# WESTFIELD RIVER WATERSHED

# 2001 WATER QUALITY ASSESSMENT REPORT


**COMMONWEALTH OF MASSACHUSETTS**
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# WESTFIELD RIVER WATERSHED

# 2001 WATER QUALITY ASSESSMENT REPORT

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Division of Watershed Management

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Division of Watershed Management
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- Department of Environmental Protection (MA DEP)
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- Department of Public Health (MA DPH)
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- United States Environmental Protection Agency (EPA)
- United States Geological Survey (USGS)
  - Water Resources Division
- United States Army Corps of Engineers (ACOE)
- Federal Energy Regulatory Commission (FERC)
- United States Fish & Wildlife Service (USFWS)
- National Park Service (NPS)

Regional

- Lower Pioneer Valley Regional Planning Commission
- Westfield River Watershed Association/ Westfield Wild and Scenic Advisory Committee
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Cover photo: Westfield River in Russell, Massachusetts
Photo credit: Alan Wynn, EOEA

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7Q10.....seven day, ten year low flow
ACEC.....Area of Critical Environmental Concern
ACO.....Adminstrative Consent Order
ACOE.....Army Corps of Engineers (United States)
ADB.....assessment database
BMP .....best management practice
BOH .....Board of Health
BPJ .....best professional judgment
BRP.....Bureau of Resource Protection
BWP.....Bureau of Waste Prevention
BWSC.....Bureau of Waste Site Cleanup
CMR.....Code of Massachusetts Regulations
CNOEC.....chronic no observed effect concentration
CSO.....combined sewer overflow
CVP.....certified vernal pool
CWA .....Clean Water Act
DDT .....dichlorodiphenyltrichloroethane
DMF .....Division of Marine Fisheries
DMR.....discharge monitoring report
DSI .....Decorative Specialties International
DO.....dissolved oxygen
DWM.....Division of Watershed Management
EOEA.....Executive Office of Environmental Affairs
EPA.....United States Environmental Protection Agency
EPT.....Ephemeroptera, Plecoptera, and Trichoptera
ESS.....Environmental Science Services
FERC.....Federal Energy Regulatory Commission
$LC_{50}$.....lethal concentration to 50% of the test organisms
L-EL.....low effect level
MA DCR.....Massachusetts Department of Conservation and Recreation
MA DEM.....Massachusetts Department of Environmental Management (now the Department of Conservation and Recreation)
MA DEP.....Massachusetts Department of Environmental Protection
MA DFG .....Massachusetts Department of Fish and Game
MDFW .....Massachusetts Division of Fisheries and Wildlife
MA DPH .....Massachusetts Department of Public Health
MassGIS.....Massachusetts Geographic Information System
MPN.....most probable number
NAS/NAE ....National Academy of Sciences/National Academy of Engineers
NAWQA.....National Water-Quality Assessment
NPDES.....National Pollutant Discharge Elimination System
ORS.....Office of Research and Standards
ORW.....Outstanding Resource Water
PAH.....Polycyclic aromatic hydrocarbons
PALIS.....Pond and Lake Information System
PCB.....polychlorinated biphenyls
POTW.....Publicly Owned Treatment Works
QA/QC .....quality assurance/ quality control
RBP.....rapid bioassessment protocol
S-EL.....severe effect level
SWPPP .....Stormwater pollution prevention plan
SWQS.....Surface Water Quality Standards
TMDL.....total maximum daily load
TNTC .....too numerous to count
TOXTD .....MA DEP DWM Toxicity Testing Database
TOC .....total organic carbon
TRC.....total residual chlorine
USFWS .....United States Fish & Wildlife Service
USGS.....United States Geological Survey
WBID .....waterbody identification code
WBS.....waterbody system database
WMA.....Water Management Act
WWTP .....wastewater treatment plant

## LIST OF UNITS

cfs .....cubic feet per second
cfu .....colony forming unit
kW.....kilowatt
kWh .....kilowatt hour
MGD .....million gallons per day
mg/L.....milligram per liter
ng.....nanograms
NTU .....nephelometric turbidity units
ppb.....parts per billion
ppm.....parts per million
SU.....standard units
TEQ/kg.....toxic equivalents per kilogram
µg/kg.....microgram per kilogram
µS/cm.....microsiemens per centimeter

# EXECUTIVE SUMMARY
## WESTFIELD RIVER WATERSHED
## 2001 WATER QUALITY ASSESSMENT REPORT

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

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

There are a total of 28 freshwater rivers, streams, or brooks (the term "rivers" will hereafter be used to include all) comprising 35 river segments in the Westfield River Watershed presented in this report. These include: Little River, Middle Branch Westfield River, Swift River, West (Falls) Branch, West Branch Westfield River, and Westfield River; Bedlam, Bradley, Depot, Dickenson, Glendale, Great, Kinne, Meadow, Miller, Moose Meadow, Paucatuck, Pond, Potash, Powdermill, Roaring, Sanderson, Shaker Mill, Walker, White, and Yokum brooks; and Watts and Wards streams. They account for approximately 51% (232.6 miles) of an estimated 452.6 named river miles. The remaining rivers are small and are currently *unassessed*. This report also includes information on 33 of the 82 lakes, ponds or impoundments (the term "lakes" will hereafter be used to include all) that have been assigned a pond and lake identification system (PALIS) number in the Westfield River Watershed. The 33 lakes included in this report represent 87% of the total lake acreage (3,654 of 4,197 acres) in the Westfield River Watershed.

### *AQUATIC LIFE USE*

The *Aquatic Life Use* is supported when suitable habitat (including water quality) is available for sustaining a native, naturally diverse, community of aquatic flora and fauna. Impairment of the *Aquatic Life Use* may result from anthropogenic stressors that include point and/or nonpoint source(s) of pollution and hydrologic modification.

### *Aquatic Life Use Summary – Rivers (Figure 1)*

Eighty-five percent (85%) of the river segments in the Westfield River Watershed included in this report are assessed as either support or impaired for the *Aquatic Life Use*. All of 23 segments and portions of three additional segments are assessed as supporting the *Aquatic Life Use*.

The *Aquatic Life Use* is assessed as support for a large portion (the upper 50 miles) of the Westfield River (all of MA32-04 and the upper 16.8 miles of MA32-05), impaired for the 1-mile reach of the river downstream from the Westfield Wastewater Treatment Plant (WWTP) discharge to the Route 20 bridge in Westfield and not assessed for the lower 10.4 miles (MA32-06 and MA32-07). Sources of impairment in the impaired one-mile reach include the municipal point source discharge and municipal separate storm sewer systems (suspected source).

**_Aquatic Life Use_ Assessment**
**Rivers**
**(total length included in report – 232.6 miles)**
**Support – 190.1 miles (82%)**
**Impaired – 6.6 miles (3%)**
**Not Assessed – 35.9 miles (15%)**

**Lakes**
**(total area included in report – 3,654 acres)**
**Impaired – 901 acres (25%)**
**Not Assessed – 2,753 acres (75%)**

The *Aquatic Life Use* is assessed as support for the majority of the Little River (all of MA32-08, MA32-16, and MA32-35 and a portion of MA32-36) but impaired for the lower 2.4-mile reach of MA32-36 downstream from its confluence with Cook Brook. Habitat quality degradation resulting from instream deposition appears to be impacting the biota in the Little River downstream from its confluence with Cook Brook. The municipal water treatment plant filter backwash discharge is the suspected source of impairment.

The *Aquatic Life Use* is assessed as support for the upper 6.1 miles of Powdermill Brook (MA32-09), but impaired for the 3.3 mile reach downstream from a small impoundment to the confluence with the Westfield River because of severe habitat quality degradation, reduced overall fish abundance, and the shift in fish community structure (dominated by pollution tolerant species). Causes of impairment in Powdermill Brook are sedimentation and siltation. Where known, sources of impairment include land development, streambank modification/destabilization, and post-development erosion. Additional suspected sources are construction road runoff, road runoff, and sand and gravel operations.

The *Aquatic Life Use* is assessed as support for 19 additional river segments and not assessed for the remaining seven segments included in this report (15% of the river miles).

***Aquatic Life Use Summary – Lakes (Figure 1)***

Few lakes in the Westfield River Watershed have recently been surveyed for variables used to assess the status of the *Aquatic Life Use* (i.e., DO, pH, nutrients, macrophytes and plankton/chlorophyll *a*). Because of the lack of these types of data 75% of the lake acreage (2,753 acres) are not assessed for the *Aquatic Life Use*. Nine lakes (Blair Pond, Buck Pond, Center Pond, Horse Pond, Pequot Pond, Windsor Pond and the three basins of Congamond Lake) totaling 901 acres are impaired due to non-native aquatic plant infestations. Additionally, the Middle and North Basins of Congamond Lake were also assessed as impaired because of oxygen depletion.

***FISH CONSUMPTION USE***

The *Fish Consumption Use* is supported when there are no pollutants present that result in unacceptable concentrations in edible portions (as opposed to whole fish - see *Aquatic Life Use*) of fish, other aquatic life or wildlife for human consumption. The assessment of the *Fish Consumption Use* is made using the most recent list of Fish Consumption Advisories issued by the Massachusetts Executive Office of Health and Human Services, Massachusetts Department of Public Health (MA DPH), Bureau of Environmental Health Assessment (MA DPH 2004a). The MA DPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species poses a health risk for human consumption. Hence the *Fish Consumption Use* is assessed as impaired in these waters. In July 2001 MA DPH issued new consumer advisories on fish consumption and mercury contamination (MA DPH 2001). Because of these statewide advisories no waters can be assessed as support for the *Fish Consumption Use*. These waters default to "not assessed". The statewide advisories read as follows.

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

***Fish Consumption Use* Summary – Rivers and Lakes**

No site-specific fish consumption advisories exist for river or lake segments in the Westfield River Watershed. Therefore, all segments default to Not Assessed for the *Fish Consumption Use* because of the statewide advisory.

| ***Fish Consumption Use* Assessment** |
|---|
| **Rivers** |
| **(total length included in report – 232.6 miles)** |
| **Not Assessed – 232.6 miles (100%)** |
| **Lakes** |
| **(total area included in report – 3,654 acres)** |
| **Not Assessed – 3,654 acres (100%)** |

***DRINKING WATER USE***

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

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

***PRIMARY AND SECONDARY CONTACT RECREATIONAL USES***

The *Primary Contact Recreational Use* is supported when conditions are suitable (fecal coliform bacteria densities, turbidity and aesthetics meet the SWQS) for any recreational or other water related activity during which there is prolonged and intimate contact with the water and there exists a significant risk of ingestion. Activities include, but are not limited to, wading, swimming, diving, surfing and water skiing. The *Secondary Contact Recreational Use* is supported when conditions are suitable for any recreational or other water use during which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact related to shoreline activities. For lakes, macrophyte cover and/or transparency data (Secchi disk depth) are evaluated to assess the status of the recreational uses.

***Primary and Secondary Contact Recreational Uses Summary – Rivers (Figures 2 and 3)***

Twenty-nine percent (29%) of the river segments in the Westfield River Watershed included in this report are assessed as either support or impaired for the *Primary Contact Recreational Use* while only 18% of the river segments are assessed as either support or impaired for the *Secondary Contact Recreational Use*.

***Primary Contact Recreational Use Assessments***
**Rivers**
**(total length included in report – 232.6 miles)**
**Support – 23.7 miles (10%)**
**Impaired – 43.3 miles (19%)**
**Not Assessed – 165.6 miles (71%)**

**Lakes**
**(total area included in report – 1,956 acres)**
**Support – 495 acres (14%)**
**Not Assessed – 3,159 acres (86%)**

***Secondary Contact Recreational Use Assessments***
**Rivers**
**(total length included in report – 232.6 miles)**
**Support – 37.6 miles (16%)**
**Impaired – 4.7 miles (2%)**
**Not Assessed – 190.3 miles (82%)**

**Lakes**
**(total area included in report – 1,956 acres)**
**Support – 495 acres (14%)**
**Not Assessed – 3,159 acres (86%)**

The mainstem Westfield River is divided into four segments. The uppermost segment, MA32-04 (33.2 miles), from the confluence of Drowned Land Brook and Center Brook in Savoy to the confluence with Middle Branch Westfield River in Huntington is assessed as impaired for the *Primary Contact Recreational Use* due to beach closures, but not assessed for the *Secondary Contact Recreational Use*. The next two segments, MA32-05 (17.8 miles) and MA32-06 (1.9 miles) are not assessed for the recreational uses. The last segment, MA32-07 (8.5 miles), from the Westfield/ West Springfield/Agawam city lines to the confluence with Connecticut River in Agawam is not assessed for the *Primary Contact Recreational Use*, but assessed as supporting the *Secondary Contact Recreational Use*.

The segment of the Little River (MA32-08) from Horton's Bridge to the confluence with the Westfield River in Westfield is assessed as support for the *Secondary Contact Recreational Use*, but impaired for the *Primary Contact Recreational Use* due to elevated fecal coliform bacteria counts. Suspected sources of the bacteria are storm drains and runoff.

All of Great Brook (MA32-25), the upper 6.9-mile portion of Moose Meadow Brook (MA32-23), and the upper 6.2-mile portion of Powdermill Brook (MA32-09) are assessed as support for both the *Primary and Secondary Contact Recreational uses*. However, the lower 1.3 miles of Moose Meadow Brook and lower 3.3 miles of Powdermill Brook are impaired. Causes of impairment in Moose Meadow Brook are fecal coliform bacteria and turbidity. Grazing of livestock in the riparian zone appears to be the source of the impairment. Causes of impairment in Powdermill Brook are sedimentation/siltation, turbidity, and excess algal growth due to land development, streambank modification/destabilization, post-development erosion and suspected sources include construction road runoff, road runoff, and sand and gravel operations.

***Primary and Secondary Contact Recreational Uses Summary – Lakes (Figures 2 and 3)***
Four lakes totaling 495 acres, Center Pond, Congamond Lake (South Basin), Pequot Pond and Russell Pond, are assessed as support for both the *Primary* and *Secondary Contact Recreational uses*. The remaining 3,159 acres of lake segments in the Westfield River Watershed are not assessed.

***AESTHETICS USE***
The *Aesthetics Use* is supported when surface waters are free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

***Aesthetics Use Summary – Rivers (Figure 4)***
All or portions of 16 segments, totaling 115.7 miles and representing 50% of the river segment mileage in the Westfield River Watershed are assessed as supporting the *Aesthetics Use*. Only 2% of the river segment mileage is assessed as impaired for the *Aesthetics Use* and the remaining 48% is not assessed. The *Aesthetics Use* is supported for a large portion (50 miles) of the Westfield River, not assessed for an additional 10.4 miles, and impaired for the 1-mile reach of the river downstream from the Westfield WWTP discharge to the Route 20 bridge in Westfield. Causes of impairment are excess algal growth, turbidity, and odor. Known and suspected sources of impairment are the point source discharge and discharge from municipal separate storm sewer systems.

**_Aesthetics Use A_ssessment**
**Rivers**
**(total length included in report – 232.6 miles)**
**Support – 115.7 miles (50%)**
**Impaired – 5.7 miles (2%)**
**Not Assessed – 111.2 miles (48%)**

**Lakes**
**(total area included in report – 1,956 acres)**
**Support – 495 acres (14%)**
**Not Assessed – 3,159 acres (86%)**

The upper 6.9-mile portion of Moose Meadow Brook and the upper 6.2-mile portion of Powdermill Brook are assessed as support for the *Aesthetics Use*. However, the lower 1.3 miles of Moose Meadow Brook and lower 3.3 miles of Powdermill Brook are impaired for this use. The cause of impairment in Moose Meadow Brook is turbidity with grazing of livestock in the riparian zone as the source of the impairment. Causes of impairment in Powdermill Brook are sedimentation/siltation, turbidity, and excess algal growth. Where known, sources of impairment in Powdermill Brook include land development, streambank modification/destabilization, and post-development erosion. Additional suspected sources are construction road runoff, road runoff, and sand and gravel operations.

***Aesthetics Use Summary – Lakes (Figure 4)***
The three basins of Congamond Lake (North, Middle and South) comprise the only lake acreage assessed as supporting the Aesthetics Use in the Westfield River Watershed. The remaining lake segments are not assessed.

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## Figure 1. *Aquatic Life Use* Assessment Summary – Rivers and Lakes

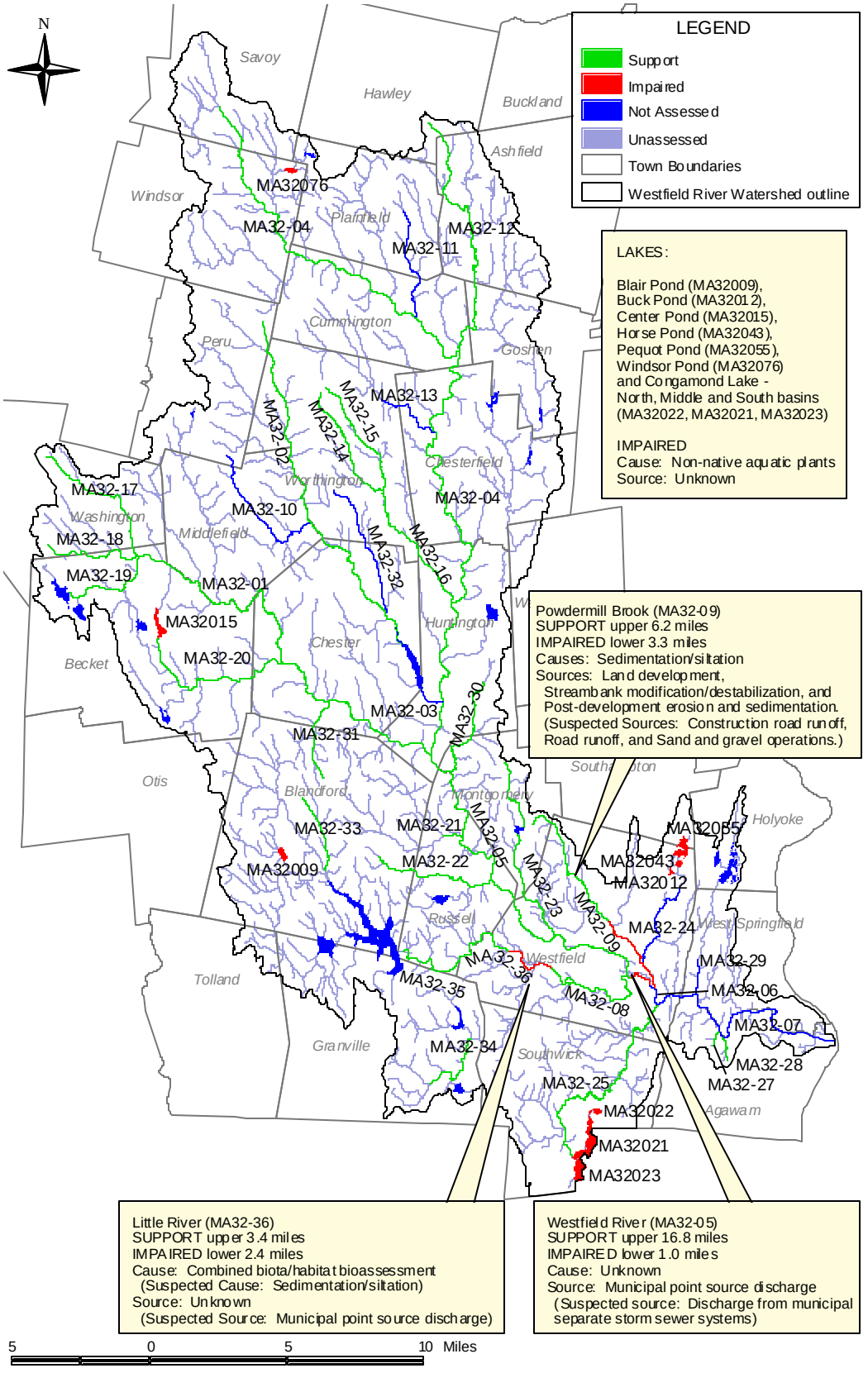

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Figure 2. *Primary Contact Recreational Use* Assessment Summary – Rivers and Lakes

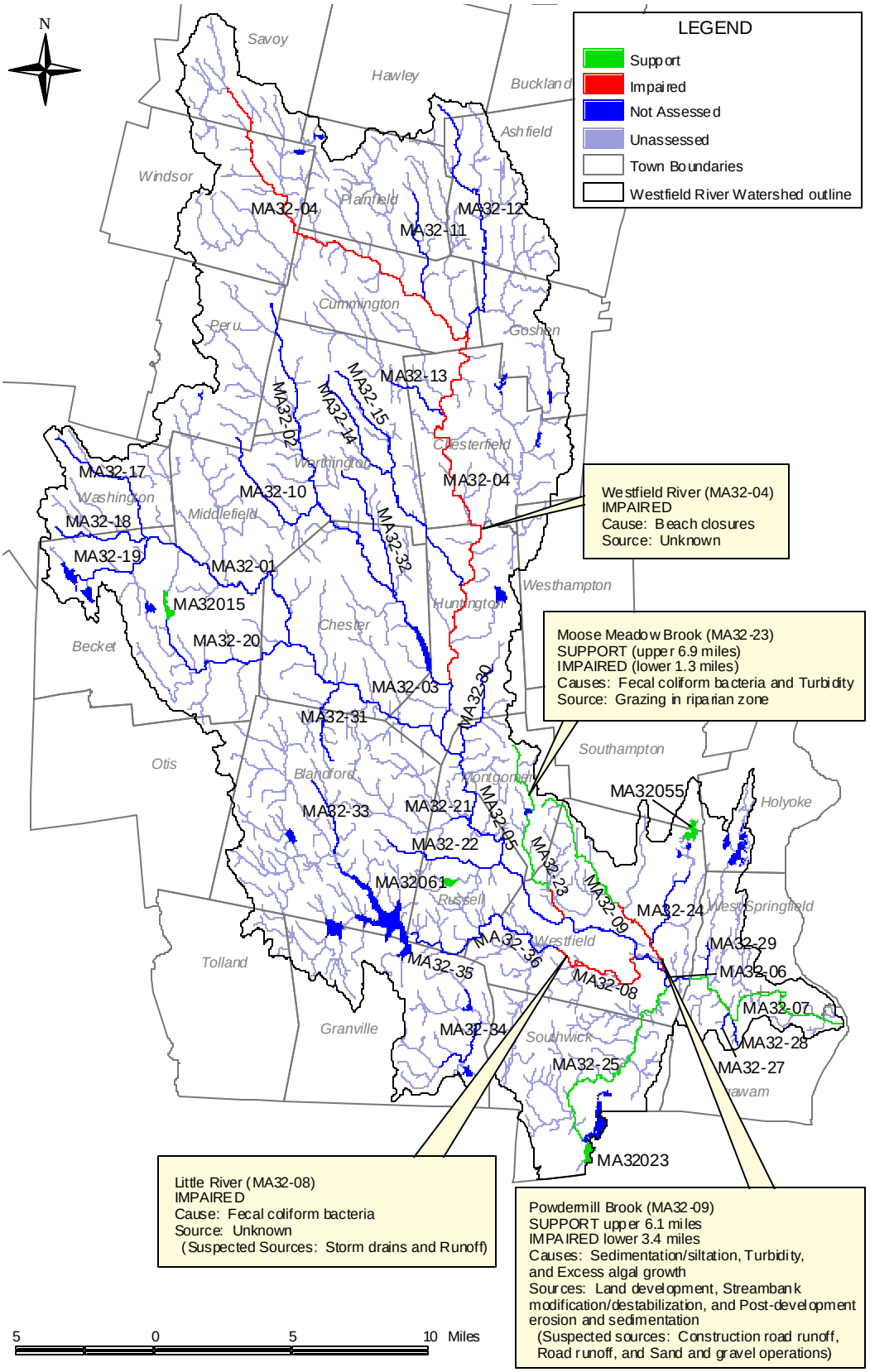

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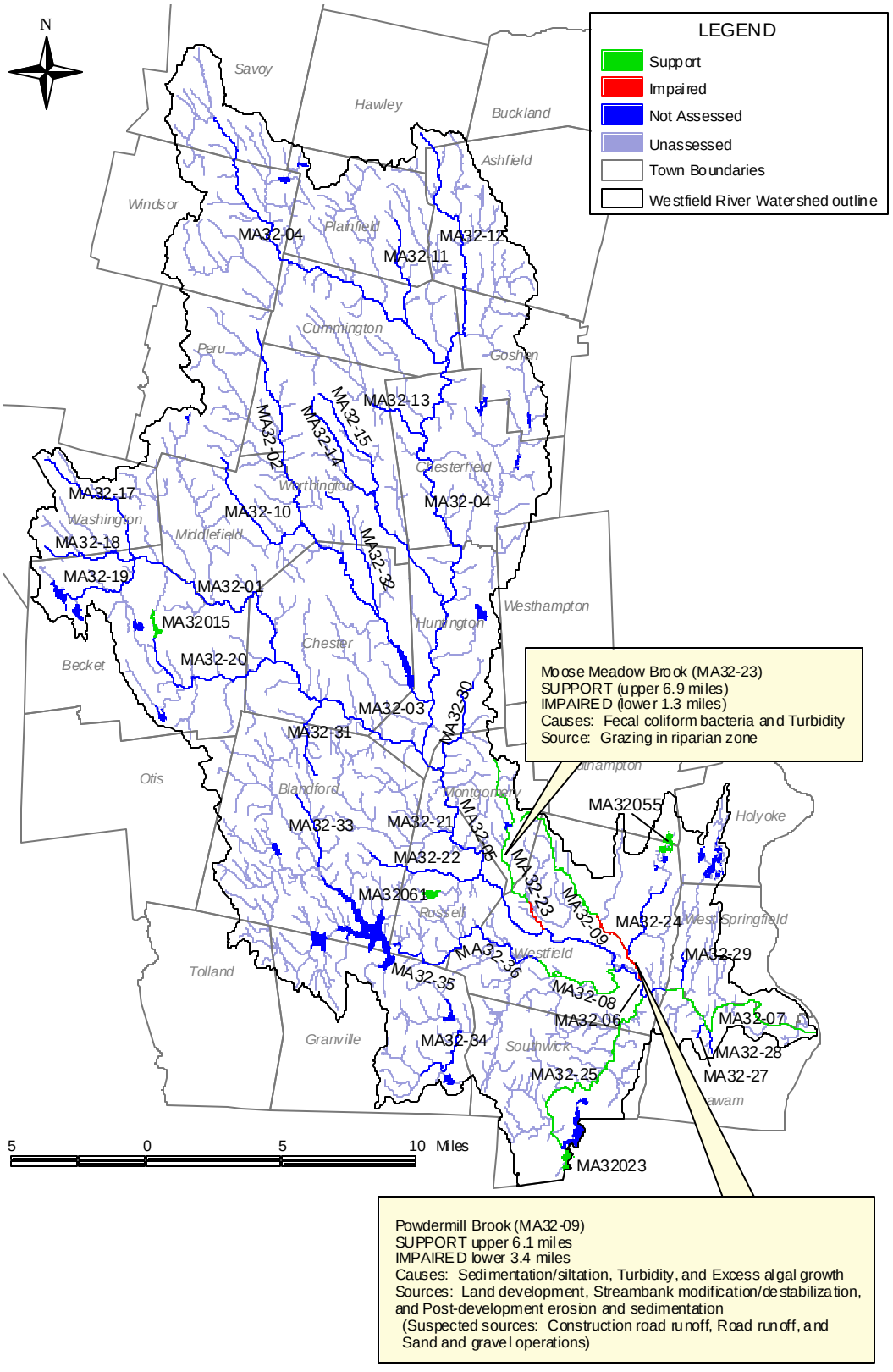
Figure 3. *Secondary Contact Recreational Use* Assessment Summary – Rivers and Lakes



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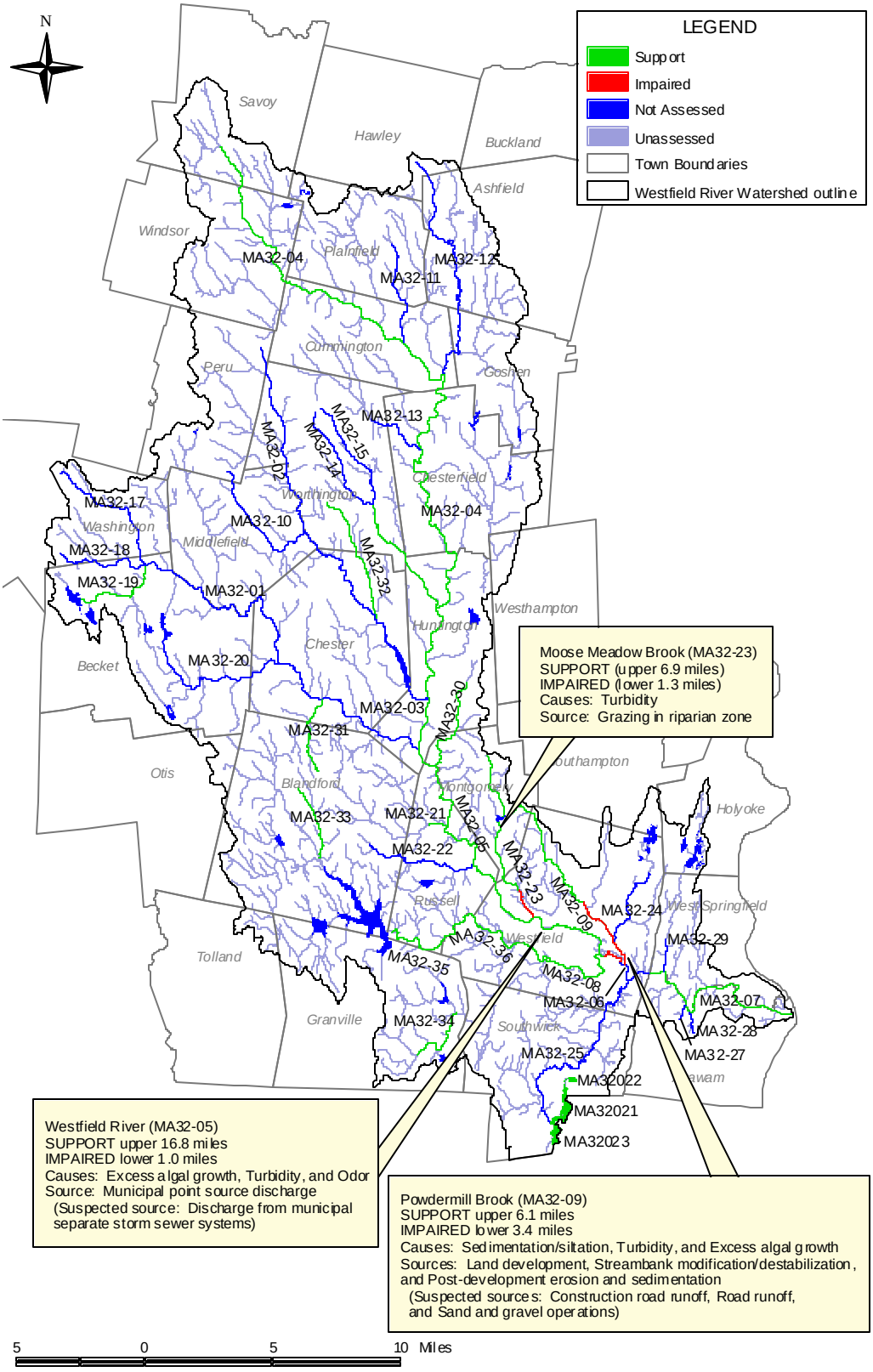
## Figure 4. *Aesthetics Use* Assessment Summary – Rivers and Lakes



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# INTRODUCTION

The Massachusetts Watershed Approach is a collaborative effort between state and federal environmental agencies, municipal agencies, citizens, non-profit groups, businesses and industries in the watershed. The mission is to improve water quality conditions and to provide a framework under which the restoration and/or protection of the watershed's natural resources can be achieved. Figure 5 illustrates the management structure to carry out the mission. This report presents the current assessment of water quality conditions in the Westfield River Watershed. The assessment is based on information that has been researched and developed by the Massachusetts Department of Environmental Protection (MA DEP) through the first three years (information gathering, monitoring, and assessment) of the five-year cycle in partial fulfillment of MA DEP's federal mandate to report on the status of the Commonwealth's waters under the Federal Water Pollution Control Act (commonly known as the Clean Water Act [CWA]).

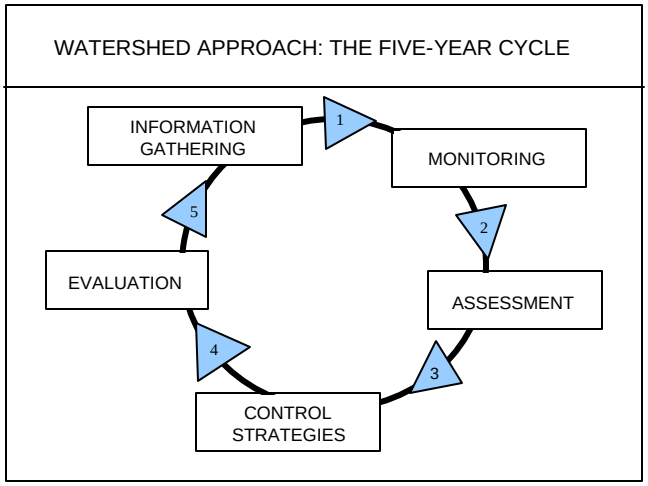



Figure 5. Five-year cycle of the Watershed Approach

The goal of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (Environmental Law Reporter 1988). To meet this objective, the CWA requires states to develop information on the quality of the Nation's water resources and report this information to the U.S. Environmental Protection Agency (EPA), the U.S. Congress, and the public. Together, these agencies are responsible for implementation of the CWA mandates. Under Section 305(b) of the Federal Clean Water Act MA DEP must submit a statewide report every two years to the EPA, which describes the status of water quality in the Commonwealth. Up until 2000 this was accomplished as a statewide summary of water quality (the 305(b) Report). States are also required to submit, under Section 303(d) of the CWA, a list of waters requiring a total maximum daily load (TMDL) calculation. In 2002, however, EPA recommended that the states combine elements of the statewide 305(b) Report and the Section 303(d) List of Waters into one "Integrated List of Waters" (EPA 2001). This statewide list is based on the compilation of information for the Commonwealth's 27 watersheds. Massachusetts has opted to write individual watershed water quality assessment reports and use them as the supporting documentation for the Integrated List of Waters. The assessment reports utilize data compiled from a variety of sources and provide an evaluation of water quality, progress made towards maintaining and restoring water quality, and the extent to which problems remain at the watershed level. In stream biological, habitat, physical/chemical, toxicity data and other information are evaluated to assess the status of water quality conditions. This analysis follows a standardized process described in the Assessment Methodology section of this report. Once the use assessments have been completed the segments are categorized for the Integrated List of Waters.

# ASSESSMENT METHODOLOGY

## WATER QUALITY CLASSIFICATION

The Massachusetts Surface Water Quality Standards (SWQS) designate the most sensitive uses for which the surface waters of the Commonwealth shall be enhanced, maintained and protected; prescribe minimum water quality criteria required to sustain the designated uses; and include provisions for the prohibition of discharges (MA DEP 1996). These regulations should undergo public review every three years. The surface waters are segmented and each segment is assigned to one of the six classes described below. Each class is identified by the most sensitive and, therefore, governing water uses to be achieved and protected. Surface waters may be suitable for other beneficial uses, but shall be regulated by the Department of Environmental Protection to protect and enhance the designated uses.

***Inland Water Classes***

1. ***Class A*** *– These waters are designated as a source of public water supply. To the extent compatible with this use they shall be an excellent habitat for fish, other aquatic life* and *wildlife, and suitable for primary and secondary contact recreation. These waters shall have excellent aesthetic value. These waters are designated for protection as Outstanding Resource Waters (ORWs) under 314 Code of Massachusetts Regulations (CMR) 4.04(3).*
2. ***Class B*** *– These waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Where designated they shall be suitable as a source of water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.*
3. ***Class C*** *– These waters are designated as a habitat for fish, other aquatic life and wildlife, and for secondary contact recreation. These waters shall be suitable for the irrigation of crops used for consumption after cooking and for compatible industrial cooling and process uses. These waters shall have good aesthetic value.*

***Coastal and Marine Classes***

4. ***Class SA*** *– These waters are designated as an excellent habitat for fish, other aquatic life and wildlife and for primary and secondary recreation. In approved areas they shall be suitable for shellfish harvesting without depuration (Open Shellfishing Areas). These waters shall have excellent aesthetic value.*
5. ***Class SB*** *– These waters are designated as a habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas they shall be suitable for shellfish harvesting with depuration (Restricted Shellfishing Areas). These waters shall have consistently good aesthetic value.*
6. ***Class SC*** *– These waters are designated as a habitat for fish, other aquatic life, and wildlife and for secondary contact recreation. They shall also be suitable for certain industrial cooling and process uses. These waters shall have good aesthetic value.*

The 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. In so doing, the states report on waterbodies within the context of meeting their designated uses (described above in each class). 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 standards: Cold Water Fishery (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).

The SWQS, summarized in Table 1, prescribes minimum water quality criteria to sustain the designated uses. Furthermore, these standards describe the hydrological conditions at which water quality criteria must be applied (MA DEP 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 most severe hydrological condition for which the aquatic life criteria must be applied shall be determined by MA DEP on a case-by-case basis.

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 organization 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, MA DEP describes its Quality System in an EPA-approved Quality Management Plan to ensure that environmental data collected or compiled by the MA DEP are of known and documented quality and are suitable for their intended use. For external sources of information MA DEP requires the following: 1) an appropriate *Quality Assurance Project Plan* including a laboratory Quality Assurance /Quality Control (QA/QC) plan, 2) use of a state certified lab (or as otherwise approved by MA DEP for a particular analysis), and 3) sample data, QA/QC and other pertinent sample handling information are documented in a citable report.

EPA provides guidelines to the States for making their use support determinations (EPA 1997, EPA 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 1) prescribe minimum water quality criteria to sustain the designated uses, numerical criteria are not available for every indicator of pollution. Best available guidance in the 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, Persaud, *et al*.). Excursions from criteria due solely to "naturally occurring" conditions (e.g., low pH in some areas) do not constitute violations of the standards.

Each designated use within a given segment is individually assessed as ***support*** or ***impaired***. When too little current data/information exists or no reliable data are available the use is ***not assessed***. In this report, however, if there is some indication of the existence of water quality impairment that is not "naturally occurring", then the use is identified with an "Alert Status". Detailed guidance for assessing the status of each use follows in the Designated Uses Section of this report. It is important to note that not all waters are assessed. Many small and/or unnamed ponds, rivers, and estuaries are currently ***unassessed***. 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 1. Summary of Massachusetts Surface Water Quality Standards (MA DEP 1996 and MA DPH 2002).

| | |
|---|---|
| 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<br>Class B Warm Water Fishery (BWWF) and Class SB: ≥5.0 mg/L and ≥60% saturation unless background conditions are lower<br>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<br>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<br>Change (Δ) allowed due to a discharge | 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.<br>Class BCWF: ≤68°F (20°C) and Δ3°F (1.7°C)<br>Class BWWF: ≤83°F (28.3°C) and Δ3°F (1.7°C) in lakes, Δ5°F (2.8°C) in rivers<br>Class C and Class SC: ≤85°F (29.4°C) nor Δ5°F (2.8°C)<br>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)<br>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.<br>Class C: 6.5 - 9.0 SU and Δ1.0 outside the naturally occurring range.<br>Class SA and Class SB: 6.5 - 8.5 SU and Δ0.2 outside the normally occurring range.<br>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.*<br>Class SA: *Waters shall be free from oil and grease and petrochemicals.*<br>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.*<br>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 1 continued. Summary of Massachusetts Surface Water Quality Standards.

| | |
|---|---|
| Bacteria (MA DEP 1996 and MA DPH 2002)<br><br>Class A criteria apply to the *Drinking Water Use*.<br><br>Class B and SB criteria apply to *Primary Contact Recreation Use* while Class C and SC criteria apply to *Secondary Contact Recreation Use*. | Class A:<br>• Fecal coliform bacteria: An arithmetic mean of <20 cfu/100mL in any representative set of samples and <10% of the samples >100 cfu/100mL.<br>Class B:<br>• 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.<br>• At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: no single *Enterococci* sample shall exceed 61 *Enterococci* /100mL and the geometric mean of the most recent five *Enterococci* samples within same bathing season shall not exceed 33 *Enterococci* /100mL.<br>• 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/100mL in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100mL. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.)<br>Class C:<br>• Fecal coliform bacteria: shall not exceed a geometric mean of 1000 cfu/100ml, nor shall 10% of the samples exceed 2000 cfu/100 mL.<br>Class SA:<br>• Fecal coliform bacteria: waters approved for open 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 43 MPN/100mL.<br>• At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: no single *Enterococci* sample shall exceed 104 *Enterococci* /100mL and the geometric mean of the five most recent *Enterococci* levels within the same bathing season shall not exceed 35 *Enterococci* /100mL.<br>• 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/100mL in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100mL. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.)<br>Class SB:<br>• Fecal coliform bacteria: in waters approved for restricted shellfish, a fecal coliform median or geometric mean (MPN method) of <88 MPN/100mL and <10% of the samples >260 MPN/100mL.<br>• At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: no single *Enterococci* sample shall exceed 104 *Enterococci* /100mL and the geometric mean of the most recent five *Enterococci* levels within the same bathing season shall not exceed 35 *Enterococci* /100mL.<br>• 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/100mL in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100mL. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.)<br>Class SC:<br>• Fecal coliform bacteria: shall not exceed a geometric mean of 1000 cfu/100mL, nor shall 10% of the samples exceed 2000 cfu/100mL. |

# 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 (MA DEP 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. In lieu of any information to the contrary, both the *Agricultural* and *Industrial* uses, where applicable, are considered by the Department to be supported.

## *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 MA DEP'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***<br>Data available clearly indicates support or minor modification of the biological community. Excursions from chemical criteria (Table 1) not frequent or prolonged and may be tolerated if the biosurvey results demonstrate support. | ***Impaired***<br>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 (Costello 2003) | Stable (No/Minimal loss), BPJ | Loss/Decline, BPJ |
| Macrophytes | BPJ | Exotic 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 (MA DEP 1996, EPA 1997) | Infrequent excursion from criteria (Table 1), BPJ (minimum of three samples representing critical period) | Frequent and/or prolonged excursion from criteria [river and shallow lakes: exceedances >10% of measurements; deep lakes (with hypolimnion): exceedances in the hypolimnetic area >10% of the surface area]. |
| pH (MA DEP 1996, EPA 1999a) | Infrequent excursion from criteria (Table 1) | Criteria exceeded >10% of measurements. |
| Temperature **(**MA DEP 1996,EPA 1997) | Infrequent excursion from criteria (Table 1)[1] | Criteria exceeded >10% of measurements. |
| Toxic Pollutants (MA DEP 1996, EPA 1999a)<br>Ammonia-N (MA DEP 1996, EPA 1999b)<br>Chlorine (MA DEP 1996, EPA 1999a) | Infrequent excursion from criteria (Table 1)<br>1.32 mg/L $NH_3$-N[2]<br>0.011 mg/L 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] [$NH_3$-N] at pH = 8.0 SU and 24°C. [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 2004a). 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."
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."

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***<br>No restrictions or bans in effect | ***Impaired***<br>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 (MA DPH 2001, MA DPH 2004a) | 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). MA DEP's Drinking Water Program has primacy for implementing the provisions of the federal Safe Drinking Water Act. 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 Safe Drinking Water Act: bacteria, volatile and synthetic organic compounds, inorganic compounds, and radionuclides. The Drinking Water Program maintains current drinking supply monitoring data. The status of the supplies is currently reported to MA DEP and EPA by the suppliers 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***<br>No closures or advisories (no contaminants with confirmed exceedances of maximum contaminant levels, conventional treatment is adequate to maintain the supply). | ***Impaired***<br>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 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/brp/dws/dwshome.htm and from the Westfield River Watershed's public water suppliers.

### *SHELLFISH HARVESTING USE*

This use is assessed using information from the Massachusetts Department of Fish and Game (MA DFG) 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***<br>SA Waters: Approved[1]<br>SB Waters: Approved[1], Conditionally Approved[2] or Restricted[3] | ***Impaired***<br>SA Waters: Conditionally Approved[2], Restricted[3], Conditionally Restricted[4], or Prohibited[5]<br>SB Waters: Conditionally Restricted[4] or Prohibited[5] |
|---|---|---|
| DMF Shellfish Project Classification Area Information | 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 the use.

| ***Variable*** | ***Support***<br>Criteria are met, no aesthetic conditions that preclude the use | ***Impaired***<br>Frequent or prolonged violations of criteria and/or formal bathing area closures, or severe aesthetic conditions that preclude the use |
|---|---|---|
| Bacteria (MA DEP 1996 and MA DPH 2002) | 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).<br><br>Other waters: Samples* collected during the primary contact season must meet criteria (Table 1).<br><br>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).<br><br>Other waters: Samples* collected during the primary contact season do not meet the criteria (Table 1). |
| Aesthetics (MA DEP 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 (minimum of 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. An impairment decision will not be based on a single sample (i.e., the geometric mean of five samples is <200 cfu/100mL but one of the five samples exceeds 400 cfu/100mL). The method detection limit will be used in the calculation of the geometric mean when data are reported as less than the method detection limit (e.g., use 20 cfu/100mL if the result is reported as <20 cfu/100mL). 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 (MA DEP 1996) | Other waters: Samples* collected must meet the Class C or SC criteria (see Table 1). | Other waters: Samples* collected do not meet the Class C or SC criteria (see Table 1). |
| Aesthetics (MA DEP 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<br><br>Transparency (MA DPH 1969)<br><br>Nuisance organisms | Narrative "free from" criteria met or excursions neither frequent nor prolonged*, BPJ.<br><br>Public bathing beach and lakes – Secchi disk depth ≥1.2 meters (≥ 4') (minimum of three samples representing critical period).<br><br>No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ. | Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged*, BPJ.<br><br>Public bathing beach and lakes - Secchi disk depth <1.2 meters (< 4') (minimum of three samples representing critical period).<br><br>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 (minimum of five samples per station recommended) over time. 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<br><br>Transparency (MA DPH 1969)<br><br>Nuisance organisms | Narrative "free from" criteria met or excursions neither frequent nor prolonged*, BPJ.<br><br>Public bathing beach and lakes – Secchi disk depth ≥1.2 meters (≥ 4') (minimum of three samples representing critical period).<br><br>No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ. | Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged*, BPJ.<br><br>Public bathing beach and lakes - Secchi disk depth <1.2 meters (< 4') (minimum of three samples representing critical period).<br><br>Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ. |

# WESTFIELD RIVER WATERSHED DESCRIPTION AND CLASSIFICATION

## WESTFIELD RIVER WATERSHED DESCRIPTION

The Westfield River Watershed drains 517 square miles from the eastern Berkshires to the Connecticut River (Figure 6). The mainstem (the upper portion sometimes referred to as the East Branch) originates in the high country of Savoy and Windsor and flows 27 miles in a southeasterly direction, where it joins the Connecticut River. The Middle Branch Westfield River begins in Peru and forms the border between Worthington and Middlefield before flowing through Chester to join the mainstem in the town of Huntington. The West Branch Westfield River, formed by the confluence of Depot and Yokum Brooks in Becket flows easterly, also meeting the mainstem in Huntington. There are a total of 850 miles of rivers, streams, and brooks and 4,200 acres of lakes and ponds in the watershed.

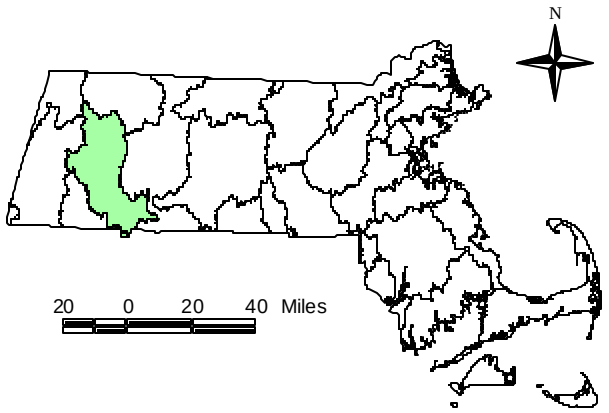


Figure 6. Location of the Westfield River Watershed

The National Park Service has designated approximately forty-three miles of the Westfield River as "Wild and Scenic". Included in this first-ever Wild and Scenic designation for a Massachusetts river are parts of the Main, Middle and West Branches.

The Westfield River Watershed is bordered by the Deerfield, Hoosic, Housatonic, Farmington and Connecticut River watersheds and is contained almost entirely within Massachusetts. The watershed covers all or a part of twenty-eight municipalities: Agawam, Ashfield, Becket, Blandford, Chester, Chesterfield, Cummington, Goshen, Granville, Hawley, Holyoke, Huntington, Middlefield, Montgomery, Otis, Peru, Plainfield, Russell, Savoy, Southampton, Southwick, Tolland, Washington, Westhampton, Westfield, West Springfield, Windsor, and Worthington.

Because the headwaters originate in mountains with little soil to retain water the Westfield River rises quickly in response to large storms and snowmelt. After those flows subside little water is left for base flows. Consequently, the river naturally fluctuates between high and low flows. Both the mainstem Westfield River and the Middle Branch Westfield River have U.S. Army Corps of Engineer dams to alleviate some of the danger of flooding. Several water supply reservoirs capture spring runoff, storing it for use throughout the year. Cobble Mountain in Blandford, Littleville in Huntington, and Bearhole in Westfield are the largest reservoirs. The lower reaches of the Westfield River flow through a broad valley filled with stratified drift, forming the Barnes Aquifer, a major groundwater resource that stretches from Holyoke to Southwick.

The upper portion of the watershed is rural. Timber harvesting and agricultural activities dominate the landuse. The lower portion of the watershed is more developed and includes the heavily urbanized areas of Agawam, West Springfield, and Westfield.

The Westfield River Watershed supplies surface water to seven public water supply systems (12 withdrawal sites) and three industrial users (four withdrawal sites) and groundwater to four of the seven municipal supply systems.

During the settlement of the watershed hydropower, available from the Westfield River, and an abundance of raw materials fueled industrial development. The major historic mill sites are still industrial sites even though hydropower has diminished in importance. In the past, sewage and industrial discharges greatly impacted the water and habitat quality of the lower mainstem Westfield River.

The Westfield River Watershed is divided into 35 segments, with sub-basins ranging in size from 0.3 to 516 square miles (with an average of 66 square miles). The impervious cover for these sub-basins was calculated into one of three impact categories as defined below. Only one sub-basin segment was classified as a moderate threat (impacted stream) to water quality: White Brook, MA32-28. All 34 other sub-basin segments were classified as low potential impact (sensitive stream) to water quality.

Research has indicated a strong correlation exists between percent impervious cover and water quality (Center for Watershed Protection 1998). Impervious cover influences streams by increasing surface runoff during storm events. In natural settings, very little annual rainfall is converted to runoff and about half is infiltrated into the ground and water table. This water is filtered by the soils and serves to supply aquifers and adjacent surface waters with clean water during dry periods. In urbanized areas less annual rainfall infiltrates and more volume is converted to runoff. The volume of runoff becomes greater and occurs more frequently and at higher magnitudes. As a result less water is available to streams during dry periods and more flow occurs during storms. Impervious cover can be a very useful indicator with which to measure the impacts of land development on aquatic systems. It can also serve as an indicator of potential problems in a watershed. The Rapid Watershed Planning Handbook (Center for Watershed Protection 1998) has defined the following three impact categories based on the percentage of impervious cover.

| Water Quality | Impervious Cover | Description |
|---|---|---|
| Sensitive Stream | 0-10% | ❖ High habitat/water quality rating characterized by stable channels and good habitat structure with diverse communities of fish and aquatic insects.<br>❖ Hydrologic regime is consistent with natural conditions.<br>❖ Species sensitive to pollution are within normal abundance ranges. |
| Impacted Stream | 11-25% | ❖ Some decline in habitat and water quality is evident.<br>❖ Erosion and stream channel widening become evident.<br>❖ Sensitive fish and aquatic insects begin to drop in overall numbers.<br>❖ Water quality is classified as fair or good. |
| Nonsupporting Stream | Exceeds 25% | ❖ Stream channels become highly unstable, severe widening occurs. Down-cutting and streambank erosion are chronic problems.<br>❖ Biological quality is relatively poor with only pollutant tolerant species existing within its reaches.<br>❖ Water quality is considered fair to poor.<br>❖ Not a candidate for stream restoration |

**WESTFIELD RIVER WATERSHED CLASSIFICATION**

Consistent with the National Goal Uses of "fishable and swimmable waters", the classification of waters in the Wesfield River Watershed according to the Massachusetts Surface Water Quality Standards (SWQS) include the following (MA DEP 1996a).

***Class A Waters***

These waters are designated as a source of public water supply. To the extent compatible with its use they shall be an excellent habitat for fish, other aquatic life and wildlife, and suitable for primary and secondary contact recreation. These waters shall have excellent aesthetic value. All Class A waters are designated for protection as ORWs under 314 CMR 4.04(3) (Rojko *et al.* 1995).

In the Westfield River Watershed, the following waterbodies are classified as A.

- *Middle Branch Westfield River,* source in Peru to the Littleville Dam in Huntington
- *Long Pond (Tucker Healy Pond, Lincoln Pond),* source to outlet in Blandford and those tributaries thereto
- *Unnamed Reservoir (Austin Brook Reservoir),* source to outlet in Chester and those tributaries thereto
- *Horn Pond,* Source to outlet in Becket and those tributaries thereto
- *Huntington Reservoir (Cold Brook Reservoir),* source to outlet in Huntington and those tributaries thereto
- *Russell Reservoir,* source to outlet in Russell and those tributaries thereto
- *Bearhole Reservoir (Prudy's Pond),* source to outlet in West Springfield and those tributaries thereto
- *Granville Reservoir,* source to outlet in Granville and those tributaries thereto
- *Cobble Mountain Reservoir,* source to outlet in Blandford and those tributaries thereto

- *Ashley Pond (Wrights Pond, Cedar Reservoir),* source to outlet and those tributaries thereto in Holyoke
- *McLean Reservoir,* source to outlet in Holyoke and those tributaries thereto
- *Wright Pond,* source to outlet in Holyoke and those tributaries thereto
- *Unnamed Reservoir (Black Brook Reservoir),* Reservoir to outlet in Blandford and those tributaries thereto

It should also be noted that MA DEP's Division of Water Supply has recommended that the Little River, and its tributaries, from the source at outlet of Cobble Mountain Reservoir Dam in Russell to a dam northwest of Gorge Road, Russell be reclassified from Class B to a Class A public water supply waterbody in the next revision of the SWQS.

The designation of ORW is applied to those waters with exceptional socio-economic, recreational, ecological and/or aesthetic values. ORWs have more stringent requirements than other waters because the existing use is so exceptional or the perceived risk of harm is such that no lowering of water quality is permissible. ORWs include certified vernal pools (CVP), all designated Class A Public Water Supplies, and may include surface waters found in National Parks, State Forests and Parks, Areas of Critical Environmental Concern (ACEC) and those protected by special legislation (MA DEM 1993). Wetlands that border ORWs are designated as ORWs to the boundary of the defined area. In the Westfield River Watershed one ACEC has been designated in the western edge of the watershed – The Hindsdale Flats Watershed in Dalton, Hinsdale, Peru, and Washington (MA DCR 2003a). Officially designated as an ACEC on 31 January 1992, it encompasses approximately 14,500 acres and is bordered by the Appalachian National Scenic Trail on its western edge. The following is excerpted from the MA DCR website (MA DCR 2003a).

> The Hinsdale Flats Watershed ACEC covers approximately 14,500 acres and is located at the headwaters of the East Branch of the Housatonic River in four communities in central Berkshire County. The ACEC is generally defined by several watershed subbasins that contribute to the northward-flowing headwaters of the East Branch of the Housatonic above the Old Grist Mill Dam in the town of Hinsdale. Beginning in the town of Washington, the East Branch flows through extensive wetlands and floodplains known as the Hinsdale Flats. Tributary streams flow into the Flats and East Branch from higher elevations and ridges to the east, west, and south. The Appalachian National Scenic Trail forms the western boundary of the ACEC. The unique topography and contrasting land forms provide scenic vistas of the lowlands of the Flats and the predominantly wooded uplands that surround it. Open fields and farmlands, extensive forestlands, and historic and archaeological resources are integral parts of the ACEC. The excellent water quality of the East Branch and its tributaries, the wetlands and floodplains of the Hinsdale Flats, and the surrounding uplands support an outstanding variety of natural communities and wildlife, including six state-listed rare species.

Vernal pools are small, shallow ponds characterized by lack of fish and by periods of dryness. Vernal pool habitat is extremely important to a variety of wildlife species including some amphibians that breed exclusively in vernal pools, and other organisms such as fairy shrimp, which spend their entire life cycles confined to vernal pool habitat. Many additional wildlife species utilize vernal pools for breeding, feeding and other important functions. Certified vernal pools are protected if they fall under the jurisdiction of the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00). Certified vernal pools are also afforded protection under the state Surface Water Quality Standards, the state Water Quality Certification regulations (401 Program), the state Title 5 regulations, and the Forest Cutting Practices Act regulations. However, the certification of a pool only establishes that it functions biologically as a vernal pool. Certification does not determine that the pool is within a resource area protected by the Wetlands Protection Act (NHESP 1999). Currently 53 vernal pools have received full certification in the Westfield River Watershed (Harding 2003). These are located in the towns of Agawam, Becket, Cummington, Holyoke, Huntington, Southwick, Westfield, and West Springfield. Additional information is available from the Natural Heritage and Endangered Species Program Website: http://www.mass.gov/dfwele/dfw/nhesp/nhesp.htm

***Class B Waters***

These waters are designated as habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation. Where designated they shall be suitable as a source of water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.

In the Westfield River Watershed, the following waterbodies are classified as B Cold Water Fisheries.

- *Westfield River*, source to confluence with Middle Branch Westfield River (this reach is sometimes referred to as the East Branch Westfield River)
- *West Branch Westfield River*, source to confluence with Westfield River

In the Westfield River Watershed, the following waterbodies are classified as B Warm Water Fisheries.

- *Middle Branch Westfield River*, Littleville Dam to confluence with the Westfield River
- *Westfield River*, from confluence with Middle Branch Westfield River to confluence with Connecticut River
- *Little River*, Cobble Mountain Reservoir Dam to confluence with Westfield River
  (Note: The MA DEP/Division of Water Supply has recommended that the Little River and its tributaries from the Cobble Mountain Reservoir Dam, Russell to a dam northwest of Gorge Road, Russell be reclassified from Class B to a Class A public water supply waterbody in the next revision of the SWQS.)

Unlisted waters in the Westfield River Watershed not otherwise designated in the SWQS are designated *Class B, High Quality Waters* for inland waters. According to the SWQS where fisheries designations are necessary they shall be made on a case-by-case basis. The Massachusetts Department of Fish and Game has recommended that an additional 55 rivers in the Westfield River Watershed be reclassified as Cold Water Fisheries in the next revision of the SWQS.

## SUMMARY OF HISTORICAL CONDITIONS AND PERCEIVED PROBLEMS

Many improvements in water quality conditions in the Westfield River Watershed have occurred over the past 30 years with the abatement of point sources of pollution (MA DEQE 1986 and MA DEP 1990). The 1970's saw construction upgrades to secondary treatment levels of domestic sewage in the towns of Huntington, Russell, and Westfield. Additionally, wastewater treatment facilities were constructed and began operation at four major paper companies and one metal finishing industry. The 1990's revealed even more change including: the closing of most of the paper industries and the metal finishing industry, as well as the continued upgrades and expansion of the three municipal sewage treatment facilities, and the construction upgrade and removal of all the Combined Sewer Overflow discharges in Westfield, Agawam and West Springfield. According to the Commonwealth of Massachusetts Summary of Water Quality 1992, Appendix I: Basin/Segment Information, water quality impairment in the Westfield River Watershed was due primarily to the presence of bacteria as measured by elevated fecal coliform levels (MA DEP 1993). Sources of these contaminants when known included urban runoff, onsite wastewater systems, municipal point sources, and combined sewer overflows. The present decade is witnessing a further upgrade and expansion of capacity at the Westfield WWTP. All of these 1990 to present events should lead to a substantial improvement in overall water quality on the mainstem Westfield River from its confluence with the Middle Branch Westfield River in Huntington to its confluence with the Connecticut River in West Springfield/Agawam.

There are an estimated 112 dams in the Westfield River Watershed (Pietrzak 2004). Included in this list are the two Army Corps of Engineers (ACOE) facilities (Knightville Dam and Littleville Lake Dam), two Federal Energy Regulatory Commission (FERC) facilities (Woronoco and Decorative Specialties International (DSI) West Springfield) and one FERC exempt hydro-generating facility (Texon, USA).

The USGS, as part of their National Water Quality Assessment (NAWQA) Program in the Connecticut, Housatonic, and Thames River Basins Study Unit, conducted water quality sampling in the Connecticut River Basin between 1992 and 1995. In the Westfield River Watershed, sampling was conducted on 27 June 1994 as part of the NAWQA program to detect concentrations of pesticides in the water column at one site on the Westfield River near Westfield MA (USGS Station # 01183500) (Zimmerman 1999).

Within the last decade, the northeastern United States has been identified as receiving elevated rates of mercury deposition from the atmosphere and high levels of mercury contamination in non-commercial freshwater fish (Tatsutani 1998). Mercury is a trace metal that exists in the earth's crust. It is a toxicant that, once mobilized in the environment, can be transformed into methylmercury, a particularly toxic form that can bioaccumulate. Most of the mercury contamination in the northeastern United States has been

linked to air emissions (incinerators, fossil fuel combustion facilities) from both local and mid-western sources. Fish and sediment from a total of five lakes in the Westfield River Watershed were sampled in 1994 as part of a research and development study on mercury contamination developed by the Department's Office of Research and Standards (ORS) (Rose *et al*. 1999). The five lakes sampled in the Westfield River Watershed as part of the mercury contamination study included Ashley Pond (Holyoke), Crooked Pond (Plainfield), and Buckley-Dunton Lake, Center Pond and Yokum Pond, (Becket). Currently there are no site-specific MA DPH fish consumption advisories for any waterbodies in the Westfield River Watershed. It should be noted, however, that the statewide fish consumption advisory is in effect (see Fish Consumption Use assessment guidance, page 8).

## SOURCES OF INFORMATION

Multiple local, private, state and federal agencies provided information used in the water quality assessment of the Westfield River Watershed. Within MA DEP information was obtained from three programmatic bureaus: Bureau of Resource Protection (BRP), Bureau of Waste Prevention (industrial wastewater discharge information) and the Bureau of Waste Site Cleanup (hazardous waste site cleanup information). Specifically, water quality, biological (including benthic macroinvertebrate and periphyton), fish toxics, and lake data were provided by BRP's Division of Watershed Management (DWM) Watershed Planning Program (Appendices A, B, C, D, E, F and G). Water withdrawal and wastewater discharge permit information were provided by MA DEP staff in the Boston and Western Regional Offices, as well as the DWM Watershed Permitting Program (Appendix H). [Note: the BRP DWM Drinking Water Program evaluates the status of the *Drinking Water Use* and this information is, therefore, not provided in this assessment report.]

**NPDES PERMITTED DISCHARGES**

The Westfield River and several of its tributaries receive discharges of treated and municipal and industrial wastewater, contact and non-contact cooling water, etc. (Appendix H, Tables H1-H3). A large number of industrial and paper production facilities are either no longer in operation or have tied their wastewater into the Westfield WWTP. In 1980 the list of these dischargers totaled nearly 20 facilities and at least six were major dischargers (MA DEQE 1975). The following types of National Pollutant Discharge Elimination System (NPDES) discharges occur in the Westfield River Watershed.
*Municipal wastewater treatment plants and sanitary wastewater discharges* (Table H1):

- Huntington WWTP, Huntington (MA0101265) discharges to Westfield River (Segment MA32-05).
- Russell Village POTW, Russell (MA0100960) discharges to Westfield River (Segment MA32-05).
- Woronoco Village POTW, Russell (MA0103233) discharges to Westfield River (Segment MA32-05).
- Westfield WWTP, Westfield (MA0101800) discharges to Westfield River (Segment MA32-05).
- The Maples, Worthington (MA0027871) discharges to Wards Stream (Segment MA32-15).
- Renaissance Manor (formerly known as Valley View Nursing Home), Southwick (permit pending), discharges to Westfield River (MA32-06).

*Industrial wastewater treatment plants and non-process discharges* (Table H2):

- Texon USA, Russell (MA0005282) discharges process wastewater, floor drainage, and non-contact cooling water to the Westfield River (Segment MA32-05).
- Northeast Utilities, Westfield (MA0035556) discharges turbine bearing cooling water, and non-contact cooling water to the Little River (MA32-36).

*NPDES General Permits* (Table H2):

- Austin Brook Reservoir Slow Sand Water Filtration Plant (MAG640035) discharges sand media filtered water to Austin Brook Reservoir and Walker Brook (Segment MA32-20)
- City of Springfield, Water Treatment Plant (MAG640023) discharges filter backwash to Cooks Brook (not a segment).
- City of Westfield, Water Treatment Plant (MAG640001) discharges effluent to Jack's Brook (not a segment).
- Jen-Coat Inc. (MAG250856) discharges non-contact cooling water to the Westfield River (Segment MA32-05).

The NPDES Phase II General Permit Program requires NPDES permit coverage for stormwater discharges from small municipal separate storm sewer systems (MS4s) and construction activity disturbing one acre or more of land in a mapped "urbanized area" defined and delineated by the US Bureau of Census in 2000 http://www.epa.gov/npdes/pubs/fact2-2.pdf. Large and medium MS4s were permitted during Phase I of the NPDES stormwater program. Under EPA's Phase II program the definition of "municipal" includes Massachusetts communities, U.S. military installations, state or federal owned facilities such as hospitals, prison complexes, state colleges or universities and state highways. An MS4 is a system that: discharges at one or more point sources, is a separate storm sewer system (not designed to carry combined stormwater and sanitary waste water), is operated by a public body; discharges to the Waters of the United States or to another MS4, and is located in an "*Urbanized Area*". The NPDES Phase II General Permit requires operators of regulated MS4s to develop and implement a stormwater management program that prevents harmful pollutants from being washed or dumped directly into the storm sewer system, which is subsequently discharged into local waterbodies. Certain Massachusetts communities were automatically designated (either in full or part) by the Phase II Rule based on the urbanized area delineations from the 2000 U.S. Census (Table H3).

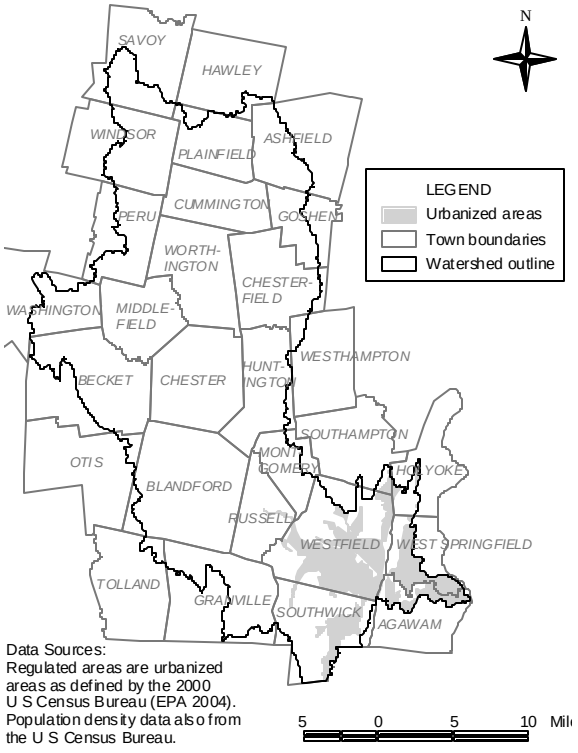



Figure 7. Phase II Regulated Area Map of the Westfield River Watershed.

With respect to the MS4 communities in the Westfield River Watershed, six communities are required to have coverage: Westfield, Southampton, Southwick, Holyoke, Agawam, and West Springfield. One other community, Russell, received a waiver from EPA from being required to have coverage (Domizio 2004) (Figure 7 and Appendix H, Table H3). All of these communities applied to EPA and MA DEP for coverage under the Phase II stormwater general permit, issued on 1 May 2003. Municipalities that are totally regulated must implement the requirements of the Phase II permit in the entire town, while communities that are partially regulated need to comply with the Phase II permit only in the mapped Urbanized Areas (see http://www.epa.gov/region01/npdes/stormwater/ma.html for detailed maps for each community). Stormwater general permits will be issued jointly by EPA and MA DEP after administrative review by EPA. A thorough review of the communities' stormwater management program will be completed by EPA, in coordination with MA DEP, during the five year permit term. Annual reports will be submitted to EPA and MA DEP by the permittees. Phase II stormwater g neral permits will expire on 1 May 2008 (Domizio 2004). This report does not have information on the other municipal (i.e., non-community) MS4s that may be in the Westfield River Watershed and are regulated under the NPDES Stormwater Phase II permit program.

**NPDES TOXICITY TESTING DISCHARGE MONITORING REPORTS (DMRS)**

All four of the municipal wastewater treatment plants in the Westfield River watershed, as well as several of the industrial and institutional dischargers, submit toxicity reports to EPA and MA DEP as required by their NPDES permits. Data from these toxicity reports are maintained by DWM in a database entitled "Toxicity Testing Data - TOXTD". Information from the reports includes: survival of test organisms exposed to ambient river water (used as dilution water), physiochemical analysis (e.g., hardness, alkalinity, pH, total suspended solids) of the dilution water, and the whole effluent toxicity test results. Data from reports submitted by these facilities were reviewed and summarized (ranges) for use in the assessment of current water quality conditions in the Westfield River Watershed. These include:

- Huntington Wastewater Treatment Facility (MA0101265) – November 1998 to May 2004
- Russell Wastewater Treatment Facility (MA0100960) – November 1998 to May 2004
- Russell Woronoco Village Treatment Facility (MA0103233) – September 1999 to September 2003
- Texon USM Corporation (MA0005282) – January 2000 to March 2004
- The Maples (formerly Worthington Senior Housing), (MA0027871) – October 1998
- Westfield Wastewater Treatment Facility (MA0101800) – May 2000 to March 2004

**HYDROPOWER**

There are two Federal Energy Regulatory Commission (FERC) licensed hydroelectric plants in the Westfield River Watershed (Kubit 2004).

- Woronoco Hydro LLC is licensed (April 2002) to operate the Woronoco Hydroelectric Project (2631) on the Westfield River (Segment MA32-05) as a run-of-river project. The project can generate 2,700 kWh.
- A&D Hydro is licensed (October 1994) to operate the West Springfield Hydroelectric (2608) on the Westfield River (Segment MA32-07) as a run-of-river project. The project can generate 1.4 megawatt hours.

There is one FERC-exempt licensed hydroelectric plant in the Westfield River Watershed. Exemptions are granted for small hydroelectric projects that meet certain characteristics and have a generating capacity of less than 5 megawatts. While the exemptions are granted in perpetuity, under Article #2 of the exemption, the projects must comply with any terms and conditions that any federal or state fish and wildlife agency has determined are appropriate to prevent the loss of or damage to fish or wildlife resources or otherwise to carry out the purposes of the Fish and Wildlife Conservation Act.

- The Littleville Power Company Inc. is licensed to operate the Crescent Hydroelectric Project (Texon Project) (2986) on the Westfield River (Segment MA32-05) as a run-of-river project. The project can generate 1,500 kW.

There is one application for a FERC-exempt licensed hydroelectric plant for the Westfield River.

- The Indian River Power Supply LLC has submitted an application (12462-000-MA) to FERC to operate a run-of-river project on the Westfield River at the Westfield River Paper Company Dam in Russell. The facility would be cable of generating 700 kWh and if projects improvements were made up to 1,500 kWh.

Hydropower projects at the two ACOE flood control dams (Littleville Lake Dam and Knightville Dam) are not permitted to generate. Additionally, there is one FERC non-jurisdictional hydropower project, Cobble Mountain Station, on the Little River owned by the Springfield Water and Sewer Commission in Granville, MA (downstream from Cobble Mountain Reservoir). There are three water wheel generators with a total rating of 30.6 megawatts.

**WATER WITHDRAWALS**

A list of registered and permitted Water Management Act (WMA) withdrawals (both public water suppliers and other industrial users) is provided in Appendix H, Table H7 (LeVangie 2002).

**WATER QUALITY**

In addition to instream water quality data generated by DWM staff (provided in the technical appendices to this report) projects funded through various MA DEP grant and loan programs also provide valuable information that may be used in the water quality assessment report. A summary of these projects for the Westfield River Watershed is provided in Appendix I.

Other state agencies contributing information to this report include: the Massachusetts Department of Public Health (MA DPH), the Department of Fish and Game (MA DFG, formerly the Department of Fisheries, Wildlife, and Environmental Law Enforcement), and the Department of Conservation and Recreation (MA DCR, formerly the Department of Environmental Management, MA DEM). Federal agencies contributing include the Environmental Protection Agency (EPA), United States Geological Survey (USGS), and the United States Army Corps of Engineers (ACOE).

MA DFG's Division of Fisheries and Wildlife (MDFW) conducted electrofishing (backpack, barge, boat) surveys in the Westfield River Watershed in the summer/fall of 2001. A summary of the fish collected (using common names) is summarized in the segments where they were sampled. A list of common and scientific names for the species collected in the Westfield River Watershed are given below.

| Common Name | Scientific Name |
|---|---|
| American eel | *Anguilla rostrata* |
| Atlantic salmon | *Salmo salar* |
| Banded sunfish | *Enneacanthus obesus* |
| Black crappie | *Pomoxis nigromaculatus* |
| blacknose dace | *Rhinichthys atratulus* |
| Bluegill | *Lepomis macrochirus* |
| Bridle shiner | *Notropis bifrenatus* |
| Brook trout | *Salvelinus fontinalis* |
| Brown bullhead | *Ameiurus nebulosus* |
| Brown trout | *Salmo trutta* |
| Chain pickerel | *Esox niger* |
| Common carp | *Cyprinus carpio* |
| Common shiner | *Notropis cornutus* |
| Creek chub | *Semotilus atromaculatus* |
| Fallfish | *Semotilus corporalis* |
| Golden shiner | *Notemigonus crysoleucas* |
| Green sunfish | *Lepomis cyanellus* |
| Lake chub | *Couesius plumbeus* |
| Largemouth bass | *Micropterus salmoides* |
| Longnosed dace | *Rhinicthys cataractae* |
| Pumpkinseed | *Lepomis gibbosus* |
| Rainbow trout | *Oncorhynchus mykiss* |
| Redbreast sunfish | *Lepomis auritus* |
| Redfin pickerel | *Esox americanus americanus* |
| Rock bass | *Ambloplites rupestris* |
| Sea Lamprey | *Petromyzon marinus* |
| Slimy sculpin | *Cottus cognatus* |
| Smallmouth bass | *Micropterus dolomieu* |
| Spottail shiner | *Notropis hudsonius* |
| Tesselated darter | *Etheostoma olmstedi* |
| White sucker | *Catostomus commersoni* |
| Yellow bullhead | *Ameiurus natalis* |
| Yellow perch | *Perca flavescens* |

The ACOE New England District owns and operates fourteen flood control projects throughout the Connecticut River Basin, including two projects in the Westfield River Basin: Knightville Dam on the mainstem Westfield River (see details in Segment MA32-04), and Littleville Lake Dam on the Middle Branch Westfield River (see Segment MA32-02) (ACOE 2003). The Knightville Dam Project includes a dry bed lake, which when filled has a lake surface area of 960 acres. The Littleville Dam Project includes Littleville Lake, which when filled to capacity has a lake surface area of 510 acres.

The goals of the ACOE reservoir water quality management program, established in 1982, are: to protect public health and safety, to meet State water quality standards, to maintain the water quality necessary to meet individual project goals, and to identify the impacts of the projects on water quality (Barker 1998). Activities conducted under the Reservoir Water Quality and Maintenance Program between 2000 and 2002 included: routine bacteria and other water quality parameter monitoring of wells and/or public water supply wells at both projects; and priority pollutant scans in sediment samples (analyses included metals, PCB's, pesticides, semi- volatile organic compounds, dioxins and furans, grain size, and TOC) (Barker 2003 and Barker 2004). Overall, levels of EPA priority pollutants at these two Westfield River Watershed projects were low, and indicative of natural background conditions. No substances were in high enough concentrations to pose a risk to humans or interfere with uses of the projects or their waters. Routine bacteria testing of all wells found no significant levels of contaminants. The Knightville and Littleville Lake Dam Projects are considered by the ACOE to be Class I projects (i.e., they do not have significant water quality problems) based on previous ACOE New England District water quality reports, state water quality reports, changes between inflow and discharge water quality, frequency of violation of water quality criteria, and the presence/absence of a conservation pool (Barker 2000).

In August 2001, the Massachusetts "Beach Bill" was enacted (MGL. C111. S5S). This act created minimum standards for public bathing waters adjacent to any public or semi-public bathing beach in the Commonwealth. A "public bathing beach" is defined as a beach open to the general public whether or not any entry fee is charged that permits access to bathing waters. A "semi-public bathing beach" is defined as a bathing beach used in connection with a hotel, motel, trailer park, campground, apartment house, condominium, country club, youth club, school, camp, or similar establishment where the primary purpose of the establishment is not the operation of the bathing beach, and where admission to the use of the bathing beach is included in the fee paid for use of the premises. A semi-public bathing beach shall also include a bathing beach operated and maintained solely for the use of members and guests of an organization that maintains such bathing beach. Under the Beach Bill, the Massachusetts Department of

Public Health (MA DPH) was directed to establish minimum uniform water quality standards for coastal and inland beach waters as well as determining the frequency and location of testing, reporting requirements, and requirements for notifying the public of threats to human health or safety. *105 CMR 445.000: Minimum Standards for Bathing Beaches (State Sanitary Code, Chapter VII)* outlines MA DPH's guidelines for the Beach Bill and is available online at http://www.mass.gov/dph/dcs/bb4_01.pdf. Additionally, under the Beach Bill and MA DPH guidelines, local boards of health and state agencies are responsible for collecting samples from public beaches using testing procedures consistent with the American Public Health Association's *Standard Methods for Examination of Water and Waste Water* or methods approved by EPA. Operators of semi-public beaches are responsible for the costs of testing their beaches. Results of testing, monitoring, and analysis of public and semi-public beaches must be submitted in an annual report to MA DPH by 31 October of each year (MA DPH 2002b).

In addition to state and federal agencies, regional and local groups provide information for the watershed management process, which may be used to indicate areas of both high and degraded water quality, as well as causes and sources of contamination. The principal regional planning association in much of the watershed is the Pioneer Valley Regional Planning Commission, located in West Springfield. In the past two decades this organization has facilitated many water quality related projects that have enhanced conditions in the watershed. The Westfield River Watershed Association, located in Westfield, has been involved in citizen monitoring efforts and river enhancement efforts associated with the State's Wild and Scenic Rivers Designation Program in the 1990s (Banks 2004). Westfield State College in Westfield has had an active volunteer monitoring program, focusing on spring-summer stream temperature monitoring efforts on the mainstem Westfield River and tributaries. The Trout Unlimited, Pioneer Valley Chapter in Westfield, has held many activities related to fisheries enhancement throughout the watershed. Other organizations concerned with water quality include: Big Pond Association in Chester and Citizens Restoring Congamond Lakes, Inc. in Southwick.

## MASSACHUSETTS YEAR 2002 INTEGRATED LIST OF WATERS

Section 305(b) of the CWA defines the process whereby states monitor and assess the quality of their surface and groundwater and report on the status of those waters every two years. Section 303(d) of the CWA requires states to periodically identify and list those waterbodies for which existing controls on point and nonpoint sources of pollutants are not stringent enough to attain or maintain compliance with applicable surface water quality standards. Through the year 2000 the MA DEP fulfilled the 305(b) and 303(d) reporting requirements in two completely separate documents. In 2001 the EPA released guidance that provided states with the option of preparing a single Integrated List of Waters to be submitted in 2002 that would meet the reporting requirements of both sections 305(b) and 303(d) of the CWA.

The Massachusetts Year 2002 Integrated List of Waters was published by the MA DEP in September 2003 (MA DEP 2003a). In that report each waterbody segment was placed in one of five major categories. Category 1 included those waters that were meeting all designated uses. No Massachusetts waters were listed in Category 1 because a state-wide health advisory pertaining to the consumption of fish precludes any waters from being in full support of the fish consumption use. Waters listed in Category 2 were found to support some of the uses for which they were assessed but other uses were unassessed. Finally, Category 3 contained those waters for which insufficient or no information was available to assess any uses.

Waters exhibiting impairment for one or more uses were placed in either Category 4 (impaired but not requiring a Total Maximum Daily Load (TMDL) report) or Category 5 (impaired and requiring one or more TMDLs) according to the EPA guidance. Category 4 was further divided into three sub-categories – 4A, 4B and 4C – depending upon the reason that TMDLs were not needed. Category 4A included waters for which the required TMDL(s) had already been completed and approved by the EPA. However, since segments could only appear in one category waters that had an approved TMDL for some pollutants, but not others, remained in Category 5. Category 4B was to include waters for which other pollution control requirements were reasonably expected to result in the attainment of the designated use before the next listing cycle (i.e., 2004). Because of the uncertainty related to making predictions about conditions in the future the MA DEP made a decision not to utilize Category 4B in the 2002 Integrated List. Finally, waters impaired by factors, such as flow modification or habitat alteration, that are not subjected to TMDL

calculations because the impairment is not related to one or more pollutants were included in Category 4C. Table 2 identifies those waterbodies in the Westfield River Watershed that were included on this list in Category 4C.

Table 2. Massachusetts Category 4c Waters, impairment not caused by a pollutant, Westfield River Watershed (MA DEP 2003a).

| Name (Segment) | Location | Cause of Impairment |
|---|---|---|
| Little River (MA32-26) | Source at outlet of Cobble Mountain Reservoir Dam, Blandford to Horton's Bridge, Westfield | Flow alteration |
| Blair Pond (MA32009) | Blandford | Exotic Species |
| Buck Pond (MA32012) | Westfield | Exotic Species |
| Congamond Lakes, North Pond (MA32022) | Southwick | Exotic Species |
| Congamond Lakes, Middle Pond (MA32021) | Southwick | Exotic Species |
| Congamond Lakes, South Pond (MA32023) | Southwick | Exotic Species |
| Horse Pond (MA32043) | Westfield | Exotic Species |

## TOTAL MAXIMUM DAILY LOADS (TMDLs)

While the EPA's guidance for the preparation of the Integrated List provided an overall framework for a five-part list of waters, the development, submittal, and review of Category 5 was subject to the prevailing regulation governing the implementation of Section 303(d) of the CWA and, so, this category was approved as the Massachusetts 2002 303(d) List by the EPA on October 1, 2003. States must develop TMDLs for each of the waterbodies in Category 5 and establish pollution control strategies to restore these waters to meet water quality standards. A TMDL is the greatest amount of a pollutant that a waterbody can accept and still meet water quality standards. Further information on the 303(d) List and the TMDL Program is available on the MA DEP website at: http://www.mass.gov/dep/brp/wm/tmdls.htm. Table 3 identifies those waterbodies in the Westfield River Watershed that were included on this list.

Table 3. Massachusetts Category 5 Waters, waters requiring a TMDL in the Westfield River Watershed (MA DEP 2003a).

| Name | Location | Cause of Impairment |
|---|---|---|
| North Railroad Pond (MA32053) | Holyoke | Noxious Aquatic Plants<br>Turbidity |
| Pequot Pond (MA32055) | Westfield/Southampton | Nutrients<br>Organic Enrichment/Low DO<br>Noxious Aquatic Plants<br>Exotic species (non-pollutant) |
| Powdermill Brook (MA32-09) | Montgomery/Westfield | Siltation<br>Pathogens<br>Suspended solids<br>Turbidity |
| Windsor Pond (MA32076) | Windsor | Organic enrichment/Low DO<br>Exotic species (non-pollutant) |

**RIVERS**

MA DEP is required to produce TMDLs for various causes of impairment including siltation, suspended solids, and turbidity for Powdermill Brook (Table 3). This work has not been specifically scheduled yet. Pathogens were also listed as a cause of impairment but a statewide TMDL being developed for pathogens may be applied to this waterbody.

**LAKES**

MA DEP is also required to produce TMDLs for three lakes in the Westfield River Watershed (Table 3), but this work has not been specifically scheduled yet.

# OBJECTIVES

This report summarizes information generated by MA DEP DWM in the Westfield River Watershed through *Year 1* (information gathering in 2000) and *Year 2* (environmental monitoring in 2001) activities established in the "Five-Year Cycle" of the Watershed Initiative. In addition, where appropriate, information collected by MA DEP DWM during the 1996 water quality and biological monitoring surveys are also summarized. Together with other sources of information (identified in each segment assessment) these data were used to assess the status of water quality conditions of rivers and lakes in the Westfield River Watershed in accordance with EPA's and MA DEP's use assessment methods. Data collected by DWM in 1996, 1997 and 2001 are provided in Appendices A through G of this report. Not all waters in the Westfield River Watershed are included in the MA DEP/EPA WBS or ADB databases or this report.

The objectives of this water quality assessment report are to:

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

# REPORT FORMAT

***RIVERS***

The rivers assessed in the Westfield River Watershed are presented in the River Segment Assessment section of this report. The order of river segments follows the Massachusetts Stream Classification Program (Halliwell *et al*. 1982) hierarchy. River segments are organized hydrologically (from most upstream to downstream) and tributary segments follow after the river segment into which they discharge. Each river segment assessment is formatted as follows.

**SEGMENT IDENTIFICATION**

Name, water body identification number (WBID), location, length, classification.

Sources of information: coding system (waterbody identification number e.g., MA32-01) used by MA DEP to reference the stream segment in databases such as 305(b) and 303(d), the Integrated List of Waters, the Massachusetts SWQS (MA DEP 1996), and other descriptive information.

**SEGMENT DESCRIPTION**

Major land-use estimates (the top three uses for the segment's subwatershed, excluding "open water", and other descriptive information.

Sources of information: descriptive information from USGS topographical maps, base geographic data from MassGIS, land use statistics from a GIS analysis using the MassGIS land use coverage developed in 1999 at a scale of 1:25,000 (Umass Amherst 1999).

**SEGMENT LOCATOR MAP**

Subbasin map, major river location, segment origin and termination points, and segment drainage area (gray shaded).

Sources of information: MassGIS data layers (stream segments and quadrangle maps from MassGIS 2001).

**2002 INTEGRATED LIST OF WATERS CATEGORY**

Category (2 – 5) in which the segment is listed on the 2002 Integrated List of Waters.

Source of information: Massachusetts Year 2002 Integrated List of Waters (MA DEP 2003a).

**WATER WITHDRAWALS AND WASTEWATER DISCHARGE PERMIT INFORMATION**

Water withdrawal, NPDES wastewater discharge

Sources of information: WMA Database Printout (LeVangie 2002); open NPDES permit files located in the Worcester and Western Regional MA DEP Offices (MA DEP 2001a, Hogan 2004, Keohane 2004, McElroy 2004, and Nietupski 2004a).

**USE ASSESSMENT**

*Aquatic Life*, *Fish Consumption*, *Drinking Water* (where applicable – see note below), *Primary Contact*, *Secondary Contact*, and *Aesthetics*.

Sources of information include: MA DEP DWM 1996/1997 and 2001 survey data (Appendix A through G); MA DEP DWM Toxicity Testing Database "TOXTD". The MA DPH Freshwater Fish Consumption Advisory Lists (MA DPH 2001 and MA DPH 2004a) were used to assess the *Fish Consumption Use*. Where other sources of information were used to assess designated uses, citations were included. [Note: Although the *Drinking Water Use* itself was not assessed in this water quality assessment report the Class A waters were identified.]

**SUMMARY**

Use summary table (uses, status, causes and sources of impairment).

**RECOMMENDATIONS**

Additional protection, monitoring and implementation needs.

***LAKES***

The assessed lakes, identified with their Waterbody Identification Code (WBID) numbers, are listed alphabetically in the Lake Assessment section of this report (Table 5). The status of the individual uses is summarized for these lakes. The location, acreage, trophic status, use assessments, and causes of impairment, are then summarized for each individual lake.

## WESTFIELD RIVER WATERSHED - RIVER SEGMENT ASSESSMENTS

There are a total of 28 rivers, comprising 35 segments, from the Westfield River Watershed assessed in this report (Figure 8). These include: the Little River (MA32-16, MA32-35, MA32-36, MA32-08); Middle Branch Westfield River (MA32-02, MA32-03); Swift River (MA32-12); West (Falls) Branch (MA32-13); West Branch Westfield River (MA32-01); Westfield River (MA32-04, MA32-05, MA32-06, MA32-07); Bedlam (MA32-33), Bradley (MA32-21), Depot (MA32-17), Dickenson (MA32-34), Glendale (MA32-10), Great (MA32-25), Kinne (MA32-32), Meadow (MA32-11), Miller (MA32-27), Moose Meadow (MA32-23), Paucatuck (MA32-29), Pond (MA32-24), Potash (MA32-22), Powdermill (MA32-09), Roaring (MA32-30), Sanderson (MA32-31), Shaker Mill (MA32-18), Walker (MA32-20), White (MA32-28), and Yokum (MA32-19) brooks; and Watts (MA32-14) and Wards (MA32-15) streams. While these rivers represent only a small number (30%) of the 89 named rivers they account for approximately 50% of the named river miles in the watershed. The remaining rivers are small and/or unnamed and are currently unassessed.

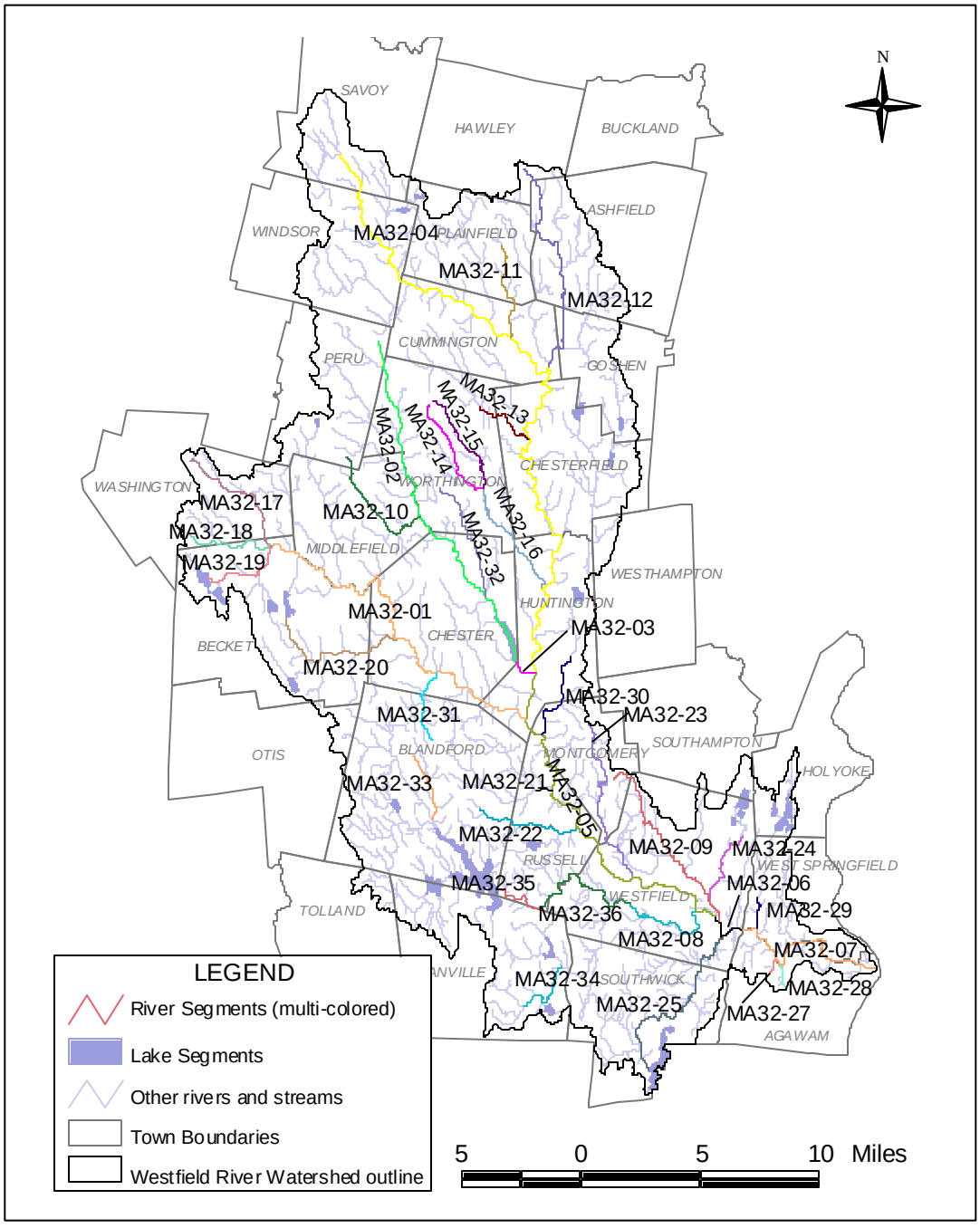
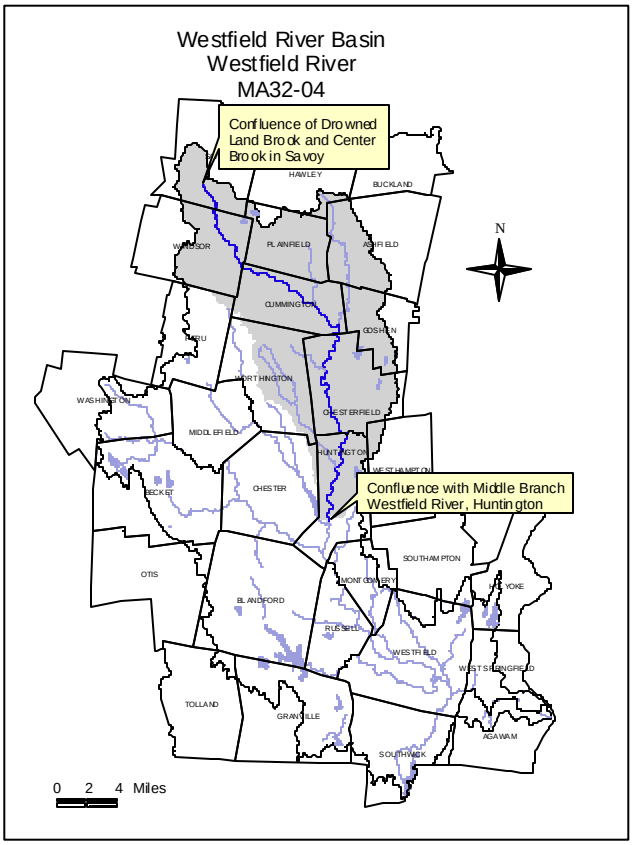



Figure 8. Westfield River Watershed - river segment locations identified by segment number.

## WESTFIELD RIVER (SEGMENT MA32-04)

Location: Confluence of Drowned Land Brook and Center Brook, in Savoy, to confluence with Middle Branch Westfield River, Huntington.
Segment Length: 33.2 miles
Classification: Class B, Cold Water Fishery




The drainage area of this segment is approximately 168 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Forest ..... 84%
- Agriculture..... 7%
- Residential ..... 4%

The impervious cover area for the individual sub-basins located in this segment is 1.5 %, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The Westfield River begins at the confluence of Drowned Land Brook and Center Brook in Savoy. The river flows in a southeast direction through mostly undeveloped steep terrain with little floodplain development through the towns of Windsor and Cummington. At Cummington Center the floodplain widens but then narrows as the river continues southeast through Cummington in a narrow steep valley. Just before entering Chesterfield the river turns east and then sharply to the north where the Swift River joins it. The Westfield River then turns abruptly to the south and flows into Chesterfield in a reach called “The Gorge” with extremely steep slopes and a narrow river channel. The floodplain then widens as the river enters Huntington. In Huntington the river picks up flow from the Little River before entering the Army Corps of Engineers (ACOE) Knightville Dam area. Approximately 2.5 miles below the dam the Middle Branch Westfield River joins the Westfield River and this segment ends.

The ACOE New England District maintains a flood control project, Knightville Dam (Reservoir) in the town of Huntington, within this segment of the Westfield River (ACOE 2003). Knightville Dam is a Class I project (with no significant water quality problems) that is part of a system of 14 ACOE flood control dams in the Connecticut River Watershed (covering parts of Vermont, New Hampshire, Massachusetts, and Connecticut). During the past five years there has been no indication of significant water quality problems, including bacteria problems.

The Knightville Dam is 1,200’ long, 150’ high (above streambed), and consists of compacted earth with an impervious core, protected with rock slopes on both sides (ACOE 2003). Peak storage capacity is 16 billion gallons when filled to spillway crest, equivalent to 5.7” of runoff from the contributing drainage area of 162 square miles. The Class I project began operation in 1940, after the disastrous floods of September 1938, to provide flood control and regulation of flows to reduce flood stages in Westfield and West Springfield. The 2430-acre Army Corps Property, in addition to another 258 acres of private land easements, encompasses approximately 4.75 miles of the mainstem Westfield River in Huntington and Chesterfield. When filled to spillway crest the reservoir extends about 6 miles and has a surface area of about 960 acres. The reservoir area and associated land offer recreational opportunities that include: camping, fishing, hiking, and cross-country skiing (but no swimming). The maximum flood stage occurred during April 1987, when the water level attained an elevation of 612.4’ above sea level, which was 2.4’ above the spillway crest of 610’ (ACOE 2003).

Based on the last evaluation of water quality conditions this segment of the Westfield River is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation, and Aesthetics) and was not assessed for others (Fish Consumption).

MDFW has proposed that several tributaries to this segment of the Westfield River be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003). They are: Pond Brook, Dead Branch, Tower Brook, Mill Brook, Bartlett Brook, Westfield Brook, and Windsor Jambs Brook.

**WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY**

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

**USE ASSESSMENT**

***AQUATIC LIFE***

Habitat and Flow

The Knightville Dam can impound up to a 6-mile reach of the Westfield River in Huntington and Chesterfield when filled to spillway crest (ACOE 2002). At Knightville Dam no permanent storage pool is maintained. However, a winter pool is maintained to prevent the flood-control gates from freezing. Historically the winter pool was held until the last weekend in April and dumped to provide flows for the "Westfield River Days" canoe and water rapids running celebration. In order to improve passage for outmigrating smolts (salmon fry are stocked by MDFW in the Westfield River and select tributaries) the pool is now released on or about 1 April (Slater 2004). The ACOE, North Atlantic Engineering Branch, started releasing the winter pool during the last weekend in March and did not store up for the Westfield River Days event until 48 hours before the scheduled release (for the event). This was done experimentally in 2001, but is now incorporated as part of normal operations. In 2002 the spring was wet enough so that sufficient storage was available, but even in a dry year the recreational release will only be the excess water that can be stored in 48 hours. This works well for the smolts running the Westfield River, because most of them will have already migrated downstream before the last weekend in April. The pool is not refilled until freezing conditions occur (late December/January). While downstream passage is no longer an issue, migrating adults are unable to move upstream past the dam at this time.

The USGS gage 01179500 is located on the Westfield River approximately 0.2 miles downstream from the Knightville Dam (upstream from this segment of the Westfield River). The USGS remarks for this gage indicate that flow has been regulated by Knightville Reservoir since 1941 (Socolow 2003). The average discharge at this gage reported by USGS for the period of record (1909 to 2002) is 332 cfs. There is no evidence of aberrant streamflow fluctuations at this gage when viewing real-time USGS gaging data (USGS 2004).

As part of the 2001 DWM Westfield River Watershed benthic macroinvertebrate survey, a habitat survey was performed in this segment of the Westfield River downstream from the Knightville Dam (upstream from the confluence with the Middle Branch Westfield River) off Rocky Brook Drive and Route 112 in Huntington (Station WR01, Appendix B). The available habitat was excellent and the score at Station WR01 was 184 out of a possible 200 (Appendix B).

Biology

The MDFW regularly stocks salmon fry and trout in this segment of the Westfield River.

In August and September 2001 MDFW personnel conducted backpack electrofishing in three reaches of this segment of the Westfield River. The sampling locations and the fish population information are described below.

- The most upstream reach surveyed by MDFW was located near the powerline crossing off River Road in Windsor (Station 336, Richards 2003). Seven fish species collected, in order of abundance, were blacknosed dace, longnosed dace, slimy sculpin, Atlantic salmon (multiple age classes), creek chubsucker, common shiner, and white sucker.
- The next reach sampled was located upstream from the Route 143 bridge and the confluence

with the West (Falls) Branch in Chesterfield (Station 547, Richards 2003). Seven fish species collected, in order of abundance, were blacknosed dace, longnosed dace, common shiner, Atlantic salmon (multiple age classes), white sucker, lake chub, and slimy sculpin. It should be noted that lake chub are a state "endangered" species.

- The most downstream reach sampled was located near the top gate of the Army Corp flood control project in the Gorge (Station 548, Richards 2003). Eight fish species collected, in order of abundance, were common shiner, longnosed dace, blacknosed dace, Atlantic salmon (multiple age classes), white sucker, lake chub, rainbow trout, and one tessellated darter.

It is interesting to note that according to a *Stream Survey of the Westfield River System 1977-1978*, "game fish, primarily trout" comprised 27% of the biomass in "Unit B" (their fishery management unit which included the area including the main stem sections of the upper branches (East, Middle, and West) of the Westfield River) (Halliwell 1978) only three trout were collected in the three stations sampled in 2001 (Richards 2003).

In September 2001 DWM conducted a modified Rapid Bioassessment Protocol III (RBP III) benthic macroinvertebrate survey in this segment of the Westfield River downstream from the Knightville Dam (upstream from the confluence with the Middle Branch Westfield River) off Rocky Brook Drive and Route 112 in Huntington (Station WR01) (Appendix B). The benthic community at this station (WR01) was diverse and was considered to represent the "least-impacted" conditions in the watershed. It was, therefore, used as a reference station. Backpack electrofishing by DWM in September 2001 in this reach of the river resulted in the collection of eight species of fish (Appendix B). However, electrofishing efficiency was limited by the width of the river. The species collected, in order of abundance, were smallmouth bass, white sucker, common shiner, longnosed dace, and an individual each of brown trout, brown bullhead, American eel, and pumpkinseed. A small amount of green filamentous algae was observed, but coverage in this open canopied reach was <1% (Appendix D, MA DEP 2001c).

Chemistry – sediment

A priority pollutant scan was conducted by ACOE on sediment samples collected from the Westfield River at Knightville Dam (ACOE 2002 and Barker 2004). Sediment samples were collected in September 2000 and analyzed for metals, PCB, pesticides, semi-volatile organic compounds, dioxins and furans, grain size, and TOC. According to the annual report the levels of EPA priority pollutants in the sediment collected from the Westfield River at Knightville Dam were low and indicative of natural background conditions (ACOE 2002).

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate and fish community data. The presence of two intolerant species and the dominance of fluvial specialists/dependant species is indicative of excellent water quality and stable flow regimes. It should be noted, however, that the lower 8.2-mile reach of this segment of the Westfield River could be affected by the operations of the ACOE Knightville Dam. It is unclear whether salmon stocking is having an effect on trout populations in this segment of the Westfield River.

***FISH CONSUMPTION***

Fish were collected from this segment of the Westfield River by MA DEP and MDFW personnel in October 1990 in the reach downstream from the Knightville Army Corps Area in Huntington (Maietta 1993). Tissue from eastern brook trout and white suckers were analyzed for selected metals (including mercury), PCB, and pesticides. MA DPH did not issue any fish consumption advisories based on this survey.

Because no site-specific fish consumption advisory was issued by MA DPH for this segment of the Westfield River the *Fish Consumption Use* is not assessed.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION***

Bacteria samples were collected at two state managed beaches, the Westfield River Beach at the Windsor State Forest, Windsor and the Westfield River Beach at the Gardner State Park, Huntington, along this segment of the Westfield River during 2001-2003 swimming seasons (MA DCR 2003b).

At the Windsor State Forest, Westfield River Beach, beach closures occurred on the following dates.

- In 2001: 2-5, 9, and 12 July, 6-7 August;
- In 2002: 22, and 24-25 July, 5-6 August;
- In 2003: 2-3, 23, 25 and 30 June, 2, 7, 9, 18, 21, 23, 25 and 28-29 July, 4 and 6-26 August.

At the Gardner State Park, Westfield River Beach beach closures occurred on the following dates.

- In 2001: 2, 5, and 9-11 July, 6-7, 13, 15, 17, 19-21, and 27 August, 1 September;
- In 2002: 5, 7-11, 19 and 26 August;
- In 2003: 27 May-1 June and 23 June, 14, 16, 21, 23, 25, and 28 July 4 and 6-26 August.

DWM collected fecal coliform bacteria samples from six sites along this segment of the Westfield River between May and August 1996 (Stations WSFR56.8, SWFR 50.6, WSFR48.1, WSFR42.7, WSFR38.0 and WSFR26.8) as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Based on the frequent and occasionally prolonged beach closures at both MA DCR Westfield River beaches the *Primary Contact Recreation Use* is assessed as impaired. The *Secondary Contact Recreational Use*, however, is not assessed at this time due to a lack of recent fecal coliform bacteria data.

***AESTHETICS***

No objectionable deposits, odors, oils, or other conditions were noted by DWM biologists at their survey site on the Westfield River downstream from the Knightville Dam (upstream from the confluence with the Middle Branch Westfield River) off Rocky Brook Drive and Route 112 in Huntington (Station WR01) in either 1996 or 2001 (Appendices B and C).

The *Aesthetics Use* is assessed as support for this segment of the Westfield River based primarily on field observations by DWM biologists in 2001.

Westfield River (MA32-04) Use Summary Table

| Designated Uses | | Status |
|---|---|---|
| Aquatic Life |  | SUPPORT |
| Fish Consumption |  | NOT ASSESSED |
| Primary Contact |  | IMPAIRED<br>Cause: Beach closures (based on *Enterococcus* sp. data)<br>Source: Unknown |
| Secondary Contact |  | NOT ASSESSED |
| Aesthetics |  | SUPPORT |

**RECOMMENDATIONS WESTFIELD RIVER (MA32-04)**

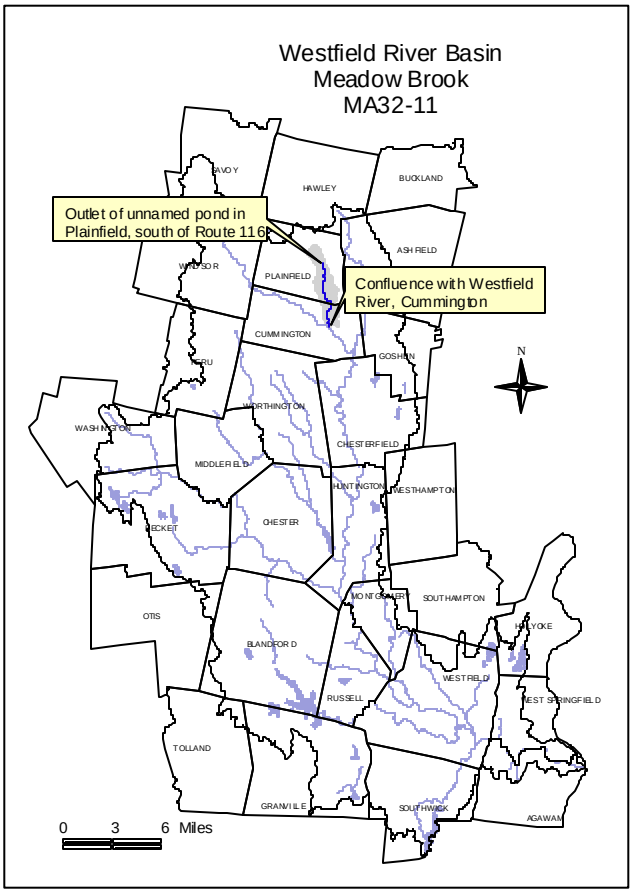
- Conduct bacteria monitoring to better assess the status of the *Primary* and *Secondary Contact Recreational* uses throughout the entire length of this river segment. Conduct additional sampling to pinpoint sources of bacteria specifically in the vicinity of the two MA DCR state beaches.

- Continue to conduct biological monitoring (habitat, benthic and fish population) to evaluate the status of the *Aquatic Life Use*.

- Long-term monitoring of fish populations in this segment of the Westfield River would be valuable to investigate possible impact of salmon stocking on reproducing wild trout populations.

## MEADOW BROOK (SEGMENT MA32-11)

Location: Outlet of unnamed pond in Plainfield, south of Route 116, to confluence with Westfield River, Cummington.
Segment Length: 4.6 miles
Classification: Class B




The drainage area of this segment is approximately 4 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Forest ..... 72%
- Agriculture..... 19%
- Residential ..... 4%

The impervious cover area for the individual sub-basins located in this segment is 1.8%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The headwaters of Meadow Brook begin as the outflow from a small, unnamed pond (east of Plainfield Center) just south of Route 116 in Plainfield. The brook flows south, first over gently sloping forested terrain, then through a reach of moderately sloping terrain and finally into a relatively flat meadow and marsh. Meadow Brook then flows for approximately one mile over moderately steep terrain before its confluence with the Westfield River in the town of Cummington.

Based on the last evaluation of water quality conditions Meadow Brook is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Primary Contact Recreation, Secondary Contact Recreation, and Aesthetics) and was not assessed for others (Aquatic Life, Fish Consumption).

MDFW has proposed that Meadow Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION***

DWM collected fecal coliform bacteria samples from Meadow Brook at the Nash Road Bridge (Station MEDB00.2) in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

No recent water quality data are available so all uses for Meadow Brook are currently not assessed.

Meadow Brook (MA32-11) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| NOT ASSESSED | | | | |

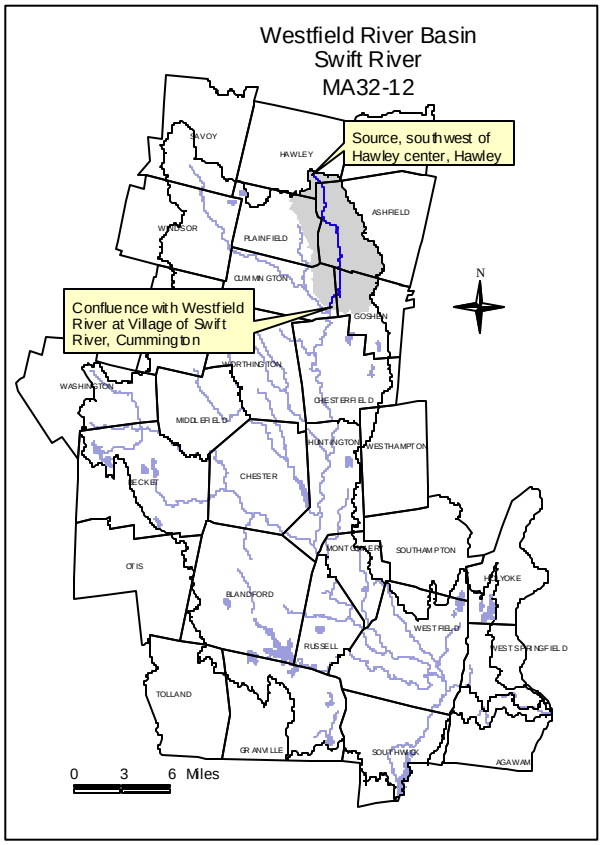
**RECOMMENDATIONS MEADOW BROOK (MA32-11)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses. Conduct additional sampling to pinpoint sources if deemed necessary.

- Monitor the fish population, dissolved oxygen and temperature in Meadow Brook to evaluate MDFW's proposal to list this segment as a cold water fishery in the next revision of the Surface Water Quality Standards.

## SWIFT RIVER (SEGMENT MA32-12)

Location: Source, southwest of Hawley center to confluence with Westfield River at the village of Swift River, Cummington.
Segment Length: 11.5 miles
Classification: Class B




The drainage area of this segment is approximately 30 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 82%
Agriculture..... 8%
Residential ..... 3%

The impervious cover area for the individual sub-basins located in this segment is 1.4%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The Swift River originates out of a small unnamed pond just south of Hawley Center in Hawley and flows southeasterly into Ashfield over moderately sloping terrain with some wetland areas. The river then flows in a more southerly direction by the village of Spruce Corner after which it enters the extensive Bassett Meadow wetland. The river then continues south into Goshen through steeper forested terrain until it reaches Route 9 where it abruptly turns west and then southwest into Cummington. The river flows through very steep terrain into the village of Swift River where the North Branch Swift River joins it and then flows a short distance before its confluence with the Westfield River.

Based on the last evaluation of water quality conditions Swift River is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that the Swift River and its tributaries, the North Branch Swift River and Stones Brook, be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Biology

MDFW regularly stocks salmon fry and trout in the Swift River.

MDFW conducted fish population sampling in the Swift River near Spruce Corner Road in Goshen using a backpack shocking unit in September 2001 (Station 487, Richards 2003). A total of six fish species collected, in order of abundance, were blacknosed dace, Atlantic salmon (multiple age classes), longnosed dace, brook trout (multiple age classes), common shiner and white sucker. These species are all fluvial specialists/dependants. In addition, the presence of two intolerant species is indicative of excellent water and habitat quality.

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

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION***

DWM collected fecal coliform bacteria samples from the Swift River from the Route 9/112 bridge, Cummington (Station SWFT00.2) in May and August as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited and no recent water quality data are available so the *Recreational uses* for Swift River are currently not assessed.

Swift River (MA32-12) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |

**RECOMMENDATIONS SWIFT RIVER (MA32-12)**

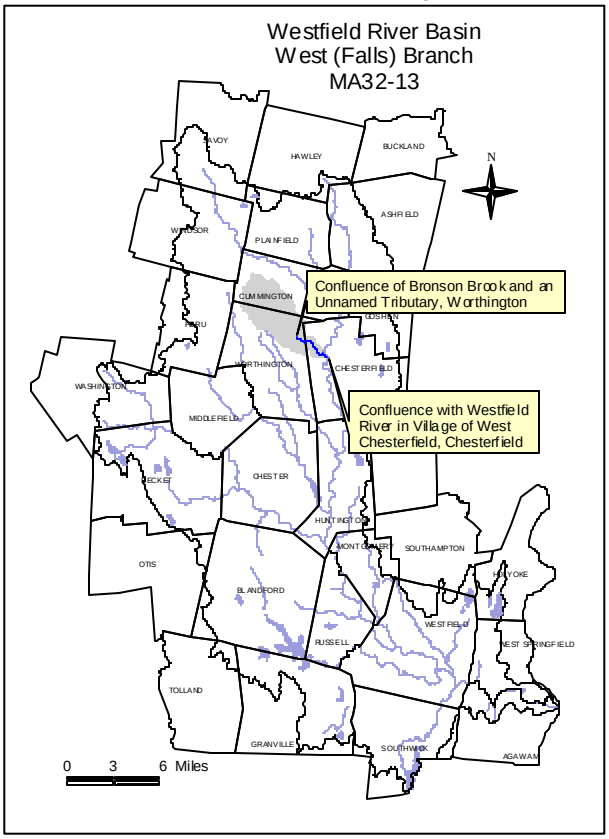
- Long-term monitoring of fish populations in the Swift River would be valuable to investigate possible impact of salmon stocking on reproducing wild trout populations.

- The Swift River should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.

## WEST FALLS BRANCH (SEGMENT MA32-13)

(Formerly identified by the Massachusetts Stream Classification Program as West Branch)
Location: Headwaters at confluence of Bronson Brook and an unnamed tributary near intersection of Dingle Road and Route 143, Worthington to confluence with Westfield River near the village of West Chesterfield, Chesterfield.
Segment Length: 2.8 miles
Classification: Class B




The drainage area of this segment is approximately 12 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 83%
Agriculture..... 11%
Residential ..... 3%

The impervious cover area for the individual sub-basins located in this segment is 1.4%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The West Falls Branch is formed by the confluence of Bronson Brook and an unnamed tributary north of the village of Worthington Corners in Worthington. The West Falls Branch flows southeast through a narrow steep valley with little development before joining the Westfield River in the Village of West Chesterfield in the town of Chesterfield.

Based on the last evaluation of water quality conditions the West Falls Branch (identified as West Branch) is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that West Falls Branch and the following tributaries: Bronson Brook, Steven Brook, Childs Brook, Kearney Brook, be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003). MDFW regularly stocks trout in West Falls Branch.

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION***

DWM collected a fecal coliform bacteria sample from the West Falls Branch near Ireland Street, south of West Chesterfield on the way to Chesterfield Gorge (Station WBWC00.1) in August as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

No recent water quality data are available so all uses for West Falls Branch are currently not assessed.

West Falls Branch (MA32-13) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
| | | | | |
| NOT ASSESSED | | | | |

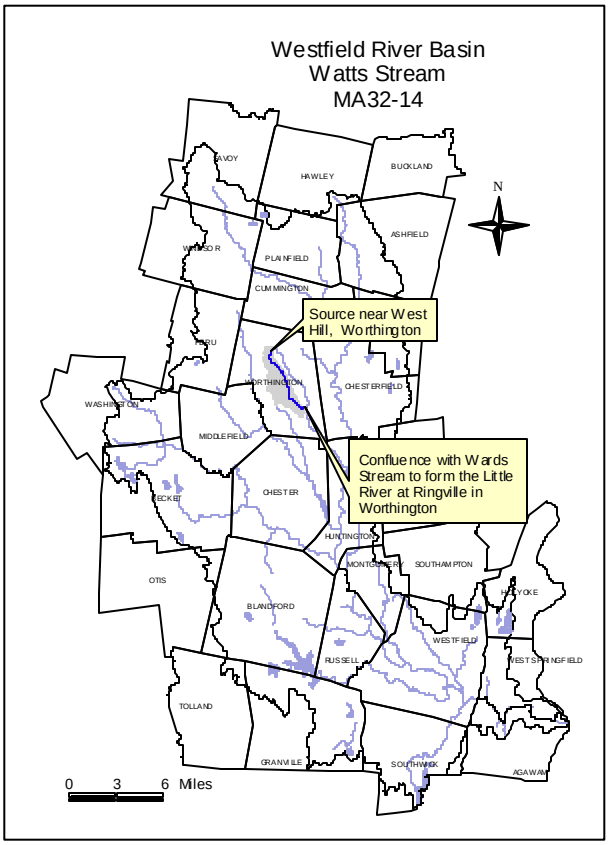
**RECOMMENDATIONS WEST FALLS BRANCH (MA32-13)**

- Monitor the fish population and/or DO and temperature in West Falls Branch to evaluate MDFW's proposal to classify this segment as a cold water fishery in the next revision of the surface water quality standards.

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.

## WATTS STREAM (SEGMENT MA32-14)

Location: Source near West Hill, Worthington to confluence with Wards Stream at Ringville, Worthington.
Segment Length: 5.2 miles
Classification: Class B




The drainage area of this segment is approximately 4 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Forest ..... 81%
- Agriculture ..... 9%
- Residential ..... 5%

The impervious cover area for the individual sub-basins located in this segment is 1.7%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Watts Stream begins on the slopes of West Hill in Worthington State Forest and flows southerly over moderately steep terrain through the center of Worthington to its confluence with Wards Stream in the village of Ringville in Worthington. This confluence marks the beginning of the Little River.

Based on the last evaluation of water quality conditions Watts Stream is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Primary Contact Recreation, Secondary Contact Recreation, Aesthetics) and was not assessed for others (Aquatic Life, Fish Consumption).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Biology

In August 2001, MDFW surveyed the fish population in Watts Stream near the Guard Road Bridge in Worthington (Station 572, Richards 2003). Four fish species collected, in order of abundance, were brook trout (multiple age classes), blacknosed dace, slimy sculpin and one creek chubsucker. These species are all fluvial specialists/dependants. In addition, the presence of two intolerant species is indicative of excellent water and habitat quality.

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

#### *PRIMARY CONTACT AND SECONDARY CONTACT RECREATION*

DWM collected fecal coliform bacteria samples from Watts Stream at Prentice Road Bridge in Ringville (Worthington) at Station WATS00.1 in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited recent water quality data are available so the *Recreational* uses for Watts Stream are currently not assessed.

Watts Stream (MA32-14) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |

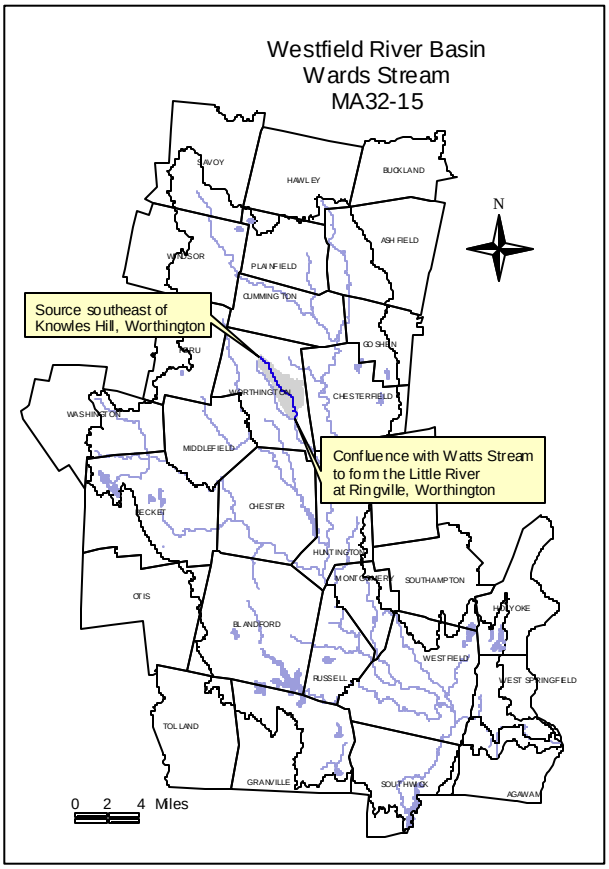
**RECOMMENDATIONS WATTS STREAM (MA-32-14)**

- Although not proposed as a cold water fisheries resource by MDFW, Watts Stream should be considered for listing as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.

## WARDS STREAM (SEGMENT MA32-15)

Location: Source southeast of Knowles Hill, Worthington, to confluence with Watts Stream at Ringville, Worthington.
Segment Length: 5.2 miles
Classification: Class B




The drainage area of this segment is approximately 4 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 62%
Agriculture .. 19%
Residential ... 8%

The impervious cover area for the individual sub-basins located in this segment is 2.5%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Wards Stream originates southeast of Knowles Hill in Worthington and flows south to southeast over moderately sloping terrain through the village of Worthington Corners in Worthington to its confluence with Watts Stream in the village of Ringville in Worthington. The confluence of these two streams marks the beginning of the Little River.

Based on the last evaluation of water quality conditions Wards Stream is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported one designated use (Aquatic Life), and was not assessed for others (Primary Contact Recreation, Secondary Contact Recreation, Aesthetics, Fish Consumption).

### WMA WATER WITHDRAWAL

Based on the available information there are no WMA regulated water withdrawals in this subwatershed.

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H1)

The Maples, formerly called the Worthington Senior Housing Inc., is authorized to discharge (NPDES MA0027871) up to 0.0023 MGD of treated sanitary wastewater to Wards Stream (permit issued in September 1999). The wastewater is treated through subsurface sand filters and, on occasion, during high groundwater conditions or excessive precipitation the wastewater reaches a chlorine contact tank after sand filtration and is discharged into Wards Stream. Therefore, the discharge is on an intermittent basis only. The facility has a maximum daily total residual chlorine (TRC) limit of 0.1 mg/L, a monthly average total phosphorus and ammonia-nitrogen limit of 2.0 and 1.0 mg/L, respectively, and a fecal coliform limit of 200 cfu/100 mls. According to the MA DEP Western Regional Office staff the facility has been in compliance with the permit limits (McElroy 2004). The previous permit required the facility to conduct whole effluent toxicity testing of the discharge. A whole effluent toxicity test (100% effluent) was conducted on the discharge in October 1998. Survival of *Ceriodaphnia dubia* and *Pimephales promelas* exposed (48-hour) to the effluent sample was excellent (≥ 100%) in the test. The present permit no longer requires whole effluent toxicity testing.

### USE ASSESSMENT

***AQUATIC LIFE***

Biology

MDFW conducted backpack electrofishing at two locations in Wards Stream in August 2001. The most upstream location was near Buffington Hill Road in Worthington (Station 350, downstream from the Maples discharge) and the downstream location was near Indian Oven Road in Worthington

(Station 347, Richards 2003). Four fish species collected at the upstream station, in order of abundance, were creek chubsucker, brook trout (multiple age classes), white sucker, and blacknosed dace. Five species collected at the downstream location, in order of abundance, were blacknosed dace, creek chubsucker, common shiner, white sucker, and one brook trout. These species are all fluvial specialists/dependants. In addition, the presence of one intolerant species is indicative of excellent water and habitat quality.

Toxicity

*Ambient*

Water was collected from Wards Stream for use as dilution water in the Maples facility's whole effluent toxicity test conducted in October 1998. Water was collected approximately 0.2 miles upstream from where Ward's Stream crosses Buffington Hill Road. Survival of *C. dubia* and *P. promelas* exposed (48-hour) to the river water was good (≥ 95%) in the test.

*Effluent*

Water from The Maples treatment plant was collected in October 1998 and tested for whole effluent toxicity. Although the toxicity test was invalid because of a sample holding-time violation it should be noted that survival of *C. dubia* and *P. promelas* exposed (48-hour) to the effluent sample was excellent (≥ 100%) in the test.

Chemistry – water

Water from Wards Stream was collected for use as dilution water in The Maples whole effluent toxicity test conducted in October 1998 (approximately 0.2 miles upstream from where Ward's Stream crosses Buffington Hill Road). Data from this report (maintained in the TOXTD database) are summarized below.

*pH*

Instream pH was 6.3 mg/L.

*Total Residual Chlorine*

The TRC measurement was ≤ 0.05 mg/L.

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

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATIONAL AND AESTHETICS***

DWM collected fecal coliform bacteria samples from Wards Stream near the Route 112 bridge in Ringville (Station WRDS00.0) in May and August as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited recent water quality data are available so the *Recreational* and *Aesthetic* uses for Wards Stream are currently not assessed.

Wards Stream (MA32-15) Use Summary Table

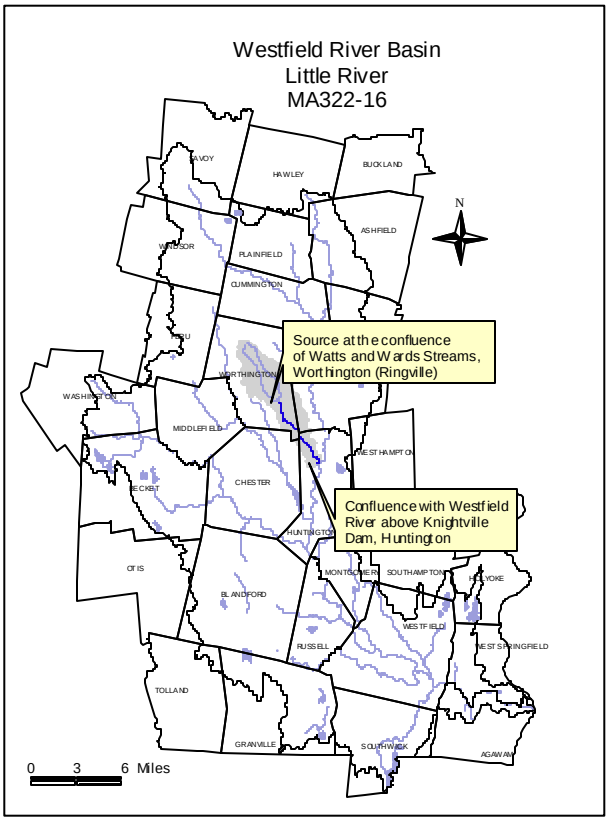
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |

**RECOMMENDATIONS WARDS STREAM (MA32-15)**

- Although not proposed as a cold water fisheries resource by MDFW, Wards Stream should be considered for listing as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

## LITTLE RIVER (SEGMENT MA32-16)

Location: Confluence of Watts and Wards streams at Ringville, Worthington, to confluence with Westfield River, Huntington.
Segment Length: 5.7 miles
Classification: Class B




The drainage area of this segment is approximately 15 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 78%
Agriculture..... 10%
Residential ..... 5%

The impervious cover area for the individual sub-basins located in this segment is 1.7 %, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The Little River is formed at the confluence of Watts and Wards Streams in the village of Ringville in Worthington paralleling Route 112 its entire length. From Ringville the river flows south to southeast and first enters a relatively flat area with low gradient before entering a narrow steep valley with a high gradient. The river then passes by the village of South Worthington before entering Huntington and its confluence with the Westfield River above the Knightville Dam.

Based on the last evaluation of water quality conditions Little River is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that the Little River be listed in the next revision of the SWQS as a cold water fishery (MDFW 2001).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Habitat and Flow

As part of the MA DEP Biocriteria Development Project a habitat survey was performed by DWM at Station BT08LIT on the Little River off the north side of Route 112 approximately 1900 meters downstream from Ireland Street crossing Huntington in September 1997. At the time of the survey the river was roughly 7 m wide with depths ranging from 0.25 m to 1.0 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 152 out of a possible 200 (MA DEP 1997). Habitat quality was limited most by the channel flow status with additional limitations related to velocity/depth combinations, embeddedness and an inadequate riparian zone on the right bank.

Biology

MDFW regularly stocks salmon fry and trout in the Little River.

In August 2001 MDFW conducted electrofishing in the Little River near Goss Hill Road Bridge in Worthington (Station 381, Richards 2003). Seven fish species collected, in order of abundance, were Atlantic salmon (multiple age classes), blacknosed dace, longnosed dace, common shiner, white sucker, and one individual each of creek chubsucker and brook trout.

As part of the MA DEP Biocriteria Development Project MA DEP DWM biologists collected benthic macroinvertebrate samples from Little River off the north side of Route 112 approximately 1900 meters southeast (downstream) from Ireland Street crossing Huntington (Station BT08LIT) in September 1997 (Lotic 1999). Electrofishing was also conducted by DWM at this location on 24 September 1997 (ENSR 1997). Fish collected in order of abundance included: blacknosed dace, longnosed dace, slimy sculpin, white sucker, eastern brook trout, common shiner, Atlantic salmon (multiple age classes), creek chubsucker, and an individual tessellated darter. These species are all fluvial specialists/dependants. In addition the presence of three intolerant species is indicative of excellent water and habitat quality.

Chemistry – water

*In-situ* measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of the Little River off the north side of Route 112 approximately 1900 meters southeast (downstream) from Ireland Street crossing Huntington (Station BT08LIT) were made on 24 September 1997 as part of the Biocriteria Development Project (Appendix G, Table G3).

The *Aquatic Life Use* is assessed as support based on the fish community data and best professional judgment. The presence of Atlantic salmon, reproducing brook trout and slimy sculpin are indicative of high quality cold water.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected fecal coliform bacteria samples from the Little River just upstream from the flood pool of Knightville Dam in Huntington (Station LRWT00.1) between May and August as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

No aesthetic quality degradation (odors, turbidity, oil, grease) or any other objectionable conditions were noted by DWM biologists during their survey in the Little River in 1997 (MA DEP 1997).

Too limited recent water quality data are available so the *Recreational* uses for the Little River are currently not assessed. The *Primary Contact Recreational* Use is identified with an Alert Status, however, because of one fairly high bacteria count. The *Aesthetics Use* is assessed as support based primarily on field observations by DWM biologists in 1997 and best professional judgment.

Little River (MA32-16) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED* | NOT ASSESSED | SUPPORT |

* Alert Status issues identified see use assessment summary for additional information.

**RECOMMENDATIONS LITTLE RIVER (MA32-16)**

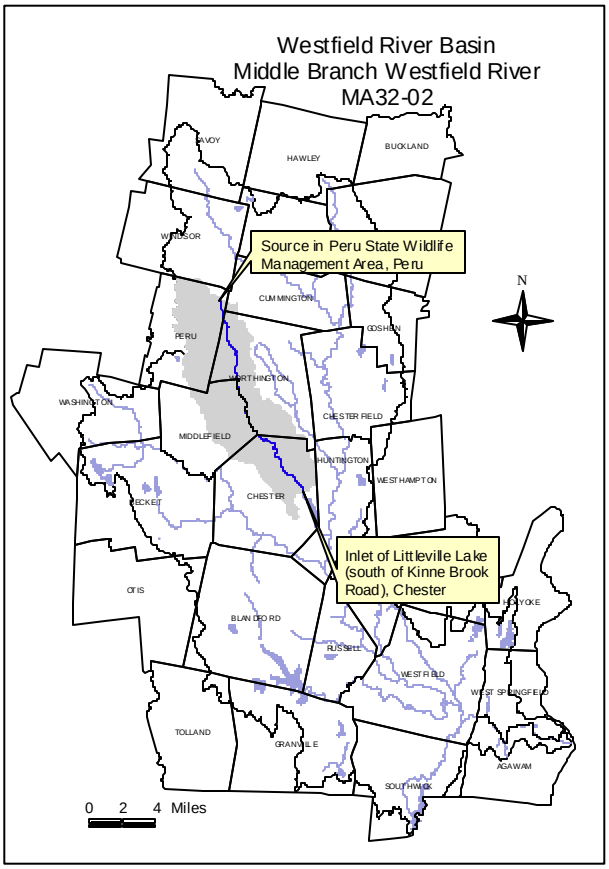
- Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable to investigate possible impact of salmon stocking on the brook trout population.

- The Little River should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.

## MIDDLE BRANCH WESTFIELD RIVER (SEGMENT MA32-02)

Location: Source in Peru State Wildlife Management Area, Peru, to inlet of Littleville Lake just upstream from boat ramp (south of Kinne Brook Road), Chester.
Segment Length: 14.7 miles
Classification: Class A




The drainage area of this segment is approximately 49 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 91%
Agriculture..... 4%
Residential ..... 3%

The impervious cover area for the individual sub-basins located in this segment is 1.3 %, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The headwaters of the Middle Branch Westfield River form in the Peru Wildlife Management Area in Peru. The river passes from Worthington to become the town boundary between Middlefield and Worthington and winds its way in a more easterly direction as it passes into Chester. The gradient decreases here and the river meanders its way to the southeast down to the village of North Chester. From North Chester the river runs in a fairly straight reach by Bemis Hill and then begins a reach of small meanders as it continues to flow southeast. The river then enters Littleville Lake, a reservoir formed by the Army Corps of Engineers Littleville Dam, at the Huntington/Chester town line.

Based on the last evaluation of water quality conditions the Middle Branch Westfield River is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation, Aesthetics) and was not assessed for others (Fish Consumption).

MDFW has proposed that this segment of the Middle Branch Westfield River and the following tributaries- Day Brook, Tuttle Brook, Fuller Brook, Trout Brook- be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

***AQUATIC LIFE***

Habitat and Flow

A benthic macroinvertebrate and habitat survey was performed by DWM biologists in the summer of 1996 in one reach of this segment of the Middle Branch Westfield River upstream from Littleville Lake (Station MB01). Habitat quality conditions at this location are described in detail in Appendix C.

Upstream fish passage to this segment of the Middle Branch Westfield River is blocked by the Littleville Lake Dam. In 2002 the ACOE installed three feet of aluminum stoplogs in the overflow channel to create a plunge pool for smolts going over the dam.

Biology

MDFW regularly stocks salmon fry and trout in the Middle Branch Westfield River upstream from Littleville Lake.

In September 2001 MDFW conducted backpack electrofishing along one reach in this segment of the Middle Branch Westfield River (Station 319, Richards 2003). The station was located upstream from the confluence with Tuttle Brook, off East River Road, Middlefield/Worthington. Seven fish species collected, in order of abundance, were blacknosed dace, longnosed dace, slimy sculpin, Atlantic salmon, brook trout, white sucker, and one common shiner. Multiple age classes of Atlantic salmon and brook trout were found. All species collected are fluvial specialists/dependants.

A benthic macroinvertebrate and habitat survey was performed by DWM biologists in the summer of 1996 in one reach of this segment of the Middle Branch Westfield River upstream from Littleville Lake (Station MB01). Results of the RBP II analysis are provided in detail in Appendix C.

The *Aquatic Life Use* is assessed as support based on the fish community data and best professional judgment. The presence of three intolerant species (Altantic salmon, brook trout and slimy sculpin) is indicative of excellent water and habitat quality.

***FISH CONSUMPTION***

Fish were collected from this segment of the Middle Branch Westfield River by MA DEP and MDFW personnel in October 1990 upstream from Dayville Bridge in Chester (Maietta 1993). Tissue from rainbow trout, eastern brook trout and brown were analyzed for selected metals (including mercury), PCB and pesticides. MA DPH did not issue any fish consumption advisories based on this data.

Because no site-specific fish consumption advisory was issued by MA DPH for this segment of the Westfield River the *Fish Consumption Use* is not assessed.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected fecal coliform bacteria samples from six stations along this segment of the Middle Branch Westfield River once in July 1996. Stations MBWF16.4, MBWF14.4, MBWF09.3, MBWF07.5, MBWF05.2, and MBWF04.0 are all described in Appendix G as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

No objectionable conditions were noted by DWM biologists in the reach sampled in this segment of the Middle Branch Westfield River upstream from Littleville Lake in the summer of 1996 (Station MB01).

Too limited recent water quality data are available so the *Recreational* and *Aesthetics* uses for this segment of the Middle Branch Westfield River are currently not assessed.

Middle Branch Westfield River (MA32-02) Use Summary Table

| Aquatic Life | Fish Consumption | Drinking Water | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
| SUPPORT | NOT ASSESSED | | | | |

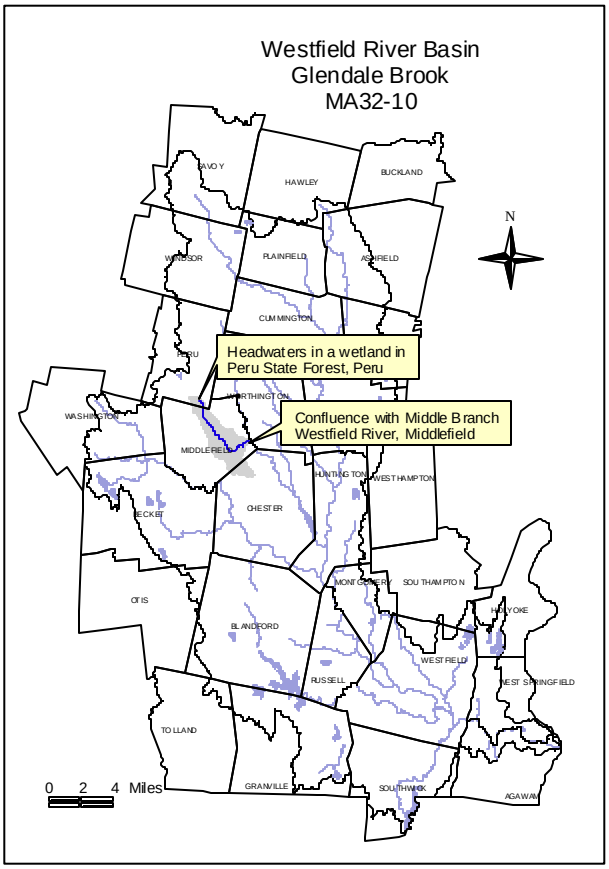
**RECOMMENDATIONS MIDDLE BRANCH WESTFIELD RIVER (MA32-02)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.

- Long-term monitoring of the Atlantic salmon and brook trout populations in the Middle Branch Westfield River would be valuable to investigate possible impact of salmon stocking on the brook trout population.

## GLENDALE BROOK (SEGMENT MA32-10)

Location: From headwaters in a wetland in Peru State Forest, Peru, to confluence with Middle Branch Westfield River, Middlefield.
Segment Length: 6.0 miles
Classification: Class A




The drainage area of this segment is approximately 7 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Forest ..... 88%
- Agriculture..... 6%
- Residential ..... 3%

The impervious cover area for the individual sub-basins located in this segment is 1.3%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Glendale Brook begins in the Peru State Forest in Peru originating in a wetland southeast of Garnet Hill. The stream flows southeasterly over moderately steep terrain until it crosses under Wright Road where it then flows northeasterly through a relatively flat area before flowing over Glendale Falls to its confluence with the Middle Branch of the Westfield River in Middlefield.

Based on the last evaluation of water quality conditions Glendale Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that Glendale Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION***

DWM collected one fecal coliform bacteria sample from the Trustees of the Reservation access to Glendale Falls (Station GDBR00.4) in July 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

No recent water quality data are available so all uses for Glendale Brook are currently not assessed.

Glendale Brook (MA32-10) Use Summary Table

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

**RECOMMENDATIONS GLENDALE BROOK (MA32-10)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses. Conduct additional sampling to pinpoint sources if deemed necessary.

- Monitor the fish population and/or DO and temperature in Glendale Brook to evaluate MDFW's proposal to list this segment as a cold water fishery in the next revision of the surface water quality standards.

## KINNE BROOK (SEGMENT MA32-32)

Location: Source, west of West Street, Worthington, to confluence with Middle Branch Westfield River, Chester.
Segment Length: 5.6 miles
Classification: Class A

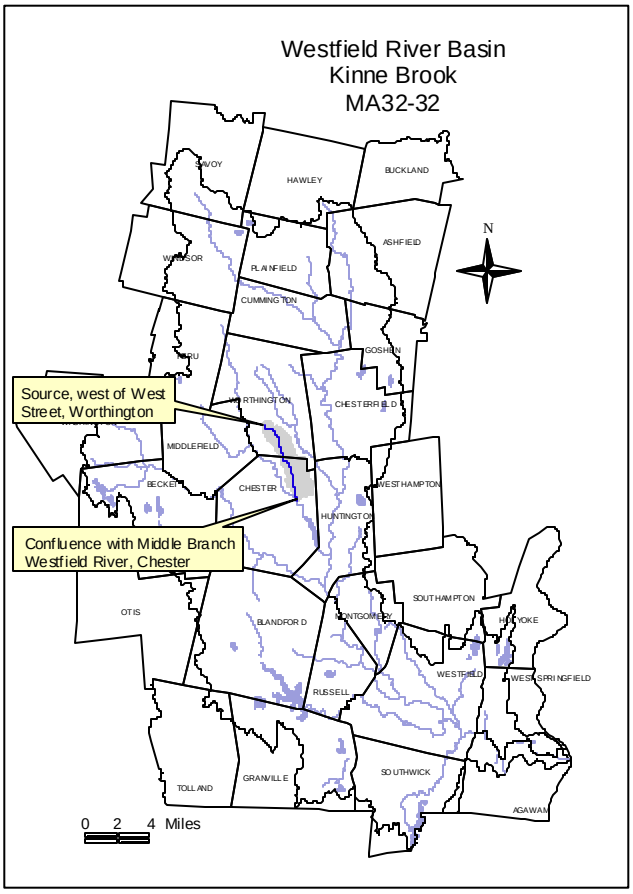
The drainage area of this segment is approximately 6 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 87%
Agriculture..... 7%
Residential ..... 3%

The impervious cover area for the individual sub-basins located in this segment is 1.3 %, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Kinne Brook originates near Parker Four Corners in Worthington on the slopes of a moderately steep hill. The brook flows south to southeast through mostly forested terrain soon entering Chester, where it has its confluence with the Middle Branch Westfield River in the village of Dayville.

Based on the last evaluation of water quality conditions Kinne Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.




MDFW has proposed that Kinne Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Habitat and Flow

As part of the MA DEP Biocriteria Development Project a habitat survey was performed by DWM on Kinne Brook at Station BT05KIN, approximately 250 meters downstream from the confluence of Skunk Brook in Chester, in September 1997. At the time of the survey the river was roughly 2 m wide with a depth of approximately 0.25 m. The substrates were comprised primarily of boulder, cobble, and gravel. The overall habitat score was 154 out of a possible 200 (MA DEP 1997). Habitat quality was limited by the channel flow status with additional limitations related to velocity/depth combinations, embeddedness, and the inadequate riparian zone on the left bank.

Biology

MDFW regularly stocks salmon fry in Kinne Brook.

In August 2001 MDFW conducted backpack electrofishing in Kinne Brook downstream from the confluence with Skunk Brook in Chester (Station 395, Richards 2003). Only blacknosed dace was collected.

As part of the MA DEP Biocriteria Development Project MA DEP DWM biologists collected benthic macroinvertebrate samples from Kinne Brook approximately 250 meters downstream from the confluence of Skunk Brook in Chester (Station BT05KIN) in September 1997 (Lotic 1999). Electrofishing was also conducted at this location on 24 September 1997 (ENSR 1997). Fish collected in order of abundance included: blacknose dace, Atlantic salmon, creek chubsucker, eastern brook trout, and an individual each of pumpkinseed, golden shiner, and slimy sculpin. Multiple age classes of Atlantic salmon and eastern brook trout were found. With the exception of the pumpkinseed and golden shiner all fish species collected were fluvial specialists/dependants. While blacknose dace dominated both MDFW and DWM samples, which were taken in close proximity to one another, the absence of other species in the more recent MDFW sample is of concern.

Chemistry – water

*In-situ* measurements (DO, % saturation, pH, temperature, conductivity, and turbidity) of Kinne Brook were made approximately 250 meters downstream from the confluence of Skunk Brook in Chester (Station BT05KIN) on 24 September 1997 as part of the Biocriteria Development Project (Appendix G, Table G3).

Although the fish assemblage documented by DWM in 1997 appears to be indicative of excellent water quality, the *Aquatic Life Use* is not assessed because of inconsistencies when compared with the more recent MDFW fish population data. However, the *Aquatic Life Use* is identified with an Alert Status because only one species was collected during the most recent sampling event.

***AESTHETICS***

No aesthetic quality degradation (odors, turbidity, oil, grease) or any other objectionable conditions were noted by DWM biologists during their survey in Kinne Brook in 1997 (MA DEP 1997).

The *Aesthetics Use* is assessed as support based primarily on field observations by DWM biologists in 1997 and best professional judgment.

Kinne Brook (MA32-32) Use Summary Table

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

* Alert Status issues identified see details in use assessment

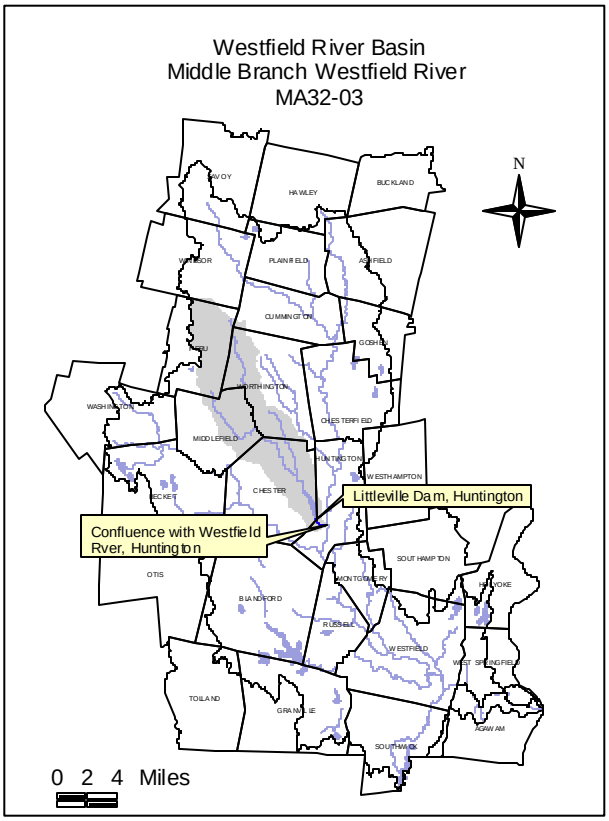
**RECOMMENDATIONS KINNE BROOK (MA32-32)**

- Conduct additional fish population and water quality (e.g., DO, temperature, pH) monitoring in Kinne Brook to assess the *Aquatic Life Use* and potential for Cold Water Fishery designation.

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.

## MIDDLE BRANCH WESTFIELD RIVER (SEGMENT MA32-03)

Location: Littleville Dam to confluence with Westfield River, Huntington.
Segment Length: 1.1 miles
Classification: Class B, Warm Water Fishery




The drainage area of this segment is approximately 53 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 91%
Agriculture..... 4%
Residential ..... 3%

The impervious cover area for the individual sub-basins located in this segment is 1.3%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

This segment starts at the Littleville Dam, Chester, and flows southeasterly for one mile to the confluence with the Westfield River, Huntington.

Based on the last evaluation of water quality conditions the Middle Branch Westfield River is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation, and Aesthetics) and was not assessed for others (Fish Consumption).

MDFW has proposed that this segment of the Middle Branch Westfield River be reclassified to a cold water fishery from a warm water fishery in the next revision of the SWQS (MDFW 2003).

### WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)

| Facility | WMA Registration Number | Source | Authorized Withdrawal (MGD) |
|---|---|---|---|
| Springfield Water and Sewer Commission | 10428101 | Littleville Lake 281-03S | 37.2* |

*indicates system wide withdrawal; all sources are not within this segment

### NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no NPDES regulated surface wastewater discharges to this segment.

### USE ASSESSMENT

***AQUATIC LIFE***

Habitat and Flow

The Littleville Lake Dam is 1360' long, 160' high above streambed consists of compacted earth fill with an impervious core, and is protected by rock slopes on both sides (ACOE 2003). Peak storage capacity is 10.6 billion gallons when filled to the spillway crest (including 7.5 billion gallons for flood control), which is equivalent to 8.3" rain from the contributing 52 square miles of drainage area. The Class I project began operations in 1940, after the disastrous floods of September 1938, to provide flood control and regulation of flows to reduce flood stages in Westfield and West Springfield. Additionally, Littleville Lake was authorized for water supply storage for the city of Springfield. The 1567-acre Army Corps property, plus private land easements of another 10 acres, bound

approximately 3.7 miles of the Middle Branch Westfield River within the town of Chester. When filled to spillway crest the reservoir has a surface area of 510 acres. The reservoir area and associated land offer recreational opportunities that include: picnics, boating, fishing, and hiking, but no swimming. The recreational emphasis is on fishing, since MDFW considers the lake an excellent cold-water fishery that has an intensive on-going trout-stocking program. The maximum flood stage occurred during the April 1987 floods, when the water level got up to an elevation of 571.7' above sea level, which was 4.3' below the spillway crest.

The Littleville Lake Dam has a year round pool with a surface water release. In 2002 the ACOE installed three feet of aluminum stoplogs in the overflow channel to create a plunge pool for smolts going over the dam. The Littleville Lake Dam also is the site of a prior FERC hydro-generating facility (Project # 8350). The permit was issued 24 March 1986 was surrendered 15 June 1988 (Cover 2004). This facility had a potential generating capacity of 1060 kWh (ACOE 2003).

A habitat survey was performed by DWM biologists in the summer of 1996 in one reach of this segment downstream from Littleville Lake (Station MB02). Habitat quality conditions at this location are described in detail in Appendix C.

Biology

MDFW regularly stocks trout in this segment of the Middle Branch Westfield River.

A benthic macroinvertebrate survey was performed by DWM biologists in the summer of 1996 in one reach of this segment downstream from Littleville Lake (Station MB02). Results of the RBP II analyses are provided in detail in Appendix C.

In August 2001 MDFW conducted backpack electrofishing of half of the stream width in one reach of this segment of the Middle Branch Westfield River (Station 355, Richards 2003). The station was located just downstream from the Littleville Dam in Huntington. Nine species were collected including, in order of abundance, longnosed dace, Micropterus dolomieu (smallmouth bass), blacknose dace, two individuals each of Anguilla rostrata (American eel), white sucker, and yellow perch, and an individual each of Atlantic salmon, brown trout, and fallfish.

The *Aquatic Life Use* is not assessed because of too limited data and the fish sampling inefficiencies.

***FISH CONSUMPTION***

Fish were collected from this segment of the Middle Branch Westfield River by MA DEP and DFW personnel in October 1990 below Littleville Dam in Huntington (Maietta 1993). Tissue from brown trout, eastern brook trout and white sucker were analyzed for selected metals (including mercury), PCB and pesticides. The results of this survey did not indicate a problem, nor did MA DPH issue any advisories with respect to fish consumption (Maietta 1993).

Because no site-specific fish consumption advisory was issued by MA DPH for this segment of the Westfield River the *Fish Consumption Use* is not assessed.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected fecal coliform bacteria samples from the Middle Branch Westfield River just upstream from its confluence with the mainstem, off the Goss Hill Road bridge, Huntington (Station MBWF00.4) in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

No objectionable deposits or other conditions were noted by DWM biologists in the reach sampled in this segment during the summer of 1996 (Station MB02, Appendix C).

Too limited water quality data are available so the *Recreational* and *Aesthetic* uses for this segment of the Middle Branch Westfield River are currently not assessed.

Middle Branch Westfield River (MA32-03) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| NOT ASSESSED | | | | |

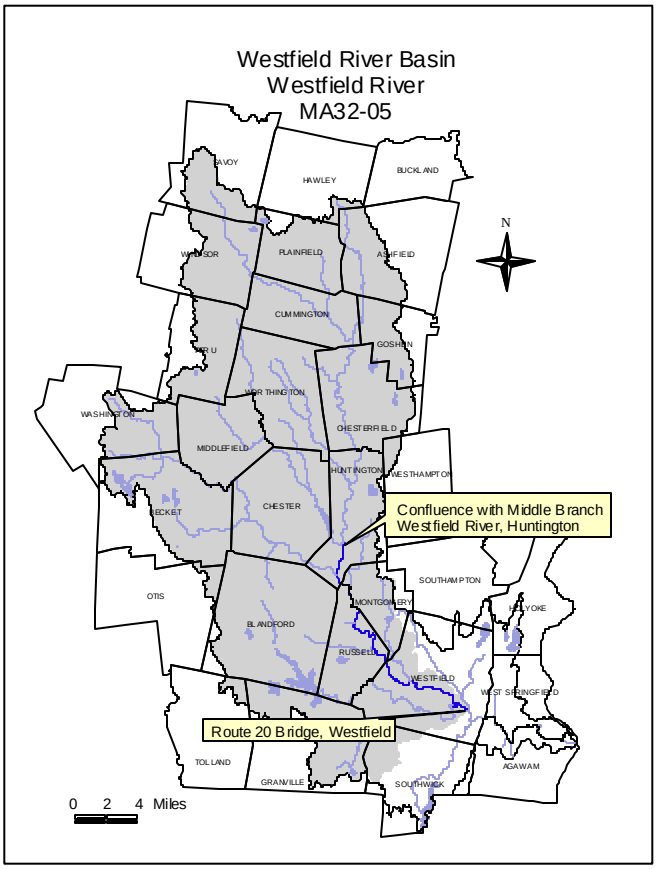
**RECOMMENDATIONS:**

- Monitor the fish population and/or DO and temperature in this segment of the Middle Branch Westfield River to evaluate MDFW's proposal to list this segment as a cold water fishery in the next revision of the surface water quality standards.

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.

## WESTFIELD RIVER (SEGMENT MA32-05)

Location: Confluence with Middle Branch Westfield River, Huntington, to Route 20 Bridge, Westfield.
Segment Length: 17.8 miles
Classification: Class B, Warm Water Fishery




The drainage area of this segment is approximately 497 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Forest ..... 84%
- Agriculture..... 5%
- Residential ..... 5%

The impervious cover area for the individual sub-basins located in this segment is 2.2 %, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

From the confluence with the Middle Branch Westfield River the Westfield River continues flowing south past the town center of Huntington to the confluence with the West Branch Westfield River (where the river receives the Huntington WWTP discharge). The Westfield River then begins to flow in a southeasterly direction. Just before passing by the village of Crescent Mills the river is dammed at the Littleville Power Company's Cresent Mill Dam, where the Crescent Hydroelectric Project is operated (also known as the Texon Project, FERC Exempt license number 2986). Downstream from the dam the river receives the process wastewater and noncontact cooling water from the Texon USA facility. The river meanders to the southeast through steep terrain to the town of Russell where it is impounded by the Westfield River Paper Company Dam. There is a hydroelectric powerhouse at this dam that is currently inactive. Just downstream from the dam the river receives the discharge of treated effluent from the Russell WWTP. A few miles further downstream in the village of Woronoco the river is again dammed at the Woronoco Dam. The Strathmore Paper Co. (MA0004995) discharges to the river in this reach. The river continues to the southeast passing under the Massachusetts Turnpike and then enters the city of Westfield. Here the topography changes to a broad floodplain and the river gradient decreases. The river then enters the urbanized part of Westfield where the Westfield WWTP (MA0101800) discharges. The Westfield River then flows southeast and continues to the Route 20 bridge in Westfield where this segment ends.

Based on the last evaluation of water quality conditions Westfield River Segment MA32-05 is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that several tributaries to this segment of the Westfield River be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003). They are: Bradley Brook, Bearden Brook, Roaring Brook (East Branch), Stage Brook (Tributary to Bradley Brook), and Freeland Brook (Tributary to Stage and Bradley Brooks).

**WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)**

| Facility | WMA Registration Number | WMA Permit Number | Source (G = ground S = surface) | Authorized Withdrawal (MGD) |
|---|---|---|---|---|
| John S. Lane & Son, Inc. | N/A | 9P210432901 | Westfield River-S | 0.65 |
| Texon, USA | N/A | 9P210425603 | Westfield River-S | 0.72 |
| Russell Water Department* | N/A | 9P210425602 | Well#2, 1256000-02G | 0.29 |
| Westfield Water Department* | 10432901 | N/A | Well#2, 329-02G | 6.11 |

* indicates system-wide withdrawal; all sources are not within this segment

**NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H1, H2, AND H3)**

The Town of Huntington is authorized to discharge treated sanitary wastewater from the Huntington POTW to the Westfield River (NPDES permit #MA0101265 issued 29 September 1998). The facility began operating in 1992 and is authorized to discharge an average monthly flow of 0.2 MGD via outfall #001(the discharge location is at the mouth of the West Branch Westfield River just upstream from the confluence with the Westfield River). The facility's whole effluent toxicity limits are $LC_{50} \geq$ 100% effluent with a monitoring frequency of 4X/year using both *C. dubia* and *P. promelas*. The facility utilizes chlorine for disinfection and the limits for total residual chlorine (TRC) are 0.6 and 1.0 mg/L (average monthly and maximum daily, respectively) between 1 April and 31 October. The maximum TRC concentration recorded in the toxicity testing reports for this facility was 0.1 mg/L. Effluent ammonia-nitrogen concentrations recorded in the toxicity testing reports ranged from <0.05 to 11 mg/L (TOXTD database).

Texon USA (formerly U.S.M. Corporation Texon Division – Russell), located at 1190 Huntington Rd., Russell, is a facility engaged in the manufacturing of specialty impregnated papers for use in inner soles, suitcases, and safety equipment, and other products used in the filtration and blotter markets. The company is authorized to discharge a daily maximum flow of 1.3 MGD (average monthly flow of 0.8 MGD) of treated process wastewater, floor drainage, boiler condensate and untreated non–contact cooling water via outfall #001 to the Westfield River (NPDES permit #MA0005282 issued November 1999). The facility's whole effluent toxicity limits are $LC_{50} \geq$ 100% effluent and a chronic no observed effect concentration (CNOEC) monitor only requirement with a monitoring frequency of 4X/year using both *C. dubia* and *P. promelas*. The facility has a maximum daily ammonia-nitrogen limit of 10.8 mg/L. Effluent ammonia-nitrogen concentrations recorded in the 18 toxicity testing reports ranged from 0.15 to 1.6 mg/L (TOXTD database). Total Residual Chlorine (TRC) was not detected in the effluent (<0.05 in all tests).

The Town of Russell is authorized to discharge treated sanitary wastewater from the POTW to the Westfield River (NPDES permit # MA0100960, issued 29 September 1998). The Town is authorized to discharge an average monthly flow of 0.24MGD via outfall #001 (the discharge location is just downstream from the Russell Falls Dam). Ultraviolet light is utilized as a disinfection process. The facility's whole effluent toxicity limits are $LC_{50} \geq$ 100% effluent with a monitoring frequency of 4X/year using both *C. dubia* and *P. promelas*. Effluent ammonia-nitrogen concentrations recorded in the toxicity testing reports ranged from <0.1 and 16 mg/L (TOXTD database).

The former Westfield River Paper Company, Inc. was authorized to discharge (NPDES permit #MA0004316, issued September 1989) treated process wastewater, beater room, bearing cooling water and sand filter backwash via outfall #001 and non-contact cooling water for machine bearings and calendar rolls via outfall #003 along the east bank of the Westfield River adjacent to the Russell Falls Dam. The facility closed in April 1994 and the permit was terminated by EPA in October 1994 (Nietupski 2004b and MA DEP 1994).

The Town of Russell is also authorized to discharge treated sanitary wastewater from the Woronoco Village POTW to the Westfield River (NPDES permit # MA0103233 issued 30 September 1998). The Town is authorized to discharge an average monthly flow of 0.02 MGD via outfall #001 (the discharge location is just downstream from the footpath and the Bridge Street bridge in Woronoco Village in Russell). Ultraviolet light is utilized as a disinfection process. The facility's whole effluent toxicity limits are $LC_{50} \geq$ 100% effluent with a monitoring frequency of 1X/year using both *C. dubia* and *P. promelas*. Effluent ammonia-

nitrogen concentrations recorded in the toxicity testing reports ranged from 1.4 and 6.8 mg/L (TOXTD database). According to the MA DEP Western Regional Office no permit violations have occurred during the past 5 years (Nietupski 2004a).

The Strathmore Paper Company located at Woronoco Mills), Valley View Avenue in Russell, was a facility engaged in the manufacturing of cotton content specialty fine papers. The Strathmore Paper Company was authorized (NPDES permit MA0004995 issued September 1983) to discharge non-contact cooling water via outfall #006 and treated process wastewater and filter backwash water via outfall #008 to the Westfield River. Although the facility completed a reapplication for their NPDES permit as of December 1993 a new permit was never reissued and the facility shut down their operations between December 1997 and mid summer 1998. The permit was terminated by EPA in October 2000 (St. Thomas 1997).

Jen-Coat Inc., located at 132 North Elm Street in Westfield, produces paper coated and laminated packaging. Jen-Coat Inc. is authorized (NPDES permit #MAG250856 issued 13 June 2001) to discharge an average monthly flow of 0.028MGD of non-contact cooling water to the Westfield River. Jen-Coat Inc. installed, in October 1993, a cooling tower that has essentially close-looped their cooling process (Gilli 1993). The permittee indicates that it will still keep the permit active in the event that they need to discharge their cooling water. Jen-Coat Inc. is also permitted (MAR05B629) to discharge stormwater to this segment of the Westfield River. As part of this permit the facility is required to develop a SWPPP and conduct quarterly visual monitoring of their stormwater discharge.

The City of Westfield is authorized to discharge treated effluent from the Westfield WWTP to the Westfield River (NPDES permit # MA0101800, issued 27 April 2000 and subsequently modified on 14 November 2001). The City is authorized to discharge an average monthly flow of 4 MGD via outfall #001 (the discharge location is near the treatment plant downstream from the confluence with the Little River in Westfield) and will be permitted to discharge 6.1 MGD once facility upgrade is completed (expected by December 2004). The facility's whole effluent toxicity limits are $LC_{50} \geq$ 100% effluent and a CNOEC = 9.4% (April 2000 permit) or CNOEC = 20% (November 2001 permit) with a monitoring frequency of 4X/year using *C. dubia*. Chlorination/dechlorination is utilized for disinfection. A TRC maximum daily limit of 0.20 mg/L was imposed in the April 2000 permit and 0.095 mg/L was imposed in the November 2001 permit.

Current upgrades to the Westfield WWTP and upgrades to other municipal treatment plants upstream, combined with less discharges from the various industrial permittees upstream that are no longer discharging should result in demonstrable future improvements in water quality throughout this segment.

Westfield is a Phase II Stormwater community. This community was issued a stormwater general permit from EPA and MA DEP in 2003 and is authorized to discharge stormwater from the municipal drainage system (MAR041236). Over the five-year permit term the City will develop, implement and enforce their stormwater management program to reduce the discharge of pollutants from the storm sewer system to protect water quality (Domizio 2004).

**FERC (APPENDIX H, TABLE H4 AND H5)**

The Littleville Power Company Inc. owns and operates the FERC-exempt Crescent Hydroelectric Project (also known as the Texon Project) # 2986A in Russell. The license was issued on 11 May 1982. The total installed generating capacity is 1500 kW. The facility operates in a run-of-river mode. The Crescent Mills Dam is an "S" shaped, stone masonry structure, approximately 250 feet long by 12' high, constructed on top of a bedrock outcrop. The spillway is topped by three foot high wooden flashboards designed to collapse under high flow conditions. The dam forms a small, three-acre impoundment. The intake and powerhouse are located at the western end of the dam and are part of a former paper mill complex. The powerhouse contains a single Kaplan turbine with a maximum hydraulic capacity of 700 cfs. The turbine discharges back to the Westfield River at the base of the dam so there is no bypassed reach of the river. A downstream fish passage flow of 20 cfs is released through a sluiceway between 1 April and 1 July of each year and trashrack overlays with one inch of clear space are installed during this period to provide additional protection to out-migrating anadromous fish (Grenier 2004).

Indian River Power Supply LLC owns the hydroelectric project formerly owned by the Westfield River Paper Company that is located at the Westfield River Paper Company Dam in Russell (Clark 2004a). The hydropower plant has not operated during the last 10 years since the paper company went out of business in 1994. An application for exemption from FERC licensing and revisions to the application has recently been filed by the owners. The hydropower project is listed as FERC Project No. 12462-000-MA. The two turbines installed in 1908 at the powerhouse have a capacity of 700 kW. The project's principal features consist of: (1) two contiguous dam sections with a crest length of 425 feet; (2) an intake area with trashracks and two 60 foot long, seven foot diameter penstocks leading to a powerhouse that contains two turbine/generator units; (3) a downstream fish passage facility will be installed adjacent to the gatehouse to conduct downstream migrants directly to the tailrace; (4) a 14.1-acre impoundment at the normal pool elevation; (5) a bypassed reach with the primary channel on the west side of the dam whose crest is 1 foot lower than the east side of the dam; and (6) appurtenant facilities. The two contiguous dam sections (east and west) provide a maximum elevation of about 30 feet above the riverbed with a crest elevation of 269.64 feet (National Geodetic Vertical Datum or NGVD) when the flashboards are installed. The powerhouse currently contains two turbines with hydraulic capacities between a minimum of 60 and a combined maximum of 543 cfs (Clark 2004b). [Following rehabilitation of the existing equipment, the owners intend to optimize the hydraulic resources by increasing capacity closer to 1,500 kW. If/when the turbines are replaced the maximum capacity would be between 1,100 and 1,200 cfs (Clark 2004b).] Based on the conditions of the proposed exemption from licensing, the Indian River Project will be operated in a run-of-river mode with a target elevation of 269.5 feet NGVD. The project's automation will minimize fluctuation of the impoundment surface water elevation by maintaining a discharge from the project so that, at any point in time, flows measured independently downstream from the project tailrace, approximate the rate of inflow into the project impoundment from Bradley Brook and from upstream. The project's bypass reach extends from the crest of the east dam down over continuous ledge outcropping to the tailrace and from the spillway and deep gate on the west side of the dam over a 80 foot diameter pool and about 70 feet of riffles for a distance of approximately 100 to 170 feet to the tailrace pool depending on the route. The minimum flow release will be made up of 25 cfs going through the downstream fish passage facility and an interim discharge of another 25 cfs through the riffle area, or inflow, whichever is less, as measured in the separate channels of the bypassed reach. Habitat evaluation and permanent minimum flow requirements will be set by FERC and the resource agencies after the hydro plant returns to service. Downstream passage flows during winter conditions result in significant ice accumulation and will be discontinued annually between December and so called "ice out" conditions or when the river temperatures reach 5 degrees Celsius. The downstream fish passage system is a free-surfaced open channel flow structure with no flow control gate (Clark 2004a).

Woronoco Hydro, LLC owns and operates the Woronoco Hydroelectric Project licensed as FERC Project No. 2631. The license was issued on 30 April 2002. The total installed capacity is 2,700 kW. The project's principal features consist of: (1) two non-contiguous dam sections and an earthen dike; (2) an intake area leading to a powerhouse that contains three turbine/generator units; (3) a downstream fish passage facility; (4) a 43-acre impoundment at the normal pool elevation; (5) a bypassed reach with three channels; and (6) appurtenant facilities. The two non-contiguous dam sections (north and south) provide an elevation of about 25 feet above the riverbed with a crest elevation of 229.0 feet (National Geodetic Vertical Datum or NGVD). The powerhouse contains three turbine-generating units with minimum and maximum hydraulic capacities of 45 cfs and 710 cfs, respectively. Based on the conditions of the FERC license, the Woronoco Hydroelectric Project will be operated in a run-of-river mode with a target elevation of 229.0 feet NGVD and will minimize fluctuation of the impoundment surface water elevation by maintaining a discharge from the project so that, at any point in time, flows measured independently downstream from the project tailrace approximate the sum of inflows to the project impoundment. The project's bypass reach extends from the toe of the north and south dams to the confluence with the project tailrace (approximately 0.2 river miles). There are three bypass reaches at the project for each of which a combined minimum flow release of 57 cfs, or inflow, whichever is less, as measured in the separate channels of the bypassed reach, is required. Downstream passage flows during winter conditions result in significant ice accumulation and will be discontinued annually between December and so called "ice out" conditions or when the river temperatures reach 5 degrees Celsius. The downstream fish passage system is a free-surfaced open channel flow structure with no flow control gate. The bypass channels and minimum flow requirements are described below.

- North Dam channel - The secondary erosion channel begins at the base of the north dam's spillway and extends about 1,000 feet to its confluence with the original channel. The minimum flow required in this channel of 22 cfs is discharged from the deep gate located on the north end of the north dam.
- South Dam channel - The original river channel extends about 700 feet from the ledge base of the south dam's spillway to the project tailrace. The minimum flow required in this channel of 15 cfs cfs is discharged from the deep gate located in the middle of the south dam.
- Fish Passage channel - This channel is located adjacent to the project intake at the base of the south dam and cascades some 200 feet over bedrock ledges to its confluence with the original river channel. The minimum flow required through this downstream fish passage of 20 cfs drops approximately eight feet into a 10-foot deep plunge pool that discharges into a rocky channel dropping into the bypass reach.

Below the confluence of all of these channels the bypass flows drop over 14.6 feet of very steep ledge that form a natural block to upstream migrant fish. In the future there will be eel passage facilities installed allowing upstream and downstream eel passage over the dam at each of the discharge points (Clark 2004a).

**USE ASSESSMENT**

***AQUATIC LIFE***

Habitat and Flow

The USGS gage 01179500 is located on the Westfield River approximately 0.2 miles downstream from the Knightville Dam (upstream from this segment of the Westfield River). The USGS remarks for this gage indicate that flow has been regulated by Knightville Reservoir since 1941 (Socolow *et al*. 2003). The average discharge at this gage reported by USGS for the period of record (1909 to 2002) is 332 cfs. There is no evidence of aberrant streamflow fluctuations at this gage when viewing real-time USGS gaging data (USGS 2004).

The Littleville Power Company Inc. is supposed to operate the FERC exempt Texon Project # 2986A located at the Crescent Mills Dam in Russell in a run-of-river mode. The turbine discharges back to the Westfield River at the base of the dam so there is no bypassed reach of the river. A downstream fish passage flow of 20 cfs is released through a sluiceway between 1 April and 1 July of each year and trashrack overlays with one inch of clear space are installed during this period to provide additional protection to out-migrating anadromous fish (Grenier 2004). According to MDFW, between 15 October and iceup, flow through the sluiceway is also required for spawned out adult salmon (kelt) passage (Slater 2004).

Indian River Power Supply LLC owns the hydroelectric project at the former Westfield River Paper Company Dam in Russell (Clark 2004a). Although the hydropower plant is now inactive the owners have filed for a FERC exemption to operate the project. Based on the conditions of the proposed exemption from licensing the Indian River Project will be operated in a run-of-river mode and the flows measured independently downstream from the project tailrace will approximate the rate of inflow into the project impoundment from Bradley Brook and from upstream. The project's bypass reach extends from the crest of the east dam down over continuous ledge outcropping to the tailrace and from the spillway and deep gate on the west side of the dam over a 80 foot diameter pool and about 70 feet of riffles for a distance of approximately 100 to 170 feet to the tailrace pool depending on the route. The minimum flow release will be made up of 25 cfs going through the downstream fish passage facility and an interim discharge of another 25 cfs through the riffle area, or inflow, whichever is less, as measured in the separate channels of the bypassed reach. Habitat evaluation and permanent minimum flow requirements will be set by FERC and the resource agencies after the hydropower plant returns to service. Downstream passage flows during winter conditions result in significant ice accumulation and will be discontinued annually between December and so called "ice out" conditions or when the river temperatures reach 5-degrees Celsius. The downstream fish passage system is a free-surfaced open channel flow structure with no flow control gate (Clark 2004a). According to MDFW the project will also be required to have upstream passage for American eels (Slater 2004).

A minimum flow release of 57 cfs or inflow, whichever is less, as measured in the separate channels of the bypass reach of the Westfield River is required at the Woronoco Hydro, LLC (FERC Project

2631). To ensure these conditions are met hourly impoundment level data are being continuously recorded. The free discharge from the gates and passage system are also being documented through the use of visual observations downstream of the gates at the confluence of the bypass reach sections. Articles 403 and 404 of the FERC license required Woronoco Hydro to develop a plan to monitor impoundment levels and minimum flow releases and to develop a comprehensive fish passage plan (Nash 2004). The plans were submitted to FERC in May 2004 (Kleinschmidt 2004a and Kleinschmidt 2004b). The project's bypass reach extends from the toe of the north and south dams to the confluence with the project tailrace (approximately 0.2 river miles). Downstream passage flows during winter conditions result in significant ice accumulation and will be discontinued annually between December and so called "ice out" conditions or when the river temperatures reach 5-degrees Celsius. According to MDFW the project will also be required to have upstream passage for American eels in 2005 (Slater 2004).

As part of the 2001 DWM Westfield River Watershed benthic macroinvertebrate survey a habitat survey was performed in three reaches of this segment of the Westfield River (Appendix B). From upstream to downstream the locations were as follows: 250m downstream from the discontinued Strathmore Paper Company treated effluent discharge in Russell (Station WR05), outside of the Westfield WWTP discharge mixing zone in Westfield (Station WR06B) and 340m downstream from the Westfield WWTP discharge in Westfield (Station WR06A). The habitat score at Station WR05 was 185 out of a possible 200 and was only slightly compromised by the drought-induced low baseflow conditions observed (Appendix B). The habitat score at Station WR06B was 165 out of 200 (Appendix B). Habitat quality in the Westfield River downstream from the Westfield WWTP outfall (Station WR06A) was limited primarily to riffle habitat, green algae covering virtually all the stream bottom, and sewage fungus beinh noted along the margins of the sampling reach. The habitat assessment score was 168 out of 200 (Appendix B).

A zone of passage for migrating fish was documented in the Westfield River during the dye study conducted by Metcalf & Eddy in September 2000 at the Westfield WWTP (Metcalf and Eddy 2000).

The USGS gage 01183500 is located downstream from this segment of the Westfield River. The USGS remarks for this gage indicate that flow is regulated (Borden Brook Reservoir, Cobble Mountain Reservoir, Knightville Reservoir and Littleville Lake, and diversion from Little River for municipal supply of Springfield) (Socolow *et al*. 2003). Evidence of substantial streamflow fluctuations are apparent when viewing real-time USGS gaging data (USGS 2004).

A benthic macroinvertebrate and habitat survey was performed by DWM biologists in the summer of 1996 at a total of six reaches in this segment of the Westfield River. From upstream to downstream the locations were as follows: upstream from the Texon USA facility near the roadside park near Huntington Health Center in Huntington (Station WR02), 450m downstream from the Texon USA discharge in Russell (Station WR03), upstream from Strathmore Paper across from the Whippernon Golf Club in Russell (Station WR04), 250m downstream from the Strathmore Paper Company treated effluent discharge in Russell (Station WR05), just upstream from the confluence with the Little River in Westfield (Station WR06), and 340m downstream from the Westfield WWTP discharge in Westfield (Station WR07). Habitat quality conditions at these locations are described in detail in Appendix C.

Biology

This segment of the Westfield River is regularly stocked by MDFW with trout.

In August 2001 MDFW conducted barge electrofishing within two reaches of this segment of the Westfield River upstream from the Texon Mill in Russell (slightly downstream from the Huntington/Russell town line and upstream from the confluence with Roaring Brook) and across from Wippernon Golf Course (downstream from the confluence with Bradley Brook, Richards 2003). Seven species of fish were collected upstream from the Texon Mill including, in order of abundance, common shiner, Micropterus dolomieu (smallmouth bass), longnosed dace, tessellated darter, Atlantic salmon, and an individual each of Lepomis gibbosus (pumpkinseed) and white sucker. The presence of a number of fluvial specialists/dependants is indicative of stable flow regimes. The presence of Atlantic salmon, an intolerant stream species (also endangered), is most likely the result of upstream fry stocking. Although other intolerant species are absent (except for two salmon), most

species collected are considered moderately tolerant and are consistent with those found in larger streams and rivers in western Massachusetts. Further downstream near Wippernon Golf Course in the town of Russell, ten fish species collected, in order of abundance, were smallmouth bass, American eel, fallfish, rock bass, creek chubsucker, tessellated darter, common shiner, white sucker, pumpkinseed, and Atlantic salmon. Smallmouth bass, a macrohabitat generalist, dominated the fish sample. This is not unusual in that smallmouth bass prefer cool, rocky, riverine habitats. Six of the remaining nine fish species collected in this reach of the Westfield River are fluvial specialists/dependants. The presence of Altantic salmon is most likely a result of upstream fry stockings. The fish community present appears to be indicative of good habitat and water quality conditions as well as stable flow regimes.

In September 2001 DWM conducted a modified Rapid Bioassessment Protocol III (RBP III) benthic macroinvertebrate survey at three reaches of this segment of the Westfield River (Appendix B). From upstream to downstream the locations were as follows: 250m downstream from the discontinued Strathmore Paper Company treated effluent discharge in Russell (Station WR05), outside the Westfield WWTP discharge mixing zone in Westfield (Station WR06B) and 340m downstream from the Westfield WWTP discharge in Westfield (Station WR06A). The RPB III analysis of the benthic macroinvertebrate community collected downstream from the discontinued Strathmore Paper Company discharge in Russell (Station WR05) indicated slightly impacted conditions compared to reference station on the Westfield River near Route 112 in Huntington (Station WR01). A dramatic improvement was found over conditions documented during the 1996 survey when Strathmore Paper Company still maintained two discharges: a discharge of non-contact cooling water and a treated process wastewater and filter backwash discharge (Appendices B and C). No periphyton samples were collected by DWM biologists from this sampling location (Appendix D).

The RPB III analysis of the benthic macroinvertebrate community collected in the Westfield River downstream from the confluence with the Little River outside the Westfield WWTP discharge mixing zone in Westfield (Station WR06B) indicated slightly impacted conditions compared to the reference station on the Westfield River near Route 112 in Huntington (Station WR01). Similarly, the RBP III analysis of the benthic macroinvertebrate community collected in the Westfield River downstream from the Westfield WWTP discharge (Station WR06A) indicated slightly impacted conditions compared to both the reference station on the Westfield River near Route 112 in Huntington (Station WR01) and the reference station downstream from the confluence with the Little River outside the Westfield WWTP discharge mixing zone in Westfield (Station WR06B). Slight improvements in community structure were evident since the last DWM survey here--results of the 1996 RPB II evaluation upstream and downstream from the Westfield WWTP discharge indicated moderately impacted benthic community downstream from the discharge (Appendix C). Metcalf & Eddy also conducted a benthic macroinvertebrate study (EPA RBP II protocols) in August 1999 at the sites used by MA DEP DWM biologists in 1996. The samples were analyzed at the Great Lakes Environmental Center. The results from the study also indicated slight improvements in water quality since the 1996 MA DEP evaluation (Metcalf & Eddy 2000). The benthic community sampled by Metcalf & Eddy was strikingly similar to that observed by DWM in 2001 (Fiorentino 2004a). The apparent improvements in the biological condition in the river downstream from the Westfield WWTP discharge appear to coincide with the ongoing upgrade of the WWTP. The green filamentous algae *Ulothrix zonata* was very abundant in the Westfield River at both sampling stations, covering an estimated 100% of the reach (Appendix D).

A benthic macroinvertebrate and habitat survey was performed by DWM biologists in the summer of 1996 at a total of six reaches in this segment of the Westfield River. From upstream to downstream the locations were as follows: upstream from the Texon USA facility near the roadside park near Huntington Health Center in Huntington (Station WR02), 450m downstream from the Texon USA discharge in Russell (Station WR03), upstream from Strathmore Paper across from the Whippernon Golf Club in Russell (Station WR04), 250m downstream from the Strathmore Paper Company treated effluent discharge in Russell (Station WR05), just upstream from the confluence with the Little River in Westfield (Station WR06), and 340m downstream from the Westfield WWTP discharge in Westfield (Station WR07). Results of the RBP II analyses are provided in detail in Appendix C.

Toxicity

*Ambient*

Water from the Westfield River was collected 50 yards upstream from the dam at Texon USA and in inclement weather from screens in the mill for use as dilution water for the Texon USA facility's whole effluent toxicity tests. Between January 2000 and March 2004 survival of *C. dubia and P. promelas* exposed (7 days) to the river was good (≥ 80%) in all 18 tests conducted.

Water from the Westfield River was collected just below Main Street Bridge for use as dilution water for the Russell WWTP whole effluent toxicity tests. Between November 1998 and May 2004 survival of *C. dubia and P. promelas* exposed (48 hr) to the river was good (≥ 83%) in 21 of the 22 tests conducted. Survival was low (50 and 43% for *C. dubia* and *P. promelas*, respectively) during the May 2003 test event.

Water from the Westfield River was collected just below Bridge Street Bridge for use as dilution water for the Russell, Woronoco Village POTW whole effluent toxicity tests. Between September 1999 and September 2003 survival of *C. dubia and P. promelas* exposed (48 hr) to the river was excellent (≥98%) in the five tests conducted.

Water from the Westfield River was collected approximately 200 feet upstream from the Westfield WWTP outfall on the south side of the river in back of the former Garvelle Appliances (now a cell phone store) for use as dilution water for the Westfield WWTP whole effluent toxicity tests. Between May 2000 and March 2004 survival of *C. dubia* exposed (7 day) to the river was good (≥ 80%) in the 15 tests conducted.

*Effluent*

A total of 22 definitive acute whole effluent toxicity tests were conducted on the Huntington POTW treated sanitary wastewater effluent (outfall #001) using both *C. dubia* and *P. promelas* between November 1998 and May 2004. The effluent was acutely toxic to *C. dubia* on two occasions (May 2001 and July 2003 with $LC_{50}$'s of 61.8 and 40.6 % effluent, respectively). Effluent water quality data during the two toxic episodes indicated the following: pH of 4.9 and 4.4 SU, aluminum concentrations of 0.32 and 0.33 mg/L, copper concentrations of 0.14 and 0.098 mg/L and zinc concentrations of 0.23 mg/L. The effluent was not acutely toxic to *P. promelas* during any of the 22 test events.

A total of 18 modified acute and chronic whole effluent toxicity tests were conducted on the Texon USA treated effluent (outfall #001) using both *C. dubia* and *P. promelas* between January 2000 and March 2004. The effluent was acutely toxic to *C. dubia* in five of the eighteen tests with $LC_{50}$s ranging between 20 and 89% effluent. The effluent was acutely toxic to *P. promelas* in three of the eighteen tests with $LC_{50}$s ranging between 39 and 87% effluent. In all but one of the modified acute tests the *C. dubia* were the more sensitive test organism. The CNOECs ranged between <6.25 and 50% effluent for *C. dubia* and between <6.25 and 100% effluent for *P. promelas*. The CNOECs were ≤ 6.25% effluent in six and two of the 18 tests for *C. dubia* and *P. promelas,* respectively.

A total of 20 of 22 definitive acute whole effluent toxicity tests conducted on the Russell POTW treated sanitary wastewater effluent (outfall #001) using both *C. dubia* and *P. promelas* between November 1998 and May 2004 were valid. The effluent was acutely toxic to *C. dubia* on two occasions (July 2000 and September 2002 with $LC_{50}$s of 19 and 59% effluent, respectively). The effluent was not acutely toxic to *P. promelas* during any of the 20 valid test events.

A total of 5 definitive acute whole effluent toxicity tests were conducted on the Russell Woronoco Village POTW treated sanitary wastewater effluent (outfall #001) using both *C. dubia* and *P. promelas* between September 1999 and September 2003. No acute toxicity was detected ($LC_{50}$s all ≥100% effluent).

A total of 15 modified acute and chronic whole effluent toxicity tests were conducted on the Westfield WWTP treated effluent (outfall #001) using *C. dubia* between May 2000 and March 2004. The effluent was acutely toxic to *C. dubia* in six of the 15 tests with $LC_{50}$s ranging between 44 and 82% effluent. The CNOECs ranged between 9 and 50% effluent.

Chemistry – water

a. Water from the Westfield River was collected 50 yards upstream from the dam at Texon USA (during inclement weather from screens in the mill) for use as dilution water for the Texon USA facility's whole effluent toxicity tests. Data from these reports (maintained in the TOXTD database) between January 2000 and March 2004 are summarized below.

b. Water from the Westfield River was collected just below Main Street Bridge for use as dilution water for the Russell WWTP whole effluent toxicity tests. Data from these reports (maintained in the TOXTD database) between November 1998 and May 2004 are summarized below.

c. DWM collected *in-situ* measurements from a station on the Westfield River (Station WSFR21.3, Unique ID W0810 - on the Western bank at Main Street, Russell) between 1 August and 3 October 2001 (n=4). Parameters measured were dissolved oxygen, pH, temperature, conductivity, and total dissolved solids. Between 1 August and 3 October grab samples were also collected and analyzed for alkalinity, hardness, chloride, suspended solids, ammonia-nitrogen, nitrate nitrogen, total phosphorus (n=8) (Appendices B and C of Appendix A).

d. Water from the Westfield River was collected just below Bridge Street Bridge for use as dilution water for the Russell, Woronoco Village POTW whole effluent toxicity tests. Data from these reports (maintained in the TOXTD database) between September 1999 and September 2003 are summarized below.

e. DWM collected *in-situ* measurements from a station on the Westfield River (Station WSFR12.7, Unique ID W0807, ~350 feet upstream from Route 202/10 bridge, Westfield) on four occasions between 1 August and 3 October 2001. Parameters regularly measured were dissolved oxygen, pH, temperature, conductivity, and total dissolved solids. Grab samples were also collected on those occasions and analyzed for alkalinity, hardness, chloride, suspended solids, ammonia-nitrogen, nitrate nitrogen, total phosphorus (Appendices 2 and 3 of Appendix A).

f. Water from the Westfield River was collected approximately 200 feet upstream from the Westfield WWTP outfall on the south side of the river in back of the former Garvelle Appliances (now a cell phone store) for use as dilution water for the Westfield WWTP whole effluent toxicity tests. Data from these reports (maintained in the TOXTD database) between May 2000 and March 2004 are summarized below.

*DO*

The instream DO measured by DWM in the Westfield River at Main Street, Russell (Station WSFR21.3) ranged from 8.2 to 10.0 mg/L (92% to 99% saturation) (Appendix 2 of Appendix A).

The instream DO measured by DWM on the Westfield River, ~350 feet upstream from Route 202/10 bridge, Westfield (Station WSFR12.7) ranged from 7.9 to 11.1 mg/L (91% to 107% saturation) (Appendix 2 of Appendix A). Three of the four measurements were representative of pre-dawn conditions.

*Temperature*

Temperatures recorded by DWM at ranged from 14.2 to 24.0°C and 14.1 to 23.3°C at Stations WSFR21.3 and WSFR12.7, respectively.

*pH*

a. Instream pH ranged between 6.0 and 7.5 SU and only one of the 18 measurements was < 6.5 SU.
b. Instream pH ranged between 6.5 and 7.7 SU.
c. DWM pH measurements ranged from 7.0 to 7.3 SU at Station WSFR21.3.
d. Instream pH ranged between 6.8 and 7.7 SU.
e. DWM pH measurements ranged from 7.2 to 7.3 SU at Station WSFR12.7.
f. Instream pH ranged between 6.5 and 8.0 SU.

*Suspended Solids*

a. The maximum suspended solids concentration was 8.0 mg/L.
b. The maximum suspended solids concentration was 6.0 mg/L.

c. The maximum suspended solids concentration in the Westfield River at Main Street Bridge in Russell (Station WSFR21.3) was 2.9 mg/L in all eight samples analyzed.
d. The suspended solids concentrations were all <5.0 mg/L.
e. The maximum suspended solids concentration in the Westfield River upstream from Route 202/10 bridge, Westfield (Station WSFR12.7) was 1.9 mg/L in all four samples analyzed.
f. The maximum suspended solids concentration was 9.5 mg/L.

*Ammonia-Nitrogen*
a. Of the 18 measurements, the maximum ammonia-nitrogen concentration was 0.2 mg/L.
b. Of the 22 measurements, the maximum ammonia-nitrogen concentration was 0.3 mg/L.
c. The concentration of ammonia-nitrogen in the Westfield River at Main Street Bridge in Russell (Station WSFR21.3) was <0.02 mg/L in all eight samples analyzed.
d. Of the 5 measurements, the maximum ammonia-nitrogen concentration was 0.2 mg/L.
e. The concentration of ammonia-nitrogen in the Westfield River upstream from Route 202/10 bridge, Westfield (Station WSFR12.7) was <0.02 mg/L in all four samples analyzed.
f. Of the 14 measurements, the maximum ammonia-nitrogen concentration was 0.3 mg/L.

None of these measurements exceeded the instream chronic criterion of 1.32 mg N/L at the highest pH (8.0SU) and temperature (24.0°C) recorded in this segment.

*Total Residual Chlorine*
a. All of the TRC measurements were $\leq$ 0.05 mg/L.
b. All of the TRC measurements were $\leq$ 0.05 mg/L.
c. N/A at Station WSFR21.3.
d. All of the TRC measurements were $\leq$ 0.05 mg/L.
e. N/A at Station WSFR12.7.
f. With the exception of one measurement (0.06) the remaining 14 TRC measurements were $\leq$ 0.05 mg/L.

*Alkalinity*
a. Alkalinity measurements ranged between 8 and 22 mg/L.
b. Alkalinity measurements ranged between 7 and 24 mg/L.
c. Alkalinity measurements ranged from 13 to 20 in the Westfield River at Main Street Bridge in Russell (Station WSFR21.3) in all eight samples analyzed.
d. Alkalinity measurements ranged between 17 and 25 mg/L.
e. Alkalinity measurements ranged from 15 to 25 in the Westfield River upstream from Route 202/10 bridge, Westfield (Station WSFR12.7) in all four samples analyzed.
f. Alkalinity measurements ranged between 8 and 30 mg/L.

*Hardness*
a. Hardness measurements ranged between 12 and 40 mg/L, with 15 out of 18 samples $\leq$25 mg/L.
b. Hardness measurements ranged between 16 and 35 mg/L, with 14 out of 22 samples $\leq$25 mg/L.
c. Alkalinity measurements ranged from 18 to 22 in the Westfield River at Main Street Bridge in Russell (Station WSFR21.3) in all eight samples analyzed.
d. Hardness measurements ranged between 22 and 32 mg/L, with 2 out of 5 samples $\leq$25 mg/L.
e. Alkalinity measurements ranged from 18 to 26 in the Westfield River upstream from Route 202/10 bridge, Westfield (Station WSFR12.7) in all four samples analyzed.
f. Hardness measurements ranged between 18 and 96 mg/L, with 9 out of 15 samples $\leq$25 mg/L.

*Total Phosphorus (as P)*
a. N/A at this station.
b. N/A at this station.
c. The maximum total phosphorus concentration measured in the Westfield River at Main Street Bridge in Russell (Station WSFR21.3) in the eight samples analyzed was 0.030 mg/L.
d. N/A at this station.
e. N/A at this station.
f. The maximum total phosphorus concentration measured in the Westfield River upstream from Route 202/10 bridge, Westfield (Station WSFR12.7) in the four samples analyzed was 0.012 mg/L.

The *Aquatic Life Use* is assessed as support in the upper 16.8 mile reach of this segment of the Westfield River based primarily on the benthic macroinvertebrate community analysis, the good survival of test organisms exposed to river water, and the presence of a balanced riverine fish community. The absence of American eel upstream from the Texon USA dam may be the result of the dam(s) located downstream from the sampling station. Aberrant streamflow fluctuations in this segment of the Westfield River, however, and the continued presence of numerous barriers to fish migration are of concern and, therefore, the *Aquatic Life Use* is identified with an Alert Status. Downstream from the Westfield WWTP discharge however, the *Aquatic Life Use* is assessed as impaired based on the best professional judgment of DWM biologists. Although the RBP III analysis indicated slight impairment at the WR06A station the percent comparability to the reference station (60%) is at the low end of that impairment category. That, coupled with a clear and dramatic shift (pollution tolerant chironomids displace virtually all sensitive EPT taxa) in community composition downstream from the discharge point, warrants the decision to list the downstream portion of this segment as impaired. Acute and chronic whole effluent toxicity detected in the Westfield WWTP effluent and the amount of green filamentous algae *Ulothrix zonata* downstream from the discharge is also of concern.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION***

Within the last five years fecal coliform bacteria samples were collected from a total of four locations along this segment of the Westfield River (Appendix 3 of Appendix A and ESS 2000).

- Environmental Sciences Services, Inc. (ESS) collected fecal coliform bacteria samples above confluence with the West Branch Westfield River, Huntington (Station SS-2) in 1999.
- DWM collected fecal coliform bacteria samples near the western bank of the Westfield River at Main Street, Russell (Station WSFR21.3, Unique ID W0810) between 1 August and 3 October 2001.
- DWM collected fecal coliform bacteria samples ~350 feet upstream from Route 202/10 bridge, Westfield (Station WSFR12.7, Unique ID W0807) between 1 August and 3 October 2001.
- (ESS) collected fecal coliform bacteria samples at the Route 202 and 10 bridge, Westfield (Station PS-1).

Of the validated ESS data the fecal coliform bacteria count was elevated at SS-2 on 30 September 1999 (1200 cfu/100 mls) (ESS 2000). The highest count (n=3) documented by DWM in the river at the Main Street Bridge in Russell (Station WSFR21.3) was 90 cfu/100 ml (Appendix 3 of Appendix A). Fecal coliform counts (n=4) were higher in the river upstream from the Route 202/10 Bridge (ranged between 62 and 690 cfu/100 mls) (Appendix 3 of Appendix A). Of the validated ESS data the count was 190 cfu/100 ml at PS-1 on 28 December (ESS 2000).

It should also be noted that several fecal coliform bacteria samples were also collected by DWM from this segment of the Westfield River in May and August 1996. The three sampling stations were located as follows: at the pull-off just south of Route 20, Huntington (Station WSFR23.5), the pull-off near Whippernon Golf Course, Russell (Station WSFR20.3), and 200 feet downstream from the Route 90 bridge access from route 20, Russell (Station WSFR17.3). Fecal coliform bacteria counts at these stations did not exceed 180 cfu/100 ml (Appendix D, Table D4).

Too limited recent bacteria data are available and, therefore, both the *Primary* and *Secondary Contact Recreational* uses are not assessed for this segment of the Westfield River.

***AESTHETICS***

There were no objectionable odors, deposits or turbidity noted by MA DEP DWM sampling crews at the station on the Westfield River (Station WSFR21.3) on the Western bank at Main Street, Russell, between 1 August and 3 October 2001 (MA DEP 2001b).

There were no objectionable deposits or oils observed by MA DEP DWM biologists in the Westfield River 250m downstream from the Strathmore Paper Company treated effluent discharge in Russell (Station WR05) in September 2001 (MA DEP 2001c). The river did have a slight effluent odor.

MA DEP DWM field sampling crews noted occasional odors of petroleum and sulfide in the Westfield River upstream from the confluence with the Little River (Station WSFR12.7, Unique ID W0807, ~350 feet upstream from Route 202/10 bridge, Westfield) between 1 August and 3 October 2001(MA DEP 2001b). No visual turbidity or other objectionable deposits were observed except for isolated amounts of trash/debris.

Downstream from the confluence with the Little River, but out of the mixing zone for the Westfield WWTP discharge, and downstream from the Westfield WWTP discharge MA DEP DWM biologists observed that the Westfield River was slightly turbid and a sewage odor was present. Some sewage fungus was observed along the river outside of the effluent mixing zone. No other objectionable conditions were noted (MA DEP 2001c). Algal growth of primarily the green filamentous algae *Ulothrix zonata* covered an estimated 100% of both reaches sampled (Appendix D).

MA DEP DWM biologists surveyed a total of six reaches in this segment of the Westfield River in the summer of 1996 (Appendix C). From upstream to downstream the locations were as follows: upstream from the Texon USA facility near the roadside park near Huntington Health Center in Huntington (Station WR02), 450m downstream from the Texon USA discharge in Russell (Station WR03), upstream from Strathmore Paper across from the Whippernon Golf Club in Russell (Station WR04), 250m downstream from the Strathmore Paper Company treated effluent discharge in Russell (Station WR05), just upstream from the confluence with the Little River in Westfield (Station WR06), and 340m downstream from the Westfield WWTP discharge in Westfield (Station WR07).

The *Aesthetics Use* is assessed as support for the upper 16.8-mile reach of this segment of the Westfield River. The lower 1.0 mile reach of the river (downstream from the Westfield WWTP discharge) is assessed as impaired for the *Aesthetics Use* because of the slight instream turbidity, presence of sewage fungus, excess algal growth, and the sewage odor as documented during the 2001 MA DEP surveys.

Westfield River (MA32-05) Use Summary Table

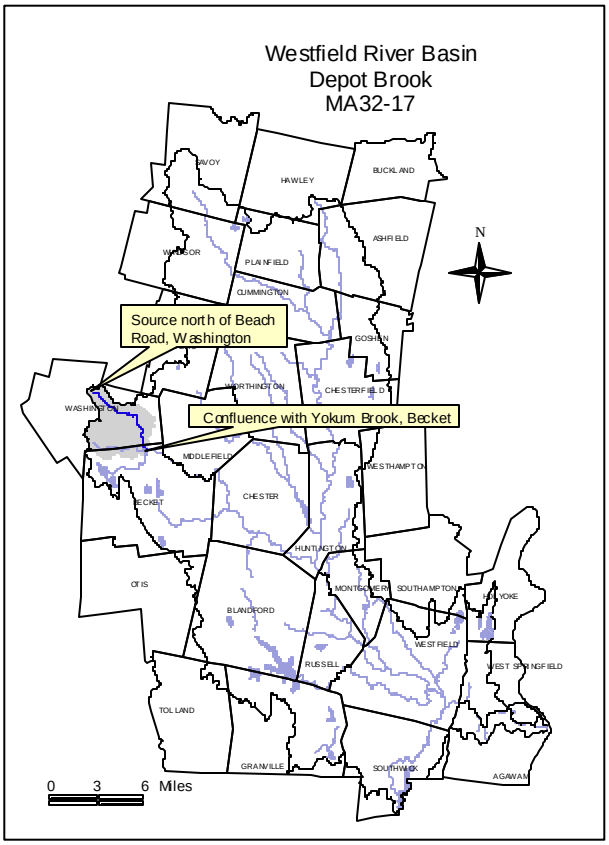
| Designated Uses | | Status |
|---|---|---|
| Aquatic Life |  | SUPPORT upper 16.8 miles<br>IMPAIRED lower 1.0 miles<br>Cause: Unknown<br>Source: Municipal point source discharge<br>(Suspected source: Discharge from municipal separate storm sewer systems) |
| Fish Consumption |  | NOT ASSESSED |
| Primary Contact |  | NOT ASSESSED |
| Secondary Contact |  | NOT ASSESSED |
| Aesthetics |  | SUPPORT upper 16.8 miles<br>IMPAIRED lower 1.0 miles<br>Cause: Excess algal growth, Turbidity, and Odor<br>Source: Municipal point source discharge<br>(Suspected source: Discharge from municipal separate storm sewer systems) |

**RECOMMENDATIONS WESTFIELD RIVER (MA32-05)**

- Evaluate flow data for FERC Project 2631 to ensure that run-of-river conditions, minimum flow releases and impoundment fluctuation conditions of the license are being met.
- Further investigate source(s) of aberrant streamflow fluctuations observed using on-line real-time data for the USGS gage 01183500. Ideally, a natural flow regime should be restored in the Westfield River.
- To ensure run-of-river operations all dam operators should install, calibrate and maintain a continuous streamflow monitoring gage or determine some other method to ensure compliance with run-of-river operations.
- Conduct fish population sampling to determine the effectiveness of fish passage facilities at FERC licensed and exempt projects.
- An upstream/downstream evaluation of the benthic macroinvertebrate community in the Westfield River should be conducted during the next Westfield River Watershed Survey to document any improvements associated with the upgrades at the Westfield WWTP.
- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Review the community of Westfield (MAR041236) Phase II Stormwater SWPPP, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River mainstem and subwatershed tributaries.

## DEPOT BROOK (SEGMENT MA32-17)

Location: Source in Washington (north of Beach Road) to confluence with Yokum Brook in Becket.
Segment Length: 6.0 miles
Classification: Class B




The drainage area of this segment is approximately 13 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 90%
Residential ..... 5%
Agriculture..... 2%

The impervious cover area for the individual sub-basins located in this segment is 1.6%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The headwaters of Depot Brook form in the northwest area of the town of Washington, just north of Beach Road. The brook flows southeast over moderately steep terrain through Washington Center and then flows more southerly towards Becket Center until it joins with Yokum Brook, forming the West Branch Westfield River.

Based on the last evaluation of water quality conditions Depot Brook is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption).

MDFW has proposed that Depot Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Biology

Depot Brook is regularly stocked by MDFW with salmon fry and trout.

In August 2001 MDFW surveyed the fish population in one reach in Depot Brook near Valley Road in Washington (Station 361, Richards 2003). Nine species were collected, including, in order of abundance, blacknose dace, slimy sculpin, creek chubsucker, Atlantic salmon, brown trout, brook trout, white sucker, common shiner, and a longnosed dace. Multiple age classes of Atlantic salmon, brown trout, and brook trout were found. The presence of multiple age classes of three salmonids (and four intolerant species) along with all fluvial dependant/specialist species is indicative of excellent water and habitat quality conditions as well as a stable flow regime.

The *Aquatic Life Use* is assessed as support based on the fish population information and best professional judgment. The presence of four intolerant species (Altantic salmon, brook trout, brown trout and slimy sculpin) is indicative of excellent water and habitat quality.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected fecal coliform bacteria samples from Depot Brook near the Cross Place Road bridge, Washington (Station DPOB02.3), in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited data are available so the *Recreational* and *Aesthetics* uses for Depot Brook are currently not assessed.

Depot Brook (MA32-17) Use Summary Table

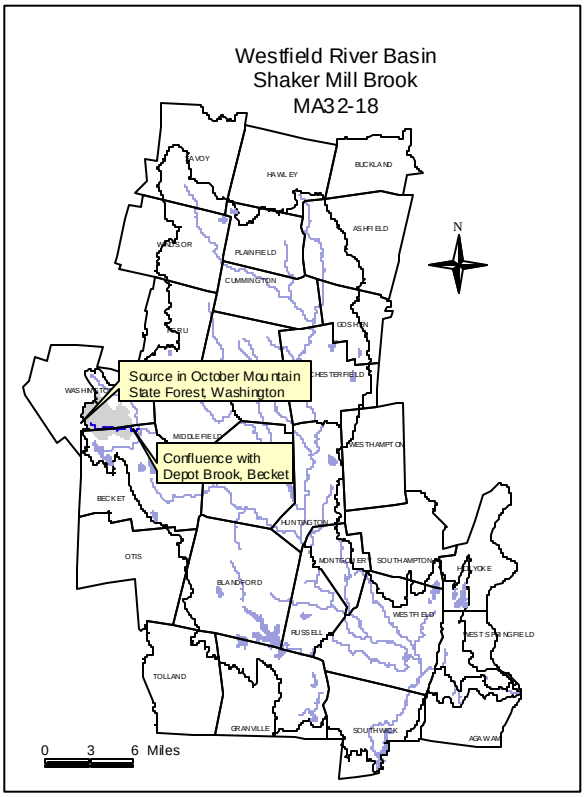
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |

**RECOMMENDATIONS DEPOT BROOK (MA32-17)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Depot Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

## SHAKER MILL BROOK (SEGMENT MA32-18)

Location: Source in October Mountain State Forest in Washington to confluence with Depot Brook in Becket.
Segment Length: 4.2 miles
Classification: Class B




The drainage area of this segment is approximately 6 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 91%
Residential ..... 5%
Agriculture ..... 1%

The impervious cover area for the individual sub-basins located in this segment is 1.1%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Shaker Mill Brook begins in the October Mountain State Forest in Washington, just east of Bald Top Mountain, and flows southeasterly down moderately steep terrain. The brook then enters Becket where its course changes to a more easterly direction flowing over generally steep terrain to its confluence with Depot Brook in the village of Becket.

Based on the last evaluation of water quality conditions Shaker Mill Brook is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Primary Contact Recreation, Secondary Contact Recreation, Aesthetics) and was not assessed for others (Aquatic Life, Fish Consumption).

MDFW has proposed that Shaker Mill Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Biology

MDFW regularly stocks salmon fry in Shaker Mill Brook.

In August 2001 MDFW conducted backpack electrofishing in one reach of Shaker Mill Brook off of Lovers Lane in Becket (Station 383, Richards 2003). Five species were collected, including, in order of abundance, Atlantic salmon, brook trout, blacknose dace, creek chubsucker, and a brown trout. Multiple age classes of Atlantic salmon and brook trout were found. These species are all fluvial specialists/dependants.

The *Aquatic Life Use* is assessed as support based on the fish population information and best professional judgment. The presence of three intolerant species (Altantic salmon, brook trout and brown trout) is indicative of excellent water and habitat quality.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected fecal coliform bacteria samples at the Lovers Lane bridge in Becket (Station SKMB00.4) between May and August 1996 (n=2) as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited data are available so the *Recreational* and *Aesthetics* uses for Shaker Mill Brook are currently not assessed.

Shaker Mill Brook (MA32-18) Use Summary Table

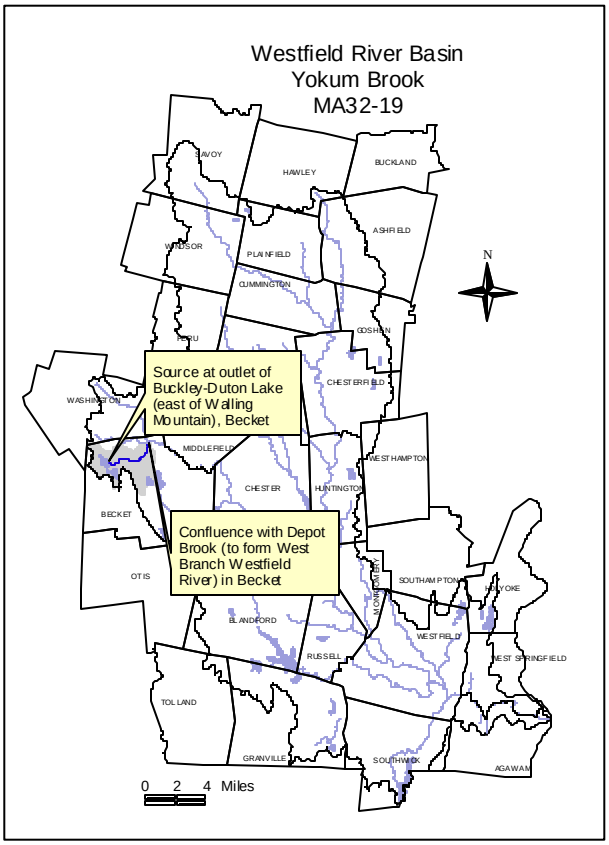
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |

**RECOMMENDATIONS SHAKER MILL BROOK (MA32-18)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Shaker Mill Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

## YOKUM BROOK (SEGMENT MA32-19)

Location: Source at outlet of Buckley-Dunton Lake (east of Walling Mountain) in Becket, to confluence with Depot Brook in Becket.
Segment Length: 4.0 miles
Classification: Class B




The drainage area of this segment is approximately 9 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 83%
Residential ..... 5%
Open Land ..... 1%

The impervious cover area for the individual sub-basins located in this segment is 1.6%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Yokum Brook originates at the outlet of Buckley Dunton Lake in Becket and flows generally in a northeasterly direction over moderately sloping terrain. The brook parallels Yokum Road and County Road into Becket Center to its confluence with Depot Brook, forming the West Branch Westfield River.

Through a project sponsored by the MA DFG, Riverways, River Restore Program, the Silk Mill Dam on Yokum Brook was removed in February 2003 (Riverways 2004). The Taconic Chapter of Trout Unlimited is also leading an effort to provide ongoing community stewardship of the fishery by implementing the Atlantic Salmon Egg Rearing Program in the Becket-Washington Elementary School with support from a Massachusetts Outdoor Classroom and EPA Environmental Education grant. The River Restore Program is also slated to raise funds for the breaching of Ballou Dam on Yokum Brook, although an alternative source of water for fire protection for Becket must be secured prior to the breaching of Ballou Dam. Additionally, the Program is developing an environmental risk predictive model to apply to these two dam breaches, as well as other similar breach situations throughout Massachusetts. The plan is to study pre- breach and post- breach effects of possible toxic sediments behind the dams (pre) and the effects of the released sediments and their effects downstream after the particular breach has occurred.

Based on the latest evaluation of water quality conditions Yokum Brook is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Primary Contact Recreation, Secondary Contact Recreation, Aesthetics) and was not assessed for others (Aquatic Life, Fish Consumption).

MDFW has proposed that Yokum Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).

**WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY**

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

**USE ASSESSMENT**

***AQUATIC LIFE***

Habitat and Flow

As part of the 2001 DWM Westfield River Watershed benthic macroinvertebrate survey a habitat survey was performed in three reaches of Yokum Brook in Becket: downstream from Route 8 near intersection with Carter Road (approximately 50m upstream from the Silk Mill Dam) (Station YB01A), 100m upstream from Prentice Place (between the Silk Mill and Ballou dams (Station YB01B) and downstream from Ballou Dam near the Becket Elementary School at the mouth of the brook (Station YB01C, Appendix B). The habitat score at Station YB01A was 151 out of a possible 200 and was only slightly compromised by the drought-induced low baseflow conditions observed. Station YB01B received a total habitat assessment score of 168 out of 200. Station YB01C received a total habitat assessment score of 140 out of 200 (Appendix B). The disturbed riparian zone along the banks, in addition to low baseflow conditions and sediment deposition (sand), was responsible for the lower habitat assessment score at this most downstream reach sampled (MA DEP 2001c). At the time of the 2001 biomonitoring survey (Appendix B) both dams were scheduled for removal, so the biological examinations were conducted to assess aquatic faunal health and pre-removal conditions. Restoring habitat for coldwater fisheries in Yokum Brook began with the removal of Silk Mill Dam in Becket in February 2003.

Biology

MDFW regularly stocks salmon fry and trout in Yokum Brook.

In August 2001 MDFW conducted backpack electrofishing in Yokum Brook along Route 8 just below the Bear Creek Store Bridge in Becket (Richards 2003). Six species were collected from within this segment, including, in order of abundance, Atlantic salmon, blacknose dace, brook trout, longnosed dace, creek chubsucker, and a brown trout. Multiple age classes of Atlantic salmon and brook trout were found.

In September 2001 DWM conducted a modified Rapid Bioassessment Protocol III (RBP III) benthic macroinvertebrate survey in three reaches of Yokum Brook in Becket: downstream from Route 8 near intersection with Carter Road (approximately 50m upstream from the Silk Mill Dam) (Station YB01A), 100m upstream from Prentice Place (between the Silk Mill and Ballou dams (Station YB01B) and downstream from Ballou Dam near the Becket Elementary School at the mouth of the brook (Station YB01C, Appendix B). The benthic community at the most upstream station (YB01A) was extremely diverse and was considered to represent the "best attainable" conditions in the watershed. It was, therefore, used as a reference station (Appendix B). Backpack electrofishing by DWM in September 2001 in this reach of the brook resulted in the collection of seven species of fish. These included, in order of abundance, Atlantic salmon, blacknose dace, yellow perch, longnosed dace, eastern brook trout, brown trout, and a creek chubsucker. Multiple age classes of Atlantic salmon, eastern brook trout, and brown trout were found. A small amount of green filamentous algae was observed. However, coverage in this partially canopied reach was very low (<1%) (Appendix D, MA DEP 2001c). The RPB III analysis of the benthic macroinvertebrate community between the Silk Mill and Ballou dams (Station YB01B) indicated non-impacted conditions compared to the upstream reference station on Yokum Brook (Station YB01A). The fish community in this reach was comprised of five species, including, in order of abundance, Atlantic salmon, eastern brook trout, blacknose dace, yellow perch, and a creek chubsucker. Multiple age classes of Atlantic salmon and eastern brook trout were found (Appendix B). The algal coverage was very low (<1%) (Appendix D, MA DEP 2001c). The RPB III analysis indicated that the benthic community at the most downstream station sampled in Yokum Brook (Station YB01C) was non-impacted when compared to upstream reference station on the Yokum Brook (Appendix B). Six species of fish were collected from this location including, in order of abundance, blacknose dace, slimy sculpin, longnosed dace, Atlantic salmon, eastern brook trout, and brown trout. Multiple age classes of Atlantic salmon and eastern brook trout were found (Appendix B). No algae were visible at this sampling location (Appendix D).

Chemistry – Sediment

On 26 July 2001 the USGS conducted a screening examination of sediments behind two dams on Yokum Brook - above the Silk Mill Dam (the upstream dam that has now been removed) and above

the Ballou Dam (the lower dam that is still slated for removal) (Zimmerman and Brealt 2003). Three sediment cores were taken from behind the Silk Mill Dam and one sediment core was taken from behind the Ballou Dam. Sediment samples from these cores were analyzed for a suite of organic and inorganic constituents. Polycyclic aromatic hydrocarbons (PAHs) were detected in all samples analyzed, ranging in concentrations from 2.2 to > 5 ppm (the deepest core samples having the highest concentrations). The Lowest Effect Level (L-EL) guideline for total PAH is 4 ppm. However, the Severe Effect Level (S-EL) cannot be calculated (no total organic carbon data are available for the calculation). Two of fourteen samples, both from the Silk Mill Dam, slightly exceeded the L-EL. Three deep core sample results (two behind Silk Mill and one behind Ballou Dam) were reported as >5 ppm and cannot be compared to the guideline for total PAH. Neither petroleum hydrocarbons nor polychlorinated biphenyls (PCB) were detected in the Yokum Brook sediment. Chlordane was detected in only one sample collected behind Ballou Dam. The concentration of chlordane did exceed the L-EL, however, the S-EL could not be calculated. Of the six metals analyzed arsenic and zinc concentrations were below the L-ELs in all samples analyzed. The cadmium samples were all reported as <1 ppm and the L-EL (0.6 ppm) is lower than the detection limit so no comparisons could be made. The concentration of three metals (copper, nickel and lead) in samples collected behind Silk Mill Dam slightly exceeded the L-ELs for those metals (one copper sample, two nickel samples and two lead samples). The concentrations in all of the other samples analyzed behind Silk Mill and Ballou dams were less than the L-ELs.

The *Aquatic Life Use* for Yokum Brook is assessed as support based primarily on the benthic macroinvertebrate community analyses and the fish population information. The presence of reproducing salmonids and other intolerant, fluvial specialists/dependants is indicative of excellent water quality and stable streamflow conditions.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected fecal coliform bacteria samples from Yokum Brook at Route 8 bridge near Carter Road, Becket (Station YKMB00.2) in May and August 1996 (n=2) as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4). Additionally, DWM collected a fecal coliform bacteria sample in May 1996 from a discharge pipe upstream from the Route 8 bridge, which was discharging to an unnamed tributary of Yokum Brook (Station TTYB00.0).

No objectionable odors, oils, deposits, turbidity or other conditions were noted by DWM biologists at any of the three stream reaches sampled in September 2001 in the lower portion of Yokum Brook (Stations YB01A, YB01B, or YB01C).

Too limited data are available so the *Recreational* uses for Yokum Brook are currently not assessed. The *Aesthetics Use* is assessed as support based primarily on field observations by DWM biologists in 2001 and best professional judgment.

Yokum Brook (MA32-19) Use Summary Table

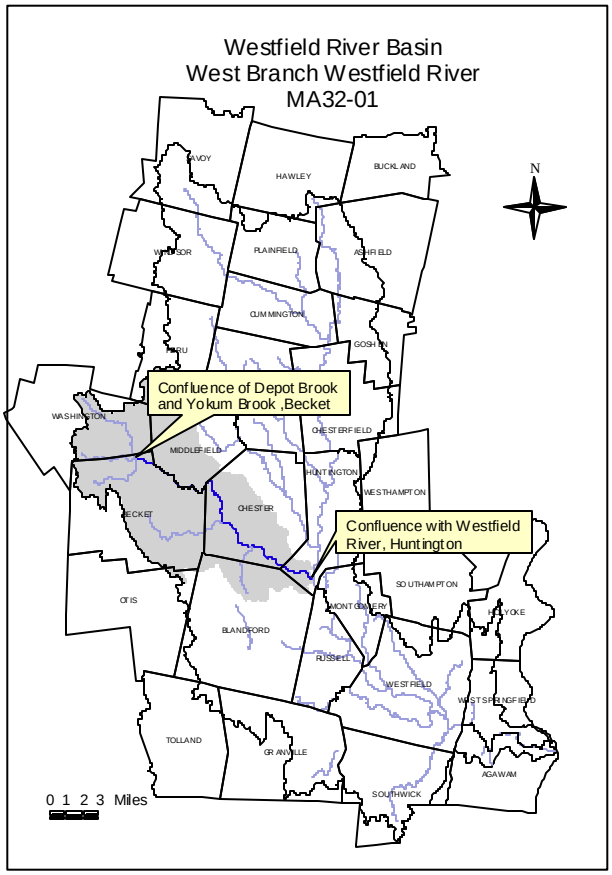
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | SUPPORT |

**RECOMMENDATIONS YOKUM BROOK (MA32-19)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Yokum Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.
- Biological monitoring is recommended to document changes in the biota of Yokum Brook following the removal of both dams and to assess the status of the *Aquatic Life Use*.
- Investigate the source of sediment (sand) loads to Yokum Brook downstream from Ballou Dam near the Becket Elementary School and remediate as deemed necessary to protect instream habitat quality.

## WEST BRANCH WESTFIELD RIVER (SEGMENT MA32-01)

Location: Source formed by confluence of Depot Brook and Yokum Brook in Becket to confluence with Westfield River, Huntington.
Segment Length: 18.1 miles
Classification: Class B, Cold Water Fishery




The drainage area of this segment is approximately 96 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Forest ..... 88%
- Residential ..... 5%
- Agriculture ..... 2%

The impervious cover area for the individual sub-basins located in this segment is 1.7%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The West Branch Westfield River is formed by the confluence of Depot Brook and Yokum Brook in Becket Center. The river flows southeasterly through steep terrain forming the municipal boundary between Middlefield and Becket. Just before crossing the town boundary of Chester the river winds to the northeast around Gobble Mountain and then resumes its southeasterly course at a fairly steep gradient through some floodplain development. The river flows through the town center of Chester, where it is joined by Walker Brook, and continues southeast into the town of Huntington, where the river gradient decreases and the terrain is not as steep. The river passes through Huntington town center and flows into the Westfield River.

Based on the last evaluation of water quality conditions the West Branch Westfield River is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation, Aesthetics) and was not assessed for others (Fish Consumption).

MDFW has proposed that several tributaries to the West Branch Westfield River be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003). They are Roaring Brook (West Branch), Goldmine Brook, Otis Wait Brook, Factory Brook, and Coles Brook.

### WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)

| Facility | WMA Registration Number | Sources | Authorized Withdrawal (MGD) |
|---|---|---|---|
| Huntington Water Department | 10414301 | Cold Brook Reservoir, 143-01S<br>Well#1, 1143000-01G<br>Well#2, 1143000-02G | 0.12 |

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H1)

The Huntington WWTP (NPDES #MA0101265) discharges midstream, approximately 10 feet upstream from the confluence with the mainstem Westfield River. Information on this facility can be found in the Westfield River segment MA32-05.

**USE ASSESSMENT**

***AQUATIC LIFE***

Habitat and Flow

The USGS, in cooperation with the MA DCR and MA DFG, investigated monthly flow-durations and low-flow statistics over a 25 year period (1976-2000) for 23 index streamflow-gaging stations in Massachusetts, Connecticut, Rhode Island, and New Hampshire (Armstrong *et al*. 2004). The index stations were located in watershed areas with minimal effects from surface-water regulation or reduction of base flow from ground-water withdrawals. Flow-duration and low-flow statistics at the index stations were compared to flow management targets and streamflow requirements for habitat protection determined using a variety of instream flow methods. One of the 23 index stations was located on the West Branch Westfield River in Huntington, approximately 1.5 miles upstream from the confluence of the West Branch Westfield River with the mainstem Westfield River. Median and interquartile ranges for 50-percent monthly flow durations and n-day low-flow statistics, normalized by drainage area, were calculated. Monthly median flows for June through August for the West Branch Westfield River were slightly less than the median values for the other 22 stations. Existing habitat quality depends on this base-flow. Consequently, water-withdrawals and alterations to land-use that further reduce summer streamflows may have consequences for instream habitat quality.

A benthic macroinvertebrate and habitat survey was performed by DWM biologists in August 1996 in two reaches of this segment of the West Branch Westfield River: upstream from the town of Huntington center just downstream from a footbridge (Station WB01) and downstream from the town's center upstream from the confluence with the mainstem Westfield River, Huntington (Station WB02). Habitat quality conditions at these locations are described in detail in Appendix C.

Biology

MDFW regularly stocks salmon fry and trout in West Branch Westfield River.

In August 2001 MDFW conducted barge and backpack electrofishing in the West Branch Westfield River off of Route 20 near the roadside park in Chester (MDFW sample Stations 353 and 378) (Richards 2003 and Richards 2004). Sampling efficiency was described as fair. A total of 12 species were collected including, longnosed dace, Atlantic salmon, blacknosed dace, common shiner, tessellated darter, as well as a few or an individual of smallmouth bass, spottail shiner, American eel, brown bullhead, creek chubsucker, slimy sculpin and white sucker. The presence of multiple age classes of Atlantic salmon and slimy sculpin (both intolerant species) is indicative of excellent water quality.

A benthic macroinvertebrate and habitat survey was performed by DWM biologists in August 1996 in two reaches of this segment of the West Branch Westfield River: upstream from the town of Huntington center just downstream from a footbridge (Station WB01) and downstream from the town's center upstream from the confluence with the mainstem Westfield River, Huntington (Station WB02). Results of the RBP II analyses are provided in detail in Appendix C.

Toxicity

*Ambient*

Water from the West Branch Westfield River was collected just downstream from the Route 112 bridge (across from Department of Public Works shed) in Huntington for use as dilution water for the Huntington POTW whole effluent toxicity tests. Between November 1998 and May 2004 survival of both *C. dubia and P. promelas* exposed (48 hours) to the river water was excellent ($\geq$ 93%) in all 22 tests conducted.

Chemistry – water

Water from the West Branch Westfield River was collected just downstream from the Route 112 bridge (across from Department of Public Works shed) in Huntington for use as dilution water for the Huntington POTW whole effluent toxicity tests. Data from these reports (maintained in the TOXTD database) between November 1998 and May 2004 are summarized below.

*pH*
Instream pH ranged between 6.4 and 7.6 SU and only one of the 22 measurements was < 6.5 SU.
*Suspended Solids*
The maximum suspended solids concentration was 7.0 mg/L.

*Ammonia-Nitrogen*
The maximum ammonia-nitrogen concentration was 1.1 mg/L although it should be noted that of the 22 measurements recorded 86% were <0.05 mg/L.

*Total Residual Chlorine*
With the exception of one measurement (0.07 mg/L), all other TRC measurements were $\leq$ 0.05 mg/L.

*Alkalinity*
Alkalinity measurements ranged between 10 and 60 mg/L.

*Hardness*
Hardness measurements ranged between 16 and 52 mg/L, with 10 out of 22 samples $\leq$ 25 mg/L.

The *Aquatic Life Use* for the West Branch Westfield River is assessed as support based on the good survival of test organisms exposed to the river water, the fish population information, and best professional judgment. The absence of trout and the relatively low abundance of intolerant fishes other than stocked salmon are of concern, so the *Aquatic Life Use* is identified with an Alert Status.

***FISH CONSUMPTION***

Fish were collected from the West Branch Westfield River by MA DEP and MDFW personnel in October 1990 in the reach at Keystone Bridges/Conrail Area, Becket/Washington (Maietta 1993). Tissue from brown trout, eastern brook trout and white suckers were analyzed for selected metals (including mercury), PCB's, and other pesticides. The results of this survey did not indicate a problem nor did MA DPH issue any advisories with respect to fish consumption (Maietta 1993).

Because no site-specific fish consumption advisory was issued by MA DPH for this segment of the Westfield River the *Fish Consumption Use* is not assessed.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

Environmental Sciences Services, Inc (ESS 2000) collected a fecal coliform sample from ESS Station SS-1 on 30 September 1999 (located on the West Branch Westfield River at the Route 112 bridge, Huntington). The fecal coliform count was 1600 cfu/100 mls.

DWM collected fecal coliform bacteria samples from five stations along the West Branch Westfield River: below Becket center downstream from the confluence with Yokum Brook in Becket (Station WBWF16.1), near the Bancroft Road/Town Hill Road bridge, Becket/Middlefield (Station WBWF13.2), Middlefield Road bridge in Chester (Station WBWF08.9), approximately 0.9 miles upstream from Sanderson Brook in Chester (Station WBWF05.4), and USGS gaging station on Fiske Avenue in Huntington (Station WBWF01.4) in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

No objectionable conditions were noted by DWM biologists at either of the two river reaches sampled for benthic macroinvertebrate assemblages in this segment in 1996 (Appendix C).

Too limited recent data are available, so the *Recreational* and *Aesthetics* uses for the West Branch Westfield River are not assessed.

West Branch Westfield River (MA32-01) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT* | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |

*Alert Status issues identified, see details in the use assessment section

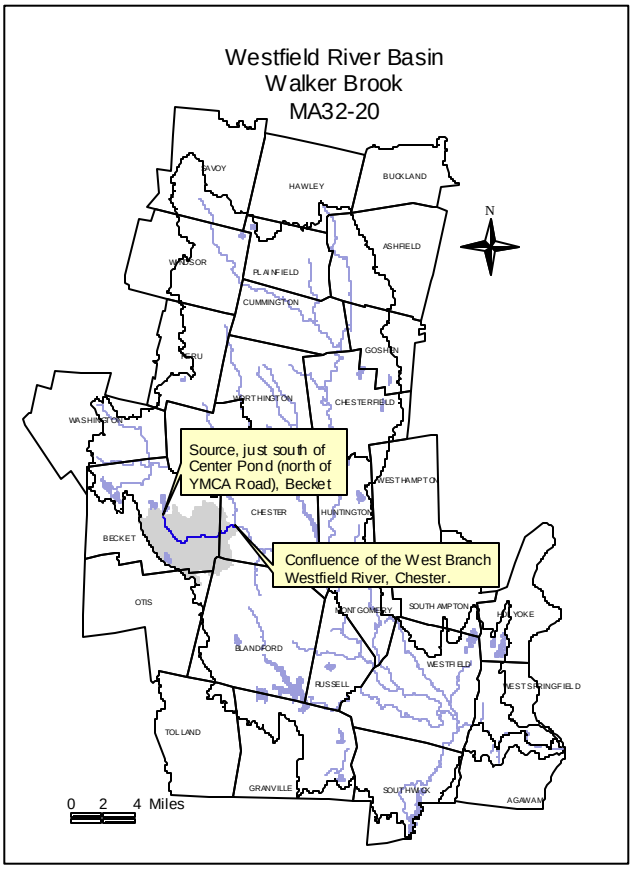
**RECOMMENDATIONS WEST BRANCH WESTFIELD RIVER (MA32-01)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.

- Additional biological monitoring (macroinvertebrates and fish) is recommended to assess the status of the *Aquatic Life Use*. Long-term monitoring of fish populations in this segment of the Westfield River would be valuable to investigate possible impact of salmon stocking on reproducing wild trout populations.

## WALKER BROOK (SEGMENT MA32-20)

Location: Headwaters, at outlet of Center Pond (north of YMCA Road) in Becket to confluence of the West Branch Westfield River, Chester.
Segment Length: 7.1 miles
Classification: Class B




The drainage area of this segment is approximately 18 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 84%
Residential ..... 9%
Open Land ..... 2%

The impervious cover area for the individual sub-basins located in this segment is 2.3%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Walker Brook forms at the outlet of Center Pond in Becket. The brook flows southeasterly over moderately sloping terrain to Bonny Rigg Corners where it turns to the east paralleling Route 20 for much of its length. After passing through Becket State Forest the brook crosses into Chester and flows towards the northeast through a very narrow steep valley to its confluence with the West Branch Westfield River in Chester town center.

Based on the last evaluation of water quality conditions Walker Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that Walker Brook and its tributary Cushman Brook be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003).

### WMA WATER WITHDRAWAL

Based on the available information there are no WMA regulated water withdrawals in this subwatershed.

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H2)

The Town of Chester is authorized (NPDES permit MAG640035 issued December 1995) to discharge sand media filtered water from the Austin Brook Reservoir Slow Sand Water Filtration Plant in Chester to Austin Brook Reservoir. (It should be noted that MA DEP and EPA are deliberating the need for an NPDES discharge for slow sand water filtration plants, since no chemicals are used in the treatment process.)

**USE ASSESSMENT**

***AQUATIC LIFE***

Biology

MDFW regularly stocks salmon fry and trout in Walker Brook.

In August 2001 MDFW conducted backpack electrofishing in Walker Brook adjacent to Route 20 (upstream from the confluence with Austin Brook near the Pine Hill Cemetery) in Chester (Richards 2003). Eight species were collected, including, in order of abundance, blacknose dace, longnosed dace, Atlantic salmon, slimy sculpin, brown trout, brook trout, white sucker, and a creek chubsucker. Multiple age classes of Atlantic salmon, brown trout, and brook trout were found. These species are all fluvial specialists/dependants.

The *Aquatic Life Use* for Walker Brook is assessed as support based on the fish population information and best professional judgment. The presence of four intolerant species of fish is indicative of excellent water and habitat quality.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected fecal coliform bacteria samples from Walker Brook near the Hampden Street Bridge (near Route 20) in Chester (Station WLKB00.4) in May and August 1996 (n=2) as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited data are available so the *Recreational* and *Aesthetics* uses are currently not assessed.

Walker Brook (MA32-20) Use Summary Table

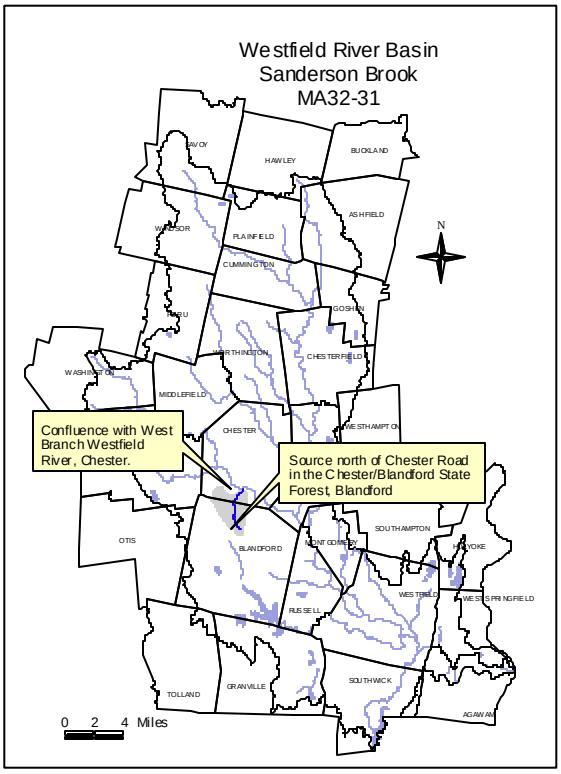
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |

**RECOMMENDATIONS WALKER BROOK (MA32-20)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Biological monitoring (benthic macroinvertebrate and fish) is recommended to assess the status of the *Aquatic Life Use*.
- Walker Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

## SANDERSON BROOK (SEGMENT MA32-31)

Location: Source north of Chester Road in the Chester/Blandford State Forest, Blandford, to confluence with West Branch Westfield River, Chester.
Segment Length: 3.5 miles
Classification: Class B




The drainage area of this segment is approximately 4 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 94%
Agriculture ..... 3%
Residential ..... 2%

The impervious cover area for the individual sub-basins located in this segment is 1.6%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The headwaters of Sanderson Brook begin just north of the Massachusetts Turnpike in Blandford and flow north into the Chester-Blandford State Forest. The brook then flows northeast into Chester soon joined by Griffin Brook. Sanderson Brook flows down very steep terrain to its confluence with the West Branch Westfield River in Chester.

Based on the last evaluation of water quality conditions Sanderson Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that Sanderson Brook and its tributary Griffin Brook be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Habitat and Flow

As part of the MA DEP Biocriteria Development Project, a habitat survey was performed by DWM in Sanderson Brook off the west side of Sanderson Brook Road approximately 1000 meters south (upstream) of Route 20 in Chester (Station BT04SAN) in September 1997. At the time of the survey the brook was roughly 3 m wide with a depth of approximately 0.25 m. The substrates were comprised primarily of boulder, cobble, and gravel. The overall habitat score was 168 out of a possible 200 (MA DEP 1997). Habitat quality was limited most by the channel flow status.

Biology

As part of the MA DEP Biocriteria Development Project, DWM biologists collected benthic macroinvertebrate samples from Sanderson Brook off the west side of Sanderson Brook Road approximately 1000 meters south (upstream) of Route 20 in Chester (Station BT04SAN) in September 1997 (Lotic 1999). Electrofishing was also conducted by DWM at this location on 23 September 1997 (ENSR 1997). Fish collected in order of abundance included: brown trout, eastern brook trout, slimy sculpin, and a longnosed dace. In a replicate reach Atlantic salmon were also found. Multiple age classes of brown trout and eastern brook trout were found. All species collected are fluvial specialists/dependants.

Chemistry – water

*In-situ* measurements (dissolved oxygen, % saturation, pH, temperature, conductivity, and turbidity) of Sanderson Brook off the west side of Sanderson Brook Road approximately 1000 meters south (upstream) of Route 20 in Chester (Station BT04SAN) were made on 23 September 1997 as part of the Biocriteria Development Project (Appendix G, Table G3).

The *Aquatic Life Use* is assessed as support based on the fish community data and best professional judgment. The presence of Atlantic salmon, reproducing brown and brook trout and slimy sculpin are indicative of high quality cold water.

***AESTHETICS***

No aesthetic quality degradation (odors, turbidity, oil, grease) or any other objectionable conditions were noted by DWM biologists during their survey in Sanderson Brook in 1997 (MA DEP 1997).

The *Aesthetics Use* is assessed as support for Sanderson Brook based primarily on field observations by DWM biologists in 1997 and best professional judgment.

Sanderson Brook (MA32-31) Use Summary Table

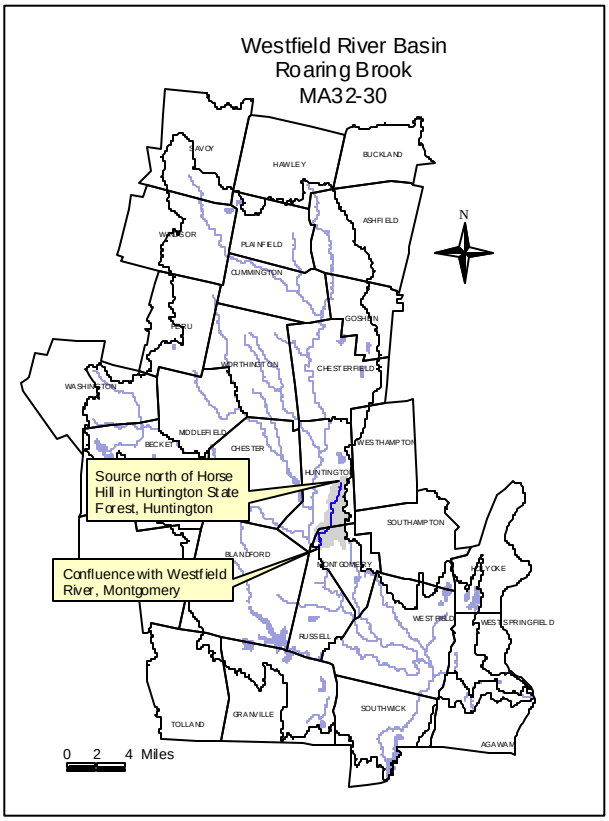
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | SUPPORT |

**RECOMMENDATIONS SANDERSON BROOK (MA32-31)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Biological monitoring is recommended to assess the status of the *Aquatic Life Use*.
- Sanderson Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

## ROARING BROOK (SEGMENT MA32-30)

Location: Source north of Horse Hill in Huntington State Forest, Huntington to confluence with Westfield River, Montgomery.
Segment Length: 4.3 miles
Classification: Class B




The drainage area of this segment is approximately 6 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 85%
Residential ..... 8%
Agriculture..... 5%

The impervious cover area for the individual sub-basins located in this segment is 1.7%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Roaring Brook forms south of the village of Norwich in Huntington. The brook flows southwesterly through undeveloped terrain entering a very steep reach in the Huntington State Forest. Horse Hill Brook joins Roaring Brook just before the town boundary with Montgomery. As the brook enters Montgomery it turns to the southwest where it is joined by Crow Brook. Roaring Brook continues flowing over steep terrain until it reaches a relatively flat area. It then turns south and flows onto a broad floodplain before its confluence with the Westfield River in Montgomery (opposite of the village of Crescent Mills in Russell).

Based on the last evaluation of water quality conditions Roaring Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that Roaring Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Habitat and Flow

As part of the MA DEP Biocriteria Development Project, a habitat survey was performed by DWM in Roaring Brook upstream from the second Carrington Road crossing of the brook in Montgomery (Station BT07ROA) in September 1997. At the time of the survey the brook was roughly 2 m wide with a depth of approximately 0.25 m. The substrates were comprised primarily of boulder, cobble, and gravel. The overall habitat score was 166 (MA DEP 1997). Habitat quality was limited most by the channel flow status and sediment deposition.

Biology

MDFW regularly stocks salmon fry in Roaring Brook.

As part of the MA DEP Biocriteria Development Project, MA DEP DWM biologists collected benthic macroinvertebrate samples from Roaring Brook upstream from the second Carrington Road crossing

of the brook in Montgomery (Station BT07ROA) in September 1997 (Lotic 1999). Electrofishing was also conducted by DWM at this location on 24 September 1997 (ENSR 1997). Fish collected in order of abundance included: blacknose dace and slimy sculpin, Atlantic salmon, eastern brook trout, and brown trout. Multiple age classes of Atlantic salmon, eastern brook trout, and brown trout were found. The presence of Atlantic salmon, reproducing brown and brook trout and slimy sculpin are indicative of high quality cold water.

Chemistry – water

*In-situ* measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of Roaring Brook upstream from the second Carrington Road crossing of the brook in Montgomery (Station BT07ROA) were made on 24 September 1997 as part of the Biocriteria Development Project (Appendix G, Table G3).

The *Aquatic Life Use* is assessed as support based on the fish community data and best professional judgment. The fish species present are all fluvial specialists/dependants. In addition, the presence of four intolerant species is indicative of excellent water and habitat quality.

***AESTHETICS***

No aesthetic quality degradation (odors, turbidity, oil, grease) or any other objectionable conditions were noted by DWM biologists during their survey in Roaring Brook in 1997 (MA DEP 1997).

The *Aesthetics Use* is assessed as support for Roaring Brook based primarily on field observations by DWM biologists in 1997 and best professional judgment.

Roaring Brook (MA32-30) Use Summary Table

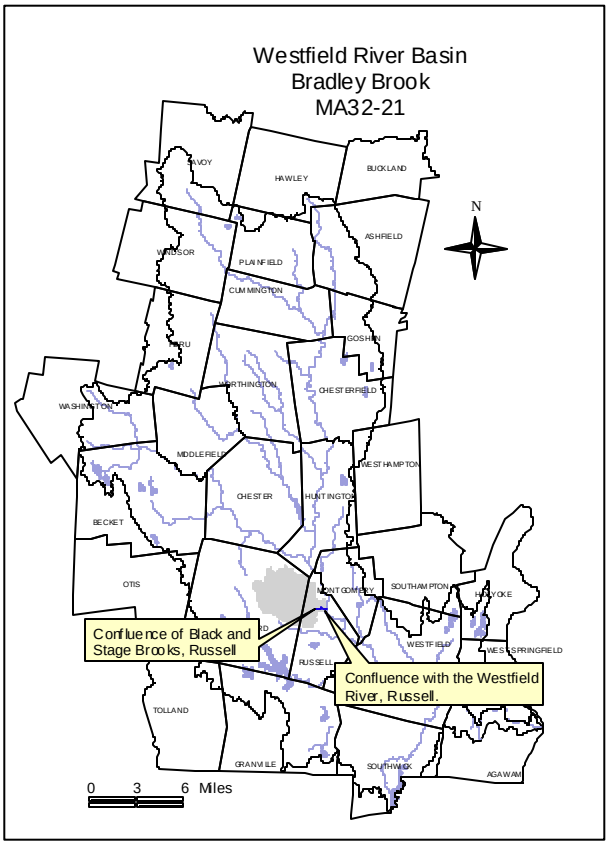
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | SUPPORT |

**RECOMMENDATIONS ROARING BROOK (MA32-30)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Biological monitoring is recommended to assess the status of the *Aquatic Life Use*.
- Roaring Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

## BRADLEY BROOK (SEGMENT MA32-21)

Location: From the confluence of Black and Stage Brooks, Russell, to the confluence with the Westfield River, Russell.
Segment Length: 0.7 miles
Classification: Class B




The drainage area of this segment is approximately 11 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 86%
Open Land ..... 5%
Residential ..... 4%

The impervious cover area for the individual sub-basins located in this segment is 2.2%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Bradley Brook is formed at the confluence of Black and Stage Brooks in the town of Russell and flows east through Russell town center to its confluence with the Westfield River just upstream from the Westfield River Paper Company Dam in Russell.

Based on the last evaluation of water quality conditions Bradley Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that Bradley Brook and its tributaries Stage and Freeland brooks be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003).

### WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)

| Facility | WMA Permit Number | WMA Registration Number | Sources | Authorized Withdrawal (MGD) |
|---|---|---|---|---|
| Russell Water Department | 9P210425602 | 12560000 | Black Brook Reservoir 256-01S<br>Well#1, 1256000-01G | 0.29* |

* indicates system-wide withdrawal; all sources are not within this segment

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H)

The Mass Turnpike Authority used to operate a sewage disposal pond (MA0023515), which discharged into Freeland Brook, a tributary to Stage Brook. According to MA DEP's Western Regional Office their discharge was routed to the Russell WWTP in 1996 (Nietupski 2004a).

### USE ASSESSMENT

***AQUATIC LIFE***

Habitat and Flow

As part of the MA DEP Biocriteria Development Project, a habitat survey was performed by DWM on Bradley Brook behind #54 Moss Hill Road, approximately 400 meters west (upstream) of Route 20 in Montgomery (Station BT03BRA), in September 1997. At the time of the survey the brook was roughly 3m wide with depths between 0.25 and 0.75m in the runs and pools. The substrates were

comprised primarily of boulder, cobble, and gravel. The overall habitat score was 184 out of a possible 200 (MA DEP 1997).

Complaints of sediment inputs from Bradley Brook to the Westfield River just upstream from the Westfield River Paper Company Dam in Russell have recently been reported (Lynch 2004).

Biology

As part of the MA DEP Biocriteria Development Project, MA DEP DWM biologists collected benthic macroinvertebrate samples from Bradley Brook behind #54 Moss Hill Road, approximately 400 meters west (upstream) of Route 20 in Montgomery (Station BT03BRA) in September 1997 (Lotic 1999). Electrofishing was also conducted by DWM at this location on 23 September 1997 (ENSR 1997). Fish collected in order of abundance included: Atlantic salmon, blacknose dace, eastern brook trout, and an individual each of brown trout and pumpkinseed. Multiple age classes of Atlantic salmon and eastern brook trout were found. With the exception of the individual pumpkinseed all species collected are fluvial specialists/dependants.

Chemistry – water

*In-situ* measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of Bradley Brook behind #54 Moss Hill Road, approximately 400 meters west (upstream) of Route 20 in Montgomery (Station BT03BRA), were made on 23 September 1997 as part of the Biocriteria Development Project (Appendix G, Table G3).

The *Aquatic Life Use* is assessed as support based on the fish community data and best professional judgment. The presence of three intolerant species (Atlantic salmon, brook trout and brown trout) is indicative of excellent water and habitat quality.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION***

DWM collected fecal coliform bacteria samples from Bradley Brook behind the fire house in Russell center (Station BDLB00.1) in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited recent data area available, so the *Primary* and *Secondary Contact Recreational* Uses are not assessed for Bradley Brook.

***AESTHETICS***

No aesthetic quality degradation (odors, turbidity, oil, grease) or any other objectionable conditions were noted by DWM biologists during their survey in Bradley Brook in 1997 (MA DEP 1997).

Discussions with Richard and Nancy Lynch (part owners of the proposed Russell Falls Hydroelectric Plant on the Westfield River) report a serious siltation problem over many years emanating from Bradley Brook. This silt deposits behind the dam after it joins the Westfield River. They note that various construction and land disturbances upstream in Bradley Brook have contributed to this continued problem. Bradley Brook, particularly near the lower end in Russell, is visibly clouded much of the time. Mr. Lynch relates that when, as dam operator before the hydroelectric plant shut down in 1994, he was responsible for dredging material from the upstream side of the dam every few years due to siltation coming from Bradley Brook (Lynch 2004).

The *Aesthetics Use* is assessed as support in Bradley Brook based primarily on the observations of DWM biologists during their survey. However, this use is identified with an Alert Status based on the observations/complaints of turbidity.

Bradley Brook (MA32-21) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | SUPPORT* |

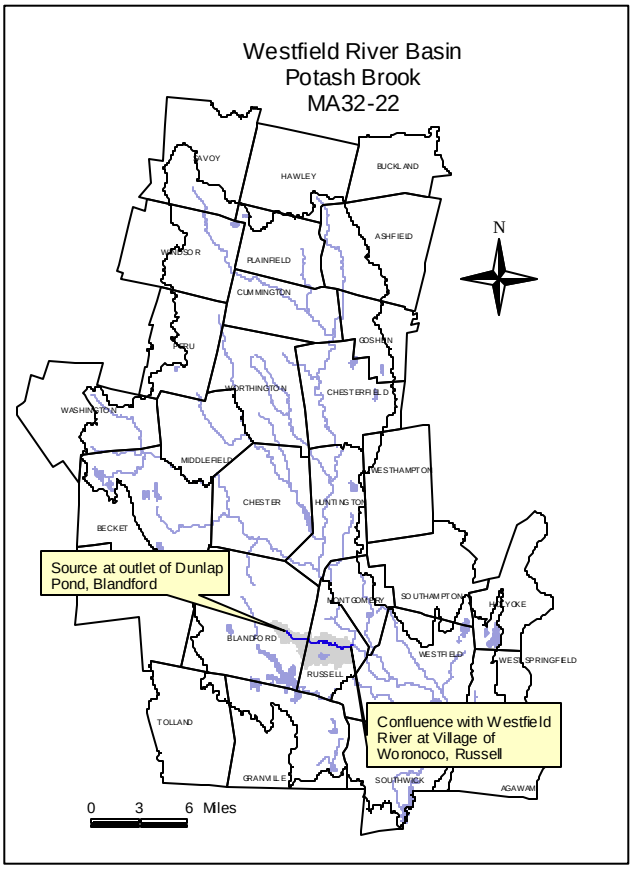
* Alert Status issues identified, see details in use assessment section

**RECOMMENDATIONS BRADLEY BROOK (MA32-21)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Biological monitoring is recommended to assess the status of the *Aquatic Life Use*.
- Bradley Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.
- Investigate inputs of sediment from Bradley Brook to the Westfield River and recommend actions as deemed necessary to remediate problem.

## POTASH BROOK (SEGMENT MA32-22)

Location: Source at outlet of Dunlap Pond in Blandford to confluence with Westfield River at the village of Woronoco, Russell.
Segment Length: 5.2 miles
Classification: Class B




The drainage area of this segment is approximately 7 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 80%
Residential ..... 9%
Transport ..... 4%

The impervious cover area for the individual sub-basins located in this segment is 4.7%. Thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Potash Brook originates from Dunlap Pond in Blandford and flows in an easterly direction paralleling the Massachusetts Turnpike and Route 23 to its confluence with the Westfield River in the village of Woronoco in Russell.

Based on the last evaluation of water quality conditions Potash Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). The segment was not assessed for any uses.

MDFW has proposed that Potash Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Biology

MDFW regularly stocks salmon fry and trout in Potash Brook.

In August 2001 MDFW surveyed the fish population within Potash Brook (Richards 2003). The station was located at the Route 23 Bridge in Russell. Six species collected, in order of abundance, were Atlantic salmon, brook trout, blacknose dace, creek chubsucker, common shiner, and one brook trout/brown trout hybrid. Multiple age classes of Atlantic salmon, brook trout were found. All species collected are fluvial specialists/dependants.

The *Aquatic Life Use* is assessed as support based on the fish community data and best professional judgment. The presence of two intolerant species (Altantic salmon and brook trout) is indicative of excellent water and habitat quality.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected a fecal coliform bacteria sample Potash Brook from the upstream side of the bridge on the road to Strathmore Paper in Russell (village of Woronoco) (Station PTAB00.1) in August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited recent data are available, so the Recreational and Aesthetic Uses for Potash Brook are not assessed.

Potash Brook (MA32-22) Use Summary Table

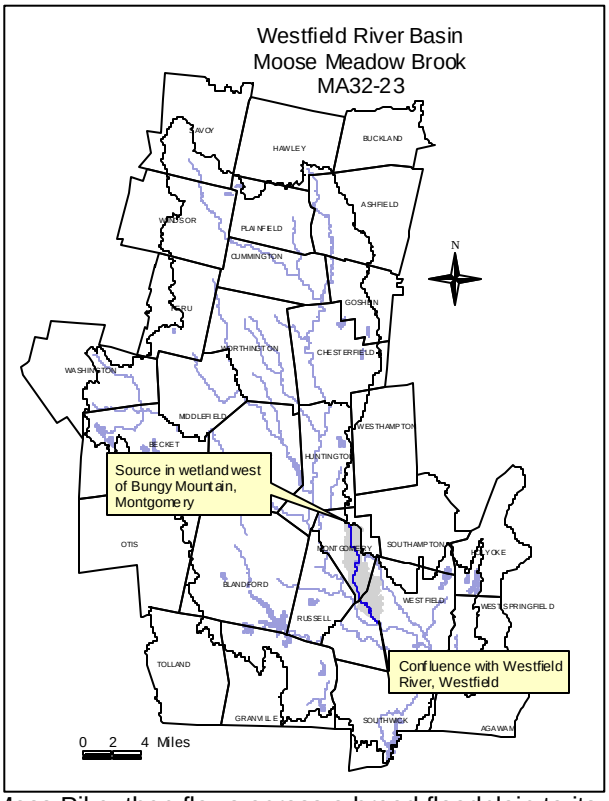
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |

**RECOMMENDATIONS POTASH BROOK (MA32-22)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Biological monitoring is recommended to assess the status of the *Aquatic Life Use*.
- Potash Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

## MOOSE MEADOW BROOK (SEGMENT MA32-23)

Location: Source in wetland west of Bungy Mountain, Montgomery, to confluence with Westfield River, Westfield.
Segment Length: 8.2 miles
Classification: Class B




The drainage area of this segment is approximately 8 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Forest ..... 80%
- Agriculture..... 9%
- Residential ..... 5%

The impervious cover area for the individual sub-basins located in this segment is 2.4%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Moose Meadow Brook originates in the town of Montgomery west of Bungy Mountain and flows south through Westfield Reservoir. The brook then continues over steep terrain past the east side of Tekoa Mountain into Tekoa Reservoir. Moose Meadow Brook continues flowing from the outlet of the reservoir initially in a southwesterly direction. It then turns towards the southeast crossing the corporate boundary into Westfield, passing under the Mass Pike, then flows across a broad floodplain to its confluence with the Westfield River.

Based on the last evaluation of water quality conditions Moose Meadow Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that Moose Meadow Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).

### WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)

| Facility | WMA Registration Number | Source | Authorized Withdrawal (MGD) |
|---|---|---|---|
| Westfield Water Department | 10432901 | Montgomery Reservoir**, 329-01S | 6.11* |

* indicates system-wide withdrawal; all sources are not within this segment
** also known as Tekoa Reservoir. This source is an emergency surface water supply and therefore this segment is not currently classified as a Class A waterbody.

### NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

***AQUATIC LIFE***

Habitat and Flow

As part of the MA DEP Biocriteria Development Project, a habitat survey was performed by DWM in Moose Meadow Brook approximately 400 meters north (upstream) of Tekoa Reservoir in Westfield (Station BT06MOO) in September 1997. At the time of the survey the river was roughly 4m wide, with a depth of approximately 0.25 m in the riffle/runs and 0.5m in the pool. The substrates were

comprised primarily of boulder, cobble, and gravel. The overall habitat score was 145 out 200 (MA DEP 1997). Habitat quality was limited most by the channel flow status, embeddedness, sediment deposition and the limited riparian vegetative cover on the right bank facing downstream.

Biology

As part of the MA DEP Biocriteria Development Project, MA DEP DWM biologists collected benthic macroinvertebrate samples from Moose Meadow Brook approximately 400 meters north (upstream) of Tekoa Reservoir in Westfield (Station BT06MOO) in September 1997 (Lotic 1999). Electrofishing was also conducted by DWM at this location on 24 September 1997 (ENSR 1997). Fish collected in order of abundance included: blacknose dace, eastern brook trout, golden shiner, and a creek chubsucker. Multiple age classes of eastern brook trout were found. The sample was dominated by fluvial specialists/dependants, one of which is intolerant (brook trout).

In August 2001 MDFW surveyed the fish population within Moose Meadow Brook (Richards 2003). The station was located near the Pochassic Road Bridge in Westfield. Nine fish species collected, in order of abundance, were blacknose dace, brown trout, longnosed dace, American eel, white sucker, tessellated darter, slimy sculpin, brook trout and creek chubsucker. Multiple age classes of brown trout and brook trout were included in the sample. The sample was dominated by fluvial specialists/dependants.

Chemistry – water

*In-situ* measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of Moose Meadow Brook approximately 400 meters north (upstream) of Tekoa Reservoir in Westfield (Station BT06MOO) were made on 24 September 1997 as part of the Biocriteria Development Project (Appendix G, Table G3).

Between 1 August and 3 October 2001 DWM collected *in-situ* measurements (n=4) from two stations on Moose Meadow Brook: Station MMBR02.4 approximately 250 feet downstream from Tekoa Reservoir, Montgomery, and Station MMBR00.5 at Farm Road (private road south off Pochassic Road) bridge, Westfield. Parameters measured included dissolved oxygen, pH, temperature, conductivity, and total dissolved solids (Appendix 2 of Appendix A). Grab samples were collected and analyzed for alkalinity, hardness, chloride, suspended solids and nutrients (Appendix 3 of Appendix A).

*DO*

The instream DO measured by DWM on Moose Meadow Brook at Station MMBR02.4 ranged from 8.9 to 10.8 mg/L (96% to 99% saturation), and at Station MMBR00.5 ranged from 4.7 to 10.1 mg/L (49% to 93% saturation).

*Temperature*

Temperatures recorded by DWM at Station MMBR02.4 ranged from 12.1 to 20.1°C and at Station MMBR00.5 ranged from 12.1 to 20.3°C.

*pH*

pH measurements recorded by DWM at Station MMBR02.4 ranged from 6.6 to 6.9 SU and at Station MMBR00.5 ranged from 6.7 to 7.0 SU.

*Conductivity*

Conductivity reported by DWM at Station MMBR02.4 ranged from 41.5 to 46.1 µS/cm and at Station MMBR00.5 ranged from 165 to 410 µS/cm.

*Solids*

The maximum total suspended solid concentrations reported by DWM at Station MMBR02.4 ranged from <1.0 to 1.5 mg/L and at Station MMBR00.5 ranged from <1.0 to 5.3 mg/L.

*Alkalinity*
The alkalinity reported by DWM at Station MMBR02.4 ranged from 7 to 8 mg/L and at Station MMBR00.5 ranged from 31 to 78 mg/L.

*Hardness*
Hardness was extremely low at Station MMBR02.4 ranging from 4 to 6 mg/L and was slightly higher at Station MMBR00.5 ranging from 14 to 53 mg/L.

*Ammonia-Nitrogen (as N)*
Ammonia-nitrogen concentrations reported by DWM at Station MMBR02.4 were below minimum detection limits and at Station MMBR00.5 ranged from <0.02 to 1.3 mg/L.

*Total Phosphorus (as P)*
Total phosphorus concentrations reported by DWM at Station MMBR02.4 ranged between 0.013 and 0.020 mg/L and at Station MMBR00.5 ranged between 0.049 and 0.29 mg/L.

The *Aquatic Life Use* is assessed as support based primarily on the fish population information, the limited water quality data, and best professional judgment. The presence of fluvial specialists/dependants, some of which are cold-water intolerant species, in both stream reaches sampled is indicative of high quality cold water. However, slightly low DO and elevated nutrients as well as the presence of the agricultural activities (grazing allowed in the riparian zone) result in the *Aquatic Life Use* being identified with an Alert Status for the lower 1.3-mile reach of the brook.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected fecal coliform bacteria samples from Moose Meadow Brook approximately 250 feet downstream of Tekoa Reservoir, Montgomery (Station MMBR02.4), between 1 August and 3 October 2001 (N=4). Sample results for fecal coliform ranged from <2 to 19 cfu/100 ml (Appendix 3 of Appendix A). Field survey crews did not note any objectionable odors, turbidity or deposits at this sampling location (MA DEP 2001b).

ESS collected fecal coliform bacteria samples from two tributaries to Moose Meadow Brook in 1999. The stations and results can be summarized as follows (ESS 2000).
Cooley Brook, north of Masspike, Westfield (Station SS-42) on 28 December - <10 cfu/100ml
Unnamed tributary, north of Masspike, Westfield (Station SS-41) on 28 December -150 cfu/100ml.

DWM collected fecal coliform bacteria samples from Moose Meadow Brook at a farm road (private access road to Conrail Line off Pochassic Road) bridge, Westfield (Station MMBR00.5) between 1 August and 3 October 2001 (N=4). Sample results for fecal coliform ranged from 3,300 to 24,000 cfu/100 ml (Appendix 3 of Appendix A). With the exception of one sampling event no objectionable odors, deposits or other conditions were noted by the field survey crews (MA DEP 2001b). However, water clarity in the brook was described as murky on one sampling occasion and there was evidence of cows having had access to the brook. ESS also collected fecal coliform bacteria samples from Moose Meadow Brook at the Conrail Bridge, Westfield (Station SS-5), on 3 November 1999. The fecal coliform bacteria result was 9,000 cfu/100ml (ESS 2000).

It should also be noted that DWM collected fecal coliform bacteria samples from Moose Meadow Brook near Pochassic Road, Westfield (Station MMBR01.1), in May and August 1996 (n=2) as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

The upper 6.9-mile reach of Moose Meadow Brook is assessed as support for the *Recreational* and *Aesthetic* uses. However the lower 1.3-mile reach of the brook is assessed as impaired for the *Recreational* and *Aesthetic* Uses because of the elevated fecal coliform bacteria counts and turbidity. The source of impairment is agricultural activities associated with grazing in the riparian zone.

Moose Meadow Brook (MA32-23) Use Summary Table

| Designated Uses | | Status |
|---|---|---|
| Aquatic Life |  | SUPPORT* |
| Fish Consumption |  | NOT ASSESSED |
| Primary Contact |  | SUPPORT upper 6.9 miles<br>IMPAIRED lower 1.3 miles<br>Causes: Fecal coliform, Turbidity<br>Source: Grazing in riparian zone |
| Secondary Contact |  | |
| Aesthetics |  | SUPPORT upper 6.9 miles<br>IMPAIRED lower 1.3 miles<br>Cause: Turbidity<br>Source: Grazing in riparian zone |

*Alert Status issues identified, see details in use assessment section

**RECOMMENDATIONS MOOSE MEADOW BROOK (MA32-23)**

- Landowners should be encouraged to implement agricultural Best Management Practices (BMPs) in this subwatershed to protect riparian areas and prevent agricultural runoff and streambank erosion. The Natural Resources Conservation Service and Department of Agricultural Resources may be able to provide assistance.

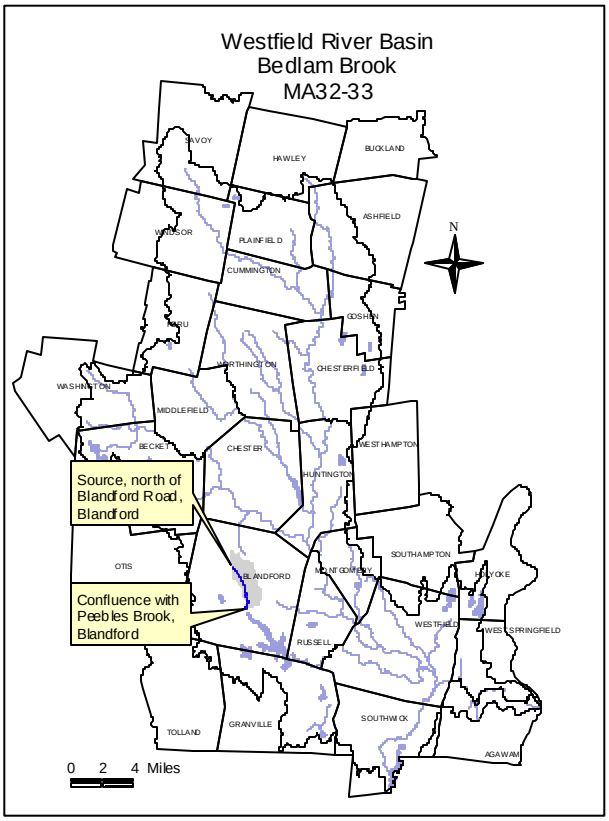
- Continue to conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses and to evaluate the implementation of any agricultural BMPs that are put into practice.

- Continue to conduct biological monitoring (habitat, benthic and fish community) to assess the status of the *Aquatic Life Use*.

- Moose Meadow Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

## BEDLAM BROOK (SEGMENT MA32-33)

Location: Source, north of Blandford Road, to confluence with Peebles Brook, Blandford.
Segment Length: 3.2 miles
Classification: Class A




The drainage area of this segment is approximately 4 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 77%
Agriculture..... 7%
Residential ..... 7%

The impervious cover area for the individual sub-basins located in this segment is 4.4%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Bedlam Brook is formed by the confluence of Tiffany Brook and an unnamed brook about 1.7 miles northwest of Blandford town center. The brook flows in a southward direction over undeveloped, moderately sloping terrain to its confluence with Peebles Brook in Blandford.

Based on the last evaluation of water quality conditions Bedlam Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that Bedlam Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Habitat and Flow

As part of the MA DEP Biocriteria Development Project, a habitat survey was performed by DWM in Bedlam Brook approximately 800 meters upstream from Route 23 in Blandford (Station BT02BED) in September 1997. At the time of the survey the brook was roughly 5m wide with a depth of approximately <0.25 m in the riffles and up to 0.5m in the run and pool habitats. The substrates were comprised primarily of boulder, cobble, and gravel. The overall habitat score was 169 (MA DEP 1997). Habitat quality was limited most by bank instability on the left side and the limitations related to velocity/depth combinations.

Biology

As part of the MA DEP Biocriteria Development Project, MA DEP DWM biologists collected benthic macroinvertebrate samples from Bedlam Brook at Station BT02BED in September 1997 (Lotic 1999). Electrofishing was also conducted by DWM at this location on 23 September 1997 (ENSR 1997). Fish collected in order of abundance included: brown trout, eastern brook trout, creek chubsucker, and blacknose dace. Multiple age classes of both brown trout and eastern brook trout were found. All species collected are fluvial specialists/dependants.

Chemistry – water

*In-situ* measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of Bedlam Brook approximately 800 meters upstream from Route 23 in Blandford (Station BT02BED) were made on 23 September 1997 as part of the Biocriteria Development Project (Appendix G, Table G3).

The *Aquatic Life Use* is assessed as support based on the fish population information and best professional judgment. The presence of two intolerant species (brook trout and brown trout) is indicative of excellent water and habitat quality.

***AESTHETICS***

No aesthetic quality degradation (odors, turbidity, oil, grease) or any other objectionable conditions were noted by DWM biologists during their survey in Bedlam Brook in 1997 (MA DEP 1997).

The *Aesthetics Use* is assessed as support based primarily on field observations by DWM biologists in 1997 and best professional judgment.

Bedlam Brook (MA32-33) Use Summary Table

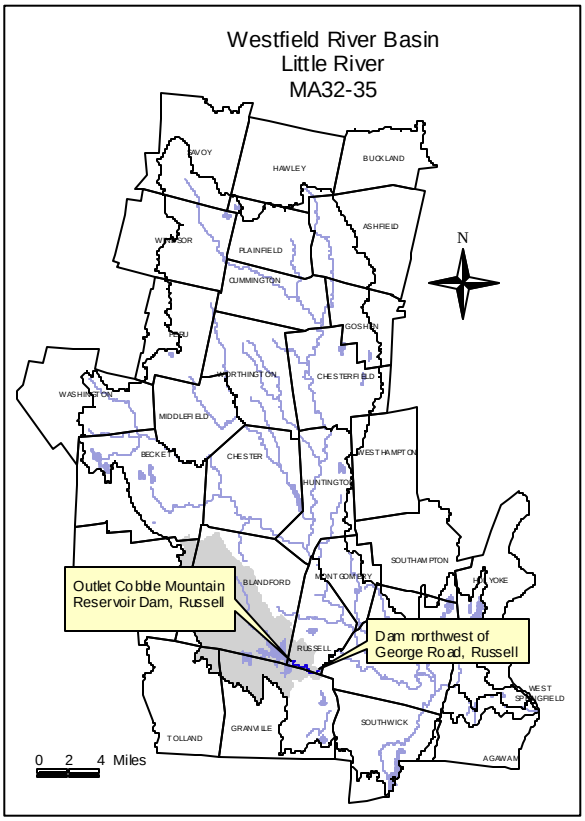
| Aquatic Life | Fish Consumption | Drinking Water | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | SUPPORT |

**RECOMMENDATIONS BEDLAM BROOK (MA32-33)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Continued biological monitoring is recommended in order to assess the *Aquatic Life Use*.
- Bedlam Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

## LITTLE RIVER (SEGMENT MA32-35, FORMERLY PART OF MA32-26)

Location: Source at the outlet of Cobble Mountain Reservoir dam, Russell, to dam northwest of Gorge Road, Russell (formerly part of Segment MA32-26).
Segment Length: 2.6 miles
Classification: Class B
*Note: MA DEP's Division of Water Supply has recommended that the Little River and its tributaries from the source at outlet of Cobble Mountain Reservoir Dam in Russel, to a dam northwest of Gorge Road, Russell, be reclassified from Class B to a Class A public water supply waterbody in the next revision of the SWQS.*




The drainage area of this segment is approximately 49 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 86%
Wetlands ..... 3%
Agriculture ..... 3%

The impervious cover area for the individual sub-basins located in this segment is 1.6%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The Little River begins at the outlet of Cobble Mountain Reservoir in Russell, a drinking water supply for the city of Springfield, and flows eastward through a very steep valley called The Gorge. The river is impounded behind a dam northwest of Gorge Road in Russell. The Borden Brook and Cobble Mountain Reservoirs, in this subwatershed, comprise the second largest water-supply storage system in Massachusetts.

Based on the last evaluation of water quality conditions this segment of the Little River is listed in Category 4C of the 2002 Integrated List of Waters (MA DEP 2003a). This segment is impaired because of flow alteration, but this impairment is considered a pollutant not subject to TMDL calculations

MDFW has proposed that Peebles Brook and Pond Brook (tributary to Peebles Brook) in this subwatershed, be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003).

### WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)

| Facility | WMA Registration Number | Sources | Authorized Withdrawal (MGD) |
|---|---|---|---|
| Springfield Water and Sewer Commission* | 10428101 | Cobble Mountain Reservoir, 281-02S<br>Borden Brook Reservoir | 37.2 |

* indicates system-wide withdrawal; all sources are not within this segment

### NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no NPDES regulated surface wastewater discharges to this segment.

### OTHER

FERC non-jurisdictional hydropower project Cobble Mountain Station, a hydroelectric generating station built in 1930 by the City of Springfield, is located downstream from Cobble Mountain Reservoir and just upstream from The Gorge on the Little River in Granville. The Station is owned by the Springfield Water and Sewer Commission and operated by Northeast Generation Services Company (NGS), a subsidiary of Northeast Utilities System (NUS). The Station contains three water wheel generators with a total rating of 30.6 megawatts. The Station's purpose is to generate electricity while meeting the city's demand for

water to the water treatment plant. The output of the hydrogenerators supplies the city's feed water to the Springfield West Parish Filter water treatment system.

**USE ASSESSMENT**

***AQUATIC LIFE***

Habitat and Flow

There are currently no flow release requirements at the Cobble Mountain Dam to the Little River. The hydropower operation is not licensed by FERC; it is a non-jurisdictional facility. There is a power tunnel leading from the reservoir to the Cobble Mountain Station that generates power when supplying the Springfield Water & Sewer Commission feed water (the output of the hydro generators flows into the impoundment of the Little River just downstream from The Gorge). Water is then taken from the impoundment via an intake tunnel and flows to the Springfield Water & Sewer Commissions West Parish Filter water treatment plant. The power tunnel bypasses approximately 2.2 miles of this segment of the Little River.

As part of the 2001 DWM Westfield River Watershed benthic macroinvertebrate survey, a habitat survey was performed in this segment of the Little River approximately 2 km downstream from the Cobble Mountain Reservoir outlet (Appendix B). The habitat score at Station LR02A was 182 out of a possible 200 and was only slightly compromised by the drought-induced low baseflow conditions observed.

Biology

In September 2001 DWM conducted a modified Rapid Bioassessment Protocol III (RBP III) benthic macroinvertebrate survey in this segment of the Little River approximately 2 km downstream from the Cobble Mountain Reservoir outlet (Station LR02A, Appendix B). The RPB III analysis of the benthic macroinvertebrate community indicated slightly impacted conditions compared to the reference station on the Westfield River near Route 112 in Huntington (Station WR01). Some green algae were present in the sample collected from the riffle area, but not in an excessive amount (Appendix D).

The *Aquatic Life Use* is assessed as support based primarily on the benthic macroinvertebrate community analysis. This use is, however, identified with an "Alert Status" because of flow alteration associated with the hydropower operation at Cobble Mountain Station (i.e., the power tunnel diversion bypasses approximately 2.2 miles of the Little River) and there are currently no flow release requirements from Cobble Mountain Reservoir to the Little River.

***AESTHETICS***

No objectionable deposits, odors or oils were observed by MA DEP DWM biologists in the Little River approximately 2 km downstream from the Cobble Mountain Reservoir outlet (Station LR02A) in September 2001 (MA DEP 2001c).

The *Aesthetics Use* is assessed as support based on the observations of DWM biologists.

LITTLE RIVER (MA32-35, formerly MA32-26) Use Summary Table

| Aquatic Life* | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | SUPPORT |

*Alert Status issues identified, see details in use assessment section

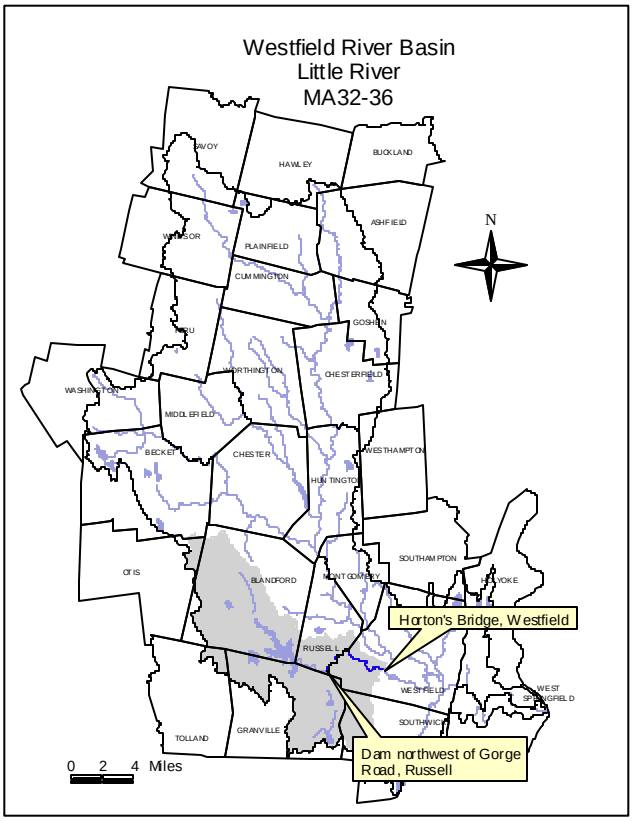
**RECOMMENDATIONS LITTLE RIVER (MA32-35)**

- Additional benthic macroinvertebrate sampling and instream flow measurements should be conducted during non-drought periods to determine the extent of effects due to flow alteration.

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.

## LITTLE RIVER (SEGMENT MA32-36, FORMERLY PART OF MA32-26)

Location: From the dam northwest of Gorge Road, Russell, to Horton's Bridge, Westfield (formerly part of Segment MA32-26)
Segment Length: 5.8 miles
Classification: Class B, Warm Water Fishery




The drainage area of this segment is approximately 78 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Forest ..... 83%
- Residential ..... 4%
- Open Land ..... 3%

The impervious cover area for the individual sub-basins located in this segment is 1.8%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

After the dam at the end of the impoundment in The Gorge the Little River continues to flow east and becomes the municipal boundary between the town of Russell and the city of Westfield. As the Little River flows into Westfield the topography changes from steep hilly to gently sloping and the river meanders to the southeast through a widened floodplain. The river then enters an impounded reach and this segment ends at Horton's Bridge in Westfield.

Based on the last evaluation of water quality conditions the segment of the Little River is listed in Category 4C of the 2002 Integrated List of Waters (MA DEP 2003a). This segment is impaired by factors such as flow alteration, but these impairments are considered pollutants not subject to TMDL calculations.

MDFW has proposed that Munn Brook, a tributary to this segment of the Little River, be listed in the next revision of the SWQS as cold water fisheries (MDFW 2003).

### WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)

| Facility | WMA Registration Number | Sources | Authorized Withdrawal (MGD) |
|---|---|---|---|
| Westfield Water Department | 10432901 | Well#6, 329-06G<br>Well#5, 329-05G<br>Granville Reservoir, 329-02S | 6.11* |

* indicates system-wide withdrawal; all sources are not within this segment

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H2 AND H3)

Northeast Utilities Service Co., Cobble Mountain Station, Old Granville Road, Westfield, MA0035556, discharges contact and non-contact cooling water to the Little River just downstream from the water supply intake dam. The most recent permit was issued 29 September 1998. The owners filed a permit reapplication in April 2003. The facility has station service sump water treated by an oil-water separator system. The sump water includes: turbine bearing cooling water, thrust bearing cooling water, trench and floor drain water, equipment de-watering, stormwater from transformer dikes, and non-contact cooling water from the transformer coolers. No water treatment chemicals are to be used, no discharge of PCB, or sanitary wastes are permitted.

The City of Springfield is permitted (NPDES permit MAG640023 issued January 2001) to discharge filter backwash from the West Parish Filters Water Treatment Plant and discharge up to 0.991 MGD (daily maximum flow) to Cook Brook, a tributary to this segment of the Little River. The effluent was not acutely toxic to *C. dubia* during the single test conducted in August 2001 ($LC_{50} \geq$ 100% effluent).

Westfield and Southwick are Phase II Stormwater communities. These communities were issued stormwater general permits from EPA and MA DEP in 2003/2004, and are authorized to discharge stormwater from the municipal drainage systems (MAR041236 and MAR041022, respectively). Over the five-year permit term the communities will develop, implement and enforce stormwater management programs to reduce the discharge of pollutants from their storm sewer systems to protect water quality (Domizio 2004).

**USE ASSESSMENT**

***AQUATIC LIFE***

Habitat and Flow

As part of the 2001 DWM Westfield River Watershed benthic macroinvertebrate survey, a habitat survey was performed in two reaches of this segment of the Little River - approximately 50m upstream from Cook Brook (Station LR02B) and approximately 100m downstream from Cook Brook (Station LR02C, Appendix B). The habitat score at Station LR02B was 154 out of a possible 200 and was only slightly compromised by the drought-induced low baseflow conditions observed. Just downstream from the confluence with Cook Brook sediment deposition was clearly visible emanating from Cook Brook. Silt comprised approximately 10% of the inorganic substrate components, which were not present in the upstream sampling reach (MA DEP 2001c). The sampling reach in the Little River downstream from Cook Brook (Station LR02C) received a total habitat assessment score of 156 out of 200 (Appendix B).

Biology

In July 2001 MDFW conducted backpack electrofishing in this segment of the Little River upstream from the Northwest Road crossing in Westfield (Station 332, Richards 2003). Eight fish species collected, in order of abundance, were blacknose dace, longnosed dace, common shiner, brook trout, American eel, brown trout, white sucker, and a creek chubsucker. Multiple age classes of brook trout and brown trout were included in the sample, but the sample was dominated by tolerant and moderately tolerant species.

In September 2001 DWM conducted a modified Rapid Bioassessment Protocol III (RBP III) benthic macroinvertebrate survey in two reaches of this segment of the Little River - upstream and downstream from the confluence with Cook Brook. The RPB III analysis of the benthic macroinvertebrate community upstream from Cook Brook (Station LR02B) indicated non-impacted conditions compared to reference station on the Westfield River near Route 112 in Huntington (Station WR01). The fish community was comprised of six species, including, in order of abundance, blacknose dace, longnosed dace, common shiner, eastern brook trout, and an individual each of brown trout and American eel (Appendix B). The fish community was similar to that found by MDFW (further upstream). The green, filamentous alga *Oedogonium* sp. covered approximately 100% of the substrates in the open-canopied riffle zone of the Little River upstream from Cook Brook, Russell (Station LR02B, Appendix D).

The RPB III analysis indicated that the benthic community in the Little River downstream from the confluence with Cook Brook (Station LR02C) was moderately impacted when compared to the reference station on the Westfield River (Appendix B). Slight impacts were detected when comparisons were made using the sampling station on the Little River upstream from Cook Brook as the reference station to assess the potential impacts originating from Cook Brook. Nine species of fish collected from this location (Station LR02C), in order of abundance, were blacknose dace, common shiner, longnosed dace, eastern brook trout, white sucker, brown trout, slimy sculpin, Atlantic salmon, and a fallfish. Multiple age classes of brown trout and Atlantic salmon were included in the sample (Appendix B). This fish community was also dominated by tolerant and moderately tolerant species. The green, filamentous alga *Oedogonium* sp. was not part of the algal assemblage found in the riffle zone of the Little River downstream from Cook Brook confluence (Station LR02C), but, it was abundant in the pool sample collected at the same station (Appendix D).

The *Aquatic* Life *Use* is assessed as support for this segment of the Little River upstream from its confluence with Cook Brook (3.6 miles) but assessed as impaired downstream from the confluence with Cook Brook (lower 2.2 mile reach). In the opinion of DWM biologists habitat quality degradation resulting from instream deposition is impacting the instream biota in the Little River downstream from its confluence with Cook Brook. Although there is a diverse assemblage of stream fishes the samples were dominated by species tolerant to both enrichment and habitat degradation (blacknose dace.

***FISH CONSUMPTION***

Fish were collected from the Little River by MA DEP and DFW personnel in October 1990 in the reach near the Northwest Street Bridge, Westfield (Maietta 1993). Tissue from brown trout, eastern brook trout and white suckers were analyzed for selected metals (including mercury), PCB, and other pesticides. The results of this survey did not indicate a problem nor did MA DPH issue any advisories with respect to fish consumption (Maietta 1993).

Because no site-specific fish consumption advisory was issued by MA DPH for this segment of the Westfield River the *Fish Consumption Use* is not assessed.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION***

ESS collected a bacteria sample from Munn Brook, a tributary to this segment of the Little River, off Grainville Road Bridge in Westfield (ESS Station SS-27) on 30 September 1999. The count was 5,800 cfu/100 ml (ESS 2000).

DWM collected fecal coliform bacteria samples from the Little River near Horton's Bridge (Station LITR04.7) in May and August 1996 and from Munn Brook in August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited data are available, so the *Primary* and *Secondary Contact Recreational* uses are not assessed for this segment of the Little River.

***AESTHETICS***

No objectionable odors, oils, or other deposits were observed by MA DEP DWM biologists in either of the two reaches surveyed in September 2001 - approximately 20 m upstream from Cook Brook (Station LR02B) and approximately 100m downstream from Cook Brook (Station LR02C, MA DEP 2001c). Green algal growth was conspicuous in the Little River upstream from its confluence with Cook Brook but was less abundant in the riffle sample collected downstream from the confluence with Cook Brook (Appendix D).

The *Aesthetics Use* is assessed as support for this segment of the Little River.

Little River (MA32-36, formerly MA32-26) Use Summary Table

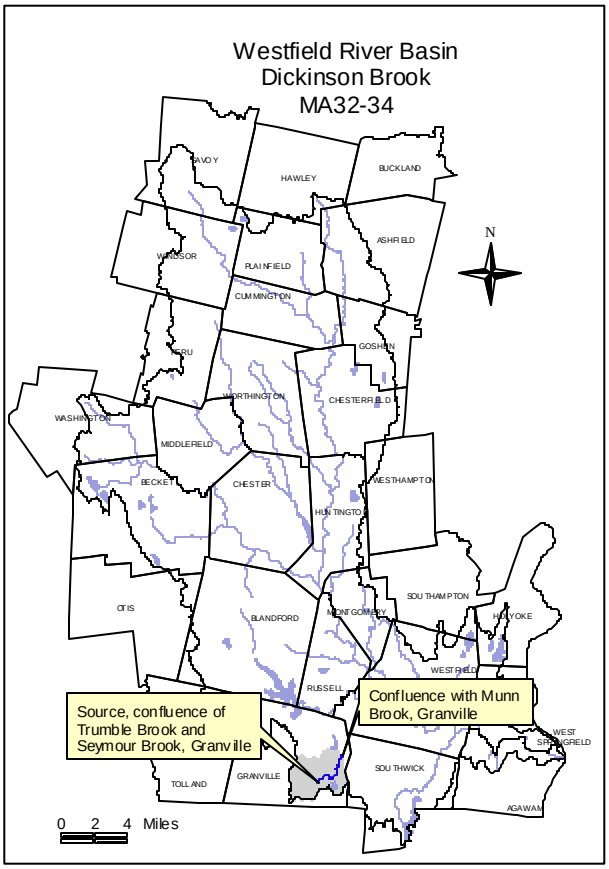
| Designated Uses | | Status |
|---|---|---|
| Aquatic Life |  | SUPPORT upper 3.6 miles<br>IMPAIRED lower 2.2 miles<br>Cause: Combined biota/habitat bioassessment<br>(Suspected Cause: Sedimentation/siltation)<br>Source: Unknown<br>(Suspected Source: Municipal point source discharge) |
| Fish Consumption |  | NOT ASSESSED |
| Primary Contact |  | NOT ASSESSED |
| Secondary Contact |  | NOT ASSESSED |
| Aesthetics |  | SUPPORT |

**RECOMMENDATIONS LITTLE RIVER (MA32-36)**

- Further evaluate streamflow conditions and other habitat quality conditions including sedimentation in this segment of the Little River.
- Conduct a site visit at the West Parish Filter water treatment plant and evaluate the effectiveness of the current NPDES permit limits in protecting water quality in Cook Brook and the Little River.
- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Continued biological monitoring is recommended in order to assess the *Aquatic Life Use*.
- Although not proposed as a cold water fisheries resource by MDFW, the Little River should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.
- Review communities of Westfield (MAR041236), and Southwick (MAR041022) Phase II Stormwater SWPPPs, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River and subwatershed tributaries.

## DICKINSON BROOK (SEGMENT MA32-34)

Location: Source, at the confluence of Trumble Brook and Seymour Brook, to confluence with Munn Brook, Granville.
Segment Length: 3.4 miles
Classification: Class B




The drainage area of this segment is approximately 8 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 75%
Open Land ..... 9%
Residential ..... 8%

The impervious cover area for the individual sub-basins located in this segment is 2.2%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Dickinson Brook is formed by the confluence of Trumble and Seymour Brooks in Granville, just northwest of South Mountain. The brook flows northeast for a short distance through a narrow valley and then flows through the village of Granville. Dickinson Brook then enters level terrain and flows to the south into a small pond and exits continuing to flow to the south. The brook then turns back to the northeast meandering along the west side of Sodom Mountain to its confluence with Munn Brook in Granville.

Based on the last evaluation of water quality conditions Dickinson Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

### WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

### USE ASSESSMENT

#### *AQUATIC LIFE*

Habitat and Flow

As part of the MA DEP Biocriteria Development Project, a habitat survey was performed by DWM in Dickinson Brook approximately 100 meters upstream from Water Street crossing in Granville (Station BT01DIC) in September 1997. At the time of the survey the brook was roughly 2 m wide with a depth of approximately 0.25 m. The substrates were comprised primarily of boulder, cobble, and gravel. The overall habitat score was 160 (MA DEP 1997). Habitat quality was limited most by the channel flow status and some limitations related to velocity/depth combinations and the limited riparian zone on the right bank.

Biology

MDFW regularly stocks salmon fry in Dickinson Brook.

As part of the MA DEP Biocriteria Development Project, MA DEP DWM biologists collected benthic macroinvertebrate samples from Dickinson Brook at Station BT01DIC in September 1997 (Lotic 1999). Electrofishing was also conducted by DWM at this location on 23 September 1997 (ENSR 1997). Fish collected in order of abundance included: eastern brook trout, brown trout, and

blacknose dace. Multiple age classes of eastern brook trout and brown trout were found. All species collected are fluvial specialists/dependants.

In August 2001 MDFW conducted backpack electrofishing in Dickinson Brook Rt. 57, from a pulloff just below bridge in Granville (Station 338, Richards 2003). Seven fish species collected, in order of abundance, were Atlantic salmon, blacknose dace, brook trout, brown trout, longnosed dace, American eel and one white sucker. Multiple age classes of Atlantic salmon, brook trout and brown trout were found. With the exception of the eel all species collected are fluvial specialists/dependants.

Chemistry – water

*In-situ* measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of Dickinson Brook approximately 100 meters upstream from Water Street crossing in Granville (Station BT01DIC) were made on 23 September 1997 as part of the Biocriteria Development Project (Appendix G, Table G3).

The *Aquatic Life Use* is assessed as support based on the fish community data and best professional judgment. The presence of three intolerant species (Altantic salmon, brook trout and brown trout) is indicative of excellent water and habitat quality.

***AESTHETICS***

No aesthetic quality degradation (odors, turbidity, oil, grease) or any other objectionable conditions were noted by DWM biologists during their survey in Dickinson Brook in 1997 (MA DEP 1997).

The *Aesthetics Use* is assessed as support based primarily on field observations by DWM biologists in 1997 and best professional judgment.

Dickinson Brook (MA32-34) Use Summary Table

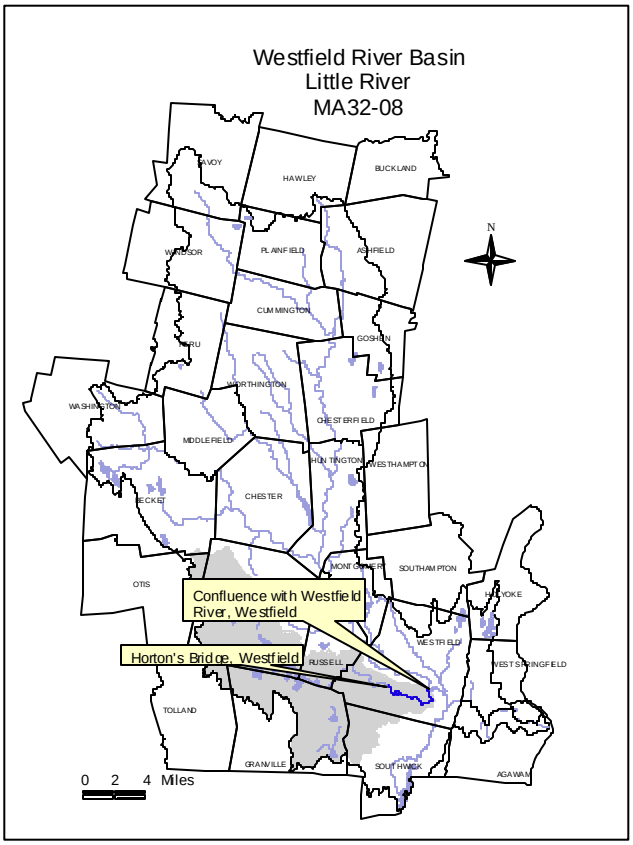
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | SUPPORT |

**RECOMMENDATIONS DICKINSON BROOK (MA32-34)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses.
- Continued biological monitoring is recommended in order to assess the *Aquatic Life Use*.
- Dickinson Brook should be listed in the next revision of the Massachusetts Surface Water Quality Standards as a cold water fishery.

## LITTLE RIVER (SEGMENT MA32-08)

Location: Horton's Bridge, Westfield, to confluence with the Westfield River, Westfield.
Segment Length: 5.4 miles
Classification: Class B, Warm Water Fishery, CSO




The drainage area of this segment is approximately 85 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 80%
Residential ..... 7%
Agriculture..... 5%

The impervious cover area for the individual sub-basins located in this segment is 2.9%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

The Little River is dammed just downstream from Horton's Bridge in Westfield. From there the river continues flowing southeast around Wolfpit Meadows where it encounters another dam forming Crane Pond in the urbanized area of Westfield. The river then flows into a large flood plain and meanders northward through an industrial area to its confluence with the Westfield River in Westfield.

No CSOs are permitted for the city of Westfield (Boisjolie 2004a).

Based on the last evaluation of water quality conditions this segment of the Little River is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

**WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)**

| Facility | WMA Permit Number | Sources | Authorized Withdrawal (MGD) |
|---|---|---|---|
| Old Farm Golf Club, LLC | 9P10427902 | Lake A<br>Lake D<br>Well # 2<br>Well # 4 | 0.15 |

**NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H2 AND H3)**

The City of Westfield is permitted (NPDES permit MAG640001 issued November 2001) to discharge effluent from the water treatment facility (near Sackett Reservoir on Reservoir Road) in Southwick and discharge up to <1 MGD to Jack's Brook, a tributary to this segment of the Little River.

The Stevens Paper Mills, Inc., Lower Mills (MA0004693), located on Mill Street in Westfield, is no longer in operation.

Columbia Manufacturing Company (Cycle Street) Westfield was permitted (MA0001571) to discharge to the Little River, but the facility tied into the Westfield WWTP in 1993. The company is no longer in operation although a permit (MAR05C251) to discharge stormwater was issued 5 May 2001 and is still active.

Westfield and Southwick are Phase II Stormwater communities. These communities were issued stormwater general permits from EPA and MA DEP in 2003/2004 and are authorized to discharge stormwater from the municipal drainage systems (MAR041236 and MAR041022, respectively). Over the five-year permit term the communities will develop, implement and enforce stormwater management programs to reduce the discharge of pollutants from their storm sewer systems to protect water quality (Domizio 2004).

**USE ASSESSMENT**

***AQUATIC LIFE***

Habitat and Flow

A benthic macroinvertebrate and habitat survey was performed by DWM biologists in the summer of 1996 in one reach of this segment of the Little River - approximately 90 m upstream from the Route 20 overpass near the confluence with the Westfield River in Westfield - in the summer of 1996 (Station LR01). Habitat quality conditions at this location are described in detail in Appendix C.

Biology

In July 2001 MDFW conducted backpack electrofishing in one reach of this segment of the Little River near Hundred Acres Road/South Meadow Road in Westfield (Station 517, Richards 2003). Eleven fish species collected, in order of abundance, were blacknose dace, longnosed dace, white sucker, tessellated darter, American eel, common shiner, brown trout, brook trout, fallfish, yellow perch, and one slimy sculpin. Multiple age classes of brown trout were collected, however the sample was dominated by tolerant and moderately tolerant species.

A benthic macroinvertebrate and habitat survey was performed by DWM biologists in the summer of 1996 in one reach of this segment of the Little River - approximately 90 m upstream from the Route 20 overpass near the confluence with the Westfield River in Westfield - in the summer of 1996 (Station LR01). Results of the RBP II analyses are provided in detail in Appendix C.

Chemistry – water

DWM collected *in-situ* measurements from a station on the Little River (Station LITR00.1) approximately 100 feet upstream from Route 20 bridge, Westfield) between 1 August and 3 October 2001 (n=4). Parameters measured were dissolved oxygen, pH, temperature, conductivity, and total dissolved solids. Grab samples were also collected and analyzed for alkalinity, hardness, chloride, and suspended solids (n=4) (Appendices B and C of Appendix A).

*DO*

The instream DO measured by DWM on the Little River (Station LITR00.1) ranged from 7.9 to 10.2 mg/L (89% to 94% saturation) (Appendix 2 of Appendix A).

*Temperature*

Temperatures recorded by DWM ranged from 12.7°C to 22.5°C.

*pH*

pH measurements recorded by DWM ranged from 7.0 SU to 7.2 SU.

*Conductivity*

Conductivity reported by DWM ranged from 120 µS/cm to 149 µS/cm.

*Solids*

Total suspended solid concentrations reported by DWM ranged from <1.0 to 1.5 mg/L (Appendix 3 of Appendix A)

*Alkalinity*

The alkalinity reported by DWM ranged from 19 to 22 mg/L.

*Hardness*

Hardness values reported by DWM ranged from 17 to 22 mg/L.

*Chloride*

Chloride concentrations reported by DWM ranged from 29 to 35 mg/L.

The *Aquatic Life Use* is assessed as support for this segment of the Little River based on the fish population information, the limited water quality information and best professional judgment. Although there is a diverse assemblage of stream fishes, the samples were dominated by species tolerant to both enrichment and habitat degradation (blacknose dace.

***FISH CONSUMPTION***

Fish were collected by MA DEP and MDFW personnel from two reaches in this segment of the Little River in October 1990 - downstream from the dam by Horton's Bridge and upstream from the Railroad Bridge in Westfield (Maietta 1993). Brown trout from the upstream reach and brown trout, eastern brook trout and white suckers from the downstream reach were analyzed for selected metals (including mercury), PCB, and other pesticides. The results of this survey did not indicate a problem, nor did MA DPH issue any advisories with respect to fish consumption (Maietta 1993).

Because no site-specific fish consumption advisory was issued by MA DPH for this segment of the Westfield River the *Fish Consumption Use* is not assessed.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected fecal coliform bacteria samples from the Little River approximately 100 feet upstream from Route 20 bridge, Westfield (Station LITR00.1) between 1 August and 3 October 2001 (N=4). Counts ranged from 200 to 670 cfu/100 ml and three of the four counts were >200 cfu/100 ml. Field survey crews did not note any objectionable odors or objectionable deposits other than a very limited amount of trash and debris (MA DEP 2001b).

ESS collected fecal coliform samples from the Little River at the Route 20 bridge (also known as East Main Street), Westfield (ESS Station PS-02) on 28 December 1999. The count was 60 cfu/100 ml (ESS 2000).

ESS, 2000) also collected fecal coliform samples from two tributaries to this segment of the Little River on 3 November 1999 - Ashley Brook at Hillside Road Bridge, Westfield (Station SS-29) on 3 November, 1999 and Jacks Brook at Sackett Road bridge, Westfield (Station SS-30). The counts were 900 and 600 cfu/100 mls, respectively.

DWM collected fecal coliform bacteria samples upstream from an outfall at the end of South Street (Station LITR00.2) as well as from the outfall itself (Station LITRPIPE) between May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4). Fecal coliform bacteria counts were elevated in the outfall.

The *Primary Contact Recreational Use* is assessed as impaired because of elevated fecal coliform bacteria. The *Secondary Contact Recreational* and *Aesthetics* uses are assessed as support.

Little River (MA32-08) Use Summary Table

| Designated Uses | | Status |
|---|---|---|
| Aquatic Life |  | SUPPORT |
| Fish Consumption |  | NOT ASSESSED |
| Primary Contact |  | IMPAIRED<br>Cause: Fecal coliform bacteria<br>Source: Unknown<br>(Suspected Sources: Storm drains and Runoff) |
| Secondary Contact |  | SUPPORT |
| Aesthetics |  | SUPPORT |

**RECOMMENDATIONS LITTLE RIVER (MA32-08)**

- Continue to conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses and the effectiveness of the City of Westfield's Phase II stormwater management permit and program.

- Continued biological monitoring is recommended to assess the status of the *Aquatic Life Use*.

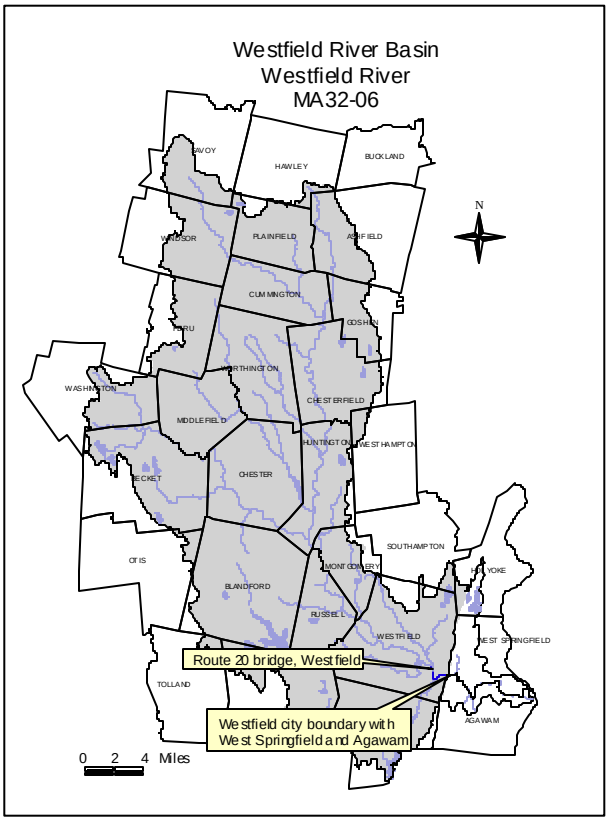
- Although not proposed as a cold water fisheries resource by MDFW, the Little River should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

- The CSO designation for this segment of the Little River should be removed in the next revision of the Massachusetts Surface Water Quality Standards.

- Review the Westfield (MAR041236) and Southwick (MAR041022) Phase II Stormwater SWPPPs, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River and subwatershed tributaries.

## WESTFIELD RIVER (SEGMENT MA32-06)

Location: Route 20 bridge, Westfield, to Westfield city boundary with West Springfield and Agawam.
Segment Length: 1.9 miles
Classification: Class B, Warm Water Fishery, CSO




The drainage area of this segment is approximately 497 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Forest ..... 81%
- Residential ... 7%
- Agriculture .... 6%

The impervious cover area for the individual sub-basins located in this segment is 2.7%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

From the Route 20 bridge in Westfield the Westfield River continues to meander to the southeast through an industrial area and then loops to the northeast where it crosses the city of Westfield municipal boundary and this segment ends. CSOs in West Springfield and Agawam to Westfield River have been eliminated (Boisjolie 2004a).

Based on the last evaluation of water quality conditions this segment of the Westfield River is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). The segment was not assessed for any uses.

### WMA WATER WITHDRAWAL

Based on the available information there are no WMA regulated water withdrawals in this subwatershed.

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H2 AND H3)

The Western Massachusetts Hospital, which discharged into a small unnamed brook that flows a short distance to the Westfield River, was last issued a minor NPDES permit (MA0102270) on 18 September 1988. Current information from the MA DEP Western Regional office indicates that a NPDES permit is no longer required since the discharge was eliminated between 1997 and 1998 when the facility tied into the Westfield WWTP (Boisjolie 2004a).

Renaissance Manor (formerly known as the Valley View Nursing Home), Feeding Hills Road, in Westfield is currently under an Administrative Consent Order (ACO) until a NPDES permit is issued (Nietupski 2004a). The facility discharges approximately 0.01 MGD of treated wastewater to the Westfield River. The wastewater receives secondary treatment and is chlorinated prior to discharge.

Westfield is a Phase II Stormwater community. The City was issued a stormwater general permit from EPA and MA DEP in 2003 and is authorized to discharge stormwater from the municipal drainage system (MAR041236). Over the five-year permit term the City will develop, implement and enforce a stormwater management program to reduce the discharge of pollutants from the storm sewer system to protect water quality (Domizio 2004).

**USE ASSESSMENT**

***AQUATIC LIFE***

Habitat and Flow

The USGS gage 01183500 is located in this segment of the Westfield River. The USGS remarks for this gage indicate that flow is regulated by several factors including: Borden Brook Reservoir, Cobble Mountain Reservoir, Knightville Reservoir and Littleville Lake, and diversion from Little River for municipal supply of Springfield (Socolow *et al*. 2003). The estimated 7Q10 flow for this gage is 69.5 cfs (USGS 2002). Evidence of regulation is observed using real-time USGS gaging data available on-line (USGS 2004).

Biology

MDFW regularly stocks trout in this segment of the Westfield River.

Chemistry – water

The USGS, as part of their National Water Quality Assessment Program (NAWQA) Connecticut, Housatonic, and Thames River Basins Study Unit, conducted sampling on 27 June 1994 at a site on the Westfield River approximately 0.7 miles downstream from the confluence with Great Brook, on the north side of the river just off Route 20 (Zimmerman 1999). Most pesticide compounds (2,4-D Alachlor, Atrazine, Carbaryl, Chorpyrifos, Cyanazine, Dichlorprop, Ethyl- Abazine, S-ethyl dipropylthiocarbamate (EPTC), Malathion, Metrribuzin, Prometon, and Propargile) tested below minimum detection limits. Other pesticides were detected (Atrazine 0.017 ug/l, Dimethyl tetrachloroterephthalate (DCPA) 0.002 ug/l, Diazinon 0.006 ug/l, Metolachlor 0.007 ug/l, and Simazine 0.010 mg/l). USGS indicates that three of these are herbicides (Atrazine, Metolachlor, Simazine) are most frequently detected downstream from agricultural activities. None of the pesticides detected at the Westfield River sampling station were in concentrations that exceeded the USEPA's maximum contaminant level or health advisory limit for the particular compound. No other NAWQA program activities, including sediment or fish tissue sampling, occurred in the Westfield River Watershed during the 1990's to the present time.

Too limited data are available for this segment of the Westfield River, so the *Aquatic Life Use* is not assessed. This use is identified with an Alert Status, however, because of the evidence of alterations in normal streamflow conditions.

Westfield River (MA32-06) Use Summary Table

| Aquatic Life* | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| NOT ASSESSED | | | | |

*Alert Status issues identified, see details in use assessment section

**RECOMMENDATIONS WESTFIELD RIVER (MA32-06)**

- There are currently no known CSO discharges to this segment of the Westfield River. Therefore, during the next revision of the Massachusetts Surface Water Quality Standards the CSO designation should be removed.

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses and the effectiveness of the City of Westfield's Phase II stormwater management permit and program. It should also be noted that a high bacteria count was documented on the small tributary to this segment of the Westfield River near the USGS gaging station.

- Biological monitoring is recommended to assess the status of the *Aquatic Life Use*.

- Further investigate source(s) of aberrant streamflow fluctuations observed using on-line real-time data for the USGS gage 01183500. Ideally, a natural flow regime should be restored in the Westfield River.

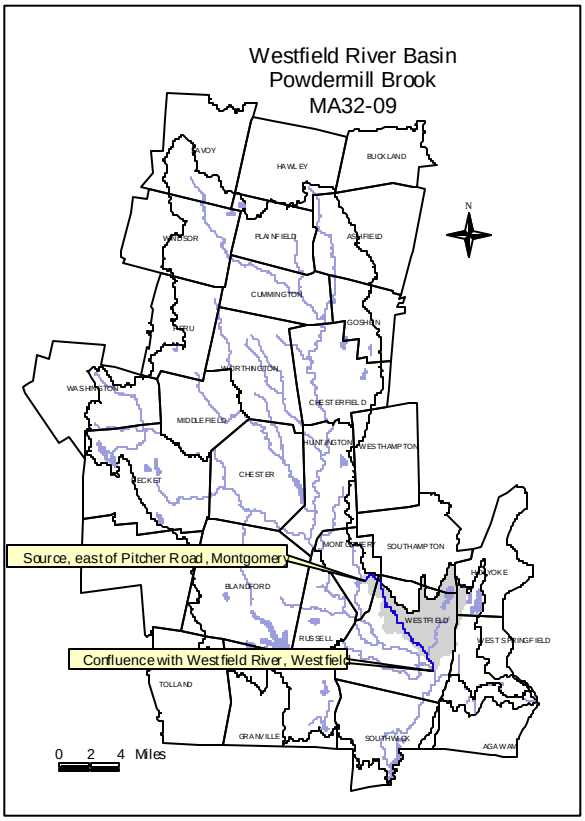
- To ensure run-of-river operations all dam operators should install, calibrate and maintain a continuous streamflow monitoring gage, or determine some other method to ensure compliance with run-of-river operations.

- Renaissance Manor NPDES permit should be issued with appropriate limits and monitoring requirements.

- Review City of Westfield (MAR041236) Phase II Stormwater SWPPP, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River and subwatershed tributaries.

## POWDERMILL BROOK (SEGMENT MA32-09)

Location: Source, east of Pitcher Road, Montgomery, to confluence with the Westfield River, Westfield.
Segment Length: 9.5 miles
Classification: Class B




The drainage area of this segment is approximately 19 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 81%
Residential ..... 7%
Agriculture..... 6%

The impervious cover area for the individual sub-basins located in this segment is 2.7%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Powdermill Brook begins north of Ball Mountain in Montgomery. It flows in a general southeast direction towards the city of Westfield, paralleling Montgomery Road through the villages of West Farms and Wyben. The brook turns more easterly and flows under the Massachusetts Turnpike near the Westfield Interchange into an unnamed pond from which it exits meandering to the southeast crossing under Routes 202 and 10. Powdermill Brook then travels through a fairly straight reach along the edge of the Westfield River floodplain, passes a sand and gravel pit, and then parallels railroad tracks. The brook crosses under Route 20 and flows by Frog Hole before its confluence with the Westfield River in Westfield.

Based on the last evaluation of water quality conditions Powdermill Brook is listed in Category 5 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment is impaired by several pollutants (siltation, pathogens, suspended solids, turbidity) and will require TMDLs for these pollutants.

MDFW has proposed that Powdermill Brook be listed in the SWQS as a cold water fishery (MDFW 2003).

### WMA WATER WITHDRAWAL

Based on the available information there are no WMA regulated water withdrawals in this subwatershed.

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H2 AND H3)

Micro Abrasives Inc. was permitted (MA0002224) to discharge into Arm Brook, a tributary to Powdermill Brook. The facility connected to the wastewater treatment plant and the permit was terminated in March 1999.

Westfield is a Phase II Stormwater community. The City was issued a stormwater general permit from EPA and MA DEP in 2003 and is authorized to discharge stormwater from the municipal drainage system (MAR041236). Over the five-year permit term the City will develop, implement and enforce a stormwater management program to reduce the discharge of pollutants from the storm sewer system to protect water quality (Domizio 2004).

### USE ASSESSMENT

#### *AQUATIC LIFE*

Habitat and Flow

As part of the 2001 DWM Westfield River Watershed benthic macroinvertebrate survey, a habitat survey was performed in Powdermill Brook downstream from I-90 behind the Westfield High School

in Westfield (Station PB00, Appendix B). The habitat score at Station PB00 was 138 out of a possible 200. Sediment deposition and embeddedness were major determinants of the low habitat score although bank instability and degradation related to reduced baseflow conditions also contributed to the low score (Appendix B). During field reconnaissance of Powdermill Brook severe habitat quality degradation was observed in Powdermill Brook downstream from the small unnamed impoundment to the confluence with the Westfield River (Fiorentino 2004b).

Biology

MDFW regularly stocks trout in Powdermill Brook.

In September 2001 DWM conducted a modified Rapid Bioassessment Protocol III (RBP III) benthic macroinvertebrate survey in Powdermill Brook downstream from I-90 behind the Westfield High School in Westfield (Station PB00). The RPB III analysis of the benthic macroinvertebrate community indicated slightly impacted conditions compared to the reference station on Yokum Brook near Route 8 in Becket (Station YB01A, Appendix B). The fish community in this reach was comprised of four species including, in order of abundance, slimy sculpin, eastern brook trout, brown trout, and a largemouth bass. Multiple age classes of eastern brook trout and brown trout were included in the sample. The presence of slimy sculpin and reproducing brook trout are indicative of high quality cold water. The yellow-green alga *Vaucheria* sp. was very abundant in the periphyton sample collected in the partially-canopied riffle zone in the brook (Station PB00, Appendix D). Approximately 40% of the substrates were observed to have algal growth in the reach sampled. It is the opinion of DWM biologists that, while water quality factors cannot be completely ruled out, sediment inputs responsible for the instream habitat degradation compromise biological potential in Powdermill Brook, at least for resident macroinvertebrate populations.

In July 2001 MDFW conducted backpack electrofishing further downstream in Powdermill Brook near Sandy Hill Road Bridge in Westfield (Station 562, Richards 2003). Five fish species collected, in order of abundance, were blacknose dace, brown trout, tessellated darter, white sucker, and one American eel. The fish community at this location was dominated by tolerant species and the total fish numbers were low including brown trout (n=3).

Chemistry – water

DWM collected *in-situ* measurements from two stations on Powdermill Brook - Station PDMB03.8 at Russellville Road in Westfield and Station PDMB00.1 downstream from the Union Street culvert, Westfield - between 1 August and 3 October 2001 (n=4). Parameters regularly measured at both stations were dissolved oxygen, pH, temperature, conductivity, and total dissolved solids (Appendix 2 of Appendix A). Grab samples were collected and analyzed for alkalinity, hardness, chloride, suspended solids while ammonia-nitrogen, nitrate nitrogen, total phosphorus samples were collected only at the upstream sampling location (Appendix 3 of Appendix A).

*DO*

The instream DO measured by DWM on Powdermill Brook at Station PDMB03.8 ranged from 6.1 to 10.6 mg/L (61% to 94% saturation) and at Station PDMB00.1 ranged from 9.1 to 9.9 mg/L (90% to 102% saturation).

*Temperature*

Temperatures recorded by DWM at Station PDMB03.8 ranged from 11.0 to 18.9°C, at Station PDMB00.1 ranged from 11.9 to 18.4°C

*pH*

pH measurements reported by DWM at Station PDMB03.8 ranged from 6.6 to 6.9 SU and at Station PDMB00.1 ranged from 7.3 to 7.8 SU.

*Conductivity*

Conductivity reported by DWM at Station PDMB03.8 ranged from 133 to 175 µS/cm and at Station PDMB00.1 ranged from 283 to 311 µS/cm.

*Solids*
Total suspended solid concentrations reported by DWM at Station PDMB03.8 ranged from <1.0 to 14 mg/L and at Station PDMB00.1 ranged from <1.0 to 2.3 mg/L.

*Alkalinity*
The alkalinity reported by DWM at Station PDMB03.8 ranged from 19 to 35 mg/L and at Station PDMB00.1 ranged from 43 to 51 mg/L.

*Hardness*
Hardness values reported by DWM at Station PDMB03.8 ranged from 15 to 18 mg/L and at Station PDMB00.1 ranged from 41 to 56 mg/L.

*Chloride*
Chloride concentrations reported by DWM at Station PDMB03.8 ranged from 30 to 36 mg/L and at Station PDMB00.1 ranged from 75 to 81 mg/L.

*Ammonia-Nitrogen (as N)*
Ammonia-nitrogen concentrations reported by DWM at Station PDMB03.8 were below minimum detection limits. No samples were collected at the downstream location.

*Total Phosphorus (as P)*
Total phosphorus concentrations reported by DWM at Station PDMB03.8 ranged between 0.016 and 0.021 mg/L. No samples were collected at the downstream location.

The *Aquatic Life Use* is assessed as support for the upper 6.1 miles of Powdermill Brook (upstream from the small unnamed impoundment behind the Westfield High School in Westfield) based primarily on the benthic macroinvertebrate community analysis, the fish population information and best professional judgment of DWM biologists. The *Aquatic Life Use* is assessed as impaired for the 3.4 mile reach downstream from the small impoundment to the confluence with the Westfield River because of severe habitat quality degradation, reduced overall fish abundance, and the shift in the fish community structure (dominated by pollution tolerant species).

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM collected fecal coliform bacteria samples from Powdermill Brook near Russellville Road in Westfield (Station PDMB03.8) between 1 August and 3 October 2001 (n=4). The fecal coliform bacteria counts ranged from 10 to 52 cfu/100 ml. Field survey crews did not note any objectionable odors or objectionable deposits other than a very limited amount of trash and debris (MA DEP 2001b).

No objectionable odors, oils, or turbidity were observed by MA DEP DWM biologists in Powdermill Brook downstream from Interstate 90, behind Westfield High School in Westfield, in September 2001(MA DEP 2001c). However, it should be noted that trash was scattered throughout the reach and especially concentrated along the steep left (south) bank in the form of scrap metal and a mostly intact automobile. Filamentous algae (*Vaucheria* sp.) and dense beds waterwort (*Elodea* sp.) were also observed covering approximately 40% of the streambed of the reach sampled (MA DEP 2001c). The yellow-green filamentous alga responds to enriched nutrient conditions (Appendix D). During field reconnaissance of Powdermill Brook in June 2001 construction activities, failing stormwater pollution controls, disturbances in the riparian zone and other activities all contributed to instream turbidity and excessive instream sedimentation in the lower 3.3 mile reach of the brook (downstream from the small unnamed impoundment).

ESS collected fecal coliform bacteria samples from two locations along the lower portion of Powdermill Brook in 1999. The locations and results are as follows (ESS 2000).

- Conrail bridge, Westfield (Station SS-40), on 3 November: 1,500 cfu/100 ml
- East Main Street bridge near Union Street (Station PS-3), on 28 December: <10 cfu/100 ml.

DWM collected fecal coliform bacteria samples from Powdermill Brook downstream from culvert at Union Street in Westfield (Station PDMB00.1) between 1 August and 3 October 2001 (N=4). Sample results for fecal coliform ranged from 57 to 140 cfu/100 mls. No objectionable odors were noted by

the field sampling crews, but the water column was described as slightly turbid during three of the four sampling events (MA DEP 2001b). Trash and debris were also present.

DWM collected fecal coliform bacteria samples from two locations on Powdermill Brook in May and August 1996 - near Russellville Road, Westfield (Station PDMB03.8) and at Union Street, Westfield (Station PDMB01.1) - as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

The *Primary* and *Secondary Contact Recreational* and *Aesthetic* uses are assessed as support for the upper 6.1-mile reach of Powdermill Brook (upstream from the small unnamed impoundment behind the Westfield High School in Westfield) based on the limited fecal coliform bacteria data and the generally good aesthetic quality, although these uses are identified with an Alert Status because of anthropogenic debris (mostly along the banks) and the presence of some filamentous instream algae. The *Recreational* and *Aesthetic* uses are assessed as impaired, however, for the lower 3.4-mile reach because of instream turbidity and severe sedimentation, and nuisance growths of algae/macrophytes.

Powdermill Brook (MA32-09) Use Summary Table

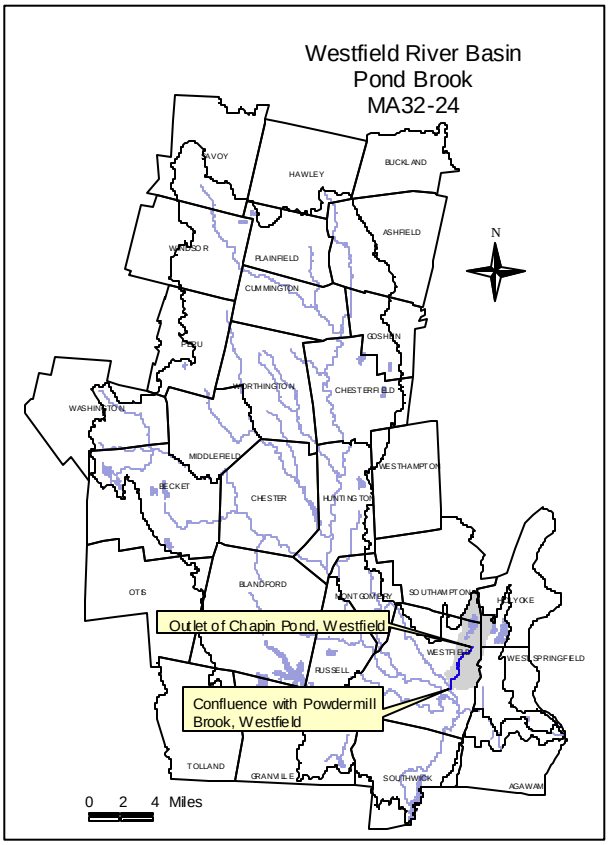
| Designated Uses | | Status |
|---|---|---|
| Aquatic Life |  | SUPPORT upper 6.1 miles<br>IMPAIRED lower 3.4 miles<br>Cause: Sedimentation/siltation<br>Sources: Land development, Streambank modification/destabilization, and Post-development erosion and sedimentation<br>(Suspected sources: Construction road runoff, Road runoff, and Sand and gravel operations) |
| Fish Consumption |  | NOT ASSESSED |
| Primary Contact |  | SUPPORT upper 6.1 miles<br>IMPAIRED lower 3.4 miles<br>Causes: Sedimentation/siltation, Turbidity, Excess algal growth<br>Sources: Land development, Streambank modification/destabilization, and Post-development erosion and sedimentation<br>(Suspected sources: Construction road runoff, Road runoff, and Sand and gravel operations) |
| Secondary Contact |  | |
| Aesthetics |  | |

**RECOMMENDATIONS POWDERMILL BROOK (MA32-09)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses and the effectiveness of the City of Westfield's Phase II stormwater management permit and program.
- Conduct more thorough habitat evaluations in Powdermill Brook and identify sites where stormwater pollution prevention plans should be developed and implemented or enforced to protect and restore instream habitat quality in the brook.
- Continue to conduct biological monitoring (benthic macroinvertebrate and fish population) to document changes resulting from nonpoint source pollution controls in Powdermill Brook.
- Excerpted from MA DEP's 2001 biological monitoring technical memorandum:
  - Potential sources of sediment loadings are numerous and include highway (I-90) runoff, a sand and gravel operation adjacent to the right (north) bank of the PB00 reach, and agricultural (livestock) runoff (streambank erosion and inadequate riparian buffer) at the Russellville Road crossing about 1.5 km upstream. An investigation into the need for BMPs at these or other potential nonpoint sources is strongly recommended.
  - A stream clean-up to improve the aesthetics of Powdermill Brook. This includes removal of the abandoned automobile located on the steep right bank of the PB00 sampling reach.
- Review City of Westfield Phase II Stormwater SWPPPs, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River and subwatershed tributaries.

## POND BROOK (SEGMENT MA32-24)

Location: Outlet of Chapin Pond to confluence with Powdermill Brook, Westfield.
Segment Length: 3.9 miles
Classification: Class B




The drainage area of this segment is approximately 9 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Forest ..... 52%
- Residential ..... 22%
- Open Land ..... 7%

The impervious cover area for the individual sub-basins located in this segment is 9.1%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Pond Brook begins at the outlet of Chapin Pond in Westfield and flows southwest. The brook soon enters a small, unnamed impoundment and continues to the southwest flowing close to Barnes Municipal Airport. The brook enters a wetland and another small impoundment and from there flows under the Mass Pike, where it is joined by Bush Brook. Pond Brook then flows through Springdale Pond and continues to its confluence with Powdermill Brook in Westfield.

Based on the last evaluation of water quality conditions Pond Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed Pond Brook and its tributary Bush Brook be listed in the SWQS as cold water fisheries (MDFW 2003).

### WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)

| Facility | WMA Registration Number | Sources | Authorized Withdrawal (MGD) |
|---|---|---|---|
| Holyoke Water Works | 10413701 | Driven Wells, 13701G | 1.01* |
| Westfield Water Department | 10432901 | Well#1, 329-01G<br>Well#7, 329-07G<br>Well#8, 329-08G | 6.11* |

* indicates system-wide withdrawal; all sources are not within this segment

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H2 AND H3)

Westfield, Holyoke, and Southampton are Phase II Stormwater communities. These communities were issued stormwater general permits from EPA and MA DEP in 2003 and are authorized to discharge stormwater from the municipal drainage systems (MAR041236, MAR041011 and MAR041021, respectively). Over the five-year permit term the communities will develop, implement and enforce stormwater management programs to reduce the discharge of pollutants from their storm sewer systems to protect water quality (Domizio 2004).

**USE ASSESSMENT**

***AQUATIC LIFE***

Biology

MDFW conducted backpack electrofishing in two reaches of Pond Brook - near the Eastern Mountain Country Club, Westfield (Station 521), in August 2001 and near the mouth of the brook near Union Street, Westfield (Station 492), in July 2001 (Richards 2003). Twelve fish species collected in the upstream reach, in order of abundance, were bluegill, blacknose dace, pumpkinseed, tessellated darter, white sucker, brook trout, largemouth bass, brown bullhead, and an individual each of American eel, chain pickerel, yellow bullhead, and yellow perch. Macrohabitat generalists and tolerant species dominated the fish community. Six species collected near the mouth of Pond Brook, in order of abundance, were blacknose dace, brown trout, brown bullhead, and an individual each of brook trout, slimy sculpin, and white sucker. Multiple age classes of brown trout were found.

The *Aquatic Life Use* is not assessed but is identified with an Alert Status because macrohabitat generalists and pollution tolerant species dominated the fish community at the upstream station. Although brown trout (multiple age classes), brook trout (n=1), and slimy sculpin (n=1) were present at the downstream location, the sample was still dominated by a pollution tolerant species (blacknose dace).

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

Environmental Sciences Services, Inc (ESS, 2000) collected fecal coliform samples on 30 September 1999 at two locations on Pond Brook - below the outlet to Horse Pond at Black Pond Road, Westfield (Station SS-11), and at Holyoke Road bridge, Westfield (Station SS-10). Both fecal coliform bacteria counts were elevated 1,200 and 1,400 cfu/100 ml at Stations SS-11 and SS-10, respectively.

DWM collected fecal coliform bacteria samples from Pond Brook at Union Street, Westfield (Station PNDB00.1), in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited data are currently available, so the *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are not assessed. The recreational uses are identified with an "Alert Status", however, because of a few high counts.

Pond Brook (MA32-24) Use Summary Table

| Aquatic Life* | Fish Consumption | Primary Contact* | Secondary Contact* | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| NOT ASSESSED | | | | |

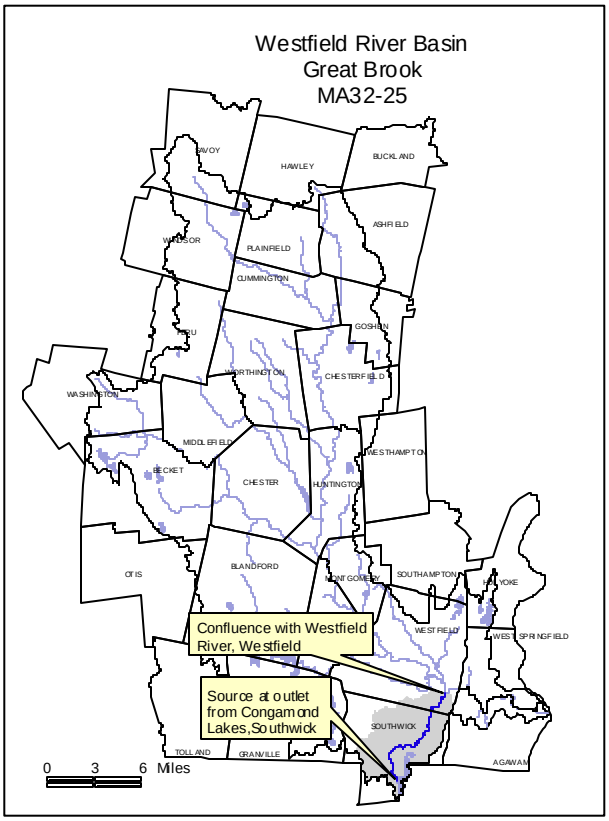
*Alert Status issues identified, see details in use assessment section

**RECOMMENDATIONS POND BROOK (MA32-24)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses and the effectiveness of the City of Westfield's, Holyoke, and Southampton Phase II stormwater management permits and programs.
- Conduct additional biological monitoring (benthic macroinvertebrate and fish population) to document changes resulting from nonpoint source pollution controls in Pond Brook and to assess the status of the *Aquatic Life Use*.
- Pond Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.
- Review municipalities of Westfield (MAR041236), Holyoke (MAR041011), and Southampton (MAR041021) Phase II Stormwater SWPPPs, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River and subwatershed tributaries.

## GREAT BROOK (SEGMENT MA32-25)

Location: Source at outlet of Congamond Lakes in Southwick to confluence with Westfield River, Westfield.
Segment Length: 10.7 miles
Classification: Class B




The drainage area of this segment is approximately 22 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 44%
Residential ..... 21%
Agriculture..... 20%

The impervious cover area for the individual sub-basins located in this segment is 5.4%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Great Brook begins at the outlet on the southwest end of Middle Congamond Lake in Southwick. The brook flows northwest through a wetland and then meanders through a floodplain looping around the north end of the Congamond lakes and flowing east through the center of Southwick. The brook then turns northeast meandering through wetlands and near residential developments to its confluence with the Westfield River in Westfield.

Based on the last evaluation of water quality conditions Great Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

MDFW has proposed that Great Brook and its tributary Johnson Brook be listed in the SWQS as cold water fisheries (MDFW 2003).

### WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)

| Facility Name | WMA Permit Number | WMA Registration Number | Source(s) | Authorized Withdrawal (MGD) |
|---|---|---|---|---|
| Southwick Water Department | 9P10427901 | 10427905 | Well #1, Great Brook | 0.45 (reg)<br>0.28 (per)<br>0.73 total |
| West Springfield Water Department | 9P10432501 | 10432503 | Well #1, 13250000-01G<br>Well #2, 13250000-02G<br>Well #3, 13250000-03G<br>Well #4, 13250000-04G | 3.89 (reg)<br>2.82 (per)<br>6.71 total* |
| Westfield Water Department | -- | 10432901 | Well #3, 329-03G<br>Well #4, 329-04G | 6.11* |

* indicates system-wide withdrawal; all sources are not within this segment

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H2 AND H3)

Westfield and Southwick are Phase II Stormwater communities. These communities were issued stormwater general permits from EPA and MA DEP in 2003/2004 and are authorized to discharge stormwater from the municipal drainage systems (MAR041236 and MAR041022, respectively). Over the five-year permit term the communities will develop, implement and enforce stormwater management programs to reduce the discharge of pollutants from their storm sewer systems to protect water quality (Domizio 2004).

**USE ASSESSMENT**

***AQUATIC LIFE***

Biology

MDFW regularly stocks trout in Great Brook.

In July 2001 MDFW conducted backpack electrofishing in two reaches of Great Brook - upstream from the Route 57 Bridge in Southwick (Station 564) and near the Shaker Road Bridge in Westfield (Station 328, Richards 2003). In the upstream reach five fish species collected, in order of abundance, were brown trout, blacknose dace, white sucker, brook trout, and one bluegill. Multiple age classes of brown trout were found. Further downstream eight species collected, in order of abundance, were brown trout, blacknose dace, brook trout, tessellated darter, white sucker, American eel, bluegill, and longnosed dace. Multiple age classes of brown trout and brook trout were found. With the exception of bluegill and American eel these species are all fluvial specialists/dependants.

Chemistry – water

DWM collected *in-situ* measurements and water quality samples from one station on Great Brook ~ 250 feet upstream from Route 187 bridge, Westfield (Station GRTB00.3), between 1 August and 3 October 2001 (n=4). *In-situ* parameters measured included dissolved oxygen, pH, temperature, conductivity, and total dissolved solids (Appendix 2 of Appendix A). Grab samples were collected and analyzed for alkalinity, hardness, chloride, and total suspended solids (Appendix 3 of Appendix A).

*DO*

The instream DO measured by DWM in Great Brook (Station GRTB00.3) ranged from 7.5 to 9.0 mg/L (74 to 81% saturation)

*Temperature*

Temperatures recorded by DWM ranged from 11.0 to 17.5°C.

*pH*

pH measurements recorded by DWM ranged from 7.1 to 7.2 SU.

*Conductivity*

Conductivity reported by DWM ranged from 224 to 230 µS/cm.

*Solids*

Total suspended solid concentrations reported by DWM ranged from <1.0 to 4.4 mg/L.

*Alkalinity*

The alkalinity reported by DWM ranged from 23 to 25 mg/L.

*Hardness*

Hardness values reported by DWM ranged from 53 to 55 mg/L.

*Chloride*

Chloride concentrations reported by DWM ranged from 73 to 82 mg/L.

The *Aquatic Life Use* for Great Brook is assessed as support based primarily on the fish population information, the water quality data, and best professional judgment. The presence of two intolerant species (brown trout and brook trout) is indicative of excellent water and habitat quality.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

ESS collected fecal coliform bacteria samples from four locations on Great Brook in 1999. The stations and results can be summarized as follows (ESS 2000).

- Outlet of Congamond Lake at Sheep Pasture Road, Southwick (Station SS-23), on 3 November: <10 cfu/100 mls,
- South Longyard Road, Southwick (Station SS-22), on 3 November: 1,700 cfu/100 mls,
- Feeding Hills Road, Southwick (Station SS-21), on 3 November: 1,800 cfu/100 mls,
- Little River Road/Feeding Hills Road bridge in Westfield (Station PS-4), on 28 December: 30 cfu/100 ml

DWM collected fecal coliform bacteria samples from Great Brook near the Route 187 bridge, Westfield (Station GRTB00.3) between 1 August and 3 October 2001 (n=4). Sample results for fecal coliform ranged from 33 to 130 cfu/100 ml (Appendix 3 of Appendix A). No trash, debris or other objectionable deposits were noted by the field survey crews (MA DEP 2001b). Occasional septic odors were noted however.

ESS also collected fecal coliform bacteria samples from three tributaries to Great Brook in 1999. The stations and results can be summarized as follows (ESS 2000).

- Pearl Brook near Route 202/10, Southwick (Station SS-45), on 28 December: 20 cfu/100 ml.
- Johnson Brook at Route 202/10, Southwick (Station SS-44), on 28 December: 30 cfu/100 ml.
- unnamed tributary at Route 202/10 (slightly south of Route 57), Southwick (Station SS-46), on 28 December: 60 cfu/100 ml.

It should also be noted that DWM collected fecal coliform bacteria samples from three stations (as described below) along Great Brook in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

- near Sheep Pasture Road in Southwick (Station GRTB08.6)
- near Route 57 in Southwick (Station GRTB03.1)
- Little River Road, Westfield (Station GRTB00.3)

The *Primary* and *Secondary Contact Recreational* uses are assessed as support for Great Brook based on the generally low fecal coliform bacteria counts for the brook. The recreational uses are identified with an "Alert Status", however, because of the two high bacteria counts documented in the brook near Longyard Road and Feeding Hills Road in 1999. Although no objectionable deposits were noted, too limited data are available, so the *Aesthetics Use* is currently not assessed.

Great Brook (MA32-25) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact* | Secondary Contact* | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | SUPPORT | SUPPORT | NOT ASSESSED |

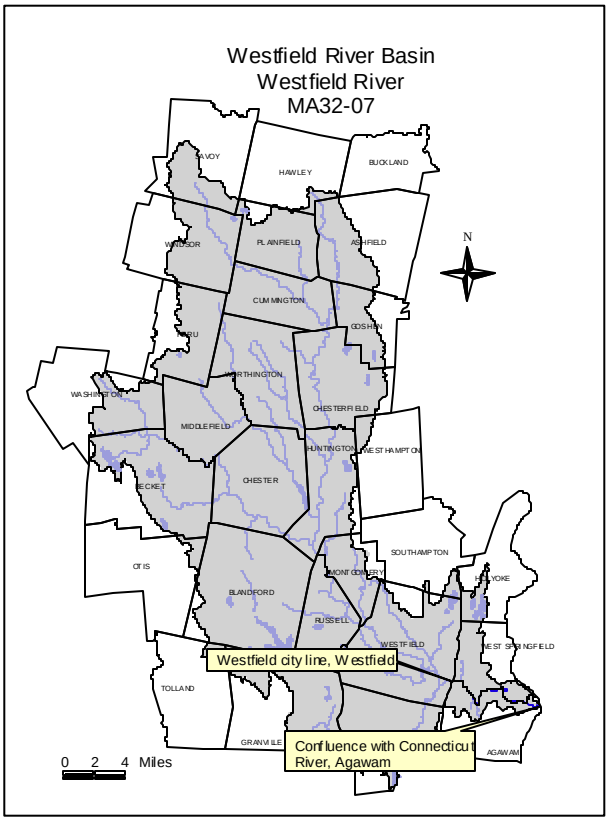
*Alert Status issues identified, see details in use assessment section

**RECOMMENDATIONS GREAT BROOK (MA32-25)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses and the effectiveness of the City of Westfield's and the Town of Southwick's Phase II stormwater management permits and programs.
- Conduct additional biological monitoring to assess the status of the *Aquatic Life Use*.
- Great Brook should be listed in the next revision of the Massachusetts Surface Water Quality Standards as a cold water fishery.
- Review municipalities of Westfield (MAR041236), and Southwick (MAR041022) Phase II Stormwater SWPPPs, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River and subwatershed tributaries.

## WESTFIELD RIVER (SEGMENT MA32-07)

Location: Westfield/ West Springfield/Agawam city line to confluence with Connecticut River, Agawam.
Segment Length: 8.5 miles
Classification: Class B, Warm Water Fishery, CSO




The drainage area of this segment is approximately 516 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 80%
Residential ..... 7%
Agriculture..... 6%

The impervious cover area for the individual sub-basins located in this segment is 3.2%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

From the Westfield city boundary with West Springfield and Agawam the Westfield River meanders in an easterly, then southeasterly, then northeasterly direction through a narrow floodplain with steep banks (this passing through Robinson State Park). The River then flows easterly by an industrial area (West Springfield side) and township of North Agawam (Agawam side), splits around an oxbow, flows southeasterly under the Route 147 bridge and continues easterly by the Eastern States Exposition Grounds (West Springfield side). The River continues east through a series of former oxbows on both sides, flows under Route 5, and reaches its confluence with the Connecticut River.

Based on the last evaluation of water quality conditions this segment of the Westfield River is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). The segment was not assessed for any uses.

### WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)

| Facility | WMA Registration Number | Sources | Authorized Withdrawal (MGD) |
|---|---|---|---|
| Southworth Company | 10432501 | Westfield River | 0.15 |
| DSI- West Springfield | 10432502 | Westfield River- Canal | 0.11 |

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H2 AND H3)

Fiber Mark DSI (formerly Decorative Specialties International, Inc. and Rexam DSI), located at Front Street, West Springfield, is authorized to discharge < 1 MGD of non–contact cooling water via outfall #001 to the Westfield River (NPDES permit # MAG250966 issued July 2001). The individual permit (#MA0032492 issued to DSI in August 1992 and modified in 1994) was terminated in January 1999 when the facility received coverage under the general permit. Fiber Mark notified the MA DEP that production at the facility stopped and the discharge was ceased until further notice in June 2002 (Rose 2002).

The Town of Agawam had an NDPES permit (MA0101320) issued September 1995 to discharge combined sewer from eight pipes into the Westfield River. These combined sewer overflows (CSO) outfalls (004, 005, 006, 007, 008, 009, 014 and 015) were located downstream from the DSI Facility in West Springfield. According to the MA DEP Western Regional Office CSO outfall 004 was eliminated in

May 1994, CSO outfalls #008 and 009 were eliminated in July 1999, CSO outfall #005 was eliminated in September 1999, and CSO outfalls # 006, 007, 014 and 015 were eliminated in April 2000 (Boisjolie 2004a and 2004b). The permit was terminated by EPA in September 2000.

The Town of West Springfield had an NPDES permit (MA0101389) issued September 1995 to discharge sanitary sewer and/or emergency bypass from three pump station outfalls to the Westfield River (outfall # 001 near Mittineague Park, 003 near Park Street, and 004 near Agawam Bridge). According to MA DEP WERO these outfalls were eliminated by 1999 (Boisjolie 2004a). The permit was terminated by EPA in September 2000.

The City of West Springfield and Town of Agawam are Phase II Stormwater communities. These communities were issued stormwater general permits from EPA and MA DEP in 2003 and are authorized to discharge stormwater from their municipal drainage systems (MAR041024 and MAR041001, respectively). Over the five-year permit term these communities will develop, implement and enforce their stormwater management programs to reduce the discharge of pollutants from the storm sewer systems to protect water quality (Domizio 2004).

**FERC (APPENDIX H, TABLE H4)**

A & D Hydro, Inc. is licensed (transfer approved by FERC in May 2004) to operate the West Springfield FERC Project No. 2608. Prior license holders include FiberMark, FiberMark DSI, Inc. and Rexam DSI, Inc. The license was last issued on 24 October 1994. The total installed capacity is 1,400 kW (DSI, Inc. 1991). The project's powerhouse, power canal, head gate structure intake, and tail-race lie in the town of West Springfield. The dam for the project, known both as the West Springfield Dam and the Mittineague Dam, spans the river between the town of West Springfield and the town of Agawam. There are two Rodney Hunt-Biggs vertical Francis turbine generating units.

Unit. 1 has a rated hydraulic capacity of 400 cfs and can generate 900 kW
Unit. 2 has a rated hydraulic capacity of 222 cfs and can generate 500 kW

The generating unit capacities listed above are for each unit operating alone. If both units are operating together, flow limitations of the power canal and tailrace result in a maximum plant capacity of 1,200 kW (800 kW for No. 1 and 400 kW No. 2) (DSI, Inc. 1991). The power canal is 6 feet by 50 feet wide and extends approximately 2,610 feet.

It should also be noted that the Southworth Company was allowed to draw a maximum of 61 cfs (39.4 MGD) from the power canal at FERC Project No. 2608 through an intake along the south bank of the canal through a water right agreement for use in their plant operations (DSI, Inc. 1991). The unlicensed Southworth Company hydroelectric facility has not operated for the last ten years (Lak 2004).

**USE ASSESSMENT**

***AQUATIC LIFE***

Habitat and Flow

USGS gage 01183500 is located just upstream from this segment of the Westfield River. The USGS remarks for this gage indicate that flow is regulated by several factors including: Borden Brook Reservoir, Cobble Mountain Reservoir, Knightville Reservoir and Littleville Lake, and diversion from Little River for municipal supply of Springfield (Socolow *et al*. 2003). The estimated 7Q10 flow for this gage is 69.5 cfs (USGS 2002). Evidence of regulation at this stream gaging location can be observed using on-line real-time USGS gaging data (USGS 2004).

A & D Hydro, Inc. is licensed to operate the West Springfield FERC Project No. 2608. The project is supposed to operate in a strict run-of-river mode with inflows to the project impoundment passed instantaneously through the project works or over the dam. The project's bypass reach extends from the dam to the confluence with the project tailrace (approximately 0.5 river miles). The license requires that a continuous minimum instream flow of 125 cfs or inflow, whichever is less, from 1 April to 15 July and from 1 September to 31 October and 85 cfs or inflow, whichever is less, the remainder of the year be released into the Westfield River bypass reach (LoVullo 2001). The minimum flow requirement was violated from 21 September 2001 through 11 October 2001 when only approximately 65 cfs was released into the bypass reach (Taylor 2002). A new fishway, a denail type

ladder, was constructed at the Project in the fall of 1995. The fish ladder is designed to allow upstream passage of anadromous and resident fish and downstream passage for Atlantic salmon smolts, American shad and blueback herring (MCFWRU 2004). Eel passage at the fishway was also installed in 2002 (WRWA 2002 and Poggi 2001).

Biology

MDFW regularly stocks trout in the Westfield River.

American shad returns at Holyoke Dam have fluctuated greatly over the last 10 years (counts ranged between 170,000 and 370,000). Westfield River shad returns at DSI appear to be declining from 2001 through 2004 (Table 4). According to the anadromous fish management plan for the Westfield River male American shad mature one year earlier than females and return as virgin spawners at ages three, four or five while females return to spawn at ages four, five or six (Slater 2001). While the reason for a decline in the American shad spawning run is not specifically known, it is interesting to note that three years after a documented minimum flow violation at FERC Project No. 2608, coincident with the outmigration of juvenile shad (fall 2001), there was a substantial decrease in the Westfield River 2004 annual return of adult American shad.

Table 4. Counts of anadromous fish between 2000 and 2004 migrating through the fish passageway at the West Springfield DSI Dam on the Westfield River in West Springfield (USFWS 2004a and USFWS 2004b).

| Species | Anadromous Fish Management Plan (AFMP) goal for the Westfield River by 2010 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|
| American Shad | annual spawning run of 15,000 adult American shad | 3,558 | 4,720 | 2,762 | 1,729 | 913 |
| Atlantic Salmon | annual spawning population of 500 adult Atlantic salmon for natural production, sport fishing, and aesthetic purposes | 11 | 8 | 5 | 5 | 11 |
| Blueback Herring | annual spawning run of 15,000 adult Blueback herring | | 2 | 4 | 5 | 1 |
| Sea Lamprey | no GOAL stated | 2,040 | 2,345 | 3,638 | 361 | 1,171 |

In August 2001 MDFW conducted boat electrofishing in the Westfield River near the Route 5 Bridge in Agawam (Station 559, Richards 2003). Ten fish species collected, in order of abundance, were rock bass, red breast sunfish, white sucker, smallmouth bass, largemouth bass, sea lamprey, tessellated darter, black crappie, and an individual each of bluegill and common carp. Although the assemblage was dominated by macrohabitat generalists, this is consistent with deep, slow-moving habitats associated with larger river systems.

Chemistry – water

DWM collected *in-situ* measurements and water quality samples from one station on the Westfield River 260 feet upstream from Route 5 bridge, Agawam (Station WSFR00.2) between 1 August and 3 October 2001. *In-situ* parameters measured included dissolved oxygen, pH, temperature, conductivity and total dissolved solids (Appendix 2 of Appendix A). Grab samples were collected and analyzed for alkalinity, hardness, chloride, suspended solids (n=4) (Appendix 3 of Appendix A).

*DO*

The instream DO measured by DWM ranged from 6.3 to 9.7 mg/L (72% to 93% saturation)

*Temperature*

Temperatures recorded by DWM ranged from 14.3 to 23.7°C.

*pH*

pH measurements recorded by DWM ranged from 7.1 to 7.2 SU.

*Conductivity*

Conductivity reported by DWM ranged from 158 to 259µS/cm.

*Solids*

Total suspended solid concentrations were low ranging from <1.0 to 4.8 mg/L.

*Alkalinity*
The alkalinity reported by DWM ranged from 18 to 39 mg/L.

*Hardness*
Hardness values reported by DWM ranged from 28 to 42 mg/L.

Too limited data are available for this segment of the Westfield River, so the *Aquatic Life Use* is not assessed. This use is identified with an Alert Status, however, because of the evidence of alterations in normal streamflow conditions.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

DWM and ESS both collected fecal coliform bacteria samples from the Westfield River near the Route 5 bridge, Agawam (DWM Station WSFR00.2 and ESS Station PS-5). Fecal coliform bacteria counts of samples collected by DWM between 1 August and 3 October 2001 (n=4) ranged from 24 to >10,000 cfu/100 ml, although only one count of the four was >52 cfu/100 ml. The replicate fecal coliform bacteria counts reported by ESS for samples collected at PS-5 on 28 December 1999 were 310 and 250 cfu/100 ml (ESS 2000). No objectionable odors and very little trash debris or other objectionable deposits were noted by the field survey crews (MA DEP 2001b).

Two tributaries to this segment of the Westfield River were also sampled by DWM or ESS in 2001 and 1999, respectively. The locations sampled and the results of the analyses are summarized below:

- ESS collected one fecal coliform bacteria sample from an unnamed tributary at Route 20 (south of Sibley Avenue), West Springfield (Station SS-13), on 30 September 1999. The count was 11,000 cfu/100 mls.
- DWM collected a total of four fecal coliform bacteria samples from Block Brook at Plymouth Terrace crossing, West Springfield (Station BLBR01.0), between 1 August and 3 October 2001. Results ranged from 170 to 900 cfu/100 ml. Three of the four sampling events exceeded 200 cfu/100 ml. No objectionable deposits, trash or debris or other conditions were noted (MA DEP 2001b).

DWM also collected fecal coliform bacteria samples from the Westfield River near the Robinson State Park in Agawam (Station WSFR01.5) and near the Route 5 bridge in Agawam (Station WSFR00.2) in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Given the variability in the limited fecal coliform bacteria dataset for this segment of the Westfield River the *Primary Contact Recreational Use* is not assessed. The *Secondary Contact Recreational Use* is assessed as support. The *Recreational Uses* are identified with an "Alert Status", however, because of the very high bacteria count and the elevated counts in tributaries to this segment of the Westfield River. The *Aesthetics Use* is assessed as support.

Westfield River (MA32-07) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact* | Secondary Contact* | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | SUPPORT | SUPPORT |

*Alert Status issues identified, see details in use assessment section

**RECOMMENDATIONS WESTFIELD RIVER (MA32-07)**

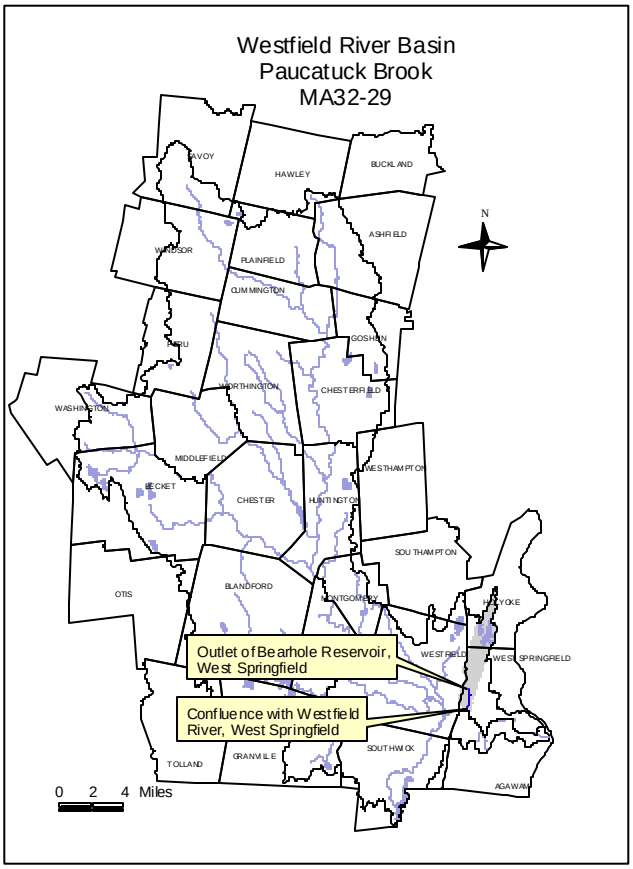
- There are currently no known CSO discharges to this segment of the Westfield River. Therefore, during the next revision of the Massachusetts Surface Water Quality Standards the CSO designation should be removed.
- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses and the effectiveness of the City of West Springfield and Town of Agawam's Phase II stormwater management permits and programs. Further investigation should also be conducted on two small

tributaries to this segment of the Westfield River where elevated bacteria counts were documented.

- Further investigate source(s) of aberrant streamflow fluctuations observed using on-line real-time data for the USGS gage 01183500. Ideally, a natural flow regime should be restored in the Westfield River.
- To ensure run-of-river operations all dam operators should install, calibrate and maintain a continuous streamflow monitoring gage, or determine some other method to ensure compliance with run-of-river operations.
- Conduct additional biomonitoring (benthic macroinvertebrate and fish community sampling) within this segment of the Westfield River to assess the status of the *Aquatic Life Use*.
- Review West Springfield (MAR041024) and Agawam (MAR041001) Phase II Stormwater SWPPPs, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River and subwatershed tributaries.

## PAUCATUCK BROOK (SEGMENT MA32-29)

Location: From outlet of Bearhole Reservoir, West Springfield, to confluence with Westfield River, West Springfield.
Segment Length: 1.5 miles
Classification: Class B




The drainage area of this segment is approximately 6 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 77%
Industrial ..... 6%
Residential ..... 4%

The impervious cover area for the individual sub-basins located in this segment is 2.2%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Paucatuck Brook flows south from the outlet of Bearhole Reservoir in West Springfield towards its confluence with the Westfield River in Westfield. The brook is culverted underground in the vicinity of the railroad lines near its mouth.

Based on the last evaluation of water quality conditions Paucatuck Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

### WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H7)

| Facility | WMA Permit Number | WMA Registration Number | Source | Authorized Withdrawal (MGD) |
|---|---|---|---|---|
| Holyoke Water Works | N/A | 10413701 | McLean, 13703S<br>Ashley Pond Reservoir, 13701S | 1.01* |
| West Springfield Water Department | 9P10432501 | 10432503 | Bearhole Reservoir, 13250000-01S** | 3.89 (reg)<br>2.82 (per)<br>6.71 total* |

*indicates system-wide withdrawal; all sources are not within this segment
**Note: Based on the Safe Yield Study of the Bearhole Reservoir, the WMA permit authorizes a maximum average annual withdrawal of 1.1 MGD from Bearhole Reservoir (MA DEP 2003c).

It should be noted, however, that all three sources identified are not the primary sources of water for their respective public water supply systems (Cabral 2004).

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H3)

The City of Holyoke and Town of West Springfield are Phase II Stormwater communities. These communities were issued stormwater general permits from EPA and MA DEP in 2003 and are authorized to discharge stormwater from their municipal drainage systems (MAR041011and MAR041024, respectively). Over the five-year permit term these communities will develop, implement and enforce their stormwater management programs to reduce the discharge of pollutants from the storm sewer systems to protect water quality (Domizio 2004).

**USE ASSESSMENT**

No recent data have been collected in Paucatuck Brook, so all uses are currently not assessed. Although there are WMA sources in this small subwatershed none of them are primary sources for their respective public water supply systems. It should be also be noted that DWM collected fecal coliform bacteria samples from Paucatuck Brook near Sikes Avenue in West Springfield (Station PCTB00.3) in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Paucatuck Brook (MA32-29) Use Summary Table

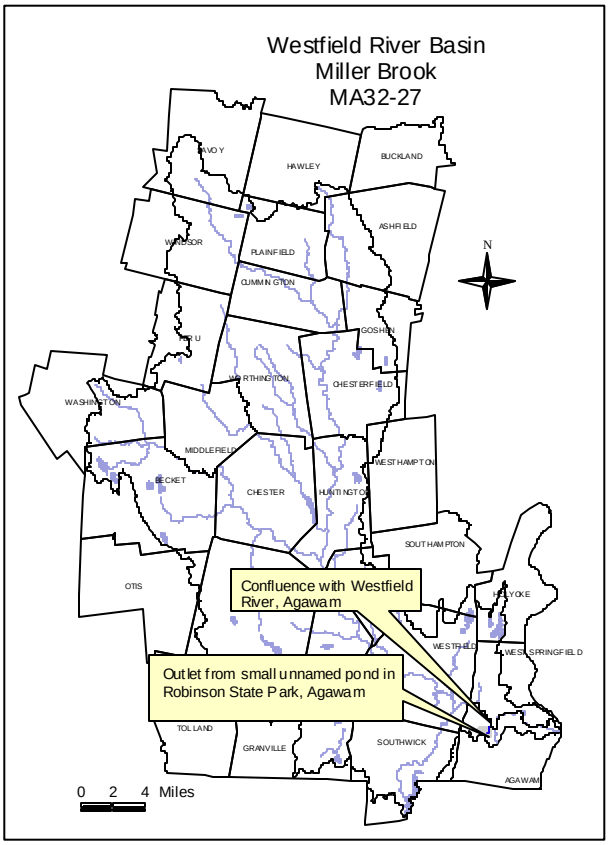
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| NOT ASSESSED | | | | |

**RECOMMENDATIONS PAUCATUCK BROOK (MA32-29)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses and the effectiveness of the City of Holyoke and Town of West Springfield Phase II stormwater management permits and programs.
- Evaluate outlet control practices at Bearhole Reservoir. To the extent possible natural flow regimes should be maintained at this outlet structure to minimize impacts to the aquatic biota in Paucatuck Brook.
- Conduct biomonitoring (benthic macroinvertebrate and fish community sampling) and water quality monitoring to assess the status of the *Aquatic Life Use*.
- Review Holyoke (MAR041024) and West Springfield (MAR041024) Phase II Stormwater SWPPPs, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River and subwatershed tributaries.

## MILLER BROOK (SEGMENT MA32-27)

Location: Outlet from small unnamed pond in Robinson State Park, north of North Street, Agawam, to confluence with Westfield River, Agawam.
Segment Length: 0.6 miles
Classification: Class B




The drainage area of this segment is approximately 0.3 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

Forest ..... 51%
Residential ..... 42%
Agriculture..... 4%

The impervious cover area for the individual sub-basins located in this segment is 5.9%, thereby classifying this subwatershed as a low threat to water quality from impervious surface water runoff (CWP 1998).

Miller Brook originates at the outlet of a small, unnamed pond in Agawam and flows north/northeast through Robinson State Park to its confluence with the Westfield River in Westfield.

Based on the last evaluation of water quality conditions Miller Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

### WMA WATER WITHDRAWAL

Based on the available information there are no WMA regulated water withdrawals in this subwatershed.

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H3)

Agawam is a Phase II Stormwater community. Agawam was issued a stormwater general permit from EPA and MA DEP in 2003 and is authorized to discharge stormwater from the municipal drainage system (MAR041001). Over the five-year permit term Agawam will develop, implement and enforce their stormwater management program to reduce the discharge of pollutants from the storm sewer system to protect water quality (Domizio 2004).

### USE ASSESSMENT

#### *AQUATIC LIFE*

Biology

In August 2001 MDFW conducted backpack electrofishing in Miller Brook in Robinson State Park in Agawam (Station 571, Richards 2003). Two fish species collected, in order of abundance, were brook trout (multiple age classes) and blacknose dace. Both species collected are fluvial specialists/dependants and brook trout are intolerant of pollution.

The *Aquatic Life Use* is assessed as support for Miller Brook based on the fish population information and best professional judgment. The presence of reproducing brook trout is indicative of high quality water.

#### *PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS*

DWM collected fecal coliform bacteria samples in Miller Brook, at the Robinson State Park entrance road bridge in Agawam (Station MILB00.2) in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited data are available and therefore the *Recreational* and *Aesthetic* Uses for Miller Brook are not assessed.

Miller Brook (MA32-27) Use Summary Table

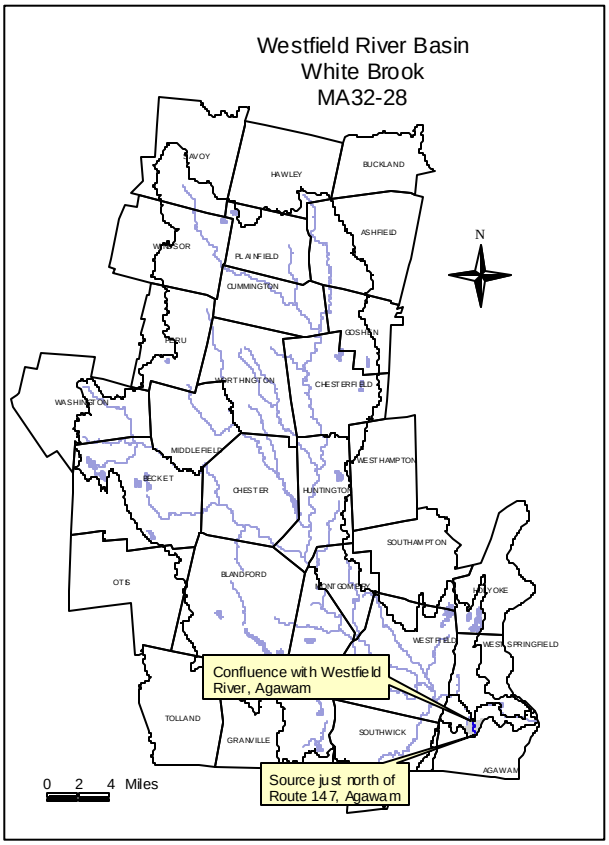
| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |

**RECOMMENDATIONS MILLER BROOK (MA32-27)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses and the effectiveness of Agawam's Phase II stormwater management permit and program.
- Although not proposed as a cold water fisheries resource by MDFW, Miller Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.
- Review municipality of Agawam's (MAR041001) Phase II Stormwater SWPPPs, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River and subwatershed tributaries.

## WHITE BROOK (SEGMENT MA32-28)

Location: Source just north of Route 147, Agawam, to confluence with Westfield River, Agawam.
Segment Length: 0.9 miles
Classification: Class B




The drainage area of this segment is approximately 0.6 square miles. Land-use estimates (top 3, excluding water) for the subwatershed (map inset, gray shaded area):

- Residential ..... 61%
- Forest ..... 32%
- Open Land ..... 4%

The impervious cover area for the individual sub-basins located in this segment is 14.7%, thereby classifying this subwatershed as a moderate threat to water quality from impervious surface water runoff (CWP 1998).

White Brook originates just north of Route 147 in Agawam and flows north through Robinson State Park to its confluence with the Westfield River in Westfield.

Based on the last evaluation of water quality conditions White Brook is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses.

### WMA WATER WITHDRAWAL

Based on the available information there are no WMA regulated water withdrawals in this subwatershed.

### NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H3)

Agawam is a Phase II Stormwater community. Agawam was issued a stormwater general permit from EPA and MA DEP in 2003 and is authorized to discharge stormwater from the municipal drainage system (MAR041001). Over the five-year permit term Agawam will develop, implement and enforce their stormwater management program to reduce the discharge of pollutants from the storm sewer system to protect water quality (Domizio 2004).

### USE ASSESSMENT

#### *AQUATIC LIFE*

Biology

In August 2001 MDFW conducted backpack electrofishing in White Brook downstream from North Street in Agawam (Station 570, Richards 2003). Two fish species collected, in order of abundance, were brook trout (multiple age classes) and blacknose dace. Both species collected are fluvial specialists/dependants and brook trout are intolerant of pollution.

The *Aquatic Life Use* is assessed as support for White Brook based on the fish population information and best professional judgment. The presence of reproducing brook trout is indicative of high quality water.

***PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS***

ESS personnel collected a fecal coliform sample from White Brook at the North Street Bridge, Agawam (Station SS-31) on 3 November 1999. The fecal coliform bacteria count was 140 cfu/100 ml (ESS 2000).

DWM collected fecal coliform bacteria samples at the mouth of White Brook in Robinson State Park at the park entrance road bridge, Agawam (Station WHTB00.0) in May and August 1996 as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

Too limited data are available, so the *Recreational* and *Aesthetic* uses for White Brook are not assessed.

WHITE BROOK (MA32-28) Use Summary Table

| Aquatic Life | Fish Consumption | Primary Contact | Secondary Contact | Aesthetics |
|---|---|---|---|---|
|  |  |  |  |  |
| SUPPORT | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |

**RECOMMENDATIONS WHITE BROOK (MA32-28)**

- Conduct bacteria monitoring to assess the *Primary* and *Secondary Contact Recreational* uses and the effectiveness of Agawam's Phase II stormwater management permit and program.
- Although not proposed as a cold water fisheries resource by MDFW, White Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.
- Review the Town of Agawam's (MAR041001) Phase II Stormwater SWPPPs, extent of compliance, and the effectiveness in minimizing impacts of stormwater runoff from their facilities into the Westfield River and subwatershed tributaries.

# WESTFIELD RIVER WATERSHED LAKE ASSESSMENTS

A total of 82 lakes, ponds or impoundments (the term "lakes" will hereafter be used to include all) have been identified and assigned Pond and Lake Information System (PALIS) code numbers in the Westfield River Watershed (Ackerman 1989 and MA DEP 2004). The total surface area of the Westfield River Watershed lakes is 4,197 acres. They range in size from 1 to 1, 034 acres. This report presents information on 33 of these lakes that are in the WBS/ADB database (Figure 9). The remaining 49 lakes, which total 543 acres, are unassessed; they are not currently included as segments in the WBS/ADB database. Twelve of the 33 lakes assessed in this report (36%), representing 1,926 of the 3,654 acres (53%), are designated public water supplies (i.e., Class A).

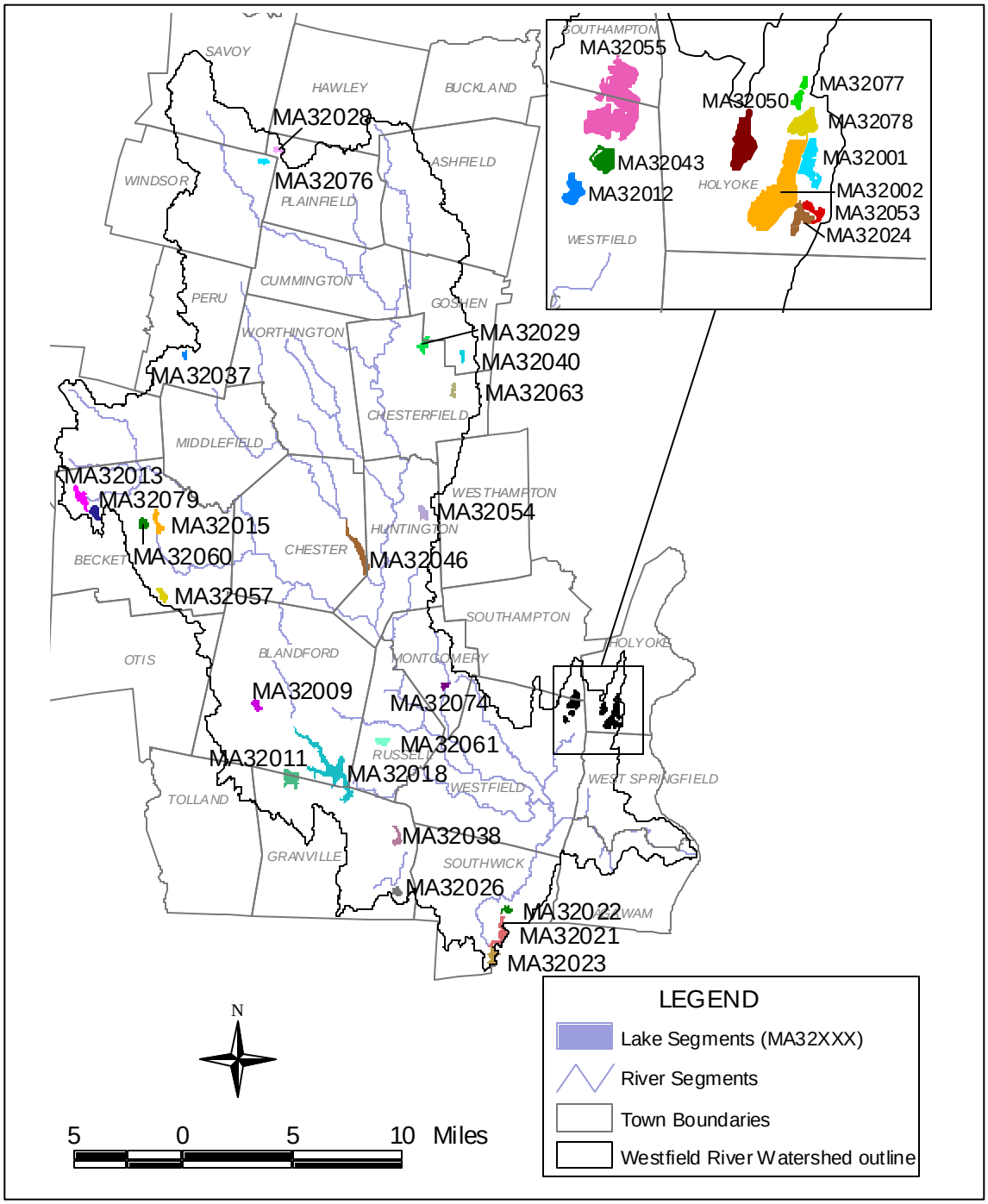



Figure 9. Westfield River Watershed – lake segment locations identified segment number

The designated use assessments for lakes are based on information gathered during DWM surveys (recent and historic) as well as pertinent information from other reliable sources (i.e., abutters, herbicide applicators, diagnostic/feasibility studies, MA DPH, etc.). The 1996 DWM synoptic surveys focused on visual observations of water quality and quantity (e.g., water level and sedimentation), the presence of native and non-native aquatic plants (as well as distribution and aerial cover) and presence/severity of algal blooms (Appendix F, Table F1). During 2001 more intensive in-lake sampling was conducted by DWM in two lakes in the Westfield River Watershed - Congamond Lake (North Basin) and Congamond Lake (Middle Basin), both in Southwick) - as part of the TMDL program. This sampling included: in-lake measurements of dissolved oxygen, pH, temperature, Secchi disk transparency, total phosphorus, alkalinity, apparent color, and chlorophyll *a* (Appendix F, Tables F2 and F3). Additionally, detailed macrophyte mapping was performed on these two lakes. While these surveys provided additional information to assess the status of the designated uses, fecal coliform bacteria data were not collected so the *Primary Contact Recreational* Use was usually not assessed. In the case of the *Fish Consumption Use* fish consumption advisory information was obtained from the MA DPH (MA DPH 2001 and MA DPH 2004a). Although the *Drinking Water Use* was not assessed in this water quality assessment report the Class A waters were identified. Information on drinking water source protection and finish water quality is available at http://www.mass.gov/dep/brp/dws/dwshome.htm and from the Westfield River Watershed's public water suppliers.

The use assessments and supporting information reported herein will be entered into either the EPA Water Body System (WBS) or Assessment Database (ADB). Data on the presence of non-native plants were entered into a MA DEP DWM informal non-native plant-tracking database.

***WMA***

Ashley Cutoff (MA32001), Ashley Pond (MA32002), Blair Pond (MA32009), Borden Brook Reservoir (MA32011), Clear Pond (MA32077), Cobble Mountain Reservoir (MA32018), Connor Resevoir (MA32024), Granville Reservoir (MA32038), Littleville Lake (MA32046), Mclean Reservoir (MA32050), North Railroad Pond (MA32053), Wright Pond (MA32078) are Class A Water Supplies. Additional information is available in Table 6 and in Appendix H, Table H7).

***NPDES***

There are no NPDES discharges to any of the 33 lakes assessed in this watershed.

**USE ASSESSMENT**

***AQUATIC LIFE***

Biology

Non-native aquatic macrophytes were observed in eight of 30 lakes surveyed by DWM or MA DCR in 1996 (Table 5 and Appendix F, Table F1). The four non-native aquatic species documented (Figure 10) in the Westfield River Watershed lakes were fanwort (*Cabomba caroliniana*), curly leaf pondweed (*Potamogeton crispus*), Eurasian milfoil (*Myriophyllum spicatum*), and variable milfoil (*Myriophyllum heterophyllum*). The mere presence of these species is considered an imbalance to the native biotic community, so these lakes are listed as impaired (901acres). Additionally, these species have a high potential for spreading and are likely to have established themselves in downstream lake and river segments in the Westfield River Watershed, which may not have been surveyed. Figure 10 indicates where these species were observed and the likely, or potential, avenues of downstream spreading. Two species were found in only one lake each. Fanwort (*Cabomba caroliniana*) was found only in Blair Pond in Blandford and curly leaf pondweed (*Potamogeton crispus*) was only noted in Pequot Pond in Southampton/Westfield. There is potential that the fanwort from Blair Pond may have spread, or could in the future spread, downstream via Pond Brook and Peeble Brook into the Cobble Mountain Reservoir. Curly leaf pondweed is one of three non-native aquatic plant species that were found in Pequot Pond. At least two of these (*Myriophyllum heterophyllum* and *Myriophyllum spicatum*) were recorded as having spread to ponds in the same vicinity. Horse Pond contained both species and Buck Pond was observed to contain *M. heterophyllum*. Since spreading of these species has already occurred in this system it is reasonable to assume that one or all species may have spread downstream to Chapin Pond and possibly the Westfield River via Pond Brook and Powdermill Brook. Eurasian milfoil (*Myriophyllum spicatum*) is a non-native aquatic species that can reproduce rapidly via vegetative cuttings and, thus, represents a threat to spread throughout watershed systems. In addition to the lakes mentioned above,

the presence of this species was recorded in Windsor Pond in Windsor and in all three basins of the Congamond Lakes in Southwick. Thus, there is reasonable potential for the spreading of Eurasian milfoil from these sites to the upper Westfield River via Clear Brook and to the lower Westfield River via Great Brook.

Two non-native wetland species, purple loosestrife (*Lythrum salicaria*) and reed grass (*Phragmites australis*), were identified at four lakes surveyed by DWM in 1995 (Table 5 and Appendix F, Table F1). Although the presence of these species is not generally a cause of impairment to lakes their invasive growth habit can result in the impairment of wetland habitat associated with lakes.

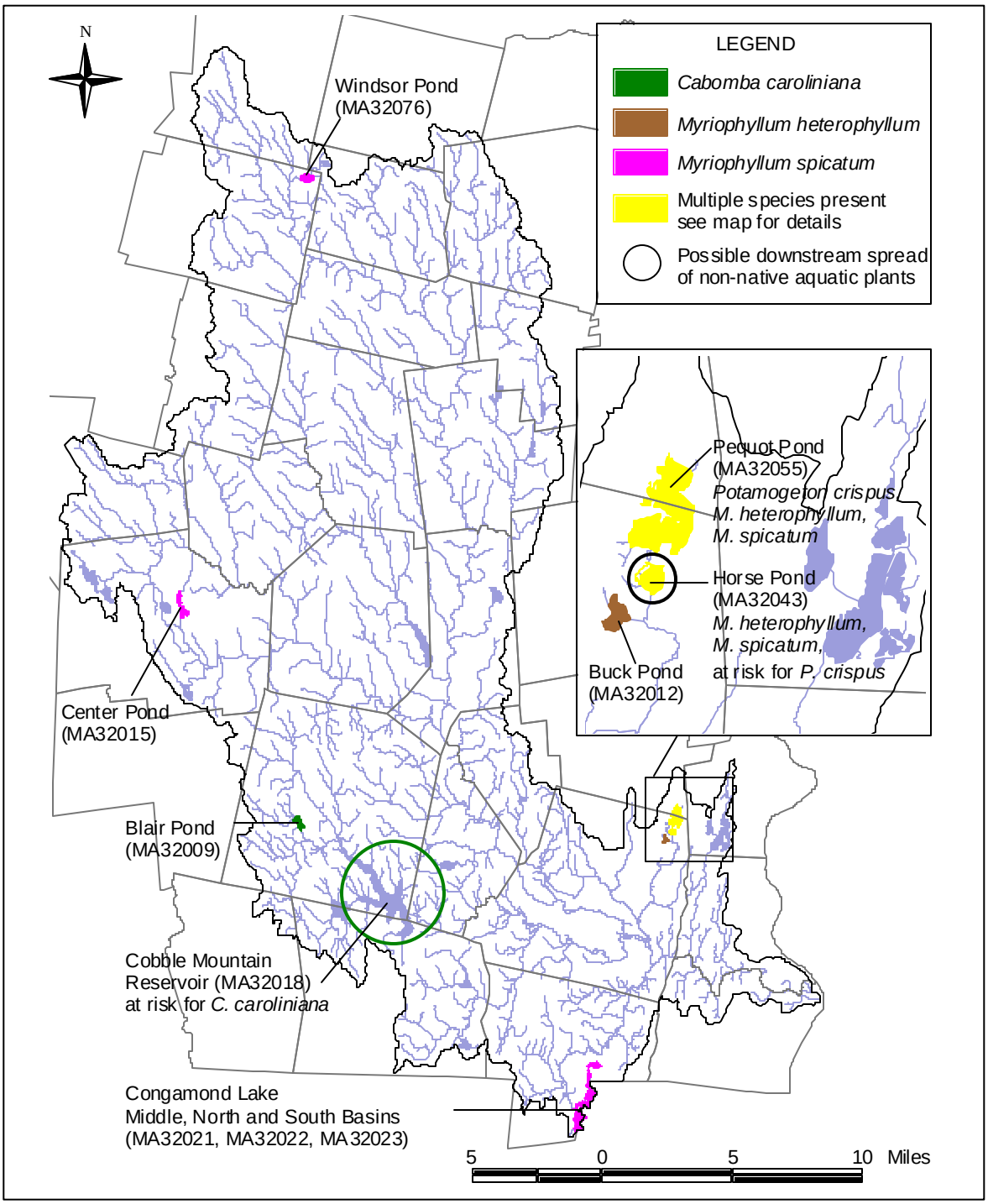



Figure 10. Westfield River Watershed – presence of non-native aquatic vegetation and potential for downstream spreading in Massachusetts.

Chemistry-water

Oxygen depletion occurred below 6 m and 8 m in Congamond Lake (Middle Basin and North Basin, respectively) in the summer of 2001 (Appendix F, Table F2). The lake area affected by oxygen depletion was almost 50% for the Middle Basin and approximately 25% for the North Basin. The total phosphorus concentrations were low to moderately high and the deep-water samples show evidence of phosphorus release due to the anoxic conditions (Appendix F, Table F3). Because >10% of the lake area in both the Middle Basin and North Basin of Congamond Lake was affected by oxygen depletion the *Aquatic Life Use* is assessed as impaired for both lakes.

The *Aquatic Life Use* is assessed as impaired for a total of nine lakes (including the three basins of Congamond Lake) in the Westfield River Watershed based on the confirmed presence of non-native macrophyte(s) representing a total of 901 acres (Table 5). The Middle and North Basins of Congamond Lake were also impaired because of oxygen depletion. The *Aquatic Life Use* for Robin Hood Lake was identified with an Alert Status as the result of an observed algal bloom. The remaining 23 lakes, representing 2,753 acres in the Westfield River Watershed, were not assessed for the *Aquatic Life Use* because of the cursory nature of the 1996 synoptic surveys and/or the lack of dissolved oxygen data and other more recent observations.

***FISH CONSUMPTION***

In July 2001 MA DPH issued new consumer advisories on fish consumption and mercury contamination (MA DPH 2001). The MA DPH "…is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age." Additionally, MA DPH "…is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury." MA DPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially. The advisory encompasses all freshwaters in Massachusetts and, therefore, the *Fish Consumption Use* for lakes in the Westfield River Watershed cannot be assessed as support.

Fish and sediment from a total of five lakes in the Westfield River Watershed were sampled in 1994 as part of a research and development study on mercury contamination developed by the Department's Office of Research and Standards (ORS) (Rose *et al*. 1999 and Maietta 2002). These lakes included Ashley Pond (Holyoke); Crooked Pond (Plainfield); and Buckley-Dunton Lake, Center Pond and Yokum Pond in Becket. Fish toxics monitoring (metals, PCB, and organochlorine pesticide in edible fillets) were conducted by DWM in Congamond Lake, Middle Basin (Southwick) and Pequot Pond (Westfield/Southampton) in June 2001. These data can be found in Appendix E, Table E1. Yokum Pond was sampled again in 2002 as part of a seasonal ORS or long-term study of mercury.

MA DPH has not issued any site-specific advisories for lakes in the Westfield River Watershed. Therefore, the *Fish Consumption Use* is not assessed for any lakes in this watershed because of the statewide advisory. [Note: The MA DPH fish consumption advisory list contains the recommendations for each waterbody for which an advisory has been issued. If a water body is not on the list it may be because either an advisory was not warranted or the water body has not been sampled. MA DPH's most current Fish Consumption Advisory list is available online at http://www.state.ma.us/dph/beha/fishlist.htm.]

***PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS***

In 1996 DWM conducted synoptic surveys of 30 lakes in the Westfield River Watershed. These surveys included general observations of water quality and quantity, the presence of native and non-native aquatic plants and the presence/severity of algal blooms (Appendix F, Table F1). Additional data were collected in three of these lakes in 2001 by DWM for the purpose of TMDL development. These data, combined with the Category 5 section of the 2002 Integrated List of Waters (the 303(d) list), MA DCR and MA DPH public beach posting data and diagnostic/feasibility studies were used to assess the recreational and aesthetics uses.

Bacteria samples were collected from three town bathing beaches in the Westfield River Watershed during the summers of 2001 to 2003 - Center Pond in Becket (MA32015), Congamond Lake (South Basin) in Southwick (MA32023), and Russell Pond in Russell (MA32061) (Becket BOH 2003, Russell BOH 2003, and Southwick BOH 2003). There was only one closure reported for these three beaches; Congamond Lake (South Basin) between 7 and 14 July 2003 (MA DPH 2004b). Although no bacteria data are available for either the Middle or North Basins of Congamond Lake, no objectionable deposits, odors, or other conditions were noted during the field surveys in either of these two basins or the South Basin Congamond Lake (MA DEP 2001b).

Bacteria samples were also collected at two state managed beaches in the Hampton Ponds State Park on Pequot Pond in Westfield -- the Kinsley Beach and the Lambert's Beach during 2001-2003 swimming seasons (MA DCR 2003b).

- At the Kinsley Beach beach closures occurred on the following dates (approximate percentage of bathing beach season noted in parentheses).
  In 2001: 20-21 June, 9 to 11and 16-18 July (8%)
  In 2002: 28-9 May, 3 to 9 June, 12 and 14-15 August (13%)
  In 2003: 27 May to 1 June (5%)
- At the Lambert's Beach beach closures occurred on the following dates.
  In 2001: 11 to 13 and 25 to 27 June, 9-11, 16-18, and 25 July (13%)
  In 2002: 28 and 30 May, 3,10, and 17 to 23 June (10%)
  In 2003: 18-19 August (2%)

The *Primary* and *Secondary Contact Recreational* uses are assessed as support in four lakes in the Westfield River Watershed (Center Pond, South Basin Congamond Lake, Pequot Pond, and Russell Pond), representing a total of 495 acres, based on beach closure information (Table 5). The *Recreational Uses* for Pequot Pond, however, are identified with an Alert Status because of the frequency of beach closures (approximately 9% overall during the 2001 to 2003 beach seasons). The *Aesthetics Use* is assessed as support for all three basins (Middle, North and South) of Congamond Lake since no objectionable conditions were noted during by DWM staff during the 2001 sampling surveys. A total of 27 lakes (2,834 acres or 78% of the total lake acreage in this report) were not assessed for either the *Recreational* or *Aesthetic* uses.

It should also be noted that there are two state managed beaches at the man-made pond in Robinson State Park. Although this pond is not a segment in this report, the following closures occurred during the 2001-2003 swimming season (MA DCR 2003b).

- At beach #1 closures occurred on the following dates
  21-23 May 2001; none in 2002; and 23-24 June, 4 and 6-10 August, 2 September 2003
- At Beach #2 beach closures occurred on the following dates:
  In 2001: 21 May, 24 May to 29 June, 4 to 11 July 2001; 28 May to 2 June 2002 and none in 2003

**SUMMARY**

A total of nine of the 33 lakes in the Westfield River Watershed assessed in this report were impaired for the *Aquatic Life Use* (Table 5). No other uses were assessed as impaired. Causes of impairment for the *Aquatic Life Use* included non-native plant infestation and oxygen depletion. Four lakes were assessed as support for the *Recreational Uses* and three lakes were assessed as support for the *Aesthetics Use*. The remaining 23 lakes, representing 2,753 acres in the Westfield River Watershed, were not assessed for any uses because of the cursory nature of the 1996 synoptic surveys and/or the lack of dissolved oxygen, other water quality data, or other more recent observations. Table 5 presents the use assessments for the individual lakes in the Westfield River Watershed.

**Table 5. Designated Use Assessments for Individual Lakes in the Westfield River Watershed.**

| Lake, Location | WBID | Size (Acres) | Aquatic Life (Impairment Cause) | Fish Consumption (Impairment Cause) | Primary Contact (Impairment Cause) | Secondary Contact (Impairment Cause) | Aesthetics (Impairment Cause) |
|---|---|---|---|---|---|---|---|
| Ashley Cutoff, Holyoke | MA32001 | 31 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Ashley Cutoff is a Class A Public Water Supply. Based on the last evaluation of water quality conditions Ashley Cutoff is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Ashley Cuttoff in 1996; no objectionable conditions were noted (Appendix F, Table F1). | | | | | | | |
| Ashley Pond, Holyoke | MA32002 | 133 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Ashley Pond is a Class A Public Water Supply. Based on the last evaluation of water quality conditions Ashley Pond is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Ashley Pond in 1996 (Appendix F, Table F1). Fish contaminant monitoring (select metals, PCB and organochlorine pesticides) was conducted in Ashley Pond in 1994 as part of the MA DEP ORS Mercury Study (Maietta 2002 and Rose *et al*. 1999) to examine fish mercury distribution in Massachusetts lakes. No site-specific advisory was issued by MA DPH, so the *Fish Consumption Use* is not assessed. | | | | | | | |
| Blair Pond, Blandford | MA32009 | 69 | IMPAIRED (Non-native aquatic plants: *C. caroliniana*) | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Blair Pond is a Class A Public Water Supply. Based on the last evaluation of water quality conditions Blair Pond is listed in Category 4C of the 2002 Integrated List of Waters (MA DEP 2003a). This segment is impaired because of exotic species, but is not subject to TMDL calculations because the impairment is not caused by a pollutant. DWM conducted a synoptic survey of Blair Pond in 1996 and the pond was found to be infested with the non-native aquatic species, *Cabomba caroliniana* (Appendix F, Table F1), so the *Aquatic Life Use* is assessed as impaired. | | | | | | | |
| Borden Brook Reservoir, Granville/Blandford | MA32011 | 211 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Borden Brook Reservoir is a Class A Public Water Supply. Based on the last evaluation of water quality conditions Borden Brook Reservoir is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Borden Brook Reservoir in 1996; no objectionable conditions were noted (Appendix F, Table F1). | | | | | | | |
| Buck Pond, Westfield | MA32012 | 23 | IMPAIRED (Non-native aquatic plants: *M. heterophyllum*) | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Buck Pond is listed in Category 4C of the 2002 Integrated List of Waters (MA DEP 2003a). This segment is impaired because of exotic species, but is not subject to TMDL calculations because the impairment is not caused by a pollutant. DWM conducted a synoptic survey of Buck Pond in 1996 and the pond was found to be infested with the non-native aquatic species, *Myriophyllum heterophyllum* (Appendix F, Table F1), so the *Aquatic Life Use* is assessed as impaired. | | | | | | | |
| Buckley-Dunton Lake, Becket | MA32013 | 154 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Buckley-Dunton Lake is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). Fish contaminant monitoring and sediment sampling was conducted in Buckley-Dunton Lake in 1994 as part of the MA DEP ORS Mercury Study (Maietta 2002 and Rose *et al*. 1999). No site-specific advisory was issued by MA DPH, so the *Fish Consumption Use* is not assessed. The concentration of arsenic in the sediment was 0.44 mg/kg, selenium was 0.32 mg/kg, mercury was 0.29 mg/kg, cadmium was 10 mg/kg, and lead was 55 mg/kg. | | | | | | | |

**Table 5 continued. Designated Use Assessments for Individual Lakes in the Westfield River Watershed.**

| Lake, Location | WBID | Size (Acres) | Aquatic Life (Impairment Cause) | Fish Consumption (Impairment Cause) | Primary Contact (Impairment Cause) | Secondary Contact (Impairment Cause) | Aesthetics (Impairment Cause) |
|---|---|---|---|---|---|---|---|
| Center Pond, Becket | MA32015 | 114 | IMPAIRED (Non-native aquatic plants: *M. spicatum*) | NOT ASSESSED | SUPPORT | SUPPORT | NOT ASSESSED |
| In 1995 the Town of Becket received an MA DEM (now MA DCR) Lakes and Ponds Grant to make structural improvements at the town beach on Center Pond by installing drainage pipes, and creating swales and vegetated buffers to prevent erosion of beach soils (MA DEM 2000). In 2000 the Town received an MA DEM Lake and Pond Grant to control the spread of the non-native nuisance aquatic plant *Myriophylum spicatum* (Eurasian Milfoil) (MA DEM 2000). Chemicals were applied in Center Pond in June 2000 and May 2001. Since the pond is infested with the non-native aquatic species, *Myriophyllum spicatum* , the *Aquatic Life Use* is assessed as impaired. Based on the last evaluation of water quality conditions Center Pond is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Center Pond in 1996; no objectionable conditions were noted (Appendix F, Table F1). Fish contaminant monitoring and sediment sampling was conducted in Center Pond in 1994 as part of the MA DEP ORS Mercury Study (Maietta 2002 and Rose *et al*. 1999). No site-specific advisory was issued by MA DPH, so the *Fish Consumption Use* is not assessed. The concentration of arsenic was 0.44 mg/kg, selenium was 0.29 mg/kg, mercury was 0.08 mg/kg, cadmium was less than the method detection limit, and lead was 144 mg/kg. The Town of Becket maintains a town beach at Center Pond. No beach closings have been reported for any of the 2001 to 2003 bathing seasons (Becket BOH 2003 and MA DPH 2004b), so the *Recreational* uses are assessed as support. The *Aesthetics Use* is not assessed. | | | | | | | |
| Clear Pond, Holyoke | MA32077 | 10 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Clear Pond is a Class A Public Water Supply. Based on the last evaluation of water quality conditions Clear Pond is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Clear Pond in 1996; the non-native wetland plant L*ythrum salicaria* was identified (Appendix F, Table F1). | | | | | | | |
| Cobble Mountain Reservoir, Blandford/Granville/Russell | 32018 | 1034 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Cobble Mountain Reservoir is a Class A Public Water Supply. Based on the last evaluation of water quality conditions Cobble Mountain Reservoir is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Cobble Mountain Reservoir in 1996; no objectionable conditions were noted (Appendix F, Table F1). | | | | | | | |
| **Note following information applicable to all three Congamond Lake segments (Middle, North and South Basins):** From 1995 - 2001 the Town of Southwick received four separate MA DEM (now MA DCR) Lakes and Ponds Grants, each for $10,000 to make structural improvements (e.g., culverts, catch basins with sumps, vegetate shorelines) to the drainage system into and between the three interconnecting ponds to reduce erosion, trap sediments and silt, reduce pollution loadings to the lakes, maintain equal levels in the lakes, and provide some flood control (MA DEM 2000 and MA DEM 2001). The Town applied chemicals to the lake to control nuisance plant growth in 1999, 2000, and 2001. Based on the last evaluation of water quality conditions Congamond Lake (Middle, North and South Basins) is listed in Category 4C of the 2002 Integrated List of Waters because of exotic species (MA DEP 2003a). | | | | | | | |
| Congamond Lake (Middle Basin), Southwick | MA32021 | 279 | IMPAIRED (DO, DO saturation, Non-native aquatic plants: *M. spicatum*) | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | SUPPORT |
| DWM conducted a synoptic survey of Congamond Lake (Middle Basin) in 1996 and the pond was found to be infested with the non-native aquatic plant, *Myriophyllum spicatum* (Appendix F, Table F1). In 2001 DWM surveyed the lake for water quality parameters (Appendix F, Table F2). Low DO and percent saturation occurred at depths greater than 6m during the 2001 survey. In-lake total phosphorus concentrations were not high but there was evidence of phosphorus release from anoxic sediments. None of the Secchi disk depth measurements violated the bathing beach guidance of four feet. The *Aquatic Life Use* is assessed as impaired because of low DO/saturation and | | | | | | | |

**Table 5 continued. Designated Use Assessments for Individual Lakes in the Westfield River Watershed.**

| Lake, Location | WBID | Size (Acres) | Aquatic Life (Impairment Cause) | Fish Consumption (Impairment Cause) | Primary Contact (Impairment Cause) | Secondary Contact (Impairment Cause) | Aesthetics (Impairment Cause) |
|---|---|---|---|---|---|---|---|
| the presence of the non-native aquatic species. Fish contaminant monitoring (select metals, PCB and organochlorine pesticides) was conducted in Congamond Lake (Middle Basin) in 2001 (Appendix E, Table E1 and Maietta and Colonna Romano 2002). No site-specific advisory was issued by MA DPH, so the *Fish Consumption Use* is not assessed. No bacteria data are available to assess the status of the *Primary* and *Secondary Contact Recreational* uses, however there were no objectionable deposits, odors or other conditions noted during the 2001 sampling surveys, so the *Aesthetics Use* is assessed as support. | | | | | | | |
| Congamond Lake (North Basin), Southwick | MA32022 | 46 | IMPAIRED (DO, DO saturation, Non-native aquatic plants: *M. spicatum*) | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | SUPPORT |
| DWM conducted a synoptic survey of Congamond Lake (North Basin) in 1996 and the pond was found to be infes ted with the non-native aquatic plant, *Myriophyllum spicatum* (Appendix F, Table F1). In 2001 DWM surveyed the lake for water quality parameters (Appendix F, Table F3). Low DO/saturation occurred at depths greater than 8 m during the 2001 survey. In-lake total phosphorus concentrations were not high but there was evidence of phosphorus release from anoxic sediments. None of the Secchi disk depth measurements violated the bathing beach guidance of four feet. The *Aquatic Life Use* is assessed as impaired because of low DO/saturation and the presence of the non-native aquatic species. Although no bacteria data are available to assess the status of the *Primary* and *Secondary Contact Recreational* uses, there were no objectionable deposits, odors or other conditions noted during the 2001 sampling surveys, so the *Aesthetics Use* is assessed as support. | | | | | | | |
| Congamond Lake (South Basin), Southwick | MA32023 | 144 | IMPAIRED (Non-native aquatic plants: *M. spicatum*) | NOT ASSESSED | SUPPORT | SUPPORT | SUPPORT |
| Although not surveyed by DWM in 1996 Congamond Lake (South Basin) was also assumed to be infested with the non-native aquatic species, *Myriophyllum spicatum* (Appendix F, Table F1), so the *Aquatic Life Use* is assessed as impaired. The Town of Southwick maintains a town beach on this basin. There were no closures reported for either the 2001 or 2002 bathing season and there was only one closure reported during the 2003 swimming season (Southwick BOH 2003 and MA DPH 2004b). No objectionable deposits, odors or other conditions noted during the 2001 sampling surveys. Based on this information the *Recreational* and *Aesthetics* are assessed as support. | | | | | | | |
| Connor Reservoir, Holyoke | MA32024 | 17 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Connor Reservoir is a Class A Public Water Supply. Based on the last evaluation of water quality conditions Connor Reservoir is listed in Category 3 of the 2002 integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses. DWM conducted a synoptic survey of Connor Reservoir in 1996 (Appendix F, Table F1). | | | | | | | |
| Cooley Lake, Granville | MA32026 | 66 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Cooley Lake is listed in Category 3 of the 2002 integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses. | | | | | | | |
| Crooked Pond, Plainfield | MA32028 | 34 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Crooked Pond is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses. DWM conducted a synoptic survey of Crooked Pond in 1996 (Appendix F, Table F1). Fish contaminant monitoring (select metals, PCB and organochlorine pesticides) and sediment sampling was conducted in Crooked Pond in 1994 as part of the MA DEP ORS Mercury Study (Maietta 2002 and Rose *et al*. 1999). No site-specific advisory was issued by MA DPH, so the *Fish Consumption Use* is not assessed. | | | | | | | |
| Damon Pond, Chesterfield/Goshen | MA32029 | 78 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Damon Pond is listed in Category 3 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment was not assessed for any uses. DWM conducted a synoptic survey of Damon Pond in 1996 (Appendix F, Table F1). | | | | | | | |

**Table 5 continued. Designated Use Assessments for Individual Lakes in the Westfield River Watershed.**

| Lake, Location | WBID | Size (Acres) | Aquatic Life (Impairment Cause) | Fish Consumption (Impairment Cause) | Primary Contact (Impairment Cause) | Secondary Contact (Impairment Cause) | Aesthetics (Impairment Cause) |
|---|---|---|---|---|---|---|---|
| Garnet Lake, Peru | MA32037 | 17 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Garnet Lake is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Garnet Lake in 1996 (Appendix F, Table F1). | | | | | | | |
| Granville Reservoir, Granville | MA32038 | 74 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Granville Reservoir is a Class A Public Water Supply. Based on the last evaluation of water quality conditions Granville Reservoir is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Granville Reservoir in 1996; no objectionable conditions were noted (Appendix F, Table F1). | | | | | | | |
| Hammond Pond, Goshen | MA32040 | 38 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Hammond Pond is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Hammond Pond in 1996; no objectionable conditions were noted (Appendix F, Table F1). | | | | | | | |
| Horse Pond, Westfield | MA32043 | 24 | IMPAIRED (Non-native aquatic plants: *M. heterophyllum and M. spicatum*) | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Horse Pond is listed in Category 4C of the 2002 Integrated List of Waters (MA DEP 2003a). This segment is impaired because of exotic species, but is not subject to TMDL calculations because the impairment is not caused by a pollutant. DWM conducted a synoptic survey of Horse Pond in 1996 and the pond was found to be infested with the non-native aquatic species, *Myriophyllum heterophyllum* and *Myriophyllum spicatum* (Appendix F, Table F1), so the *Aquatic Life Use* is assessed as impaired. | | | | | | | |
| Littleville Lake, Chester/Huntington | MA32046 | 255 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Littleville Lake is a Class A Public Water Supply. The Springfield Water and Sewer Commission has a WMA registration (10428101) to withdraw up to 37.2 MGD from their sources including Littleville Lake (Appendix H, Table H7). Based on the last evaluation of water quality conditions Littleville Lake is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a) for supporting some designated uses (Secondary Contact Recreation, Aesthetics) and not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Littleville Lake in 1996; the non-native wetland plant L*ythrum salicaria* was identified (Appendix F, Table F1). Littleville Dam is classified by the ACOE as a Class A project (no significant water quality problems) and is one of 14 flood control dams in the Connecticut River Basin (encompassing parts of the states of Vermont, New Hampshire, Massachusetts, and Connecticut). During the past five years there has been no indication of significant water quality problems, including bacteria problems. There is one well that is regularly monitored by the ACOE. In FY 02 The Water Management Section of ACOE, New England District, completed a report on a priority pollutant scan conducted by ACOE at Littleville Dam (ACOE 2002 and Barker 2004). Sediment samples were collected in September 2000 and analyzed for metals, PCB' pesticides, semi-volatile organic compounds, dioxins and furans, grain size, and TOC. Overall levels of EPA priority pollutants at these Westfield River projects were low and indicative of natural background conditions. No substances were in concentrations high enough to pose a risk to humans or interfere with uses of the projects or their waters. | | | | | | | |

**Table 5 continued. Designated Use Assessments for Individual Lakes in the Westfield River Watershed.**

| Lake, Location | WBID | Size (Acres) | Aquatic Life (Impairment Cause) | Fish Consumption (Impairment Cause) | Primary Contact (Impairment Cause) | Secondary Contact (Impairment Cause) | Aesthetics (Impairment Cause) |
|---|---|---|---|---|---|---|---|
| McLean Reservoir, Holyoke | MA32050 | 55 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| McLean Reservoir is a Class A Public Water Supply (PWS). Based on the last evaluation of water quality conditions McLean Reservoir is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of McLean Reservoir in 1996; no objectionable conditions were noted (Appendix F, Table F1). | | | | | | | |
| North Railroad Pond, Holyoke | MA32053 | 9 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| North Railroad Pond is a Class A Public Water Supply. Based on the last evaluation of water quality conditions North Railroad Pond is listed in category 5 of the 2002 Integrated List of Waters because of noxious aquatic plants and turbidity (MA DEP 2003a). DWM conducted a synoptic survey of North Railroad Pond in 1996 (Appendix F, Table F1). Although objectionable turbidity was noted, there are no recent data available, so all uses are currently not assessed. | | | | | | | |
| Norwich Pond, Huntington | MA32054 | 116 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| In 2000 the Town of Huntington received a $520 MA DEM (now MA DCR) Lakes and Ponds Grant to improve water quality by conducting a water quality monitoring program and developing a newsletter to educate residents on best applicable best management practices to improve water quality. Based on the last evaluation of water quality conditions Norwich Pond is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Norwich Pond in 1996; no objectionable conditions were noted (Appendix F, Table F1). | | | | | | | |
| Pequot Pond, Westfield/Southampton | MA32055 | 155 | IMPAIRED (Non-native aquatic plants: *P. crispus, M. spicatum* and *M. heterophyllum*) | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| In 1997 the City of Westfield received a $10,000 MA DEM (now MA DCR) Lakes and Ponds Grant to control the spread of the non-native nuisance aquatic plant, *Myriophyllum spicatum*, through the application of the chemical herbicide SONAR. Based on the last evaluation of water quality conditions Pequot Pond is listed in category 5 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment is impaired by pollutants (nutrients, organic enrichment/low DO, noxious aquatic plants) and will require TMDLs for these pollutants. MA DEM conducted surveys of Pequot Pond in 1995 and 1996 and the pond was found to be infested with three non-native aquatic species, *Potamogeton crispus*, *M. spicatum* and *M. heterophyllum*, so the *Aquatic Life Use* is assessed as impaired. Fish contaminant monitoring (select metals, PCB and organochlorine pesticides) was conducted in Pequot Pond in 2001 (See Appendix E, Table EX and Maietta and Colonna-Romano 2002). No site-specific advisory was issued by MA DPH, so the *Fish Consumption Use* is not assessed. | | | | | | | |
| Robin Hood Lake, Becket | MA32057 | 64 | NOT ASSESSED* | NOT ASSESSED | NOT ASSESSED* | NOT ASSESSED | NOT ASSESSED* |
| Based on the last evaluation of water quality conditions Robin Hood Lake is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Robin Hood Lake in 1996; the non-native wetland plant *Phragmites australis* was identified (Appendix F, Table F1). An algal bloom that decreased transparency was observed by DWM staff in Robin Hood Lake in September 2001 (estimated <4 foot Secchi disk) (Mitchell 2005). Because of these observations the *Aquatic Life*, *Primary Contact Recreation* and the *Aesthetics* uses are identified with an Alert Status. Robin Hood Lake was treated in 2002 and 2003 with a herbicide to control nuisance aquatic plants. | | | | | | | |

**Table 5 continued. Designated Use Assessments for Individual Lakes in the Westfield River Watershed.**

| Lake, Location | WBID | Size (Acres) | Aquatic Life (Impairment Cause) | Fish Consumption (Impairment Cause) | Primary Contact (Impairment Cause) | Secondary Contact (Impairment Cause) | Aesthetics (Impairment Cause) |
|---|---|---|---|---|---|---|---|
| Rudd Pond, Becket | MA32060 | 72 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Rudd Pond is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Rudd Pond in 1996; no objectionable conditions were noted (Appendix F, Table F1). | | | | | | | |
| Russell Pond, Russell | MA32061 | 82 | NOT ASSESSED | NOT ASSESSED | SUPPORT | SUPPORT | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Russell Pond is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Russell Pond in 1996; no objectionable conditions were noted (Appendix F, Table F1). The Town of Russell maintains a town beach at Russell Pond. No beach closings have been reported for any of the 2001 to 2003 bathing seasons (Russell BOH 2003 and DPH 2004b), so the *Recreational* uses are assessed as support. | | | | | | | |
| Scout Pond, Chesterfield | MA32063 | 37 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Scout Pond is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Scout Pond in 1996; no objectionable conditions were noted (Appendix F, Table F1). | | | | | | | |
| Westfield Reservoir, Montgomery | MA32074 | 40 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Westfield Reservoir is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Westfield Reservoir in 1996; no objectionable conditions were noted (Appendix F, Table F1). | | | | | | | |
| Windsor Pond, Windsor | MA32076 | 47 | IMPAIRED (Non-native aquatic plants – *M. spicatum*) | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Windsor Pond is listed in Category 5 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment is impaired by pollutants (Organic Enrichment/Low DO) and will require TMDLs for these pollutants. It is also impaired by exotic species, but this will not require a TMDL since the cause is not a pollutant. DWM conducted a synoptic survey of Windsor Pond in 1996 and the pond was found to be infested with the non-native aquatic species, *Myriophyllum spicatum* (Appendix F, Table F1), so the *Aquatic Life Use* is assessed as impaired. | | | | | | | |
| Wright Pond, Holyoke | MA32078 | 28 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Wright Pond is a Class A PWS. Based on the last evaluation of water quality conditions Wright Pond is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Wright Pond in 1996; the non-native wetland plant *Lythrum salicaria* was identified (Appendix F, Table F1). | | | | | | | |

**Table 5 continued. Designated Use Assessments for Individual Lakes in the Westfield River Watershed.**

| Lake, Location | WBID | Size (Acres) | Aquatic Life (Impairment Cause) | Fish Consumption (Impairment Cause) | Primary Contact (Impairment Cause) | Secondary Contact (Impairment Cause) | Aesthetics (Impairment Cause) |
|---|---|---|---|---|---|---|---|
| Yokum Pond, Becket | MA32079 | 98 | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED | NOT ASSESSED |
| Based on the last evaluation of water quality conditions Yokum Pond is listed in Category 2 of the 2002 Integrated List of Waters (MA DEP 2003a). This segment supported some designated uses (Secondary Contact Recreation, Aesthetics) and was not assessed for others (Primary Contact Recreation, Aquatic Life, Fish Consumption). DWM conducted a synoptic survey of Yokum Pond in 1996; no objectionable conditions were noted (Appendix F, Table F1). Yokum Pond was sampled as part of the MA DEP DWM nutrient criteria development study in 2003. These data however are not yet available. In August 2003 a macrophyte survey of Yokum Pond was conducted by DWM; no non-native aquatic species were observed (MA DEP 2003b). Fish contaminant monitoring (select metals, PCB and organochlorine pesticides) and sediment sampling was conducted in Yokum Pond in 1994 as part of the MA DEP ORS Mercury Study and additional monitoring was conducted in 2002 (Maietta 2002 and Rose *et al*. 1999). No site-specific advisory has been issued by MA DPH, so the *Fish Consumption Use* is not assessed. | | | | | | | |

**RECOMMENDATIONS – LAKES**

- Coordinate with DCR and/or other groups conducting lake surveys to generate quality assured lake data. Conduct more intensive lake surveys to better determine the lake trophic and use support status and identify causes and sources of impairment. As sources are identified within lake watersheds they should be eliminated or, at least, minimized through the application of appropriate point or non-point source control techniques.

- Implement recommendations identified in lake diagnostic/feasibility studies, including lake watershed surveys to identify sources of impairment.

- Continue to review data from "Beaches Bill" required water quality testing (bacteria sampling at all formal bathing beaches) to assess the status of the recreational uses.

- Quick action is necessary to manage non-native aquatic or wetland plant species that are isolated in one or a few location(s) in order to alleviate the need for costly and potentially fruitless efforts to do so in the future. Two courses of action should be pursued concurrently. More extensive surveys need to be conducted, particularly downstream from these recorded locations to determine the extent of the infestation. And, "spot" treatments (refer to the Final Generic Environmental Impact Report [GEIR] for Eutrophication and Aquatic Plant Management in Massachusetts [Mattson et *al*. 2004] for advantages and disadvantages of each) should be undertaken to control populations at these sites. These treatments include careful hand-pulling of individual plants in small areas. In larger areas other techniques, such as selective herbicide application, may be necessary. In either case the treatments should be undertaken prior to fruit formation and with a minimum of fragmentation of the individual plants. These actions will minimize the spreading of the populations. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson et *al*. 2004) should be consulted prior to the development of any lake management plan to control non-native aquatic or wetland plant species.

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

- Continue to monitor for the presence of invasive non-native aquatic vegetation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and responsibility of spreading these species.

- Develop TMDLs for lakes listed in Category 5 of the 2002 Integrated List of Waters (MA DEP 2003a).

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There are no tables or figures in this appendix.

# APPENDIX A

*Technical Memorandum TM-32-4*

**WESTFIELD RIVER WATERSHED**
**DWM 2001 WATER QUALITY MONITORING DATA**

DWM Control Number: CN 111.0


**COMMONWEALTH OF MASSACHUSETTS**
**EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS**
ELLEN ROY HERZFELDER, SECRETARY
**MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION**
ROBERT W. GOLLEDGE JR., COMMISSIONER
**BUREAU OF RESOURCE PROTECTION**
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**DIVISION OF WATERSHED MANAGEMENT**
GLENN HAAS, DIRECTOR

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## Introduction

Water quality sampling of the Westfield River Watershed was conducted in 2001 to address DWM program objectives. Specific objectives for the Westfield 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: *in-situ* Hydrolab® measurements, and physico-chemical, nutrient, and bacteria sampling.

## Project Objectives

The primary objective of this Year Two sampling, as outlined in CN 062.0 *Quality Assurance Project Plan for Year 2001 Watershed Assessments of the Farmington, Westfield, Concord, Taunton and South Coastal basins*, 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.

This technical memorandum presents the water quality sampling component of the survey. Results of other monitoring efforts, such as biological assessments and monitoring to support the development of lake Total Maximum Daily Loads, are reported in separate technical memoranda.

## Methods

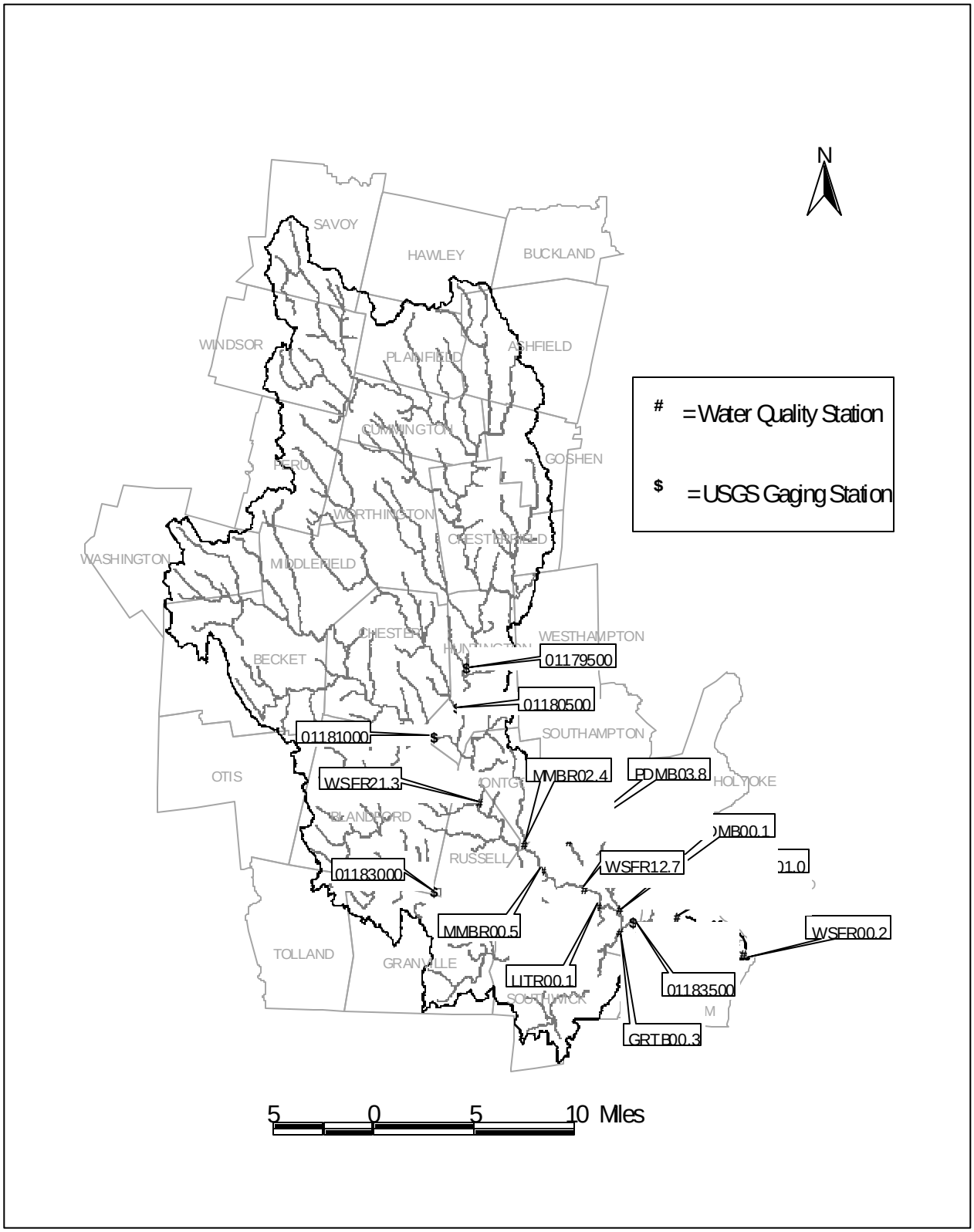
Water quality samples were collected in the Westfield River Watershed on the dates and for the parameters as shown in Table 1. See Figure 1 for station locations. The parameters included in the sampling were: *in-situ* Hydrolab® measurements (dissolved oxygen, percent dissolved oxygen saturation, pH, conductivity, water temperature and total dissolved solids), and alkalinity, hardness, chloride, total suspended solids, ammonia, nitrate-nitrite, total phosphorus, and fecal coliform and E. coli bacteria sampling. The water quality sampling procedures are included in the publication: CN 001.2 *Sample Collection Techniques for DWM Surface Water Quality Monitoring*. Standard operating procedure CN 004.1 *Hydrolab® Series 3/Series 4 Multiprobe* outlines the standard operating procedures for Hydrolab® sampling. Samples for alkalinity, hardness, chloride, total suspended solids, nutrients (nitrate-N, ammonia-N, total phosphorus) and bacteria were analyzed at the Wall Experiment Station (WES), the Department's analytical laboratory in Lawrence, Massachusetts.

DWM quality assurance and database management staff reviewed lab data reports and all Hydrolab® multi-probe data. The data were validated and finalized per data validation procedures outlined in DWM SOP CN 56.0 Draft *Data Validation and Usability Standard Operating Procedure*. 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 2001 DWM data is provided in CN 149.0 *Data Validation Report for Year 2001 Project Data*. A list of Symbols and Qualifiers Used for DWM Data is presented in Appendix 4.

| Table 1: Westfield River Watershed 2001 Water Quality Sampling Summary - Site Descriptions, Segment Numbers, Parameters* | | | | | | |
|---|---|---|---|---|---|---|
| **Site Description** | **Segment No.** | **Station No.** | **Aug 1** | **Aug 22** | **Sept 12** | **Oct 3** |
| Westfield River, West Bank at Main Street Bridge, Russell | MA32-05 | WSFR21.3 | DO, C, N, TSS | DO, C, N, TSS, B | DO, C, N, TSS, B | DO, C, N, TSS, B |
| Moose Meadow Brook, below Tekoa Res., Montgomery | MA32-23 | MMBR02.4 | DO, C, N, TSS, B | DO, C, N, TSS, B | DO, C, N, TSS, B | DO, C, N, TSS, B |
| Moose Meadow Brook off Pochassic Rd., Westfield | MA32-23 | MMBR00.5 | DO, C, N, TSS, B | DO, C, N, TSS, B | DO, C, N, TSS, B | DO, C, N, TSS, B |
| Westfield River, upstream from Rte. 202/10 Bridge, Westfield | MA32-05 | WSFR12.7 | DO, C, N, TSS, B | DO, C, N, TSS, B | DO, C, N, TSS, B | DO, C, N, TSS, B |
| Little River, upstream from Rte. 20 Bridge, Westfield | MA32-08 | LITR00.1 | DO, C, TSS, B | DO, C, TSS, B | DO, C, TSS, B | DO, C, TSS, B |
| Powdermill Brook, Russellville Rd., Westfield | MA32-09 | PDMB03.8 | DO, C, N, TSS, B | DO, C, N, TSS, B | DO, C, N, TSS, B | DO, C, N, TSS, B |
| Powdermill Brook downstream from Union St. culvert, Westfield | MA32-09 | PDMB00.1 | DO, C, TSS, B | DO, C, TSS, B | DO, C, TSS, B | DO, C, TSS, B |
| Great Brook, upstream from Rte. 187 Bridge, Westfield | MA32-25 | GRTB00.3 | DO, C, TSS, B | DO, C, TSS, B | DO, C, TSS, B | DO, C, TSS, B |
| Block Brook, Plymouth Terrace, Agawam | (Undefined) | BLBR01.0 | DO, C, TSS, B | DO, C, TSS, B | DO, C, TSS, B | DO, C, TSS, B |
| Westfield River, upstream from Rte. 5 Bridge, Agawam | MA32-07 | WSFR00.2 | DO, C, TSS, B | DO, C, TSS, B | DO, C, TSS, B | DO, C, TSS, B |

* Parameters:
DO = dissolved oxygen (pre-dawn)
C = total alkalinity, total hardness, chlorides
N = nitrates, ammonia, total phosphorus (low-level)
TSS = total suspended solids
B = bacteria (fecal coliform and E. coli)

**Figure 1: Westfield River Watershed 2001 Water Quality Sampling Stations and USGS Stream Gages**



**Survey Conditions**

Meteorological and hydrological conditions antecedent to each sampling date were characterized by analyzing precipitation and streamflow data. Rainfall data from the National Weather Service station at Barnes Municipal Airport (BAF) was reviewed for the five days prior to the sampling dates (Table 2). These data were taken from the NOAA website (http://tgsv5.nws.noaa.gov/er/box/clstns.htm).

Data from three USGS stream gages were used for discharge assessment (Tables 3 – 5). Those gages are 01179500 on Westfield River at Knightville, MA; 01181000 on West Branch Westfield River at Huntington, MA; and 01183500 on West Branch Westfield River near Westfield, MA. Locations of the gages are depicted in Figure 1. Streamflow statistics for these gages are available from USGS (Socolow *et al.* 2002 and 2003 and USGS 2004).

Gage 01179500 is located 0.2 miles downstream of Knightville Dam (Huntington, MA). This impoundment is managed by the ACOE. There is a power generating facility associated with this impoundment that is capable of producing 3000kwh. As such, the gage reading is a measurement of the release from Knightville Dam, rather than a measurement of natural flow conditions. Gage 01181000 is located upstream of Huntington center. The flow at this gage does not appear to be regulated by any major upstream impoundment, and represents the best measure of natural flow conditions. A chart of the 2001 summer discharge and dates of sample collection may be seen in figure 2. Gage 01183500 is located in the city of Westfield. Borden Brook Reservoir, Cobble Mountain Reservoir, Knightville Reservoir, and Littleville Lake regulate flow past this gage.

Appendix 1 contains figures of the discharge and precipitation data combined for the days prior to the sampling dates. In general, water conditions in the Westfield River Watershed, during the 2001 DWM water quality sampling season, were normal to dry. This resulted in a decrease in instream flow below historic mean levels.

**August 1, 2001 -** This survey was conducted during a dry period, with no rain reported at Barnes Municipal Airport (BAF, Westfield, MA) during the week prior to sampling. Gage data (USGS gage 01181000) revealed a consistent decline in flow in the week prior to sample collection.

**August 22, 2001 -** This survey was conducted during a relatively dry period, with less than ¼ inch of rain falling on any one day during the week prior to sampling. The total rainfall during the week prior to sampling was 0.29 inches. Discharge (at USGS gage 01181000) remained relatively steady (~13cfs), with less than a 1cfs variation in discharge during the week prior to sample collection.

**September 12, 2001 -** This survey was conducted during a relatively dry period, with less than ¼ inch of rain falling on any one day during the week prior to sampling. The total rainfall during the week prior to sampling was 0.18 inches. Discharge (USGS gage 01181000) remained low, with a mean discharge of 9cfs during the week prior to sample collection.

**October 3, 2001** - This survey was conducted during a relatively dry period, with less than ¼ inch of rain falling on any one day during the week prior to sampling. However, a rain event that dropped 0.83 inches at BAF occurred on September 25$^{th}$. This event resulted in a short-term (<48hr) increase in measured discharge at USGS gage 01181000. The discharge during the week prior to sampling displayed a steady decline, with a mean discharge of 48cfs for the week.

**Figure 2: Discharge at USGS Gage 01181000 – 2001 Mean Daily Discharge, 7Q10, and Mean Daily Discharge for the period of record (67 years)**
Figure deleted for this copy see original document for chart.

| Table 2: Westfield River Watershed 2001 Precipitation Data Summary (reported in inches of rain) | | | | | | |
|---|---|---|---|---|---|---|
| Survey Dates | 5 Days Prior | 4 Days Prior | 3 Days Prior | 2 Days Prior | 1 Day Prior | Sample Date |
| National Weather Service at Barnes Airfield, MA (unofficial NWS data at http://tgsv5.nws.noaa.gov/er/box/clstns.htm) | | | | | | |
| 01 Aug 2001 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 Aug 2001 | 0.24 | 0.00 | 0.01 | 0.03 | 0.01 | 0.00 |
| 12 Sep 2001 | 0.00 | 0.01 | 0.00 | 0.16 | 0.00 | 0.01 |
| 03 Oct 2001 | 0.00 | 0.00 | 0.08 | 0.03 | 0.00 | 0.01 |

| Table 3: Westfield River at Knightville, MA-USGS Flow Data Summary Mean Daily Discharge in Cubic Feet per Second (cfs) Gage # 01179500 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Survey Dates | 5 Days Prior | 4 Days Prior | 3 Days Prior | 2 Days Prior | 1 Day Prior | Sample Date | Monthly Mean | POR* Monthly Mean |
| 1 Aug 2001 | 154 | 113 | 88 | 73 | 63 | 56 | 125 | 130 |
| 22 Aug 2001 | 31 | 30 | 28 | 28 | 27 | 26 | 44.9 | 108 |
| 12 Sep 2001 | 23 | 20 | 19 | 17 | 47 | 53 | 124 | 126 |
| 3 Oct 2001 | 168 | 119 | 103 | 86 | 74 | 64 | 124 | 126 |
| 7Q10 @ USGS Gage 01179500 = 10.9 cfs, Westfield<br>Period of Record: 1910-1990, 1996-present (mean annual discharge = 333 cfs) | | | | | | | | |

| Table 4: West Branch Westfield River at Huntington, MA-USGS Flow Data Summary Mean Daily Discharge in Cubic Feet per Second (cfs) Gage # 01181000 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Survey Dates | 5 Days Prior | 4 Days Prior | 3 Days Prior | 2 Days Prior | 1 Day Prior | Sample Date | Monthly Mean | POR* Monthly Mean |
| 1 Aug 2001 | 36 | 26 | 23 | 20 | 18 | 16 | 42.7 | 67.8 |
| 22 Aug 2001 | 13 | 13 | 13 | 11 | 12 | 13 | 13.8 | 58.4 |
| 12 Sep 2001 | 8.3 | 7.4 | 7.0 | 7.1 | 9.6 | 14 | 48.6 | 64.3 |
| 3 Oct 2001 | 63 | 46 | 39 | 32 | 32 | 29 | 23.8 | 106 |
| 7Q10 @ USGS Gage 01181000 = 5.79 cfs, Westfield<br>Period of Record: 1935 - present (mean annual discharge = 191 cfs) | | | | | | | | |

| Table 5: West Branch Westfield River near Westfield, MA-USGS Flow Data Summary Mean Daily Discharge in Cubic Feet per Second (cfs) Gage # 01183500 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Survey Dates | 5 Days Prior | 4 Days Prior | 3 Days Prior | 2 Days Prior | 1 Day Prior | Sample Date | Monthly Mean | POR* Monthly Mean |
| 1 Aug 2001 | 216 | 201 | 158 | 145 | 130 | 122 | 291 | 407 |
| 22 Aug 2001 | 121 | 133 | 114 | 113 | 110 | 104 | 145 | 387 |
| 12 Sep 2001 | 104 | 98 | 98 | 80 | 83 | 105 | 299 | 400 |
| 3 Oct 2001 | 507 | 398 | 342 | 292 | 250 | 239 | 299 | 400 |
| 7Q10 @ USGS Gage 01183500 = 77.3 cfs, Westfield<br>Period of Record: 1935 - present (mean annual discharge = 931 cfs) | | | | | | | | |

**Water Quality Data**

Water quality data are included for Hydrolab® parameters (dissolved oxygen, percent saturation, pH, temperature, dissolved solids and conductivity) (Appendix 2), as well as for nutrients (total phosphorus, nitrate-nitrite, ammonia), and chemistry (alkalinity, hardness, chloride, total suspended solids), and fecal coliform and E. coli bacteria (Appendix 3).

Quality control sample data are also provided in Appendix 3. Based on acceptable relative percent differences for field duplicates and the lack of contamination (i.e. less than method detection limits) for ambient field blanks, there were no censoring or qualification decisions made for 2001 Westfield River Watershed water quality data in rivers (except for minor Hydrolab® data qualifications, i.e. unstable readings-see Appendix 2).

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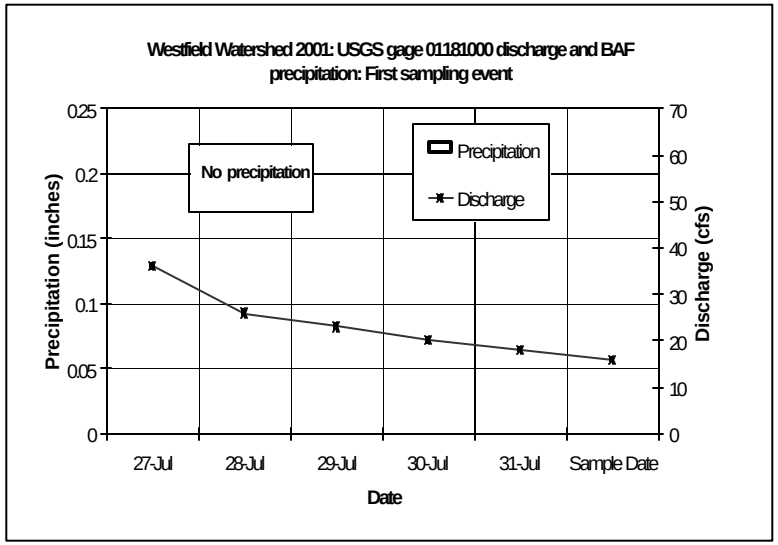
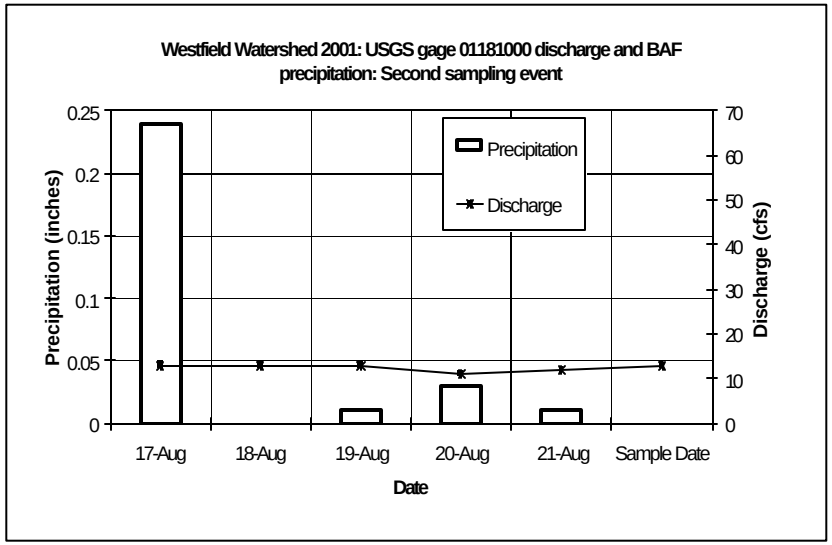
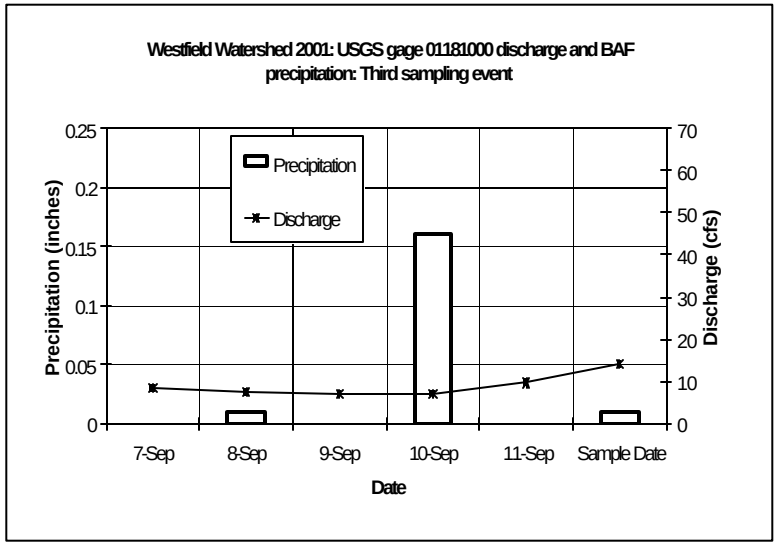
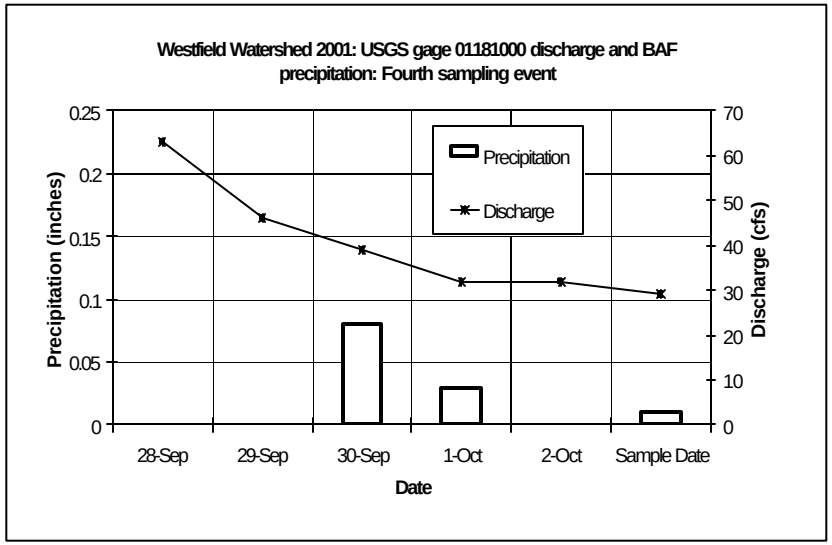
## Appendix 1: Graphs of Precipitation and Discharge Data

Westfield Watershed 2001 Precipitation (inches) measured at Barnes Municipal Airport (BAF) Westfield, MA and Discharge (cfs) measured at USGS gage 01181000 West Branch Westfield at Huntington.



**Appendix 2: Westfield River Watershed Survey 2001 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.)

**WESTFIELD RIVER (Saris: 3208250)**
Station: WSFR21.3, Mile Point: 22.1, Unique ID: W0810
Description: Western bank at Main Street Bridge, Russell

| Date | OWMID | Time | Depth | Temp | pH | Conductivity @ 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (°C) | (SU) | (µS/cm) | (mg/l) | (mg/l) | (%) |
| 08/01/01 | 32-0113 | 04:33 | ##I | 22.4u | 7.3c | 108 | 69.3 | 8.2u | 92u |
| 08/22/01 | 32-0148 | 04:08 | 0.8 | 24.0 | 7.3cu | 120 | 77.1 | 8.5u | 99u |
| 09/12/01 | 32-0174 | 04:16 | 0.6 | 20.6 | 7.3cu | 119 | 76.0 | 8.9iu | 96iu |
| 10/03/01 | 32-0203 | 11:08 | 0.4 | 14.2 | 7.0cu | 96.2 | 61.6 | 10.0u | 96u |

**MOOSE MEADOW BROOK (Saris: 3209700)**
Station: MMBR02.4, Mile Point: 2.5, Unique ID: W0809
Description: ~250 feet downstream of Tekoa Reservoir, Montgomery

| Date | OWMID | Time | Depth | Temp | pH | Conductivity @ 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (°C) | (SU) | (µS/cm) | (mg/l) | (mg/l) | (%) |
| 08/01/01 | 32-0112 | 03:13 | ##I | 18.1 | 6.8u | 43.0 | 27.5 | 9.5u | 98u |
| 08/22/01 | 32-0147 | 03:13 | 1.0 | 20.1 | 6.8u | 44.7 | 28.6 | 8.9 | 96 |
| 09/12/01 | 32-0173 | 03:20 | 0.9 | 17.3 | 6.9u | 41.5 | 26.6 | 9.5iu | 97iu |
| 10/03/01 | 32-0202 | 10:09 | 0.9 | 12.1 | 6.6u | 46.1 | 29.5 | 10.8u | 99u |

**MOOSE MEADOW BROOK (Saris: 3209700)**
Station: MMBR00.5, Mile Point: 0.4, Unique ID: W0812
Description: at farm road (private road off Pochassic Road) bridge, Westfield

| Date | OWMID | Time | Depth | Temp | pH | Conductivity @ 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (°C) | (SU) | (µS/cm) | (mg/l) | (mg/l) | (%) |
| 08/01/01 | 32-0111 | 02:29 | ##I | 18.8 | 6.8 | 175 | 112 | 7.2 | 76 |
| 08/22/01 | 32-0146 | 02:36 | 0.5 | 20.3 | 6.7u | 214 | 137 | 6.2 | 67 |
| 09/12/01 | 32-0172 | 02:41 | 0.3 | 18.2 | 7.0c | 410 | 263 | 4.7iu | 49iu |
| 10/03/01 | 32-0201 | 09:28 | 0.3 | 12.1 | 6.9cu | 165 | 105 | 10.1 | 93 |

**WESTFIELD RIVER (Saris: 3208250)**
Station: WSFR12.7, Mile Point: 13, Unique ID: W0807
Description: ~350 feet upstream of Route 202/10 bridge, Westfield

| Date | OWMID | Time | Depth | Temp | pH | Conductivity @ 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (°C) | (SU) | (µS/cm) | (mg/l) | (mg/l) | (%) |
| 08/01/01 | 32-0116 | 05:09 | ##I | 22.3 | 7.2cu | 122 | 78.2 | 8.1 | 91 |
| 08/22/01 | 32-0151 | 04:43 | 0.5 | 23.3 | 7.2cu | 149 | 95.1 | 7.9u | 91u |
| 09/12/01 | 32-0177 | 04:55 | 0.4 | 20.0 | 7.3cu | 149 | 95.0 | 8.6iu | 92iu |
| 10/03/01 | 32-0206 | 11:48 | 0.2 | 14.1 | 7.2cu | 106 | 67.9 | 11.1u | 107u |

**LITTLE RIVER (Saris: 3208725)**
Station: LITR00.1, Mile Point: 0.04, Unique ID: W0808
Description: ~100 feet upstream of Route 20 bridge, Westfield

| Date | OWMID | Time | Depth | Temp | pH | Conductivity @ 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (°C) | (SU) | (µS/cm) | (mg/l) | (mg/l) | (%) |
| 08/01/01 | 32-0125 | 01:54 | ##I | 21.8 | 7.2c | 134 | 85.7 | 8.3u | 92u |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 08/22/01 | 32-0152 | 02:00 | 0.1i | 22.5 | 7.1cu | 139 | 89.1 | 7.9 | 89 |
| 09/12/01 | 32-0178 | 01:58 | 0.2 | 19.4 | 7.2cu | 149 | 95.5 | 8.5i | 90i |
| 10/03/01 | 32-0207 | 08:53 | 0.1i | 12.7 | 7.0c | 120 | 76.7 | 10.2 | 94 |

**POWDERMILL BROOK (Saris: 3208575)**
Station: PDMB03.8, Mile Point: 5.4, Unique ID: W0234
Description: at Russellville Road

| Date | OWMID | Time | Depth | Temp | pH | Conductivity @ 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (°C) | (SU) | (µS/cm) | (mg/l) | (mg/l) | (%) |
| 08/01/01 | 32-0117 | 01:46 | ##I | 17.1 | 6.9cu | 133 | 84.9 | 8.9 | 90 |
| 08/22/01 | 32-0145 | 02:02 | 0.4 | 18.9 | 6.8u | 142 | 90.8 | 8.3u | 88u |
| 09/12/01 | 32-0171 | 02:11 | 0.4 | 16.3 | 6.6 | 175 | 112 | 6.1iu | 61iu |
| 10/03/01 | 32-0200 | 08:58 | 0.2 | 11.0 | 6.7u | 156 | 100 | 10.6u | 94u |

**POWDERMILL BROOK (Saris: 3208575)**
Station: PDMB00.1, Mile Point: 0.3, Unique ID: W0805
Description: downstream of Union Street culvert, Westfield

| Date | OWMID | Time | Depth | Temp | pH | Conductivity @ 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (°C) | (SU) | (µS/cm) | (mg/l) | (mg/l) | (%) |
| 08/01/01 | 32-0128 | 03:19 | 0.2 | 17.9 | 7.8c | 292 | 187 | 9.9u | 102u |
| 08/22/01 | 32-0154 | 02:51 | 0.4 | 18.4 | 7.4cu | 283 | 181 | 9.1 | 96 |
| 09/12/01 | 32-0180 | 02:49 | 0.4 | 16.4 | 7.6cu | 311 | 199 | 9.5iu | 95iu |
| 10/03/01 | 32-0209 | 09:38 | 0.3 | 11.9 | 7.3cu | 299 | 191 | 9.9 | 90 |

**GREAT BROOK (Saris: 3208375)**
Station: GRTB00.3, Mile Point: 0.3, Unique ID: W0804
Description: ~250 feet upstream of Route 187 bridge, Westfield

| Date | OWMID | Time | Depth | Temp | pH | Conductivity @ 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (°C) | (SU) | (µS/cm) | (mg/l) | (mg/l) | (%) |
| 08/01/01 | 32-0126 | 02:29 | 0.3 | 16.0 | 7.2c | 230 | 147 | 7.7u | 76u |
| 08/22/01 | 32-0153 | 02:27 | 0.3 | 17.5 | 7.2cu | 224 | 144 | 7.8 | 80 |
| 09/12/01 | 32-0179 | 02:23 | 0.4 | 15.5 | 7.2cu | 227 | 145 | 7.5i | 74i |
| 10/03/01 | 32-0208 | 09:16 | 0.4 | 11.0 | 7.1cu | 225 | 144 | 9.0 | 81 |

**BLOCK BROOK (Saris: 3208275)**
Station: BLBR01.0, Mile Point: 1, Unique ID: W0806
Description: at Plymouth Terrace crossing, West Springfield

| Date | OWMID | Time | Depth | Temp | pH | Conductivity @ 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (°C) | (SU) | (µS/cm) | (mg/l) | (mg/l) | (%) |
| 08/01/01 | 32-0129 | 04:10 | 0.1i | 17.9 | 7.6c | 594 | 380 | 8.0u | 82u |
| 08/22/01 | 32-0155 | 03:30 | 0.2 | 19.4 | 7.6c | 486 | 311 | 8.0 | 85 |
| 09/12/01 | 32-0181 | 03:22 | 0.2 | 16.7 | 7.5cu | 515 | 329 | 7.4i | 74i |
| 10/03/01 | 32-0210 | 10:06 | 0.2 | 12.1u | 7.5cu | 510 | 327 | 9.5 | 87 |

**WESTFIELD RIVER (Saris: 3208250)**
Station: WSFR00.2, Mile Point: 0.4, Unique ID: W0857
Description: ~250 feet upstream of Route 5 bridge, Agawam

| Date | OWMID | Time | Depth | Temp | pH | Conductivity @ 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (°C) | (SU) | (µS/cm) | (mg/l) | (mg/l) | (%) |
| 08/01/01 | 32-0130 | 04:51 | 0.4 | 22.3 | 7.1c | 190 | 122 | 6.6u | 74u |
| 08/22/01 | 32-0158 | 04:01 | 0.4 | 23.7 | 7.1c | 226 | 145 | 6.3u | 72u |
| 09/12/01 | 32-0184 | 04:00 | 0.5 | 21.0 | 7.2c | 259 | 166 | 6.6iu | 72iu |
| 10/03/01 | 32-0213 | 10:39 | 0.6 | 14.3 | 7.1cu | 158 | 101 | 9.7 | 93 |

**Appendix 3: Westfield River Watershed Survey 2001 Water Quality Data**
(Note: Symbols and Qualifiers Used for DWM Data can be found in Appendix 4.)

***Field Blank Sample***
Station: BLANK
Description: QAQC: Field Blank Sample

| Date | OWMID | Fecal Coliform | E. Coli | Chloride | Alkalinity | Hardness | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0114 | -- | -- | <1 | <2 | <0.66 | <0.02 | <0.06 | <0.005 | <1.0 |
| 08/01/01 | 32-0122 | -- | -- | <1 | <2 | <0.66 | -- | -- | -- | <1.0 |
| 08/01/01 | 32-0131 | <5 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 08/22/01 | 32-0149 | -- | -- | <1 | <2 | <0.66 | <0.02 | <0.06 | <0.005 | <1.0 |
| 08/22/01 | 32-0156 | -- | -- | <1 | <2 | <0.66 | -- | -- | -- | <1.0 |
| 08/22/01 | 32-0168 | <5 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0175 | -- | -- | <1 | <2 | <0.66 | <0.02 | <0.06 | <0.005 | <1.0 |
| 09/12/01 | 32-0182 | -- | -- | <1 | <2 | <0.66 | -- | -- | -- | <1.0 |
| 09/12/01 | 32-0194 | <2 | <2 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0204 | -- | -- | <1 | <2 | <0.66 | <0.02 | <0.06 | <0.005 | <1.0 |
| 10/03/01 | 32-0211 | -- | -- | <1 | <2 | <0.66 | -- | -- | -- | <1.0 |
| 10/03/01 | 32-0223 | <5 | <5 | -- | -- | -- | -- | -- | -- | -- |

***Field Duplicate Sample***
**WESTFIELD RIVER (Saris: 3208250)**
Station: WSFR21.3, Mile Point: 22.1, Unique ID: W0810
Description: Western bank at Main Street Bridge, Russell

| Date | OWMID | QAQC | Chloride | Alkalinity | Hardness | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|
| | | | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0115 | 32-0113 | 15 | 20 | 28 | <0.02 | <0.06 | 0.010 | <1.0 |
| 08/01/01 | 32-0113 | 32-0115 | 14 | 22 | 28 | <0.02 | <0.06 | 0.011 | <1.0 |
| *Relative Percent Difference* | | | *6.9%* | *9.5%* | *0.0%* | *0.0%* | *0.0%* | *9.5%* | *0.0%* |
| 08/22/01 | 32-0150 | 32-0148 | 20 | 22 | 30 | <0.02 | 0.06 | 0.011 | <1.0 |
| 08/22/01 | 32-0148 | 32-0150 | 20 | 22 | 30 | <0.02 | 0.06 | 0.011 | <1.0 |
| *Relative Percent Difference* | | | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* |
| 09/12/01 | 32-0176 | 32-0174 | 18 | 20 | 28 | <0.02 | 0.12 | 0.015d | 1.3d |
| 09/12/01 | 32-0174 | 32-0176 | 19 | 21 | 28 | <0.02 | 0.12 | 0.030d | 2.9d |
| *Relative Percent Difference* | | | *5.4%* | *4.9%* | *0.0%* | *0.0%* | *0.0%* | *66.7%* | *76.2%* |
| 10/03/01 | 32-0205 | 32-0203 | 13 | 18 | 25 | <0.02 | <0.06 | 0.009d | <1.0 |
| 10/03/01 | 32-0203 | 32-0205 | 13 | 18 | 25 | <0.02 | <0.06 | 0.019d | <1.0 |
| *Relative Percent Difference* | | | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *71.4%* | *0.0%* |

***Field Duplicate Sample***

**BLOCK BROOK(Saris: 3208275)**

Station: BLBR01.0, Mile Point: 1, Unique ID: W0806

Description: at Plymouth Terrace crossing, West Springfield

| Date | OWMID | QAQC | Fecal Coliform (Log10) | E. coli Log10 | Chloride | Alkalinity | Hardness | TSS |
|---|---|---|---|---|---|---|---|---|
| | | | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0121 | 32-0120 | -- | -- | 110 | 82 | 158 | 7.8 |
| 08/01/01 | 32-0120 | 32-0121 | -- | -- | 110 | 83 | 158 | 7.3 |
| *Relative Percent Difference* | | | | | *0.0%* | -- | *0.0%* | *6.6%* |
| 08/22/01 | 32-0157 | 32-0155 | -- | -- | 82 | 85 | 135 | 4.9 |
| 08/22/01 | 32-0155 | 32-0157 | -- | -- | 84 | 85 | 135 | 5.2 |
| *Relative Percent Difference* | | | | | *2.4%* | -- | *0.0%* | *5.9%* |
| 08/22/01 | 32-0169 | 32-0167 | 2.643 | 2.041 | -- | -- | -- | -- |
| 08/22/01 | 32-0167 | 32-0169 | 2.519 | 2.204 | -- | -- | -- | -- |
| *Relative Percent Difference* | | | *4.8%* | *7.7%* | -- | -- | -- | -- |
| 09/12/01 | 32-0183 | 32-0181 | -- | -- | 93 | 83 | 126 | 4.6 |
| 09/12/01 | 32-0181 | 32-0183 | -- | -- | 95 | 83 | 126 | 4.8 |
| *Relative Percent Difference* | | | | | *2.1%* | *0.0%* | *0.0%* | *4.3%* |
| 09/12/01 | 32-0195 | 32-0193 | 2.954 | 1.462 | -- | -- | -- | -- |
| 09/12/01 | 32-0193 | 32-0195 | 2.613 | 0.699 | -- | -- | -- | -- |
| *Relative Percent Difference* | | | *12.3%* | *70.6%* | -- | -- | -- | -- |
| 10/03/01 | 32-0212 | 32-0210 | -- | -- | 92 | 83 | 139 | <1.0 |
| 10/03/01 | 32-0210 | 32-0212 | -- | -- | 92 | 83 | 140 | <1.0 |
| *Relative Percent Difference* | | | -- | -- | *0.0%* | *0.0%* | *0.7%* | *0.0%* |
| 10/03/01 | 32-0224 | 32-0222 | 2.230 | 2.041 | -- | -- | -- | -- |
| 10/03/01 | 32-0222 | 32-0224 | 2.255 | 1.633 | -- | -- | -- | -- |
| *Relative Percent Difference* | | | *1.1%* | *22.2%* | -- | -- | -- | -- |

***Field Duplicate Sample***

**POWDERMILL BROOK (Saris: 3208575)**

Station: PDMB00.1, Mile Point: 0.3, Unique ID: W0805

Description: downstream of culvert at Union Street, Westfield

| Date | OWMID | QAQC | Fecal Coliform (Log10) | E. coli (Log10) |
|---|---|---|---|---|
| | | | cfu/100ml | cfu/100ml |
| 08/01/01 | 32-0137 | 32-0138 | 1.826 | 1.462 |
| 08/01/01 | 32-0138 | 32-0137 | 2.146 | 1.756 |
| *Relative Percent Difference* | | | *16.1%* | *18.2%* |

**WESTFIELD RIVER (Saris: 3208250)**
Station: WSFR21.3, Mile Point: 22.1, Unique ID: W0810
Description: Western bank at Main Street Bridge, Russell

| Date | OWMID | Time | Fecal | E. coli | Alkalinity | Hardness | Chloride | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24hr | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0115 | ** | -- | -- | 15 | 20 | 28 | <0.02 | <0.06 | 0.010 | <1.0 |
| 08/01/01 | 32-0113 | 04:15 | -- | -- | 14 | 22 | 28 | <0.02 | <0.06 | 0.011 | <1.0 |
| 08/22/01 | 32-0150 | ** | -- | -- | 20 | 22 | 30 | <0.02 | 0.06 | 0.011 | <1.0 |
| 08/22/01 | 32-0148 | 04:10 | -- | -- | 20 | 22 | 30 | <0.02 | 0.06 | 0.011 | <1.0 |
| 08/22/01 | 32-0162 | 09:53 | 90 | 19 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0176 | ** | -- | -- | 18 | 20 | 28 | <0.02 | 0.12 | 0.015d | 1.3d |
| 09/12/01 | 32-0174 | 04:10 | -- | -- | 19 | 21 | 28 | <0.02 | 0.12 | 0.030d | 2.9d |
| 09/12/01 | 32-0188 | 09:54 | 57 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0205 | ** | -- | -- | 13 | 18 | 25 | <0.02 | <0.06 | 0.009d | <1.0 |
| 10/03/01 | 32-0217 | 09:33 | 5 | 5 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0203 | 11:00 | -- | -- | 13 | 18 | 25 | <0.02 | <0.06 | 0.019d | <1.0 |

**MOOSE MEADOW BROOK (Saris: 3209700)**
Unique_ID: W0809 Station: MMBR02.4, Mile Point: 2.5
Description: approximately 250 feet downstream of Tekoa Reservoir, Montgomery

| Date | OWMID | Time | Fecal | E. coli | Alkalinity | Hardness | Chloride | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24hr | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0112 | ** | -- | -- | 7 | 5 | 8.8 | <0.02 | <0.06 | 0.018 | <1.0 |
| 08/01/01 | 32-0133 | 09:40 | 19 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 08/22/01 | 32-0147 | 03:10 | -- | -- | 7 | 6 | 9.5 | <0.02 | 0.12 | 0.014 | <1.0 |
| 08/22/01 | 32-0161 | 09:11 | 10 | <2 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0173 | 03:18 | -- | -- | 7 | 6 | 9 | <0.02 | 0.09 | 0.013 | 1.0 |
| 09/12/01 | 32-0187 | 09:13 | 10 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0216 | 08:54 | <2 | 5 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0202 | 10:10 | -- | -- | 8 | 4 | 8.7 | <0.02 | <0.06 | 0.020 | 1.5 |

**MOOSE MEADOW BROOK (Saris: 3209700)**
Unique_ID: W0812 Station: MMBR00.5, Mile Point: 0.4
Description: at Farm Road (private road south off Pochassic Road) bridge, Westfield

| Date | OWMID | Time | Fecal | E. coli | Alkalinity | Hardness | Chloride | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24hr | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0134 | ** | 4700 | 2000 | -- | -- | -- | -- | -- | -- | -- |
| 08/01/01 | 32-0111 | 02:29 | -- | -- | 39 | 15 | 32 | <0.02 | 1.6 | 0.049 | 2.0 |
| 08/22/01 | 32-0146 | 02:30 | -- | -- | 43 | 18 | 38 | <0.02 | 1.7 | 0.069 | 5.3 |
| 08/22/01 | 32-0160 | 08:48 | 3300 | 1200 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0172 | 02:13 | -- | -- | 78 | 53 | 61 | 1.3 | 0.86 | 0.29 | <1.0 |
| 09/12/01 | 32-0186 | 08:50 | 24000 | 300 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0215 | 08:32 | 7100 | 5000 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0201 | 09:30 | -- | -- | 31 | 14 | 26 | 0.33 | 0.97 | 0.052 | <1.0 |

**WESTFIELD RIVER (Saris: 3208250)**
Unique_ID: W0807 Station: WSFR12.7, Mile Point: 13
Description: approximately 350 feet upstream/west of Route 202/10 bridge, Westfield

| Date | OWMID | Time | Fecal | E. coli | Alkalinity | Hardness | Chloride | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24hr | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0116 | ** | -- | -- | 18 | 20 | 30 | <0.02 | 0.23 | 0.012 | 1.9 |
| 08/01/01 | 32-0135 | 10:15 | 300 | 180 | -- | -- | -- | -- | -- | -- | -- |
| 08/22/01 | 32-0151 | 04:45 | -- | -- | 25 | 24 | 34 | <0.02 | 0.27 | 0.008 | <1.0 |
| 08/22/01 | 32-0163 | 10:17 | 210 | 48 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0177 | 04:20 | -- | -- | 23 | 26 | 33 | <0.02 | 0.29 | 0.009 | <1.0 |
| 09/12/01 | 32-0189 | 10:17 | 62 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0218 | 09:57 | 690 | 410 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0206 | 11:45 | -- | -- | 15 | 18 | 27 | <0.02 | 0.12 | 0.009 | <1.0 |

**LITTLE RIVER (Saris: 3208725)**
Unique_ID: W0808 Station: LITR00.1, Mile Point: 0.04
Description: approximately 100 feet upstream/west of Route 20 bridge, Westfield

| Date | OWMID | Time | Fecal | E. coli | Alkalinity | Hardness | Chloride | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24hr | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0118 | 02:00 | -- | -- | 22 | 17 | 32 | -- | -- | -- | <1.0 |
| 08/01/01 | 32-0136 | 10:25 | 670 | 76 | -- | -- | -- | -- | -- | -- | -- |
| 08/22/01 | 32-0152 | 01:43 | -- | -- | 22 | 21 | 35 | -- | -- | -- | <1.0 |
| 08/22/01 | 32-0164 | 10:32 | 590 | 300 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0178 | 01:55 | -- | -- | 22 | 22 | 35 | -- | -- | -- | 1.5 |
| 09/12/01 | 32-0190 | 10:31 | 210 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0207 | 08:50 | -- | -- | 19 | 18 | 29 | -- | -- | -- | <1.0 |
| 10/03/01 | 32-0219 | 10:13 | 200 | 110 | -- | -- | -- | -- | -- | -- | -- |

**POWDERMILL BROOK (Saris: 3208575)**
Unique_ID: W0234 Station: PDMB03.8, Mile Point: 5.4
Description: at Russellville Road, Westfield

| Date | OWMID | Time | Fecal | E. coli | Alkalinity | Hardness | Chloride | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24hr | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0117 | 01:45 | -- | -- | 19 | 15 | 30 | <0.02 | 0.40 | 0.019 | 1.6 |
| 08/01/01 | 32-0132 | 09:00 | 24 | 5 | -- | -- | -- | -- | -- | -- | -- |
| 08/22/01 | 32-0145 | 02:05 | -- | -- | 29 | 17 | 31 | <0.02 | 0.51 | 0.021 | <1.0 |
| 08/22/01 | 32-0159 | 08:30 | 43 | 19 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0171 | 02:00 | -- | -- | 35 | 18 | 36 | <0.02 | 0.36 | 0.017 | 14 |
| 09/12/01 | 32-0185 | 08:29 | 52 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0214 | 08:15 | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0200 | 08:55 | -- | -- | 29 | 18 | 34 | <0.02 | 0.21 | 0.016 | 7.0 |

**POWDERMILL BROOK (Saris: 3208575)**
Unique_ID: W0805 Station: PDMB00.1, Mile Point: 0.3
Description: downstream of culvert at Union Street, Westfield

| Date | OWMID | Time | Fecal | E. coli | Alkalinity | Hardness | Chloride | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24hr | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0124 | 03:20 | -- | -- | 48 | 41 | 78 | -- | -- | -- | 1.9 |
| 08/01/01 | 32-0137 | 11:00 | 67d | 29 | -- | -- | -- | -- | -- | -- | -- |
| 08/01/01 | 32-0138 | 11:00 | 140d | 57 | -- | -- | -- | -- | -- | -- | -- |
| 08/22/01 | 32-0154 | 02:41 | -- | -- | 43 | 52 | 75 | -- | -- | -- | 2.3 |
| 08/22/01 | 32-0166 | 10:59 | 81 | 29 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0180 | 02:50 | -- | -- | 51 | 56 | 77 | -- | -- | -- | 1.7 |
| 09/12/01 | 32-0192 | 11:04 | 57 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0209 | 09:40 | -- | -- | 45 | 55 | 81 | -- | -- | -- | <1.0 |
| 10/03/01 | 32-0221 | 10:55 | 62 | 19 | -- | -- | -- | -- | -- | -- | -- |

**GREAT BROOK (Saris: 3208375)**
Unique_ID: W0804 Station: GRTB00.3, Mile Point: 0.3
Description: approximately 250 feet upstream of Route 187 bridge, Westfield

| Date | OWMID | Time | Fecal | E. coli | Alkalinity | Hardness | Chloride | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24hr | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0119 | 02:37 | -- | -- | 24 | 53 | 82 | -- | -- | -- | 1.9 |
| 08/01/01 | 32-0139 | 11:10 | 52 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 08/22/01 | 32-0153 | 02:20 | -- | -- | 25 | 53 | 76 | -- | -- | -- | 4.4 |
| 08/22/01 | 32-0165 | 10:42 | 120 | 19 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0179 | 02:20 | -- | -- | 23 | 53 | 73 | -- | -- | -- | 2.7 |
| 09/12/01 | 32-0191 | 10:48 | 130 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0208 | 09:15 | -- | -- | 23 | 55 | 76 | -- | -- | -- | <1.0 |
| 10/03/01 | 32-0220 | 10:35 | 33 | <5 | -- | -- | -- | -- | -- | -- | -- |

**BLOCK BROOK (Saris: 3208275)**
Unique_ID: W0806 Station: BLBR01.0, Mile Point: 1
Description: at Plymouth Terrace crossing, West Springfield

| Date | OWMID | Time | Fecal | E. coli | Alkalinity | Hardness | Chloride | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24hr | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0121 | ** | -- | -- | 110 | 82 | 158 | -- | -- | -- | 7.8 |
| 08/01/01 | 32-0120 | 04:15 | -- | -- | 110 | 83 | 158 | -- | -- | -- | 7.3 |
| 08/01/01 | 32-0140 | 11:25 | 570 | 210 | -- | -- | -- | -- | -- | -- | -- |
| 08/22/01 | 32-0157 | ** | -- | -- | 82 | 85 | 135 | -- | -- | -- | 4.9 |
| 08/22/01 | 32-0169 | ** | 440 | 110 | -- | -- | -- | -- | -- | -- | -- |
| 08/22/01 | 32-0155 | 03:25 | -- | -- | 84 | 85 | 135 | -- | -- | -- | 5.2 |
| 08/22/01 | 32-0167 | 11:21 | 330 | 160 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0183 | ** | -- | -- | 93 | 83 | 126 | -- | -- | -- | 4.6 |
| 09/12/01 | 32-0195 | ** | 900d | 29d | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0181 | 03:25 | -- | -- | 95 | 83 | 126 | -- | -- | -- | 4.8 |
| 09/12/01 | 32-0193 | 11:25 | 410d | <5d | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0212 | ** | -- | -- | 92 | 83 | 139 | -- | -- | -- | <1.0 |
| 10/03/01 | 32-0224 | ** | 170 | 110d | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0210 | 10:12 | -- | -- | 92 | 83 | 140 | -- | -- | -- | <1.0 |
| 10/03/01 | 32-0222 | 11:17 | 180 | 43d | -- | -- | -- | -- | -- | -- | -- |

**WESTFIELD RIVER (Saris: 3208250)**
Unique_ID: W0857 Station: WSFR00.2, Mile Point: 0.4
Description: approximately 260 feet upstream of Route 5 bridge, Agawam

| Date | OWMID | Time | Fecal | E. coli | Alkalinity | Hardness | Chloride | NH3-N | NO3-NO2-N | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24hr | cfu/100ml | cfu/100ml | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 08/01/01 | 32-0123 | 04:55 | -- | -- | 36 | 31 | 50 | -- | -- | -- | 1.7 |
| 08/01/01 | 32-0141 | 11:45 | 29 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 08/22/01 | 32-0158 | 03:50 | -- | -- | 35 | 37 | 58 | -- | -- | -- | 4.8 |
| 08/22/01 | 32-0170 | 11:50 | 52 | <5 | -- | -- | -- | -- | -- | -- | -- |
| 09/12/01 | 32-0184 | 03:55 | -- | -- | 39 | 42 | 61 | -- | -- | -- | 4.1 |
| 09/12/01 | 32-0196 | 11:45 | >10000j | <5 | -- | -- | -- | -- | -- | -- | -- |
| 10/03/01 | 32-0213 | 10:46 | -- | -- | 18 | 28 | 41 | -- | -- | -- | <1.0 |
| 10/03/01 | 32-0225 | 11:39 | 24 | 14 | -- | -- | -- | -- | -- | -- | -- |

Appendix 4: Symbols and Qualifiers Used for DWM Data

The following data qualifiers or symbols are used in the MA DEP 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)

" <mdl " = Less than method detection limit (MDL). Denotes a sample result that went undetected using a specific analytical method. The actual, numeric MDL is typically specified (eg. <0.2).

**Multi-probe-specific Qualifiers:**

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

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, not data electronically recorded in the Multi-probe surveyor unit, due to operator error or equipment failure.

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

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

" ? " = 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.

# APPENDIX B

**Technical Memorandum TM-32-3**

**WESTFIELD RIVER WATERSHED 2001 BIOLOGICAL ASSESSMENT**

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Division of Watershed Management
Worcester, MA

9 March 2004

**CN 186.0**

## CONTENTS



## Tables and Figures

## INTRODUCTION

Biological monitoring is a useful means 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). Biological surveys and assessments are the primary approaches to biomonitoring.

As part of the Massachusetts Department of Environmental Protection/Division of Watershed Management's (MA DEP/DWM) 2001 Westfield River watershed assessments, aquatic benthic macroinvertebrate biomonitoring and fish population biomonitoring were conducted to evaluate the biological health of selected portions of the watershed. A total of 12 macroinvertebrate biomonitoring stations and 8 fish population biomonitoring stations were sampled to investigate the effects of various nonpoint source (NPS) and point source stressors on resident biological communities. Some stations were historical MA DEP biomonitoring stations—most recently assessed in 1996 (Szal 1998). The 2001 data, then, allow MA DEP to determine if water quality and habitat conditions at these stations have improved or worsened over time.

In some cases (e.g., point source investigations), a site-specific sampling approach was implemented, in which the aquatic community and habitat downstream from the perceived stressor (downstream study site) were compared to an upstream reference station (control site) representative of "least disturbed" biological conditions in the waterbody. While the alternative to this site-specific approach is to compare the study site to a regional or watershed reference station (i.e., "best attainable" condition), the site-specific approach is more appropriate for an assessment of a known or suspected stressor, provided that the stations being compared share basically similar instream and riparian habitat characteristics (Barbour et al. 1999). Since both the quality and quantity of available habitat affect the structure and composition of resident biological communities, effects of such features can be minimized by sampling similar habitats at stations being compared, providing a more direct comparison of water quality conditions (Barbour et al. 1999). Sampling highly similar habitats also reduces metric variability, attributable to factors such as current speed and substrate type. Upstream reference stations were established in the Westfield and Little rivers and in Yokum Brook. 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 1996 biosurveys.

To provide additional information necessary for making basin-wide aquatic life use-support determinations required by Section 305(b) of the Clean Water Act, all Westfield River watershed biomonitoring stations were compared to a reference station 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). Watershed reference stations were established in the Westfield River (fourth-order) and Yokum Brook (second/third-order). Both stations were unaffected by point sources of water pollution, and they were also assumed (based on topographic map examinations and field reconnaissance) to be relatively unimpacted by nonpoint sources. The decision of which 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", problem areas within the Westfield River watershed were defined more specifically through such processes as coordination with appropriate groups (EOEA Westfield River Watershed Team, local watershed associations, MA DEP/DWM, MA DEP/WERO), assessing existing data, and conducting site visits. Following these activities, the 2001 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 2001 Westfield River watershed biomonitoring survey are listed in Table 2.

The main objectives of biomonitoring in the Westfield 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 NPDES and Water Management Act permits, stormwater management, and control of other nonpoint source pollution. Specific tasks were:

1. Conduct benthic macroinvertebrate and fish population sampling and habitat assessments at locations throughout the Westfield River watershed;

2. Based upon the benthic macroinvertebrate, fish population, and habitat data, identify river segments within the watershed with potential nonpoint source and/or point source 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 biomonitoring stations sampled during the 2001 Westfield River watershed survey, including station identification number, mile point (distance from mouth), upstream drainage area, station description, and date. Due to equipment constraints, fish population sampling was not conducted at WR06B, WR06A, WR05, and LR02A.

| Station ID | Mile Point | Upstream Drainage Area ($mi^2$) | Westfield River Watershed Station Description | Sampling Date |
|---|---|---|---|---|
| WR01* | 25.6 | 168.26 | Westfield River, dnst. from Knightville Dam, near Rt. 112, Huntington, MA | 6 Sept. 2001 - benthos<br>5 Sept. 2001 - fish |
| WR06B | 11.3 | 445.56 | Westfield River, outside Westfield WWTP discharge mix.zone, Westfield, MA | 6 Sept. 2001 - benthos |
| WR06A* | 11.0 | 452.63 | Westfield River, 340 m dnst. from Westfield WWTP discharge, Westfield, MA | 6 Sept. 2001 - benthos |
| WR05* | 18.2 | 352.43 | Westfield River, 250 m dnst. from Strathmore Paper, Russell, MA | 5 Sept. 2001 - benthos |
| LR02A | 11.5 | 47.60 | Little River, dnst. from Cobble Mountain Reservoir, Russell, MA | 4 Sept. 2001 - benthos |
| LR02B | 7.1 | 52.38 | Little River, 20 m upst. from Cook Brook, Russell, MA | 4 Sept. 2001 - benthos<br>5 Sept. 2001 - fish |
| LR02C | 6.9 | 53.89 | Little River, 100 m dnst. from Cook Brook, Russell, MA | 4 Sept. 2001 - benthos<br>5 Sept. 2001 - fish |
| YB01A | 0.4 | 8.50 | Yokum Brook, 50 m upst. from large dam, dnst. from Rt. 8, Becket, MA | 5 Sept. 2001 - benthos<br>6 Sept. 2001 - fish |
| YB01B | 0.2 | 8.58 | Yokum Brook, 100 m upst. from Prentice Place, Becket, MA | 5 Sept. 2001 - benthos<br>6 Sept. 2001 - fish |
| YB01C | 0.0 | 8.60 | Yokum Brook, near mouth, Becket, MA | 5 Sept. 2001 - benthos<br>6 Sept. 2001 - fish |
| WB01 | 5.5 | 2.18 | West Branch Walker Brook, dnst. from Robin Hood Lake, Becket, MA | 5 Sept. 2001 - benthos<br>6 Sept. 2001 - fish |
| PB00 | 3.8 | 4.12 | Powdermill Brook, dnst. From I-90, behind High School, Westfield, MA | 4 Sept. 2001 - benthos<br>5 Sept. 2001 - fish |

* sampled by DEP in 1996

**Table 2.** List of existing conditions and perceived problems identified prior to the 2001 Westfield River watershed biomonitoring survey.

| Station | Issues/Problems |
|---|---|
| Westfield River (WR01) | -reference condition for mainstem Westfield and Little rivers[1,2] |
| Westfield River (WR05) | -industrial discharge (Strathmore Paper) – post-removal[1, 2, 3] |
| Westfield River (WR06A; WR06B) | -Westfield WWTP (increased discharge proposed) [1, 2, 3] |
| Little River (LR02A) | -flow diversion to adjacent power tunnel[2,4]; unassessed for aquatic life[2,4] |
| Little River (LR02B; LR02C) | -siltation via Cook Brook; flow diversion effects [2]; unassessed for aquatic life[2,4] |
| Yokum Brook (YB01A) | -reference condition for tributaries; unassessed for aquatic life[2,4] |
| Yokum Brook (YB01B) | -dams (scheduled for removal); unassessed for aquatic life[4] |
| Yokum Brook (YB01C) | -dams (scheduled for removal); unassessed for aquatic life[4] |
| West Branch Walker Brook (WB01) | -impoundment effects; unassessed for aquatic life[2,4] |
| Powdermill Brook (PB00) | -303d listed for silt, pathogens, solids, turbidity; misc. NPS pollution[2, 4] |

[1](Szal 1998); [2](MA DEP 1998); [3](MA DEP 2003); [4](MA DEP 2002)

WESTFIELD RIVER WATERSHED
**BIOMONITORING STATIONS**

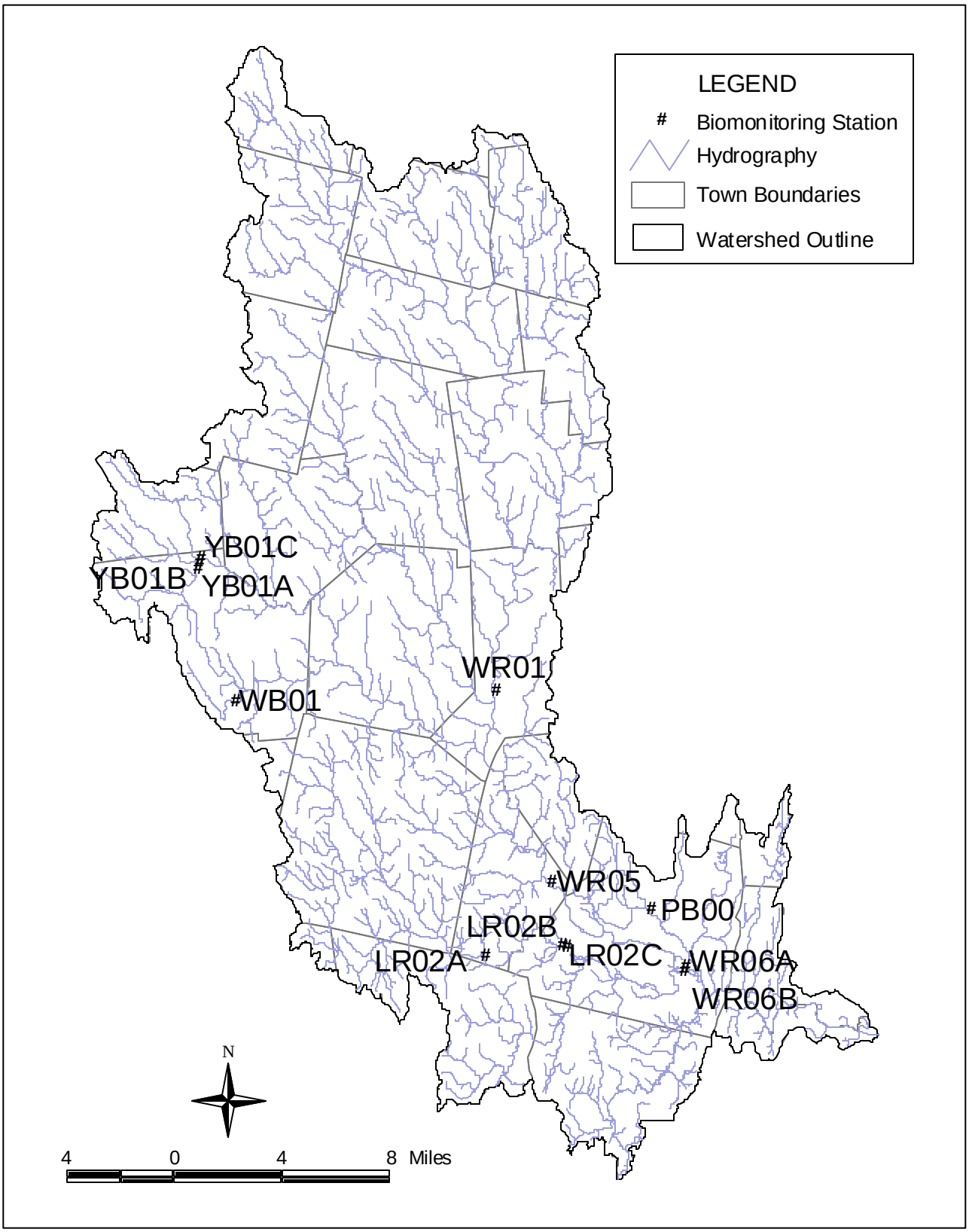


**Figure 1**. Location of MA DEP biomonitoring stations for the 2001 Westfield River watershed survey.

## METHODS

### *Macroinvertebrate Sampling*

The macroinvertebrate sampling procedures employed during the 2001 Westfield River watershed biomonitoring survey are described in the *CN 39.0 Water Quality Monitoring In Streams Using Aquatic Macroinvertebrates* standard operating procedures (Nuzzo 1999), 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 (Figure 2). Sampling activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (Fiorentino 2001). 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.

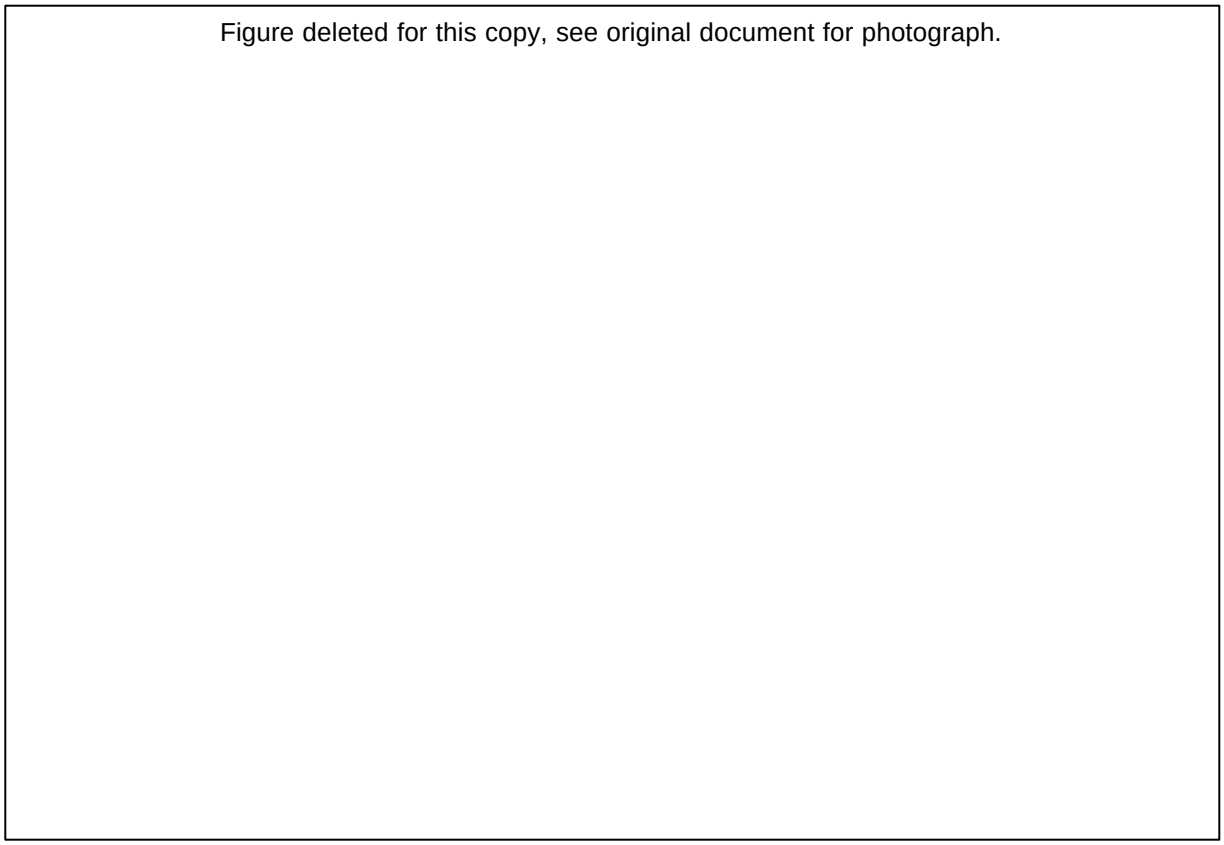


**Figure 2**. MA DEP/DWM biologist collecting macroinvertebrates using the “kick-sampling” technique.

### *Fish Population Sampling*

The fish sampling and processing procedures employed during the 2001 Westfield River watershed biomonitoring survey are described in *CN 75.1 Fish Collection Procedures for Evaluations of Resident Fish Populations, Method 003/11.20.95* standard operating procedures (Maietta and Decesare 2001), and are similar to Rapid Bioassement Protocol V (RBPV) as described originally by Plafkin (1989) and later by Barbour et al. (1999). Fish populations were sampled by electrofishing using a Coffelt Mark 18 gas-powered backpack electrofisher (Figure 3). A reach of between 80 m and 100 m in length was sampled by passing a pole-mounted anode ring side to side through the stream channel and in and around likely fish cover. All fish observed were netted and held in buckets. Sampling proceeded from an obstruction or constriction at the downstream end of the reach to an endpoint at another obstruction or constriction such as a waterfall or shallow riffle at the upstream end of the reach. Following completion of a sampling run, all fish were identified to species, measured, weighed, and released.

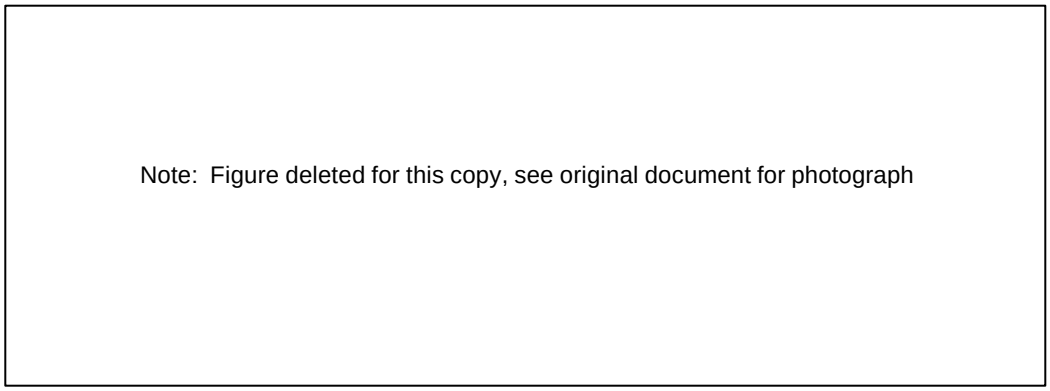


**Figure 3**. MA DEP/DWM biologists collecting fish using backpack electrofisher.

### *Macroinvertebrate Sample Processing and Analysis*

The macroinvertebrate sample processing and analysis procedures employed for the 2001 Westfield River watershed biomonitoring samples are described in the standard operating procedures (Nuzzo 1999) and were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (Fiorentino 2001). Macroinvertebrate sample processing entailed distributing whole samples in pans, selecting grids within the pans at random, and sorting 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). RBPIII offers a more rigorous bioassessment than RBPII, which was employed in the analysis of the 1996 family-level macroinvertebrate data for the Westfield River watershed. By increasing the level of taxonomic resolution; that is, by performing taxonomic identification to the lowest practical level, the ability to discriminate the level of impairment is enhanced. In addition, this increased taxonomic effort will provide information on population as well as community level effects. While this additional taxonomy requires considerably more time, discrimination of additional degrees of aquatic impairment is achieved. Based on the taxonomy, various community, population, and functional parameters, or “metrics”, were calculated which allow measurement of important aspects of the biological integrity of the community. This integrated approach provides more assurance of a valid

assessment because a variety of biological parameters are evaluated. Deficiency of any one metric should not invalidate the entire approach (Barbour et al. 1999). 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 2001 Westfield 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:

   $$HBI = \sum \frac{x_i t_i}{n}$$

   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 Westfield 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 $\delta$ 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 ≥65%.

### *Fish Sample Processing and Analysis*

The RBP V protocol (Plafkin et al. 1989; Barbour et al. 1999) calls for the analysis of the data generated from fish collections using an established Index of Biotic Integrity (IBI) similar to that described by Karr et al. (1986). However, since no formal IBI exists for Massachusetts' surface waters, the data provided by this sampling effort were used to qualitatively assess the general condition of the resident fish population as a function of overall abundance (number of species and individuals) and species composition classifications listed below.

1. Tolerance Classification – Classification of tolerance to environmental stressors similar to that provided in Plafkin et al. (1989), Barbour et al. (1999), and Halliwell et al. (1999). Final tolerance classes (TC) are those provided by Halliwell et al. (1999).

2. Macrohabitat Classification – Classification by common macrohabitat use as presented by Bain and Meixler (2000) modified regionally following discussions with MA DEP and MA Division of Fisheries and Wildlife (DFW) biologists.

3. Trophic Classes – Classification that utilizes both dominant food items as well as feeding habitat type as presented in Halliwell et al. (1999).

### *Habitat Assessment*

An evaluation of physical and biological 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 Westfield River watershed macroinvertebrate biosurveys, habitat qualities were scored 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 2001). Quality Control procedures are further detailed in the standard operating procedures (Maietta and Decesare 2001; Nuzzo 1999).

### *Field Sampling Quality Control*

Macroinvertebrate Sampling:

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) To assess the consistency of the sampling effort, collection of a duplicate sample is performed at one of the biomonitoring stations. Two samples are collected "side by side"—a second kick sample (i.e., the duplicate) is taken adjacent to (where different assessment results are not expected due to the apparent absence of additional stressors) the original kick at each of the ten kicks conducted in a given 100 m sample reach. Duplicate samples are composited in a similar manner to the original sample; yet, they are 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.

Fish Population Sampling:

All field equipment must be in good operating condition, and a plan of routine inspection, maintenance and/or calibration must be developed to ensure consistency and quality of field data. Field data must be complete and legible, and must be entered on standardized field data forms and chains-of custody for all anticipated sampling sites, as well as copies of all applicable SOPs.
Field validation is conduced at selected sites and involves the collection of a replicate sample taken from an adjacent reach upstream of the initial sampling site. The adjacent reach must be similar to the initial site with respect to habitat and stressors. Sampling QC data are evaluated in order to determine a level of acceptable variability and the appropriate replication frequency.

### *Field Analytical Quality Control*

Macroinvertebrate Survey:

Field Analytical QC entails multiple observers (at least both DWM benthic biologists, and 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.

Fish Population Survey:

Field Analytical QC entails taking appropriate measures to ensure accurate fish identifications. Field identification of fish must be conducted by qualified/trained fish taxonomists, familiar with Massachusetts ichthyofauna.

Questionable records are prevented by preserving select specimens and those that cannot be readily identified in the field for laboratory verification and /or examination by a second qualified fish taxonomist. Specimens must be properly preserved and labeled. Specimens may be sent to authorities for particular taxonomic groups.

***Fixed Laboratory Quality Control***

Macroinvertebrate Samples:

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).

## RESULTS AND DISCUSSION

The biological and habitat data collected at each sampling station during the 2001 biomonitoring survey are attached as an Appendix (Tables A1 – A6). Fish population data were collected at 8 of the 12 stations where macroinvertebrates were collected. Included in the macroinvertebrate and fish taxa lists (Table A1 and A6) are total organism counts, the functional feeding group designation (FG) for each macroinvertebrate taxon, the habitat and trophic class for each fish taxon, and the tolerance designation (TV for macroinvertebrates; TC for fish) for each taxon (macroinvertebrates and fish).

Summary tables of the macroinvertebrate data analysis, including biological metric calculations, metric scores, and impairment designations, are also included in the Appendix. Table A2 is the summary table for those biomonitoring stations compared to the Westfield River watershed reference station (WR01). Table A3 is the summary table for station comparisons to the Yokum Brook reference site (YB01A). Table A4 shows the analysis of those stations (LR02C, WR06A, YB01B, YB01C) being compared to a site-specific control (i.e., upstream reference station) station (WR02B, WR06B, YB01A). Habitat assessment scores for each station are also included in the summary tables, while a more detailed summary of habitat parameters is shown in Table A5.

As was determined following the 1996 Westfield River watershed biomonitoring survey, the 2001 biological data generally indicated good overall water quality and biological health at most sampling stations investigated. Impacts to resident biota observed at some stations were mainly the result of urban runoff, habitat degradation, and other forms of NPS pollution. In addition, the effects of water quality degradation may be exacerbated by compromised assimilative capacities in those streams affected by drought and/or anthropogenic-induced low baseflows. Reference-quality biomonitoring stations in both the mainstem Westfield River and tributary streams continue to support diverse and well-balanced aquatic communities expected in a "least-impacted" stream system.

### *Westfield River Watershed*

The Westfield River watershed drains 517 square miles (1340 $km^2$) from the eastern Berkshires to the Connecticut River. The Main, or East Branch as it is sometimes called, originates in the high country of Savoy and Windsor and flows 27 miles (43 km) in a southeasterly direction where it joins the Connecticut River. The Middle Branch begins in Peru and forms the border between Worthington and Middlefield before flowing through Chester to join the Main Branch in the town of Huntington. The West Branch, formed by the confluence of Depot and Yokum Brooks in Becket flows easterly, also meeting the main stem in Huntington. There are a total of 850 miles (1368 km) of rivers, streams, and brooks and 4,200 acres (17 $km^2$) of lakes and ponds in the watershed. Approximately forty-three miles (69 km) of the Westfield River have been designated by the National Park Service as "Wild and Scenic". Included in this first ever designation for a Massachusetts river are parts of the Main, Middle and West Branches.

The Westfield River watershed is bordered by the Deerfield, Hoosic, Housatonic, Farmington and Connecticut River basins and is contained almost entirely within Massachusetts. The basin covers all or a part of twenty-eight municipalities: Savoy, Windsor, Hawley, Plainfield, Ashfield, Peru, Cummington, Goshen, Chesterfield, Worthington, Middlefield, Washington, Becket, Chester, Huntington, Westhampton, Montgomery, Russell, Blandford, Otis, Tolland, Granville, Westfield, Southampton, Holyoke, West Springfield, Agawam and Southwick.

Because the headwaters originate in mountains with little soil to retain water, the Westfield River rises quickly in response to large storms and snowmelt. After those flows subside, little water is left for baseflows. Consequently, the river naturally fluctuates between high and low flows. Both the Main Branch and the Middle Branch have U.S. Army Corps of Engineer Dams to alleviate some of the danger of flooding. Several water supply reservoirs capture spring runoff, storing it for use throughout the year. Cobble Mountain in Blandford, Littleville in Huntington, and Bearhole in Westfield are the largest reservoirs. The lower reaches of the Westfield flow through a broad valley filled with stratified drift, forming the Barnes Aquifer, a major groundwater resource that stretches from Holyoke to Southwick.

The upper portion of the watershed is very rural and timber harvesting and agricultural activities dominate the land-use. The lower portion of the watershed is more developed and includes heavily urbanized areas of Agawam, West Springfield, and Westfield. The Westfield River Basin supplies both surface water (12 withdrawal sites) to seven public water supply systems and three industrial users (four withdrawal sites) and groundwater to four of the seven municipal supply systems.

During the settlement of the watershed, hydro-power available from the Westfield and an abundance of raw materials fueled industrial development. The major historic mill sites are still industrial sites even though hydro-power has diminished in importance. In the past, sewage and industrial discharges greatly impacted the water and habitat quality of the lower Westfield River. Currently these point source discharges are regulated by NPDES permits. There are seven municipal wastewater discharge permits and three industrial wastewater permits in the basin. Although these permits, and their strict effluent limits, have resulted in a marked improvement in water quality over the last twenty years, several facilities occasionally have difficulty in meeting permit limits. In addition, there may be a need to regulate contaminants that were not considered a priority when previous NPDES permits were issued.

### *Hydrologic Conditions*

The Westfield River watershed was affected by drought conditions during the 2001 biomonitoring survey (USGS 2004). Precipitation was virtually absent (0.11 inches) during the month leading up to the biosurvey, reducing stream discharges well below the expected mean for their period of record (USGS 2004) (Figure 4). The net effect was a reduction in available instream habitat, exposure of substrates, and an increase in instream water temperatures. These habitat constraints may result in the stranding or concentration of biota (both benthic macroinvertebrates and fish) into the remaining available habitats. In addition, these conditions tend to increase the stress upon sensitive species, and increase the metabolic rate of poikilothermic biota.

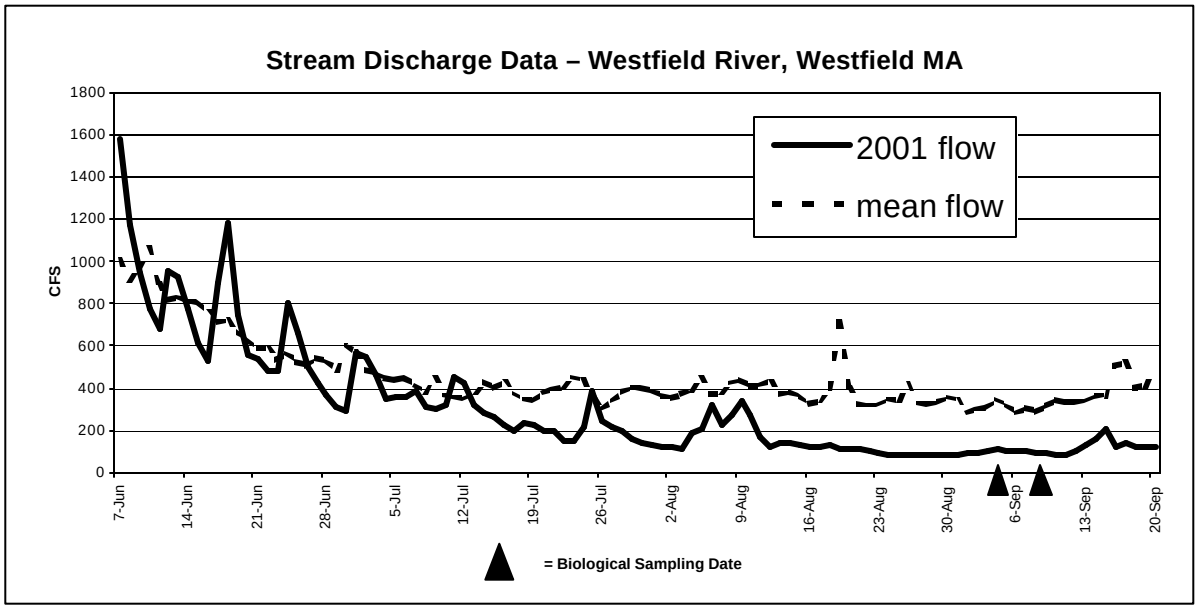


**Figure 4.** Discharge data at mainstem USGS gage 01183500: 2001 flow and mean flow over 88-year period of record (USGS 2004).

### *Westfield River*

The Westfield River begins at the confluence of Center Brook and Drowned Land Brook in Savoy on the eastern flanks of the Hoosac Range. The river flows in a southeast direction through mostly undeveloped steep terrain with little floodplain development through the towns of Windsor and Cummington. At Cummington Center the floodplain widens but then narrows as the river continues southeast through Cummington in a narrow steep valley. Just before entering Chesterfield, the river turns east and then sharply to the north where the Swift River joins it. The Westfield River then turns abruptly to the south and flows into Chesterfield in a narrow steep valley which then enters a state forest in a reach called The Gorge with extremely steep slopes and a narrow river channel. The floodplain then widens as the river enters Huntington continuing to flow south. The river then enters the Army Corps of Engineers Knightville Dam area and several miles below the dam is the confluence with the Middle Branch of the Westfield River.

From the confluence with the Middle Branch Westfield River (below Littleville Dam), the Westfield River continues flowing south past the town center of Huntington to the confluence with the West Branch Westfield River. Here the river receives the Huntington WWTP (NPDES permit no. MA0101265) treated municipal wastewater in the uppermost end of this segment, approximately 2.3 miles (3.7 km) below the Middle Branch confluence. The Westfield River then begins to flow in a southeasterly direction. Just before passing by the Village of Crescent Mills, the river becomes impounded at the USM Corp. Texon Division Dam (MA0005282), a major NPDES discharger. The river "zig-zags" to the southeast through steep terrain to the town of Russell where it encounters a hydroelectric dam and where the Russell

Wastewater Treatment Plant discharges (MA0100960) just downstream of the dam. A few miles downstream in Woronoco, the river is again impounded. Strathmore Paper Co. (MA0004995) has historically discharged into the river in this reach; however, the facility is no longer operational. The river continues to the southeast passing under Interstate Route 90 and then enters the City of Westfield. Here the topography changes to a broad floodplain and the river gradient decreases. The river then enters the urbanized part of Westfield where the Westfield WWTP (MA0101800) discharges. The Westfield River then flows southeast where the Little River joins it and then continues to the Route 20 bridge. This segment also historically received wastewater from the Westfield River Paper Company, although this discharge is no longer active.

From the Route 20 bridge in Westfield, the Westfield River continues to meander to the southeast through an industrial area and then loops to the northeast to where it crosses the city of Westfield municipal boundary. The river then flows to the east and the floodplain narrows and the banks steepen as the river passes by Westfield's boundary with West Springfield and Agawam. The Westfield State Hospital (MA0102270), a minor NPDES permit, discharges into a small unnamed brook which flows a short distance to the Westfield River.

From the Westfield city boundary with West Springfield and Agawam, the Westfield River continues to meander in an easterly direction through a narrow floodplain with steep banks. The river then becomes the municipal boundary between West Springfield and Agawam, then flows through an industrial area in West Springfield and urbanized areas of Agawam before entering a delta at its confluence with the Connecticut River in Agawam. Decorative Specialities (MA0032492) discharges into this segment of the Westfield River.

**WR01**—Westfield River, mile point 25.6 (41.1 km), downstream from Knightville Dam, off Rocky Hill Road near Route 112, Huntington, MA

*Habitat*

The WR01 sampling reach was located approximately 2 miles (3.2 km) downstream from the Knightville Dam and a short distance (700 m) above the mainstem Westfield River's confluence with the Middle Branch in Huntington. The biomonitoring station was accessed via the backyard of a private residence at the cul-de-sac of Rocky Brook Road. Despite the forested nature of this portion of the watershed, the width (30 m) of the river here precluded the presence of any meaningful canopy cover. Riffles of varying depth (0.1 – 0.5 m) and an abundance of boulder substrates provided exceptional habitat for macroinvertebrates. Fish habitat was also excellent, with ample deep (0.5 – 1.0 m) water areas and stable cover in the form of boulder, bedrock ledge, and submerged logs. In fact, this was the only Westfield River biomonitoring station to receive perfect scores for both the instream cover and epifaunal substrates habitat parameters. Sediment deposition or other signs of NPS pollution were absent. Water reached the base of both stream banks, leaving only minimal amounts of instream substrates exposed. Instream aquatic vegetation was absent, and only occasional (<1% cover) patches of periphyton were observed as thin films attached to boulders in riffle areas. Both banks were well vegetated and stable, save for a small area where tree clearing and slight bank erosion had occurred on the right (west) bank. Riparian vegetation was undisturbed along the left (east) bank and comprised shrubby (alder, *Alnus* sp.; sweet pepperbush, *Clethra alnifolia*) and herbaceous (ferns, Joe-Pye weed, *Eupatorium* sp.) growth along the stream margin before giving way to a dense mixed hardwood (birch, *Betula* sp.; slippery elm, *Ulmus rubra*; white ash, *Fraxinus americana*) and hemlock (*Tsuga canadensis*) forest.

WR01 received a total habitat score of 184/200 (Table A5). This was used as the primary reference station for biomonitoring stations in the mainstem Westfield River and the Little River—all of which are predominately open-canopied reaches with comparable flow regimes and instream habitat. Designation of WR01 as a reference condition was based on its high habitat evaluation, historically good water quality and biological integrity (Szal 1998), absence of nonpoint source pollution inputs, and minimal surrounding land-use impacts (e.g., absence of point source influences, lack of channelization, minimal development or agricultural activity nearby, undisturbed and well vegetated riparian zone).

*Benthos*

As was the case during the 1996 Westfield River watershed biological assessments (Szal 1998), WR01 was characterized by a macroinvertebrate assemblage indicating a healthy aquatic community, with metric values indicative of good water quality and "least-impacted" conditions (Table A2). In particular, those attributes that measure components of community structure (i.e., Taxa Richness, EPT Index)—which display the lowest inherent variability among the RBP metrics used (Resh 1988)—scored well, further corroborating the designation as a reference station. A low Biotic Index (4.10) and a high (highest value in the survey) EPT Index (17) indicated the dominance of pollution-sensitive taxa among the WR01 benthos assemblage. Filter-feeding caddisflies (*Chimarra* sp.) were fairly well represented (n=23), as was the case during the 1996 biosurvey (Szal 1998). Their presence resulted in slight point reductions (score=4) for the Percent Dominant Taxon metric for both the 1996 data set and current benthos evaluations here. Filter-feeders did not dominate the WR01 sample, however. Indeed, pollution sensitive algal scraping taxa such as the Elmidae and Heptageniidae were numerous as well, indicating good trophic balance and the presence of multiple (FPOM, periphyton, etc.) important food resources in this portion of the river. The WR01 benthic community received a total metric score of 40 out of a possible score of 42 (Table A2).

*Fish*

Fifty-five fish were collected at WR01 (Table A6). The width of the river at this station decreased the efficiency of the backpack electrofishing device. The dominant species present in the sampled population was smallmouth bass (*Micropterus dolomieu*, n=22). The sub-dominant species collected was white sucker (*Catostomus commersoni*, n=12). These two species accounted for 62% of the specimens collected at this station. Both of these fish are capable of inhabiting thermal regimes intermediate to those of cold-water species (e.g., Atlantic salmon, *Salmo salar*; eastern brook trout, *Salvelinus fontinalis*) and warm-water species (e.g., largemouth bass, *Micropterus salmoides*; pumpkinseed, *Lepomis gibbosus*). Smallmouth bass and white sucker are mid-tolerant and tolerant respectively. The dominance of these two species may be a response to the drought conditions observed in this watershed during the 2001 biosurveys, or a result of the impounded (Knightville Dam is just upstream) nature of the upper Westfield River.

**WR05**—Westfield River, mile point 18.2 (29.3 km), 250 m downstream from Strathmore Paper Company discharge (inactive), Russell, MA

*Habitat*

The WR05 sampling reach was located approximately 250 m downstream from the inactive wastewater and thermal discharges of the now-defunct Strathmore Paper Company in the Woronoco section of Russell. The open-canopied reach was wide (12 m) and of swift current velocity—numerous riffle areas (0.2 – 0.4 m deep) and boulder/cobble substrates provided macroinvertebrates with excellent epifaunal habitat. Fish habitat was also considered optimal, with boulders and submerged woody materials in deep pools providing ample stable cover. Fish population data were not collected here, however, as the wide and deep nature of much of the WR01 sampling reach precluded the use of backpack electrofishing as a viable means of fish population sampling. Sediment deposition was not observed, nor were other NPS pollution inputs. Aquatic macrophytes and algae were absent despite the open canopy. Only habitat parameters for velocity-depth combinations and channel flow status were less than optimal (score of 15 and 14 respectively), the result of a lack of deep riffle areas and some channel substrate exposure. Parameters for bank and riparian habitat scored high—banks were well-vegetated and stable along both sides of the channel. Riparian vegetation was undisturbed and equally comprised of grasses and herbaceous (Japanese knotweed and smartweeds, *Polygonum* spp.) growth, vines (riverbank grape, *Vitis riparia*), shrubs (bittersweet, *Calastrus* sp.; dogwood, *Cornus* sp.), and mixed hardwoods (maple, *Acer* spp.; white ash, *Fraxinus americana*; elm, *Ulmus* spp.; sycamore, *Platanus occidentalis*).

WR05 received a total habitat score of 185/200—the highest habitat evaluation recorded during the 2001 Westfield River watershed biomonitoring survey (Table A5). Habitat quality was only slightly compromised by the drought-induced low baseflow conditions observed during the 2001 biosurveys.

*Benthos*

The WR05 benthos assemblage received a total metric score of 30, representing 75% comparability to the mainstem reference station and resulting in an assessment of "slightly impacted" for biological condition (Table A2). Point reductions for compositional metrics were most noticeable, with Taxa Richness and EPT Index receiving scores of only 2. The preponderance of filter-feeding caddisflies (especially *Chimarra* sp.) contributed to the displacement of other more pollution sensitive taxa, although their presence was not enough to impact the Scraper/Filterer metric (score=6). The numerous filter-feeders observed here probably results from an ample supply of FPOM originating from large upstream impoundments (e.g., Littleville Lake) and is delivered to downstream benthic communities such as WR05. Urban runoff associated with downtown Russell, as well as treated wastewater from the town's WWTP, may contribute organic loads to this portion of the river as well.

The current bioassessment of WR01 is dramatically improved from that observed following the 1996 survey, when Strathmore still maintained both a heated discharge and a second discharge of treated paper process wastewater. The 1996 macroinvertebrate biomonitoring efforts found a "severely impacted" community relative to watershed and upstream reference conditions, with extreme reductions of both total and sensitive taxa, and the highest Biotic Index in the survey (Szal 1998). Coupled with a hyperdominance of chironomids (n=79), benthos metrics for the 1996 sample suggested severe water quality degradation in the form of organic enrichment attributable to the Strathmore discharges. With the removal of the Strathmore discharges water quality at WR01, as reflected in the resident benthos, appears to have improved significantly. Chironomids and other taxa highly tolerant (e.g., Naididae) of organic pollutants and observed in the 1996 sample were virtually absent from the 2001 benthos sample, while the Biotic Index has returned to a level comparable to that of the reference community.

**WR06B**—Westfield River, mile point 11.3 (18.1 km), opposite the Westfield WWTP discharge (i.e., outside of the effluent plume), Westfield MA

*Habitat*

The WR06B sampling reach began approximately 400 m downstream from the Little River's confluence with the mainstem Westfield River and was confined to a short channel opposite (i.e., along the south bank and clearly outside the effluent plume) the WWTP discharge that entered the river from the left (north) bank. The reach was about 420 m downstream from DEP's historical biomonitoring station (WR06) in this segment of the river. Habitat constraints (lack of riffle areas) at WR06 and elsewhere upstream from the discharge outfall resulted in less than ideal conditions for kick sampling and led to DEP's decision to establish the new station at WR06B. In addition, moving the biomonitoring station farther downstream (i.e., below the mouth of the Little River) allowed for a "tighter" bracketing of the Westfield WWTP, resulting in a more accurate assessment of discharge impacts by eliminating the potentially confounding effects of water quality factors originating from the Little River.

The constricted nature of WR06B—formed by the riverbank to the south and a small island to the north—resulted in good current velocity and well formed riffles of varying depths (0.2 – 0.5 m) throughout the 2 m wide sampling reach. Hard substrates mainly comprised of cobble provided macroinvertebrates with optimal epifaunal habitat. Fish habitat was also good, with undercut banks, occasional boulder, and submerged logs providing stable cover in both shallow and deep (up to 1 m) areas. Dense algal growth, especially filamentous green forms, covered rocky substrates in the majority of the reach and was afforded full sunlight penetration due to the mostly (30% shaded) open-canopied nature of this wide (20 m) portion of the Westfield River. Channel flow status, in both the side channel where sampling was conducted and the river as a whole here, was optimal. Banks were well-vegetated with shrubs (bittersweet, *Celastrus* sp.; elderberry, *Sambucus canadensis*) and herbaceous (ferns) growth; streambank vegetation also provided good bank stability, as did the "rip-rap" deposited along much of the

bank here. The riparian zone was wide and undisturbed along the left (north) bank of the river, with a mix of hardwoods (cottonwood, *Populus deltoides*; maple, *Acer* spp.; white ash, *Fraxinus americana*; elm, *Ulmus* sp.; sycamore, *Platanus occidentalis*) providing a good vegetative buffer. Riparian vegetation was much reduced along the right (south) bank due to adjacent commercial/industrial activities and parking lots. Turbidity in the water column was observed, and the effluent odor emanating from the outfall across the river was quite pronounced.

WR06B received a total habitat assessment score of 165/200 (Table A5). Most of the habitat point reductions were a result of the urbanized nature of this portion of the watershed.

*Benthos*

The WR06B macroinvertebrate community received a total metric score of 28, representing 70% comparability to the reference community at WR01 and resulting in an assessment of "slightly impacted" for biological condition (Table A2). EPT Index and EPT/Chironomidae metrics performed particularly poorly (score=0), indicating that chironomids have displaced some of the more sensitive EPT taxa in this portion of the river. Suppression of the EPT community is consistent with the findings of Szal (1998) during the last DEP biomonitoring survey conducted in this segment (i.e., upstream from Westfield WWTP) of the Westfield River. But despite the Chironomidae comprising greater than 25% of the WR06B benthos sample (Table A1), no one species dominated nor did their presence negatively affect the Biotic Index (score=6). High scoring values for Scraper/Filterers and Percent Dominant Taxon metrics suggest community structure and function remain relatively balanced among the benthos assemblage here despite the potential for runoff effects originating in downtown Westfield.

**WR06A**—Westfield River, mile point 11.0 (17.7 km), 340 m downstream from Westfield WWTP discharge, Westfield, MA

*Habitat*

WR06A was located approximately 340 m downstream from the Westfield WWTP outfall. Though land-use is highly urbanized in this portion of the watershed, the area immediately adjacent to the sampling reach was forested and relatively undisturbed. Trees provided only minimal (20% canopy cover) shading in this wide (20 m) segment of the Westfield River. The reach was rocky (mostly cobble) and riffle-dominated, with swift current velocity of varying (0.2 – 0.5 m) depths providing ideal epifaunal benthos habitat. Some areas of cobble stream bottom were left exposed and unavailable for macroinvertebrates due to the suboptimal channel flow status here during the time of the biosurvey. Fish habitat was only marginal at best due to the lack of stable cover and well-defined pools. Various types of green algae covered virtually all the stream bottom in the sampling reach. In addition to the luxuriant algal growth, an abundance of sewage fungus was noted along the margins of the reach. The smell of treated sewage was quite strong here, and instream turbidity was obvious. Bank and riparian habitat quality was excellent at WR06A. Banks were well-vegetated with ferns and grasses and stabilized with boulders and tree roots. The deciduous (cottonwood, *Populus deltoides*; maple, *Acer* spp.; sycamore, *Platanus occidentalis*) forest on both sides of the river provided a wide and undisturbed riparian zone.

WR06A received a total habitat assessment score of 168/200 (Table A5). The habitat evaluation conducted here during the 1996 biosurvey yielded similar results (Szal 1998). Habitat quality, especially instream parameters, was highly comparable to conditions recorded just upstream at WR06B.

*Benthos*

The WR06A benthos assemblage received a total metric score of 24, representing 60% comparability to the watershed reference station located on the Westfield River. Chironomids dominated the community, comprising half of the assemblage and resulting in displacement of pollution sensitive taxa (an EPT Index of 5 was the lowest in the entire Westfield River watershed biomonitoring survey) and a low scoring EPT/Chironomidae metric value (Table A2). The resulting bioassessment—"slightly impacted"—was similar to previous assessments in this portion of the river. In 1996, biomonitoring efforts detected an

assemblage with metric scores that were 60% comparable to watershed reference conditions and an assessment of “moderately impacted”; however, analysis of benthos metrics for that biosurvey was based on only family-level (i.e., RBPII) taxonomy. Chironomids were an even larger component of the benthos sample collected in 1996, comprising almost 80% of the total assemblage (Szal 1998).

To better assess the potential impacts of the Westfield WWTP discharge, WR06A was compared to an upstream control station (WR06B). Again, the comparison of benthic communities yielded an assessment of “slightly impacted” for biological condition (Table A4). Impairment here appears to be the result of water quality degradation, as habitat scores were comparable (better in fact) to the upstream reference station. Most notable among the benthic metrics for WR06A was the EPT Index, which was greatly reduced (by more than half) compared to WR06B due to the displacement of EPTs by chironomids (EPT/Chironomidae metric score=2). That DWM biologists were able to closely bracket the Westfield WWTP discharge with both the macroinvertebrate test station and control station suggests biological impairment at WR06A can be at least partially attributed to discharge effects, as was concluded by DEP following the 1996 biosurvey here (Szal 1998).

***Little River***

The Little River begins at the outfall of Cobble Mountain Reservoir. This reservoir has 15 streams (including the outfall of Borden Brook Reservoir) contributing to its 96.5 million cubic meter volume. The Springfield Water and Sewer Commission operate the reservoir and the West Parish Filtration Plant, and sells water to approximately 250,000 people in Westfield, Southwick, West Springfield, Agawam, and other surrounding towns. Much of the land (approximately 12,000 acres (4.85 $km^2$)) surrounding the reservoir (mostly in the town of Blandford) has been taken by the City of Springfield through eminent domain and purchase. Public access to Cobble Mountain Road, and by default, the reservoir, has been forbidden since the fall of 2001.

Water from the reservoir may be discharged through a spill gate at the base of the dam (the headwaters of the Little River) or an aqueduct leading to a 33 megawatt generating facility on the banks of the Little River (4 km downstream of the dam). The Little River emerges from the base of the Cobble Mountain Dam and flows through a steep-sided and heavily forested valley. The river receives the flows of Pitcher Brook and three other unnamed low-order streams within the first 3 km of its length. After receiving the thermal discharge from the generating facility, the Little River enters the impoundment known as The Gorge. Water from this impoundment may either be released back into the Little River streambed, or sent by aqueduct to the West Parish Filtration Plant. Water released to the Little River courses northeasterly for 2.5 km, where it receives the flow from Sodom Brook. After flowing around Westfield Mountain, the river turns southeasterly. After the river leaves the slopes of Westfield Mountain, it loses most of its high-gradient nature, and enters the Westfield River valley. The mean gradient of the Little River is 100 feet per mile (19 meters per kilometer) to the base of Westfield Mountain. The gradient for the remaining 12-km course of the river is just over 16 feet per mile (3 meters per kilometer). 4 km below Sodom Brook, the Little River receives the flows from Cook Brook. Cook Brook is a small, first-order stream that receives the effluent from the West Parish Filtration Plant. This filtration plant is a gravity-fed slow-sand, and mixed media filtration system designed to clarify raw water. The sand and media must, on occasion, be back-flushed to remove sediment from the filtration beds. This process has led to local concerns regarding potential degradation of instream habitat and associated biota from increased sedimentation in both Cook Brook and its receiving water, the Little River.

**LR02A**—Little River, mile point 11.5 (18.5 km), downstream from Cobble Mountain Reservoir, immediately below Pitcher Brook, Russell, MA

*Habitat*

LR02A was established in order to document biological conditions at this relatively “pristine", albeit flow-modified, location. The LR02A sampling reach was located approximately 2 km downstream from the Cobble Mountain Reservoir outlet in a remote and densely forested portion of the Little River

subwatershed. The reach was accessed via a trail off of Wildcat Gorge Road and required a long hike over extremely steep-sloping terrain. The stream was approximately 3 m wide and ranged in depth from 0.2 m in the riffle areas to almost half a meter in the deepest pools. Rocky substrates were plentiful and consisted mainly of boulders and large cobble, which, coupled with swift current velocity provided excellent habitat for macroinvertebrates throughout the reach. Fish habitat was also optimal, with a good mix of snags, submerged logs, and other stable cover in the majority of the reach. Aquatic mosses covered about 50% of the sampling reach, while algal growth (mostly filamentous green forms) was observed in 25% of the reach. Channel flow status here was suboptimal, with water filling just over 75% of the channel. Shrubs (elderberry, *Sambucus canadensis*), vines (riverbank grape, *Vitis riparia*), and herbaceous (Joe-Pye weed, *Eupatorium* sp.; various ferns; turtlehead, *Chelone glabra*) growth not only provided good vegetative protection, but also aided in the stabilization of these extremely steep banks. The dense forest, with a mix of hardwoods (birch, *Betula* sp.; red maple, *Acer rubrum*) and evergreens (hemlock, *Tsuga canadensis*; white pine, *Pinus strobus*), provided a 50% canopy cover and offered an unlimited riparian zone in all directions.

LR02A received a total habitat assessment score of 182/200 (Table A5). Only those habitat parameters most closely associated with baseflow (i.e., velocity depth combinations and channel flow status) received less than optimal scores.

*Benthos*

The LR02A macroinvertebrate community received a total metric score of 26, representing 65% comparability to the reference station and resulting in a bioassessment of “slightly impacted” (Table A2). Low values for EPT Index and EPT/Chironomidae metrics affected the overall metric score most negatively. Yet despite the lack of EPT taxa, the Plecoptera—generally considered the most pollution-sensitive insect order—were well-represented in the LR02A sample, contributing to one of the lowest Biotic Indexes (3.30) in the entire Westfield River watershed survey (Tables A2-A4). And while high densities of chironomids were responsible for the displacement of EPTs, the numerically dominant midge, *Eukiefferiella brehmi* gr., is fairly intolerant of organic pollution with a preference for cold-water trout streams (Bode and Novak 1998). In general, the benthic community here was well-balanced—Percent Dominant Taxon was low—with all major trophic groups represented, including numerous pollution sensitive algal scrapers (e.g., *Promoresia tardella*, n=18, TV=2).

The high densities of pollution sensitive taxa in the LR02A benthos assemblage suggest that water quality does not limit biological potential in this portion of the Little River. Rather, it is probably low baseflow, as indicated by the marginal channel flow status here, that compromises aquatic health. Potential impacts to instream habitat and resident biota at LR02A may be caused by the diversion of water from the reservoir outlet to the power generating station further downstream, and may have been more pronounced during the time of the 2001 biosurvey due to drought conditions.

**LR02B**—Little River, mile point 7.1 (11.4 km), 20 m upstream from Cook Brook, Russell, MA

*Habitat*

The LR02B biomonitoring station began approximately 50 m upstream from the mouth of Cook Brook and about 550 m downstream from Northwest Road in a relatively undeveloped portion of Westfield. The sampling reach, essentially a long shallow (0.2 m) riffle, ranged in width from 2 – 6 m and completely lacked canopy cover. Low baseflow resulted in a channel only half full of water, and with a significant amount of rocky substrates left completely exposed along the margins of the stream. Grasses were well established along the dry portions of the streambed, suggesting that substrate exposure had occurred for some time. The shallow nature of the stream and lack of stable cover other than a few boulders resulted in less than optimal fish habitat. Epifaunal substrates that were submerged offered suboptimal benthos habitat due to a lack of riffle variety. There were no obvious signs of NPS pollution; however, an active sand and gravel operation was located adjacent to the reach along the (left) north bank and was only marginally buffered with riparian vegetation. In addition, substantial (almost 100%) periphyton cover throughout much of the reach (also easily visible from the Northwest Road bridge) suggested an

upstream nutrient source. A dense shrub (witchhazel, *Hamamelis virginiana*; willow, *Salix* sp.; alder, *Alnus* sp.) and herbaceous (goldenrod, *Salidago* sp.;Joe-Pye weed, *Eupatorium* sp.; ferns) layer provided good bank vegetation and stability along the right (south) bank, while the steep nature of the left (north) bank resulted in a few small areas of bank instability and vegetative disruption. Streamside vegetation along the right (south) bank gave way to an undisturbed riparian forest comprised of a mix of hardwoods (red oak, *Quercus rubra*; red maple, *Acer rubrum*; slippery elm, *Ulmus rubra*; birch, *Betula* sp.) and white pine (*Pinus strobus*). Riparian zone width was reduced to about 15 m along the left (north) bank due to the encroaching sand and gravel pit.

LR02B received a total habitat assessment score of 154/200 (Table A5). Point reductions for instream cover, epifaunal substrate, velocity-depth combinations, and channel flow status were the direct result of low baseflow conditions during the time of the biosurvey. The extreme habitat constraints caused by drought conditions here were probably exacerbated by the effects of upstream flow diversion.

This station was established as an upstream reference station for comparisons to biological conditions (i.e., benthic and fish community health, habitat quality) immediately downstream (at LR02C) from Cook Brook. Cook Brook receives the input from the West Parish Filtration Plant. This drinking water supply system treats waters from the Cobble Mountain Reservoir before transmission to the city of Springfield. The waters entering the West Parish filtration system are drawn from the Little River as it flows down Cobble Mountain. An aqueduct transports these waters to the filtration system. The majority of these waters are sent to the city of Springfield; however, the system requires occasional back-flushing to clean the sands. The debris and silt from back-flushing has a potentially deleterious effect upon the instream habitat and biota of both Cook Brook and its receiving water, the Little River.

*Benthos*

The benthic community at LR02B received a total metric score of 34, representing 85% comparability to the reference station and placing resident biota in the "non-impacted" category for biological condition (Table A2). Only EPT Index and EPT/Chironomidae metric values suffered point reductions, the result of a displacement of EPT taxa by midges. But while the presence of numerous chiromonids in a macroinvertebrate assemblage often leads to an increased Biotic Index, in this case the Biotic Index actually was lower than the reference condition. This was the result of an abundance of pollution sensitive midges—most notably, *Polypedilum aviceps*, which is known to be a "clean water" indicator rarely associated with impacted water quality (Bode and Novak 1998). And while low baseflow clearly compromises habitat quality in this portion of the river, these effects were not reflected in the benthic community during the time of the biosurvey, as was observed farther upstream at LR02A. The seemingly healthy aquatic community here corroborates its use as an upstream reference station for LR02C.

*Fish*

Two hundred four fish were collected at this station (Table A6). The dominant species collected was blacknose dace (*Rhinichthys atratulus*, n=147). The sub-dominant species collected was longnose dace (*Rhinichthys cataractae*) (n=44). These two species accounted for 94% of the specimens collected at this station. Both of these species are fluvial specialists, requiring flowing-water habitats for all life stages of development. This points towards the perennial nature of this stream and some degree of tolerance to encountered drought conditions.

**LR02C**—Little River, mile point 6.9 (11.1 km), 100 m downstream from Cook Brook, Russell, MA

*Habitat*

The LR02C sampling reach began approximately 100 m downstream from the Cook Brook confluence, ending immediately at its mouth. As with the upstream control station, channel flow status was only marginal in this portion of the river, although epifaunal and fish habitat were not affected as negatively as at LR02B—probably due to stream discharge contributions from Cook Brook. Nevertheless, riffles were extremely shallow (0.2 m) here, and while macroinvertebrate habitat was considered optimal, fish habitat

remained somewhat reduced due the lack of pool areas and stable cover. Instream algal cover was noticeably reduced (<50%) compared to the near-100% cover observed at LR02B. Bank and riparian habitat quality were highly comparable to conditions observed at the upstream reference station (LR02B).

LR02C was established to examine the potential effects of Cook Brook (and the discharge from the West Parish Filtration Plant) on the instream biota (macroinvertebrates and fish) and habitat quality of the Little River. That this station is geomorphically similar to conditions observed at the upstream reference station (LR02B) in terms of width, depth, flow regimes, and habitat allows for a direct comparison of biological conditions. There were clear indications that sediment had entered the Little River from Cook Brook—sediment deposition was observed in approximately 30% of the sampling reach, and a "trail" of sediment could be easily traced to a silty delta at the mouth of Cook Brook. This resulted in the second lowest score (11) for sediment deposition in the entire biomonitoring survey.

LR02C received a total habitat assessment score of 156/200 (Table A5). While the overall habitat evaluation was highly comparable to the upstream reference station, habitat parameters most closely associated with instream sedimentation—embeddedness and sediment deposition—were extremely reduced relative to reference conditions. Sand and other fine sediments drastically reduce macroinvertebrate microhabitat by filling the interstitial spaces of epifaunal substrates. In addition, the filling of pools with sediment reduces fish cover and may be detrimental to fish spawning habitat and egg incubation at LR02C.

*Benthos*

When compared to the watershed reference station on the Westfield River, the LR02C benthos assemblage received a total metric score of 21, representing 50% comparability to WR01 and resulting in an assessment of "moderately impacted" (Table A2). Low densities of EPTs and scraping taxa contributed most to the reduced total metric score. Reduced substrate microhabitat due to embeddedness and sediment deposition may contribute to the suppressed EPT community observed at LR02C, as these organisms may be susceptible to increases in sediment loading due to their inability to burrow (Johnson et al. 1993). The absence of algal scrapers here may also be a result of instream deposition, as the smothering and/or scouring of hard substrates and associated periphyton cover may negate the use of benthic algae as a viable food resource for macroinvertebrates in this portion of the river.

The LR02C benthic community was also compared to an upstream reference community to more effectively assess the potential impacts originating from Cook Brook. Metric comparisons to LR02B, which was located immediately upstream from the Cook Brook mouth, yielded a total score of 26 and resulted in an assessment of "slightly impacted" for biological condition at LR02C (Table A4). Reductions in EPT taxa and scrapers once again contributed to low scoring metrics. In addition, a low scoring (score=2) Percent Dominant Taxon value indicated a lack of community balance. Given the "tight" bracketing of the Cook Brook confluence by LR02B and LR02C and the fact that both stations were highly similar in terms of overall habitat type and flow regime, it appears highly likely that sediment inputs or other unknown impacts originating from Cook Brook are directly responsible for impairment of the resident biota at LR02C. In addition, the effects of sedimentation may be more pronounced in this portion of the Little River due to epifaunal habitat already compromised by reductions (both anthropogenic and naturally occurring) in baseflow (channel flow status at both LR02B and LR02C scored only an 8 out of a possible 20). The combination of instream sediment deposition and reduced flow here may explain why the LR02C community was considered slightly impacted relative to upstream reference conditions subjected to similar flow regimes, yet moderately impacted compared to the watershed reference condition where flow constraints were less pronounced.

*Fish*

The fish examined at LR02C were similar to those collected at the upstream reference station. Two hundred thirty-eight fish were collected at this station compared to 204 collected just upstream at LR02B. The dominant species was blacknose dace (n=149). The sub-dominant species collected was common shiner (*Luxilus cornutus*, n=37). These two species accounted for 84% of the specimens collected at this

station. There were 30 more common shiner collected at this station compared to the seven common shiner collected at the reference station. It is unlikely that the observed increase in the numbers of common shiner represents a response to the inputs from Cook Brook. Rather, it is likely that a school of common shiner was encountered at this location and time. If the common shiners are discounted, then the sub-dominant species would be longnose dace (n=31). This mirrors the dominant and sub-dominant species collected at the reference station.

Common shiners are fluvial dependents, requiring lotic habitats for at least part of their life cycle. However, the community structure at this station (like the reference station) remains dominated by fluvial specialists. It is possible that resident fish populations in this portion of the river can better withstand drought conditions due to the hydrologic influences of Cook Brook. In addition, sediment inputs originating from Cook Brook appeared to have a less discernable impact on the LR02C fish community than the benthic community.

### *Yokum Brook*

Yokum Brook begins at the confluence of the outfalls of Buckley-Dunton Lake (impounded) and Yokum Pond (impounded) on the eastern edge of October Mountain State Forest in Becket, MA. The stream flows easterly through a high-gradient, heavily forested landscape as it parallels Yokum Brook Road. After flowing under Route 8, Yokum Brook receives the flow from Rudd Pond Brook. The bed-gradient remains relatively high as Yokum Brook parallels Route 8, flowing through the thickly settled town of Becket. Two dams existed on this stream in the town of Becket at the time of the 2001 biosurveys. These dams were built during the industrial revolution to power small mills. The dams pose a barrier to upstream migration by aquatic fauna, and due to more than a century of siltation, perform little to no flood control. Yokum Brook encounters the upper dam approximately 0.27 km downstream from Carter Road. The brook continues easterly from this upper dam for 0.4 km where it encounters the lower dam near the Becket Elementary School. Yokum Brook then flows the short (0.11 km) remainder of its course to the West Branch of the Westfield River. The total watershed area of this second-order stream is approximately 22.7 $km^2$.

Three biological monitoring stations were prescribed for Yokum Brook—located above, between, and below the Becket dams. During the time of the 2001 biomonitoring survey, both dams were scheduled for removal, and biological examinations were conducted to assess aquatic faunal health and pre-removal conditions. To date, the upper-most dam has been removed, and progress is currently being made to remove the lower dam. It is anticipated that, with the removal of these dams, catadromous, anadromous, and fresh-water fish species will have access to a greater area and variety of aquatic habitats.

**YB01A**—Yokum Brook, mile point 0.4 (0.65 km), 50 m upstream from upper dam, downstream from Route 8, Becket, MA

*Habitat*

YB01A meanders through a forested portion of the watershed with some residential development nearby. The small size of the adjacent trees limits the canopy cover at this reach to approximately 75%. Nevertheless, the reach remains mostly shaded. This upper-most station on Yokum Brook is upstream from both dams, and extends from an obstructing riffle at the top of the pool behind the upper dam to a bedrock constriction approximately 100 meters upstream. Stream width ranges from 3 – 4 m. Fish are unable to migrate to this station from the downstream portions of Yokum Brook; however, access from portions upstream of this station (including Rudd Pond) is possible. Boulder and cobble-dominated substrates subjected to swift current velocity provided optimal, albeit shallow (0.1 – 0.3 m), riffle habitat for macroinvertebrates. The larger boulders provided some stable fish cover; however, the shallow nature of the stream resulted in less than optimal fish habitat. Indeed, channel flow status was marginal at best, with water filling only about half the available channel and leaving much exposed substrate. Both aquatic vegetation and algae were absent. Large boulders stabilized both stream banks, which were well-vegetated with grasses and herbaceous (Joe-Pye weed, *Eupatorium* sp.; various ferns) growth. Riparian

vegetative zone width was good along both sides of the channel. Main Street (Route 8) parallels the course of this reach along the right (east) bank but does not cross the stream within the reach, and remains at least 18 meters from the stream. The riparian zone between the road and the stream is forested with smaller deciduous trees (cottonwood, *Populus deltoides*; maple, *Acer* spp.; white ash, *Fraxinus americana*; slippery elm, *Ulmus rubra*; sycamore, *Platanus occidentalis*) and occasional shrubs. Nearby residences reduce the riparian zone width only slightly along the right (west) bank. Obvious signs of NPS pollution were not observed, although upstream road crossings offer a potential source of runoff.

YB01A received a total habitat score of 151/200 (Table A5). This was used as the primary reference station for comparisons to biomonitoring stations in the lower-order tributaries of the Westfield River watershed—all of which are predominately closed-canopied reaches with comparable flow regimes and instream habitat. Designation of YB01A as a reference condition was based on its presumed good water quality and biological integrity, absence of nonpoint source pollution inputs, and minimal surrounding land-use impacts (e.g., absence of point sources, lack of channelization, minimal development and agricultural activity nearby, undisturbed and well vegetated riparian zone). YB01A was also used as the upstream control station in the assessment of damming impacts (prior to dam removal) to downstream communities at YB01B and YB01C.

*Benthos*

YB01A supported an extremely diverse macroinvertebrate assemblage that displayed optimum community structure and balanced trophic structure. And a Biotic Index of 3.07, the lowest value in the entire Westfield River watershed survey, indicated that the YB01A benthic community was comprised mainly of pollution sensitive taxa. Indeed, the numerically dominant taxon was the heptageniid mayfly *Epeorus* sp., a highly intolerant taxon with a Tolerance Value of 0. The YB01A benthos received a total metric score of 42 out of a possible 42 (Table A3), further supporting that this station represents the "best attainable" conditions in the watershed and warrants its status as a reference station (watershed and upstream reference).

*Fish*

One hundred fifty-six fish were collected at this station. The dominant species collected was Atlantic salmon (*Salmo salar*, n=76). The sub-dominant species collected was blacknose dace (*Rhinichthys atratulus*, n=59). These two species accounted for 87% of the specimens collected at this station. Fifty-two percent of the fish collected at this station were fluvial dependents. Top carnivores dominated (58%) the feeding groups encountered here. However, the Atlantic salmon (top carnivore) collected were all of a size (mean=8.2 cm) that precludes their ability to fulfill this role. This station appears capable of supporting a fish community dominated by cold-water to cool-water insectivore species.

**YB01B**—Yokum Brook, mile point 0.2 (0.3 km), 100 m upstream from Prentice Place, Becket, MA

*Habitat*

The middle Yokum Brook station was located between the two Becket dams. The YB01B sampling reach extends from a bedrock constriction located approximately 100 m upstream from Prentice Place (the driveway to Becket Elementary School) to a large "plunge" pool located immediately downstream from Route 8 near Becket center. The lower dam (below this station) provides a complete barrier to upstream migration of fish species (i.e., fish collected at this station must have originated within this sampling reach, or passed over the dam at the top of this reach). The stream is approximately 3 m wide and is mostly (75% canopy cover) shaded. The gradient is steep here, with boulders, bedrock, and cobble dominating the substrate and providing excellent benthos habitat in a series of cascades and shallow (0.1 – 0.3 m) riffles. Deep pools (0.75 m) with large boulders and bedrock ledge provided fish with optimal habitat as well. Instream vegetation was minimal and composed only of mosses. Algal growth was also greatly reduced (coverage within reach <1%) and consisted of thin layers of periphyton on rocky substrates. Channel flow status appeared considerably better than at the upstream reference station, with water reaching the base of both banks and leaving only a minimal amount of channel substrate exposed. The

right (east) bank was well-vegetated with shrubs (dogwood, *Cornus* sp.; barberry, *Berberis* sp.) and herbaceous (Joe-Pye weed, *Eupatorium* sp.; various ferns) growth, while a nearby park disrupted streambank vegetation slightly along the left (west) bank. Massive boulders and bedrock slabs provided banks with good stability. Riparian vegetative zone width was reduced along the right bank due to an encroaching residential property, and along the left bank due to the adjacent road and park (Route 8).

YB01B received a total habitat assessment score of 168/200, which was higher than that received by the reference station at YB01A (Table A5). The effects of reduced baseflow, such as those observed upstream at YB01A, did not appear as pronounced in this segment of Yokum Brook.

*Benthos*

The YB01B macroinvertebrate community received a total metric score that was highly (100%) comparable to the reference condition located just upstream (Table A3 and A4). In fact, metrics outperformed those for the reference station for Taxa Richness and Scrapers/Filterers, suggesting good diversity and balanced trophic structure among the YB01B assemblage. In addition, high Reference Affinity values corroborate good overall comparability to the reference community. Thus, the resident benthos here does not appear to be negatively impacted by the dammed nature of this portion of Yokum Brook, as reflected in its "non-impacted" biological assessment compared to the upstream control.

*Fish*

Sixty-four fish were collected at this station—a lower number than were collected at either YB01C (n=187) or YB01A (n=156). It is probable that the reduced fish densities are a result of the barriers to migration provided by the dams at the upstream and downstream ends of this segment. The dominant species collected was Atlantic salmon (n=35). The sub-dominant species collected was eastern brook trout (*Salvelinus fontinalis*, n=15). These two species accounted for 78% of the specimens collected at this station. The abundance, and the relatively small size, of Atlantic salmon encountered (mean length=10.4 cm) suggest the presence of salmon restocking efforts within this stream. Atlantic salmon (and eastern brook trout) are classified as fluvial dependents. Atlantic salmon are also classified as top carnivores. However, the small size of the salmon collected indicates that these fish are still primarily insectivores at this life stage. This station appears to be capable of supporting a fish community dominated by cold-water insectivores.

**YB01C**—Yokum Brook, mile point 0.0 (0.0 km), immediately upstream from confluence with the West Branch Westfield River, Becket, MA

*Habitat*

The lower Yokum Brook station is located below both dams. The YB01C sampling reach extends from Yokum Brook's confluence with the West Branch of the Westfield River upstream to the base of the first dam (near the Becket Elementary School). Fish at this station, then, have access to and from the West Branch of the Westfield River although a minor barrier to fish passage, consisting of boulders and rubble, exists at the mouth of Yokum Brook. Cobble/boulder substrates and swift current velocity, which is probably enhanced by the channelized and constricted nature of the stream, provided optimal epifaunal habitat for macroinvertebrates. Areas of instream sedimentation, consisting mainly of sand deposits, were avoided during kick sampling. Fish habitat was also considered optimal, with boulders providing most of the stable cover. Channel flow status was slightly less than optimal, though water filled >75% of the channel and left only minimal (<25%) amounts of substrate exposed. Instream algae and aquatic vegetation were not observed. Both stream banks have been highly modified at this station. The left (west) bank is a vertical stone wall built of (presumably) native stone and cemented in place. The right bank (east) is a 45-degree stone wall. Both retaining walls measure approximately 6 feet in height. A single line of deciduous trees (maple, *Acer* spp.; white ash, *Fraxinus americana*; birch, *Betula* sp.; slippery elm, *Ulmus rubra*; hemlock, *Tsuga canadensis*) lines the tops of the retaining walls. These trees extend out over the stream and provide approximately 90% canopy cover. The understory and riparian

zone beyond this single line of trees is maintained lawn. Beyond the lawn along the right bank is a road, offering an obvious potential source of NPS pollution (e.g., sand), as does the Prentice Place crossing. YB01C received a total habitat assessment score of 140/200 (Table A5). This was the second lowest evaluation for the entire Westfield River watershed survey. Riparian disturbances and instream sediment deposition were most responsible for the low overall score.

*Benthos*

Despite a degraded habitat in terms of riparian quality (and to a lesser extent, sediment deposition), the macroinvertebrate assemblage at YB01C received a total metric score of 42, representing 100% comparability to the upstream reference station (Table A3 and A4). Metric values for Taxa Richness, EPT Index, and EPT/Chironomidae not only outperformed those for the reference station, but they also outperformed all other biomonitoring stations in the 2001 survey (Table A2-A4). In addition, a Biotic Index of 3.27 (second lowest in the entire survey) and a Percent Dominant Taxon metric value of 10% (lowest in the entire survey) indicate an extremely well balanced community dominated by highly sensitive taxa.

As was the case at YB01B, the presence of upstream dam(s) does not appear to negatively impact macroinvertebrate community health in this portion of the stream. Rather, sediment inputs—probably originating from upstream and adjacent roads—may pose the greatest threat to future biological potential at YB01C. The effects of runoff may be exacerbated by the removal of an adequate riparian buffer in this lower portion of Yokum Brook.

*Fish*

One hundred eighty-seven fish were collected at this station. The dominant species collected was blacknose dace (n=60). The sub-dominant species collected was slimy sculpin (*Cottus cognatus*, n=52). These two species accounted for 60% of the specimens collected at this station. The majority (55%) of the species collected at this station were fluvial specialists. This stands in contrast to the fluvial dependents that dominated YB01A and YB01B. It is possible that the species collected at YB01C are more representative of species present in the West Branch of the Westfield River. It appears that flow regimes at this station are capable of supporting species requiring lotic conditions for all stages of their life cycle. It is possible that the slimy sculpin are immigrants from the West Branch of the Westfield River, as this was the only station in Yokum Brook at which they were encountered. The majority (51%) of fish collected at this station are classified as benthic insectivores. The abundance of slimy sculpin (n=52) collected at this station accounts for the dominance of benthic insectivores at this station. This station seems capable of supporting a community dominated by cold-water benthic insectivores.

The fish communities examined at the upstream Yokum Brook biomonitoring stations (YB01A and YB01B) appeared different from the downstream biomonitoring station (YB01C). Yellow perch were present in the specimens collected at both YB01A and YB01B, but were absent from YB01C. This lacustrine species may be emigrating from upstream impoundments (Buckley-Dunton Lake, Yokum Pond, Rudd Pond), or may be residing in the limited pools behind the dams. Creek chub were also collected at both upstream stations, but absent form the downstream station. In addition, many more stocked juvenile Atlantic salmon were collected at upstream stations than were at YB01C. Conversely, slimy sculpin (an indicator of a cold-water fishery) were present at YB01C, but not at either upstream station. It appears that the differences observed in the fish population at YB01C and the upstream stations YB01A/YB01B are related to the unrestricted access to YB01C by the fish residing in the West Branch of the Westfield River.

***West Branch Walker Brook***

The West Branch Walker Brook begins at an unnamed pond near Woodchuck Road in Becket, MA. The stream flows approximately 0.77 km, then receives the flow from a small unnamed stream. The West Branch continues its southerly course through a heavily forested, mid-gradient landscape and crosses under Route 8/20 approximately 2 km from its source. On the south side of Route 8/20, the stream enters the Robin Hood Lake residential development and a series of ponds—the largest of these waterbodies

being Robin Hood Lake. From the outlet of Robin Hood Lake, the West Branch Walker Brook flows north then east, through two unnamed ponds before merging with Walker Brook just east of Bonny Rigg Corners. This stream is second-order to its confluence with Walker Brook.

It was originally planned to perform biological sampling at two locations on the West Branch Walker Brook. One station was to be near the bridge crossing on Goldfinch Road (upstream of Route 8/20 and Robin Hood Lake). However, upon arrival during the biological sampling period, the streambed here was dry. The second (lower) station (near Porcupine Road) did contain enough water for sampling activities. This lower station (WB01) receives the flow from approximately 90% of the entire West Branch Walker Brook subwatershed.

**WB01**—West Branch Walker Brook, mile point 5.5 (8.9 km), near Porcupine Road and downstream from Robin Hood Lake, Becket, MA

*Habitat*

The WB01 sampling reach was located approximately midway between the outlet of Robin Hood Lake and Bonnie Rigg Hill Road in Becket. The contributing subwatershed was heavily affected by drought—the portion of Walker Brook that flows into Robin Hood Lake was dry during the week of the biomonitoring survey. These drought conditions also had an obvious affect downstream from Robin Hood Lake in the WB01 sampling reach. Baseflow was extremely low here, with water filling only about half the available 3 m wide channel and leaving bottom substrates mostly exposed. Despite the shallow nature of this portion of the stream, those rocky substrates that remained submerged provided good epifaunal habitat in the numerous, albeit shallow (0.1 – 0.2 m), riffle areas. Additional benthic microhabitat was provided by mosses, although deposits of fine organic matter coated much of these and other instream substrates. Other types of aquatic vegetation and algae were absent, which is not surprising given the completely closed (100% shaded) canopy cover. The low baseflow here probably impacted fish habitat more than benthos habitat, as much of the potential fish cover (snags and woody debris, undercut banks) at WB01 was exposed and unavailable. Those pool areas present contained shallow (0.3 m), isolated pockets of water. Both stream banks were well vegetated with mosses and ferns, and despite their steepness (especially along the east bank) banks were stabilized with boulder, dense moss cover, and root mats. Hemlocks (*Tsuga canadensis*) dominated the riparian zone at this station and provided extensive shading of the sampling reach. Other vegetation (hardwoods) contributing to the wide and undisturbed riparian zone included maple (*Acer* spp.), birch (*Betula* sp.), and beech (*Fagus* sp.). With the exception of a few ferns, there was virtually no understory, as is typical of most hemlock forests. Obvious signs of NPS pollution (other than the aforementioned FPOM deposits) were absent, although turbidity in the water column was observed.

WB01 received a total habitat assessment score of 165/200 (Table A5). Increased flow here would have resulted in a considerably better evaluation of instream habitat quality.

*Benthos*

The WB01 benthic community received a total metric score of 32, representing 76% comparability to the watershed reference station (YB01A) and resulting in a bioassessment of “slightly impacted” (Table A3). While overall taxa richness remained high here, the conspicuous loss of taxa sensitive to organic pollution resulted in a low scoring EPT Index and an elevated Biotic Index relative to reference conditions. Robin Hood Lake, located immediately upstream from WB01 and subjected to heavy shorefront development (both seasonal and year-round homes are numerous here), may contribute the organic loads that appear to shape benthic community composition at WB01. The effects of organic enrichment (e.g., FPOM deposits, instream turbidity, high Biotic Index) or other water quality effects observed at WB01 may be exacerbated by reduced baseflow here and the resulting reduced assimilative capacity of this small stream. In addition, instream habitat constraints related to low baseflow (e.g., poor channel flow status and resulting substrate exposure) observed in this portion of the stream may compromise biological integrity at WB01. Decreasing discharge and the subsequent elimination of epifaunal habitat may contribute—at least partially—to the reductions in EPT taxa here, as many of these organisms are

particularly susceptible to substrate exposure and stranding (Minshall 1984). Additionally, the dominance of *Micropsectra* sp. among the chironomid constituency may corroborate the presence of low flow effects at WB01, as this taxon has been known to predominate in streams subjected to periods of reduced flow (Fiorentino 2000 and 1999; Bode, NY DEC, personal communication 1998).

*Fish*

One hundred nine fish were collected at this station (Table A6). Blacknose dace dominated the sampled population (n=85). The sub-dominant species collected was white sucker (*Catostomus commersoni*, n=21). These two species accounted for 98% of the specimens collected. Both of these species are tolerant, cool-water species. There was only one cold-water species (eastern brook trout) collected at this station. Although the rather high gradient, rocky substrates, and extensive canopy cover point towards a cold-water regime, the proximal (upstream) Robin Hood Lake supplied this reach with warm water. This relatively shallow impoundment also allowed the migration of pond species not readily encountered in a stream habitat (largemouth bass, *Micropterus salmoides*; yellow perch, *Perca flavescens*).

***Powdermill Brook***

Powdermill Brook begins at an unnamed stream just east of Pitcher Road in Montgomery MA, and soon parallels Montgomery Road. The stream is high-gradient for its first 2.7 km with an elevational drop of 157 meters (approximately 17 meters per kilometer). The stream receives the flow from an unnamed first-order stream, in a heavily forested portion of the subwatershed, during this first 2.7 km. After this point, Powdermill Brook leaves the southern tip of Grindstone Mountain and enters the Westfield River Valley near West Farms. Here, the high-gradient nature of the brook is replaced by a low-gradient disposition, with increasing meanders. The surrounding riparian zone changes as well—from heavily forested to abutting pastures and agricultural (and residential) land use. After receiving the flow from an unnamed first-order stream, Powdermill Brook continues through agricultural lands, flows under the Massachusetts Turnpike, and receives the flow from Fuller Reservation Pond at approximately eight km from its headwaters. The stream meanders behind the Westfield Regional High School, then flows through a discontinued flood control dike before reaching the Conrail railroad tracks. Powdermill Brook then receives the discharge from Arm Brook below the Conrail tracks. Below this confluence, the riparian land use changes again, and the agricultural lands are replaced by urbanized and dense residential and commercial zones. About 0.8 km from the Conrail tracks, Powdermill Brook crosses under Route 10/202, and parallels the Westfield River as it flows easterly. The stream then receives the flow from Pond Brook 2.4 km from Route 10/202. At 1.4 km from the confluence with Pond Brook, Powdermill Brook forms a delta (known as Frog Hole) as it empties into the Westfield River. The entire Powdermill Brook watershed measures 49.5 $km^2$.

**PB00**—Powdermill Brook, mile point 3.8 (6.1 km), downstream from Interstate 90, behind Westfield High School, Westfield, MA

*Habitat*

The PB00 biomonitoring station was approximately 800 m downstream from Interstate 90, and was accessed via the parking lot behind the Westfield High School. Land use in the immediate area of the sampling station was forest, which provided a mostly (60% shaded) closed canopy over the meandering reach. Stream width was 3 – 4 m and depth ranged from 0.2 m in the riffle and run areas to 0.3 in the deepest pools. While macroinvertebrate sampling was confined to cobble-dominated riffle areas, the majority of the substrates in the sampling reach were sand. As a result, epifaunal habitat was considered less than optimal. Fish habitat was also suboptimal, with snags and anthropogenic debris providing most of the stable cover. Trash was scattered throughout the reach, but was especially concentrated along the steep left (south) bank in the form of scrap metal and a mostly-intact automobile. Instream sedimentation was substantial throughout the PB00 sampling reach, contributing to the lowest scoring parameters for embeddedness and sediment deposition in the entire survey (Table A5). Potential sources of sedimentation are numerous and include highway (I-90) runoff, a sand and gravel operation adjacent to

the right (north) bank of the PB00 reach, and agricultural (livestock) runoff (streambank erosion and inadequate riparian buffer) at the Russellville Road crossing about 1.5 km upstream. Green algae (filamentous and matted forms) covered approximately 40% of the streambed in the reach and were especially dense on both the rocky and sandy surfaces of the pool areas. Grasses, vines (riverbank grape, *Vitis riparia*), and various herbaceous floodplain vegetation provided fairly good bank vegetative protection on both sides of the stream, though less so along the left (south) bank which was vulnerable to erosion due to its steepness and the aforementioned trash. Riparian vegetative zone width was optimal—the adjacent sand/gravel operation (right bank) and high school property (left bank) appeared fairly well buffered with a dense layer of mixed hardwoods (cottonwood, *Populus deltoides*; red maple, *Acer rubrum*; white ash, *Fraxinus americana*; slippery elm, *Ulmus rubra*; red oak, *Quercus rubra*; birch, *Betula* sp.; hop hornbeam, *Ostrya virginiana*).

PB00 received a total habitat assessment score of 138/200—the lowest score in the entire Westfield River watershed survey. While extremely reduced scores for embeddedness and sediment deposition parameters were major determinants of the low habitat assessment here, bank instability and habitat degradation related to reduced baseflow also contributed to the poor habitat evaluation.

*Benthos*

The PB00 macroinvertebrate community received a total metric score of 32, representing 76% comparability to the reference station at Yokum Brook and resulting in an assessment of "slightly impacted" for biological condition (Table A3). Most notable among PB00 metrics were low scoring EPT Index and EPT/Chironomidae values (Table A3), a result of low densities of EPT taxa relative to other tributary stations sampled.

While water quality factors cannot be completely ruled out, the sediment inputs responsible for instream habitat degradation at PB00 most certainly compromise biological potential here, at least for resident macroinvertebrate populations. A recent study by Zweig and Rabeni (2001) found EPT density and EPT richness to be significantly negatively correlated with deposited sediment. As noted above, EPT richness was reduced at PB00 during the 2001 biosurvey.

*Fish*

One hundred eighty-three fish were collected at this station. Slimy sculpin (*Cottus cognatus*) dominated the sampled population (n=100). The second most dominant species collected was eastern brook trout (n= 75). These two species accounted for more than 95% of the specimens sampled. Both species prefer cold water and are known to be "intolerant" of eutrophication and increased temperatures. Their presence in such numbers alludes to a healthy, cold-water fish population at this station. In addition, the presence of numerous pollution sensitive forms among the PB00 fish assemblage suggests that it is habitat quality rather than water quality that is most responsible for the impacts observed in the benthic community here.

## SUMMARY AND RECOMMENDATIONS

Reference-quality biomonitoring stations in both the upper Westfield River and Yokum Brook continue to support the diverse and well-balanced aquatic communities expected in a "least-impacted" stream system. In addition, three Westfield River watershed biomonitoring study stations were found to be non-impacted and six stations were considered slightly impacted relative to reference conditions. One station was considered moderately impacted compared to its watershed reference station. Impacts to resident biota were generally a result of habitat degradation (especially sedimentation and flow-related habitat constraints) and/or nonpoint source-related water quality impairment, with point source effects observed as well.

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 WR01, WR05, WR06A, WR06B, LR02A, LR02B, YB01A, YB01B, YB01C, PB00, and WB01 *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). The moderately impacted (*impaired*) aquatic community observed at LR02C does not support the *Aquatic Life* use and fails to meet the goals of the CWA.

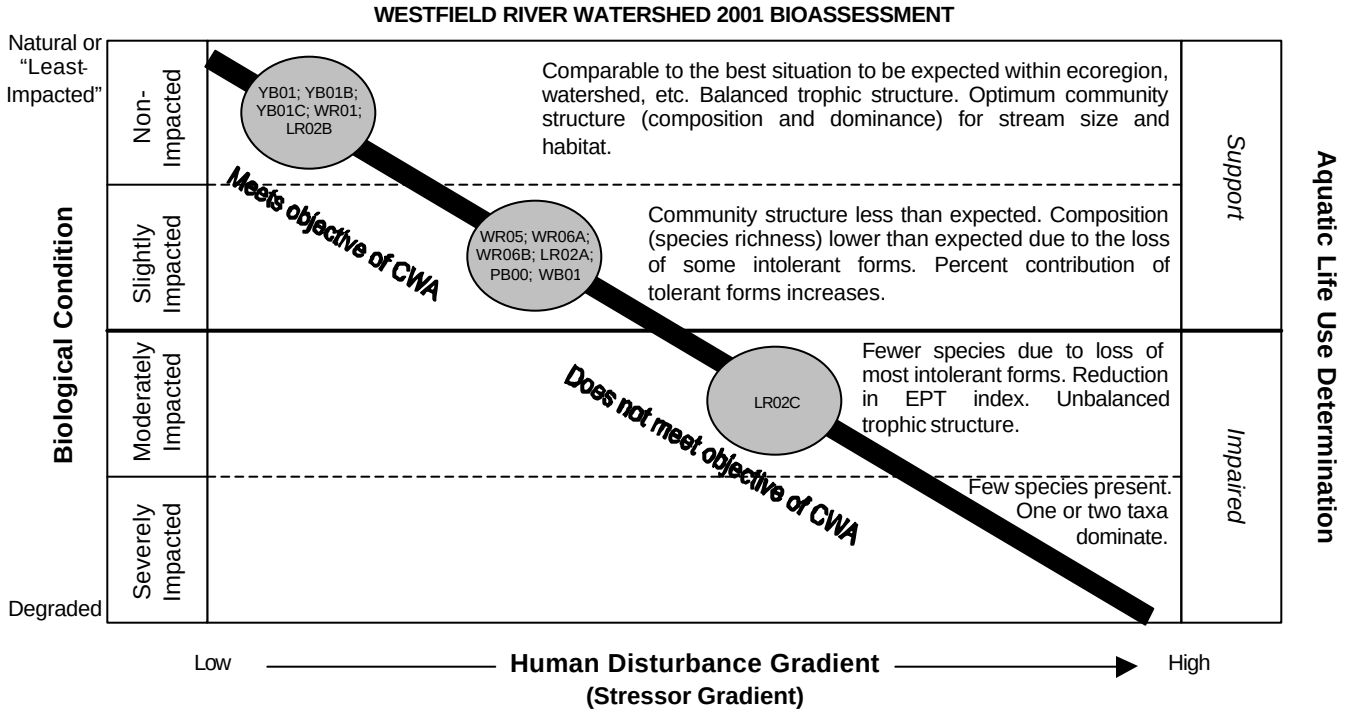


**Figure 5.** Schematic of the predictive response of aquatic communities to increasing human disturbance. Included is the performance (Biological Condition and Aquatic Life Use determinations) of the Westfield River watershed 2001 biomonitoring stations along the Human Disturbance Gradient.

***Westfield River***

**WR01** - downstream from Knightville Dam, off Rocky Hill Road near Route 112, Huntington, MA
**Biota**: Watershed reference for study stations in high-order streams.
**Habitat**: Watershed reference for study stations in high-order streams.

The WR01 benthic community was thought to represent the "best attainable" conditions in the watershed with respect to biological integrity, habitat quality, and water quality. Fish community composition appeared structured in response to drought conditions and/or the impounded nature of the river upstream from WR01. As a reference condition, biomonitoring is recommended here during the next MA DEP Westfield River watershed survey in 2006, especially if evaluations of third to fifth-order stream biota are again planned. Fish population sampling should again accompany the macroinvertebrate sampling effort, although to more efficiently sample the WR01 reach, use of multiple backpack electrofishing units or a barge-mounted electrofisher should be utilized. In addition, water quality monitoring here would help to establish baseline conditions while supplementing the biological data. To maintain the biological integrity of the upper Westfield River, every effort should be made to properly manage land development in this relatively "pristine" portion of the watershed.

**WR05** - 250 m downstream from Strathmore Paper Company discharge (inactive), Russell, MA
**Biota**: "Slightly impacted" compared to reference station (WR01)
**Habitat**: 100% comparable to reference station (WR01)

The slightly impacted benthic community observed at WR05 was dramatically improved from the severely impaired assemblage documented by DEP in 1996 (Szal 1998). Improvements in water quality and biological integrity in this portion of the river are probably the direct result of the removal of the Strathmore wastewater discharge. Current impacts to the macroinvertebrate community appear related to water quality factors associated with organic enrichment. Upstream impoundments, urban runoff, and treated wastewater (Russell WWTP), may provide the organic inputs that support the filter-feeder dominated benthos assemblage found at WR05.

Macroinvertebrate biomonitoring is recommended here during the next DEP Westfield River watershed survey in 2006. Fish population sampling, using multiple crews (i.e., two backpack electrofishers) or a barge-mounted electrofishing unit due to the wide nature of the WR05 reach, should accompany the macroinvertebrate sampling effort. In addition, water quality monitoring may help to determine the type(s) of water quality degradation present here.

**WR06B -** opposite the Westfield WWTP discharge (i.e., outside and "upstream" of the effluent plume), Westfield MA
**Biota**: "Slightly impacted" compared to reference station (WR01)
**Habitat**: 90% comparable to reference station (WR01)

Impairment of the benthic community at WR06B probably results from a combination of habitat quality and water quality degradation associated with the highly urbanized nature of this portion of the watershed. While it may be difficult to eliminate or isolate some sources of urban runoff (stormwater, parking lot runoff, riparian disturbances) that threaten habitat and biological quality at WR06B, streambank stabilization and restoration of an adequate riparian buffer along the right (south) bank may help to alleviate the effects of some nonpoint source inputs to this portion of the river.

Macroinvertebrate biomonitoring is recommended here during the next DEP Westfield River watershed survey in 2006, especially if WR06B is to again be used as an upstream control station in the assessment of discharge impacts to biota downstream from the Westfield WWTP. Fish population sampling, which has not historically been performed by DEP in the lower Westfield River, should accompany the macroinvertebrate sampling effort. Due to the wide nature of the WR06B sampling reach, the fish population survey may require multiple crews or a barge-mounted electrofishing unit. In addition, water quality monitoring may help to determine the type(s) of water quality degradation present here.

**WR06A -** 340 m downstream from Westfield WWTP discharge, Westfield, MA
**Biota:** "Slightly impacted" compared to watershed reference station (WR01) and upstream reference station (WR06B)
**Habitat**: 91% comparable to watershed reference station (WR01); 100% comparable to upstream reference station (WR06B)

Generally good habitat quality here suggests that impacts to the resident biota are a result of water quality degradation. That habitat quality was highly comparable to conditions documented at the nearby upstream reference station implies that the midge-dominated, slightly impacted benthic community observed at WR06A is strongly influenced by wastewater discharge effects. Other observations here—most notably, dense algal cover, presence of sewage fungus, and instream turbidity—corroborate effluent-related water quality degradation in this portion of the Westfield River.

In light of the anticipated discharge increases presently proposed for the Westfield WWTP, biomonitoring is recommended here during the next DEP Westfield River watershed survey in 2006. Fish population sampling, which has not historically been performed by DEP in the lower Westfield River, should accompany the macroinvertebrate sampling effort. Due to the wide nature of the WR06B sampling reach, the fish population survey may require multiple crews or a barge-mounted electrofishing unit. As water quality appears to limit biological integrity in this portion of the Westfield River, additional monitoring of various physico-chemical parameters in 2006 would be instrumental in determining the specific types of water quality degradation present here. In addition, a NPDES permit review is recommended for the Westfield WWTP. The MA DEP may wish to consider new modifications to the facility's permit (including a reevaluation of proposed nutrient limits) prior to its upcoming reissuance.

***Little River***

**LR02A** - downstream from Cobble Mountain Reservoir, immediately below Pitcher Brook, Russell, MA
**Biota**: "Slightly-impacted" compared to reference station (WR01)
**Habitat**: 100% comparable to reference station (WR01)

The high densities of pollution sensitive non-EPT taxa in the LR02A benthos assemblage suggest that habitat constraints rather than water quality limit biological potential in this portion of the Little River. The diversion of water from the reservoir outlet to the power generating station further downstream has the potential to impact instream habitat and resident biota at LR02A. Current impacts may be exacerbated by the drought conditions observed during the 2001 biosurvey. The potential for habitat here to support healthy benthic and fish populations corroborates the importance of maintaining minimum baseflow in the upper Little River.

Biomonitoring and instream flow measurements are recommended here during the next DEP Westfield River watershed survey in 2006 to establish baseline biological and hydrological conditions during non-drought periods. Biomonitoring should again be limited to the sampling of macroinvertebrates, as the remoteness of this station precludes the ability to safely utilize standard electrofishing gear.

**LR02B** - 20 m upstream from Cook Brook, Russell, MA
**Biota**: "Non-impacted" compared to reference station (WR01)
**Habitat**: 84% comparable to reference station (WR01)

While low baseflow clearly compromised habitat quality at LR02B, these effects were not reflected in the resident fish or benthic community during the time of the biosurvey. The potential for habitat here to support healthy benthic and fish populations illustrates the need to maintain minimal baseflow in this portion of the Little River.

As an upstream reference station, biomonitoring (fish, periphyton, and macroinvertebrates) is recommended here during the next DEP Westfield River watershed survey in 2006 to continue to assess potential impacts (or remediation-based improvements associated with the West Parish Filtration Plant)

originating from Cook Brook. Water quality monitoring (especially nutrient sampling) is also recommended at LR02B during the next Westfield River watershed survey, as the dense algal cover observed here suggests nitrogen and/or phosphorus loading to this portion of the Little River.

**LR02C** - 100 m downstream from Cook Brook, Russell, MA
**Biota**: "Moderately impacted" compared to watershed reference station (WR01); "Slightly impacted" compared to upstream reference station (LR02B)
**Habitat**: 85% comparable to watershed reference station (WR01); 100% comparable to upstream reference station (LR02B)

This was the most impaired biomonitoring station in the 2001 Westfield River watershed survey in terms of aquatic health. That impacts to the resident benthos were pronounced when compared to the upstream reference station, coupled with the fact that habitat quality was similar at LR02B and LR02C, strongly suggests that Cook Brook is the source of water quality degradation here. Sediment deposition in particular appears to pose the greatest threat to fish, and especially, benthic communities in this portion of the river—instream sedimentation was substantial throughout the LR02C sampling reach, and densities of macroinvertebrate taxa most-susceptible to sediment loads were greatly reduced. In addition, the effects of sedimentation may be more pronounced due to epifaunal habitat already compromised by reductions (anthropogenic and/or naturally occurring) in baseflow. A review of the filtration bed maintenance activities conducted by the West Parish Filtration Plant is highly recommended, as is the consideration of an appropriate Best Management Practice (BMP) at that facility.

Biomonitoring (fish, periphyton, and macroinvertebrates) is recommended here during the next DEP Westfield River watershed survey in 2006 to continue to assess potential impacts originating from Cook Brook, or to document biological status following remediation efforts (i.e., implementation of BMPs) by the West Parish Filtration Plant. DEP should consider conducting biomonitoring in Cook Brook itself, as this stream is no doubt more vulnerable to sedimentation effects than the Little River due to its small size (first-order) and inherently limited assimilative capacity.

***Yokum Brook***

**YB01A** - 50 m upstream from upper dam, downstream from Route 8, Becket, MA
**Biota**: Watershed reference for study stations in low-order streams.
**Habitat**: Watershed reference for study stations in low-order streams.

Despite a reduction in baseflow and the resulting limitations to instream habitat, YB01A was thought to represent the "best attainable" conditions in the watershed with respect to biological integrity, habitat quality, and water quality. As a reference condition for lower-order tributary stations, and as an upstream control for post dam-removal investigations of Yokum Brook, biomonitoring is recommended here during the next MA DEP Westfield River watershed survey in 2006. Fish population sampling should accompany the macroinvertebrate sampling effort. In addition, water quality monitoring here would help to establish baseline reference conditions while supplementing the biological data.

**YB01B -** 100 m upstream from Prentice Place, Becket, MA; **YB01C -** immediately upstream from confluence with the West Branch Westfield River, Becket, MA
**Biota**: "Non-impacted" compared to reference station (YB01A)
**Habitat**: 100%; 93% comparable to reference station (YB01A)

Despite the presence of dams immediately upstream from their respective sampling reaches, and low baseflows due to drought conditions, benthic communities at YB01B and YB01C were extremely diverse and well-balanced in terms of trophic structure. Sediment inputs do threaten biological potential at YB01C, however. An investigation into the source of sediment loads (sand deposition) observed at YB01C is recommended, as is the possibility of implementing BMPs at upstream road crossings or other impervious surfaces adjacent to the sampling reach. In addition, the restoration of an adequate riparian

buffer along the left (west) bank of both the YB01C and YB01B biomonitoring stations would help to minimize the potential for runoff and other NPS pollution inputs. Environmentally sensitive lawn maintenance practices are recommended here as well.

The Becket dams did influence ichthyofaunal community composition, mostly due to impediments to fish passageway. The fish community observed at YB01C, which was afforded unrestricted access to the West Branch of the Westfield River, appeared different from YB01A and YB01B, which were located behind the dams. Native, cold-water fish species and fluvial specialists were more numerous at YB01C than both upstream stations, while warm-water (pond species) species and habitat/feeding generalists were observed at YB01A and YB01C but not at the mouth.

Biomonitoring is recommended at YB01B and YB01C during the next MA DEP Westfield River watershed survey in 2006 to document changes in the biota here following the removal of both dams. Fish population sampling should be made a higher priority than macroinvertebrate sampling in this portion of Yokum Brook during future biosurveys.

### *West Branch Walker Brook*

**WB01 -** near Porcupine Road and downstream from Robin Hood Lake, Becket, MA
**Biota**: "Slightly impacted" compared to reference station (YB01A)
**Habitat**: 100% comparable to reference station (YB01A)

Impoundment effects strongly influence benthic and fish community composition in this portion of the West Branch Walker Brook. Robin Hood Lake, located immediately upstream from WB01 and subjected to heavy shorefront development (both seasonal and year-round homes are numerous here) may contribute the nutrient/organic loads that appear to shape benthic community composition and function at WB01. In addition, the effects of organic enrichment (e.g., FPOM deposits, instream turbidity, high Biotic Index) or other water quality effects (e.g., temperature increases and the displacement of cold-water fish with warm-water, pond species) observed at WB01 may have been exacerbated by reduced baseflow conditions during the 2001 biosurvey.

Potentially-failing septic systems should be inspected and/or tested (e.g., dye testing) to evaluate the potential for impacts to Robin Hood Lake. In addition, lake-abutting homeowners should be educated about low-impact landscaping options, the importance of maintaining a riparian buffer, and use of environmentally sensitive lawn care products (e.g., slow releasing fertilizers)—all of which would help to minimize the potential for nonpoint source pollution inputs to the lake. To determine the specific types of water quality degradation that may impact Robin Hood Lake and downstream lotic communities, DEP should consider additional water quality monitoring (nutrients, bacteria, dissolved oxygen, etc.) upstream and downstream from Robin Hood Lake, and in the lake itself (baseline lake survey and estimate of trophic status), as part of future watershed surveys.

### *Powdermill Brook*

**PB00** - downstream from Interstate 90, behind Westfield High School, Westfield, MA
**Biota**: "Slightly impacted" compared to reference station (YB01A)
**Habitat**: 91% comparable to reference station (YB01A)

PB00 received the lowest habitat assessment of any biomonitoring station in the 2001 survey. The sediment inputs responsible for instream habitat degradation at PB00 most certainly compromise biological potential here, at least for resident macroinvertebrate populations which are highly vulnerable to instream sedimentation. The fish community appeared relatively unaffected by the habitat constraints documented by DEP. The presence of numerous pollution sensitive forms (e.g., eastern brook trout, slimy sculpin) among the PB00 fish assemblage suggests that it is indeed habitat quality rather than water quality that is most responsible for the impacts observed in the resident biota (i.e., macroinvertebrates) here.

Potential sources of sediment loadings are numerous and include highway (I-90) runoff, a sand and gravel operation adjacent to the right (north) bank of the PB00 reach, and agricultural (livestock) runoff (streambank erosion and inadequate riparian buffer) at the Russellville Road crossing about 1.5 km upstream. An investigation into the need for BMPs at these or other potential nonpoint sources is strongly recommended. In addition, a stream clean-up—perhaps by students at the adjacent high school—would greatly improve the aesthetics of this portion of Powdermill Brook, as well as aid in the stabilization of the vulnerable and eroding right bank. The City of Westfield may wish to look into the possibility of removing the abandoned automobile located on the steep right bank of the PB00 sampling reach.

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## APPENDIX

### Macroinvertebrate and Fish Taxa Lists, Benthos Data Analysis, and Habitat Assessments

Table A1. Species-level taxa list and counts, functional feeding groups (FG), and tolerance values (TV) for macroinvertebrates collected from stream sites during the 2001 Westfield River watershed survey between 4 and 6 September 2001. Refer to Table 1 for a complete listing and description of sampling stations.

| TAXON | FG [1] | TV [2] | PB00 | LR02C | LR02B | LR02A | YB01C | YB01B | YB01A [3] | YB01A (dup) [4] | WB01 | WR05 | WR01 [3] | WR06A | WR06B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ferrissia* sp. | SC | 6 | 1 | | | | | | | | | 2 | | | 2 |
| Pisidiidae | FC | 6 | | | | | 1 | | | | 7 | | | | |
| Enchytraeidae | GC | 10 | | | | | 1 | | 1 | | | | | | |
| *Nais behningi* | GC | 6 | 1 | | | | 1 | | | 1 | | | | | |
| *Nais communis* | GC | 8 | | | | | | 2 | | | | | | | |
| *Pristinella jenkinae* | GC | 10 | | | | 1 | | | | | | | | | |
| *Slavina appendiculata* | GC | 6 | | | | | | | | | | | | 2 | |
| Tubificidae | GC | 10 | | | | | | | | | 1 | | | | |
| Lumbriculidae | GC | 7 | 2 | | | | | 1 | | | | | 2 | | 1 |
| Hydrachnidia | PR | 6 | 1 | | 1 | 1 | | | 1 | 2 | | | | | |
| Baetidae | GC | 4 | | | | | 2 | | | | | | 4 | | 1 |
| *Baetis* sp. (cerci only) | GC | 6 | | | | | 3 | | 2 | | | | 3 | | |
| *Baetis* sp. (short terminal filament) | GC | 6 | | | | | | | | | | | 1 | | |
| *Baetis* sp. (subequal terminal filaments) | GC | 6 | 1 | | | | 1 | | | | | | 4 | | |
| Baetidae (cerci only) | GC | 6 | 2 | 1 | | | | 1 | | 4 | | 9 | | | |
| Baetidae (subequal terminal filaments) | GC | 6 | | 7 | | | | 6 | | | 1 | 1 | | | 1 |
| Ephemerellidae | GC | 1 | 1 | | 6 | 3 | 1 | | | | 1 | 1 | | 1 | 3 |
| *Serratella* sp. | GC | 2 | | 7 | | | | 4 | 7 | 5 | | | | | |
| Heptageniidae | SC | 4 | | | | | | 4 | | | | 12 | 8 | | |
| *Epeorus* sp. | SC | 0 | | | | | 7 | 1 | 13 | 9 | 1 | | 3 | | |
| *Leucrocuta* sp. | SC | 1 | | | | | | | | | | | 1 | | |
| *Rhithrogena* sp. | GC | 0 | | | | | 2 | 3 | 1 | 1 | | | | | |
| *Stenonema* sp. | SC | 3 | | | 11 | 3 | 4 | 1 | | | 1 | | 1 | 6 | 9 |
| *Isonychia* sp. | GC | 2 | | | 4 | | 4 | | | 6 | | 2 | 9 | 1 | 3 |
| Leptophlebiidae | GC | 2 | 3 | | | 2 | 6 | 4 | | | | | 2 | | |
| *Paraleptophlebia* sp. | GC | 1 | | | | | | | 7 | | 6 | | | | |
| Gomphidae | PR | 5 | | | | | | | 1 | | | | | | |
| Chloroperlidae | PR | 1 | | | | 1 | | | | | | | | | |
| *Sweltsa* sp. | PR | 0 | | | | | 3 | | 1 | | | | | | |
| Leuctridae | SH | 0 | | | | | 4 | | | | | | | | |
| *Leuctra* sp. | SH | 0 | 1 | 2 | 2 | 1 | | | | | | | | | |
| Leuctridae/Capniidae | SH | 2 | | | | 7 | | 1 | 4 | | 4 | | | | |
| *Tallaperla* sp. | SH | 0 | | | | | 1 | | | | | | | | 1 |
| Perlidae | PR | 1 | | | | 1 | | | | | 1 | | | | |
| *Acroneuria* sp. | PR | 0 | | | | | 1 | | 1 | | 2 | | 1 | | |
| *Agnetina* sp. | PR | 2 | | | | | | 2 | | | | | | | |
| *Beloneuria* sp. | PR | 0 | 1 | | | | | | | | | | | | |
| *Neoperla* sp. | PR | 3 | | | 1 | | 3 | | 2 | 3 | | | 1 | | |
| *Paragnetina* sp. | PR | 1 | | | 1 | | 1 | | | 1 | | | 2 | | 1 |
| Perlodidae | PR | 2 | | | 1 | | | 3 | 2 | 3 | | | | | |
| *Corydalus* sp. | PR | 4 | | | | | | | | | | | 5 | | |
| *Nigronia* sp. | PR | 0 | | | | 1 | | | 1 | | 1 | | | | |
| *Micrasema* sp. | SH | 2 | | 1 | | | | 1 | | | | | | | |

Table A1 (cont.)

| TAXON | FG [1] | TV [2] | PB00 | LR02C | LR02B | LR02A | YB01C | YB01B | YB01A [3] | YB01A (dup) [4] | WB01 | WR05 | WR01 [3] | WR06A | WR06B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Glossosoma* sp. | SC | 0 | | 1 | | | | 1 | 1 | 1 | | | | | |
| *Protoptila* sp. | SC | 1 | | | | | | | | | | 2 | | | |
| *Helicopsyche borealis* | SC | 3 | | | | | 1 | | | | | | | | |
| *Cheumatopsyche* sp. | FC | 5 | 2 | | 14 | 9 | 2 | | | 4 | 5 | 1 | 2 | 10 | 16 |
| *Hydropsyche* sp. | FC | 4 | | | | 2 | | 8 | | | | | | | |
| *Hydropsyche morosa* gr. | FC | 6 | 10 | 29 | 8 | | 10 | | 7 | 6 | 2 | 20 | 9 | 16 | 12 |
| *Macrostemum zebratum* | FC | 3 | | | | | | | | | | 3 | | | 1 |
| *Hydroptila* sp. | GC | 6 | | | 3 | | | | | | | | | | |
| Lepidostomatidae | SH | 1 | | | | | | | | | | | 1 | | |
| *Lepidostoma* sp. | SH | 1 | 1 | | 3 | 4 | 4 | | 1 | 1 | 1 | 1 | 1 | | |
| Limnephilidae | SH | 4 | | | | | | | 2 | 1 | | | | | |
| *Psilotreta* sp. | SC | 0 | | | | 2 | | | | | | | | | |
| *Chimarra* sp. | FC | 4 | | | 1 | | | | | | 10 | 35 | 23 | | 2 |
| *Dolophilodes* sp. | FC | 0 | 9 | 16 | 7 | 5 | 6 | 2 | 5 | 8 | | | | | |
| *Neureclipsis* sp. | FC | 7 | | | | | | | | | | 1 | | | 1 |
| *Rhyacophila* sp. | PR | 1 | 2 | 2 | | | 4 | 4 | 4 | 2 | | | 1 | | |
| Elmidae | SC | 4 | 1 | | | | | | | | | | | | |
| *Optioservus* sp. | SC | 4 | | | | | | | | 1 | | | | | 3 |
| *Optioservus ampliatus* | SC | 4 | 7 | | | | | | | | | | | | |
| *Optioservus trivittatus* | SC | 4 | | 1 | | | | | | | | | 1 | 1 | |
| *Oulimnius latiusculus* | SC | 4 | 10 | 1 | | | 6 | 2 | | | 2 | 1 | 1 | 3 | 1 |
| *Promoresia* sp. | SC | 2 | | | | | | | 1 | 1 | 1 | | | | |
| *Promoresia tardella* | SC | 2 | 6 | | | 18 | | 15 | | | | | | | |
| *Stenelmis* sp. | SC | 5 | | | 2 | | 1 | 1 | 1 | | 11 | 10 | 7 | 14 | 9 |
| *Psephenus herricki* | SC | 4 | | | 3 | | 1 | 1 | 3 | | 1 | | 1 | | 2 |
| Ceratopogonidae | PR | 6 | 1 | | | | | | | | | | | | |
| *Probezzia* sp. | PR | 6 | | | | | 1 | | | | | | 1 | | |
| Chironomidae | GC | 6 | 10 | 2 | 2 | 9 | 3 | 4 | 2 | 4 | 6 | | 1 | 2 | 3 |
| Chironominae | GC | 6 | | | 1 | | | | | | | | | | |
| *Microtendipes pedellus* gr. | FC | 6 | | | | | | | 1 | | 1 | | | 1 | |
| *Microtendipes rydalensis* gr. | FC | 6 | | | | | 1 | 1 | | | 1 | | | 3 | |
| *Nilothauma* sp. | GC | 6 | | | | | | | | | | | | 2 | |
| *Phaenopsectra* sp. | SC | 7 | | | | | | | | | 1 | | | | |
| *Polypedilum aviceps* | SH | 4 | 2 | 2 | 10 | | 1 | 2 | 11 | 2 | 2 | | | | |
| *Polypedilum flavum* | SH | 6 | | | | | | | 1 | 1 | | | 1 | 8 | 2 |
| *Polypedilum illinoense* | SH | 6 | | | | | | | | | | | | 1 | |
| *Polypedilum tritum* | SH | 6 | | | | | 1 | | | 1 | 1 | | | | |
| *Cladotanytarsus* sp. | FC | 5 | | | | | | | | 1 | | | | | |
| *Micropsectra* sp. | GC | 7 | 3 | | 1 | 1 | 5 | | 2 | 3 | 8 | | 1 | | |
| *Micropsectra/Tanytarsus* sp. | FC | 7 | 5 | | | | | 1 | | | 1 | | | | 1 |
| *Rheotanytarsus distinctissimus* gr. | FC | 6 | 1 | | | | 1 | 3 | 1 | 5 | 1 | | | 7 | 4 |
| *Rheotanytarsus exiguus* gr. | FC | 6 | 1 | | | 2 | | 1 | | | | | 1 | 3 | 4 |
| *Tanytarsus* sp. | FC | 6 | | | 1 | | 1 | 1 | | | 1 | | | 12 | 1 |
| *Zavrelia* sp. | FC | 4 | | | | | | | | | 1 | | | | |
| *Pagastia* sp. | GC | 1 | | | 1 | 1 | | | | | | | | | |
| Orthocladiinae | GC | 5 | | 1 | | 2 | | | | | | | | | |
| *Cardiocladius* sp. | PR | 5 | | | | | | | | | | | | 2 | |
| *Corynoneura* sp. | GC | 4 | 1 | | | | | | 2 | 1 | | | | | |
| *Cricotopus bicinctus* | GC | 7 | | 1 | 2 | | | 1 | | | | | | 2 | 1 |
| *Cricotopus tremulus* gr. | SH | 7 | | 1 | | | | | | | | | | | |
| *Cricotopus vierriensis* | SH | 7 | | 1 | | | | | | | | | | | |
| *Cricotopus/Orthocladius* sp. | GC | 7 | | 1 | 1 | | | | | | | | | 2 | 1 |

Table A1 (cont.)

| TAXON | FG[1] | TV[2] | PB00 | LR02C | LR02B | LR02A | YB01C | YB01B | YB01A[3] | YB01A (dup)[4] | WB01 | WR05 | WR01[3] | WR06A | WR06B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Eukiefferiella* sp. | GC | 6 | | 1 | | | | 2 | | | | | | | |
| *Eukiefferiella brehmi* gr. | GC | 4 | | | | 13 | | 2 | | | | | | | |
| *Eukiefferiella claripennis* gr. | GC | 8 | | | | | 1 | | | | | | | | |
| *Eukiefferiella devonica* gr. | GC | 4 | | | | | | 2 | | | | | | | |
| *Eukiefferiella gracei* gr. | GC | 4 | | | | | | 1 | | | | | | | |
| *Eukiefferiella pseudomontana* gr. | GC | 8 | | | | | | 1 | | | | | | | |
| *Lopescladius* sp. | GC | 4 | | | | | 1 | 1 | 1 | 1 | | | 1 | | |
| *Nanocladius parvulus* gr. | GC | 7 | | | | | | | | | | | | 4 | 2 |
| *Orthocladius* sp. | GC | 6 | | 4 | 1 | 2 | | | | | | | | | |
| *Parachaetocladius* sp. | GC | 2 | | 1 | | | | 1 | 1 | 2 | 1 | | | | |
| *Parametriocnemus* sp. | GC | 5 | 5 | | 4 | 1 | 2 | 1 | | 6 | 1 | | 1 | | |
| *Rheocricotopus* sp. | GC | 6 | | | 1 | | | | | | | | | | |
| *Symposiocladius lignicola* | SH | 5 | | | | | | | | | | | 1 | | |
| *Synorthocladius* sp. | GC | 6 | | | | | | | 1 | 1 | | | | 1 | |
| *Thienemanniella* sp. | GC | 6 | | 1 | 2 | | | 1 | | | | | 1 | | |
| *Tvetenia bavarica* gr. | GC | 5 | 2 | | | | | | | | 5 | | | | |
| *Tvetenia vitracies* gr. | GC | 5 | | 1 | | | | | | | | | | 2 | 5 |
| Tanypodinae | PR | 7 | | | | 1 | | | | | | | | | |
| *Conchapelopia* sp. | PR | 6 | | | | 1 | | | | | | | | | 1 |
| *Nilotanypus* sp. | PR | 6 | | | | | | | 1 | | | | | | |
| *Thienemannimyia* sp. | PR | 6 | | | 1 | 1 | | | | | | 1 | 1 | | |
| *Trissopelopia* sp. | PR | 4 | | | | 1 | | | | | | | | | |
| *Clinocera* sp. | PR | 6 | | | | | 1 | | | | | | | | |
| *Hemerodromia* sp. | PR | 6 | | 1 | | | | | | | 1 | | 1 | | |
| Simuliidae | FC | 6 | | | | | | | | 1 | | | | | |
| *Simulium* sp. | FC | 5 | | 3 | 1 | | 1 | 1 | | | | 2 | | | |
| Tipulidae | SH | 5 | 1 | | | | | | | | | | | | |
| *Antocha* sp. | GC | 3 | 2 | 1 | | | | | | | | | | 1 | 1 |
| *Dicranota* sp. | PR | 3 | | 1 | | | 3 | 1 | | 2 | | | | | |
| *Hexatoma* sp. | PR | 2 | 1 | | 2 | | | 2 | 4 | 1 | | | | | |
| *Tipula* sp. | SH | 6 | 1 | 1 | | | | | | | 1 | | | | |
| TOTAL | | | 98 | 92 | 99 | 96 | 104 | 98 | 97 | 92 | 92 | 104 | 105 | 107 | 95 |

[1]Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR-Predator.
[2]Tolerance Value (TV) is an assigned value used in the calculation of the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant.
[3]Reference station
[4]Duplicate sample

Table A2. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Westfield River watershed survey between 4 and 6 September 2001. Shown are the calculated metric values, metric scores (in italics) based on comparability to the watershed reference station (WR01), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

| STATION | **WR01** | | **WR05** | | **WR06A** | | **WR06B** | | **LR02A** | | **LR02B** | | **LR02C** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREAM | Westfield River | | Westfield River | | Westfield River | | Westfield River | | Little River | | Little River | | Little River | |
| HABITAT SCORE | 184 | | 185 | | 168 | | 165 | | 185 | | 154 | | 156 | |
| TAXA RICHNESS | 33 | *6* | 17 | *2* | 23 | *4* | 26 | *4* | 24 | *4* | 28 | *6* | 25 | *4* |
| BIOTIC INDEX | 4.10 | *6* | 4.61 | *6* | 5.46 | *4* | 4.82 | *6* | 3.30 | *6* | 3.80 | *6* | 4.10 | *6* |
| EPT INDEX | 17 | *6* | 12 | *2* | 5 | *0* | 11 | *0* | 11 | *0* | 13 | *2* | 9 | *0* |
| EPT/CHIRONOMIDAE | 8.56 | *6* | 88.0 | *6* | 0.65 | *0* | 2.04 | *0* | 1.14 | *0* | 2.21 | *2* | 3.88 | *2* |
| SCRAPER/FILTERER | 0.66 | *6* | 0.44 | *6* | 0.46 | *6* | 0.62 | *6* | 1.28 | *6* | 0.50 | *6* | 0.06 | *0* |
| % DOMINANT TAXON | 22% | *4* | 34% | *2* | 15% | *6* | 17% | *6* | 19% | *6* | 14% | *6* | 32% | *2* |
| REFERENCE AFFINITY | 100% | *6* | 74% | *6* | 53% | *4* | 76% | *6* | 56% | *4* | 78% | *6* | 71% | *6* |
| TOTAL METRIC SCORE | *40* | | *30* | | *24* | | *28* | | *26* | | *34* | | *20* | |
| % COMPARABILITY TO REFERENCE | | | 75% | | 60% | | 70% | | 65% | | 85% | | 50% | |
| BIOLOGICAL CONDITION -DEGREE IMPACTED | ***REFERENCE*** **(NON-IMPACTED)** | | **SLIGHTLY IMPACTED** | | **SLIGHTLY IMPACTED** | | **SLIGHTLY IMPACTED** | | **SLIGHTLY IMPACTED** | | **NON-IMPACTED** | | **MODERATELY IMPACTED** | |

Table A3. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Westfield River watershed survey between 4 and 6 September 2001. Shown are the calculated metric values, metric scores (in italics) based on comparability to the watershed reference station (YB01A), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

| STATION | **YB01A*** | | **YB01B** | | **YB01C** | | **PB00** | | **WB01** | |
|---|---|---|---|---|---|---|---|---|---|---|
| STREAM | Yokum Brook | | Yokum Brook | | Yokum Brook | | Powder Mill Brook | | West Br. Walker Brook | |
| HABITAT SCORE | 151 | | 168 | | 140 | | 138 | | 165 | |
| TAXA RICHNESS | 33.5 | *6* | 38 | *6* | 39 | *6* | 29 | *6* | 33 | *6* |
| BIOTIC INDEX | 3.07 | *6* | 3.55 | *6* | 3.27 | *6* | 4.22 | *4* | 4.52 | *2* |
| EPT INDEX | 15.5 | *6* | 15 | *6* | 20 | *6* | 11 | *2* | 12 | *2* |
| EPT/CHIRONOMIDAE | 2.23 | *6* | 1.77 | *6* | 4.12 | *6* | 1.10 | *2* | 1.13 | *4* |
| SCRAPERS/FILTERERS | 0.92 | *6* | 1.44 | *6* | 0.87 | *6* | 0.89 | *6* | 0.60 | *6* |
| % DOMINANT TAXON | 12% | *6* | 15% | *6* | 10% | *6* | 10% | *6* | 12% | *6* |
| REFERENCE AFFINITY** | 100% | *6* | 82%<br>81% | *6* | 89%<br>86% | *6* | 68%<br>74% | *6* | 76%<br>78% | *6* |
| TOTAL METRIC SCORE | *42* | | *42* | | *42* | | *32* | | *32* | |
| % COMPARABILITY TO REFERENCE STATION | | | 100% | | 100% | | 76% | | 76% | |
| BIOLOGICAL CONDITION -DEGREE IMPACTED | ***REFERENCE*** **(NON-IMPACTED)** | | **NON-IMPACTED** | | **NON-IMPACTED** | | **SLIGHTLY IMPACTED** | | **SLIGHTLY IMPACTED** | |

*Reference station; metric values represent mean of values for YB01A and YB01A duplicate sample
**Test stations receive two values for this metric because similarity is calculated against YB01A and YB01A duplicate sample.

Table A4. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Westfield River watershed survey between 4 and 6 September 2001. Shown are the calculated metric values, metric scores (in italics) based on comparability to an upstream reference station (WR06B, LR02B, YB01A), and the corresponding assessment designation for each test station (WR06A, LR02C, YB01B, YB01C). Stations WR06B-WR06A bracket the Westfield WWTP discharge, stations LR02B-LR02C bracket the Cook Brook confluence, and stations YB01A-YB01B-YB01C bracket the Yokum Brook dams in Becket.

| **STATION** | **WR06B** | | **WR06A** | | **LR02B** | | **LR02C** | | **YB01A*** | | **YB01B** | | **YB01C** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREAM | Westfield River | | Westfield River | | Little River | | Little River | | Yokum Brook | | Yokum Brook | | Yokum Brook | |
| HABITAT SCORE | 165 | | 168 | | 154 | | 156 | | 151 | | 168 | | 140 | |
| TAXA RICHNESS | 26 | *6* | 23 | *6* | 28 | *6* | 25 | *6* | 33.5 | *6* | 38 | *6* | 39 | *6* |
| BIOTIC INDEX | 4.82 | *6* | 5.46 | *6* | 3.80 | *6* | 4.10 | *6* | 3.07 | *6* | 3.55 | *6* | 3.27 | *6* |
| EPT INDEX | 11 | *6* | 5 | *0* | 13 | *6* | 9 | *0* | 15.5 | *6* | 15 | *6* | 20 | *6* |
| EPT/CHIRONOMIDAE | 2.04 | *6* | 0.65 | *2* | 2.21 | *6* | 3.88 | *6* | 2.23 | *6* | 1.77 | *6* | 4.12 | *6* |
| SCRAPER/FILTERER | 0.62 | *6* | 0.46 | *6* | 0.50 | *6* | 0.06 | *0* | 0.92 | *6* | 1.44 | *6* | 0.87 | *6* |
| % DOMINANT TAXON | 17% | *6* | 15% | *6* | 14% | *6* | 32% | *2* | 12% | *6* | 15% | *6* | 10% | *6* |
| REFERENCE AFFINITY** | 100% | *6* | 76% | *6* | 100% | *6* | 80% | *6* | 100% | *6* | 82%<br>81% | *6* | 89%<br>86% | *6* |
| TOTAL METRIC SCORE | *42* | | *32* | | *42* | | *26* | | *42* | | *42* | | *42* | |
| % COMPARABILITY TO REFERENCE | | | 76% | | | | 62% | | | | 100% | | 100% | |
| BIOLOGICAL CONDITION -DEGREE IMPACTED | ***REFERENCE*** **(NON-IMPACTED)** | | **SLIGHTLY IMPACTED** | | ***REFERENCE*** **(NON-IMPACTED)** | | **SLIGHTLY IMPACTED** | | ***REFERENCE*** **(NON-IMPACTED)** | | **NON-MPACTED** | | **NON-IMPACTED** | |

*Metric values represent mean of values for YB01A and YB01A duplicate sample
**YB01B and YB01C receive two values for this metric because similarity is calculated against YB01A and YB01A duplicate sample.

Table A5. Habitat assessment summary for biomonitoring stations sampled during the Westfield River watershed survey between 4 and 6 September 2001. 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.

| STATION | | WR01 | WR06B | WR06A | WR05 | LR02A | LR02B | LR02C | YB01A | YB01B | YB01C | PB00 | WB01 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRIMARY PARAMETERS (range is 0-20)** | | **SCORE** | | | | | | | | | | | |
| INSTREAM COVER | | 20 | 16 | 6 | 18 | 18 | 12 | 14 | 10 | 18 | 17 | 15 | 15 |
| EPIFAUNAL SUBSTRATE | | 20 | 18 | 20 | 19 | 18 | 14 | 18 | 16 | 18 | 18 | 15 | 18 |
| EMBEDDEDNESS | | 18 | 16 | 13 | 20 | 20 | 20 | 17 | 16 | 20 | 18 | 12 | 19 |
| CHANNEL ALTERATION | | 20 | 15 | 20 | 20 | 20 | 20 | 20 | 20 | 19 | 13 | 17 | 20 |
| SEDIMENT DEPOSITION | | 17 | 17 | 19 | 19 | 20 | 20 | 11 | 18 | 18 | 13 | 6 | 16 |
| VELOCITY-DEPTH COMBINATIONS | | 19 | 16 | 15 | 15 | 13 | 8 | 10 | 7 | 12 | 10 | 10 | 10 |
| CHANNEL FLOW STATUS | | 18 | 16 | 15 | 14 | 13 | 8 | 8 | 8 | 16 | 15 | 15 | 8 |
| **SECONDARY PARAMETERS (range is 0-10 for each bank)** | | **SCORE** | | | | | | | | | | | |
| BANK VEGETATED PROTECTION | right | 10 | 10 | 10 | 10 | 10 | 8 | 10 | 10 | 8 | 5 | 10 | 10 |
| | left | 8 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 7 | 8 | 10 |
| BANK STABILITY | right | 10 | 8 | 10 | 10 | 10 | 8 | 10 | 10 | 10 | 10 | 6 | 9 |
| | left | 8 | 10 | 10 | 10 | 10 | 10 | 10 | 7 | 9 | 10 | 5 | 10 |
| RIPARIAN ZONE WIDTH | right | 10 | 10 | 10 | 10 | 10 | 6 | 8 | 10 | 5 | 2 | 10 | 10 |
| | left | 6 | 3 | 10 | 10 | 10 | 10 | 10 | 9 | 6 | 2 | 9 | 10 |
| **TOTAL SCORE** | | **184** | **165** | **168** | **185** | **182** | **154** | **156** | **151** | **168** | **140** | **138** | **165** |

Table A6. Fish population data collected by DWM at eight biomonitoring stations in the Westfield River watershed between 5 and 6 September 2001. Sampling stations were at: Powdermill Brook (PB00), West Branch Walker Brook (WB01), Westfield River (WR01), Little River upstream of Cook Brook (LR02B), Little River downstream of Cook Brook (LR02C), Yokum Brook upstream of Becket dams (YB01A), Yokum Brook between Becket dams (YB01B), and Yokum Brook downstream from Becket dams (YB01C). Refer to Table 1 for a complete listing and description of sampling stations.

| TAXON | | Habitat Class[1] | Trophic Class[2] | Tolerance Class[3] | PB00 | WB01 | WR01 | LR02B | LR02C | YB01A | YB01B | YB01C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| common shiner | *Luxilus cornutus* | FDR | GF | M | - | - | 9 | 7 | 37 | - | - | - |
| blacknose dace | *Rhinichthys atratulus* | FS | GF | T | - | 85 | - | 147 | 149 | 59 | 11 | 60 |
| longnose dace | *Rhinichthys cataractae* | FS | BI | M | - | - | 8 | 44 | 31 | 6 | - | 43 |
| creek chub | *Semotilus atromaculatus* | MG | GF | M | - | - | - | - | - | 1 | 1 | - |
| fallfish | *Semotilus corporalis* | RFS | GF | M | - | - | - | - | 1 | - | - | - |
| white sucker | *Catostomus commersoni* | FDR | GF | T | - | 21 | 12 | - | 5 | - | - | - |
| brown bullhead | *Ameirus nebulosus* | MG | GF | T | - | - | 1 | - | - | - | - | - |
| yellow perch | *Perca flavescens* | MG | TC | M | - | 1 | - | - | - | 8 | 2 | - |
| Atlantic salmon | *Salmo salar* | FS | BITC | I | - | - | - | - | 2 | 76 | 35 | 16 |
| brown trout | *Salmo trutta* | FS | TC | I | 7 | - | 1 | 1 | 4 | 2 | - | 2 |
| brook trout | *Salvelinus fontinalis* | FDR | TC | I | 75 | 1 | - | 4 | 5 | 4 | 15 | 14 |
| largemouth bass | *Micropterus salmoides* | MG | TC | M | 1 | 1 | - | - | - | - | - | - |
| smallmouth bass | *Micropterus dolomieu* | MG | TC | M | - | - | 22 | - | - | - | - | - |
| pumpkinseed | *Lepomis gibbosus* | MG | GF | M | - | - | 1 | - | - | - | - | - |
| American eel | *Anguilla rostrata* | MG | TC | T | - | - | 1 | 1 | - | - | - | - |
| slimy sculpin | *Cottus cognatus* | FS | BI | I | 100 | - | - | - | 4 | - | - | 52 |
| **TOTAL** | | | | | 183 | 109 | 55 | 204 | 238 | 156 | 64 | 187 |

[1] Habitat Class – FS (fluvial specialist), FDR (fluvial dependent reproduction), MG (macrohabitat generalist), RFS (regional fluvial specialist). From Bain and Meixler (2000), modified for Massachusetts
[2] Trophic Class – GF (generalist feeder), BI (benthic invertivore), TC (top carnivore), WC (water column invertivore). From Halliwell et al. (1999)
[3] Tolerance Classification – I (intolerant), M (moderately tolerant), T (tolerant). From Halliwell et al. (1999)

# APPENDIX C

## TECHNICAL MEMORANDUM FOR THE RECORD

**BY:** **Gerald M. Szal, Aquatic Ecologist, and Division of Watershed Management, Worcester**

**DATE:** **March 17, 1998**

**SUBJECT:** **1996 Westfield River Macroinvertebrate Monitoring Results**

## PROJECT OVERVIEW:

Over the summer of 1996, biologists from the Division of Watershed Management (DWM) collected riverine benthic macroinvertebrate samples from twelve stations in the Westfield River basin. These collections and subsequent analyses were conducted to evaluate potential impacts from a number of known or suspect pollutant sources. The survey included assessments of macroinvertebrate community effects from three wastewater discharges (Texxon in Huntington, Strathmore Paper in Russell, and the Westfield publicly-owned treatment works [POTW] in Westfield) to the mainstem Westfield River, from the Littleville Lake impoundment to the Middle Branch of the Westfield and from the town of Huntington to the West Branch of the Westfield. In addition to these upstream/downstream analyses of specific sites, comparisons of some of the mainstem reference stations were made to assess any large-scale benthic community changes in the Westfield River. Station locations and their placement with regard to pollutant sources are given in Table 1.

## METHODS:

Field, laboratory and analytical methods used in these investigations followed procedures outlined by the U.S. Environmental Protection Agency (EPA) in a document entitled **Rapid Bioassessment Protocols** ("RBP") **for use in Wadeable Streams and Rivers** (EPA/444/4-89-001) with a few minor changes which are described here.

The basic format for this approach is as follows: 1) Potential sampling sites are investigated upstream and downstream of a suspected pollutant source. Hereafter in this report, these stations will be referred to as "reference" and "test" stations respectively. They are evaluated for habitat similarity based on a number of variables known to affect the composition of stream-dwelling macroinvertebrate communities. The original list of EPA habitat variables and their descriptions has been updated for DWM and can be obtained upon request. 2) Reference and test stations are positioned in areas that are as similar as possible to minimize the influence of habitat differences on invertebrate community composition between sites, other than those due to the pollution source being evaluated. 3) Investigators collect macroinvertebrate samples from riffle areas at reference and test stations. Researchers typically use their feet or hands (only one method is chosen for a station pair) to disturb substrates while holding a net immediately downstream of the substrates being disturbed to collect organisms that become dislodged. In the 1996 Westfield study, 2square meters of substrates were sampled at each station. Benthic materials found in the net are bottled in alcohol and returned to the laboratory. 4) A subsample of approximately 100 organisms is selected from the benthic samples collected at each station using a randomization procedure. 5) The organisms in these subsamples are identified to the family level (EPA's RBPII methods) by DWM biologists and a taxonomic list is prepared for each station which shows the number of individuals found in each taxonomic group. 6) A number of biological metrics are calculated for each station using the information in the taxonomic list. These metrics are used to evaluate differences between communities sampled at reference and test stations with regard to structure, feeding function and tolerance to certain types of pollution. Six of the eight EPA RBP metrics are used by DWM; an additional metric, Community Similarity (described below) is also used. 7) Metric values from each reference/test station pair are compared and each metric is given a score. The value of the score (0, 3 or 6) awarded to a metric is based on a table prepared by EPA in the RBP document for the six EPA metrics. Scores used for Community Similarity were derived by DWM. Scores for each test station metric are summed and compared to the sum of the scores from the reference station. The ratio of test station to reference station scores is called the Percent Comparability of the Test Station to the Reference Station.

A high Percent Comparability value for a test station indicates that the benthic community sampled is similar to that at the reference station or that dissimilarities are not considered detrimental, and a judgment of "No Impact" is ascribed to the test station. A low Percent Comparability score indicates that there are differences in the structure and/or function of the community sampled at the two stations and that these differences are of a detrimental nature. Depending on both the degree and type of differences between reference and test stations, the level of impact ascribed to test stations will vary.

The RBP process also includes a comparison of habitat scores at reference and test stations. In general, we assume that minor differences ($\leq$ 10%) in habitat scores do not affect the interpretation of the degree of impact at test stations. However, as major habitat differences are expected to alter the composition of invertebrate communities, large differences in habitat scores may alter the assessment of impact. The degree of allowable difference between reference and test stations and its effect on interpreting degree of impact between these stations is a sliding scale that is described in the EPA RBP document.

Community Similarity: This is an index that compares the community structures of test and reference stations. First, the number of individuals found in each taxa group common to both stations are converted to a proportion of the total number of individuals in the sample collected at each station. Second, for each taxon common to both stations, one chooses the lower of the two proportions. Third, one sums these values for all common taxa groups and multiplies the total by 100. The result is the percent similarity between the two stations. This can vary from 0 (no taxa common to both groups) to 100 (both stations having the same number of individuals in each taxon). For this metric, a value of 70% or greater received a Criterion Score of 6; metric values that were $\geq$ 25% but <70 received a 3; metric values of less than 25% received a zero.

## RESULTS AND DISCUSSION

The macroinvertebrate taxonomic list for stations sampled in this study appears in Table 2. Tables 3a and 3b list habitat and metric scores for each station, the degree of biological degradation to the macroinvertebrate community at the test station, and a judgment whether or not this degradation can be considered an "impact" caused by the pollutant source being investigated. A discussion of RBPII results for each station pair is presented below.

### MB01/MB02

**Habitat:** These two stations were located on the Middle Branch of the Westfield and were sampled to evaluate the effects of the Littleville Lake impoundment on the stream benthos. Samples were collected at both stations by disturbing sediments by hand rather than by kick sampling to lessen the chance of damaging diagnostic characteristics of the benthos. The two stations were similar in width (approx. 14 m at the reference station and 15 m at the test station) and depth (0.15-0.45 m in riffles at the reference station and 0.15-0.3 m in the test station riffles). The substrate composition of the two sampling stations was also fairly similar: boulders (>25 cm diameter) accounted for about 60-65% of the substrate at both stations; cobble (6.4-25 cm diameter) was more common at the reference station (30% compared to 15% at the test station); gravel (0.25-6.4 cm diameter) was observed, but not extensive at both stations (10% reference and 15% test); sand (0.06-2 mm and "gritty") was not observed at the reference station but accounted for about 5 or so percent of the test station substrates.

The habitat score at the test station was about 11% lower than that at the reference station which is slightly lower than we like to see in comparing stations. There were some obvious habitat differences between the two stations that may have influenced benthic community composition. The riparian zone at the reference station was primarily boulder and cobble and although the banks were steep, the potential for erosion at this station did not appear to be substantial due to the presence of glacial erratics and boulders. By comparison, the streambanks immediately upstream of the test station were soft, devoid of vegetation and had obviously eroded. Periphytic growth at the two stations was also different. At the reference station periphytic growth was minimal. At the test station most cobbles and boulders were coated with green filamentous algae. Riparian vegetation at the reference station was composed primarily of trees dominated by mixed hardwoods and hemlocks. Grasses and ferns were also found at the border of the stream. Riparian vegetation at the test station was about 50% trees and 50% shrubs. Dominant tree types at the test station were sycamore, willow, alder and maple.

**Benthos: Non-Impaired** The RBP II analysis yielded an impairment status that was between "Non-Impaired" and "Moderately Impaired". In this "gray" area, the researcher conducting the analysis is asked to make a professional judgment as to whether or not impacts appear evident. A more detailed analysis of the metrics and taxa list than that afforded by the RBPII is provided below for this purpose.

Differences in the benthic samples collected from these stations are apparent in the relative abundance of certain organisms and in differences in the relative abundance of certain functional feeding groups. Oligoneuriids, mayflies which in this area are restricted to the genus Isonychia, were relatively rare (3% of the sample) at the reference station, but quite abundant (22% of the sample) at the test station. Oligoneuriids function as filterer-collectors of primarily fine particulate organic matter (FPOM). Their increased abundance at the test station, and that of two other families of filterer-collectors, were responsible for a large shift in the major feeding functions of the two sampled communities. While only 27% of the reference station sample fell into the filterer-collector group, this feeding group, at 54%, dominated the test station sample.

FPOM is usually composed of decaying plants, the bacteria and fungus that colonize the latter, and phytoplankton. FPOM levels are expected to naturally increase as one moves from upland to lowland systems for a number of reasons including the fact that leafy inputs get ground up from biotic and abiotic factors as they move downstream, but stations well downstream of MB02, in the mainstem, had lower representation of filterer-collectors so we can't ascribe the increase seen at MB02 to a natural progression in the stream continuum.

In Massachusetts, one often sees a dramatic rise in the relative abundance of hydropsychid caddisflies, which are filterer-collectors, downstream of impoundments. It stands to reason that both the degree of this rise and the downstream extent of this community change would be influenced by the degree of eutrophication of the impoundment as this will influence the concentration of FPOM in the water column. However, we do not see a large change in the hydropsychid component of the sample at the test station, although there was an increase in the abundance of other filter-collectors. A sample closer to the dam (preferably in an area more similar to the reference station) might show more dramatic changes in the filtering-collecting component of the community and would be a good test of the hypothesis that the impoundment, and not the structural changes in habitats between the two stations, is causing the differences observed in the two sample collections.

One of the metrics contributing to a low Percent Comparability between the two stations is the EPT metric. The EPT taxa (Ephemeroptera - Mayflies, Plecoptera - Stoneflies, and Trichoptera - Caddisflies) are used in the RBP analyses as indicators of high biological integrity. Both the richness (# of taxa) and evenness (relative distribution of individuals across different taxa) of the EPT community, together called diversity, are often used as metrics for evaluating the complexity of the community structure. In general, high richness and evenness in the EPT community are often characteristics of natural lotic systems that are unimpacted by man. Systems that are highly stressed usually are unable to support a diverse EPT assemblage. The RBP II uses EPT Richness to evaluate the EPT community and also employs the Percent Contribution of the Dominant Family as an index of the overall evenness of the entire community, but a highly unbalanced distribution of individuals among taxa in the EPT complex may go unnoticed in the RBP II analysis unless the researcher also examines the taxa list directly.

There were eight EPT taxa in the reference station sample, but only six in the sample taken from the test station. RBPII protocols dictate that the test station EPT metric "lose" points as a result. In comparing data from these two stations, I am concerned that, with these particular samples, the EPT metric may not be a very robust indicator of the differences in EPT richness or of the importance of the EPT communities at the two stations. Of the eight EPT groups found in the reference station sample, only five were represented by more than one individual. By comparison, all six of the EPT taxa found in the test station sample were represented by three or more individuals. As the probability of encountering rare taxa is low, it is quite possible that some, or all, of the three reference station EPT taxa for which only one individual was encountered might not be found if a second sample were generated for this station. In addition, judging from the samples collected at the two stations, it appears that the relative importance of the EPT community at the test station is actually greater than that at the reference station: the relative proportion of individuals found in EPT groups is about 50% higher in the test station sample (64%) than that in the reference station sample

(about 40%). Both of these characteristics are indicators that the low EPT metric score at the test station should be interpreted with some caution.
One metric, the Percent Contribution of Dominant Family showed a dramatic improvement at the test station. This metric was about 50% better (lower) for the test station sample than for the reference station sample. This particular metric is used as an estimator of "Evenness", the relative distribution of individuals across the different taxa in the sample. Unimpaired sites often exhibit much more even distributions of individuals across different taxa groups than sites undergoing some type of stress.

Because of the conflicting results outlined above, in my opinion a more detailed collection and analysis effort would have to be conducted in order to get a clear determination of presence/absence and extent of impacts from the impoundment at the test station. It is unclear to me whether or not incongruities in the two datasets were primarily a function of the impoundment or whether they were due to habitat differences between the two stations.

**WB01/WBO2**

**Habitat:** These two stations were established to evaluate inputs from the town of Huntington on the West Branch of the Westfield. Benthic samples were collected at both stations by hand-cleaning substrates rather than through kick sampling. Reviewers should note that the Huntington POTW discharges to the Westfield mainstem and was not evaluated by this station pair.

The reference station, WB01, was located less than 60 m downstream of a footbridge that crosses the West Branch of the Westfield. The footbridge is about midway between the U.S. Geological Survey gaging station on the river and the Rt. 112 crossing of the West Branch. There are some homes in this area but they are separated from the streambank on both sides of the river by roads.

WB01 was almost completely unshaded. The river is about 21 m across in this area; a small island dominated by willow trees was adjacent to the sampling area. River banks in this area are steep, but are naturally lined with boulders and do not appear to be prone to erosion. There were some obvious sources of road runoff (sand) upstream of the site (which the team may wish to look into) although this sand did not appear to be deposited in the streambed at the sampling site. Riparian zone vegetation was about half trees (locust, willow, sycamore) and half shrub. Benthic substrates at the site were primarily boulder (60%) and cobble (30%) with lesser components of gravel (5%) and sand (5%). The riffles sampled in this area ranged in depth from 0.15-0.46 m in depth. Substrates were thinly coated with green filamentous algae. The type of streambed described appeared to stretch well upstream of the sampling area.

WB02, the downstream station, was located adjacent to a pumping station (drinking water?) on Rt. 20, about two tenths of a mile downstream of the point where Rt. 112 crosses the West Branch of the Westfield. Our sampling site was located about 15-30 m downstream of a large pipe that runs through the streambed from the pumping station. This station was also almost completely unshaded. Stream width in this area was about 15 m. Stream banks in this section of the West Branch rise gradually from the streambed and were vegetated primarily by shrubs. Our sampling was conducted in a riffle section that stretched well upstream and was dominated by cobble (65%) and boulder (25%) with a smaller complement of gravel (10%). The riffles sampled ranged in depth from about 0.15-0.3 m. There were some potential sources of runoff, but as the stream slopes were fairly gradual, they did not appear to be of great concern. The water clarity was high, and there was a growth of green algae on the rocks in this area which appeared similar to that upstream.

Habitat scores for the upstream and downstream sites were very similar (less than 6% different). As a result, habitat differences are not expected to alter judgments of impact at the test station.

**Benthos: Non-Impaired** The benthic samples from these two stations were quite similar and a judgment of "Non Impaired" was awarded to the test station. There were some differences in the number of rare (2 or less individuals per taxon) groups in each sample as well as in the percentage of the sample composed of heptageniids. There were more rare groups in the reference station sample than there were in the test station sample, but this may simply be a factor of routine sampling error. Of the eight taxonomic groups that were represented by more than 2 individuals in the reference station sample, seven of these were found in the test station sample. This indicates that at least the major community components of the reference station

sample were present at the test station. In addition, the community similarity metric was 76%, which demonstrates that the relative proportions of individuals in the major taxonomic groups in the two samples were quite similar. The difference in relative proportions of heptageniids found in the two samples did not affect the relative proportion of scrapers seen at the two sites, which was almost exactly the same (about 26%-WB01, 28%-WB02). Other functional feeding components were also quite similar.

**WR02/WR03**

**Habitat:** These two Westfield River mainstem stations were chosen to evaluate potential impacts from the Texxon wastewater discharge in Russell. Substrates were hand-cleaned at both reference and test stations to obtain benthic samples. The reference station, WR02, was located adjacent to a small roadside park near the Huntington Health center. The Westfield River is fairly wide (about 28 m across) at this spot and is dominated by riffles just about as far as one can see upstream and downstream. It was divided into two braids at this spot; we sampled the eastern braid. The depth of riffles sampled ranged from 9-30 cm. Cobble was abundant here accounting for about 60% of the surface area. Gravel (20% of the surface area) and sand (about 15%) were also common. Small boulders and glacial erratics accounted for about 5% of the substrate surface area in the stretch of river sampled. Water clarity was excellent at the time of sampling; substrate surfaces in this area were covered by a thin layer of green algae.

The area sampled at WR02 was relatively unshaded (90% open). The roadside park along the southwest bank of the stream was primarily vegetated by mixed hardwoods as was the northeast side of the stream. There was some erosion along the roadside park which the team might wish to take a look at in order to increase protection of the trees that border the roadside park.

WR03 was located downstream of the Texxon discharge by about 460 m. We attempted to get closer to the discharge, but stream channel characteristics and substrates were too dissimilar to the reference station until we traveled a fair distance downstream of the discharge. Although it is not reflected in the habitat scores (reference/test = 168/162) there were some habitat differences between the two stations that were greater than I would have liked. The substrates at WR03 were primarily boulder (60%), but had a substantial complement (30%) of cobble with some sand (10%), and although the canopy cover across the stream was only about 20%, the area sampled was only about 4.5-6 m from the shore and received much more shade than the reference station. In addition, the water velocity was substantially greater than that at the reference station. Periphytic growth on substrates was a brownish gray, quite different than the more natural-looking green algal growth at the reference station.

This area of the river has some enormous pools and smooth outcroppings which, during our August survey, appeared to be begging for a party of swimmers. However, the west bank of the stream in this area is quite steep and was littered with broken glass, old car parts and a lot of rusted metal as well as other trash, all of which made the area quite unsafe for walking. We also found broken glass and large pieces of industrial-sized metal items embedded in the streambed which swimmers probably would not appreciate.

**Benthos: No Impacts** The RBPII evaluation for the test station yielded a judgment of “No Impacts”. Although the metrics employed in the RBPII yielded similar scores for the two sites, the taxa lists for the two stations are quite different. Ancylids, gastropods with a cone-shaped shell that are in the scraper functional feeding group, are a major component (about 17%) of the test station sample, but are absent from the reference station sample. Philopotamids and hydropsychids, which together account for 20% of the reference station sample, were represented by only one specimen in the test station sample. Other, rarer groups were found at one station and not the other, but this is to be expected as routine sample variability. The distribution of functional feeding groups was quite different in samples collected at these two stations as well. In the reference station sample, scrapers and collector-filterers were about equally represented (23 vs 21 individuals respectively). By contrast, scrapers (approx. 33% of the sample) were about seven times more abundant than collector-filterers (5% of the sample) in the test station sample. As a result of the major differences in the taxa lists mentioned, the community similarity index was somewhat low (58%) for the two samples. Many of these differences may be related to the fact that the two habitats were not as similar as is preferred rather than due to any impact of the Texxon discharge. A more rigorous sampling program with better control over certain habitat variables would be needed to determine if the benthic community downstream of Texxon is being impaired by the discharge.

**WR04/WR05**

These stations were selected to evaluate the potential impacts from the Strathmore Paper Company, located on the mainstem Westfield in the village of Woronoco in Russell.

**Habitat:** WR04 was located in the mainstem Westfield, upstream of Strathmore and across from the Whippernon Golf Club which lies adjacent to Route 20 in Russell. A few hundred yards downstream of the sampling area, the stream slowed down due to a dam upstream of the Strathmore discharge. The mainstem Westfield at this station was fairly wide (about 25 m across) and upstream of the sampling area there was a long stretch of fairly fast riffles and runs. Substrates at WR04 were predominantly composed of cobble (about 60%) and boulder (about 30%) with the remainder (10%) as gravel, with small deposits of sand behind major obstructions in the stream. Depth in the riffles ranged from 0.15 to 0.3 m. Kick samples, rather than hand-cleaned samples, were taken at this station and at WR05.

The stream banks at WR04 were fairly steep and a railroad bed ran along the east side of the river. Although there was some potential for erosion, the stream was bordered by cobble and boulders and streambanks appeared stable. Riparian vegetation in this area was primarily composed of deciduous trees: birch, mountain ash, sycamore and cherry; there was a lot of standing deadwood in the area as well. The canopy at the sampling site was primarily open.

At the time of our survey, Strathmore had a heated discharge which entered the mainstem Westfield from the east bank as well as a second discharge of treated paper process wastewater which flowed through a diffuser pipe that stretched across the mainstream. The test station, WR05, was located about 250 m downstream of the diffuser pipe. The width of the river at this location was about 15-18 m. Boulders were common at this site and accounted for about 70% of the substrates; cobble covered most of the remaining bottom (near 30%) and small pockets of sand and gravel were seen behind major obstructions. Water clarity was good. Deciduous trees predominated in the riparian zone. Due to the width of the river at the sampling station, the canopy was almost completely open (95%). There was evidence of flooding along the banks which very gently rose from the river along the east side; slopes along the west side of the river were steep and vegetated with hardwoods and hemlocks. There did not appear to be a great potential for erosion on either bank due to an abundance of boulder and cobble.

Benthic substrates in the sampling area were covered with brownish-green periphyton. The latter was completely different than that at any other station sampled in the Westfield basin. In addition, we observed what appeared to be sewage fungus downstream of the discharge, although we did not take a sample back to the lab for verification. Aside from station WR07 (downstream of the Westfield WWTF), this is the only station where we observed gray periphyton of this sort.

The habitat score at the test station was higher than that at the reference station. As a result, other than those community changes expected due to the impoundment, habitat differences were not expected to be detrimental to the macroinvertebrate community at the test station.

**Benthos: Severe Impacts** WR05, the test station, received an RBPII rating of "Severe Impacts". All seven of the metrics used in the RBPII analysis at this station received either the lowest score possible or a less than optimal score. Macroinvertebrate samples from the reference (WR04) and test (WR05) stations exhibited a wide range of major differences: 1. the number of different taxonomic groups found in the WR05 sample was 40% lower than that found at the upstream station; 2. seventy-five percent of the organisms in the WR05 sample were from one family (Chironomidae - midges), which is highly unusual for the habitat (riffle) and type of sampling we were conducting; 3. due to the preponderance of midges, there was a substantial shift in the distribution of individuals across different functional feeding groups; 4. the organisms found in the WR05 sample had a much higher average biotic index value than those from the reference station.

The Biotic Index is a measure of the relative tolerance to organic waste of the sampled community as a whole. A "tolerance value" is ascribed to each of the taxa (primarily based on literature values), and the mean tolerance value of all individuals in the sample is recorded as the Biotic Index value for the sample. Tolerance values (listed in Table 2) run from 0-10. A value of 0 is given to taxa groups that are most

intolerant of organic wastes; a value of 10 is given to organisms that can tolerate high concentrations of organic wastes. Since the concentration of organic waste in the water column is often positively correlated with the frequency of low-oxygen events in a waterbody, very high tolerance values are linked to the ability of individual taxa (e.g., sludge worms) to withstand periods of anoxia or near-anoxia.

There were a few individuals in the test station sample that had very low Biotic Index tolerance values, which may be an indication that oxygen concentrations at WR05 are not responsible for the dramatic community changes seen at this station. The high average Biotic Index value for the test station is primarily a function of the relatively high Biotic Index value (6) for the family Chironomidae. The reasons for their high relative abundance at the test station may be be related to increased temperatures or interactions among heat and other components of the waste streams from Strathmore.

I expected to see an increase in filterer-collectors at the downstream site due to the impoundment upstream of Strathmore. This was not observed which leads me to believe that the algal community in the impoundment was not overly productive. The filterer-collector group at the reference station accounted for about 24% of the sample but comprised only about 10% of the sample at the test station. This could have been due, in part, to the level of taxonomy used in RBPII: chironomids are lumped into the collector-gatherer group even though not all chironomids fall into this feeding group. However, DWM biologists examined a subset of the chironomids from this station, and collector-filtering genera were not observed. Perhaps the effluent characteristics rendered this site primarily hospitable to only a few taxa and the collector-filtering groups found upstream were not among these.

**WR06/LR01/WR07:**

These three stations were sampled to evaluate the effects of the Westfield Wastewater Treatment Facility on the benthic macroinvertebrate community. The Westfield mainstem and the Little River converge within 0.9 km upstream of the Westfield WWTF discharge to the mainstem. Because it appeared that the mainstem Westfield and the Little River were not completely mixed upstream of the Westfield discharge, reference stations were established on both waterbodies.

**Habitat:** LR01, the Little River station, was located approximately 90 m upstream of the point where Rt. 20 crosses over the Little River. The Little River converges with the Westfield mainstem another 90 m or so downstream of the Rt. 20 bridge. Substrates in the sampling area, a run rather than a riffle, were 50% cobble, 30% gravel and 20% sand. The stream width was about 14 m across and the canopy was about 50% open in this area. The run that we sampled ranged in depth from about 0.2-0.3 m. Green periphyton was fairly abundant at this station. Deciduous trees were the primary form of riparian vegetation on both banks; there was a lawn on the south bank of the stream near the sampling area which stretched nearly to the streambank.

Surface water velocity measurements were taken at each of the three stations by recording the float-time of similar-sized sticks over a measured distance. Velocity in the areas sampled at LR01 ranged from 0.26-0.3 m/second. (A note for the team: both streambanks were covered with trash and the south bank of the little river had areas where lawn clippings and leaves had been dumped.)

WR06 was located in the Westfield mainstem, on the east side of the streambed and slightly upstream of the point where the Little River converges with the Westfield from the west. Substrates sampled were in a run (similar to LR01) and were composed of about 60% cobble, 20% gravel and 20% sand. Sample depth at this station was 0.3-0.6 m. Estimated stream width was about 28 m. The mainstem, due to its width, is only about 10% shaded in this area. Water clarity was good; water velocity in the area sampled ranged from 0.24-0.26 m/second (fairly similar to the Little River station). Deciduous trees lined the banks and there was an extensive understory of herbaceous plants as well.

Our test station, WR07, was located on the mainstem Westfield River, about 335 m downstream of the Westfield WWTF discharge. We observed what appeared to be sewage fungus which was fairly dense directly downstream of the discharge and which extended past the area where we sampled at WR07, athough its abundance diminished substantially by the time we were at WR07. Periphyton at this station also included some filamentous green algae, not seen at the two reference stations.

We sampled a run at this station as we did at the two reference stations. Kick sampling was employed as a collection method here as well as at the other two stations. Cobble dominated the substrates at WR07 and accounted for about 75% of the benthic surface area; the rest of the substrates were about equally divided between gravel and sand. Depth at the sampling sites ranged from 0.3-0.46 m. The water velocity at this station was greater than that at the two reference stations and ranged from 0.37-0.46 m/second. Canopy cover was about 10%, similar to that at WR06. Sandy floodplains, with an abundance of trash, bordered the mainstem on the east side of the sampling area; they were vegetated primarily by herbaceous plants and shrubs. The west side of the Westfield was bordered by deciduous trees.

The habitat score for WR07 was higher those for WR06 or LR01. As a result, we might expect that the habitat at the test station might provide that station a greater potential for supporting a benthic community of high integrity than was available at either reference station.

**Benthos: Moderate Impacts** WR07, the test station, received a judgment of "Moderate Impacts" when compared to either the Little River reference station or to the Westfield mainstem reference station. The test station benthic sample was dominated by midges (Chironomidae) which accounted for 73% of the total sample. In contrast, the most abundant groups at the Little River and Westfield reference stations accounted for only 24% and 32% of the total, respectively. Although there were (surprisingly) 10 other families represented by at least one individual in the test station taxa list, the distribution of abundance across different taxa was quite lopsided due to the high number of midges. By comparison, benthic samples from the two reference stations had four taxa groups with ten or more individuals in each and had a much more even distribution of individuals across all taxa. A highly skewed distribution of individuals across the different taxa groups is often a sign of stress and is seldom observed at pristine sites. A shift in functional feeding groups was another result of the dominance of midges at the test station: although scrapers were present at the test station, they only comprised about 8% of the total number of individuals in that sample whereas they accounted for 50% and 38% of the total sample at LR01 and WR06, respectively.

**WR01/WR02:**

These two stations were compared to provide an evaluation of macroinvertebrate communities in the Westfield mainstem upstream and downstream of its confluence with the Middle and West Branches.

**Habitat:** WR01 was our most upstream station on the Westfield River mainstem. It was located approximately 3.2 km downstream of the Knightville dam, and was upstream of the confluence of the Middle Branch of the Westfield River with the mainstem. The stream width at this site was about 27 m. Boulders comprised about 45% of the benthic substrate; cobble accounted for 30%, gravel for 15% and sand for about 10%. Riffle depth was 0.3-0.6 m. The canopy was almost completely open in this area. Water clarity was very good. The predominant land use was forest with some residential directly adjacent to and downstream of the sampling area; mixed hardwoods and evergreens were the predominant riparian vegetation.

WR02 was located another 3.5 km or so downstream of WR01 and was downstream of both the Middle and West Branches of the Westfield. A description of the Habitat for this station is given above. Habitat scores for WR01 and WR02 were similar (173 and 168 respectively) and other than the differences in substrate composition, the sites appeared fairly similar. Benthic organisms were dislodged from substrates at both stations by hand rather than through kick sampling.

**Benthos: No Impacts** The RBP II analysis classified the downstream station in-between "No Impacts" and "Moderate Impacts" (see Table 3b). The metric that scored the lowest in the RBPII analysis was EPT. The reference station had 10 EPT taxa, and the test station had only 6. Although the reference station sample had a large number of EPT taxa, only half (5) of these taxa were represented by more than 1 individual. Five EPT taxa in the test station sample were also well represented (6-17 individuals per taxon). As a result, since half the EPT score at the reference station is due to rare taxa, the apparently wide difference in EPT between the two stations could be primarily due to sampling error rather than an expression of the relative importance of EPT taxa to the total sample.

The relative abundance of EPT taxa was quite similar at the two sites: 54% of all individuals at the test station were EPT taxa, with a fairly even distribution across the five groups. This compares well with the reference

station sample in which 50% of all individuals were EPT taxa. Other community characteristics appear similar at the two stations including the relative abundance of scrapers in the two samples (26% at WR01 and 23% at WR02). For these reasons, judging from the two samples taken at these stations, I would say that there were no observable "impacts" in the macroinvertebrate assemblage at the test station.

**WR04/WR06**

These two stations were compared to determine if there were any substantial differences in the macroinvertebrate community upstream and downstream of the city of Westfield. This comparison was added to this report upon request of those working on the Section 305b (Federal Clean Water Act) report to the U.S. congress. It was not part of the original study design or the two stations would have been placed closer together (they were about 14.5 km apart).

**Habitat:** Habitat descriptions are given above for both stations. WR04 was located well above the Strathmore discharge and WR06 was downstream of the city of Westfield. Kick samples were collected at both stations. Although there were some notable differences in the habitats sampled at the two stations, Habitat Scores for the two stations were comparable (WR04:WR06 = 158:148). WR04 samples were taken in a riffle while those at WR06 were taken in a run. In addition, WR04 substrates were primarily boulder (30%) and cobble (60%) with some areas of gravel (10%) with very little embeddedness (about 10-15%). By comparison, boulders were rare at WR06; substrates here were primarily cobble with a good proportion of gravel (20%) and sand (20%) and a higher degree of embeddedness (about 50%). Even with these differences, Habitat Scores were comparable

**Benthos: Moderate Impacts** The RBP II analysis for these two stations indicates that some degradation has taken place in the macroinvertebrate community between these two stations. The most obvious differences are the change in the biotic index and the presence/absence and relative abundance of the EPT taxa.

The Biotic Index of the test station sample averaged much higher (indicating greater tolerance for low dissolved oxygen) than that at the reference station. All but one of the individuals found in the test station sample had a Biotic Index tolerance value of 4 or greater. By comparison, a major portion - over 20%, of the reference community had a tolerance value of zero. The absence of low tolerance groups in the test station sample is notable, and may suggest that the community at the test station is subjected to more organic waste and lower oxygen concentrations than the reference station. Biotic Index values worsen at the next station downstream (WR07) after the Westfield mainstem receives a discharge from the Westfield WWTF, although one fairly intolerant group (ephemerellids) accounts for about 6% of the sample at that station. The EPT complex was a much more important component of the reference station sample than of the test station sample. In addition to the difference between the stations in EPT Richness (8:4, reference:test), the reference station sample had a more even distribution of individuals among the EPT taxa present: of the 8 EPT taxa found in the reference station sample, six were represented by five or more individuals. By comparison, of the four EPT taxa found in the test station sample, only two such groups were found.

In summary, the taxa in the test station sample were more tolerant of organic waste and low oxygen concentrations than those found in the reference station sample and the test station EPT complex was much less diverse than that at the reference station.

## RECOMMENDATIONS:

Notes regarding small areas of erosion and stream segments where trash collection or debris removal are needed can be found in the text. Two NPDES wastestreams appeared to be responsible for substantial degradation of macroinvertebrate communities downstream of their discharges to the Westfield mainstem and are noted below.

**Strathmore:** While we were conducting reconnaissance in the Westfield, two passers-by expressed concerns about the Strathmore discharges. These individuals claimed that they fished in the area and that the water temperature downstream of Strathmore was substantially higher than that upstream of the discharge at certain times. In addition, when we visited the treatment plant at this site, one of the operators

told us that toxicity testing had been conducted and that the discharge had been shown not to be toxic. When we asked to see the reports, we were shown one report that clearly indicated that the wastewater discharge was toxic at the time of sampling. To my knowledge, DEP has not received copies of these reports.

Due to the fact that invertebrate samples downstream of this discharge indicate a severe problem at this site, and based on the concerns over stream temperatures and toxicity, I recommend that DEP start gathering information on toxicity and temperature well in advance of the next NPDES permit reissuance. I suggest that we communicate with EPA and representatives from Strathmore to see how this might best be done. If toxicity tests have been conducted, we should ask that copies of all such reports be forwarded to DEP and attempt to determine how we can be certain that all reports are forwarded to the regulators. Furthermore, I recommend that additional toxicity tests be run and provided for regulatory review. I also recommend that a series of temperature evaluations be conducted to determine if there is the potential for Water Quality criteria violations and suggest that we attempt to determine how the permit will address temperature monitoring such that Water Quality criteria violations will be documented.

**Westfield POTW:** Two of the three times we visited this facility, the discharge was extremely turbid. On one of these occasions we asked about this apparent violation of MA Water Quality Criteria, and we were told that one of the clarifiers was being cleaned, but we were unable to determine what might have been the cause of the other incident of high turbidity.

The facility was experiencing some toxicity problems in1994 and 1995, but none of the three samples tested in 1996 were acutely toxic; chronic toxicity during 1996 was evident, though not strongly so. Chronic No-Effect concentrations ranged from 25-50% over the 1994-95 period and were in the range of 25% for 1996. Judging from the amount of dilution apparently available at the time we conducted our invertebrate studies at this site, this degree of toxicity should not have affected the test station community. Although ammonia concentrations were fairly high in earlier years (38 mg/L in the winter of 1994), most of the chemical evaluations conducted as part of the NPDES effluent toxicity assessments were not reported for some reason and there are no data for ammonia in the 1996 dataset. Unfortunately, compliance evaluations were not conducted along with invertebrate community evaluations during the 1996 survey, so we have no explanations for the impacts observed at the test station. I suggest that the team attempt to identify the cause of the impacts to the macroinvertebrate community observed downstream of the Westfield POTW. It is not apparent from the data collected through the NPDES toxicity testing program in 1996.

**Table 1**
**1996 Westfield River Macroinvertebrate Study, Station Descriptions**

| Station | Description |
|---|---|
| **WR01** | Westfield River, downstream of Knightville Dam, off Rocky Road near Rt. 112, Huntington |
| **MB01** | Middle Branch of the Westfield, upstream of Littleville Lake, off East River Road and upstream of the Dayville fairgrounds, Chester |
| **MB02** | Middle Branch of the Westfield, downstream of Littleville Lake, downstream of Goss Hill Rd., Huntington |
| **WB01** | West Branch of the Westfield, upstream of the town of Huntington, downstream of footbridge which is located 0.8 km downstream of USGS gage, Huntington |
| **WB02** | West Branch of the Westfield, downstream of the town of Huntington, near confluence with Westfield River, Huntington |
| **WR02** | Westfield River, upstream from Texon plant, at roadside park near Huntington Health Center, Huntington |
| **WR03** | Westfield River, approx. 450 m downstream of Texxon discharge, Russell, MA |
| **WR04** | Westfield River, upstream of Strathmore and across from Whippernon Golf Club, adjacent to Rt. 20, Russell |
| **WR05** | Westfield River, approx. 250 m downstream of Strathmore diffuser pipe for wastewater discharge, Russell. |
| **WR06** | Westfield River, upstream of the Westfield WWTP discharge, and about 15-20 m upstream of the confluence of the Little and Westfield rivers, Westfield |
| **LR01** | Little River, approx. 90 m upstream of the Rt. 20 overpass, near the confluence of the Little and Westfield rivers, Westfield |
| **WR07** | Westfield River, approx. 340 m downstream of Westfield WWTP discharge, Westfield |

Table 2. Family-level taxa list and counts, functional feeding groups, and tolerance values for macroinvertebrates collected from 12 stream sites in the Westfield River watershed between August 20 and August 28, 1996.

| TAXON | FFG[1] | TV[2] | WR01 | MB01 | MB02 | WB01 | WB02 | WR02 | WR03 | WR04 | WR05 | WR06 | LR01 | WR07 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gastropoda | SC | 8 | | | | | | | | | | 1 | | |
| Physidae | GC | 8 | | | | | | | | | | | 1 | |
| Ancylidae | SC | 7 | 1 | | 2 | | | | 17 | | | | 26 | 1 |
| Pisidiidae | FC | 6 | | | | | | | | | | 1 | 1 | 1 |
| Lumbricina | GC | 8 | | | 1 | | | | | | | | | |
| Naididae | GC | 9 | | 4 | 3 | | | | 6 | 1 | 8 | | 2 | |
| Lumbriculidae | GC | 7 | 1 | | 1 | | 1 | 7 | 1 | 2 | | | 2 | |
| Erpobdellidae | PR | 8 | | | | | | | | | | | 1 | |
| Hydracarina | PR | 6 | | | 1 | | | 1 | | | | 2 | 2 | 3 |
| Ephemeroptera | GC | 2 | | | | 1 | | | | | | | | |
| Baetidae | GC | 4 | 1 | 2 | 5 | 4 | 6 | 17 | 22 | 6 | 2 | 33 | 11 | 4 |
| Oligoneuriidae | FC | 4 | 2 | 3 | 22 | 6 | 5 | | 4 | 4 | | | | 1 |
| Heptageniidae | SC | 4 | 17 | 9 | 3 | 16 | 25 | 10 | 12 | 5 | | 20 | 24 | 4 |
| Ephemerellidae | GC | 1 | 1 | 1 | | | | | 1 | 1 | | | 3 | 6 |
| Tricorythidae | GC | 5 | | | | 2 | | | | | | | 4 | |
| Leptophlebiidae | GC | 2 | | 1 | | | | | | | | | | |
| Potamanthidae | GC | 2 | | | | 2 | | | | | | | | |
| Gomphidae | PR | 5 | | 2 | | | | | | | | | | |
| Calopterygidae | PR | 5 | | | | 1 | | | | | | | | |
| Coenagrionidae | PR | 9 | | | 1 | | | | | | | 1 | | |
| Peltoperlidae | SH | 0 | | | | | 1 | | | | | | | |
| Perlidae | PR | 1 | 2 | | 2 | 1 | 2 | 6 | 3 | 1 | 1 | | | |
| Corydalidae | PR | 5 | | 7 | 6 | 1 | | | 4 | 1 | | | 1 | |
| Philopotamidae | FC | 3 | 13 | 4 | 9 | 7 | 4 | 10 | | 5 | 7 | 1 | | |
| Hydropsychidae | FC | 4 | 12 | 18 | 23 | 9 | 10 | 10 | 1 | 14 | 4 | 2 | 18 | 5 |
| Rhyacophilidae | PR | 0 | | | | 2 | | | 1 | | 1 | | | |
| Glossosomatidae | SC | 0 | | | | | | | | 22 | | | | |
| Hydroptilidae | GC | 4 | 1 | | | | | | | | | | | |
| Brachycentridae | FC | 1 | 1 | 1 | | | | | | | | | | |
| Lepidostomatidae | SH | 1 | 1 | | | | | 1 | 1 | | | | | |
| Pyralidae | SH | 5 | 1 | | | | | | 1 | | 1 | | | |
| Psephenidae | SC | 4 | 4 | 1 | 1 | 4 | 1 | 2 | 1 | 3 | | 2 | 2 | |
| Elmidae | SC | 4 | 5 | 6 | 1 | 4 | | 11 | 4 | 10 | 2 | 16 | 4 | 3 |
| Tipulidae | SH | 5 | | | | 1 | | 1 | | | | | | |
| Ceratopogonidae | PR | 6 | | 1 | | | | | | | | 2 | | |
| Simuliidae | FC | 6 | 1 | | | 1 | | 1 | | 2 | | | | |
| Chironomidae | GC | 6 | 36 | 38 | 19 | 31 | 38 | 23 | 25 | 29 | 79 | 20 | 6 | 79 |
| Empididae | PR | 6 | 2 | | | 1 | | | | | | 1 | | 1 |
| TOTALS | | | 102 | 98 | 100 | 94 | 93 | 100 | 104 | 106 | 105 | 102 | 108 | 108 |

[1] Functional Feeding Group (FFG) lists the primary feeding habit of each taxon and follows the abbreviations: SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR-Predator.
[2] Tolerance Value (TV) is an assigned value used in the calculation of the biotic index, tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant.

Table 3a. Summary of RBP II data analysis for macroinvertebrate communities sampled at 12 stream sites in the Westfield River watershed. Stations were located upstream (reference) and downstream (test) of potential pollution sources. Seven biological metrics were calculated for taxa collected at each station and scored (in parentheses). Scores for each test station were totaled and compared to scores from each reference station. The percent comparability of test to reference station yields a final impairment score for each test station.

| STATION # | MB01 | MB02 | WB01 | WB02 | WR02 | WR03 | WR04 | WR05 | WR06 | WR07 | LR01 | WR07 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREAM | Middle Branch Westfield River (upst Littleville Lake) | Middle Branch Westfield River (dnst Littleville Lake) | West Branch Westfield River (upst of Huntington) | West Branch Westfield River (dnst of Huntington) | Westfield River (upst of Texxon) | Westfield River (dnst of Texxon) | Westfield River (upst of Strathmore) | Westfield River (dnst of Strathmore) | Westfield River (upst of Westfield WWTP) | Westfield River (dnst of Westfield WWTP) | Little River (upst of Westfield WWTP) | Westfield River (dnst of Westfield WWTP) |
| HABITAT SCORE | 183 | 164 | 160 | 169 | 168 | 162 | 158 | 169 | 148 | 159 | 140 | 159 |
| TAXA RICHNESS | 15 (6) | 16 (6) | 18 (6) | 10 (3) | 13 (6) | 16 (6) | 15 (6) | 9 (3) | 13 (6) | 11 (6) | 16 (6) | 11 (3) |
| BIOTIC INDEX | 4.97 (6) | 4.64 (6) | 4.50 (6) | 4.70 (6) | 4.41 (6) | 4.98 (6) | 3.75 (6) | 5.76 (3) | 4.59 (6) | 5.36 (6) | 5.07 (6) | 5.36 (6) |
| EPT INDEX | 8 (6) | 6 (3) | 10 (6) | 7 (3) | 6 (6) | 8 (6) | 8 (6) | 5 (0) | 4 (6) | 5 (6) | 5 (6) | 5 (6) |
| EPT/CHIRONOMIDAE | 1.03 (6) | 3.37 6) | 1.61 (6) | 1.39 (6) | 2.35 (6) | 1.80 (6) | 1.93 (6) | 0.19 (0) | 2.80 (6) | 0.25 (0) | 10.0 (6) | 0.25 (0) |
| RIFFLE COMMUNITY: SCRAPERS/FILTERERS | 0.62 (6) | 0.13 (0) | 1.04 (6) | 1.37 (6) | 1.10 (6) | 6.80 (6) | 1.60 (6) | 0.18 (0) | 9.75 (6) | 1.14 (0) | 2.95 (6) | 1.14 (3) |
| % CONTRIBUTION DOMINANT FAMILY | 39% (3) | 23% (6) | 33% (3) | 41% (3) | 23% (6) | 24% (6) | 27% (6) | 75% (0) | 32% (3) | 73% (0) | 24% (6) | 73% (0) |
| COMMUNITY SIMILARITY | 100% (6) | 60% (3) | 100% (6) | 76% (6) | 100% (6) | 58% (3) | 100% (6) | 42% (3) | 100% (6) | 37% (3) | 100% (6) | 37% (3) |
| TOTAL METRIC SCORE | 39 | 30 | 39 | 33 | 42 | 39 | 42 | 9 | 39 | 24 | 42 | 21 |
| % COMPARABILITY TO REFERENCE STATION | | 77% | | 85% | | 93% | | 21% | | 62% | | 50% |
| BIOLOGICAL STATUS - DEGREE IMPAIRMENT | upstream reference | moderate/ non | upstream reference | non | upstream reference | non | upstream reference | severe | upstream reference | moderate | upstream reference | moderate |

Table 3b. Summary of modified RBP II analysis for macroinvertebrate communities sampled in the Westfield Basin. Location of reference and test stations and general method used to calculate Degree Impairment as in Table 2. Some of the metrics used in this table are different than those used in Table 2. An explanation of reasons for using different metrics appears in the text.

| STATION # | WR01 | WR02 | WR04 | WR06 |
|---|---|---|---|---|
| STREAM | Westfield River (off Rocky Hill Rd, Near Rt 112, Huntington) | Westfield River (upst of Texxon) | Westfield River (upst of Strathmore) | Westfield River (upst of Westfield WWTP) |
| HABITAT SCORE | 173 | 168 | 158 | 148 |
| TAXA RICHNESS | 18 (6) | 13 (3) | 15 (6) | 13 (6) |
| BIOTIC INDEX | 4.56 (6) | 4.41 (6) | 3.75 (6) | 4.59 (3) |
| EPT | 10 (6) | 6 (0) | 8 (6) | 4 (0) |
| EPT/CHIRONOMIDS | 1.36 (6) | 2.35 (6) | 1.93 (6) | 2.80 (6) |
| RIFFLE COMMUNITY: SCRAPERS/FILTERERS | 0.93 (6) | 1.10 (6) | 1.6 (6) | 9.75 (6) |
| % CONTRIBUTION OF DOMINANT FAMILY | 35% (3) | 23% (6) | 27% (6) | 32% (3) |
| COMMUNITY SIMILARITY | 100% (6) | 66% (3) | 100% (6) | 44% (3) |
| TOTAL METRIC SCORE | 39 | 30 | 42 | 27 |
| % COMPARABILITY TO REFERENCE STATION | | 77% | | 64% |
| BIOLOGICAL STATUS -DEGREE IMPAIRMENT | | Moderate/non | | Moderate |

# APPENDIX D

Technical Memorandum

**WESTFIELD RIVER BASIN 2001 PERIPHYTON DATA**

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MA DEP/Division of Watershed Management, Worcester, MA
March 2004

During the summer of 2001, Massachusetts Department of Environmental Protection (MA DEP) personnel collected periphyton samples from stations in the Westfield River basin. This was part of the biological assessment of the Westfield River that included macroinvertebrate identifications, habitat assessment and fish community analysis. The objectives of the periphyton sampling were to document areas with nuisance algal growth, to examine community changes over time, as well as spatially, and to provide a record of the taxa that are found in Massachusetts. The periphyton identifications and estimates of percent algal cover are used along with the percent canopy cover to determine if Aesthetics and Aquatic life uses are supported or threatened (Barbour, 1999). Nuisance levels of algal biomass are defined as >100 $mg/m^2$ chlorophyll a and/or >40 % cover by macroalgae (Barbour, 1999) (Biggs, 1996). This amount of algal growth indicates nutrient or organic enrichment in-stream. Reaches exhibiting these levels are typically placed on "alert status" in watershed assessments since Aesthetics or Aquatic Life uses may be compromised.

The stations chosen for biological examination were located on major tributaries as well as the mainstem of the Westfield River and offer a wide spatial coverage of the basin. The locations where "alert status" may be necessary are described.

## MATERIALS and METHODS

### *Periphyton Identifications and Relative Abundance*

#### Field Methods

Table 1 lists the stations that were included in this study with descriptions of their locations as well as the percent algal cover, percent canopy cover and dominant algal type. The stations are listed beginning with the headwaters and continuing downstream. The periphyton taxonomic identifications and relative abundance are included in Appendix A. The habitat information is based on visual determinations of parameters including both riparian and instream conditions. Habitat assessment and the biological collections were primarily done by John Fiorentino or Robert Nuzzo. Periphyton grab samples from the riffle zone were gathered along with the macroinvertebrate samples and habitat information using methods described in Barbour (1999). Algae on boulder or cobble substrates in the riffle were scraped with a knife or gathered by hand (MA DEP, 2001). The material was collected in labeled glass vials and transported to the lab at DEP-DWM-Worcester without refrigeration. Samples were held in plastic containers that were partially filled with *insitu* water to keep them cool. Once at the lab they were refrigerated until identifications were completed or they were preserved using M3 (Reinke, 1984). At the laboratory, the vials were logged in and assigned lab numbers. The vial was shaken to get a uniform sample before subsampling. If clumps of filamentous algae were present in the sample they were removed first, identified separately and then the remainder of the sample was examined. If moss or other macrophytes were present they were shaken in the sample container to dislodge epiphytic algae and then a sample was extracted. An Olympus BH2 compound microscope with Nomarski optics and equipped with a Whipple grid was used for the identifications following a modified method for periphyton analysis developed by L. Bahls (1993). Slides were typically examined under 200 power. The scheme (Bahls, 1993) for determining the relative abundance of the soft-bodied algae is as follows:

| | |
|---|---|
| R (rare) | fewer than one cell per field of view at 200x, on the average; |
| C (common) | at least one, but fewer than five cells per field of view; |
| VC (very common) | between 5 and 25 cells per field; |
| A (abundant) | more than 25 cells per field, but countable; |
| VA (very abundant) | number of cells per field too numerous to count. |

Typically, 10 fields are examined per slide. If just R and C type abundance is found, then a second slide is prepared and examined. This determination of abundance provides a relative approximation of the phyla that contribute the most to the cell count in the riffle, run or pool habitats.

Table 1: Westfield River Periphyton-2001
Station Locations, % Canopy Cover, % Algal Cover and Dominant Algal Type

| Station # | Location | Date | % Canopy Cover | % Algal Cover | Dominant algal type |
|---|---|---|---|---|---|
| YB01A | Yokum Brook, upstream from large dam, approximately 270 m upstream from the most downstream Route 8 crossing, Becket. | 5 Sept. | 65 | <1 | Green (Chlorophyceae) |
| YB01B | Yokum Brook, approximately 100 m upstream from Prentice Place, Becket. | 5 Sept. | 75 | <1 | Green (Chlorophyceae) |
| YB01C | Yokum Brook, near mouth, Becket. | 5 Sept. | 75 | * no visible accumulation of algae present-not sampled | |
| WR01 | Westfield River downstream from Knightville Dam, Huntington. | 6 Sept. | 0 | <1 | Green (Chlorophyceae) |
| WR05 | Westfield River, 250 m downstream from Strathmore Paper, Russell. | 5 Sept. | 0 | * no visible accumulation of algae present-not sampled | |
| PB00 | Powdermill Brook, downstream from I-90, behind high school, Westfield. | 4 Sept. | 60 | 40 | Yellow-green (Xanthophyceae) |
| LR02A | Little River between Cobble Mountain Reservoir and power tunnel, approximately 750 m downstream from power lines. | 4 Sept. | 50 | 25 | Green (Chlorophyceae) |
| LR02B | Little River, upstream from Cook Brook, Westfield. | 4 Sept. | 0 | 100 | Green (Chlorophyceae) |
| LR02C | Little River, downstream from Cook Brook, Westfield. | 4 Sept. | 0 | 40 | Green (Chlorophyceae) Diatoms (Bacillariophyceae) |
| WR06B | Westfield River, downstream from Westfield WWTF discharge, approx 15 m, near south bank, Westfield-control for WR06A. | 6 Sept. | 30 | 100 | Green (Chlorophyceae) |
| WR06A | Westfield River downstream from Westfield WWTF mixing zone. | 6 Sept. | 20 | 100 | Green (Chlorophyceae) |

**RESULTS and CONCLUSIONS**

Algal growth was conspicuous at several stations in the Westfield River. **At five of the Westfield River stations (PB00, LR02C, LR02B, WR06B, WR06A)** macroalgal growth (does not require a microscope to see) covered 40 % or more of the bottom substrates. This percentage of macroalgae is likely to be having a harmful effect on the invertebrate community particularly when they decompose and fill the interstitial spaces thereby eliminating space used by the meiofauna (invertebrates that dwell in the interstitial spaces). Algal growth of this magnitude may impair Aquatic Life uses and Aesthetics as well (Biggs, 1996). In contrast, the algal coverage was low at Yokum Brook (YB01A) <1%, a reference station

established for macroinvertebrate community comparisons, and at WR01, a mainstem reference station which also had <1% macroalgal growth.

Szal (2001), mentions that the Strathmore Paper Company, Russell (WR05) was still discharging in 1996 when the river was previously sampled. Green, filamentous algal growth was observed to be quite prolific in this reach. The filamentous bacteria, *Sphaerotilus* sp. which thrives on organic carbon sources, was also present. Yet, in contrast to 1996, in 2001 when the paper company no longer was discharging, no algal growth or aquatic vegetation was observed at this location. No explanation is offered for this change. The invertebrate sampling indicated that in 2001 the river impairment at WR05 improved from severely impaired (1996) to slightly impaired (Fiorentino and Mitchell, 2004).

The green, filamentous alga *Oedogonium* sp. covered approximately 100% of the substrates in the riffle zone of the Little River upstream from Cook Brook, Russell (LR02B). ***The reach including LR02B should be considered for alert status for Aesthetics and Aquatic Life.***

*Oedogonium* sp. was not part of the algal assemblage found in the riffle zone of LR02C although this site is located approximately 100 m downstream from Cook Brook. It was abundant, however, in the pool sample collected at the same station. Any impacts which resulted from Cook Brook entering the Little River could not be distinguished by the algae sampling done here. Although a change in the algal community would be a way of determining if a particular source has impacted the community structure, the sampling at this location was not rigorous enough to determine this. No explanation can be given for this change in community at this time.

Westfield River station WR06B was located approximately 400 m downstream from Little River in Westfield. This stretch of the river was 50 % forest and 50% commercial/industrial. The water column was slightly turbid, but the light penetration was good and even with 30% canopy cover, algal growth of primarily the green filamentous algae *Ulothrix zonata* covered an estimated 100% of the reach. ***This reach should be considered for alert status for Aesthetics and Aquatic Life because of nuisance, algal growth*** (Barbour, 1999).

WR06A is located approximately 375 m downstream of the Westfield Wastewater Treatment Facility (WWTF) and was determined to be moderately impacted in 1996 (Szal, 2001). In 2001, Fiorentino and Mitchell (2004) found that it was still impaired, but with increased taxonomic resolution - from family to species level identifications - the determination changed so that now it is considered "slightly impaired". This is not necessarily a reflection of any major community improvements at the site. However, the algal growth both "above" and below the wastewater treatment facility was marked by excessive (100% cover) amounts of green filamentous algae. The green alga *Ulothrix* grows to prolific amounts in areas with high nutrient concentrations and low water temperatures (Biggs, 1996). This genus was found downstream of the Westfield WWTF in open canopy conditions. This excess growth is deleterious to aesthetic enjoyment. ***Part of this reach should be considered for alert status for both Aquatic Life and Aesthetic uses.***

At PB00, on the Powdermill Brook downstream of the Westfield High School, the yellow-green alga Vaucheria sp. covered approximately 40% of the substrates. This filamentous alga responds to enriched nutrient conditions, so although canopy cover was relatively high at 60%, areas of suitable substrates, light and stable flow conditions allowed the development of a relatively high percent cover of algae. ***Further changes in the riparian zone without accompanying reductions in in-stream nutrients could lead to increased nuisance algal growth that would diminish Aquatic Life and Aesthetic uses.***

The upper and lower parts of the Westfield River basin vary considerably in their benthic algal coverage. The tributary and mainstem stations down to approximately river mile 18.1 (WR05) on the Westfield River mainstem (by Strathmore Paper) had <1% cover of benthic algae. Below this station, the Little River in Westfield had prodigious filamentous algal growth as did the mainstem stations sampled starting just above the Westfield WWTF. The opening of the forest canopy as the river widened increased light availability compared to the more closed canopy areas upstream. This combination of available light and nutrients likely led to the several areas (Table 1) with excessive or nuisance algal growth.

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**Appendix**

**Periphyton Westfield River 2001**

| Date | Habitat | Class | Genus | Abundance |
|---|---|---|---|---|
| **Location: Yokum Brook (YB01A) upstream from large dam and approximately 270 meters upstream from the most downstream Rte 8 crossing, Becket.** | | | | |
| 5 September 2001 | riffle | Bacillariophyceae | *Melosira* sp. | R |
| | | Chlorophyceae | *Mougeotia* sp. | A |
| | | Chlorophyceae | *Spirogyra* sp. | C |
| | | Chlorophyceae | ui green filament | R |
| **Location: Yokum Brook (YB01B) upstream from Prentice Place, Becket.** | | | | |
| 5 September 2001 | riffle | Chlorophyceae | *Spirogyra* sp. | VA |
| | | Chlorophyceae | *Ulothrix* sp. | A |
| **Location: Westfield River (WR01) downstream from Knightville Dam, Huntington.** | | | | |
| 6 September 2001 | riffle | Chlorophyceae | *Spirogyra* sp. | VA |
| **Location: Powdermill Brook (PB00) approximately 800 meters downstream from I-90, behind high school, Westfield.** | | | | |
| 4 September 2001 | riffle-run | Bacillariophyceae | *Melosira* sp. | R |
| | | Chlorophyceae | *Closterium* sp. | R |
| | | Cyanophyceae | *Lyngbya* sp. | R |
| | | Xanthophyceae | *Vaucheria* sp. | VA |
| | pool | Bacillariophyceae | *Fragilaria* sp. | C |
| | | Bacillariophyceae | *Melosira varians* | R |
| | | Bacillariophyceae | *Navicula* sp. | C |
| | | Bacillariophyceae | ui pennate diatoms | C |
| | | Chlorophyceae | *Closterium* sp. | R |
| | | Chlorophyceae | ui desmid | C |
| | | Xanthophyceae | *Vaucheria* sp. | C |
| **Location: Little River (LR02A) between Cobble Mountain Reservoir and power tunnel, approximately 750 meters downstream from power lines, Russell.** | | | | |
| 4 September 2001 | riffle | Bacillariophyceae | *Navicula* sp. | C |
| | | Bacillariophyceae | *Synedra* sp. | C |
| | | Chlorophyceae | *Mougeotia* sp. | A |
| | | Chlorophyceae | *Sirogonium* sp. | A |
| | | Chlorophyceae | *Spirogyra* sp. | C |
| **Location: Little River (LR02B) upstream from Cook Brook, Westfield.** | | | | |
| 4 September 2001 | riffle | Bacillariophyceae | *Meridion* sp. | R |
| | | Bacillariophyceae | *Tabellaria* sp. | R |
| | | Chlorophyceae | *Cosmarium* sp. | C |
| | | Chlorophyceae | *Oedogonium* sp. | VA |
| | | Chlorophyceae | ui green filament | A |
| **Location: Little River (LR02C) downstream from Cook Brook, Westfield.** | | | | |
| 4 September 2001 | riffle | Bacillariophyceae | *Tabellaria* sp. | A |
| | | Chlorophyceae | placcoderm desmid | VA |
| | | Chlorophyceae | ui green filaments | VA |
| | pool | Bacillariophyceae | *Cymbella* sp. | R |
| | | Bacillariophyceae | *Synedra* sp. | R |
| | | Bacillariophyceae | *Tabellaria* sp. | A |
| | | Chlorophyceae | *Cosmarium* sp. | C |
| | | Chlorophyceae | *Oedogonium* sp. | VA |
| | | Chlorophyceae | *Zygnema* sp. | A |

**Appendix**

**Periphyton Westfield River 2001 continued**

| | | | | |
|---|---|---|---|---|
| **Location: Westfield River (WR06A) downstream from Westfield WWTF mixing zone, Westfield.** | | | | |
| 6 September 2001 | riffle | Bacillariophyceae | *Cocconeis* sp. | C |
| | | Bacillariophyceae | *Melosira* sp. | C |
| | | Bacillariophyceae | *Synedra* sp. | R |
| | | Chlorophyceae | saccoderm desmid | R |
| | | Chlorophyceae | *Scenedesmus* sp. | R |
| | | Chlorophyceae | *Ulothix zonata* | VA |
| | pool | Bacillariophyceae | *Cyclotella* sp. | C |
| | | Bacillariophyceae | *Navicula* sp. | A |
| | | Bacillariophyceae | pennate diatoms | A |
| | | Chlorophyceae | *Euastrum* sp. | C |
| | | Chlorophyceae | *Hydrodictyon* sp. | A |
| | | Chlorophyceae | saccoderm desmid | A |
| | | Chlorophyceae | *Scenedesmus* sp. | C |
| | | Chlorophyceae | Ulothix zonata | C |
| **Location: Westfield River (WR06B) approximately 15 meters downstream from Westfield WWTP discharge, near south bank, Westfield.** | | | | |
| 6 September 2001 | riffle | Chlorophyceae | *Ulothix zonata* | VA |

# APPENDIX E
## MA DEP DWM 2001 FISH TOXICS MONITORING IN THE WESTFIELD RIVER WATERSHED

### INTRODUCTION
Fish contaminant monitoring is a cooperative effort between three MA DEP Divisions/Offices, (Watershed Management (DWM), Environmental Analysis, Research and Standards), the Department of Fish and Game, and the Department of Public Health (MA DPH). Fish contaminant monitoring is typically conducted to assess the concentrations of toxic contaminants in freshwater fish, identify waterbodies where those concentrations may pose a risk to human health, and identify waters where toxic contaminants may impact fish and other wildlife.

During the summer of 2001 fish from Congamond Lake and Pequot Pond were collected and analyzed for selected metals, PCB and organochlorine pesticides. The objective of the fish contaminant monitoring was designed to screen the edible fillets of several species of fish desired by the angling public for consumption, as well as species representing different feeding guilds (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals (Pb, Cd, Se, Hg, As), PCB, and organochlorine pesticides. These data are used by the Massachusetts Department of Public Health in assessing human health risks associated with the consumption of freshwater fishes.

### Project Objectives
Fish tissue monitoring is typically conducted to assess the levels of toxic contaminants in freshwater fish, identify waterbodies where those levels may impact human health, and identify waters where toxic chemicals may impact fish and other aquatic life. Nonetheless, human health concerns have received higher priority and, therefore, fish tissue analysis has been restricted to edible fillets. The fish toxics monitoring was designed to screen the edible fillets of several species of fish representing different feeding groups (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals, Polychlorinated biphenyls (PCBs) and chlorinated pesticides. In 2001, MA DEP DWM Fish Toxics Monitoring was conducted under an EPA-approved Fish Toxics Quality Assurance Project Plan (MA DEP 2001). Data Quality Objectives are presented in the above-mentioned QAPP. There were no deviations from the QAPP.

### METHODS
Details related to the collection, handling, and processing of samples were excerpted from the report entitled *2001 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta and Colonna-Romano 2002).

#### Field Methods
Waterbodies were sampled using an electrofishing boat. Electrofishing was performed by maneuvering the boat through the littoral zone and shallow water habitat of a given waterbody and collecting most fish shocked. Fish collected by electrofishing were stored in a live-well filled with site water until the completion of sampling. In all cases live fish, that were not included as part of the sample, were released. Fish that were included in the sample were stored on ice. Table E1 contains the results of the fish tissue analyses.

The following samples were retained and subsequently submitted for analysis:

| Waterbody | Date Sampled | Fish Species (number of fish) |
|---|---|---|
| Congamond Lake | 06/18/01 | largemouth bass *Micropterus salmoides* (3) |
| | | brown bullhead *Ameiurus nebulosus* (3) |
| | | bluegill and pumpkinseed *Lepomis* spp. (3) |
| Pequot Pond | 06/19/01 | largemouth bass *Micropterus salmoides* (3) |
| | | brown bullhead *Ameiurus nebulosus* (3) |
| | | bluegill *Lepomis macrochirus* sp. (3) |

#### Laboratory Methods
Fish were placed on ice and brought to MA DEP's Division of Watershed Management in Worcester where lengths and weights were measured and fish were visually inspected for tumors, lesions, or other

indications of stress or disease. Scale samples or pectoral fin spines were obtained from each fish to determine the approximate age of the fish. Species, length, and weight data can be found in Table E1.

All equipment used in the filleting process was rinsed in tap water and then rinsed twice in de-ionized water before and or after each sample. Samples (individual or composite) targeted for % lipids, PCBs and organochlorine pesticide analysis were wrapped in aluminum foil. Samples targeted for metals analysis were placed in VWR high-density polyethylene (HDPE) cups with covers. Composite samples were composed of three fillets from like-sized individuals of the same species (occasionally the same genus). Two bluegill and one pumpkinseed from Congamond Lake (analysis # 2001003) that were composited prior to analysis. Samples were tagged and frozen for subsequent delivery to the Department's Wall Experiment Station (WES).

Methods used at WES for metals analysis include the following:
Mercury is analyzed by a cold vapor method using a Perkin Elmer, FIMS (Flow Injection Mercury System), which uses Flow Injection Atomic Absorption Spectroscopy. Cadmium and lead are analyzed using a Perkin Elmer, Optima 3000 XL ICP - Optical Emission Spectrophotometer. Arsenic and selenium are analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace, Atomic Absorption Spectrophotometer.

PCB Arochlor, PCB congener, and organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector "according to the modified AOAC 983.21 procedure for the analysis of PCB Arochlors, Congeners, and Organochlorine Pesticides." Additional information on analytical technique used at WES is available from the laboratory. According to standard practice, all laboratory analytical results were forwarded to the Massachusetts Department of Public Health.

**RESULTS**

The results of MA DEP Westfield River Watershed fish toxics monitoring surveys are described below for each sampling event (Maietta and Colonna-Romano 2002). Data for these surveys are presented in Table E1. All raw data files, field sheets, lab reports, chain of custody forms, and other metadata are maintained in databases at the MA DEP Division of Watershed Management office in Worcester. Quality assurance data are available in a data validation report (MA DEP 2004).

**Congamond Lakes (North, Middle, and South Basins):** Congamond Lake is composed of three interconnected basins located in the town of Southwick. Congamond Lake (Middle Basin) is a 267-acre eutrophic pond located in between the 48-acre North and 135-acre South basins. The watershed surrounding the lake is a 50/50 mix of medium density residential and croplands. Approximately 95% of the shoreline area is developed with seasonal and year round residences. Dense beds of submerged/emergent and floating aquatic macrophytes cover much of the littoral area.

Mercury concentrations were below the MDPH trigger level of 0.5 mg/kg in the three samples analyzed. Arsenic, lead, and selenium were either below method detection limits (MDLs) or at concentrations that do not appear to be of concern. Cadmium was slightly elevated (0.94 mg/kg) in the largemouth bass sample. PCB and most pesticides were below method detection limits. The largemouth bass sample contained a trace amount of a DDE (0.020 mg/kg). The USFDA Action Level for DDT and its metabolites (DDE and DDD) is 5.0 mg/kg.

**Pequot Pond (Hampton Pond):** Pequot Pond is a 154-acre mesotrophic pond located in Westfield/ Southampton. The immediate watershed is a mix of medium density residential and forest. The shoreline is approximately 40% developed with seasonal and year-round homes. Hampton Ponds State Park is located in the southeastern corner of the pond.

Mercury concentrations were below the MDPH trigger level of 0.5 mg/kg in the three samples analyzed. Arsenic, cadmium, lead, and selenium were either below MDLs or at concentrations that do not appear to be of concern. PCB and organochlorine pesticides were below method detection limits (MDLs) in all samples analyzed from Pequot Pond.

**Table E1. 2001 Westfield River Watershed Fish Contaminant Survey. Fish contaminant data (mg/kg wet wt. unless otherwise specified) for Congamond Lake, Southwick, and Pequot Pond, Southhampton.**

| Analysis # | Sample ID | Collection Date | Species Code [1] | Length (cm) | Weight (g) | Sample Type [2] | Cd | Pb | Hg | As | Se | % Lipids | PCB (ug/g) | Pesticides (ug/g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Congamond Lake** | | | | | | | | | | | | | | |
| 2001001 | CLF01-01 | 06/18/01 | LMB | 35.0 | 600 | Composite | 0.94 | <0.80 | 0.47* | <0.060 | 0.16 | 0.27 | ND[3] | ND |
| | CLF01-02 | 06/18/01 | LMB | 35.8 | 600 | | | | | | | | | |
| | CLF01-03 | 06/18/01 | LMB | 35.0 | 680 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 2001002 | CLF01-04 | 06/18/01 | BB | 30.0 | 420 | Composite | <0.08 | <0.80 | <0.010 | <0.060 | 0.15 | 0.29 | ND | ND |
| | CLF01-05 | 06/18/01 | BB | 32.2 | 420 | | | | | | | | | |
| | CLF01-06 | 06/18/01 | BB | 32.2 | 430 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 2001003 | CLF01-07 | 06/18/01 | B | 19.0 | 120 | Composite | <0.08 | <0.80 | 0.090* | <0.060 | 0.21 | 0.11 | ND | ND |
| | CLF01-08 | 06/18/01 | B | 18.0 | 120 | | | | | | | | | |
| | CLF01-09 | 06/18/01 | P | 18.0 | 120 | | | | | | | | | |
| **Pequot Pond** | | | | | | | | | | | | | | |
| 2001004 | PLF01-01 | 06/19/01 | LMB | 30.0 | 300 | Composite | <0.08 | <0.80 | 0.32 | <0.060 | 0.15 | 0.05 | ND | ND |
| | PLF01-02 | 06/19/01 | LMB | 28.6 | 280 | | | | | | | | | |
| | PLF01-03 | 06/19/01 | LMB | 28.7 | 290 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 2001005 | PLF01-04 | 06/19/01 | B | 20.0 | 180 | Composite | <0.08 | <0.80 | 0.14 | <0.060 | 0.22 | 0.30 | ND | ND |
| | PLF01-05 | 06/19/01 | B | 21.0 | 180 | | | | | | | | | |
| | PLF01-06 | 06/19/01 | B | 20.2 | 160 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 2001006 | PLF01-07 | 06/19/01 | BB | 32.4 | 460 | Composite | <0.08 | <0.80 | 0.040 | <0.060 | 0.10 | 0.19 | ND | ND |
| | PLF01-08 | 06/19/01 | BB | 31.5 | 440 | | | | | | | | | |
| | PLF01-09 | 06/19/01 | BB | 31.5 | 400 | | | | | | | | | |

[1]Species Code:
largemouth bass (LMB) *Micropterus salmoides*
brown bullhead (BB) *Ameiurus nebulosus*
bluegill (B) *Lepomis macrochirus*
pumpkinseed (P) *Lepomis gibbous*
[2]Sample Type (All samples were fillets with skin off.)
[3]ND = Not Detected
*Analyzed beyond EPA recommended holding time of 28 days.

**REFERENCES**

MA DEP. 2001. *Quality Assurance Project Plan for 2001 Fish Toxics Monitoring.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2004. CN 149.0. *Data Validation Report for Year 2001 Project Data.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Maietta, R. J. and J. Colonna-Romano. 2002. *2001 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

# APPENDIX F
## MA DEP DWM 1996 AND 2001 LAKES SURVEY DATA
## WESTFIELD RIVER WATERSHED

**1996**

In the Westfield River Watershed DWM conducted synoptic surveys at 30 lakes during the 1996 field season. Observations, from at least one access point on each lake (multiple access points on larger lakes) were recorded on standardized field sheets. An attempt was made to observe the entire surface area of each lake to determine the extent of aerial macrophyte cover. At each sampling location general water quality conditions, identification and abundance of aquatic and wetland macrophyte plant species, and estimates of total percent areal coverage were recorded. Macrophyte visual observations were augmented at each station by identifying plant specimens collected from the lake bottom. Specimens were retrieved using a "rake" (a short handled, double-sided garden rake on a 50 foot line) thrown to its maximum extension in multiple directions at each station. Macrophytes collected in the "rake" were identified (on site or in the laboratory) and recorded on the field sheets. Transparency was measured where possible using a standard 20-centimeter diameter Secchi disk. Where Secchi disk measurements were not feasible transparency was estimated as being above or below 1.2 meters (the bathing beach guideline). Trophic status was estimated primarily using visual observations of macrophyte cover and phytoplankton populations. A more definitive assessment of trophic status would require more extensive collection of water quality and biological data.

**Table F1. 1996 Westfield River Watershed lake observations and trophic status estimates.**

| Lake Name, Location | Waterbody Identification Code (WBID) | Trophic Status Estimate | Survey Observations |
|---|---|---|---|
| Ashley Cutoff*, Holyoke | MA32001 | M | Clear; little turbidity; slight brown silt on rocks and vegetation; few patches of floating leaf plants and very dense submergent (well below surface) on northwest side, very dense floating and submergent plants in southeast cove |
| Ashley Pond*, Holyoke | MA32002 | M | Slight to moderate green/gray to brown turbidity; black staining on rocks and orange floc at some shore locations; occasional algae on rocks and white foam on shore; moderate density of submergents and some very dense patches on northeast side, sparse plant cover throughout most of pond |
| Blair Pond*, Blandford | MA32009 | M | Slight stain; little turbidity; moderate brown silt over rock and gravel bottom; very dense submergent and floating leaf plants in southern cove, remainder is open water; non-native aquatic species (Cc) |
| Borden Brook Reservoir*, Granville/Blandford | MA32011 | U | Dark stain; slight turbidity; white foam on shore; moss present on rocks; sparse plant cover |
| Buck Pond, Westfield | MA32012 | E | Slight stain; slight turbidity; brown powdery scum; brown silt over sandy bottom; very dense floating leaf, submergent and encroaching emergents around perimeter and band across center of pond (about 50% of the pond affected); non-native aquatic species (Mh) |
| Center Pond, Becket | MA32015 | U | No stain; little turbidity; slight brown silt and some green algae on sand and rock bottom; sparse floating vegetation, possibly denser submergent cover next to beach and at southern end of the pond |
| Clear Pond*, Holyoke | MA32077 | M | No stain; slight turbidity, slight brown silt on rock and vegetation bottom; very dense submergent plants and nearly to the surface; non-native wetland species (Ls) |

* Indicates Class A (water supply) water body; all others are Class B.
**Trophic Status Estimate:** O = Oligotrophic, M = Mesotrophic, E = Eutrophic, H = Hypereutrophic, U = Undetermined.
**Non-native Aquatic Plants:** Cc = *Cabomba caroliniana*, Mh = *Myriophyllum heterophyllum* , Ms = *Myriophyllum spicatum*
**Non-native Wetland Plants:** Pa = *Phragmites australs*, Ls = *Lythrum salicaria*

**Table F1 (cont). 1996 Westfield River Watershed lake observations and trophic status estimates.**

| Lake Name, Location | Waterbody Identification Code (WBID) | Trophic Status Estimate | Survey Observations |
|---|---|---|---|
| Cobble Mountain Reservoir*, Blandford/ Granville/Russell | MA32018 | U | Clear to slight stain; slight turbidity; moderate brown silt and much undecomposed matter over rock and muck bottom; sparse plant cover |
| Conqamond Lake (Middle Basin), Southwick | MA32021 | M | No stain; moderate green turbidity; slight brown silt over sand and gravel bottom; periphyton on vegetation; very dense floating and submerged plant life along both shores, north of access (northeast end of lake) and along east shore to south of access (< 5 acres affected), very dense floating leaf and submergent plants in cove next to access (SW end of lake) and along east shore, dense patches along west shore (about 10 acres total affected area); non-native aquatic species (Ms) |
| Congamond Lake (North Basin), Southwick | MA32022 | U | No water quality observations; very dense submergent plant cover along both banks of southern cove (about 5 acres affected), remainder of the pond is not visible; non-native aquatic species (Ms) |
| Congamond Lake (South Basin), Southwick | MA32023 | U | No water quality observations; non-native aquatic species (Ms) based on local observer's comments |
| Connor Reservoir*, Holyoke | MA32024 | E | Clear; little turbidity; much vegetation, perimeter is dense with floating leaf plants along south shore, very dense submergent plants, but not reaching the surface, southwest area very dense with floating leaf plants |
| Crooked Pond, Plainfield | MA32028 | U | Dense submergent and floating leaf plants in northeast cove and around much of the shore (about 25% of the pond affected) |
| Damon Pond, Chesterfield/ Goshen | MA32029 | E | Moderate tea stain; slight turbidity (> 1.2 m SD, est.); slight fine muck over rock and gravel bottom at the outlet; about a third of the lower cove covered by dense submergent plants, most of the open water dense with clusters of yellow flowers indicating dense submergent plant growth, some patches of floating leaf plants, moderate cover on north end |
| Garnet Lake, Peru | MA32037 | U | Clear; slight turbidity; slight silt over sand, rock, and vegetation bottom; powdery brown scum on surface at outlet; patches of moderate emergent and floating leaf plant cover frequent around the pond, overall moderate cover |
| Granville Reservoir*, Granville | MA32038 | U | Very little stain; very little turbidity; brown silt over vegetated bottom; plant cover sparse in lower area of the lake |
| Hammond Pond, Goshen | MA32040 | U | Moderate tea stain; moderate brown turbidity (likely > 1.2 m SD, est.); slight brown muck over sand and gravel bottom; plant cover sparse throughout pond, except moderate floating leaf patch at north end |
| Horse Pond, Westfield | MA32043 | E | Very slight stain; slight turbidity; vegetation on bottom; north end has islands of emergent plants surrounded by very dense floating leaf and submergent plants, west shore very dense, east shore mostly open water, southeast and south shores with very dense floating leaf plants along perimeter (about a third of the pond covered with very dense plants); non-native aquatic species (Mh, Ms) |

* Indicates Class A (water supply) water body; all others are Class B**.**

**Trophic Status Estimate:** O = Oligotrophic, M = Mesotrophic, E = Eutrophic, H = Hypereutrophic, U = Undetermined.

**Non-native Aquatic Plants:** Cc = *Cabomba caroliniana*, Mh = *Myriophyllum heterophyllum* , Ms = *Myriophyllum spicatum*

**Non-native Wetland Plants:** Pa = *Phragmites australs*, Ls = *Lythrum salicaria*

**Table F1 (cont). 1996 Westfield River Watershed lake observations and trophic status estimates.**

| Lake Name, Location | Waterbody Identification Code (WBID) | Trophic Status Estimate | Survey Observations |
|---|---|---|---|
| Littleville Lake*, Chester/ Huntington | MA32046 | U | Slight stain; very little turbidity; sandy silt and some undecomposed matter over rock bottom; sparse vegetation throughout the pond. Non-native species observed (Ls) |
| McLean Reservoir*, Holyoke | MA32050 | U | No stain; slight turbidity; moderate brown silt over rocks, muck and decomposed matter on bottom; sparse plant cover over entire pond |
| North Railroad Pond*, Holyoke | MA32053 | E | Little open water to observe; heavy brown turbidity observed from a distance (likely < 1.2 m SD, est.); nearly 100% covered with floating leaf plants |
| Norwich Pond, Huntington | MA32054 | U | Clear; little turbidity; little silt on sand and gravel bottom; white foam on windward shore; some orange staining along shore north of ramp; sparse plant cover throughout pond |
| Robin Hood Lake, Becket | MA32057 | U | Slight to moderate stain; moderate turbidity; large amounts of undecomposed matter on bottom, slight brown silt over sand at beach areas; some orange stain and oily scums near beaches on northeast "arm" and along east shore; sparse aquatic plant cover throughout pond; pond likely treated chemically; many lawns in the area and densely developed shoreline; non-native wetland plant (Pa) |
| Rudd Pond, Becket | MA32060 | U | Slight stain; slight turbidity; slight brown silt on rocks, undecomposed debris on bottom; sparse plant cover throughout the pond |
| Russell Pond, Russell | MA32061 | U | Clear; little turbidity; slight brown silt over vegetation and some partly decomposed matter on bottom; sparse plant cover throughout; shallow at dam end, leaking under spillway |
| Scout Pond, Chesterfield | MA32063 | M | Slight stain; slight turbidity; bottom mainly undecomposed organic matter; band of dense emergents around much of pond, moderate submerged plant cover with floating leaf plants in patches (< 10% of the pond affected) |
| Westfield Reservoir, Montgomery | MA32074 | U | Slight stain; slight turbidity; moderate brown silt/floc on rocks and partly to undecomposed matter on bottom; sparse plant cover throughout the reservoir |
| Windsor Pond, Windsor | MA32076 | U | Very slight stain; very slight turbidity; slight brown silt over rock and muck bottom; occasional patches of emergent and floating leaf plants around shore (< 10% of the pond affected); non-native aquatic species (Ms) |
| Wright Pond*, Holyoke | MA32078 | M | Clear; slight turbidity, green/gray turbidity in small cove on south side; slight brown silt on rocks and green algae on some rocks throughout most of the pond; sparse plant cover in northeast corner, very dense submergent plantss in most of the north basin and cove on south side; non-native wetland species (Ls) |
| Yokum Pond, Becket | MA32079 | U | Clear; little turbidity; slight brown over stone, gravel, and sand bottom; sparse plant cover throughout most of the lake with a few moderate beds of emergent plants |

* Indicates Class A (water supply) water body; all others are Class B**.**
**Trophic Status Estimate:** O = Oligotrophic, M = Mesotrophic, E = Eutrophic, H = Hypereutrophic, U = Undetermined.
**Non-native Aquatic Plants:** Cc = *Cabomba caroliniana*, Mh = *Myriophyllum heterophyllum* , Ms = *Myriophyllum spicatum*
**Non-native Wetland Plants:** Pa = *Phragmites australs*, Ls = *Lythrum salicaria*

**2001**

In the Westfield River Watershed a baseline lake survey was conducted for Congamond Lakes (North, Middle, and South basins). Data were collected on 19 June, 18 July, and 22 August 2001 to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. A technical memorandum (CN167.0) entitled *Baseline Lake Survey 2001 Technical Memo* provides details of sample collection methods, results, data, and weed maps for the lakes surveyed in the Westfield, Taunton, South Coastal, and SuAsCo Watersheds in 2001 (Mattson and Haque 2004).

*In situ* measurements using a Hydrolab® multiprobe (measuring dissolved oxygen, water temperature, pH, specific conductivity, and depth and calculating total dissolved solids and % oxygen saturation) were recorded at deep hole stations and at various depths creating profiles. In-lake samples were also collected and analyzed for alkalinity, total phosphorus, apparent color, and chlorophyll *a* (an integrated sample). Procedures used for water sampling and sample handling are described in the *Grab Collection Techniques for DWM Water Quality Sampling Standard Operating Procedure* and the *Hydrolab® Series 3 Multiprobe Standard Operating Procedure* (MA DEP 1999a and MA DEP 1999b). The Wall Experiment Station (WES), the Department's analytical laboratory, supplied all sample bottles and field preservatives, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MA DEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to WES Standard Operating Procedures (SOPs). Both quality control samples (field blanks, trip blanks, and split samples) and raw water quality samples were transported on ice to WES on each sampling date; they were subsequently analyzed according to the WES SOP. Information about data quality objectives (accuracy, precision, detection limits, holding times, representativeness and comparability) is available in the 2001 Data Validation Report (MA DEP 2004). Apparent color and chlorophyll *a* were measured according to standard procedures at the MA DEP office in Worcester (MA DEP 1999c and MA DEP 1999d). An aquatic macrophyte survey was conducted at each lake. The aquatic plant cover (native and non-native) and species distribution was mapped and recorded. Details on procedures used can be found in the TMDL Baseline Lakes Survey 2001 (Mattson and Haque 2004). Data were excerpted from the Baseline Lake Survey 2001 Technical Memo and presented in Tables F2, F3 and F4. Data qualifiers were excerpted from the Data Validation Report for Year 2001 Project Data and can be found in Table F5 (MA DEP 2004).

**Table F2. 2001 Congamond Lake (Middle Basin) Hydrolab® and Water Quality Data (see any data qualifiers in Table F5).**

**Congamond Lakes (Palis: 32021)**
Unique ID: W0923, Station: A, Description: Deep hole, center of Middle Basin, Southwick

| Date | OWMID | Time | Depth | Temp | pH | Conductivity at 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | © | (SU) | (uS/cm) | (mg/l) | (mg/l) | (%) |
| 06/19/01 | LB-1208 | 10:40 | 0.5 | 25.8u | 7.6cu | 163 | 105 | 9.1u | 109u |
| | | 10:55 | 1.5 | 25.2u | 7.6cu | 163 | 104 | 8.9 | 106 |
| | | 11:02 | 2.5 | 24.7u | 7.5c | 163 | 104 | 8.1u | 95u |
| | | 11:07 | 3.5 | 21.1u | 7.6c | 165 | 106 | 9.4u | 103u |
| | | 11:14 | 4.5 | 17.7u | 7.5cu | 167 | 107 | 9.5u | 97u |
| | | 11:21 | 5.4 | 14.5u | 7.4cu | 167 | 107 | 9.2u | 88u |
| | | 11:29 | 6.4 | 12.7u | 7.1cu | 168 | 108 | 6.5u | 60u |
| | | 11:37 | 7.4 | 10.6 | 6.8u | 169 | 108 | 0.9u | 8u |
| | | 11:43 | 8.5 | 9.1 | 6.6u | 170 | 109 | <0.2 | <2 |
| | | 11:48 | 9.2 | 8.7 | 6.6 | 177 | 113 | <0.2 | <2 |
| 07/18/01 | LB-1301 | 11:05 | 0.5 | 24.3 | 8.1c | 167 | 107 | 9.6 | 112 |
| | | 11:20 | 1.5 | 24.0 | 8.1c | 168 | 107 | 9.7 | 113 |
| | | 11:25 | 3.4 | 23.9 | 8.0c | 167 | 107 | 9.5 | 110 |
| | | 11:32 | 4.5 | 22.9u | 7.5c | 168 | 108 | 7.9u | 90u |
| | | 11:40 | 5.5 | 19.2u | 7.0cu | 170 | 109 | 6.3u | 66u |
| | | 11:47 | 6.5 | 14.8u | 6.7 | 169 | 108 | 3.6 | 35 |
| | | 11:53 | 7.5 | 12.0 | 6.6 | 167 | 107 | 2.8u | 25u |
| | | 11:59 | 8.5 | 10.2 | 6.5 | 172 | 110 | <0.2 | <2 |
| | | 12:04 | 10.0 | 8.8 | 6.5 | 187 | 120 | <0.2 | <2 |
| | | 12:09 | 11.5 | 8.0u | 6.4 | 224u | 144u | <0.2 | <2 |
| 08/22/01 | LB-1394 | 11:26 | 0.5 | 26.4 | 8.6c | 168 | 108 | 9.9 | 120 |
| | | 11:37 | 2.5 | 26.0 | 8.6c | 168 | 107 | 9.9 | 119 |
| | | 11:44 | 4.0 | 25.8 | 8.4c | 168 | 108 | 9.1u | 109u |
| | | 11:53 | 5.0 | 23.1 | 6.7 | 172 | 110 | ##u | ##u |
| | | 11:59 | 6.0 | 19.8u | 6.5 | 173 | 110 | 0.6u | 6u |
| | | 12:05 | 7.0 | 15.9u | 6.4 | 171 | 109 | <0.2 | <2 |
| | | 12:13 | 8.0 | 11.7u | 6.4 | 174u | 111u | <0.2 | <2 |
| | | 12:19 | 9.5 | 9.5u | 6.4 | 195 | 125 | <0.2 | <2 |
| | | 12:29 | 11.4 | 8.3 | 6.2 | 232u | 148u | <0.2 | <2 |

**Congamond Lakes (Palis: 32021)**
Unique ID: W0923, Station: A, Description: Deep hole, center of Middle Basin, Southwick

| Date | Secchi Depth | Secchi Time | Station Depth | OWMID | QAQC | Time | Sample Depth | Relative Depth | Alkalinity | TP | Apparent Color | Chloro-phyll a |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | m | 24 hr | m | | | 24hr | m | | mg/l | mg/l | PCU | mg/m3 |
| 06/19/01 | 3.0 | 10:37 | 9.8 | LB-1204 | LB-1203 | ** | 0.5 | Surface | 20d | 0.021 | 22 | -- |
| | | | | LB-1203 | LB-1204 | 11:55 | 0.5 | Surface | 11d | 0.021 | 16 | -- |
| | | | | LB-1205 | -- | ** | 9.3 | Bottom | 48 | 0.046 | 24 | -- |
| | | | | LB-1206 | LB-1207 | ** | 0 - ** | Integrated | -- | -- | -- | 8.6 |
| | | | | LB-1207 | LB-1206 | ** | 0 - ** | Integrated | -- | -- | -- | 10.4 |
| 07/18/01 | 2.7 | 11:00 | 12.0 | LB-1296 | LB-1297 | 11:30 | 0.5 | Surface | 43 | 0.017 | <15h | |
| | | | | LB-1297 | LB-1296 | 11:35 | 0.5 | Surface | 43 | 0.016 | <15h | |
| | | | | LB-1298 | -- | 12:30 | 11.5 | Bottom | 73 | 0.19 | 65h | |
| | | | | LB-1299 | LB-1300 | 12:24 | 0 – 8.1 | Integrated | | | | 12.9 |
| | | | | LB-1300 | LB-1299 | 12:26 | 0 – 8.1 | Integrated | | | | 12.1 |
| 08/22/01 | 2.4 | 11:50 | 12.0 | LB-1390 | LB-1389 | 12:15 | 0.5 | Surface | 44 | 0.019b | 22 | |
| | | | | LB-1389 | LB-1390 | 12:15 | 0.5 | Surface | 43 | 0.020b | 18 | |
| | | | | LB-1391 | -- | 12:30 | 11.4 | Bottom | 85 | 0.34b | 75 | |
| | | | | LB-1392 | LB-1393 | 12:45 | 0 – 7.2 | Integrated | | | | 16.7 |
| | | | | LB-1393 | LB-1392 | 12:50 | 0 - 7.2 | Integrated | | | | 15.6 |

**Table F3. 2001 Congamond Lake (North Basin) Hydrolab® and water quality data**

**Congamond Lakes (Palis: 32022)**
Unique ID: W0924, Station: B, Description: Deep hole, center of North Pond, Southwick

| Date | OWMID | Time | Depth | Temp | pH | Conductivity at 25°C | TDS | DO | Saturation |
|---|---|---|---|---|---|---|---|---|---|
| | | (24hr) | (m) | (C) | (SU) | (uS/cm) | (mg/l) | (mg/l) | (%) |
| 06/19/01 | LB-1213 | 13:49 | 0.5 | 26.5 | 7.3cu | 119 | 76.2 | 8.6u | 105u |
| | | 13:54 | 1.5 | 25.5u | 7.4cu | 119 | 76.0 | 8.6 | 102 |
| | | 13:59 | 2.5 | 24.7u | 7.7cu | 119 | 76.0u | 9.2u | 107u |
| | | 14:05 | 3.5 | 21.5u | 7.9c | 118 | 75.6 | 10.0u | 111u |
| | | 14:09 | 4.4 | 17.1u | 7.9cu | 118 | 75.8u | 11.5u | 116u |
| | | 14:15 | 5.4 | 13.0u | 7.7cu | 121 | 77.6u | 11.6u | 107u |
| | | 14:21 | 6.4 | 10.0u | 7.4cu | 124 | 79.5 | 11.1u | 96u |
| | | 14:27 | 7.4 | 8.1 | 7.4c | 126 | 80.7 | 12.0u | 99u |
| | | 14:32 | 8.4 | 6.6u | 6.9cu | 129 | 82.3 | 1.4u | 11u |
| | | 14:37 | 10.4 | 5.6u | 6.7u | 136 | 86.8 | <0.2u | <2u |
| 07/18/01 | LB-1305 | 14:12 | 0.5 | 25.1 | 8.1c | 122u | 78.1u | 8.9u | 106u |
| | | 14:22 | 2.5 | 24.3u | 8.2c | 121 | 77.7 | 9.1 | 107 |
| | | 14:27 | 4.5 | 23.2u | 8.3c | 121u | 77.3u | 10.3u | 118u |
| | | 14:33 | 5.5 | 17.4u | 7.6cu | 121 | 77.4 | 11.9 | 122 |
| | | 14:38 | 6.5 | 13.6u | 7.1cu | 123 | 78.9 | 11.0u | 103u |
| | | 14:43 | 7.5 | 10.6 | 7.0cu | 125u | 79.9u | 10.5u | 92u |
| | | 14:48 | 8.5 | 8.8 | 6.7u | 126 | 80.8 | ##u | ##u |
| | | 14:55 | 10.0 | 6.8u | 6.3u | 129u | 82.7u | <0.2 | <2 |
| | | 14:59 | 11.5 | 5.8 | 6.2 | 141u | 90.2u | <0.2 | <2 |
| | | 15:06 | 12.2 | 5.7u | 6.2 | 144u | 91.8u | <0.2 | <2 |
| 08/22/01 | LB-1398 | 14:44 | 0.5 | 27.4u | 8.3cu | 126 | 80.4 | 9.2u | 113u |
| | | 14:56 | 2.5 | 26.8u | 8.3c | 126 | 80.3 | 9.2u | 113u |
| | | 15:01 | 4.0 | 26.5 | 8.2c | 125 | 80.3 | 9.2u | 112u |
| | | 15:06 | 5.0 | 23.6 | 8.9c | 123 | 79.0 | 13.8 | 159 |
| | | 15:13 | 6.0 | 17.9u | 7.2cu | 124 | 79.3 | ##u | ##u |
| | | 15:18 | 7.0 | 14.3u | 6.7u | 126 | 80.3 | 8.3u | 79u |
| | | 15:24 | 8.0 | ##u | 6.4 | 127 | 81.2 | ##u | ##u |
| | | 15:30 | 9.0 | 9.4u | 6.2u | 127 | 81.3 | 1.9u | 16u |
| | | 15:35 | 10.5 | 7.2 | 6.0 | 137u | 87.8u | <0.2 | <2 |
| | | 15:42 | 12.0 | 6.2 | 6.0 | 148 | 94.9 | <0.2 | <2 |

**Congamond Lakes (Palis: 32022)**
Unique ID: W0924, Station: B, Description: Deep hole, center of North Pond, Southwick

| Date | Secchi | Secchi Time | Station Depth | OWMID | Time | Sample Depth | Relative Depth | Alkalinity | TP | Apparent Color | Chloro-phyll a |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | m | 24hr | m | | 24hr | m | | mg/l | mg/l | PCU | mg/m3 |
| 06/19/01 | 4.6 | 13:45 | 13.4 | LB-1210 | ** | 0.5 | Surface | 11 | 0.017b | <15 | -- |
| | | | | LB-1211 | ** | 10.8 | Bottom | 34 | 0.068b | 24 | -- |
| | | | | LB-1212 | ** | 0 - ** | Integrated | -- | -- | -- | 2.6 |
| 07/18/01 | 3.3 | 14:00 | 13.5 | LB-1302 | 14:45 | 0.5 | Surface | 30 | 0.013b | <15h | -- |
| | | | | LB-1303 | 15:05 | 12.2 | Bottom | 41 | 0.083b | 40h | -- |
| | | | | LB-1304 | 14:55 | 0 - 8.1 | Integrated | -- | -- | -- | 3.3 |
| 08/22/01 | 3.7 | 15:10 | 12.5 | LB-1395 | 15:00 | 0.5 | Surface | 30 | 0.012 | <15 | -- |
| | | | | LB-1396 | 16:00 | 12.0 | Bottom | 44 | 0.083 | 43 | -- |
| | | | | LB-1397 | 15:50 | 0 - 11.1 | Integrated | -- | -- | -- | 11.3 |

**Table F4. 2001 Congamond Lake (South Basin) Water Quality Data**

**Congamond Lakes (Palis: 32023)**

Unique ID: W0925, Station: C, Description: Deep hole, center of South Pond, Southwick

| Date | Secchi | Secchi Time | Station Depth | OWMID | Time | Sample Depth | Relative Depth | Alkalinity | TP | Apparent Color | Chloro-phyll a |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | m | 24hr | m | | 24hr | m | | mg/l | mg/l | PCU | mg/m3 |
| 06/19/01 | ** | 13:00 | 7.3 | LB-1209 | ** | 0.5 | Surface | -- | 0.025b | -- | -- |
| 07/18/01 | 1.5 | 13:15 | ** | LB-1306 | 13:15 | 0.5 | Surface | -- | 0.028b | -- | -- |
| 08/22/01 | 2.0 | 13:40 | 6.1 | LB-1399 | 13:40 | 0.5 | Surface | -- | 0.027b | -- | -- |

**Table F5. Data Symbols and Qualifiers.** (These are used in the MA DEP DWM WQD database for qualified and censored water quality and Hydrolab® 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, including the magnitude or extent of the problem(s) (MA DEP 2004).

**General Symbols (applicable to all types):**

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

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

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

" <mdl " = Less than method detection limit (MDL). Denotes a sample result that went undetected using a specific analytical method. The actual, numeric MDL is typically specified (eg. <0.2).

**Multiprobe-Specific Qualifiers:**

" **u "** = **u**nstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc.

" **c** " = greater than **c**alibration 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).

**Sample-specific Qualifiers:**

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

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

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

**REFERENCES**

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

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MA DEP. 1999b. CN 4.0 *Hydrolab® Series 3 Multiprobe, Standard Operating Procedure*. September 23, 1999. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999c. CN 2.0 *Apparent Color Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999d. CN 3.0 *Chlorophyll a Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2001. CN 65.1. *TMDL Baseline Lakes Survey 2001.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2004. CN 149.0. *Data Validation Report for Year 2001 Project Data.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Mattson, M. and A. Haque. 2004. CN 167.0. *Baseline Lake Survey 2001 Technical Memorandum (TM-S-16).* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

# APPENDIX G
## 1996/1997 MA DEP DWM WATER QUALITY MONITORING IN THE WESTFIELD RIVER WATERSHED

A preliminary monitoring plan for the Westfield River Watershed was developed by the MA DEP DWM office based on a review of past water quality reports, input from MA DEP Western Regional office staff in Springfield, the watershed association, and local input received during public information gathering meetings held throughout the basin. The following general objectives were initially identified for the 1996 Westfield River Watershed survey:

1) to quantitatively characterize ambient aluminum concentrations in the Westfield River to facilitate review of NPDES permits,
2) to determine the existence and extent of sedimentation impacts from known and suspected nonpoint sources in the basin,
3) to identify areas impacted by bacterial contamination that may impair recreational use and threaten public health,
4) to determine the extent to which macrophytes impact the recreational use of lakes and ponds;
5) to identify lakes and ponds containing exotic plant species,
6) to assess the degree of impact from point source discharges via biological monitoring above and below selected NPDES discharges,
7) to assess the habitat in the Little River with regards to flow management,
8) to evaluate the water quality in the Westfield River during wet weather conditions, and
9) to assess the degree to which waters of the Westfield River Watershed support their designated uses.

It became necessary to make modifications to the monitoring plan during the 1996 sampling period. Ultimately, the revised 1996 monitoring plan concentrated on objectives 3, 4, 5, 6, 7 and 9 above. The water quality sampling matrix for the DWM 1996 Westfield River Watershed survey is summarized in Table G1. Bacteria samples were collected from the Main, Middle, and West branches of the Westfield River and numerous tributaries to these subwatersheds. Samples were collected twice at most stations in the spring and summer at a variety of flow conditions. Many of the tributary stream stations were established near their confluences with the larger branches. If fecal coliform contamination was detected at these locations, upstream investigative sampling was recommended.

Additionally, water quality monitoring was conducted by DWM in eight streams in 1997 as part of the 104(b)(3) Numeric Biocriteria Development Project surveys. Water quality sampling was restricted to in-situ Hydrolab® measurements of depth, pH, dissolved oxygen, conductivity, temperature, total dissolved solids, and turbidity. The surveyed streams were: Little River, Kinne Brook, Sanderson Brook, Roaring Brook, Bradley Brook, Moose Meadow Brook, Bedlam Brook, and Dickerson Brook. Sampling of these streams was completed during the week of 22-26 September 1997. In addition to characterizing the stream biota in the Berkshire Transition subecoregion, physical characteristics and habitat assessments were performed by Division of Watershed Management biologists at each 100-meter sampling reach.

**Table G1: Westfield River Watershed Sampling Summary for Water Quality – 1996-1997 Segment Numbers, Station IDs, and Parameters**

| Station ID | Unique ID[1] | 8 May 1996 | 9 May 1996 | 22 May 1996 | 23 May 1996 | 30 July 1996 | 5 Aug 1996 | 6 Aug 1996 | 12 Aug 1996 | 13 Aug 1996 | Sept 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WSFR56.8 | W0215 | | B | | | | B | | | | |
| SWFR50.6 | W0216 | | B | | | | B | | | | |
| WSFR48.1 | W0217 | | B | | | | B | | | | |
| WSFR42.7 | W0218 | | B | | | | B | | | | |
| WSFR38.0 | W0219 | | | | | | B | | | | |
| WSFR26.8 | W0220 | B | | | | B | B | | | | |
| MEDB00.2 | W0273 | | B | | | | B | | | | |
| SWFT00.2 | W0272 | | B | | | | B | | | | |
| WBWC00.1 | W0271 | | | | | | B | | | | |

[1]Unique ID = unique station identification number, B = Fecal coliform bacteria, H = Hydrolab® meter (pH, temperature, dissolved oxygen, percent saturation, specific conductance), O = Dissolved oxygen YSI meter

* This data collection effort was conducted as part of the numeric biocriteria development project

**Table G1 (continued)**

| Station ID | Unique ID[1] | 8 May 1996 | 9 May 1996 | 22 May 1996 | 23 May 1996 | 30 July 1996 | 5 Aug 1996 | 6 Aug 1996 | 12 Aug 1996 | 13 Aug 1996 | Sept 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WATS00.1 | W0269 | | B | | | | B | | | | |
| WRDS00.0 | W0270 | | B | | | B | B | | | | |
| LRWT00.1 | W0268 | | B | | | B | B | | | | |
| BT08LIT | W0267 | | | | | | | | | | H |
| MBWF16.4 | W0258 | | | | | B | | | | | |
| MBWF14.4 | W0259 | | | | | B | | | | | |
| MBWF09.3 | W0260 | | | | | B | | | | | |
| MBWF07.5 | W0261 | | | | | B | | | | | |
| MBWF05.2 | W0262 | | | | | B | | | | | |
| MBWF04.0 | W0263 | | | | | B | | | | | |
| MBWF00.4 | W0264 | B | | | | B | | | | | |
| GDBR00.4 | W0266 | | | | | B | | | | | |
| BT05KIN | W0265 | | | | | | | | | | H |
| WSFR23.5 | W0221 | B | | B | | | B | | | B | |
| WSFR20.3 | W0222 | | | B | | | | | | B | |
| WSRF17.3 | W0223 | | B | | | | | | | B | |
| WBWF16.1 | W0248 | B | | | | | | B | | | |
| WBWF13.2 | W0249 | | | | | | | B | | | |
| WBWF08.9 | W0250 | B | | | | | | B | | | |
| WBWF05.4 | W0251 | B | | | | | | B | | | |
| WBWF01.4 | W0252 | B | | | | | | B | | | |
| DPOB02.3 | W0256 | B | | | | | | B | | | |
| SKMB00.4 | W0257 | B | | | | | | B | | | |
| YKMB00.2 | W0255 | B | | | | | | B | | | |
| WLKB00.4 | W0254 | B | | | | | | B | | | |
| BT04SAN | W0253 | | | | | | | | | | H |
| BT07ROA | W0247 | | | | | | | | | | H |
| BDLB00.1 | W0246 | | | B | | | | | | B | |
| BT03BRA | W0245 | | | | | | | | | | H |
| PTAB00.1 | W0244 | | | | | | | | | B | |
| MMBR01.0 | W0243 | | | | B | | | | | B | |
| BT06MOO | W0242 | | | | | | | | | | H |
| LITR04.7 | W0237 | | B | | | | | | B | | |
| BT02BED | W0241 | | | | | | | | | | H |
| LITR00.2 | W0238 | | | B | | | | | B | | |
| LITRPIPE | W0239 | | | B | B | | | | B | | |
| BT01DIC | W0240 | | | | | | | | | | H |
| PDMB03.8 | W0234 | | | | B | | | | | B | |
| PDMB01.1 | W0235 | | | B | B | | | | | B | |
| PNDB0.1 | W0236 | B | | | B | | B | | | B | |
| GRTB08.6 | W0231 | | | B | | | | | B | | |
| GRTB03.1 | W0232 | | | B | | | | | B | | |
| GRTB00.3 | W0233 | | | B | | | | | B | | |
| WSFR07.2 | W0224 | | | | | | O | | | | |
| WSFR01.5 | W0225 | | | | B | | | | B | | |
| WSFR03.2 | W0226 | | | | | | O | | | | |
| WSFR00.2 | W0227 | | | | B | | O, B | | B | | |
| PCTB00.3 | W0230 | | | | B | | B | | | B | |
| MILB00.2 | W0228 | B | | | | | B | | | | |
| WHTB000 | W0229 | | | | B | | | | B | | |
| TTYB00.0 | W0214 | B | | | | | | | | | |
| MUNB00.1 | W0346 | | | | | | | | B | | |

[1]Unique ID = unique station identification number, B = Fecal coliform bacteria, H = Hydrolab® meter (pH, temperature, dissolved oxygen, percent saturation, specific conductance), O = Dissolved oxygen YSI meter

* This data collection effort was conducted as part of the numeric biocriteria development project

**Materials and Methods**
Procedures followed in 1996 are detailed in MA DEP's *Basins Program Standard Operating Procedures River and Stream Monitoring* (MA DEP 1990). The Wall Experiment Station (WES), the Department's analytical laboratory, supplied all sample bottles and field preservatives, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MA DEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to WES standard operating procedures. Quality control samples generally included field blanks, field replicates, and sample splits. In 1996 water temperature, dissolved oxygen, and pH measurements were made *in-situ* at each station using a pre-calibrated YSI® multi-parameter meter. *In-situ* measurements made in 1997 were obtained using a pre-calibrated Hydrolab® multi-probe meter.

**Quality Assurance and Quality Control**
In general, monitoring surveys in the Westfield River Watershed in 1996 were performed with attention to maintaining quality assurance and control of field samples and field-generated data. For the majority of the water quality surveys quality control samples (field blanks and sample splits) were taken at a minimum of one each per crew per survey. Typically, field monitoring activities followed accepted DWM standard operating procedures. Where strict procedures were not in place or necessary it is assumed that DWM field staff exercised best professional judgment.

Water quality sample data were validated by reviewing QC sample results, analytical holding time compliance, QC sample frequency and related ancillary data/documentation (at a minimum). Data validation for the 1996 surveys is available in a memorandum, *1994, 95 & 96 QA/QC Assessment Report* (MA DEP 2000). Specific notes regarding the Westfield River Watershed were excerpted and appear in Table G2. All YSI® and Hydrolab® multi-probe data were validated using multi-staff review. Data symbols (e.g., ** for censored/missing data) were applied to Hydrolab® data as necessary.

**Results**
Quality control data decisions appear in Table G2 (MA DEP 2000). *In-situ* Hydrolab® data from the 1997 Biocriteria numerical development in the Westfield Watershed surveys are presented in Table G3. Fecal Coliform bacteria data appear in Table G4. *In-situ* YSI® data from the 1996 watershed survey appear in Table G5.

**Table G2. 1995/1996 DWM Data Decisions for Westfield River Watershed Discrete Sample Data (excerpted from MA DEP 2000).**

| OWMID | Description / Suggested Action |
|---|---|
| **32-0061-107** | No field blank had been collected for Fecal Coliform analysis for the following Westfield surveys: 8/13/96, 8/12/96, 8/6/96, 8/5/96 and 5/22/96 (see note 1). |
| **32-0073/74**<br>**32-0058/59**<br>**32-0019/20** | Replicate results are at or below the ideal counting range of 20 CFU for Fecal Coliform analysis (see note 2). |

Notes:
1. The DWM QA Program was not fully established during the 1994, 95 and 96 sampling surveys. In addition, DWM relied on WES to supply the reagent water for field blanks. DWM staff members were not always supplied with contaminant-free reagent water. If the field blank objective was violated the associated survey data are not necessarily suspect unless a trend is found or there is documented evidence that aberrant collection, handling or analysis procedures were used. If, however, two or more data quality objectives were violated than all associated data by that sampling crew on that day are to be censored.

2. Individual analytes can not have > 20% of their replicate population outside the established data quality objectives. Analytes that exceed the 20% limit will be reviewed independently against other quality control factors (i.e. laboratory duplicate data) and decision made on their validity. The percentages are calculated and presented below in the replicate summary.

**Table G3. 1997 *In-situ* Hydrolab® Data at Biocriteria Development Project Stations in the Westfield River Watershed.**

| OWMID[1] | Date | Time (24hr) | Measurement Depth (m) | Temp (°C) | pH (SU) | Conductivity (µS/cm) | TDS (mg/L) | DO (mg/L) | Saturation (%) | Turbidity (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|
| **DICKINSON BROOK** | | | | | | | | | | |
| Station: BT01DIC, Mile Point: 3.2, Unique ID[2]: W0240 | | | | | | | | | | |
| Description: Approximately 100 meters west (upstream) of Water Street crossing, Granville. | | | | | | | | | | |
| BC-0044 | 09/23/97 | 09:30 | **i | 11.2 | 6.8 | 46.3 | 30.0 | 10.5 | 93 | 5.9i |
| **BEDLAM BROOK** | | | | | | | | | | |
| Station: BT02BED, Mile Point: 0.5, Unique ID[2]: W0241 | | | | | | | | | | |
| Description: Approximately 800 meters north (upstream) of Route 23, Blandford. | | | | | | | | | | |
| BC-0045 | 09/23/97 | 11:31 | **i | 11.5 | 7.1 | 311 | 199 | 9.9 | 88 | 4.4i |
| **MOOSE MEADOW BROOK** | | | | | | | | | | |
| Station: BT06MOO, Mile Point: 3, Unique ID[2]: W0242 | | | | | | | | | | |
| Description: Approximately 400 meters north (upstream) of Tekoa Reservoir, Westfield. | | | | | | | | | | |
| BC-0048 | 09/24/97 | 09:17 | **i | 9.8 | 6.7 | 41.6 | 27.0 | 11.0 | 94 | 2.1i |
| **BRADLEY BROOK** | | | | | | | | | | |
| Station: BT03BRA, Mile Point: 0.7, Unique ID[2]: W0245 | | | | | | | | | | |
| Description: Behind #54 Moss Hill Road, approximately 400 meters west (upstream) of Route 20, Montgomery. | | | | | | | | | | |
| BC-0046 | 09/23/97 | 14:17 | **i | 12.1 | 7.4 | 102 | 65.0 | 10.8 | 98 | 6.3i |
| **ROARING BROOK** | | | | | | | | | | |
| Station: BT07ROA, Mile Point: 0.9, Unique ID[2]: W0247 | | | | | | | | | | |
| Description: Approximately 100 meters northwest (upstream) of second Carrington Road crossing of Roaring Brook, Montgomery. | | | | | | | | | | |
| BC-0049 | 09/24/97 | 11:25 | **i | 9.5 | 7.0 | 72.8 | 47.0 | 11.0 | 93 | 4.5i |
| **SANDERSON BROOK** | | | | | | | | | | |
| Station: BT04SAN, Mile Point: 0.7, Unique ID[2]: W0253 | | | | | | | | | | |
| Description: Off the west side of Sanderson Brook Road approximately 1000 meters south (upstream) of Route 20, Chester. | | | | | | | | | | |
| BC-0047 | 09/23/97 | 16:13 | **i | 11.7 | 7.2 | 57.4 | 37.0 | 10.5 | 94 | 2.6i |
| **KINNE BROOK** | | | | | | | | | | |
| Station: BT05KIN, Mile Point: 1.7, Unique ID[2]: W0265 | | | | | | | | | | |
| Description: Approximately 250 meters south (downstream) of confluence of Skunk Brook off the west side of Kinne Brook Road, Chester. | | | | | | | | | | |
| BC-0050 | 09/24/97 | 13:01 | **i | 10.0 | 7.5 | 71.4 | 46.0 | 11.1 | 95 | 5.0i |
| **LITTLE RIVER** | | | | | | | | | | |
| Station: BT08LIT, Mile Point: 1.9, Unique ID[2]: W0267 | | | | | | | | | | |
| Description: Off the north side of Route 112 approximately 1900 meters southeast (downstream) of Ireland Street crossing, Huntington. | | | | | | | | | | |
| BC-0051 | 09/24/97 | 15:13 | **i | 11.7 | 7.6 | 127 | 81.0 | 10.8 | 96 | 3.9i |

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number.
** = Censored Data, i = Inaccurate Data

**Table G4. 1996 Westfield River Watershed fecal coliform bacteria**

| OWMID[1] | QA/QC | Date | Time | Fecal Coliform Bacteria (colonies/100mL) |
|---|---|---|---|---|
| **Pipe/Discharge to Unnamed Tributary to Yokum Brook** | | | | |
| Station: TTYB00.0, Mile Point: 0.01, Unique ID[2]: W0214 | | | | |
| Description: pipe located upstream, right hand side of Route 8 bridge, Becket. | | | | |
| 32-0005 | | 05/08/96 | 11:04 | <10 |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR56.8, Mile Point: 61.4, Unique ID[2]: W0215 | | | | |
| Description: River Road bridge, Windsor. . | | | | |
| 32-0024 | | 05/09/96 | 11:56 | <10 |
| 32-0066 | | 08/05/96 | 10:08 | 120 |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR50.6, Mile Point: 54.8, Unique ID[2]: W0216 | | | | |
| Description: West Main Street bridge, Cummington. | | | | |
| 32-0023 | | 05/09/96 | 11:31 | <10 |
| 32-0067 | | 08/05/96 | 10:30 | 40 |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR48.1, Mile Point: 52.2, Unique ID[2]: W0217 | | | | |
| Description: Route 9 bridge near Stage Road, Cummington. | | | | |
| 32-0022 | | 05/09/96 | 11:19 | <10 |
| 32-0068 | | 08/05/96 | 10:41 | 140 |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR42.7, Mile Point: 46.7, Unique ID[2]: W0218 | | | | |
| Description: Route 9/112 at roadside park upstream of Swift River confluence, Cummington. | | | | |
| 32-0019 | 32-0020 | 05/09/96 | 10:43 | 20 |
| 32-0020 | 32-0019 | 05/09/96 | 10:43 | 50 |
| 32-0070 | | 08/05/96 | 11:15 | 180 |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR38.0, Mile Point: 41, Unique ID[2]: W0219 | | | | |
| Description: Base of Chesterfield Gorge just upstream confluence with Whitside Brook, Chesterfield. | | | | |
| 32-0073 | 32-0074 | 08/05/96 | 12:00 | 80 |
| 32-0074 | 32-0073 | 08/05/96 | 12:00 | <20 |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR26.8, Mile Point: 29.4, Unique ID[2]: W0220 | | | | |
| Description: Gardner State Park, Route 112, Huntington. | | | | |
| 32-0011 | 32-0012 | 05/08/96 | 12:52 | <10 |
| 32-0012 | 32-0011 | 05/08/96 | 12:52 | <10 |
| 32-0058 | 32-0059 | 07/30/96 | 11:16 | 20 |
| 32-0059 | 32-0058 | 07/30/96 | 11:16 | 40 |
| 32-0062 | | 08/05/96 | 09:00 | 640 |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR23.5, Mile Point: 25.9, Unique ID[2]: W0221 | | | | |
| Description: Route 20 at roadside park downstream from confluence with West Branch Westfield River, Huntington. | | | | |
| 32-0013 | | 05/08/96 | 13:06 | <10 |
| 32-0026 | | 05/22/96 | 09:34 | 10 |
| 32-0061 | | 08/05/96 | 08:40 | 160 |
| 32-0097 | | 08/13/96 | 09:10 | 120 |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR20.3, Mile Point: 21.4, Unique ID[2]: W0222 | | | | |
| Description: Route 20, near Whippernon Golf Course, downstream from confluence with Bradley Brook and Westfield River Paper Company Dam, Russell. | | | | |
| 32-0028 | | 05/22/96 | 10:03 | 180 |
| 32-0099 | | 08/13/96 | 09:31 | 40 |

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number.

**Table G4 (continued). 1996 Westfield River Watershed fecal coliform bacteria**

| OWMID[1] | QA/QC | Date | Time | Fecal Coliform Bacteria (colonies/100mL) |
|---|---|---|---|---|
| **WESTFIELD RIVER** | | | | |
| Station: WSFR17.3, Mile Point: 18.3, Unique ID[2]: W0223 | | | | |
| Description: Route 20, at Route 90 overpass, Russell. | | | | |
| 32-0030 | | 05/22/96 | 10:24 | 60 |
| 32-0101 | | 08/13/96 | 09:54 | 120 |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR01.5, Mile Point: 6.5, Unique ID[2]: W0225 | | | | |
| Description: Robinson State Park, upstream of confluence with Miller Brook, Agawam/West Springfield. | | | | |
| 32-0045 | 32-0046 | 05/23/96 | 12:04 | 140 |
| 32-0046 | 32-0045 | 05/23/96 | 12:04 | 140 |
| 32-0094 | | 08/12/96 | 11:40 | 40 |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR00.2, Mile Point: 0.3, Unique ID[2]: W0227 | | | | |
| Description: Route 5 bridge, Agawam. | | | | |
| 32-0047 | | 05/23/96 | 12:35 | 70 |
| 32-0095 | 32-0096 | 08/12/96 | 12:10 | 60 |
| 32-0096 | 32-0095 | 08/12/96 | 12:10 | 60 |
| **WHITE BROOK** | | | | |
| Station: WHTB00.0, Mile Point: 0.01, Unique ID[2]: W0229 | | | | |
| Description: Robinson State Park entrance road bridge, Agawam. | | | | |
| 32-0043 | | 05/23/96 | 11:45 | 150 |
| 32-0092 | | 08/12/96 | 11:25 | 280 |
| **MILLER BROOK** | | | | |
| Station: MILB00.2, Mile Point: 0.3, Unique ID[2]: W0228 | | | | |
| Description: Robinson State Park entrance road bridge, Agawam. | | | | |
| 32-0044 | | 05/23/96 | 11:48 | 40 |
| 32-0093 | | 08/12/96 | 11:30 | 60 |
| **PAUCATUCK BROOK** | | | | |
| Station: PCTB00.3, Mile Point: 0.2, Unique ID[2]: W0230 | | | | |
| Description: Sikes Avenue bridge, West Springfield. | | | | |
| 32-0042 | | 05/23/96 | 11:23 | <10 |
| 32-0106 | 32-0107 | 08/13/96 | 12:04 | 2,600 |
| 32-0107 | 32-0106 | 08/13/96 | 12:04 | 2,500 |
| **GREAT BROOK** | | | | |
| Station: GRTB08.6, Mile Point: 10.8, Unique ID[2]: W0231 | | | | |
| Description: Sheep Pasture Road bridge, Southwick. | | | | |
| 32-0032 | | 05/22/96 | 11:17 | 50 |
| 32-0089 | | 08/12/96 | 10:43 | 40 |
| **GREAT BROOK** | | | | |
| Station: GRTB03.1, Mile Point: 7.3, Unique ID[2]: W0232 | | | | |
| Description: Route 57 bridge, Southwick. | | | | |
| 32-0033 | | 05/22/96 | 11:51 | 170 |
| 32-0090 | | 08/12/96 | 10:58 | 80 |
| **GREAT BROOK** | | | | |
| Station: GRTB00.3, Mile Point: 0.2, Unique ID[2]: W0233 | | | | |
| Description: Little River Road bridge, Westfield. | | | | |
| 32-0034 | | 05/22/96 | 12:02 | 180 |
| 32-0091 | | 08/12/96 | 11:10 | 20 |

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number.

**Table G4 (continued). 1996 Westfield River Watershed fecal coliform bacteria**

| OWMID[1] | QA/QC | Date | Time | Fecal Coliform Bacteria (colonies/100mL) |
|---|---|---|---|---|
| **POWDERMILL BROOK** | | | | |
| Station: PDMB03.8, Mile Point: 5.4, Unique ID[2]: W0234 | | | | |
| Description: Russellville Road bridge, Westfield. | | | | |
| 32-0039 | | 05/23/96 | 10:48 | 320 |
| 32-0102 | | 08/13/96 | 10:46 | 960 |
| **POWDERMILL BROOK** | | | | |
| Station: PDMB01.1, Mile Point: 1.2, Unique ID[2]: W0235 | | | | |
| Description: Union Street bridge, Westfield. | | | | |
| 32-0029 | | 05/22/96 | 10:09 | 10 |
| 32-0040 | | 05/23/96 | 11:11 | 220 |
| 32-0104 | | 08/13/96 | 11:48 | 680 |
| **POND BROOK** | | | | |
| Station: PNDB00.1, Mile Point: 0.1, Unique ID[2]: W0236 | | | | |
| Description: Union Street bridge, Westfield. | | | | |
| 32-0041 | | 05/23/96 | 11:15 | 10 |
| 32-0105 | | 08/13/96 | 11:52 | 120 |
| **LITTLE RIVER** | | | | |
| Station: LITR04.7, Mile Point: 5, Unique ID[2]: W0237 | | | | |
| Description: Horton's Bridge on Granville Road, Westfield. | | | | |
| 32-0031 | | 05/22/96 | 10:45 | 90 |
| 32-0087 | | 08/12/96 | 08:47 | 480 |
| **LITTLE RIVER** | | | | |
| Station: LITR00.2, Mile Point: 0.3, Unique ID[2]: W0238 | | | | |
| Description: Upstream of stormdrain discharge at end of South Street, Westfield. | | | | |
| 32-0035 | | 05/22/96 | 12:28 | 90 |
| 32-0085 | | 08/12/96 | 08:27 | 40 |
| **Pipe/Discharge to LITTLE RIVER** | | | | |
| Station: LITRPIPE, Mile Point: 0.29, Unique ID[2]: W0239 | | | | |
| Description: stormdrain discharge to Little River located at the end of South Street, Westfield. | | | | |
| 32-0036 | | 05/22/96 | 12:28 | 500,000 |
| 32-0037 | | 05/23/96 | 10:15 | 900,000 |
| 32-0086 | | 08/12/96 | 08:30 | 5,000 |
| **MUNN BROOK** | | | | |
| Station: MUNB00.1, Mile Point: 0.4, Unique ID[2]: W0346 | | | | |
| Description: Granville Road bridge, Westfield. | | | | |
| 32-0088 | | 08/12/96 | 08:53 | 220 |
| **MOOSE MEADOW BROOK** | | | | |
| Station: MMBR01.1, Mile Point: 1.2, Unique ID[2]: W0243 | | | | |
| Description: Pochassic Road bridge, Westfield. | | | | |
| 32-0038 | | 05/23/96 | 10:36 | 370 |
| 32-0103 | | 08/13/96 | 11:01 | 68,000 |
| **POTASH BROOK** | | | | |
| Station: PTAB00.1, Mile Point: 0.01, Unique ID[2]: W0244 | | | | |
| Description: Woronoco Road bridge, Russell. | | | | |
| 32-0100 | | 08/13/96 | 09:42 | 40 |
| **BRADLEY BROOK** | | | | |
| Station: BDLB00.1, Mile Point: 0.1, Unique ID[2]: W0246 | | | | |
| Description: Upstream of unnamed tributary southwest of Lincoln Avenue, behind ball park, Russell. | | | | |
| 32-0027 | | 05/22/96 | 09:50 | 20 |
| 32-0098 | | 08/13/96 | 09:21 | 440 |

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number.

**Table G4 (continued). 1996 Westfield River Watershed fecal coliform bacteria**

| OWMID[1] | QA/QC | Date | Time | Fecal Coliform Bacteria (colonies/100mL) |
|---|---|---|---|---|
| **WEST BRANCH WESTFIELD RIVER** | | | | |
| Station: WBWF16.1, Mile Point: 17.4, Unique ID[2]: W0248 | | | | |
| Description: Off Pleasant Street, downstream from confluence with Yokum Brook, Becket. | | | | |
| 32-0003 | | 05/08/96 | 10:47 | 50 |
| 32-0076 | | 08/06/96 | 09:53 | 100 |
| **WEST BRANCH WESTFIELD RIVER** | | | | |
| Station: WBWF13.2, Mile Point: 13.9, Unique ID[2]: W0249 | | | | |
| Description: Bancroft Road/Town Hill Road bridge, Becket/Middlefield. | | | | |
| 32-0079 | | 08/06/96 | 10:29 | 120 |
| **WEST BRANCH WESTFIELD RIVER** | | | | |
| Station: WBWF08.9, Mile Point: 9.6, Unique ID[2]: W0250 | | | | |
| Description: Middlefield Road bridge, Chester. | | | | |
| 32-0007 | | 05/08/96 | 11:46 | <10 |
| 32-0081 | | 08/06/96 | 11:01 | 340 |
| **WEST BRANCH WESTFIELD RIVER** | | | | |
| Station: WBWF05.4, Mile Point: 6, Unique ID[2]: W0251 | | | | |
| Description: Unnamed bridge off Route 20, upstream of confluence of Abbott Brook, Chester. | | | | |
| 32-0008 | | 05/08/96 | 12:00 | <10 |
| 32-0082 | 32-0083 | 08/06/96 | 11:18 | 240 |
| 32-0083 | 32-0082 | 08/06/96 | 11:18 | 360 |
| **WEST BRANCH WESTFIELD RIVER** | | | | |
| Station: WBWF01.4, Mile Point: 1.5, Unique ID[2]: W0252 | | | | |
| Description: At USGS gaging station #01181000 near Fiske Avenue, Huntington. | | | | |
| 32-0009 | | 05/08/96 | 12:30 | <10 |
| 32-0084 | | 08/06/96 | 12:02 | 240 |
| **WALKER BROOK** | | | | |
| Station: WLKB00.4, Mile Point: 0.5, Unique ID[2]: W0254 | | | | |
| Description: Hampton Street bridge, Chester | | | | |
| 32-0006 | | 05/08/96 | 11:34 | <10 |
| 32-0080 | | 08/06/96 | 10:46 | 40 |
| **YOKUM BROOK** | | | | |
| Station: YKMB00.2, Mile Point: 0.6, Unique ID[2]: W0255 | | | | |
| Description: Route 8 bridge near Carter Road, Becket. | | | | |
| 32-0004 | | 05/08/96 | 11:03 | <10 |
| 32-0078 | | 08/06/96 | ** | 140 |
| **DEPOT BROOK** | | | | |
| Station: DPOB02.3, Mile Point: 2.5, Unique ID[2]: W0256 | | | | |
| Description: Cross Place Road bridge, Washington. | | | | |
| 32-0001 | | 05/08/96 | 10:15 | 20 |
| 32-0075 | | 08/06/96 | 09:38 | 420 |
| **SHAKER MILL BROOK** | | | | |
| Station: SKMB00.4, Mile Point: 0.5, Unique ID[2]: W0257 | | | | |
| Description: Lovers Lane bridge, Becket. | | | | |
| 32-0002 | | 05/08/96 | 10:33 | <10 |
| 32-0077 | | 08/06/96 | 10:02 | 20 |
| **MIDDLE BRANCH WESTFIELD RIVER** | | | | |
| Station: MBWF16.4, Mile Point: 15.6, Unique ID[2]: W0258 | | | | |
| Description: Parish Road bridge nearest Route 143, Worthington. | | | | |
| 32-0055 | | 07/30/96 | 10:23 | 40 |

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number.

**Table G4 (continued). 1996 Westfield River Watershed fecal coliform bacteria**

| OWMID[1] | QA/QC | Date | Time | Fecal Coliform Bacteria (colonies/100mL) |
|---|---|---|---|---|
| **MIDDLE BRANCH WESTFIELD RIVER** | | | | |
| Station: MBWF14.4, Mile Point: 13.5, Unique ID[2]: W0259 | | | | |
| Description: River Road bridge upstream of confluence with Fuller Brook, Worthington. | | | | |
| 32-0054 | | 07/30/96 | 10:11 | <20 |
| **MIDDLE BRANCH WESTFIELD RIVER** | | | | |
| Station: MBWF09.3, Mile Point: 9.3, Unique ID[2]: W0260 | | | | |
| Description: Off East River Road upstream of confluence with Glendale Brook, Middlefield/Worthington. | | | | |
| 32-0052 | | 07/30/96 | 09:43 | <20 |
| **MIDDLE BRANCH WESTFIELD RIVER** | | | | |
| Station: MBWF07.5, Mile Point: 7.4, Unique ID[2]: W0261 | | | | |
| Description: Herring Road bridge, Chester. | | | | |
| 32-0051 | | 07/30/96 | 09:33 | <20 |
| **MIDDLE BRANCH WESTFIELD RIVER** | | | | |
| Station: MBWF05.2, Mile Point: 5.1, Unique ID[2]: W0262 | | | | |
| Description: Off East River Road, approximately 1 mile upstream of confluence with Kinne Brook, Chester. | | | | |
| 32-0050 | | 07/30/96 | 09:21 | 80 |
| **MIDDLE BRANCH WESTFIELD RIVER** | | | | |
| Station: MBWF04.0, Mile Point: 3.8, Unique ID[2]: W0263 | | | | |
| Description: Kinne Brook Road bridge, Chester. | | | | |
| 32-0049 | | 07/30/96 | 09:10 | 20 |
| **MIDDLE BRANCH WESTFIELD RIVER** | | | | |
| Station: MBWF00.4, Mile Point: 0.3, Unique ID[2]: W0264 | | | | |
| Description: Goss Hill Road bridge at USGS gage # 01180500, Huntington. | | | | |
| 32-0010 | | 05/08/96 | 12:44 | <10 |
| 32-0060 | | 07/30/96 | 11:32 | <20 |
| **GLENDALE BROOK** | | | | |
| Station: GDBR00.4, Mile Point: 0.3, Unique ID[2]: W0266 | | | | |
| Description: Clark Wright Road bridge, Middlefield. | | | | |
| 32-0053 | | 07/30/96 | 09:55 | 140 |
| **LITTLE RIVER** | | | | |
| Station: LRWT00.1, Mile Point: 1.1, Unique ID[2]: W0268 | | | | |
| Description: Off Route 112, just above flood pool of Knightville Dam, Huntington. | | | | |
| 32-0015 | | 05/09/96 | 09:55 | 660 |
| 32-0056 | | 07/30/96 | 10:48 | <20 |
| 32-0063 | | 08/05/96 | 09:14 | 100 |
| **WATTS STREAM** | | | | |
| Station: WATS00.1, Mile Point: 0.1, Unique ID[2]: W0269 | | | | |
| Description: Prentice Road bridge, Worthington. | | | | |
| 32-0016 | | 05/09/96 | 09:32 | 50 |
| 32-0065 | | 08/05/96 | 09:31 | 160 |
| **WARDS STREAM** | | | | |
| Station: WRDS00.0, Mile Point: 0.01, Unique ID[2]: W0270 | | | | |
| Description: Route 112 bridge, Worthington. | | | | |
| 32-0017 | | 05/09/96 | 09:44 | <10 |
| 32-0064 | | 08/05/96 | 09:23 | 180 |
| **WEST BRANCH** | | | | |
| Station: WBWC00.1, Mile Point: 0.1, Unique ID[2]: W0271 | | | | |
| Description: Ireland Street bridge, Chesterfield. | | | | |
| 32-0072 | | 08/05/96 | 11:45 | 120 |

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number.

**Table G4 (continued). 1996 Westfield River Watershed fecal coliform bacteria**

| OWMID[1] | QA/QC | Date | Time | Fecal Coliform Bacteria (colonies/100mL) |
|---|---|---|---|---|
| **SWIFT RIVER** | | | | |
| Station: SWFT00.2, Mile Point: 0.3, Unique ID[2]: W0272 | | | | |
| Description: Route 9/112 bridge, Cummington. | | | | |
| 32-0018 | | 05/09/96 | 10:27 | 10 |
| 32-0071 | | 08/05/96 | 11:28 | <20 |
| **MEADOW BROOK** | | | | |
| Station: MEDB00.2, Mile Point: 0.2, Unique ID[2]: W0273 | | | | |
| Description: Nash Road bridge, Cummington. | | | | |
| 32-0021 | | 05/09/96 | 11:00 | 20 |
| 32-0069 | | 08/05/96 | 11:02 | 1,800 |

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number.

**Table G5. 1996 YSI® Data**

| Date | OWMID[1] | Time (24hr) | Temp (C) | DO (mg/L) |
|---|---|---|---|---|
| **WESTFIELD RIVER** | | | | |
| Station: WSFR07.2, Unique ID[2]: W0224 | | | | |
| Description: Route 20 and Dewey Street, downstream confluence with Paucatuck Brook, West Springfield/Agawam. | | | | |
| 08/28/96 | 32-0110 | ** | 17.0is | 7.7is |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR03.2, Unique ID: W0226 | | | | |
| Description: Mittineague Bridge Road/Bridge Street bridge, West Springfield/Agawam. | | | | |
| 08/28/96 | 32-0109 | ** | 18.0is | 10.0is |
| **WESTFIELD RIVER** | | | | |
| Station: WSFR00.2, Unique ID: W0227 | | | | |
| Description: Route 5 bridge, Agawam. | | | | |
| 08/28/96 | 32-0108 | ** | 19.0is | 7.7is |

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number.
** = Censored Data
i = inaccurate data
s = field sheet recorded data were used to accept data, not data electronically recorded in the Hydrolab surveyor unit, due to operator error or equipment failure.

## *REFERENCES*


MA DEP 1990. *BASINS PROGRAM Standard Operating Procedures River and Stream Monitoring. Massachusetts Department of Environmental Protection, Division of Water Pollution Control, Technical Services Branch. Westborough, MA.*

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

MA DEP. 2000. Memorandum to Rick McVoy, Laurie Kennedy, Tom Dallaire, Arthur Johson and Mollie Weinstein from Mark Guilmain dated February 2000. *1994, 95 & 96 QA/QC Assessment Report.* CN 36.0. Division of Watershed Management Department of Environmental Protection. Worcester, MA

# APPENDIX H
## SUMMARY OF NPDES AND WMA PERMITTING INFORMATION FOR THE WESTFIELD RIVER WATERSHED

*Information from open permit files located in MA DEP Boston, Worcester, and Springfield Offices.*

**Table H1. Westfield River Watershed Municipal and Sanitary Wastewater Surface Discharges.**

| Permitee | NPDES # | Issuance | Flow (MGD) | Receiving Water (Segment) |
|---|---|---|---|---|
| Huntington WWTP, Huntington | MA0101265 | 28 September 1998 | 0.2 | Westfield River Segment MA32-05 |
| Russell Village POTW, Russell | MA0100960 | 29 September 1998 | 0.24 | Westfield River Segment MA32-05 |
| Woronoco Village POTW, Russell | MA0103233 | 30 September 1998 | 0.02 | Westfield River Segment MA32-05 |
| Westfield WWTP[1], Westfield | MA0101800 | 14 November 2001 | 6.1 | Westfield River Segment MA32-05 |
| The Maples, Worthington | MA0027871 | 22 September 1995 | 0.0023 | Wards Stream Segment MA32-15 |
| Renaissance Manor, Westfield | Under DEP (WRO) ACO | To be issued | 0.01 | Westfield River Segment MA32-06 |

WWTP = waste water treatment plant, POTW = publicly owned treatment works
Note: There are many past wastewater dischargers no longer operating, or discharging to the watershed: Massachusetts Turnpike Authority Sewage Disposal Pond, Western Massachusetts Hospital, Combined Sewer Overflow permits for Westfield, Agawam, and West Springfield.

**[1]Details on the status of upgrades at the Westfield WWTP and summary of permit limits**:
The Westfield WWTP is an activated sludge secondary treatment facility, currently under a construction upgrade to increase its wastewater collection system service area to provide treatment for increased wastewater flows. According to the MA DEP Western Regional Office all the upgrades were expected to be completed by November 2004. The permit was reissued 27 September 2000 by MA DEP and USEPA and substantially modified 14 November 2001 to reflect permit limits once the upgrades are on- line. The cost of this upgrade project is between 14 and 15 million dollars. The existing WWTP is being upgraded from a 4.0 MGD to a 6.1 MGD rated capacity treatment plant. The proposed expansion includes: construction of a new aerated grit chamber and aeration tank, new primary and secondary settling tanks, new chlorine contact tank, new blower and sludge processing buildings, new effluent pump station, modifications to various existing facilities such as chemical storage, and work platforms. A special note here regarding the existing facility is that it consists of one grit chamber, two primaries, two aeration tanks, two secondary tanks, chlorine contact chamber with dechlorination. The two existing aeration systems (currently mechanically aerated) will be converted to fine bubble diffusers. Additionally, a third backup aeration system (fine bubble diffuser) will be constructed.

Effluent permit limits before upgrade completion include: an average monthly flow of 4.0 MGD; average monthly/weekly/daily limitations, BOD and TSS, in mg/l; 30/45/report, and lbs/day, 1000/1500; Fecal Coliform, cfu/100ml, 200 (average monthly)/ 400 (maximum daily); Total Residual Chlorine in mg/l, 0.12 (average monthly)/ 0.20 (maximum daily); Total Copper in mg/l, 0.035 (average monthly)/ 0.05 (maximum daily); Total Nickel in mg/l, 0.20 (average monthly)/ 1.81 (maximum daily). Phosphorous, NH3, Nitrite + Nitrate, and TKN are all report in mg/l (average monthly).

Effluent permit limits after the upgrades are on-line include: an average monthly flow of 6.1 MGD; average monthly/weekly/daily limitations, BOD and TSS, November 1 to May 31 each year, in mg/l: 30/45/report, and lbs/day, 1530/2290, June 1 to October 31 each year, in mg/l, 20/30/report, and lbs/day, 1000/1500/report; Fecal Coliform, cfu/100ml, 200 (average monthly)/ 400 (maximum daily); Total Residual Chlorine in mg/l, .055 (average monthly)/ .095 (maximum daily); Total Copper in mg/l, .0167 (average monthly), .0225 (maximum daily); Total Nickel in mg/l, .094 (average monthly), report (maximum daily); Cadmium in mg/l, .0006 (average monthly), .0031 (maximum daily); Total Aluminum in mg/l, report (average monthly); Total Ammonia Nitrogen, as N, June 1$^{st}$ to October 31$^{st}$ , in mg/l, 3 (average monthly), 5 (average weekly), report (daily maximum). Total ammonia-nitrogen as N (November 1$^{st}$ to May 31$^{st}$ report in mg/l (average monthly). Total phosphorus (June 1$^{st}$ to October 31$^{st}$ (1.0 mg/l average monthly) and report (maximum daily). Chlorination is utilized at a minimum, yet adequate level, as a disinfection process. Whole Effluent Modified Acute, and Whole Effluent Chronic Toxicity Testing is required 4 times per year with daphnid (Ceriodaphnia dubia), with maximum Modified Acute allowable limits of $LC_{50} \geq 100\%$ effluent, and maximum Chronic allowable limits of $CNOEC \geq 20\%$ maximum daily. Chlorination/dechlorination will continue to be utilized as a disinfection process.

**Table H2. Westfield River Watershed NPDES Industrial Wastewater Discharge Facilities.**

| Permitee | NPDES # | Issuance | Flow (MGD) | Type of Discharge | Receiving Water (Segment) |
|---|---|---|---|---|---|
| Northeast Utilities | MA0035556 | 29 September 1998 | Report Quarterly | Turbine and Thrust Bearing cooling water, trench/drain, NCCW | Little River MA32-36 |
| Texon USA | MA0005282 | 12 November 1999 | 0.8 | Process Wastewater, Floor drainage, NCCW | Westfield River MA32-05 |
| **NPDES General Permits:** | | | | | |
| Austin Brook Reservoir Slow Sand Water Filtration Plant | MAG640035 | 13 December 1995 | N/A | Sand media filtered water | Austin Brook Reservoir, Walker Brook MA32-20 |
| City of Springfield, Water Treatment Plant | MAG640023 | 30 January 2001 | 0.991 maximum | Filter backwash (West Parish Filters) | Cooks Brook to the Little River MA32-36 |
| City of Westfield, Water Treatment Plant | MAG640001 | 22 November 2001 | 0.33 maximum | Effluent | Jack's Brook to the Little River MA32-08 |
| Fiber Mark DSI, Inc. | MAG250966 | 30 July 2000 | Ceased operation June 2002 | Non Contact Cooling Water (NCCW) | Westfield River MA32-07 |
| Jen-Coat Inc. | MAG250856 | 18 June 2001 | 0.028 monthly | NCCW | Westfield River MA32-05 |

**Note:** There are many industrial dischargers (both major and minor) who are not currently operating, or discharging to the watershed. This list includes: Columbia Manufacturing Co., Decorative Specialties Inc., General Abrasive Division, Inc., Micro Abrasives, Inc., Strathmore Paper Co., Stevens Paper Mills Inc., Upper Mill, Lower Mill, and Westfield River Paper Co.

**Table H3. Westfield River Watershed NPDES Phase II Stormwater Communities. All permits expire 1 May 2008.**

| Town | NPDES Permit Number | Permit Issued Date | Mapped Regulated Area in Community |
|---|---|---|---|
| Agawam | MAR041001 | 08/22/2003 | Partial |
| Holyoke | MAR041011 | 10/02/2003 | Total |
| Southampton | MAR041021 | 10/03/2003 | Partial |
| Southwick | MAR041022 | 01/08/2004 | Partial |
| West Springfield | MAR041024 | 09/18/2003 | Total |
| Westfield | MAR041236 | 09/26/2003 | Total |

**Table H4. Westfield River Watershed FERC Projects.**

| Project Name | Project Number | Owner Name / Issuance date | Receiving Water (Segment) | Kilowatts |
|---|---|---|---|---|
| Woronoco | 2631 | Woronoco Hydro LLC/ Permit issued 4/30/02 | Westfield River Segment MA32-05 | 2,700 KWh |
| West Springfield Hydroelectric | 2608 | A & D Hydro, Inc./Permit issued 24 October 1994 | Westfield River Segment MA32-07 | 1.4 MWh |

**Table H5. Westfield River Watershed FERC-exempt Projects.**

| Project Name | Project Number | Owner Name / Issuance date | Receiving Water (Segment) | Kilowatts |
|---|---|---|---|---|
| Crescent Hydroelectric Project (Texon Project) | 2986A | Littleville Power Company Inc. | Westfield River Segment MA32-05 | 1500 KWh |
| Knightville Dam | 9895X | U.S. Army Corps of Engineers/ applied for FERC 1986, denied 25 February 1986 | Westfield River Segment MA32-04 | 963 KWh (potential) |
| Littleville (Dam) Lake | 8350X | U.S. Army Corps of Engineers/ issued as FERC 24 March 1986, surrendered 15 June 1988 | Westfield River Segment MA32-03 | 1060 KWh (potential) |

**Table H6. Westfield River Watershed NPDES Industrial Storm Water Permits.**

Note: All towns identified (except Russell) are only partially located in the Westfield River Watershed; therefore receiving waters from these facilities may not be located in the Westfield River Watershed.

| Permitee | NPDES # | Issuance | Location |
|---|---|---|---|
| Atlas Founders | MAR05B956 | 01/25/2001 | Agawam |
| Berkshire Power LLC | MAR05C154 | 01/31/2001 | Agawam |
| HP Hood Inc | MAR05C091 | 01/29/2001 | Agawam |
| Pioneer Valley Resource Recovery | MAR05B972 | 01/27/2001 | Agawam |
| Roberts Bros Lumber Co Inc | MAR05B951 | 01/25/2001 | Ashfield |
| Becket Transfer Station | MAR05C472 | 03/07/2003 | Becket |
| Berkshire Hardwoods Inc | MAR05B820 | 01/17/2001 | Chesterfield |
| Highway Department Garage | MAR05C459 | 03/04/2003 | Granville |
| Transfer Station | MAR05C460 | 03/04/2003 | Granville |
| City of Holyoke WWTP | MAR05C561 | 07/02/2003 | Holyoke |
| Hampden Papers Inc | MAR05C229 | 04/09/2001 | Holyoke |
| Hampden Papers Inc | MAR05C230 | 04/09/2001 | Holyoke |
| Hazen Paper Company | MAR05B689 | 12/27/2000 | Holyoke |
| Holyoke Gas & Electric Department | MAR05B765 | 01/11/2001 | Holyoke |
| Kodak Polychrome Graphics | MAR05B851 | 01/22/2001 | Holyoke |
| Marox Corporation | MAR05C584 | 10/17/2003 | Holyoke |
| William F Sullivan Co Inc | MAR05B799 | 01/19/2001 | Holyoke |
| Texon Usa | MAR05B679 | 12/20/2000 | Russell |
| Bob's Auto Salvage | MAR05B754 | 01/09/2001 | Southampton |
| The Lane Construction Corp | MAR05C242 | 04/24/2001 | Southwick |
| Tolland DPN | MAR05C482 | 03/06/2003 | Tolland |
| Barnes Air National Guard Base | MAR05C225 | 02/01/2001 | Westfield |
| Cersosimo Lumber Co Inc | MAR05B916 | 01/24/2001 | Westfield |
| Columbia Manufacturing Inc | MAR05C251 | 05/02/2001 | Westfield |
| Day Lumber Corp | MAR05C218 | 03/14/2001 | Westfield |
| International Paper | MAR05B904 | 01/24/2001 | Westfield |
| Jen Coat Inc | MAR05B629 | 12/07/2000 | Westfield |
| Mestek Inc | MAR05C002 | 01/26/2001 | Westfield |
| Mestek Inc | MAR05C159 | 02/01/2001 | Westfield |
| Son Inc., Plant No 1 | MAR05C356 | 03/15/2002 | Westfield |
| Stone Container Corp | MAR05B775 | 01/04/2001 | Westfield |
| The Lane Construction Corp | MAR05C239 | 04/24/2001 | Westfield |
| The Lane Construction Corp | MAR05C243 | 04/24/2001 | Westfield |
| Westfield Coatings Corp | MAR05B678 | 12/20/2000 | Westfield |

**Table H7. List of WMA registered and permitted average annual water withdrawals in the Westfield River Watershed (LeVangie 2002).**

| Permit | Registration | PWSID | System Name | Registered Volume (MGD) | 20 Year Permitted Volume (MGD) | Source (G = ground S = surface) | Well/Source Name | Withdrawal Location Segment |
|---|---|---|---|---|---|---|---|---|
| 9P10427902 | N/A | N/A | Old Farm Golf Club, Inc | N/A | 0.15 | | Lake A<br>Lake D<br>Well #2<br>Well #4 | MA32-08 |
| 9P210432901 | N/A | N/A | John S. Lane & Son Inc. | N/A | 0.65 | | Westfield River | MA32-05 |
| 9P210425603 | N/A | N/A | Texon USA | N/A | 0.72 | | Intake on Westfield River | MA32-05 |
| N/A | 10413701 | 1137000 | Holyoke Water Works | 1.01 | N/A | 1137000-01G | Driven Wells | MA32-24 |
| | | | | | | 1137000-03S<br>1137000-01S | McLean Reservoir<br>Ashley Pond Reservoir | MA32-29 |
| N/A | 10414301 | 1143000 | Huntington Water Department | 0.12 | N/A | 1143000-01S<br>1143000-01G<br>1143000-02G | Cold Brook Reservoir<br>Well #1<br>Well #2 | MA32-01 |
| 9P210425602 | 10425601 | 1256000 | Russell Water Department | 0.29 | N/A | 1256000-01S<br>1256000-01G<br>1256000-02G | Black Brook Reservoir<br>Well #1<br>Well #2 | MA32-21<br>MA32-21<br>MA32-05 |
| 9P10427901 | 10427905 | 1279000 | Southwick Water Department | 0.45 | 0.28 | 1279000-01G | Well #1 Great Brook | MA32-25 |
| N/A | 10428101 | 1281000 | Springfield Water and Sewer Commission | 37.2 | N/A | 281-03S | Littleville Lake Reservoir | MA32046 and MA32-03 |
| | | | | | | 281-02S | Cobble Mountain Reservoir | MA32018 and MA32-35 |
| | | | | | | 281-04S | Borden Brook Reservoir | MA32011 |
| N/A | 10432501 | | Southworth Company | 0.15 | N/A | | Westfield River | MA32-07 |
| N/A | 10432502 | | DSI - West Springfield | 0.11 | N/A | | Westfield River - Canal | MA32-07 |
| 9P10432501 | 10432503 | 1325000 | West Springfield Water Department | 3.89 | 2.82 | 1325000-01S | Bearhole Reservoir | MA32-29 |
| | | | | | | 1325000-01G<br>1325000-02G<br>1325000-03G<br>1325000-04G | Southwick Well #1<br>Southwick Well #2<br>Southwick Well #3<br>Southwick Well #4 | MA32-25 |
| N/A | 10432901 | 1329000 | Westfield Water Department | 6.11 | N/A | 1329000-01G<br>1329000-07G<br>1329000-08G | Well #1<br>Well #7<br>Well #8 | MA32-24 |
| | | | | | | 1329000-01S | Montgomery Reservoir | MA32-23 |
| | | | | | | 1329000-05G<br>1329000-06G<br>1329000-02S | Well #5<br>Well #6<br>Granville Reservoir | MA32-36 |
| | | | | | | 1329000-02G | Well #2 | MA32-05 |
| | | | | | | 1329000-03G<br>1329000-04G | Well #3<br>Well #4 | MA32-25 |

# APPENDIX I

## MA DEP GRANT AND LOAN PROGRAMS

Excerpted from MA DEP's World Wide Web site http://www.mass.gov/dep/brp/wm/projsums.htm.

**604(b) WATER QUALITY MANAGEMENT PLANNING GRANT PROGRAM**
This grant program is authorized under the federal Clean Water Act Section 604(b) for water quality assessment and management planning.

No recent 604(b) grants have been awarded within the Westfield River Watershed.

**104(b)(3) WETLANDS AND WATER QUALITY GRANT PROGRAM**
This grant program is authorized under Wetlands and Clean Water Act Section 104(b)(3) of the federal Clean Water Act. The water quality proposals received by MA DEP under this National Environmental Performance Partnership Agreement (NEPPA) with the U.S. Environmental Protection Agency is a results-oriented approach that will focus attention on environmental protection goals and the efforts to achieve them. The goals of the NEPPA are to: 1) achieve clean air, 2) achieve clean water, 3) protect wetlands, 4) reduce waste generation, and 5) clean up waste sites. 104(b)(3) projects in the Westfield River Watershed include the following.

- 97-09/104 *Project on Numeric Biocriteria.* This proposal is designed to address two issues relating to the current Biocriteria Pilot Study; specifically, to evaluate subecoregion difference in stream biota, if any, and to formulate the biological indicators (fish and macroinvertebrates) that are essential to assess conditions and monitor changes in streams. Study expects to establish reference streams in 5 of the 13 Massachusetts Ecological Subregions. The study streams are located in the Connecticut, Westfield, Chicopee, Millers and Quinebaug River Basins.

**319 NONPOINT SOURCE GRANT PROGRAM**

This grant program is authorized under Section 319 of the CWA for implementation projects that address the prevention, control, and abatement of nonpoint source (NPS) pollution. In order to be considered eligible for funding projects must: implement measures that address the prevention, control, and abatement of NPS pollution; target the major source(s) of nonpoint source pollution within a watershed/subwatershed; have a 40 percent non-federal match of the total project cost (match funds must meet the same eligibility criteria as the federal funds); contain an appropriate method for evaluating the project results; address activities that are identified in the Massachusetts NPS Management Program Plan. 319 projects in the Westfield River Watershed include the following.

- 00-14/319 *Forestry BMP implementation monitoring Protocol Project*. The purpose of this project is to develop a forestry BMP monitoring protocol for use in evaluating and monitoring the effectiveness of BMPs in controlling NPS pollution, in conjunction with forest harvesting operations conducted under the state's Forest Cutting Practices Act, Ch. 132 s. 40-48. Tasks include development of assessment methods to evaluate the effectiveness of BMPs contained in the Massachusetts BMP Manual, which are required in the MA Forest Cutting Practices Regulations. This will result in the development of performance standards for forestry BMPs. A draft field manual will be developed explaining the measurement and interpretation procedures. Field surveys on completed harvests in the Westfield watershed will be conducted to test the monitoring protocol, and the manual will be adjusted based on those findings.

  The project is consistent with Forestry Actions/Implementation efforts outlined in the Massachusetts Nonpoint Source Management Plan, Volume 1, p. 46. As forestry activity is generally regarded to be a source of nonpoint source pollution, particularly phosphorous, the development of performance standards and rigorous investigation into the effectiveness of forestry BMPs will greatly enhance efforts to implement TMDLs in forested watersheds.

- 02-03/319 *Stormwater Management on the Middle Pond of the Congamond Lakes*. The purpose of this project is to address the quality of street runoff entering Middle Pond of the Congamond Lakes from the Berkshire Avenue sub-basin drainage area. A diagnostic / feasibility study conducted in 1983 recommended stormwater management measures, including structural BMPs as well as watershed controls for source reduction of pollutants.

**SOURCE WATER AND TECHNICAL ASSISTANCE/LAND MANAGEMENT GRANT PROGRAM**

The Source Water Protection Technical Assistance/Land Management Grant Program provides funds to *third party* technical assistance organizations that assist public water suppliers in protecting local and regional ground and surface drinking water supplies. Source Water Protection projects in the Westfield River Watershed include the following.

- 99-05/SWT *Granville Reservoir Source Water Protection Project*. This project will develop a Surface Water Supply Protection Plan for the Granville Reservoir, which provides approximately 60% of the water requirements for Westfield. As development encroaches on crucial areas in the watershed, a completed plan will provide guidance and implementation tools for the Town of Granville to use in protecting its water supply.

- 00-04/SWT *Granville Source Water Protection Project.* This project will conduct a Household Hazardous Waste and Hard to Dispose of Materials Collection (HHW/HDMC), update the Town of Granville's Open Space Plan, and coordinate area aquifer protection efforts. An updated Open Space Plan and the coordination of protection efforts will permit the Massachusetts communities of Granville, Springfield, and Westfield, and the Connecticut Metropolitan District to formally exchange information on potential threats to water supplies as well as current efforts to acquire open space and conservation lands.

- 00-05/SWT *Austin Brook Reservoir Source Water Protection Project*. The project will develop a comprehensive Surface Water Supply Protection Plan, land use inventory, and education program for the Town of Chester. The Plan will inventory and assess potential threats and existing impacts in the Austin Brook Reservoir and Horn Pond watersheds, and provide strategic planning guidance and implementation tools for use in protecting these water supplies. The Plan also will include provisions for watershed areas in the adjacent town of Becket, parcel-based land use GIS maps, and an emergency response component. This project will be conducted in concert with the Department's SWAP program.

- 01-05/SWT *Westfield Source Water Protection Project*. This project will develop a Forest Management Plan for the city of Westfield's Granville Reservoir watershed. This project will inventory forested watershed lands and incorporate forestry management strategies to ensure safe water supplies for the future. The maintenance of a diverse, healthy forest cover throughout the watershed can help protect reservoir water quality.

- 01-09/SWT *West Springfield Source Water Protection Project*. This project will inventory forested watershed lands, prescribe management of the protection/infiltration forest, and develop a public education brochure for the town of West Springfield's Bear Hole Reservoir watershed. The maintenance of a diverse, healthy forest cover throughout the watershed can help protect reservoir water quality. The educational brochure will improve the water consumer's understanding of the importance of watershed management for water quality protection and will be distributed to water consumers, schools, garden clubs, and town government offices. This project will be conducted in concert with the Department's Source Water Assessment Program.

- 02-09/SWT *West Springfield Source Water Protection Project.* This project will develop an Interior Roadway Improvement Plan for West Springfield's Bear Hole Reservoir. This project will identify nonpublic roadway problem areas that may compromise the quality of drinking water, located in the watershed within ½ mile of the reservoir and Paucatuck Brook and provide recommendations for roadway improvements relative to watershed patrolling (e.g., restricting public access while improving roadway conditions for routine inspections and patrolling of watershed area).

**WELLHEAD PROTECTION GRANT PROGRAM**

The Wellhead Protection Grant Program provides funds to assist public water suppliers in addressing wellhead protection through local projects and education. Wellhead Protection projects in the Westfield River Watershed include the following.

- 99-02/WHP *Huntington Wellhead Protection Project*. This project will develop a Wellhead Protection Plan and construct a new storage facility for water treatment chemicals in the Zone I of wells #1 and #2. Relocating and upgrading the storage facility will ensure that liquid chemicals cannot contaminate the nearby wells in the event of a spill. Development of a Wellhead Protection Plan will also include an Emergency Response component for potential or accidental spills on nearby state Route 20 and an adjacent railroad line.

- 01-13/WHP *Russell Wellhead Protection Project*. This project will develop a comprehensive Wellhead Protection Plan as per Department guidance, and install fencing around the pump house for the town of Russell water supply. Wellhead protection efforts will include a public education and outreach program.

- 02-08/WHP *Cummington Wellhead Protection Project*. This project will develop a Wellhead Protection plan for the four drinking water wells operated by the two water departments in the town of Cummington, install security systems for West Cummington pump house and Center Well pump house, and install chain-link fencing around the West Cummington pump house.

**MASSACHUSETTS WATERSHED INITIATIVE PROJECTS**

The Massachusetts Watershed Initiative (MWI) was a broad partnership of state and federal agencies, conservation organizations, businesses, municipal officials and individuals that protects and restores natural resources and ecosystems on a watershed basis. The primary goals of the Watershed Initiative was to: improve water quality; restore natural flows to rivers; protect and restore habitats; improve public access and balanced resource use; improve local capacity to protect water resources; and, promote shared responsibility for watershed protection and management. Projects funded under the MWI included hydrologic and water quality monitoring and assessment, habitat assessment, nonpoint source assessment, hydrologic modeling, open space and growth planning, technical assistance and outreach. MWI projects in the Westfield River Watershed include the following.

- 99-14 MWI *An Assessment of Water Quality Impairment in the Westfield River*. The purpose of this project is to identify and assess the causes and sources of water quality impairment in the Westfield River. This will include water quality sampling during dry and wet weather conditions and aquatic macroinvertebrate and periphyton assessments.

- 02-15 MWI *Pequot Pond Pollution Survey*. This project will identify the sources contributing to water quality impairment at Pequot Pond.

- 02-16 MWI *Pond Brook Nonpoint Source Remediation Project*. This project will implement structural and non-structural best management practices (BMPs) in the East Mountain Country Club areas of Pond Brook to remediate identified nonpoint source pollution contributing to water quality impairment.

- 03-27 MWI *Westfield Vegetative Buffer Implementation*. This project will work with landowners to implement buffer protection/restoration at selected sites in the Great Brook sub-watershed of the Westfield River Watershed.

**CLEAN WATER STATE REVOLVING LOAN FUND (SRF) PROGRAM**

The Massachusetts State Revolving Loan Fund for water pollution abatement projects was established to provide a low-cost funding mechanism to assist municipalities seeking to comply with federal and state water quality requirements. The SRF Program is jointly administered by the Division of Municipal Services of the MA DEP and the Massachusetts Water Pollution Abatement Trust. Each year the MA DEP solicits projects from the Massachusetts municipalities and wastewater districts to be considered for subsidized loans, which are currently offered at 50% grant equivalency (approximates a two percent

interest loan). The SRF Program now provides increased emphasis on watershed management priorities. A major goal of the SRF Program is to provide incentives to communities to undertake projects with meaningful water quality and public health benefits and which address the needs of the communities and the watershed. Recent SRF projects specific to the Westfield Watershed include:

- 00-46 CW SRF Westfield WWTP upgrade and Expansion. The cost of this project is between 14 and 15 million dollars. The existing WWTP is being upgraded from a 4.0 MGD to a 6.1 MGD rated capacity treatment plant. The proposed expansion includes: construction of a new aerated grit chamber and aeration tank, new primary and secondary settling tanks, new chlorine contact tank, new blower and sludge processing buildings, new effluent pump station, modifications to various existing facilities such as chemical storage, and work platforms. A special note here regarding aeration is that the two current aerations (currently mechanical aerated) will be converted to fine bubble diffusers along with a third aeration tank.

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