21-AC-4

HOUSATONIC RIVER WATERSHED
2002 WATER QUALITY ASSESSMENT REPORT

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
IAN BOWLES, SECRETARY
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
LAURIE BURT, COMMISSIONER
BUREAU OF RESOURCE PROTECTION
GLENN HAAS, ACTING ASSISTANT COMMISSIONER
DIVISION OF WATERSHED MANAGEMENT
GLENN HAAS, DIRECTOR

NOTICE OF AVAILABILITY

LIMITED COPIES OF THIS REPORT ARE AVAILABLE AT NO COST BY WRITTEN REQUEST TO:

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATERSHED MANAGEMENT
627 MAIN STREET
WORCESTER, MA 01608

This report is also available from the MassDEP's home page on the World Wide Web at:

http://www.mass.gov/dep/water/resources/wqassess.htm

Furthermore, at the time of first printing, eight copies of each report published by this office are submitted to the State Library at the State House in Boston; these copies are subsequently distributed as follows:

- On shelf; retained at the State Library (two copies);
- Microfilmed retained at the State Library;
- Delivered to the Boston Public Library at Copley Square;
- Delivered to the Worcester Public Library;
- Delivered to the Springfield Public Library;
- Delivered to the University Library at UMass, Amherst;
- Delivered to the Library of Congress in Washington, D.C.

Moreover, this wide circulation is augmented by inter-library loans from the above-listed libraries. For example a resident in Marlborough can apply at their local library for loan of any MassDEP/DWM report from the Worcester Public Library.

A complete list of reports published since 1963 is updated annually and printed in July. This report, entitled, "Publications of the Massachusetts Division of Watershed Management – Watershed Planning Program, 1963-(current year)", is also available by writing to the Division of Watershed Management (DWM) in Worcester.

DISCLAIMER

References to trade names, commercial products, manufacturers, or distributors in this report constituted neither endorsement nor recommendations by the Division of Watershed Management for use.

HOUSATONIC RIVER WATERSHED

2002 WATER QUALITY ASSESSMENT REPORT

Prepared by:
Jamie W. Carr and Laurie E. Kennedy

Department of Environmental Protection
Division of Watershed Management

Report Number:

21-AC-4

DWM Control Number:

CN141.5

Massachusetts Department of Environmental Protection
Division of Watershed Management
Worcester, Massachusetts

September 2007

ACKNOWLEDGEMENTS

We would like to thank Tom O'Brien (formerly of the Executive Office of Environmental Affairs, Massachusetts Watershed Initiative) and the Housatonic Valley Association for their efforts in facilitating the collaborative effort involved in the assessment process.

Data and information used in this report were provided in part by the following agencies and organizations:

Federal

- Environmental Protection Agency (EPA)
- United States Geological Survey (USGS)
  - Water Resources Division
- United States Army Corps of Engineers (ACOE)
- United States Fish and Wildlife Service (USFWS)
- National Oceanic and Atmospheric Administration (NOAA)

State

- Massachusetts Department of Environmental Protection (MassDEP):
  - Bureau of Strategic Policy and Technology, Wall Experiment Station (WES)
  - Bureau of Resource Protection (BRP)
  - Bureau of Waste Prevention (BWP)
  - Bureau of Waste Site Cleanup (BWSC)
- Massachusetts Department of Public Health (MA DPH)
- Department of Fish and Game (MA DFG)
  - Division of Fisheries and Wildlife
  - Riverways Program
  - Public Access Board
- Massachusetts Department of Conservation and Recreation, Division of State Parks and Recreation (MA DCR)

Regional

- Housatonic Valley Association (HVA)
- Lake Onota Preservation Association
- Berkshire Regional Planning Commission

Much appreciation is also extended to several MassDEP employees for their contributions: Richard Chase, Christine Duerring, Daniel Kurpaska, Matthew Poach, Richard McVoy, Peter Mitchell, Jane Ryder, and Arthur Screpetis.

It is impossible to thank everyone who contributed to the assessment report process: field, laboratory, data management, writing, editing, review and graphics, as well as meetings, phone calls, and many e-mails. All of these contributions are very much appreciated.

Cover photo: Housatonic River at Holmes Road, Pittsfield. Photo by: Jamie Carr

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES AND TABLES

LIST OF ACRONYMS

7Q10	seven day, ten year low flow
ACEC	Area of Critical Environmental Concern
ACOE	Army Corps of Engineers (United States)
BMP	best management practice
BPJ	best professional judgment
BRPC	Berkshire Regional Planning Commission
CFU	colony forming unit
CMR	Code of Massachusetts Regulations
CNOEC	chronic no observed effect concentration
CSO	combined sewer overflow
CWA	Clean Water Act
DFG	Department of Fish and Game
DMF	Division of Marine Fisheries
DO	dissolved oxygen
DWM	Division of Watershed Management
DMR	discharge monitoring report
EOEA	Executive Office of Environmental Affairs
EPA	United States Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GIS	geographic information system
HVA	Housatonic Valley Association
LC_{50}	lethal concentration to 50% of the test organisms
L-EL	low effect level
MA DCR	Massachusetts Department of Conservation and Recreation
MassDEP	Massachusetts Department of Environmental Protection
MA DFG	Massachusetts Department of Fish and Game
MA DPH	Massachusetts Department of Public Health
MS4	Municipal Separate Stormwater System
MassGIS	Massachusetts Geographic Information System
NAS/NAE	National Academy of Sciences and National Academy of Engineering
ND	non detectable
NPDES	National Pollutant Discharge Elimination System
NPS	non-point source pollution
ORW	Outstanding Resource Water
PCB	polychlorinated biphenyl
PWS	public water supply
QA/QC	quality assurance/ quality control
QAPP	quality assurance project plan
RIFLS	River Instream Flow Stewards
S-EL	severe effect level
SOP	standard operating procedure
SWAP	Surface Water Assessment Program
SWQS	Surface Water Quality Standards
TMDL	total maximum daily load
TOXTD	MassDEP DWM Toxicity Testing Database
TPCB	total polychlorinated biphenyl
TSS	total suspended solids
USGS	United States Geological Survey
WBID	waterbody identification code
WBS	waterbody system database
WMA	Water Management Act
w/w	wet weight
WWTP	wastewater treatment plant

LIST OF UNITS

cfs	cubic feet per second
cfu	colony forming unit
GPM(D)	gallons per minute (day)
MGD	million gallons per day
µg/kg	microgram per kilogram
M	meter
mL	milliliters
mg/L	milligram per liter
mg/m^3	milligrams per cubic meter
ng	nanograms
NTU	nephelometric turbidity units
ppb	parts per billion
ppm	parts per million
SU	standard units
TEQ/kg	toxic equivalents per kilogram
µeq/L	microequivalants per liter
µS/cm	micro seimens per centimeter

LIST OF FISH SPECIES

Common Name	Scientific Name
Banded killifish	*Fundulus diaphanus*
Black crappie	*Pomoxis nigromaculatus*
Blacknose dace	*Rhinichthys atratulus*
Bluegill	*Lepomis macrochirus*
Brook trout	*Salvelinus fontinalis*
Brown bullhead	*Ameiurus nebulosus*
Brown trout	*Salmo trutta*
Chain pickerel	*Esox niger*
Common carp	*Cyprinus carpio*
Common shiner	*Notropis cornutus*
Creek chub	*Semotilus atromaculatus*
Fallfish	*Semotilus corporalis*
Golden shiner	*Notemigonus crysoleucas*
Green sunfish	*Lepomis cyanellus*
Largemouth bass	*Micropterus salmoides*
Longnose dace	*Rhinicthys cataractae*
Northern pike	*Esox lucius*
Pumpkinseed	*Lepomis gibbosus*
Rainbow trout	*Oncorhynchus mykiss*
Rock bass	*Ambloplites rupestris*
Slimy sculpin	*Cottus cognatus*
Smallmouth bass	*Micropterus dolomieu*
Spottail shiner	*Notropis hudsonius*
Tesselated darter	*Etheostoma olmstedi*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*

EXECUTIVE SUMMARY
HOUSATONIC WATERSHED 2002 WATER QUALITY ASSESSMENT REPORT

The Massachusetts Surface Water Quality Standards (SWQS) designate the most sensitive uses for which surface waters in the state shall be protected. The assessment of current water quality conditions is a key step in the successful implementation of the Watershed Approach. This critical phase provides an assessment of whether or not the designated uses are supported or impaired, or are not assessed, as well as basic information needed to focus resource protection and remediation activities later in the watershed management planning process.

This report presents a summary of current water quality data/information in the Housatonic Watershed used to assess the status of the designated uses as defined in the SWQS. The designated uses, where applicable, include: *Aquatic Life, Fish Consumption, Primary* and *Secondary Contact Recreation* and *Aesthetics*. Each use, within a given segment, is individually assessed as ***support*** or ***impaired***. When too little current data/information exists or no reliable data are available the use is ***not assessed***. However, if there is some indication of water quality impairment, which is not "naturally occurring", the use is identified with an "Alert Status". It is important to note that not all waters are assessed. Many small and/or unnamed rivers and lakes have ***never been assessed***; the status of their designated uses has never been reported to the EPA in the Commonwealth's Summary of Water Quality Report (305(b) Report) nor is information on these waters maintained in the Waterbody System (WBS) or the new Assessment Database (ADB).

The term *Drinking Water Use* is used to indicate sources of public drinking water. While this use is not assessed in this report, the state provides general guidance on drinking water source protection of both surface water and groundwater sources (available at http://www.mass.gov/dep/water/drinking.htm). These waters are subject to stringent regulation in accordance with the Massachusetts Drinking Water Regulations. MassDEP's Drinking Water Program has primacy for implementing the provisions of the federal Safe Drinking Water Act. The Drinking Water Program also continues to work on its Source Water Assessment Program, which requires that the Commonwealth delineate protection areas for all public ground and surface water sources, inventory land uses in these areas that may present potential threats to drinking water quality, determine the susceptibility of water supplies to contamination from these sources, and publicize the results.

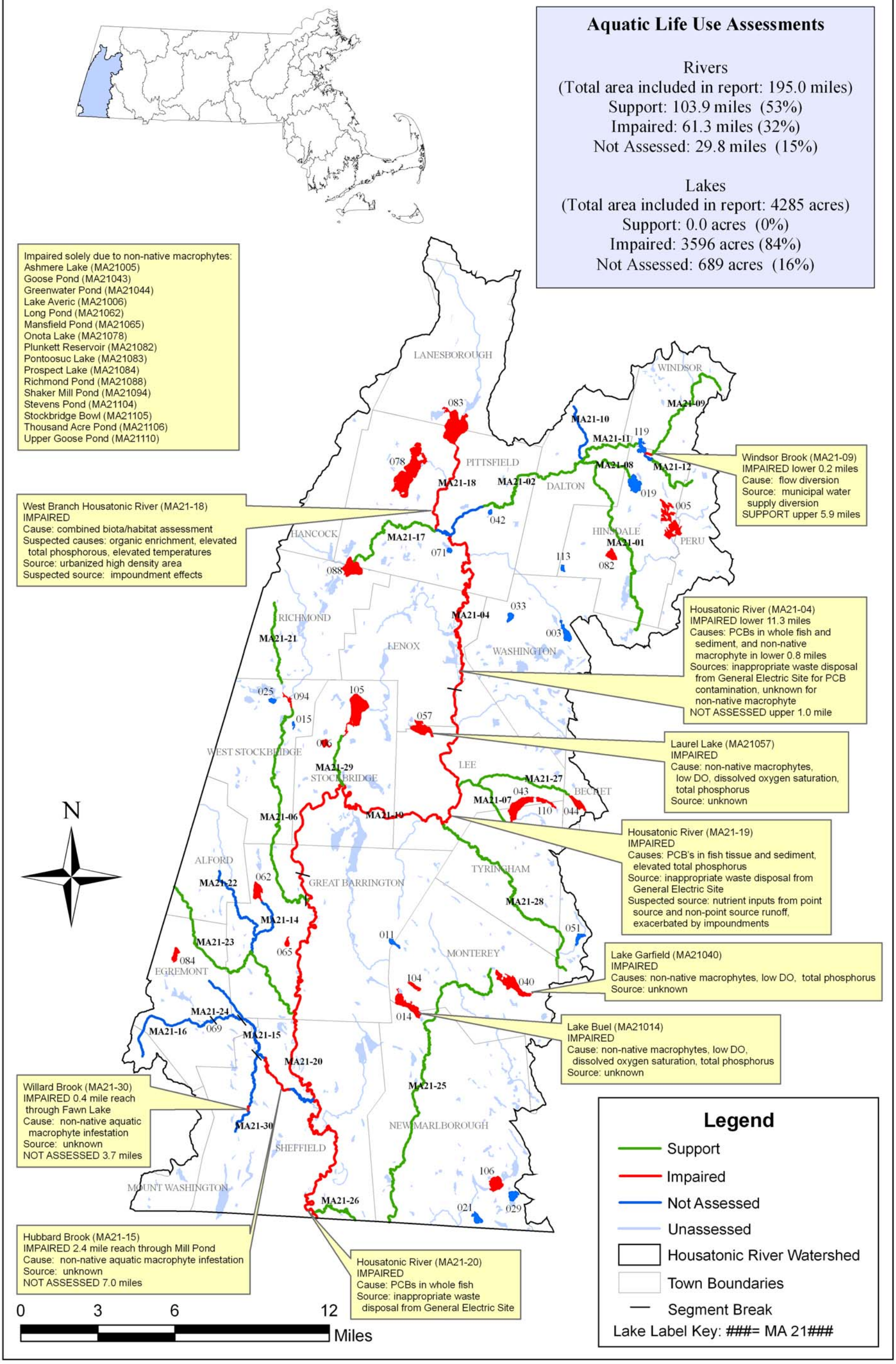
Public water suppliers monitor their finished water (tap water) for major categories of both naturally occurring and man-made contaminants such as: microbiological, inorganic, organic, pesticides, herbicides, and radioactive contaminants. Specific information on community drinking water sources, including Source Water Assessment Program activities and drinking water quality information, are updated and distributed annually by the public water system to its customers in a "Consumer Confidence Report". These reports are available from the public water system, the local boards of health, MA DPH and MassDEP.

The *Fish Consumption Use* (See Figure 2*)* is supported when there are no pollutants present that result in unacceptable concentrations in edible portions (as opposed to whole fish - see *Figure 1 Aquatic Life Use*) of fish, other aquatic life or wildlife for human consumption. The assessment of the *Fish Consumption Use* is made using the most recent list of Fish Consumption Advisories issued by the Massachusetts Executive Office of Health and Human Services, Department of Public Health (MDPH), Bureau of Environmental Health Assessment (MA DPH 2005b). The MDPH list identifies water bodies where elevated levels of a specified contaminant in edible portions of freshwater species pose a health risk for human consumption; hence, the *Fish Consumption Use* is assessed as impaired in these waters. In July 2001 MA DPH issued new statewide consumer advisories on fish consumption and mercury contamination (MA DPH 2001). Because of these statewide advisories no waters can be assessed as support for the *Fish Consumption Use*. These waters default to "not assessed". The statewide advisories read as follows:

The MA DPH "is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age." Additionally, MA DPH "is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury." MA DPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially.

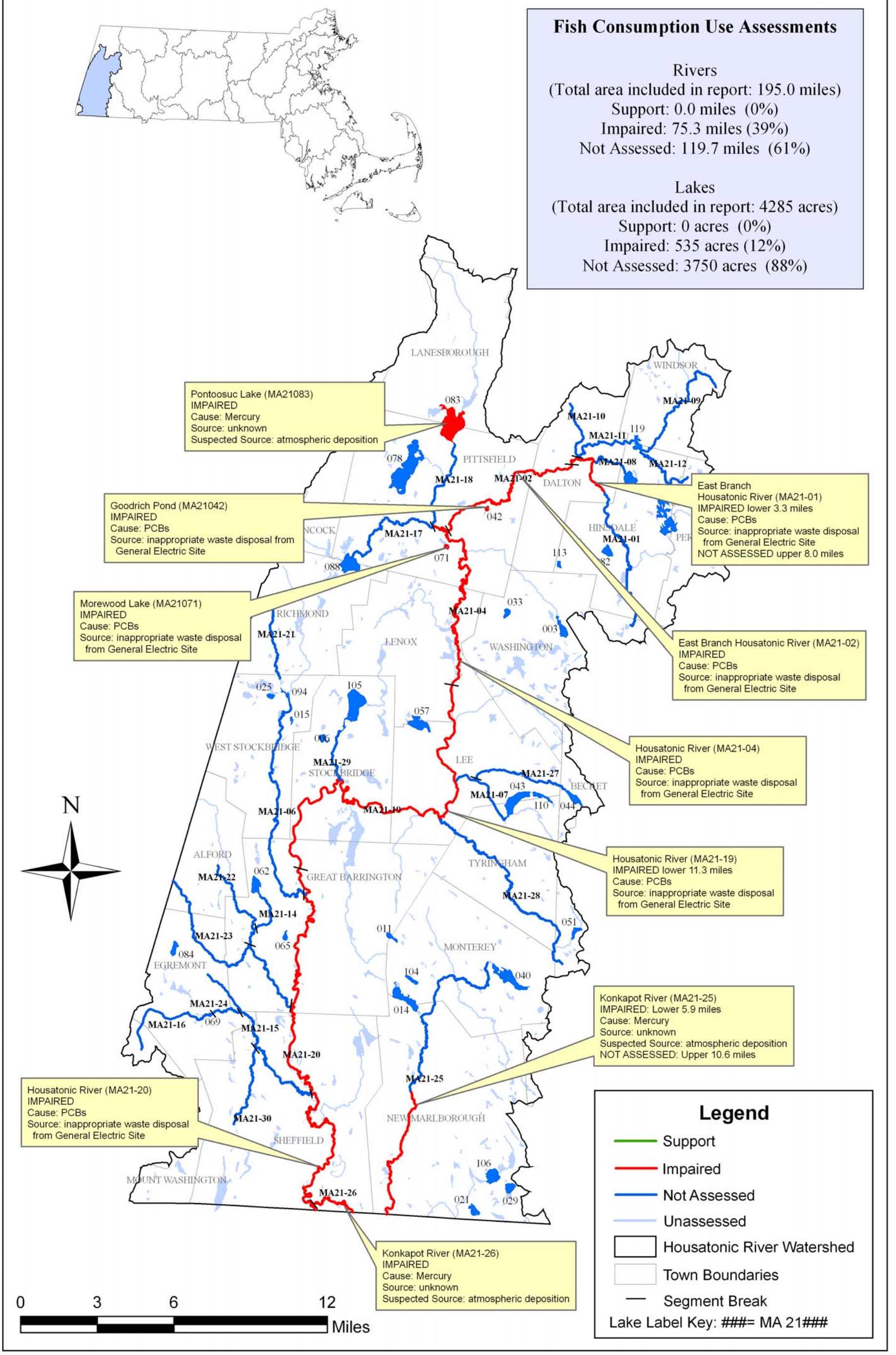
This page intentionally left blank.

Figure 1. 2002 *Aquatic Life Use* assessment summary for river and lake segments in the Housatonic Watershed
Note: The *Aquatic Life Use* is supported when suitable habitat (including water quality) is available for sustaining a native, naturally diverse, community of aquatic flora and fauna. Impairment of the *Aquatic Life Use* may result from anthropogenic stressors that include point and/or non-point source(s) of pollution and hydrologic modification. Causes and/or sources of impairments, when known, are noted in the callouts.



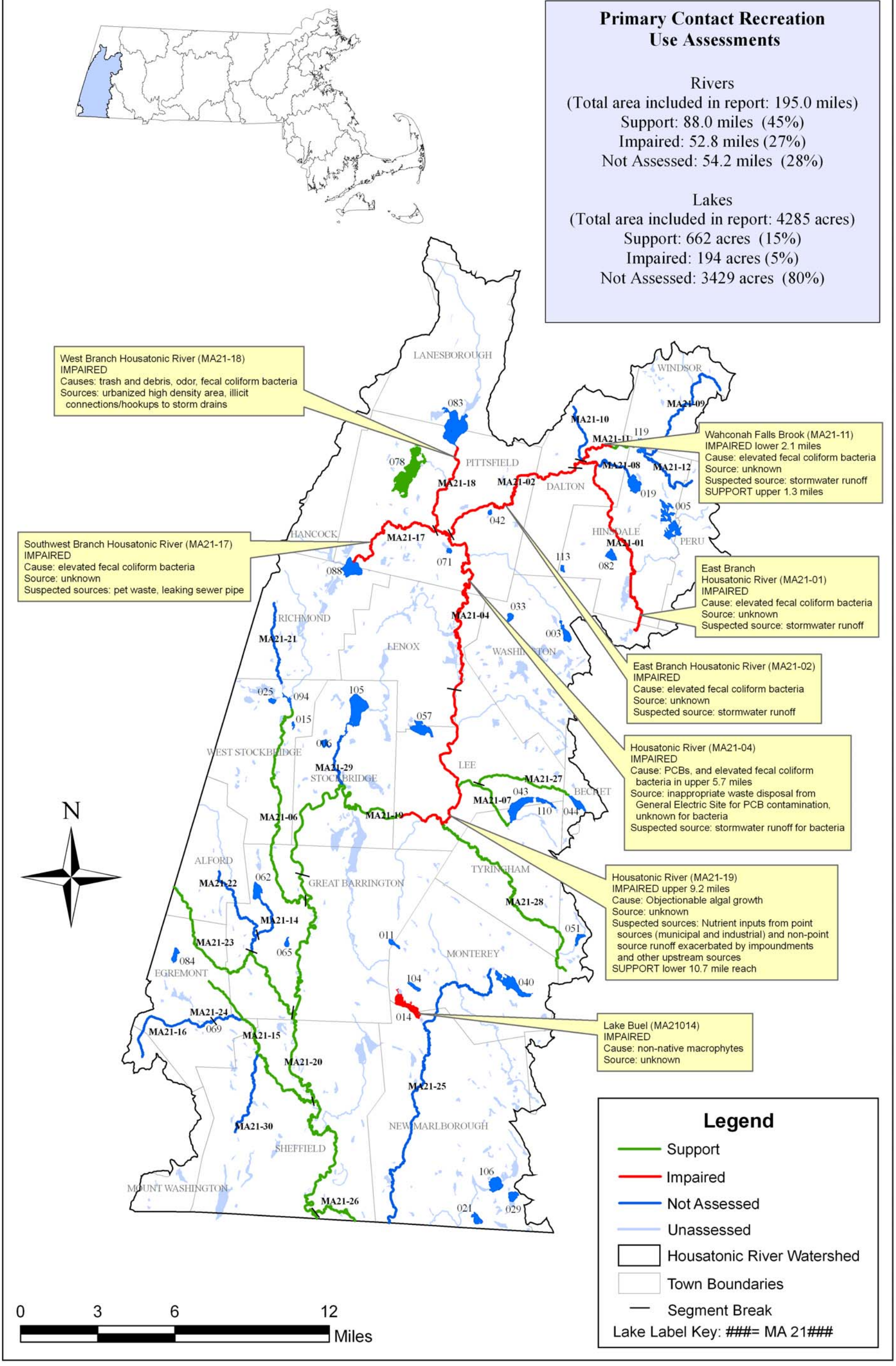
This page intentionally left blank.

Figure 2. 2002 *Fish Consumption Use* assessment summary for river and lake segments in the Housatonic Watershed.
Note: The *Fish Consumption Use* is supported when there are no pollutants present that result in unacceptable concentrations in edible portions (as opposed to whole fish - see *Aquatic Life Use*) of fish, other aquatic life or wildlife for human consumption. The assessment of the *Fish Consumption Use* is made using the most recent list of Fish Consumption Advisories issued by the Massachusetts Executive Office of Health and Human Services, Department of Public Health (MA DPH), Bureau of Environmental Health Assessment (MA DPH 2005b). The MA DPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species pose a health risk for human consumption; hence, the *Fish Consumption Use* is assessed as impaired in these waters. In July 2001 MA DPH issued new consumer advisories on fish consumption and mercury contamination (MA DPH 2001). Because of these statewide advisories no waters can be assessed as support for the *Fish Consumption Use*. These waters default to "not assessed". Causes and/or sources of impairments, when known, are noted in the callouts.



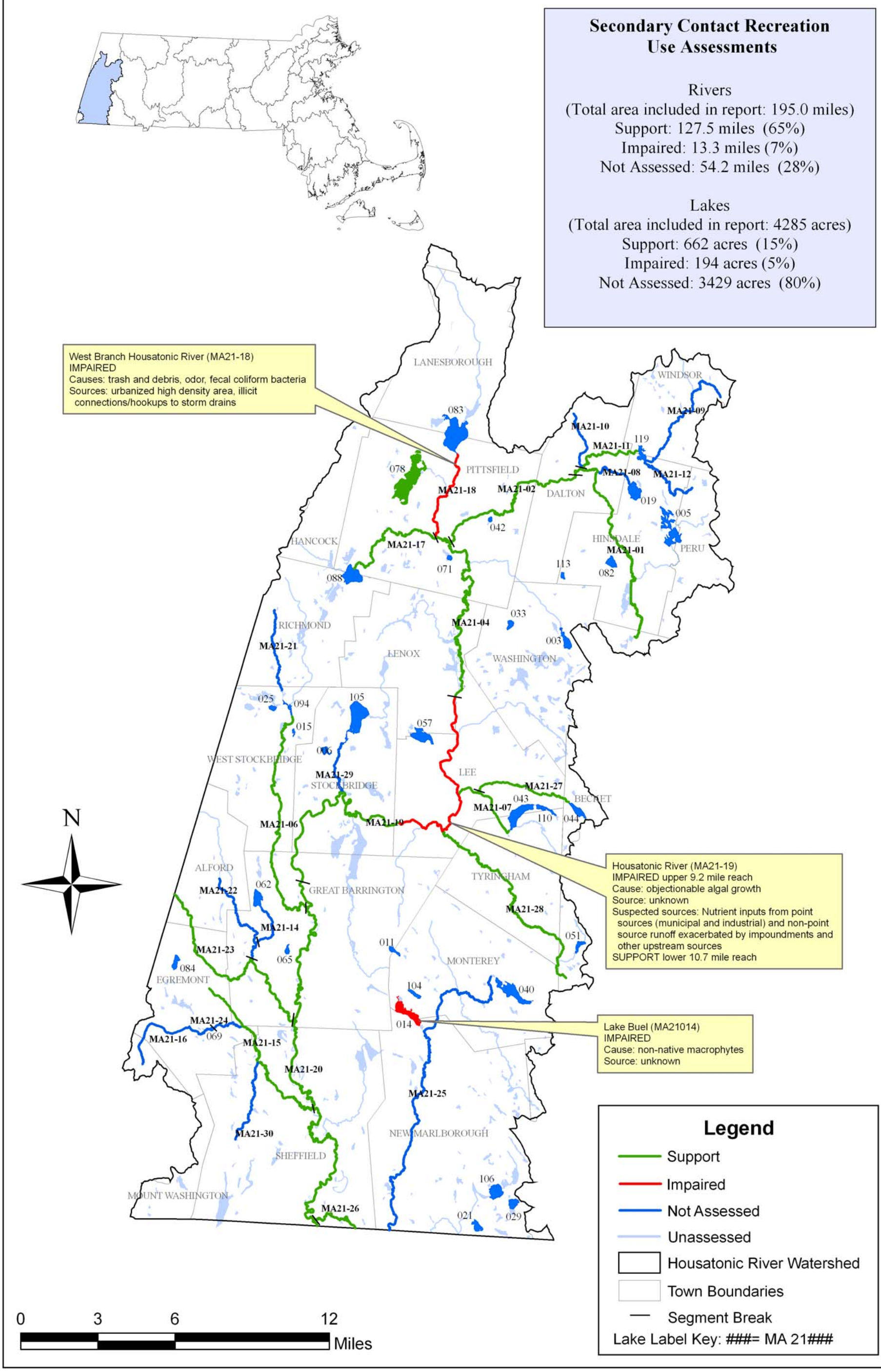
This page intentionally left blank.

Figure 3. 2002 *Primary Contact Recreational Use* assessment summary for river and lake segments in the Housatonic Watershed
Note: The *Primary Contact Recreational Use* is supported when conditions are suitable (fecal coliform bacteria densities, turbidity and aesthetics meet the SWQS and/or the MA DPH Bathing Beaches State Sanitary Code and/or guidance) for any recreational or other water related activity during which there is prolonged and intimate contact with the water and there exists a significant risk of ingestion. Activities include, but are not limited to, wading, swimming, diving, surfing and water skiing. Causes and/or sources of impairments, when known, are noted in the callouts.



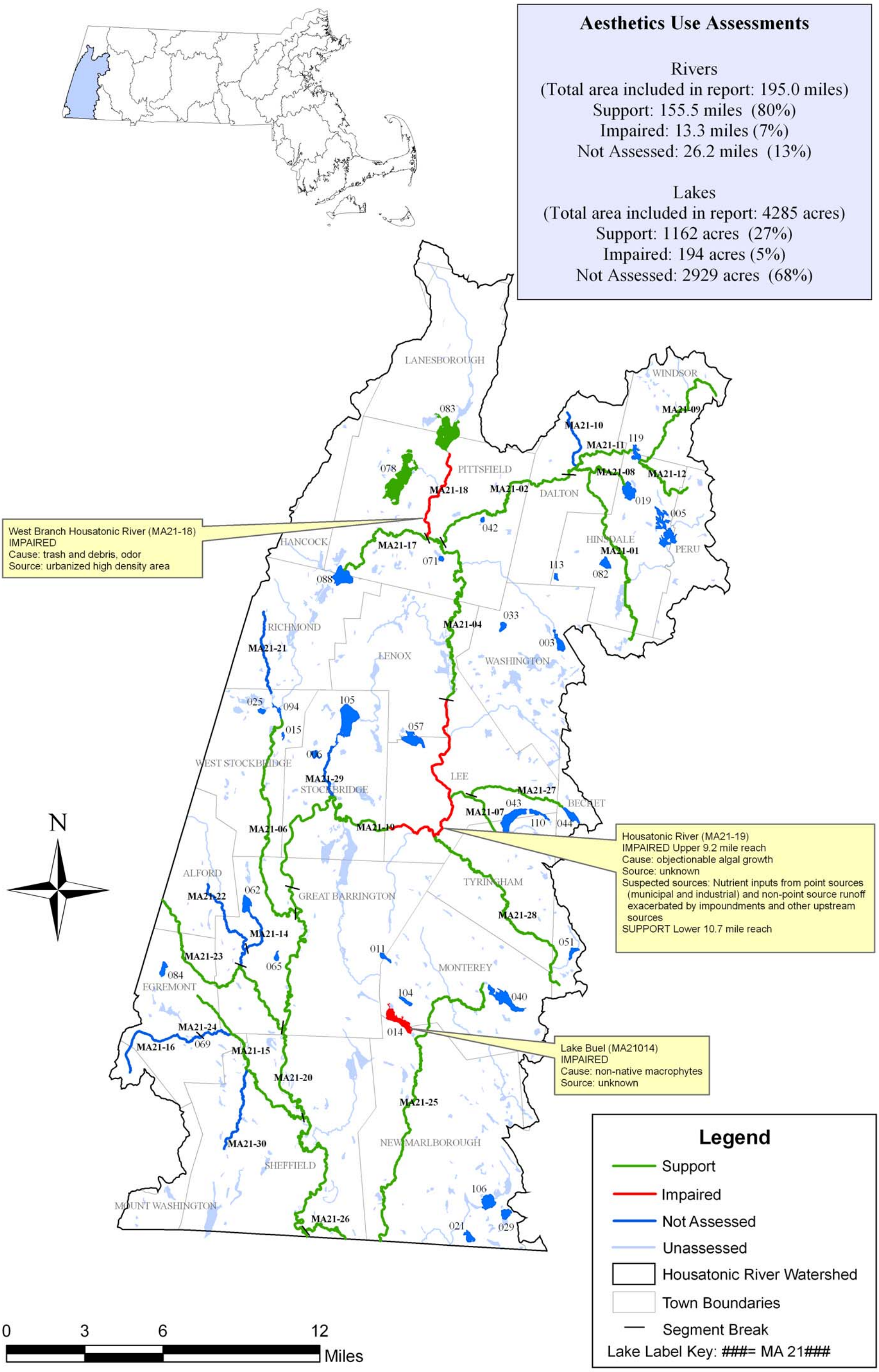
This page intentionally left blank.

Figure 4. 2002 *Secondary Contact Recreational Use* assessment summary for river and lake segments in the Housatonic Watershed
Note: The *Secondary Contact Recreational Use* is supported when conditions are suitable for any recreational or other water use during which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact related to shoreline activities. For lakes, non-native aquatic macrophyte cover and/or transparency data (Secchi disk depth) are evaluated to assess the status of the recreational uses. Causes and/or sources of impairments, when known, are noted in the callouts.



This page intentionally left blank.

Figure 5. 2002 *Aesthetics Use* assessment summary for river and lake segments in the Housatonic Watershed
Note: The *Aesthetics Use* is supported when surface waters are free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life. Causes and/or sources of impairments, when known, are noted in the callouts.



This page intentionally left blank.

INTRODUCTION

HOUSATONIC WATERSHED 2002 WATER QUALITY ASSESSMENT REPORT

The goal of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (Environmental Law Reporter 1988). To meet this objective, the CWA requires states to develop information on the quality of the Nation's water resources and report this information to the U.S. Environmental Protection Agency (EPA), the U.S. Congress, and the public. Together, these agencies are responsible for implementation of the CWA mandates. Under Section 305(b) of the Federal Clean Water Act, MassDEP must submit a statewide report every two years to the EPA, which describes the status of water quality in the Commonwealth. Until 2002 this was accomplished as a statewide summary of water quality (the 305(b) Report). States are also required to submit, under Section 303(d) of the CWA, a list of impaired waters requiring a total maximum daily load (TMDL) calculation. In 2002, however, EPA required the states to combine elements of the statewide 305(b) Report and the Section 303(d) List of Impaired Waters into one "Integrated List of Waters" (Integrated List). This statewide list is based on the compilation of information for the Commonwealth's 27 watersheds. Massachusetts has opted to write individual watershed surface water quality assessment reports and use them as the supporting documentation for the Integrated List. The assessment reports utilize data compiled from a variety of sources and provide an evaluation of water quality, progress made towards maintaining and restoring water quality, and the extent to which problems remain at the watershed level. Quality assured in-stream biological, habitat, physical/chemical, toxicity data and other information are evaluated to assess the status of water quality conditions. This analysis follows a standardized process described in Appendix A (Assessment Methodology) of this report.

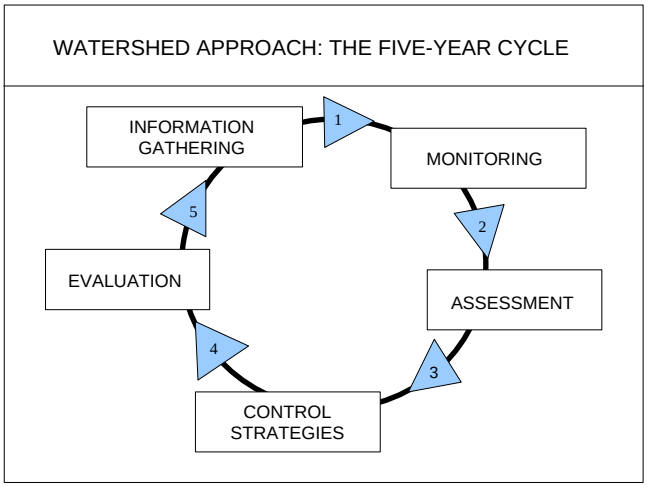


Figure 6. Five-year cycle of the Watershed Approach

This report presents the current assessment of water quality conditions in the Housatonic Watershed. The assessment is based on information that has been researched and developed by the Massachusetts Department of Environmental Protection (MassDEP) through the first three years (information gathering, monitoring, and assessment) of the five-year cycle (Figure 6) in partial fulfillment of MassDEP's federal mandate to report on the status of the Commonwealth's waters under the CWA. In keeping with past document nomenclature, this report is titled in reference to the actual year (2002) in which the year two monitoring phase of the five year cycle last occurred for the Housatonic Watershed.

MASSACHUSETTS INTEGRATED LIST OF WATERS

Section 305(b) of the CWA defines the process whereby states monitor and assess the quality of their surface and groundwater and report on the status of those waters every two years. Section 303(d) of the CWA requires states to periodically identify and list those waterbodies for which existing controls on point and nonpoint sources of pollutants are not stringent enough to attain or maintain compliance with applicable surface water quality standards. Through the year 2000 the MassDEP fulfilled the 305(b) and 303(d) reporting requirements in two completely separate documents. In 2001 the EPA released guidance that provided states with the option of preparing a single Integrated List of Waters to be submitted that would meet the reporting requirements of both sections 305(b) and 303(d) of the CWA.

MassDEP submitted the Massachusetts Year 2004 Integrated List of Waters to the EPA in September 2005 (MassDEP 2005a). In that report each waterbody segment was placed in one of five major

categories. Category 1 included those waters that were meeting all designated uses. No Massachusetts waters were listed in Category 1 because a statewide health advisory pertaining to the consumption of fish precludes any waters from being in full support of the fish consumption use. Waters listed in Category 2 were found to support some of the uses for which they were assessed but other uses were not assessed or "unassessed." Category 3 contained those waters for which insufficient or no information was available to assess any uses.

Waters exhibiting impairment for one or more uses were placed in either Category 4 (impaired but not requiring a TMDL report) or Category 5 (impaired and requiring one or more TMDLs) according to the EPA guidance. Category 4 was further divided into three sub-categories – 4A, 4B and 4C – depending upon the reason that TMDLs were not needed. Category 4A included waters for which the required TMDL(s) had already been completed and approved by the EPA. However, since segments could only appear in one category, waters that had an approved TMDL for some pollutants, but not others, remained in Category 5. Category 4B was to include waters for which other pollution control requirements were reasonably expected to result in the attainment of the designated use before the next listing cycle (i.e., 2006). Because of the uncertainty related to making predictions about conditions in the future the MassDEP made a decision not to utilize Category 4B in the 2004 Integrated List. Finally, waters impaired by factors, such as flow modification or habitat alteration, that are not subjected to TMDL calculations because the impairment is not related to one or more pollutants were included in Category 4C.

See individual segment assessments for information pertaining to the 2004 Integrated List category and causes of impairment.

HOUSATONIC RIVER WATERSHED DESCRIPTION AND CLASSIFICATION

The Housatonic Basin (Figure 7) is located in southwestern Massachusetts. It is bordered by the Hudson River Basin to the north, the Westfield River Basin to the northeast and by the Farmington River Basin to the southeast. The south and west portions of the basin are bordered by the states of Connecticut and New York, respectively. The Housatonic River originates at the confluence of the West and Southwest Branches of the Housatonic River at Clapp Park in Pittsfield. The West Branch Housatonic River originates at the outlet of Pontoosuc Lake in Lanesborough and Pittsfield and the Southwest Branch originates from Richmond Pond in Richmond/Pittsfield. The East Branch Housatonic River, which originates from Muddy Pond in Washington/Hinsdale, joins the mainstem Housatonic River at Fred Garner Park in Pittsfield. From Pittsfield, the river flows south for 150 miles (approximately 54 river miles in Massachusetts) until it empties into Long Island Sound near Bridgeport, Connecticut. Other major tributaries to the Housatonic River in Massachusetts include the Williams, Green and Konkapot Rivers and Hubbard Brook.

The drainage basin of the Massachusetts portion of the Housatonic River encompasses 545 square miles and is located entirely in Berkshire County. The communities of Alford, Becket, Cheshire, Dalton, Egremont, Great Barrington, Hancock, Hinsdale, Lanesborough, Lee, Lenox, Monterey, Mount Washington, New Ashford, New Marlborough, Otis, Peru, Pittsfield, Richmond, Sandisfield, Sheffield, Stockbridge, Tyringham, Washington, West Stockbridge, and Windsor lie wholly or in part within the basin boundaries.

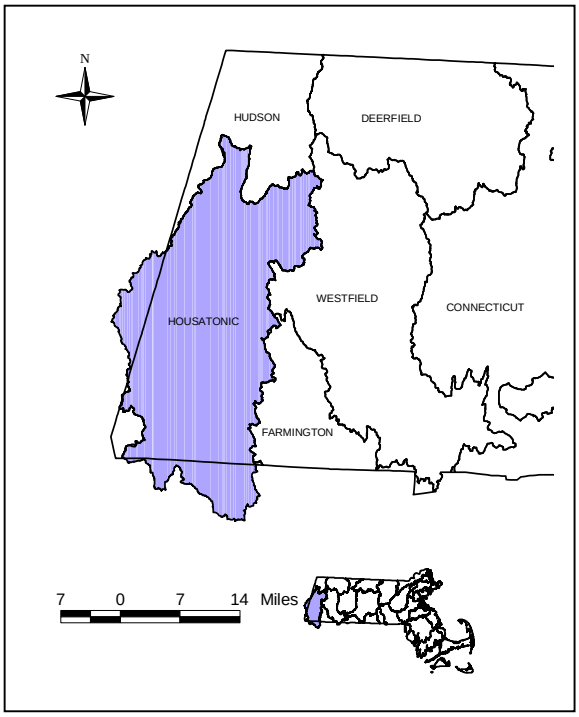


Figure 7. Location of the Housatonic River Watershed

OBJECTIVES

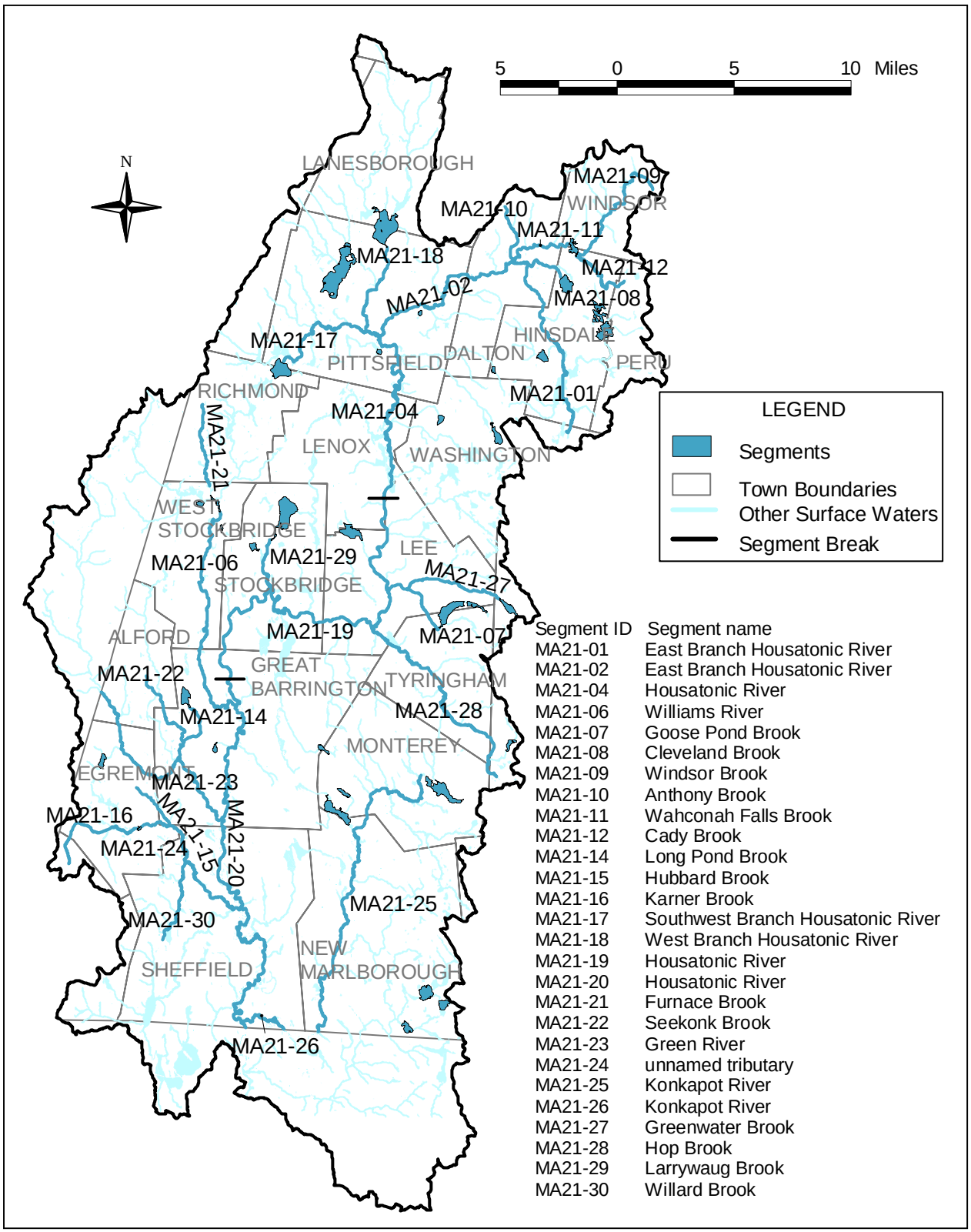
This report summarizes information generated in the Housatonic River Watershed since the 1997/98 Housatonic River Basin Water Quality Assessment Report published in June 2000 (Kennedy and Weinstein 2000). The methodology used to assess the status of water quality conditions of rivers, estuaries and lakes in accordance with EPA's and MassDEP's use assessment methods is provided in Appendix A. Data collected by DWM in 2002 are provided in Appendices B through I of this report. Appendix J provides a summary of Water Management Act (WMA) registration/permit holders and National Pollutant Discharge Elimination System (NPDES) permittees in the Housatonic River Watershed. Not all waters in the Housatonic River Watershed are included in the MassDEP/EPA databases (either the waterbody system database -- WBS, or the newer assessment database – ADB) or this report.

The objectives of this water quality assessment report are to:

1. evaluate whether or not surface waters in the Housatonic River Watershed, defined as segments in the MassDEP/EAP databases, currently support their designated uses (i.e., meet surface water quality standards);
2. identify water withdrawals (habitat quality/water quantity) and/or major point (wastewater discharges) and non-point (land-use practices, storm water discharges, etc.) sources of pollution that may impair water quality conditions;
3. identify the presence or absence of any non-native macrophytes in lakes;
4. identify waters (or segments) of concern that require additional data to fully assess water quality conditions;
5. recommend additional monitoring needs and/or remediation actions in order to better determine the level of impairment or to improve/restore water quality; and
6. provide information for the development of an action plan.

HOUSATONIC RIVER WATERSHED- RIVER SEGMENTS ASSESSED

Figure 8: Housatonic River Watershed – River Segments Assessed
The Housatonic River Basin segments included in this report are displayed below:



Segment ID	Segment name
MA21-01	East Branch Housatonic River
MA21-02	East Branch Housatonic River
MA21-04	Housatonic River
MA21-06	Williams River
MA21-07	Goose Pond Brook
MA21-08	Cleveland Brook
MA21-09	Windsor Brook
MA21-10	Anthony Brook
MA21-11	Wahconah Falls Brook
MA21-12	Cady Brook
MA21-14	Long Pond Brook
MA21-15	Hubbard Brook
MA21-16	Karner Brook
MA21-17	Southwest Branch Housatonic River
MA21-18	West Branch Housatonic River
MA21-19	Housatonic River
MA21-20	Housatonic River
MA21-21	Furnace Brook
MA21-22	Seekonk Brook
MA21-23	Green River
MA21-24	unnamed tributary
MA21-25	Konkapot River
MA21-26	Konkapot River
MA21-27	Greenwater Brook
MA21-28	Hop Brook
MA21-29	Larrywaug Brook
MA21-30	Willard Brook

EAST BRANCH HOUSATONIC RIVER (SEGMENT MA21-01)
Location: Outlet of Muddy Pond, Washington, to the outlet of Center Pond, Dalton.
Segment Length: 11.3 miles.
Classification: Class B, Cold Water Fishery.

The upper portion of this segment is located within the Hinsdale Flats ACEC.

Center Pond (MA21016) will no longer be reported on as a lake segment since the retention time of this 12-acre waterbody was estimated at 1 day; it will be considered a run of the river impoundment (McVoy 2006). The retention time estimate was based on the annual historical mean discharge from two stream gages in the Housatonic River Basin (01197500 and 01197000) and the normal storage volume of the dam reported by MA DCR in their Massachusetts Dam Safety Program Database (Socolow *et al*. 2004 and MA DCR 2002).

Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires a TMDL for priority organics (MassDEP 2005a).

East Branch Housatonic Watershed Assessment Grant Project (Project #02-05/604b) 2005 grant description: The Berkshire Regional Planning Commission (BRPC) and Housatonic Valley Association will conduct targeted water quality sampling of suspected problem areas and will pilot an effort to include volunteer water quality monitoring into a municipal stormwater management plan. This project will assess the extent of known and suspected nonpoint source pollution problems in the East Branch subwatershed of the Housatonic River. Additional efforts, if needed, will be directed towards waters on the 303d List. BRPC will assist the two communities in the subwatershed in meeting their stormwater management goals and will recommend remediation of identified erosion and sedimentation problems in two surface water supply watersheds.

WMA WATER WITHDRAWALS (APPENDIX J)
Hinsdale Water System (9P210213201)

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
In 1999, Housatonic Valley Association (HVA) volunteers conducted a shoreline survey of the East Branch Housatonic River from Muddy Pond to Hubbard Ave. in Pittsfield, which includes this entire segment. Potential in-stream sedimentation from road runoff was a concern along most of the area covered (HVA 2004a).

DWM performed a habitat assessment on the East Branch Housatonic River near Jericho Road in Hinsdale (Station EB01B) in September 2002. The sampling reach received an overall score of 176 out of 200. Habitat was limited most by the low flow conditions and some deposition of fine sediment on the substrates (Appendix C). DWM biologists collected periphyton samples from Station EB01B in September of 2002 (Appendix G). Canopy cover at this site was reported as 70%, algal cover was <1%, and the dominant algal genera was *Cladophera* sp.

Center Pond was dewatered during 2005 and 2006 in order to carry out repair work at downstream dams (Noel 2005).

Biology
MA DFG conducted fish population sampling (Site 636) along the East Branch of the Housatonic River near Jericho Road, Hinsdale) on 11 July 2002 (Richards 2006). A total of 109 fish, representing 7 species, were collected including 41 blacknose dace, 41 longnose dace, 22 brown trout (56-197 mm), two white sucker, one pumpkinseed, one fallfish, and one brook trout (51mm). The fish assemblage is dominated by fluvial specialist species. Multiple age classes of brown trout and a young of the year brook trout represented pollution intolerant species.

DWM conducted benthic macroinvertebrate sampling on the East Branch Housatonic River at Station EB01B (B0502), near Jericho Road in Hinsdale in September 2002. This station was used as a reference station representative of a healthy community and least impacted conditions (Appendix C).

Toxicity

Ambient

General Electric Company dilution and control water is collected from the East Branch of the Housatonic River upstream at Old Dalton Road Bridge in Hinsdale for use as dilution water in the GE Pittsfield facility's whole effluent toxicity testing. Between July 2000 and September 2005 (n=18), survival of *Ceriodaphnia dubia* exposed (7-day) to the river water ranged from 90 to 100% (TOXTD database). Between January 2000 and March 2006 (n=73), survival of *Daphnia pulex* exposed (48-hour) ranged from 88 to 100%.

Chemistry-water

HVA conducted monthly water quality sampling at eight sites along this segment between June and October 2002; April and October 2003; and May and October 2004 (HVA 2002b, 2003c, and 2004b). The sites were labeled from upstream to downstream as: Bullard's Crossing, Home Club, Metal Bridge, Carmel House, Partridgefield, High School, Orchard St., and Center Pond Bridge. HVA also sampled many of these sites in 2001; data from 2001 is not summarized below, since their QAPP was not approved until 2002. Parameters measured included: dissolved oxygen, pH, temperature, alkalinity, total phosphorus, nitrate and total suspended solids. Dissolved oxygen data were not collected during worst-case, pre-dawn conditions. Low DO measurements were reported at sampling stations upstream from Hinsdale center. These conditions are considered to be naturally occurring as this section of the river flows through a large wetland and the stream gradient is low. Water temperatures were slightly elevated; seven of the eight stations had at least one temperature measurement of greater than 20°C (n= 90, 11 >20°C). Total phosphorous concentrations were also slightly elevated, ranging from <0.01 to 0.09 mg/L (n=98, 13 $\geq$ 0.05 mg/L). Though seven of the eight stations had at least one phosphorous measurement of 0.05 mg/L, the highest measurements were most frequently observed at the most upstream station. Total suspended solid measurements were typically low, but three measurements did exceed 25 mg/L (n=82).

The *Aquatic Life Use* is assessed as support. This assessment is based primarily on the biological data and the excellent survival of test organisms exposed to river water. The benthic community was deemed to be a suitable reference station indicative of excellent water quality conditions. The fish community was comprised of multiple age classes of brown trout, a pollution intolerant fluvial species. Habitat quality was excellent. Water temperatures did exceed 20°C, however thermal problems did not appear to be extended or severe. The slightly elevated total phosphorous levels could also be naturally influenced by the wetlands in the upper portion of this segment.

FISH CONSUMPTION

In 1982 the Massachusetts Department of Public Health (MA DPH) issued a fish consumption advisory for the Housatonic River because of PCB contamination associated with the General Electric site. The MA DPH advisory recommends: "*The general public should not consume any fish, frogs, or turtles from Housatonic River in the towns of Dalton, Pittsfield, Lenox, Lee, Stockbridge, Great Barrington, and Sheffield".* Since it is the East Branch Housatonic River that flows through Dalton and past the GE plant in Pittsfield, the MA DPH advisory for the Housatonic River is assumed to cover this area of the East Branch of the Housatonic River. In 1995 MA DPH updated their advisory to include a recommendation that fish taken from feeder streams to the Housatonic River should be trimmed of fatty tissue prior to cooking.

Due to the MA DPH site-specific fish consumption advisory, the *Fish Consumption Use* is assessed as impaired for this segment from the Dalton/Hinsdale town line to the outlet of Center Pond (lower 3.3 miles) because of PCB contamination. The upper 8.0 miles are currently not assessed for the *Fish Consumption Use*.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

HVA conducted bacteria monitoring at the eight water quality sites listed above (HVA 2002b, 2003c, and 2004b). Fecal coliform counts ranged from <10 to 3,900 cfu/100mL (n=114). The highest three-year

fecal coliform count at all but one of the eight sites came from one wet-weather sampling event in May of 2002. During another wet-weather sampling event in August 2003 five of the six stations had bacteria counts greater than 400 cfu/100mL. Excluding these two wet-weather sampling events, only 7 of 100 dry weather samples, or 7% were greater than 400 cfu/100mL. The geometric mean of the fecal coliform bacteria counts exceeded 200 cfu/100mL, and/or 10% exceeded 400 cfu/100mL at almost all stations sampled.

DWM biologists noted slight turbidity at Station EB01B in September 2002, however no other objectionable conditions were noted (e.g., oils, water odors, or other deposits).

In 1999 HVA volunteers conducted a shoreline survey of this segment of the East Branch Housatonic River. Trash was reported, but HVA volunteers conducted a cleanup at Bullard's Crossing Road in Hinsdale so it is no longer considered a problem. Overall this segment was described as generally aesthetically pleasing with a few areas specifically described as scenic and a potential location for a greenway (HVA 2004a).

The *Primary Contact Recreational Use* is assessed as impaired because of elevated fecal coliform bacteria counts, noted particularly during wet weather. However, the *Secondary Contact Recreation and Aesthetics* uses are assessed as support based upon bacteria counts that are acceptable for secondary contact and the lack of objectionable conditions.

EAST BRANCH HOUSATONIC RIVER (Segment MA21-01) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED upper 8.0 miles IMPAIRED lower 3.3 miles Cause: PCBs Source: inappropriate waste disposal from General Electric Site
Primary Contact		IMPAIRED Cause: elevated fecal coliform bacteria Source: unknown
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

RECOMMENDATIONS

Develop a monitoring plan and conduct bacteria sampling to evaluate effectiveness of point (Phase II stormwater permits) and non-point source pollution in Dalton and Hinsdale to control activities and to assess the status of the Primary and Secondary Contact Recreational uses. Conduct bacteria source tracking as needed to identify undocumented sources.

CLEVELAND BROOK (SEGMENT MA21-08)
Location: Headwaters, outlet of Cleveland Brook Reservoir, Hinsdale, to confluence with East Branch Housatonic River, Dalton.
Segment Length 1.9 miles.
Classification: Class B.

Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Aquatic Life* and *Aesthetics*) and was not assessed for others (MassDEP 2005a).

WMA WITHDRAWALS
Wahconah Country Club (10207001)

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
DWM performed a habitat assessment of Cleveland Brook upstream from Old Windsor Road in Hinsdale on 20 August 2002 as part of the fish population survey. This sampling reach received a habitat score of 147 out of 200. Habitat was limited most by the low channel flow status and the limited riparian zone width adjacent to the road (Appendix F). Water from Cleveland Brook Reservoir is utilized for the municipal supply for the city of Pittsfield and the town of Dalton. It is unknown if minimum flows are required at the outlet of Cleveland Brook Reservoir for the protection of aquatic life.

Biology
DWM conducted fish population sampling in Cleveland Brook as described above. Seventy-five brook trout (multiple age classes), eight blacknose dace, three brown trout and one white sucker were collected (87 fish total) (Appendix F). The assemblage was dominated by pollution intolerant, fluvial dependent species indicative of excellent water quality.

The *Aquatic Life Use* is assessed as support based on the fish community data and best professional judgment. The presence of multiple year age classes of reproducing brook trout is indicative of high quality cold water.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
DWM biologists noted no deposits, odors, turbidity or other objectionable conditions (Mitchell 2006).

The *Aesthetics Use* is assessed as support based on the lack of objectionable conditions. The *Primary* and *Secondary Contact Recreational* uses are not assessed due to the lack of recent quality-assured bacteria data.

CLEVELAND BROOK (Segment MA21-08) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

RECOMMENDATIONS:
Conduct water quality monitoring to evaluate designated uses. Develop and implement a flow management plan to protect in-stream biota in Cleveland Brook.

CADY BROOK (SEGMENT MA21-12)
Location: Source in Peru to the inlet of Windsor Reservoir, Hinsdale.
Segment Length: 3.5 miles.
Classification: Class A, Public Water Supply.

Much of the upper portion of this segment is located within the Hinsdale Flats ACEC.

Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Aquatic Life* and *Aesthetics*) and was not assessed for others (MassDEP 2005a).

WMA WATER WITHDRAWALS (APPENDIX J)
Pittsfield Water Department (10223601)

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
DWM performed a habitat assessment of Cady Brook upstream from New Windsor Road in Hinsdale on 20 August 2002 as part of the fish population survey. This sampling reach received a habitat score of 169 out of 200. The habitat was limited most by the marginal bank stability -- likely the result of the flashy nature of this stream (Appendix F).

Cady Brook is diverted for the municipal supply of drinking water for the city of Pittsfield and the town of Dalton approximately 0.5 miles upstream from the inlet to Windsor Reservoir. The diverted water is sent to Cleveland Brook Reservoir. It is unknown what effects, if any, this practice has on the habitat quality of the lower 0.5 miles of this segment.

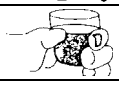
Biology
DWM and MA DFG conducted fish population sampling in Cady Brook as described above. Over one hundred eighty fish were collected represented by two species (blacknose dace and brook trout). Both species are fluvial specialist/dependants. The blacknose dace are classified as pollution tolerant, and the brook trout are classified as pollution intolerant. Multiple age classes of brook trout were present (52-180 mm in length) (Appendix F and Richards 2006).

The *Aquatic Life Use* is assessed as support based on the fish community data and best professional judgment for the upper 3.0 mile reach of this segment. The presence of multiple year age classes of reproducing brook trout is indicative of high quality cold water and excellent habitat. This use is not assessed in the lower 0.5 mile reach because potential impacts associated with the water supply diversion.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
No objectionable deposits, odors, turbidity or other conditions were noted by DWM biologists in the stream reach sampled in Cady Brook (Mitchell 2006).

The *Aesthetics Use* is assessed as support based on the lack of objectionable conditions. The *Primary* and *Secondary Contact Recreational* uses are not assessed due to the lack of recent quality-assured bacteria data.

CADY BROOK (Segment MA21-12) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT upper 3.0 miles NOT ASSESSED lower 0.5 miles
Fish Consumption		NOT ASSESSED
Drinking Water**		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

*The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS:
Conduct water quality monitoring to evaluate designated uses. Develop and implement a flow management plan to protect in-stream biota in Cady Brook downstream from the aqueduct diversion.

WINDSOR BROOK (SEGMENT MA21-09)
Location: Source, southeast of Fobes Hill (west of Savoy Road/Route 8A), Windsor, to the Windsor Reservoir, Windsor.
Segment Length: 6.1 miles.
Classification: Class A, Public Water Supply.

Based on the last evaluation of water quality conditions, this segment is listed in Category 4c of the 2004 Integrated List of Waters. This segment was assessed as impaired due to flow alteration, which is not a pollutant requiring calculations of a TMDL (MassDEP 2005a).

WMA WATER WITHDRAWALS (APPENDIX J)
Pittsfield Water Department (10223601)

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
DWM performed a habitat assessment of Windsor Brook as part of the fish population survey conducted on 20 August 2002 upstream from Old Windsor Road, Hinsdale. The fish sampling reach received a habitat score of 166 out of 200.

On 10 September 2002 DWM performed a habitat assessment of Windsor Brook at Station WB01 as part of the benthic macroinvertebrate sampling (Appendix C). The sampling reach received a habitat score of 164 out of 200. Habitat was limited most by low channel flow status (associated with natural drought conditions) and a reduced riparian vegetated zone width.

Windsor Brook downstream from the aqueduct was observed to be dry during field reconnaissance in 2002 (Mitchell 2006).

Biology
MA DFG conducted fish population sampling at one site (Site 677) along Windsor Brook (~785 meters upstream from Windsor Reservoir) on 20 August 2002 (Richards 2006). Only two species (n=54) of fish were collected: 25 blacknose dace and 29 brook trout ranging in length from 67 to 203 mm.

DWM conducted fish population sampling upstream from the Old Windsor Road Bridge, Hinsdale, on 29 August 2002 (Appendix F). A total of 102 fish were collected, but only two species were present: 73 blacknose dace and 29 brook trout (multiple age classes). The dace are classified as pollution tolerant fluvial specialists, while the trout are pollution intolerant fluvial specialists.

DWM conducted benthic macroinvertebrate sampling in Windsor Brook at Station WB01 (B0291), approximately 150 meters upstream from the Cleveland Brook Reservoir Aqueduct at Old Windsor Road in Hinsdale. This station was a reference station representative of a healthy community and least impacted conditions (Appendix C).

DWM biologists collected periphyton samples from two habitat types at Station WB01 in September of 2002 (Appendix G). Canopy cover within rock/riffle habitat at this station was reported as 90%, algal cover was 60%, and the dominant algal genera was *Lyngbya* sp. Canopy cover within pool habitat at this station was reported as 90%, algal cover was 60%, and the dominant algal genera were *Spirogyra* sp. and *Melosira* sp.

Chemistry-water
DWM conducted monthly *in situ*, pre-dawn water quality sampling in Windsor Brook upstream from Windsor Road in Hinsdale (Station 09A) between May and September 2002 (Appendix B). All *in-situ* measurements met water quality standards.

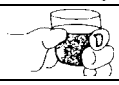
With the exception of the lower 0.2 mile reach below the aqueduct, which is dewatered, the upper 5.9 miles of Windsor Brook are assessed as support for the *Aquatic Life Use*. This assessment is based primarily on the biological data. The benthic community was deemed to be a suitable reference station indicative of excellent water quality conditions. The fish community was comprised of multiple age

classes of brook trout, a pollution intolerant fluvial species. All water chemistry parameters met standards.

AESTHETICS

DWM field biologists made field observations at Station WB01 on 10 September 2002 and did not note any objectionable conditions. Water clarity was noted to be clear and no water odors, oils or objectionable deposits (trash etc.) were noted (MassDEP 2002b). DWM personnel also made field observations during the surveys conducted between May and September 2002. With the exception of one occasion when white foam was noted, no water odors, scums or objectionable deposits were noted (Station 09A) (MassDEP 2002a). The *Aesthetics Use* is assessed as support.

WINDSOR BROOK (Segment MA21-09) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT for upper 5.9 miles IMPAIRED for lower 0.2 miles Cause: flow diversion Source: municipal water supply diversion
Fish Consumption		NOT ASSESSED
Drinking Water*		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

*The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS:

Conduct water quality monitoring to evaluate designated uses. Develop and implement a flow management plan in order to protect in-stream biota in Windsor Brook downstream from the aqueduct diversion.

WAHCONAH FALLS BROOK (SEGMENT MA21-11)
Location: Headwaters, outlet of Windsor Reservoir, Windsor, to confluence with East Branch Housatonic River, Dalton.
Segment Length: 3.4 miles.
Classification: Class B.

Based on the last evaluation of water quality conditions, this segment is listed in Category 3 of the 2004 Integrated List of Waters. This segment was not assessed for any of the designated uses (MassDEP 2005a).

WMA WATER WITHDRAWALS (APPENDIX J)
Dalton Fire District (10207003)

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
DWM performed a habitat assessment of Wahconah Falls Brook as part of the benthic macroinvertebrate sampling at Station WF01A (B0501), upstream from Holiday Cottage Road in Dalton, on 10 September 2002. This sampling reach received a habitat score of 149 out of 200 (Appendix C). The habitat at this station, similar to others throughout the watershed, was affected by drought conditions (decreased channel flow status). Additionally, the riparian zone width scored in the poor category. There were no aquatic macrophytes within the reach, but green filamentous and thin film algae covered 80% of the rocks in the riffles. Canopy cover was estimated at 60% (Appendix C).

Biology
MA DFG conducted fish population sampling at stations 618 and 622 on Wahconah Falls Brook on 18 July 2002. At station 618, Cleveland Road Crossing, a total of 252 fish, representing 10 species, were collected including 132 blacknose dace, 32 brook trout (59-177 mm), 26 slimy sculpin, 20 creek chub, 17 longnose dace, 17 white sucker, four brown trout (65-193 mm), two common shiner, one largemouth bass, and one pumpkinseed (Richards 2006).

DWM sampled the benthic macroinvertebrate community at Station WF01A (upstream from Holiday Cottage Road in Dalton) in 2002. The RBP III analysis indicated this station was slightly impacted when compared to the reference station on Windsor Brook. DWM biologists collected periphyton samples from Station WF01A in September of 2002. Canopy cover at this station was reported as 60%, algal cover was 80%, and the dominant algal genera were *Synedra* sp. and *Fragilaria* sp. (Appendix G).

At Station 622, the most downstream station located upstream from the Route 9 crossing in Dalton, a total of 359 fish were collected. Eleven species were represented, including: 196 blacknose dace, 47 white sucker, 44 creek chub, 39 longnose dace, 17 common shiner, five brown trout (59-66 mm), four pumpkinseed, three brook trout (46- 62 mm), two slimy sculpin, one brown bullhead, and one rainbow trout (Richards 2006).

Chemistry-water
HVA conducted monthly water quality sampling at three sites along Wahconah Falls Brook between June and October 2002; April and October 2003; and May and October 2004 (HVA 2002b, 2003c, and 2004b). The three HVA stations were: State Park, Cleveland Road, and Route 9 crossing. HVA also sampled many of these sites in 2001; data from 2001 is not summarized below, as their QAPP was not approved until 2002. Parameters measured included dissolved oxygen, pH, temperature, alkalinity, total phosphorus, and total suspended solids. Dissolved oxygen data were not collected during worst-case, pre-dawn conditions. All water quality measurements from these three stations during the years 2002-2004 met standards and were indicative of good water quality.

The *Aquatic Life Use* is assessed as support for Wahconah Falls Brook based on the RBP III analysis and the good water quality. However, there appears to be a slight shift in the fish community structure at the downstream sampling station, where reduced numbers of brook trout and slimy sculpin (both pollution intolerant cold water species) were noted. Agricultural land use activities in close proximity to the brook

may be contributing to this shift, so the *Aquatic Life Use* is identified as support with an Alert Status in the lower reach of this segment.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
HVA conducted fecal coliform and *E. coli* bacteria sampling at the water quality stations described above (HVA 2002b, 2003c, and 2004b). Fecal coliform bacteria counts from all three stations across all three years ranged from <10 to a high of 920 cfu/100 mL (n=59). Six counts exceeded 400 cfu/100mL (10%). Four of these high counts (n=20, 20%) were recorded at the Route 9 sampling location, which is the most downstream station.

In 1999 HVA volunteers performed a shoreline survey of Wahconah Falls Brook. No aesthetic degradation was noted (i.e., no trash, odors, scums, nuisance vegetation). In fact, this stream flows through Wahconah Falls State Park, falling 312 feet over its course for a vertical drop of 92 feet/mile and creating Wahconah Falls. Of concern to the volunteers was stormwater runoff from unpaved roads resulting in siltation of the brook (HVA 2004a).

DWM field biologists made field observations at Station WF01A (B0501) on September 10, 2006. DWM biologists did not note any objectionable conditions. Water clarity was noted to be clear and no water odors, oils or objectionable deposits (trash, etc.) were noted (MassDEP 2002b).

The *Primary Contact Recreational Use* is assessed as support in the upper 1.3 mile reach from the outlet of Windsor Reservoir downstream to Cleveland Street. The Primary Contact Recreational Use is assessed as impaired for the lower 2.1 mile reach from Cleveland Street to the confluence with East Branch Housatonic because of elevated fecal coliform bacteria counts. The *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support for this segment due to the acceptable bacteria counts and lack of objectionable conditions.

WAHCONAH FALLS BROOK (Segment MA21-11) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT upper 1.3 miles IMPAIRED lower 2.1 miles Cause: elevated fecal coliform bacteria Source: unknown Suspected sources: stormwater runoff
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

*Alert status issues identified, see details in use assessment

RECOMMENDATIONS
Habitat conditions would benefit from increased shading and adoption of agricultural BMPs. This may best be achieved by the planting of more trees within the riparian zone. Also, increased late-summer flows (in terms of both frequency and volume) from Windsor Reservoir would also improve the condition of this stream.

Continue to evaluate water quality conditions. Evaluate potential impacts associated with agricultural activities adjacent to the brook.

Develop a monitoring plan and conduct bacteria sampling to evaluate effectiveness of point (Phase II stormwater permits) and non-point source pollution control activities in the town of Dalton and to assess the status of the *Primary* and *Secondary Contact Recreational* uses. Conduct bacteria source tracking as needed to identify undocumented sources.

Reduce sediment contributions to the brook due to stormwater runoff from unpaved roads.

ANTHONY BROOK (SEGMENT MA21-10)
Location: Headwaters, outlet of Anthony Pond (locally known as Anthony Brook Reservoir), Dalton, to confluence with Wahconah Falls Brook, Dalton.
Segment Length: 2.6 miles.
Classification: Class B.

Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Aquatic Life* and *Aesthetics*) and was not assessed for others (MassDEP 2005a).

WMA WATER WITHDRAWALS (APPENDIX J)
Dalton Fire District (10207003)

USE ASSESSMENT
No recent quality-assured data are available for Anthony Brook.

ANTHONY BROOK (Segment MA21-10) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct water quality monitoring to evaluate designated uses.

Develop and implement a water use/withdrawal plan that will minimize low flow periods and negative impacts to in-stream biota.

Develop a monitoring plan and conduct bacteria sampling to evaluate effectiveness of point (Phase II stormwater permits) and non-point source pollution control activities in Dalton and to assess the status of the *Primary* and *Secondary Contact Recreational* uses. Conduct bacteria source tracking as needed to identify undocumented sources.

EAST BRANCH HOUSATONIC RIVER (SEGMENT MA21-02)
Location: Outlet of Center Pond, Dalton, to confluence with the Housatonic River, Pittsfield.
Segment Length: 8.0 miles.
Classification: Class B, Warm Water Fishery.

Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires TMDLs for unknown causes, unknown toxicity, priority organics, and pathogens (MassDEP 2005a).

WMA WATER WITHDRAWALS (APPENDIX J)
Crane & Co., Inc (10207002)
Pittsfield Generating Company (Altresco Pittsfield L.P) (9P10223601)
Berkshire Hills Country Club (10223602)

NPDES SURFACE WATER DISCHARGES (APPENDIX J)
Crane & Co., Inc. Byron Weston Mill (MAG250956)
Crane & Co., Inc. Pioneer Mill (MAG250955)
Crane & Co., Inc (MA0000671)
Pittsfield Development Authority (MA0040231) was General Electric Company (GE), Pittsfield (MA0003891) until June 2005
General Dynamics Defense Systems (MA0035718)

OTHER
General Electric Company, Pittsfield (http://www.epa.gov/region01/ge/).
It is important to note that the upper ½ mile and 1½ mile sections of the GE/EPA PCB Housatonic River cleanup project are located along the lower 2 miles of this segment. See EPA website above for more details. The upper ½ mile reach cleanup was completed in September 2002. Cleanup of the 1½ mile reach is ongoing.

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
Crane & Co. maintains five dams for their mill along this segment of the East Branch Housatonic River.

Crane & Co. made repairs to the Center Pond dam in October 2006. Center Pond has been dewatered in order to carry out repair work (Noel 2006). Byron Weston Dam #2 was temporarily by-passed while repair work was carried out, but it is now back to normal level. The Old Berkshire Mill Dam (formerly dam #3) breach was completed in November 2000. The process of removing the dam began in 1999 as a collaboration between Crane & Company and the Department of Fish and Game's Riverways Program. The dam, an historic timber-crib structure and concrete dam, had stood on the East Branch Housatonic River for 200 years (Riverways 2000). Crane & Co. also owns and operates three additional dams that are located along this segment downstream from the Old Berkshire Mill Dam. From upstream to downstream the dams are: Pioneer Mill Dam, Baystate Mill Dam, and Government Mill Dam. There are no fish passage facilities at these three dams.

DWM also performed a habitat assessment on the East Branch Housatonic River at Station EB02A (B0502) on 10 Sept. 2002 (Appendix C). The sampling reach, described below, received an overall score of 156 out of 200 due to a lack of in-stream fish cover, channel alteration, riparian vegetative zone width. Aquatic macrophytes (mosses) were present in 20% of the reach. Green filamentous and mat algae covered 50% of the rock substrates (Appendix G). The dominant algal genera were *Vaucheria* sp. and *Melosira* sp.

The United State Geological Survey (USGS) maintains one streamflow monitoring gage on this segment of the East Branch Housatonic River. USGS Gage #01197000 on the East Branch Housatonic River at Coltsville, MA, is located on the right bank 250 ft downstream from Hubbard Avenue Bridge in Pittsfield. Data are available from 1936 to the present (prior to 1945 data were published as the Housatonic River at Coltsville). The drainage area at the gage is 57.6 mi^2 and the average annual discharge over the period of record is 107 cfs. According to USGS flows are regulated by power plants upstream and, since 1949, for

the diversion of water upstream from Cleveland Brook Reservoir for the municipal supply of Pittsfield (Socolow *et al.* 2004). The estimated 7-day, 10-year low flow (7Q10) is 12.1 cfs (USGS 1998).

Biology

DWM also conducted benthic macroinvertebrate sampling on the East Branch Housatonic River at Station EB02A upstream from the Hubbard Avenue Bridge in Pittsfield, MA, on 10 Sept. 2002 (Appendix C). RBP III analysis of the benthos at Station EB02A indicated a non-impacted community when compared to the upstream reference station. However, DWM biologists point out that biotic index, EPT/ Chironomidae Ratio, and Scraper/Filterer Ratio all indicated nutrient loading at this station.

DWM conducted fish population sampling upstream from the Hubbard Avenue Bridge in Pittsfield at Station 680 on 20 August 2002 (Appendix F). A total of 64 fish were collected including: 21 longnose dace, 20 rock bass, six fallfish, five creek chub, three white sucker, three brown trout (196-425mm), two pumpkinseed, two common shiner, and two blacknose dace. The assemblage in this reach was dominated by moderately pollution tolerant fluvial specialist/dependent species.

Toxicity

Ambient

The Crane and Company WWTF staff collected water from this segment of the East Branch Housatonic River approximately 1,350 feet upstream of the WWTF Outfall # 001 at the trestle next to the Bay State Mill where a pipeline enters the WWTF (Noel 2005). This collected river water is used as dilution water in the facility's whole effluent toxicity tests. Between May 1999 and January 2006 (n=25), survival of *C. dubia* exposed (7-day) to the river water ranged from 80 to 100% (TOXTD database).

Effluent

A total of 20 modified acute and chronic whole effluent toxicity tests were conducted on the Crane and Company effluent between May 1999 and January 2006 (n=27) using *C. dubia.* The effluent did not exhibit any acute toxicity (LC_{50}s were all >100% effluent). The C-NOEC results for the 26 valid tests ranged from 25 to 100% effluent with only two tests (May 1999 and July 2004) failing to meet the C-NOEC limit of 63% effluent (TOXTD database).

The effluent toxicity tests from GE Company in Pittsfield are conducted on composite samples (flow weighted) from various outfalls (Appendix J) that actually discharge into three different water bodies (Unkamet Brook, Silver Lake, and the East Branch Housatonic River). Since these tests represent combined outfalls they are not summarized here.

Chemistry-water

DWM sampled the water quality of the East Branch Housatonic River at two stations in 2002. Station 02A was located upstream from the Hubbard Ave. Bridge in Pittsfield and Station 02B was located ~600 feet downstream from Pomeroy Avenue in Pittsfield. *In-situ* sampling was conducted to measure dissolved oxygen, temperature, pH, and conductivity during pre-dawn hours. Grab samples were collected from Station 02A only and analyzed for total suspended solids, nitrate-nitrogen, ammonia-nitrogen, and total phosphorus (low-level).

HVA conducted monthly water quality sampling downstream from Hubbard Avenue in Pittsfield between June and October 2002; April and October 2003; and May and October 2004 (HVA 2002b, 2003c, and 2004b). HVA also sampled this site in 2001, but data from 2001 are not summarized below, since their QAPP was not approved until 2002. Parameters measured included dissolved oxygen, pH, temperature, alkalinity, total phosphorus, and total suspended solids. Dissolved oxygen data were not collected during worst-case, pre-dawn conditions.

USGS also collected discrete water samples at their gage on the East Branch Housatonic on 21 August 2003 near Hubbard Avenue (USGS 2006a).

All water quality data collected by DWM, HVA, and USGS in the river near Hubbard Avenue met criteria except for elevated levels of total phosphorous. The two total phosphorous measurements taken by DWM in 2002 were 0.1 and 0.2 mg/L. The 17 total phosphorus measurements recorded by HVA between 2002 and 2004 ranged from <0.01 to 0.574 and 3 measurements exceeded 0.05 mg/L. USGS reported

0.026 mg/L (USGS 2006a). All *in-situ* measurements taken by DWM in the river near Pomeroy Avenue met standards.

The *Aquatic Life Use* is assessed as support for the upper six mile reach of this segment of the East Branch Housatonic River based primarily on the non-impacted benthic community, the good survival of test organisms exposed to the river water, and the generally good water quality conditions. However, this use is identified with an Alert Status downstream from the Crane and Company WWTP discharge because of elevated phosphorous concentrations and some evidence of nutrient enrichment in the benthic community attributes. The *Aquatic Life Use* will not be not assessed for the lower two mile reach (downstream from GE site) until water quality monitoring is conducted post remediation of the PCB contaminated sediments.

FISH CONSUMPTION

In 1982 the Massachusetts Department of Public Health (MA DPH) issued a fish consumption advisory for the Housatonic River because of PCB contamination associated with the General Electric site. The MA DPH advisory recommends: "*The general public should not consume any fish, frogs, or turtles from Housatonic River in the towns of Dalton, Pittsfield, Lenox, Lee, Stockbridge, Great Barrington, and Sheffield".* Since it is the East Branch Housatonic River that flows through Dalton and past the GE plant in Pittsfield, the MA DPH advisory for the Housatonic River is assumed to cover this area of the East Branch of the Housatonic River. In 1995 MA DPH updated their advisory to include a recommendation that fish taken from feeder streams to the Housatonic River should be trimmed of fatty tissue prior to cooking.

Due to the MA DPH site-specific fish consumption advisory issued in 1982 (see previous segment), the *Fish Consumption Use* is assessed as impaired due to PCBs.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS

HVA collected monthly bacteria samples at their Hubbard Avenue water quality station in 2002, 2003, and 2004 (HVA 2002b, 2003c, and 2004b).

DWM collected fecal coliform bacteria and *E. coli* samples from the East Branch Housatonic River approximately 600 feet downstream from Pomeroy Avenue in Pittsfield (Station 02B) between May and September 2002 (Appendix B).

Fecal coliform counts from sampling conducted by DWM and HVA ranged from 20 to 1400 cfu/100mL (n=25). Bacteria counts collected at DWM Station 02B (the farthest downstream) had a geometric mean of 234 cfu/100mL. Elevated bacteria, particularly during wet-weather sampling events, were documented by HVA in 2002 and 2003.

In 1999 HVA volunteers conducted a shoreline survey of the East Branch Housatonic River between the Center Pond Dam and the Government Mill Dam in Pittsfield. Improper disposal of pet waste into the storm drains was reported near Depot Street in Dalton (HVA initiated a Storm Drain Awareness Program in 2001). Isolated areas of trash were noted. However, after the removal of the Berkshire Mill Dam in 2001, HVA conducted a river cleanup and removed the trash. Numerous pipes were noted and their locations have been mapped and entered into HVA's Geographic Information System for future action. It is important to note that HVA and Berkshire Regional Planning Commission are working on several projects to measure the impact of storm drains on the East Branch Housatonic River (HVA 2004a). Overall this segment was generally free from odor, oil and grease, color and turbidity, floating matter, and nuisance organisms.

DWM biologists noted the water at Station EB02A was "rust" colored and had a paper effluent odor (Mitchell 2005). DWM biologists also noted slight turbidity to the water but no oils or objectionable deposits (MassDEP 2002b). DWM personnel also made visual observations at this station during water quality surveys. At Station 02A trash was noted on two occasions (5/21/02 and 7/21/02) while on eight other occasions no objectionable deposits were noted (MassDEP 2002a). On 21 May 2002 no indication of the extent of deposits was noted, but on 21 July 2002 it was noted that the trash/garbage was "light, (a) few bottles". With the exception of 24 September 2002 when white foam was noted, no scums were noted. A musky water odor and a "rotting vegetable" water odor were noted on two different occasions,

respectively. All other occasions no odor was noted. Water clarity was noted as clear on four occasions, slightly turbid on four other occasions and murky once. At Station 02B no objectionable deposits or scums were noted. A musky water odor was noted on one occasion, a septic water odor was noted twice, and sewage water odor was noted once. On the remaining six occasions no water odor was noted but of these occasions a sewer smell in the air was noted three times. Water clarity was generally noted as clear, and on only a few occasions it was rated as slightly turbid.

Similar to the upper East Branch Housatonic River segment, the *Primary Contact Recreational Use* is assessed as impaired because of elevated fecal coliform bacteria counts, noted particularly during wet weather. The *Secondary Contact* and *Aesthetics* uses are assessed as support based upon the acceptable bacteria counts and the generally acceptable aesthetic conditions noted by HVA volunteers and DWM personnel. However, these uses are identified with an Alert Status due to occasional septic/sewage odors and issues with turbidity.

EAST BRANCH HOUSATONIC RIVER (Segment MA21-02) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT* upper 6 miles NOT ASSESSED lower 2 miles
Fish Consumption		IMPAIRED Cause: PCBs Source: inappropriate waste disposal from General Electric Site
Primary Contact		IMPAIRED Cause: elevated fecal coliform bacteria Source: unknown Suspected sources: stormwater runoff
Secondary Contact		SUPPORT*
Aesthetics		SUPPORT*

*Alert status issues identified, see details in use assessment

RECOMMENDATIONS

Continued monitoring of the aquatic conditions (both chemical and biological) is recommended to monitor the status of the resident biotic communities.

Develop a monitoring plan and conduct bacteria sampling to evaluate effectiveness of point (Phase II stormwater permits) and non-point source pollution control activities in Dalton and Pittsfield and to assess the status of the *Primary* and *Secondary Contact Recreational* uses. Conduct bacteria source tracking as needed to identify undocumented sources.

It is currently being investigated by EPA as part of their Ecological Risk Assessment whether or not the biota in the East Branch Housatonic River upstream from the Crane & Co., Inc. dams (which pose a barrier to fish migration) are contaminated by PCBs. The MA DPH should review the results of this investigation and adjust the fish consumption advisory as needed.

WEST BRANCH HOUSATONIC RIVER (SEGMENT MA21-18)
Location: Headwaters, outlet of Pontoosuc Lake, Pittsfield, to confluence with Southwest Branch Housatonic River (forming the headwaters of the Housatonic River), Pittsfield.
Segment Length: 4.1 miles.
Classification: Class B, Cold Water Fishery.

Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires TMDLs for priority organics, siltation, and pathogens. Other habitat alterations also impair the segment, but they are a pollutant that does not require the calculation of a TMDL (MassDEP 2005a).

WMA WATER WITHDRAWALS (APPENDIX J)
Lanesborough Village Water District (10214801)

UPCOMING PROJECTS
The Riverways Program, in partnership with the City of Pittsfield and Berkshire Regional Planning Commission, is currently evaluating the feasibility of removing the Tel-Electric (Mill Street) Dam on the West Branch Housatonic River to open up over one hundred miles of river continuity, extending to the mainstem Housatonic River. The feasibility study, being prepared by Kleinschmidt, will include a sediment management plan, conceptual dam removal alternatives analysis and hydraulic scour analysis. This project is being considered in concert with improved public access and flood control to protect historic Wahconah Park (MA DFG 2006c).

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
Water flows from Pontoosuc Lake via one of two ways--either over the dam into the main channel of the river or by diversion into a bypass channel, or “sluiceway”, on the west end of the dam. This bypass channel runs parallel to the main riverbed for approximately 100 yards before joining with it. This 100-yard stretch of the main riverbed is often dry or very nearly dry since much more water leaves the lake via the bypass channel instead of flowing over the dam (HVA 2003c).

The Housatonic Valley Association (HVA), in cooperation with the Riverways Instream Flow Stewards (RIFLS) program, has documented issues with flows over the outlet of Pontoosuc Lake Dam (HVA 2002b). At times there has been no flow coming over the dam, resulting in recently stocked trout being stranded in isolated pools. Flows in this section of river do not correlate well with rainfall data or other flow data (e.g., flow is high when all others are low or vice versa). Downstream, near Wahconah Park, there are problems with the river flooding every time it rains.

In 2000 HVA conducted a shoreline survey of the West Branch Housatonic River from the outlet of Pontoosuc Lake to the confluence with the East Branch Housatonic River (HVA 2000). In the section from the outflow of Pontoosuc Lake to Wahconah Street, the river was channelized with “rocked-in or bricked-in walls or banks”. In the section from Pecks Brook confluence to the Linden Street bridge, an active beaver dam impounds the river. Additionally, in-stream sedimentation is problematic in the vicinity of King Street.

DWM performed a habitat assessment at Station HW01 (B0021) on 10 September 2002, approximately 300 meters downstream from Route 20 in Pittsfield, MA (Appendix C). The habitat at station HW01 received the lowest habitat score of the 15 Housatonic Watershed stations examined in 2002 (94/200) due to poor in-stream fish cover, lack of deep pools or deep runs, sparse vegetation along the stream banks, and small industrial facilities, residences, roads, and parking areas impacting the riparian zone width. The sampled reach was channelized, with stone walls containing the flows for approximately half of the 100 meter reach. There were no aquatic macrophytes within the reach, and green filamentous algal coverage was estimated at less than 5%. Canopy cover was estimated at 65% (Appendix C).

Biology
MA DFG conducted fish population sampling at one station (Site 617, at Route 20, Pittsfield, near Clapp Park) on 11 July 2002. A total of 81 fish representing 13 species were collected, including: 29 white

sucker, 18 fallfish, nine bluegill, six pumpkinseed, six rock bass, three blunt nose minnows, three black crappie, two common shiner, one blacknose dace, one creek chub, one golden shiner, one largemouth bass, and one yellow perch (Richards 2006). The fish community was composed of pollution tolerant or moderately tolerant species, with a complete absence of pollution intolerant species. Few fluvial specialist species were present.

DWM sampled the benthic macroinvertebrate community in the river downstream from Route 20 (Station HW01) in September 2002 (Appendix C). RBP III analysis indicated this station was slightly impacted when compared to the regional reference station on the East Branch Housatonic River (Station EB01B). It should be noted that highly pollution tolerant worms dominated the community (37%); these organisms are indicative of organic enrichment. Additionally, this sampling reach exhibited the most degraded benthic community structure encountered during the 2002 Housatonic River watershed survey. Habitat quality was only 53% comparable to the reference station condition.

Chemistry-water

HVA conducted monthly water quality sampling at three sites along this segment between June and October 2002 and April and October 2003 (HVA 2002b and 2003c). In 2004 HVA sampled five sites on the West Branch (HVA 2004b). These stations were called: Pontoosuc Lake Dam, Taconic Park Drive, West Branch above Peck's, Jimmy's & Route 20, and Atwood Avenue. Parameters measured included dissolved oxygen, pH, temperature, alkalinity, total phosphorus, and total suspended solids. Dissolved oxygen data were not collected during worst-case, pre-dawn conditions.

The majority of water quality data collected by HVA in the West Branch Housatonic River met criteria. Elevated levels of total phosphorous, temperatures exceeding 20°C, and two high concentrations of total suspended solids were recorded. Total phosphorous concentrations ranged from <0.01 to 0.13 mg/L (n=31). The highest measurements of total phosphorous and TSS were associated with wet-weather sampling. Water temperatures exceeding 20°C were frequently observed during the summer months.

The *Aquatic Life Use* is assessed as impaired based upon the examination of the collective data available for this segment. The RBP III analysis indicated that the benthic community was only slightly impacted. However, pollution tolerant worms dominated the sample, the biotic index was the highest (worst) and the EPT index was the lowest (worst) of any of the sites monitored. These community attributes were considered to be strong indicators of organic enrichment. Furthermore, the in-stream habitat quality was degraded and pollution intolerant cold-water fish species were absent. HVA water quality corroborates these findings, as they recorded elevated summer temperatures and elevated total phosphorous concentrations.

FISH CONSUMPTION

In 1982 the Massachusetts Department of Public Health (MA DPH) issued a fish consumption advisory for the Housatonic River because of PCB contamination associated with the General Electric site. In 1995 MA DPH updated their advisory to include a recommendation that fish taken from feeder streams to the Housatonic River should be trimmed of fatty tissue prior to cooking.

Because there are no barriers to migration for fish between the West Branch Housatonic River and the GE site, the *Fish Consumption Use* is identified with an Alert Status.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS

HVA collected monthly fecal coliform and *E. coli* bacteria samples from the five water quality stations described above (HVA 2002b, 2003c,and 2004b). Fecal coliform counts at these five stations ranged from 5 to >20,000 cfu/100mL (n=50). In 2002 a leaking sewer line was discovered due to these extremely high bacteria counts in the vicinity of the Jimmy's Restaurant & Rt. 20 site. The City of Pittsfield repaired the line that summer. Since that time the highest count was 3,960 cfu/100mL, recorded by HVA in 2003 at the Atwood Avenue station. Three of 19 samples collected at the Jimmy's and Atwood Ave stations in 2003 and 2004 exceeded 2000 cfu/100mL. Seven of these 19 exceeded 400 cfu/100mL.

In 2000 HVA conducted a shoreline survey of the West Branch Housatonic River (HVA 2000). Multiple crews noted trash throughout this reach, with one volunteer describing the river as "trashy, dangerous and aesthetically very unappealing". Volunteers noted a milky discharge from a storm drain in the West

Street to Atwood Avenue section. Sewage odors were documented at Wahconah Park and the Mill Street Dam.

DWM field biologists recorded field observations at Station HW01 (B0021) on 10 September 2002. They noted that the sediment smelled musty and there was an abundance of trash and debris in-stream (i.e., broken glass, bricks, etc). The water was also described as slightly turbid with a musty smell. No sedimentation or water oils were noted (MassDEP 2002b).

The *Primary* and *Secondary Contact Recreation* and *Aesthetics* uses are assessed as impaired for this segment due to the objectionable deposits of trash and odors throughout this segment noted by DWM biologists and shoreline survey observations made by HVA volunteers. In addition, the fecal coliform bacteria counts are sufficiently high to impair the *Primary Contact Use* downstream from the Peck's station and the *Secondary Contact Recreation Use* downstream from the Jimmy's station.

WEST BRANCH HOUSATONIC RIVER (Segment MA21-18) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Combined biota/habitat assessment Suspected causes: Organic enrichment, elevated total phosphorous, elevated temperatures Source: urbanized high density area Suspected source: impoundment effects
Fish Consumption		NOT ASSESSED*
Primary Contact		IMPAIRED Cause: trash and debris, odor, fecal coliform bacteria Source: urbanized high density area, illicit connections/hookups to storm drains
Secondary Contact		IMPAIRED Cause: trash and debris, odor, fecal coliform bacteria Source: urbanized high density area, illicit connections/hookups to storm drains
Aesthetics		IMPAIRED Cause: trash and debris, odor Source: urbanized high density area

*Alert status issues identified, see details in use assessment

RECOMMENDATIONS

Monitor bacteria counts and conduct bacteria source tracking to identify and address point sources.

Monitor summer water temperatures with deployed probes. Investigate flow alterations or other actions that could improve the cold water habitat of this designated cold water fishery.

Control pollutant loading from storm drains by implementing Phase II stormwater permit requirements in the city of Pittsfield. Develop a monitoring plan and conduct bacteria sampling to evaluate effectiveness of point (Phase II stormwater permits) and non-point source pollution control activities in Pittsfield and to assess the status of the *Primary* and *Secondary Contact Recreational* uses. Conduct bacteria source tracking as needed to identify undocumented sources.

Due to the no flow occurrence documented by HVA volunteers, local regulatory authorities are encouraged to establish a flow management strategy to protect in-stream biota in the West Branch Housatonic River downstream from Lake Pontoosuc.

SOUTHWEST BRANCH HOUSATONIC RIVER (SEGMENT MA21-17)
Location: Headwaters, outlet Richmond Pond, Pittsfield, to confluence with West Branch Housatonic River, Pittsfield.
Segment Length: 5.8 miles.
Classification: Class B, Cold Water Fishery.

Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires TMDLs for unknown causes and siltation. An additional pollutant not requiring the calculation of a TMDL is other habitat alteration (MassDEP 2005a).

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
DWM performed a habitat assessment at Station HW02S (B0022) in September 2002, downstream from Barker Road in Pittsfield, MA. The total habitat score for Station HW02S was 146/200 due to sediment deposition (up to 50% of the stream bed affected by new sediment deposits) and the lack of deep-water habitat. Although the substrate embeddedness was limited in riffle areas, it was a negative impact on benthic habitat within the remainder of the sampling reach. All substrates had a "silty cover" overlaying them and the water appeared to be slightly turbid. DWM biologists collected periphyton samples from Station HW02S in September of 2002 (Appendix G). Canopy cover at this station was reported as 70%. There were no aquatic macrophytes within the reach, nor was there any algal coverage.

Biology
MA DFG conducted fish population sampling on the Southwest Branch of the Housatonic River (Site 620, Barker Road, Pittsfield) on 11 July 2002 (Richards 2006). A total of 134 fish were collected, representing 12 species, including: 52 blacknose dace, 26 white sucker, 22 longnose dace, 11 brown trout (70-260mm), nine fallfish, seven common shiner, two yellow perch, one creek chub, one bluegill, one largemouth bass, one pumpkinseed, and one rock bass. Fluvial specialists dominated the fish community at this site. Multiple age classes of brown trout, a pollution intolerant species, were also present.

DWM sampled the benthic macroinvertebrate community in the river downstream from Barker Road (Station HW02S) in September 2002 (Appendix C). RBP III analysis indicated this station was non-impacted when compared to the regional reference station on the East Branch Housatonic River (Station EB01B). The structure of the 2002 benthic community was much improved over conditions observed in 1997, when RBP III analysis indicated slight/moderate impairment.

Chemistry-water
HVA conducted monthly water quality sampling at two sites along this segment between June and October 2002 and April and October 2003 (HVA 2002b and 2003c). In 2004 HVA sampled three sites on the Southwest Branch Housatonic River (HVA 2004b). The four stations where sampling was conducted between 2002 and 2004 were called Richmond Pond Dam, Lebanon Ave., West Hungerford, and Barker Ave. Parameters measured included: dissolved oxygen, pH, temperature, alkalinity, total phosphorus, and total suspended solids. Dissolved oxygen data were not collected during worst-case, pre-dawn conditions. These data are summarized below. It is important to note that 2002 was a drought year and HVA reports that flows out of Richmond Pond were minimal (HVA 2002b).

The majority of water quality data collected by HVA in the Southwest Branch Housatonic River met standards. Total phosphorous concentrations ranged from <0.01 to 0.147 mg/L (n=24). Only two measurements exceeded 0.05 mg/L, and these measurements were associated with wet-weather sampling. One elevated measurement of TSS (63 mg/L) was also recorded during wet-weather sampling. Water temperatures exceeding 20°C were often observed during the summer months, particularly at the outlet of Richmond Pond. Also worthy of note are occasional low DO measurements (3) recorded in the river below the Richmond Pond Dam and Lebanon Avenue (n=37).

The *Aquatic Life Use* is assessed as support based upon the non-impacted benthic community and the fish assemblage. This use is identified with an Alert Status because of extensive sediment deposition and the embeddedness of substrates.

FISH CONSUMPTION

In 1982, the Massachusetts Department of Public Health (MA DPH) issued a fish consumption advisory for the Housatonic River because of PCB contamination associated with the General Electric site. In 1995 MA DPH updated their advisory to include a recommendation that fish taken from feeder streams to the Housatonic River should be trimmed of fatty tissue prior to cooking.

Because there are no barriers to migration for fish between the Southwest Branch Housatonic River and the GE site, the *Fish Consumption Use* is identified with an Alert Status.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS

HVA collected monthly fecal coliform and *E. coli* bacteria samples from the four water quality stations named above between June and October 2002 and between April and October during 2003 and 2004 (HVA 2002b, HVA 2003c, and HVA 2004b).

Fecal coliform bacteria counts ranged from <10 to 1000 cfu/100 mL (n=37) at the four HVA stations. Eight fecal coliform bacteria counts were greater than 400 cfu/100mL. The geometric mean of samples collected at Lebanon Ave in 2004 and Barker Road in 2002, 2003, and 2004 were all greater than 200 cfu/100mL.

In 2006 a MassDEP bacteria source tracking reconnaissance team discovered a leaking sewer line near Route 20 at the East end of Hungerford Road. The sewer line has been fixed and subsequent sampling did not find any elevated bacteria levels (Kurpaska 2006). A pet walking area adjacent to Walker Brook was also identified as a possible source of bacteria, especially during rain events.

DWM biologists noted that the water was slightly turbid but no odors or oils were present in the Southwest Branch Housatonic River near Barker Road in Pittsfield (Station HW02S) on 10 September 2002 (MassDEP 2002b).

The *Primary Contact Recreational Use* is assessed as impaired because of elevated fecal coliform bacteria counts. The *Secondary Recreation* and *Aesthetics* uses are assessed as support based on the bacteria counts being acceptable for secondary contact and the lack of any objectionable conditions, odors, or deposits.

SOUTHWEST BRANCH HOUSATONIC RIVER (SEGMENT MA21-17) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED*
Primary Contact		IMPAIRED Cause: elevated fecal coliform bacteria Source: unknown Suspected sources: pet waste, leaking sewer pipe
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

*Alert status issues identified, see details in use assessment

RECOMMENDATIONS

Field reconnaissance and implementation of Phase II stormwater permit requirements should be conducted to help to identify and address potential areas contributing to sediment deposition. Develop a monitoring plan and conduct bacteria sampling to evaluate effectiveness of point (Phase II stormwater permits) and non-point source pollution control activities in Pittsfield and to assess the status of the *Primary* and *Secondary Contact Recreational* uses. Conduct bacteria source tracking as needed to identify undocumented sources.

Conduct long term temperature monitoring during the summer months to determine if the water quality standards for cold water fisheries are being exceeded.

HOUSATONIC RIVER (SEGMENT MA21-04)
Location: Confluence of Southwest Branch Housatonic River and West Branch Housatonic River, Pittsfield, to outlet of Woods Pond, Lee/Lenox.
Segment Length: 12.3 miles.
Classification: Class B, Warm Water Fishery.

Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires TMDLs for priority organics, pathogens, and turbidity (MassDEP 2005a).

Woods Pond (MA21120) will no longer be reported on as a lake segment since the retention time of this 114 acre waterbody was estimated at less than 1 day; it will be considered a run of the river impoundment (McVoy 2006). The retention time estimate was based on the annual historical mean discharge from two stream gages in the Housatonic River Basin (01197500 and 01197000) and the normal storage volume of the dam reported by MA DCR in their Massachusetts Dam Safety Program Database (Socolow *et al*. 2004 and MA DCR 2002).

WMA WATER WITHDRAWALS (APPENDIX J)
Pittsfield Water Department (10223601)
Pittsfield Country Club (10223603)
Bosquet Ski Area (9P210223602)

NPDES SURFACE WATER DISCHARGES (APPENDIX J)
Pittsfield Wastewater Treatment Plant (MA0101681)

USE ASSESSMENT
AQUATIC LIFE USE
Biology
DWM biologists collected chlorophyll *a* samples from Stations 04B, 04C, and 19AU on July 31st and September 25th 2002. Chlorophyll *a* levels measured on these dates at stations 04B and 04C were between 1.8 and 3.3 mg/m^3, respectively (Appendix G). These are low levels of chlorophyll *a*. Chlorophyll *a* levels were measured at station 19AU above Woods Pond dam (14.6 mg/m^3 on September 25th and 23.6 mg/m^3 (mean of two samples) on July 31st). These elevated measurements are indicative of nutrient enriched conditions.

Woods Pond is infested with the non-native aquatic macrophyte *Trapas natans* (MA DFG 2005). The length of river through Woods Pond is approximately 0.8 miles.

Toxicity
Ambient
The Pittsfield WWTP staff collected water from the Housatonic River approximately 2.2 miles upstream from Outfall # 003 at the Pomeroy Avenue Bridge for accessibility reasons (Landry 2005). The water is collected for use as dilution water in the facility's whole effluent toxicity tests. Between April 2000 and March 2006 (n=25), survivals of *C. dubia* exposed (7-day) to the river water were all 100% (TOXTD database).

Effluent
Between December 2000 and June 2005, 19 whole effluent toxicity tests were conducted on the City of Pittsfield WWTP effluent using the test organism *C. dubia*. No acute or chronic toxicity was detected (LC_{50}s$\geq$100% effluent, C-NOECs ranged from 75 to 100% effluent). The permitted limits for this facility are LC_{50} > 100% effluent and C-NOEC $\geq$ 50% effluent.

Chemistry-water
DWM conducted water quality sampling at three stations on this segment of the Housatonic River between May and September 2002 (Appendix B). Station 04X was located upstream from South St., Pittsfield. Station 04B was located upstream from Holmes Road, Pittsfield. Station 04C was located upstream from New Lenox Road, Lenox. *In-situ* sampling was conducted to measure dissolved oxygen,

temperature, pH, and conductivity during pre-dawn hours. All *in-situ* measurements met water quality criteria.

Chemistry-sediment

Blasland, Bouck & Lee, Inc. and Quantitative Environmental Analysis, LLC prepared a 2003 report for the General Electric Company detailing the extent of PCB contamination in Housatonic River sediments (BBL 2003). This report was based upon sediment cores collected by the EPA between 1998 and 2002. Four of the study reaches presented within this report are located within segment MA 21-04. The study reaches are defined as follows: 5A is the river section from the confluence to just above the Pittsfield WWTP; 5B is the river section from the Pittsfield WWTP to Roaring Brook; 5C is the river section from Roaring Brook to the headwaters of Woods Pond; and 6 is Woods Pond from its headwaters to the dam.

Concentrations of PCBs and total organic carbon (TOC) measured in the top 6 inches of sediment within reaches of this segment of the Housatonic River are below (BBL 2003 as summarized by Poach and Kurpaska 2006). The numbers (n) of cores analyzed to produce the results appear in parentheses after the reach designation.

Reach	Sediment PCB Concentration in 0 - 6 inch layer (mg/kg)			
(n)	Min	Max	Mean	Median
5A (369)	ND	290	20	11
5B (179)	ND	165	6.5	3.3
5C (224)	ND	294	22	6.1
6 (113)	ND	210	32	17

Reach	Sediment TOC Concentration in 0 - 6 inch layer (%)			
(n)	Min	Max	Mean	Median
5A (351)	ND	21	1.4	0.77
5B (177)	ND	13	1.4	1
5C (236)	ND	25	3.2	2.3
6 (121)	0.058	36	7.8	6.2

Since minimum TOC levels were listed as non-detectable, the median TOC concentrations were used to calculate the S-EL to make this a conservative estimate of the level of PCB toxicity. The mean PCB sediment concentrations within these reaches were found to approach or exceed the total PCB S-EL (by a factor of 0.97 to 5). Maximum PCB sediment concentrations all exceeded the total PCB S-EL based upon the maximum TOC level of 10% (Persaud et al 1993).

Chemistry-tissue

Weston Solutions, Inc. prepared a 2004 report for the Army Corps of Engineers and the U.S. Environmental Protection Agency detailing the extent of PCB contamination in fish tissue from fish caught in the Housatonic River (Weston 2004). This report is based upon fish collected by EPA between 1998 and 2002. Reaches 5A, 5BC (reached 5B and 5C combined) and 6 are located within Segment MA 21-04.

Concentrations of PCB in fish collected from reaches within Housatonic River segment 21-04 appear below (Weston 2004 as summarized by Poach and Kurpaska 2006). The numbers of fish analyzed to produce the results appear in parentheses after the fish name.

Whole body concentrations of PCB in fish

	Whole Body tPCB (μg/kg w/w)		
Reach	Min	Max	Fish Sampled
5A	3,030	220,000	largemouth bass (5), smallmouth bass (2), white sucker (16)
5BC	10,700	412,000	largemouth bass(10), brown bullhead(2), common carp(8), goldfish(19), white sucker(26)
6	8,260	447,000	largemouth bass (11), goldfish (23), white sucker (15)

Composite concentrations of PCB in fish

	Composite tPCB (μg/kg w/w)		
Reach	Min	Max	Fish Sampled
5A	24,100	54,300	largemouth bass (2), fallfish (5), yellow perch (5)
5BC	2,590	39,800	largemouth bass (5), pumpkinseed (4), golden shiner (5), yellow perch (5)
6	8,800	120,000	largemouth bass(5), common carp(3), pumpkinseed(5), golden shiner(5), yellow perch(5)

Composite concentrations of PCB in young of the year fish in 2002

	Young of Year tPCB (μg/kg w/w)		
Reach	Min	Max	Fish Sampled
5B	10,000	27,000	largemouth bass (7), bluegill (6), pumpkinseed (1), yellow perch (4)
6	12,000	19,000	largemouth bass (7), bluegill (7), yellow perch (2)

All of the whole fish samples analyzed for total PCB exceeded (by between 5 and 894 times) the NAS/NAE guideline for the protection of fish eating wildlife (500μg/kg wet weight).

The *Aquatic Life Use* is not assessed for the upper one mile of this segment (upstream from the confluence with the East Branch Housatonic River) due to too limited data. Downstream from the confluence with the East Branch Housatonic River, the *Aquatic Life Use* is assessed as impaired for the lower 11.3 miles based upon high levels of PCB contamination. Whole fish PCB levels greatly exceeded the National Academy of Sciences and National Academy of Engineering (NAS/NAE) guideline for the protection of fish eating wildlife. Surficial sediments are also contaminated with PCBs in this reach. The invasive aquatic macrophyte *Trapas natans* was also observed in the 0.8 mile Woods Pond section of the river. Water quality was generally acceptable, except for elevated chlorophyll *a* levels (See Appendix G) indicative of enrichment measured in Woods Pond.

FISH CONSUMPTION

Weston Solutions, Inc. prepared a 2005 report for the Army Corps of Engineers and the U.S. Environmental Protection Agency detailing the extent of PCB contamination in fish fillets from fish caught in the Housatonic River. The mean total PCB concentrations in fish fillets collected in reaches 5 and 6 (confluence downstream to the Woods Pond dam) were reported as follows: bass 16.7, bullhead 13.2, perch 7.4, and sunfish 6.5 mg/kg wet weight (Weston 2005).

In 1982 the Massachusetts Department of Public Health (MA DPH) issued a fish consumption advisory for the Housatonic River because of PCB contamination associated with the General Electric site. The MA DPH advisory recommends: "*The general public should not consume any fish, frogs, or turtles from Housatonic River in the towns of Dalton, Pittsfield, Lenox, Lee, Stockbridge, Great Barrington, and Sheffield".* The upper one mile portion of this segment of the Housatonic River is upstream of its confluence with the East Branch Housatonic River. Therefore, it is assumed that the MA DPH advisory for the Housatonic River does not cover this one mile reach. In 1995 MA DPH updated their advisory to include a recommendation that fish taken from feeder streams to the Housatonic River should be trimmed of fatty tissue prior to cooking.

Due to the MA DPH site-specific fish consumption advisory, the *Fish Consumption Use* is assessed as impaired for this segment because of PCB contamination.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from this segment of the Housatonic River at water quality stations 04B and 04C (Appendix B). Fecal coliform counts ranged from 110 to 1300 cfu/100mL (n=10). The geometric mean of five samples collected at the upstream station, 04B near Holmes Road in

Pittsfield, was 451 cfu/100mL. Further downstream at Station 04C near New Lenox Road in Lenox, the geometric mean of five samples was 152 cfu/100mL.

DWM personnel did not note objectionable conditions at stations 04X, 04B and 04C (MassDEP 2002a). Water clarity was found to be clear or slightly turbid and no objectionable deposits, scums or water odor were recorded at any of the stations.

Weston Solutions, Inc. prepared a 2005 report entitled "Human Health Risk Assessment GE/Housatonic River Site, Rest of River" for the U.S. EPA and U.S. Army Corps of Engineers (Weston 2005). In this study, total hazard index values calculated for reasonable maximum exposure to sediment within Housatonic River reaches 5 and 6, located within segment MA21-04, were shown to slightly exceed the EPA non-cancer hazard level of 1.0. Total hazard index values calculated for the central tendency exposure to sediment within this segment were all less than the EPA non-cancer hazard level of 1.0.

The *Primary Contact Recreational Use* is assessed as impaired in the upper 5.7 mile reach from the headwaters to the Pittsfield WWTP due to elevated fecal coliform bacteria counts. The Primary Contact Recreation Use is assessed as impaired for this segment based upon the results of the human health risk assessment for exposure to PCB contaminated sediment within this segment. The *Secondary Contact Recreation and Aesthetics* uses are assessed as support, based on fecal coliform bacteria counts that are acceptable for secondary contact and the lack of any objectionable conditions.

HOUSATONIC RIVER (Segment MA21-04) Use Summary

Designated Uses		Status
Aquatic Life		NOT ASSESSED upper 1.0 mile IMPAIRED lower 11.3 miles Cause: PCBs in whole fish and sediment, and non-native macrophyte in lower 0.8 miles Source: inappropriate waste disposal from General Electric Site for PCB contamination, unknown for non-native macrophyte
Fish Consumption		IMPAIRED Cause: PCBs Source: inappropriate waste disposal from General Electric Site
Primary Contact		IMPAIRED Cause: PCBs, and elevated fecal coliform bacteria in upper 5.7 miles Source: inappropriate waste disposal from General Electric Site for PCB contamination, unknown for bacteria Suspected source: stormwater runoff for bacteria
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

RECOMMENDATIONS

Develop a monitoring plan and conduct bacteria sampling to evaluate effectiveness of point (Phase II stormwater permits) and non-point source pollution control activities in Pittsfield and to assess the status of the Primary and Secondary Contact Recreational uses. Conduct bacteria source tracking as needed to identify undocumented sources.

HOUSATONIC RIVER (SEGMENT MA21-19)
Location: Outlet of Woods Pond, Lee/Lenox, to the Risingdale impoundment dam, Great Barrington.
Segment Length: 19.9 miles.
Classification: Class B, Warm Water Fishery

Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires TMDLs for unknown toxicity, priority organics, thermal modifications, pathogens, and turbidity (MassDEP 2005a).

Risingdale Impoundment (MA21121) will no longer be reported on as a lake segment since the retention time of this 41 acre waterbody was estimated at less than 1 day; it will be considered a run of the river impoundment (McVoy 2006). The retention time estimate was based on the annual historical mean discharge from two stream gages in the Housatonic River Basin (01197500 and 01197000) and the normal storage volume of the dam reported by MA DCR in their Massachusetts Dam Safety Program Database (Socolow *et al*. 2004 and MA DCR 2002).

Through the River Instream Flow Stewards (RIFLS) program, HVA has monitored the water level in Beartown Brook, a tributary to this segment, in Lee (RIFLS 2006). Trout and crayfish were documented in the brook. HVA also deployed a temperature logger in the brook.

WMA WATER WITHDRAWALS (APPENDIX J)
Schweitzer-Mauduit International, Inc (10215002/9P210215002)
Mead Westvaco formerly Mead Corporation – Specialty Paper Division (10215001/9P10215001) Two sources listed, Housatonic River and Beartown Brook
Cranwell Conference Center (V10215202)
Lane Construction Company (9P210215004)
Lee Water Department (10215003/9P210215003)

NPDES SURFACE WATER DISCHARGES (APPENDIX J)
Lenox Wastewater Treatment Plant (MA0100935)
Schweitzer-Mauduit International, Inc (MA0005371)
Oldcastle Architectural Products Group (MAR05A083)
Lee WWTP (MA0100153)
MW Custom Papers, Inc.– Laurel Mill (MA0001716)
MW Custom Papers, Inc.– Willow Mill (MA0001848)
Stockbridge Wastewater Treatment Plant (MA0101087)

FERC
Willow Mill Hydroelectric Project FERC No. 2985
The Willow Mill Hydroelectric Project is owned and operated by MeadWestvaco Corporation and has an existing FERC license, which was issued on May 1, 1981 and has an expiration date of April 30, 2011. MeadWestvaco Corporation intends to submit an Application for a New License by April 30, 2009. In order to expedite the licensing process, the MeadWestvaco Corporation submitted a Pre-Application Document and Notice of Intent for a new FERC license in April 2006. Comments by resource agencies and stakeholders on the Pre-Application Document and Notice of Intent will result in data gathered from fieldwork and those study results will be incorporated into the license application.

Glendale Hydroelectric Project (P-2801).
The Glendale Project is owned and operated by Littleville Power Company, Inc. (LPC), a subsidiary of Enel North America, Inc. (Enel). LPC is preparing an application to the FERC for a new federal license. The existing license, which was issued on November 23, 1979, has an expiration date of October 31, 2009. LPC must file its application with FERC on or before October 31, 2007. The following information is excerpted from the Initial Consultation Document (ICD) for the Glendale Hydroelectric Project (LPC 2005).

A FERC preliminary permit was issued to Fox River Paper Co. to operate the Risingdale Dam (Project Number 12528). The facility is authorized to generate 1100 kW. The permit was issued in December 2004 and expires in November 2007. Multiple preliminary permits have been granted for this site dating

back to 1985. A preliminary permit is issued to allow a project proponent time to study the feasibility of a project and determine if it is economically viable. It is anticipated that this permittee will apply for a license in the winter of 2008 and the project should be online by 2010. The operator plans to continue the project in run-of-river mode. Environmental and engineering studies are projected to be finished in 2006. The HVA has submitted comments requesting minimum flow requirements and that recreational access for the public is allowed. MassDEP and the US Department of the Interior also submitted comments to FERC concerning this project including its impact on the cleanup of PCBs associated with the General Electric site and impacts to fish and wildlife (FERC 2006).

USE ASSESSMENT

AQUATIC LIFE USE

Habitat and Flow

DWM performed habitat assessments at three stations on this segment of the Housatonic River (Appendix C) in September 2002.

Station HT19A was adjacent to Crescent Mills – Crystal Street in Lenox, MA, downstream from the Woods Pond dam and the Lenox WWTP discharge. The total habitat score for Station HT19A was 162 out of 200. Habitat was limited by a narrow riparian zone. Filamentous green algal coverage within the reach was extensive (95%). Canopy coverage was estimated to be 0% (Appendix G). The dominant algal genera were *Rhizoclonium* sp*., Tabellaria* sp*., and Cocconeis* sp.

Station HT19C was downstream from power lines that cross Tyringham Road and 185 meters downstream from the Lee WWTP outfall in Lee. The total habitat score was 172 out of 200. Aquatic macrophytes were present in 25% of the reach, and were comprised almost entirely of the rooted submerged plants milfoil (*Myriophyllum* sp.) and Coontail (*Ceratophyllum* sp.). Also present, though sparse, was free floating Duckweed (*Lemna* sp.). Canopy cover was reported as 0%, while green filamentous algae covered 50% of the reach (Appendix G). The dominant algal genera were *Rhizoclonium* sp*. and Cocconeis* sp. Also notable were patches of sewage fungus near and downstream of the Lee WWTP outfall.

Station HT19E was located 145 meters downstream from the Springfield Terminal Railroad Bridge, and 1,940 meters downstream of the Glendale Dam in Stockbridge. The total habitat score for station HT19E was 185 out of 200. There was no canopy cover at this station. Aquatic macrophytes (*Myriophyllum* sp.) were sparse. Algal coverage was dense and dominated by thin-film green algae (100% within reach coverage) (Appendix G).

According to FERC records available online (FERC 2006), the Glendale Project has operated as run-of-river and met the minimum flow requirement of 10 cfs at the dam in 2002, 2003, and 2004. No fish passage facilities are currently required at this project. When requested the licensee is required to install fish passage facilities. It should also be noted that a flow study in the bypass reach of the Glendale Hydroelectric Project was conducted in the summer/fall 2006 (Smith 2006). The study results in the form of habitat versus flow relationships for each evaluation species (an In-stream Flow Incremental Methodology – IFIM evaluation that included brown trout, fallfish, and longnose dace) should provide a basis for making future recommendations on in-stream flow in the bypass reach, as well as serve as a decision making tool that will allow the FERC to balance in-stream flow and energy generation needs at the Project (Smith 2006).

Biology

DWM biologists collected chlorophyll *a* samples from Stations 19C and 19E on July 31st and September 25th 2002 (Appendix G). Chlorophyll *a* levels measured on these dates at stations 19C and 19E were between 1.5 and 3.7 mg/m^3. These are low chlorophyll *a* levels.

MA DFG conducted fish population sampling by barge, boat or backpack electroshocking within this segment of the Housatonic River at 18 sites between 2002 and 2004 (Richards 2006). Thirteen of these sites were located in Lee and five were located in Stockbridge. Sampling consisted of nine sites sampled in 2002, seven in 2003, and two in 2004. A total of 3,623 fish representing 24 species were observed at these 18 sites collectively, including: 1,662 rock bass, 419 smallmouth bass, 310 longnose dace, 303 white sucker, 262 bluntnose minnow, 210 brown trout (53-530mm), 84 bluegill, 59 common shiner, 57 blacknose dace, 43 common carp, 32 black crappie, 31 largemouth bass, 30 creek chub, 22 brook trout

(66-200mm), 21 fallfish, 21 pumpkinseed, 18 banded killifish, 16 brown bullhead, 12 golden shiner, 4 yellow perch, 3 northern pike, 2 tesselated darter, 1 chain pickerel, and 1 spottail shiner. Brown trout were observed at 13 of the 18 sites, while the 22 brook trout observed were all captured at one site. Although the fish assemblage was dominated by macrohabitat generalist species, the presence of 9 fluvial specialist/dependent species (though often represented by few individuals) is indicative of adequate water and habitat quality and a stable flow regime. The fish community was dominated by species tolerant to pollution, however two pollution intolerant species were present (brown and brook trout).

DWM sampled the benthic macroinvertebrate community at three sites along this segment of the Housatonic River (stations HT19A, HT19C, and HT19E) (Appendix C). The RBP III analysis of the benthic community in the river downstream from the Woods Pond dam and the Lenox WWTP discharge ((Station HT19A) indicated this station was slightly impacted when compared to the reference station on the mainstem river in Stockbridge (Station HT19E).

The RBP III analysis of the benthic community in the river downstream from the Lee WWTP outfall (Station HT19C) was found to be slightly impacted when compared to the mainstem reference (Station HT19E).

A reference station on the mainstem Housatonic River in Stockbridge (Station HT19E) was chosen that represented least impacted conditions and a healthy community (Appendix C). When compared to the reference station on the East Branch Housatonic River (Station EB01B) the benthic community at this site indicated the benthos were non-impacted.

Toxicity

Ambient

The Lenox WWTP staff collected water from the Housatonic River at the Foot Bridge at Woods Pond upstream from Outfall #001 for use as dilution water in the whole effluent toxicity tests. Between March 2002 and March 2006 (n=17), survival of *C. dubia* exposed (48 hours) to the river water ranged from 90 to 100% and survival of *P. promelas* exposed (48 hours) to the river water ranged from 95 to 100% (TOXTD database).

The Schweitzer-Mauduit staff collected water from the Housatonic River, approximately 100 yards upstream of the Columbia Mill Dam behind the Columbia WWTF (Columbia Street, Lee), for use as dilution water in the facility's whole effluent toxicity tests (Ryan 2005). River water is collected further upstream (approximately 1300 feet upstream of the Columbia Mill Dam at the Golden Hill Bridge) when snow and ice conditions are present. Between September 2000 and March 2006 (n=25), survival of *C. dubia* exposed (7-day) to the river water ranged from 80 to 100% (TOXTD database).

The Town of Lee has contracted the services of a private laboratory to conduct toxicity sampling and analysis of the WWTP effluent. The contracted laboratory personnel collected river water approximately 75 to 100 feet upstream of Outfall# 001 for use as dilution water in the whole effluent toxicity tests (Zerbato 2005). Between February 2000 and March 2006 (n=23), survival of *C. dubia* exposed (48 hours) to the river water ranged from 90 to 100% (TOXTD database).

The MW Custom Papers staff collected river water approximately 150 feet upstream of the Laurel Mill outfall at a point near the process water intake for use as dilution water in the facility's whole effluent toxicity tests (Grant 2005). Between October 2000 and April 2006 (n=23), survival of *C. dubia* exposed (7-day) to the river water ranged from 90 to 100% (TOXTD database). Between October 2000 and June 2005 survival of *P. promelas* exposed (7-day) to the river water ranged from 18 to 98% and survival was less than 75% in 17 of the 19 test events (TOXTD database). It should be noted that as of June 2005 the facility is no longer required to perform tests using *P. promelas*.

The MW Custom Papers staff collected river water approximately 3000 feet upstream of the Willow Mill outfall at the Meadow Street Bridge for use as dilution water for the Willow Mill WWTF's whole effluent toxicity tests. Between October 2000 and January 2006 (n=22), survival of *C. dubia* exposed (7-day) to the river water ranged from 80 to 100% (TOXTD database). During the same time period, survival of *P.*

promelas exposed (7-day) to the river water ranged from 8 to 98% and survival was less than 75% in 16 of the 22 test events (TOXTD database).

The Town of Stockbridge has contracted the services of a private laboratory to conduct toxicity sampling and analysis. The contracted laboratory personnel collected water from the Housatonic River approximately 30 feet upstream of Outfall # 001 for use as dilution water in the whole effluent toxicity tests (Campetti 2005). Between October 2004 and October 2005, survival of *C. dubia* exposed (48-hour) to the river water was between 90 and 100% (n=3), and survival of *P. promelas* was 100% (n=3) (TOXTD database).

Effluent
Between March 2002 and March 2006, acute whole effluent toxicity tests were conducted on the Lenox WWTP effluent using *C. dubia* and *P. promelas*. The LC_{50}s were all >100% (n=17) for each species, with the exception of one invalid *C. dubia* test (TOXTD database).

Between September 2000 and March 2006, twenty-five whole effluent toxicity tests were conducted on the Schweitzer-Mauduit WWTP effluent using the test organism *C. dubia.* The LC_{50}s ranged from 35 to 100% effluent with three test events (December 2001, 71%; June 2002, 37%; and March 2004, 35%) failing to meet the permit limit of $LC_{50} \geq$ 100% effluent. C-NOEC's ranged from 6.25 to 100% effluent with only one event (March 2005, 6.25% effluent) failing to meet the permit limit of $\geq$ 14% effluent (TOXTD database). However, in the 7-day chronic renewal, test organisms are sequentially exposed to three separate composite effluent samples collected over the course of the test. Thus, it is possible to observe acute effluent toxicity soon after effluent renewals during the chronic test. In 20 of the 25 toxicity tests there was evidence of some chronic toxicity. Of these 20 tests, acute toxicity was manifested in 8 tests, 6 of which were conducted during the month of March (2001-2006).

Between February 2000 and March 2006 twenty-three whole effluent toxicity tests were conducted on the Lee WWTF effluent using *C. dubia* as a test species. The LC_{50} 's were all $\geq$100% (TOXTD database). This facility is in the process of being upgraded.

Between October 2000 and April 2006 twenty-three whole effluent toxicity tests using *C. dubia* were conducted on the effluent from the MW Custom Papers WWTF at Laurel Mill. The LC_{50} results were all $\geq$100%. When *P. promelas* were used as test organisms (November 2000 through April 2005 n=19 test events) the LC_{50} results were all $\geq$100% (TOXTD database). For the 21 valid chronic tests using *C. dubia*, the C-NOEC results ranged from 6.25 to 100% effluent. C-NOEC results using *P. promelas* ranged from 25 to 100% effluent (n=17 valid tests using lab water as diluent). These data indicate that whole effluent acute and chronic toxicity in this discharge has been vastly reduced compared to data reported between July 1995 and September 2000.

Between October 2000 and January 2006 whole effluent toxicity tests were conducted on the effluent (Outfall #001) from the MW Custom Papers WWTF at Willow Mill using *C. dubia (n*=22) and *P. promelas* (n=22). The LC_{50} results from the *C. dubia* tests were all $\geq$100%, except for one test event (January 2002, 71% effluent). The LC_{50} results using *P. promelas* were all $\geq$100% (TOXTD database). C-NOEC results using *C. dubia* ranged from 12.5 to 100% effluent. C-NOEC results using *P. promelas* ranged from <6.25 to 100% effluent (n=21 valid tests using lab water as diluent). The C-NOEC was <6.25% effluent for three of these tests (January 2002, January 2003, and April 2003). It should be noted that whole effluent acute and chronic toxicity in this discharge has been vastly reduced since the upgrades to the treatment plant were completed in 1998.

Whole effluent toxicity tests were conducted on the Stockbridge WWTP effluent between October 2004 and October 2005 using *C. dubia* and *P. promelas* as test organisms. The LC_{50}s for both test organisms were $\geq$ 100% effluent (n=3) (TOXTD database).

Chemistry-water
DWM sampled the water quality of this segment of the Housatonic River at three stations in 2002. Station 19A was located ~360 feet upstream from Valley St. and downstream from the Lenox WWTP discharge. Station 19C was located ~300 feet downstream from Lee WWTP in Lee. Station 19E was located

upstream from railroad bridge, east of Rte. 183 in Stockbridge. *In-situ* sampling was conducted to measure dissolved oxygen, temperature, pH, and conductivity during pre-dawn hours.

Water quality conditions at Station 19A generally met criteria. High phosphorous concentrations were recorded on 3 of 4 visits (concentrations ranging from 0.04 to 0.19 mg/L).

Water quality conditions at Station 19C were generally poor (low DO/saturation, extremely high concentrations of both total phosphorous and ammonia-nitrogen). Two of the five ammonia-nitrogen measurements were above toxic levels (4.48 and 5.72 mg/L). Total phosphorous levels at Station 19C were 2 to 5 times higher than levels measured upstream at 19A. However, water quality data collected downstream from the Lee treatment plant at Station 19C were collected on the same bank as the effluent discharge. Despite being 300 feet below the outfall, it is likely that these samples are not representative of a fully mixed effluent at this point in the river. [Note: The concentration of ammonia in the Lee WWTP effluent reported by the facility in their monthly discharge monitoring reports (DMRs) between May and September 2002 ranged from 7.7 to 22 mg/L. The monthly average concentration of total phosphorous ranged from 0.52 to 1.7 mg/L, and the maximum total phosphorous concentration measured was 6.3 mg/L. The total phosphorus concentrations in the Schweitzer-Mauduit WWTP effluent reported by the facility in their monthly DMRs between May and September 2002 ranged from 0.02 to 1.0 mg/L, although the discharge from this facility is approximately four times greater than the Lee WWTP effluent.]

Continuous *in-situ* temperature monitoring was conducted from the 25th of July through the 28th of August, 2002, behind HVA offices on Route 102 in Lee (Appendix H). In-stream temperatures ranged from 19.2-27.0 ºC. The mean temperature over this 35-day period was 22.3 ºC.

USGS also collected discrete water samples from the Housatonic River near Glendale on 18 September 2003 (USGS 2006b). Water quality collected by USGS at this station was similar to conditions observed by DWM at Station 19E in 2002. Phosphorous was recorded as 0.05 mg/L.

Water quality conditions at Station 19E generally met criteria, with the exception of high phosphorous levels collected on 3 of 4 visits.

Chemistry- sediment

Blasland, Bouck & Lee, Inc. and Quantitative Environmental Analysis, LLC. prepared a 2003 report for the General Electric Company detailing the extent of PCB contamination in Housatonic River sediments (BBL 2003). This report was based upon sediment cores collected by the EPA and BBL/GE between 1997 and 2002. Study reaches 7 and 8 as described in this report are located within Segment MA21-19. Study Reach 7 is defined as the river section from downstream of Woods Pond Dam to the upstream extent of Rising Pond. Study Reach 8 is defined as Rising Pond from its upstream extent to the Risingdale impoundment dam.

Concentrations of PCBs and total organic carbon (TOC) measured in the top 6 inches of sediment within reaches of this segment of the Housatonic River are summarized below (BBL 2003 as summarized by Poach and Kurpaska 2006). The numbers (n) of cores analyzed to produce the results appear in parentheses after the reach designation.

Reach	Sediment PCB Concentration in 0 - 6 inch layer (mg/kg)			
(n)	Min	Max	Mean	Median
7 (198)	ND	38	1.8	0.28
8 (25)	ND	11	2.7	2.2

Reach	Sediment TOC Concentration in 0 - 6 inch layer (%)			
(n)	Min	Max	Mean	Median
7 (173)	ND	19	2.1	1.8
8 (27)	ND	5.3	2.4	2.4

Since minimum TOC levels were listed as non-detectable, the median TOC concentrations were used to calculate the S-EL and make this a conservative estimate of the level of PCB toxicity. The mean PCB sediment concentrations within these reaches did not exceed the PCB S-EL. Maximum PCB sediment concentrations did not exceed the total PCB S-EL based upon the maximum TOC levels (Persaud et al 1993).

Chemistry- fish tissue

Weston Solutions, Inc. prepared a 2004 report for the Army Corps of Engineers and the U.S. Environmental Protection Agency detailing the extent of PCB contamination in fish tissue from fish caught in the Housatonic River (Weston 2004). This report is based upon fish collected by the EPA between 1998 and 2002. Reaches 7 and 8 are located within Segment MA 21-19.

Concentrations of PCB in fish collected from reaches within Housatonic River Segment 21-19 appear below (Weston 2004 as summarized by Poach and Kurpaska 2006). The numbers of fish analyzed to produce the results appear in parentheses after the fish name.

Composite concentrations of PCB in young of the year fish in 2002

	Young of Year tPCB (μg/kg w/w)		
Reach	Min	Max	Fish Sampled
7	2,000	4,200	largemouth bass (7), bluegill (3), pumpkinseed (4)

Whole body concentrations of PCB in fish

Segment	Whole Body tPCB (μg/kg w/w)		
Reach	Min	Max	Fish Sampled
8	12,800	41,500	largemouth bass (14)

Composite concentrations of PCB in fish

Segment	Composite tPCB (μg/kg w/w)		
Reach	Min	Max	Fish Sampled
8	8,080	11,200	largemouth bass (5), pumpkinseed (5), yellow perch (5)

All of the whole fish samples analyzed for total PCB exceeded (by between 4 and 83 times) the NAS/NAE guideline for the protection of fish eating wildlife (500µg/kg wet weight).

The *Aquatic Life Use* is assessed as impaired for this reach based upon high levels of PCB contamination in whole fish exceeding the NAS/NAE guideline for the protection of fish eating wildlife. PCB contamination of surficial sediments was greatly reduced within this reach when compared to sediments upstream. Water quality data indicate nutrient enrichment affects in the upper half of this reach (the upper 9.2 miles). Nutrient inputs from point sources (municipal and industrial) and non-point source runoff exacerbated by impoundments and other upstream sources all likely contribute to this condition. Although the RBP III analyses of benthic communities at three stations in this reach show either slight or no impacts and fish communities appear normal for a warm water fish community, the frequent poor survival of *P. promelas* exposed to river water upstream from the MW Custom Papers WWTF Laurel Mill and Willow Mill is of concern. Acute and/or chronic whole effluent toxicity has been greatly reduced in the MW Custom Papers WWTF Laurel and Willow Mill effluents, although it is still occasionally present. Whole effluent toxicity in the Schweitzer-Mauduit WWTP effluent is also of concern.

FISH CONSUMPTION

Weston Solutions, Inc. prepared a 2005 report for the Army Corps of Engineers and the U.S. Environmental Protection Agency detailing the extent of PCB contamination in fish fillets from fish caught in the Housatonic River. The mean total PCB concentrations in fish fillets collected in Rising Pond were reported as follows: bass 3.8, bullhead 4.5, perch 8.2, and sunfish 2.9 mg/kg wet weight (Weston 2005).

In 1982 the Massachusetts Department of Public Health (MA DPH) issued a fish consumption advisory for the Housatonic River because of PCB contamination associated with the General Electric site. The MA

DPH advisory recommends: "*The general public should not consume any fish, frogs, or turtles from Housatonic River in the towns of Dalton, Pittsfield, Lenox, Lee, Stockbridge, Great Barrington, and Sheffield".*

Due to the MA DPH site-specific fish consumption advisory the *Fish Consumption Use* is assessed as impaired for the entire 19.9 miles of this segment because of PCB levels in edible fish tissue.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected fecal coliform bacteria samples from this segment of the Housatonic River at water quality stations 19A, 19C, and 19E (Appendix B). The geometric mean of five samples collected at the upstream station, 19A, was 77 cfu/100mL. One bacteria sample did exceed 400 cfu/mL (1300 cfu/mL). Further downstream at Station 19C (300 feet below the Lee WWTP), the geometric mean of five samples was 979 cfu/100mL. Three samples collected at this station exceeded 400 cfu/mL. None of the five samples collected at the most downstream station, 19E, exceeded 70 cfu/mL.

HVA volunteers conducted a shoreline survey within this segment of the Housatonic River from the dam at Woods Pond in Lenox to the Willow Mill Dam in South Lee in May of 2001. At the impoundment created by the Schweitzer-Mauduit dam, the river was described as weedy with occasional patches of milfoil. Multiple stormwater pipes were noted. The majority of this segment was described as beautiful with few signs of human disturbance (HVA 2001).

DWM biologists noted moderate to dense filamentous green and brown algae covered the rock substrates at Station 19A (~360 feet upstream from Valley St. and downstream from the Lenox WWTP discharge) (MassDEP 2002b). DWM personnel also made field observations during the surveys conducted between May and September 2002. At Station 19A water clarity was generally clear and no scum was noted. Generally, no water odor was noted, but on two occasion an odor was recorded (septic and chlorine, respectively. With the exception of one occasion where trash was noted, objectionable deposits were not noted (MassDEP 2002a).

There was a "septic" odor coming from the water at Station 19C (~300 feet downstream from Lee WWTP in Lee), and dense algal growth on both the submerged plants and rocks (MassDEP 2002b). No objectionable deposits or scum were noted, but a septic water odor was noted on all occasions. Water clarity was generally clear (MassDEP 2002a).

HVA volunteers also conducted a shoreline survey of the Housatonic River from the Willow Mill Dam in South Lee to the Risingdale dam in Great Barrington in May of 2002 (HVA 2002a). Volunteers noted that immediately downstream from the Willow Mill Dam riffles and pools contain heavy algae growth. A grey slippery clay-like material was observed in weeds below two pipes in the same areas. Red and blue stains were seen below the mill on the river bottom soil. Garbage was noted in isolated areas throughout the segment.

Above the Glendale Dam there was an influx of duckweed. An "alluvial fan of sand" was deposited at a stormwater pipe outfall from Route 183. Algae and an oily sheen were noted in the cove just downstream from the discharge. Numerous other pipes were also reported. Overall, however, this section was described as attractive and appeared to be healthy (HVA 2002a).

The river moves swiftly at Station 19E (upstream from the Railroad bridge, east of Rte. 183 in Stockbridge). The water had a slightly musty odor and moderate amounts of filamentous green algae covered many of the rocks (MassDEP 2002b). Water clarity was generally clear and no scums were noted. Generally, no objectionable deposits were noted, but on two occasions slight deposits of trash were observed. Out of ten visits, on three occasions a musty odor was recorded and on one occasion a pulp mill smell was recorded (MassDEP 2002a).

Weston Solutions, Inc. prepared a 2005 report entitled "Human Health Risk Assessment GE/Housatonic River Site, Rest of River" for the U.S. EPA and U.S. Army Corps of Engineers (Weston 2005). In this study, total hazard index values calculated for reasonable maximum exposure to sediment within Housatonic River reach 7, located within segment MA21-19, were shown to fall below the EPA non-

cancer hazard level of 1.0. Total hazard index values calculated for the central tendency exposure to sediment within this segment were all less than the EPA non-cancer hazard level of 1.0.

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as impaired for the upper 9.2 mile reach of this segment, based primarily upon the excess algal growth observed in the river. It is BPJ that the high bacteria counts measured at Station 19C, though concerning, are not representative of the entire river in that section and most likely reflect the Lee WWTP effluent quality. The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support downstream from the Willow Mill dam (the lower 10.7 miles of this segment). This is based upon the water quality, lack of elevated bacteria counts, acceptable cancer risk assessment values, and field observations of DWM personnel and HVA volunteers.

HOUSATONIC RIVER (Segment MA21-19) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: PCBs in whole fish and sediment, elevated total phosphorus in upper 9.2 miles of segment Source: inappropriate waste disposal from General Electric Site for PCB contamination Suspected source: Nutrient inputs from point sources (municipal and industrial) and non-point source runoff exacerbated by impoundments and other upstream sources
Fish Consumption		IMPAIRED Cause: PCBs Source: inappropriate waste disposal from General Electric Site
Primary Contact		IMPAIRED Upper 9.2 mile reach Cause: Objectionable algal growth Source: Unknown Suspected source: Nutrient inputs from point sources (municipal and industrial) and non-point source runoff exacerbated by impoundments and other upstream sources SUPPORT lower 10.7 mile reach
Secondary Contact		IMPAIRED Upper 9.2 mile reach Cause: Objectionable algal growth Source: Unknown Suspected source: Nutrient inputs from point sources (municipal and industrial) and non-point source runoff exacerbated by impoundments and other upstream sources SUPPORT lower 10.7 mile reach
Aesthetics		IMPAIRED Upper 9.2 mile reach Cause: Objectionable algal growth Source: Unknown Suspected source: Nutrient inputs from point sources (municipal and industrial) and non-point source runoff exacerbated by impoundments and other upstream sources SUPPORT lower 10.7 mile reach

RECOMMENDATIONS

Stressors resulting in the “slightly impacted” conditions observed at Station 19A in 2002 likely can be traced to the effects from Woods Pond and, potentially, the Lenox WWTP. While the extensive wetlands in Woods Pond may be a natural condition, upstream / downstream water quality monitoring should be performed to determine if any effect is occurring as a result of the operation of the Lenox WWTP.

More benthic community study is needed, with more locations (particularly bracketing the NPDES discharges and potential nonpoint sources), to determine if the benthic community is indeed slightly or

non-impacted as the three 2002 stations indicate. Consider bracketing more of the point source discharges with water quality stations to define nutrient inputs into the system (total phosphorous loads especially).

More bacteria sampling stations (both banks, and farther down) are required downstream from Lee to better evaluate uses within that stretch of the river.

The Lee WWTP effluent does not appear to be readily mixing with the river water as evidenced by the poor water quality observed at Station 19C. Investigate mixing zone of discharge under various flow conditions and how far downstream this condition may persist.

Investigate the correlation between the discharge from the Lee WWTP and/or run-off from the town of Lee and the impairment of the benthic community at Station 19C.

Evaluate the results of the flow study in the bypass reach of the Glendale Hydroelectric Project and make appropriate recommendations to protect aquatic life in the bypass reach of the project.

Because of the frequency of the reduced survival of *P. promelas* in the Housatonic River downstream from the Lee WWTP discharge, additional in-stream studies (ambient chronic toxicity testing) should be conducted. If significant chronic toxicity is detected, determine cause(s) and source(s) of in-stream toxicity.

Investigate the sources/causes of the chronic and acute toxicities observed in the Schweitzer-Mauduit WWTP effluent, particularly during the month of March.

GREENWATER BROOK (SEGMENT MA21-27)
Location: Headwaters, outlet of Greenwater Pond, Becket, to the confluence with Goose Pond Brook, Lee.
Segment Length: 4.4 miles.
Classification: Class B.

This is a new segment, and therefore it does not appear on the 2004 Integrated List.

USE ASSESSMENT
AQUATIC LIFE USE
Biology
MA DFG conducted fish population at one site (Site 676) on Greenwater Brook, just downstream from the confluence with Basin Pond Brook, on 19 August 2002 using backpack electroshocking equipment (Richards 2006). A total of 170 fish were collected including 144 brown trout (49-335 mm in length), 24 slimy sculpin, and two brook trout (230 and 235 mm long).

Chemistry-water
DWM sampled the water quality of Greenwater Brook Station (Station GWPB) between May and September 2002. Station GWPB was located downstream from Forest St., Lee (Appendix B). *In-situ* sampling was conducted to measure dissolved oxygen, temperature, pH, and conductivity during pre-dawn hours. Grab samples were collected and analyzed for total suspended solids, ammonia-nitrogen, and total phosphorus (low-level). All *in-situ* and water quality measurements/data met water quality standards.

The *Aquatic Life Use* is assessed as support based on the fish community and the limited water quality data. The fish community was comprised of multiple age classes of brown trout, a pollution intolerant fluvial dependent species. All water chemistry parameters met standards.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected fecal coliform bacteria and *E. coli* samples from Greenwater Brook at Station GWPB, Forest Street in Lee, between May and September 2002 (Appendix B). None of the fecal coliform bacteria counts exceeded 160 cfu/100mL. DWM collected optical brightener samples from Greenwater Brook at Station GWPB, Forest Street in Lee, over two-day periods on July 29th and September 23rd, 2002 (Appendix I). One of the two results was positive for optical brightening agents. It should be noted that the positive optical brightener result was obtained on 9/25, which corresponded to the highest observed fecal coliform measurement of 160 cfu/100 mL. At this time more bacterial and optical brightener data would need to be collected to prove or disprove the presence of a human source.

DWM personnel made field observations at Station GWPB during the surveys conducted between May and September 2002. No objectionable deposits, scums or water odors were noted (MassDEP 2002a).

The *Primary Contact Recreation, Secondary Contact Recreation* and *Aesthetics* uses are assessed as support, based on the low fecal coliform bacteria counts and the lack of any objectionable conditions.

GREENWATER BROOK (Segment MA21-27) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

RECOMMENDATIONS

Fish community data collected in 2002 indicate that Greenwater Brook merits consideration to be designated as a cold water fishery. Its receiving water, Goose Pond Brook, has already been designated as a cold water fishery. The appropriate fish community and temperature data should be collected to validate the designation of Greenwater Brook as a cold water fishery.

GOOSE POND BROOK (SEGMENT MA21-07)
Location: Outlet of Goose Pond, Tyringham, to confluence with Housatonic River, Lee.
Segment Length: 3.3 miles.
Classification: Class B, Cold Water Fishery.

Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires a TMDL for pathogens (MassDEP 2005a).

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
DWM performed a habitat assessment at Station GPB07A (B0506), approximately 100 meters downstream from Forest Street in Lee, MA. The total habitat score for Station GPB07A was 174 out of 200 (Appendix C). There were no aquatic macrophytes within the reach, but algal coverage was estimated at 60%. Algae types included green filamentous and thin film algae attached to rocks in the riffle zones. Canopy cover was estimated to be 30%. The dominant algal genera was *Cladophera* sp. *(Appendix G).*

Biology
DWM sampled the benthic macroinvertebrate community at Station GPB07A (see above) in 2002 (Appendix B). RBP III analysis indicated this station was slightly impacted when compared to the regional reference station on Windsor Brook (WB01).

MA DFG conducted fish population sampling on Goose Pond Brook on 19 August 2002 at Site 627, Tyringham Road, in Lee (Richards 2006). A total of 214 fish were collected, including: 81 longnose dace, 65 brown trout (69-218 mm length), 39 blacknose dace, 23 bluntnose minnow, four creek chub, one brook trout, and one rainbow trout.

Chemistry-water
DWM sampled the water quality of Goose Pond Brook at Station 07A between May and September 2002. Station 07A was located ~30 feet upstream from the Greenwater Brook confluence, Lee. *In-situ* sampling was conducted to measure dissolved oxygen, temperature, pH, and conductivity during pre-dawn hours. Grab samples were collected and analyzed for total suspended solids, ammonia-nitrogen, and total phosphorus (low-level). All *in-situ* and water quality measurements/data met water quality criteria.

The *Aquatic Life Use* is assessed as support based on the RBP III analysis, fish community and water quality data. The fish community was comprised of multiple age classes of brown trout, a pollution intolerant fluvial dependent species. All water chemistry parameters met standards.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected fecal coliform bacteria and *E. coli* samples from Goose Pond Brook at Station 07A between May and September 2002 (Appendix B). None of the fecal coliform counts exceeded 30 cfu/100mL. Goose Pond Brook was also sampled at Station 07B, Tyringham Road, Lee on 5 and 25 September 2002. Fecal coliform bacteria counts were 90 and 70 cfu/100mL respectively.

DWM biologists noted on September 11, 2002 at Station GPB07A (B0506) that water was clear with no odors or surface oils (MassDEP 2002b). DWM personnel also made field observations during the surveys conducted between May and September 2002. No objectionable deposits, scums or water odors were recorded. It was noted that there was a storm drain producing sedimentation in this reach. Water clarity recorded as clear on all occasions (MassDEP 2002a).

DWM collected optical brightener samples from Goose Pond Brook at two stations in Lee; Station 07A at Forest Street and Station 07B at Tyringham Road. Samples were collected at Station 07A over two day periods on July 29th and September 23rd, 2002. One sample was collected at Station 07B on September 23rd, 2002 (Appendix I). Optical brightener results for all three of these samples were negative.

The *Primary Contact Recreation, Secondary Contact Recreation* and *Aesthetics* uses are assessed as support, based on the low fecal coliform bacteria counts and the lack of any objectionable conditions.

GOOSE POND BROOK (Segment MA21-07) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

HOP BROOK (SEGMENT MA21-28)
Location: Headwaters, outlet of Curtin Pond, Otis, to the confluence with the Housatonic River, Lee.
Segment Length: 11.9 miles.
Classification: Class B.

This is a new segment, and therefore it does not appear on the 2004 Integrated List.

USE ASSESSMENT
AQUATIC LIFE USE
Biology
DWM/MA DFG conducted fish population sampling on Hop Brook on 20 August 2002 at Site 682 upstream from Merry Brook and Jerusalem Road in Tyringham (Richards 2006). A total of 703 fish, representing 10 species, were collected including 433 blacknose dace, 135 longnose dace, 89 common shiner, 18 tesselated darter, 11 creek chub, six white sucker, five brown trout (75-260mm), four rock bass, one brook trout (80 mm), and one pumpkinseed. This fish community was dominated by fluvial specialist species.

Chemistry-water
DWM sampled the water quality of Hop Brook Station at Station HB, Meadow Street in Lee, between May and September 2002 (Appendix B). *In-situ* sampling was conducted to measure dissolved oxygen, temperature, pH, and conductivity during pre-dawn hours. Grab samples were collected and analyzed for total suspended solids, ammonia-nitrogen, and total phosphorus (low-level). Although one pre-dawn dissolved oxygen saturation measurement (out of 5) was below 60%, given the low stream gradient and potential influence of wetlands, these conditions are considered to be naturally occurring. All other measurements were indicative of good water quality conditions and met water quality criteria.

Continuous *in-situ* temperature monitoring was conducted from the 25th of July through the 28th of August, 2002 at Station HB (Appendix H). In-stream temperatures ranged from 17.2-28.5 ºC. The mean temperature over this 35-day period was 22.8 ºC.

DWM biologists collected a chlorophyll *a* sample from Station HB on July 31st, 2002. The chlorophyll *a* level measured on this date was <1 mg/m^3 (Appendix G).

The *Aquatic Life Use* is assessed as support for Hop Brook, based upon the limited water quality data and the relatively diverse fish community dominated by fluvial specialist species.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected fecal coliform bacteria and *E. coli* samples from Hop Brook at Station HB between May and September 2002 (Appendix B). The maximum fecal coliform measurement was 160 cfu/100mL.

DWM personnel made field observations during the surveys conducted between May and September 2002. Water clarity was generally noted as slightly turbid, except on one occasion when it was highly cloudy. No scum or water odor was noted and no objectionable deposits were noted with the exception of one occasion where trash was observed (MassDEP 2002a).

The *Primary Contact Recreation, Secondary Contact Recreation* and *Aesthetics* uses are assessed as support, based on the low fecal coliform bacteria counts and the general lack of any objectionable conditions.

HOP BROOK (SEGMENT MA21-28) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

LARRYWAUG BROOK (SEGMENT MA21-29)
Location: Headwaters, outlet Stockbridge Bowl, Stockbridge, to confluence with Housatonic River, Stockbridge.
Segment Length: 2.9 miles.
Classification: Class B.

This is a new segment, and therefore it does not appear on the 2004 Integrated List.

WMA WATER WITHDRAWALS (APPENDIX J)
Stockbridge Water Department (10228301)

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
HVA volunteers have been monitoring the height of the water flowing over the spillway structure at the outlet of Stockbridge Bowl since January 2004 as part of the Massachusetts Riverways Program pilot River Instream Flow Stewards (RIFLS) project (MA DFG 2006b). In addition to the passive spillway dam, there is also a gate valve at the outlet that can be set manually. Stage height and some limited streamflow data have also been collected by the volunteers for Larrywaug Brook at the most upstream crossing of Route 183 in Stockbridge (MA DFG 2006b). HVA has expressed concern about alteration of the natural flow pattern in Larrywaug Brook due to manual manipulation of the outlet, leaves clogging the outlet structure, and beavers attempting to build a dam at the outlet.

Biology
DWM/MA DFG conducted fish population sampling at two stations on Larrywaug Brook on 19 July 2002. Site 621 was located upstream from Averic Road in Stockbridge (Richards 2006). A total of 115 fish, representing 5 species, were collected including 84 longnose dace, 17 blacknose dace, six bluntnose minnow, five rock bass, and three largemouth bass. Site 616 was located at the Route 183 crossing South of the Mass Pike in Stockbridge (Richards 2006). A total of 117 fish, representing 10 species, were collected including 41 blacknose dace, 25 longnose dace, 22 fallfish, 17 common shiner, two bluegill, three smallmouth bass, three white sucker, two rock bass, one largemouth bass, and one bluntnose minnow.

At both stations, fluvial species and individuals that are tolerant to moderately tolerant of pollution dominated the fish community. Longnose dace were the only cold water fish species present.

The *Aquatic Life Use* is assessed as support based upon the fish community (dominated by fluvial species) and BPJ.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
E. coli bacteria testing was conducted at Averic Road Park Beach on Larrywaug Brook in Stockbridge. Eleven tests were conducted in both 2004 and 2005 (MA DPH 2005a, 2006). Only one of these samples, with a count of 250 cfu/100mL, collected in 2005, exceeded the bathing beach single sample criteria of 235 cfu/100mL. There were no postings at this beach. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

The *Primary Contact Recreation, Secondary Contact Recreation* and *Aesthetics* uses are not assessed due to a lack of data.

LARRYWAUG BROOK (Segment MA21-29) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Conduct water quality monitoring to evaluate designated uses.

Due to the manipulated flows observed by HVA volunteers at the outlet of Stockbridge Bowl, local regulatory authorities are encouraged to establish a flow management strategy to protect in-stream biota in Larrywaug Brook.

HOUSATONIC RIVER (SEGMENT MA21-20)
Location: Outlet of Risingdale Impoundment, Great Barrington, to the state line in Sheffield, MA/Canaan, CT.
Segment Length: 23.0 miles.
Classification: Class B, Warm Water Fishery.

Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires TMDLs for priority organics, pathogens, and taste, odor, and color (MassDEP 2005a).

WMA WATER WITHDRAWALS (APPENDIX J)
Butternut Basin Ski Area (10211304/ 9P210211302)
Fox River Paper Co.-Rising Paper Division (10211303)
Great Barrington Fire District (10211301)
Sheffield Water Company (10226701)

NPDES SURFACE WATER DISCHARGES (APPENDIX J)
Fox River Paper Company, Rising Paper Division (MAG250281)
Great Barrington WWTP (MA0101524)

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
The United State Geological Survey (USGS) maintains one streamflow monitoring gage on this segment of the Housatonic River. USGS Gage #01197500, Housatonic River near Great Barrington, MA, is located on the left bank at upstream side of the highway bridge at Van Deusenville and 0.5 mi upstream from Williams River, Great Barrington. Data are available from 1913 to the present. The drainage area at the gage is 282 mi^2 and the average annual discharge over the period of record is 527 cfs. According to USGS, flows are regulated by power plants upstream during low flows and since 1973 high flows are slightly affected by a retarding reservoir (Socolow *et al.* 2004). The estimated 7Q10 at the gage is 69 cfs (Wandle and Lippert 1984).

USGS measured instantaneous discharge from the Housatonic River near Ashley Falls, MA (Station #01198125) between October 1991 and September 2004. Discharge measurements from January, March, May, June, July, August, September, and November 2002 through 2004 (n=23) ranged between 106 cfs and 1790 cfs (USGS 2006c).

Biology
The few large rocks and boulders that were part of the substrate at Station 20D (described below) were covered with long, green, filamentous algae (Appendix B).

MA DFG conducted fish population sampling by barge within this segment of the Housatonic River at four sites between 2002 and 2004 (Richards 2006). Fish community data collected between 2002 and 2004 varied between stations based upon differences in habitat and the influence of tributaries. At two stations, the fish assemblage was dominated by macrohabitat generalist species. The other two stations were dominated by fluvial dependent/specialist species. The fish community was dominated by species tolerant and moderately tolerant to pollution. Pollution intolerant fish species were represented only by two brown trout, which may or may not have been stocked fish. Species observed at these four sites are presented below in Table 1.

Table 1: Fish species observed at four stations located within the Housatonic River (Segment MA21-20)

	Site 623 Upstream of Division St., Great Barrington July 17 2002 (n=254)	Site 645 Upstream of Cottage St., Great Barrington Sept. 19 2002 (n=136)	Site 1094 ~350m upstream of Kellogg St., Sheffield August 6 2004 (n=154)	Site 624 Upstream side of Kellogg St., Sheffield July 16 2002 (n=208)	**Total**
Smallmouth bass	35	85	6	11	137
White sucker	9	13	78	11	111
Bluntnose Minnow	46		32	18	96
Common shiner	85				85
Rock bass	27	17	3	28	75
Green sunfish			3	47	50
Pumpkinseed	1	3	2	41	47
Fallfish	2	17	14	3	36
Tesselated darter	2		10	15	27
Longnose dace	22		3		25
Yellow perch				22	22
Bluegill	10		1	9	20
Common carp	10				10
Largemouth bass	2			1	3
Brown trout	1 (183mm)	1 (245mm)			2
Northern pike	1			1	2
Blacknose dace			1		1
Banded killifish				1	1
Spottail shiner			1		1
Brown bullhead	1				1

Toxicity

Ambient

The Great Barrington WWTP staff collected water from the Housatonic River approximately 500 feet upstream from Outfall # 001 at the Bridge Street Bridge for use as dilution water in their whole effluent toxicity tests. Between June 2000 and March 2006 (n=24) survival of *C. dubia* exposed (7-day) to the river water ranged from 90 to 100% (TOXTD database). Between June 1999 and June 2000 (n=7) survival of *P. promelas* exposed (7 day) to the river water ranged from 30 to 98%. Survival was less than 75% in 5 of 7 test events (TOXTD database).

Effluent

Between June 2000 and March 2006, twenty-four whole effluent toxicity tests were conducted on the Great Barrington WWTP effluent using the test organism *C. dubia.* The LC_{50}s ranged from 8.8 to 100% effluent with four of the 21 test events not meeting the permit limit of $LC_{50} \geq 100\%$ effluent. The C-NOEC results ranged from < 6.25 to 100% effluent (TOXTD database). The facility is only required to report the C-NOEC results. It should be noted, however, that acute toxicity was present in three of the five chronic tests conducted between March 2005 and March 2006 in the second or third renewal samples.

Chemistry-water

DWM conducted water quality at two stations on this segment of the Housatonic River between May and September 2002. Station 20A was located upstream from Division Street (USGS gage 01197500) in Great Barrington and Station 20D was located upstream from Kellogg Road in Sheffield. *In-situ* sampling was conducted on five occasions at each station to measure dissolved oxygen, temperature, pH, and conductivity during pre-dawn hours. Grab samples were collected and analyzed for total suspended solids, ammonia-nitrogen, and total phosphorus (Appendix B).

Continuous *in-situ* temperature monitoring was conducted from the 25th of July through the 24th of August, 2002 at Station 20A, Division St. (Appendix H). In-stream temperatures ranged from 19.6-31.0 ºC. The mean temperature over this 35-day period was 24.1 ºC.

USGS collected discrete water samples from the Housatonic River near Ashley Falls, MA (Station #01198125) between October 1991 and September 2004. Data were collected from January, March, May, June, July, August, September, and November 2002 through 2004 (n=23) (USGS 2006d).

USGS water quality data corroborated those collected by DWM. With the exception of slightly elevated total phosphorous concentrations, all other water quality measures collected by both groups at a total of three stations met criteria and were indicative of good water quality.

DWM biologists collected chlorophyll *a* samples from Stations 20A and 20D on July 31st and September 25th 2002. Chlorophyll *a* levels measured on these dates were between 1.2 and 3.4 mg/m^3, respectively (Appendix G). These are low chlorophyll *a* levels.

Chemistry- fish tissue

Weston Solutions, Inc. prepared a 2004 report for the Army Corps of Engineers and the U.S. Environmental Protection Agency detailing the extent of PCB contamination in fish tissue from fish caught in the Housatonic River (Weston 2004). This report is based upon fish collected by the EPA between 1998 and 2002. Reach 9 is located within Segment MA21-20.

Concentrations of PCB in fish collected from reaches within Housatonic River Segment MA21-20 appear below (Weston 2004 as summarized by Poach and Kurpaska 2006). The numbers of fish analyzed to produce the results appear in parentheses after the fish name.

Composite concentrations of PCB in young of the year fish in 2002

	Young of Year tPCB (µg/kg w/w)		
Reach	Min	Max	Fish Sampled
9	1,600	2,700	largemouth bass (7), bluegill (5), pumpkinseed (2), yellow perch (4)

All of the young of the year whole fish samples analyzed for total PCB exceeded (by between 3 and 5 times) the NAS/NAE guideline for the protection of fish eating wildlife (500 µg/kg wet weight).

The *Aquatic Life Use* is assessed as impaired for this reach because of PCB contamination in young of the year whole fish exceeding the NAS/NAE guideline for the protection of fish eating wildlife.

FISH CONSUMPTION

In 1982 the Massachusetts Department of Public Health (MA DPH) issued a fish consumption advisory for the Housatonic River because of PCB contamination associated with the General Electric site. The MA DPH advisory recommends: "*The general public should not consume any fish, frogs, or turtles from Housatonic River in the towns of Dalton, Pittsfield, Lenox, Lee, Stockbridge, Great Barrington, and Sheffield".*

Based on the MA DPH site-specific fish consumption advisory, the *Fish Consumption Use* is assessed as impaired for this entire segment (23.0 miles) for elevated concentrations of PCBs in edible fish tissue.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from this segment of the Housatonic River at the stations described above between May and September 2002 (Appendix B). Bacteria counts at this station ranged between <10 and 160 cfu/100mL, with no counts exceeding 400 cfu/100mL.

USGS also collected bacteria samples at their site near Ashley Falls (#01198125) between 1991 and 2004 (USGS 2006d). During the collection period between 2002 and 2004 (n=23) fecal coliform bacteria counts ranged from 35 to 2700 cfu/100mL, with only 2 counts (less than 10%) exceeding 400 cfu/100mL. The geometric mean of these 23 samples was 103 cfu/100mL.

DWM personnel made field observations at both water quality stations during each survey conducted between May and September 2002. Water clarity was generally described as clear and no objectionable deposits were noted. On the majority of occasions no water odor was noted although on three occasions a musty water odor was recorded (MassDEP 2002a).

In April of 2003, HVA volunteers conducted a shoreline survey of the Housatonic River from the Rising Pond Dam in Housatonic to Rob's Landing near the Sheffield border. Consistent with the upper portions of the Housatonic, HVA volunteers noted that this section was generally pleasant with occasional isolated areas of trash and debris and numerous storm water pipes (HVA 2003b).

HVA volunteers also conducted a shoreline survey from Rob's Landing at the Great Barrington/Sheffield town line to the Massachusetts/Connecticut state line in November 2003. In this section HVA volunteers noted numerous areas of erosion and a plethora of drainage pipes, but otherwise this section was a "pristine section of the Housatonic River" (HVA 2003a). Volunteers in the section near the Route 7A bridge in Ashley Falls noted "dairy cows grazing to the water's edge with evidence of them entering the river."

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support based on the low bacteria counts and the lack of objectionable conditions.

HOUSATONIC RIVER (Segment MA21-20) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: PCBs in whole fish Source: inappropriate waste disposal from General Electric Site
Fish Consumption		IMPAIRED Cause: Elevated concentration of total PCB Source: inappropriate waste disposal from General Electric Site
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

RECOMMENDATIONS

Issues with *P. promelas* survival warrant a toxicity identification/reduction evaluation at the Great Barrington WWTF to reduce acute whole effluent toxicity.

Conduct future monitoring to evaluate the extent of elevated temperatures observed in this segment. Temperatures measured in the river at Great Barrington reached 31°C, and exceeded 28°C on 11 consecutive days in August 2002.

Monitor phosphorous levels given the presence of the Great Barrington WWTP and the possible expansion of the Fox River Paper Co.

Fish population assemblages should be monitored, as two of the four fish stations were dominated by macrohabitat generalist species. Also of note was the relative absence of pollution intolerant fish species.

FURNACE BROOK (SEGMENT MA21-21)
Location: Headwaters south of Route 295 (Canaan Road), Richmond, to inlet of Mud Ponds, West Stockbridge.
Segment Length: 3.6 miles.
Classification: Class B.

Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Aquatic Life* and *Aesthetics*) and was not assessed for others (MassDEP 2005a).

USE ASSESSMENT
AQUATIC LIFE USE
Biology
MA DFG conducted fish population sampling in Furnace Brook at Site 640, Furnace Road crossing in Richmond, on 5 September 2002 using backpack electroshocking equipment (Richards 2006). A total of 101 fish representing nine species were collected including: 24 creek chub, 20 blacknose dace, 17 brown trout (61-190 mm length), 11 rock bass, eight white sucker, eight pumpkinseed, seven largemouth bass, five chain pickerel, and one brook trout. Multiple age classes of brown trout, a pollution intolerant fluvial specialist species, were present.

The *Aquatic Life Use* is assessed as support based on the fish community data and the presence of intolerant fluvial species.

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are not assessed due to a lack of data.

FURNACE BROOK (Segment MA21-21) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Conduct water quality monitoring to evaluate designated uses.

WILLIAMS RIVER (SEGMENT MA21-06)
Location: Source, outlet of Shaker Mill Pond, West Stockbridge, to confluence with Housatonic River, Great Barrington.
Segment Length: 11.0 miles.
Classification: Class B, Cold Water Fishery.

Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Aquatic Life* and *Aesthetics*) and was not assessed for others (MassDEP 2005a).

Although this segment is classified as a cold water fishery, there are no records of young of year brook trout or brown trout, or slimy sculpin occurring in this river (Richards 2006, MA DFG 1971).

WMA WATER WITHDRAWALS (APPENDIX J)
Lenox Water Department (10215201)

NPDES SURFACE WATER DISCHARGES (APPENDIX J)
West Stockbridge WWTP (MA0103110)
Town of Lenox Root Reservoir WTF (MAG640015) located on Lenox Mountain Brook

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
Stage height and some limited streamflow data have also been collected for the Williams River at Division Street in Great Barrington between July 2003 and September 2006 by HVA volunteers partnering with the Massachusetts Riverways Programs pilot River Instream Flow Stewards (RIFLS) project (MA DFG 2006b).

DWM performed a habitat assessment at Station WR01 (B0017), downstream from Division Street, Great Barrington, MA (Appendix B). The total habitat score for Station WR01 was 142 out of 200 because of the moderate sediment deposition and poor bank stability. Low flow conditions and the limited width of the riparian vegetative zone also contributed to a lower habitat score. DWM biologists collected periphyton samples from two habitat types at Station WR01 in September of 2002 (Appendix G). Canopy cover within cobble/riffle habitat at this station was reported as 50%, algal cover was 30%, and the dominant algal genera was *Cladophora glomerata.* Canopy cover within cobble/pool habitat at this station was reported as 50%, algal cover was 30%, and the dominant algal genera were *Ulothrix zonata* and *Oscillatoria* sp.

Biology
Fish population sampling was conducted by either MA DFG (Richards 2006) or DWM (Appendix F) at a total of three stations on the Williams River in August of 2002 (See Table 2). The assemblage was dominated by fluvial dependent/specialists and most species were moderately tolerant to tolerant of pollution. It should be noted that the Williams River is on the MA Trout Stocked Waters 2006 list (MA DFG 2006a).

Table 2: Fish species observed at three stations located within the Williams River (Segment MA21-06)

	Site 629 ~3100 m downstream from MassPike, West Stockbridge 1 August 2002 (n=148)	Site 630 At Division Street, Great Barrington 13 August 2002 (n=253)	Site 683 ~170 m downstream from Division Street, Great Barrington 19 August 2002 (n=107)
Blacknose dace	--	41	6
Bluegill	11	--	--
Bluntnose minnow	--	50	--
Brown bullhead	6	--	--
Brown trout	--	3 (183-264 mm)	1 (448 mm)
Chain pickerel	6	--	--
Common shiner	41	23	21
Creek chub	--	2	--
Fallfish	29	2	--
Golden shiner	--	1	--
Largemouth Bass	1	--	--
Longnose dace	--	56	60
Pumpkinseed	27	1	--
Rock bass	24	6	--
Smallmouth bass	1	35	13
Tesselated darter	--	6	2
White sucker	2	27	4

DWM sampled the benthic macroinvertebrate community at Station WR01 (see above) in 2002. RBP III analysis indicated this station was non-impacted when compared to the regional reference station EB01B on the East Branch Housatonic River (Appendix C).

Toxicity

Ambient

The Town of West Stockbridge contracted the services of a private laboratory to collect samples and perform laboratory analysis for their toxicity testing requirements. Water is collected from the Williams River approximately 30 feet upstream from outfall # 001 at the Old Train Bridge for use as dilution water in the whole effluent toxicity tests. Between April 1999 and April 2006, survival of *C. dubia* exposed (48 hours) to the river water ranged from 90 to 100% (n=22). Survival of *P. promelas* exposed (48 hours) to the river water between April 1999 and November 2004 (n=16) was 100% (TOXTD database).

Effluent

Whole effluent toxicity tests were conducted on the West Stockbridge WWTF effluent between April 1999 and April 2006 using *C. dubia* (n=22) and *P. promelas* (n=16) as test species. LC_{50} s were all $\geq$100% effluent , with the exception of one test event in March 2001 (LC_{50}= 70.7% and 61.6 % for *C. dubia* and *P. promelas* respectively) (TOXTD database). It should be noted that the ammonia concentration in the effluent during the March 2001 test event was 25.1 mg/L (TOXTD Database).

Chemistry-water

DWM sampled the water quality of the Williams River upstream from Division Street in Great Barrington (Station 06A) between May and September 2002. *In-situ* sampling was conducted to measure dissolved oxygen, temperature, pH, and conductivity during pre-dawn hours. Grab samples were collected and analyzed for total suspended solids, ammonia-nitrogen, and total phosphorus (low-level). Two of the five temperature measurements taken were greater than 20 °C. With the exception of the temperature measurements, all other *in-situ* measurements/data met water quality criteria.

The *Aquatic Life Use* for the Williams River is assessed as support based on the following: the RBP III analysis indicated the benthic community was non-impacted, the fish community was dominated by fluvial specialist/dependant species, there was excellent survival of organisms exposed to the river water, and most of the limited water quality data met criteria. In-stream temperatures did exceed criteria (20°C) on

two of five occasions. This use is identified with an Alert Status because of the apparent absence of reproducing cold water fish species. Although three brown trout were captured, there were no young of the year captured and these fish appear likely to have been stocked.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected fecal coliform bacteria and *E. coli* samples from the Williams River at Station 06A (described above) between May and September 2002 (Appendix B). The highest fecal coliform measurement recorded was 50 cfu/100mL.

DWM biologists noted at Station WR01 that the water was clear with no odors or surface oils. Silt deposits were noted in shallow areas (MassDEP 2002b). DWM personnel also made field observations at Station 06A during the surveys conducted between May and September 2002. No objectionable deposits, scums or water odors were recorded and water clarity was generally noted as clear (MassDEP 2002a).

Based upon the lack of objectionable conditions and the low fecal coliform measurements, this segment is assessed as support for the *Primary* and *Secondary Contact Recreation* and *Aesthetics* uses.

WILLIAMS RIVER (Segment MA21-06) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

* Alert Status issues identified, see details in use assessment

RECOMMENDATIONS
Conduct continuous temperature monitoring at several places to investigate the extent of thermal issues along this 11 mile stretch of river.

Conduct additional fish population and habitat monitoring to better evaluate the current status of the fish community in the Williams River.

LONG POND BROOK (SEGMENT MA21-14)
Location: Outlet of Long Pond, Great Barrington, to the confluence with Seekonk Brook, Great Barrington.
Segment Length: 2.0 miles.
Classification: Class B.

Based on the last evaluation of water quality conditions, this segment is listed in Category 4c of the 2004 Integrated List of Waters. This segment was assessed as impaired or threatened due to flow alteration which is not a pollutant requiring calculations of a TMDL (MassDEP 2005a).

USE ASSESSMENT
No recent quality assured data are available, thus all uses are not assessed. Housatonic Water Works Company (WMA registration 10211306) withdraws from Long Pond.

LONG POND BROOK (Segment MA21-14) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct water quality monitoring to evaluate designated uses.

SEEKONK BROOK (SEGMENT MA21-22)
Location: Outlet of small impoundment east of West Road, Alford, to confluence with the Green River, Great Barrington
Segment Length: 4.8 miles.
Classification: Class B.

Based on the last evaluation of water quality conditions, this segment is listed in Category 3 of the 2004 Integrated List of Waters. This segment was not assessed for any of the designated uses (MassDEP 2005a).

USE ASSESSMENT

No recent quality assured data are available, thus all uses are not assessed.

SEEKONK BROOK (Segment MA21-22) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct water quality monitoring to evaluate designated uses.

GREEN RIVER (SEGMENT MA21-23)
Location: Alford, Massachusetts/ Hillsdale, New York border southwest of Route 71 to confluence with the Housatonic River, Great Barrington.
Segment Length: 10.1 miles.
Classification: Class B, Cold Water Fishery.

Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Aesthetics*) and was not assessed for others (MassDEP 2005a).

WMA WATER WITHDRAWALS (APPENDIX J)
Great Barrington Fire District (10211301)

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
Stage height and some limited streamflow data have been collected for the Green River at Hurlburt Street in Great Barrington between March and August 2006 by HVA volunteers partnering with the Massachusetts Riverways Programs pilot River Instream Flow Stewards (RIFLS) project (MA DFG 2006b).

DWM performed a habitat assessment at Station GR23A (B0497), downstream from Route 23/41 in Great Barrington, MA. The total habitat score for Station WR01 was 130 out of 200 because of "poor quality of in-stream features, not riparian features" (Appendix C). Habitat such as in-stream cover for fish was poor, and there was a large amount of sediment deposition. DWM biologists collected periphyton samples at Station GR23A in September of 2002 (Appendix G). Canopy cover at this station was reported as 10%, algal cover was 90%, and the dominant algal genera were *Zygnema* sp., *Mougeeotia* sp., *and Cocconeis* sp.

Biology
DWM sampled the benthic macroinvertebrate community at Station GR23A (see above) in 2002. RBP III analysis indicated this station was non-impacted when compared to the regional reference station on the East Branch Housatonic River (Station EB01B).

MA DFG sampled two sites on the Green River. Site 649 was located downstream from Cross Road near West Plain Road in Great Barrington. One hundred twenty-two fish were collected, representing seven species, including: 69 brown trout (62-370 mm long), 30 slimy sculpin, nine brook trout (70-175 mm long), seven bluegill, three green sunfish, three pumpkinseed, and one blacknose dace. Site 669 was located between the Boston and Maine Railroad and Route 7 in Great Barrington (Richards 2006). A total of 162 fish were collected, representing 13 species, including: 89 white sucker, 26 brown trout (51-475 mm in length), 14 blacknose dace, nine slimy sculpin, eight tesselated darter, five bluntnose minnow, three green sunfish, two bluegill, two common shiner, one creek chub, one fallfish, one largemouth bass, and one rock bass. The fish community at station 649 was dominated by pollution intolerant fluvial specialist species. Station 669 displayed a diverse fish community, with 13 species present, and included multiple age classes of brown trout, a pollution intolerant species.

Chemistry-water
DWM sampled the water quality of the Green River at Station 23A, downstream from Rte. 23/41 in Great Barrington between May and September 2002 (Appendix B). *In-situ* sampling was conducted to measure dissolved oxygen, temperature, pH, and conductivity during pre-dawn hours. Grab samples were collected and analyzed for total suspended solids, ammonia-nitrogen, and total phosphorus (low-level). All *in-situ* measurements met water quality criteria.

The Aquatic Life use is assessed as support based upon the RBP III analysis of the macroinvertebrate community as non-impacted, the cold water fish communities, and the good water quality. Sedimentation issues are a concern (Appendix C).

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected fecal coliform bacteria and *E. coli* samples from the Green River at Station 23A between May and September 2002 (Appendix B). None of the fecal coliform counts exceeded 180 cfu/100mL.

The Town of Great Barrington conducted weekly *E. coli* bacteria testing at a bathing beach on the Green River in 2003 and 2004. Despite nine of the 23 counts exceeded the bathing beach single sample criteria of 235 cfu/100mL, there were no postings at this beach in 2003 or 2004 (MA DPH 2004, 2005a). Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

DWM biologists made field observations at Station GR23A on September 9, 2002. No sediment odors, deposits or oils were noted and the water was noted to be clear with no odors or oils (MassDEP 2002b). DWM personnel also made field observations at Station 23A during the surveys conducted between May and September 2002. No objectionable deposits, scums or water odors were noted and water clarity was generally noted as clear (MassDEP 2002a).

The *Primary Contact Recreation, Secondary Contact Recreation* and *Aesthetics* uses are assessed as support, based on the low fecal coliform bacteria counts and the lack of any objectionable conditions.

GREEN RIVER (Segment MA21-23) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

RECOMMENDATIONS
Investigate the sediment contributions from the upstream agricultural activities. Monitoring of the biota has not yet shown an impact but the sediment contributions are significant enough to warrant concern for negative impacts in the future.

Continue to monitor elevated bacteria levels around the beach area, and, if possible, use bacteria source tracking methods to identify sources.

KARNER BROOK (SEGMENT MA21-16)
Location: Headwaters, east of East Street, Mount Washington, to the inlet of Mill Pond, Egremont.
Segment Length: 4.7 miles.
Classification: Class A, Public Water Supply.

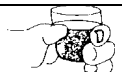
This lower portion of this segment is located within the Karner Brook ACEC.

Based on the last evaluation of water quality conditions, this segment is listed in Category 4c of the 2004 Integrated List of Waters. This segment was assessed as impaired or threatened due to flow alteration which is not a pollutant requiring calculations of a TMDL (MassDEP 2005a).

WMA WATER WITHDRAWALS (APPENDIX J)
Catamount Ski Area (10109001)
South Egremont water Company (PWS # 10900000-01S)

USE ASSESSMENT
No recent quality assured data are available, thus all uses are not assessed.

KARNER BROOK (Segment MA21-16) Use Summary

Aquatic Life	Fish Consumption	Drinking Water*	Primary Contact	Secondary Contact	Aesthetics
					
NOT ASSESSED					

*The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS
Conduct water quality monitoring to evaluate designated uses.

UNNAMED TRIBUTARY (SEGMENT MA21-24)
Location: Headwaters, outlet of Mill Pond, Egremont, to confluence with Hubbard Brook, Egremont.
Segment Length: 1.5 miles.
Classification: Class B.

Based on the last evaluation of water quality conditions, this segment is listed in Category 3 of the 2004 Integrated List of Waters. This segment was not assessed for any of the designated uses (MassDEP 2005a).

USE ASSESSMENT
No recent quality assured data are available, thus all uses are not assessed.

UNNAMED TRIBUTARY (Segment MA21-24) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct water quality monitoring to evaluate designated uses.

WILLARD BROOK (SEGMENT MA21-30)
Location: Headwaters, north of Salisbury Road, Sheffield, to confluence with Hubbard Brook, Sheffield.
Segment Length: 4.1 miles.
Classification: Class B.

This is a new segment, so it does not appear on the 2004 Integrated List of Waters.

The upper portion of this segment is located within the Schenob Brook ACEC.

This segment goes through two impoundments: Fawn Lake and Combes Pond. The estimated retention time of Fawn Lake is approximately two days so it will be considered a run of the river impoundment (McVoy 2006). The retention time estimate was based on the annual historical mean discharge from two stream gages in the Housatonic River Basin (01197500 and 01197000) and the normal storage volume of the dam reported by MA DCR in their Massachusetts Dam Safety Program Database (Socolow *et al*. 2004 and MA DCR 2002).

USE ASSESSMENT
AQUATIC LIFE USE
Biology
Myriophyllum spicatum is present in Fawn Lake (MassDEP 2005b).

The *Aquatic Life Use* is assessed as impaired for the 0.4 mile reach of Willard Brook that flows through Fawn Lake based upon the presence of the non-native aquatic macrophyte *M. spicatum*. The remaining 3.7 miles of Willard Brook are not assessed for the *Aquatic Life Use* but are identified with an Alert Status due to the possible presence of non-native aquatic macrophytes.

WILLARD BROOK (Segment MA21-30) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED 0.4 mile reach through Fawn Lake Cause: Non-native aquatic macrophyte infestation Source: Introduction of non-native plant NOT ASSESSED 3.7 miles*
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

*Alert Status issues identified, see details in use assessment

RECOMMENDATIONS
Conduct water quality monitoring to evaluate designated uses.

Determine if *M. spicatum* is present throughout this segment of Willard Brook. Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for

Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

HUBBARD BROOK (SEGMENT MA21-15)
Location: Source, northwest of Townhouse Hill Road, Egremont, to confluence with Housatonic River, Sheffield (thru Mill Pond, which was formerly reported as Segment MA21068).
Segment Length: 9.4 miles.
Classification: Class B, Cold Water Fishery.

This segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment requires a TMDL for pathogens (MassDEP 2005a).

Mill Pond (MA21068) will no longer be reported as a lake segment since the retention time of this 97-acre waterbody was estimated at 8 days. It will be considered a run of the river impoundment (McVoy 2006). The retention time estimate was based on the annual historical mean discharge from two stream gages in the Housatonic River Basin (01197500 and 01197000) and the normal storage volume of the dam reported by MA DCR in their Massachusetts Dam Safety Program Database (Socolow *et al.* 2004 and MA DCR 2002).

Although this segment is classified as a cold water fishery, there are no records of young of year brook trout, brown trout, or slimy sculpin occurring in this river (Richards 2006, MA DFG 1971). One long nosed sucker, a cold water fish species, was observed in Hubbard Brook during a 1984 survey (Richards 2006).

NPDES SURFACE WATER DISCHARGES (APPENDIX J)
Sheffield Plastics, Inc. (MAR05B410 and MAR05B411)

USE ASSESSMENT
AQUATIC LIFE USE
Biology
Mill Pond is infested with two non-native aquatic macrophytes: *Myriophyllum spicatum* and *Trapas natans* (MassDEP 2003b, MassDEP 2004, and MassDEP 2005b). The Mill Pond impoundment encompasses a 2.4 mile reach of Hubbard Brook.

Chemistry-water
DWM sampled the water quality of Hubbard Brook at Station 15A, upstream from Route 7, Sheffield, between May and September 2002 (Appendix B). *In situ* sampling was conducted to measure dissolved oxygen, temperature, pH, and conductivity during pre-dawn hours. Grab samples were collected and analyzed for total suspended solids, ammonia-nitrogen, and total phosphorus (low-level).

One pre-dawn dissolved oxygen saturation measurement (out of 5) was below 75%. Temperatures were found to be elevated (24.0°C) during June and July, exceeding cold water standards of 20 °C. All other *in-situ* measurements/data met water quality criteria.

Continuous *in-situ* temperature monitoring was conducted from the 25th of July through the 28th of August, 2002 at Station 15A (Appendix H). In-stream temperatures ranged from 17.9-26.8 ºC. The mean temperature over this 35-day period was 22.6 ºC, and 31 of out of the 35 days had a mean daily temperature greater than the cold water criteria of 20ºC.

The *Aquatic Life Use* is assessed as impaired for the 2.4 mile reach through the Mill Pond impoundment due to the presence of non-native aquatic macrophytes. The potential for infestation in the remaining 7.0 miles downstream is also of concern. Although elevated temperatures were documented and are of concern, the remainder of the reach is not assessed due the limited data available for this segment. Because of these issues the *Aquatic Life Use* is not assessed but is identified with an Alert Status in the remaining 7.0 miles.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected fecal coliform bacteria and *E. coli* samples from Hubbard Brook at Station 15A between May and September 2002 (Appendix B). Fecal coliform bacteria counts ranged from <10 to 290 cfu/100mL and the geometric mean was 90 cfu/100mL.

DWM personnel made field observations at Station 15A during the surveys conducted between May and September 2002. No objectionable deposits, scums or water odors were noted. Water clarity was generally slightly turbid, but on two occasions it was highly cloudy (MassDEP 2002a).
The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* Uses are assessed as support based upon the low fecal coliform counts and the lack of objectionable conditions.

HUBBARD BROOK (Segment MA21-15) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED 2.4 mile reach through Mill Pond Cause: non-native aquatic macrophyte infestation Source: Introduction of non-native plant NOT ASSESSED 7.0 miles*
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

*Alert Status issues identified, see details in use assessment

RECOMMENDATIONS
Additional water quality monitoring is recommended, with better spatial coverage, to distinguish between Schenob Brook water quality and that of Hubbard Brook.

Determine if *M. spicatum* is present throughout this segment of Hubbard Brook. Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Conduct bio-monitoring to better evaluate whether the upper and lower portions of Hubbard Brook are supporting cold water fish communities.

KONKAPOT RIVER (SEGMENT MA21-25)
Location: Outlet of Brewer Lake, Monterey, to the state line in New Marlborough, MA/Canaan, CT.
Segment Length: 16.5 miles.
Classification: Class B.

This segment is included on the 2004 303(d) List of Impaired Waters due to mercury contamination (http://mass.gov/dep/water/resources/tmdls.htm).

WMA WATER WITHDRAWALS (APPENDIX J)
Berkshire National Fish Hatchery (10211302)
Lowland Farm (10219301)

NPDES SURFACE WATER DISCHARGES (APPENDIX J)
Berkshire National Fish Hatchery (MA0005401)
Gould Farm (MA0022705)

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
DWM performed a habitat assessment of this segment of the Konkapot River as part of the benthic macroinvertebrate sampling at Station KR11 (B0015), downstream from Bidwell Park falls in Monterey, on 11 September 2002. This sampling reach received a score of 170 out of 200 (Appendix C). The habitat at this station, similar to others throughout the watershed, was affected by drought conditions (decreased channel flow status). DWM biologists collected periphyton samples at Station KR11 in September of 2002 (Appendix G). Canopy cover at Station KR11 was reported as 75%, algal cover was <1%, and the dominant algal genera were *Cladophera* sp., *Melosira* sp., and *Cocconeis* sp.

DWM also performed a habitat assessment at Station KR07 (B0012), east of Clayton Mill River Road, in the village of Mill River, New Marlborough. This sampling reach received a score of 172 out of 200 (Appendix C). Aquatic vegetation covered less than 1% of the in-stream habitat, and consisted entirely of mosses. DWM biologists collected periphyton samples at Station KR07 in September of 2002 (Appendix G). Canopy cover at Station KR07 was reported as 60%, algal cover was 80%, and the dominant algal genera were *Cladophera* sp. and an unidentified green coccoid.

Biology
MA DFG and DWM (Richards 2006, Appendix F) conducted fish population sampling at five stations along this segment of the Konkapot River. Data are summarized in the table below (from upstream to downstream).

Table 3: Fish species observed at three stations located within the Konkapot River (Segment MA21-25)

	Site 910 7/28/2003 n=62	Site 679 Great Barrington Rd, New Marlborough 8/19/2002 n=97	Site 670 Clayton Mill Rd, New Marlborough 7/31/2002 n=111	Site 909 Konkapot Road, New Marlborough 7/28/2003 n=69	Site 911 East of Canaan Southfield Road, New Marlborough 7/28/2003 n=30
Blacknose dace	41	50	31	9	5
Bluegill	--	--	1	2	--
Brook Trout		3 (77-80 mm)			
Brown bullhead	--	--	--	1	--
Brown trout	1 (373 mm)	12 (75-384 mm)	21 (67-440 mm)	5 (63-211 mm)	2 (76-78 mm)
Common shiner	4	1	2	4	3
Creek chub	2	--	--	--	--
Longnose dace	11	29	30	22	8
Pumpkinseed	1	--	1	19	--
Rock bass	2	1	1	2	3
Slimy sculpin	--	--	20	5	--
White sucker	--	1	4	--	9

Fluvial specialist fishes dominate the Konkapot River fish community. Although each station was dominated by pollution tolerant or moderately tolerant species such as blacknose or longnose dace, the presence of several pollution intolerant species and evidence of reproducing trout is indicative of good water quality throughout the segment.

DWM sampled the benthic macroinvertebrate community at two stations in this segment of the Konkapot River in September 2002. The most upstream sampling reach (Station KR11) was used as a reference station and typifies least impacted conditions and a healthy benthic community (Appendix C). The RBP III analysis of the benthic macroinvertebrate community in the Konkapot River at Station KR07 was non-impacted when compared to the KR11 reference station.

The *Aquatic Life Use* is assessed as support for this segment of the Konkapot River based upon the benthic macroinvertebrate community data, the high quality in-stream habitat, and the fish community data.

FISH CONSUMPTION

Because of elevated concentrations of mercury in fish collected from the Konkapot River downstream from the dam at Mill River, MA DPH issued a site specific fish consumption advisory (MA DPH 2005b). The advisory warns that children under Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any fish from this water body. In addition, the general public should limit consumption of all fish from this water body to two meals per month.

The lower 5.9 mile reach of this segment is assessed as Impaired for the *Fish Consumption Use* due to the MA DPH fish consumption advisory for elevated concentrations of mercury in fish tissue. The upper 10.6 miles of segment are not assessed for this use.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS

DWM field biologists made field observations at Stations KR11 and KR07 (B0015) during September 2002. No objectionable odors, deposits or oils were noted at either station and the water was described as being clear with no odors or oils (MassDEP 2002b).

The *Aesthetics Use* is assessed as support based upon the lack of objectionable conditions. No recent quality assured bacteria data are available, so the *Primary* and *Secondary Contact Recreation* uses are not assessed.

KONKAPOT RIVER (Segment MA21-25) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED: Upper 10.6 miles IMPAIRED: Lower 5.9 miles CAUSE: Mercury SOURCE: Unknown SUSPECTED SOURCE: Atmospheric deposition
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

RECOMMENDATIONS

Conduct water quality monitoring to assess the *Primary* and *Secondary Contact Recreation* uses and determine if Mill River village is having a negative impact on the water quality of the Konkapot River.

KONKAPOT RIVER (SEGMENT MA21-26)
Location: From the state line in Sheffield, MA/Caanan, CT, to the confluence with the Housatonic River, Sheffield.
Segment Length: 2.9 miles.
Classification: Class B.

Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires TMDLs for metals, organic enrichment/low DO, and pathogens (MassDEP 2005a).

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and Flow
DWM biologists performed a habitat assessment of this segment of the Konkapot River as part of the benthic macroinvertebrate sampling at Station KR02 (B0500), approximately 100 meters downstream from Route 124, North Canaan, CT, on 9 September 2002. This sampling reach received a score of 139 out of 200 due to decreased channel flow status (drought conditions), lack of habitat variety (velocity-depth combinations), elevated sediment deposition, decrease in the in-stream cover, and highly abbreviated riparian zone width (Appendix C). DWM biologists collected periphyton samples at Station KR02 in September of 2002 (Appendix G). Canopy cover at this station was reported as 0%, algal cover was 25%, and the dominant algal genera were *Cladophera* sp*.* and *Tabellaria* sp.

Biology
DWM sampled the benthic macroinvertebrate community at Station KR02 in 2002 (Appendix C). The RBP III analysis indicated this station was non-impacted when compared to the upstream Konkapot River reference station (KR11).

Chemistry-water
DWM sampled the water quality of the Konkapot River upstream from the railroad bridge, ~160 feet upstream from Rte. 7A, in Sheffield (Station 26A), between May and September 2002. *In-situ* sampling was conducted to measure dissolved oxygen, temperature, pH, and conductivity during pre-dawn hours. Grab samples were collected and analyzed for total suspended solids, ammonia-nitrogen, and total phosphorus (low-level). All in-situ measurements met water quality criteria.

The *Aquatic Life Use* is assessed as support for this segment of the Konkapot River based upon the benthic macroinvertebrate community data and the *in-situ* water quality data.

FISH CONSUMPTION
Because of elevated concentrations of mercury in fish collected from the Konkapot River downstream from the dam at Mill River, MA DPH issued a site-specific fish consumption advisory (MA DPH 2005b). The advisory warns that children under Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any fish from this water body. In addition, the general public should limit consumption of all fish from this water body to two meals per month.

This segment is assessed as Impaired for the *Fish Consumption Use* due to the MA DPH fish consumption advisory for elevated concentrations of mercury in fish tissue.

PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected fecal coliform and *E. coli* bacteria samples from the Konkapot River at Station 26A between May and September 2002 (Appendix B). Fecal coliform bacteria counts ranged from <70 to 250 cfu/100mL, and the geometric mean was 146 cfu/100mL.

Neither DWM biologists or water quality field sampling crews noted any deposits, odors, oils or other objectionable conditions in the Konkapot River near the Route 7A bridge in Ashley Falls, Sheffield. The water column was described as either clear or slightly turbid on all sampling occasions (MassDEP 2002a and MassDEP 2002b).

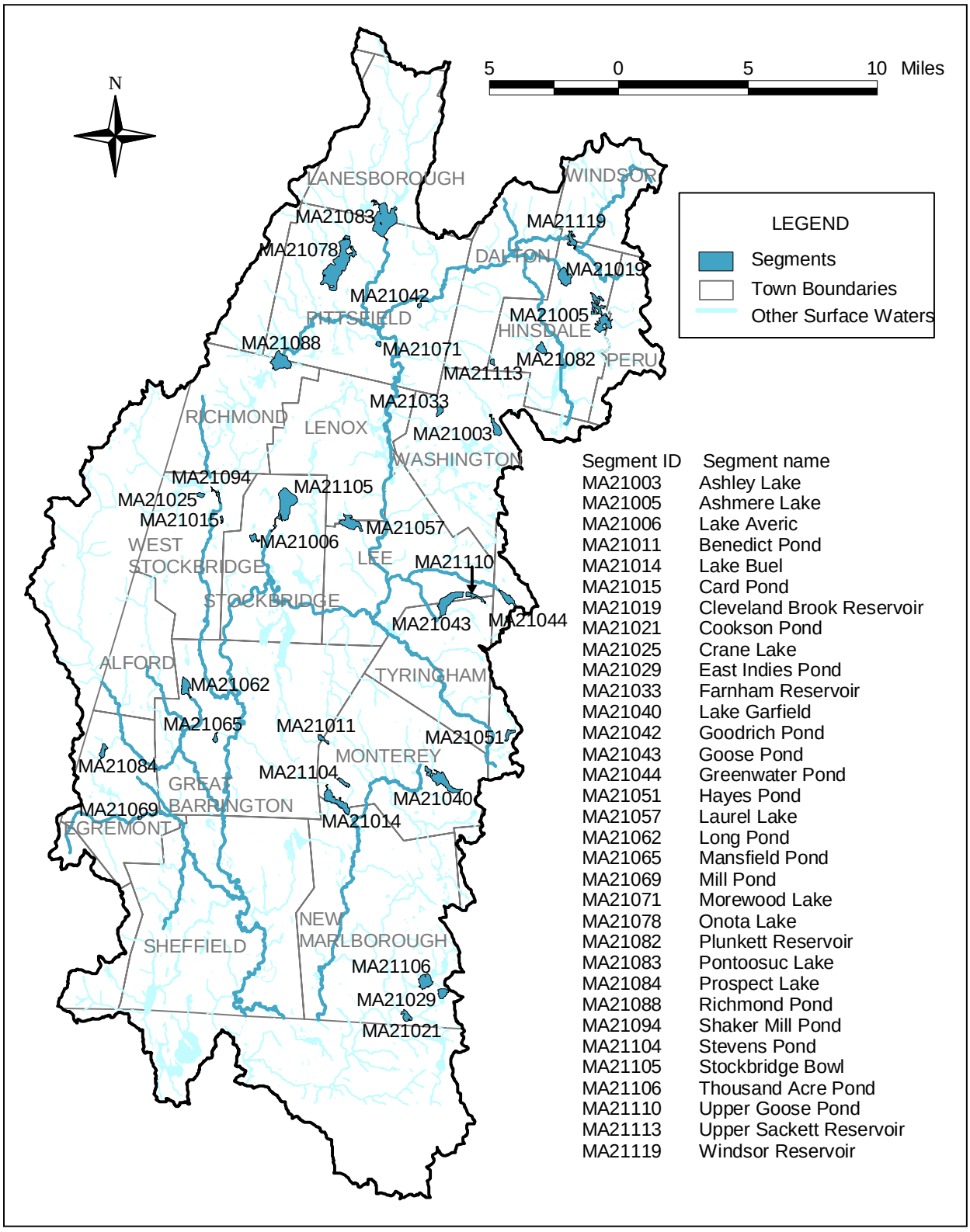
The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support based upon the low fecal coliform counts and the lack of objectionable conditions.

KONKAPOT RIVER (Segment MA21-26) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		IMPAIRED Cause: Mercury Source: Unknown Suspected Source: Atmospheric deposition
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

HOUSATONIC RIVER WATERSHED- LAKES SEGMENTS ASSESSED

Figure 9: Housatonic River Watershed – Lake Segments Assessed



Segment ID	Segment name
MA21003	Ashley Lake
MA21005	Ashmere Lake
MA21006	Lake Averic
MA21011	Benedict Pond
MA21014	Lake Buel
MA21015	Card Pond
MA21019	Cleveland Brook Reservoir
MA21021	Cookson Pond
MA21025	Crane Lake
MA21029	East Indies Pond
MA21033	Farnham Reservoir
MA21040	Lake Garfield
MA21042	Goodrich Pond
MA21043	Goose Pond
MA21044	Greenwater Pond
MA21051	Hayes Pond
MA21057	Laurel Lake
MA21062	Long Pond
MA21065	Mansfield Pond
MA21069	Mill Pond
MA21071	Morewood Lake
MA21078	Onota Lake
MA21082	Plunkett Reservoir
MA21083	Pontoosuc Lake
MA21084	Prospect Lake
MA21088	Richmond Pond
MA21094	Shaker Mill Pond
MA21104	Stevens Pond
MA21105	Stockbridge Bowl
MA21106	Thousand Acre Pond
MA21110	Upper Goose Pond
MA21113	Upper Sackett Reservoir
MA21119	Windsor Reservoir

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Ashley Lake, Washington	MA21003	94	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Ashley Lake is a Class A, Public Water Supply. Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Secondary Contact* and *Aesthetics*) and was not assessed for others (MassDEP 2005a).

WMA Water Withdrawals (Appendix J)
Pittsfield Water Department (10223601). The system is described in more detail in Kennedy and Weinstein (2000).
Other: The City of Pittsfield owns and operates a FERC exempt hydro project on Ashley Lake (Project Number 9983, issued February 1987). The capacity of this project is 225 kW (http://www.ferc.gov/industries/hydropower/gen-info/licensing/exemptions.xls.

No recent quality-assured data are available for Ashley Lake. All designated uses are not assessed. It should be noted that the MassDEP Drinking Water Program maintains current drinking water supply data for this source.

Ashmere Lake, Hinsdale/Peru	MA21005	294	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Ashmere Lake is located within the Hinsdale Flats ACEC. Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a).

The non-native aquatic macrophyte *Myriophyllum spicatum* was documented in Ashmere Lake during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). The non-native aquatic macrophyte *Potamogeton crispus* has also been reported in this waterbody (MassDEP 2003b, MassDEP 2004, and MassDEP 2005b). The *Aquatic Life Use* is assessed as impaired because of the presence of non-native aquatic macrophytes.

Bacteria samples (*E. coli)* were collected weekly from the Camp Taconic beach on Lake Ashmere in Hinsdale 2002, 2003, and 2004 (n=38). *E. coli* samples were also collected weekly from the Camp Ashmere beach in Hinsdale in 2002, 2003, and 2004 (n=40). Camp Danbee also collected weekly *E. coli* bacteria samples at their beach on Lake Ashmere in Peru in 2002, 2003, and 2004 (n=36) (MA DPH 2003, 2004, 2005a). The beaches were never formally posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

Though no water quality monitoring data was generated, one project (*Implementing a Stormwater Remediation Strategy at Ashmere Lake* -- Project 01-15/319) sought to implement a comprehensive stormwater remediation strategy recommended by studies to prevent sedimentation from gravel roads and prevent the spread of non-native aquatic species. It should also be noted that the outlet flow from Lake Ashmere into Bennett Brook has been documented to be zero on occasion and there have been periods where flow in the brook has been static for days on end (RIFLS 2006). To the extent possible a natural flow regime should be maintained in Bennett Brook.

Lake Averic, Stockbridge	MA21006	42	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Lake Averic is a Class A, Public Water Supply. Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a).

The Stockbridge Water Department has a water withdrawal registration (WMA # 10228301) allowing for the withdrawal of 0.29 MGD from Lake Averic.

The non-native aquatic macrophyte *Myriophyllum spicatum* was documented in Lake Averic during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000).

The *Aquatic Life Use* is assessed as impaired because of the presence of non-native aquatic macrophytes. The other uses are not assessed. It should be noted that the MassDEP Drinking Water Program maintains current drinking water supply data for this source.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Benedict Pond, Great Barrington/Monterey	MA21011	37	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Secondary Contact* and *Aesthetics*) and was not assessed for others (MassDEP 2005a). The water at the Benedict Pond Beach in Monterey was tested weekly for *Enterococci* bacteria in 2001, 2002, 2003, and 2004 (n=70) (MA DPH 2002, 2003, 2004, 2005a). There were six exceedances of the bathing beach criteria- one in 2001, one in 2002, and four in 2003; however, the beach was not posted. In 2004, the beach was posted on two occasions. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody. No other data are available so all uses are not assessed.							
Lake Buel, Monterey/New Marlborough	MA21014	194	IMPAIRED (non-native macrophytes, low DO, dissolved oxygen saturation, total phosphorus)	NOT ASSESSED	IMPAIRED (non-native macrophytes)	IMPAIRED (non-native macrophytes)	IMPAIRED (non-native macrophytes)
Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires a TMDL for nutrients. The presence of exotic species also impairs the segment, but is a pollutant that does not require the calculation of a TMDL (MassDEP 2005a). Two non-native aquatic macrophytes, *Myriophyllum spicatum* and *Najas minor,* were documented in Lake Buel during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). One additional non-native aquatic macrophyte, *Potamogeton crispus*, was also observed by DWM in 2002 (MassDEP 2002a). An *in-situ* profile was taken by DWM at the deep hole of the lake on 22 August 2002. Dissolved oxygen concentrations ranged from 14.1 to <0.2 mg/L; percent saturations ranged from 152 to <2% (Appendix D). Anoxic conditions (≤2.1 mg/L and 19% saturation) were measured in the bottom water at depths of 6.9 meters or greater. Grab samples were collected in June, July, and August and analyzed for total phosphorus (n=8) apparent color (n=6) and chlorophyll *a* (n=4). Total phosphorus concentrations suggest that phosphorus may be released from the sediments with concentrations in the bottom water measured at 0.059 and 0.24 mg/L. Chlorophyll *a* concentrations ranged from 4.6 to 12.6 mg/m^3. The *Aquatic Life Use* is assessed as impaired for Lake Buel since approximately 33% of the lake area had low DO in the epilimnion. Supersaturation and evidence of phosphorus release from the sediments were also problematic. Although the lake is being actively harvested, invasive non-native macrophytes also impair the *Aquatic Life Use*. DWM conducted fish toxics monitoring in Lake Buel on 9 July 2002 (Appendix E). MA DPH did not issue a site-specific advisory for Lake Buel, so the *Fish Consumption Use* is currently not assessed. The water at the Seven Stones Beach on Lake Buel in Monterey was tested weekly for *E. coli* bacteria in 2003 and 2004 (n=33) (MA DPH 2004, 2005a). The beach was never posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody. However, because of the area of the lake occupied by the non-native aquatic macrophytes, the *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as impaired. One project (*Lake Buel Implementation and Demonstration Project* 01-13/319) was completed in June 2005. A stormwater BMP was designed and installed at the public boat ramp. Annual weed harvesting and a plant replacement trial were also conducted.							

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Card Pond, West Stockbridge	MA21015	11	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed in Category 3 of the 2004 Integrated List of Waters. This segment was not assessed for any of the designated uses (MassDEP 2005a). The water at Card Pond Beach was tested weekly for *E. coli* in 2003 and 2004 (n=32) (MA DPH 2004, 2005a). The beach was never posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody. No recent quality-assured data are available for Card Pond. All designated uses are not assessed.							
Center Pond, Dalton	MA21016	12	THIS WATERBODY IS NO LONGER BEING ASSESSED AS A LAKE SEGMENT. It is a run-of-river impoundment (river segment MA21-01).				
Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires a TMDL for priority organics (MassDEP 2005a).							
Cleveland Brook Reservoir, Hinsdale	MA21019	156	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Cleveland Brook Reservoir is a Class A, Public Water Supply. Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Secondary Contact* and *Aesthetics*) and was not assessed for others (MassDEP 2005a). **WMA Water Withdrawals (Appendix J)** Pittsfield Water Department (10223601) One project, *Pittsfield Water Supply: Stormwater Remediation Project 03-06/319*, is underway. Cleveland Brook Reservoir is threatened by stormwater runoff from adjacent roadways. The MassDEP Drinking Water Program maintains current drinking water supply data for this source. No recent quality-assured data are available for Cleveland Brook Reservoir. All designated uses are not assessed.							
Cookson Pond, New Marlborough	MA21021	67	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Secondary Contact* and *Aesthetics*) and was not assessed for others (MassDEP 2005a). No recent quality-assured data are available for Cookson Pond. All designated uses are not assessed.							
Crane Lake, West Stockbridge	MA21025	27	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed in Category 3 of the 2004 Integrated List of Waters. This segment was not assessed for any of the designated uses (MassDEP 2005a). The water at the Camp Crane Lake beach was sampled weekly for *E. coli* bacteria in 2003 and 2004 (n=20) (2004, 2005a). The beach was never posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody. No recent quality-assured data are available for Crane Lake. All designated uses are not assessed.							

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
East Indies Pond, New Marlborough	MA21029	72	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed in Category 3 of the 2004 Integrated List of Waters. This segment was not assessed for any of the designated uses (MassDEP 2005a). No recent quality-assured data are available for East Indies Pond. All designated uses are not assessed.							
Farnham Reservoir, Washington	MA21033	41	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Farnham Reservoir is a Class A, Public Water Supply. Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Secondary Contact* and *Aesthetics*) and was not assessed for others (MassDEP 2005a). **WMA Water Withdrawals (Appendix J)** Pittsfield Water Department (10223601) No recent quality-assured data are available for Farnham Reservoir. All designated uses are not assessed. It should be noted that the MassDEP Drinking Water Program maintains current drinking water supply data for this source.							
Lake Garfield, Monterey	MA21040	256	IMPAIRED (non-native macrophytes, low DO, total phosphorus)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Secondary Contact* and *Aesthetics*) and was not assessed for others (MassDEP 2005a). Two non-native macrophytes, *Myriophyllum spicatum* and *Potamogeton crispus*, were found in the lake in 2004 (MA DCR 2004). In 2003 DWM collected water quality data from the deep-hole station of Lake Garfield (Appendix D, Table D2). Low DO was found at 6m and below (approximately 50% of the lake area). There was also evidence of total phosphorus release from the sediment and moderate levels of chlorophyll *a*. Because of these conditions and the presence of non-native aquatic macrophytes, the *Aquatic Life Use* is assessed as impaired. Friends of Lake Garfield conducted water quality monitoring at three stations on Lake Garfield (Edelstein 2006). Despite the fact that these data do not meet minimum QA/QC requirements because they are not found in a citable report, they appear to corroborate the findings of MassDEP. Fish from Lake Garfield were sampled for toxins in fish tissue in 1993 by DWM. Samples were analyzed for metals and PCBs (Maietta undated). No site-specific fish consumption advisory was issued for this waterbody, so the *Fish Consumption* use is not assessed. The water at the Monterey town beach on Lake Garfield was tested weekly for *E. coli* bacteria in 2002, 2003, and 2004 (n=48) (MA DPH 2003, 2004, 2005a). The beach was never posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.							

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Goodrich Pond, Pittsfield	MA21042	15	NOT ASSESSED	IMPAIRED PCBs	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed in Category 3 of the 2004 Integrated List of Waters. This segment was not assessed for any of the designated uses (MassDEP 2005a). MA DPH issued the Goodrich Pond advisory in in February 2001. The US Fish and Wildlife Service sampled in October 1998 and the analysis was done by Environmental Data Services, Inc. and Texas A&M University, Geochemical & Environmental Research Group (GERG), College of Geosciences and Maritime Studies (Beattie 2006). MA DPH issued a site-specific fish consumption advisory for Goodrich Pond. The advisory states: *The general public should not consume any fish from this waterbody due to elevated concentrations of PCBs in fish tissue* (MDPH 2005). The source of PCB is the General Electric site (16).							
Goose Pond, Lee/Tyringham	MA21043	237	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a). Two non-native aquatic macrophytes, *Myriophyllum spicatum* and *Potamogeton crispus*, were documented in Goose Pond in 1995 (Kennedy and Weinstein 2000). *Myriophyllum spicatum* was also identified in a recent application submitted to the Department to apply herbicides to the pond (MassDEP 2004). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophytes. Fish were collected from Goose Pond by DWM in 1993. Fish tissue samples were analyzed for As, Hg, PB, and Zn (Maietta undated). No site-specific fish consumption advisory was issued so the *Fish Consumption Use* is not assessed. Leisure Lee Beach on Goose Pond in Lee was sampled weekly for *E. coli* bacteria in 2001, 2002, 2003, and 2004 (n=45) (MA DPH 2002, 2003, 2004, 2005a). The beach was never posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.							
Greenwater Pond, Becket	MA21044	89	IMPAIRED (non-native macrophyte)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a). The non-native aquatic macrophyte *Myriophyllum spicatum* was documented in Greenwater Pond during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophyte. No other recent data are available so the other uses are not assessed.							
Hayes Pond, Otis	MA21051	46	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Secondary Contact* and *Aesthetics*) and was not assessed for others (MassDEP 2005a). No recent data are available so the uses are not assessed.							

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Laurel Lake, Lee/Lenox	MA21057	173	IMPAIRED (non-native macrophytes, low DO, dissolved oxygen saturation, total phosphorus)	NOT ASSESSED	NOT ASSESSED* Alert Status	NOT ASSESSED	NOT ASSESSED

Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species which, is not a pollutant requiring calculation of a TMDL (MassDEP 2005a).

Schweitzer-Mauduit International, Inc (10215002/9P210215002) is authorized to withdraw water from Laurel Lake (WMA 10215002/9P210215002).

The non-native aquatic macrophytes *Myriophyllum spicatum, Potamogeton crispus,* and *Najas minor* were documented in Laurel Lake during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000, MassDEP 1997).

An *in-situ* profile was taken by DWM at the deep hole of the lake on 26 August 2003. Dissolved oxygen concentrations ranged from 0.3 to 16.8 mg/L; percent saturations ranged from 3 to 173% (Appendix D, Table D3). Severe oxygen depletion (<5 mg/L and 50% saturation) was measured at depths of 8.5 meters or greater (approximately 44% of the lake area). There was also evidence of a metalimnetic bloom (DO supersaturation at depths of 6 and 7m). Grab samples were collected in August and analyzed for total phosphorus, apparent color, and chlorophyll *a*. Total phosphorus concentrations suggest that phosphorus may be released from the sediments with concentrations in the bottom water measured at 0.41 mg/L. The chlorophyll *a* concentration was low/moderate (6.7 mg/m^3).

The *Aquatic Life Use* is assessed as impaired for Laurel Lake since approximately 44% of the lake area had low DO in the epilimnion. Supersaturation and evidence of phosphorus release from the sediments were also problematic.
The presence of the non-native aquatic macrophytes also impairs the *Aquatic Life Use.*

There are three public bathing beaches on Laurel Lake. In Lee, the town beach and Sandy Beach were sampled weekly for *E. coli* in 2001, 2002, 2003, and 2004 (n=73). There were never any postings. In Lenox the town beach was also sampled weekly for *E. coli* in 2001, 2002, 2003, and 2004 (n=49) (MA DPH 2002, 2003, 2004, 2005a). The beach was never posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

It should be noted that *Myriophyllum spicatum* was the dominant aquatic macrophyte between the 6 and 14 foot depth contours (essentially, the entire shoreline area of the lake). Because this species may interfere with swimming, the *Primary Contact Use* is identified with an Alert Status. No other recent quality assured data are available so the other uses are not assessed.

Long Pond, Great Barrington	MA21062	114	IMPAIRED (non-native macrophyte)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Long Pond is a Class A, Public Water Supply (source Housatonic Water Works Company, WMA registration 10211306). Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculations of a TMDL (MassDEP 2005a).

The non-native aquatic macrophyte *Myriophyllum spicatum* was documented in Long Pond during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophyte. No other recent data are available so the other uses are not assessed.

It should be noted that the MassDEP Drinking Water Program maintains current drinking water supply data for this source.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Mansfield Pond, Great Barrington	MA21065	28	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a).

The non-native aquatic macrophytes *Myriophyllum spicatum* and *Potamogeton crispus* were documented in Mansfield Pond during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). There was a project to reduce the *Myriophyllum spicatum* infestation using biological control (weevils) with a DEM 2000 lake and pond grant, however no post implementation data are available on the effectiveness.

An *in situ* profile was taken by DWM at the deep hole of the lake on 26 August 2003. Dissolved oxygen concentrations ranged from 0.8 to 7.9 mg/L; percent saturations ranged from 10 to 98% (Appendix D, Table D4). Severe oxygen depletion (<5 mg/L and 50% saturation) was only measured at depths greater than 4m, which does not constitute a significant portion of the lake area. Grab samples were collected in August and analyzed for total phosphorus, apparent color, and chlorophyll *a*. Total phosphorus concentrations suggest that phosphorus may be released from the sediments with concentrations in the bottom water measured at 0.08 mg/L. The chlorophyll *a* concentration was low (4.0 mg/m^3).

The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophytes. Phosphorus release from sediments is also of concern.

The Town of Great Barrington maintains a public bathing beach on Mansfield Pond. The beach area was tested weekly during the bathing season for *E. coli* bacteria in 2001, 2003, and 2004 (n=36) (MA DPH 2002, 2004, 2005a). The beach was never formally posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

No other recent data are available so the other uses are not assessed.

Mill Pond, Egremont	MA21069	10	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Based on the last evaluation of water quality conditions, this segment is listed in Category 3 of the 2004 Integrated List of Waters. This segment was not assessed for any of the designated uses (MassDEP 2005a). This segment is entirely within the Karner Brook ACEC.

No recent data are available so the uses are not assessed.

Mill Pond, Sheffield	MA21068	97	THIS WATERBODY IS NO LONGER BEING ASSESSED AS A LAKE SEGMENT. It is a run-of-river impoundment (see Hubbard Brook - segment MA21-15)

Based on the last evaluation of water quality conditions, this segment is listed in Category 3 of the 2004 Integrated List of Waters. This segment was not assessed for any of the designated uses (MassDEP 2005a). This waterbody is infested with two non-native aquatic macrophytes, *Myriophyllum spicatum* and *Trapas natans* (MassDEP 2003b, MassDEP 2004, and MassDEP 2005b).

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Morewood Lake, Pittsfield	MA21071	20	NOT ASSESSED	IMPAIRED PCBs	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

This segment is new, so it does not appear in the 2004 Integrated List of Waters.

Pittsfield Country Club maintains a registered WMA to withdraw 0.12 MGD from Morewood Lake (WMA 10223603).

At the request of MassDEP, BBL acting as consultant to GE sampled fish from Morewood Lake in September 2004 (Messur 2004). Concentrations of total PCB in individual largemouth bass (n=10) ranged from 0.37 to 28.1 ppm with an average PCB concentration of 9.3 ppm. Concentrations in individual bluegill (n=10) ranged from <MDL to 3.8 ppm (average concentration of 0.75 ppm).

MA DPH issued a site-specific fish consumption advisory for Morewood Lake. The advisory states: *The general public should not consume any fish from this waterbody due to elevated levels of PCBs.* The source of PCBs is attributed to the GE Company Pittsfield Plant. Because of the site-specific fish consumption advisory due to PCB contamination, the *Fish Consumption Use* is assessed as impaired. The source of PCB is the General Electric site (16).

There is a public bathing beach on Morewood Lake. The beach area was tested during the 2005 bathing season for *E. coli* bacteria (n=10) (MA DPH 2006). The beach was never formally posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Onota Lake, Pittsfield	MA21078	662	IMPAIRED (non-native macrophytes)	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT

Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a).

Three non-native aquatic macrophytes *Myriophyllum spicatum*, *Najas minor,* and *Potamogeton crispus* were documented in Onota Lake during the 1997-1998 DWM synoptic survey (Kennedy and Weinstein 2000). Two of these species (*Myriophyllum spicatum* and/or *Potamogeton crispus*, were also identified in a recent applications submitted to the Department to apply herbicides to the lake (MassDEP 2003b and MassDEP 2005b). A fourth non-native aquatic macrophyte, *Trapas natans,* was also recently reported to be in this waterbody (MA DFG 2005).

Lake Onota Preservation Association (LOPA) volunteers have conducted water quality monitoring at several Lake Onota stations during 2001-2004. Low dissolved oxygen concentrations were measured in all years at the two deep hole stations (D2 northern deep hole and D6 southern deep hole)(LOPA Annual Report 2001, 2002, 2003, 2004). The low DO conditions affect approximately 25% of the lake area. Despite not being covered under an approved QAPP, these DO data corroborate a 1987 diagnostic study for Onota Lake (ITC 1987), which demonstrated low DO conditions in a significant portion of the lake during the summer months.

The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophytes and the low dissolved oxygen levels. In the fall of 2006, zebra mussels (an invasive non-native organism) were found in boats brought to Onota Lake (NALMS 2006).

LOPA volunteers also measured Secchi disk depth at the deep hole stations at regular intervals during 2001-2004. The Secchi disk measurements are included within a MassDEP approved QAPP. Secchi disk depth ranged from 2.1 to 5.6 m at Station D2 and 2.6 to 7.5 m at Station D6 (D2 northern deep hole and D6 southern deep hole)(LOPA Annual Report 2001, 2002, 2003, 2004).

The *Primary* and *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support based upon the acceptable water clarity as measured by the Secchi disk depths.

Fish from Onota Lake were sampled for toxics in fish tissue as part of an Office of Research and Standards managed research project in 2002 and 2004. Samples were analyzed for mercury and selenium (Maietta undated). Since no site-specific fish consumption advisory was issued for this waterbody, the *Fish Consumption Use* is not assessed.

Camp Witawentin tested the water at their bathing beach on Onota Lake weekly during 2002 for *E. coli* bacteria (n=10) (MA DPH 2003). The beach was never posted. The City of Pittsfield also tested the water at their bathing beach on Onota Lake weekly during 2002 for *E. coli*. The City beach was also never posted. Camp Winadu also maintains a beach on Onota Lake, no data were reported. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

There were two grant projects which received funding as listed below:
00-01/319: Implementing the Diagnostic/ Feasibility Study Recommendation for Onota Lake. The overall goal of abating the accelerated eutrophication of Onota Lake will be accomplished through the continued implementation of in-lake restoration and watershed management measures to reduce nutrient and sediment loading. Implementation of these measures will improve water quality, improve fish habitat, and improve recreational use of the lake.
03-15/MWI Onota Lake Watershed Assessment This project will perform an assessment of current and past aquatic vegetation and nutrient control practices at Onota Lake and develop a lake and watershed management plan targeted at controlling nuisance aquatic vegetation. Tasks include: conducting two qualitative and quantitative aquatic macrophyte surveys; training volunteers from the Lake Onota Preservation Association in macrophyte identification and mapping; conducting a lake watershed assessment.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Plunkett Reservoir, Hinsdale	MA21082	72	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a). This segment is located within the Hinsdale Flats ACEC.

The non-native aquatic macrophytes *Myriophyllum spicatum* and *Najas minor* were documented in Plunkett Reservoir during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). *Myriophyllum spicatum* was also identified in a recent applications submitted to the Department to apply herbicides to the lake (MassDEP 2004 and MassDEP 2005b). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophytes.

There is a public bathing beach on Plunkett Reservoir. The water at the beach was sampled weekly during the bathing season for *E. coli* in 2001, 2002, 2003, and 2004 (MA DPH 2002, 2003, 2004, 2005a). The beach was never formerly posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Pontoosuc Lake, Pittsfield/ Lanesborough	MA21083	500	IMPAIRED (non-native macrophytes)	IMPAIRED Mercury	NOT ASSESSED	NOT ASSESSED	SUPPORT

Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a). Pontoosuc Lake was also assessed as impaired due to metals (mercury) (see MassDEP 2005a). Lanesborough Village Water District is registered (10214801) to withdraw from two groundwater sources along Town Brook, a tributary to Pontoosuc Lake (Appendix J, Table J1).

Four non-native aquatic macrophytes (*Myriophyllum spicatum*, *Najas minor*, *Potamogeton crispus*, and *Trapas natans)* were documented in Pontoosuc Lake (Kennedy and Weinstein 2000 and Robinson 2006b). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophytes.

In 1994 EPA funded an agricultural waste management project to reduce nonpoint source inputs to Pontoosuc Lake from five farms in the watershed. A diagnostic assessment of conditions in Pontoosuc Lake was conducted in 1997 as a follow-up to evaluate the effectiveness the project. No methods or quality assurance data are provided in this report, so the information was not used to make *Aquatic Life Use* assessments. According to ENSR, "*summer anoxia was observed in the small hypolimnion and appeared to promote internal recycling of phosphorus during the growing season, algal blooms in the lake were reported to be common but not severe, and rooted plant growths were dominated by non-native species with high nuisance potential but appeared to be adequately managed with drawdown and harvesting*" (ENSR 2000). It was determined that pollutant inputs of nutrients from storm drain systems were problematic because of their proximity and rapid discharge to the lake. As part of projects 99-03/319 and 01-14/319 priority storm drain problems were corrected by the installation of innovative stormwater infiltration technologies at three locations. These systems were designed to capture the "first flush" of storm runoff and infiltrate it into the ground. It should be noted that a newly funded project, 04-10/319, is underway. Water quality monitoring under an approved quality assurance project plan will be conducted as part of this project.

In 1993 DWM conducted fish toxics monitoring in Pontoosuc Lake that resulted in MA DPH issuing a site-specific fish consumption advisory for the lake due to elevated concentrations of mercury in fish tissue. On 20 June 2002 DWM resampled the fish in Pontoosuc Lake (Appendix E, Table E1). Although the data generated in 2002 indicate that mercury is below the MA DPH "trigger level" in all samples (including one composite sample of three largemouth bass), MA DPH took the data point for largemouth bass in 2002 and combined it with the 1993 largemouth bass data and calculated an average concentration. As a result MA DPH decided to re-issue the previous advisory (Maietta *et al.* 2004, MA DPH 2005b). The current MA DPH fish consumption advisory recommends that due to elevated concentrations of mercury "*Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant and nursing mothers should not eat any largemouth bass from this waterbody and the general public should limit consumption of largemouth bass to two meals per month*". Because of this site-specific advisory, the *Fish Consumption Use* is assessed as impaired due to mercury contamination. Although the source of mercury is unknown, atmospheric deposition is suspected.

Pontoosuc Lake was sampled weekly for *E. coli* bacteria at the Lanesborough town beach off Sunrise Street in 2002, 2003, and 2004 (n=34) (MA DPH 2003, 2004, 2005a). The lake was also sampled from the beach at Memorial Park in 2002 (n=8). The beaches were never posted. In 2002 the City of Pittsfield tested the water at their bathing beach on Pontoosuc Lake for *E. coli* bacteria on a weekly basis (n=11). The beach was never posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

Algal blooms in the lake were reported to be common but not severe, and rooted plant growths were dominated by non-native species with high nuisance potential but appeared to be adequately managed with drawdown and harvesting" (ENSR 2000).

The *Aesthetics Use* is assessed as support based on the documentation provided by ENSR that algal blooms are not severe and the non-native aquatic macrophyte populations appear to be adequately managed.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Prospect Lake, Egremont	MA21084	59	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Based on the last evaluation of water quality conditions, this segment is listed in Category 3 of the 2004 Integrated List of Waters. This segment was not assessed for any of the designated uses (MassDEP 2005a).

An *in-situ* profile was taken by DWM at the deep hole of the lake on 26 August 2003. Dissolved oxygen concentrations ranged from 7.3 to 9.4 mg/L; percent saturations ranged from 84 to 113% (Appendix D, Table D5). Grab samples were collected in August and analyzed for total phosphorus, apparent color, and chlorophyll *a*. Total phosphorus concentrations were low. The chlorophyll *a* concentration was low/moderate (6.8 and 9.0 mg/m^3). Two non-native macrophytes, *Potamogeton crispus* and *Marsilea quadrifolia,* were also documented (MassDEP 2002a).

The *Aquatic Life Use* is assessed as impaired because of the infestation of non-native aquatic macrophytes.

The Egremont Town Beach and Prospect Lake Park Beach were sampled weekly in 2001, 2002, 2003, and 2004 (n=72) (MA DPH 2002, 2003, 2004, 2005a). The beaches were never formally posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

Richmond Pond, Richmond/Pittsfield	MA21088	227	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a).

The non-native aquatic macrophytes *Myriophyllum spicatum* and *Najas minor* were documented in Richmond Pond during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). *Myriophyllum spicatum* and *Potamogeton crispus* were also identified in a recent application submitted to MassDEP to apply herbicides to the pond (MassDEP 2005b). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophytes.

The water in Richmond Pond was sampled weekly at three bathing beaches for *E. coli* in 2001, 2002, 2003, and 2004 (Camp Russell n=34, Richmond Shores =52, and the Town beach=43) (MA DPH 2002, 2003, 2004, 2005a). The beaches were never posted. Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

Grant Project 02-04/319: Implementing Nonpoint Source BMPs at Richmond Pond. Project goals include implementation of watershed and in-lake BMPs to mitigate NPS, restoration and protection of recreational uses and habitat value, and implementation of recommendations for the elimination and control of invasive aquatics.

Risingdale Impoundment, Great Barrington	MA21121	41	THIS WATERBODY NO LONGER ASSESSED AS LAKE SEGMENT. This waterbody Is considered a run-of-river impoundment (see Housatonic River – Segment MA21-19).

Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires a TMDL for priority organics (MassDEP 2005a).

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Shaker Mill Pond, West Stockbridge	MA21094	27	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
This segment is new and therefore does not appear in the 2004 Integrated List of Waters. Shaker Mill Pond is infested with three non-native aquatic macrophytes *Myriophyllum spicatum, Potamogeton crispus* and *Trapas natans* (MA DFG 2005 and Robinson 2006a). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophytes. **NPDES Permits (Appendix J)** Town of Lenox Root Reservoir (MAG640015) No other data are available so the other uses are not assessed.							
Stevens Pond, Monterey	MA21104	39	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Secondary Contact* and *Aesthetics*) and was not assessed for others (MassDEP 2005a). In recent applications submitted to MassDEP to apply herbicides to the pond, Stevens Pond was reported to be infested with *Myriophyllum spicatum* and *Potamogeton crispus* (MassDEP 2004 and MassDEP 2005b). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophytes. No other data are available so the other uses are not assessed.							

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Stockbridge Bowl, Stockbridge	MA21105	383	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a).

The non-native aquatic macrophytes *Myriophyllum spicatum* was documented in Stockbridge Bowl during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophyte.

The Town of Stockbridge has been trying to draw down water levels in the Bowl for five years for management of aquatic plant species. In one year, leaves clogged the outlet allowing on a tiny trickle to Larrywaug Brook. In October 2005, heavy rains resulted in high water levels, so the lake could not be drawn down.

Fish from Stockbridge Bowl were collected by DWM in 1983 and fish tissue samples were analyzed for dioxins (Maietta undated). No site-specific fish consumption advisory was issued for this water body, so the *Fish Consumption Use* is not assessed.

There are nine bathing beaches on the shores of Stockbridge Bowl. The water at the beaches was tested weekly for *E. coli* bacteria in 2001, 2002, 2003, and 2004 (MA DPH 2002, 2003, 2004, 2005a).

Beachwood Association (n=53) no postings
Berkshire Country Day School (n=76) no postings
Camp Mahkeenac (n=82) no postings
Kripalu (n=48) three exceedances, no postings
Sports Day camp (n=35) two exceedances, no postings
Tanglewood (n=42) no postings
Town Beach (n=48) one exceedance, no postings
White Pines (n=38) no postings
Mah-Kee-Nac Shores (n=35) no postings

Currently, there is uncertainty associated with the accurate reporting of freshwater beach closure information to the Massachusetts DPH, which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

Thousand Acre Pond, New Marlborough	MA21106	145	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a).

The non-native aquatic macrophyte *Myriophyllum spicatum* was documented in Thousand Acre Pond during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophyte.

No other quality assured data are available so the other uses are not assessed.

Lake, Location	WBID	Size (Acres)	Aquatic Life  (Impairment Cause)	Fish Consumption  (Impairment Cause)	Primary Contact  (Impairment Cause)	Secondary Contact  (Impairment Cause)	Aesthetics  (Impairment Cause)
Upper Goose Pond, Lee/Tyringham	MA21110	55	IMPAIRED (non-native macrophytes)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Based on the last evaluation of water quality conditions, this segment is listed on the 2004 Integrated List of Waters in Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL (MassDEP 2005a). The non-native aquatic macrophyte *Myriophyllum spicatum* was documented in Upper Goose Pond during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). *Myriophyllum spicatum* was also identified in a recent application submitted to MassDEP to apply herbicides to the pond (MassDEP 2004). The *Aquatic Life Use* is assessed as impaired because of the presence of the non-native aquatic macrophytes. No other quality assured data are available so the other uses are not assessed.							
Upper Sackett Reservoir, Hinsdale	MA21113	19	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Upper Sackett Reservoir is a Class A, Public Water Supply (source Housatonic Water Works Company - WMA registration 10223601). Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Secondary Contact* and *Aesthetics*) and was not assessed for others (MassDEP 2005a). One project, *Pittsfield Water Supply: Stormwater Remediation Project 03-06/319*, is underway. Upper Sackett Reservoir is threatened by stormwater runoff from adjacent roadways. No recent water quality data are available so all uses are not assessed. It should be noted that the MassDEP Drinking Water Program maintains current drinking water supply data for this source.							
Windsor Reservoir, Hinsdale/Windsor	MA21119	74	NOT ASSESSED*	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Windsor Reservoir is a Class A, Public Water Supply (emergency source Dalton Fire District (WMA registration 10207003). Based on the last evaluation of water quality conditions, this segment is listed in Category 2 of the 2004 Integrated List of Waters. This segment supported some designated uses (*Secondary Contact* and *Aesthetics*) and was not assessed for others (MassDEP 2005a). Grant Project 05-03/319: Windsor Reservoir Restoration Project. Although no water quality data will be collected, the goal of this project is to repair and stabilize the roadways, install flood protection and stormwater BMPs, and remove accumulated sediment from the inlet tributary. This work is recommended in a SWAP report for the water supply. Pollutants of concern are sediment, turbidity, and phosphorus. The *Aquatic Life Use* is not assessed but sedimentation and erosion issues from the road/runoff are of concern so this use is identified with an Alert Status. No other recent water quality data are available so the other uses are not assessed. It should be noted that the MassDEP Drinking Water Program maintains current drinking water supply data for this source.							
Woods Pond, Lee/Lenox	MA21120	114	THIS WATERBODY NO LONGER ASSESSED AS LAKE SEGMENT. It is considered a run of river impoundment see Housatonic River - Segment MA21-04.				
Based on the last evaluation of water quality conditions, this segment is listed in Category 5 of the 2004 Integrated List of Waters. This segment was assessed as impaired and requires a TMDL for priority organics, noxious aquatic plants, and turbidity (MassDEP 2005a). This waterbody is infested with the non-native aquatic macrophyte *Trapas natans* (MA DFG 2005).							

LITERATURE CITED

BBL. 2003. Blasland, Bouck & Lee, Inc. and Quantitative Environmental Analysis, LLC. Housatonic River – Rest of River RCRA Facility Investigation Report. Prepared for General Electric Company. January 2003.

Beattie, M. 2006. FW: Goodrich Pond. Massachusetts Department of Public Health. Email to Robert Maietta, Massachusetts Department of Environmental Protection, Worcester, MA, dated 7 November, 2006.

Campetti, A. 2005. Personal Communication. *Stockbridge WWTF operational status.* Communication with Richard Alden, Massachusetts department of Environmental Protection, Division of Watershed Management, 12 September 2005. Chief Operator, Stockbridge WWTP.

Edelstein. 2006. *Lake Garfield Lakes Data* Friends of Lake Garfield (mdrnhart@yahoo.com), Monterey, MA. Email to Christine Duerring, Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA. Dated 20 March 2006.

ENSR. 2000. *Post Implementation Study of Pontoosuc Lake Pittsfield/Lanesborough*. Project Number 8726-123. ENSR, Northborough, MA.

Environmental Law Reporter. 1988. *Clean Water Deskbook*. Environmental Law Institute. Washington, D.C.

MA DFG. 2006a. Massachusetts Trout Stocked Waters-2006. [Online]. Massachusetts Department of Fish and Game. Retrieved 27 October 2006 from http://www.mass.gov/dfwele/dfw/dfw_trout_waters.htm.

FERC. 2006. Project P-2801. [Online]. Federal Energy Regulatory Commission. Retrieved 22 December 2006 from http://elibrary.ferc.gov/idmws/docket_sheet.asp. Site last updated November 20, 2006.

Grant, D. 2005. Personal Communication. *MW Custom Papers, operational status of the WWTFs at Laurel Mill and Willow Mill.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 14 September 2005. Environmental Engineer, MW Custom Papers' WWTFs at Laurel Mill and Willow Mill.

HVA. 2000. *West Branch Stream Team Shoreline Survey Report and Action Plan Update.* Housatonic Valley Association. Lee, MA.

HVA. 2001. *Housatonic River Lenox and Lee Stream Team Shoreline Survey Report and Action Plan.* Housatonic Valley Association. Lee, MA.

HVA. 2002a. *Housatonic River Stockbridge Stream Team Shoreline Survey Report and Action Plan.* Housatonic Valley Association. Lee, MA.

HVA. 2002b. *2002 Water Quality Results for the Housatonic River.* Housatonic Valley Association. Lee, MA.

HVA. 2003a. *Housatonic River Great Barrington Stream Team Shoreline Survey Report and Action Plan.* Housatonic Valley Association. Lee, MA.

HVA. 2003b. *Housatonic River Sheffield Stream Team Shoreline Survey Report and Action Plan.* Housatonic Valley Association. Lee, MA.

HVA. 2003c. *2003 Water Quality Report- The Housatonic River West and Southwest Branches.* Housatonic Valley Association. Lee, MA.

HVA. 2003d. *Housatonic River Water Quality Report- East Branch 2001-2003.* Housatonic Valley Association. Lee, MA.

HVA. 2004a. *East Branch Stream Team Shoreline Survey Report and Action Plan Update.* Housatonic Valley Association. Lee, MA.

HVA. 2004b. Housatonic Valley Association 2004 Water Quality Data, Lee, MA.

ITC. 1987. *Diagnostic/Feasibility Study For Onota Lake, Pittsfield, Massachusetts.* IT Corporation. Edison, New Jersey.

Kennedy, L.E. and M.J. Weinstein. 2000. *Housatonic River Basin 1997/1998 Water Quality Assessment Report.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Kurpaska, D. 2006. Re: Sampling Results. Massachusetts Department of Environmental Protection, Bureau of Resource Protection, Springfield, MA. Email to Carolyn Sibner, Housatonic Valley Association, dated 22 August 2006.

Landry, T. 2005. Personal Communication. *Pittsfield WWTF operational status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 13 September 2005. Superintendent, Pittsfield WWTF.

LOPA. 2001. *Lake Onota Preservation Association 2001 Annual Report*. Lake Onota Preservation Association, Pittsfield, MA.

LOPA. 2002. *Lake Onota Preservation Association 2002 Annual Report*. Lake Onota Preservation Association, Pittsfield, MA.

LOPA. 2003. *Lake Onota Preservation Association 2003 Annual Report*. Lake Onota Preservation Association, Pittsfield, MA.

LOPA. 2004. *Lake Onota Preservation Association 2004 Annual Report*. Lake Onota Preservation Association, Pittsfield, MA.

LPC. 2005. *Initial Consultation Document for the Glendale Hydroelectric Project FERC No.2801.* Littleville Power Company, Inc., Russell, MA. Subsidiary of Enel North America, Inc.

MA DCR. 2002. *Massachusetts Dam Safety Program Database as of 16 May 2002.* Massachusetts Department of Conservation and Recreation, Dam Safety Program. Boston, MA.

MA DCR. 2004. *Lake monitoring information*. Massachusetts Department of Conservation and Recreation, Lakes and Ponds Program. Boston, MA.

MA DFG. 1971. *Coldwater Fisheries Investigations, Survey and Inventory of Streams, Job Progress Report, Housatonic River Drainage. Period: August 1, 1970 to July 31, 1971*. Massachusetts Division of Fisheries and Game.

MA DFG. 2005. *Non-native aquatic macrophyte information – Housatonic River Watershed Lakes*. Massachusetts Department of Fish and Game, Natural Heritage Program. Westborough, MA.

MA DFG. 2006a. Massachusetts Trout Stocked Waters-2006. [Online]. Massachusetts Department of Fish and Game. Retrieved 27 October 2006 from http://www.mass.gov/dfwele/dfw/dfw_trout_waters.htm.

MA DFG. 2006b. River Instream Flow Stewards (RIFLS Project) Housatonic River Basin. [Online]. Massachusetts Department of Fish and Game, Riverways Program. Retrieved 27 October 2006 from http://rifls.bn-t.com/default.asp.

MA DFG. 2006c. Riverways Program River Restoration Priority Projects. [Online]. Massachusetts Department of Fish and Game, Riverways Program. Retrieved 31 October 2006 from http://www.mass.gov/dfwele/river/programs/priorityprojects/projectlist.htm.

MA DPH. 2001. *MA DPH Issues New Consumer Advisories on Fish Consumption and Mercury Contamination.* Massachusetts Department of Public health, Bureau of Environmental Health Assessment, Boston, MA.

MA DPH. 2002. *Marine and Freshwater Beach Testing in Massachusetts, 2001 Season*. Massachusetts Department of Public Health, Boston, MA.

MA DPH. 2003. *Marine and Freshwater Beach Testing in Massachusetts, 2002 Season*. Massachusetts Department of Public Health, Boston, MA.

MA DPH. 2004. *Marine and Freshwater Beach Testing in Massachusetts, 2003 Season*. Massachusetts Department of Public Health, Boston, MA.

MA DPH. 2005a. *Marine and Freshwater Beach Testing in Massachusetts, 2004 Season*. Massachusetts Department of Public Health, Boston, MA.

MA DPH. 2005b. *Freshwater Fish Consumption Advisory List May 2005.* Massachusetts Department of Public Health, Center for Environmental Health. Boston, MA.

MA DPH. 2006. *Marine and Freshwater Beach Testing in Massachusetts, 2005 Season*. Massachusetts Department of Public Health, Boston, MA.

Maietta, R.J. undated. *1983-2004 Fish Toxics Monitoring Survey List* CN 219.0 Massachusetts Department Of Environmental Protection, Divisions of Watershed Management and Environmental Analysis, Worcester, MA.

Maietta, R., Ryder, J., and Chase, R. 2004. 2002 *Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* CN 99.0 Massachusetts Department Of Environmental Protection, Divisions of Watershed Management and Environmental Analysis, Worcester and Lawrence, MA.

MassDEP. 2002a. Open File*. Water quality monitoring fieldsheets rivers and lakes*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MassDEP. 2002b*.* Open File*. Habitat assessment fieldsheets*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MassDEP. 2003b. Open File. *Herbicide license applications for 2003*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MassDEP. 2004. Open File. *Herbicide license applications for 2004*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MassDEP. 2005a*. Massachusetts Year 2004 Integrated List of Waters: Part 2 – proposed Listing of Individual Categories of Waters.* Massachusetts Department of Environmental Protection, Bureau of Resource Protection, Division of Watershed Management. Worcester, MA.

MassDEP. 2005b. Open File. *Herbicide license applications for 2005*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Mattson et al. 2004. *DWM 2002 and 2003 Lake Survey Data in the Housatonic Watershed.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

McVoy, R. 2006. *Open Retention Time Analysis Files.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Messur, S. 2004. Letter to Anna Symington, MassDEP Bureau of Waste Site Cleanup, Springfield, MA dated 8 November 2004. *Re: Morewood Lake Fish Sampling Report.* Vice President, Blasland, Bouck, & Lee, Inc. Syracuse, NY.

Mitchell, P. 2006. Personal Communication. *Observations during field reconnaissance*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

NALMS. 2006. Online citation. *NALMS notes 2006, issue 3.* North American Lake Management Society. http://www.nalms.org/newsletter/notes06-04.html

Noel, J. 2005. Personal Communication. *Crane and Company WWTF operational status, the status of two general permitted facilities, and the status of the company-owned dams.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 1 September 2005. Environmental Manager, Crane and Company WWTF.

Noel, J. 2006. Personal Communication. *Status of the Crane and Company dams.* Communication with Peter Mitchell, Massachusetts Department of Environmental Protection, Division of Watershed Management, 2 November 2006. Environmental Manager, Crane and Company WWTF.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. *Guidelines for the protection* and *management of aquatic sediment quality in Ontario.* Water Resources Branch, Ontario Ministry of the Environment, Ontario, Canada.

Pizzutto, E (ernest.pizzuto@po.state.ct.us). 2006. *RE: Housatonic 1998-2005* Email from Ernie Pizzutto, Connecticut Department of Environmental Protection, to Peter Mitchell, Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA dated 26 January 2006.

Poach, M and Kurpaska, D. 2006. *Re: Housatonic River PCB contamination.* Massachusetts Department of Environmental Protection, Bureau of Resource Protection, Springfield, MA. Emails to Jamie Carr, Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA dated 2 November 2006 to 15 November 2006.

Reis, K.G. III. 1998. *Streamflow Measurements, Basin Characteristics,* and *Streamflow Statistics for Low-Flow Partial-Record Stations Operated in Massachusetts from 1989 Through 1996.* U.S. Geological Survey Water-Resources Investigations Report 98-4006. Northborough, MA. Reference obtained from StreamStats website http://ststdmamrl.er.usgs.gov/streamstats/expert.htm station lookup for USGS Gages 01197000, United States Geological Survey, Northborough, MA accessed 21 April 2006.

Richards, T. 2006. *DFG Fish Population Database (Distribution Copy) 1998-2005*. Massachusetts Department of Fish and Game, Division of Fisheries and Wildlife, Westborough, MA.

RIFLS. 2006. Online citation. *Bennett Brook at Smith St. discharge, map and photographs.* River Instream Flow Stewards. http://www.rifls.org/default.asp

Riverways. 2000. *River Restore and Crane & Co. Celebrate Dam Removal*. Riverways Newsletter Insert. Early Winter 2000-1. Massachusetts Department of Fish and Game, River Restore Program. Boston, MA.

Robinson, M. 2006a. FW: Shaker Mill Pond. Department of Conservation and Recreation. Email to Laurie Kennedy, Massachusetts Department of Environmental Protection, Worcester, MA, dated 31 October 2006.

Robinson, M. 2006b. FW: Lake Pontoosuc. Department of Conservation and Recreation. Email to Laurie Kennedy, Massachusetts Department of Environmental Protection, Worcester, MA, dated 8 November 2006.

Ryan, T. 2005. Personal Communication. *Schweitzer-Mauduit WWTFs operational status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 15 September 2005. Environmental Safety and Utility's Manager, Schweitzer-Mauduit WWTFs.

Smith, K. (ksmith@gomezandsullivan.com) 2006. *Glendale Hydroelectric Project-Bypass Flow Study Plan*. Gomez and Sullivan Engineers, Weare, NH. Email to Robert Kubit, Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA dated 25 September 2006.

Socolow, R.S., Comeau, L.Y., and Murino, Domenic, Jr. 2004. *Water Resources Data for Massachusetts and Rhode Island, 2004.* Water-Data Report MA-RI-04-1. Water Resources Division, Marlborough, MA.

USGS. 1998. Unpublished Data. Provisional Data for low-flow frequency statistics for Massachusetts gaging stations. (3.5" floppy disk). U. S. Geological Survey, Water Resources Investigations Report 84-4282. Boston, MA.

USGS. 2006a. *Water Quality Samples for the Nation* [Online]. Water Quality Discrete Samples Data Retrieval 2003-8-21 East Branch Housatonic Gage 01197000.
http://nwis.waterdata.usgs.gov/nwis/qwdata?site_no=01197000&agency_cd=USGS&begin_date=2000-01-01&end_date=2003-08-30&format=html_table&inventory_output=0&rdb_inventory_output=file&date_format=YYYY-MM-DD&rdb_compression=file&qw_sample_wide=0&survey_email_address=&submitted_form=brief_list

USGS. 2006b. *Water Quality Samples for the Nation* [Online]. Water Quality Discrete Samples Data Retrieval 2003-11-18 Housatonic River near Glendale.
http://nwis.waterdata.usgs.gov/nwis/qwdata?site_no=01197440&agency_cd=USGS&begin_date=2003-09-01&end_date=2003-09-30&format=html_table&inventory_output=0&rdb_inventory_output=file&date_format=YYYY-MM-DD&rdb_compression=file&qw_sample_wide=0&survey_email_address=&submitted_form=brief_list

USGS. 2006c. *Water Quality Samples for Massachusetts* [Online]. Water Quality Discrete Samples Data Retrieval 1991 to 2004 for Ashley Falls Gage 01198125.
http://nwis.waterdata.usgs.gov/ma/nwis/qwdata?site_no=01198125&agency_cd=USGS&format=inventory_retrieval

USGS. 2006d. *Water Quality Samples for the Nation* [Online]. Water Quality Discrete Samples Data Retrieval between October 1991 and September 2004 for Ashley Falls Gage 01198125.
http://nwis.waterdata.usgs.gov/nwis/qwdata?site_no=01198125&agency_cd=USGS&begin_date=2002-01-01&end_date=2004-09-30&format=html_table&inventory_output=0&rdb_inventory_output=file&date_format=YYYY-MM-DD&rdb_compression=file&qw_sample_wide=0&survey_email_address=&submitted_form=brief_list

Wandle, S.W., Jr. and Lippert, R.G. 1984. *Gazetteer of Hydrologic Characteristics of Streams in Massachusetts—Housatonic River Basin* U.S. geological Survey Water-Resources Investigations Report 84-4285 27p. Reference obtained from StreamStats website http://ststdmamrl.er.usgs.gov/streamstats/expert.htm station lookup for USGS Gages 01197500, United States Geological Survey, Northborough, MA accessed 21 April 2006.

Weston. 2004. Ecological Risk Assessment for General Electric Housatonic Site, Rest of River. Prepared for the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency. Weston Solutions, Inc.

Weston. 2005. Human Health Risk Assessment GE/Housatonic River Site, Rest of River, February 2005. Prepared for the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency. Weston Solutions, Inc.

Zerbato, A. 2005. Personal Communication. *Lee WWTF operational status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 12 September 2005. Chief Operator, Lee WWTF.

APPENDIX D
DWM 2002 AND 2003 LAKE SURVEY DATA IN THE HOUSATONIC RIVER WATERSHED

In the Housatonic River Watershed, the MassDEP Division of Watershed Management (DWM) staff conducted lake surveys at one lake in 2002 and four lakes in 2003. In 2005, three lakes were surveyed once each in August 2005 (MassDEP 2005a) including Goose Pond in Lee, Onota Lake in Pittsfield, and Stockbridge Bowl in Stockbridge. Final data for the 2005 surveys, however, are not yet available.

The lake surveys were conducted to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. *In situ* depth profile measurements using the multiprobe instruments (including dissolved oxygen, water temperature, pH, conductivity, and depth and calculated total dissolved solids and % oxygen saturation) were recorded once in each waterbody at deep-hole stations. In-lake samples were also collected and analyzed for total phosphorus, apparent color, and chlorophyll *a* (depth-integrated). Lake monitoring also included the mapping of aquatic vegetation, and Secchi disc readings.

For all survey years, the Wall Experiment Station (WES), the Department's analytical laboratory, supplied all sample bottles and field preservatives, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MassDEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to the WES Standard Operating Procedures (SOP). Quality control samples (field blanks and duplicates) were also taken and transported on ice to WES on each sampling date.

2002

MassDEP DWM staff conducted baseline lake surveys at Lake Buel in June, July, and August 2002 (MassDEP 2002). Procedures used in 2002 for water sampling and sample handling are described in the *Sample Collection Techniques for DWM Surface Water Quality Monitoring Standard Operating Procedure* and the *Hydrolab® Series3/Series 4 Multiprobe Standard Operating Procedure* (MassDEP 2001a and MassDEP 2001b). Apparent color and chlorophyll *a* were measured according to standard procedures at the MassDEP DWM office in Worcester (MassDEP 2001c and MassDEP 2001d). The aquatic plant cover (native and non-native) and species distribution were mapped and recorded (MassDEP 2002c). Details on procedures used can be found in the *Quality Assurance Project Plan for TMDL Baseline Lakes Survey 2002* (MassDEP 2002a).

Information about data quality objectives (accuracy, precision, completeness, representativeness and comparability) and qualified and censored data is available in the 2002 Data Validation Report (MassDEP 2005b). Water quality data were excerpted from the *Baseline Lake Survey 2002 Technical Memo* (MassDEP 2002b) and are presented in Table D1. Symbols and qualifiers used for DWM data are provided in Attachment 1 (excerpted from data validation report).

2003

In 2003, four lakes in the Housatonic River Watershed were surveyed as part of the nutrient criteria development efforts. Lake Garfield in Monterey, Laurel Lake in Lee, Mansfield Pond in Great Barrington, and Prospect Lake in Egremont were surveyed once each in August 2003.

Procedures used in 2003 for water sampling and sample handling are described in the *Sample Collection Techniques for DWM Surface Water Quality Monitoring Standard Operating Procedure* and the *Water Quality Multi-probe Instrument Use Standard Operating Procedure* (MassDEP 2003b and MassDEP 2003c). Apparent color and chlorophyll *a* were measured according to standard procedures at the MassDEP DWM office in Worcester (MassDEP 2001c and MassDEP 2003d). The aquatic plant cover (native and non-native) and species distribution were mapped and recorded (MassDEP 2002c). Details on procedures used can be found in the *Quality Assurance Project Plan for Nutrient Criteria Lakes Survey 2003* (MassDEP 2003a).

Information about data quality objectives and qualified and censored data is available in the 2003 Data Validation Report (MassDEP 2005c). Water quality data were excerpted from the *Draft Baseline Lake Survey 2003 Technical Memo* (Mattson in preparation) and are presented in tables D2, D3, D4, and D5. Symbols and qualifiers used for DWM data are provided in Attachment 1 (excerpted from data validation report).

Table D1. 2002 water quality data deep hole in Lake Buel, Monterey.
Lake Buel (Palis: 21014)
Unique_ID: W0957 Station: A
Description: deep hole, northwestern end, Monterey

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
08/22/02									
	LB-2202	14:35	0.5	25.7	8.8 c	320	205	9.5	113
	LB-2202	14:41	1.5	25.7	8.8 c	320	205	9.5	113
	LB-2202	14:48	2.5	25.7	8.8 c	320	205	9.5	113
	LB-2202	14:59	3.5	25.3 u	8.8 c	323	207	10.0 u	118 u
	LB-2202	15:16	4.0	22.9 u	8.8 c	335	214	13.1	149
	LB-2202	15:06	4.5	20.7	8.7 c	345	221	14.1	152
	LB-2202	15:34	5.5	14.8 u	8.1 c	354	226	10.0 u	96 u
	LB-2202	15:23	6.9	11.5	7.3 c	356	228	2.1	19
	LB-2202	15:40	12.8	7.1	7.0 c	366	235	<0.2	<2

Lake Buel (Palis: 21014)
Unique_ID: W0957 Station: A
Description: deep hole, northwestern end, Monterey

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth*	Depth	Chloride	Chl-a	TP	AppColor
	m	24hr	m			24hr		--	m	mg/L	mg/m3	mg/L	PCU
06/13/02	4.8	13:50	13.4										
				LB-1913	LB-1914	13:35	VDOR	s	0.5	--	--	0.014 j	21*
				LB-1914	LB-1913	13:40	VDOR	s	0.5	--	--	0.013 j	20*
				LB-1919	--	13:45	VDOR	nb	12.9	--	--	0.059	--
				LB-1915	LB-1918	13:55	DINT	--	0 - 8.0	--	6.0* d	--	--
				LB-1918	LB-1915	13:55	DINT	--	0 - 8.0	--	4.6* d	--	--
07/31/02	3.4	10:30	12.5										
				LB-2055	LB-2056	10:45	VDOR	s	0.5	--	--	0.015 bd	<15*
				LB-2056	LB-2055	10:50	VDOR	s	0.5	--	--	0.044 bd	<15*
				LB-2057	--	10:53	VDOR	nb	11.5	--	--	## bdj	--
				LB-2059	LB-2060	10:58	DINT	--	0 - 7.0	--	##* b	--	--
				LB-2060	LB-2059	10:59	DINT	--	0 - 7.0	--	##* b	--	--
08/22/02	4.2	14:20	13.3										
				LB-2196	LB-2197	14:35	VDOR	s	0.5	--	--	0.009 j	<15*
				LB-2197	LB-2196	14:40	VDOR	s	0.5	--	--	0.009 j	<15*
				LB-2198	--	14:45	VDOR	nb	12.8	--	--	0.24	--
				LB-2200	LB-2201	14:50	DINT	--	0 - 12.8	--	10.5*	--	--
				LB-2201	LB-2200	15:00	DINT	--	0 - 12.8	--	12.6*	--	--

*RelDepth key: Relative Depth- s= Near Surface; m= middle depth; nb= near bottom.

Table D2. 2003 water quality data deep hole in Lake Garfield, Monterey.

Lake Garfield (PALIS: 21040)
Unique_ID: W1075 Station: A
Description: [deep hole, Monterey]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
08/25/03									
	LC-0006	15:34	0.5	24.7	8.7	161	103	8.7	106
	LC-0006	15:40	2.5	23.9 u	8.8	160	102	8.7	105
	LC-0006	15:46	5.0	23.5	8.6	161	103	8.2	97
	LC-0006	15:52	6.0	15.9	6.9 u	158	101	1.0	10
	LC-0006	15:57	7.5	11.8	6.6 c	158	101	0.3	3
	LC-0006	16:02	9.0	9.6	6.7 uc	227	145	0.3	2

Lake Garfield (PALIS: 21040)
Unique_ID: W1075 Station: A
Description: [deep hole, Monterey]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth*	Depth	Chl-a	NO3-NO2-N	TKN	TN	TP	Apparent Color
	m	24hr	m			24hr			m	mg/m3	mg/L	mg/L	mg/L	mg/L	PCU
08/25/03	4.4	15:30	9.5												
				LC-0003	--	15:35	VDOR	nb	9.0	--	<0.02	--	3.0 bh	0.66	--
				LC-0002	--	15:30	MNGR	--	--	--	<0.02	--	0.38 bh	0.011	15* h
				LC-0004	LC-0005	15:50	DINT	--	0 - 8.0	14.4*	--	--	--	--	--
				LC-0005	LC-0004	15:55	DINT	--	0 - 8.0	13.2*	--	--	--	--	--

*RelDepth key: Relative Depth- s= Near Surface; m= middle depth; nb= near bottom.

Table D3. 2003 water quality data deep hole in Laurel Lake, Lee.

Laurel Lake (PALIS: 21057)
Unique_ID: W1076 Station: A
Description: [deep hole, Lee]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
08/26/03									
	LC-0014	12:41	0.5	24.8	8.5	589	377	8.9	109
	LC-0014	12:45	2.5	24.1	8.6	587	376	8.9	108
	LC-0014	12:52	5.0	23.5	8.4	594	380	9.1	109
	LC-0014	12:57	6.0	16.1 u	8.5	631 u	404 u	16.8 u	173 u
	LC-0014	13:04	7.0	12.8 u	8.3	639	409	14.1 u	135 u
	LC-0014	13:12	8.0	9.0	7.5	671	429	5.0 u	44 u
	LC-0014	13:16	9.0	7.6	7.3	686	439	1.4	12
	LC-0014	13:23	15.3	4.7	7.0	769 c	492 c	0.3	3

Laurel Lake (PALIS: 21057)
Unique_ID: W1076 Station: A
Description: [deep hole, Lee]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth*	Depth	Chl-a	NO3-NO2-N	TKN	TN	TP	AppColor
	m	24hr	m			24hr			m	mg/m3	mg/L	mg/L	mg/L	mg/L	PCU
08/26/03	5.8	13:00	15.8												
				LC-0011	--	13:00	VDOR	nb	15.3	--	<0.02	--	2.7 bh	0.41	--
				LC-0013	--	13:05	DINT	--	0 - 15.3	6.7*	--	--	--	--	--
				LC-0009	LC-0010	13:10	MNGR	--	--	--	<0.06	0.31	--	0.006	<15*
				LC-0010	LC-0009	13:10	MNGR	--	--	--	<0.02	--	0.37 bh	<0.005	<15*

*RelDepth key: Relative Depth- s= Near Surface; m= middle depth; nb= near bottom.

Table D4. 2003 water quality data deep hole in Mansfield Pond, Great Barrington.

Mansfield Pond (PALIS: 21065)
Unique_ID: W1077 Station: A
Description: [deep hole, Great Barrington]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
08/26/03									
	LC-0021	11:09	0.5	25.4 u	9.0	356	228	7.9	98
	LC-0021	11:13	1.5	24.9	9.0	356	228	7.9	97
	LC-0021	11:18	2.5	24.8	9.0	356	228	7.8	96
	LC-0021	11:23	3.5	24.5	8.8	363	232	6.8 u	83 u
	LC-0021	11:28	4.3	23.6	7.1 u	429 u	274 u	0.8 u	10 u

Mansfield Pond (PALIS: 21065)
Unique_ID: W1077 Station: A
Description: [deep hole, Great Barrington]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth*	Depth	Chl-a	NO3-NO2-N	TKN	TN	TP	AppColor
	m	24hr	m			24hr			m	mg/m3	mg/L	mg/L	mg/L	mg/L	PCU
08/26/03	3.8	11:05	4.8												
				LC-0018	--	11:15	VDOR	nb	4.3	--	<0.02	--	1.3 bh	0.080	--
				LC-0016	LC-0017	11:05	MNGR	--	--	--	<0.02	--	0.51 bh	0.013	<15*
				LC-0017	LC-0016	11:05	MNGR	--	--	--	<0.02	--	0.52 bh	0.013	18*
				LC-0020	--	11:10	DINT	--	0 - 4.3	4.0*	--	--	--	--	--

*RelDepth key: Relative Depth- s= Near Surface; m= middle depth; nb= near bottom.

Table D5. 2003 water quality data deep hole in Prospect Lake, Egregmont.

Prospect Lake (PALIS: 21084)
Unique_ID: W1078 Station: A
Description: [deep hole,southeastern end, Egremont]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
08/26/03									
	LC-0027	09:48	0.5	24.0	9.0	175	112	9.0	108
	LC-0027	09:53	1.5	23.9	9.0	176	112	8.8	106
	LC-0027	09:58	2.5	23.5	9.1	173	110	9.4	113
	LC-0027	10:04	3.6	21.5	8.2	198	127	7.3	84

Prospect Lake (PALIS: 21084)
Unique_ID: W1078 Station: A
Description: [deep hole,southeastern end, Egremont]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth*	Depth	Chl-a	NO3-NO2-N	TKN	TN	TP	AppColor
	m	24hr	m			24hr			m	mg/m3	mg/L	mg/L	mg/L	mg/L	PCU
08/26/03	3.1	10:00	4.1												
				LC-0024	--	10:05	VDOR	nb	3.6	--	0.07	--	0.40 bh	0.015	--
				LC-0023	--	09:45	MNGR	--	--	--	<0.02	--	0.33 bh	0.012	15*
				LC-0025	LC-0026	10:00	DINT	--	0 - 3.6	9.0* d	--	--	--	--	--
				LC-0026	LC-0025	10:02	DINT	--	0 - 3.6	6.8* d	--	--	--	--	--

*RelDepth key: Relative Depth- s= Near Surface; m= middle depth; nb= near bottom.

ATTACHMENT 1

The following data qualifiers or symbols are used in the MassDEP/DWM Water Quality Database (WQD) for qualified and censored water quality and multi-probe data. Decisions regarding censoring vs. qualification for specific, problematic data are made based on a thorough review of all pertinent information related to the data.

General Symbols (applicable to all types):

" ## " = Censored data (i.e., data that has been discarded for some reason).

" ** " = Missing data (i.e., data that should have been reported).

" -- " = No data (i.e., data not taken/not required)

* = Analysis performed by Laboratory OTHER than DEP's Wall Experiment Station (WES)

[ ] = A result reported inside brackets has been "censored", but is shown for informational purposes (e.g., high blank results).

Multi-probe-specific Qualifiers:

" i " = inaccurate readings from Multi-probe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low ionic check and for the deionized blank water check, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses. Specifically, for depth readings the following criteria were applied:

General Depth Criteria: Apply to each OWMID#
- Clearly erroneous readings due to faulty depth sensor: Censor (i)
- Negative and zero depth readings: Censor (i); (likely in error)
- 0.1 m depth readings: Qualify (i); (potentially in error)
- 0.2 and greater depth readings: Accept without qualification; (likely accurate)

Specific Depth Criteria: Apply to entirety of depth data for survey date

- If zero and/or negative depth readings occur more than once per survey date, censor all negative/zero depth data, and qualify all other depth data for that survey (indicates that erroneous depth readings were not recognized in the field and that corrective action (field calibration of the depth sensor) was not taken, ie. that all positive readings may be in error.)

" m " = method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed, ie. operator error (eg. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

" s " = field sheet recorded data were used to accept data, not data electronically recorded in the Multi-probe surveyor unit, due to operator error or equipment failure.

" u " = unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

" c " = greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for conductivity (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or turbidity (>10, 20 or 40 NTU). It can also be used for TDS and Salinity calculations based on qualified ("c") conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

" r " = data not representative of actual field conditions.

" ? " = Light interference on Turbidity sensor (Multiprobe error message). Data is typically censored.

Sample-Specific Qualifiers:

" a " = accuracy as estimated at WES Lab via matrix spikes, PT sample recoveries, internal check standards and lab-fortified blanks did not meet project data quality objectives identified for program or in QAPP.

" b " = blank Contamination in lab reagant blanks and/or field blank samples (indicating possible bias high and false positives).

" d " = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.

" e " = not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for e-coli bacteria > fecal coliform bacteria, for lake Secchi and station depth data where a specific Secchi depth is greater than the reported station depth, and for other incongruous or conflicting results.

" f " = frequency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.

" h " = holding time violation (usually indicating possible bias low)

" j " = 'estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used to report sample data where the sample concentration is less than the 'reporting' limit or RDL and greater than the method detection limit or MDL (mdl< x <rdl). Also used to note where values have been reported at levels less than the mdl.

" m " = method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (eg. sediment in sample, floc formation), lab error (eg. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, and missing data.

" p " = samples not preserved per SOP or analytical method requirements.

" r " = samples collected may not be representative of actual field conditions, including the possibility of "outlier" data and flow-limited conditions (e.g., pooled).

Sample codes used:

OWMID: Office of Watershed Management Identification Code for the sample bottle.

QAQC: the OWMID codes (e.g. LB-1903) refer to the field duplicate sample (usually immediately above or below in the table) to be compared with the current sample.

Time: Local time.

SymTyp: Sample Type- VDOR= Van Dorn; DINT= Depth integrated by vertical hose; MNGR= Manual Grab; NR= not recorded.

RelDepth: Relative Depth- s= Near Surface; m= middle depth; nb= near bottom.

References

Mattson, M. in preparation. *Baseline Lake Survey 2003 Technical Memo CN205.0*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 1995. January Draft *Laboratory Quality Assurance Plan and Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Environmental Analysis, Wall Experiment Station, Lawrence, MA.

MassDEP. 2001a. *Sample Collection Techniques for DWM Surface Water Quality Monitoring CN001.1.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2001b. *Hydrolab® Series 3/Series 4 Multiprobe Standard Operating Procedure CN004.1.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2001c. *Standard Operating Procedures for Apparent Color CN2.1* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA

MassDEP. 2001d. *Standard Operating Procedures for Chlorophyll a CN3.2* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA

MassDEP 2002a. *Quality Assurance Project Plan for TMDL Baseline Lake Survey 2002 CN72.0.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2002b. *Baseline Lake Survey 2002 Technical Memo CN204.0*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2002c. *Aquatic Plant Mapping CN067.1*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP 2003a. *Quality Assurance Project Plan for Nutrient Criteria Lakes Survey 2003 CN165.0.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2003b. *Sample Collection Techniques for DWM Surface Water Quality Monitoring CN001.2.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2003c. *Water Quality Multi-probe Instrument Use Standard Operating Procedure CN004.2.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2003d. *Extracted Chlorophyll a (SM-10200 H) (USEPA Fluorometric Method 445 and 445 with the Welschmeyer modification) Standard Operating Procedures CN0003.3.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA

MassDEP 2005a. *Sampling Plan for Year 2005 Lake Nutrient Monitoring in Massachusetts CN224.1.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP 2005b. *Data Validation Report for Year 2002 Project Data CN202.0.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP 2005c. *Data Validation Report for Year 2003 Project Data CN211.0.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

APPENDIX E
MassDEP DWM 2002 Fish Toxics Monitoring in the Housatonic River Watershed

INTRODUCTION

Fish contaminant monitoring is a cooperative effort between three Massachusetts Department of Environmental Protection (MassDEP) Divisions/Offices (Watershed Management (DWM), Environmental Analysis, and Research and Standards), the Massachusetts Department of Fish and Game, and the Massachusetts Department of Public Health (MA DPH). Fish contaminant monitoring is designed to screen the edible fillets of several species of fish desired by the angling public for consumption, as well as species representing different feeding guilds (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals (Pb, Cd, Se, Hg, As), Polychlorinated biphenyls (PCBs), and organochlorine pesticides. These data are used by the MA DPH in assessing human health risks associated with the consumption of freshwater fishes.

In the Housatonic River Watershed fish contaminant monitoring surveys were conducted by MassDEP DWM staff in two waterbodies in 2002 including Pontoosuc Lake (Lanesborough/Pittsfield) and Lake Buel (Monterey (Maietta undated)). Fish contaminant monitoring data provided here include surveys conducted in 2002. The objective of these surveys was to screen the edible fillets of fishes for potential contaminants (e.g., selected metals, PCBs and organochlorine pesticides). All results were submitted to the MA DPH for review.

Project Objectives

Fish contaminant monitoring is typically conducted to assess the levels of toxic contaminants in freshwater fish, identify waterbodies where those levels may impact human health, and identify waters where toxic chemicals may impact fish and other aquatic life. Nonetheless, human health concerns have received higher priority and, therefore, fish tissue analysis has been restricted to edible fillets. The fish toxics monitoring was designed to screen the edible fillets of several species of fish representing different feeding groups (i.e., bottom-dwelling omnivores, top-level predators, etc.) for the presence of heavy metals, PCBs and chlorinated pesticides.

Fish toxics monitoring conducted in 2002 followed guidance in the Quality Assurance Project Plan (QAPP) for Fish Toxics Monitoring (MassDEP 2003). Data quality objectives are presented in the above-mentioned QAPP.

METHODS

Field Methods

Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing and shipping fish (MassDEP 2003 and MassDEP 2005). The characteristics of each site determine the method(s) of sample collection. Waterbodies in the Housatonic Watershed were sampled by DWM using boat electrofishing. Electrofishing was performed by maneuvering the boat through the littoral zone and shallow water habitat of a given waterbody and collecting most fish shocked. Fish collected by electrofishing were stored in a live well filled with site water until the completion of sampling. Fish to be included in the sample were stored on ice and transported to the DWM laboratory in Worcester.

DWM Laboratory Methods (Sample processing)

Fish brought to the MassDEP DWM laboratory in Worcester were processed using protocols designed to assure accuracy and prevent cross-contamination of samples (MassDEP 2003 and MassDEP 2005). Specimen lengths and weights were recorded along with notes on tumors, lesions, or other anomalies noticed during an external visual inspection. Scales, spines, or pectoral fin ray samples were obtained for use in age determination. Species, length, and weight data can be found in Tables E1. Fish were filleted (skin off) on glass cutting boards and prepared for freezing. All equipment used in the filleting process was rinsed in tap water and then rinsed twice in de-ionized water before and or after each sample. Samples (individual or composite) targeted for % lipids, PCBs and organochlorine pesticide analysis were wrapped in aluminum foil. Samples targeted for metals analysis were placed in VWR high density polyethylene (HDPE) cups with covers. Composite samples were composed of three fillets from like-sized individuals of the same species (occasionally the same genus). Samples were tagged and frozen for subsequent delivery to the MassDEP's Wall Experiment Station (WES).

WES Laboratory Methods (Analytical)

All analyses for cadmium, lead and selenium were conducted using EPA method 200.7. All analyses for PCBs and organics were conducted using AOAC method 983.21. All mercury analyses prior to 2005 were conducted using EPA method 245.1. Additional information on analytical techniques used at WES is available from the laboratory (Maietta *et al*. 2004).

In 2002 mercury was analyzed by a cold vapor method using a Perkin Elmer, FIMS (Flow Injection Mercury System), which uses Flow Injection Atomic Absorption Spectroscopy. Cadmium and lead were analyzed using a Perkin Elmer, Optima 3000 XL ICP - Optical Emmission Spectrophotometer. Arsenic and selenium were analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace, Atomic Absorption Spectrophotometer. PCB Arochlor, PCB congener, and organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector "according to the modified AOAC 983.21 procedure for the analysis of PCB Arochlors, Congeners, and Organochlorine Pesticides" (Maietta *et al*. 2004).

RESULTS

All fish tissue data met DWM data quality objectives and passed quality control acceptance limits of the WES laboratory without qualification unless otherwise noted below. Fish toxics monitoring survey data can be found in Table E1 (excerpted from Maietta *et al*. 2004).

Fish tissue data passed the QC acceptance limits of the WES laboratory. WES reported a number of lab-validated data with "qualification". All but one of these "qualified" data points were for very low concentrations of either PCBs (Congeners and Arochlors) and/or organochlorine pesticides. One data point for arsenic at the detection limit was also qualified. The lab fortified matrix spike recovery for toxaphene was 50% resulting in "J" (estimated) qualification by WES. These QC data suggest potential poor recovery of toxaphene in samples. Lab accuracy estimates for metals (all analytes) using lab-fortified matrix samples were acceptable ranging from 80-112 % recovery except for two selenium samples at 126 and 128 % recovery and one lead sample at 130% recovery. QC sample recoveries were acceptable ranging from 83-117%. Lab accuracy estimates for metals (all analytes) using lab fortified blanks were acceptable ranging from 82 to 111 % recovery except for one lead sample at 128% recovery.

All quality assurance and quality control data are available from the laboratory upon request.

Table E1. 2002 Fish Toxics Monitoring data for Housatonic River Watershed Waterbodies (Pontoosuc Lake, Lanesborough/Pittsfield and Lake Buel, Monterey) (Maietta *et al*. 2004). Results, reported in wet weight, are from composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Arochlors and Congeners (μg/g)	Pesticides (μg/g)
Lake Buel, Monterey/New Marlborough, Housatonic River Watershed													
BF02-01	7/9/02	LMB	36.5	780	2002047 (L2002300-1) (L2002301-1)	<0.040	<0.20	0.40	<0.060	0.24	0.06	BZ#118-0.0012J	DDE-0.0068J
BF02-02	7/9/02	LMB	32.9	330									
BF02-03	7/9/02	LMB	33.5	462									
BF02-04	7/9/02	YP	27.2	230	2002048 (L2002300-2) (L2002301-2)	<0.040	<0.20	0.25	<0.060	0.21	0.20	ND	ND
BF02-05	7/9/02	YP	30.3	296									
BF02-06	7/9/02	YP	26.7	215									
BF02-07	7/9/02	BC	22.0	142	2002049 (L2002300-3) (L2002301-3)	<0.040	<0.20	0.22	0.080	0.21	0.05	ND	ND
BF02-08	7/9/02	BC	27.2	240									
BF02-09	7/9/02	BC	25.5	230									
BF02-10	7/9/02	P	18.0	120	2002050 (L2002300-4) (L2002301-4)	<0.040	<0.20	0.10	0.090	0.25	0.19	ND	ND
BF02-11	7/9/02	P	17.7	117									
BF02-12	7/9/02	P	18.1	128									
BF02-13	7/9/02	BB	29.6	333	2002051 (L2002300-5) (L2002301-5)	<0.040	<0.20	0.060	<0.060	0.12	0.21	ND	DDE-0.0083J
BF02-14	7/9/02	BB	27.3	219									
BF02-15	7/9/02	BB	27.2	233									
Pontoosuc Lake, Pittsfield, Housatonic River Watershed													
PNF02-01	6/20/02	LMB	44.0	1165	2002032 (L2002248-1) (L2002256-1)	<0.040	<0.20	0.25	<0.060	0.33	0.06	A1254-0.035J A1260-0.031J BZ#118-0.0027J BZ#180-0.0037J BZ#170-0.0018J	DDE-0.0085J
PNF02-02	6/20/02	LMB	38.6	883									
PNF02-03	6/20/02	LMB	38.8	846									
PNF02-04	6/20/02	YP	24.1	168	2002033 (L2002248-2) (L2002256-2)	<0.040	<0.20	0.12	<0.060	0.32	0.12	A1254-0.016J BZ#118-0.0014J	ND
PNF02-05	6/20/02	YP	23.2	163									
PNF02-06	6/20/02	YP	18.9	73									
PNF02-07	6/20/02	B	17.5	104	2002034 (L2002248-3) (L2002256-3)	<0.040	<0.20	0.050	<0.060	0.32	0.17	A1254-0.049 A1260-0.047J BZ#118-0.0046 BZ#180-0.0041J BZ#170-0.0025J	DDE-0.012J
PNF02-08	6/20/02	B	16.6	91									
PNF02-09	6/20/02	B	15.8	71									
PNF02-10	6/20/02	RB	22.1	220	2002035 (L2002248-4) (L2002256-4)	<0.040	<0.20	0.15	<0.060	0.23	0.07	A1254-0.014J BZ#118-0.0015J BZ#180-0.0019J	ND
PNF02-11	6/20/02	RB	19.7	154									
PNF02-12	6/20/02	RB	19.0	127									
PNF02-13	6/20/02	BB	26.4	259	2002036 (L2002248-5) (L2002256-5)	<0.040	<0.20	<RDL (0.030)	<0.060	<RDL (0.080)	0.37	A1254-0.047 A1260-0.069 BZ#180-0.0057 BZ#170-0.0027J	DDE-0.011J
PNF02-14	6/20/02	BB	29.4	319									

[1] Species Code , Common Name, *Scientific name*

(B)	bluegill	*Lepomis macrochirus*
(BB)	brown bullhead	*Ameiurus nebulosus*
(BC)	black crappie	*Pomoxis nigromaculatus*
(LMB)	largemouth bass	*Micropterus salmoides*
(P)	pumpkinseed	*Lepomis gibbosus*
(RB)	rock bass	*Ambloplites rupestris*
(YP)	yellow perch	*Perca flavescens*

ND - not detected or the analytical result is at or below the established method detection limit (MDL).

J-estimated value, concentration <RDL or certain QC criteria not met

RDL = reporting detection limit

< = result not detected above method detection limit, unless otherwise noted

REFERENCES

MassDEP. 2003. CN096.0. *Quality Assurance Project Plan for Fish Toxics Monitoring.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MassDEP. 2005. CN040.1. *Standard Operating Procedure for Fish Toxics Monitoring Fish Collection and Preparation.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Maietta, R. J. undated. *1983-2004 Fish Toxics Monitoring Survey List*. CN219.0. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. (TM-S-18).

Maietta, R. J., J. Ryder, and R.F. Chase. 2004. CN099.0. *2002 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

APPENDIX F

MassDEP / DWM TECHNICAL MEMORANDUM CN 197.3

2002 HOUSATONIC RIVER WATERSHED FISH POPULATION ASSESSMENT

Prepared by: Peter Mitchell, MassDEP/ Division of Watershed Management, Worcester, MA

Date: December, 2005

The Massachusetts Division of Watershed Management (MA DWM) conducted fish population surveys on the Housatonic River and its selected tributaries during August of 2002 (Figure 1). Sampling was conducted as part of a comprehensive water quality monitoring project carried out by MA DWM. Surveys of the resident fish populations were conducted at a total of seven stations (Table 1). Surveys were conducted using techniques similar to Rapid Bioassement Protocol V (fish) as described by Barbour et al (1999).

Fish Population Sample Collection, Processing, and Analysis

Fish populations were sampled by electrofishing using a Coffelt Mark 18 gas-powered backpack electrofisher. A reach of between 80m and 100m was sampled by passing a pole-mounted anode ring side to side through the stream channel and in and around likely fish holding cover. All stunned fish were netted and held in buckets. Sampling proceeded from an obstruction or constriction, upstream to an endpoint at another obstruction or constriction such as a waterfall or shallow riffle. Following completion of a sampling run, all fish were identified to species, measured, weighed, and released.

The RBP V protocol (Barbour et al. 1999) calls for the analysis of the data generated from fish collections using an established Index of Biotic Integrity (IBI) similar to that described by Karr et al. (1986). Since no formal IBI for Massachusetts currently exists, the data provided by this sampling effort were used to qualitatively assess the general condition of the resident fish population as a function of the overall abundance (number of species and individuals) and species composition classifications listed below.

1. Tolerance Classification - Classification of tolerance to environmental stressors similar to that provided in Barbour et al. (1999), and Halliwell et al. (1999). Final tolerance classes are those provided by Halliwell et al. (1999).

2. Macrohabitat Classification – Classification by common macrohabitat use as presented by Bain and Knight (1996) modified regionally following discussions with MA DEP and MA Division of Fisheries and Wildlife (DFW) biologists.

3. Trophic Classes- Classification which utilizes both dominant food items as well as feeding habitat type as presented in Halliwell et al. (1999).

For a more complete explanation of MA DWM fish collection procedures, see CN 75.1 “Fish Collection Procedures for Evaluation of Resident Fish Populations” (MassDEP 2003a). Tabulated results of the fish population surveys can be found in Table 3.

Habitat Assessment

These surveys also included a habitat assessment component modified from Rapid Bioassessment Protocol V (Barbour et al. 1999). Recording site characteristics and rating habitat qualities is important for the interpretation of biomonitoring data. The habitat data and assessments help distinguish between

pollution impacts and habitat limitations. These data can also help identify causes of habitat destruction and loss.

Habitat assessment is accomplished by a visual-based method (Barbour et al. 1999) conducted at the time of sample collection. Each of ten habitat categories is rated from 0 (lowest, "poor") to 20 (highest, "optimal"). The ten categories are: Instream cover (fish); Epifaunal substrate (in sampled portions of reach); Embeddedness; Channel alteration; Sediment deposition; Velocity-depth combinations; Channel flow status; Bank vegetative protection (each bank scored separately for a maximum of 10 points each); Bank stability (each bank scored separately for a maximum of 10 points each); Riparian vegetated zone width (each bank scored separately for a maximum of 10 points each). Descriptions of the considerations for scoring each habitat category can be found in Barbour et al. (1999). Tabulated results of this habitat assessment can be found in Table 2.

Results

The Housatonic watershed was affected by drought during the time of sampling. This condition resulted in extremely low water levels (Figure 2), increased water temperatures, and a reduction of available, adequate habitat as expressed by the low "channel flow status" habitat scores in Table 2.

Station Specific Conditions and Findings:

Waterbody Name: Williams River
Waterbody Location: Upstream of Route 41 Bridge, Great Barrington
Latitude: 42.13.35
Longitude: 73.21.51
Sampling Date: August 19, 2002

This river is classified as a class-B, cold-water fishery (Kennedy and Weinstein 2000). This station was also sampled in 2002 to assess the benthic community structure and health. For a more in-depth examination of habitat conditions, and benthic communities, please see Housatonic River Watershed 2002 Biological Assessment (CN 197.0)(Mitchell 2005).

As was the case during the aforementioned benthic survey, the Williams River stream reach was affected by low water conditions at the time of examination (Figure 2). This condition resulted in a "marginal" rating of the Channel Flow Status (9/20). The Bank Stability of both the right and left banks was also marginal (6/20, Total score), with steep banks subject to erosion and failure under high flow conditions. The fisheries habitat assessment noted optimal conditions regarding Channel Alteration, Embeddedness, and Bank Vegetative Protection. However, the survey also noted marginal conditions regarding Bank Stability (on both banks) and Channel Flow status. The total habitat score arrived at during the fish population survey of 2002 was 160/200.

Moderately tolerant, fluvial specialist / dependant species dominated the one hundred seven fish collected at this station (Halliwell et al 1998, Bain and Meixler 2000). Aside from the one brown trout, there were no cold-water fishes collected.

Waterbody Name: Konkapot River
Waterbody Location: Great Barrington Road, New Marlborough
Latitude: 42.07.14
Longitude: 73.16.10
Sampling Date: August 19, 2002

Much of the proximal portion of the Konkapot watershed upstream of the 2002 fish population sampling reach is low-gradient, and meanders through an extensive wetland area, and then through a narrow flood plain approximately 0.1 miles wide. The stream gradient increases at the sampled reach (upstream of bridge crossing on Great Barrington Road) to 32 feet/mile. This station on the Konkapot River was also affected by low flow conditions during the 2002 fish population surveys. The reduced quantity of water

resulted in a “marginal” classification of the Channel Flow Status habitat parameter (9/20). The Riparian Vegetative Zone Width score was reduced to a “marginal” level (5/10) along the left bank. Here, human activities have impacted the riparian zone a great deal, including abutting agricultural and residential development.

The ninety-seven collected fish specimens were dominated by tolerant (53%), fluvial specialist / dependant (99%) species. The collected brown trout appear to be reproducing, as the variety of their lengths indicates multiple age classes.

This segment has been recommended for “cold-water fishery” designation (Kennedy and Weinstein 2000) Two of the seven species collected were classified as cold-water species. The multiple age-classes of brown trout, combined with the presence of eastern brook trout, lend credence to the cold-water fishery designation.

Waterbody Name: East Branch Housatonic River
Waterbody Location: Hubbard Avenue, Pittsfield
Latitude: 42.28.10
Longitude: 73.11.48
Sampling Date: August 20, 2002

This segment is located downstream from proximal upstream impoundments and industrial discharges. Historically, fish tissue examinations conducted below Center Pond (and, hence, within this segment) revealed elevated concentrations of PCBs (Kennedy and Weinstein 2000). According to the Western Wildlife District of the MA DFW, there is no management plan for the East Branch Housatonic River due to contamination issues (Bell 1999).

The total habitat conditions encountered at the East Branch of the Housatonic station were suboptimal (131/200) – the lowest habitat score of all seven stations examined in 2002.The Riparian Zone Width parameter scored poorly for both the right and left banks (2/20). The right bank was noted as being “marginal” in terms of Bank Vegetative Protection (4/10), and Bank Stability (4/10). This reach, like many of the examined reaches in 2002, was affected by low-flow conditions; resulting in a “marginal” Channel Flow Status determination (8/20).

Sixty-four fish were collected at the East Branch of the Housatonic station. The collected fish were dominated by moderately tolerant and fluvial specialist / dependant species.

This stream reach was also sampled in 2002 for the purposes of benthic community and habitat assessment. For a more in-depth examination of benthic parameters, see (Mitchell, 2005).

Waterbody Name: Cleveland Brook
Waterbody Location: Old Windsor Road, Hinsdale
Latitude: 42.28.35
Longitude: 73.07.45
Sampling Date: August 20, 2002

Cleveland Brook is described as a cold-water, stable fishery (Kennedy and Weinstein 2000). The sampled stream reach was located downstream from the Cleveland Brook Reservoir. Instream discharges from this drinking-water impoundment account for the vast majority of flow to this reach, as there is only one, first-order, tributary entering Cleveland Brook between the station and the reservoir. The examined reach is 1 mile from the impoundment, with a very high gradient of 155 feet / mile. The demand for drinking water from the Town of Dalton, and the City of Pittsfield, combined with the low-flow conditions encountered in 2002, greatly reduced flows to this reach. These conditions resulted in a “marginal” score with regard to the Channel Flow Status (7/20). Also, the proximity of Old Windsor Road to this station reduced the right bank Riparian Zone Width to a “poor” condition (1/10). However, no other

habitat measures scored below the “suboptimal” level, and the sampled reach attained an over-all habitat score of 147/200.

Eighty-seven fish were collected at the Cleveland Brook station. The collected fish were dominated by intolerant, fluvial specialist / dependant species. The eastern brook trout were numerically dominant (86%), and drove the numerical distribution to represent 90% cold-water species, and 90% top carnivores. The eastern brook trout appear to be reproducing, as the variety of their lengths indicates multiple age classes. The above conditions appear to support the current cold-water fishery designation for this stream.

Waterbody Name: Hop Brook
Waterbody Location: near Main Road, Tyringham
Latitude: 42.14.59
Longitude: 73.12.30
Sampling Date: August 20, 2002

Hop Brook flows through the narrow Tyringham valley. The valley, for the most part, is low-gradient, and the stream meanders through the pastures and fields in a natural manner. However, there is a constriction in the valley (between Cobble Hill, and Baldy Mountain) that marks a higher gradient stream section through the Town of Tyringham. Here, the stream drops 46 feet / mile. The Hop Brook sampling reach was located within this constricted area, behind the fire station, in the Town of Tyringham. The riparian zone abutting the Hop Brook station was highly modified; with pastures, lawns and a parking area replacing what was – at one time – a forested area. This resulted in a “poor” rating for both the left and right riparian zones (2/10 – left bank, 1/10 – right bank). The Channel Flow Status (9/20) was “marginal”, as was the case at other stations during the summer of 2002. The total habitat score for Hop Brook was 157/200.

Seven hundred and two fish were collected at Hop Brook. The collected fish were dominated by tolerant (64%), fluvial specialist / dependant (98%) species. The five brown trout appeared to be reproducing, as the varieties of their lengths indicate multiple age classes.

MA DFW sampled this station in 1998. Their results were quite similar to those observed by MA DWM in 2002. However, MA DFW collected one slimy sculpin in 1998, and no rock bass (Richards 2002).

Waterbody Name: Cady Brook
Waterbody Location: New Windsor Road, Hinsdale
Latitude: 42.28.27
Longitude: 73.05.23
Sampling Date: August 20, 2002

Cady Brook is described as a cold-water, stable fishery (Kennedy and Weinstein 2000). Cady Brook is a first-order stream that flows through a watershed devoid of permanent human habitation. That is not to say that human impact has not affected this stream. There exists a power line right-of-way (with associated sub-station), a dirt jeep trail, and an aqueduct within the small (7.5 mi^2) watershed. Cady Brook’s natural course to Windsor Reservoir is diverted to Cleveland Brook Reservoir through the use of this aqueduct. Both impoundments are drinking water sources for the Town of Dalton and the City of Pittsfield. The current effects of the above-mentioned human intrusions seemed to have no impact upon the sampled reach (the reach was 0.2 miles upstream of the aqueduct).

The within-reach habitat assessment of Cady Brook resulted in the highest habitat score of all Housatonic stations examined in 2002 (169/200). The stream was of relatively high gradient, with a drop of 53 feet / mile. Like all other stations in 2002, Cady Brook was affected by low-flow conditions. This is acknowledged in the “marginal” Channel Flow Status score (7/20). Also, both banks were “marginally” stable (5/10 – left bank, 3/10 – right bank). It is likely that this stream is subject to freshettes, and exhibits a “flashy” disposition. This would account for the marginally stable banks.

One hundred eighty-four fish were collected from Cady Brook. Two species (blacknose dace and eastern brook trout) were collected. Both species are fluvial specialist / dependant species. The blacknose dace are classified as tolerant, and the eastern brook trout are classified as intolerant. The eastern brook trout appear to be reproducing, as the variety of their lengths indicates multiple age classes. This condition supports this stream's classification as a cold-water fishery.

This reach was last sampled by DWM (for the purposes of fish population assessment) in 1992. Habitat observations from 1992 were similar to those observed in 2002. During the 1992 fish population survey, 58 fish were collected, comprising (in order of abundance): eastern brook trout (*Salvelinus fontanalis*) and blacknose dace (*Rhinicthys atratulus*), and a solitary brown trout (*Salmo trutta*).

Waterbody Name: Windsor Brook
Waterbody Location: Old Windsor Road, Hinsdale
Latitude: 42.29.02
Longitude: 73.05.48
Sampling Date: August 20, 2002

This stream is described as a cold-water, stable fishery (Kennedy and Weinstein 2000). The stream reach examined for fish population assessment was also examined for benthic community assessment.

Windsor Brook is a high gradient stream (115 ft / mile), supplying drinking water to both Windsor Reservoir (by natural channel) and to Cleveland Brook Reservoir (by aqueduct). Residents of both the Town of Dalton and the City of Pittsfield consume this water. Windsor Brook is currently listed in the 2004 Massachusetts Integrated List of Waters as a Category 4c water body ("impairment not due to a pollutant") as a result of the operation of the aqueduct that diverts water to Cleveland Brook Reservoir (Mass DEP 2005).

Habitat assessment performed during the 2002 fish population survey concluded in an over-all habitat score of 166/200. The only parameter to score at the "marginal" level was the Channel Flow Status (7/20). Windsor Brook, like all other 2002 Housatonic stations, was affected by low flow conditions. This is almost exactly what was observed by the benthic assessment team (164/200).

One hundred two fish were collected at Windsor Brook. The two species represented in this collection were blacknose dace (*Rhinicthys atratulus*, n=73), and eastern brook trout (*Salvelinus fontinalis*, n=29). Brook trout appear to be reproducing, as the varieties of their lengths indicate multiple age classes. The presence of multiple age-class eastern brook trout lends credence to the designation of this stream as a cold-water fishery.

MA DFW previously sampled this station in July of 1999 (Richards 2001). They also observed multiple age-classes of eastern brook trout. Windsor Brook was last sampled by MA DWM during the 1992 *Housatonic River Tributary Biomonitoring Survey* (Kennedy, Maietta and Nuzzo 1993). Although the 1992 station was located ~300 meters downstream from the 2002 station, the same two species were collected.

Summary of Conditions

The fishes collected during the 2002 Housatonic watershed survey indicate the relatively healthy conditions of local fisheries. The collected specimens seemed healthy, and many appeared to be reproducing, although at the time of sampling the watershed was affected by low-flow conditions that can hinder reproduction.

One of the most surprising findings was the richness of the population sampled at the East Branch of the Housatonic River (Hubbard Avenue Bridge, Pittsfield). The proximity of industrial impoundments and commercial development would lead one to expect a depauperate community. This was not the case. Nine species were collected at this station (tying it with Hop Brook for the most species collected).

However, fishes may be concentrating within this reach due to the proximity of the upstream dam, and the within reach “deep pool” (approximately 6-feet deep) that may be the largest refugia for fishes in the area.

Two of the smaller streams sampled (Windsor Brook and Cady Brook) contained only two species (eastern brook trout and blacknose dace). This condition should not be inferred to mean that these streams are impacted in some regard. The small watershed area, high-gradient nature, and small size of the stream, provides conditions that are amenable to these two species. Both of these species (in both streams) showed signs of local reproduction (multiple age classes). Both streams appear to contain a healthy fish population. However, an examination of Cady Brook below the aqueduct may result in Cady Brook joining Windsor Brook on the Integrated List due to flow alteration.

Cleveland Brook displayed conditions somewhat similar to Windsor Brook and Cady Brook in that the population was dominated by reproducing eastern brook trout. Although the release schedule from Cleveland Brook Reservoir is unknown, it is recommended that its operation provides adequate water for the continued propagation of cold-water species.

The community collected at Hop Brook was quite encouraging. This station had the greatest richness (9 species - tied with East Branch of the Housatonic) encountered. Six of the nine species collected showed signs that they are reproducing locally. Although this stream does not appear to be a cold-water fishery, the diverse resident fish community is illustrative of a healthy stream.

The fishes collected from the Konkapot River station (at Mill River Road, New Marlborough) displayed a community containing both high-gradient, cold-water species (eastern brook trout and longnose dace) and low-gradient, warmer-water species (rock bass and common shiner). However, the mere presence of cold-water species (although not obviously reproducing) under the stressful conditions encountered during the survey (low-flow, high temperatures) supports the 1997 request that this stream be classified as a cold-water fishery.

The Williams River is classified as a cold-water fishery, and is heavily utilized as such. However, the community encountered during the 2002 survey does not support this designation. The presence of reproducing smallmouth bass and common shiner indicate warmer conditions than are acceptable to most trout. While it is true that a solitary brown trout was collected, the thermal tolerance of this fish is much greater than that of native species. It may also be the case that the Williams River was greatly affected by low flow conditions. The proximal upstream riparian zone (600-meters upstream) provides little shading to the river, and the river is low gradient with many meanders within this area. These physical attributes, combined with low-flow conditions, tend to favor the development of warm water species.

Literature Cited

Bain, M.B. and J.G. Knight. 1996. *Classifying stream habitat using fish community analysis*. Pages 107-117 in M. Leclerc, H. Capra, S. Valentin, A. Boudreault, and Y. Cote, eds. Proceedings of the second IAHR symposium on habitat hydraulics, Ecohydraulics 2000. Institute National de la Recherche Scietifique - Eau, Ste-Foy, Quebec, Canada.

Bain, M. B., and M. S. Meixler. 2000. *Defining a target fish community for planning and evaluating enhancement of the Quinebaug River in Massachusetts and Connecticut*. Final report by the New York Cooperative Fish and Wildlife Research Unit, Cornell University, Ithaca, NY to the New England Interstate Water Pollution Control Commission, Lowell, MA. 51 p.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. *Rapid bioassessment protocols for use in wadeable streams and rivers: Periphyton, benthic macroinvertebrates, and fish, second edition*. U.S. Environmental Protection Agency. Washington, DC. EPA 841-B-99-002.

Bell, C. 1999. *Memorandum: Water quality data supplement. dated 25 June 1999 to William Prendergast, MassDEP.* Department of Fisheries Wildlife and Environmental Law Enforcement. Western Wildlife District. Pittsfield, MA.

Halliwell, D.B, Langdon, R.W., Daniels, R.A., Kurtenbach, J.P., and R.A. Jacobson. 1999. *Classification of Freshwater Fish Species of the Northeastern United States for Use in the Development of Indices of Biological Integrity, with Regional Applications.* pp. 301-338 in T. P. Simon (ed.). Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Boca Raton, FL. 671 p.

Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J. Schlosser. 1986. *Addressing biological integrity in running waters: A method and its rationale*. Spec. Publ. 5. Illinois Nat. Hist. Survey, Champaign.

Kennedy, L.E., R.J. Maietta and R.N. Nuzzo. 1993. *1992 Housatonic River Tributary Biomonitoring Survey – Assessing Instream Impacts To Biota From Surface Water Supply Withdrawals.* Resource Assessment Project Number 92-5. Massachusetts Department of Environmental Protection, Division of Water Pollution Control, Technical Services Section, North Grafton, MA.

Kennedy, L.K., and M.J. Weinstein. 2000. *Housatonic River Basin 1997/1998 Water Quality Assessment Report*. CN: 019.0. 21-AC-3. MassDEP/DWM. Worcester, MA. 105 p.

Mass DEP. 2003a. *CN 75.1 Fish Collection Procedures for Evaluation of Resident Fish Populations (Method 003/11.20.95.* Massachusetts Department of Environmental Protection / Division of Watershed Management. Worcester, MA.

Mass DEP. 2003b. *Massachusetts 2002 Integrated List of Impaired Waters.* Massachusetts Department of Environmental Protection / Division of Watershed Management. Worcester, MA.

MassDEP. 2005. *Massachusetts Year 2004 Integrated List of Waters. Final listing of the condition of Massachusetts' waters pursuant to sections 303(d) and 305(b) of the Clean Water Act.* Massachusetts Department of Environmental Protection / Division of Watershed Management. Worcester, MA.

Mitchell, P. 2005. *Housatonic River Watershed 2002 Biological Assessment Report*. CN197.0 Technical Memorandum TM-21-5. Massachusetts Department of Environmental Protection / Division of Watershed Management. Worcester, MA.

Richards, T. 2002. *2001Housatonic River Watershed Fish Population Data* (Excel Spreadsheet). Massachusetts Department of Fish and Game, Westborough, MA. Email to Peter Mitchell, Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA. Dated 23 January 2002.

USGS 2003. *Surface-Water Runoff Conditions – August 2002.* United States Geologic Survey. Northborough, MA. http://ma.water.usgs.gov/current_cond/images/02_08_sw_map.gif

Figure 1: 2002 Housatonic Watershed MA DWM Fish Population Monitoring Stations

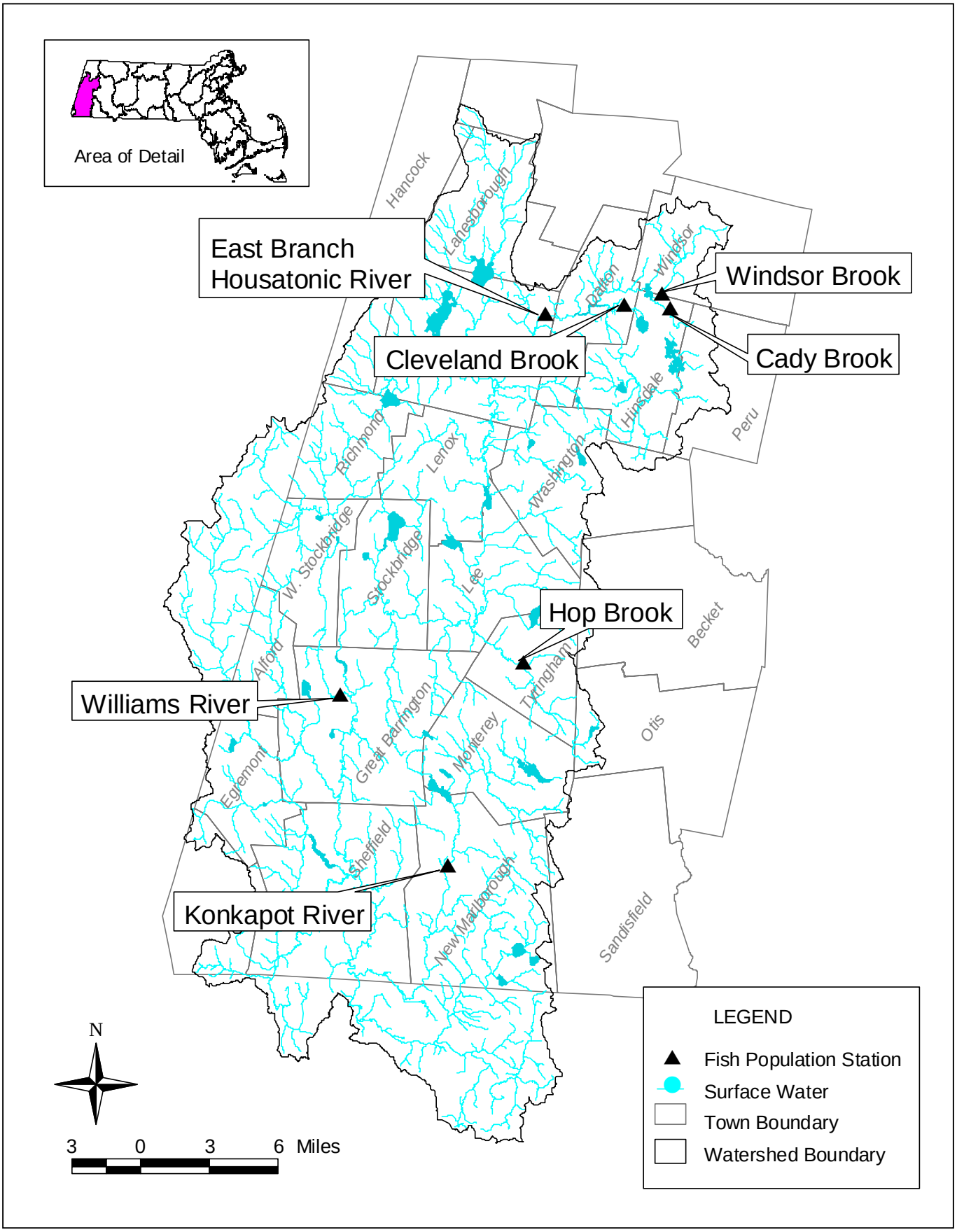


Figure 2. Massachusetts Surface-Water Runoff Conditions, August 2002. (USGS 2003).

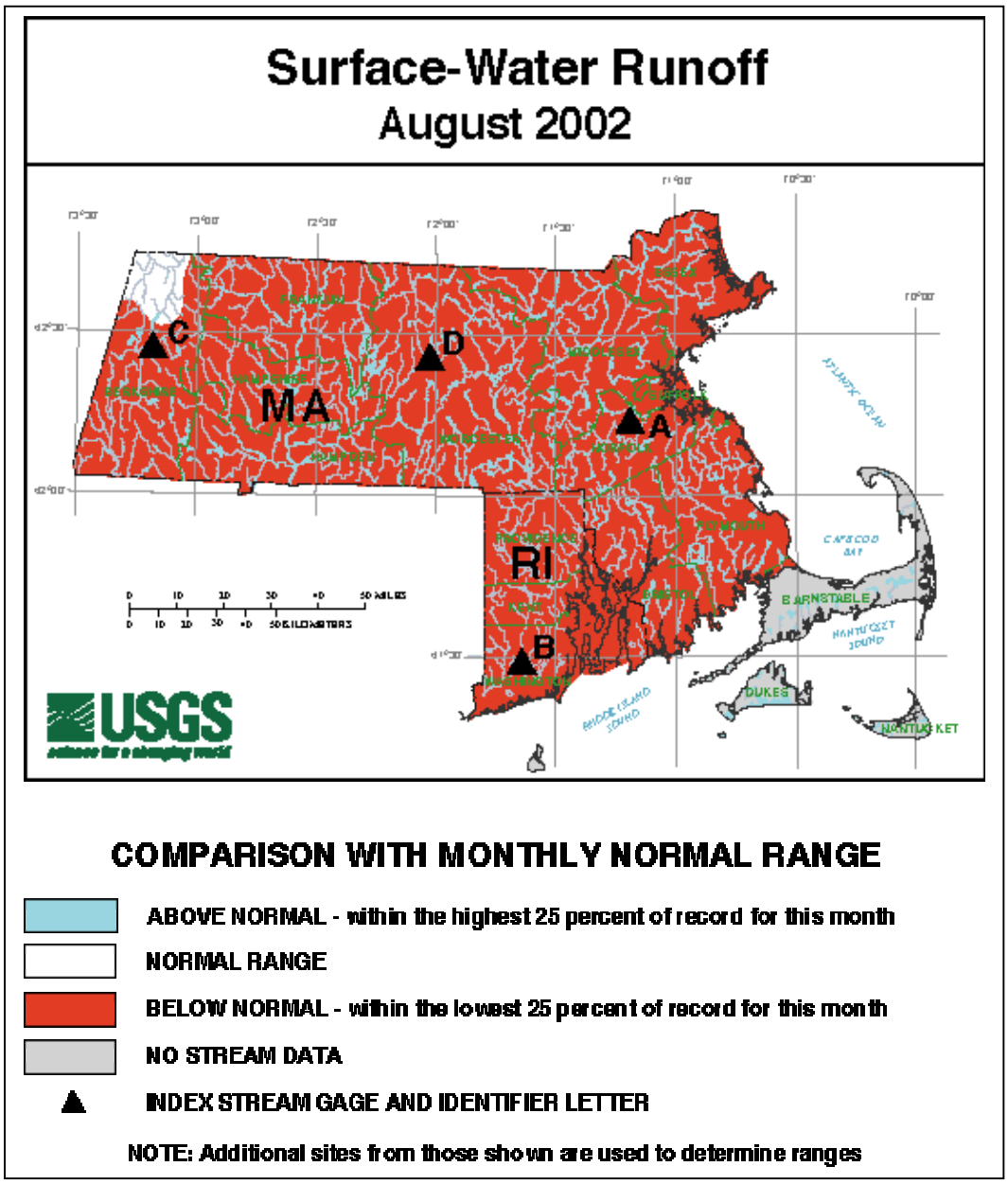


Table 1: 2002 Housatonic Watershed Fish Population Station Locations

Waterbody	Location	Lat. / Lon.	Date
Williams River	Upstream of Route 41 Bridge, Great Barrington	42.13.35/ 73.21.51	19 August 2002
Konkapot River	Upstream of Mill River Road Bridge, New Marlborough	42.07.14/ 73.16.10	19 August 2002
East Branch Housatonic River	Upstream of Hubbard Avenue Bridge, Pittsfield	42.28.10/ 73.11.48	20 August 2002
Cleveland Brook	Upstream of Old Windsor Road Bridge, Hinsdale	42.28.35/ 73.07.45	20 August 2002
Hop Brook	Upstream of foot bridge, behind Fire Station, near Main Road, Tyringham	42.14.59/ 73.12.30	20 August 2002
Cady Brook	Upstream of New Windsor Road Bridge, Hinsdale	42.28.27/ 73.05.23	20 August 2002
Windsor Brook	Upstream of Old Windsor Road Bridge, Hinsdale	42.29.02/ 73.05.48	20 August 2002

Table 2: Habitat assessment summary for fish population stations sampled during the 2002 Housatonic river watershed survey of 19 and 20 August 2002.

Habitat Parameter	Williams River		Konkapot River		East Branch Housatonic River		Cleveland Brook		Hop Brook		Cady Brook		Windsor Brook	
Instream Cover	17		14		14		14		19		20		16	
Epifaunal Substrate	19		18		12		19		19		20		16	
Embeddedness	19		18		19		14		19		20		19	
Channel Alteration	20		15		13		19		15		20		20	
Sediment Deposition	15		18		19		13		18		19		18	
Velocity-Depth Combination	18		18		15		19		19		15		17	
Channel Flow Status	9		9		8		7		9		7		7	
Bank Vegetative Protection	10	10	9	9	9	9	9	9	9	9	10	10	10	10
Bank Stability	3	3	8	8	7	4	7	8	9	9	5	3	8	8
Riparian Vegetative Zone - Width	10	7	5	9	1	1	8	1	2	1	10	10	10	7
TOTAL SCORE	160		158		131		147		157		169		166	

Table 3. Fish population data collected by DWM at seven biomonitoring stations in the Housatonic River watershed on 19 and 20 August 2002. Sampling stations were located at: Williams River, Konkapot River, East Branch of the Housatonic River, Cleveland Brook, Hop Brook, Cady Brook, and Windsor Brook. Refer to Table 1 for a listing and description of sampling stations.

TAXON (SORTED BY FAMILY)	**Habitat Class**[1]	**Trophic Class**[2]	**Tolerance Class**[3]	**Williams R.**	**Konkapot R.**	**East Branch Housatonic**	**Cleveland Brook**	**Hop Brook**	**Cady Brook**	**Windsor Brook**
common shiner *Luxilus cornutus*	FD	GF	M	21	1	2	-	89	-	-
blacknose dace *Rhinicthys atratulus*	FS	GF	T	6	50	2	8	433	110	73
longnose dace *Rhinicthys cataractae*	FS	BI	M	60	29	21	-	135	-	-
creek chub *Semotilus atromaculatus*	MG	GF	T	-	-	5	-	11	-	-
fallfish *Semotilus corporalis*	MG	GF	M	-	-	6	-	-	-	-
white sucker *Catostomus commersoni*	FD	GF	T	4	1	3	1	6	-	-
tessellated darter *Etheostoma olmstedi*	FS	BI	M	2	-	-	-	18	-	-
brown trout *Salmo trutta*	FD	TC	I	1	12	3	3	5	-	-
brook trout *Salvelinus fontinalis*	FD	TC	I	-	3	-	75	1	74	29
smallmouth bass *Micropterus dolomieu*	MG	TC	M	13	-	-	-	-	-	-
pumpkinseed *Lepomis gibbosus*	MG	GF	M	-	-	2	-	-	-	-
rock bass *Ambloplites rupestris*	MG	GF	M	-	1	20	-	4	-	-
Total Number of Fish Collected	-	-	-	107	97	64	87	702	184	102

[1] Habitat Class - FS (fluvial specialist), FDR (fluvial dependant reproduction), MG (macrohabitat generalist). From Bain and Meixler (2000), modified for Massachusetts

[2] Trophic Class - GF (generalist feeder), BI (benthic invertivore), TC (top carnivore), WC (water column invertivore). From Halliwell et al. (1999)

[3] Tolerance Classification - I (intolerant), M (moderately tolerant), T (tolerant). From Halliwell et al. (1999) Classification described as tolerance to "environmental perturbation".

APPENDIX G

HOUSATONIC RIVER WATERSHED

2002 Chlorophyll a and Periphyton Technical Memorandum

Prepared by
Joan Beskenis

Massachusetts Department of Environmental Protection
Division of Watershed Management
Worcester,MA

May, 2006

CN: 213.0

Introduction

Biological assessment was performed at several stations in the Housatonic River Basin located in Western Massachusetts during the summer of 2002. The sampling was conducted by personnel from Massachusetts Department of Environmental Protection (MassDEP). Mainstem stations were sampled for chlorophyll a from phytoplankton in conjunction with water quality sampling. Chlorophyll a is a pigment that is found in all plants and algae and provides an estimate of biomass as well as an indication of the biological production of the water body.

In the tributaries, samples were collected for the identification of periphyton (attached microscopic algae) and benthic algae (attached macroscopic algae); both types will be referred to as periphyton for this report. Estimates were made of the percent algal cover within the riffle of the sampling reach and algal type and abundance were also recorded. Periphyton sampling was limited to sites chosen for macroinvertebrate/habitat investigations.

Objectives of the periphyton sampling were to offer a means of comparing biological communities along with the macroinvertebrate and habitat information, and to examine community changes such as the amount and type of algae over time. The periphyton assessment provides a way to determine if the designated uses, as described in the Surface Water Quality Standards (MassDEP 1996), are being supported, threatened or lost in particular segments. Periphyton data can be used to evaluate two uses of the Housatonic River: Aquatic Life and Aesthetics.

Aquatic life evaluations determine if suitable habitat is available for “sustaining a native, naturally diverse, community of aquatic flora and fauna.” Natural diversity and the presence of native species may not be sustained when there are dense growths of a monoculture of a particular alga. This alteration of the community structure can mean that the aquatic life use support is lost or threatened. Loss of parts of the food chain, which is vital for use support, may result from this alteration. In addition, the large amounts of biomass from macroalgae when they die off and decompose can fill in the interstitial sites in the substrate and destroy this habitat for the benthic invertebrates and compromise the aquatic life use support.

The algal data are also used to determine if aesthetics have been impacted. Floating rafts of previously attached benthic mats can make a waterbody visually unappealing, as can large areas of the bottom substrates covered with long streamers of algae that can discourage swimmers and hinder fishermen by making the substrata slippery for walking. Fishermen can also snag their fishing lines on the filamentous algae. Nuisance amounts of algae, which can compromise aesthetics, can be determined by estimating the percent macroalgal cover in a particular habitat (e.g. riffles or pool) (Biggs 1996) (Barbour et al. 1999). If the percent cover is greater than 40 %

by filamentous green algae (macroalgae) then nuisance amounts of algae are described as being present, but it still must be determined if designated uses of the particular reach have been altered. It must still be determined if the use of the benthos by aquatic life is threatened or if the aesthetics are impacted (Biggs 1996) (Barbour et al. 1999).

Because the Housatonic River is a large, often deep, often slow river, it can maintain its own population of phytoplankton. In order to learn more about the phytoplankton biomass in this river, chlorophyll a samples were collected to gather information on the main stem water quality and to determine if it was impacted by sources of nutrients (phosphorus and nitrogen) located along the river, in particular, agricultural runoff and wastewater treatment plants.

Periphyton sampling is typically done on first, second or third order streams and rivers that are small, shallow, and often fast moving. At each of the stations an estimate of the percent cover of the periphyton and benthic algae is made and samples are collected for algal identification. Periphyton samples are typically scrapes of one type of substrata in the riffle zone. A qualitative microscopic examination is done to determine the presence and the abundance of the phyla that contribute the most to the biomass in the riffle or pool habitats. This information, in addition to the estimate of percent cover of the filamentous algae (macroalgae), is used to determine if uses of the river (Aquatic Life Support and Aesthetics) are lost or threatened because of excessive algal growth.

Materials and Methods

Chlorophyll a

Samples for chlorophyll a analysis and phytoplankton identifications were collected on July 31 and September 25, 2002 by wading in-stream and reaching into the main flow using a pole with a sample container attached. These grab samples were collected just below the surface in plastic containers that were placed into iced coolers until they could be returned to MassDEP's laboratory in Worcester for analysis. Samples were processed within the 24-hour holding period. Table 1 presents a list of stations included in the chlorophyll a sampling. A Turner Designs, Inc. TD-700 fluorometer was used in the chlorophyll a analysis (MassDEP 2000). Fifty milliliters of sample water are filtered through a glass fiber filter. The filter is ground using a motor driven grinder and a glass pestle. The ground material is transferred to plastic centrifuge tubes that are kept in the dark and refrigerated for 24 hours while the chlorophyll a extraction continues in 90% acetone. The plastic centrifuge tubes are kept in the dark, brought to room temperature, and then decanted into borosilicate disposable cuvettes that are placed in the TD-700 fluorometer for analysis. Results are reported in mg chlorophyll a per m^3 water.

Table 1: HOUSATONIC RIVER CHLOROPHYLL a SAMPLING Location of Sampling Stations		
Station	Location	Date Sampled
04B	Housatonic River-Holmes St. Bridge, Pittsfield	July 31, Sept. 25
04C	Housatonic River-New Lenox Rd. Bridge, New Lenox	July 31, Sept. 25
19AU	Housatonic River- At the foot-bridge, above dam at outlet to Woods Pond, east of Housatonic Street, Lenox	Sept. 25
19C	Housatonic River, Tyringham Rd., Lee	July 31, Sept. 25
HB	Hop Brook-Meadow St., Lee	July 31
20A	Housatonic River-Division Street Bridge (USGS gage), Great Barrington	July 31, Sept. 25
20D	Housatonic River-Kellogg Rd. Bridge, Sheffield	July 31, Sept. 25
19E	Housatonic River-Route 183, Stockbridge	July 31, Sept. 25

Periphyton Identifications and Relative Abundance

Periphyton samples were gathered along with the macroinvertebrate samples and habitat data using methods described in Barbour (1999). Sampling was done by the macroinvertebrate sampling crew and consisted of randomly scraping rocks and cobble substrates, typically within the riffle area, but other habitats were also sampled. Material was removed with a knife or by hand from rock substrates and the material was added to labeled glass vials that contained sample water. Table 2 contains descriptions of the station locations where periphyton was collected. The samples were transported to the lab at MassDEP-Worcester in one liter plastic jars containing stream water to keep them cool. Once at the lab, they were refrigerated until

identifications were completed. Samples held longer than a week were preserved using M^3 with a dose rate of 2 ml of preservative per 100 ml of sample (Reinke 1984).

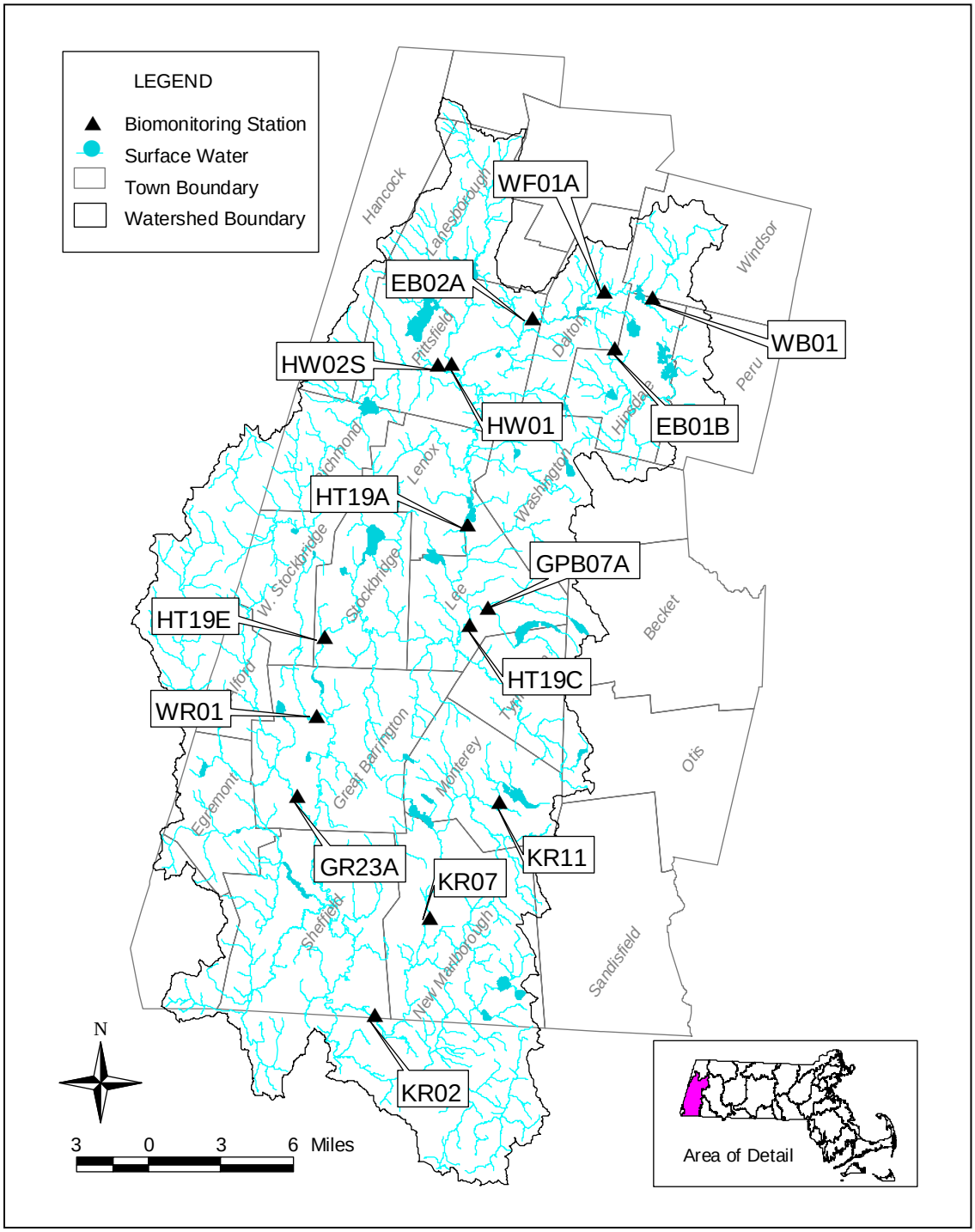
Vials were shaken to get uniform samples before subsampling. Filamentous algae were removed first, identified separately and then the remainder of the sample was examined. An Olympus BH2 compound microscope with Nomarski optics was used for the identifications. Slides were typically examined under 200 power. A modified method for periphyton analysis developed by Bahls (1993) was used. The scheme developed by Bahls for determining abundance on a slide is as follows:

R (rare)	fewer than one cell per field of view at 200x, on the average;
C (common)	at least one, but fewer than five cells per field of view;
VC (very common)	between 5 and 25 cells per field;
A (abundant)	more than 25 cells per field, but countable;
VA (very abundant)	number of cells per field too numerous to count.

Table 2 **2002 HOUSATONIC RIVER PERIPHYTON SAMPLING**
Location of Sampling Stations

Station	***Mainstem Locations***		***Station***	***Tributary Locations***
EB01B	East Branch Housatonic River at Jericho Rd., Hinsdale		WB01	Windsor Brook at Old Windsor Rd., Windsor
EB02A	E. Branch Housatonic, upstream from Hubbard Ave., Pittsfield		WF01A	Wahconah Falls Brook, Holiday Farms Rd., Dalton
HW02S	Southwest Branch Housatonic River downstream from Barker Rd., Pittsfield		WR01	Williams River, upstream from Route 41, Great Barrington
HT19AU	Woods Pond, at the foot-bridge, east of Housatonic Street, Lenox		GR23A	Green River at Route 23/41, Great Barrington
HT19A	Housatonic River, downstream Lenox WWTP, upstream from Crescent Mills (Crystal Street), Lenox		KR11	Konkapot River at Bidwell Park, Monterey
HT19C	Housatonic River, downstream of Lee WWTP, Tyringham Rd., Lee		KR07	Konkapot River at Clayton Mill Rd. downstream from Mill River, New Marlborough
HT19E	Housatonic River, near Route 183, Stockbridge		KR02	Konkapot River, Route 124, New Canaan, CT

Figure 1. Location map of MA DWM 2002 Housatonic Watershed Benthic/Habitat and Periphyton Sampling Locations



(MITCHELL 2005)

Results

Chlorophyll a

Table 3 presents the results of the chlorophyll sampling recorded as mg/m^3. The highest chlorophyll a values were measured where the river is impounded at station 19 AU (above the dam at the outlet to Woods Pond), while the remainder of the mainstem stations had low chlorophyll a values in both the July and September sampling events. The range in July was from <1-3.4 mg/m^3 while in September the values ranged from 1.2-3.7 mg/m^3.

Table 3 RESULTS OF 2002 HOUSATONIC RIVER CHLOROPHYLL a SAMPLING Location, Date, Water Column Chlorophyll a (mg/m^3)

Station	Location	Date	Chlorophyll a	Date	Chlorophyll a
04B	Housatonic River-Holmes St. Bridge, Pittsfield	July 31	3.3	Sept. 25	2.2
04C	Housatonic River-New Lenox Rd. Bridge, New Lenox	July 31	2.2	Sept. 25	1.8
19AU	Housatonic River- At the foot-bridge, above dam at outlet to Woods Pond, east of Housatonic Street, Lenox	July 31	Mean 2 samples 23.6	Sept. 25	14.6
19C	Housatonic River- Tyringham Rd., Lee	July 31	2.5	Sept. 25	3.7
HB	Hop Brook-Meadow St., Lee	July 31	<1	---*	---*
19E	Housatonic River-Route 183, Stockbridge	July 31	2.5	Sept. 25	1.5
20A	Housatonic River-Division Street Bridge (USGS gage), Great Barrington	July 31	3.4	Sept. 25	1.9
20D	Housatonic River-Kellogg Rd. Bridge, Sheffield	July 31	1.8	Sept. 25	1.2

---*-not done

Periphyton and Benthic Algae-Identifications and Percent Cover

Nuisance amounts of algae, which can compromise aesthetics, can be determined by estimating the percent macroalgal cover in a particular habitat (e.g. riffles or pool) (Biggs 1996) (Barbour et al. 1999). Filamentous green algae (macroalgae) that cover more than 40% of the substrata in the riffle of a sampling reach, are described as nuisance amounts of algae (Biggs 1996) (Barbour et al. 1999). Perceptions of the users are needed to determine if the aesthetics are impacted (Biggs 1996) (Barbour et al. 1999).

Percent cover estimates of the algal cover and of the canopy cover were made in the riffle zone of the sampling reach. Both of these estimates are presented in Table 4, which includes a listing of the most abundant genera and the common name of their family grouping (green, yellow-green, diatoms, golden-brown, blue-green) found at each station. Green and yellow-green groups include filamentous macroalgal representatives. Appendix A lists genera found at each station as well as their abundance in the sample.

Several stations had greater than 40% algal cover (Table 4) (Barbour 1999, Biggs 1996). Many of these had macroalgae, particularly green filamentous algae. Prolific algal growth may limit uses of the river site, in particular the Aesthetics and Aquatic Life uses, so the stations with greater than 40% filamentous green benthic algae are first described below. Stations EB01B HW02S and KR11 are not discussed further because they had limited algal growth.

Mainstem

EB02A was located approximately 210 meters downstream of an industrial impoundment on the East Branch of the Housatonic River. Upstream of this site is the urbanized area of Pittsfield, as well as the Crane and Company industrial effluent discharge (MA0000671). The algal cover in the reach sampled for macroinvertebrates was approximately 50%. The riffle was dominated by the filamentous Xanthophyte (yellow green) *Vaucheria* sp., which often is very productive when nutrients are high and water temperatures low (Biggs 1996). Also very abundant in the sample was the diatom *Melosira* sp. that forms loosely linked chains held together by mucilage. It is often found in organically enriched areas (Palmer 1962). *Melosira* sp. chains can break apart easily causing the water to turn gray and turbid. Both the color, which often appears like “gray water” draining from a sink, and the cloudy water caused by the turbidity, can be unattractive and reduce the aesthetics of a reach.

HT19A was located on the mainstem of the Housatonic River at Crescent Mills, Lenox and it had 0% canopy cover and 95% algal cover. The periphyton sample was primarily composed of the green filamentous algae *Rhizoclonium* sp. and *Oedogonium* sp., both of these are filamentous algae that do well in high nutrient areas (Biggs 1996). The nuisance alga, *Hydrodictyon* sp. was also found, but it represented only a small part of the assemblage. Since it is planktonic, the *Hydrodictyon* sp. may have washed in from Woods Pond, the eutrophic impoundment located upstream.

HT19C was located approximately 185 meters downstream of the Lee WWTP outfall on the mainstem of the Housatonic River. The 0% canopy cover allowed plenty of light for

photosynthesis and this likely contributed to the 50% algal cover. The green filamentous alga *Rhizoclonium* sp. that was also present at HT19A, was present in very abundant amounts in the material collected in the riffle, while along the margins there were lots of ciliates (*Vorticella* sp.) present as well as fungal hyphae. Both of these are found in areas of organic enrichment. Substrata in the pools had "slime" covering them possibly contributed by the planktonic diatom *Cyclotella* sp. that was also very abundant.

HT19E is another mainstem Housatonic station that was located along Route 183 (near Blue Moon Kennels), downstream of the Glendale Dam, Stockbridge. It was a reference station for macroinvertebrate sampling conducted along the mainstem, although it had 0 % canopy cover and 100 % algal cover (Table 4), and the green, filamentous alga *Cladophora* sp. appeared to be very abundant in the sample from the riffle (Appendix A). This alga, which can develop to nuisance amounts (Biggs 1996), likely represented isolated clumps of filaments. Most of the algal cover was composed of a green film that did not appear in the sample provided. These films can be firmly attached to the surface or in crevasses that make them difficult to remove.

Tributaries

WB01 had 60% algal cover, but the algae sample had very few cells present and was mostly amorphous material. Filaments of the cyanobacteria -*Lyngbya* sp. were not very abundant. Visually, *Lyngbya* sp. is not a nuisance unless the growth is prolific, this is particularly evident when it forms mats on the substrata (Komarek et. al. 2003), that break free and float on the surface.

WF01A Eighty percent of the substrata at station WF01A on Wahconah Falls Brook was covered by algae. Located approximately 1.75 miles downstream of Windsor Reservoir (a drinking water reservoir, Dalton), the canopy cover was relatively high (60%) primarily caused by a single line of trees in the riparian zone. According to Mitchell (2005), behind this line of trees were fields and pastures which are potential sources of nutrients. Although the cover of periphyton was high, the biomass was low since it was dominated by the stalked diatom *Synedra* sp. Mitchell (2005) mentions a thin green film and filamentous green algae on the rocks, but no indication of nuisance growth.

GPB07A Goose Pond Brook originates at the outlet of Goose Pond (Tyringham, MA) . Although the shoreline of Goose Pond has many dwellings, the brook passes through a "very undeveloped, forested, landscape" (Mitchell 2005). The trees (Willow (*Salix* sp.), Cottonwood (*Populus deltoides*), and Paper Birch (*Betula papyrifera*)) create a slightly closed canopy cover (30%). But, ambient light and nutrients contributed to the growth of the green filamentous alga *Cladophora*

sp. and a film of green coccoid algae. Together, they covered approximately 60 % of the in the riffle areas in this reach.

WR01 was located at the Williams River upstream from Route 41, Great Barrington. According to Mitchell (2005), the Williams River watershed at the point sampled is primarily forested although the nearby landuse is residential. Mitchell's (2005) analysis of 1997 and 2002 macroinvertebrate data indicated that some community changes had occurred over this time period. He suggested that one possible cause could be low flow conditions during 2002. The filamentous green alga *Cladophora* sp. population might have benefited from the lack of disturbance and low flow, but it only covered approximately 30% of the substrata. Pools that were sampled in this reach had some mats of blue-green algae (Table 4) that were still attached to the substrata. Their visual impact would be minimal under these conditions. Widespread algal mats could affect Aquatic life use by "smothering" organisms that inhabit interstitial areas of the benthos.

GR23A At the Green River, station GR23A, the algal cover was 90%. This station was located below the Great Barrington WWTP and was dominated by the green, filamentous algae *Zygnema* sp. and *Mougeotia* sp., both of which are often found in the metaphyton, the drift community. Drift algae can significantly affect an area by reducing sunlight to the benthos, appearing like surface scums, by entangling swimmers especially the ones that are semi-buoyant and float just below the surface. The *Mougeotia* sp. was covered by the diatom *Cocconeis* sp.

KR07 Another tributary, the Konkapot River at KR07, had 80 % algal cover that was dominated in the sample by the green filamentous *Cladophora* sp., but a thin green film represented most of the coverage on the rocks. The film was composed of an unidentified green coccoid alga. NIWA (2002) describes these thin, green, tightly bound films as occurring in areas with slight nutrient enrichment.

KR02, at the Konkapot River (Route 124, New Canaan, CT), had obvious potential sources of non-point source pollution in its watershed that included dairy farms and fields. There was only a thin buffer (a line of trees) between these sources and the river. Surprisingly, with no canopy cover and with potential nutrient sources, the algal cover was only approximately 25% (Table 4). The green filamentous alga *Cladophora* sp., which often grows to a nuisance amount, was present in the sample (Appendix A), but did not occupy all favorable substrata.

Table 4 **PERIPHYTON HOUSATONIC RIVER-2002**

Habitat, % Canopy Cover, % Algal Cover, Dominant Algal Genera

Station #, Location	Date	Habitat	% Canopy Cover	% Algal Cover	Dominant Algal Genera
	Mainstem Stations				
EB01B-East Branch Housatonic River at Jericho Rd., Hinsdale	Sept. 10	Rock, riffle	70	<1	Green- *Cladophora* sp.
EB02A-E. Branch Housatonic, upstream from Hubbard Ave., Pittsfield	Sept. 10	Rock, riffle	10	50	Yellow-Green-*Vaucheria* sp. Diatoms-*Melosira* sp.
HT19A-Housatonic River at Crescent Mills, Lenox	Sept. 11	Rock, riffle	0	95	Green-*Rhizoclonium* sp. Diatoms-*Tabellaria* sp., *Cocconeis* sp.
HW02S-Southwest Branch Housatonic River downstream fr Barker Rd., Pittsfield	Sept. 10	Rock, riffle	70	0	---*
HT19C-Housatonic River, Tyringham Rd., Lee	Sept.11	Rock, riffle	0	50	Green-*Rhizoclonium* sp. Diatoms-*Cocconeis* sp.
HT19E-Housatonic River, Route 183, Stockbridge	Sept. 9	Rock, riffle	0	100	Green- *Cladophora* sp.
	Tributary Stations				
WB01-Windsor Brook at Old Windsor Rd., Windsor	Sept. 10	Rock, riffle	90	60	Blue-green-*Lyngbya* sp.
WB01-Windsor Brook at Old Windsor Rd., Windsor	Sept. 10	Pool	90	60	Green-*Spirogyra* sp. Diatoms-*Melosira* sp.
WF01A-Wahconah Falls Brook, Holiday Farms Rd., Dalton	Sept. 10	Rock, riffle	60	80	Diatoms-*Synedra* sp. Diatoms-*Fragilaria* sp.
GPB07A-Goose Pond Brook downstream from Forest St., Lee	Sept. 11	Rock, riffle	30	60	Green- *Cladophora* sp.
WR01- Williams River-upstream from Route 41, Great Barrington	Sept. 9	Cobble, riffle	50	30	Green-*Cladophora glomerata*
WR01-Williams River-upstream from Rte. 41, Great Barrington	Sept. 9	Cobble pool	50	30	Green-*Ulothrix zonata* Blue-green-*Oscillatoria* sp.
GR23A-Green River at Route 23/41, Great Barrington	Sept.9	Rock, riffle	10	90	Green-*Zygnema* sp., *Mougeotia* sp. Diatoms on *Mougeotia* sp. *Cocconeis* sp.
KR11-Konkapot River at Bidwell Park, Monterey	Sept. 11	Rock, riffle	75	<1	Green-*Cladophora* sp. Diatoms-*Melosira* sp., *Cocconeis* sp.

KR07-Konkapot River east of Clayton Mill River Rd., downstream from Mill River, village of Mill River, town of New Marlborough	Sept. 9	Rock, riffle	60	80	Green-*Cladophora* sp. Green-unidentified green coccoid
KR02-Konkapot River, Route 124, New Canaan, CT	Sept.9	Rock, riffle	0	25	Green-*Cladophora* sp. Diatoms-*Tabellaria* sp.

---*-not done

Discussion

Chlorophyll a

The water column chlorophyll a values for the portion of the mainstem Housatonic River sampled were almost all low and are characterized as oligotrophic on both sampling dates (Wetzel 1983). Oligotrophic conditions in flowing waters is described by Wetzel (1983) as having chlorophyll a values of 0.3-4.5 mg/m^3 while eutrophic waters range from 3-78 mg/m^3. The chlorophyll a values at the Housatonic stations ranged from <1 mg/m^3 at Hop Brook to the elevated values at station 19A just below the Woods Pond Dam, Lenox with 23.6 mg/m^3 (mean two samples) in June and 14.6 mg/m^3 in Sept. This is considered to be eutrophic or nutrient enriched.

The chlorophyll values represented the biomass of the phytoplankton in the water column, if light reached the benthos then nutrients could be utilized by the periphyton. Although chlorophyll analysis of the periphyton was not conducted, percent saturation of the dissolved oxygen (DO) was recorded (Mitchell 2006). None of the stations where chlorophyll a was measured had supersaturated DO values (>100 %), but if algal mats were present on the bottom and widespread the 100 % saturation values would be exceeded. Characterization of these stations as oligotrophic cannot be verified by this approach, instead it still needs to be known if turbidity in the water column or color is impeding light from reaching the bottom which would limit overall algal production.

Periphyton

Many of the reaches sampled in the tributaries to the Housatonic River had algal growth and genera that are indicative of nutrient enrichment. The green filamentous alga-*Cladophora* sp.-develops high biomass communities in enriched streams particularly in low velocity runs and pools (Biggs 1996). The percent cover of filamentous macroalgae is a good indication of nuisance aquatic growth (Barbour et al. 1999, Biggs 1996) that can threaten both aesthetics and aquatic life. Stations where nuisance macroalgae were present at amounts that could threaten

use included: EB02A-*Vaucheria* sp.*,* HT19A –*Rhizoclonium* sp., and GPB07A on Goose Pond Brook (*Cladophora* sp.).

References Cited

Bahls, L. L. 1993. *Periphyton Bioassessment Methods for Montana Streams*. Water Quality Bureau, Dept. of Health and Environmental Sciences. Helena, Montana.

Barbour, M., Gerritsen, J, Synder, B. D. and J. B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish*, 2nd edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Biggs, B. J. F. 1996. "Patterns of benthic algae in streams". IN: *Algal Ecology: Freshwater Benthic Ecosystems*. R. J. Stevenson, M. Bothwell, and R. L. Lowe. Pp 31-55. Academic Press, San Diego, California.

Komarek, J., Kling, H., and J. Komarkova. 2003. "Filamentous Cyanobacteria". IN: *Freshwater Algae of North America Ecology and Classification*. J. D. Wehr and R. G. Sheath. Academic Press. Boston.

MassDEP. 1996. (Revision of 1995 report). *Massachusetts Surface Water Quality Standards (Revision of 314 CMR 4.00, effective June 23, 1996)*. Massachusetts Department of Environmental Protection, Division of Water Pollution Control, Technical Services Branch, Westborough, MA.

MassDEP. 2000. *2000 Chlorophyll a TD-700 Fluorometer Standard Operating Procedure (SM -10200 H) (USEPA Fluorometric Method 445)* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Mitchell, P. 2005. *TM-21-5 Housatonic River Watershed 2002 Biological Assessment CM 97.0*. Massachusetts Department of Environmental Protection, Division of Watershed Management.. Worcester, MA.

Mitchell, P. 2006. *TM-21-6 Housatonic River Watershed 2002 Water Quality Monitoring Data.* Massachusetts Department of Environmental Protection, Division of Watershed Management.. Worcester, MA.

National Institute of Water and Atmospheric Research. 2002. New Zealand Stream Health Monitoring and Assessment Kit: Sream Monitoring Manual. Version 2. NIWA Technical Report 111. Christchurch, NZ. 190 p.

Palmer, C. M. 1962. *Algae in Water Supplies*. US Dept. of Health, Education and Welfare. Washington D. C. 88 p.

Reinke, D. C.1984. *Algal Identification Workshop*. Kansas Biological Survey. Manhattan, Kansas.276 p.

Wetzel, R. G., 1983*. Limnology*, CBS College Publishing, New York. 767 p.

Appendix A: PERIPHYTON-Housatonic River 2002 Habitat, Algal Identification and Abundance

Sta #	Location	Date	Habitat	Family	Genus	Abundance
	Housatonic River					
EB01B	East Branch Housatonic River at Jericho Rd., Hinsdale	Sept. 10	Rock, riffle	Bacillariophyceae	*Gomphonema* sp.	A
				Chlorophyceae	*Chaetophora* sp.	A
				Chlorophyceae	*Cladophora glomerata*	VA
				Cyanophyceae	*Lyngbya* sp.	R
EB02A	E. Branch Housatonic, upstream from Hubbard Ave., Pittsfield	Sept. 10	Rock, riffle	Bacillariophyceae	*Melosira* sp.	VA
				Bacillariophyceae	*Cocconeis* sp.	A
				Bacillariophyceae	*Synedra* sp.	C
				Bacillariophyceae	*Cymbella* sp.	C
				Bacillariophyceae	*Fragilaria* sp.	C
				Chlorophyceae	*Ulothrix* sp.	R
				Cyanophyceae	*Lyngbya* sp.	R
				Xanthophyceae	*Vaucheria* sp.	VA
EB02A	E. Branch Housatonic, upstream from Hubbard Ave. , Pittsfield	Sept. 10	Rock, pool, mat	Bacillariophyceae	*Synedra* sp.	A
				Bacillariophyceae	*Pinnularia* sp.	VA
				Bacillariophyceae	*Cymbella* sp.	VA
				Bacillariophyceae	*Navicula* sp.	VA
				Bacillariophyceae	*Diatoma* sp.	VA
				Bacillariophyceae	*Fragilaria* sp.	VA
				Bacillariophyceae	*Amphirora* sp.	VA
				Bacillariophyceae	*Surirella* sp.	R
				Bacillariophyceae	*Melosira varians*	R
				Chlorophyceae	*Ulothrix* sp.	R
				Cyanophyceae	*Oscillatoria curviceps*	A
				Euglenophyceae	*Phacus* sp.	R
HW02S	Southwest Branch Housatonic River downstream from Barker Rd., Pittsfield	Sept. 10	Rock, riffle		Not done	
HT19A	Housatonic River at Crescent Mills, Lenox	Sept. 11	Rock, riffle	Bacillariophyceae	*Synedra* sp.	R
				Bacillariophyceae	*Fragilaria* sp.	R
				Bacillariophyceae	*Cocconeis* sp.	VA

Appendix A: PERIPHYTON-Housatonic River 2002 Habitat, Algal Identification and Abundance						
Sta #	Location	Date	Habitat	Family	Genus	Abundance
				Chlorophyceae	*Hydrodictyon* sp.	R
				Chlorophyceae	*Closterium* sp.	R
				Chlorophyceae	*Oedogonium* sp.	A
				Chlorophyceae	*Rhizoclonium* sp.	VA
				Cyanophyceae	*Lynbya* sp.	R
GPB07A	Goose Pond Brook downstream from Forest St., Lee	Sept. 11	Rock, riffle	Chlorophyceae	*Cladophora* sp.	VA
HT19C	Housatonic River, Tyringham Rd., Lee	Sept.11	Rock, riffle	Bacillariophyceae	*Cocconeis* sp.	VA
				Bacillariophyceae	*Navicula* sp.	C
				Bacillariophyceae	*Cyclotella* sp.	VA
HT19C	Housatonic River, Tyringham Rd., Lee	Sept. 11	Rock, pool	Chlorophyceae	*Coleochaete* sp.	VA
				Chlorophyceae	*Rhizoclonium* sp.	VA
HT19C	Housatonic River, Tyringham Rd., Lee	Sept. 11	margins	Bacillariophyceae	naviculoids	VA
				Bacillariophyceae	*Cyclotella* sp.	C
				Chlorophyceae	*Pediastrum* sp.	R
				Cyanophyceae	*Lyngbya* sp.	R
HT19E	Housatonic River, Route 183, Stockbridge	Sept. 9	Rock, riffle	Chlorophyceae	*Cladophora* sp.	VA
	Tributary Stations					
Sta #	Location	Date	Habitat	Family	Genus	Abundance
WB01	Windsor Brook at Old Windsor Rd., Windsor	Sept. 10	Rock, riffle	Cyanophyceae	*Lyngbya* sp.	C
WB01	WB01-Windsor Brook at Old Windsor Rd., Windsor	Sept. 10	Pool	Bacillariophyceae	*Melosira* sp.	VA
				Chlorophyceae	*Sirogonium* sp.	C
				Chlorophyceae	*Spirogyra* sp.	VA
WF01A	Wahconah Falls Brook, Holiday Farms Rd., Dalton	Sept.10	Rock, riffle	Bacillariophyceae	*Synedra* sp.	VA
					Gomphonema sp.	C
				Bacillariophyceae	*Surirella* sp.	R
					Scenedesmus sp.	R
				Bacillariophyceae	*Melosira* sp.	C
					Microspora sp.	R
				Bacillariophyceae	*Cymbella* sp.	C
				Bacillariophyceae	*Meridion* sp.	R
				Bacillariophyceae	*Fragilaria* sp.	A
					Oscillatoria	R

					rubescens	
Appendix A: PERIPHYTON-Housatonic River 2002 Habitat, Algal Identification and Abundance						
Sta #	Location	Date	Habitat	Family	Genus	Abundance
				Bacillariophyceae	*Nitzchia* sp.	R
					Tetradesmus sp.	R
					Zygnema sp.	C
					Spirogyra sp.	C
WR01	Williams River-upstream from Route 41, Great Barrington	Sept. 9	Cobble, riffle	Chlorophyceae	*Spirogyra sp*.	A
				Chlorophyceae	*Cladophora glomerata*	VA
WR01	Williams River-upstream from Rte. 41, Great Barrington	Sept. 9	Cobble pool	Bacillariophyceae	*Gyrosigma*	R
				Chlorophyceae	*Ulothrix zonata*	VA
				Cyanophyceae	*Oscillatoria curviceps*	C
				Cyanophyceae	*Oscillatoria* spp.	VA
GR23A	Green River at Route 23/41, Great Barrington	Sept.9	Rock, riffle	Chlorophyceae	*Zygnema* sp.	VA
KR11	Konkapot River at Bidwell Park, Monterey	Sept. 11	Rock, riffle	Bacillariophyceae	*Melosira* sp.	VA
				Bacillariophyceae	*Cocconeis* sp.	VA
				Chlorophyceae	*Cladophora* sp.	VA
KR07	Konkapot River east of Clayton Mill River Rd., downstream from Mill River, village of Mill River, town of New Marlborough	Sept. 9	Rock, riffle	Chlorophyceae	*Cladophora* sp.	VA
					Ui green coccoid	VA
KR02	Konkapot River, Route 124, New Canaan, CT	Sept.9	Rock, riffle	Bacillariophyceae	*Tabellaria* sp.	VA
				Chlorophyceae	*Cladophora glomerata*	VA

APPENDIX H

DWM Technical Memorandum (CN 131.0)
TM-21-4

Continuous Temperature Data at Four Locations in the Housatonic River Watershed (July-August, 2002)

Prepared by: Richard Chase and Peter Mitchell
MADEP, Division of Watershed Management

Date: 8/26/2003

Contents:

INTRODUCTION

Cost-efficient, continuous water temperature data can be useful to environmental managers trying to understand surface water temperature dynamics in single waterbodies or at many locations within watersheds. Specifically, validated data can help to determine maximum, minimum and mean daily temperatures, examine the timing of diurnal temperature fluctuations, assess the potential for exceedances of state surface water quality criteria, determine appropriate thermal NPDES permit limits, and assist in waterbody classifications based on temperature (e.g. cold vs. warm water fishery).

Continuous, in-stream temperature data were gathered during summertime, 2002 baseflow conditions in three waterbodies in the Housatonic watershed.

BACKGROUND INFORMATION

Basin Description

The Housatonic River Basin is located in southwestern Massachusetts. It is bordered by the Hoosic River Basin to the north, the Westfield River Basin to the northeast and by the Farmington River Basin to the southeast. The south and west portions of the basin are bordered by the states of Connecticut and New York, respectively. The Housatonic River originates at the confluence of the West and Southwest Branches of the Housatonic River in Pittsfield. The West Branch Housatonic River originates at the outlet of Pontoosuc Lake in Lanesborough and Pittsfield and the Southwest Branch originates from Richmond Pond in the town of Richmond. The East Branch Housatonic River, which originates from Muddy Pond in the town of Washington, soon joins the mainstem Housatonic River. From Pittsfield, the river flows south for 150 miles (approximately 54 river miles in Massachusetts) until it empties into Long Island Sound near Bridgeport, Connecticut. Other major tributaries to the Housatonic River in Massachusetts include the Williams, Green and Konkapot Rivers and Hubbard Brook.

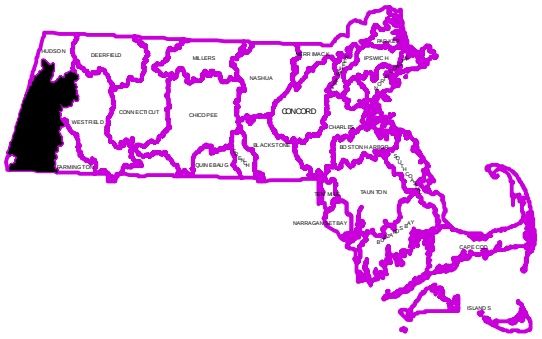


Figure 1. Housatonic River Basin Location.

The drainage basin of the Massachusetts portion of the Housatonic River encompasses 545 square miles, and is located entirely in Berkshire County. The communities of Alford, Becket, Cheshire, Dalton, Egremont, Great Barrington, Hancock, Hinsdale, Lanesborough, Lee, Lenox, Monterey, Mount Washington, New Ashford, New Marlborough, Otis, Peru, Pittsfield, Richmond, Sandisfield, Sheffield, Stockbridge, Tyringham, Washington, West Stockbridge, and Windsor lie wholly or in part within the basin boundaries.

Much of the upper third of the Housatonic River Basin is urbanized, with the city of Pittsfield being the major urban area. The remaining two-thirds of the watershed is primarily rural; large portions of the basin are undeveloped as forest or large wetland systems. The major industries of this region are paper manufacturing and tourism, and both industries have traditionally supported the economy of the area.

Water Quality

The major industrial discharges of wastewater to the river include: Crane Paper Company, General Electric Company, Schweitzer-Mauduit International, Inc. and Mead Paper Company. All of these companies provide treatment for their process wastewater prior to discharge to the river. Major municipal wastewater treatment plants are located at Pittsfield, Lenox, Lee, Stockbridge, and Great Barrington. One additional municipal wastewater treatment plant (WWTP), the West Stockbridge WWTP, discharges into the Williams River.

Water quality problems within the basin include eutrophication due to phosphorous loading, sediment and fecal coliform bacteria, these problems have been overshadowed by the PCB contamination from electrical manufacturing in the upper portion of the watershed. Non-point source pollution that is associated with storm water runoff and failing septic systems is also known to contribute to the basin's water quality problems. Urbanization around lakes and ponds has lead to increased loadings of sediment and nutrients, resulting in eutrophication of these waterbodies.

Waterbody and Fisheries Classifications

The Housatonic watershed contains both cold and warm water fisheries. Class B, Cold-Water Fisheries (CWF) are described as waterbodies "in which the maximum mean monthly temperature generally does not exceed 68°F (20°C)" and that are capable of supporting year-round populations of cold water species, such as trout. Class B, Warm-Water Fisheries (WWF) are described as waterbodies "in which the maximum mean monthly temperature generally exceeds 68°F (20°C)" and that cannot support cold water species. Also, Class C waters (of which there are none designated in the Housatonic)"…shall not exceed 85°F (29.4°C)."

The current waterbody classifications per the Massachusetts State Water Quality Standards (SWQS) are as follows.

Table 1: Current SWQS Waterbody Classifications for Project Segments

Waterbody	Segment	Class B designation
Hubbard Brook	Entire length	CWF (≤ 20 deg. C)
Housatonic River	MA 21-20	WWF (≤ 28.3 deg. C)
Hop Brook	MA 21-TBD	CWF* (≤ 20 deg. C)
Housatonic River	MA 21-19	WWF (≤ 28.3 deg. C)

* This stream is not officially designated as a Cold Water Fishery. However, Hop Brook is stocked with trout and a resident/reproducing trout population was observed during the DWM 2002 Housatonic Fish Population Survey. This survey took place ~ 3-miles upstream from the Stowaway® installation location.

Recent Temperature Monitoring

The headwaters of the Housatonic River are, for the most part, small high-gradient streams with almost complete canopy cover. These cold-water streams stand in contrast to the mainstem of the Housatonic, which is much wider with a lower gradient than the tributaries. It occupies the sandy Housatonic valley floor, allowing the river to meander across the valley and create oxbows and backwaters. The width of the mainstem makes complete canopy cover an impossibility along most of the mainstem's length. This, in turn, allows for increased solar radiation to affect this slower moving water.

In 1997 DWM obtained instantaneous temperature measurements from 12 stations (on four occasions) using a Hydrolab® multi-probe unit. These data are contained in the "Housatonic River Basin 1997/1998 Water Quality Assessment Report" (Kennedy and Weinstein 2000). All stations were located along the Konkapot River. There are no temperature data from that report for the mainstem of the Housatonic River or other tributaries.

In 2002 DWM returned to the Housatonic River and sampled 18 stations for Hydrolab® parameters, including temperature. These stations were sampled during the pre-dawn hours on five occasions. Three of these 2002 watershed monitoring stations (Hubbard Brook 21-15A, Mainstem Housatonic 21-20A, and Hop Brook HB) were also employed for this temperature study.

A private consulting firm (Woodlot Alternatives, Inc.) contracted by the US Environmental Protection Agency (EPA) employed continuous temperature data loggers to examine water temperatures at five stations in the upper Housatonic River in 2000 and 2001. The closest "Woodlot" station was located approximately 13 river miles upstream from DWM sensor Number 3. Although no direct comparisons between these two data sets may be established, similar diurnal fluctuations in temperature have been noted at all locations in both data sets.

PROJECT OBJECTIVES, SAMPLING DESIGN AND QUALITY ASSURANCE

The project **objectives** in gathering continuous temperature data at selected locations in the Housatonic watershed were as follows:

1. document and evaluate the field methods for deployment and data retrievel, and to assess in-situ equipment accuracy, in order to formalize DWM standard operating procedures for continuous temperature monitoring;
2. record "worst case" temperature conditions over a several week period at four separate locations under summertime baseflow conditions; and
3. assist in assessing each waterbody's health with regard to designated uses, including the evaluation of current and future water quality classifications using the Massachusetts Surface Water Quality Standards.

The **data quality objectives (DQOs)** for the project were as follows.

Table 2: Project DQOs.

Analyte	Units	Expected Range	Accuracy (+/-)	Resolution	Overall Precision (Relative percent difference)
Temperature	°C	15-35	0.2	0.15	NA
Time (logger internal clock)	minutes	NA	< 5 minutes over an approximate 1 month deployment	NA	NA

The selection of continuous temperature logging equipment was based on a review of available equipment to purchase, internal DWM experience using continuous temperature sensors, cost and ease of use. Optic Stowaway® Temp sensors and BoxCar Pro 4 software (Onset Computer Corporation, Bourne, Ma.) were used, along with an "optic shuttle" (for portable field data downloading) and an optic "base station" (for data transmittal to a computer).

The seasonal timing of data collection aligned with theoretical "worst case" temperature conditions (late July through August) and was limited by other planned deployments. The recording interval was set at 15 minutes to maximize data quantity while ensuring adequate available storage though the anticipated monitoring period (approx. 1 month). About 82 days of data storage is available using a logger reading interval of 15 minutes.

Logger temperature accuracy and logging capability was tested prior to deployment in the lab. In-situ accuracy was tested by side-by-side comparison against a National Institute of Standards and Technology (NIST)-traceable precision thermometer (Eutechnics 4400 series) at each location on two occasions --- when initially deployed and when retrieved.

Logger time accuracy was limited by the Onset loggers, which can vary up to one hour per year at 20 deg. C. The internal clock of each logger was set at launch (via the BoxCar software) by a DWM office network PC in Worcester, Ma. Due to the relatively short monitoring period and how the data may be used, time errors are considered much less important than potential errors in temperature.

Due to limited staff and scheduling issues, a formal project-specific Quality Assurance Project Plan (QAPP) was not produced for this monitoring. A formal Standard Operating Procedure (SOP) for continuous temperature monitoring was developed in 2002, based in part on insights gained during this project (MassDEP 2002).

The number of continuous temperature sensors deployed was limited to four, based on the number of sensors purchased in May, 2002. Sampling site locations were chosen to coincide with a subset of existing 2002 DWM sampling stations and to assess those stations believed to exhibit unusually high summertime temperatures.

Continuous temperature was monitored at the following **stations.** See also Figures 3-6.

Table 3: Project Monitoring Stations

Sensor #	Station Name & Segment ID	Station ID#	Site Description	Parameters	Frequency
1	Hubbard Brook 21-15	15A	At the Route 7 bridge, Miller Road, Sheffield, MA (left bank, approx. 100' upstream) 42.06.50 / 73.21.03	Temperature	15 minute intervals from 7/25-8/28
2	Housatonic River 21-20	20A	Division Road, Great Barrington, MA (approx. 150' upstream from USGS gage site, left bank) 42.13.53 / 73.21.17	Temperature	15 minute intervals from 7/25-8/24
3	Housatonic River 21-19	NA	Behind HVA offices Route 102, Lee, MA 42.16.39 / 73.16.39	Temperature	15 minute intervals from 7/25-8/28
4	Hop Brook 21-TBD	HB	Meadow Street bridge, Lee, MA (approx. 20 feet upstream from bridge) 42.16.13 / 73.15.03	Temperature	15 minute intervals from 7/25-8/28

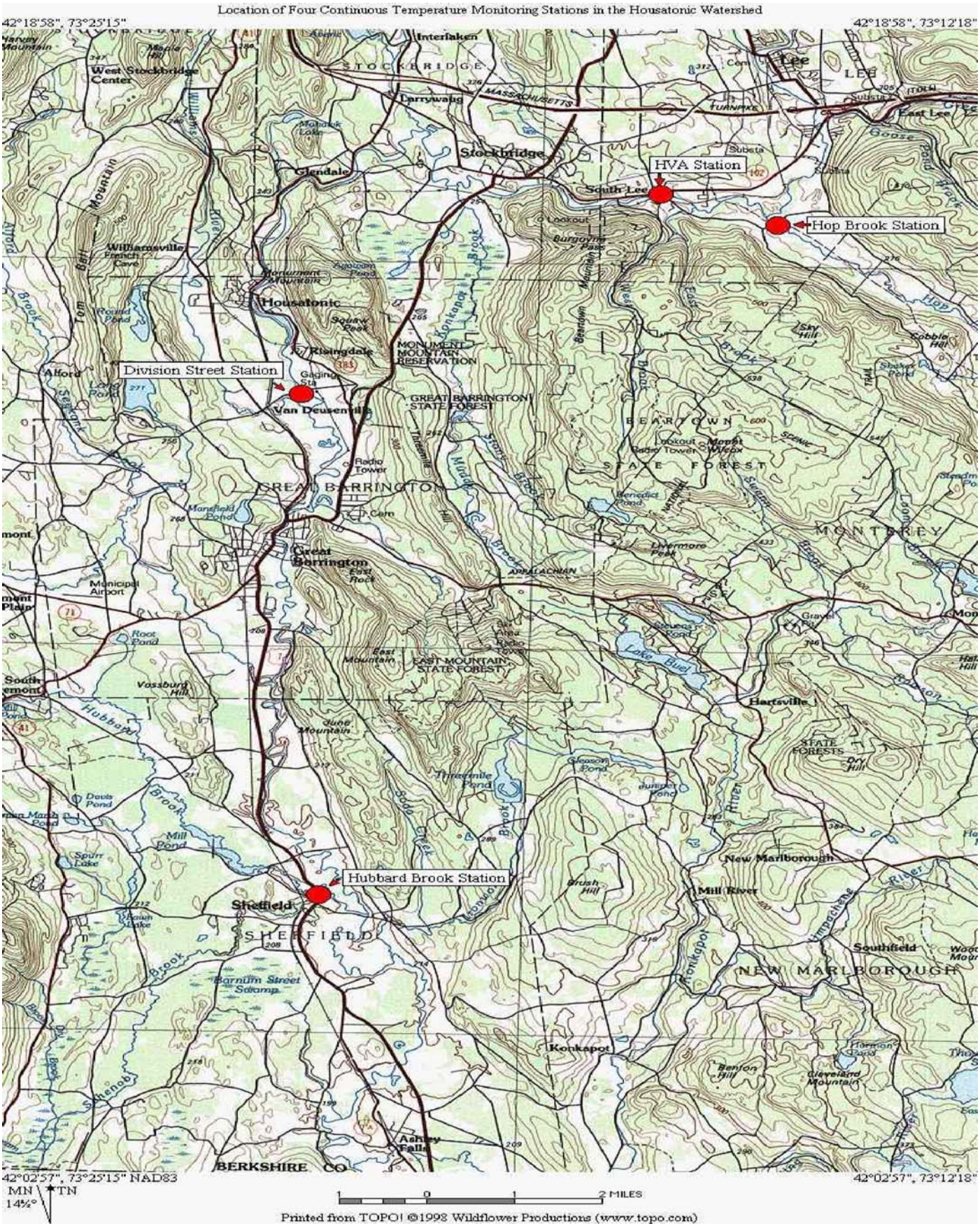


Figure 2: Project Locations

Figure 3: Hubbard Brook (MA21-15) station at Rt. 7 bridge in Sheffield, MA.

Figure 4: Housatonic River (MA21-20) station @ Division Street, Great Barrington, MA.

Figure 5: Hop Brook (MA21-TBD) station at Meadow St. in Lee, MA.

METHODS AND MATERIALS

See Appendix A for temperature logging equipment descriptions and manufacturer specifications. The following materials were used in this project.

Sensing and Data Retrieval Equipment: Optic Stowaway® Temp loggers, optic shuttle, optic base station and BoxCar Pro software (Onset Computer Corp.). The 6" long, sealed polycarbonate optic loggers were initially launched (logging initiated) using the BoxCar program loaded on a DWM computer and tested for logging capability and accuracy over several days. All sensors were deemed fit to use and were re-launched prior to placement in rigid plastic tubes for field use. At the same time, the optic shuttle (used for field downloading without a laptop) and the optic base station (for data transmittal from a logger or the shuttle to the PC) were also tested to make sure they worked. The BoxCar program was also tested and used to look for any potential software problems and none were found. After placement in the plastic tubes, the loggers were anchored at representative stream/river locations at each of the four stations.

Sensor Housing and Anchoring Assembly: Each sensor was placed in a 9-12" long, 2" O.D. plastic pipe with glued, white caps on both ends for protection. Several ¾" holes were drilled into each pipe section so each assembly would sink. Prior to glueing the caps, a small, round rock was placed inside each pipe to reduce buoyancy and guarantee submergence. Also, the white caps were numbered (#1-4) to keep track of which loggers were at which locations. Approximate 10-15' long, 1/8" diameter, flexible steel cables were swage-fitted to each pipe (on one end) and attached to the top loop of 18" long steel screw anchors.

Field Deployment: At each station the anchors were screwed into a stable streambank at the water's edge. The cable was hidden as much as possible and the pipe containing the sensor allowed to drift downstream and sink (or the pipe was secured under large rock). All locations and placements were selected to be representative of typical stream/river conditions. The pipe number, station name and number, exact time and other relevant field data were documented.

Data Analysis: Recorded data were viewed, graphed and analyzed using the BoxCar Pro 4 software (Onset Computer Corp.). Data were also exported to MS Excel.

NIST-traceable accuracy checks: A hand-held digital thermometer (Eutechnics 4400 Series) traceable to a NIST-certified thermometer was used in the field to check logger accuracy at deployment and at retrieval. (This unit was purchased in 6/2001 and came with a National Institute of Standards and Technology traceable calibration certificate; the unit was then checked against a MassDEP NIST-certified thermometer (from Wall Experiment Station) in September, 2002). Based on manufacturer specifications, the Eutechnics unit is accurate within 0-50 deg. C to +/- 0.015 (plus probe tolerance) deg. C. The resolution is listed as 0.01 deg. C, with a one year probe drift of +/- 0.010 deg. C.

RESULTS AND DISCUSSION

The temperature loggers were installed at each location on July 24, 2002 and were retrieved on August 29, 2002. A summary of the data for each station is provided below. **See Appendix B for graphic presentation of the data at each station.**

Continuous Temperature Data

Hubbard Brook (MA 21-15) (Station 15A)

Temperature Range: 17.9-26.8
Mean Temperature (3360 readings over 35 days): 22.6
Avg. daily time MAX reached: 1730
Avg. daily time MIN reached: 0830
Avg. daily duration > 20 deg. C: 21.5 hrs/day
# of days MAX exceeded 20 deg. C: 34/35
Max. Daily Temp. variation: 3.6 C
Mean Daily Temp variation: 2.5 C

Hop Brook (MA21-TBD) (Station HB)

Temperature Range: 17.2-28.5
Mean Temperature (3360 values over 35 days): 22.8
Avg. daily time MAX reached: 1600
Avg. daily time MIN reached: 0900
Avg. daily duration >20 deg. C: 18:45 hrs/day
days MAX >20 deg. C: 34/35
Max Daily Temp variation: 5.7 C
Mean Daily Temp variation: 3.5 C

Housatonic River (MA21-20) (Station 20A, Division St.)

Temperature Range: 19.6-31.0
Mean Temperature (2976 values over 31 days): 24.1
Avg. daily time MAX reached: 1500
Avg. daily time MIN reached: 0900
Avg. daily duration > 20 deg. C: 23.9 hrs/day
# of days MAX > 20 deg. C: 30/31
Max Daily Temp variation: 8.2 C
Mean Daily Temp Variation: 5.0 C

Housatonic River (MA21-19) (Behind HVA).

Temperature Range: 19.2-27.0
Mean Temperature (3360 values over 37 days): 22.3
Avg. daily time MAX reached: 1600
Avg. daily time MIN reached: 1100
Avg. daily duration > 20 deg. C: 23.5 hours
# of days MAX > 20 deg. C: 33/35
Max Daily Temp variation: 3.5 C
Mean daily Temp Variation: 1.5 C

Table 4: Mean Daily Temperature Data at Four Locations in the Housatonic Watershed (7/25-8/28/2002)

Date	Hubbard Brook	Division Street	HVA	Hop Brook
07/25/02	22.93	23.76	22.62	20.73
07/26/02	21.73	22.40	21.86	19.74
07/27/02	21.47	21.83	21.26	19.32
07/28/02	21.55	22.01	21.47	19.87
07/29/02	23.16	23.76	22.81	21.97
07/30/02	24.26	24.51	24.40	23.58
07/31/02	24.54	24.89	24.69	23.92
08/01/02	24.96	25.38	25.34	24.74
08/02/02	24.47	24.96	25.42	24.22
08/03/02	24.10	25.46	23.94	22.73
08/04/02	24.70	25.78	24.93	23.62
08/05/02	24.98	26.03	25.86	24.53
08/06/02	23.47	23.88	23.94	22.74
08/07/02	21.45	22.44	21.87	20.60
08/08/02	20.88	22.46	21.75	19.99
08/09/02	20.36	22.37	21.46	19.61
08/10/02	20.87	22.55	22.28	20.47
08/11/02	21.84	23.47	23.37	21.81
08/12/02	22.86	24.46	24.38	23.05
08/13/02	23.67	25.24	25.16	23.95
08/14/02	24.32	25.80	25.88	25.00

Date	Hubbard Brook	Division Street	HVA	Hop Brook
08/15/02	24.68	25.83	26.16	25.43
08/16/02	25.23	25.90	26.30	25.85
08/17/02	25.13	26.42	26.33	26.13
08/18/02	25.16	26.56	26.41	26.10
08/19/02	24.44	25.79	26.33	25.41
08/20/02	22.88	24.32	25.00	23.50
08/21/02	21.49	23.49	23.47	22.22
08/22/02	20.86	22.20	23.18	21.14
08/23/02	21.08	22.26	22.40	20.96
08/24/02	19.30	20.49	20.68	18.74
08/25/02	19.04		20.09	18.78
08/26/02	19.33		21.50	19.58
08/27/02	20.17		22.03	20.29
08/28/02	19.67		21.73	19.64

Analysis of 2002 Housatonic Watershed Continuous Temperature Data

The summer of 2002 was noteworthy for its lack of rain. Drought conditions plagued the watershed for almost the entire summer. Decreased in-stream flows can exacerbate already elevated in-stream water temperatures. Lower water levels can expose more of the substrate to warm summer air temperatures and solar radiation. Decreases in cold ground water infiltration can also accompany the drought conditions noted in the watershed.

It is noteworthy that the data for Hop and Hubbard Brooks do not seem to support the temperature criteria for cold water fishery designation; mid-late summer continuous temperatures indicates that temperatures generally exceeded 20 deg. C. in both waterbodies.

Although similar diurnal fluxes in water temperature may be seen in both the EPA/Woodlot data and the DWM data, a direct comparison between these two data sets cannot be made. The Woodlot data was collected a year earlier than the DWM data. Also, the closest Woodlot station is 13 miles from the nearest DWM station.

Precipitation and discharge at Division Street, Great Barrington

The temperature sensor station at the Housatonic River, Division Street location was approx. 150' upstream from the USGS Division Street stream gage (Gage # 01197500). See Figure 7.

The closest known precipitation station, located in Pittsfield, MA, and is more than 20 miles upstream from the Division Street sensor station. In general, daily rainfall amounts in the summer of 2002 were low and localized. There are several impoundments between the rainfall gauge and the most upstream sensor station. The rainfall data shows very little relationship to the stream flow at the gage. For example, the 0.55" rain event recorded in Pittsfield on August 13, 2002 shows no impact upon the gage reading. This may be because of the several impoundments between the rainfall event and the gage.

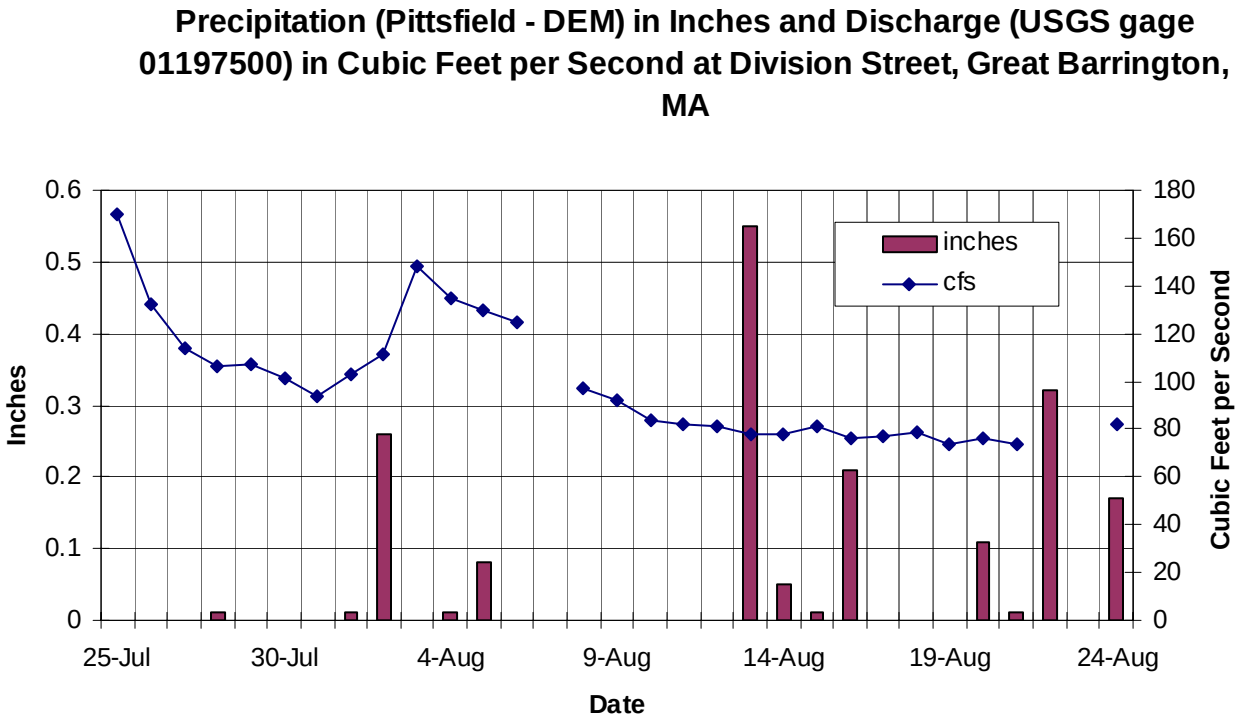


Figure 7: Representative river flow and precipitation data in the area

Fishery Status

While the actual presence of cold water fish can be the most important factor in determining fishery status, habitat-related information, such as temperature data, are also important. Such habitat assessment is especially relevant when the fish surveys indicate little or no use by cold water species, which can be due to a number of factors, including lack of woody debris and cover, elevated temperatures and poor water quality.

The most recent fish population surveys performed by MassDEP/DWM in the project area were in 2002. A station was established on Hop Brook 3.7 miles upstream of the Hop Brook temperature sensor location. The DWM fish population survey (conducted on 20 August 2002) revealed in an in-stream fish community dominated by blacknose and longnose dace. However, five brown trout and one eastern brook trout (obligatory cold-water species) were also captured. In 1998 Massachusetts Division of Fish and Game (MA DFG) collected similar species at this location, and classified this stream as a Cold-Water Fishery.) A station sampled by both groups was located upstream from Merry Brook (Lat: 41.14.51 / Lon: 73.12.24), behind the firehouse in Tyringham. Hop Brook changes dramatically after the confluence with Merry Brook. The gradient disappears as the stream enters the flood plain of the Housatonic River. Also, there

is a lack of trees along the banks that could provide shading. These two factors may increase water temperature. The upstream fish population data and the downstream temperature data indicate that Hop Brook might be more accurately classified as a warm water fishery below the confluence with Merry Brook.

The fish population of Hubbard Brook was sampled by MA DFG in 1987, and is classified as a Cold Water Fishery. Although fishery classification involves several factors (most of which concerns the presence / absence of multiple age classes of cold water fishes), the temperature data recorded in this study would support a warm water fishery designation. It may be the case that the fish population survey was performed upstream from the location of the temperature sensor. If so, then Hubbard Brook could be bifurcated into cold water and warm water sections. A return to Hubbard Brook to determine if cold-water species are reproducing throughout the length of the stream would yield more conclusive information.

Quality Control Data

Based on *in-situ*, side-by-side QC checks at deployment and upon retrieval, the data generally met project data quality objectives for temperature and time logging, with minor exception as explained below. At deployment, each logger was within 0.1 deg. C (+/-) of the NIST-traceable hand-held unit. Sensor #2 (Station 20A), however, was only within about 0.25 deg. C. Although the digital precision thermometer was not available at retrieval, QC temperature checks were performed when each logger was re-deployed at other locations within the following week.

Table 5: QC Accuracy Check Data Using Precision NIST-Traceable Thermometer

Sensor #	Station Name	Date	Time	Stowaway Logger Temp (deg. C)	NIST-Traceable Temp (deg. C)	Range
1	Hubbard Brook	7/24	10:35	22.7 *	22.75	0.05
1		*9/5*	*11:30*	*17.58*	*17.45*	*0.13*
2	Housatonic River (20A)	7/24	11:20	24.29	24.03	0.26
2		8/29	14:30	21.23	21.45	0.22
3	Housatonic River	7/24	12:35	22.82	22.93	0.11
3		8/29	14:00	15.66	ND	NA
3		*9/5*	*12:37*	*18.38*	*18.36*	*0.02*
4	Hop Brook	7/24	13:15	22.14	22.18	0.04
4		*9/5*	*12:22*	*25.06*	*25.04*	*0.02*

* interpolated between 15 minute interval readings
ND = No Data
NA = Not Applicable
Italics = upon re-deployment at other sites

Preliminary Hydrolab® temperature data shown below in Table 6 were similar to those obtained from the Stowaway® temperature loggers.

Table 6: Hydrolab® temperature data (for comparison)

Station	Date	Hydrolab (temp and time)	Stowaway (temp and time)
Hubbard Brook	7/30/02	23.98 01:02	23.84 00:57
Housatonic River (20A)	7/30/02	23.96 02:47	23.61 02:42
Hop Brook	7/30/02	22.93 04:42	22.82 04:42

SOP Development for Continuous Temperature Monitoring

Experience gained during this monitoring project (and review of similar-type projects) helped to formulate standard operating procedures (MassDEP 2002) and guidance for DWM's deployment and use of continuous temperature loggers, including analysis of the data. Important considerations for future use of continuous temperature loggers include:

1. Target sampling period consistent with project objectives. For example, if interested in maximum mean monthly temperature(s), deploy sensors long enough to estimate the statistic, and during "worst-case" months (July through August-September) when daytime air temperatures are highest and flows lowest.

2. When evaluating thermal impacts from a discharge, deploy a sufficient number of properly-placed sensors to be able to draw conclusions. Ensure that upstream and downstream sensors are spaced as close as possible (outside mixing zones) to minimize effects of natural heat gain, which complicate the analysis.

3. Perform adequate quality control procedures to increase confidence in the data. Consider duplicate (side-by-side) sensors to better estimate instantaneous mean temperatures for each location (and to estimate sampling precision), as well as more frequent QC accuracy checks using high-quality, NIST-certified/traceable thermometer(s).

4. When analyzing the data, use appropriate tools and data sets based on project objectives and the results of QC sampling. Statistical estimates, such as means, medians and maximums, may vary greatly depending on what data is used. Perform adequate data validation prior to analysis to ensure data is usable.

5. Apply adequate attention to sensor placement at all locations. Loss of data from one sensor, due to vandalism, poor placement or other problem, may seriously compromise project objectives.

6. Provide sufficient time for project documentation (e.g., to prepare the project QAPP, fill out continuous temperature monitoring fieldsheets, report data in a detailed, organized manner, etc.) and for proper implementation of SOP(s). Use of continuous temperature sensors should follow adopted SOPs, but may not require a dedicated QAPP (although it should be discussed in a watershed-based monitoring QAPP, if applicable).

7. Perform standard data management and analysis procedures for continuous temperature data, in order to streamline and focus the reporting of results. Provide validated data to the DWM database manager in an acceptable format (ASCI, comma-delimited, Excel or Access), so that data can be stored and provided to users, including EPA (STORET).

8. Although some projects may require specific data analyses, calculate the following baseline statistics for each location. When comparing upstream-downstream locations, use time-shifts as appropriate to account for time-of-travel between locations (measured or estimated):
    a. monthly (and overall) mean temperature,
    b. daily mean temperature,
    c. maximum and minimum overall temperature,
    d. average daily duration > 20° C,
    e. average daily duration > 28.3° C. (and other "thresholds" as applicable)
    f. T-test for statistically-significant differences in means (as applicable; e.g. mean daily temperatures upstream/downstream of a discharge), and
    g. instantaneous "delta T"s (temperature changes) from one location to another (if applicable).

SUMMARY AND RECOMMENDATIONS

1. Based only on the continuous ("worst case") temperature data collected in this study, it appears that Hubbard Brook (Segment MA21-15) and Hop Brook at Meadow St. (MA21-TBD) would not support CWF designations (subject to additional considerations). These data should be shared with MA DFG to assist in making informed decisions regarding CWF/WWF classifications.

2. Consideration should be given to creating two separate stream segments for Hop Brook, split at the Merry Brook confluence. The upstream segment may be more accurately classified as a CWF, while the downstream segment a WWF. A similar strategy could be applied to Hubbard Brook.

REFERENCES

USGS. 2000. Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation and Reporting, WRIR 00-4252

Kennedy, L.E. and M.J. Weinstein. 2000. *Housatonic River Basin 1997/1998 Water Quality Assessment Report.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Idaho Division of Environmental Quality. 1999. Protocol for Placement and Retrieval of Temperature Data Loggers in Idaho Streams. Report#10

Oregon Dept. of Environmental Quality. 2002. Consolidated Assessment and Listing Methodology for Oregon's Draft 2002 303(d) List and 305(b) Report, Draft

MassDEP. 2002. Standard Operating Procedure for Continuous Temperature Monitoring. CN 103.0. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

Appendix A: Temperature Logging Equipment

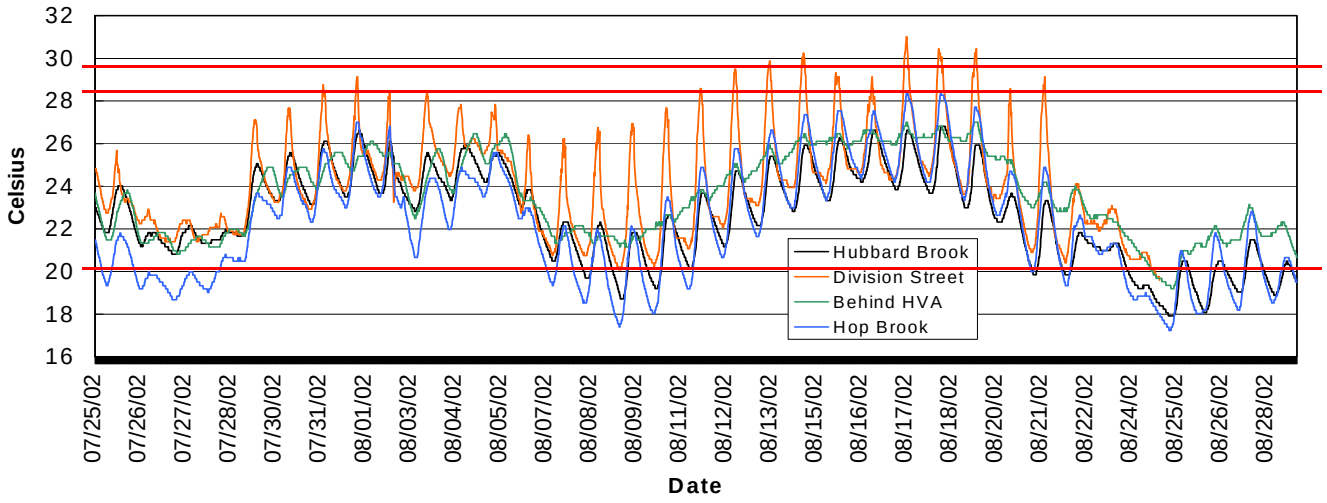
Stowaway sensor, plastic tube and cable/anchoring assembly shown.

Optic Stowaway Temp Specifications: (as provided by Onset Computer Corp.)

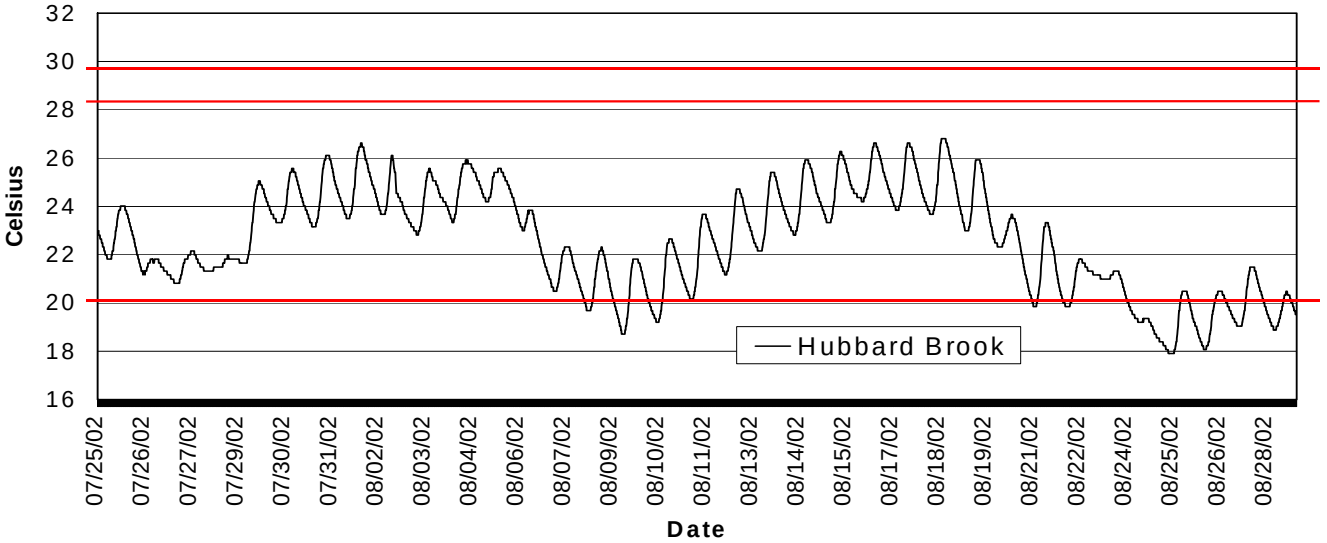
- ◇ *Accuracy* (maximum measurement error, including thermistor error, resistor value errors and quantization errors) for –5 to 37 deg. C unit: 0.2 deg. C at ambient temps of 10-30 deg. C
- ◇ *Resolution* for –5 to 37 deg. C unit: 0.15 deg. C at ambient temps of 10-30 deg. C
- ◇ *Depth Resistance*: >100 feet
- ◇ *Battery Life*: 10 years, but depends on how used…
- ◇ *Time Error*: Up to one hour per year
- ◇ *Storage*: About 82 days of data storage is available using a sensor reading interval of 15 minutes (8K sensor).

Appendix B: Temperature Data Graphs

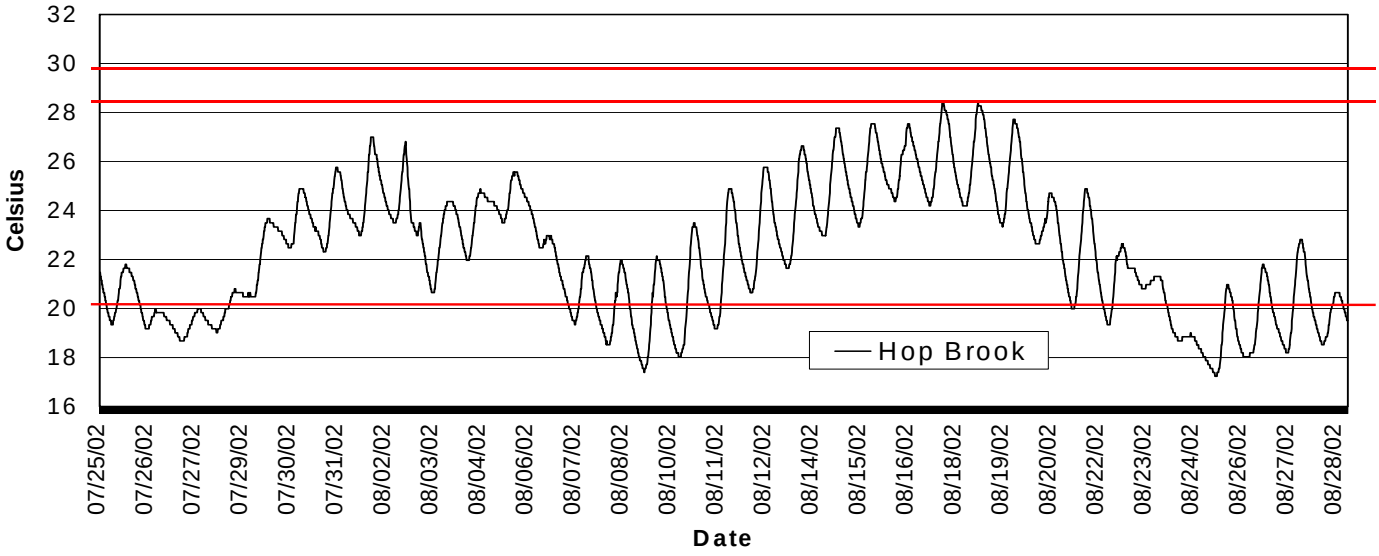
Continuous Temperature Data from Four Locations in the Housatonic Watershed



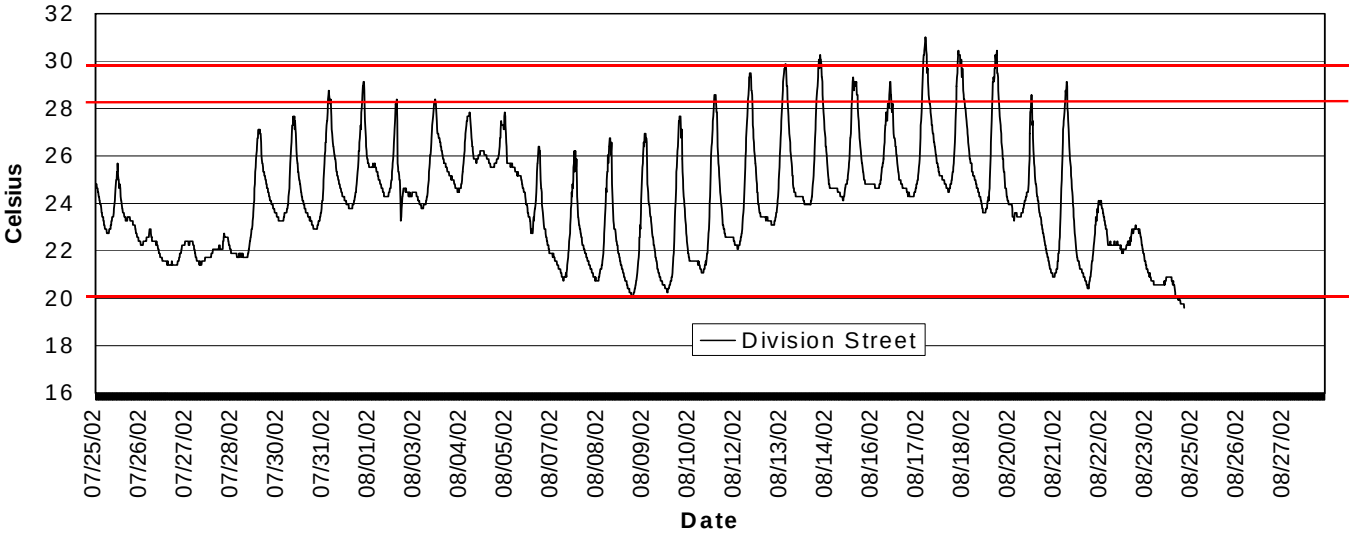
Continuous Water Temperature at Hubbard Brook

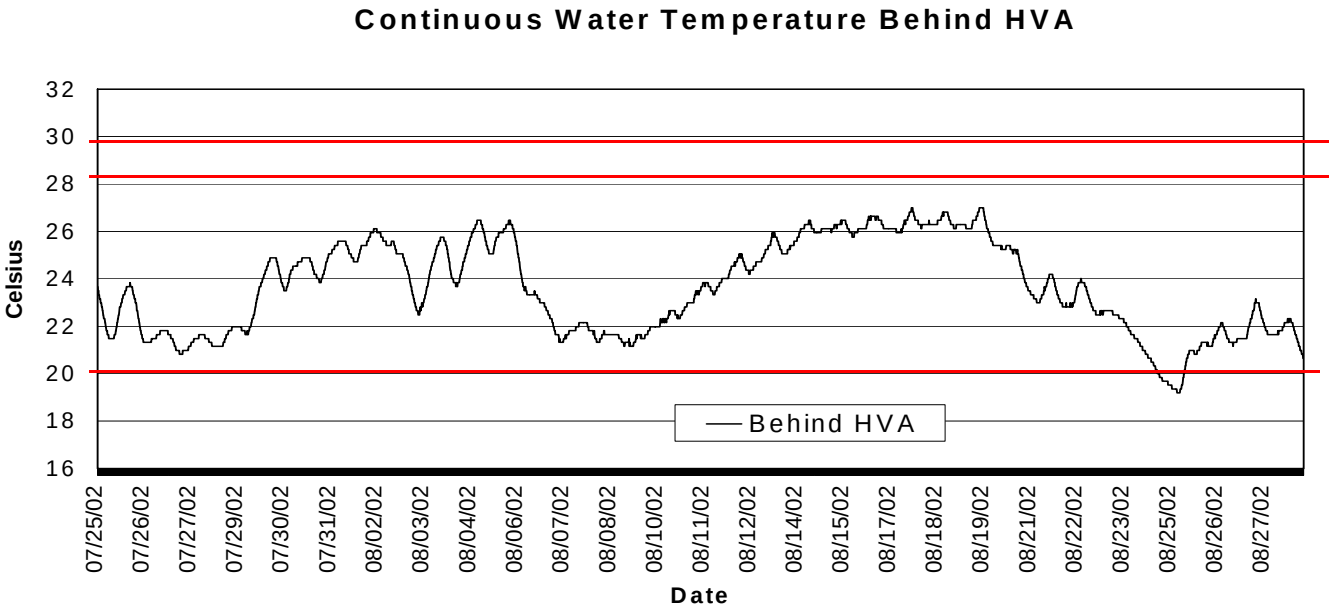


Continuous Water Temperature at Hop Brook



Continuous Water Temperature at Division Street




Continuous Water Temperature Behind HVA
Celsius
32
30
28
26
24
22
20
18
16
Behind HVA
07/25/02
07/26/02
07/27/02
07/29/02
07/30/02
07/31/02
08/02/02
08/03/02
08/04/02
08/06/02
08/07/02
08/08/02
08/10/02
08/11/02
08/12/02
08/14/02
08/15/02
08/17/02
08/18/02
08/19/02
08/21/02
08/22/02
08/23/02
08/25/02
08/26/02
08/27/02
Date

APPENDIX I

Division of Watershed Management

Housatonic River Watershed
Year 2002 Water Quality Monitoring Survey

Results of Optical Brightener Sampling

DWM Control Number CN 197.7

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Stephen R. Pritchard, Secretary
Massachusetts Department of Environmental Protection
Robert W. Golledge Jr., Commissioner
Bureau of Resource Protection
Glenn Haas, Acting Assistant Commissioner
Division of Watershed Management
Glenn Haas, Director

March, 2006

INTRODUCTION

Optical brighteners are added to laundry detergents to enhance the brightness of colors. They readily adsorb to fabrics particularly cotton. Also referred to as fluorescent whitening agents (FWA's), the optical brighteners are excited by near-ultraviolet (UV) wavelengths (360-365 nm), but they release light in the "blue range" (400-440 nm) (Hagedorn et al. 2005). Optical brightener testing is a way of determining whether or not laundry detergents are entering a waterbody either through a direct discharge or after traveling through the ground from a poorly functioning Title V septic system. The method is being used as a screening tool by MassDEP to identify waterbodies with elevated bacterial counts from human sources (septic systems or cross connections) as opposed to those with bacteria contributed by other warm-blooded animals, domestic or wild. Samples collected from a stream or a pipe are likely to contain human waste if the sample, when held under a UV lamp, gives off a bright, somewhat blue, glow indicating that FWA's are present.

Optical brightener samplers were deployed at two tributaries to the Housatonic River - Goose Pond Brook and Green Water Pond Brook during the 2002 surveys. Station locations and sampling dates are presented in Table 1. Goose Pond Brook was listed in the 1998 303d list of impaired waterbodies for pathogens based on elevated bacterial counts at Goose Pond Brook in 1997 (MassDEP 2000). Upstream sources for the bacteria, which could include its tributary Green Water Pond Brook, were not identified at that time, so sampling in 2002 focused on separating the influence of these two brooks on elevated bacterial counts. Optical brightener sampling was done along with bacterial sampling to try to identify areas where humans might be the source of contamination.

MATERIALS AND METHODS

Optical brightener samplers were composed of unpolished cotton pads that were held upright on a cement block by wire screening. The pads were deployed in-stream and left for a day or two. Following retrieval of the cement block, the pads are removed from the screening, swirled around in the ambient water and placed in a plastic bag. The cotton pads were transported to the lab at DWM-CERO in Worcester for analysis. Light exposure was kept at a minimum to reduce the effect of photodegradation on the optical brighteners. The pads were removed from the plastic bags and hung up to dry. Once dry, the pads were read using a lamp equipped with a long-wave ultraviolet bulb that causes any optical brighteners absorbed to the pads to glow; if the pads were negative for optical brighteners they would appear as dull white surfaces.

RESULTS

Results of the optical brightener sampling are presented in the Table 1. Only the sample collected in September from Greenwater Pond Brook was positive for optical brighteners.

Table 1. Housatonic River Basin - Optical Brightener Sampling - July and September 2002

Station Number	Location	Dates Deployed	Result	Dates Deployed	Result
07A	Goose Pond Brook, Forest Street, Lee, MA	7/29-7/31	Negative	9/23-9/25	Negative
07A	(Duplicate)	7/29-7/31	Negative	9/23-9/25	NT*
07B	Goose Pond Brook Tyringham Road Lee, MA	NT*	NT*	9/23-9/25	Negative
GWPB	Green Water Pond Brook, Forest Street, Lee, MA	7/29-7/31	Negative	9/23-9/25	Positive
Blank	--	7/31	Negative	9/23-9/25	Negative

*NT – not tested

DISCUSSION

Green Water Pond Brook at GWPB had the highest bacterial counts of the three optical brightener sampling stations in 2002. The *Escherichia coli* counts ranged from 70 to 140 cfu/100 ml (n=5) over May to September 2002, while the two Goose Pond Brook stations had *E. coli* values of <10 to 60 cfu/100 mL (n=7) (Mitchell 2005). Neither of these waterbodies, however, exhibited counts that would cause them to lose their most sensitive use for Class B waters, (i.e., primary contact recreation) (MassDEP 1996).

The only positive sample for optical brighteners was collected on September 25, 2002 at Green Water Pond Brook. This is an indication that material from a septic system may have been reaching the Brook. Materials other than laundry detergents may also cause positive results for FWA's. These include metal particles, bleached materials, cotton dust, or paper products. It is important that the unbleached cotton pads are not exposed to these contaminants via aerial deposition or by physical contact, such as placing the pad down on paper, particularly if either is wet, and allowing the optical brighteners to leach out. The lack of elevated bacterial counts at the sampling station could indicate that the source of the optical brighteners (and bacteria) was a considerable distance from the sampling station or that the discharge of bacteria occurred sometime earlier. At this time more bacterial and optical brightener data would need to be collected to prove or disprove the presence of a human source.

Additional sampling is still needed to determine if Goose Pond Brook could be taken off of the Section 303(d) List or if the actual impaired status could be applied only to Green Water Pond Brook. The low bacterial counts obtained in 2002 are an indication that something was mitigating the sources of bacterial contamination that led to the 1998 listing decision. It is also possible that the lack of precipitation that occurred during July, August and September 2002 in the Housatonic River Basin (Mitchell 2005, USGS 2003) may have lowered groundwater levels enough to keep problem septic systems from affecting surface waters.

REFERENCES CITED

Hagedorn, C. Saluta, M., Hassall, A., Dickerson, J. 2005. *Fluorometric Detection of Optical Brighteners as an Indicator of Human Sources of Water Pollution. Part I. Description and Detection of Optical Brighteners.* Dept. of Crop and Soil Environmental Sciences. Virginia Tech. Blacksburg, Virginia

MassDEP. 1996. (Revision of 1995 report). *Massachusetts Surface Water Quality Standards (Revision of 314 CMR 4.00, effective June 23, 1996)*. Massachusetts Department of Environmental Protection, Division of Water Pollution Control, Technical Services Branch, Westborough, MA.

MassDEP. 2000. *Housatonic River Basin 1997/1998 Water Quality Assessment Report*. EDS: Kennedy and Weinstein. CN 019.0. Massachusetts Division of Watershed Management. Department of Environmental Protection. Worcester, MA.

Mitchell, P. 2005. *DRAFT Technical Memorandum TM-21-6 Housatonic River Watershed DWM 2002 Water Quality Monitoring Data.* Massachusetts Division of Watershed Management. Department of Environmental Protection. Worcester, MA.

USGS 2003. *MA Drought Index Maps*. http://ma.water.usgs.gov/drought/drought_index.htm.

APPENDIX J
SUMMARY OF NPDES AND WMA PERMITTING INFORMATION
HOUSATONIC RIVER BASIN

Table J1. Water Management Act (WMA) Registration/Permittees Housatonic River Watershed.							
Permit	Registration#	Water Supply System Name	Registered Volume (MGD)	Registered Withdrawal (Days)	20 Year Permitted Volume (MGD)	Permit Withdrawal (Days)	Segment
	10223602	Berkshire Hills Country Club	Found to be below WMA threshold of 0.1 MGD.				MA21-02 subwatershed
	10211302	Berkshire National Fish Hatchery	0.25	365	0	0	MA21-25
9P210223602		Bousquet Ski Area	0	0	0.25	120	MA21-04
9P210211302	10211304	Butternut Basin Ski Area	0.43	120	0.27	120	MA21-20
	10207002	Crane & Company, Inc.	2.97	365	0	0	MA21-02
	V10215202	Cranwell Conference Center, Inc.	0.02	153	0	0	MA21-19
	10207003	Dalton Fire District	0.67	365	0	0	MA21-10, MA21-11, and MA21119
9P210211301	10211303	Fox River Paper Company	1.04	365	0.46	365	MA21-20
	10211301	Great Barrington Fire District	1.09	365	0	0	MA21-23 and East Mountain Reservoir near MA21-20
9P210213201		Hinsdale Water System	0	0	0.29	365	Belmont Reservoir near MA21-01
	10211306	Housatonic Water Works Company	0.27	365	0	0	MA21062 (upstream of MA21-14)
9P210215004		Lane Construction Company	0		1.3	210	MA21-19
	10214801	Lanesborough Village Water District	0.21	365	0	0	Tributary to MA21083
9P210215003	10215003	Lee Water Department	1.13	365	0	365	MA21-19
	10215201	Lenox Water Department	0.76	365	0	0	MA21-06
	10219301	Lowland Farm	0.04	153	0	0	Tributary to MA21-25
9P10215001	10215001	MW Custom Papers, LLC - Specialty Div.	2.21	365	1.61	365	MA21-19
	10223603	Pittsfield Country Club	0.12	214	0	0	MA21071 (upstream of 21-04)
9P10223601		Pittsfield Generating Company, LP.	0		1.58	365	MA21-02
	10223601	Pittsfield Water Department	13.5	365	0	0	MA21003, MA21033, MA21113, MA21019 and other reservoirs
9P210215002	10215002	Schweitzer Mauduit International, Inc.	6	365	0	365	MA21-19, MA21057
	10226701	Sheffield Water Company	0.13	365	0	0	Tributary to MA21-20
	10228301	Stockbridge Water Department	0.29	365	0	0	MA21006 (upstream of MA 21-29)
	10207001	Wahconah Country Club	Found to be below WMA threshold of 0.1 MGD.				MA21-08

Table J2. Housatonic River Basin Municipal and Sanitary Surface Wastewater Discharges

PERMITTEE	NPDES #	SEGMENT
TOWN OF GREAT BARRINGTON WWTF	**MA0101524**	**MA21-20**

The Town of Great Barrington is authorized (May 2000) to discharge a flow of 3.2 MGD (average monthly) of treated sanitary and industrial wastewater from the Great Barrington Waste Water Treatment Facility (WWTF) via Outfall# 001 to the Housatonic River. A draft permit has recently been developed for this facility (public comment period through November 2006).

This conventional activated sludge facility incorporates primary sedimentation, aeration, secondary sedimentation, and disinfection. It should be noted that the secondary sludge is co-thickened in the primary settling tanks and the resulting settled sludge is then sent to gravity thickeners for additional thickening. The thickened sludge is then sent to belt-filter presses for dewatering and ultimate disposal of the sludge cake is incineration by a private contractor. Currently, the total phosphorus concentration in the effluent (April 1 to October 15, 1.0 mg/L average monthly permit limit) is low enough where chemical addition is not performed but is available if needed. Disinfection is performed by the addition of sodium hypochlorite and dechlorination is carried out by the addition of sodium bisulfite (Drumm 2005).

The pH (6.5 to 8.3 SU limits) of the effluent between June 2000 and March 2006 (n=24) ranged from 7.2 to 8.2 SU (TOXTD database). The ammonia-nitrogen concentration of the effluent between June 2000 and March 2006 (n=24) ranged from 0.18 to 14.0 mg/L (TOXTD database). The total residual chlorine (TRC) (April 1 to October 15, 0.135 average monthly and 0.234 maximum daily limits) of the effluent between June 2000 and March 2006 (n=23) ranged from < 0.01 to 0.06 mg/L (TOXTD database). The facility is required to conduct quarterly whole effluent toxicity tests using *Ceriodaphnia dubia* as the test species. The permit limits for whole effluent toxicity are $LC_{50} \geq 100\%$ and C-NOEC (report only). Other permitted parameters include Biochemical oxygen demand (BOD), Total Suspended Solids (TSS), fecal coliform bacteria and Settleable Solids.

Chemistry-water
Hardness: The hardness in the river water between June 2000 and March 2006 (n=24) ranged from 94 to 180 mg/L (TOXTD database).

PERMITTEE	NPDES #	SEGMENT
GOULD FARM	**MA0022705**	**MA21-25**

Gould Farm, Monterey, MA (MA0022705) is authorized (August 1975) to discharge a flow of 0.012 MGD (average monthly) of sanitary treatment plant effluent from their facility via Outfall# 001 to Rawson Brook. The facility is a small residential psychological rehabilitation facility with about 100 residents and staff. Wastewater is currently collected in a series of three lagoons. There is no aeration or any additional treatment in the lagoons other than natural biological processes. Chlorine is added to the discharge just prior to discharge for disinfection. The operator manually adjusts the chlorine dosing based on the results of the bacteria sampling. The facility needs to have better control of their chlorine residual. TRC in January 2006 was reported as high as 4.26 mg/L. Although the facility is exploring a groundwater discharge, EPA will be drafting a new permit for this facility.

PERMITTEE	NPDES #	SEGMENT
LAKESIDE CHRISTIAN CAMP	**MA0028410**	**MA21-17**

Lakeside Christian Camp (MA0028410) is located in Pittsfield, MA. A letter dated April 20, 1999 from Olga Vergara at EPA addressed to Mark Watkins, Executive Director, Lakeside Christian Camp states that since the Northeast Baptist Conference is connected to the Pittsfield Sewer System, then there is no longer a need for the NPDES permit. The permit was terminated.

PERMITTEE	NPDES #	SEGMENT
TOWN OF LEE WWTF	**MA0100153**	**MA21-19**

The Town of Lee is authorized (MA0100153 issued in September 2000) to discharge a flow of 1.0 MGD (rolling annual monthly average) of treated sanitary effluent from an extended aeration wastewater treatment facility via Outfall# 001 to the Housatonic River. In 2002 a phosphorus reduction system was installed (Zerbato 2005). Total phosphorus (May 1 to October 31, 1.0 mg/L average monthly limit) is reduced by the addition of commercial alum prior to secondary sedimentation (Zerbato 2005). Disinfection is accomplished by the addition of gaseous chlorine. Currently, this facility does not serve any industrial users (Zerbato 2005). An upgrade to this facility is in process. The upgrade will increase the annual average daily design flow from 1.0 MGD to 1.25 MGD. Treatment will be accomplished by a sequencing batch reactor. The facility design kinetics anticipated a future NPDES permit that will require nutrient removal so the total phosphorous design effluent quality objective is 0.2 mg/l and total nitrogen is 6.0 mg/l.

The pH (6.5 to 8.3 SU limits) of the effluent between February 2000 and March 2006 ranged from 6.7 to 7.6 SU (n=23)(TOXTD database). The ammonia-nitrogen concentration of the effluent between February 2000 and March 2006 ranged from <0.1 to 24.6 mg/L (n=23)(TOXTD database). The TRC (limits are April 1 to October 31, 0.3 mg/L average monthly and 0.51 mg/L maximum daily) of the effluent between February 2000 and March 2006 were all < 0.05 mg/L except for two measurements (n=23). None of the reported measurements exceeded permit limits(TOXTD database). The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ tested four times per year using *Ceriodaphnia dubia.* Other permitted parameters include BOD, TSS, and fecal coliform bacteria.

Chemistry-water

Hardness: The hardness in the river water between February 2000 and March 2006 ranged from 95 to 184 mg/L (n=23)(TOXTD database).

PERMITTEE	NPDES #	SEGMENT
TOWN OF LENOX WWTP	**MA0100935**	**MA21-19**

The Town of Lenox is authorized (MA0100935 issued in November 2001) to discharge a flow of 1.19 MGD (rolling annual monthly average) of treated effluent from an extended aeration activated sludge wastewater treatment plant (WWTP) via Outfall# 001 to the Housatonic River. This facility currently uses gaseous chlorine for seasonal disinfection. Between May 1 and October 31, total phosphorus (1.0 mg/L limit) is reduced by the addition of alum at the effluent of the aeration system (White 2005).

The pH (6.5 to 8.3 SU limits) of the effluent between March 2002 and March 2006 ranged from 7.4 to 7.8 SU (n=17)(TOXTD database). The TRC (permitted April 1 to October 15, average monthly is 0.3 mg/L and maximum daily is 0.51 mg/L) in the effluent between March 2002 and March 2006 were all <0.05 mg/L (n=17)(TOXTD database). The ammonia-nitrogen concentrations in the effluent ranged from less than 0.1 to 11 mg/L. The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ effluent using *Ceriodaphnia dubia* and *Pimephales promelas* as test species on a quarterly basis. Other permitted parameters include BOD, TSS, fecal coliform bacteria and report only for ammonia-nitrogen, TKN, total nitrite and total nitrate.

Chemistry-water

Hardness: The hardness in the river water between March 2002 and March 2006 ranged from 93 to 161 mg/L (n=17)(TOXTD database).

PERMITTEE	NPDES #	SEGMENT
TOWN OF LENOX ROOT RESERVOIR WATER TREATMENT FACILITY	**MAG640015**	**MA21094 upstream of MA21-06**

The Town of Lenox Root Reservoir Water Treatment Facility is authorized (MAG640015 issued in April 2001) to discharge 0.012 MGD (average monthly) to Lenox Mountain Brook from their facility located at 471 Reservoir Road in Lenox.

PERMITTEE CITY OF PITTSFIELD WWTF	NPDES # MA0101681	SEGMENT MA21-04

The City of Pittsfield is authorized (MA0101681 issued in October 2000) to discharge a flow (17.0 MGD average monthly and 28.7 MGD maximum daily limits – rolling annual monthly average) of treated effluent from the advanced wastewater treatment facility (WWTF) via Outfall# 003 to the Housatonic River. Outfall# 001 and Outfall# 002 have not been used since 1974 and 1977, respectively. In 2005 the WWTF upgraded the primary digester by installing a new tank cover. The WWTF unit processes include primary clarification, trickling filters, intermediate clarification (not used), aeration, secondary clarification, chlorination and dechlorination. Sodium aluminate can be added at the head of aeration to reduce the total phosphorus concentration (April 1 to 30, 2.0 mg/L – May 1 to August 30, 1.0 mg/L – all limits are average monthly). A gravity-belt thickener thickens the secondary sludge. Primary sludge and thickened secondary sludge are digested in anaerobic digesters and dewatered with belt-filter presses. The resulting sludge cake is hauled to an incineration facility in Connecticut (Landry 2005). This facility has the ability to add caustic soda for pH control during nitrification. In 2003 the WWTF staff discontinued the use of gaseous chlorine and installed a sodium hydroxide system for disinfection (Landry 2005). Dechlorination is accomplished by the addition of sodium bisulfite.

The ammonia-nitrogen concentration of the effluent (April 1 to 30, 10 mg/L – May 1 to 31, 5.0 mg/L – June 1 to September 30, 1.0 mg/L – all limits are average monthly) between April 2000 and March 2006 ranged from <0.03 to 0.320 mg/L (n=25)(TOXTD database). The pH of the effluent (6.5 to 8.3 SU limits) between April 2000 and March 2006 ranged from 7.4 to 7.6 SU (n=16)(TOXTD database). The TRC of the effluent (April 1 to October 15, 0.0216 mg/L average monthly and 0.0374 mg/L maximum daily limits) between April 2000 and March 2006 were all below the minimum quantification limit of < 0.05 mg/L (n=25)(TOXTD database). The facility's chronic and modified acute toxicity limits are $LC_{50} \geq 100\%$ and C-NOEC is $\geq 50\%$ testing with *Ceriodaphnia dubia* four times per year. Other permitted parameters include: BOD, TSS, fecal coliform bacteria, effluent DO, and copper.

Chemistry-water

Hardness: The hardness in the river water between April 2000 and March 2006 ranged from 67 to 200 mg/L (n=25)(TOXTD database).

PERMITTEE PITTSFIELD ECONOMIC DEVELOPMENT AUTHORITY	NPDES # MA0040231	SEGMENT MA21-02 (Silver Lake)

Pittsfield Economic Development Authority (PEDA) (MA0040231) has received the transfer of land and outfalls formerly permitted by the General Electric Company, Pittsfield (MA0003891 issued in May 1992). A letter addressed to EPA and MassDEP dated May 2005 from John Novotny, Facility Manager, GE Pittsfield Remediation Programs, states that a transfer of land and improvements including NPDES outfalls 001, 01A, 004, and MAR05A021 (YD3) to PEDA has occurred. A second letter dated June 2005 from Linda Murphy, Director of the Office of Ecosystem Protection co-addressed to Michael Carroll, Pittsfield Remediation Programs, General Electric Company, states that a new NPDES permit (File Number MA0040231) is for PEDA's outfalls 001, 01A*, and 004.

Outfall #001-for a maximum daily flow up to 2.55 MGD of non-contact cooling water and stormwater runoff into Silver Lake,

Outfall #004- for a maximum daily flow up to 2.09 MGD of contact and non-contact cooling water and stormwater runoff into Silver Lake,

*Outfall 01A is a stormwater bypass.

PERMITTEE	NPDES #	SEGMENT
TOWN OF STOCKBRIDGE WWTP	**MA0101087**	**MA21-19**

The Town of Stockbridge is authorized (MA0101087 issued in September 2004) to discharge a flow of 0.3 MGD (rolling annual monthly average) of treated effluent from the wastewater treatment plant (WWTP) via Outfall# 001 to the Housatonic River. The WWTP, located on Route 102 – West Stockbridge Road in Stockbridge, only treats municipal wastewater and has recently been upgraded (Campetti 2005). The WWTP operates in the extended aeration mode using oxidation ditches and secondary clarification while ultraviolet light provides disinfection. Secondary sludge is thickened on-site using a rotary screen thickener. The thickened sludge is hauled to Fitchburg for disposal. Total phosphorus (May 1 to October 31, 1.0 mg/L limit) is reduced in the effluent by the addition of aluminum sulfate to the secondary clarifier distribution box (Campetti 2005).

The pH (6.5 to 8.3 SU limits) of the effluent between October 2004 and October 2005 ranged from 7.6 to 7.8 SU (n=3)(TOXTD database). The ammonia-nitrogen concentration of the effluent between October 2004 and October 2005 ranged from 0.20 to 0.24 mg/L (n=3)(TOXTD database). The facility's whole effluent toxicity limits are $LC_{50} \geq 50\%$ using *Ceriodaphnia dubia* and *Pimephales promelas* tested two times per year. Other permitted parameters include: BOD, TSS, and fecal coliform bacteria.

Chemistry-water:
Hardness: The hardness in the river water between October 2004 and October 2005 ranged from 90 to 140 mg/L (n=3)(TOXTD database).

PERMITTEE	NPDES #	SEGMENT
TOWN OF WEST STOCKBRIDGE WWTP	**MA0103110**	**MA21-06**

The Town of West Stockbridge is authorized (MA0103110 issued in December 2004) to discharge a 0.076 MGD (rolling annual monthly average flow) of treated effluent from the wastewater treatment facility located on Moscow Road, West Stockbridge, via Outfall# 001 to the Williams River. This advanced wastewater treatment facility utilizes rotating biological contactors (RBC) and anoxic reactors for ammonia-nitrogen reduction. The effluent from the RBC units is directed to a rapid mix tank followed by a flocculation tank where alum is added for total phosphorus reduction (May 1 to October 31, 0.5 mg/L limit). After secondary clarification, caustic soda can be added to a rapid mix tank followed by a flocculation tank for pH adjustment if necessary (Buffoni 2005). Disinfection is accomplished by ultraviolet light.

The ammonia-nitrogen concentration (limits are April 1 to 30, 10 mg/L and May 1 to October 31, 5 mg/L) in the effluent between April 1999 and April 2006 ranged from <0.07 to 4.44 mg/L with the exception of the March 2001 test where the concentration was reported as 25.1 mg/L (n=22)(TOXTD database). The pH (6.5 to 8.3 SU limits) of the effluent between April 1999 and April 2006 ranged from 6.9 to 8.0 SU (n=22)(TOXTD database). The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ effluent using *Ceriodaphnia dubia* on a quarterly basis. The use of *Pimephales promelas* as a second test species was discontinued with the issuance of the December 2004 permit. Other permitted parameters include: BOD, TSS, fecal coliform bacteria, effluent DO, and report only for TKN, nitrite-nitrogen, and nitrate-nitrogen.

Chemistry-water
Hardness: The hardness in the river water between April 1999 and April 2006 ranged from 85 to 282 mg/L (n=23)(TOXTD database).

Table J3. Housatonic River Basin Commercial and Industrial Surface Wastewater Discharges

PERMITTEE	NPDES #	SEGMENT
BERKSHIRE NATIONAL FISH HATCHERY	**Not currently applicable**	**MA21-25**

In September 1999 Hampshire College and the Western Massachusetts Center for Sustainable Aquaculture (WMCSA) reopened the Berkshire National Fish Hatchery in the village of Hartsville, New Marlborough, MA, for aquaculture and environmental education and research. Presently ten 3,500-gallon fish tanks have been refurbished and are operational (several tanks are stocked with Atlantic salmon, rainbow and brown trout brood stock) and the egg hatch house has been retrofitted with new equipment for hatching rainbow and brown trout. This facility currently does not have an NPDES permit since their average annual production is approximately 2,000 lbs/year (Emmons and Bouchard 2006). The permitting threshold is 20,000 lbs/year (314 CMR 3.16).

The Berkshire National Fish Hatchery was previously authorized (MA0005401) to discharge effluent from their facility to the Konkapot River. In August 1981 EPA terminated the individual NPDES permit. The facility was closed down in 1994.

PERMITTEE	NPDES #	SEGMENT
CRANE & COMPANY, INC. WWTP	**MA0000671, MAG250956, and MAG250955**	**MA21-02**

Crane and Company, Inc. is authorized (MA0000671 issued in September 2000) to discharge, from the company-owned and operated wastewater treatment facility (WWTF), treated industrial wastewater via Outfall# 001 to the East Branch of the Housatonic River. This WWTF receives flow from all 6 company-owned facilities (Noel 2005). The WWTF design incorporates a conventional activated sludge process with chemically enhanced influent pH adjustment and solids flocculation for increased solids removal in primary treatment. Sulfuric acid and sodium hydroxide are used for pH control and solids flocculation is assisted by polymer addition (either spent or virgin). The primary and secondary sludge co-settle in the primary settling units. This facility is not required to perform disinfection. Sludge is dewatered on-site and the resulting product is sent to the Springfield Regional WWTF for final treatment (Noel 2005). All sanitary wastewater is conveyed via the Dalton Sewer System to the Pittsfield WWTF.

The pH (6.5 to 9.0 SU limits) of the effluent between May 2000 and January 2006 ranged from 6.8 to 8.3 SU (n=23)(TOXTD database). Total phosphorus (1.0 mg/L limit) is reduced during the treatment process by physical and chemical precipitation. The ammonia-nitrogen concentration in the effluent between May 2000 and January 2006 ranged from 0.1 to 26.0 mg/L (n=23)(TOXTD database). The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ effluent and the CNOEC $\geq$ 63% effluent using *Ceriodaphnia dubia* on a quarterly basis. Other permitted parameters include: BOD, TSS, total aluminum, total copper, effluent DO, flow, and total nitrogen.

Chemistry-water
Hardness: The hardness in the river water between May 2000 and January 2006 ranged from 39 to 152 mg/L (n=22)(TOXTD database).

MAG250956 was issued in September 1995 for the discharge of non-contact cooling water to the East Branch of the Housatonic River from the Byron Weston Mill, Main Street, Dalton. The permit is being administratively continued until the new general permit for non-contact cooling water is available.

MAG250955 was issued in September 1995 for the discharge of non-contact cooling water to the East Branch of the Housatonic River from the Pioneer Mill, Pioneer Street, Dalton. The permit is being administratively continued until the new general permit for non-contact cooling water is available.

PERMITTEE	NPDES #	SEGMENT
FOX RIVER PAPER CO.	**MAG250281**	**MA21-20**

Fox River Paper Company is authorized (MAG250281 issued in August 2000) to discharge 0.1 MGD (maximum daily discharge) of non-contact cooling water to the Housatonic River via a single outfall from their facility located at 295 Park Street in Housatonic.

PERMITTEE	NPDES #	SEGMENT
GENERAL DYNAMICS DEFENSE SYSTEMS	**MA0035718**	**MA21-02**

General Dynamics Defense Systems (MA0035718), formerly Lockheed Martin, is located at Plastics Avenue, Pittsfield, MA. EPA terminated their permit in February 1999 because all process discharges had been eliminated from Outfall 011. All remaining stormwater discharges will be permitted under the Multi-Sector General Stormwater Permit (MSGSP).

PERMITTEE	NPDES #	SEGMENT
GENERAL ELECTRIC COMPANY	**MA0003891**	**MA21-02**

The General Electric Company (GE Pittsfied) was authorized (MA0003891 issued in May 1992) to discharge via outfalls 005, 007, and 009 to the East Branch of the Housatonic River and Unkamet Brook. (Some of their former discharges are now permitted to Pittsfield Economic Development Authority or PEDA MA0040231). The discharge from these outfalls required toxicity testing of their effluent as stated in the NPDES permit. The permitted outfall descriptions are listed below.

*Outfall #005- for a maximum daily flow up to 1.08 MGD of contact and non-contact cooling water, treated process wastewater, treated groundwater and stormwater runoff into the East Branch Housatonic River,

*Outfall #007- report the maximum daily and average monthly discharge of non-contact cooling water and stormwater runoff into the East Branch Housatonic River with a maximum daily temperature limit of 75°F,

*Outfall #009- report the maximum daily and average monthly discharge of non-contact cooling water, treated process water and stormwater runoff into Unkamet Brook.

*Note: Denotes that a composite sample will be made by combining discharges from these outfalls and outfall #011 in NPDES permit MA0035718 for General Dynamic Defense Systems formerly Lockheed Martin into a 24-hour proportionate-to-flow composite sample. This composite sample shall be tested for acute and chronic toxicity. The acute toxicity tests are to be conducted monthly with a NOAEL (where 90% or more of the test organisms survive after 48 hours) is $\geq$35% effluent. (One acute test per quarter, however, is to be conducted under wet weather conditions -- a monitoring only requirement.) The chronic tests results conducted in July, August, and September are to be reported only (no limit).

It also should be noted that due to the extensive environmental studies and remediation activities on-going at the GE Pittsfield site, the nature of the sources and characteristics discharged via any of the outfall numbers mentioned above may have changed or may be in the process of being changed at the time that this report was prepared.

GE Pittsfield has obtained coverage under the Multi-Sector General Storm Water Permit for Industrial Activities (MSGP) issued in October 30, 2000, for a number of stormwater discharges (GE 2004). GE Pittsfield has executed an agreement with the Pittsfield Economic Development Authority (PEDA) and the City of Pittsfield regarding the transfer of land and improvements including NPDES outfalls 001, 01A, 004, and MAR05A021 (YD3) that discharge into Silver Lake.

Source: GE Pittsfield's new fact sheet to go along with their new draft permit (Janet Labonte@EPA)

Chemistry-water

Hardness: The hardness in the river water between January 2000 and March 2006 ranged from 38 to 528 mg/L (n=82)(TOXTD database).

PERMITTEE MW CUSTOM PAPERS, LLC WWTP LAUREL MILL	NPDES # MA0001716	SEGMENT MA21-19

MW Custom Papers, formerly the Mead Corporation, is authorized (MA0001716 issued in June 2005) to discharge treated industrial wastewater via Outfall# 001 to the Housatonic River from their Laurel Mill wastewater treatment facility (WWTF) located on Pleasant Street in South Lee. The permittee manufactures decorative and overlay papers for laminates used in furniture, flooring, countertops, and cabinets. Laurel Mill's process water source is the river (maximum volume, 2.88 MGD)(Grant 2005). Sources of wastewater include: whitewater recirculation, grade change water, wash-up water, pump and equipment seal discharges, boiler blowdown, water softener backwater, condensate from air compressors and stormwater from roof drains. The WWTF influent pH can be adjusted by chemical addition using either sodium hydroxide or sulfuric acid. Primary clarification is enhanced by the addition of alum and/or polymer for solids removal. Flow is then directed to cooling towers and/or RBCs. Nutrient addition takes place at the RBCs by chemical addition. Flow is then directed to secondary clarification and subsequently to the Housatonic River (Grant 2005). In 2003 the WWTF staff started to recycle 50% of the final effluent flow back to the process intake (Grant 2005). The sludge is dewatered with a belt-filter press and the resulting sludge cake is hauled off-site to a composting facility. All sanitary wastewater is directed to the Lee WWTF for treatment.

The pH of the effluent (6.0 to 9.0 SU limits) between October 2000 and April 2006 ranged from 7.0 to 7.7 SU (n=23)(TOXTD database). The ammonia-nitrogen concentration in the effluent between October 2000 and April 2006 ranged from <0.08 to 0.21 mg/L (n=23)(TOXTD database).

The facility's whole effluent toxicity testing limits are $LC_{50} \geq 100\%$ effluent performed quarterly using *Ceriodaphnia dubia* with a monitor only requirement for chronic toxicity (CNOEC report only). It should be noted that the previous permit required toxicity testing using *Pimephales promelas* as a second species.

The temperature of the effluent has a 90º-Fahrenheit maximum daily limit and there is no requirement for disinfection. Other permitted parameters include BOD and TSS.

Chemistry-water

Hardness: The hardness in the river water between October 2000 and April 2006 ranged from 60 to 154 mg/L (n=23)(TOXTD database).

PERMITTEE MW CUSTOM PAPERS, INC. WWTP WILLOW MILL	NPDES # MA0001848	SEGMENT MA21-19

MW Custom Papers, formerly the Mead Corporation, is authorized (MA0001848 issued in June 2005) to discharge treated industrial wastewater (via Outfall# 001) to the Housatonic River from the Willow Mill wastewater treatment facility (WWTF) located on Willow Street in South Lee. The permittee manufactures decorative and overlay papers for laminates used in furniture, flooring, countertops, and cabinets. Willow Mill is less than 1 mile downstream from Laurel Mill. The Willow Mill maximum daily water withdrawal volume is 2.36 MGD (Grant 2005). The sources of daily water withdrawal are the Willow Mill Boiler House (0.036 MGD from spring-feed water), Willow Mill Basement River (1.87 MGD canal-feed from the Housatonic River) and the East and West Branches of the Bear Town Brook (0.45 MGD)(Grant 2005). The process water sources at Willow Mill are similar to the sources at Laurel Mill. The WWTF primary flocculation clarifier performance is enhanced by chemical addition using polymer and/or alum. A flow equalization tank accepts flow from the primary clarifier and distributes it to RBC units for biological treatment. Secondary clarification completes the treatment process (Grant 2005). All sanitary wastewater is directed to the Lee WWTF for treatment.

The pH of the effluent (6.0 to 9.0 SU limits) between October 2000 and January 2006 ranged from 6.8 to 7.9 SU (n=23)(TOXTD database). The ammonia-nitrogen concentration in the effluent between October 2000 and January 2006 ranged from <0.02 to 0.28 mg/L (n=22)(TOXTD database).

The facility's whole effluent toxicity testing limits are $LC_{50} \geq 100\%$ effluent performed quarterly using *Ceriodaphnia dubia* and *Pimphales promelas* with a monitor only requirement for chronic toxicity (CNOEC report only).

The temperature of the effluent has a 90º-Fahrenheit maximum daily limit and there is no requirement for disinfection. Other permitted parameters include BOD and TSS.

Chemistry-water

Hardness: The hardness in the river water between October 2000 and January 2006 ranged from 44 to 154 mg/L (n=22)(TOXTD database).

PERMITTEE OLDCASTLE STONE PRODUCTS	NPDES # MAR05A083	SEGMENT MA21-19

Oldcastle Stone Products is authorized (MAR05A083) to discharge stormwater from their facility in Lee, MA. In January 2006 EPA terminated the individual NPDES permit MA0001911 (formerly held by Southdown Corp. and prior to that Lee Lime Corp). Oldcastle Stone Products is engaged in the manufacturing of lime and limestone products. According to the plant manager, operations include quarrying, calcining, crushing, screening, drying, mixing and bagging. Outfall#001 consists of storm water collected in the quarry pit and Outfall 002 is the overflow from a settling pond. Storm water from processing areas of the plant is collected and pumped to the settling pond. Both outfalls discharge to an unnamed tributary of the Housatonic River located downstream of the Lee WWTP discharge and upstream of the Housatonic River's confluence with Hop Brook.

PERMITTEE SCHWEITZER-MAUDUIT INTERNATIONAL, INC. WWTF	NPDES # MA0005371	SEGMENT MA21-19

Schweitzer-Mauduit International, formerly the Kimberly-Clark Corporation, is authorized (MA0005371 issued in May 2000) to discharge treated effluent from a wastewater treatment facility located at Columbia Street in Lee via Outfalls # 002 and #003 to the Housatonic River. Other outfalls (#006 and #007) are permitted for discharge of water supply and fire protection storage overflow and Outfall #008 has been eliminated. Fine and lightweight papers are produced at the four company-owned and operated paper mills known as Greylock, Niagara, Eagle, and Columbia. The source of water comes from the Housatonic River (maximum daily volume, 6.0 MGD)(Ryan 2005). The untreated process water from all four mills is sent to one of two WWTFs (Columbia WWTF and Greylock WWTF). The Columbia WWTF treats process water from Niagara, Eagle, and Columbia and discharges to the river via Outfall# 002. The Greylock WWTF treats process water from Greylock and has the option to discharge to the river via Outfall# 003 or the discharge can be directed to the Columbia WWTF for polishing (the latter is the preferred method of operation, Ryan 2005). The Greylock WWTF is an extended aeration activated sludge process with secondary sedimentation that treats wastes biologically. The Columbia WWTF utilizes pre- and post- pH neutralization with the option of adding alum, sodium hydroxide, or potassium hydroxide. Primary treatment is enhanced by the addition of alum and polymer. The total phosphorus concentration in the effluent (April 1 to September 30, 40 lbs./day, average monthly limit) is reduced by the addition of alum. Primary and secondary sludges are blended then dewatered by a belt-filter press before entering a steam-assisted hot air dryer. The final product is hauled off-site for use as landfill cover (Ryan 2005). The sanitary wastewater is sent to the Lee WWTF for treatment.

The pH (7.1 to 8.0 SU limits) of the effluent between September 2000 and March 2006 ranged from 7.1 to 8.0 SU (n=25)(TOXTD database). The facility's whole effluent toxicity test limits using *Ceriodaphnia dubia* are LC_{50} $\geq$100% and C-NOEC $\geq$14% tested four times per year. Other permitted parameters include BOD and TSS.

Chemistry-water

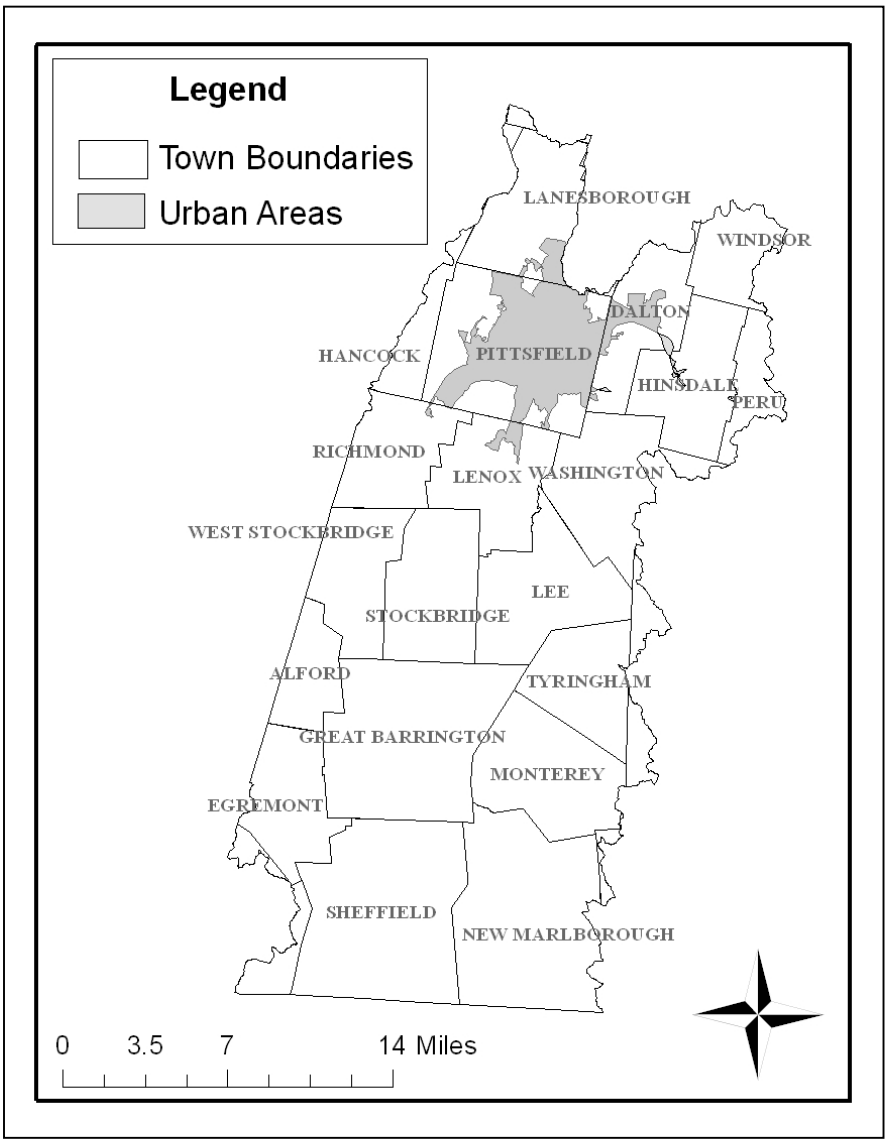
Hardness: The hardness in the river water between September 2000 and March 2006 ranged from 22 to 150 mg/L (n=25)(TOXTD database).

PERMITTEE SHEFFIELD PLASTICS, INC.	NPDES # MAR05B410 and MAR05B411	SEGMENT MA21-15

Sheffield Plastics, Inc. (MAR05B410 and MAR05B411) is located in Sheffield, MA. A letter dated May 1999 from Olga Vergara at EPA addressed to Edward O'Connor, Environmental Manager, terminated the individual NPDES permit (MA0027294). The facility's stormwater discharges were covered under the multi-sector general permits. However, the facility did not reapply in 2000 and the older general permits have expired. The stormwater discharges into Schenob Brook via a ditch and a wetland, respectively (Vergara 1999) which ultimately flow into Hubbard Brook. The facility should reapply for coverage.

STORMWATER

The NPDES Phase II General Permit program requires NPDES permit coverage for stormwater discharges from small municipal separate storm sewer systems (MS4s), and construction activity disturbing one acre or more of land in a mapped "urbanized area" defined and delineated by the US Bureau of Census in 2000 (http://www.epa.gov/npdes/pubs/fact2-2.pdf). Large and medium municipal separate storm sewer systems (MS4s) for populations over 100,000 were permitted during Phase I of the NPDES Stormwater Program. Under EPA's Phase II Program, the definition of "municipal" includes Massachusetts communities, U.S. military installations, state or federal owned facilities such as hospitals, prison complexes, state colleges or universities and state highways. An MS4 is a system that: discharges at one or more a point sources; is a separate storm sewer system (not designed to carry combined stormwater and sanitary waste water); is operated by a public body; discharges to the Waters of the United States or to another MS4; and, is located in an "Urbanized Area". The NPDES Phase II General Permit requires operators of regulated MS4s to develop and implement a stormwater management program that prevents harmful pollutants from being washed or dumped directly into the storm sewer system, which is subsequently discharged into local waterbodies. The NPDES Stormwater Phase II General Permit requires operators of regulated small MS4s to develop a stormwater management program that prevents harmful pollutants from being washed or dumped directly into the storm sewer system, and then discharged into local waterbodies. Certain Massachusetts communities were automatically designated (either in full or part) by the Phase II rule based on the urbanized area delineations from the 2000 U.S. Census.



As a result of the census mapping, six communities in the Housatonic River Watershed were located either totally or partially in the regulated Urbanized Area (see below Figure above). Municipalities that are totally regulated must implement the requirements of the Phase II permit in the entire town, while communities that are partially regulated need to comply with the Phase II permit only in the mapped Urbanized Areas. The towns of Cheshire, Hinsdale, and Lenox received waivers of the Phase II stormwater requirements on May 16, 2003 since the area subject to jurisdiction has a population under 1,000 and otherwise satisfies the criteria identified at 40 CFR 123.35(d) 1. EPA issued stormwater general permits to the municipalities of Dalton, Lanesborough, and Pittsfield after administrative review, and, in coordination with MassDEP, will complete a thorough review of the communities' stormwater management program during the five-year permit term. Phase II stormwater general permits will expire on 1 May 2008 (Domizio 2004). For detailed community maps see http://www.epa.gov/region01/npdes/stormwater/ma.html.

Table J4. NPDES Phase II stormwater permit information for the Housatonic River Watershed communities (Note: Cheshire, Hinsdale, and Lenox were all granted waivers).

Community	Permit #	Permit Issued	Mapped Regulatory area in community
Dalton	MAR041004	11/16/2003	Partial
Lanesborough	MAR041012	10/31/2003	Partial
Pittsfield	MAR041018	12/5/2003	Total

The NPDES Phase I Storm Water Program, in place since 1990, regulates cities and counties with populations of 100,000 that operate a municipal separate storm sewer system (MS4), specific industrial operations (as defined at 40 CFR 122.26(b)(14)), and construction activities that disturb 5 or more acres of land. Information for these permittees can be found online at: http://cfpub.epa.gov/npdes/stormwater/noi/noisearch.cfm.

LITERATURE CITED

Buffoni, Michael. 2005. Personal Communication. *West Stockbridge WWTF operational status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 6 September 2005. Chief Operator, West Stockbridge WWTF.

Campetti, Anthony. 2005. Personal Communication. *Stockbridge WWTF operational status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 12 September 2005. Chief Operator, Stockbridge WWTP.

Domizio, L. 2004. *Stormwater permitting information Phase II Communities*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA. Personal Communication.

Drumm, Timothy. 2005. Personal Communication. *Great Barrington WWTF operational status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 12 September 2005. Superintendent, Great Barrington WWTF.

Emmons, G. and H. Bouchard. 2006. Personal Communication. *Berkshire National Fish Hatchery current production.* Communication with Robert Maietta, Massachusetts Department of Environmental Protection, Division of Watershed Management, 22 December 2006. George Emmons, Berkshire National Fish Hatchery, volunteer hatchery manager.

GE. 2004. *Draft NPDES permit and accompanying fact sheet.* Available online at: http://www.epa.gov/ne/ge/.

Grant, Daniel. 2005. Personal Communication. *MW Custom Papers, operational status of the WWTFs at Laurel Mill and Willow Mill.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 14 September 2005. Environmental Engineer, MW Custom Papers' WWTFs at Laurel Mill and Willow Mill.

Landry, Thomas. 2005. Personal Communication. *Pittsfield WWTF operational status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 13 September 2005. Superintendent, Pittsfield WWTF.

LeVangie, D. 2006. *Water withdrawal registration and permit information.* Water Management Act Database. Massachusetts Department of Environmental Protection, Division of Watershed Management, Database Manager. Boston, MA.

Noel, James. 2005. Personal Communication. *Crane and Company WWTF operational status, the status of two general permitted facilities, and the status of the company-owned dams.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 1 September 2005. Environmental Manager, Crane and Company WWTF.

Ryan, Timothy. 2005. Personal Communication. *Schweitzer-Mauduit WWTFs operational status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 15 September 2005. Environmental Safety and Utility's Manager, Schweitzer-Mauduit WWTFs.

Vergara, Olga. 1999. *Re: termination of NPDES Permit MA0027294.* Letter from Olga Vergara, US EPA, to Edward O'Connor, Sheffield Plastics. Dated may 7, 1999.

White, Jeffery. 2005. Personal Communication. *Lenox WWTP operational status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 30 August 2005. Chief Operator, Lenox WWTP.

Zerbato, Alan. 2005. Personal Communication. *Lee WWTF operational status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 12 September 2005. Chief Operator, Lee WWTF.

APPENDIX A
ASSESSMENT METHODOLOGY GUIDELINES FOR EVALUATING DESIGNATED USE STATUS OF MASSACHUSETTS SURFACE WATERS

The Clean Water Act (CWA) Section 305(b) water quality reporting process is an essential aspect of the Nation's water pollution control effort. It is the principal means by which EPA, Congress, and the public evaluate existing water quality, assess progress made in maintaining and restoring water quality, and determine the extent of remaining problems. By this process, states report on waterbodies within the context of meeting their designated uses. These uses include: *Aquatic Life, Fish Consumption, Drinking Water, Primary Contact Recreation, Secondary Contact Recreation, Shellfish Harvesting* and *Aesthetics*. Two subclasses of Aquatic Life are also designated in the Massachusetts Surface Water Quality Standards (SWQS): Cold Water Fishery – waters capable of sustaining a year-round population of cold water aquatic life, such as trout – and Warm Water Fishery – waters that are not capable of sustaining a year-round population of cold water aquatic life (MassDEP 1996).

The SWQS, summarized in Table A1, prescribe minimum water quality criteria to sustain the designated uses. Furthermore, these standards describe the hydrological conditions at which water quality criteria must be applied (MassDEP 1996). In rivers the lowest flow conditions at and above which aquatic life criteria must be applied are the lowest mean flow for seven consecutive days to be expected once in ten years (7Q10). In artificially regulated waters, the lowest flow conditions at which aquatic life criteria must be applied are the flow equal or exceeded 99% of the time on a yearly basis or another equivalent flow that has been agreed upon. In coastal and marine waters and for lakes, the Massachusetts Department of Environmental Protection (MassDEP) will determine by on a case-by-case basis the most severe hydrological condition for which the aquatic life criteria must be applied.

The availability of appropriate and reliable scientific data and technical information is fundamental to the 305(b) reporting process. It is EPA policy (EPA Order 5360.1 CHG 1) that any individual or group performing work for or on behalf of EPA establish a quality system to support the development, review, approval, implementation, and assessment of data collection operations. To this end MassDEP describes its Quality System in an EPA-approved Quality Management Plan to ensure that environmental data collected or compiled by the MassDEP are of known and documented quality and are suitable for their intended use. For external sources of information, MassDEP requires the following: 1) an appropriate Quality Assurance Project Plan (QAPP) including a laboratory Quality Assurance /Quality Control (QA/QC) plan; 2) use of a state certified lab (or as otherwise approved by DEP for a particular analysis); and 3) sample data, QA/QC and other pertinent sample handling information documented in a citable report. This information will be reviewed by MassDEP to determine its validity and usability to assess water use support. Data use could be modified or rejected due to poor or undocumented QAPP implementation, lack of project documentation, incomplete reporting of data or information, and/or project monitoring objectives unsuitable for MassDEP assessment purposes.

EPA provides guidelines to states for making their use support determinations (EPA 1997 and 2002, Grubbs and Wayland III 2000 and Wayland III 2001). The determination of whether or not a waterbody supports each of its designated uses is a function of the type(s), quality and quantity of available current information. Although data/information older than five years are usually considered “historical” and used for descriptive purposes they can be utilized in the use support determination provided they are known to reflect the current conditions. While the water quality standards (Table A1) prescribe minimum water quality criteria to sustain the designated uses, numerical criteria are not available for every indicator of pollution. Best available guidance from available literature may be applied in lieu of actual numerical criteria (e.g., freshwater sediment data may be compared to *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario* 1993 by D. Persaud, R. Jaagumagi and A. Hayton). Excursions from criteria due solely to “naturally occurring” conditions (e.g., low pH in some areas) do not constitute violations of the SWQS.

Each designated use within a given segment is individually assessed as ***support*** or ***impaired***. When too little current data/information exist or no reliable data are available, the use is ***not assessed***. In this report, however, if there is some indication that water quality impairment may exist, and it is not “naturally occurring”, the use is identified with an “Alert Status”. It is important to note that not all waters are

assessed. Many small and/or unnamed ponds, rivers, and estuaries have *never been assessed*; the status of their designated uses has never been reported to EPA in the Commonwealth's 305(b) Report or the Integrated List of Waters nor is information on these waters maintained in the waterbody system database (WBS) or the new assessment database (ADB).

Table A1. Summary of Massachusetts Surface Water Quality Standards (MassDEP 1996, MA DPH 2002, and FDA 2003).

Dissolved Oxygen	Class A, Class B Cold Water Fishery (BCWF), and Class SA: ≥6.0 mg/L and ≥75% saturation unless background conditions are lower Class B Warm Water Fishery (BWWF) and Class SB: ≥5.0 mg/L and ≥60% saturation unless background conditions are lower Class C: Not <5.0 mg/L for more than 16 of any 24-hour period and not <3.0 mg/L anytime unless background conditions are lower; levels cannot be lowered below 50% saturation due to a discharge Class SC: Not <5.0 mg/L for more than 16 of any 24-hour period and not <4.0 mg/L anytime unless background conditions are lower; and 50% saturation; levels cannot be lowered below 50% saturation due to a discharge
Temperature	Class A: ≤68°F (20°C) and Δ1.5°F (0.8°C) for Cold Water and ≤83°F (28.3°C) and Δ1.5°F (0.8°C) for Warm Water. Class BCWF: ≤68°F (20°C) and Δ3°F (1.7°C) due to a discharge Class BWWF: ≤83°F (28.3°C) and Δ3°F (1.7°C) in lakes, Δ5°F (2.8°C) in rivers Class C and Class SC: ≤85°F (29.4°C) nor Δ5°F (2.8°C) due to a discharge Class SA: ≤85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and Δ1.5°F (0.8°C) Class SB: ≤85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and Δ1.5°F (0.8°C) between July through September and Δ4.0°F (2.2°C) between October through June
pH	Class A, Class BCWF and Class BWWF: 6.5 - 8.3 SU and Δ0.5 outside the background range. Class C: 6.5 - 9.0 SU and Δ1.0 outside the naturally occurring range. Class SA and Class SB: 6.5 - 8.5 SU and Δ0.2 outside the normally occurring range. Class SC: 6.5 - 9.0 SU and Δ0.5 outside the naturally occurring range.
Solids	All Classes: *These waters shall be free from floating, suspended, and settleable solids in concentrations or combinations that would impair any use assigned to each class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.*
Color and Turbidity	All Classes: *These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use.*
Oil and Grease	Class A and Class SA: *Waters shall be free from oil and grease, petrochemicals and other volatile or synthetic organic pollutants.* Class SA: *Waters shall be free from oil and grease and petrochemicals.* Class B, Class C, Class SB and Class SC: *Waters shall be free from oil* and *grease, petrochemicals that produce a visible film on the surface of the water, impart an oily taste to the water or an oily or other undesirable taste to the edible portions of aquatic life, coat the banks or bottom of the water course or are deleterious or become toxic to aquatic life.*
Taste and Odor	Class A and Class SA: *None other than of natural origin.* Class B, Class C, Class SB and Class SC: *None in such concentrations or combinations that are aesthetically objectionable, that would impair any use assigned to each class, or that would cause tainting or undesirable flavors in the edible portions of aquatic life.*
Aesthetics	All Classes: *All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.*
Toxic Pollutants	All Classes: *All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife… The division shall use the recommended limit published by EPA pursuant to 33 USC 1251, 304(a) as the allowable receiving water concentrations for the affected waters unless a site-specific limit is established*.
Nutrients	*Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.*

Note: *Italics are direct quotations.*

Δ criterion (referring to a change from natural background conditions) is applied to the effects of a permitted discharge.

Table A1 Continued. Summary of Massachusetts Surface Water Quality Standards (MassDEP 1996, MA DPH 2002, and FDA 2003).

Bacteria (MassDEP 1996 and MA DPH 2002) Class A criteria apply to the *Drinking Water Use*. Class B and SB criteria apply to *Primary Contact Recreation Use* while Class C and SC criteria apply to *Secondary Contact Recreation Use*.	<u>Class A:</u> Fecal coliform bacteria: An arithmetic mean of <20 cfu/100 ml in any representative set of samples and <10% of the samples >100 cfu/100 ml. <u>Class B:</u> At public bathing beaches, as defined by MA DPH, where *E. coli* is the chosen indicator: No single *E. coli* sample shall exceed 235 *E. coli* /100 ml and the geometric mean of the most recent five *E. coli* samples within the same bathing season shall not exceed 126 *E. coli* / 100 ml. At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 61 *Enterococci* /100 ml and the geometric mean of the most recent five *Enterococci* samples within same bathing season shall not exceed 33 *Enterococci* /100 ml. Current standards for other waters (not designated as bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 cfu/100 ml in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 ml. (This criterion may be applied on a seasonal basis at the discretion of the MassDEP.) <u>Class C:</u> Fecal coliform bacteria: Shall not exceed a geometric mean of 1,000 cfu/100 ml, nor shall 10% of the samples exceed 2,000 cfu/100 ml. <u>Class SA:</u> Fecal coliform bacteria: Waters designated shellfishing shall not exceed a geometric mean (most probable number (MPN) method) of 14 MPN/100 ml, nor shall more than 10% of the samples exceed 28 MPN/100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest version of the Guide for the Control of Molluscan Shellfish Areas (more stringent regulations may apply). At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 104 *Enterococci* /100 ml and the geometric mean of the five most recent *Enterococci* levels within the same bathing season shall not exceed 35 *Enterococci* /100 ml. Current standards for other waters (not designated as shellfishing areas or public bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 cfu/100 ml in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 ml. (This criterion may be applied on a seasonal basis at the discretion of the MassDEP.) <u>Class SB:</u> Fecal coliform bacteria: Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean (MPN method) of 88 MPN/100 ml, nor shall <10% of the samples exceed 260 MPN/100 ml or other values of equivalent protection base on sampling and analytical methods used by the Massachusetts Shellfish Sanitation Program in the latest revision of the guide for the Control of Moluscan Shellfish (more stringent regulations may apply). At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 104 *Enterococci* /100 ml and the geometric mean of the most recent five *Enterococci* levels within the same bathing season shall not exceed 35 *Enterococci* /100 ml. Current standards for other waters (not designated as shellfishing areas or public bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 cfu/100 ml in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 ml. (This criterion may be applied on a seasonal basis at the discretion of the MassDEP.) <u>Class SC:</u> Fecal coliform bacteria: Shall not exceed a geometric mean of 1,000 cfu/100 ml, nor shall 10% of the samples exceed 2,000 cfu/100 ml.

DESIGNATED USES

The Massachusetts Surface Water Quality Standards designate the most sensitive uses for which the surface waters of the Commonwealth shall be enhanced, maintained and protected. Each of these uses is briefly described below (MassDEP 1996):

- *AQUATIC LIFE* - suitable habitat for sustaining a native, naturally diverse, community of aquatic flora and fauna. Two subclasses of aquatic life are also designated in the standards for freshwater bodies: *Cold Water Fishery* - capable of sustaining a year-round population of cold water aquatic life, such as trout; *Warm Water Fishery* - waters that are not capable of sustaining a year-round population of cold water aquatic life.
- *FISH CONSUMPTION* - pollutants shall not result in unacceptable concentrations in edible portions of marketable fish or for the recreational use of fish, other aquatic life or wildlife for human consumption.
- *DRINKING WATER* - used to denote those waters used as a source of public drinking water. They may be subject to more stringent regulation in accordance with the Massachusetts Drinking Water Regulations (310 CMR 22.00). These waters are designated for protection as Outstanding Resource Waters under 314 CMR 4.04(3).
- *SHELLFISH HARVESTING* (in SA and SB segments) – Class SA waters in approved areas (Open Shellfish Areas) shellfish harvested without depuration shall be suitable for consumption; Class SB waters in approved areas (Restricted Shellfish Areas) shellfish harvested with depuration shall be suitable for consumption.
- *PRIMARY CONTACT RECREATION* - suitable for any recreation or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water. These include, but are not limited to, wading, swimming, diving, surfing and water skiing.
- *SECONDARY CONTACT RECREATION* - suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities.
- *AESTHETICS* - all surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *AGRICULTURAL AND INDUSTRIAL* - suitable for irrigation or other agricultural process water and for compatible industrial cooling and process water.

The guidance used to assess the *Aquatic Life, Fish Consumption, Drinking Water, Shellfish Harvesting, Primary* and *Secondary Contact Recreation* and *Aesthetics* uses follows.

AQUATIC LIFE USE

This use is suitable for sustaining a native, naturally diverse, community of aquatic flora and fauna. The results of biological (and habitat), toxicological, and chemical data are integrated to assess this use. The nature, frequency, and precision of the MassDEP's data collection techniques dictate that a weight of evidence be used to make the assessment, with biosurvey results used as the final arbiter of borderline cases. The following chart provides an overview of the guidance used to assess the status (support or impaired) of the *Aquatic Life Use.*

Variable	***Support*** Data available clearly indicates support or minor modification of the biological community. Excursions from chemical criteria (Table A1) not frequent or prolonged and may be tolerated if the biosurvey results demonstrate support.	***Impaired*** There are frequent or severe violations of chemical criteria, presence of acute toxicity, or a moderate or severe modification of the biological community.
BIOLOGY		
Rapid Bioassessment Protocol (RBP) III*	Non/Slightly impacted	Moderately or Severely Impacted
Fish Community	Best Professional Judgment (BPJ)	BPJ
Habitat and Flow	BPJ	Dewatered streambed due to artificial regulation or channel alteration, BPJ
Eelgrass Bed Habitat (Howes *et al.* 2003)	Stable (No/minimal loss), BPJ	Loss/decline, BPJ
Non-native species	BPJ	Non-native species present, BPJ
Plankton/Periphyton	No/infrequent algal blooms	Frequent and/or prolonged algal blooms
TOXICITY TESTS**		
Water Column/Ambient	≥75% survival either 48 hr or 7-day exposure	<75% survival either 48 hr or 7-day exposure
Sediment	≥75% survival	<75% survival
CHEMISTRY-WATER**		
Dissolved oxygen (DO)/Percent saturation (MassDEP 1996, EPA 1997)	Infrequent excursion from criteria (Table A1), BPJ (minimum of three samples representing critical period)	Frequent and/or prolonged excursion from criteria [river and shallow lakes - exceedances >10% of representative measurements; deep lakes (with hypolimnion) - exceedances in the hypolimnetic area >10% of the surface area during maximum oxygen depletion].
pH (MassDEP 1996, EPA 1999a)	Infrequent excursion from criteria (Table A1)	Criteria exceeded >10% of measurements.
Temperature **(**MassDEP 1996,EPA 1997)	Infrequent excursion from criteria (Table A1)[1]	Criteria exceeded >10% of measurements.
Toxic Pollutants (MassDEP 1996, EPA 1999a) Ammonia-N (MassDEP 1996, EPA 1999b) Chlorine (MassDEP 1996, EPA 1999a)	Infrequent excursion from criteria (Table A1) Ammonia is pH and temperature dependent[2] 0.011 mg/L (freshwater) or 0.0075 mg/L (saltwater) total residual chlorine (TRC)[3]	Frequent and/or prolonged excursion from criteria (exceeded >10% of measurements).
CHEMISTRY-SEDIMENT**		
Toxic Pollutants (Persaud *et al.* 1993)	Concentrations ≤ Low Effect Level (L-EL), BPJ	Concentrations ≥ Severe Effect Level (S-EL)[4], BPJ
CHEMISTRY-TISSUE		
PCB – whole fish (Coles 1998)	≤500 μg/kg wet weight	BPJ
DDT (Environment Canada 1999)	≤14.0 μg/kg wet weight	BPJ
PCB in aquatic tissue (Environment Canada 1999)	≤0.79 ng TEQ/kg wet weight	BPJ

*RBP II analysis may be considered for assessment decision on a case-by-case basis, **For identification of impairment, one or more of the following variables may be used to identify possible causes/sources of impairment: NPDES facility compliance with whole effluent toxicity test and other limits, turbidity and suspended solids data, nutrient (nitrogen and phosphorus) data for water column/sediments. [1]Maximum daily mean T in a month (minimum six measurements evenly distributed over 24-hours) less than criterion. [2] Saltwater is temperature dependent only. [3] The minimum quantification level for TRC is 0.05 mg/L. [4]For the purpose of this report, the S-EL for total polychlorinated biphenyl compounds (PCB) in sediment (which varies with Total Organic Carbon (TOC) content) with 1% TOC is 5.3 ppm while a sediment sample with 10% TOC is 53 ppm.

Note: National Academy of Sciences/National Academy of Engineering (NAS/NAE) guideline for maximum organochlorine concentrations (i.e., total PCB) in fish tissue for the protection of fish-eating wildlife is 500μg/kg wet weight (ppb, not lipid-normalized). PCB data (tissue) in this report are presented in μg/kg wet weight (ppb) and are not lipid-normalized to allow for direct comparison to the NAS/NAE guideline.

FISH CONSUMPTION USE

Pollutants shall not result in unacceptable concentrations in edible portions of marketable fish or for the recreational use of fish, other aquatic life or wildlife for human consumption. The assessment of this use is made using the most recent list of Fish Consumption Advisories issued by the Massachusetts Executive Office of Health and Human Services, Department of Public Health (MA DPH), Bureau of Environmental Health Assessment (MA DPH 2005 and Krueger 2006). The MA DPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species pose a health risk for human consumption. Hence, the Fish Consumption Use is assessed as non-support in these waters.

In July 2001, MA DPH issued new consumer advisories on fish consumption and mercury contamination (MA DPH 2001).

1. The MA DPH "…is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age (MA DPH 2001)."
2. Additionally, MA DPH "…is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury (MA DPH 2001)."

Other statewide advisories that MA DPH has previously issued and are still in effect are as follows (MA DPH 2001):

1. Due to concerns about chemical contamination, primarily from polychlorinated biphenyl compounds (PCB) and other contaminants, no individual should consume lobster tomalley from any source. Lobster tomalley is the soft green substance found in the tail and body section of the lobster.
2. Pregnant and breastfeeding women and those who are considering becoming pregnant should not eat bluefish due to concerns about PCB contamination in this species.

The following is an overview of EPA's guidance used to assess the status (support or impaired) of the *Fish Consumption Use*. Because of the statewide advisory no waters can be assessed as support for the *Fish Consumption Use*. Therefore, if no site-specific advisory is in place, the *Fish Consumption Use* is not assessed.

Variable	***Support*** No restrictions or bans in effect	***Impaired*** There is a "no consumption" advisory or ban in effect for the general population or a sub-population for one or more fish species or there is a commercial fishing ban in effect.
MA DPH Fish Consumption Advisory List	Not applicable, precluded by statewide advisory (Hg)	Waterbody on MA DPH Fish Consumption Advisory List

Note: MA DPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially.

DRINKING WATER USE

The term *Drinking Water Use* denotes those waters used as a source of public drinking water. These waters may be subject to more stringent regulation in accordance with the Massachusetts Drinking Water Regulations (310 CMR 22.00). They are designated for protection as Outstanding Resource Waters in 314 CMR 4.04(3). MassDEP's Drinking Water Program (DWP) has primacy for implementing the provisions of the federal Safe Drinking Water Act (SDWA). Except for suppliers with surface water sources for which a waiver from filtration has been granted (these systems also monitor surface water quality) all public drinking water supplies are monitored as finished water (tap water). Monitoring includes the major categories of contaminants established in the SDWA: bacteria, volatile and synthetic organic compounds, inorganic compounds and radionuclides. The DWP maintains current drinking supply monitoring data. The suppliers currently report to MassDEP and EPA the status of the supplies on an annual basis in the form of a consumer confidence report (http://yosemite.epa.gov/ogwdw/ccr.nsf/Massachusetts). Below is EPA's guidance to assess the status (support or impaired) of the drinking water use.

Variable	***Support*** No closures or advisories (no contaminants with confirmed exceedances of maximum contaminant levels, conventional treatment is adequate to maintain the supply).	***Impaired*** Has one or more advisories or more than conventional treatment is required or has a contamination-based closure of the water supply.
Drinking Water Program (DWP) Evaluation	See note below	See note below

Note: While this use is not assessed in this report, information on drinking water source protection and finish water quality is available at http://www.mass.gov/dep/water/drinking.htm and from local public water suppliers.

SHELLFISHING USE

This use is assessed using information from the Department of Fish and Game's Division of Marine Fisheries (DMF). A designated shellfish growing area is an area of potential shellfish habitat. Growing areas are managed with respect to shellfish harvest for direct human consumption, and comprise at least one or more classification areas. The classification areas are the management units, and range from being approved to prohibited (described below) with respect to shellfish harvest. Shellfish areas under management closures are *not assessed.* Not enough testing has been done in these areas to determine whether or not they are fit for shellfish harvest, therefore, they are closed for the harvest of shellfish.

Variable	***Support*** SA Waters: Approved[1] SB Waters: Approved[1], Conditionally Approved[2] or Restricted[3]	***Impaired*** SA Waters: Conditionally Approved[2], Restricted[3], Conditionally Restricted[4], or Prohibited[5] SB Waters: Conditionally Restricted[4] or Prohibited[5]
DMF Shellfish Project Classification Area Information (MA DFG 2000)	Reported by DMF	Reported by DMF

NOTE: Designated shellfish growing areas may be viewed using the MassGIS datalayer available from MassGIS at http://www.mass.gov/mgis/dsga.htm. This coverage currently reflects classification areas as of July 1, 2000.

[1] **Approved** - "...open for harvest of shellfish for direct human consumption subject to local rules and regulations..." An approved area is open all the time and closes only due to hurricanes or other major coastwide events.

[2] **Conditionally Approved** - "...subject to intermittent microbiological pollution..." During the time the area is open, it is "...for harvest of shellfish for direct human consumption subject to local rules and regulations…" A conditionally approved area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, shellfish harvested are treated as from an approved area.

[3] **Restricted** - area contains a "limited degree of pollution." It is open for "harvest of shellfish with depuration subject to local rules and state regulations" or for the relay of shellfish. A restricted area is used by DMF for the relay of shellfish to a less contaminated area.

[4] **Conditionally Restricted** - "...subject to intermittent microbiological pollution..." During the time area is restricted, it is only open for "the harvest of shellfish with depuration subject to local rules and state regulations." A conditionally restricted area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, only soft-shell clams may be harvested by specially licensed diggers (Master/Subordinate Diggers) and transported to the DMF Shellfish Purification Plant for depuration (purification).

[5] **Prohibited -** Closed for harvest of shellfish.

PRIMARY CONTACT RECREATION USE

This use is suitable for any recreational or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water during the primary contact recreation season (1 April to 15 October). These include, but are not limited to, wading, swimming, diving, surfing and water skiing. The chart below provides an overview of the guidance used to assess the status (support or impaired) of the *Primary Contact Recreation Use*. Excursions from criteria due to natural conditions are not considered impairment of use.

Variable	***Support*** Criteria are met, no aesthetic conditions that preclude the use	***Impaired*** Frequent or prolonged violations of criteria and/or formal bathing area closures, or severe aesthetic conditions that preclude the use
Bacteria (105 CMR 445.000) Minimum Standards for Bathing Beaches State Sanitary Code) (MassDEP 1996)	At "public bathing beach" areas: Formal beach postings/advisories neither frequent nor prolonged during the swimming season (the number of days posted or closed cannot exceed 10% during the locally operated swimming season). Other waters: Samples* collected during the primary contact season must meet criteria (Table A1). Shellfish Growing Area classified as "Approved" by DMF.	At "public bathing beach" areas: Formal beach closures/postings >10% of time during swimming season (the number of days posted or closed exceeds 10% during the locally operated swimming season). Other waters: Samples* collected during the primary contact season do not meet the criteria (Table A1).
Aesthetics (MassDEP 1996) - *All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance* [growth or amount] *species of aquatic life*		
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged, BPJ.
Transparency (MA DPH 1969)	Public bathing beach and lakes – Secchi disk depth $\geq$1.2 meters ($\geq$ 4') (minimum of three samples representing critical period).	Public bathing beach and lakes - Secchi disk depth <1.2 meters (< 4') (minimum of three samples representing critical period).
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

* Data sets to be evaluated for assessment purposes must be representative of a sampling location (at least five samples per station recommended) over the course of the primary contact season. Samples collected on one date from multiple stations on a river are not considered adequate to assess this designated use. Because of low sample frequency (i.e., less than ten samples per station) an impairment decision will not be based on a single sample exceedance (i.e., the geometric mean of five samples is <200 cfu/100 ml but one of the five sample exceeds 400 cfu/100 ml). The method detection limit (MDL) will be used in the calculation of the geometric mean when data are reported as less than the MDL (e.g. use 20 cfu/100 ml if the result is reported as <20 cfu/100 ml). Those data reported as too numerous to count (TNTC) will not be used in the geometric mean calculation; however frequency of TNTC sample results should be presented.

SECONDARY CONTACT RECREATION USE

This use is suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities. Following is an overview of the guidance used to assess the status (support or impaired) of the *Secondary Contact Use*. Excursions from criteria due to natural conditions are not considered impairment of use.

Variable	***Support*** Criteria are met, no aesthetic conditions that preclude the use	***Impaired*** Frequent or prolonged violations of criteria, or severe aesthetic conditions that preclude the use
Fecal Coliform Bacteria (MassDEP 1996)	Other waters: Samples* collected must meet the Class C or SC criteria (see Table A1).	Other waters: Samples* collected do not meet the Class C or SC criteria (see Table A1).
Aesthetics (MassDEP 1996) - *All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance* [growth or amount] *species of aquatic life*		
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged, BPJ.
Transparency (MA DPH 1969)	Public bathing beach and lakes – Secchi disk depth ≥1.2 meters (≥ 4') (minimum of three samples representing critical period).	Public bathing beach and lakes - Secchi disk depth <1.2 meters (< 4') (minimum of three samples representing critical period).
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

*Data sets to be evaluated for assessment purposes must be representative of a sampling location (at least five samples per station recommended) over time. Because of low sample frequency (i.e., less than ten samples per station) an impairment decision will not be based on a single sample exceedance. Samples collected on one date from multiple stations on a river are not considered adequate to assess this designated use.

AESTHETICS USE

All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life. The aesthetic use is closely tied to the public health aspects of the recreational uses (swimming and boating). Below is an overview of the guidance used to assess the status (support or impaired) of the *Aesthetics Use*.

Variable	***Support*** Narrative "free from" criteria met	***Impaired*** Objectionable conditions frequent and/or prolonged
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged, BPJ.
Transparency (MA DPH 1969)	Public bathing beach and lakes – Secchi disk depth ≥1.2 meters (≥ 4') (minimum of three samples representing critical period).	Public bathing beach and lakes - Secchi disk depth <1.2 meters (< 4') (minimum of three samples representing critical period).
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

REFERENCES

Coles, J.F. 1998. *Organochlorine compounds in fish tissue for the Connecticut, Housatonic,* and *Thames River Basins study unit, 1992-94.* USGS Water-Resources Investigations Report 98-4075. U.S. Geological Survey, National Water Quality Assessment Program, Water Resources Division, Marlborough, MA.

Costello, C. 2003. *Mapping Eelgrass in Massachusetts, 1993-2003.* Massachusetts Department of Environmental Protection, Bureau of Resource Protection, Boston, MA.

Environment Canada. 1999. *Canadian Environmental Quality Guidelines* [Online]. Environment Canada. Retrieved 04 November 1999 from http://www.ec.gc.ca/CEQG-RCQE/English/default.cfm updated 28 September 1998.

EPA. 1997. *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates Report Contents.* U.S. Environmental Protection Agency, Assessment and Watershed Protection Division (4503F); Office of Wetlands, Oceans, and Watersheds; Office of Water, Washington D.C.

EPA. 1999a. *Federal Register Document* [Online]. U.S. Environmental Protection Agency, Washington, D.C. Retrieved 19 November 1999 from http://www.epa.gov/fedrgstr/EPA-WATER/1998/December/Day-10/w30272.htm.

EPA. 1999b. *1999 Update of Ambient Water Quality Criteria for Ammonia*. U.S. Environmental Protection Agency, Office of Water and Office of Science and Technology, Washington, D.C. and Office of Research and Development, Duluth, MN.

EPA. 2002. *Consolidated Assessment and Listing Methodology – toward a compendium of best practices*. U.S. Environmental Protection Agency; Office of Wetlands, Oceans and Watersheds; Washington, D.C.

FDA. 2003. G*uide for the Control of Molluscan Shellfish 2003 Revision.* [Online]. Updated 12 November 2004. United States Food and Drug Administration, Department of Health and Human Services, National Shellfish Sanitation Program. http://www.cfsan.fda.gov/~ear/nss2-toc.html. Accessed 2005 December 5.

Grubbs, G.H. and R.H. Wayland III. 2000. Letter to Colleague dated 24 October 2000. *EPA recommendations on the use of fish and shellfish consumption advisories and certain shellfish growing area classifications in determining attainment of water quality standards and listing impaired waterbodies under section 303(d) of the Clean Water Act*. United States Environmental Protection Agency; Office of Wetlands, Oceans and Watersheds; Washington, D.C.

Howes, B.L., R. Samimy, and B. Dudley. 2003. *Massachusetts Estuaries Project Site-Specific Nitrogen Thresholds for Southeastern Massachusetts Embayments: Critical Indicators Interim Report Revised December 22, 2003*. University of Massachusetts Dartmouth, School of Marine Science and Technology (SMAST), Coastal Systems Laboratory. New Bedford, MA and Massachusetts Department of Environmental Protection, Lakeville, MA.

Krueger, E.T. 2006. Letter to the members of the Interagency Committee on Fish Toxics dated 29 June 2006. *Re: Public Health Fish Consumption Advisories Being Issued.* Massachusetts Department of Public Health, Environmental Toxicology Program, Boston, MA.

MassDEP. 1996. (Revision of 1995 report). *Massachusetts Surface Water Quality Standards (Revision of 314 CMR 4.00, effective June 23, 1996)*. Massachusetts Department of Environmental Protection, Division of Water Pollution Control, Technical Services Branch, Westborough, MA.

MA DFG. 2000. *Designated Shellfish Growing Areas Datalayer – July 2000.* Published by MassGIS in October 2000. Massachusetts Department of Fish and Game, Division of Marine Fisheries, Boston, MA.

MA DPH. 1969. *Article 7 Regulation 10.2B of the State Sanitary Code.* Massachusetts Department of Public Health. Boston, MA.

MA DPH. 2001. *MA DPH Issues New Consumer Advisories on Fish Consumption and Mercury Contamination.* Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA.

MA DPH. 2002. *105 CMR 445.000: Minimum Standards For Bathing Beaches, State Sanitary Code, Chapter VII* [Online]. Massachusetts Department of Public Health, Division of Community Sanitation Regulations and Statutes, Boston, MA. Retrieved 19 September 2002 from http://www.state.ma.us/dph/dcs/csanregs.htm.

MA DPH. 2005. *Freshwater Fish Consumption Advisory List – May 2005.* Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. *Guidelines for the protection* and *management of aquatic sediment quality in Ontario.* Water Resources Branch, Ontario Ministry of the Environment, Ontario, Canada.

Wayland III, R.H. 2001. Memorandum to EPA Regional Water Management Directors, EPA Regional Science and Technology Directors, and State, Territory and Authorized Tribe Water Quality Program Directors dated 19 November 2001. Re: *2002 Integrated Water Quality Monitoring and Assessment Report Guidance*. U.S. Environmental Protection Agency; Office of Wetlands, Oceans and Watersheds; Washington, D.C.

APPENDIX B

Technical Memorandum TM-21-6

HOUSATONIC RIVER WATERSHED
DWM 2002 WATER QUALITY MONITORING DATA

DWM Control Number: CN 141.0

Prepared by
Peter Mitchell

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
STEPHEN R. PRITCHARD, SECRETARY
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
ROBERT W. GOLLEDGE JR., COMMISSIONER
BUREAU OF RESOURCE PROTECTION
GLENN HAAS, ACTING ASSISTANT COMMISSIONER
DIVISION OF WATERSHED MANAGEMENT
GLENN HAAS, DIRECTOR

March, 2006

Table of Contents

List of Tables and Figures

INTRODUCTION

Water quality sampling of the Housatonic River Watershed was conducted in May - September 2002 to address Massachusetts Division of Watershed Management (DWM) program objectives. Specific objectives for the Housatonic River are outlined below. The DWM sampling plan matrix for the year-two monitoring is presented in Table 1. Sampling components at river stations included: *insitu* Hydrolab® measurements, and physicochemical, and bacteria sampling.

PROJECT OBJECTIVES

The primary objective of this year-two sampling, as outlined in CN 078.0 *Quality Assurance Project Plan for Year 2002 Watershed Assessments of the Housatonic, Hudson, Charles, Ten Mile and North Coastal basins - Basin: Housatonic* (MassDEP / DWM 2002), was to obtain sufficient data to determine the status of selected main stem segments and tributaries with regard to their attainment of the Massachusetts Surface Water Quality Standards and designated uses.

This technical memorandum presents the water quality sampling component of the survey. Results of other monitoring efforts, such as biological assessments, are reported in separate technical memoranda (Beskenis 2006, Mitchell 2005a, Mitchell 2005b).

METHODS

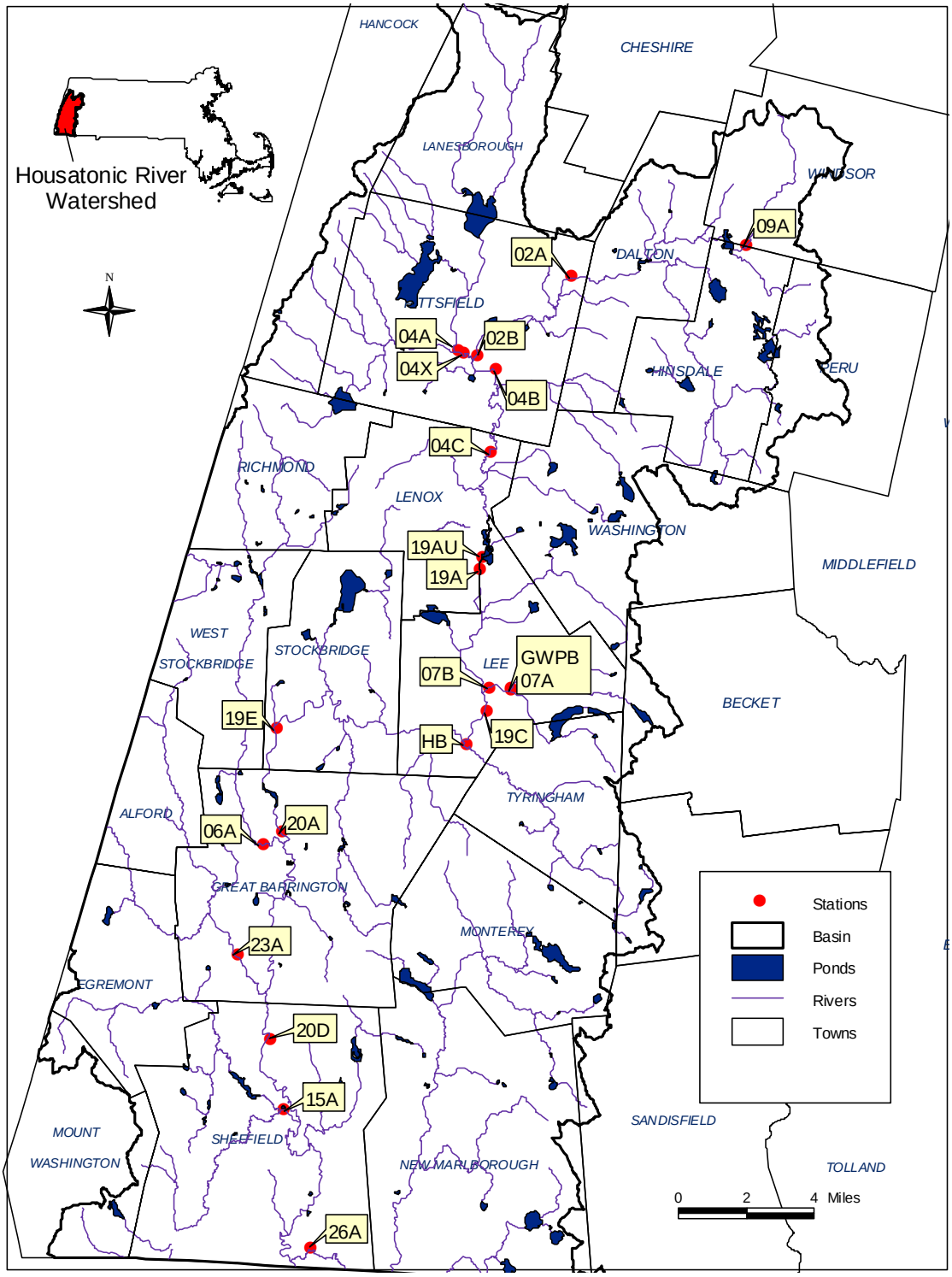
Water quality samples were collected in the Housatonic River Watershed on the dates and for the parameters as shown in Table 1. See Figure 1 for station locations. The parameters included in the sampling were: *in-situ* Hydrolab® measurements (dissolved oxygen, percent dissolved oxygen saturation, pH, conductivity, water temperature and total dissolved solids – measured during pre-dawn hours), and, total suspended solids, ammonia - nitrogen, total phosphorus, chlorophyll-a, and fecal coliform and *E. coli* bacteria. The water quality sampling procedures are included in the publication: CN 001.1 *Sample Collection Techniques for DWM Surface Water Quality Monitoring* (Chase 2001). Standard operating procedure CN 004.1 *Hydrolab® Series 3/Series 4 Multiprobe* (Haynes et al. 2001)outlines the standard operating procedures for Hydrolab® sampling. Samples for total suspended solids, nutrients (ammonia-N, total phosphorus) and bacteria were analyzed at Berkshire Environmental Labs (BEL), a private environmental testing lab in Lee, Massachusetts, following MassDEP approved analytical laboratory SOPs.

DWM quality assurance and database management staff reviewed lab data reports and all Hydrolab® multiprobe data. In general, all water sample data were validated by reviewing QC sample results, analytical holding time compliance, QC sample frequency and related ancillary data/documentation (at a minimum). A complete summary of censoring and qualification decisions for 2002 DWM data is provided in *CN 202.0 2002 Data Validation for Year 2002 Project Data* (Chase et al. 2005). A list of symbols and qualifiers used for DWM data is presented in Appendix 4.

Table 1: Housatonic River Watershed 2002 Water Quality Sampling Summary - Site Descriptions, Segment Numbers, Parameters*						
Site Description	**Station No.**	**May 21-22**	**June 25-26**	**July 30-31**	**Sept 4-5**	**Sept 24-25**
East Branch Housatonic River, upstream of Hubbard Ave. Bridge, Pittsfield	02A	DO, TSS	DO, TSS	DO, N, TSS	DO, N, TSS	DO, N, TSS
East Branch Housatonic River, ~600 feet downstream of Pomeroy Ave., Pittsfield	02B	DO, B	DO, B	DO, B	DO, B	DO, B
Housatonic River, west of Fairfield Street; downstream of the confluence of the Southwest Branch and West Branch Housatonic River, Pittsfield	04A	DO, B	DO, B	B	B	B
Housatonic River, upstream of South St., Pittsfield	04X			DO	DO	DO
Housatonic River, upstream of Holmes Rd., Pittsfield	04B	DO, B	DO, B	DO, B, CHL-a	DO, B	DO, B, CHL-a
Housatonic River, upstream of New Lenox Rd., Lenox	04C	DO, B	DO, B	DO, B, CHL-a	DO, B	DO, B, CHL-a
Williams River, upstream of Division St., Great Barrington	06A	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N
Goose Pond Brook, ~30 feet upstream of Greenwater Brook confluence, Lee	07A	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N
Goose Pond Brook, upstream of Tyringham Rd., Lee	07B				B	B
Windsor Brook, upstream of Windsor Rd., Hinsdale	09A	DO	DO	DO	DO	DO
Hubbard Brook, upstream of Route 7, Sheffield	15A	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N
Woods Pond, at the foot-bridge, east of Housatonic Street, Lenox	19AU			CHL-a		
Housatonic River, ~360 feet upstream of Valley St., Lenox	19A	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N
Housatonic River, ~300 feet downstream of Lee WWTP, Lee	19C	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N, CHL-a	DO, TSS, B, N	DO, TSS, B, N, CHL-a
Housatonic River, upstream of RR bridge, east of Rte. 183, Stockbridge	19E	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N, CHL-a	DO, TSS, B, N	DO, TSS, B, N, CHL-a
Housatonic River, upstream of Division Street (USGS gage 01197500), Great Barrington	20A	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N, CHL-a	DO, TSS, B, N	DO, TSS, B, N, CHL-a
Housatonic River, upstream of Kellogg Rd., Sheffield	20D	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N, CHL-a	DO, TSS, B, N	DO, TSS, B, N, CHL-a
Green River, downstream of Rte. 23/41, Great Barrington	23A	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N
Konkapot River, upstream of RR bridge, ~160 feet upstream of Rte. 7A, Sheffield	26A	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N
Greenwater Pond Brook, downstream of Forest St., Lee	GWPB	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N
Hop Brook, upstream of Meadow St., Lee	HB	DO, TSS, B, N	DO, TSS, B, N	DO, TSS, B, N, CHL-a	DO, TSS, B, N	DO, TSS, B, N

* Parameters:
DO = dissolved oxygen (pre-dawn: includes temperature, pH, conductance, and TDS)
C = total alkalinity, total hardness, chlorides
N = ammonia-nitrogen, total phosphorus (low-level)
TSS = total suspended solids
B = bacteria (fecal coliform and E. coli)
CHL-a = Chlorophyll-a

Figure 1: Housatonic River Watershed 2002 Water Quality Sampling Stations



SURVEY CONDITIONS

Hydrological and meteorological conditions antecedent to each sampling event were characterized by examining discharge and precipitation data. Discharge data (Socolow et al. 2003) was obtained from the two active USGS streamflow gages, and precipitation data (MA DCR, Undated) from gauges proximal to the above streamflow gages.

The two USGS streamflow gages in the Housatonic are:

01197000	EAST BRANCH HOUSATONIC RIVER AT COLTSVILLE, MA
01197500	HOUSATONIC RIVER NEAR GREAT BARRINGTON, MA

Corresponding rainfall data are not collected at the USGS gages mentioned above. As a result, rainfall data were taken from MA-DCR weather stations most proximal to the USGS gages. Those MA-DCR rainfall gauges are located at Dalton, MA (Station DAL104. Lat/Lon: 42.28.33 / 73.10.20) and Great Barrington, MA (Station GRE114. Lat/Lon: 42.12.05.4 / 73.21.13.6). MA-DCR operates a series of weather stations throughout the Commonwealth. These stations, operated with local assistance, record hourly observations of a variety of meteorological conditions (Marler 2003)

Neither set of paired data showed any significant correlation between rainfall events and streamflow during the sampling period. This lack of correspondence exemplifies the highly regulated nature of the rivers at both of these stations, and below average flow conditions encountered during the months of July, August and September (USGS, Undated.). The USGS gage on the East Branch of the Housatonic River (01197000) is ~800-feet downstream of an impoundment, and four other dams in the reach extend upstream to Center Pond. The USGS gage on the mainstem Housatonic River (01197500) is located ~5,000-feet downstream of the Rising Pond dam. The many impoundments along the course of the Housatonic River (and its many tributaries), during the drier conditions encountered during the sampling season, have the effect of controlling the flow of the river to such an extent that a rainfall event in excess of one-inch may be required to have any immediate effect upon gaged flow conditions.

The data from the two MA-DCR rainfall gauges (tables 2 and 3) show that in the five-days prior to sample collection, there were no major rain events (rainfall in excess of 0.5-inches, 72-hours prior to sample collection). The largest rain event recorded at the Dalton gauge was 0.73-inches (a thunderstorm, two-days prior to sample collection), and had no effect on measured flow. There were no rainfall events in excess of 0.25-inches observed at the Great Barrington gauge during the same time periods. As such, all samples collected can be considered “dry weather” samples.

Table 2: 2002 precipitation and discharge data near Dalton, MA						
Precipitation data: MA-DCR rainfall gauge DAL104, Dalton, MA Discharge data: USGS gage 01197000, Coltsville, MA 7Q10: 12.4 cfs*						
	5-days prior	4-days prior	3-days prior	2-days prior	1-day prior	Sample Date
Date	17-May	18-May	19-May	20-May	21-May	22-May
Rain (inches)	0.11	0.00	0.00	0.73	0.00	0.00
Flow (CFS)	168	259	295	183	138	115
Date	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun
Rain (inches)	0.00	0.00	0.56	0.00	0.00	0.23
Flow (CFS)	51	48	72	98	65	47
Date	26-Jul	27-Jul	28-Jul	29-Jul	30-Jul	31-Jul
Rain (inches)	0.00	0.00	0.06	0.00	0.00	0.00
Flow (CFS)	22	22	24	24	22	21
Date	31-Aug	1-Sep	2-Sep	3-Sep	4-Sep	5-Sep
Rain (inches)	0.00	0.00	0.06	0.00	0.00	0.00
Flow (CFS)	22	18	17	16	17	16
Date	20-Sep	21-Sep	22-Sep	23-Sep	24-Sep	25-Sep
Rain (inches)	0.00	0.00	0.00	0.06	0.00	0.00
Flow (CFS)	15	17	16	15	14	14

*Ries 1999

Table 3: 2002 precipitation and discharge data near Great Barrington, MA						
Precipitation data: MA-DCR rainfall gauge GRE114, Great Barrington, MA Discharge data: USGS gage 01197500, Housatonic River near Great Barrington, MA 7Q10: 69 cfs*						
	5-days prior	4-days prior	3-days prior	2-days prior	1-day prior	Sample Date
Date	17-May	18-May	19-May	20-May	21-May	22-May
Rain (inches)	0.00	0.00	0.00	0.00	0.00	0.00
Flow (CFS)	933	987	1370	1230	924	746
Date	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun
Rain (inches)	0.11	0.00	0.00	0.00	0.00	0.00
Flow (CFS)	348	306	321	315	316	267
Date	26-Jul	27-Jul	28-Jul	29-Jul	30-Jul	31-July
Rain (inches)	0.08	0.00	0.01	0.00	0.00	0.00
Flow (CFS)	144	125	117	118	111	104
Date	31-Aug	1-Sep	2-Sep	3-Sep	4-Sep	5-Sep
Rain (inches)	0.00	0.08	0.00	0.00	0.14	0.00
Flow (CFS)	155	120	105	92	91	94
Date	20-Sep	21-Sep	22-Sep	23-Sep	24-Sep	25-Sep
Rain (inches)	0.00	0.06	0.00	0.00	0.00	0.00
Flow (CFS)	96	89	86	80	75	73

*Wandle and Lippert 1984

May 22, 2002 – This survey was conducted during a time of decreasing flows, and decreasing rainfall. The largest rain event during the entire 2002-sampling season was observed at the MA-DCR rainfall gauge at Dalton (DAL104) two-days prior (May 20, 2002) to the sampling event. The precipitation on that day was 0.73-inches, and most likely due to a thunderstorm. It showed no effect on the streamflow at USGS gage 01197000; that continued to decline from May 20th through the sample collection date. There was no rain recorded at the MA-DCR Great Barrington rainfall gauge (GRE114) in the five-days

antecedent to sample collection, and flows at Great Barrington (USGS gage 01197500), that crested at 1370cfs three-days prior to sample collection, eventually declined to 746cfs on the sample collection date.

June 26, 2002 – Discharge at USGS gage 01197000 showed an increase of 26-cfs (72-cfs on June 23rd; 98-cfs on June 24th) in the 24-hours after a 0.56-inch rain event on June 23rd at Dalton. However, it remains unclear if the rain event, or the operation of one of the many dams was responsible for the temporary increase in discharge. A flow rate of 47-cfs was observed at USGS gage 01197000 on the day of sample collection; a decrease in flow from the 51-cfs recorded five-days prior to sample collection. A 0.11-inch rain event was measured at the MA-DCR Great Barrington rain gauge on June 21st. This rain had no effect on measured discharge, and flows continued to decline throughout the period.

July 31, 2002 – A rain event of 0.06-inches was recorded in Dalton on July 28th (three-days prior to sample collection). However, the discharge remained almost constant at 22-cfs. Two minor rain events (0.08-inches on July 26 and 0.01-inches on July 28) were recorded at MA-DCR rainfall gauge at Great Barrington. The discharge recorded at Great Barrington continued to decline from 144-cfs on July 26th to 104-cfs on July 31st.

September 5, 2002 – A rain event of 0.06-inches was recorded on September 2nd at the Dalton MA-DCR rain guage, and flows declined from 22-cfs (August 31) to 16-cfs (September 5). Two minor rain events were recorded at Great Barrington on September 1st and September 4th. These events appeared to have no effect on the regulated flow, as the discharge continued to decline from 155-cfs on August 31 to 94-cfs on September 5.

September 25, 2002 – A rain event of 0.06-inches was measured at the MA-DCR rainfall gauge in Dalton on September 23rd. This event had no effect on flow at gage 01179000. Discharge at the USGS Coltsville gage remained almost constant at 15-cfs; quite close to the 7Q10 low flow of 12.4-cfs. A rain event of 0.06-inches was recorded at MA-DCR rainfall gauge at Great Barrington on September 21st. This rain event, also, had no effect on streamflow at the proximal USGS gage (01179500). Flow at this gage declined through the period from 96-cfs on September 20th to 73-cfs on the day of sampling; also quite close to the 7Q10 low flow of 69-cfs.

PERTINENT OBSERVATIONS REGARDING STATIONS AND CONDITIONS

Station 02A: East Branch Housatonic River
This station was located ~80-feet upstream of USGS stream gage 01197000 (East Branch Housatonic River at Coltsville, MA) in Pittsfield, MA. This station was accessed via the City Tire parking lot, and by walking to the river (upstream of the Hubbard Avenue Bridge and storm drain) on river-left. Upstream landuse features proximal to this station include the Town of Dalton historic industrial development, and Crane Paper Company. Also, Route 9/8 parallels the immediate upstream portion of the East Branch of the Housatonic River. The first 330-feet upstream of the sampling location is abutted by a Crane Paper Company factory on river-right. The river-right bank is armored with asphalt, concrete, and rip-rap. The river-left bank is mostly forested, but is also stabilized by large boulders. Cut bank erosion, on both banks, was observed below the armoring once the spring river levels dropped. Extensive brown, flocculent algae were observed at this station from the first sampling event (May 22nd). The amount of algal coverage increased throughout the sampling season. It is unclear as to the primary reason for this occurrence. However, the canopy cover was negligible at this station (providing more than adequate sunlight for vegetative growth); there were five impoundments within the first two-miles upstream of this station (potentially providing increased nutrients to this station). There were, up until November 3rd, 2000, six dams. However, on that date the "Old Berkshire Mill Dam" (downstream of Housatonic Street, Dalton) was breeched, and subsequently removed. Also, this station was located below the Dalton WWTP, and the Crane Paper Company discharges (potentially providing both nutrients and substrates for organic growth).

Station 02B: East Branch Housatonic River
This station was established to assess conditions on the East Branch of the Housatonic, just prior to its confluence with the West and Southwest Branches. The station was accessed by walking to the Fred Garner canoe launch area and collecting samples from river-right (~600-feet from Pomeroy Avenue). This

station was located immediately downstream of the urban portion of the City of Pittsfield. The Fred Garner Canoe Park appeared to be well used and well maintained. Some erosion of the soft banks, especially on river-right, was noted. The substrates consisted of packed sand and gravel.

Station 04A: Housatonic River
Station 04A (west of Fairfield Street, Pittsfield, downstream of the confluence of the Southwest Branch Housatonic River and the West Branch Housatonic River) was discontinued after flows subsided and it was suspected that inadequate mixing of the West and Southwest Branches of the Housatonic River was taking place at this location. A new station was then established on July 31st at the South Street Bridge (Station 04X). Due to potentially inadequate mixing, all data from station 04A have been censored.

Station 04B: Housatonic River
Samples were collected at this station upstream of the Holmes Road Bridge, on river-left. This station is located downstream of the confluence of the East Branch, West Branch and Southwest Branch of the Housatonic River. It is the most upstream station on the mainstem of the Housatonic River. Although this station is located in a thickly settled residential area, there were no signs of human visitation at this station. The streambed was almost all sand, and a limited, but forested, buffer exists between the river and the proximal homes and yards.

Station 04C: Housatonic River
This station was located immediately downstream of the Housatonic River Valley State Wildlife Management Area, on the mainstem of the Housatonic River. Samples were collected immediately upstream of the New Lenox Road Bridge, on river-right; adjacent to a General Electric sampling location. The river is quite deep here and has many meanders and oxbows both upstream and downstream. Some algal growth was observed, but due to the slight turbidity and depth of the water, the full extent of this coverage was unobserved. There is also a recreational canoe launch ~600-feet downstream from this station.

Station 04X: Housatonic River
Station 04X was added to replace station 04A. Concerns regarding the mixing of the Southwest and West Branches of the Housatonic River called for this addition. Adequate mixing of these two branches had taken place by the time the flow reached the South Street Bridge. This station was accessed via the "bridge-drop" method; from the upstream side of the bridge.

Station 06A: Williams River
Samples were collected from this station on the Williams River, upstream of the Division Street Bridge, on river-right. This area is frequently used for recreational fishing. The river flows through a mostly forested watershed, with reasonably good gradient. Approximately 1,500-feet upstream of this station, the river begins to meander through pastures that provide very little canopy cover. Sparse and moderate algal coverage was noted as occurring on the rock substrates throughout the sampling season.

Station 07A: Goose Pond Brook
Goose Pond Brook was assessed using data from this station. This station was accessed by parking along side of Forest Street, and collecting samples from center stream, approximately 35-feet upstream of the confluence with Greenwater Brook. This station was established, primarily, to address concerns regarding increased bacterial counts noted in the 1997 survey (Kennedy and Weinstein 2000). The water appeared to have good clarity and no color throughout the survey. A sparse covering of thin film, green, algae covered the rock substrates throughout the sampling season.

Station 07B: Goose Pond Brook
Station 07B (downstream of station 07A) was added to assess primary and secondary contact recreation when preliminary data revealed that bacterial concentrations were far lower at station 07A than observed in 1997. This station was accessed by wading upstream, under the Tyringham Road Bridge, and collecting a sample from center-stream. Thin-film green algae was observed on the rock substrates during sample collection.

Station 09A: Windsor Brook
Windsor Brook samples were collected from this station by parking along Windsor Road, and walking to a point approximately 75-feet upstream of the Windsor Road Bridge. Samples were collected from the river-right side.

Station 15A: Hubbard Brook
This station on Hubbard Brook was accessed on the river-left shore, approximately 50-feet upstream of the Route 7A bridge. Little human access takes place at this location. The streambed is sandy and the stream meanders through an area of wetlands and oxbows both upstream and downstream of this station. The water appeared slightly turbid throughout the sampling season. This may be due to the loose soil types in the riparian zone.

Station 19AU: Woods Pond
Woods Pond (formed by impounding the mainstem Housatonic River) was sampled at the footbridge, ~1,000-feet upstream of its outfall in Lenox MA. Chlorophyll-a samples were collected from this station on July 31st. Samples were obtained from the river-right side, upstream of the footbridge. The water column contained a dense assortment of floating aquatic plants, and phytoplankton. There was also a dense covering of several types of algae on both the rocks and submerged vegetation. An additional Chlorophyll-a sample was collected on September 25th, 2002. For additional information regarding Chlorophyll-a sampling, see the Housatonic Chlorophyll-a and Periphyton Technical Memorandum.

Station 19A: Housatonic River
The mainstem Housatonic River was sampled at Station 19A; approximately 650-feet downstream from the dam that forms Woods Pond, and 700-feet downstream from the Lenox WWTP. Samples were collected from this station by parking at the Crescent Mills parking lot, then collecting samples approximately 300-feet upstream of the Valley Road Bridge. Moderate to dense filamentous green and brown-colored algae covered the rock substrates.

Station 19C: Housatonic River
This station was established to assess conditions in the Housatonic River mainstem below the Town of Lee and its WWTP. This station was accessed by parking at the electrical sub-station (behind the MassHighways shed) on Route 102. Samples were collected behind the substation (under the downstream most wire) from the river-right side. There was a “septic” odor coming from the water at this station, and dense algal growth was observed on both the submerged plants and rocks.

Station 19E: Housatonic River
This station was established to assess conditions on the mainstem of the Housatonic River. Samples were collected from this station by parking at the dirt road marked with the “Blue Moon Kennels” sign, and walking down to the river. Samples were collected approximately 150-feet upstream of the railroad bridge, on river-right. The river moves swiftly through this location, and the boulders form a very handsome set of rapids. The water had a slightly musty odor, and moderate amounts of filamentous green algae covered many of the rocks.

Station 20A: Housatonic River
This station was located below Rising Pond Dam, on the mainstem Housatonic River, Great Barrington. Samples were collected from this station by parking at USGS gage 01197500, and walking upstream approximately 65-feet. Samples were collected from the river-left bank.

Station 20D: Housatonic River
This mainstem Housatonic River station was accessed by parking along Kellogg Road, Sheffield, and walking up the Appalachian Trail approximately 330-feet upstream of the Kellogg Street Bridge, on river-right. The riverbed substrates were primarily sand. The river followed a relatively straight course, past cut-off oxbow ponds. The few large rocks and boulders that were part of the substrate were covered with long, green, filamentous algae.

Station 23A: Green River
This station was accessed by parking along route 23/41 and walking to the downstream side of the route 23/41 Bridge. Samples were collected immediately downstream of the bridge, from the river-left side. The streambed substrates consisted mostly of gravel and sand. Flows became quite low at this station during the later portion of the sampling season.

Station 26A: Konkapot River
This Konkapot River station was accessed by parking on the shoulder of Route 7A, and walking through the woods to the railroad bridge. Samples were collected ~60-feet upstream of the railroad bridge on the river-left side. This is the furthest downstream station on the Konkapot River; approximately 5,000-feet upstream of the confluence with the Housatonic River. The water was observed to be clear and without color. Filamentous green algal growth on rocky substrates increased throughout the sampling season.

Station GWPB: Greenwater Pond Brook
This station was accessed by parking at the same point as was used to access Station 07A. This station was sampled approximately 30-feet upstream from its confluence with Goose Pond Brook (immediately downstream of the Forest Street Bridge). Greenwater Pond Brook flows through an area of commercial and residential development, and is paralleled by Route 20 and the MassPike. The water was clear, and without color. Sparse to moderately dense concentrations of thin-film green algae on the rocky substrates were observed during sample collection.

Station HB: Hop Brook
Station HB was accessed by parking along side the Meadow Street Bridge, and walking to a point on river-left; approximately 50-feet upstream of the Meadow Street Bridge. The upstream portion of Hop Brook (flowing through the Town of Tyringham) is high gradient. However, as this brook enters the Housatonic River floodplain, wetlands and pastures abut this lower portion of Hop Brook, and the brook is quite sinuous. The soft soil types lend themselves to meanders and erosion.

WATER QUALITY DATA

Water quality data are included for Hydrolab® parameters (dissolved oxygen, percent saturation, pH, temperature, dissolved solids and conductivity) in Appendix 1, and for nutrients (total phosphorus, ammonia - nitrogen), fecal coliform and E. coli bacteria in Appendix 2.

Quality control sample data are also provided in Appendices 3A and 3B. Data are examined for reportability based on acceptable relative percent differences for field duplicates and the lack of contamination for ambient field blanks.

REFERENCES CITED

Beskenis, J. 2006. *CN 213.0 Housatonic River Watershed Chlorophyll-a and Periphyton Technical Memorandum.* Massachusetts Department of Environmental Protection / Division of Watershed Management. Worcester, MA.

Chase, R. 2001. *CN 001.1 Sample Collection Techniques for DWM Surface Water Quality Monitoring*. Massachusetts Department of Environmental Protection / Division of Watershed Management. Worcester, MA.

Chase, R., J. Ryder, L. Chan, T. Dallaire. 2005. *CN 202.0 2002 Data Validation Report for Year 2002 Project Data*. Massachusetts Department of Environmental Protection / Division of Watershed Management. Worcester, MA.

Haynes, R., J. Smith, R. Chase. 2001. *CN 004.1 Standard Operating Procedure for the Hydrolab® Series 3/Series 4 Multiprobe*. Massachusetts Department of Environmental Protection / Division of Watershed Management. Worcester, MA.

Kennedy, L.E. and M.J. Weinstein. 2000. *Housatonic River Basin 1997/1998 Water Quality Assessment Report*. CN 019.0 Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Marler, L. 2003. *Personal communication: 2002 Rainfall Data*. Massachusetts Department of Conservation and Recreation - Rainfall Program. Boston, MA.

MA DCR. Undated. [Online]. Precipitation Database. Massachusetts Department of Conservation and Recreation Rainfall Program Home Page. Retrieved 2004 from http://www.mass.gov/dcr/waterSupply/rainfall/

MassDEP / DWM. 2002. CN 078.0 *Quality Assurance Project Plan for Year 2002 Watershed Assessments of the Housatonic, Hudson, Charles, Ten Mile and North Coastal basins. Basin: Housatonic*. Worcester, MA

Mitchell. 2005a. *CN 197.0 Housatonic River Watershed 2002 Biological Assessment.* Massachusetts Department of Environmental Protection / Division of Watershed Management. Worcester, MA.

Mitchell. 2005b. *CN 197.3 2002 Housatonic River Watershed Fish Population Assessment.* Massachusetts Department of Environmental Protection / Division of Watershed Management. Worcester, MA.

Ries, K.G. III, 1999. *Streamflow Measurements, Basin Characteristics, and Streamflow Statistics for Low-Flow Partial-Record Stations Operated in Massachusetts from 1989 Through 1996.* Water-Resources Investigations Report 99-4006. USGS MA-RI. Northborough, MA.

Socolow, R.S., G.G. Girouard, and L.R. Ramsbey. 2003. *Water Resources Data for Massachusetts and Rhode Island, Water Year 2002*. U.S. Geological Survey Report MA-RI-02-1. Water Resources Division, Northborough, MA.

USGS. Undated. [Online] *MA Drought Index Maps*. United States Geological Survey. Retrieved 2003 from http://ma.water.usgs.gov/drought/drought_index.htm.

Wandle Jr., S.W. and R.G. Lippert. 1984. *Gazetteer of Hydrologic Characteristics of Streams in Massachusetts: Housatonic River Basin.* U.S. Geological Survey Water-Resources Investigations Report 84-4285. Boston, MA.

APPENDIX 1: HOUSATONIC RIVER WATERSHED SURVEY 2002 HYDROLAB® DATA - TEMPERATURE, PH, CONDUCTIVITY, TOTAL DISSOLVED SOLIDS, DISSOLVED OXYGEN, % SATURATION

(Note: Symbols and Qualifiers Used for DWM Data can be found in Appendix 4.)

Housatonic (2002) (QC Status: 4) Exported: 9/21/2005 3:10:44 PM

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1106 Station: 04A, Mile Point: 55.432
Description: west of Fairfield Street, Pittsfield, downstream of the confluence of the Southwest Branch Housatonic River and the West Branch Housatonic River

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0118	02:40	## ri	## ru	## r	## ru	## ru	## r	## r
06/25/02	21-0162	02:03	## r	## ru	## r	## ru	## ru	## r	## r

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1396 Station: 04X, Mile Point: 55.225
Description: South Street (Route 20), Pittsfield

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
07/30/02	21-0202	01:28	0.2	23.1	7.8	405	259	5.8	67
09/04/02	21-0252	01:30	0.1 i	19.8	7.6	393	251	6.5	70
09/24/02	21-0302	01:10	0.2	17.1	7.7	378	242	7.0	71

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1105 Station: 04B, Mile Point: 53.466
Description: Holmes Road, Pittsfield

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0120	03:40	0.1 i	9.3	7.8 u	241	154	10.5 u	89 u
06/25/02	21-0164	03:01	0.5	21.0	7.7	270	173	7.5	82
07/30/02	21-0204	02:03	0.2	22.1	7.9	434	278	6.8	77
09/04/02	21-0254	02:09	0.1 i	19.0	7.7	483 u	309 u	7.2	76
09/24/02	21-0304	01:47	0.1 i	17.2	7.8	517	331	6.5	66

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1104 Station: 04C, Mile Point: 48.357
Description: New Lenox Road, Lenox

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0121	04:16	0.2 i	9.6	7.8	261	167	10.2	87
06/25/02	21-0165	03:28	2.2	21.3	7.7	306	196	7.3	81
07/30/02	21-0205	02:25	1.7	22.2	7.9	440	282	7.9 u	90 u
09/04/02	21-0255	02:32	1.9	19.4	7.7	463	297	7.9	84
09/24/02	21-0305	02:08	1.8	18.8	7.7	478	306	7.3	77

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1103 Station: 19A, Mile Point: 43.042
Description: approximately 360 feet upstream of Valley Street, Lenox

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0122	04:49	0.1 i	9.2	7.8	240	154	10.7	91
06/25/02	21-0166	03:54	0.3	22.1	7.7	319	204	7.2	81
07/30/02	21-0206	02:56	0.2	22.6	7.9	402	257	7.4 u	85 u
09/04/02	21-0256	03:03	0.2	19.6	7.9	423 u	271 u	8.0	86
09/24/02	21-0306	02:32	0.1 i	19.8	7.9	458	293	7.2	77

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1102 Station: 19C, Mile Point: 37.693
Description: approximately 3300 feet downstream of Route 102 bridge beneath the most downstream high tension line, Lee (approximately 300 feet downstream of the Lee WWTP (MA0100153) discharge)

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0131	04:00	## i	8.8 u	7.3 u	261	167	10.5 u	89 u
06/25/02	21-0176	04:05	0.1 i	20.2 u	7.7	389 u	249 u	6.5 u	70 u
07/30/02	21-0216	04:13	## i	22.6	7.5	449	287	4.4	51
09/04/02	21-0266	00:07	## i	20.0	7.4	485	310	5.0	54
09/23/02	21-0316	23:48	0.1 i	19.0	7.3	507	325	5.4	57

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1101 Station: 19E, Mile Point: 26.131
Description: upstream of railroad bridge east of Route 183, Stockbridge

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0130	03:25	## i	10.2	7.6 u	230	147	10.8	93
06/25/02	21-0175	03:24	0.2	23.0	7.8	354	227	7.4	84
07/30/02	21-0215	03:30	## i	22.9	7.9	391	250	7.3	84
09/04/02	21-0265	03:40	1.3	19.0	8.0	452	290	8.2	86
09/24/02	21-0315	03:27	0.1 i	19.8	7.8	438	280	7.8	84

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1100 Station: 20A, Mile Point: 22.405
Description: Division Street at USGS flow gauging station #01197500, Great Barrington

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0129	02:56	## i	10.0	7.8	228	146	11.0	96
06/25/02	21-0174	02:58	0.2	22.7	8.0	339	217	7.6	86
07/30/02	21-0214	02:47	## i	24.0	8.2	390	249	7.1	83
09/04/02	21-0264	03:17	0.9	20.0	8.2	465	298	7.7	83
09/24/02	21-0314	03:00	## i	19.2	8.0	452	289	7.3 u	77 u

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1099 Station: 20D, Mile Point: 13.001
Description: Kellogg Road, Sheffield

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0127	01:35	0.5 i	9.6	7.6 u	235	150	10.8	93
06/25/02	21-0171	01:31	0.9	22.6	7.9	340	217	7.7	87
07/30/02	21-0211	01:26	## i	24.2	8.0	410	262	7.2 u	85 u
09/04/02	21-0261	02:11	1.0	20.5	8.0	466	299	7.9	86
09/24/02	21-0311	01:51	0.1 i	19.6	7.9	489	313	8.0	85

KONKAPOT RIVER (Saris: 2103525)
Unique_ID: W1114 Station: 26A, Mile Point: 0.936
Description: upstream of railroad trestle approximately 160 feet upstream of Route 7A , Sheffield

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0125	00:27	0.3 i	9.2	7.3 u	192	123	10.9 u	92 u
06/25/02	21-0169	00:34	0.4	20.7	7.9	299	191	7.8	86
07/30/02	21-0209	00:31	## i	21.4	8.0	313	200	7.7	86
09/04/02	21-0259	01:27	1.2	18.5	7.9	332	212	8.0	83
09/24/02	21-0309	01:03	## i	17.1	7.7	343	219	8.0 u	82 u

HUBBARD BROOK (Saris: 2103750)
Unique_ID: W1113 Station: 15A, Mile Point: 0.616
Description: Route 7, Sheffield

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0126	01:04	1.3 i	11.3	8.1 u	231	148	10.7 u	96 u
06/25/02	21-0170	01:04	0.1 i	24.0	8.3	265	170	7.5	88
07/30/02	21-0210	01:02	## i	24.0	7.8	284	182	6.4 u	75 u
09/04/02	21-0260	01:51	0.9	19.4	7.8	291	186	7.6	81
09/24/02	21-0310	01:27	## i	18.7	7.5	302	194	6.7 u	70 u

GREEN RIVER (Saris: 2103950)
Unique_ID: W1112 Station: 23A, Mile Point: 1.889
Description: Route 23\41, Great Barrington

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0151	02:06	## i	7.9	7.2 u	179 u	114 u	11.1	92
06/25/02	21-0172	02:03	0.1 i	15.3	7.6	240	154	9.0	88
07/30/02	21-0212	01:56	## i	19.7	7.6	299	191	7.4	80
09/04/02	21-0262	02:38	0.9	17.6	7.5	307	196	7.5 u	77 u
09/24/02	21-0312	02:17	## i	15.4	7.3	314 u	201 u	7.7	75

WILLIAMS RIVER (Saris: 2104100)
Unique_ID: W1098 Station: 06A, Mile Point: 1.235
Description: Division Street, Great Barrington

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0128	02:36	## i	10.0	8.0	372	238	10.6	92
06/25/02	21-0173	02:33	0.2	21.0	8.1	434	278	7.7 u	84 u
07/30/02	21-0213	02:23	## i	22.8	8.1	480	307	7.1 u	81 u
09/04/02	21-0263	03:01	0.9	19.0	8.0	504	323	8.0	84
09/24/02	21-0313	02:42	## i	16.7	7.9	516	330	8.3 u	84 u

HOP BROOK (Saris: 2104625)
Unique_ID: W1115 Station: HB, Mile Point: 0.232
Description: Meadow Street, Lee

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0132	04:29	0.2 i	7.6	6.9	105	67.0	10.0	81
06/25/02	21-0177	04:34	0.4	20.6	7.4	175	112	6.5	71
07/30/02	21-0217	04:42	## i	22.9	7.4	209	134	5.8	67
09/04/02	21-0267	00:36	1.0	18.5	7.4	257	164	6.7	70
09/24/02	21-0318	00:11	0.3 i	19.1	7.2	225 u	144 u	5.0 u	53 u

GOOSE POND BROOK (Saris: 2104775)
Unique_ID: W1109 Station: 07A, Mile Point: 0.979
Description: approximately 30 feet upstream of Greenwater Brook confluence, Lee

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0123	05:28	0.1 i	8.8	7.7	78.7	50.3	11.5	96
06/25/02	21-0167	04:24	0.3	16.2 u	8.0	425	272	9.6	95
07/30/02	21-0207	03:25	0.1 i	17.5	8.2	678	434	9.0	93
09/04/02	21-0257	04:08	0.1 i	16.1	8.1	659	422	9.2 u	92 u
09/24/02	21-0307	02:56	0.1 i	12.5	8.2	751 c	481 c	9.4	86

GREENWATER BROOK (Saris: 2104800)
Unique_ID: W1108 Station: GWPB, Mile Point: 0.014
Description: Forest Street, Lee

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0124	05:20	## i	6.2	7.7	277	177	11.9 u	94 u
06/25/02	21-0168	04:41	0.4	15.2	8.0	179	114	9.8	96
07/30/02	21-0208	03:33	0.1 i	20.4	8.0	142	90.8	8.7	95
09/04/02	21-0258	04:19	## i	17.8	7.8	129	82.2	9.2	94
09/24/02	21-0308	03:06	0.1 i	14.9	7.9	95.2	60.9	9.2	89

EAST BRANCH HOUSATONIC RIVER (Saris: 2105275)
Unique_ID: W1111 Station: 02A, Mile Point: 5.453
Description: upstream of Hubbard Avenue (upstream of stormwater pipe), Pittsfield

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0117	01:57	0.1 i	8.3	7.7	155	99.0	11.6	97
06/25/02	21-0161	01:20	0.4	21.2	7.9	226	145	8.7	96
07/30/02	21-0201	01:02	0.2	21.6	8.3	327	209	8.3	94
09/04/02	21-0251	01:06	0.3	18.3	8.1	507 u	325 u	8.8	92
09/24/02	21-0301	00:48	0.2	18.9	8.0	517	331	7.6	80

EAST BRANCH HOUSATONIC RIVER (Saris: 2105275)
Unique_ID: W1107 Station: 02B, Mile Point: 0.151
Description: approximately 600 feet downstream of Pomeroy Avenue, Pittsfield

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0119	03:10	0.1 i	8.6	7.6	206	132	10.6 u	88 u
06/25/02	21-0163	02:28	0.6	20.6	7.7	260	167	7.5	82
07/30/02	21-0203	01:45	0.2	22.4	7.9	433	277	7.6	87
09/04/02	21-0253	01:47	0.2	19.3	7.7	508 u	325 u	7.5	80
09/24/02	21-0303	01:26	0.2	17.5	7.7	578	370	6.5 u	66 u

WINDSOR BROOK (Saris: 2105475)
Unique_ID: W1116 Station: 09A, Mile Point: 0.464
Description: Windsor Road, Hinsdale

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
05/21/02	21-0116	01:07	0.2 i	5.6	7.3	72.8	46.6	12.2	95
06/25/02	21-0160	00:40	0.1 i	16.4	7.5	93.0	59.5	9.6	96
07/30/02	21-0200	00:30	## i	19.0	7.8	168	107	8.8	93
09/04/02	21-0250	00:34	0.2	16.3	7.8	170 u	109 u	9.2	92
09/24/02	21-0300	00:18	## i	13.9	7.6 u	175	112	9.3 u	88 u

APPENDIX 2: HOUSATONIC RIVER WATERSHED SURVEY 2002 BACTERIOLOGICAL WATER QUALITY DATA
(Note: Symbols and Qualifiers Used for DWM Data can be found in Appendix 4.)

Housatonic (2002) (QC Status: 4) Exported: 9/21/2005 4:51:15 PM

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1106 Station: 04A, Mile Point: 55.432
Description: west of Fairfield Street, Pittsfield, downstream of the confluence of the Southwest Branch Housatonic River and the West Branch Housatonic River

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0134	--	07:10	##* r	##* r	--	--	--	--
06/26/02	21-0179	--	06:45	##* r	##* r	--	--	--	--
07/31/02	21-0219	--	06:50	##* r	##* r	--	--	--	--
09/05/02	21-0269	--	07:50	##* dr	##* dr	--	--	--	--
09/25/02	21-0320	--	07:54	##* r	##* r	--	--	--	--

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1105 Station: 04B, Mile Point: 53.466
Description: Holmes Road, Pittsfield

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0136	--	07:35	210* e	230* e	--	--	--	--
06/26/02	21-0181	--	07:24	200*	160*	--	--	--	--
07/31/02	21-0221	--	07:30	1300*	1100*	3.3* h	--	--	--
09/05/02	21-0271	--	08:20	1000* d	800* d	--	--	--	--
09/25/02	21-0322	--	08:20	340*	300*	2.2* f	--	--	--

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1104 Station: 04C, Mile Point: 48.357
Description: New Lenox Road, Lenox

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0137	--	07:50	130*	110*	--	--	--	--
06/26/02	21-0182	--	08:00	150*	120*	--	--	--	--
07/31/02	21-0222	--	07:50j	130*	120*	2.2* h	--	--	--
09/05/02	21-0272	--	08:30	290* d	250* d	--	--	--	--
09/25/02	21-0323	--	08:35	110*	110*	1.8* f	--	--	--

HOUSATONIC RIVER/Woods Pond (Saris: 2103450) (Palis: 21120)
Unique_ID: W1117 Station: 19AU, Mile Point: 43.403
Description: Woods Pond at the foot bridge east of Housatonic Street, Lenox

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
07/31/02	21-0237	21-0239	08:20	--	--	23.0* h	--	--	--
07/31/02	21-0239	21-0237	08:20	--	--	24.2* h	--	--	--

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1103 Station: 19A, Mile Point: 43.042
Description: approximately 360 feet upstream of Valley Street, Lenox

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0138	21-0140	08:30	<10* de	20* e	--	0.010*	0.040*	1*
05/22/02	21-0140	21-0138	08:30	40* d	40*	--	0.020*	0.050*	2*
06/26/02	21-0183	21-0185	08:20	80*	30* d	--	0.110*	0.090*	1*
06/26/02	21-0185	21-0183	08:22	60* e	110* de	--	0.100*	0.080*	1*
07/31/02	21-0223	21-0225	08:35	40*	20*	--	0.070* d	0.162* b	1*
07/31/02	21-0225	21-0223	08:35	50*	50*	--	0.056* d	0.151* b	1*
09/05/02	21-0273	21-0275	09:00	210* d	140* d	--	0.052*	##* d	1* d
09/05/02	21-0275	21-0273	09:00	1300* d	800* d	--	0.057*	##* d	4* d
09/25/02	21-0324	21-0326	09:00	80*	50*	--	0.042*	0.188*	3.5*
09/25/02	21-0326	21-0324	09:00	90*	60*	--	0.040*	0.190*	3*

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1102 Station: 19C, Mile Point: 37.693
Description: approximately 3300 feet downstream of Route 102 bridge beneath the most downstream high tension line, Lee (approximately 300 feet downstream of the Lee WWTP
(MA0100153) discharge)

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0149	--	13:15	2600*	1900*	--	1.24*	0.250*	7*
06/26/02	21-0195	--	13:15	620*	570*	--	1.84*	0.180*	4*
07/31/02	21-0235	--	14:30	310*	280*	2.5*	2.42*	0.319* b	9*
09/05/02	21-0285	--	14:15	90* d	70* d	--	4.48*	##* d	4* d
09/25/02	21-0336	--	13:15	>20000*	>20000*	3.7* f	5.72*	0.504*	9.5*

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1101 Station: 19E, Mile Point: 26.131
Description: upstream of railroad bridge east of Route 183, Stockbridge

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0148	--	12:50	50*	20*	--	0.020*	0.040*	6*
06/26/02	21-0194	--	12:45	70* e	80* e	--	0.050*	0.070*	<1*
07/31/02	21-0234	--	14:00	<10*	<10*	2.5*	0.033*	0.108* b	1*
09/05/02	21-0284	--	13:15	30* de	50* de	--	<0.01*	##* d	<1* d
09/25/02	21-0335	--	12:50	<10*	<10*	1.5* f	0.035*	0.092*	1.0*

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1100 Station: 20A, Mile Point: 22.405
Description: Division Street at USGS flow gauging station #01197500, Great Barrington

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0147	--	12:30	30*	<10*	--	0.020*	0.050*	5*
06/26/02	21-0193	--	12:30	50*	30*	--	0.050*	0.080*	6*
07/31/02	21-0233	--	13:25	40*	20*	3.4*	0.040*	0.086* b	7*
09/05/02	21-0283	--	12:50	60* d	40* d	--	0.022*	##* d	3* d
09/25/02	21-0334	--	12:20	10*	<10*	1.9* f	0.020*	0.081*	3.5*

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1099 Station: 20D, Mile Point: 13.001
Description: Kellogg Road, Sheffield

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0145	--	11:40	<10*	<10*	--	0.060*	0.050*	12*
06/26/02	21-0190	--	11:45	160* e	180* e	--	0.070*	0.070*	3*
07/31/02	21-0230	--	12:25	30*	20*	1.8*	0.090*	0.081* b	6*
09/05/02	21-0280	--	11:50	120* d	110* d	--	0.017*	##* d	1* d
09/25/02	21-0331	--	11:30	50*	30*	1.2* f	0.065*	0.081*	1.5*

KONKAPOT RIVER (Saris: 2103525)
Unique_ID: W1114 Station: 26A, Mile Point: 0.936
Description: upstream of railroad trestle approximately 160 feet upstream of Route 7A , Sheffield

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0143	--	11:00	70*	30*	--	<0.01*	0.020*	4*
06/26/02	21-0188	--	11:11	250*	210*	--	<0.01*	0.010*	1*
07/31/02	21-0228	--	11:30	170* e	180* e	--	0.028*	0.027* b	4*
09/05/02	21-0278	--	11:05	140* d	130* d	--	0.025*	##* d	<1* d
09/25/02	21-0329	--	11:00	160*	150*	--	<0.01*	<0.01*	<0.5*

HUBBARD BROOK (Saris: 2103750)
Unique_ID: W1113 Station: 15A, Mile Point: 0.616
Description: Route 7, Sheffield

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0144	--	11:24	<10*	10*	--	<0.01*	0.020*	7*
06/26/02	21-0189	--	11:31	290*	250*	--	0.020*	0.020*	2*
07/31/02	21-0229	--	12:00	120*	110*	--	0.058*	0.043* b	5*
09/05/02	21-0279	--	11:25	80* de	90* de	--	0.015*	##* d	1* d
09/25/02	21-0330	--	11:15	210*	190*	--	0.017*	0.017*	2.0*

GREEN RIVER (Saris: 2103950)
Unique_ID: W1112 Station: 23A, Mile Point: 1.889
Description: Route 23\41, Great Barrington

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0152	--	12:00	20*	<10*	--	<0.01*	0.010*	4*
06/26/02	21-0191	--	12:00	180*	150*	--	<0.01*	<0.01*	<1*
07/31/02	21-0231	--	12:50	50*	30*	--	<0.01*	0.016* b	4*
09/05/02	21-0281	--	12:15	40* d	10* d	--	<0.01*	##* d	<1* d
09/25/02	21-0332	--	11:50	110*	70*	--	<0.01*	<0.01*	1.5*

WILLIAMS RIVER (Saris: 2104100)
Unique_ID: W1098 Station: 06A, Mile Point: 1.235
Description: Division Street, Great Barrington

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0146	--	12:20	10*	<10*	--	<0.01*	0.030*	3*
06/26/02	21-0192	--	12:15	50*	30*	--	<0.01*	<0.01*	1*
07/31/02	21-0232	--	13:10	30*	20*	--	<0.01*	0.016* b	4*
09/05/02	21-0282	--	12:35	40* d	10* d	--	<0.01*	##* d	<1* d
09/25/02	21-0333	--	12:10	30*	10*	--	<0.01*	<0.01*	1.0*

HOP BROOK (Saris: 2104625)
Unique_ID: W1115 Station: HB, Mile Point: 0.232
Description: Meadow Street, Lee

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0150	--	13:30	10*	10*	--	<0.01*	0.030*	4*
06/26/02	21-0196	--	13:30	110* e	140* e	--	0.020*	0.030*	1*
07/31/02	21-0236	--	14:50	40*	30*	<1.0*	0.038*	0.038* b	4*
09/05/02	21-0286	--	14:40	160* d	130* d	--	0.027*	##* d	1* d
09/25/02	21-0337	--	13:40	80*	50*	--	0.020*	0.011*	0.5*

GOOSE POND BROOK (Saris: 2104775)
Unique_ID: W1109 Station: 07A, Mile Point: 0.979
Description: approximately 30 feet upstream of Greenwater Brook confluence, Lee

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0141	--	09:01	<10*	<10*	--	<0.01*	0.030*	1*
06/26/02	21-0186	--	09:00	30*	<10*	--	<0.01*	<0.01*	<1*
07/31/02	21-0226	--	09:30	<10*	<10*	--	<0.01*	0.011* b	<1*
09/05/02	21-0276	--	09:35	<10* d	10* d	--	<0.01*	##* d	1* d
09/25/02	21-0327	--	09:28	<10*	<10*	--	<0.01*	<0.01*	<1*

GOOSE POND BROOK (Saris: 2104775)
Unique_ID: W1110 Station: 07B, Mile Point: 0.168
Description: Tyringham Road, Lee

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
09/05/02	21-0287	--	09:50	90* d	60* d	--	--	--	--
09/25/02	21-0338	--	13:45	70*	30*	--	--	--	--

GREENWATER BROOK (Saris: 2104800)
Unique_ID: W1108 Station: GWPB, Mile Point: 0.014
Description: Forest Street, Lee

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0142	--	09:02	60* e	70* e	--	<0.01*	0.010*	1*
06/26/02	21-0187	--	08:55	100*	100*	--	<0.01*	<0.01*	<1*
07/31/02	21-0227	--	09:35	70* e	80* e	--	<0.01*	0.016* b	1*
09/05/02	21-0277	--	09:35	110* d	110* d	--	<0.01*	##* d	1* d
09/25/02	21-0328	--	09:30	160*	140*	--	<0.01*	<0.01*	<1*

EAST BRANCH HOUSATONIC RIVER (Saris: 2105275)
Unique_ID: W1111 Station: 02A, Mile Point: 5.453
Description: upstream of Hubbard Avenue (upstream of stormwater pipe), Pittsfield

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0133	--	06:45	--	--	--	--	--	2*
06/26/02	21-0178	--	06:26	--	--	--	--	--	2*
07/31/02	21-0218	--	06:30	--	--	--	0.104*	0.096* b	2*
09/05/02	21-0268	--	07:20	--	--	--	0.194*	##* d	2* d
09/25/02	21-0319	--	07:33	--	--	--	0.269*	0.202*	4*

EAST BRANCH HOUSATONIC RIVER (Saris: 2105275)
Unique_ID: W1107 Station: 02B, Mile Point: 0.151
Description: approximately 600 feet downstream of Pomeroy Avenue, Pittsfield

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0135	--	07:20	50*	30*	--	--	--	--
06/26/02	21-0180	--	07:13	190*	190*	--	--	--	--
07/31/02	21-0220	--	07:15	340*	310*	--	--	--	--
09/05/02	21-0270	--	08:05	800* d	700* d	--	--	--	--
09/25/02	21-0321	--	08:05	270*	240*	--	--	--	--

APPENDIX 3A: HOUSATONIC RIVER WATERSHED SURVEY 2002 BLANK QC SAMPLE RESULTS
(Note: Symbols and Qualifiers Used for DWM Data can be found in Appendix 4)

Housatonic (2002) (QC Status: 4) Exported: 9/26/2005 4:43:39 PM

Date	OWMID	QAQC	Time	Fecal	E.coli	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0139	Blank	08:30j	<10*	<10*	--	<0.01*	<0.01*	1* b
06/26/02	21-0184	Blank	08:20j	<10*	<10*	--	<0.01*	<0.01*	<1*
07/31/02	21-0224	Blank	08:35j	<10*	<10*	--	0.010* b	0.014* b	<1*
07/31/02	21-0238	Blank	08:20j	--	--	<1.0* h	--	--	--
09/05/02	21-0274	Blank	09:00j	<10* d	<10* d	--	<0.01*	##* bd	<1* d
09/25/02	21-0325	Blank	09:00j	<10*	<10*	--	<0.01*	<0.01*	<1*

APPENDIX 3B: HOUSATONIC RIVER WATERSHED SURVEY 2002 RELATIVE PERCENT DIFFERENCE RESULTS
(Note: Symbols and Qualifiers Used for DWM Data can be found in Appendix 4)

Housatonic (2002) (QC Status: 4) Exported: 9/26/2005 2:36:02 PM

HOUSATONIC RIVER/Woods Pond (Saris: 2103450) (Palis: 21120)
Unique_ID: W1117 Station: 19AU, Mile Point: 43.403
Description: Woods Pond at the foot bridge east of Housatonic Street , Lenox

Date	OWMID	QAQC	Time	Log10(Fecal)	Log10(E.coli)	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
07/31/02	21-0237	21-0239	08:20	--	--	23.0* h	--	--	--
07/31/02	21-0239	21-0237	08:20	--	--	24.2* h	--	--	--
Relative	*Percent*	*Difference*		--	--	*5.1%*	--	--	--

HOUSATONIC RIVER (Saris: 2103450)
Unique_ID: W1103 Station: 19A, Mile Point: 43.042
Description: approximately 360 feet upstream of Valley Street, Lenox

Date	OWMID	QAQC	Time	Log10(Fecal)	Log10(E.coli)	Chl-a	NH3-N	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	mg/m3	mg/L	mg/L	mg/L
05/22/02	21-0138	21-0140	08:30	1.000* de	1.301* e	--	0.010*	0.040*	1*
05/22/02	21-0140	21-0138	08:30	1.602* d	1.602*	--	0.020*	0.050*	2*
Relative	*Percent*	*Difference*		*46.3%*	*20.7%*	--	*66.7%*	*22.2%*	*66.7%*
06/26/02	21-0183	21-0185	08:20	1.903*	1.477* d	--	0.110*	0.090*	1*
06/26/02	21-0185	21-0183	08:22	1.778* e	2.041* de	--	0.100*	0.080*	1*
Relative	*Percent*	*Difference*		*6.8%*	*32.1%*	--	*9.5%*	*11.8%*	*0.0%*
07/31/02	21-0223	21-0225	08:35	1.602*	1.301*	--	0.070* d	0.162* b	1*
07/31/02	21-0225	21-0223	08:35	1.699*	1.699*	--	0.056* d	0.151* b	1*
Relative	*Percent*	*Difference*		*5.9%*	*26.5%*	--	*22.2%*	*7.0%*	*0.0%*
09/05/02	21-0273	21-0275	09:00	2.322* d	2.146* d	--	0.052*	##* d	1* d
09/05/02	21-0275	21-0273	09:00	3.114* d	2.903* d	--	0.057*	##* d	4* d
Relative	*Percent*	*Difference*		*29.1%*	*30.0%*	--	*9.2%*	--	*120.0%*
09/25/02	21-0324	21-0326	09:00	1.903*	1.699*	--	0.042*	0.188*	3.5*
09/25/02	21-0326	21-0324	09:00	1.954*	1.778*	--	0.040*	0.190*	3*
Relative	*Percent*	*Difference*		*2.7%*	*4.6%*	--	*4.9%*	*1.1%*	*15.4%*

APPENDIX 4: SYMBOLS AND QUALIFIERS USED FOR DWM DATA

The following data qualifiers or symbols are used in the MADEP/DWM WQD database for qualified and censored water quality and multi-probe data. Decisions regarding censoring vs. qualification for specific, problematic data are made based on a thorough review of all pertinent information related to the data.

General Symbols (applicable to all types):

*" ## " = Censored data (i.e., data that has been discarded for some reason). NOTE: Prior to 2001 data, "**" denoted either censored or missing data.*

*" ** " = Missing data (i.e., data that should have been reported). See NOTE above.*

" -- " = No data (i.e., data not taken/not required)

** = Analysis performed by Laboratory OTHER than DEP's Wall Experiment Station (WES)*

[ ] = A result reported inside brackets has been "censored", but is shown for informational purposes (e.g., high blank results).

Multi-probe-specific Qualifiers:

" i " = inaccurate readings from Multi-probe likely; may be due to significant pre-survey calibration problems, post-survey checks outside typical acceptance ranges for the low ionic and deionized water checks, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses. Where documentation on unit pre-calibration is lacking, but SOPs at the time of sampling dictated pre-calibration prior to use, then data are considered potentially inaccurate.

Qualification Criteria for Depth (i):

General Depth Criteria: Apply to each OWMID#

- Clearly erroneous readings due to faulty depth sensor: Censor (i)
- Negative and zero depth readings: Censor (i); (likely in error)
- 0.1 m depth readings: Qualify (i); (potentially in error)
- 0.2 and greater depth readings: Accept without qualification; (likely accurate)

Specific Depth Criteria: Apply to entirety of depth data for survey date

- If zero and/or negative depth readings occur more than once per survey date, censor all negative/zero depth data, and qualify all other depth data for that survey (indicates that erroneous depth readings were not recognized in the field and that corrective action (field calibration of the depth sensor) was not taken, ie. that all positive readings may be in error.)

" m " = method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed, ie. operator error (eg. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

" s " = field sheet recorded data were used to accept data (i.e., not data electronically recorded in a data logger or in cases where data logging is not possible (e.g., single-probes)).

" u " = unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

" c " = unit not calibrated for a particular parameter and/or greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for conductivity (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or turbidity (>10, 20 or 40 NTU). It can also be used for TDS and Salinity calculations based on qualified ("c") conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

" r " = data not representative of actual field conditions.

" ? " = Light interference on Turbidity sensor (Multiprobe error message). Data is typically censored.

Sample-Specific Qualifiers:

" a " = accuracy as estimated at WES Lab via matrix spikes, PT sample recoveries, internal check standards and lab-fortified blanks did not meet project data quality objectives identified for program or in QAPP.

" b " = blank Contamination in lab reagant blanks and/or field blank samples (indicating possible bias high and false positives).

" d " = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.

" e " = not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for e-coli bacteria > fecal coliform bacteria, for lake Secchi and station depth data where a specific Secchi depth is greater than the reported station depth, and for other incongruous or conflicting results.

" f " = frequency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.

" h " = holding time violation (usually indicating possible bias low)

" j " = 'estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used to report sample data where the sample concentration is less than the 'reporting' limit or RDL and greater than the method detection limit or MDL (mdl< x <rdl). Also used to note where values have been reported at levels less than the mdl.

" m " = method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (eg. sediment in sample, floc formation), lab error (eg. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, and missing data.

" p " = samples not preserved per SOP or analytical method requirements.

" r " = samples collected may not be representative of actual field conditions, including the possibility of "outlier" data and flow-limited conditions (e.g., pooled).

APPENDIX C

Technical Memorandum TM-21-5

HOUSATONIC RIVER WATERSHED 2002 BIOLOGICAL ASSESSMENT

Peter Mitchell
Massachusetts Department of Environmental Protection
Division of Watershed Management
Worcester, MA

20 July 2005

CN 197.0

CONTENTS

Tables and Figures

INTRODUCTION

Biological monitoring is a useful, cost-effective method of detecting anthropogenic impacts to the aquatic community. Resident biota (e.g., benthic macroinvertebrates, fish, periphyton) in a water body are natural monitors of environmental quality and can reveal the effects of episodic and cumulative pollution and habitat alteration (Barbour et al. 1999, Barbour et al. 1995). Surveying and assessing these sentinel species and their habitats are the principle tools of biomonitoring.

As part of the Massachusetts Department of Environmental Protection/Division of Watershed Management's (DWM) 2002 Housatonic River watershed assessments, aquatic benthic macroinvertebrate biomonitoring, fish population biomonitoring, and habitat assessment were conducted to evaluate the biological health of selected portions of the watershed. A total of 15 biomonitoring stations were sampled to investigate the effects of a variety of stressors on resident biological communities. Six stations were historical Massachusetts Department of Environmental Protection (MA DEP) biomonitoring stations—most recently assessed in 1997 (Kennedy and Weinstein 2000). The addition of the 2002 data collected again at these stations allows the MA DEP to determine if water quality and habitat conditions at these stations have changed over time.

Collection and analysis of macroinvertebrate data also provides information necessary for making basin-wide aquatic life use-support determinations required by Section 305(b) of the Clean Water Act. All Housatonic River watershed biomonitoring stations were compared to reference stations most representative of the "best attainable" (i.e., least-impacted) conditions in the watershed. Use of a watershed reference station is particularly useful in assessing nonpoint source pollution originating from multiple and/or unknown sources in a watershed (Hughes 1989). Both the quality and quantity of available habitat affect the structure and composition of resident biological communities. Effects of habitat features can be minimized by comparing collected data to reference stations with similar habitats (Barbour et al. 1999). Sampling highly similar habitats also reduces metric variability attributable to factors such as current speed and substrate type. Four reference stations were established in the Housatonic Watershed, each representing best attainable conditions in three different flow and instream habitat conditions. To minimize the effects of temporal (seasonal and year to year) variability, sampling was conducted at approximately the same time of the year as the 1997 biosurveys. Streamflow was much reduced in 2002 when compared to 1997. The USGS gage on the East Branch of the Housatonic River at Coltsville, MA (01197000) reported a daily mean flow of 32.8cfs for the month of August 1997 and a daily mean flow 18cfs for the month August 2002. 2002 streamflow, at this gage, was reduced to 55% of the 1997 reported streamflow. A similar case was noted when examining the streamflow data from the USGS gage on the Housatonic River near Great Barrington, MA (01197500). Here, the daily mean streamflow for August 1997 was 175cfs. In 2002, the daily mean streamflow was recorded as 92cfs for the month of August. 2002 streamflow at this gage was 53% of flow conditions observed in 1997.

Watershed reference stations were established in Windsor Brook (station WB01), the Konkapot River (station KR11), the East Branch of the Housatonic River (station EB01B), and the Housatonic River (HT19E). The selection of the reference station to use for comparisons to a study site was based on comparability of stream morphology, flow regimes, and drainage area.

During "year 1" of its "5-year basin cycle", areas of concern within the Housatonic River watershed were defined more specifically through such processes as coordination with appropriate groups (Housatonic Valley Association (HVA), MA DEP/DWM, MA DEP/WERO, MA DFG), assessing existing data, and conducting site visits. Following these activities, the 2002 biomonitoring plan was more closely focused and the study objectives better defined. Biomonitoring station locations, along with station identification numbers and sampling dates, are noted in Table 1. Sampling locations are also shown in Figure 1. A summary of the existing conditions and perceived problems—both historical and current—identified prior to the 2002 Housatonic River watershed biomonitoring survey is provided in Table 2.

The main objectives of the 2002 biomonitoring in the Housatonic River watershed were: (a) to determine the biological health of streams within the watershed by conducting assessments based on aquatic

macroinvertebrate and fish communities; and (b) to identify impaired stream segments so that efforts can be focused on developing remediation strategies. Specific tasks were:

1. Conduct benthic macroinvertebrate and fish population sampling and habitat assessments at locations throughout the Housatonic River watershed;
2. Based upon the benthic macroinvertebrate, fish population, and habitat data, identify river segments within the watershed with potential impairments and pollution problems; and
3. Using the benthic macroinvertebrate and fish population data, and supporting water chemistry (when available) and field/habitat data:
    - assess the types of water quality and/or water quantity problems that are present.
    - make recommendations for remedial actions or additional monitoring and assessment.
    - provide macroinvertebrate, fish population, and habitat data to MA DEP/DWM's Environmental Monitoring and Assessment Program for assessments of aquatic life use and aesthetics use-support status required by Section 305(b) of the Federal Clean Water Act (CWA).
    - provide macroinvertebrate, fish population, and habitat data for other informational needs of Massachusetts regulatory agencies, non-governmental organizations, and others.

Table 1. List of benthic biomonitoring stations sampled during the 2002 Housatonic River watershed survey, including station identification number, mile point (distance from mouth), upstream drainage area, station description, and sampling date.

Station ID	Mile Point	Upstream Drainage Area (mi^2)	HOUSATONIC RIVER WATERSHED Benthic Station Description	Sampling Date
KR07*	10.7	38.35	Konkapot River, East of Clayton Mill River Rd. New Marlboro, MA	9 Sept. 2002
KR11^{R}*	20.6	7.46	Konkapot River, dnst. of Bidwell Park falls, Monterey, MA	11 Sept. 2002
WR01*	1.1	43.58	Williams River, dnst. of Division Street, Great Barrington, MA	9 Sept. 2002
HW02S*	0.6	23.16	Southwest Branch Housatonic River, dnst. of Barker Road, Pittsfield, MA	10 Sept. 2002
WB01^{R}	0.3	9.04	Windsor Brook, ~150m upst. of Cleveland Brook Aqueduct, Hinsdale, MA	10 Sept. 2002
HT19E^{R}	26	279.62	Housatonic River, ~150m dnst. of RxR tracks nr Rt. 183, Stockbridge, MA	9 Sept. 2002
GR23A	1.8	52.28	Green River, ~100m dnst. of Rt. 23/41, Great Barrington, MA	9 Sept. 2002
KR02*	2.9	59.83	Konkapot River, ~100m dnst. of Rt. 124 North Canaan, CT	9 Sept. 2002
WF01A	1.5	17.82	Wahconah Falls Brook, upst. of Holiday Cottage Road, Dalton, MA	10 Sept. 2002
EB01B^{R}	11.5	26.25	East Branch Housatonic River, ~700m upst. of Rt. 8, Hinsdale, MA	10 Sept. 2002
HT19A	43	170.56	Housatonic River, upst. from Crescent Mills (Crystal Street), Lenox, MA	11 Sept. 2002
HT19C	37.6	205.66	Housatonic River, dnst. of Lee WWTP (Tyringham Road), Lee, MA	11 Sept. 2002
GPB07A	0.9	14.03	Goose Pond Brook, ~100m dnst. of Forest St., Lee, MA	11 Sept. 2002
EB02A	5.5	57.47	East Branch Housatonic River, ~50m upst. of Hubbard Ave., Pittsfield, MA	10 Sept. 2002
HW01*	0.3	36.84	West Branch Housatonic River, ~300m dnst. of Rt. 20, Pittsfield, MA	10 Sept. 2002

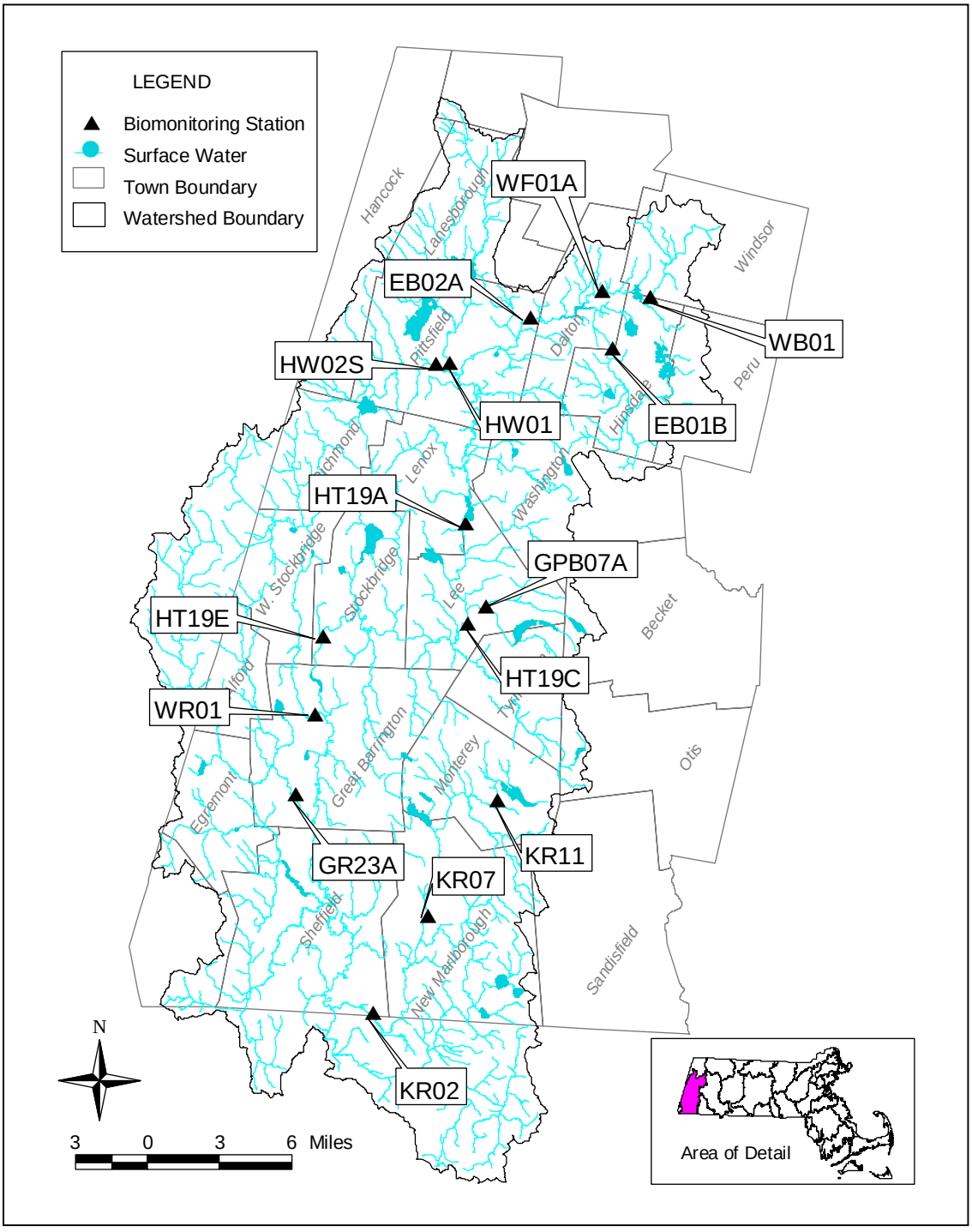
^{R} 2002 reference station, * sampled by DWM in 1997

Table 2. List of existing conditions and perceived problems identified prior to the 2002 Housatonic River watershed biomonitoring survey.

Station	Conditions/Problems
East Branch Housatonic River (EB01B)	-priority organics*, reference condition
Konkapot River (KR11)	-metals*, reference condition
Windsor Brook (WB01)	-flow altewration*, reference condition, drinking water source
Goose Pond Brook (GPB07A)	-pathogens*
Wahconah Falls Brook (WF01A)	-unassessed*
Southwest Branch Housatonic River (HW02S)	-siltation, habitat alteration, cause unknown*
West Branch Housatonic River (HW01)	-priority organics, siltation, habitat alteration, pathogens*
Konkapot River (KR07)	-metals*
Williams River (WR01)	-some uses not assessed*
Green River (GR23A)	-metals, pathogens*
East Branch Housatonic River (EB02A)	-priority organics*
Konkapot River (KR02)	- metals, organic enrichment/low DO, pathogens*
Housatonic River (HT19A)	- unknown toxicity, pathogens, thermal modification, priority organics, turbidity*
Housatonic River (HT19C)	- unknown toxicity, pathogens, thermal modification, priority organics, turbidity*
Housatonic River (HT19E)	- unknown toxicity, pathogens, thermal modification, priority organics, turbidity*

* MA DEP. 2002. *Massachusetts Year 2002 Integrated List of Waters. Part 2 – Proposed Listing of Individual Categories of Waters*.

Figure 1. Location map of MA DWM 2002 Housatonic Watershed Benthic Sampling Locations



METHODS

Macroinvertebrate Sampling

The macroinvertebrate sampling procedures employed during the 2002 Housatonic River watershed biomonitoring survey are described in the *Standard Operating Procedures (Draft): Water Quality Monitoring in Streams Using Aquatic Macroinvertebrates*. (Nuzzo 2002), and are based on US EPA Rapid Bioassessment Protocols (RBPs) for wadeable streams and rivers (Barbour et al. 1999). The macroinvertebrate collection procedure utilized kick-sampling, a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms in a net as the current carries them downstream. Sampling activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (Fiorentino 2002). Sampling was conducted by MA DEP/DWM biologists throughout a 100 m reach, in riffle/run areas with fast currents and rocky (boulder, cobble, pebble, and gravel) substrates—generally the most productive habitats, supporting the most diverse communities in the stream system. Ten kicks in squares approximately 0.46 m x 0.46 m were composited for a total sample area of about 2 m^2. Samples were labeled and preserved in the field with denatured 95% ethanol, then brought to the MA DEP/DWM lab for further processing.

Macroinvertebrate Sample Processing and Analysis

The macroinvertebrate sample processing and analysis procedures employed for the 2002 Housatonic River watershed biomonitoring samples are described in the standard operating procedures (Nuzzo 2002) and were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (Fiorentino 2002). Macroinvertebrate sample processing entailed random selection of specimens from the other materials in the sample until approximately 100 organisms (±10%) were extracted. Specimens were identified to genus or species as allowed by available keys, specimen condition, and specimen maturity. Taxonomic data were analyzed using a modification of Rapid Bioassessment Protocol III (RBP III) metrics and scores (Plafkin et al. 1989). Metric values for each station were scored based on comparability to the reference station, and scores were totaled. The percent comparability of total metric scores for each study site to those for a selected “least-impacted” reference station yields an impairment score for each site. The analysis separates sites into four categories: non-impacted, slightly impacted, moderately impacted, and severely impacted. Each impact category corresponds to a specific aquatic life use-support determination used in the CWA Section 305(b) water quality reporting process—non-impacted and slightly impacted communities are assessed as “support” in the 305(b) report; moderately impacted and severely impacted communities are assessed as “impaired.” A description of the *Aquatic Life* use designation is outlined in the *Massachusetts Surface Water Quality Standards* (SWQS) (MA DEP 1996). Impacts to the benthic community may be indicated by the absence of generally pollution-sensitive macroinvertebrate taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT); dominance of a particular taxon, especially the pollution-tolerant Chironomidae and Oligochaeta taxa; low taxa richness; or shifts in community composition relative to the reference station (Barbour et al. 1999). Those biological metrics calculated and used in the analysis of 2002 Housatonic River watershed macroinvertebrate data are listed and defined below [For a more detailed description of metrics used to evaluate benthos data, and the predicted response of these metrics to increasing perturbation, see Barbour et al. (1999)]:

1. Taxa Richness—a measure based on the number of taxa present. Generally increases with increasing water quality, habitat diversity, and habitat suitability. The lowest possible taxonomic level is assumed to be genus or species.

2. EPT Index—a count of the number of genera/species from the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). As a group these are considered three of the more pollution sensitive aquatic insect orders. Therefore, the greater the contribution to total richness from these three orders, the healthier the community.

3. Biotic Index—Based on the Hilsenhoff Biotic Index (HBI), this is an index designed to produce a numerical value to indicate the level of organic pollution (Hilsenhoff 1987). Organisms have been assigned a value ranging from zero to ten based on their tolerance to organic pollution. Tolerance values (TV) currently used by MA DEP/DWM biologists were originally developed by Hilsenhoff and have since been supplemented by Bode et al. (1991) and Lenat (1993). A value of zero indicates the taxon is highly

intolerant of pollution and is likely to be found only in pollution-free waters. A value of ten indicates the taxon is tolerant of pollution and may be found in highly polluted waters. The number of organisms and the individually assigned values are used in a mathematical formula that describes the degree of organic pollution at the study site. The formula for calculating HBI is:

$$HBI = \sum_{n} \frac{x_i t_i}{}$$

where
x_i = number of individuals within a taxon
t_i = tolerance value of a taxon
n = total number of organisms in the sample

4. Ratio of EPT and Chironomidae Abundance—The EPT and Chironomidae abundance ratio uses relative abundance of these indicator groups as a measure of community balance. Skewed populations having a disproportionate number of the generally tolerant Chironomidae ("midges") relative to the more sensitive insect groups may indicate environmental stress.

5. Percent Contribution Dominant Taxon—is the percent contribution of the numerically dominant taxon (genus or species) to the total numbers of organisms. A community dominated by few species indicates environmental stress. Conversely, more balance among species indicates a healthier community.

6. Ratio of Scraper and Filtering Collector Functional Feeding Groups—This ratio reflects the community food base. The proportion of the two feeding groups is important because predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source (Barbour et al. 1999). Scrapers predominate when diatoms are the dominant food resource, and decrease in abundance when filamentous algae and mosses prevail. Filtering collectors thrive where filamentous algae and mosses are prevalent and where fine particulate organic matter (FPOM) levels are high.

7. Community Similarity—is a comparison of a study site community to a reference site community. Similarity is often based on indices that compare community composition. Most Community Similarity indices stress richness and/or richness and abundance. Generally speaking, communities with comparable habitat will become more dissimilar as stress increases. In the case of the Housatonic River watershed bioassessment, an index of macroinvertebrate community composition was calculated based on similarity (i.e., affinity) to the reference community, expressed as percent composition of the following organism groups: Oligochaeta, Ephemeroptera, Plecoptera, Coleoptera, Trichoptera, Chironomidae, and Other. This approach is based on a modification of the Percent Model Affinity (Novak and Bode 1992). The reference site affinity (RSA) metric is calculated as:

$100 - (\Sigma\ \delta \times 0.5)$
where δ is the difference between the reference percentage and the sample percentage for each taxonomic grouping. RSA percentages convert to RBPIII scores as follows: <35% receives 0 points; 2 points in the range from 35 to 49%; 4 points for 50 to 64%; and 6 points for $\geq$65%.

Habitat Assessment

An evaluation of physical habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Barbour et al. 1999). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). Before leaving the sampling reach during the 2001 Housatonic River watershed macroinvertebrate biosurveys, habitat qualities were scored, and assessed, using a modification of the evaluation procedure in Barbour et al. (1999). The matrix used to assess habitat quality is based on key physical characteristics of the water body and related streamside features. Most parameters evaluated are instream physical attributes often related to overall land-use and are potential sources of limitation to the aquatic biota (Barbour et al. 1999). The ten habitat parameters are as follow:

instream cover, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and compared to a reference station to provide a final habitat ranking.

QUALITY CONTROL

Field and laboratory Quality Control (QC) activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) for biomonitoring and habitat assessment (Fiorentino 2002). Quality Control procedures are further detailed in the standard operating procedures (Nuzzo 2002).

Field Sampling Quality Control

Field Sampling QC entails: 1) Pre- and post-sampling rinses, inspection of, and picking of nets, sieves, and pans to prevent organisms collected from one station to be transferred to samples taken elsewhere. 2) On-site preservation of benthos sample in 95% ethanol to ensure proper preservation, and 3) collection of a duplicate sample at one in ten biomonitoring stations. A duplicate is collected as a "side by side" (where different assessment results are not expected due to the apparent absence of additional stressors) to each of the 10 kicks making up the "original" sample. A duplicate sample is composited in a similar manner to the original sample, yet, is preserved in a separate sample bottle marked "duplicate" and with all other information regarding station location remaining the same. Duplicate samples are used for the calculation of Precision of the benthos data.

Field Analytical Quality Control

Habitat analysis QC entails multiple observers (at least both DWM benthic biologists, and often a third person) performing the Habitat Assessment at each macroinvertebrate biomonitoring station. A standardized Habitat Assessment Field Scoring Sheet is completed at all biomonitoring stations. Disagreement in habitat parameter scoring is discussed and resolved before the Habitat Assessment can be considered complete.

Fixed Laboratory Quality Control

Fixed Laboratory QC entails the following: 1) Taxonomy bench sheets are examined by a reviewer (the DWM biologist not responsible for the initial taxonomic identifications) for errors in transcription from bench notebook, count totals, and spelling. All bench sheets are examined, and detected errors are brought to the taxonomists attention, discussed, and corrected. 2) Taxonomic duplication, in which "spot checks" are performed by a reviewer (the DWM biologist not responsible for the initial taxonomic identifications) on taxonomy, are performed at the reviewer's discretion. In general, all taxa that are rarely encountered in routine benthos samples, or taxa that the primary taxonomist may be less than optimally proficient at identifying, are checked. Spot checks are performed for all stations. Specimens may be sent to authorities for particular taxonomic groups. 3) Data reduction and analysis, including biological metric scoring (metric values are calculated through queries run in the DWM Benthic Macroinvertebrate Database), comparisons to reference station metrics, and impairment designations, are checked by a reviewer (the DWM biologist not responsible for performing the initial taxonomy and data analysis) for all benthos data at all stations. Detected errors are brought to the original taxonomist's attention and resolved. 4) Precision, a measure of mutual agreement among individual measurements or enumerated values of the same property of a sample and usually expressed as a standard deviation in absolute or relative terms, is compared using raw benthos data and metric values. If metric values and resulting scoring are significantly different (i.e., beyond an acceptable Relative Percent Difference) between the original and duplicate samples, the investigators will attempt to determine the cause of the discrepancy. Guidance regarding the calculation of Precision, including Relative Percent Difference (RPD) calculations and recommendations, can be found in US EPA (1995) and Barbour et al. (1999).

Housatonic River Watershed

"The Housatonic watershed drains 504 of its 1,946 mi2 in the Massachusetts portion of the watershed with an additional 30 mi2 entering from eastern New York" (BRPC 1999). The mainstem Housatonic River begins at the confluence of the east and west branches in Pittsfield, MA. The river meanders through a fertile valley that is framed by the Berkshire Highlands to the east and the Taconic Range to the west. The high gradient streams entering from these hills greatly contrast with the meandering mainstem.

The mainstem Housatonic River runs through geology rich in carbonates – a singularly rare condition in Massachusetts. "Bedrock in the upper Housatonic River Basin consists of limestone, dolomite, and marble, as well as schist, quartzite, and gneiss. The carbonate rocks are bounded on the west (Taconic Range) by quartz-mica schist with some garnetiferous schist. The carbonate rocks are bounded on the east by quartzitic rocks that consist of quartzite, conglomerate, and feldspathic quartzite with some mica schist, and by gneissic rocks that are mostly granite-biotite gneiss with some micaceous schist and quartzite." (Olcott 1995).

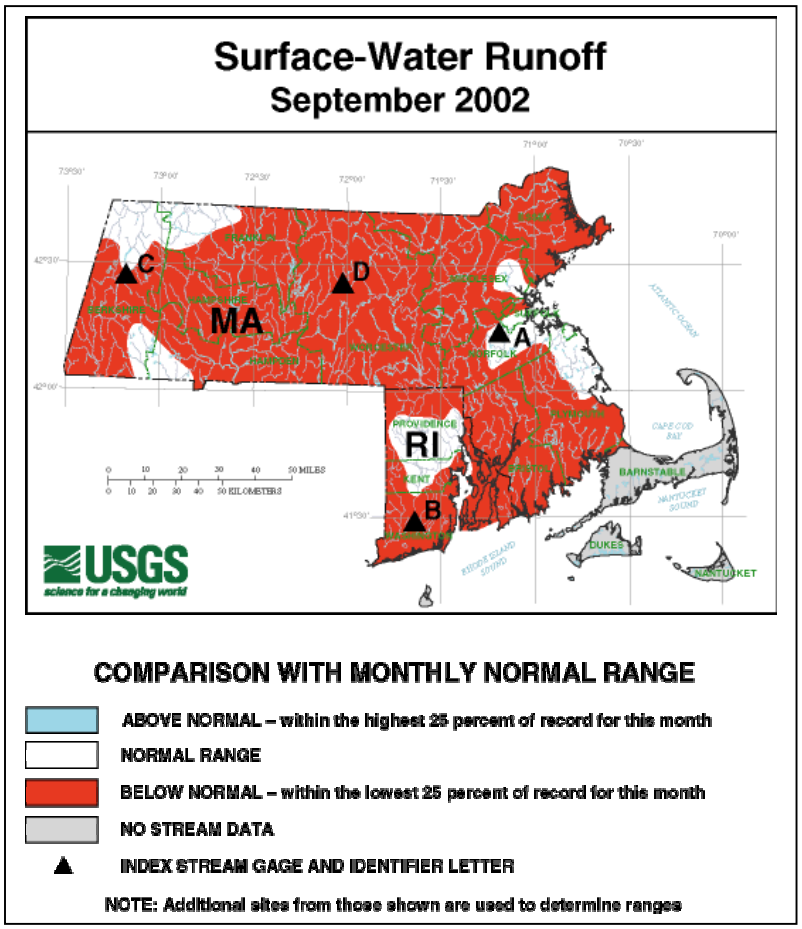
The constituents of the tributarial substrates (in the Taconic Range and Berkshire Hills) are not as prone to dissolution as the carbonaceous rock underlying the bed of the mainstem Housatonic River. Thus, the hardness, dissolved solids, and specific conductance tend to be greater in streams that run through the Housatonic valley floor, than in streams that run through the abutting hills. Also, the addition of carbonates provides an increased acid neutralizing capacity not found in other watersheds of the Commonwealth.

The high concentrations of carbonates mentioned above may have several effects upon the waters, flora, and fauna of the Housatonic River. Many of the aquatic plants favor alkaline conditions (i.e.: Myrophyllum exalbescens, Najas minor, Lemna trisulca, Heteranthera dubia, Ceratophyllum echinatum, Potamogeton sp., and Chara sp.) (Hellquist and Crow 1980 – 1985). Waters high in carbonates may also tend to be more supportive of macroinvertebrates such as mussels and crayfish that require calcium for shell development. Furthermore, alkaline waters tend to reduce the availability of toxic metals to sensitive fish species such as salmonids. There is, however, a down-side to elevated carbonate buffering. Nitrogen (an essential plant nutrient) is made more available under alkaline conditions and may have the affect of increasing aquatic plant growth – including algal blooms – beyond acceptable levels.

Polychlorinated biphenyls (PCBs) remain a contaminant of concern from below Center Pond (Dalton, MA) to Long Island Sound (Breault and Harris 1997, Coles 1998). Unfortunately, examinations of this endocrine disruptor are beyond the purview of this biological investigation. However, MA DPH has issued fish consumption advisories regarding PCBs.

The Housatonic Watershed was affected by a lack of precipitation during the 2002-sampling schedule. July and August precipitation was below normal – with July attaining less than 51% of normal rainfall (MA DEM 2002). Indeed, much of the entire state suffered from reduced rainfall, and streamflow, during August 2002 (Figure 2). Groundwater volume was also reduced during this same time period.

Figure 2. USGS Massachusetts flow condition map for September 2002.



RESULTS AND DISCUSSION

EB01B—East Branch Housatonic River, mile point 11.5, approximately 700m upstream of Route 8, near Jericho Road, Hinsdale, MA (Reference Station)

Habitat

The East Branch of the Housatonic River – within this segment – is classified as a Class B, Cold Water Fishery. The watershed contributing to station EB01B is 26.25 mi^2, and receives flows emanating from the Hinsdale Flats State Wildlife Management Area. This area of critical environmental concern (ACECs: places in Massachusetts that receive special recognition because of the quality, uniqueness and significance of their natural and cultural resources.) covers approximately 14,500 acres in the towns of Dalton, Hinsdale, Peru, and Washington, and is dominated by a calcareous fen (a wetland rich in calcium). Hinsdale Flats is home to many state-listed species (Szczebak, et al. 1999). From Hinsdale Flats, water passes through the town of Hinsdale. Hinsdale has recently expanded (post-1997 DWM survey) the number of homes connected to its sewer system. However, many homes remain, as yet, unconnected. Aside from residences, Hinsdale is home to several gravel operations that lay within the East Branch subbasin. The East Branch of the Housatonic River continues north from the town of Hinsdale, and begins a high-gradient descent (>45 ft/mi) (BRPC 1999) to the town of Dalton, MA. This segment of the East Branch of the Housatonic River is currently considered a “category 5” waterbody (waters impaired by a pollutant - MA DEP 2003). Review of EPA sediment and fish tissue analysis (McGrath 2001) performed in Center Pond (Dalton, MA), however, should remove this classification.

The EB01B biomonitoring station was accessed by walking approximately 110 meters east from Jericho Road. The riparian zone within this reach is dominated by forest, with mostly Hemlock (*Tsuga canadensis*) on the right bank, and sugar maple (*Acer saccharum*) and ash (*Fraxinus* sp.) on the left bank. These trees provided 70% canopy cover over the 5 meter-wide stream reach. Grasses and ferns dominated the understory below the deciduous trees, but there was, as expected, no understory below the hemlocks. The riparian zone appeared relatively undisturbed; however, the remains of an old (industrial revolution era) mill indicate where the channel was once modified for hydro-development. There were no aquatic macrophytes present within the reach, and thin-film green algae covered less than 1% of the substrates.

The instream substrates were dominated by boulder and cobble – providing good instream habitats for benthos. Detritus (CPOM – coarse particulate organic matter) dominated the organic substrate component. As mentioned above, the instream flows were below normal during the late summer of 2002. These reduced flows resulted in a sub-optimal Channel Flow Status score (13/20). There were also signs of fine sediment deposition on much of the streambed, and a slight turbidity to the water. This may be due to suspension of natural geolithic components (e.g. $CaCO_3$), fine organic components discharged from Hinsdale Flats, or run off from gravel operations. This station received the second highest habitat score of all fifteen 2002 Housatonic stations (176/200). This high score adds merit to using EB01B as a reference station.

Benthos

Station EB01B was used as a reference station to be compared to five other benthic stations (Stations: GR23A, WR01, HW02S, HW01, EBO2A). The hydrologies, substrates, and watershed areas are similar amongst these stations and allow for this comparison.

This was the first time the DWM had sampled benthos from this segment of the East Branch of the Housatonic River. An assemblage indicating a healthy aquatic community, with metric values indicative of good water quality and "least-impacted" conditions, characterized the macroinvertebrate community at this station. Of the 15 stations examined by the DWM during the 2002 survey, station EB01B had the second best Biotic Index metric score (3.76), second only to station WB01 (2.77) - another reference station. This score indicates that fauna intolerant of conventional organic pollution dominate the benthic community. EB01B scored the fourth best in terms of Percent Dominant Taxa (14.7%). This low percentage indicates a diverse community structure. The dominant species in the EB01B collection was *Oulimnius latiasculus* (14.7%). This herbivorous beetle is intolerant (tolerance value = 2) and requires waters with high concentrations of dissolved oxygen to thrive.

The macroinvertebrate orders Ephemeroptera, Plecoptera, and Trichoptera (EPT) are often grouped together as many of their members are intolerant of eutrophication and many other types of water quality degradation. EPT made up 48% of the sampled benthic community at EB01B. This is not the highest EPT contribution encountered among the 15 stations; due, in part to the few Trichopterans collected. EB01B displayed the lowest percentage of Trichopterans (14.70%) of all stations.

WB01—Windsor Brook, mile point 0.3, approximately 150 meters upstream of the Cleveland Brook Reservoir Aqueduct, Old Windsor Road, Hinsdale, MA (Reference Station)

Habitat

The Windsor Brook watershed, contributing to station WB01, is 9.04 mi^2. The WB01 sampling reach was located along a dirt portion of Old Windsor Road, less than 0.1 miles from the Windsor/Dalton town line. The stream, and proximal road, lay in a sparsely populated, heavily forested watershed that provides drinking water for the town of Dalton and the city of Pittsfield. The headwaters of this 5.6 mile, 3rd order stream are northeast of Fobes Hill (west of Savory Hollow Road), Windsor, and the stream's mouth is located at the Windsor Reservoir, Hinsdale. There is one point withdrawal located 0.2 miles upstream of the mouth. This withdrawal project consists of a small dam and an aqueduct that transports water to Cleveland Brook Reservoir. This aqueduct is operated by the Pittsfield Water Department. The use of this aqueduct is based on the water level within Cleveland Brook Reservoir. When Cleveland Brook Reservoir

is full, water is allowed to flow into Windsor Reservoir. Windsor Reservoir serves the town of Dalton, and Cleveland Brook Reservoir serves the city of Pittsfield. However, Dalton is permitted to withdraw up to 46 MGD from Cleveland Brook Reservoir. Windsor Brook is on the "The Massachusetts 2002 Integrated List of Waters" (MA DEP 2003) as a category 4c water ("Impairment not caused by a pollutant"). This entire stream (5.6 miles) is listed as such due to dewatering by an aqueduct (located at mile 0.2) that transfers water to Cleveland Brook Reservoir.

Windsor Brook is classified as a high-gradient stream, with a gradient of 130ft/mi for the first river mile upstream of station WB01. The riparian zone, although reduced in width because of the proximity of Old Windsor Road, provided 90% canopy cover to this stream reach. The dominant riparian trees were: Hemlock (*Tsuga canadensis*), Yellow Birch (*Betula lutea*), Sugar Maple (*Acer saccarum*), Mountain Maple (*Acer spicatum*), and Slippery Elm (*Ulmus rubra*). Dominant Shrubs (that covered 50% of the riparian zone) included: Yew (*Taxus canadensis*), Striped Maple (*Acer pennsylvanicum*), and Moosewood (*Viburnum alnifolium*). Ten percent of the riparian zone was covered with ferns (Pteridophyta), mosses (Bryophyta sp.), grasses (Poaceae sp.), Partridgeberry (*Mitchella repens*), and other indeterminate species. Algae coverage within the reach was estimated at 60% with green filamentous and green thin film algae present on rocks in both the pools and riffles.

The stream within the sampled reach was approximately 3 meters wide, with depths ranging from 0.2 meters in the riffles to 0.3 meters in the pools. The within-reach substrates were dominated by bedrock and boulder. This is to be expected, due to the high gradient nature, and geologic characteristics of the watershed. The organic substrate components consisted entirely of detritus (CPOM), no doubt being provided by the abundant forestation. Much of the substrate was exposed during the sampling event due to a natural reduction in rain during the 2002 summer (Figure 2). The low instream flow greatly affected this small stream, and caused a reduction in the Channel Flow Status score (6/20), with up to 75% of the substrate being left exposed. The proximity of Old Windsor Road also reduced the Riparian Vegetative Zone Width score for the right bank (2/10). The total habitat score for station WB01 was 164/200 (ranked 7th of the 15 stations examined). However, this stream remains a reference station to similar small streams (Goose Pond Brook – GPB07A, Wahconah Falls Brook – WF01A) in the Housatonic watershed.

Benthos

The benthic community of station WB01 displayed the highest biological integrity of the 15 stations examined in 2002. The WB01 community displayed the best scores in terms of Biotic Index (2.77), EPT Index (19), Percent Filter-Collectors (12%), and Percent Dominant Taxon (8.41%). This station has all the attributes of the ideal high-gradient New England stream. The low Biotic Index score points towards a community populated with intolerant fauna. This is again expressed in the high EPT Index score. The percent contribution of the dominant taxon was the lowest at WB01 (8.41%). This alludes to a very diverse community. There were three macroinvertebrates that tied for the dominant taxon. They were *Baetis* sp., Chloroperlidae, and *Hydropsyche morosa* group.

WF01A – Wahconah Falls Brook, mile point 1.5, immediately upstream of Holiday Cottage Road, Dalton, MA

Habitat

Station WF01A was located approximately 1.75 miles downstream of Windsor Reservoir (a drinking water reservoir serving the town of Dalton). The watershed area upstream of station WF01A is 17.8 mi^2, and Wahconah Falls Brook drops 62 ft in the first upstream mile. However, the majority of the elevation loss occurs immediately after Windsor Reservoir (hence the name Wahconah Falls), and much of the high gradient nature of this stream is quickly lost as it flows through a more level topology. The stream segment containing WF01A is classified as a "category 3" segment, with no uses assessed (MA DEP 2003). The proximal landuse is agricultural and sparse residential. The within-reach riparian zone consisted of a single line of trees (providing 60% canopy cover to the reach), and then transitioning to field and pasture. The dominant trees (occupying 10% of the riparian zone) were Slippery Elm (*Ulmus rubra*), Ash (*Fraxinus* sp.), Sugar Maple (*Acer saccharum*), and Sycamore (*Platanus occidentalis*). Shrubs (also occupying 10% of the riparian zone) were comprised of: Honeysuckle (*Lonicera* sp.), Wild Rose (*Rosa* sp.), Wild Grape (*Vitis* sp.), Barberry (*Berberis* sp.), and Witch-hazel (*Hamamelis virginiana*).

Grasses and other herbaceous vegetation, including Goldenrod (*Solidago sp.*), occupied 100% of the riparian zone. There were no aquatic macrophytes within the reach, but green filamentous and thin film algae covered 80% of the rocks in the riffles. The high amount of algal coverage is indicative of a system with increased nutrient concentrations.

Within-reach substrates were dominated by boulder and cobble. The organic fraction of the substrates was entirely detritus (CPOM). Much of these substrates were exposed due to the low flow conditions encountered during the 2002 survey. These conditions resulted in a decrease in the Channel Flow Status score (8/20), and were measured in the depths of riffles (0.15m), runs (0.15m), and pools (0.6m). The brevity of the undisturbed portion of the riparian zone also caused a drop in the score of the Riparian Zone Width (4/20). These two habitat parameters accounted for the majority of the reductions in the habitat score (149/200) (Table A6). These observed conditions were similar (91%) to the reference station for this site (WB01).

Benthos

Station WF01A employed station WB01 as a benthic reference station. While the watershed supporting station WF01A flows through a larger area (17.8 mi^2) than WB01 (7.46 mi^2), both stations are considered to be small streams. WF01A received at total metric score of 34, and is 81% comparable to the reference station. This score resulted in an assessment of "slightly impacted" for biological conditon. (Table A2 and figure 5)

WF01A slightly exceeded its reference condition Taxa Richness of 32 (Station WB01) by containing 34 different taxa in the sample. This fact alludes to slightly increased benthic diversity at WF01A. Station WF01A scored poorly when compared to the reference station in terms of the Biotic Index (WF01A = 4.26. However, the reference station WB01 had the best Biotic Index score of all stations in the Housatonic watershed (WB01 = 2.77). The EPT Index was quite high at WF01A (14). It was the third highest in the survey of 15 stations, with the reference station (WB01 = 19) and station GR23A (16) being the only stations that scored better. This condition points towards a community with a diverse population of the orders Ephemeroptera, Plecoptera, and Trichoptera. These benthic orders are, on the whole, populated with intolerant macroinvertebrates. However, the WF01A sample contained a high proportion of Filter – Collectors (39%). This elevated condition is explained by the fact that 84% of the Trichopterans collected were Filter–Collectors, and they are potentially more tolerant of eutrophication. Indeed, WF01A had the third highest percent contribution of Filter–Collectors of all 15 stations examined, inferring that there may be some increase in nutrient loading, or FPOM, to this station. Station WF01A was quite comparable to the reference station WB01 in terms of community composition, as indicated by its high-scoring Percent Reference Affinity (72). This station contained a healthy benthic community, however, the contribution of Filter–Collectors should be monitored as an increase in their numbers may indicate an adverse response to nutrient loads, or increases in the resident plankton coming from Windsor Reservoir. Future examinations of the benthic community at this station should also include evaluations of the localized algal community, and conditions immediately below the Windsor Reservoir.

KR11 – Konkapot River, mile point 20.6, downstream of Bidwell Park falls, Monterey, MA (Reference Station)

Habitat

Station KR11 (located at river mile 20.6) was located 0.2 miles below the town center of Monterey, and 1.1 miles downstream from the outfall of Brewer Pond. Brewer Pond receives its water from Lake Garfield. The stream is considered high-gradient - dropping 70 feet from the outlet of Brewer Pond. The stream segment containing KR11 is listed as a "category 5" segment, due to high levels of metals – specifically mercury in fish tissue (MA DEP 2003). The watershed area, up to station KR11, was 7.5 mi^2. The majority of the landuse within this drainage area is forested and contains sparse residential development. There is a small concrete dam 0.2 miles upstream of station KR11.

The riparian zone at station KR11 was heavily forested, with trees providing 75% canopy cover. Dominant tree species within the riparian zone included: Eastern Hemlock (*Tsuga canadensis*), White Pine (*Pinus strobus*), Yellow Birch (*Betula lutea*), Ash (*Fraxinus* sp.), Sugar Maple (*Acer saccharum*), Slippery Elm

(*Ulmus rubra*), and Beech (*Fagus* sp.). These trees occupied 95% of the riparian zone. Shrubs (occupying less than 1% of the riparian zone) included Dogwood (*Cornus sp.*) and Hobblebush (*Viburnum alnifolium*). Grasses and herbaceous vegetation occupied less than 1% of the riparian zone. Dominant species included ferns (*Filicinophyta*), Joe-Pye weed (*Eupatorium sp.*), goldenrod (*Solidago* sp.), and Horsetail (*Equisetum* sp.). The *Equisetum sp*. made up the majority of the maple understory. There were no macrophytes within the sampling reach, and algal growth was estimated at less than 1% coverage.

Substrates were dominated by boulder and sand, and the organic substrate components were entirely detritus (CPOM). Water levels were diminished during the 2002 survey, resulting in a decrease in the Channel Flow Status score (7/20). The stream width was four meters, with riffle depths of 0.2m, run depths of 0.3m, and pool depths of 0.4m. The total habitat score in 2002 was 170/200. This station was sampled by DWM in 1997 and the total habitat score was 180/200. The primary reason for the reduction in score in 2002 was the decrease in Channel Flow Status. All other habitat parameters measured in both 1997 and 2002 remained within three points of each other.

Benthos

When sampled during the 1997 Housatonic biological survey, KR11 was found to be suitable for use as a reference station (Fiorentino, 1999). This is again the case based on the 2002 survey of this station. While there were some minor differences in metric scores, the overall assessment of this station is the same as it was in 1997.

KR11 was again used as a reference station to which downstream stations on the Konkapot River were compared. KR11 was third best in terms of the Percent Dominant Taxon metric (12%). This points towards a community of diversity, with no single taxa representing an overwhelming majority of the community. However, KR11 was again low in the number of collected EPT taxa (9 in 2002, 8 in 1997). This low score was exacerbated by the second worst score in terms of the EPT / Chironomidae metric. It appears that low flow conditions affected the instream community; decreasing viable habitat for benthics with an affinity for stronger flows, and increasing the habitats for benthics that favor lacustrine habitats. Still, these low flow conditions were obvious at the majority of stations examined in 2002, and did not prevent the use of KR11 as a reference station for other stations within the Konkapot watershed.

A duplicate sample was collected at KR11 to evaluate the precision of field collection procedures (see *Field Sampling Quality Control*). Assessment of the metric comparison between sample KR11 and KR11 (duplicate) revealed a 95% metric similarity. Also, the taxonomic comparison between the two samples revealed a 91% reference affinity. This is the highest percent reference affinity score observed in all of the 2002 Housatonic benthic data, and suggests the absence of significant sample bias.

KR02 – Konkapot River, mile point 2.9, approximately 100 meters downstream of Route 124, North Canaan, CT.

Habitat

The Konkapot River returns to MA after a 2.3 river-mile course through North Canaan, CT. The watershed area contributing to station KR02 iss 59.83 mi^2. The landuse in the upstream Connecticut portion appears to be dominated by agriculture. This was also the case upstream and adjacent to station KR02 (located at river mile 2.9). Indeed, proximal agricultural practices presented obvious sources of potential non-point source pollution. The stream segment containing KR02 is listed as a “category 5” segment due to the presence of mercury in fish tissue, organic enrichment, low dissolved oxygen, and excessive pathogens (MA DEP 2003). Much of the high-gradient nature of the Konkapot River has dissipated by the time it flows through KR02 (6ft drop in previous mile). However, an area of swiftly flowing water with coarse substrates adequate for the collection of macroinvertebrates was found at this station. The riparian zone had been much modified by human activities within this reach. There was a large pasture on river right, and a house on river left. Both are buffered from the river by a single line of young trees. Those trees provided no canopy cover (0%), and consisted of Box elder (*Acer negundo*), Sycamore (*Platanus occidentalis*), Willow (*Salix* sp.), and Silver Maple (*Acer saccharinum*). These trees occupied 10% of the riparian zone. Shrubs occupied 1% of the riparian zone, and consisted of wild Rose (*Rosa* sp.). Grasses

and herbaceous growth were the dominating vegetative cover within the riparian zone. They occupied 100% of the available riparian zone and consisted of grasses (*Poaceae*), Goldenrod (*Solidago sp.*), Loosestrife (*Lythrum* sp.), Jewelweed (*Impatiens* sp.), Forget-me-not (*Myosotis* sp.), Joe Pye weed (*Eupatorium purpureum*), and Bedstraw (*Galium molugo*). There were no aquatic macrophytes with the reach, but green filamentous algae covered 25% of the rock substrates in the riffle zones. More algae was expected, considering the lack of canopy cover.

The substrates were dominated by boulder and sand/gravel, and the organic fraction of the substrates was entirely detritus (CPOM). The boulders are most likely additions to the stream as a result of the construction of the Route 124 Bridge. The bridge, and associated construction, has also channelized this portion of the river to prevent abutment erosion and bridge scour. The stream width was approximately 12 meters; with riffles displaying a depth of 0.2 meters. There were no pools present within the sampling reach. The lack of habitat variety (Velocity-Depth Combinations = 10/20) and the elevated sediment deposition (Sediment Deposition = 11/20) accounted for the decrease in the Instream Cover habitat score (6/20). The highly abbreviated riparian zone width (Riparian Vegetative Zone Width = 6/20), along with the aforementioned poor habitat measures, resulted in a total habitat score of 139/200. This score is slightly higher than the score given to this station in 1997 (123/200).

Benthos

Despite the obvious habitat constraints, the 2002 benthic community at KR02 received a determination of "non-impacted" when compared to the KR11 reference station (95% comparability to the reference condition – in terms of all scored metrics). There is, however, a difference in the benthic community structure between KR02 and KR11 with regards to the Percent Dominant Taxon. The dominant taxon at the reference station (KR11) was equally divided between the mayfly *Stenonema* sp. and the caddisfly *Hydropsyche morosa* group. Each taxon represented 10% of the collected community. The dominant taxon at KR02 was the riffle beetle *Optioservus trivittatus*. This macroinvertebrate represented 22% of the sampled macroinvertebrates. It was the Percent Dominant Taxon metric that showed the only reduction in metric scoring. KR02 displayed a relatively high percentage of Scrapers (41%), when compared to the reference station (26%). It may be the case that Scrapers are responding to the increased amounts of algae (a food resource for Scrapers). The algae coverage at KR02 was 25%, and was less than 1% at KR11.

The benthic community at KR02 showed an improvement over the "slightly impacted" conditions observed in 1997 (Fiorentino 1999). There was an increase in the number of EPT taxa (8 in 1997, 13 in 2002). Also, there was a decline in the percent contribution of the order Chironomidae (38% in 1997, 14% in 2002). This is a potential improvement over 1997 conditions.

KR07 – Konkapot River, mile point 10.7, East of Clayton Mill River Road, village of Mill River, town of New Marlborough, MA.

Habitat

Station KR07 was located 0.6 miles downstream of Church Road Bridge in the Village of Mill River. Station KR07 is also 9.4 river miles downstream of station KR11. The Konkapot River, between the two stations, flows through both high gradient and low gradient habitats, and receives the discharge from Lake Buel. Lake Buel is listed as a "category 5" water body, due to nutrients and exotic species (MA DEP 2003). The segment containing station KR07 is also a "category 5" waterbody, due to the presence of mercury in fish tissue. Station KR07 was located in a high gradient reach (69ft drop in previous river mile), providing proper instream conditions for application of DWM Benthic Monitoring SOPs, and comparison between stations. The total drainage area, down to station KR07, was 38.35mi^2.

The within-reach riparian zone was relatively undisturbed, yet abbreviated by the proximity of Clayton Mill Road. Dominant tree species (occupying 70% of the available riparian zone, and providing 60% canopy cover) within the reach were: Eastern Hemlock (*Tsuga canadensis*), Red Maple (*Acer rubrum*), Hornbeam (*Carpinus caroliniana*), Ash (*Fraxinus* sp.), Yellow Birch (*Betula lutea*), and Elm (*Ulmus* sp.). Shrubs (occupying 5% of the riparian zone) included: Barberry (*Berberis* sp.), Mountain Laurel (*Kalmia latifolia*), and Witch hazel (*Hamamelis virginiana*). Grasses and other herbaceous vegetation occupied 100% of the

available riparian zone and included: Ferns (*Filicinophyta*), Horsetail (*Equisetum sp.*), Grasses (*Poaceae*), and Knotweed (*Polygonum cuspidatum*). Aquatic vegetation covered less than 1% of the instream habitat, and consisted entirely of mosses. Algal coverage was estimated at 80%, and consisted primarily of green thin-film and some filamentous algae, attached to rocks within the riffles.

The substrates were dominated by bedrock and boulder – attesting to the high-gradient nature of this station. The organic fraction of the substrates was made up entirely of detritus (CPOM). The stream width was 11 meters at station KR07. The riffle depth was 0.4 meters, the run depth was 0.4 meters, and the pool depth was 0.6 meters. This station did not seem as affected by the low flow conditions encountered at other stations. The Channel Flow Status score of 18/20 expressed this condition. All habitat parameters were quite high scoring, with the exception of the Right Bank Riparian Vegetative Zone Width. This measure received a score of 4 during the 2002 survey. The reduction in score (out of a possible 10) was due to the proximity of Clayton Mill Road.

This station was sampled during the 1997 survey of the Housatonic watershed. Habitat scores were very similar (1997 = 171/200, 2002 = 172/200). As was this case in 2002, the Right Bank Riparian Vegetative Zone Width was the major detractor to the overall habitat score (3/10).

Benthos

The benthic community at KR07 was found to be "non-impacted" when compared to the KR11 reference station. All metrics examined, with the exception of Percent Dominant Taxon, scored within the highest level. The Percent Dominant Taxon exceeded the threshold level of 20%. The dominant taxon at KR07 was *Hydropsyche morosa group.* (a common Filter–Collector). Filter–Collectors made up 26.4% of the entire collection. This is negligibly higher than the Filter-Collector contribution to the reference condition (21%). However, there is a great improvement in the EPT/Chironomidae metric. The reference condition for the EPT / Chironomidae metric was 1.55. The KR07 EPT/Chironomidae score was 6.22. Not only is the number of EPT taxa increased at KR07 (KR07 = 12, KR11 = 9), but also KR07 had the second lowest abundance of Chironomidae of all 15 stations examined. This points towards a healthy, high-gradient benthic community.

In 1997, KR07 received 81% comparability to KR11 (the reference station). This was improved in 2002, with a 95% comparability rating. Also, the 1997 survey noted metric point losses with regard to Biotic Index and Percent Dominant Taxon. While Percent Dominant Taxon was still elevated in 2002, the Biotic Index scored in the highest bracket.

HW01 – West Branch Housatonic River, mile point 0.3, approximately 300 meters downstream of Route 20, Pittsfield, MA

Habitat

The West Branch of the Housatonic River is classified as a Class B Cold Water Fishery (Kennedy and Weinstein 2000). The 36.84 mi^2 watershed upstream of station HW01 is highly modified with dense residential and industrial development. The contributing watershed also includes Pontoosuc Lake. Pontoosuc Lake is a "category 5" water body, due to mercury in fish tissue and exotic species (MA DEP 2003). The segment containing HW01 is also a "category 5" water body due to priority organics contamination (PCBs). The over-all gradient is low (18ft in the previous mile). However, an area of adequate substrates (primarily cobble and pebble) existed at this station. The sampled reach was channelized, with stone walls containing the flows for approximately half of the 100 meter reach. Trash, storm drains, and roads indicated obvious sources of NPS pollution, and the water had a musty odor, and a slightly turbid, grey/tan color. A thin line of trees occupied the narrow riparian zone, and provided 65% canopy cover. These trees covered 30% of the available zone, and consisted of: Ash (*Fraxinus* sp.), Silver Maple (*Acer saccharinum*), Norway Maple (*Acer platanoides*), and Beech (*Fagus* sp.). Shrubs and vines (occupying 20% of the available zone) in the reach included Sumac (*Rhus* sp.), and Wild Grape (*Vitis* sp.). Herbaceous cover (occupying 50% of the riparian zone) was dominated by Knotweed (*Polygonum cuspidatum*). There were no aquatic macrophytes within the reach, and algal coverage was

estimated at less than 5%. The algae present was green filamentous, attached to rock within the riffle zones.

Within-reach substrates were dominated by cobble (60%), and sub-dominated by pebble (15%). Stream depths in the 3.5 meter-wide reach were quite low in all three habitat features. The depth of riffles was 0.1 meter, the depth of runs was 0.2 meters, and the depth of the pools was 0.25 meters. Substrates appeared to be uniformly distributed throughout the reach. This greatly reduced the habitat variability. The substrate organic fraction included 75% detritus (CPOM) and 25% mud-muck (FPOM).

The habitat of station HW01 was poor, and received the lowest habitat score of the 15 stations examined in 2002 (94/200). Several habitat parameters were responsible for such a low score. The reach contained primarily shallow riffles and runs, and very little structure. This provided poor Instream Fish Cover (4/20). There were only 2 of 4 Velocity / Depth Combinations (shallow-slow, shallow-fast. score = 7/20); with no deep pools or deep runs. The vegetation along the stream banks was sparse on either bank (Bank Vegetative Protection Right Bank = 4/10, Bank Vegetative Protection Left Bank = 4/10). The Riparian Zone Width was quite abbreviated, due to human impact consisting of residences, small industrial facilities, roads, and parking areas (Right Bank = 2/10, Left Bank = 2/10).

Poor habitat conditions were also noted when station HW01 was examined in 1997 (102/200). Some significant differences exist amongst the parameters. The Channel Flow Status was better in 1997 (19/20) than in 2002 (12/20). The Embeddedness was worse in 1997 (6/20) than in 2002 (14/20), and the Sediment Deposition was worse in 1997 (6/20) than in 2002 (17/20).

Benthos

HW01 received a rating of “slightly impacted”. The comparison to the reference station (EB01B) revealed a degraded community structure in all metrics except the EPT/Chironomidae Ratio, and the Scraper/Filter–Collector Ratio. The Percent Dominant Taxon (34% - the worst of the 15 stations examined) was represented by *Nais variabilis*. This worm is classified as a Collector–Gatherer, and has the highest tolerance rating (10) possible. The Biotic Index rating for HW01 was 6.84 (contrasting to 3.76 at the reference station, EB01B) representing the worst score of all stations examined. This is also the case for the number of EPT taxa. HW01 had only 5 taxa belonging to the EPT group (the lowest of all 15 stations examined), and EB01B had 12 EPT taxa.

HW01 was also sampled in 1997 and received a rating of “slight/moderately impacted” (Fiorentino 1999). However, the extensive algal coverage noted in 1997 (50%) was not observed in 2002 (<5% coverage). Also, the FPOM substrate constituent observed in 1997 (40%) was estimated as 25% in 2002. The two functional feeding groups that utilize such habitat variables were also reduced in 2002. The contribution of Scrapers declined from 40% in 1997 to 27% in 2002. This was also the case regarding Filter–Collectors. They represented 34.7% of the collected taxa in 1997, but this declined to 26% in 2002. While this positive community change may be a result of slight improvement in habitat conditions and/or water quality, HW01 remains in need of improvement.

HW02S – Southwest Branch of the Housatonic, mile point 0.6, immediately downstream of Barker Road, Pittsfield, MA.

Habitat

The Southwest Branch of the Housatonic River is classified as a Class B Cold Water Fishery (Kennedy and Weinstein 2000). The watershed area contributing to this station measures 23.16 mi^2. Major features within this watershed include Richmond Pond (Category 4c – non-native plants) and the Pittsfield Municipal Airport. The segment containing HW02S is listed as a “category 5” water body due to unknown causes, siltation, and habitat alteration (MA DEP 2003). The landuse surrounding station HW02S was equally divided between residential and forest landuse types. The 8-meter wide river had been channelized with riprap at this station, and the road crossing (Barker Road) provided a potential source of NPS pollution.

Trees within the riparian zone provided 70% canopy cover to the reach and included Ash (*Fraxinus* sp.), Cottonwood (*Populus* sp.), Willow (*Salix* sp.), Slippery Elm (*Ulmus rubra*), Yellow Birch (*Betula lutea*), and Sugar Maple (*Acer saccharum*). Shrubs within the riparian zone included Alder (*Alnus sp.*), Dogwood (*Cornus sp.*), Honeysuckle (*Lonicera sp*), Wild Rose (*Rosa* sp.), and Wild Grape (*Vitis* sp.). Herbaceous vegetation within the riparian zone was dominated by Knotweed (*Polygonum cuspidatum*), but also included grasses (*Poaceae* sp.), and various undetermined composites. There were no aquatic macrophytes within the reach, nor was there any algal coverage.

The substrates at station HW02S were dominated by cobble (40%), and pebble (40%). All substrates had a "silty cover" overlaying them, and the water appeared to be slightly turbid. The organic fraction of the substrates was entirely detritus (CPOM).

The total habitat score for station HW02S was 146/200 (ranked 11th of 15 stations). Poor conditions were observed for the Sediment Deposition habitat parameter (7/20); with up to 50% of the stream bed being affected by new sediment deposits. The Velocity–Depth Combinations habitat parameter also received a marginal rating (8/20), with no deep habitats observed.

HW02S was sampled in 1997 (also as part of the DWM Biomonitoring Program). Overall habitat conditions improved only slightly; from 137/200 in 1997 to 146/200 in 2002. There was a marked improvement in Embeddedness (8/20 in 1997, 17/20 in 2002). The reduction in fine particles occluding the substrates increases the area of habitat available for benthic colonization.

Benthos

HW02S received a "non-impacted" rating when compared to the EB01B reference station. Two community metrics (EPT and Percent Dominant Taxa) accounted for the minor reduction in score. The number of EPT taxa at HW02S was 10, and the reference station yielded 12 taxa. The Percent Dominant Taxa at HW02S (28%) was represented by *Optioservus trivittatus*. This water beetle is classified as a Scraper, with a mid-level tolerance value (4).

Perhaps the most intriguing comparisons relate to the changes in observed conditions at HW02S between the 1997 survey and the 2002 survey. In 1997, HW02S received a "slight / moderate" impairment rating. Two of the metrics that scored poorly in 1997 were EPT Index and Percent Dominant Taxon. There were only 4 EPT taxa collected in 1997 (resulting in a score of 0/6). The dominant taxon accounted for 62% of the entire sample, and was represented by the family *Optioservus* sp.. (Resulting in a score of 0/6). The 1997 total metric score was 22/42 (52% comparability). Conditions were much improved in 2002. The EPT taxa had 10 representatives (resulting in a score of 4/6). The dominant taxon was again represented by *Optioservus* sp., but accounted for 28% of the entire sample (resulting in a score of 4/6). The increase in EPT taxa implies a community more populated by sensitive taxa, and the reduction in the dominant taxon implies a more diverse community structure. The 2002 total metric score was 38/42 (90% comparability). *Optioservus* sp. was still the dominant taxon encountered at HW02S, but it made up a smaller portion of the examined sample. This may be a result of the reduction in the algae coverage within this reach. In 1997 algal coverage was estimated at 60%. In 2002, algal coverage was estimated as 0%, with no algae observed. The reduction in this potential food source (and perhaps a reduction in nutrient loads, as algae requires nutrients to flourish) may be one reason that *Optioservus* sp. numbers were reduced in 2002.

WR01 – Williams River, mile point 1.1, immediately downstream from Division Street, Great Barrington, MA.

Habitat

Station WR01 was located between the Division Street Bridge and the Route 41 bridge in Great Barrington MA. The Williams River watershed, down to station WR01, is 43.58 mi^2. Only a small portion of the watershed has been developed for residential purposes (~7%). The remaining portion is primarily forested. The headwaters of the Williams river are located in Richmond, MA and Canaan, NY. Some of the more interesting features within the watershed are the four ponds to the northwest of Stockbridge,

MA. Hudson Ore Bed Pond, Lee Ore Bed Pond, Crane Lake, and Cranberry Pond lay in close proximity to each other, and appear to have a high concentration of limestone within their watershed areas. The segment containing WR01 is listed as a "category 2" water body ("Attaining some uses; others not assessed"), and has been assessed as supporting the Aquatic Life Use and the Aesthetics Use (MA DEP 2003). The Williams River flows through West Stockbridge, MA; paralleling the Housatonic River until the confluence in Great Barrington, MA. The Williams River is not very high gradient, and drops 19 feet in the first river mile upstream of station WR01. Still, the substrates and flows were adequate for DWM biological investigations within the sampling reach.

The local landuse at WR01 was entirely residential. The steep, proximal stream banks showed signs of moderate erosion, with high erosion potential during floods. Some historic channelization was noticeable in the vicinity of the two bridges above and below this reach. Trees occupied 30% of the available riparian zone, provided 50% canopy cover, and included: Black Locust (*Robina pseudoacacia*), Sugar Maple (*Acer saccharum*), Ash (*Fraxinus* sp.), and Slippery Elm (*Ulmus rubra*). Shrubs (also occupying 30% of the available riparian zone) included: Honeysuckle (*Lonicera* sp.), Barberry (*Berberis* sp.), Wild Grape (*Vitis* sp.), Dogwood (*Cornus* sp.), and Spindle tree (*Euonymus* sp.). Grasses and other herbaceous vegetation occupied 100% of the available riparian habitat and included: Grasses (*Poaceae* sp.), many different composites, ferns, and Deadly nightshade (*Solamum* dulcamara). There were no aquatic macrophytes observed within the reach, but algal coverage was estimated at 30%. Algae included both green filamentous algae (attached to rocks in the pools and riffles) and green mat algae (attached to rocks in the pools).

The dominant substrates were divided equally among bedrock, boulder, and cobble (25% each). Moderate amounts of sand and fine sediments were apparent in the reach, and accounted for some enlargement of point bars. The stream was approximately 10 meters wide, 0.2 meters deep in the riffle zone, and 0.4 meters deep in the runs and pools. The stream was affected by the low-flow conditions encountered at many of the other stations. This is expressed in the Channel Flow Status score of 11/20 (suboptimal). The overall habitat score (142/200) was also deleteriously affected by suboptimal scores in Sediment Deposition (10/20), Bank Stability (7/20), and Riparian Vegetative Zone Width (12/20).

Station WR01 was sampled during the 1997 DWM Housatonic survey. At that time, the habitat score was (169/200). Habitat conditions were slightly better during the 1997 survey, than in 2002. The habitat measures of Bank stability, Channel Flow status and Sediment Deposition were all better in 1997 than conditions encountered in 2002. An exception to this is the assessment of Embeddedness. This metric was improved in 2002. It is possible that a high-flow event(s) occurred between the surveys. This would have the effect of reducing Embeddedness, yet worsen Bank Stability, and Sediment Deposition.

Benthos

WR01 received an assessment of "non-impacted" based on data gathered as part of the 2002 DWM benthic survey. The only metric to score below the optimal category (6) was Richness. WR01 revealed 24 different taxa, and EB01B revealed 31 different taxa. The decline in taxa at WR01 was enough to reduce this metric score to 4. The dominant taxon collected at WR01 was the philopotamid *Chimarra* sp. (20%), and the second most dominant taxon was the hydropsychid *Hydropsyche morosa gr.* (10%). Both of these macroinvertebrates are Filter–Collectors and their dominance alludes to potentially elevated FPOM or nutrients. Indeed, Filter–Collectors accounted for 41% of all macroinvertebrates collected at WR01. Based on the total metric score, WR01 is not impacted.

In 1997, WR01 was sampled by DWM as part of its Housatonic Watershed Survey. In general, the community appeared healthier in 1997 than it did in 2002. All seven parameters (Richness, Biotic Index, EPT Index, EPT/Chironomidae, Scraper/Filter–Collector, Filter–Collector/Total, and Percent Dominant Taxa) had better scores in 1997, than they did in 2002. It is, at this time, unclear as to the slight decline in conditions at WR01. It is quite possible that low-flow conditions, or other habitat degradation (especially sediment deposition and bank stability), encountered during 2002 were responsible for this shift in benthic community conditions. It may also be the case that natural variability may account for this difference.

GR23A – Green River, mile point 1.8, downstream of Route 23/41 Great Barrington. MA.

Habitat

The headwaters of the Green River are located in Austerlitz, NY. The river begins its course to the Housatonic River at the outfall of No Bottom Pond. There are relatively few ponds and wetlands within the 52.28 mi^2 watershed, and many agricultural practices. This condition may put the river at risk to NPS pollution, as there are few areas to utilize (or sequester) nutrients, and many potential sources of NPS.

Station GR23A (at river mile 1.8) was located immediately downstream of the Route 23/41 bridge. This station is upstream of the heavily utilized local "swimming hole". The segment containing GR23A is listed as a "category 2" water body ("attaining some uses; others not assessed"), and has been assessed as supporting aesthetics (MA DEP 2003). The Green River drops 14 feet in the first river mile upstream of GR23A. The landuse adjacent to station GR23A is primarily pasture and residential. Canopy coverage at this station was minimal (10%). There were very few trees occupying the riparian zone (25% of habitat utilized). The few trees present included: Willows (*Salix* sp.), and Sycamore (*Platanus occidentalis*). Shrubs were more prevalent, and occupied 40% of the available riparian habitat. Common shrubs included: Dogwood (*Cornus* sp.), Wild Rose (*Rosa* sp.), and Wild Grape (*Vitis* sp.). Grasses and other herbaceous vegetation occupied 100% of the available riparian zone and included: Grasses (*Poaceae* sp.), various composites (*Asteraceae* sp.), Goldenrod (*Solidago* sp.), Smartweed (*Polygonum* sp.), Joe-Pye Weed (*Eupatorium* sp.), Forget-me-not (*Myosotis* sp.), Speedwell (*Veronica* sp.), Jewelweed (*Impatiens* sp.), and Loosestrife (*Lythrum* sp.). Aquatic macrophytes were present in about 10% of the reach, and consisted entirely of rooted submergent watercress (*Nasturtium officinale*). Algal coverage within the reach was estimated at 90% and consisted of filamentous green algae on rocks in the pools and riffles. Also, present was mat algae attached to rocks in the riffles.

The substrates at station GR23A were dominated by pebble and gravel. The organic substrates were entirely detritus (CPOM). These smaller substrates (combined with the poor channel flow status) created very poor instream cover for fish (score = 2/20). The stream was approximately 4.5 meters wide, with riffles measuring 0.2 m deep, runs measuring 0.2 meters deep, and pools almost non-existent. There were slight signs of erosion in proximity to the Route 23/41 bridge – most likely due to the restriction of flow between the abutments. This stream, despite its rather large watershed was also affected by low-flow conditions during the survey. The Channel Flow Status scored 8/20, and is considered marginal, with much of the substrates exposed. Sediment Deposition (6/20) was also a problem at this station. Sand and fine sediments affected 30-50% of the streambed. The Velocity-Depth Combinations also scored low (7/20). This may be due to the reduced flows that did not allow for the availability of any deep habitats. However, the Bank Vegetative Protection, Bank Stability and Riparian Vegetative Zone Width all received perfect scores (20/20). This brought the total habitat score to 130/200. This is the second lowest score (of all 15 stations examined in 2002), and its shortcoming is due to the poor quality of instream features, not riparian features.

Benthos

Despite instream habitat limitations that could reduce the health of the aquatic community, GR23A received a rating of "non-impacted" when compared to the reference station EB01B. The total metric score (including habitat assessment) was 40 (out of a possible 42 at EB01B), or 95% comparable to the reference station. The only short-coming (-2 points) was regarding the Scraper/Filterer Ratio. EB01B had a Scraper/Filterer Ratio of 1.86 (nearly twice as many scrapers as filterers). GR23A had a Scraper/Filterer Ratio of 0.71 (more Filterers than Scrapers). Even though the Scraper / Filterer ratio was less than optimal at GR23A, the percent contribution of filterers to the total community sampled was not overly elevated (33%). Despite the minor differences in the contribution of filterers to the GR23A and EB01B, GR23A scored well and is considered not impacted.

GPB07A – Goose Pond Brook, mile point 0.9, approximately 100 meters downstream of Forest Street, Lee, MA.

Habitat

The Goose Pond Brook watershed, down to station GPB07A (located at river mile 0.9) , is 14 mi^2. The brook begins at the impounded outfall of Goose Pond (Tyringham, MA). While Goose Pond has many

shoreline residences, the brook cascades through a very undeveloped, forested, landscape. The brook is very high gradient; falling 290 feet in the first river mile upstream of the station. There is an abandoned hydroelectric facility (Westfield River Paper Company – NPDES MA0001031 (Kennedy and Weinstein 2000)) that exploited the vertical drop. A canal (0.82 miles upstream of the station) withdrew water from the Goose Pond Brook and sent it via pipe to the generating station located less than 100 m downstream of station GPB07A. This facility had no effect on the stream, as it has lain idle since 1994. Station GPB07A was located approximately 100 m downstream of the Forest Street Bridge. This bridge marks the confluence of Greenwater Pond Brook with Goose Pond Brook. Greenwater Pond Brook runs 4.6 miles from the outfall of Greenwater Pond to the confluence with Goose Pond Brook. Unlike Goose Pond Brook, Greenwater Pond Brook is lower gradient (although still considered high-gradient with an elevational drop of 120 feet in the mile above the confluence), and parallels Route 20 and the Mass Pike for its entire length. The land use adjacent to the station is 50% forest, 25% residential, and 25% industrial (abandoned hydroelectric facility).

Trees within the riparian zone of station GPB07A included Willow (*Salix* sp.), Cottonwood (*Populus deltoides*), and Paper Birch (*Betula papyrifera*). These trees provided 30% canopy cover, and occupied 75% of the available riparian zone. Shrubs also covered 75% of the available habitat and included Alder (*Alnus rugosa*), Grape (*Vitis* sp.), Dogwood (*Cornus* sp.), and Bittersweet (*Celastrus* sp.). Grasses and other herbaceous vegetation occupied 100% of the available riparian zone and included Grasses (Poaceae sp.), various composites (*Asteraceae* sp.), Knotweed (*Polygonum cuspidatum*), Goldenrod (*Solidago* sp.), Joe-Pye Weed (*Eupatorium* sp.), Poison Ivy (*Rhus radicans*), and Loosestrife (*Lythrum* sp.). There were no aquatic macrophytes within the reach, but algae coverage was estimated at 60%. Algae types included green filamentous and thin film algae attached to rocks in the riffle zones.

Boulders accounted for 70% the substrates at Station GPB07A. Bedrock and cobble were sub-dominant, accounting for 20% (10% each) of the remaining substrates. Larger substrates are to be expected at high-gradient stations, such as GPB07A. The organic fraction of the substrates was composed entirely of detritus (CPOM). Goose Pond Brook averaged a width of 5 meters within this reach, with riffle depths of 0.25 meters, and pool depths of 0.5 meters. Runs were lacking at this station, primarily due to the high gradient, “pool / drop” nature of this stream. The overall habitat score was 174/200 (the third highest score of the 15 stations examined). Points were deducted for Instream Fish Cover (12/20), due to the lack of low-velocity areas. Points were also deducted for Velocity – Depth Combinations, again, for the lack of low velocity areas. Finally, points were deducted for low water quantity (i.e. channel flow status) – a frequent occurrence during the 2002 survey.

Benthos

GPB07A received an assessment of “slightly impacted” based upon the benthic survey of 2002. The sampled community showed a large reduction in the EPT Index metric. GPB07A contained 11 EPT Index, as compared to 19 EPT taxa at WB01 (the reference station). The disparity between the two stations resulted in a score of “0” for the EPT Taxa metric. This poor representation of sensitive taxa can also be seen in the Biotic Index metric. GPB07A had a Biotic Index of 4.20 (score of 2), whereas WB01 had a Biotic Index score of 2.77 (score of 6). The Percent Dominant Taxon metric also cost GPB07A points - 28% of the benthos sample consisted of the baetid mayfly *Baetis* sp. (tolerance value = 6). This indicates a slightly unbalanced community.

EB02A – East Branch Housatonic, mile point 5.5, Hubbard Avenue Bridge, Pittsfield, MA.

Habitat

Station EB02A has a 57.2 mi^2 contributing watershed, and was the second station on the East Branch of the Housatonic (6 river miles downstream of station EB01B). Station EB02A was located approximately 210 meters downstream of an industrial impoundment. Also, there were several industrial sites upstream of this station, as well as the Crane and Company industrial effluent discharge (MA0000671), and industrial waste ponds. Indeed, these proximal facilities, and impoundments, contrast station EB02A from the upstream reference station EB01B. Also, this segment (21-02) is classified as a Class B, *Warm* Watery Fishery (Kennedy and Weinstein 2000). Station EB01B was located in segment 21-01 – a class B, *Cold* Water Fishery (Kennedy and Weinstein 2000). The water at station EB02A appeared “rust”

colored and had a paper effluent odor. Also, the segment containing EB02A is listed as a “category 5” water body due to priority organics (PCBs) (MA DEP 2003).

The riparian zone was abbreviated, and sparsely occupied by plants. Trees (occupying 50% of the available zone, and providing 10% canopy cover) included Slippery Elm (*Ulmus rubra*), Cottonwood (*Populus sp.*), Ash (*Fraxinus* sp.), and Norway Maple (*Acer platanoides*). Shrubs (occupying 50% of the available zone) included Sumac (*Rhus* sp.), Honeysuckle (*Lonicera* sp.), Wild Rose (*Rosa* sp.), and Ninebark (*Physocarpus opulifolius*). Grasses and other herbaceous vegetation occupied only 10% of the available riparian zone, and included ferns, grasses (*Poaceae sp*), Ferns (*Psilotopsida*), Goldenrod (*Solidago* sp.), and Joe-Pye weed (*Eupatorium* sp.). Aquatic macrophytes were present in 20% of the reach, and consisted entirely of mosses. Algae were also present, and covered 50% of the reach. Green filamentous and mat algae colonized the rock substrates in the pools and riffles represented the algae present.

The substrates were dominated by boulder (60%). The majority of these boulders seem to be naturally occuring, but it is possible that some are the result of construction and bank stabilization efforts to keep the river from compromising the adjacent roads and buildings. Cobble was also present, but to a lesser extent (30%). The organic fraction of the substrates consisted of 90% detritus (CPOM) and 10% mud-muck (FPOM). A thin layer of fine sediments was observed to cover much of the substrates. The sampled reach had an average width of 10 meters. The riffles were 0.3 meters deep; runs 0.6 meters deep, and pools 2 meters deep. The overall habitat score was 156/200. This score places station EB02A in the middle (7/15) of the 15 stations investigated. The major detractors to a better habitat score were: Instream Fish Cover (12/20) – The instream habitat was devoid of any significant structure that would allow for fish refugia; Channel Alteration (8/20) – embankments and channelization were plentiful within the reach; and Riparian Vegetative Zone Width – Right Bank (0/10) – almost the entire right bank was concrete and rip-rap due to the proximity of a mill building.

Benthos

EB02A received an assessment of “non-impacted” based upon the 2002 benthic survey data. Points were deducted for shortfalls regarding the Biotic Index. The Biotic Index was 5.11, representing the second worst score of all 15 stations, and indicating nutrient enrichment. The EPT / Chironomidae Ratio (1.65) was also poor, in comparison to reference conditions. The Scraper/Filterer Ratio (0.78) was low, displaying an increase in the number of Filter–Collectors, and a potential increase in nutrient loading. Even so, the number of different taxa (Richness) at EB02A was increased. EB02A displayed 38 different taxa, whereas EB01B displayed 31 different taxa. The increased Richness also points towards nutrient enrichment. The total metric score was 86% comparable to the reference condition. This percent comparability was just over the threshold of 85%, and does, therefore, result in a determination of “non-impacted”.

HT19A – Housatonic River, mile point 43, Adjacent to Crescent Mills – Crystal Street, Lenox, MA

Habitat

Station HT19A was located approximately 340 meters downstream of the dam that marks the outfall of Woods Pond, and has a 170 mi^2 contributing watershed. It was also downstream of the Lenox WWTP. Woods Pond is a hypereutrophic waterbody that has the potential to elevate water temperatures and increase the concentration of organic matter and nutrients. The segment containing HT19A is listed as a “category 5” water body, due to unknown toxicity, priority organics (PCBs), thermal modification, excessive pathogens, and turbidity (MA DEP 2003).

The river at station HT19A was wide (22 meters), and channelized on both banks. The trees within the riparian zone were unable to provide any canopy cover to this reach. Tree species included: Sugar Maple (*Acer saccharum*), Ash (*Fraxinus* sp.), and Willow (*Salix* sp.). These trees occupied 10% of the available riparian zone. This sparse coverage is primarily due to the proximity of Crystal Street, and the Cresent Mills parking lot. Shrubs occupied 50% of the riparian zone and included Dogwood (*Cornus* sp.), Honeysuckle (*Lonicera* sp.), and wild Grape (*Vitis* sp.). Grasses and other herbaceous vegetation also occupied 50% of the riparian zone and included grasses (*Poaceae* sp.), several undetermined

composites, loosestrife (*Lythrum* sp.), goldenrod (*Solidago* sp.), Joe-Pye weed (*Eupatorium* sp.), and Jewelweed (*Impatiens sp*). The aquatic macrophytes observed were all free-floating and included *Lemna* sp., and *Wolffia* sp. It is highly likely that these plants originated in Woods Pond and drifted down to this station. Algae coverage within the reach was extensive (95%). The algae encountered were filamentous greens, and were attached to rocks in the riffle zones. This extensive algae coverage likely indicates elevated nutrient levels.

Substrates at station HT19A were dominated by boulder (70%), and sub-dominated by cobble (20%). The organic fraction of the substrates was entirely composed of detritus (CPOM). River depth was estimated at 0.35 meters in the riffles, 0.4 meters in the runs, and pools were not present. The overall habitat score for station HT19A was 162/200 (8^{th} of the 15 stations examined in 2002). This station scored well with regard to most habitat measures, but the Riparian Vegetative Zone Width was reduced, due to the rail line and Crystal Street along the right bank, and the parking lot and mill on the left bank. The score for the Riparian Zone parameter was 2/20.

Benthos

HT19A was 71% comparable to conditions at the HT19E reference station. As such, HT19A received a benthic assessment of "slightly impacted". The greatest difference between test conditions (HT19A) and reference conditions (HT19E) appeared in the EPT Index score. There were 6 representatives of EPT taxa at HT19A, but there were 13 EPT representatives at the reference station (HT19E). This lack of potentially sensitive taxa can also be seen in the HT19A Biotic Index (4.87). This is the third worst score (EB02A = 5.11, HW01 = 6.84) of all 15 stations examined in 2002. There was also a lack of diversity amongst collected macroinvertebrates at HT19A. There were only 21 taxa (the lowest of all stations examined) represented in the Richness metric. The Percent Dominant Taxon was 29% (second highest of all 15 stations), and was represented by the philopotamid *Chimarra* sp. This filter feeder spins a silken net in which it collects FPOM. It is quite likely that the lack of canopy cover, combined with the outfall from Woods Pond, and the Lenox WWTP are elevating FPOM (and, potentially, nutrient loads). Indeed, the percentage of filter feeders was the highest at HT19A of all stations examined in 2002.

HT19C – Housatonic River, mile point 37.6, Tyringham Road, Lee, MA

Habitat

Station HT19C was located 170 meters downstream of powerlines that cross Tyringham Road and the Housatonic River, and 185 meters downstream of the Lee WWTP outfall. The watershed area, down to station HT19C, was 206 mi^2. The surrounding land use was estimated as 50% forest (to the east) and 50% industrial (to the west). Potential point source pollution exists from storm drains in the town of Lee, and the outfall from the Lee WWTP. Some potential non-point source pollution exists near the powerline right-of-way, and the town of Lee. The segment containing HT19C is listed as a "category 5" water body, due to unknown toxicity, priority organics (PCBs), thermal modification, excessive pathogens, and turbidity (MA DEP 2003).

The river was approximately 18 meters wide at station HT19C. Trees provided no canopy cover to this reach. Trees occupied 50% of the available riparian zone, and included Elm (*Ulmus* sp.), Boxelder (*Acer negundo*), Cottonwood (*Populus deltoides*), Silver Maple (*Acer saccharinum*), Sycamore (*Platanus occidentalis*), and Willow (*Salix* sp.). Shrubs, occupying 75% of the available habitat, included Honeysuckle (*Lonicera* sp.), and grape (*Vitis* sp.). Grasses and other herbaceaous vegetation also occupied 75% of the available habitat and included grasses (Poaceae sp.), Loosestrife (*Lythrum* sp.), Cattails (*Typha* sp.), Goldenrod (*Solidago* sp.), Joe-Pye Weed (*Eupatorium purpureum*), Jewelweed (*Impatiens* sp.), Knotweed (*Polygonum cuspidatum*), and Rushes (*Juncus* sp.). Aquatic macrophytes were present in 25% of the reach, and were comprised almost entirely of the rooted submergent plants milfoil (*Myriophyllum* sp.) and Coontail (*Ceratophyllum* sp.). Also present, but very sparsely, was free floating Duckweed (*Lemna* sp.). Algae covered 50% of the reach and were comprised of green filamentous algae attached to rocks in all habitat types. Also notable were patches of sewage fungus near, and downstream of, the Lee WWTP outfall. Sewage fungus is a colony of microorganisms (including filamentous bacteria, fungi, and protozoa). It can entrap silt and detritus, and smother aquatic

plants. The entrapped sediments can affect the instream community. Also, sewage fungus has the effect of creating localized areas of high oxygen demand. (Osmond, et al. 1995.)

The substrates were dominated by boulder and cobble (40% each). The organic fraction of the substrates consisted entirely of detritus (CPOM). River depths were estimated at 0.25 meters in the riffle zone. The entire reach was dominated by riffles, with no runs or pools observed. The instream features lacked structures that would provide instream cover for fish. Thus, the Instream Cover habitat score was low (5/20). However, the Epifaunal Substrate score was high (20/20), as the extensive riffle zone provided very good habitat for benthos. The Velocity–Depth Combinations score was suboptimal (13/20), as fast-deep habitats were lacking. The Bank Stability score for the left bank was also suboptimal (6/10), as there was some evidence of erosion along this outside bend. The total habitat score for station HT19C was 172/200. This score ranks station HT19C as tied for 4th of the 15 stations examined.

Benthos

HT19C was 76.19% comparable to the reference station (HT19E). As such, HT19C received a rating of "slightly impacted". The majority of the score reduction is due to the paucity of EPT taxa. This can be seen in the metrics "EPT Index" (2/6), and "EPT/Chironomidae" (2/6). The overall Richness was also reduced. The 22 different taxa collected represents the 2nd lowest number of taxa collected in all of the 2002 Housatonic stations. The lowest Richness was detected at station HT19A.

The contribution of Filter-Collectors at HT19C was the third lowest of all 15 Housatonic stations examined in 2002. This is usually a good sign, as increased numbers of Filter-Collectors often indicate an increase in FPOM, and, potentially, increased nutrient concentrations. In the case of HT19C, there is no major increase in the number of Filter-Collectors. However, there was a great increase in the number of Scrapers with regard to Filter-Collectors. The Scraper/Filter-Collector Ratio was 2.27 at HT19C – the highest of all 2002 Housatonic stations. It may be the case that the lack of shading (0% canopy cover), combined with a potential elevation in nutrients, is responsible for the 50% algae cover encountered at this station. Scrapers are major consumers of attached algae, and their increased numbers at this station indicate potential nutrient elevation, and lack of shading. This supposition is bolstered by the fact that the dominant taxon (19%) was *Optioservus* sp. (a Scraper).

HT19E – Housatonic River, mile point 26, Route 183, Stockbridge, MA

Habitat

Station HT19E was located along Route 183 (near Blue Moon Kennels), 145 meters downstream of the Springfield Terminal Railroad Bridge, and 1,940 meters down stream of the Glendale Dam. The watershed area, down to station HT19E, was 279.62 mi^2. The surrounding landuse was 50% forest, and 50% pasture, and the river falls 28 feet in the previous upstream mile. A potential non-point pollution source problem from creosoted rail timbers abandoned along the railroad tracks was noticed near the railroad bridge. The segment containing HT19E is listed as a "category 5" water body, due to unknown toxicity, priority organics (PCBs), thermal modification, excessive pathogens, and turbidity (MA DEP 2003).

The river was quite wide at station HT19E (40 meters). Due to this width, trees were unable to provide any observable canopy cover. Trees (occupying 75% of the available habitat within the riparian zone) included Cottonwood (*Populus deltoides*) and Silver Maple (*Acer saccharinum*). Shrubs, occupying 50% of the available habitat) included Honeysuckle (*Lonicera* sp.), grape (*Vitis* sp.), and Speckled Alder (*Alnus rugosa*). Grasses and other herbaceous vegetation occupied 75% of the riparian zone and included grasses (Poaceae sp.), goldenrod (*Solidago* sp.), and ferns. Aquatic macrophytes were sparse within the reach and consisted entirely of milfoil (*Myriophyllum* sp.). Algae coverage, on the other hand, was dense (100% within reach coverage), and consisted of filamentous and thin-film green algae attached to the rocks in the riffle zones.

Substrates at station HT19E were dominated by boulder (90%), with the remaining 10% divided equally between cobble and gravel. The organic fraction of the substrates consisted entirely of detritus (CPOM). The riffle zones were approximately 0.3 meters deep, and the runs were 0.5 meters deep. The overall

habitat score was 185/200 – the highest scoring station of the 15 examined in 2002. Only the Velocity-Depth Combinations scored in the suboptimal range (15/20), due to a lack of fast-deep habitats.

Benthos

Station HT19E was used as a reference station to be compared to the two other mainstem Housatonic stations (HT19A, HT19C). The hydrologies, substrates, and watershed areas are similar amongst these stations and allow for this comparison. The sampled benthic community at HT19E contained an assemblage indicating a healthy aquatic community, with metric values indicative of good water quality and "least-impacted" conditions. Of the 15 stations sampled during the 2002 survey, HT19E had the best EPT/Chironomidae metric score (8.00). The majority of EPT taxa are intolerant to pollution, whereas the family Chironomidae is mostly tolerant of pollution (and are often the dominant taxa in highly impacted streams). Thirteen different taxa representing EPT were collected at HT19E. This is the fourth highest EPT Index of all stations examined, but perhaps more importantly, EPT taxa accounted for 73% of all insects collected. This high percentage of potentially intolerant taxa is only exceeded at station WB01 (a small, high-gradient, stream supplying drinking water).

An additional comparison of HT19E to another reference station, EB01B, was also performed to assess the validity of using HT19E as a reference station for other mainstem stations. This comparison led to an assessment of "non-impacted" for HT19E. The Scraper/Filterer Ratio was the only metric that reduced the overall metric score for HT19E. At EB01B, the Scraper/Filterer Ratio was 1.86 (almost twice as many Scrapers as Filterers). At HT19E, the Scraper/Filterer Ratio was 0.57 (almost half as many Scrapers as Filterers). The EPT/Chironomidae Ratio was much improved at HT19E (8), in comparison to EB01B (2.58). This ratio indicates that the number of Chironomidae (a potentially tolerant family) was greatly reduced at HT19E, with respect to EPT (potentially intolerant families).

SUMMARY AND RECOMMENDATIONS

Biomonitoring stations used for reference in the Housatonic River Watershed included sites on the tributaries (Windsor Brook, the East Branch of the Housatonic River, the Konkapot River) and the mainstem Housatonic River. These stations continue to support the diverse and well-balanced aquatic communities expected in a "least-impacted" stream system. In addition, six Housatonic River watershed biomonitoring study stations were found to be non-impacted and five stations were considered slightly impacted relative to reference conditions. No station was considered to be either moderately or severely impacted. Impacts to resident biota in this watershed were generally a result of habitat degradation (especially flow-related habitat constraints) and/or nonpoint source-related water quality impairment, with potential point source effects, and nutrient effects, observed as well. Reduced flow was an obvious stressor to the entire watershed during the 2002 benthic survey. (figure 2).

The schematic below (Figure 5) is based on a proposed conceptual model that predicts the response of aquatic communities to increasing human disturbance. It incorporates both the biological condition impact categories outlined in the RBPIII biological assessment methodology currently used by MA DEP and the Tiered Aquatic Life Use (TALU) conceptual model developed by the US EPA and refined by various state environmental agencies (US EPA 2003). The model summarizes the main attributes of an aquatic community (in this case the benthic macroinvertebrate community **only**) that can be expected at each level of the biological condition category, and how these metric-based bioassessments can then be used to make aquatic life use determinations as part of the 305(b) reporting process. Minimally or non-impacted aquatic communities, such as those encountered at all Housatonic stations, *support* the Massachusetts SWQS designated *Aquatic Life* use in addition to meeting the objective of the Clean Water Act (CWA), which is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (Environmental Law Reporter 1988). No benthic communities assessed in this study failed to support the *Aquatic Life* use goal of the CWA. This is not to say that stations achieving a designation of *non-impacted* should be considered pristine. There may be stressors affecting water quality, aesthetics, and other biotic communities that have little impact upon the benthic community.

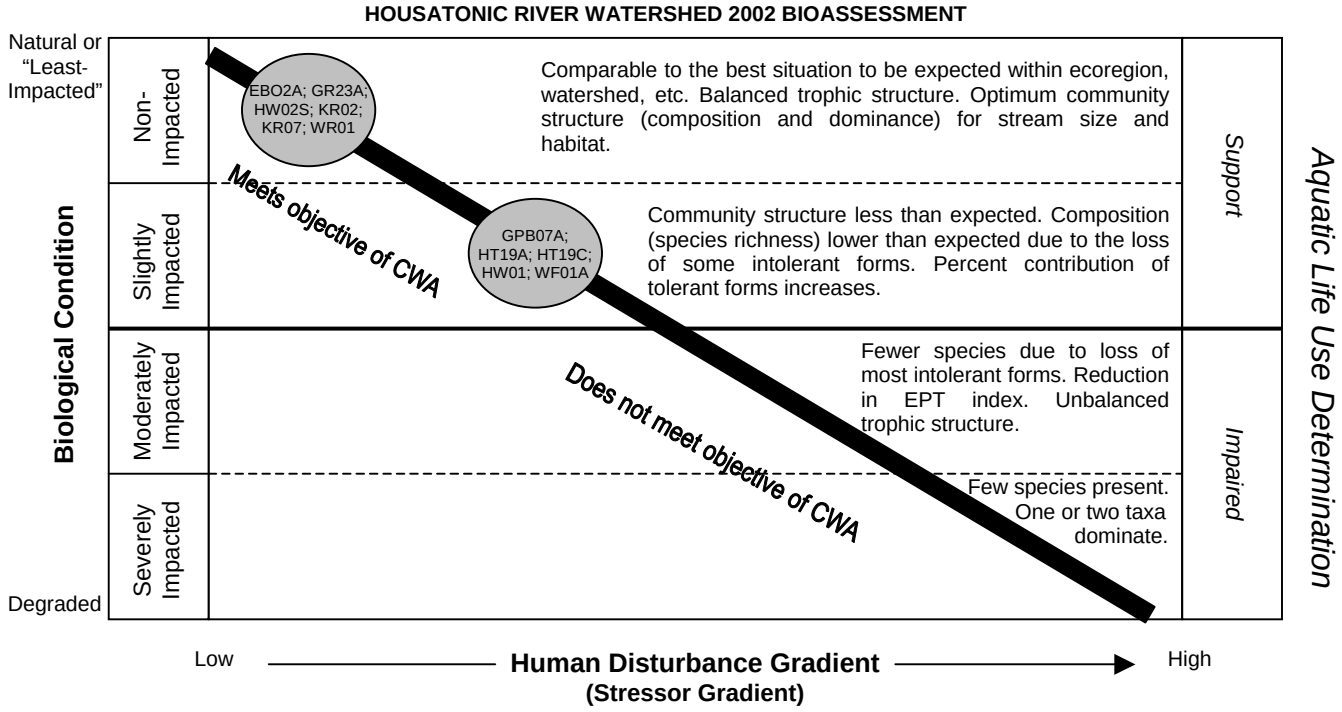


Figure 5. Schematic of the predictive response of aquatic communities to increasing human disturbance. Included is the performance (Biological Condition and Aquatic Life Use determinations) of the Housatonic River watershed 2002 biomonitoring stations along the Human Disturbance Gradient. NOTE: All reference stations (EBO1B, HT19E, KR11, WB01) are considered to represent the "best attainable" conditions and to be supportive of the *Aquatic Life* use.

East Branch Housatonic River - EB01B

Benthos: Reference station for stations EB02A, GR23A, HW01, HW02S, WR01
Habitat: Reference station for stations EB02A, GR23A, HW01, HW02S, WR01

This segment of the East Branch of the Housatonic River is considered to represent "least impacted" conditions for streams of its size in the Housatonic Watershed. The collected benthic community displayed healthy conditions in terms of the Biotic Index, and was not heavily dominated by a single genus / species.

The habitat appeared to supply the benthos with more than adequate conditions for healthy survival and reproduction. Although some reduction in the habitat score was a result of the low-flow conditions encountered, the overall habitat condition was the second best observed of all stations examined.

This segment should be protected. The recent sewering of the Town of Hinsdale is one example of how protection may be achieved. It is hoped that expansion of the sewer system to more homes may be realized, and that the operation of local gravel extraction is performed in a least impacting manner. Continued monitoring of the aquatic conditions (both chemical and biological) are recommended to monitor the status of the resident biotic communities. Furthermore, sediment and fish tissue data from within this segment (especially regarding Center Pond, Dalton, MA) should be reviewed to determine if this segment merits continued listing as a "category 5" waterbody.

Windsor Brook - WB01

Benthos: Reference station for stations GPB07A and WF01A
Habitat: Reference station for stations GPB07A and WF01A

The benthic community collected at Windsor Brook represents the best conditions in terms of the Biotic Index, EPT Index, and Percent Dominant Taxon of all stations examined in 2002. As such, this station merits its assignment as a reference station for other small, high-gradient streams within the Housatonic watershed.

The habitat score for Windsor Brook placed it "mid-range" in comparison to all other Housatonic stations. The reduction in habitat score was due to very low flows (as a result of drought conditions), and the proximity of Old Dalton Road.

Windsor Brook is a drinking water supply for both the Town of Dalton and the City of Pittsfield. As such, both water quality and quantity should be monitored. The entire stream is currently designated as a "category 4C" water body (MA DEP 2003). It is impaired due to flow alteration, not a pollutant. That impairment designation is due to the operation of an aqueduct (located at mile 0.2, and affecting only that 0.2 mile length of stream) that shunts water from the stream to Cleveland Reservoir. The remaining 5.4 miles of stream is unaffected by this flow alteration. An almost identical situation occurs on Cady Brook (also a tributary of Windsor Reservoir, Hinsdale, MA), yet this stream is not classified as a "category 4C" water body.

Wahconah Falls Brook - WF01A

Benthics: "Slightly Impacted" (reference station: WB01).
Habitat: 91% comparable to reference condition.

The WF01A benthic community displayed increased numbers of Filter–Collectors in comparison to the WB01 reference condition. It is likely that increased nutrient loading and decreased stream shading are the sources of this change in the benthic community structure. The large within-reach algae coverage also points towards increased nutrients, increased photosynthetic activity, and decreased canopy cover. The single line of trees on the banks provided little canopy cover to the sampled reach. This condition begins approximately 1,500 meters upstream, where the primary landuse shifts from forest to agriculture.

Habitat conditions, and, in turn, faunal health, could benefit from increased shading and adoption of agricultural BMPs. This may best be achieved by the planting of more trees within the riparian zone. Also, increased late-summer flows (in terms of both frequency and volume) from Windsor Reservoir would also improve the condition of this stream.

Konkapot River - KR11

Benthos: Reference station for stations KR02 and KR07
Habitat: Reference station for stations KR02 and KR07

Benthic community conditions were representative of reference conditions, as was also the case in 1997. The community displayed a diverse collection of fauna, as exemplified by the low Percent Dominant Taxon. However, low flow conditions affected the community at this, and other, stations. Decreased velocities expanded the habitats suitable for lacustrine species.

Habitat conditions were also representative of reference conditions and mirrored those observed in 1997. The major reduction in habitat scoring occurred as a result of the decreased Channel Flow Status. However, the lack of development within the sampled reach, and the extensive native vegetation, greatly enhance the bank and riparian habitats.

Protection within, and above, this reach should be continued. The citizens of the Town of Monterey have been doing a good job of protecting this reach of the Konkapot River by maintaining the surrounding park area. Further examination of the metals concentrations (mercury in fish tissues), that resulted in the "category 5" listing of this segment, should be monitored in the future.

Konkapot River - KR02

Benthos: "Non-impacted" (Reference station: KR11)

Habitat: 82% comparable to reference station (KR11)

The benthic community at KR02 was highly (95%) comparable to the reference condition, and represents a healthy community. Perhaps more intriguing is the improvement in community structure at this station in comparison to conditions observed in 1997. The 2002 sampling effort revealed an increase in the number of sensitive EPT taxa, and a reduction in the numerical contribution of potentially tolerant Chironomidae. It may very well be the case that agricultural practices upstream (within Connecticut and Massachusetts) have established better land management practices.

Habitat conditions at KR02 were also improved in relation to the conditions observed in 1997. However, there still remain problems with sediment deposition, and a lack of canopy cover. The planting of trees within the narrow riparian zone may be able to help with both of these problems. The trees would both increase the shade and stabilize the loose soils.

Konkapot River - KR07

Benthos: "Non-impacted" (Reference station: KR11)
Habitat: 101% comparable to reference conditions

The collected benthic community at KR07 was quite healthy, and represented a sound, high-gradient benthic assemblage. The 2002 survey also revealed improvements in the benthic community structure in comparison to the 1997 survey conducted at this station.

Habitat conditions exceeded those observed at the reference station. This was due, primarily, to the increased Channel Flow Status. The source(s) of the increased flows at this station remain undetermined. The increase in the water quantity observed at this staton may be due to localized rain within this watershed, or, it may be the case that Lake Buel is the origin of the increased water passing through KR07.

The health of the benthic community is sound, and, in some respects, improved over conditions observed in 1997. If it is the case that Lake Buel is contributing a large amount of water to this station, then increased monitoring of conditions within Lake Buel is in order. Lake Buel is currently classified as a "category 5" (MA DEP 2003), impaired by nutrients and exotic species.

West Branch of the Housatonic River - HW01

Benthos: "Slightly impacted" (Reference station: EB01B)
Habitat: 53% comparable to reference conditions

The benthic community at HW01 exhibited the most degraded structure encountered during the 2002 survey. Highly tolerant worms dominated the community. Clearly, activities within, and proximal to, this stream have adversely affected the aquatic life.

The habitat conditions encountered at HW01 were also the worst encountered during the 2002 survey. Severe channelization of the reach, decreased riparian zone width, and monotonic instream habitat conditions all conspired to impact the habitat conditions.

Southwest Branch of the Housatonic River - HW02S

Benthos: "Non-impacted" (Reference station: EB01B)
Habitat: 83% comparable to reference stations

The benthic community collected at HW02S represented a relatively healthy community with respect to the reference condition. The structure of the 2002 community was much improved over conditions observed in 1997. The number of EPT taxa were increased in 2002; representing an increase in the

number and type of sensitive taxa. The Percent Dominant Taxon were decreased in 2002. Although *Optioservus* sp. was still the dominant taxon, their percent contribution was reduced from 62% in 1997 to 28% in 2002.

Increased sedimentation and lack of varieties of flow reduced the habitat quality at HW02S. Also, a "silty cover" on all substrates was noted. Habitat conditions observed in 1997 were only slightly worse than those observed in 2002. However, there was a large reduction in algae coverage in 2002 (0%) when compared to 1997 conditions (60%).

The decrease in the numbers of *Optioservus* sp. may be linked to the reduction in algae coverage, as algae is a primary food resource of this insect. Monitoring of the nutrient concentrations (as well as algal growth) are in order to document potentially deleterious conditions.

Williams River - WR01

Benthic: "Non-impacted" (Reference station: EB01B)
Habitat: 81% comparable to reference conditions

The benthic community structure examined in 2002 was quite comparable to the 2002 reference condition. There was a slight decline in the number of taxa (Richness) at WR01, but this accounted for only a slight decline in the overall metric score. This station was sampled in 1997 and, unfortunately, the benthic community health appears to have slightly declined since then.

Habitat conditions observed in 2002, although comparable to reference conditions, were affected by low flow conditions, sediment deposition, narrow riparian zone width, and bank instability. This represents a slight deterioration in habitat conditions observed in 1997.

It is probably the case that many stressors are responsible for the reduction in habitat and benthic community conditions between the 1997 and the 2002 surveys. Among these, the reduction in flow (Channel Flow Status) is likely to have the greatest negative effect. The problems with increased sediment deposition (potentially the result of bank instability; i.e. erosion) may best be addressed by increasing the number of trees and deep rooted vegetation along the banks.

Green River - GR23A

Benthos: "Non-impacted" (Reference station: EB01B)
Habitat: 74% comparable to reference conditions

The benthic community at GR23A displayed a healthy community structure. All metrics (with the exception of the Scraper / Filterer Ratio) scored in the top range. This station is "non-impacted".

The canopy coverage at GR23A was reduced to 10% over the sampled reach, and the increased sunlight reaching the stream may be the primary reason that algae coverage was estimated at 90%. Reduced flows also affected this station, and left much of the substrates exposed. Sediment deposition was also increased at GR23A. The total habitat score (130/200) was the second lowest score of all stations examined in 2002.

The low flow conditions encountered in 2002 may have much to do with the habitat impacts observed during the survey. However, bank stabilization efforts upstream of this station would tend to improve habitat conditions by reducing the influx of sediment. Also, adoption of BMPs may be successful in curtailing road-runoff.

Goose Pond Brook - GPB07A

Benthos: "Slightly impacted" (Reference station: WB01)
Habitat: 106% comparable to reference conditions

A lack of diversity was observed in the collected benthic community from GPB07A. The EPT taxa collected were represented by 11 different taxa. Whereas, the reference station sample contained 19 different EPT taxa. Also, the Biotic index score at GPB07A was degraded in comparison to WB01.

Habitat was better at GPB07A than at the reference station. Large substrates and large woody debris (CPOM) dominated the instream features. The GPB07A habitat score (174/200) was the third best of all stations examined in 2002. Thus, water quality, not habitat quality, appears to limit biological integrity at this station.

The "slightly impacted" condition of the benthic community may be traceable to landuse upstream of this station, along Greenwater Pond Brook. Major roadways (Route 20 and the Mass Pike) parallel (and cross) Greenwater Pond Brook upstream of this station. Also, Greenwater Pond Brook is heavily channelized, and proximal development has reduced the riparian vegetative zone width.

It may be the case that landuse practices (increases in commercial and residential densities) along either Greenwater Pond Brook and/or Goose Pond Brook are ultimately responsible for the degraded community encountered during the 2002 survey. Additional water quality monitoring to identify potential sources of pollution is recommended.

East Branch of the Housatonic River - EB02A

Benthos: "Non-impacted" (Reference station: EB01B)
Habitat: 89% comparable to reference conditions

Many of the metrics examined displayed reductions in the community health of the sampled community (Biotic Index, EPT/Chironomidae Ratio, and the Scraper / Filterer Ratio). However, the number of different taxa (Richness) was beyond that encountered at the reference station (EB02A: 38 taxa, EB01B: 31 taxa). This condition drove the metric score just over the threshold of 85% comparability, and resulted in an appraisal of "non-impacted".

Although the channel was heavily altered in comparison to the reference station, and the vegetative zone width and instream cover were highly reduced, the habitat score was not greatly affected.

It may be the case that more emphasis should be placed on the Biotic Index in addressing the benthic community health at this station. This metric scored the worst at this station of all other stations examined in 2002, and is indicative of a stressed community. The combination of relatively high HBI and increased Richness could be early indicators of a growing enrichment problem.

Housatonic River - HT19A

Benthos: "Slightly Impacted" (Reference station: HT19E)
Habitat: 88% comparable to reference conditions

A reduction in the EPT taxa collected at HT19A was the primary reason that this station received a determination of "slightly impacted". Also, there was a reduction in the number of taxa represented in the collected sample (Richness: 21 taxa). The number of filter feeders – potentially indicative of increased nutrient loading and FPOM – was highest at this station of all stations examined in 2002.

The instream habitat features were mostly in the "optimal" range. This includes an optimal score for Channel Flow Status, that habitat measure usually scored poorly at the tributarial stations in 2002. However, the riparian zone width score was "poor", as development within the riparian zone eliminated much of the natural vegetation.

Stressors resulting in the "slightly impacted" conditions observed here in 2002 likely can be traced to the effects from Woods Pond and, potentially, the Lenox WWTP. While the extensive wetlands in Woods Pond may be a natural condition, upstream / downstream water quality monitoring should be performed to determine if any effect is occurring as a result of the operation of the Lenox WWTP.

Housatonic River - HT19C

Benthos: "Slightly impacted" (Reference station: HT19E)
Habitat: 93% comparable to reference conditions

The number of total taxa and potentially sensitive taxa (EPT taxa, EPT/Chironomidae) were greatly reduced at HT19A. These are the primary reasons that HT19A received a "slightly impacted" rating. Scrapers dominated the collected taxa that may allude to potentially excessive amounts of algae.

The habitat at HT19C, although poor with regard to Instream Cover, nonetheless scored quite well overall. The optimal Channel Flow Status (similar amongst all mainstem stations), and optimal substrates allowed for the 93% comparability to reference conditions.

Since the habitat conditions are sound at this station, yet the benthic community is slightly impacted, stressors other than habitat limitations must be the causes of impairment. It is highly likely that the discharge from the Lee WWTP, and/or run-off from the town of Lee are the primary causes of the impairment of the benthic community.

Housatonic River - HT19E

Benthos: Reference station for HT19A and HT19C
Habitat: Reference station for HT19A and HT19C

The sampled community of HT19E contained an assemblage indicative of a healthy benthic community. The EPT/Chironomidae Ratio (8) was the highest of all stations examined in 2002. Also, EPT taxa accounted for approximately 73% of all taxa collected at HT19E. EPT taxa contain some of the most sensitive species.

Habitat conditions at HT19E were the best of all stations examined in 2002 (185/200). The only parameter scoring below the "optimal" level was Velocity – Depth Combinations. This condition was due to a lack of fast flowing, deep habitats.

The sound benthic community conditions observed at HT19E were quite surprising, as this reference station is downstream of its test stations. It is possible that operations of the Glendale Dam are having a positive effect on water quality conditions by trapping sediments behind the dam, and providing adequate late summer flows and greater assimilative capacity in this portion of the Housatonic River. It may also be the case that the increased velocities encountered here do not allow for the deposition of fine sediments.

LITERATURE CITED

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish.* Second Edition. EPA 841-B-99-002. Office of Water, US Environmental Protection Agency, Washington, DC. 151 p. + appendices

Barbour, M. T., J. B. Stribling, and J. R. Carr. 1995. *The multimetric approach for establishing biocriteria and measuring biological condition*. Pp. 63-80. in W. S. Davis and T. P. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL. 415 p.

Bode, R. W., M. A. Novak, and L. E. Abele. 1991. *Quality Assurance Work Plan for Biological Stream Monitoring in New York State*. Stream Biomonitoring Unit, Division of Water, NYS Department of Environmental Conservation. Albany, NY. 78 p.

Breault, R.F. and S. L. Harris. 1997. *Geographical Distribution and Potential for Adverse Biological Effects of Selected Trace Elements and Organic Compounds in Streambed Sediment in the Connecticut, Housatonic, and Thames River Basins, 1992-94.* Water Resources Investigations Report 97-4169. USGS. United State Geologic Survey. Northboro, MA.

Berkshire Regional Planning Commission. 1999. *Assessment of Land Use Activities and Nonpoint Source Pollution in the Housatonic River Watershed*. Nonpoint Source Project Number: 96-05/604. BRPC. Pittsfield, MA. 124 p.

Coles, J.F., 1998, *Organochlorine compounds in fish tissue from the Connecticut, Housatonic, and Thames River Basins.* Water-Resources Investigations Report 98-4075. USGS. Northboro, MA. 23 p. (abstract)

Environmental Law Reporter. 1988. Clean Water Deskbook. Environmental Law Institute. Washington, D.C.

Fiorentino, J. 1999. *Appendix C - Housatonic River Watershed 1997 Biological Assessment*. In Kennedy, L.E., and M.J. Weinstein. 2000. *Housatonic River Basin 1997/1998 Water Quality Assessment Report.* CN: 019.0. 21-AC-3. MA DEP/DWM. Worcester, MA. 105 p.

Fiorentino, J. 2002. *Quality Assurance Project Plan for 2002 Benthic Macroinvertebrate Biomonitoring and Habitat Assessment* CN: 74.0. DWM. Worcester, MA.

Hellquist, C.B., and G.E. Crow. 1980 – 1985. *Aquatic Vascular Plants of New England*. Parts 1-8. University of New Hampshire, Durham, NH. 262 p.

Hilsenhoff, W. L. 1987. An improved index of organic stream pollution. *Great Lakes Entomologist. 20: 31-39.*

Hughes, R. M. 1989. *Ecoregional biological criteria*. Proceedings from EPA Conference, Water Quality Standards for the 21st Century. Dallas, Texas. 1989: 147-151.

Karr, J. R., K. D. Fausch, P. L. Angermeier, P. R. Yant, and I. J. Schlosser. 1986. *Assessing Biological Integrity in Running Waters: A Method and Its Rationale*. Special Publication 5. Illinois Natural History Survey. Champaign, IL. 28 p.

Kennedy, L.E., and M.J. Weinstein. 2000. *Housatonic River Basin 1997/1998 Water Quality Assessment Report*. CN: 019.0. 21-AC-3. MA DEP/DWM. Worcester, MA. 105 p.

Lenat, D. R. 1993. *A biotic index for the southeastern United States: derivation and list of tolerance values, with criteria for assigning water-quality ratings*. J. N. Am. Benthol. Soc., 12(3): 279-290.

MA DEM. 2002. *Statement of rainfall conditions 2002.* Massachusetts Department of Environmental Management. Boston, MA.
http://www.state.ma.us/dem/programs/rainfall/dr0802.htm

MA DEP. 1996. (Revision of 1995 report). *Massachusetts Surface Water Quality Standards (Revision of 314 CMR 4.00, effective June 23, 1996)*. Massachusetts Department of Environmental Protection, Division of Water Pollution Control, Technical Services Branch, Westborough, MA.

MA DEP 2003. *Massachusetts 2002 Integrated List of Waters.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

McGrath, R. 2001. *Personal Communication.* Data transmission regarding USEPA sediment and fish tissue investigations of Center Pond, Dalton, MA conducted by R.F. Weston, Inc, and General Electric. 1998.

Novak, M. A. and R. W. Bode. 1992. *Percent model affinity: a new measure of macroinvertebrate community composition*. J. N. Am. Benthol. Soc., 11(4): 80-110.

Nuzzo, R. M. 2002. *Standard Operating Procedures (Draft): Water Quality Monitoring in Streams Using Aquatic Macroinvertebrates*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 19 p.

Olcott, P.G. 1995. *Ground Water Atlas of the United States: Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont*. HA 730-M. USGS. Reston, VA. 15 p.

Osmond, D.L., D.E. Line, J.A. Gale, R.W. Gannon, C.B. Knott, K.A. Bartenhagen, M.H. Turner, S.W. Coffey, J. Spooner, J. Wells, J.C. Walker, L.L. Hargrove, M.A. Foster, P.D. Robillard, and D.W. Lehning. 1995. *WATERSHEDS: Water, Soil and Hydro-Environmental Decision Support System*, http://h2osparc.wq.ncsu.edu

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. *Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish.* EPA/440/4-89-001. Office of Water, US Environmental Protection Agency, Washington, DC.

Szczebak, D., A. Maher, H. Dinkeloo, P. Huckery, J. Collins, H. Woolsey, and C. Blais. 1999. *Massachusetts Natural Heritage Atlas*. MA DFW. Westborough, MA.

US EPA. 1995. *Generic Quality Assurance Project Plan Guidance for Programs Using Community Level Biological Assessment in Wadeable Streams and Rivers*. U.S. Environmental Protection Agency, Office of Water. 71 p.

US EPA 2003. Using Biological Assessments to Refine Designated Aquatic Life Uses. Presented at the National Biological Assessment and Criteria Workshop: Advancing State and Tribal Programs. Coeur d' Alene, ID. 31 March-4 April 2003.

USGS 2002. *Map of drought conditions 2002.* United States Geologic Survey. Northboro, MA.
http://ma.water.usgs.gov/current_cond/images/02_08_sw_map.gif

APPENDIX

Macroinvertebrate taxa list, RBPIII benthos analyses, and Habitat evaluations

Table A1. Taxa list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from stream sites during the 2002 Housatonic River watershed survey between 9 and 11 September 2002.

Taxon	FFG[1]	TV[2]	GR23A	HT19E[3]	KR02	KR07	WR01	WF01A	EB01B[3]	HW02S	WB01[3]	HW01	EB02A	HT19A	GPB07A	HT19C	KR11[3]	KR11 (dup.)
Ferrissia rivularis	SC	10				1		1										
Planorbidae	SC	6											1					
Pisidiidae	FC	6		3										2				
Lumbricina	GC	8													1			
Enchytraeidae	GC	10						3									1	1
Nais alpina	GC	8											1					
Nais bretscheri	GC	6			1					2		1	2					
Nais communis	GC	8										1						
Nais variabilis	GC	10		1						1		35						1
Pristinella osborni	GC	10										1						
Slavina appendiculata	GC	6										1						
Tubificidae IWB	GC	10									1							
Lumbriculus sp.	GC	8									3							
Hyalella azteca	GC	8												5				
Hydrachnidia	PR	6	2		2	1		3		4	2	2	2	1				
Baetidae	GC	4															6	
Acentrella sp.	SC	4	3		1	9	1	2	9		1		1	1	2	3		
Baetis sp.	GC	6	1	17	7		2		2		9		5	1	31	15		3
Heterocloeon curiosum	GC	2		6														
Baetidae (cerci only)	GC	6																2
Caenis sp.	GC	6				2	4			3		1						
Ephemerellidae	GC	1	3	6	1	1	4	8	2		2		1		11	3	6	9
Ephemera sp.	GC	2				1												
Heptageniidae	SC	4									1							
Epeorus (Iron) sp.	SC	0						2	1		8				2			
Leucrocuta sp.	SC	1					1											
Rhithrogena sp.	GC	0									4							
Stenonema sp.	SC	3	4	6	8	4	5	5	8	2		6	5			10	12	9

Table A1 (continued)

Taxon	FFG[1]	TV[2]	GR23A	HT19E[3]	KR02	KR07	WR01	WF01A	EB01B[3]	HW02S	WB01[3]	HW01	EB02A	HT19A	GPB07A	HT19C	KR11[3]	KR11 (dup.)
Isonychia sp.	GC	2	7	5	4	2	3	1	9	7	2		1					
Paraleptophlebia sp.	GC	1	1					5			7							
Gomphidae	PR	5							1									1
Chloroperlidae	PR	1									9							
Leuctra sp.	SH	0									2							
Tallaperla sp.	SH	0									2							
Acroneuria sp.	PR	0	1				1								2		2	
Agnetina sp.	PR	2						3			1							
Paragnetina sp.	PR	1			3			2	3		3				2		3	5
Perlodidae	PR	2									2							
Pteronarcys sp.	SH	0									1							
Corydalus sp.	PR	4		1														
Nigronia serricornis	PR	0			1	1			2	2	1							
Micrasema sp.	SH	2		5											1		2	2
Glossosoma sp.	SC	0	2		1	1				1	1						3	3
Helicopsyche borealis	SC	3					2	5										
Hydropsychidae	FC	4			2			1	1				1					
Cheumatopsyche sp.	FC	5	4		2		5	16	3	9		14	10	17		10		
Hydropsyche sp.	FC	4		1												3		
Hydropsyche betteni	FC	6			2								5	1				
Hydropsyche morosa gr.	FC	6	20	13	13	23	10	17	3	5	9	1	12		11	4	13	8
Macrostemum zebratum	FC	3		9												2		
Hydroptila sp.	GC	6						1						1				1
Leucotrichia sp.	SC	6		2	1	5							7			1		
Lepidostoma sp.	SH	1	7	1				1			5				1	1		
Oecetis sp.	PR	5		1		1												
Apatania sp.	SC	3	1															
Goera sp.	SC	3				1				1								
Chimarra sp.	FC	4	1	8	2		21		4	3		4		28			8	3
Dolophilodes sp.	FC	0	3					2			4				2			
Psychomyia sp.	GC	2	1		1					1			2					
Rhyacophila sp.	PR	1	5			6	1		4	1	6		1		4			

Table A1 (continued)

Taxon	FFG[1]	TV[2]	GR23A	HT19E[3]	KR02	KR07	WR01	WF01A	EB01B[3]	HW02S	WB01[3]	HW01	EB02A	HT19A	GPB07A	HT19C	KR11[3]	KR11 (dup.)
Acentria sp.	SH	5												1			1	
Macronychus glabratus	SH	5				1												3
Optioservus sp.	SC	4		2								2	6	7	1	21	3	
Optioservus ovalis	SC	4	12				7	2										
Optioservus trivittatus	SC	4			24	16			4	27								
Oulimnius latiusculus	SC	4	3	1	5	3	8		15	4			2	1	4	1		
Promoresia sp.	SC	2		2	1	12	9			1			3	2	2	3		
Stenelmis sp.	SC	5		8	1									16			5	6
Stenelmis crenata	SC	5					9	1				18	2			11		
Ectopria nervosa	SC	5													1		1	
Psephenus herricki	SC	4			3	3	1	9	2	5	3	1	2		1		4	6
Atherix sp.	PR	4							5									
Palpomyia/Bezzia sp.	PR	6						1							1		1	
Chironomidae	GC	6							1									
Chironomus sp.	GC	10										1						
Demicryptochironomus sp.	GC	2													1		1	
Microtendipes pedellus gr.	FC	6	1		1			2		1		1	1					
Nilothauma sp.	GC	6															1	
Polypedilum sp.	SH	6					1											1
Polypedilum aviceps	SH	4	3			1		1	1		2				9		5	3
Polypedilum flavum	SH	6			2								2	3		5		
Polypedilum halterale gr.	SH	6			1													
Polypedilum tritum	SH	6										2						
Saetheria sp.	CG	4																1
Stenochironomus sp.	GC	5																2
Micropsectra sp.	GC	7						3							1		1	
Rheotanytarsus exiguus gr.	FC	6		2	2		4	1	2	3		1	4	1				1
Rheotanytarsus pellucidus	FC	5				1	1		1	1					1	1		2
Stempellina sp.	GC	2								2								
Stempellinella sp.	GC	2															2	1
Sublettea coffmani	FC	4				4		3	3						1		2	2

Table A1 (continued)

Taxon	FFG[1]	TV[2]	GR23A	HT19E[3]	KR02	KR07	WR01	WF01A	EB01B[3]	HW02S	WB01[3]	HW01	EB02A	HT19A	GPB07A	HT19C	KR11[3]	KR11 (dup.)
Tanytarsus sp.	FC	6	3		4			1		3		5	4					1
Diamesa sp.	GC	5															2	1
Pagastia sp.	GC	1				1							1		1			
Potthastia gaedii gr.	GC	2	1			1												
Brillia flavifrons	SH	5													1			
Cardiocladius sp.	PR	5							1									
Cardiocladius obscurus	PR	5		2														
Corynoneura sp.	GC	4													1			1
Cricotopus bicinctus	GC	7			1			1						3		2		
Cricotopus tremulus gr.	SH	7			1								3					
Cricotopus trifascia	SH	6	1	2									1	1		4		
Cricotopus vierriensis	SH	7	1			1			2			1	3					1
Cricotopus/Orthocladius sp.	GC	7						3										
Eukiefferiella brehmi gr.	GC	4		2									1					1
Eukiefferiella claripennis gr.	GC	8													1			
Eukiefferiella devonica gr.	GC	4							1				1		2			
Lopescladius sp.	GC	4									1						7	9
Nanocladius sp.	GC	7											2					
Nanocladius (Plecopteracoluthus) branchicolus	GC	3					3											
Orthocladius sp.	GC	6											2					
Orthocladius (Symposiocladius) lignicola	SH	5							1									
Parachaetocladius sp.	GC	2									2				1		2	2
Parametriocnemus sp.	GC	5	1					1	1	5	4	1	1		2			1
Synorthocladius sp.	GC	6		1												3		
Thienemanniella xena	GC	6									1							1
Tvetenia paucunca	GC	5	1		3				4		6		2		5		6	3
Tvetenia vitracies	GC	5	5										1			2		
Conchapelopia sp.	PR	6	2									1	2		2		2	
Nilotanypus sp.	PR	6	1															
Nilotanypus fimbriatus	PR	8		1					1									

Table A1 (continued)

Taxon	FFG[1]	TV[2]	GR23A	HT19E[3]	KR02	KR07	WR01	WF01A	EB01B[3]	HW02S	WB01[3]	HW01	EB02A	HT19A	GPB07A	HT19C	KR11[3]	KR11 (dup.)
Thienemannimyia gr.	PR	6									1					2		
Empididae	PR	6								1								
Clinocera sp.	PR	6															1	
Hemerodromia sp.	PR	6	1	1	1	2	1			1		1	1	1	1			2
Simulium sp.	FC	5	3	1			2		4					1			3	1
Simulium vittatum complex	FC	9														2		
Antocha sp.	GC	3	1		7	1		1	1	1			2	1				1
Cryptolabis sp.	GC	4						1										
Dicranota sp.	PR	3						1										2
Hexatoma sp.	PR	2	1					1			1							3
Total Number of Organisms			**107**	**110**	**109**	**106**	**106**	**111**	**102**	**97**	**107**	**102**	**106**	**95**	**110**	**109**	**106**	**106**

[1]Functional Feeding Group (FFG). The feeding habit of each taxon. SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR-Predator.
[2]Tolerance Value (TV). An assigned value used to calculate the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant.
[3] Reference station

Table A2. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Housatonic River watershed survey - September 2002. Shown are the calculated metric values, metric scores (in italics) based on comparability to the Windsor Brook (WB01) reference station, and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	**WB01**		**GPB07A**		**WF01A**	
STREAM	Windsor Brook		Goose Pond Brook		Wahconah Falls Brook	
HABITAT SCORE	164		174		149	
TAXA RICHNESS	32	*6*	33	*6*	34	*6*
BIOTIC INDEX	2.77	*6*	4.20	*2*	4.26	*2*
EPT INDEX	19	*6*	11	*0*	14	*2*
EPT/CHIRONOMIDAE	4.65	*6*	2.38	*4*	4.44	*6*
SCRAPER/FILTERER	1.08	*6*	0.87	*6*	0.63	*6*
% DOMINANT TAXON	8%	*6*	28%	*4*	15%	*6*
REFERENCE AFFINITY	100%	*6*	74%	*6*	72%	*6*
TOTAL METRIC SCORE	*42*		*28*		*34*	
% COMPARABILITY TO REFERENCE	100%		67%		81%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**SLIGHTLY IMPACTED**		**SLIGHTLY IMPACTED**	

Table A3. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Housatonic River watershed survey - September 2002. Shown are the calculated metric values, metric scores (in italics) based on comparability to the Konkapot River (KR11) reference station, and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	**KR11**		**KR11 (DUP)**		**KR07**		**KR02**	
STREAM	Konkapot River		Konkapot River		Konkapot River		Konkapot River	
HABITAT SCORE	170		170		172		139	
TAXA RICHNESS	29	*6*	38	*6*	28	*6*	31	*6*
BIOTIC INDEX	3.91	*6*	3.93	*6*	4.08	*6*	4.36	*6*
EPT INDEX	9	*6*	10	*6*	12	*6*	13	*6*
EPT/CHIRONOMIDAE	1.77	*6*	1.32	*4*	6.22	*6*	3.20	*6*
SCRAPER/FILTERER	1.08	*6*	1.33	*6*	1.96	*6*	1.61	*6*
% DOMINANT TAXON	12%	*6*	8%	*6*	22%	*4*	22%	*4*
REFERENCE AFFINITY	100%	*6*	91%	*6*	69%	*6*	77%	*6*
TOTAL METRIC SCORE	*42*		*40*		*40*		*40*	
% COMPARABILITY TO REFERENCE	100%		95%		95%		95%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**NON-IMPACTED**		**NON-IMPACTED**		**NON-IMPACTED**	

Table A4. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Housatonic River watershed survey - September 2002. Shown are the calculated metric values, metric scores (in italics) based on comparability to the East Branch Housatonic River (EB01B) reference station, and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	**EB01B**		**GR23A**		**HW01**		**HW02S**		**EB02A**		**WR01**	
STREAM	East Branch Housatonic River		Green River		West Branch Housatonic River		Southwest Branch Housatonic River		East Branch Housatonic River		Williams River	
HABITAT SCORE	176		130		94		146		156		142	
TAXA RICHNESS	31	*6*	34	*6*	23	*4*	26	*6*	38	*6*	24	*4*
BIOTIC INDEX	3.76	*6*	3.84	*6*	6.84	*2*	4.27	*6*	5.11	*4*	4.05	*6*
EPT INDEX	12	*6*	16	*6*	5	*0*	10	*4*	11	*6*	13	*6*
EPT/CHIRONOMIDAE	2.58	*6*	3.20	*6*	2.00	*6*	2.20	*6*	1.65	*4*	6.67	*6*
SCRAPER/FILTERER	1.86	*6*	0.71	*4*	1.04	*6*	1.64	*6*	0.78	*4*	1.00	*6*
% DOMINANT TAXON	15%	*6*	19%	*6*	34%	*2*	28%	*4*	11%	*6*	20%	*6*
REFERENCE AFFINITY	100%	*6*	74%	*6*	58%	*4*	72%	*6*	65%	*6*	66%	*6*
TOTAL METRIC SCORE		*42*		*40*		*24*		*38*		*36*		*40*
% COMPARABILITY TO REFERENCE	100%		95%		57%		90%		86%		95%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**NON-IMPACTED**		**SLIGHTLY-IMPACTED**		**NON-IMPACTED**		**NON-IMPACTED**		**NON-IMPACTED**	

Table A5. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Housatonic River watershed survey - September 2002. Shown are the calculated metric values, metric scores (in italics) based on comparability to the Housatonic River (HT19E) reference station, and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	**HT19E**		**HT19A**		**HT19C**	
STREAM	Housatonic River		Housatonic River		Housatonic River	
HABITAT SCORE	185		162		172	
TAXA RICHNESS	28	*6*	21	*4*	22	*4*
BIOTIC INDEX	4.29	*6*	4.87	*6*	4.72	*6*
EPT INDEX	13	*6*	6	*0*	10	*2*
EPT/CHIRONOMIDAE	8.00	*6*	6.13	*6*	2.74	*2*
SCRAPER/FILTERER	0.57	*6*	0.54	*6*	2.27	*6*
% DOMINANT TAXON	15%	*6*	29%	*4*	19%	*6*
REFERENCE AFFINITY	100%	*6*	58%	*4*	83%	*6*
TOTAL METRIC SCORE	*42*		*30*		*32*	
% COMPARABILITY TO REFERENCE	100%		71%		76%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**SLIGHTLY IMPACTED**		**SLIGHTLY IMPACTED**	

Table A6. Habitat assessment summary for biomonitoring stations sampled during the Housatonic River watershed survey - September 2002. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a complete listing and description of sampling stations.

Habitat Parameter	**EB01B***		**EB02A**		**GPB07A**		**GR23A**		**HT19A**		**HT19C**		**HT19E***		**HW01**		**HW02S**		*KR02*		**KR07**		**KR11***		**WB01***		**WF01A**		**WR01**	
Instream Cover	17		12		12		2		16		5		16		4		11		6		15		18		17		14		16	
Epifaunal Substrate	19		19		20		13		19		20		19		9		15		17		19		18		18		16		16	
Embeddedness	19		19		20		16		16		19		19		14		17		19		20		19		19		20		17	
Channel Alteration	15		8		18		18		16		20		20		11		15		13		17		18		20		18		18	
Sediment Deposition	17		17		19		6		19		20		19		17		7		11		16		15		18		18		10	
Velocity-Depth Combinations	17		18		15		7		15		13		15		7		8		10		16		16		15		13		16	
Channel Flow Status	13		15		10		8		19		19		18		12		15		18		18		7		6		8		11	
Bank Vegetative Protection	10^{L}	10^{R}	10	10	10	10	10	10	10	10	10	10	10	9	4	4	10	10	10	10	10	9	10	10	10	10	10	10	10	9
Bank Stability	9	10	9	10	10	10	10	10	10	10	6	10	10	10	4	4	9	10	10	9	10	8	10	9	10	9	8	10	4	3
Riparian Vegetative Zone Width	10	10	9	0	10	10	10	10	1	1	10	10	10	10	2	2	9	10	3	3	10	4	10	10	10	2	1	3	9	3
TOTAL SCORE	**176**		**156**		**174**		**130**		**162**		**172**		**185**		**94**		**146**		**139**		**172**		**170**		**164**		**149**		**142**	

* = Reference Station
L = Left Bank
R = Right Bank