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.

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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
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GLENN HAAS, DIRECTOR

March, 2006

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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

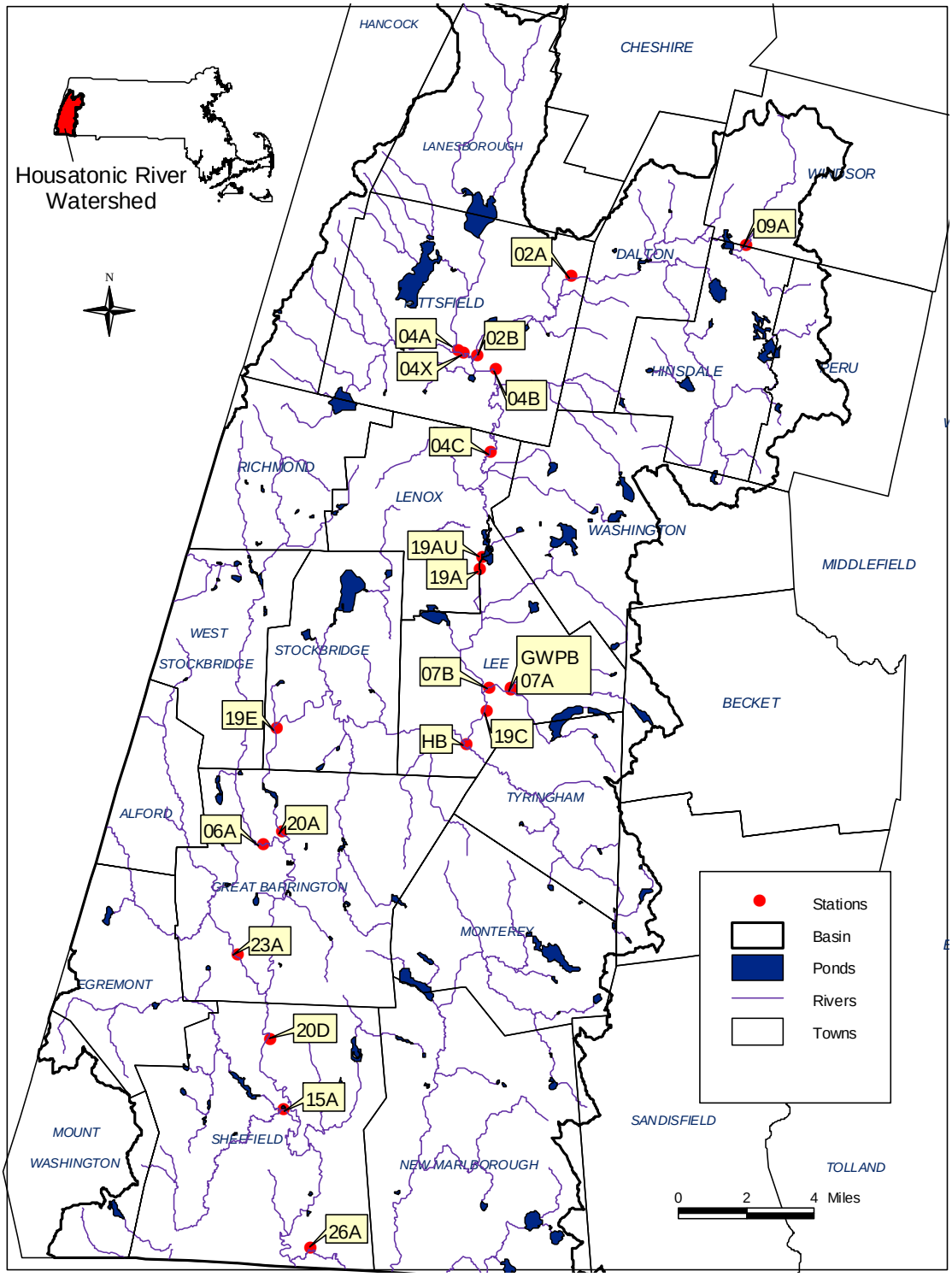
Water quality samples were collected in the Housatonic River Watershed on the dates and for the parameters as shown in Table 1. See Figure 1 for station locations. The parameters included in the sampling were: *in-situ* Hydrolab® measurements (dissolved oxygen, percent dissolved oxygen saturation, pH, 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.

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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

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20 July 2005

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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

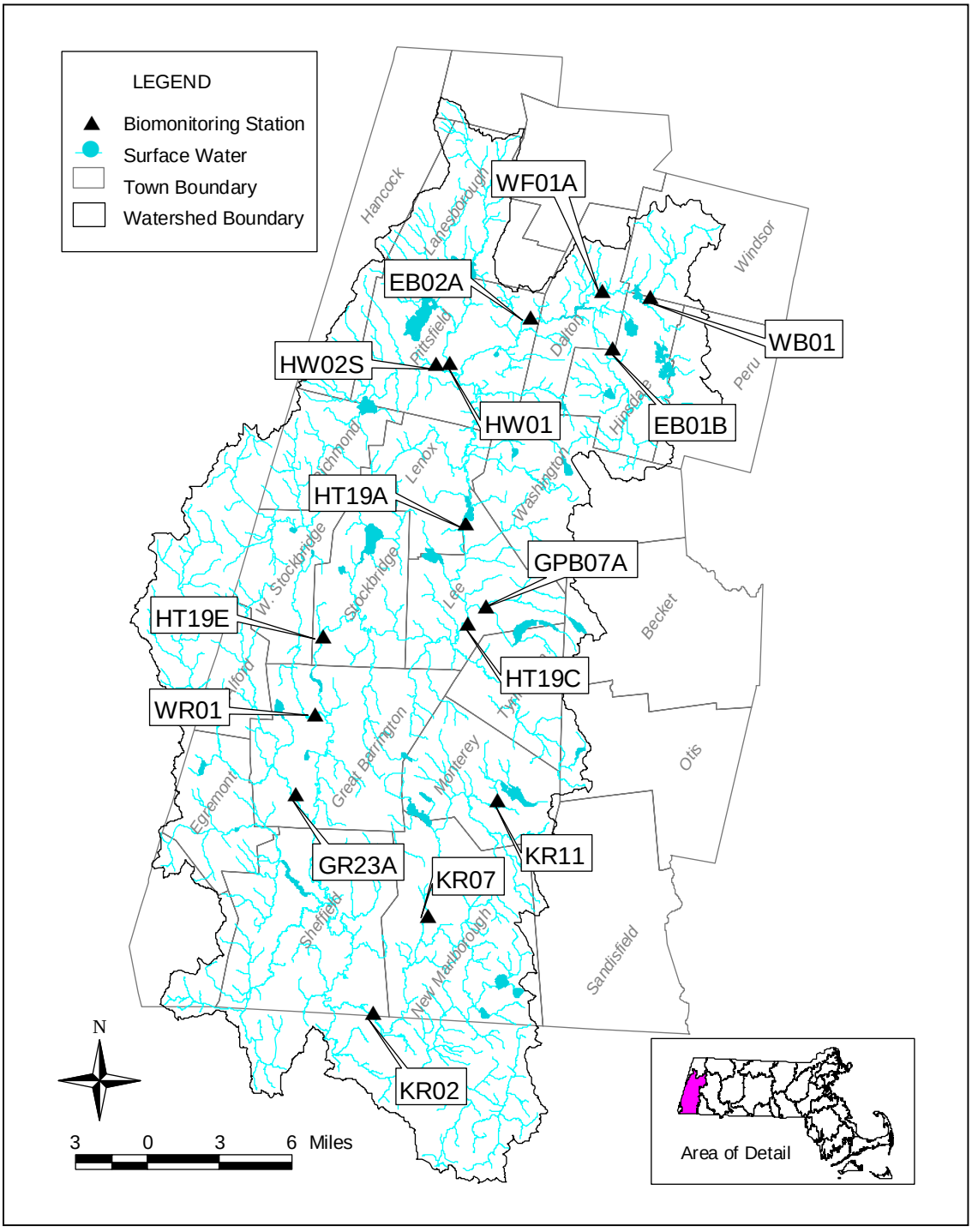
^{R} 2002 reference station, * sampled by DWM in 1997

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).

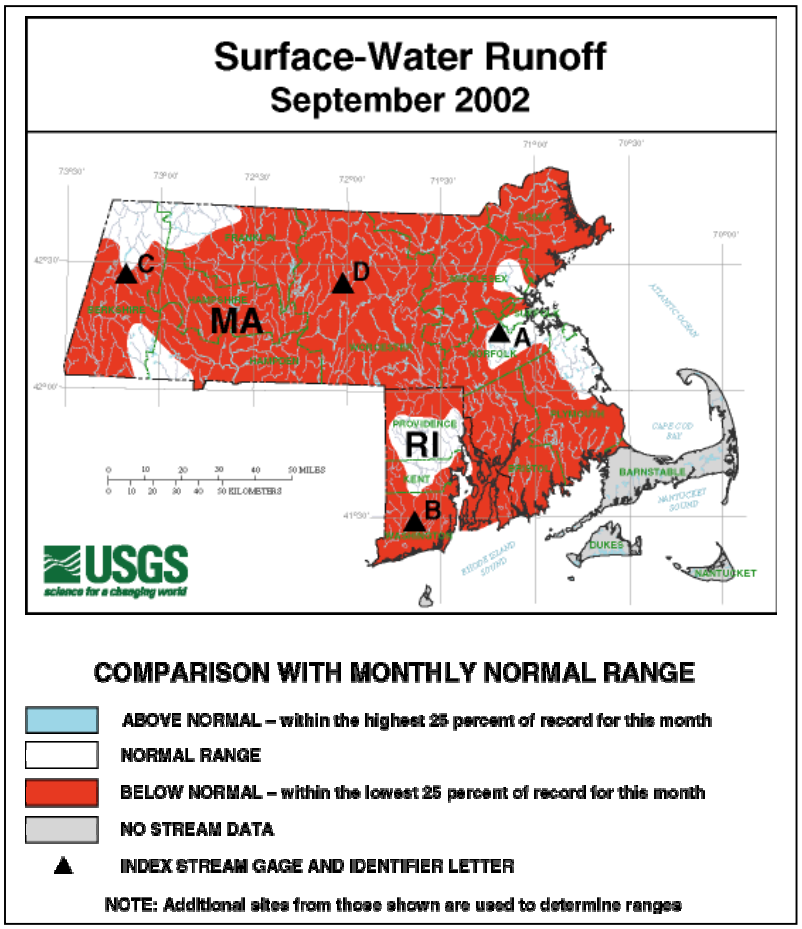
The constituents of the tributarial substrates (in the Taconic Range and Berkshire Hills) are not as prone to dissolution as the carbonaceous rock underlying the bed of the mainstem Housatonic River. Thus, the hardness, dissolved solids, and specific conductance tend to be greater in streams that run 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.

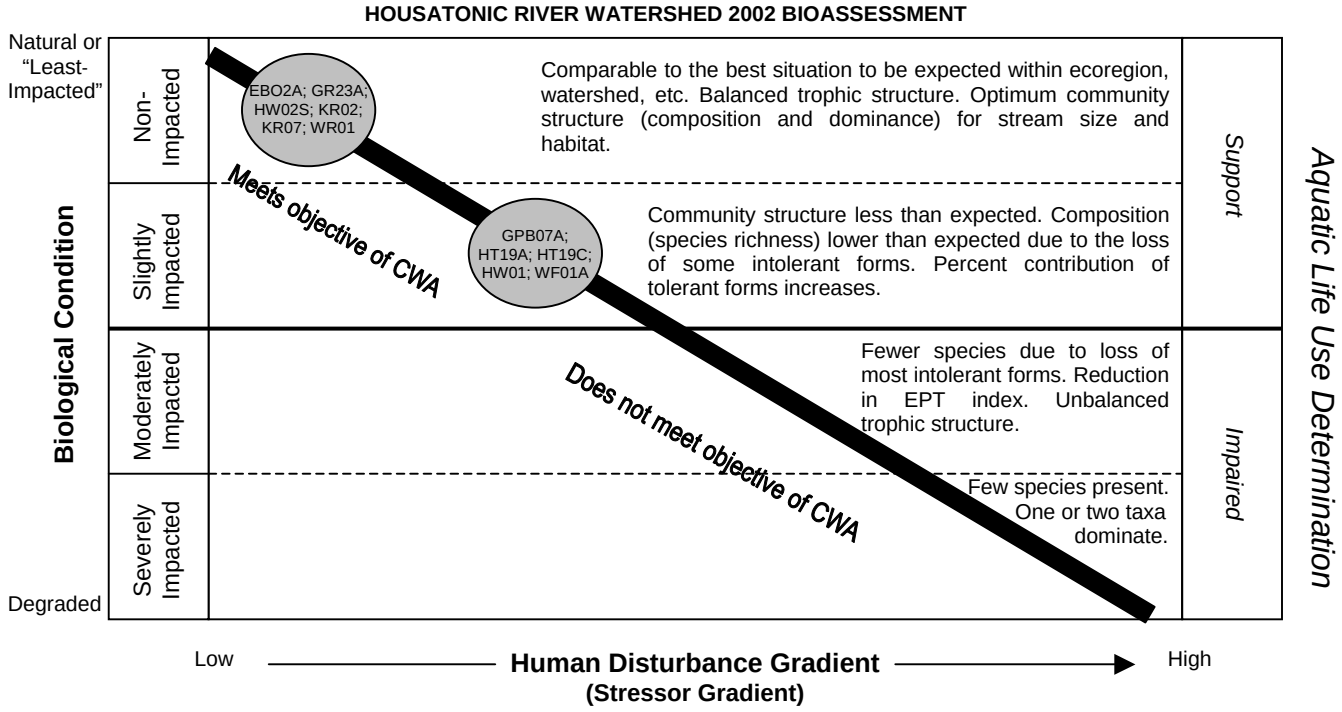


Figure 5. Schematic of the predictive response of aquatic communities to increasing human disturbance. Included is the performance (Biological Condition and Aquatic Life Use determinations) of the Housatonic River watershed 2002 biomonitoring stations along the Human Disturbance Gradient. NOTE: All reference 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.

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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