DEERFIELD RIVER WATERSHED

2000 WATER QUALITY ASSESSMENT REPORT

COMMONWEALTH OF MASSACHUSETTS
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DEERFIELD RIVER WATERSHED

2000 WATER QUALITY ASSESSMENT REPORT

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Department of Environmental Protection
Division of Watershed Management

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- Massachusetts Department of Environmental Protection (MA DEP)
  - Bureau of Resource Protection
  - Bureau of Strategic Policy and Technology's Wall Experiment Station
  - Bureau of Waste Prevention
  - Bureau of Waste Site Cleanup
- Massachusetts Department of Public Health (MA DPH)
- Massachusetts Department of Fish and Game (MA DFG) (Formerly Department of Fisheries, Wildlife, and Environmental Law Enforcement, MA DFWELE)
  - Division of Fisheries and Wildlife (MassWildlife)
  - Riverways Program
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Cover photo: Tannery Brook in Savoy, Massachusetts
Photo credit: Alan Wynn, EOEA

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cfs	cubic feet per second
cfu	colony forming unit
ft^3	cubic feet
gpm	gallons per minute
km^2	square kilometers
KW	kilowatts
MGD	million gallons per day
mi^2	square miles
µg/kg	microgram per kilogram
µS/cm	microsiemans per centimeter
mg/kg	milligram per kilogram
mg/L	milligram per liter
mL	milliliter
msl	mean sea level
ng	nanograms
NTU	nephelometric turbidity units
ppb	parts per billion
ppm	parts per million
SU	standard units
TEQ/kg	toxic equivalents per kilogram

LIST OF ACRONYMS

7Q10	seven day, ten year low flow
ACEC	Areas of Critical Environmental Concern
ACOE	Army Corps of Engineers (United States)
ADB	assessment database
AKA	also known as
BMP	best management practice
BPJ	best professional judgment
BRP	Bureau of Resource Protection
CMR	Code of Massachusetts Regulations
CNOEC	chronic no observed effect concentration
CRWA	Connecticut River Watershed Association
CT DEP	Connecticut Department of Environmental Protection
CVP	Certified Vernal Pool
CWA	Clean Water Act
DDT	dichlorodiphenyltrichloroethane
DAR	Department of Agricultural Resources
DFA	Department of Food and Agriculture
DMF	Division of Marine Fisheries
DMR	discharge monito ring report
DO	dissolved oxygen
DPW	Department of Public Works
DRWA	Deerfield River Watershed Association
DWM	Division of Watershed Management
DWP	Drinking Water Program
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
FPOM	fine particulate organic matter
GCC	Greenfield Community College
IWPA	Interim Wellhead Protection Act
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
MA DFWELE	Department of Fisheries, Wildlife and Environmental Law Enforcement (now the Department of Fish and Game)
MA DPH	Massachusetts Department of Public Health
MassGIS	Massachusetts Geographic Information System
MassWildlife	Massachusetts Division of Fisheries and Wildlife
MCL	Maximum Contaminant Level
MDL	Minimum Detection Limit
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
NPS	nonpoint source pollution
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
ORV	off road vehicle
ORW	Outstanding Resource Water
PAH	Polyaromatic Hydrocarbons
PALIS	Pond and Lake Information System
PCB	polychlorinated biphenyls
PGE-NEG	Pacific Gas and Electric – Northeast Generating Group
PWS	public water supply
QAPP	quality assurance project plan
QA/QC	quality assurance/ qua lity control
RBP	rapid bioassessment protocol
SARIS	Stream and River Inventory System
SDWA	Safe Drinking Water Act
S-EL	severe effect level
SMART	Strategic Monitoring and Assessment for River Basin Teams
SWAP	Source Water Assessment Program
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
TPH	total petroleum hydrocarbons
TRC	total residual chlorine
UMass	University of Massachusetts
USGS	United States Geological Survey
VOC	volatile organic compounds
VS	volatile solids
VT DEC	Vermont Department of Environmental Conservation
WBID	waterbody identification code
WBS	waterbody system database
WERO	Western Re gional Office
WMA	Water Management Act
WPCF	water pollution control facility
WPCP	water pollution control plant
WQC	water quality criteria
WTF	water treatment facility
WWTF	wastewater treatment facility
WWTP	wastewater treatment plant
YAEC	Yankee Atomic Electric Company
YNPS	Yankee Nuclear Power Station

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EXECUTIVE SUMMARY
DEERFIELD RIVER WATERSHED
2000 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, 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 Deerfield 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 exist 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 Assessment Database (ADB).

The Deerfield River watershed occupies a total of 665 mi^2 (1738 km^2). Approximately half of the watershed is in southern Vermont (318 mi^2) and half lies in the Franklin and Berkshire counties of western Massachusetts (347mi^2). Overall, landuse within this predominately rural watershed is classified as 81% forested, 13% agriculture/open land, 4% urban, and 2% water. The southern portion of the watershed contains most of the population and the land use, although still heavily forested, contains more of a mix of agricultural, residential, and industrial uses. The largest and only city in the watershed is Greenfield, MA (population 18,168). It contains almost half the population of the entire watershed (US Census Bureau 2003). In the northern and western areas of the watershed the topography is mountainous and the river's profile is steep, which makes it attractive for hydroelectric power generation. Along the mainstem there are nine licensed hydroelectric stations (seven in MA, including a pumped storage facility) and associated dams, that effectively control the flow of the river. Water released from the dams affects the entire range of stream flow and causes multiple daily stream stage fluctuations.

There are 149 named rivers, streams, brooks or creeks (the term "rivers" will hereafter be used to include all) totaling 344.8 river miles within the Massachusetts portion of the Deerfield River Watershed (Halliwell *et al*. 1982). There are 24 rivers (179.4 miles) representing 9% of the total named river miles in the Massachusetts portion of the Deerfield River Watershed assessed in this report. These include: Bear River, Bozrah Brook, Chickley River, Clark Brook, Clesson Brook, Cold River, Davis Mine Brook, Deerfield River, Dragon Brook, Drakes Brook, East Branch of the North River, Foundry Brook, Green River, Hinsdale Brook, Mill Brook, North River, Pelham Brook, Pumpkin Hollow Brook, Shingle Brook, Smith Brook, South River, Taylor Brook, Tisdale Brook and the West Branch of the North River. The remaining rivers are small and/or unnamed and currently unassessed.

This report also presents information on 22 of the 24 named lakes, ponds or impoundments (the term "lakes" will hereafter be used to include all) in the Deerfield River Watershed. The 22 lakes listed in this report represent over 99% of the total lake acreage (560.6 of the 562 acres) in the Massachusetts portion of the Deerfield River Watershed. A total of 29 lakes, ponds or impoundments at one time were identified and assigned PALIS code numbers in the Deerfield River Watershed (Ackerman 1989 and MA DEP 2001a). However, three lakes from this PALIS list (Greenfield Reservoir in Leyden, Little Mohawk Pond in Shelburne, and Schneck Brook Pond in Conway) have not been included in this report because they no longer exist as lakes (dam removed and/or filled in with aquatic vegetation). Another lake (Paddy Hill Pond, Ashfield) on the Deerfield Watershed PALIS list was found to be located in the Westfield Watershed. Two others (South River Impoundment in Conway and Lower Reservoir in Rowe/Florida) are assessed as part of the river segments in which they exist as run-of-the-river impoundments and are not included in the lakes assessment to avoid redundancy.

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/or hydrologic modification.

Aquatic Life Use Summary – Rivers (Figure 1)

As illustrated in Figure 1, eighty-six percent (86%) of the river miles in the Deerfield River Watershed reviewed in this report were assessed (supported or impaired) for the *Aquatic Life Use*. A total of 153.4 river miles, representing 15 tributaries to and the entire length of the Deerfield River, are assessed as supporting the *Aquatic Life Use*. The *Aquatic Life Use* is assessed as impaired in the lower 1.7 miles of Davis Mine Brook. This impairment represents only 1% of the river miles reviewed in this report. The primary cause of impairment is pH from acid mine drainage. The remaining seven named rivers in this report and the upper portions of Davis Mine Brook and the South River totaling 24.3 miles (14% of the river miles in the watershed) are currently not assessed for the *Aquatic Life Use*.

DEERFIELD RIVER WATERSHED:
***Aquatic Life Use* assessment for rivers**
(Total length reviewed in report is 179.4 miles.)

- **Support – 153.4 miles (86%)**
- **Impaired – 1.7 miles (1%)**
- **Not Assessed – 24.3 miles (14%)**

***Aquatic Life Use* assessment for lakes**
(Total area reviewed in report is 562 acres.)

- **Not Assessed – 562 (100%)**

Aquatic Life Use Summary – Lakes (Figure 1)

Few lakes in the Deerfield 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 none of the lakes in the Deerfield River Watershed are assessed for the *Aquatic Life Use*.

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 description of *Aquatic Life Use* guidance) 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, MADPH, Bureau of Environmental Health Assessment (MADPH 2002a). The MADPH 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 (MA DPH 2001)." Additionally, MA DPH "is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury (MA DPH 2001)." 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 (Figure 2)

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

Fish Consumption Use Summary – Lakes (Figure 2)
Because of health concerns associated with exposure to mercury, MA DPH issued fish consumption advisories for Sherman Reservoir and Plainfield Pond (MA DPH 1996 and MA DPH 2002a). The advisories recommend the following.

DEERFIELD RIVER WATERSHED:
***Fish Consumption Use* assessment for rivers**
(Total length reviewed in report is 179.4 miles.)
- **Not Assessed – 179.4 miles (100%)**

***Fish Consumption Use* assessment for lakes**
(Total area reviewed in report is 562 acres.)
- **Impaired – 132 acres (23%)**
- **Not Assessed – 430 acres (77%)**

Sherman Reservoir (Rowe):
1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat fish from Sherman Reservoir.
2. The general public should not consume any yellow perch from Sherman Reservoir, and
3. the general public should limit consumption of non-affected fish species from Sherman Reservoir to two meals per month."

Plainfield Pond (Plainfield):
1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any largemouth bass from this waterbody, and
2. the general public should limit consumption of largemouth bass from this waterbody."

Consequently, the *Fish Consumption Use* is impaired for Sherman Reservoir (72 acres in MA out of a total of 162 acres representing both MA and VT acreage) and Plainfield Pond (60 acres). These two lakes represent 23% of the lake acreage reviewed in the Deerfield River Watershed. It should be noted that Sherman Reservoir in Vermont is listed as partially supporting the *Fish Consumption Use* due to elevated tissue mercury concentrations (VT DEC 2003). The remaining lakes default to Not Assessed for the *Fish Consumption Use* because of the statewide advisory. Sources of mercury in this area are currently unknown, although atmospheric deposition is suspected.

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 (DWP) has primacy for implementing the provisions of the federal Safe Drinking Water Act. DWP has also initiated work on its Source Water Assessment Program (SWAP), 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 SWAP 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, as well as bacteria.

Primary and Secondary Contact Recreational Uses Summary – Rivers (Figure 3)

Four segments of the Deerfield River and six tributaries to the Deerfield, totaling 102.6 miles and representing 57% of the reviewed river miles, support the *Primary Contact Recreational Use*. These same river miles were assessed as supporting the *Secondary Contact Recreational Use*. The lower 1.7 miles of Davis Mine Brook are assessed as impaired for both *Primary and Secondary Contact Recreational uses* because of poor (impaired) aesthetic quality due to the presence of objectionable deposits on the streambed that result from acid mine drainage. The number of river miles in the Deerfield River watershed impaired for Primary Contact Recreational use is 1.7 miles, representing 1% of the total reviewed river miles. The number of river miles impaired for Secondary Contact Use is 1.7, or 1% of the total reviewed river miles. Not assessed river miles for *Primary and Secondary Contact Recreational Uses* each totaled 75.1 miles.

DEERFIELD RIVER WATERSHED:
***Primary Contact Recreational Use* assessment for rivers**
(Total length reviewed in report is 179.4 miles.)

- **Support – 102.6 miles (57%)**
- **Impaired – 1.7 miles (1%)**
- **Not Assessed – 75.1 miles (42%)**

***Secondary Contact Recreational Use* assessment for rivers**
(Total length reviewed in report is 179.4 miles.)

- **Support – 102.6 miles (57%)**
- **Impaired – 1.7 miles (1%)**
- **Not Assessed – 75.1 (42%)**

***Primary and Secondary Contact Recreational Use* assessments for lakes**
(Total area reviewed in report is 562 acres.)

- **Support – 48 acres (9%)**
- **Not Assessed - 514 acres (91%)**

Primary and Secondary Contact Recreational Uses Summary – Lakes (Figure 3)

Two lakes (North Pond, Florida and South Pond, Savoy) totaling 48 acres were assessed as supporting both the *Primary and Secondary Contact Recreational Uses*. Due to a lack of current bacteria data the remaining 514 acres (representing 91% of the reviewed lake acreage) were not assessed in the Deerfield River Watershed.

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)

The majority of river segments in the Deerfield River Watershed (150.8 miles representing 84% of the reviewed river miles) support the *Aesthetics Use*. The lower 1.7 miles of Davis Mine Brook is impaired for this use due to the presence of objectionable deposits on the streambed that result from acid mine drainage. The upper portion of Davis Mine Brook and the remaining six segments (totaling 26.9 miles and representing 15% of the reviewed river miles) were not assessed.

DEERFIELD RIVER WATERSHED:
***Aesthetics Use* assessment for rivers**
(Total length reviewed in report is 179.4 miles.)

- **Support – 150.8 miles (84%)**
- **Impaired – 1.7 miles (1%)**
- **Not Assessed – 26.9 miles (15%)**

***Aesthetics Use* assessments for lakes**
(Total area reviewed in report is 562 acres.)

- **Not Assessed – 562 acres (100%)**

Aesthetics Use Summary – Lakes (Figure 4)

Due to a lack of current information none of the lake acreage was assessed in the Deerfield River Watershed for this use.

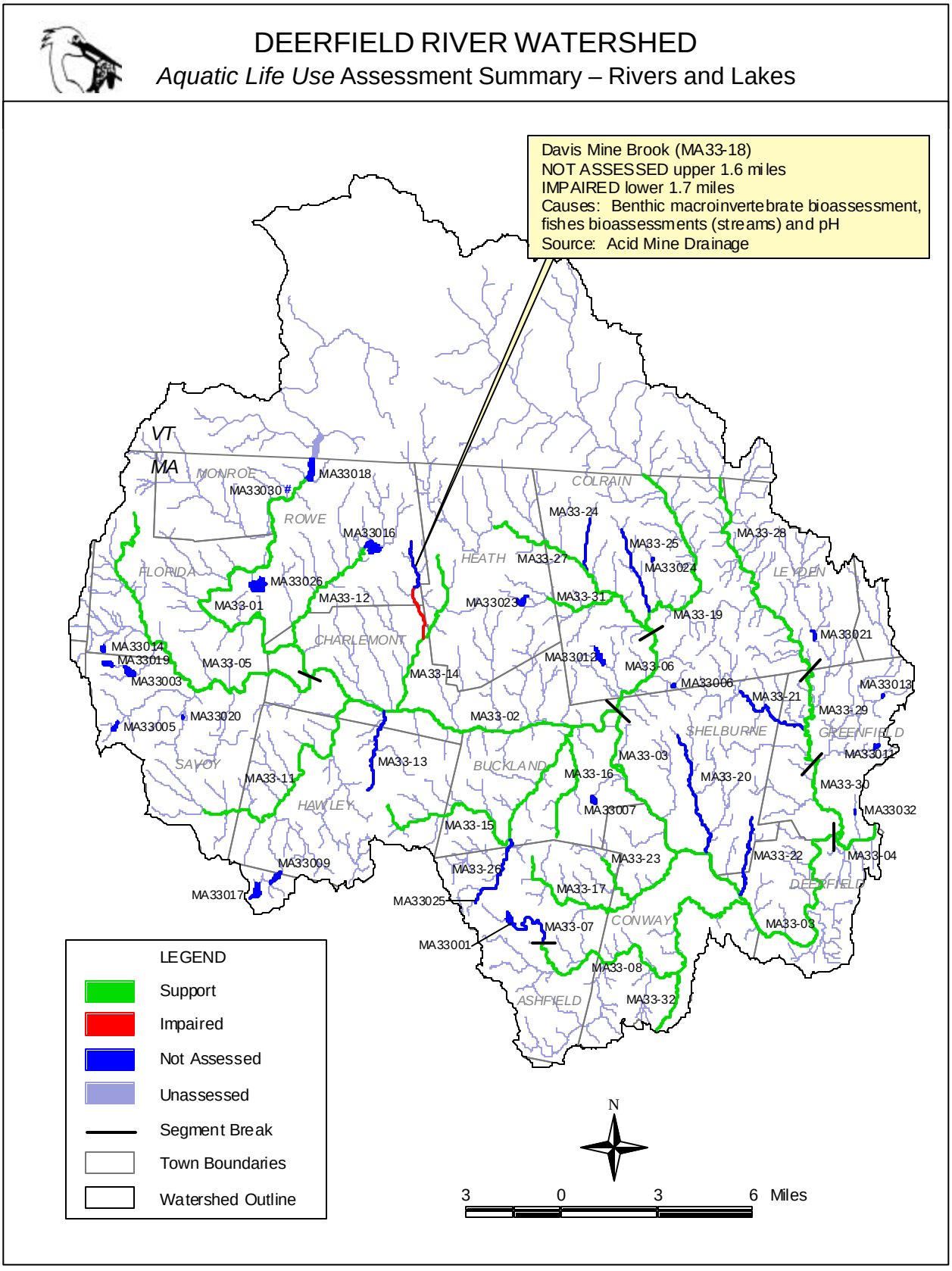

Figure 1. Deerfield River Watershed *Aquatic Life Use* Assessment Summary.

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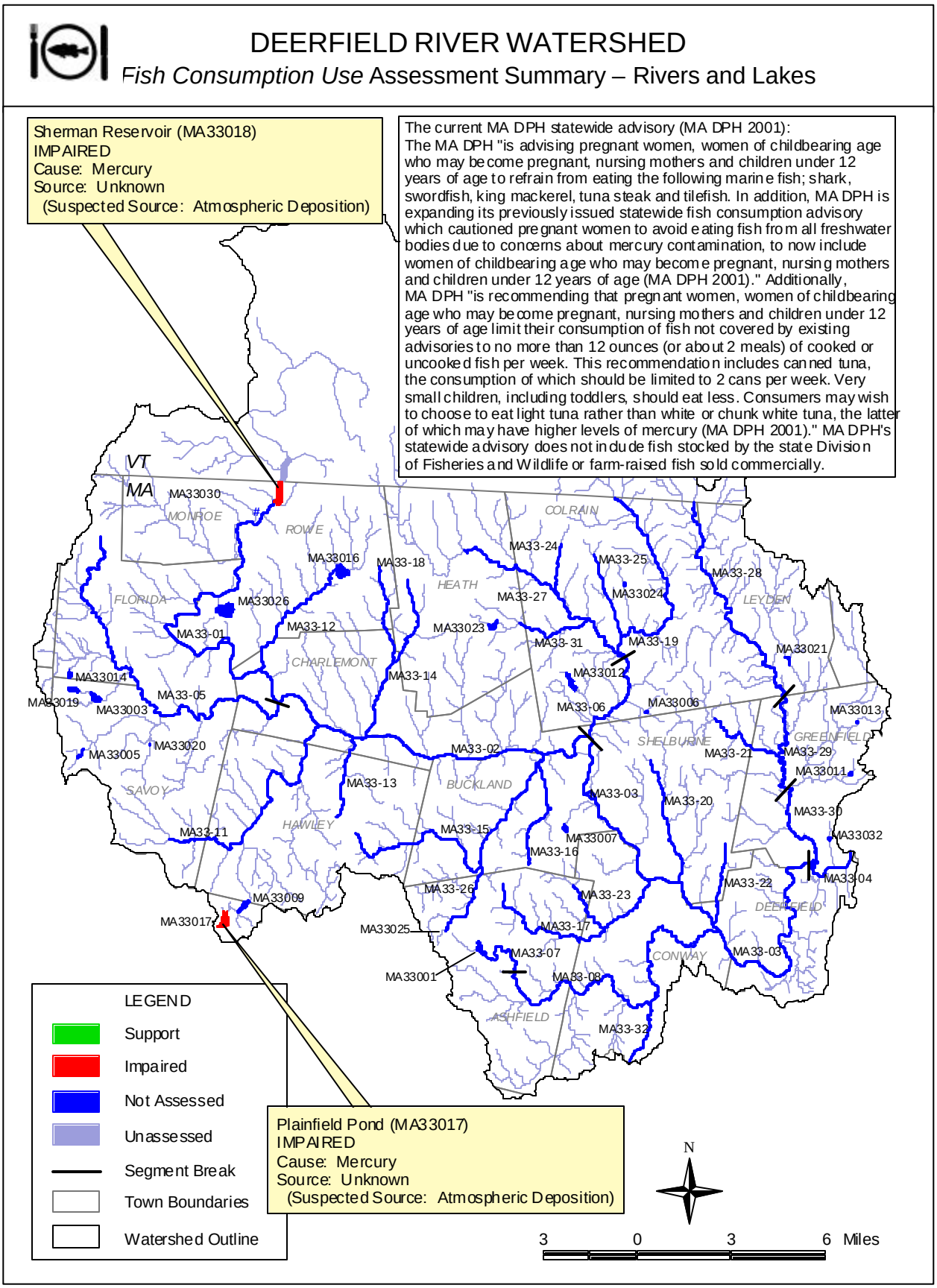

Figure 2. Deerfield River Watershed *Fish Consumption Use* Assessment Summary.

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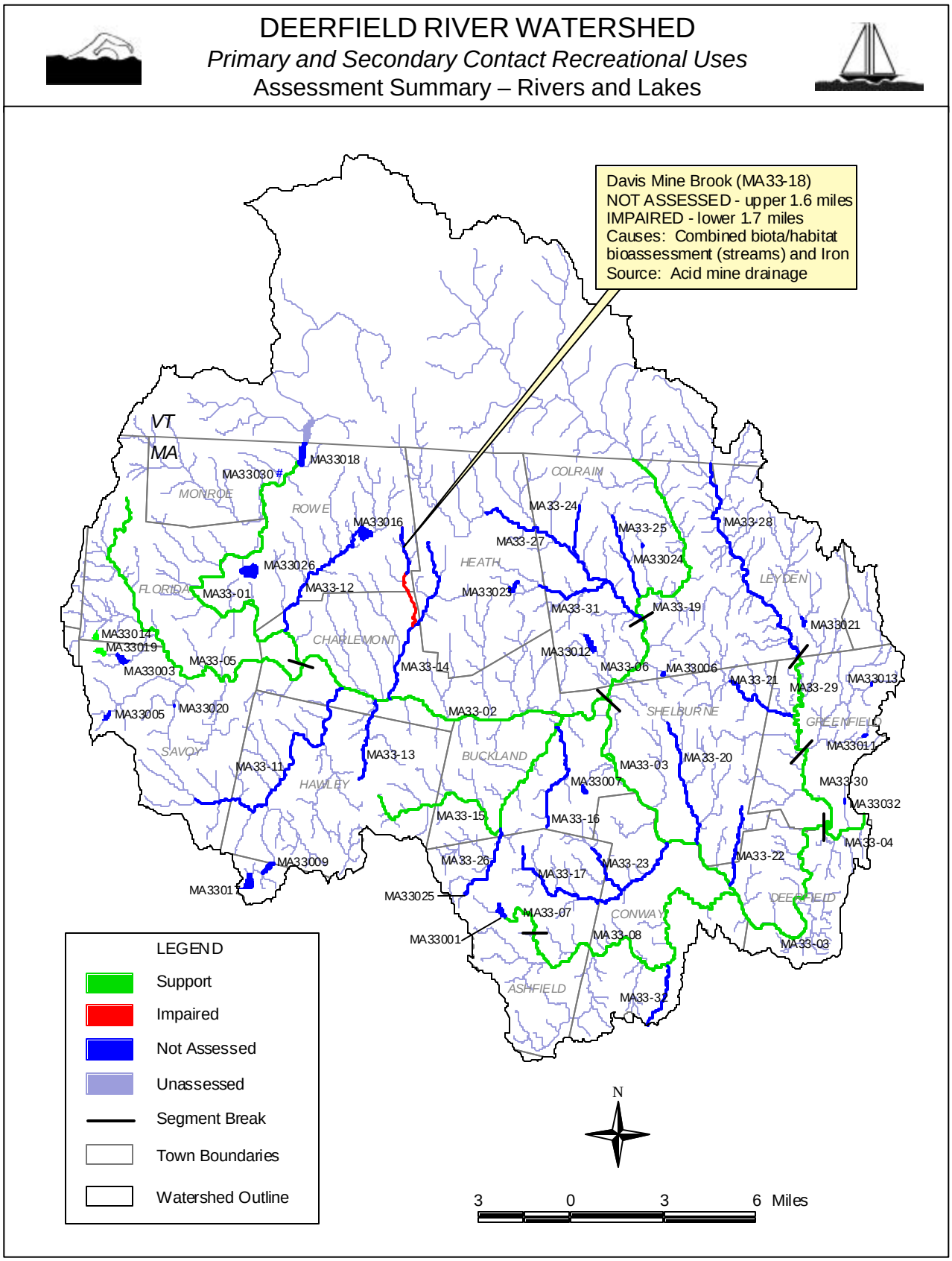

Figure 3. Deerfield River Watershed *Primary* and *Secondary Contact Recreational Uses* Assessment Summary.

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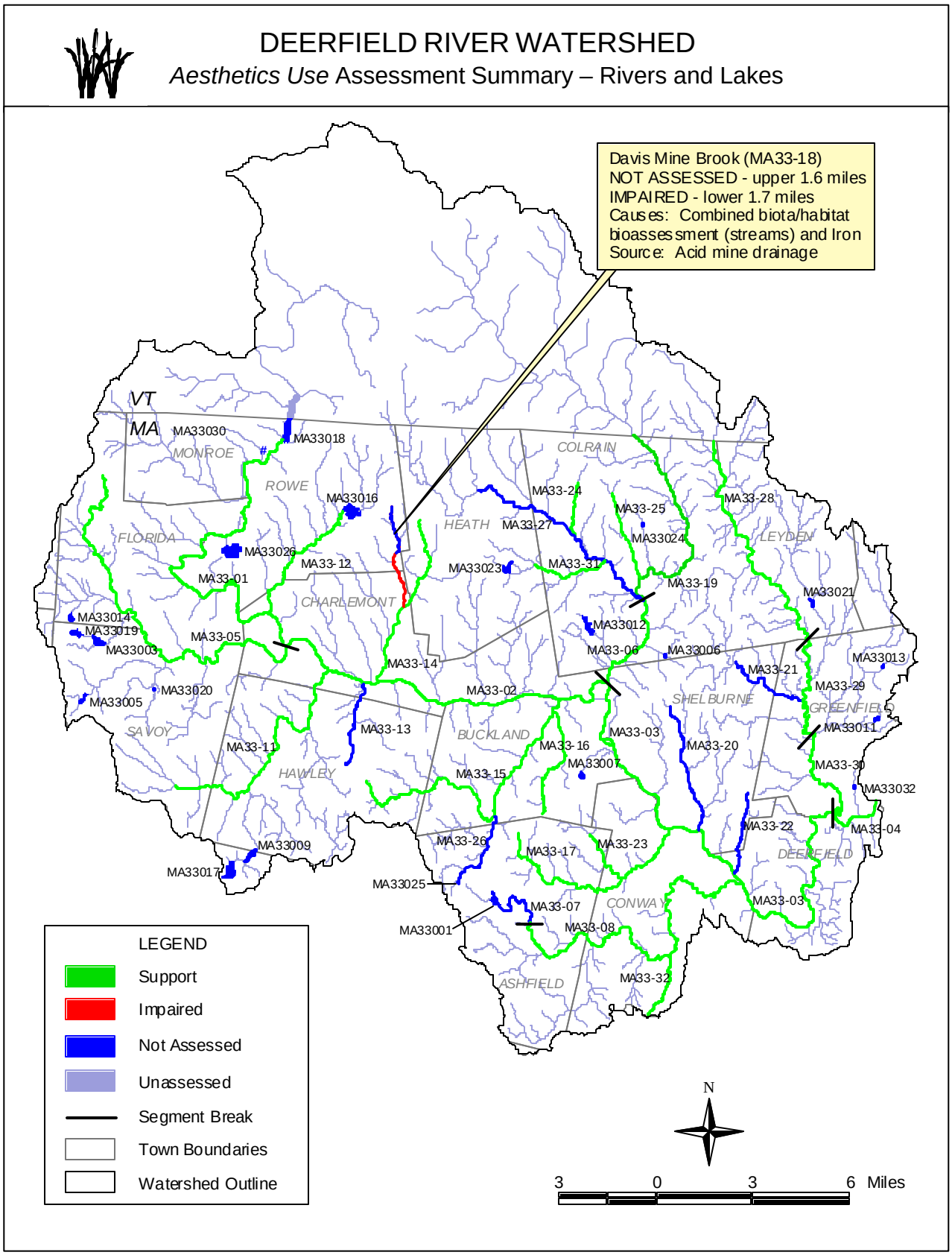

Figure 4. Deerfield River Watershed *Aesthetics Use* Assessment Summary

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RECOMMENDATIONS

In addition to specific actions identified for each individual segment, this assessment report has revealed the need for the following actions to be taken throughout the Deerfield River Watershed to protect, restore and/or improve water quality conditions.

- In view of the illegal dumping that occurs throughout the watershed, educational programs should be offered to inform residents of the negative effects of illegal solid waste dumping on the water quality and communities should be encouraged to provide incentives to residents for proper disposal of household items and building materials.
- Most communities in the watershed rely on septic systems for wastewater disposal. Efforts should be made, therefore, to ensure that on-site systems are properly sited, maintained and inspected.
- In order to prevent degradation of water quality in the watershed it is recommended that land use planning techniques be applied to direct development to desired zones, preserve sensitive areas, and maintain or reduce the impervious cover. Communities should review the information generated through the buildout analysis performed by EOEA that created a profile of how the community would look at full buildout according to its current zoning and follow the recommendations to protect priority and/or sensitive water resources described in their individual town open space plans and the watershed-wide open space plan (EOEA 2000 - 2001).
- According to the Massachusetts Natural Heritage and Endangered Species Program there are approximately 440 potential vernal pools in the Deerfield River Watershed. Currently, only 10 of these pools have been officially certified (Maher 2001). These potential vernal pools should be prioritized for protection measures and to pursue a course of certification to obtain further protection under the Wetlands Protection Act.
- Efforts should continue to document and describe the barriers to migration of fish and wildlife in tributaries of the Deerfield River similar to the road-stream crossing inventory work done by volunteers in the Bear River subwatershed. Information can be used to help determine if crossings are a barrier to fish and wildlife movement, and cause habitat fragmentation. Barriers that are identified can be prioritized for potential remediation.
- MA DFWELE has recommended that 61 streams and 164 river miles be protected as cold water fishery habitat based on surveys they have conducted in the watershed.
- Continue to conduct biological and water quality monitoring to evaluate the effect(s), if any, of National Pollutant Discharge Elimination System (NPDES) discharges, water withdrawals, power plant operations, and nonpoint sources of pollution and to document any changes in water quality conditions as a result of infrastructure improvements/pollution abatement controls.
- Encourage the use of riparian buffers on private and public lands to protect water and habitat quality.
- Monitor and control the spread and growth of exotic, invasive aquatic and wetland vegetation. Determine the effectiveness of various control options on the non-native plant growth. Prevent the spread of these plants to unaffected areas by alerting lake-users and landowners to the problem and the responsibility of spreading these exotic species.
- As part of the Water Management Act (WMA) 5-year review process MA DEP should continue to evaluate compliance with registration and/or permit limits for withdrawals in the Deerfield River Watershed. Work with water suppliers to encourage the development and implementation of local watershed and wellhead protection plans.
- Support the efforts of the Massachusetts Division of Fish and Game, Riverways Program to organize and direct stream teams in subwatersheds of the Deerfield River in order to document and address local non-point source problems affecting water quality.
- Although none of the communities in the Deerfield River Watershed are currently regulated as operators of small municipal separate storm sewer systems under the EPA Stormwater Phase II NPDES permit, it is recommended that municipalities in the watershed with urban centers proactively develop and implement appropriate stormwater management BMPs to protect water quality.
- Coordinate with the Deerfield Watershed Team and other groups to support the implementation of the Deerfield River Watershed Action Plan being developed for EOEA.
- Encourage and support efforts of citizen groups, such as the DRWA and Trout Unlimited, to build watershed awareness, foster watershed stewardship, and increase the number of volunteers active in watershed education and protection projects, such as river cleanups, volunteer water quality and wetlands monitoring, and the Atlantic Salmon Egg Rearing Project.

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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 Deerfield 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).

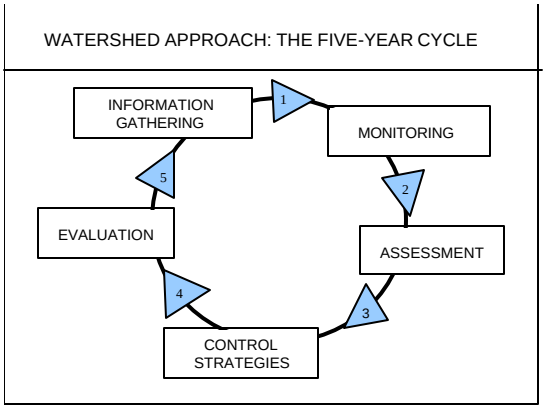


Figure 5. Five-year cycle of the Watershed Approach

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 United States 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 that describes the status of water quality in the Commonwealth. Up until 2002 this was accomplished as a statewide summary of water quality (the 305(b) Report). States are also required to submit, under Section 303(d) of the CWA, a list of impaired waters requiring a total maximum daily load (TMDL) calculation. In 2002, however, EPA recommended to states that they combine elements of the statewide 305(b) Report and the Section 303(d) list of impaired waters into one "Integrated List of Waters". 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. 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. Instream 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 below (Assessment Methodology). Once the use assessments have been completed the segments are categorized for the Integrated List.

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 1996a). 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). Each class is identified by the most sensitive and, therefore, governing water uses to be achieved and protected. 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 1996a). 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 and 2002, Grubbs and Wayland III 2000 and Wayland III 2001). The determination of whether or not a waterbody supports each of its designated uses is a function of the type(s), quality and quantity of available current information. Although data/information older than five years are usually considered "historical" and used for descriptive purposes, they can be utilized in the use support determination provided they are known to reflect the current conditions. While the water quality standards (Table 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 by D. Persaud, R. Jaagumagi and A. Hayton). Excursions from criteria due solely to "naturally occurring" conditions (e.g., low pH in some areas) do not constitute violations of the 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 that water quality impairment may exist, which is not "naturally occurring", 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 1996a and MA DPH 2002b).

Dissolved Oxygen	Class A, Class B Cold Water Fishery (BCWF), and Class SA: ≥6.0 mg/L and ≥75% saturation unless background conditions are lower Class B Warm Water Fishery (BWWF) and Class SB: ≥5.0 mg/L and ≥60% saturation unless background conditions are lower Class C: Not ≤5.0 mg/L for more than 16 of any 24-hour period and not ≤3.0 mg/L anytime unless background conditions are lower; levels cannot be lowered below 50% saturation due to a discharge Class SC: Not ≤5.0 mg/L for more than 16 of any 24-hour period and not ≤4.0 mg/L anytime unless background conditions are lower; and 50% saturation; levels cannot be lowered below 50% saturation due to a discharge
Temperature	Class A: ≤68°F (20°C) and Δ1.5°F (0.8°C) for Cold Water and ≤83°F (28.3°C) and Δ1.5°F (0.8°C) for Warm Water. Class BCWF: ≤68°F (20°C) and Δ3°F (1.7°C) due to a discharge Class BWWF: ≤83°F (28.3°C) and Δ3°F (1.7°C) in lakes, Δ5°F (2.8°C) in rivers Class C and Class SC: ≤85°F (29.4°C) nor Δ5°F (2.8°C) due to a discharge Class SA: ≤85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and Δ1.5°F (0.8°C) Class SB: ≤85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and Δ1.5°F (0.8°C) between July through September and Δ4.0°F (2.2°C) between October through June
pH	Class A, Class BCWF and Class BWWF: 6.5 - 8.3 SU and Δ0.5 outside the background range. Class C: 6.5 - 9.0 SU and Δ1.0 outside the naturally occurring range. Class SA and Class SB: 6.5 - 8.5 SU and Δ0.2 outside the normally occurring range. Class SC: 6.5 - 9.0SU and Δ0.5 outside the naturally occurring range.
Solids	All Classes: *These waters shall be free from floating, suspended, and settleable solids in concentrations or combinations that would impair any use assigned to each class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.*
Color and Turbidity	All Classes: *These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use.*
Oil and Grease	Class A and Class SA: *Waters shall be free from oil and grease, petrochemicals and other volatile or synthetic organic pollutants.* Class SA: *Waters shall be free from oil and grease and petrochemicals.* Class B, Class C, Class SB and Class SC: *Waters shall be free from oil* and *grease, petrochemicals that produce a visible film on the surface of the water, impart an oily taste to the water or an oily or other undesirable taste to the edible portions of aquatic life, coat the banks or bottom of the water course or are deleterious or become toxic to aquatic life.*
Taste and Odor	Class A and Class SA: *None other than of natural origin.* Class B, Class C, Class SB and Class SC: *None in such concentrations or combinations that are aesthetically objectionable, that would impair any use assigned to each class, or that would cause tainting or undesirable flavors in the edible portions of aquatic life.*
Aesthetics	All Classes: *All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.*
Toxic Pollutants	All Classes: *All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife… The Division shall use the recommended limit published by EPA pursuant to 33 USC 1251, 304(a) as the allowable receiving water concentrations for the affected waters unless a site-specific limit is established*.
Nutrients	*Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.*

Note: *Italics are direct quotations.*
Δ criterion (referring to a change from natural background conditions) is applied to the effects of a permitted discharge.

Table 1. Summary of Massachusetts Surface Water Quality Standards (MA DEP 1996a and MA DPH 2002b) - *Continued*.

Bacteria (MA DEP 1996a and MA DPH 2002b) Class A criteria apply to the *Drinking Water Use*. Class B and SB criteria apply to *Primary Contact Recreation Use* while Class C and SC criteria apply to *Secondary Contact Recreation Use*.	Class A: • Fecal coliform bacteria: An arithmetic mean of <20 cfu/100 mL in any representative set of samples and <10% of the samples >100 cfu/100 mL. Class B: • At public bathing beaches, as defined by MA DPH, where *E. coli* is the chosen indicator: No single *E. coli* sample shall exceed 235 *E. coli* /100 mL and the geometric mean of the most recent five *E. coli* samples within the same bathing season shall not exceed 126 *E. coli* / 100 mL. • At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 61 *Enterococci* /100 mL and the geometric mean of the most recent five *Enterococci* samples within same bathing season shall not exceed 33 *Enterococci* /100 mL. • Current standards for other waters (not designated as bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 cfu/100 mL in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 mL. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.) Class C: • Fecal coliform bacteria: Shall not exceed a geometric mean of 1000 cfu/100 mL, nor shall 10% of the samples exceed 2000 cfu/100 mL. Class SA: • 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/100 mL. • At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 104 *Enterococci* /100 mL and the geometric mean of the five most recent *Enterococci* levels within the same bathing season shall not exceed 35 *Enterococci* /100 mL. • Current standards for other waters (not designated as shellfishing areas or public bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 cfu/100 mL in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 mL. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.) Class SB: • Fecal coliform bacteria: In waters approved for restricted shellfish, a fecal coliform median or geometric mean (MPN method) of <88 MPN/100 mL and <10% of the samples >260 MPN/100 mL. • At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 104 *Enterococci* /100 mL and the geometric mean of the most recent five *Enterococci* levels within the same bathing season shall not exceed 35 *Enterococci* /100 mL. • Current standards for other waters (not designated as shellfishing areas or public bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 cfu/100 mL in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 mL. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.) Class SC: • Fecal coliform bacteria: Shall not exceed a geometric mean of 1000 cfu/100 mL, nor shall 10% of the samples exceed 2000 cfu/100 mL.

DESIGNATED USES

The Massachusetts Surface Water Quality Standards designate the most sensitive uses for which the surface waters of the Commonwealth shall be enhanced, maintained and protected. Each of these uses is briefly described below (MA DEP 1996a).

- *AQUATIC LIFE* - suitable habitat for sustaining a native, naturally diverse, community of aquatic flora and fauna. Two subclasses of aquatic life are also designated in the standards for freshwater bodies: *Cold Water Fishery* - capable of sustaining a year-round population of cold water aquatic life, such as trout; *Warm Water Fishery* - waters that are not capable of sustaining a year-round population of cold water aquatic life.
- *FISH CONSUMPTION* - pollutants shall not result in unacceptable concentrations in edible portions of marketable fish or for the recreational use of fish, other aquatic life or wildlife for human consumption.
- *DRINKING WATER* - used to denote those waters used as a source of public drinking water. They may be subject to more stringent regulation in accordance with the Massachusetts Drinking Water Regulations (310 CMR 22.00). These waters are designated for protection as Outstanding Resource Waters under 314 CMR 4.04(3).
- *SHELLFISH HARVESTING* (in SA and SB segments) – Class SA waters in approved areas (Open Shellfish Areas) shellfish harvested without depuration shall be suitable for consumption; Class SB waters in approved areas (Restricted Shellfish Areas) shellfish harvested with depuration shall be suitable for consumption.
- *PRIMARY CONTACT RECREATION* - suitable for any recreation or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water. These include, but are not limited to, wading, swimming, diving, surfing and water skiing.
- *SECONDARY CONTACT RECREATION* - suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities.
- *AESTHETICS* - all surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *AGRICULTURAL AND INDUSTRIAL* - suitable for irrigation or other agricultural process water and for compatible industrial cooling and process water.

The guidance used to assess the *Aquatic Life, Fish Consumption, Drinking Water, Shellfish Harvesting, Primary* and *Secondary Contact Recreation* and *Aesthetics* uses follows.

AQUATIC LIFE USE

This use is suitable for sustaining a native, naturally diverse, community of aquatic flora and fauna. The results of biological (and habitat), toxicological, and chemical data are integrated to assess this use. The nature, frequency, and precision of the 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 -*** 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*** There are frequent or severe violations of chemical criteria, presence of acute toxicity, or a moderate or severe modification of the biological community.
BIOLOGY		
Rapid Bioassessment Protocol (RBP) III*	Non/Slightly impacted	Moderately or Severely Impacted
Fish Community	Best Professional Judgment (BPJ)	BPJ
Habitat and Flow	BPJ	Dewatered streambed due to artificial regulation or channel alteration, BPJ
Eelgrass Bed Habitat (Howes et al. 2002)	No/minimal loss, BPJ	Moderate/severe loss, 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 1996a, 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 1996a, EPA 19 November 1999)	Infrequent excursion from criteria (Table 1)	Criteria exceeded >10% of measurements.
Temperature (MA DEP 1996a,EPA 1997)	Infrequent excursion from criteria (Table 1)	Criteria exceeded >10% of measurements.
Toxic Pollutants (MA DEP 1996a, EPA 1999b) Ammonia-N (MA DEP 1996a, EPA 1999a) Chlorine (MA DEP 1996a, EPA 1999b)	Infrequent excursion from criteria (Table 1) 1.32 mg/L NH_3-N [2] 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.

[2] [NH_3-N] at pH = 7.7 SU and 30°C, actual "criterion" varies with pH and temperature and is evaluated case-by-case. [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 2002a). The MA DPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species pose a health risk for human consumption. Hence, the *Fish Consumption Use* is assessed as non-support in these waters.

In July 2001, MA DPH issued new consumer advisories on fish consumption and mercury contamination (MA DPH 2001).

1. The MA DPH "…is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age (MA DPH 2001)."
2. Additionally, MA DPH "…is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury (MA DPH 2001)."

Other statewide advisories that MA DPH has previously issued and are still in effect are as follows (MA DPH 2001):

1. "Due to concerns about chemical contamination, primarily from polychlorinated biphenyl compounds (PCB) and other contaminants, no individual should consume lobster tomalley from any source. Lobster tomalley is the soft green substance found in the tail and body section of the lobster.
2. Pregnant and breastfeeding women and those who are considering becoming pregnant should not eat bluefish due to concerns about PCB contamination in this species."

The following is an overview of EPA's guidance used to assess the status (support or impaired) of the *Fish Consumption Use*. Because of the statewide advisory no waters can be assessed as support for the *Fish Consumption Use*. Therefore, if no site-specific advisory is in place the *Fish Consumption Use* is not assessed.

Variable	***Support*** No restrictions or bans in effect	***Impaired*** There is a "no consumption" advisory or ban in effect for the general population or a sub-population for one or more fish species or there is a commercial fishing ban in effect
MA DPH Fish Consumption Advisory List (MA DPH 2001, MA DPH 2002a)	Not applicable, precluded by statewide advisory (Mercury)	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 (DWP) has primacy for implementing the provisions of the federal Safe Drinking Water Act (SDWA). Except for suppliers with surface water sources for which a waiver from filtration has been granted (these systems also monitor surface water quality) all public drinking water supplies are monitored as finished water (tap water). Monitoring includes the major categories of contaminants established in the SDWA: bacteria, volatile and synthetic organic compounds, inorganic compounds and radionuclides. The DWP maintains current drinking supply monitoring data. The 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*** No closures or advisories (no contaminants with confirmed exceedances of maximum contaminant levels, conventional treatment is adequate to maintain the supply).	***Impaired*** Has one or more advisories or more than conventional treatment is required or has a contamination-based closure of the water supply.
Drinking Water Program (DWP) Evaluation	See note below	See note below

Note: While this use is not assessed in this report, information on drinking water source protection and finish water quality is available at http://www.mass.gov/dep/brp/dws/dwshome.htm and from the Deerfield River Watershed's public water suppliers.

SHELLFISH HARVESTING USE

This use is assessed using information from the Department of Fisheries, Wildlife and Environmental Law Enforcement's Division of Marine Fisheries (DMF). A designated shellfish growing area is an area of potential shellfish habitat. Growing areas are managed with respect to shellfish harvest for direct human consumption, and comprise at least one or more classification areas. The classification areas are the management units, and range from being approved to prohibited (described below) with respect to shellfish harvest. Shellfish areas under management closures are *not assessed.* Not enough testing has been done in these areas to determine whether or not they are fit for shellfish harvest, therefore, they are closed for the harvest of shellfish.

Variable	***Support*** SA Waters: Approved[1] SB Waters: Approved[1], Conditionally Approved[2] or Restricted[3]	***Impaired*** SA Waters: Conditionally Approved[2], Restricted[3], Conditionally Restricted[4], or Prohibited[5] SB Waters: Conditionally Restricted[4] or Prohibited[5]
DMF Shellfish Project Classification Area Information (MA DFWELE 2000)	Reported by DMF	Reported by DMF

NOTE: Designated shellfish growing areas may be viewed using the MassGIS datalayer available from MassGIS at http://www.state.ma.us/mgis/dsga.htm. This coverage currently reflects classification areas as of July 1, 2000.

[1] **Approved** - "...open for harvest of shellfish for direct human consumption subject to local rules and regulations..." An approved area is open all the time and closes only due to hurricanes or other major coastwide events.

[2] **Conditionally Approved** - "...subject to intermittent microbiological pollution..." During the time the area is open, it is "...for harvest of shellfish for direct human consumption subject to local rules and regulations…" A conditionally approved area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, shellfish harvested are treated as from an approved area.

[3] **Restricted** - area contains a "limited degree of pollution." It is open for "harvest of shellfish with depuration subject to local rules and state regulations" or for the relay of shellfish. A restricted area is used by DMF for the relay of shellfish to a less contaminated area.

[4] **Conditionally Restricted** - "...subject to intermittent microbiological pollution..." During the time area is restricted, it is only open for "the harvest of shellfish with depuration subject to local rules and state regulations." A conditionally restricted area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, only soft-shell clams may be harvested by specially licensed diggers (Master/Subordinate Diggers) and transported to the DMF Shellfish Purification Plant for depuration (purification).

[5] **Prohibited -** Closed for harvest of shellfish.

PRIMARY CONTACT RECREATION USE

This use is suitable for any recreational or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water during the primary contact recreation season (1 April to 15 October). These include, but are not limited to, wading, swimming, diving, surfing and water skiing. The chart below provides an overview of the guidance used to assess the status (support or impaired) of the *Primary Contact Recreation Use*. Excursions from criteria due to natural conditions are not considered impairment of use.

Variable	***Support*** Criteria are met, no aesthetic conditions that preclude the use	***Impaired*** Frequent or prolonged violations of criteria and/or formal bathing area closures, or severe aesthetic conditions that preclude the use
Bacteria (105 CMR 445.000) Minimum Standards for Bathing Beaches State Sanitary Code) (MA DEP 1996a)	At "public bathing beach" areas: formal beach postings/advisories neither frequent nor prolonged during the swimming season (the number of days posted or closed cannot exceed 10% during the locally operated swimming season). Other waters: samples* collected during the primary contact season must meet criteria (Table 1). Shellfish Growing Area classified as "Approved" by DMF.	At "public bathing beach" areas: formal beach closures/postings >10% of time during swimming season (the number of days posted or closed exceeds 10% during the locally operated swimming season). Other waters: samples* collected during the primary contact season do not meet the criteria (Table 1).
Aesthetics (MA DEP 1996a) - *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/100 mL but one of the five samples exceeds 400 cfu/100 mL). The method detection limit (MDL) will be used in the calculation of the geometric mean when data are reported as less than the MDL (e.g., use 20 cfu/100 mL if the result is reported as <20 cfu/100 mL). Those data reported as too numerous to count (TNTC) will not be used in the geometric mean calculation; however, frequency of TNTC sample results should be presented.

SECONDARY CONTACT RECREATION USE

This use is suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities. The 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 1996a)	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 1996a) - *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.
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 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	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.
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.

DEERFIELD RIVER WATERSHED DESCRIPTION AND CLASSIFICATION

DESCRIPTION

The Deerfield River Watershed (Figures 6 and 7) occupies a total of 665 mi^2 (1738 km^2). Approximately half of the watershed is in southern Vermont (318mi^2) and half lies in the Franklin and Berkshire Counties of western Massachusetts (347mi^2). The Deerfield River is a major tributary to the Connecticut River and extends 70.2 mainstem river miles from the river's source on Stratton Mountain (VT) to its mouth in Greenfield, MA.

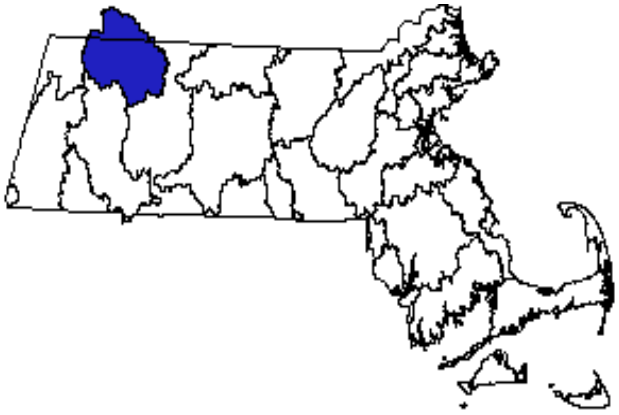


Figure 6. Location of the Deerfield River Watershed in MA showing southern portion of the watershed area in VT.

The beginning of the Deerfield River in Massachusetts is at the outlet of Sherman Reservoir dam in Monroe and Rowe, Massachusetts. Sherman Reservoir lies across the Vermont-Massachusetts border and is fed by the drainage of both the main branch of the Deerfield River and the South Branch of the Deerfield River in Vermont. From the outlet of Sherman Reservoir dam in Massachusetts the river flows generally south and then easterly 44 miles to its confluence with the Connecticut River.

In Massachusetts most of the drainage area is in the Berkshire Hills physiographic province where the topography consists of narrow river valleys bordered by steep slopes. The southeastern part of the basin is part of the Connecticut Valley Lowlands physiographic province where the topography is flatter than the Berkshire Hills. Land surface altitudes in the basin range from 120 feet above sea level in the Connecticut Valley Lowlands to 2,841 feet above sea level in the Berkshire Hills. Average annual precipitation ranges from 44 inches in the low altitudes of the southeast to 50 inches in the higher altitudes in the western part of the basin.

The Deerfield River Watershed in Massachusetts is bordered by the Hoosic River Watershed to the west, the Westfield River Watershed to the south, and the Connecticut River Watershed to the east. Major tributaries to the Deerfield River in Massachusetts, in order of decreasing drainage area are: the North River (92.9 mi^2), the Green River (89.8 mi^2), the Cold River (31.7 mi^2), the Chickley River (27.4 mi^2), the South River (26.3 mi^2), and Clesson Brook (21.2 mi^2).

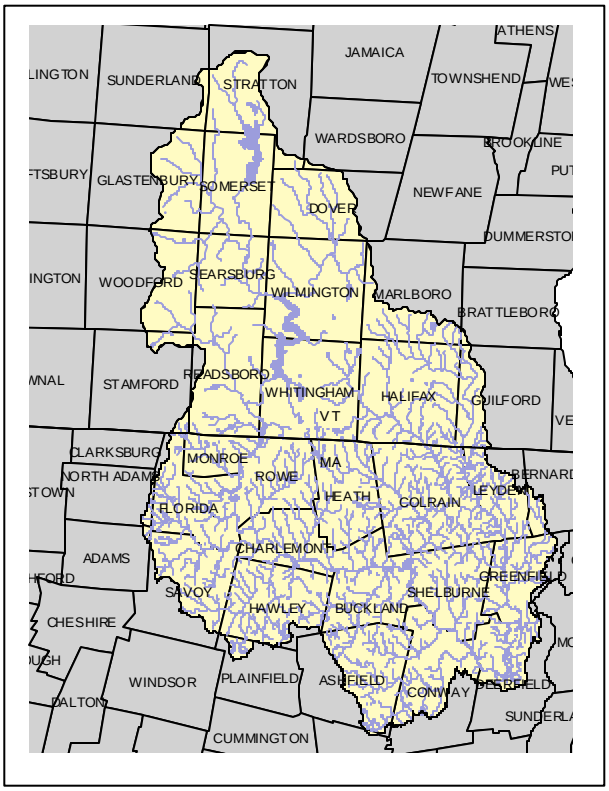


Figure 7. Deerfield River Watershed Towns in VT and MA.

Twenty communities, including Adams, Ashfield, Bernardston, Buckland, Charlemont, Colrain, Conway, Deerfield, Florida, Goshen, Greenfield, Hawley, Heath, Leyden, Monroe, North Adams, Plainfield, Rowe, Savoy, and Shelburne, lie wholly or partially within the Massachusetts area drained by the Deerfield River. The total population of all the aforementioned towns is 40,229 (US Census Bureau 2003). The Vermont portion of the watershed contributes a population of approximately 7,000 (VTDEC 1992). In Massachusetts landuse within this predominately rural watershed is classified as 81% forested, 13% agriculture/open land, 4% urban, and 2% water. The southern portion of the watershed contains most of the population, so the land use, although

still heavily forested, contains more of a mix of agricultural, residential, and industrial uses. The largest, and only city in the watershed is Greenfield, MA (population 18,168) and contains almost half the population in the entire watershed (US Census Bureau 2003). It is located in the southern part of the watershed at its most downstream end near the Deerfield's confluence with the Connecticut River.

There are currently ten facilities with permitted NPDES discharges in the watershed – five municipal wastewater treatment plants (Monroe, Charlemont, Buckland/Shelburne, Old Deerfield, and Greenfield), and five industrial dischargers (Yankee Atomic Electric Company in Rowe, BBA Nonwovens in Colrain, US GenNE and Consolidated Edison hydroelectric projects, and WTE Recycling). The largest discharger is the Greenfield wastewater treatment plant, which was renovated in 1998. Its discharge was moved from the Green River to the mainstem Deerfield. The Town of Ashfield uses a modified design of a Solar Aquatics facility to treat its municipal wastewater, which discharges to groundwater in the South River subwatershed. The Yankee Nuclear Power Station in Rowe, MA is located on the southeastern shore of Sherman Reservoir. This facility has been permanently shutdown since February 1992 and has been actively decommissioning since that time. Sherman Reservoir provided a source of cooling water when the reactor was in operation.

In the northern and western areas of the watershed the topography is mountainous and the river's profile is steep, which makes it attractive for hydroelectric power generation. The river gradient averages 28.4 ft/mi from the Vermont border to the streamflow-gaging station at West Deerfield, a distance of about 33 river miles. The United States Geological Survey (USGS) maintains five flow monitoring stations in the Massachusetts portion of the watershed; two on the mainstem and one in each of the North, South and Green River subwatersheds. Along the mainstem there are 9 licensed hydroelectric stations (7 in MA, including a pumped storage facility) and 10 associated dams, which effectively control the flow of the river. Because the water released from the hydroelectric facility dams affects the entire range of stream flow and causes multiple daily stream stage fluctuations in the mainstem a detailed description of the hydroelectric system is provided here.

In Vermont drainage from the Green Mountains forms the headwaters of the Deerfield River. The water is impounded in the Somerset Reservoir (1,514 acres) and then again in the Searsburg Reservoir (30 acres). From there the river flows into Harriman Reservoir (2,039 acres), the most downstream development in Vermont. Water from Harriman Reservoir may either be released to the Deerfield River or sent through a bypass pipe to a generating station on Sherman Reservoir.

Downstream from the Harriman Dam, in the Town of Readsboro, VT, the West Branch of the Deerfield River joins the mainstem of the Deerfield River. From this confluence water is impounded to form Sherman Reservoir (218 acres), which straddles the Vermont and Massachusetts border. From the dam and hydroelectric powerhouse on Sherman Reservoir the river flows for a short distance to the Deerfield Hydroelectric Station Number Five Dam. Sherman Reservoir and Number Five Station dam are so close that no lotic habitat is present between them. The water is released from pool to pool. The Number Five Station Dam has a FERC license minimum flow requirement of 73 cfs or inflow from upstream, and inflow cannot be less than 57 cfs guaranteed from Harriman Reservoir. The license also provides for thirty-two whitewater releases (average 1,000 cfs) from April to October. For power production the station releases water to a bypass pipe leading to a generating facility downstream on the Fife Brook Reservoir. Before a new FERC license was executed in 1997 this stretch of river was known as the "Dryway" because, except in times of flood, the entire flow of the river was piped to the generating facility on Fife Brook Reservoir.

Once the water reaches the Fife Brook Impoundment it may be used to fill the Bear Swamp Pumped Storage Facility on Negus Mountain. Water is pumped up to this pond and released down through the mountain via vertical pipes to generate electricity during periods of peak demand. All Deerfield River water returns to the Fife Brook Impoundment. Under the FERC license the year-round minimum flow requirement from the Fife Brook Dam is 125 cfs. FERC mandated whitewater releases (minimum flow of 700 cfs) occur 102 times between April and October.

Below Fife Brook Dam the unimpounded Cold River merges with the Deerfield River. From this confluence the river enters the Town of Charlemont, MA (population ~1,300) (US Census Bureau 2003). In addition, several smaller rivers and streams, such as Pelham Brook, the Chickley River, Bozrah Brook,

and Clesson Brook, enter the mainstem before encountering Deerfield Hydroelectric Station Number Four dam. The FERC license minimum flow requirement for this dam is 100 cfs or inflow from upstream from October 1 – May 31 and 125 cfs from June 1 to September 30.

The North River joins the mainstem just below this dam. The Deerfield then flows approximately 2 miles and is again impounded by Deerfield Hydroelectric Station Number Three Dam. Minimum flow requirements at Number Three are 100 cfs or inflow. Just below this dam are the historic "Glacial Potholes". Again, after just 0.4 miles the river is impounded by the Gardner Falls Hydroelectric Facility Dam. The year round FERC minimum flow requirement from this dam is 150 cfs or inflow. Deerfield Hydroelectric Station Number Two is the last generating facility and dam on the mainstem. Minimum flow requirements from this dam are 200 cfs guaranteed flow. Below this final impoundment the river flows for 9 miles to its confluence with the Connecticut River. The South River and then the Green River join the Deerfield River in this stretch.

Besides the mainstem dams, there are at least 45 additional dams located in the tributary subwatersheds of Massachusetts (MA DCR 2003). The majority of these structures are no longer maintained or in use. Several function to impound local water supply reservoirs or to form a number of lakes and ponds in the watershed.

There are relatively few (24) named lakes and ponds in the Massachusetts portion of the Deerfield watershed. About half (10) are located within MA DCR State Forest lands and the other half are privately owned, town owned, or are town-owned water supply reservoirs. The total surface acreage of all of the Deerfield Watershed lakes in Massachusetts is approximately 563 acres.

CLASSIFICATION

Consistent with the National Goal Uses of “fishable and swimmable waters”, the classification of waters in the Deerfield River Basin 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 their 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).

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

- Upper Reservoir and Lower Reservoir (Highland Springs), source to outlet in Ashfield and those tributaries thereto (Note: Lower Reservoir no longer exists and will be removed from the list of Class A waterbodies in the next revision of the SWQS.)
- Unnamed Reservoir (Mt. Spring Reservoir, Mountain Brook Reservoir), source to outlet in Colrain and those tributaries thereto
- Greenfield Reservoir (Glen Brook Upper Reservoir), source to outlet in Leyden and those tributaries thereto
- Unnamed Reservoir (Fox Brook Upper Reservoir), source to outlet in Colrain and those tributaries thereto
- Unnamed Reservoir (Phelps Brook Reservoir), reservoir outlet in Monroe and those tributaries thereto
- The MA DEP/Division of Water Supply has recommended that the Green River and its tributaries from the VT border to the Greenfield pumping station dam near the Greenfield/Colrain town line 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 (CVPs), 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.

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.

Within the Deerfield Watershed there are currently ten Certified Vernal Pools (CVPs) (Maher 2001). These are located in the Towns of Hawley, Conway, and Buckland. Species of special concern observed in these pools include the spotted turtle (*Clemmys guttata*). Other obligate vernal pool species observed include the spotted salamander (*Ambystoma maculatum*), the wood frog (*Rana sylvatica*), and the Jefferson Salamander (*Ambystoma jeffersonianum*).

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 Deerfield River Watershed the following waterbodies are classified as B Cold Water Fisheries.

- Deerfield River, Vermont-Massachusetts State Line to confluence with North River
- North River, East and West Branches from the Vermont-Massachusetts State Line to confluence with the Deerfield River
- Green River, Vermont-Massachusetts State Line to confluence with the Deerfield River.

In the Deerfield River Watershed the following waterbody is classified as B Warm Water Fishery.

- Deerfield River, North River confluence to confluence with the Connecticut River.

Unlisted waters in the Deerfield 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.

SUMMARY OF EXISTING CONDITIONS AND PERCEIVED PROBLEMS

The general perception of most people who live in or visit the area is that the environmental quality of the Deerfield Watershed is excellent. The rural character of the watershed has helped to protect the environment from the impacts of point and non-point sources of pollution common to more urbanized areas. Throughout the watershed there are, however, localized water quality problems that arise from a variety of land use activities that cause non-point source pollution. The EOEA, Massachusetts Watershed Initiative, Deerfield Watershed Team's annual workplans from 1999 to 2004 have identified a number of issues of concern related to environmental degradation of the watershed including: stormwater runoff impacts to the Green River in Greenfield, sedimentation of streams from rural road runoff, invasive plants, localized failing septic systems, localized wetland fillings, localized agricultural impacts, old municipal landfills, acid mine drainage into Davis Mine Brook in Rowe, sewage contamination into Maple Brook in Greenfield, flow alterations from hydropower generation in the mainstem, illegal ORV use in state forests, need for emergency planning for potential hazardous materials spills into the river from nearby major rail and truck transportation routes, and impeded fish passage and instream habitat degradation from dams (EOEA 1999, 2000, 2001, 2002, 2003 and 2004).

There are over 50 dams in the Massachusetts portion of the Deerfield watershed (MA DCR 2003). Many of these dams no longer fulfill the role for which they were built or any subsequent purpose. However, their presence alters flow patterns, reduces riverine habitat, impedes fish movement, may change water

temperature, and potentially changes other water physicochemical parameters. Since many of these relict dams are no longer maintained they may pose a threat to human lives, ecosystems, and downstream properties. Sediments deposited behind dams also often contain contaminants from upstream industrial, agricultural, and other sources. In 2000 the US Army Corps of Engineers began a Feasibility Study of four dams on the Green River in Greenfield, funded by the Executive Office of Environmental Affairs, Deerfield River Watershed Team. The study is investigating the hydrologic, environmental, physical, cultural, and economic impacts of dam removal and/or fish passage structures on these dams as well as other potential stream ecosystem restoration activities. The project is expected to be completed in late 2004. Recommendations may include dam removal and/or fish passage structures at Wiley Russell Dam and Mill Street Dam and fish passage structures for the still functioning Swimming Pool Dam and the Water Supply Dam. Implementation of the recommendations is optional, however funding may be available from ACOE for up to 65% of the cost if Greenfield decides to follow them.

Although there are large blocks of protected open space in some watershed communities, there are also many towns that have very little permanently protected open space. The need for ongoing open space planning and protection to address habitat loss and fragmentation and non-point source pollution from increasing development is a key concern in the watershed. The Franklin Regional Council of Governments recently completed a Deerfield Watershed Regional Open Space and Recreation Plan as well as several individual watershed town Open Space and Recreation Plans with funds from the Executive Office of Environmental Affairs, Deerfield Watershed Team. A municipal and regional Open Space Plan was also developed for several watershed communities by Dodsen Associates with EOEA, Deerfield Watershed Team funding. Buildout analysis and maps were also prepared for all of the watershed towns by the Massachusetts Community Preservation Initiative in EOEA.

The Deerfield Watershed is used heavily for recreation. MA DCR (formerly MA DEM) owns state forest lands covering over 15% of the watershed (Franklin County Planning Department, 1990) and these provide many camping, hiking, swimming, birding, fishing, cross-county skiing, snowmobiling, hunting, and sightseeing opportunities. Access to the Deerfield River for boating, fishing, and picnicking is provided at numerous sites by the hydropower companies as required by their FERC license. Both commercial whitewater boating companies and private citizens heavily use the upper Deerfield River for rafting, kayaking, canoeing and inner tubing. In recent years concerns about river safety have increased, particularly because of the increasing number of private boaters that may be unfamiliar with safe whitewater boating practices. In addition, safety risks to other river users such as fishermen are an ongoing concern because of the rapid changes in flow caused by the releases of water from the dams for hydropower generation. The hydropower companies have implemented a number measures to warn river users of the danger of rapidly rising water from releases from the dams and continue to work with user groups to enhance these measures.

The Clean Water Act Section 303(d) requires states to identify those waterbodies that are not meeting standards and prioritize the development of TMDLs for these waterbodies. Table 2 identifies the waterbodies in the Deerfield River Watershed on the most recent, EPA approved, 1998 Massachusetts Section 303(d) List of Waters (MA DEP 1999a).

Table 2. 1998 303(d) List of Waters in the Deerfield River Watershed.

Name, Town	Waterbody Identification Code (WBID)	Cause of Impairment
Bog Pond, Savoy	MA33003	Noxious Aquatic Plants
Burnett Pond, Savoy	MA33005	Noxious Aquatic Plants
Goodnow Road Pond, Buckland	MA33007	Noxious Aquatic Plants
Hallockville Pond, Hawley/Plainfield	MA33009	Noxious Aquatic Plants
Little Mohawk Road Pond, Shelburne[1]	MA33027	Noxious Aquatic Plants
McLeod Pond, Colrain	MA33012	Noxious Aquatic Plants
Pelham Lake, Rowe	MA33016	Noxious Aquatic Plants
Plainfield Pond, Plainfield	MA33017	Noxious Aquatic Plants

Table 2 continued. 1998 303(d) List of Waters in the Deerfield River Watershed.

Name, Town	Waterbody Identification Code (WBID)	Cause of Impairment
Schneck Brook Pond, Conway[1]	MA33029	Noxious Aquatic Plants
Deerfield River[2], Charlemont/ Shelburne	MA33-02	Unknown Toxicity, Metals, and Chlorine
Chickley River[2], Savoy/Hawley	MA33-11	Pathogens
Davis Mine Brook[2], Rowe/Charlemont	MA33-18	pH, Other Habitat Alterations
North River, Colrain/Shelburne	MA33-06	Pathogens, Taste, Odor and Color
South River, Ashfield/Conway	MA33-08	Pathogens, Other Habitat Alterations (Cause Unknown)
Green River, Colrain/Greenfield	MA33-09[3]	Pathogens, Metals (Cause Unknown)

[1] These ponds have been removed from the PALIS database for this assessment report because it has been determined that they no longer exist as lakes due to dam failure and/or they have filled in with aquatic vegetation.
[2] Needing confirmation
[3] Now WBID MA33-30

The northeastern United States has been identified as receiving elevated rates of mercury deposition from the atmosphere and having high levels of mercury contamination in freshwater fishes (Tatsutani 1998). All forms of mercury are toxic to humans and have no known function in any normal biological process. Mercury can be transformed into methylmercury. The ability of methylmercury to bind to proteins (e.g., muscle tissues) contributes to its ability to biologically concentrate into aquatic organisms by factors ranging from 10,000 to 1,000,000 its concentration in water (Stein, et. al., 1996). Aside from point discharges, most of the mercury contamination in the northeastern United States has been linked to air emissions (incineration, fossil fuel combustion, and sewage treatment plant operation) and agricultural practices (herbicides, fungicides) from both local and distant up-wind sources. The primary vector of mercury exposure in people is through the consumption of contaminated foodstuffs. As a result of this risk, the MA DPH, like the other New England States, has issued a statewide fish consumption advisory. 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. MA DPH has also expanded its previously issued statewide fish consumption advisory, which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age (MA DPH 2001).

In addition, MA DPH has issued the following site-specific fish consumption advisory due to elevated levels of mercury for Sherman Reservoir in Rowe/Monroe: children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this water body; the general public should not consume any yellow perch from this water body; and the general public should limit consumption of non-affected fish from this water body to two meals per month (MA DPH, 2002a). The Vermont Department of Environmental Conservation has also identified Sherman Reservoir as having elevated fish tissue mercury concentrations and has only partially supported the *Fish Consumption Use* for this waterbody (VT DEC 2003).

SOURCES OF INFORMATION

Multiple local, private, state and federal agencies provided information used in the water quality assessment of the Deerfield River Watershed. Within MA DEP information was obtained from three programmatic bureaus: Bureau of Resource Protection (BRP, see below), Bureau of Waste Prevention (industrial wastewater discharge information) and the Bureau of Waste Site Cleanup (hazardous waste site cleanup information). Specifically, water quality, habitat assessment, biological and lake data were provided by MA DEP, Division of Watershed Management (DWM), Watershed Planning Program. Water withdrawal and wastewater discharge permit information were provided by members of the Deerfield River Watershed Team in the MA DEP, Western Regional Office, as well as the DWM, Watershed Permitting Program.

The Deerfield River and some of its tributaries receive discharges of treated municipal and industrial wastewater, contact and non-contact cooling water, etc. (Appendix H, Tables H1 and H2). The following types of National Pollutant Discharge Elimination System (NPDES) discharges occur in the Deerfield River Watershed (Hogan 2003).

- *Municipal wastewater treatment plants (WWTPs).* These facilities treat wastewater from domestic and industrial sources within the WWTP service area. Five WWTPs discharge to the Deerfield River or its tributaries. They are: Old Deerfield Municipal Treatment Facility (MA0101940), Monroe Wastewater Treatment facility (MA0100188), Town of Charlemont Wastewater Treatment Facility (MA0103101), Shelburne Falls Waste Water Treatment Facility (MA0101044), and Greenfield Wastewater Treatment Facility (MA0101214). All of the municipal wastewater treatment facilities discharge to the mainstem of the Deerfield River. These discharges range in size from the Monroe WWTP that is authorized to discharge an average monthly flow of 0.015 MGD to the Greenfield WWTP, which is currently authorized to discharge an average monthly flow of 3.2 MGD.
- *Industrial WWTPs.* BBA Nonwovens (Colrain, MA) (MA0003697) is authorized to discharge 1.35 MGD of treated wastewater to the North River.
- *Non-process discharges*. Yankee Atomic Electric Company (MA0004367) and eight hydroelectric projects (listed below) in the Massachusetts portion of the Deerfield River have NPDES permits for the discharge of cooling water and internal facility drainage (floor drains).

  Deerfield #2 Station (MA0034843)
  Deerfield #3 Station (MA0034851)
  Deerfield #4 Station (MA0034860)
  Fife Brook Station (MA0034878)
  Deerfield #5 Station (MA0034894)
  Sherman Station (MA0034908)
  Bear Swamp Station (MA0034886)
  Gardners Falls Station (MA0035670)

NPDES Toxicity Testing Discharge Monitoring Reports (DMRs)

All of the municipal wastewater treatment plants in the Deerfield River Watershed, and BBA Nonwovens submit toxicity testing 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 "TOXTD". Information from the reports includes: survival of test organisms exposed to ambient river water (used as dilution water), physicochemical analysis (e.g., hardness, alkalinity, pH, total suspended solids) of the dilution water, and the whole effluent toxicity test results. Data from these reports for the time period noted in parentheses were reviewed and summarized (ranges) for use in the assessment of current water quality conditions in the Deerfield River Watershed. These include:

- Old Deerfield Municipal Treatment Facility (MA0101940) (October 1996 to October 2002)
- Town of Charlemont WWTP (MA0103101) (January 1996 to August 2002)
- Shelburne Falls WWTF (MA0101044) (April 1998 to April 2003)
- Greenfield WWTP (MA0101214) (November 1999 to December 2002)
- BBA Nonwovens (MA0003697) (February 1997 to September 2002)
- Monroe Wastewater Treatment Facility (MA0100188) (April 1999 to April 2001)

There are no "Phase II" stormwater communities in the Deerfield River Watershed.

There are eight Federal Energy Regulatory Commission (FERC) licensed hydroelectric power plants in the Deerfield River Watershed in Massachusetts. A table that describes these hydroelectric facilities can be found in Appendix H, Table H3.

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 H4 (LeVangie 2002).

Projects funded through various state and federal 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 Deerfield River Watershed is provided in Appendix I.

Other state agencies contributing information to this report include: the MA DPH, the Department of Fish and Game (formerly Department of Fish and Wildlife, and Environmental Law Enforcement (MA DFWELE)), Division of Fisheries and Wildlife and Riverways programs, and the Department of Resource Conservation (DCR) (formerly Department of Environmental Management (MA DEM)). Contributing federal agencies include: EPA, United States Geological Survey (USGS), Federal Energy Regulatory Commission (FERC), and the United States Army Corps of Engineers (ACOE).

The US Army Corps of Engineers (ACOE), New England District ongoing ecosystem restoration study on the Green River in Greenfield is an outgrowth of a study originally intended to evaluate the Searsburg and Somerset dams in Vermont. ACOE will consider alternatives for fish passage at four dams on the Green River, a Deerfield River tributary, as well as other habitat enhancement opportunities (ACOE 2001).

The USGS currently maintains and operates the following five stream gaging stations within the Massachusetts portion of the Deerfield Watershed.

01170000	Deerfield River near West Deerfield	Segment MA33-03
01169900	South River near Conway	Segment MA33-08
01170100	Green River near Colrain	Segment MA33-09
01169000	North River at Shattuckville	Segment MA33-06
01168500	Deerfield River at Charlemont	Segment MA33-02

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 Deerfield River Basin between 1992 and 1995. A summary of their data collection by study component is provided in Table 3. Results of the USGS investigations are published in Breault and Harris (1997), Coles (1998), Garabedian *et al.* (1998), Harris (1997), and Zimmerman (1999). Under the NAWQA Program, more than 50 of the largest river basins and aquifers in the U.S. (representing 50 percent of the land area of the nation) were assessed.

Table 3. Summary of Data Collection by USGS NAWQA Program in the Deerfield River Watershed (Garabedian *et al*. 1998).

Study Component	Study Objective	Brief Description Of Sampling Effort	Frequency Of Sample Collection And Location
Contaminants in fish tissue	Determine the presence of organochlorine compounds and trace elements that can accumulate in fish tissues.	Collect white suckers and s ubmit composite of whole fishes for inorganic compound analysis	Once per site (August 1994)
Bottom-sediment survey	Determine presence of potentially toxic compounds within the streambed sediments and evaluate their potential for adverse biological effects on aquatic organisms.	Sample depositional zones of streams for trace elements and hydrophobic organic compounds.	Once per site (August 1994)
Water chemistry – synoptic studies	Describe the short-term presence and distribution of contamination over broad areas, and determine how well the water chemistry stations represent the watershed's surface water.	Sample streams during high flow and low flow conditions for pesticides and/or nutrients, suspended sediment, organic carbon and streamflow	Once per site (August 1994)

In August 2001 the Massachusetts "Beach Bill" was enacted by the legislature and signed by the Governor (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 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.state.ma.us/dph/dcs/bb4_01.pdf (MA DPH 2002b). 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).

The Deerfield River Watershed Association (DRWA) is a volunteer non-profit organization that conducts volunteer monitoring in the watershed. Its mission is to preserve, protect, and enhance the natural resources of the Deerfield River watershed in southeastern Vermont and northwestern Massachusetts. DRWA began its volunteer water quality monitoring program in 1990. Currently DRWA monitors at 12 sites throughout the watershed in the spring for pH, alkalinity, temperature and dissolved oxygen. During the recreational season volunteers collect samples at 11 sites in the watershed that people use informally as "swimming holes" and test for fecal coliform bacteria to assess the safety of recreational waters. As part of a two year "Marsh Monitoring Project", DRWA volunteers surveyed more than 20 marshes in the watershed for frogs and toads and waterbirds to document the diversity of little known wildlife communities. DRWA volunteers have also recently surveyed several Deerfield subwatersheds to locate and map infestations of the invasive non-native plant – Japanese knotweed. Quality Assurance Project Plans (QAPPs) were prepared for all of these volunteer monitoring efforts. An MA DEP approved QAPP exists for the volunteer water quality monitoring program. DRWA also conducts annual river clean-ups with other organizations such as FLOW, Trout Unlimited, Zoar Outdoor, Crabapple, and the Connecticut River Source to Sea Consortium. Additional information about the DRWA can be found on their website at www.deerfieldriver.org.

ESS conducted a water and sediment quality assessment of selected sites in the Deerfield Watershed from July through November of 2000. The study was funded through DEP under a grant from the Massachusetts Watershed Initiative as part of the Deerfield River Watershed Team's annual workplan for 2000. ESS measured fecal coliform bacteria, turbidity, pH, conductivity, temperature, dissolved oxygen and flow rate at 21 sites on 3 dry and 3 wet weather sampling dates. ESS also collected sediment samples from behind 6 impoundments and tested for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, polychlorinated biphenyls (PCB), polynuclear aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), total organic carbons (TOC), percent volatile solids, and percent water. The QAPP for this study was approved by MA DEP before sampling commenced.

Between 1983 and 1985 the University of Massachusetts Water Resources Research Center Acid Rain Monitoring Project used as many as 1,000 citizen volunteers to collect and help analyze more than 40,000 samples from 2,444 lakes and 1,670 streams, respectively 87% and 69% of the named lakes and streams in the state. They also monitored a representative 453 randomly selected and 119 special interest lakes and streams for eight successive years (1985-1993) with approximately 300 volunteers. . (Godfrey, *et al.* 1996). In 2001 and 2002 the Acid Rain Monitoring Project resumed and collected samples three times per year (April, July, and October) from approximately 150 lakes and ponds. Samples were analyzed for pH, alkalinity, total phosphorus and ions. In the Deerfield River Watershed three sites were sampled in 2001 and 2002: Ashfield Lake, Ashfield; Bog Pond, Savoy; and Newell Pond, Greenfield.

TOTAL MAXIMUM DAILY LOADS (TMDLs)

As part of the Federal Clean Water Act states are required to develop TMDLs for lakes, rivers and coastal waters that do not meet SWQS as indicated by the states' 303(d) List of Impaired Waters (see Tables 1 and 2). 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 are available on the MA DEP website at: http://www.mass.gov/dep/brp/wm/wmpubs.htm.

There are nine lakes in the Deerfield River Watershed on the 303 (d) List for which the most common cause of impairment is noxious aquatic plants (Table 2). TMDLs are expected to be developed for these lakes within five to 10 years (Mattson 2003b).

OBJECTIVES

This report summarizes information generated in the Deerfield River Watershed through *Year 1* (information gathering in 1999) and *Year 2* (environmental monitoring in 2000) activities established in the "Five-Year Cycle" of the Watershed Approach. Data collected by DWM in 2000 are provided in Appendices A, B, D, E and F of this report. Together with other sources of information (identified in each segment assessment) these data were used to assess the status of water quality conditions of lakes and rivers in the Deerfield River Watershed in accordance with EPA's and MA DEP's use assessment methods. Not all waters in the Deerfield River Watershed are included in the waterbody system database (WBS), the new assessment database (ADB), or this report.

The objectives of this water quality assessment report are to:

1. evaluate whether or not surface waters in the Deerfield 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 point (wastewater discharges) and 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 Deerfield River Watershed action plan.

REPORT FORMAT

RIVERS

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., MA33-01) used by MA DEP to reference the stream segment in databases such as 305(b) and 303(d), the Massachusetts SWQS (MA DEP 1996a), and other descriptive information.

SEGMENT DESCRIPTION

Major land-use estimates (the top three uses for the 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 at a scale of 1:25,000 and based on aerial photographs taken in 1999 (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).

WATER WITHDRAWALS AND WASTEWATER DISCHARGE PERMIT INFORMATION

Water withdrawal, NPDES wastewater discharge

Sources of information: WMA Database Printout (LeVangie 2002); open permit files located in the Springfield Regional MA DEP Office (MA DEP 2001b).

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 2000 Survey data (Appendix A, B, D, E and F); MA DEP DWM Toxicity Testing Database "TOXTD"; DRWA Volunteer Monitoring Data for 2001 and 2002; MA DPH Swimming Beach Water Quality Data (MA DPH 2001b and MA DPH 2002c); MA DEM beach bacteria data (MA DEM 2002); Environmental Science Services, Inc. (2002) Water and Sediment Quality Assessment of the Deerfield River Watershed. The MA DPH Freshwater Fish Consumption Advisory Lists (MA DPH 2002a and MA DPH 2001) 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 monitoring and implementation needs.

LAKES

The assessed lakes, identified with their WBID code numbers, are listed alphabetically in the Lake Assessment Section of this report (Table 4). 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 (listed alphabetically).

DEERFIELD RIVER WATERSHED RIVER SEGMENTS

There are 24 named rivers/brooks, including 30 segments, assessed in this report (Figure 8). They are as follows:

MA33-01	Deerfield River	MA33-13	Bozrah Brook	MA33-23	Drakes Brook
MA33-02	Deerfield River	MA33-14	Mill Brook	MA33-24	Tissdale Brook
MA33-03	Deerfield River	MA33-15	Clesson Brook	MA33-25	Foundry Brook
MA33-04	Deerfield River	MA33-16	Clark Brook	MA33-26	Smith Brook
MA33-05	Cold River	MA33-17	Bear River	MA33-27	West Branch North River
MA33-06	North River	MA33-18	Davis Mine Brook	MA33-28	Green River
MA33-07	South River	MA33-19	East Branch North River	MA33-29	Green River
MA33-08	South River	MA33-20	Dragon Brook	MA33-30	Green River
MA33-11	Chickley River	MA33-21	Hinsdale Brook	MA33-31	Taylor Brook
MA33-12	Pelham Brook	MA33-22	Shingle Brook	MA33-32	Pumpkin Hollow Brook

The remaining rivers/brooks are currently unassessed.

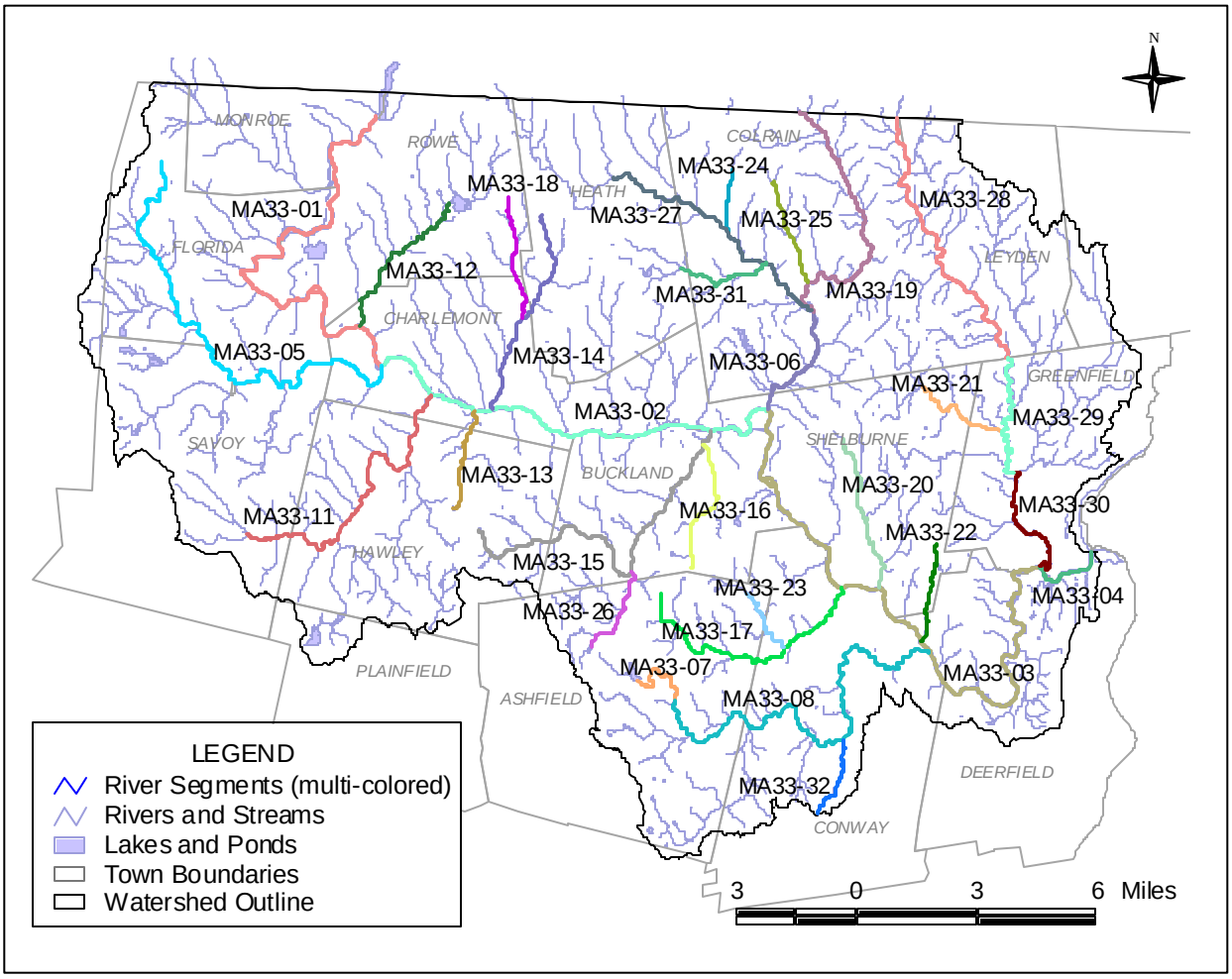
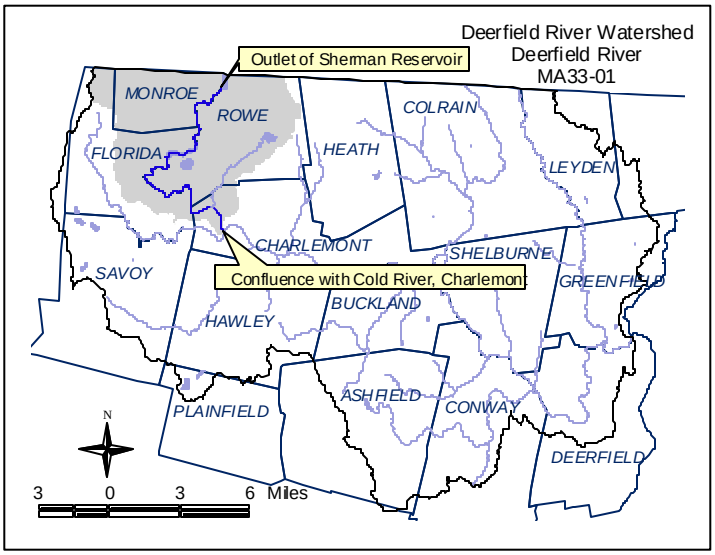


Figure 8. Deerfield River Watershed (Massachusetts Portion) – River Segment Locations identified by WBID

DEERFIELD RIVER (SEGMENT MA33-01)
Location: Outlet of Sherman Reservoir in Monroe/Rowe (formerly this segment began at the VT/MA line and included Sherman Reservoir), to confluence with Cold River, Charlemont.
Segment Length: 13.4 miles
Classification: Class B, Cold Water Fishery



The drainage area of this segment is approximately 43.63 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	89.8%
Open Land	2.9%
Agriculture	2.3%

The Massachusetts portion of the Deerfield River begins at the outflow from the Sherman Dam at USGenNE's Sherman Reservoir in Monroe/Rowe. From here the Deerfield River flows through Deerfield No. 5 Dam at Monroe Bridge and then twists south and west through the narrow valley forming the border first between Monroe and Rowe and then Rowe and Florida. About five miles further downstream from the Deerfield No. 5 dam the Fife Brook hydroelectric power station dam impounds the river and releases water from the hypolimnion. The Bear Swamp pumped storage facility withdraws the water from the reservoir pool behind Fife Brook Dam and pumps it to Bear Swamp Reservoir at the top of the mountain where it is used to produce power in a generating station located within the mountain. After Fife Brook Dam the river flows past the eastern portal of the Hoosic Tunnel and turns south and east entering Charlemont where the gradient lessens. This segment ends at the confluence with the Cold River along Route 2 in the Mohawk Trail State Forest, Charlemont.

MA DFWELE surveyed tributaries to this segment of the Deerfield River and has recommended that seven brooks (Dunbar, Fife, Cascade, Whitcomb, Reed, Todd, and Smith brooks) be protected as cold water fishery habitat (MassWildlife 2001).

The VT DEC assessed the Aquatic Life Use for the mainstem Deerfield River from the Harriman Reservoir outfall to the VT/MA border (Sherman Reservoir) (19.2 miles). Aquatic Life Use was supported for 13.1 miles and 6.1 miles were threatened. In the spring of 1998 Harriman Dam provided a continual minimum instream release of 70 cfs from 1 October to 30 June and 57cfs from 1 July to 30 September. This deep-water release provides a consistently cold discharge, creating an opportunity to establish a wild brook trout population. The 2003 Vermont assessment report found that wild brook trout populations in a two mile study area below Harriman Dam have been successfully restored and continue to increase in numbers, yet fish growth (mass) was depressed due to the very cold water discharged from the Harriman Dam and the naturally low fish productivity within the Deerfield watershed (VT DEC 2003).

WMA WATER WITHDRAWAL SUMMARY
Based on available information there are no WMA regulated water withdrawals in this segment of the Deerfield River.

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

USGenNE is authorized to discharge via two outfalls to the Deerfield River near Monroe Bridge in Monroe (NPDES permit MA0034908 issued in September 1997). The discharges are as follows.

- Outfall 001A: 0.05 MGD maximum discharge of station sump water with oil separation
- Outfall 001B: 0.02 MGD average discharge of station sump water with oil separation

USGenNE is authorized to discharge at the Deerfield No. 5 Station via four outfalls to the Fife Brook Dam Impoundment of the Deerfield River in Florida (NPDES permit MA0034894 issued in September 1997). The discharges are as follows.

- Outfall 001A: 0.072 MGD of station sump water with oil flotation
- Outfall 001B2: 0.252 MGD bearing cooling water
- Outfall 003: 0.0126 MGD strainer backwash
- Outfall 004: <10 GPD sump water with oil flotation at the N0. 5 Dam

USGenNE is authorized to discharge at the Bear Swamp Station via two outfalls to the Fife Brook Dam Impoundment of the Deerfield River in Rowe (NPDES permit MA0034886 issued in September 1997). The discharges are as follows.

- Outfall 001: 6.58 MGD of equipment cooling water, floor and associated drain water
- Outfall 002: 0.22 MGD of strainer backwash

USGenNE is authorized to discharge at the Fife Brook Station via three outfalls to the Deerfield River in Rowe/Florida (NPDES permit MA0034878 issued in September 1997). The discharges are as follows.

- Outfall 001: 0.07 MGD of station sump water with oil flotation
- Outfall 002: 0.34 MGD of bearing cooling water
- Outfall 003: 0.009 MGD of bearing cooling water strainer backwash

The Town of Monroe is authorized to discharge from the Monroe Wastewater Treatment Facility (WTF) to the Deerfield River near the Mill Street/Monroe Bridge in Monroe (NPDES permit MA0100188 issued in September 1997). The permittee is authorized to discharge 0.015 MGD of treated sanitary wastewater via Outfall 001. The facility's acute whole effluent toxicity limits are $LC_{50} \geq 50\%$ with a monitoring frequency of twice per year. The facility utilizes ultraviolet light for disinfection.

OTHER

Hydropower (Federal Energy Regulatory Commission- FERC)

The Deerfield River Hydroelectric System along this segment of the Deerfield River is comprised of two FERC licensed projects. The Deerfield River Project (L.P. No. 2323 is owned by and licensed to USGen New England, Inc. (USGenNE), formerly owned by and licensed to New England Power). FERC L.P. No. 2669, the Bear Swamp Pumped Storage Project, is owned by Bear Swamp Generating Trusts 1 and 2 and USGenNE currently operates the project and is a co-licensee. FERC L.P. No. 2323 consists of three developments in Vermont and five developments in MA; two of which are located in this segment of the Deerfield River. The FERC license for 2323 was reissued in April 1997. There are two developments on this segment of the Deerfield River authorized by FERC L.P. No. 2669. This license was issued in 1970 and amended in 1997 (FERC 1997).

- The most upstream hydropower development in MA is located at the Sherman Reservoir Dam on the Deerfield River in Rowe/Monroe authorized by FERC L.P. No. 2323. This development has one powerhouse equipped with a vertical Francis turbine unit that can generate 7,200 Kilowatts. This project includes: (1) a 100-foot-high 810-foot-long earthfill dam, (2) a 204-foot-long concrete gravity spillway, topped with four-foot-high flashboards that operate year round, (3) a concrete and brick intake structure and penstock that conveys water to the powerhouse via a concrete conduit 98 feet in length and a steel penstock 13 feet in diameter and 227 feet long, (4) an impoundment (Sherman Reservoir – Lakes Segment MA 33018), about two miles long, with a surface area of about 218 acres (72.6 acres is the MA portion only). There are currently no minimum streamflow or fish passage requirements at this development.
- The second development in MA is located at the Deerfield No. 5 Reservoir Dam in Rowe/Monroe located approximately 0.7 miles downstream from the Sherman Reservoir Dam. This development, also authorized by FERC L.P. No. 2323, includes a concrete dam 90 feet long, 35 feet high with 8 feet high hydraulic steel flap gates that can impound a surface area of about 38 acres (FERC 1997). This development has a 14,941-foot long (2.8 mile) power canal located to the west of the Deerfield River. Water from the Deerfield No. 5 Dam is diverted into this power canal and is conveyed to the powerhouse that holds one vertical Francis turbine generating unit, which can generate 17,550 Kilowatts. The hydraulic capacity of this unit is 1,250 cfs. Water then flows into the Fife Brook Reservoir. It should also be noted that flow from one tributary (Dunbar Brook) is also diverted into the power canal. The power canal bypasses approximately 3.1 miles

of the Deerfield River. A minimum flow of 73 cfs or inflow, whichever is less, is required at this development, although at no time shall the inflow be less than the 57 cfs minimum flow released from the upstream Harriman dam (VT) as specified in Article 405 of the FERC license agreement (FERC 1997). The FERC license also requires 32 whitewater releases (average 1000 cfs) between 1 April and 31 October annually from Deerfield No. 5. There are currently no fish passage requirements at this development.

- The third development in MA is the Bear Swamp Pumped Storage Project, which is located on the Deerfield River in Rowe/Florida. Although this facility operates under a different FERC license (FERC L.P. No. 2669) it is owned by Bear Swamp Generating Trusts 1 and 2 and currently leased to and operated by USGenNE, which is a co-licensee. The two generating stations at this development, the Bear Swamp Pumped Storage Facility and the Fife Brook Dam Station, were completed in 1974. The Bear Swamp pumped storage facility consists of two underground, reversible pump turbines that raise water from Fife Brook Reservoir on the Deerfield River to the Bear Swamp Upper Reservoir during hours of low power demand. The Upper Reservoir has a surface area of about 110 acres. During times of peak demand water is released back down to Fife Brook Reservoir. The capacity of the turbines at this peaking facility totals 610 megawatts. Each turbine capacity is 4,430 cfs for a total hydraulic capacity of 8,860 cfs. The Fife Brook Station (also part of FERC L.P. No. 2669) consists of a dam that is 50 feet high and 160 feet long that impounds about 2 miles of river with a surface area of approximately 75 acres. There is one powerhouse that contains one vertical Francis turbine unit with a generating capacity of 11,250 Kilowatts. A minimum flow of 125 cfs or inflow, whichever is less, is required at this development year-round. The FERC license also requires a total of 106 whitewater releases (average 1000 cfs) between 1 April and 31 October annually from Fife Brook Dam. There are currently no fish passage requirements at this development.

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill, 2003), performed for the Deerfield Watershed Team and funded by the Massachusetts Watershed Initiative, identified three historic landfills in this segment, the Florida Landfill, the Monroe Bridge/Deerfield Specialty Paper landfill and the Yankee Nuclear Power Station – Southeast Construction Fill Area. The Florida Landfill is well over 25 years old and was capped in 1999 but is not lined. The site contains wood and municipal solid waste, construction/demolition debris, tires and asbestos and is upgradient of the Deerfield River (0.8 miles) and Whitcomb Brook (0.3 miles). An Initial Site Investigation conducted by MA DEP in 1998 did not recommend a Comprehensive Site Investigation. Because more extensive sampling has occurred at this site, screening level sampling was not recommended here as part of this study. The Monroe Bridge/Deerfield Specialty Paper landfill is well over 25 years old and was capped in 1996 but is not lined. The site contains municipal solid waste and paper sludge and is within one-half mile of public and private water supplies and within 200 feet of the Deerfield River. Environmental monitoring has been conducted at this site since 1995 as required by MA DEP so, consequently, screening level sampling was not recommended here as part of this study. The Yankee Nuclear Power Station landfill is over 25 years old and received construction and demolition waste. The landfill, within 500 feet of the Deerfield River, Sherman Reservoir and Wheeler Brook, has been inactive since the mid 1980's and is now capped and is currently undergoing final closure. Because extensive environmental monitoring has been conducted at this landfill since 1997 screening level sampling was not recommended here as part of this study.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The FERC license for the Deerfield Project Number 2323 at the Sherman Development currently has no minimum streamflow or fish passage requirements. The turbine capacity at this development is variable up to 1,150 cfs.

The 1997 FERC license for the Deerfield Project Number 2323 at the Deerfield No. 5 Dam currently requires a minimum flow of 73 cfs or inflow, whichever is less, to the mainstem Deerfield River and at no time shall the inflow be less than the 57 cfs minimum flow released from the upstream Harriman

Dam (VT), as specified in Article 405 of the license agreement (FERC 1997). The FERC license also requires 32 whitewater releases (average 1000 cfs) to occur between April 1 and October 31 annually from Deerfield No. 5 Dam. Historically, the entire flow of the river was diverted through the bypass pipe and canal, so the river section between Deerfield No. 5 Dam and Fife Brook impoundment was known as "the dryway" because it contained no water. The turbine capacity at the Deerfield No. 5 Station development is variable up to 1,250 cfs. As part of the requirements of the 1997 FERC license the power company has improved river access and protected the river banks by installing boat slides and stairs, as well as conducted erosion control and bank stabilization practices at the "dryway" boater access put-in downstream from the Deerfield No. 5 Dam. There are currently no fish passage requirements at this development.

The Bear Swamp pumped storage facility (1997 FERC license amendment for Project No. 2669) consists of two underground, reversible pump turbines that raise water from Fife Brook Reservoir on the Deerfield River to the Bear Swamp Upper Reservoir during hours of low power demand. During times of peak demand water is released back down to Fife Brook Reservoir. Each turbine capacity is 4,430 cfs for a total hydraulic capacity of 8,860 cfs.

According to the 1997 FERC license amendment for Project No. 2669, a minimum flow in the Deerfield River of 125 cfs must be maintained year-round downstream from the Fife Brook Dam development. The FERC license also requires 106 whitewater releases (average 1000 cfs) to occur between April 1 and October 31 annually from the Fife Brook Dam. As part of the requirements of the FERC license the power company has improved river access and protected the river banks by installing boat slides and stairs, as well as conducted erosion control and bank stabilization practices at the "Zoar Gap" boater access put-in downstream from the Fife Brook Dam. There are currently no fish passage requirements at this development.

The EOEA, Massachusetts Watershed Initiative, Deerfield Watershed Team's annual workplans from fiscal years 2001, 2002, 2003 and 2004 have reported concerns from river users about impacts from flow regulation on the mainstem (EOEA 2001, 2002, 2003 and 2004). A project to measure streamflow below Fife Brook Dam to independently monitor minimum flow releases from the dam was funded by the EOEA Deerfield Watershed Team in 2003 and was completed in January, 2004 (Gomez and Sullivan 2004). Development of a stage-discharge rating curve, installation of a series of manual water level staff gages and installation of data logging equipment in a discontinued USGS gage house to collect continuous data from a previously installed water level sensor was performed in 2003. Volunteers were trained to accurately read the manual gages and download gage height and streamflow information from the data logger. An access database was developed to store the volunteer data. Flow data from this gage is periodically transferred to the Department of Fish and Game's Riverways Program.

Biology

Macroinvertebrate biomonitoring was conducted in the Deerfield River upstream of Zoar Gap in the Town of Florida (Station UDR01) in 1988 and 1995 by DWM (Appendix C). No more recent data, however, were collected.

Toxicity

Ambient

Water from this segment of the Deerfield River was collected approximately 1000 feet upstream from the Monroe WWTF discharge for use in their whole effluent toxicity tests. Between April 1999 and April 2001 survival of *Ceriodaphnia dubia* and *Pimephales promelas* exposed (48-hour) to the river water was good ($\geq$95 and 98%, respectively).

Effluent

Five definitive acute whole effluent toxicity tests were conducted on the Monroe WWTF effluent using *C. dubia* and *P. promelas* between April 1999 and 2001. The effluent was not acutely toxic (LC_{50} >100% effluent) to either test organism during these test events ($LC_{50} \geq$ 100% effluent).

Chemistry – water

Deerfield River water was collected approximately 1000 feet upstream from the Monroe WWTF discharge for use as dilution water for the facility's whole effluent toxicity tests, as required by their NPDES permit, on five occasions between April 1999 to April 2001. Data from these reports, which are maintained in the TOXTD database by DWM, were summarized for the period between April 1999 and April 2001. Water quality sampling was also conducted by DWM in the Deerfield River approximately 800 feet downstream from Fife Brook Dam in Florida (Station UD01, see Appendix A, Figure A1 for location) in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9). This location was also sampled by DWM between June 1995 and June 1996 (n = 9 sampling events) as was a second location on the Deerfield River approximately 0.25 miles upstream from the Florida Bridge (Station UD02) (Appendix G, tables G3 and G4). The Deerfield River Watershed Association performs volunteer water quality monitoring in this segment at a site just below Zoar Gap in Charlemont (DER-025). Samples were collected for pH, D.O., alkalinity, and temperature once during April in 2001 and 2002. However, due to the limited number of samples the results were not included in this assessment.

DO

DO in the Deerfield River at Station UD01 ranged from 8.5 to 9.8 mg/L and saturation was not less than 86% on the three sampling events conducted in the summer of 2000. It should be noted that these data represent the worst-case (pre-dawn conditions).

Temperature

The maximum temperature measured by DWM in the Deerfield River at Station UD01 was 17.0 º C recorded during a pre-dawn survey in August 2000.

pH and Alkalinity

The pH of the Deerfield River (recorded in the TOXTD database between April 1999 and April 2001) ranged between 6.3 and 6.8 SU and 2 of the 5 measurements (40%) reported were less than 6.5 SU. Alkalinity recorded in the TOXTD database ranged from 10 to 20 mg/L. The instream pH and alkalinity of the Deerfield River (Station UD01) reported by DWM was low ranging from 5.8 to 6.5 SU and 4 to 5 mg/L, respectively (Appendix A, Tables A8 and A9, qualified data excluded).

Specific Conductance

Conductivity measurements in the Deerfield River (recorded in the TOXTD database between April 1999 and April 2001) ranged between 42 and 90 µS/cm. Measurements in the river downstream from Fife Brook Dam (Station UD01) ranged from 33.7 to 36.6 µS/cm (Appendix A, Table A8).

Suspended Solids

Suspended solids measurements in the Deerfield River (Station UD01) were very low ranging between <1.0 to 2.3 mg/L (Appendix A, Table A9).

Turbidity

Measurements for turbidity in the Deerfield River (Station UD01) were very low ranging between 1.3 to 2.4 mg/L NTU (Appendix A, Table A9, qualified data excluded).

Ammonia-Nitrogen

No detectable concentrations of ammonia-nitrogen were documented in the Deerfield River (Station UD01; Appendix A, Table A9).

Nitrate-Nitrogen

Measurements for nitrate-nitrogen in the Deerfield River (Station UD01) ranged from 0.09 to 0.12 mg/L (Appendix A, Table A9).

Phosphorus

Total phosphorus measured by DWM in the Deerfield River (Station UD01) ranged from 0.012 to 0.013 mg/L (Appendix A, Table A9).

Total Residual Chlorine
The maximum reported TRC measurement for this segment of the Deerfield River (recorded in the TOXTD database upstream of the Monroe WWTF between April 1999 and 2001) was 0.04mg/L. All five measurements were below the minimum quantification level of 0.05 mg/L.

Hardness
Hardness reported for this segment of the Deerfield River (recorded in the TOXTD database upstream of the Monroe WWTF between April 1999 and 2001) ranged between 8 and 18 mg/L. Hardness measured by DWM in the Deerfield River (Station UD01) ranged from 7.6 to 8.3 mg/L (Appendix A, Table A9, qualified data excluded).

The *Aquatic Life Use* is assessed as support based on the good survival of test organisms exposed to the Deerfield River and the water quality data. This use, however, is identified with an Alert Status because of concerns reported to the Deerfield River Watershed Team from river users' observations regarding flow regulation (hydromodification) resulting from the operations of the hydroelectric generating facilities (EOEA 2002, EOEA 2003 and EOEA 2004). It is USGen New England, Inc.'s first priority to continue to operate hydropower facilities on the Deerfield River in accordance with the FERC licenses, the Offer of Settlement and the Massachusetts Water Quality Certificate. However, the effect, if any, of the hydropower generating developments on instream habitat and aquatic life is of concern and merits further investigation.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

Fecal coliform bacteria sampling was conducted by the DRWA in the Deerfield River downstream from Zoar Gap in Charlemont (Station DER-025) between June and August 2001 and 2002 (n = 8 sampling events). Fecal coliform counts at this station ranged from 0 to 12 colonies/100 mL even during five wet weather sampling events (DRWA 2001 and DRWA 2002).

Fecal coliform bacteria sampling was conducted by DWM in the Deerfield River approximately 800 feet downstream from Fife Brook Dam in Florida (Station UD01) between June 1995 and June 1996 (n = 9 sampling events) as was a second location on the Deerfield River approximately 0.25 miles upstream from the Florida Bridge (Station UD02; Appendix G, Table G4).

With the exception of the FERC hydropower projects, much of this segment of the Deerfield River is undeveloped and the mainstem flows through steep, rugged valleys, providing some of the most beautiful scenery in Massachusetts. It attracts a large number of visitors (for boating, fishing, hiking, picnicking, swimming, sightseeing) mainly during the spring, summer, and fall. Litter is sometimes found at many of the public access points along the mainstem. However, the whitewater boating company, Zoar Outdoor, coordinates an annual river cleanup on the upper Deerfield River and litter and trash are removed from instream by rafters and along the roadsides and river banks by volunteers from Trout Unlimited and the Deerfield River Watershed Association and other local groups. In addition, the hydropower company, USGenNE provides funding for trash dumpsters and disposal annually for this project.

Based on the low fecal coliform bacteria data and the generally excellent aesthetic conditions along this segment the *Recreational* and *Aesthetics Uses* are assessed as support.

Deerfield River (MA33-01) Use Summary Table

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

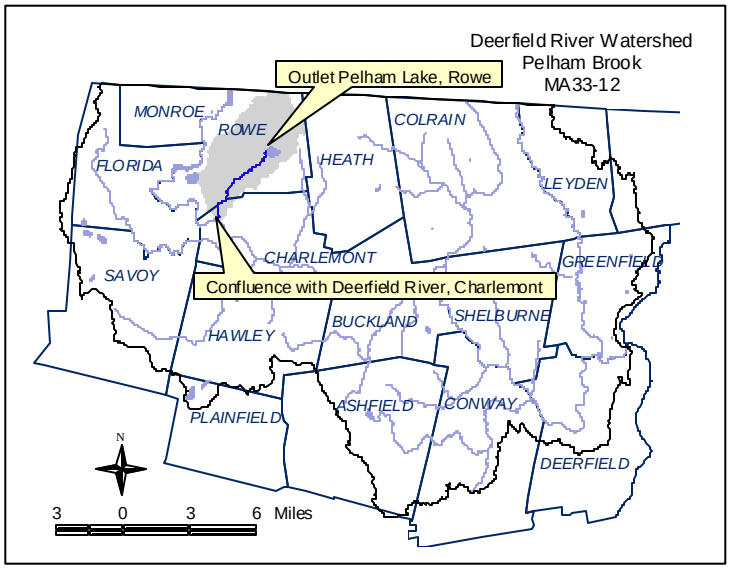
* "Alert Status" issues identified, see details in the use assessment section

RECOMMENDATIONS DEERFIELD RIVER (MA33-01)

- Continue to perform DWM water quality and biological monitoring of this segment during the next monitoring year cycle (2005). Refer to recommendations in Appendix C, 1988 and 1995 Deerfield River Watershed Benthic Macroinvertebrate Biomonitoring. Because of the fish consumption advisory in place for Sherman Reservoir immediately upstream of this segment, fish tissue sampling should be conducted in this segment to assess the *Fish Consumption* use.
- Biological surveys designed to assess impacts of hydroregulation on aquatic biota would be useful to investigate concerns voiced by members of the Deerfield Watershed Team that habitat and benthic macroinvertebrates downstream from Fife Brook Dam may be affected by frequent water level changes and rapid ramping rates that result from hydropower production.
- Work with USGen New England Inc. and settlement parties (including Massachusetts Executive Office of Environmental Affairs, Attorney General, MA DEP, MA DCR, MA DFG, US Fish and Wildlife Service, New England F.L.O.W., Trout Unlimited, and the Deerfield River Watershed Association) to ensure that releases from the hydropower dams are meeting the requirements of the FERC licenses, the Offer of Settlement, and the Massachusetts Water Quality Certification requirements.
- Support the recommendations of the Massachusetts Watershed Initiative/Deerfield River Watershed Team's Deerfield River Flow Monitoring Project that enabled volunteers to monitor stream flow below Fife Brook Dam (Gomez and Sullivan 2004). Volunteer monitoring of this gage should continue to assure all river users, the project owners, and regulatory agencies that prescribed minimum flows are being met. Flow data from the gage should continue to be made available through the Massachusetts Department of Fish and Game, Riverways Program website (www.mass.gov/dfwele/river/rifls/sites/deerfield/fifebrook119/rifls_site_page.html).
- The Towns of Monroe, Rowe and Florida should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in this segment of the Deerfield River it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Rowe and Florida should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- Dunbar, Fife, Cascade, Whitcomb, Reed, Todd, and Smith brooks should be protected as cold water fishery habitat, as recommended by MA DFWELE.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by DRWA, Zoar Outdoor and Trout Unlimited.

PELHAM BROOK (SEGMENT MA33-12)

Location: Outlet Pelham Lake, Rowe to confluence with Deerfield River, Charlemont.
Segment Length: 4.8 miles.
Classification: Class B.



The drainage area of this segment is approximately 13.69 square miles
Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	87.1%
Agriculture	4.0%
Residential	3.9%

Pelham Brook, from the outlet of Pelham Lake, flows southwest through a narrow and steep valley. On its course to the Deerfield River (Segment 33-01), it receives flows from Shippee Brook, Rice Brook, County Brook, Taylor Brook, and Steele Brook.

MA DFWELE has recommended that Pelham Brook and several tributaries in its subwatershed - Tuttle, Potter, Shippee, County, Taylor and Steele brooks - be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

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

OTHER

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified two historic landfills in the subwatershed of this segment; Rowe Brush Dump and Rowe Landfill. The Rowe Brush Dump is over 25 years old and is not lined or capped. It received demolition debris and lies within 100 feet of Pelham Brook. It was not recommended for screening level sampling as part of the Fuss and O'Neill study. The Rowe landfill received municipal waste and is also over 25 years old. It is not lined or capped and is within 100 feet of Pelham Brook. As part of the project screening level sampling was conducted in 2003 from a downgradient groundwater seep. No adverse water quality impacts were detected.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

Pelham Brook was sampled by DWM near the mouth of the brook upstream from Rowe Road, Charlemont (Station PB01) in September 2000. At the time of the survey the brook was roughly 7 m wide with depths ranging from 0.2 m to 0.75 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 187 (Appendix B). Both banks were well-vegetated and the forested riparian zone provided ample stream shading. The instream habitat provided a variety of velocity conditions.

Biology

Compared to the Bear River reference station (Station VP11BEA) the RBP III analysis indicated the benthic community was non-impacted in Pelham Brook 200 m upstream from Rowe Road, Charlemont (Station PB01) in September 2000 (Appendix B). Fish species captured in order of abundance included: slimy sculpin (*Cottus cognatus*), longnose dace (*Rhinichthys cataractae*), Atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*), blacknose dace (*Rhinichthys atratulus*), and brown trout (*Salmo trutta*) (Appendix B). Four of the species collected are considered to be intolerant of pollution. In addition to these species, longnose sucker (*Catostomus catostomus*) (an intolerant

species) were documented in Pelham Brook in Rowe by MA DFWELE in August 2000 and September 2001. Their sampling also documented multiple age classes of both Atlantic salmon and brook trout (Richards 2003). All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions, as well as stable flow regimes.

Chemistry-water
DWM collected water quality samples from Pelham Brook just upstream from the bridge off Zoar Road in Charlemont (Station PE) in November and December 1995 and April 1996 (Appendix G, Table G4).

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community analysis and fish population information.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from Pelham Brook just upstream from the bridge off Zoar Road in Charlemont (Station PE) in November and December 1995 and April 1996 (Appendix G, Table G4).

No objectionable deposits, odors or conditions were noted during the biological monitoring survey conducted by DWM biologists in Pelham Brook in September 2000 (Appendix B).

Although too limited bacteria data are available to assess the recreational uses the *Aesthetics Use* is assessed as support.

Pelham Brook (MA33-12) Use Summary Table

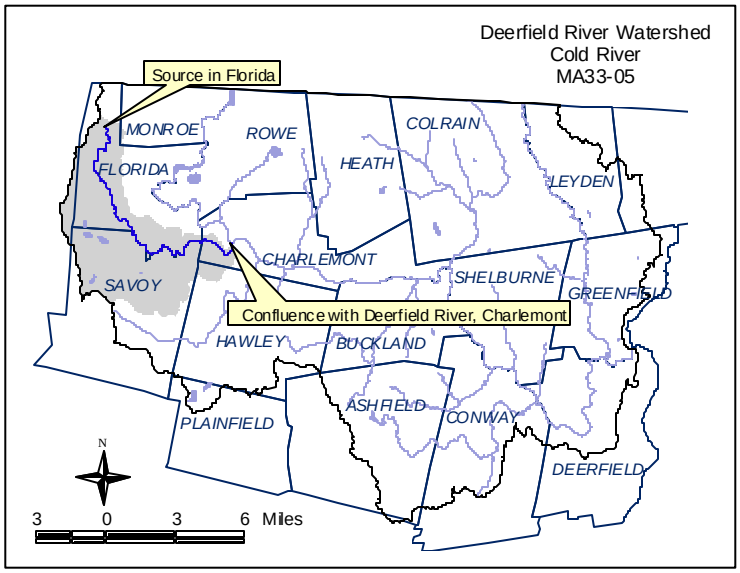
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS PELHAM BROOK (MA33-12)

- Continue to perform DWM water quality and biological monitoring of this segment during the next monitoring year cycle (2005).
- 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.
- Pelham Brook and several tributaries in its subwatershed - Tuttle, Potter, Shippee, County, Taylor and Steele brooks - should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Support the recommendations of the Fuss and O'Neill (2003) landfill assessment study for management of Rowe Landfill along Pelham Brook, including: removal of solid waste from Pelham Brook, cleanup of refuse along the base of the landfill, and repair and stabilization of the eroded areas of the landfill side slopes. Additional field investigation may be warranted to further assess the environmental risk posed by the landfill and determine the need for corrective/remedial action.
- The Towns of Rowe and Charlemont should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Pelham Brook subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Rowe and Charlemont should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

COLD RIVER (SEGMENT MA33-05)

Location: Source in Florida to confluence with Deerfield River, Charlemont.
Segment Length: 13.7 miles.
Classification: Class B.



The drainage area of this segment is approximately 31.68 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	93.1%
Residential	2.3%
Agriculture	2.2%

The Cold River forms on the eastern flanks of the Hoosac Range in the Town of Florida. The river flows south under Route 2 and then changes course to the southeast until its confluence with Gulf Brook in Savoy. From this point it parallels Route 2 flowing eastward, passing through the Mohawk Trail State Forest, to its confluence with the Deerfield River in Charlemont. For most of its length the river is a high gradient stream flowing in a narrow valley.

MA DFWELE has recommended that the Cold River and several tributaries in its subwatershed - Green River, Tower, Gulf, and Manning brooks - be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

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

OTHER

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in the watershed of this segment - the Savoy Mt. State Forest Brush Landfill. This landfill is over 25 years old and is not capped or lined. Since it received only wood waste and was previously investigated by MA DEP in 1998, it was not recommended for screening level sampling as part of this study. The 1998 study found no evidence of contamination at the site. The landowner (MA DCR) has removed visible refuse from the site and further dumping has been prohibited.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The Cold River was sampled by DWM upstream from Trout Brook, in Charlemont, MA (Station CR01) in September 2000. At the time of the survey the brook was roughly 14 m wide with depths ranging from 0.3 m to 0.5 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 178 (Appendix B). Instream vegetation was lacking, except for a thin film of filamentous algae. Stream banks were well vegetated, as was the forested riparian zone.

DWM biologists collected periphyton samples from Station CR01 (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 0% and percent algal cover was 60%. The dominant algal type and form was greens/filamentous-thin film. No nuisance algal growth was documented.

Flow in this subwatershed is unrestricted. With no impoundments and steep relief the river levels can rise and fall quickly in response to localized precipitation. Known as a "steep creek" to the local paddling community, the river's water level is too low to paddle except during spring run-off and during large thunderstorms (Mitchell 2003).

Biology

The benthic sample collected by DWM from the Cold River upstream from Trout Brook in Charlemont, MA (Station CR01) in September 2000 was used as the reference station condition for the 2000 Deerfield River Watershed Biomonitoring Survey (Appendix B). Given its status as a reference station the benthic community was considered to be non-impacted. Macroinvertebrate biomonitoring was also conducted in the Cold River upstream from the confluence with the Deerfield River in 1988 (Appendix C). Fish species captured in order of abundance included Atlantic salmon (*Salmo salar*), blacknose dace (*Rhinichthys atratulus*) longnose dace (*Rhinichthys cataractae*), and a brown trout (*Salmo trutta*) (Appendix B). Two of the species collected are considered to be intolerant of pollution. In addition to these species, slimy sculpin (*Cottus cognatus*) and rainbow trout (*Onchorynchus mykiss*) (both intolerant species) were documented in the Cold River by MA DFWELE in either August 2000 and/or September 2001. Their sampling also documented multiple age classes of Atlantic salmon (Richards 2003). All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

Chemistry-water

DWM collected water quality samples from the Cold River at the bridge to the Mohawk Forest State Campground in Florida (Station CO) between September 1995 and June 1996 (n = 8 sampling events; Appendix G, tables G3 and G4). The Deerfield River Watershed Association (DRWA) performs volunteer water quality monitoring in this segment in the Cold River downstream from Mohawk Trail State Forest – near the confluence with Trout Brook (COR-010). Samples were collected for pH, D.O., alkalinity, and temperature once during April in 2001 and 2002. However, due to the limited number of samples the results were not included in this assessment (DRWA 2001and DRWA 2002).

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community (reference station) and fish population information.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION

Fecal coliform bacteria sampling was conducted by the DRWA in the Cold River downstream from Mohawk State Forest in Charlemont (Station COR-010) between June and August 2001 and 2002 (n = 11 sampling events). Fecal coliform counts at this station ranged from 0 to 200 colonies/100 mL during both dry and wet weather sampling events (DRWA 2001 and DRWA 2002).

DWM collected water quality samples from the Cold River at the bridge to the Mohawk Forest State Campground in Florida (Station CO) between September 1995 and June 1996 (n = 8 sampling events; Appendix G, Table G4).

It should be noted that MA DCR owns and operates the Mohawk State Park in the Town of Charlemont. This park has a swimming area formed by a diversion from the Cold River. The MA DCR monitors the coliform levels in this swimming area, which is not on the Cold River proper. This bathing area was closed for two days (31 July to 1 August 2002) due to elevated *Enterococci* levels. The bathing area closed again on 6 August 2002 throughout the remainder of the swimming season due to elevated *Enterococci* levels.

No objectionable deposits, odors or conditions were noted during the biological monitoring survey conducted by DWM biologists in the Cold River in September 2000 (Appendix B).

Based on the low fecal coliform bacteria data and the excellent aesthetic conditions the *Recreational* and *Aesthetics Uses* are assessed as support.

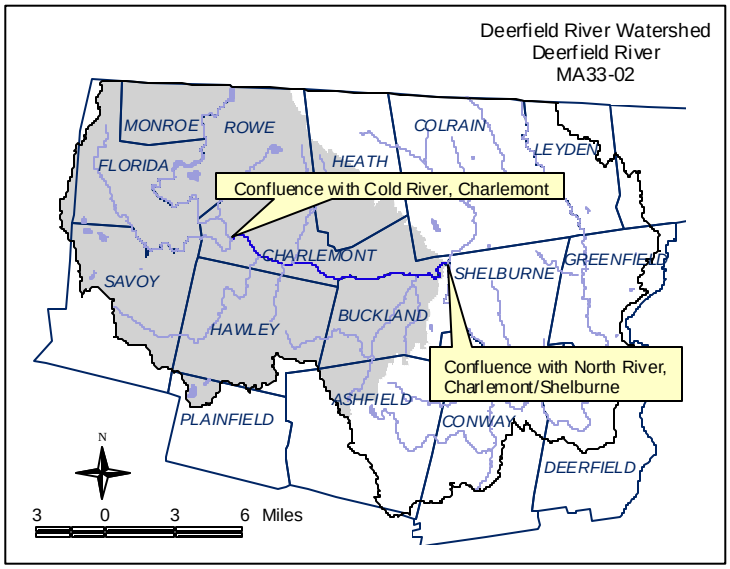
Cold River (MA33-05) Use Summary Table

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

RECOMMENDATIONS COLD RIVER (MA33-05)

- Continue to perform DWM water quality and biological monitoring to protect the high water quality of this segment during the next monitoring year cycle (2005). As a reference station, biomonitoring is recommended here in 2005 especially if evaluations of third to fifth-order stream biota are planned. Fish population sampling using multiple crews or a barge-mounted electrofishing unit should accompany the macroinvertebrate sampling effort.
- The Cold River and several tributaries in its subwatershed - Green River, Tower, Gulf, and Manning brooks - should be protected as cold water fishery habitat as recommended by MA DFWELE.
- 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 Towns of Charlemont, Florida, and Savoy should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Cold River subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Charlemont, Savoy and Florida should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged as appropriate.
- The results of the volunteer monitoring surveys to locate and map locations of Japanese knotweed stands conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Tannery Brook subwatershed should be consulted to help prevent or control future infestations of this invasive in this subwatershed (Serrentino 2003). This was the only Deerfield subwatershed surveyed during this project that volunteers did not find Japanese knotweed. Efforts should be made to continue to monitor this subwatershed for this invasive plant and implement control measures if it is found.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by DRWA, Zoar Outdoor and Trout Unlimited.

DEERFIELD RIVER (SEGMENT MA33-02)
Location: Confluence with Cold River, Charlemont to confluence with North River, Charlemont/Shelburne.
Segment Length: 11.4 miles.
Classification: Class B, Cold Water Fishery



The drainage area of this segment is approximately 169.66 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	88.3%
Residential	2.6%
Agriculture	4.8%

This segment is on the 1998 303(d) List of Waters needing confirmation for unknown toxicity, metals, and chlorine (Table 2).

From the confluence with the Cold River in Charlemont the Deerfield River flows about a mile and a half before being joined by the Chickley River in Charlemont. Approximately one mile below Charlemont Center the river becomes the boundary between Buckland and Charlemont flowing east about four miles through a fairly broad valley. As the river passes under Route 2 it turns north flowing over a hydroelectric dam (Deerfield No.4) and is joined at the top of its northward loop by the North River at the border of Charlemont, Buckland and Shelburne. This confluence marks the end of this segment.

MA DFWELE has recommended that 12 tributaries to this segment of the Deerfield River be protected as cold water fishery habitat (Legate Hill, Bozrah, Rice, Mill and its tributaries Heath and Maxwell, Albee, First, Second, Third, Wilder, and East Oxbow brooks) (MassWildlife 2001).

The Natural Heritage and Endangered Species Program has certified one vernal pool in this subwatershed (MassGIS 1999).

WMA WATER WITHDRAWAL SUMMARY
Based on available data there are no regulated water withdrawals from this segment.

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H2 AND H3)
The Town of Charlemont is authorized to discharge from the Charlemont Wastewater Treatment Plant (WWTP) to the Deerfield River just downstream from the confluence of Mill Brook (off Route 2) in Charlemont (NPDES permit MA0103101, issued February 2004). The permittee is authorized to discharge 0.05 MGD of treated sanitary wastewater via Outfall 001. The facility's acute whole effluent toxicity limits are $LC_{50} \geq 50\%$ with a monitoring frequency of twice per year. The facility utilizes ultraviolet light for disinfection. A facility upgrade (improvement of sand filter beds) was completed in the winter of 1999 (Peters 2003).

OTHER
Hydropower (Federal Energy Regulatory Commission - FERC)
The Deerfield River Hydroelectric System along this segment of the Deerfield River is comprised of one FERC licensed project (FERC L.P. No. 2323, owned by USGenNE), which was reissued April 1997 (Appendix H, Table H3).

- The Deerfield No. 4 Development is located on the Deerfield River approximately 0.9 miles upstream from the confluence with the North River in Buckland/Charlemont. This development includes a concrete dam 160 feet long, 50 feet high with six 8 feet high wooden flashboards that can impound a surface area of about 75 acres and approximately 2 river miles (FERC 1997). There is a 241' long concrete gravity spillway. This development has a power tunnel that conveys water from the intake structure at the impoundment via a 12.5-foot diameter, 1,514 feet long concrete and brick-lined horseshoe shaped tunnel to the powerhouse. The powerhouse

contains three horizontal Francis turbine units with a capacity of 1,600 kw each, and a total hydraulic capacity of 1,490 cfs. (FERC 1997). The power canal tunnel cuts through a bend in the river, which bypasses approximately 1.4 miles of the Deerfield River (the lower 0.9 miles of this segment and the upper 0.5 miles of segment MA33-03). A minimum flow of 100 cfs or inflow, whichever is less is required from 1 October to 31 May and 125 cfs or inflow, whichever is less is required from 1 June to 30 September at this development. Downstream fish passage was required at the Deerfield No. 4 project in the April 1997 FERC license for Project 2323. A 60 cfs release from 1 April to 15 June and 15 September to 15 November is required for downstream smolt passage. This downstream smolt passage flow is not in addition to minimum instream flow requirements.

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Heath/Hawley/Charlemont Landfill (Three Town Landfill). This landfill received municipal solid waste from households, farms and commercial establishments for over 25 years and is not capped or lined. The site is within one-half mile of private water supplies and less than 500 feet from a surface receiving water. Environmental monitoring has been conducted here since 1987 so screening level sampling was not recommended at this site as part of this study. The three towns are currently evaluating impacts of this landfill on nearby private wells and other downstream receptors and plans are being discussed to properly cap the site.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

According to USGS (information from gaging station on the Deerfield River near Charlemont - 01168500) flows have been regulated by Somerset Reservoir, Harriman Reservoir, and by several powerplants upstream. The drainage area at this gage is 361 mi^2. Data from the USGS gage revealed that the 2000 water year annual mean flow (1,137 cfs) was greater than the mean annual flow for the 87-year period of record (903 cfs) (Socolow *et al*. 2001). The estimated 7Q10 flow at the gage is 66.4 cfs (USGS 2003).

The 1997 FERC license for the Deerfield Project Number 2323 at the Deerfield No. 4 Station currently requires a minimum flow from the dam to the mainstem Deerfield River of 100 cfs or inflow, whichever is less from October 1 to May 31. During June 1 to September 30 minimum flow required from this dam is 125 cfs or inflow, whichever is less (FERC 1997). The turbine capacity at the Deerfield No. 4 Station development is variable up to 1,490 cfs (total of the three generators). Downstream fish passage at this development is also required with a 60 cfs release from 1 April to 15 June and from 15 September to 15 November for downstream smolt passage.

Biology

Macroinvertebrate biomonitoring was conducted in the Deerfield River near the USGS gage in Charlemont (Station LDR02) in 1988 (Appendix C). A screening survey (RBP I) was also conducted in August 1999 by DWM biologists in response to a request from the Deerfield River Watershed Team and the MA DEP WERO to evaluate any gross impact in the Deerfield River resulting from a train derailment accident that spilled latex into the Deerfield River in Charlemont. No gross impairment to the benthic community was observed and more than half of the taxa collected were comprised of pollution intolerant EPT orders (Fiorentino 1999). No recent RBP III level data have been collected from this segment of the Deerfield River.

Toxicity

Ambient

Water from this segment of the Deerfield River was collected approximately 100 to 1000 feet upstream from the Charlemont WWTF discharge for use in their whole effluent toxicity tests. Between January 1996 and August 2002 survival of Ceriodaphnia dubia and Pimephales promelas exposed (48-hour) to the river water ranged between 20 to 100% and 75 to 100%, respectively. Survival of C. dubia was less than 75% during one of the nine test events (January 1996 test) and has not been less than 90% since.

Effluent
Nine definitive acute whole effluent toxicity tests were conducted on the Charlemont WWTF effluent using *C. dubia* and *P. promelas* between January 1996 and August 2002. The effluent was acutely toxic (LC_{50} = 60.85% effluent) to *C. dubia* during one of the eight valid test events and acutely toxic (LC_{50} = 60. 5 and 70.7% effluent) to *P. promelas* during two of the eight valid test events, all of which occurred prior to the facility upgrade, which was completed in the winter of 1999. The discharge was, however, in compliance with the permit's whole effluent toxicity limit of $LC_{50} \geq$ 50% effluent. Effluent quality at the facility in terms of both ammonia-nitrogen and whole effluent toxicity has improved since the facility upgrade.

Chemistry - Water
Deerfield River water was collected approximately 100 to 1000 feet upstream from the Charlemont WWTF discharge for use as dilution water for the facility's whole effluent toxicity tests, as required by their NPDES permit, on nine occasions between January 1996 and August 2002. Data from these reports, which are maintained in the TOXTD database by DWM, were summarized for this period. Water quality sampling was also conducted by DWM on the Deerfield River near the USGS gage 01168500 in Charlemont (Station DR03) in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9).

Water quality samples were also collected from the Deerfield River near the USGS gage in Charlemont (Station DW2) on as many as six occasions between August and November 2000 by ESS (ESS 2002).

The Deerfield River Watershed Association (DRWA) performs volunteer water quality monitoring in this segment of the Deerfield River at two stations: downstream from the Charlemont WWTP discharge (DER-021) and at "Old Willow", above the Stillwater Restaurant in Charlemont, MA (DER-020). Samples were collected for pH, D.O., alkalinity, and temperature once during April in 2001 and 2002. However, due to the limited number of samples the results were not used in this assessment (DRWA 2001 and DRWA 2002).

DO and % saturation
DO in the Deerfield River near the USGS gage in Charlemont (Station DR03 and DW2) measured by DWM and ESS in 2000 ranged from 9.3 to 12.77 mg/L and saturation was not less than 91% during the sampling events conducted. It should be noted that these data represent both worst-case (pre-dawn) and daytime conditions.

Temperature
The maximum temperature in this segment of the Deerfield River recorded by DWM and ESS in 2000 in the Deerfield River was 19.7°C (Appendix A, Table A8 and ESS 2002).

pH and Alkalinity
The pH of the Deerfield River upstream from the Charlemont WWTF discharge (recorded in the TOXTD database between January 1996 and August 2002) ranged between 6.1 and 7.2 SU and one of the 10 measurements (10%) reported was less than 6.5 SU. Alkalinity recorded in the TOXTD database ranged from 10 to 40 mg/L. The pH of the Deerfield River (Station DR03) reported by DWM and ESS ranged from 6.4 to 6.8 SU and alkalinity was low (4 to 6 mg/L - qualified data excluded; Appendix A, Tables A8 and A9 and ESS 2002).

Specific Conductance
Conductivity measurements in the Deerfield River upstream from the Charlemont WWTF discharge (recorded in the TOXTD database between January 1996 and August 2002) ranged between 42 and 160 µS/cm. Measurements in the river near the USGS gage in Charlemont (Station DR03) ranged from 87.1 to 101 µS/cm (Appendix A, Table A8).

Suspended Solids
Suspended solids measurements in the Deerfield River (station DR03) were very low; ranging between 1.4 to 1.9 mg/L (Appendix A, Table A9).

Turbidity
Measurements for turbidity in the Deerfield River (Stations DR03 and DW2) were very low; ranging between 0.15 to 1.7 mg/L NTU (qualified data excluded; Appendix A, Table A9 and ESS 2002).

Ammonia-Nitrogen
The concentration of ammonia-nitrogen recorded in the TOXTD database from samples collected upstream from the Charlemont WWTF (between January 1996 and August 2002) ranged from 0.02 to 0.11mg/L. No detectable concentrations of ammonia-nitrogen were documented by DWM in the Deerfield River (Station DR03) in the summer of 2000 (Appendix A, Table A9).

Nitrate-Nitrogen
Measurements for nitrate-nitrogen in the Deerfield River (Station DR03) ranged from 0.10 to 0.12 mg/L (Appendix A, Table A9).

Phosphorus
Total phosphorus measured by DWM in the Deerfield River (Station DR03) ranged from <0.010 to 0.014 mg/L (Appendix A, Table A9).

Total Residual Chlorine
The maximum reported TRC measurement for this segment of the Deerfield River (recorded in the TOXTD database upstream from the Charlemont WWTF between January 1996 and August 2002) was 0.06mg/L. With the exception of this one measurement all of the other nine measurements were below the minimum quantification level of 0.05 mg/L.

Hardness
Hardness reported for this segment of the Deerfield River (recorded in the TOXTD database upstream from the Charlemont WWTF between January 1996 and August 2002) ranged between 8 and 36 mg/L. Hardness measured by DWM in the Deerfield River (Station DR03) ranged from 8.9 to 10 mg/L (Appendix A, Table A9; qualified data excluded).

Chemistry – sediment
Three sediment grab samples were collected and composited from behind the Deerfield No. 4 impoundment on the Deerfield River (Station DWS-2) in July of 2000 by ESS (ESS 2002). The sediment sample was analyzed for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, PCB (polychlorinated biphenyls), PAHs (polynuclear aromatic hydrocarbons), TPH (total petroleum hydrocarbons), total organic carbon (TOC), percent volatile solids, percent water, and grain size. With the exception of arsenic, all analytes fell below the low effects range (L-EL) as defined by Persaud *et al*. (1993). The arsenic concentration was measured at 12.0 ppm, which is approximately two times greater than the L-EL. The sediment was comprised primarily of medium sand (82%). No PAH, TPH, volatile solids or PCB were detected.

The *Aquatic Life Use* is assessed as support based on the generally good survival of test organisms exposed to the Deerfield River and the water quality data. This use, however, is identified with an Alert Status because of concerns reported to the Deerfield River Watershed Team from river users' observations regarding flow regulation (hydromodification) resulting from the operations of the hydroelectric generating facilities (EOEA 2001, 2002, 2003 and 2004). It is USGen New England, Inc.'s first priority to continue to operate hydropower facilities on the Deerfield River in accordance with the FERC licenses, the Offer of Settlement and the Massachusetts Water Quality Certificate. However, the effect, if any, of the hydropower generating developments on instream habitat and aquatic life is of concern and merits further investigation. The concentration of arsenic in the sediment sample collected behind the Deerfield No. 4 dam in this segment of the Deerfield River was also slightly elevated, but is due likely to natural background conditions typical of sediment from New England freshwater rivers (ESS 2002).

PRIMARY AND SECONDARY CONTACT RECREATION

Fecal coliform bacteria samples were collected from the Deerfield River near the USGS gage in Charlemont (Station DW2) on six occasions (during three dry and three wet weather events) between August and November 2000 by ESS (ESS 2002). Four of these sampling events occurred during the *Primary Contact Recreational* season. Fecal coliform counts at this sampling location ranged from 10 to 50 colonies/100 mL.

This segment of the Deerfield River flows through small towns and agricultural areas and attracts a large number of visitors (for boating, fishing, hiking, picnicking, swimming, sightseeing) mainly during the spring, summer, and fall. The river was clear (turbidity and suspended solids data were very low and no objectionable deposits, odors, or oil sheens were reported (Appendix A, Tables A8 and A9 and ESS 2002).

The *Recreational* and *Aesthetics* uses are assessed as support for this segment of the Deerfield River based on the low fecal coliform bacteria counts and the aesthetic conditions.

Deerfield River (MA33-02) Use Summary Table

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

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

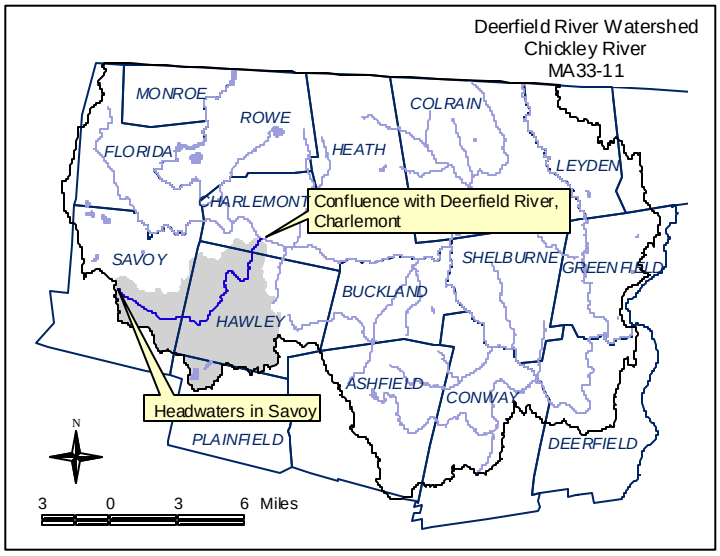
RECOMMENDATIONS DEERFIELD RIVER (MA33-02)

- Continue to perform DWM water quality and biological monitoring in this segment during the next monitoring year cycle (2005).
- Biological surveys designed to assess impacts of hydroregulation on aquatic biota would be useful to investigate concerns voiced by members of the Deerfield Watershed Team that habitat and benthic macroinvertebrates downstream from power station dams may be affected by frequent water level changes and rapid ramping rates that result from hydropower production.
- Evaluate the possibility of removing this segment from the 303d List since the WWTP has been improved and NPDES monitoring data indicate improvement over 1995 data.
- Work with USGen New England Inc. and settlement parties (including Massachusetts Executive Office of Environmental Affairs, Attorney General, MA DEP, MA DCR, MA DFG, US Fish and Wildlife Service, New England F.L.O.W., Trout Unlimited, and the Deerfield River Watershed Association) to ensure that releases from the hydropower dams are meeting the requirements of the FERC licenses, the Offer of Settlement, and the Massachusetts Water Quality Certification requirements.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by DRWA, Zoar Outdoor and Trout Unlimited.
- Work with NRCS, DFA and landowners to protect riparian buffers and encourage use of agricultural BMPs.
- The Towns of Charlemont, Buckland, Florida, Savoy, Hawley, Heath, Rowe, and Monroe should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in this segment of the Deerfield River it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Charlemont, Buckland, Florida, Savoy, Hawley, Heath, Rowe, and Monroe should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and

habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

- The results of the volunteer monitoring surveys to locate and map Japanese knotweed stands conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Avery Brook subwatershed should be consulted to help manage infestations of this invasive plant in this subwatershed (Serrentino 2003). In addition, encourage work by the DRWA, other local groups and agencies, and the power company to address invasive Japanese knotweed already well established along mainstem in this segment.
- Based on MA DFWELE recommendations, the following 12 tributaries to this segment of the Deerfield River should be protected as cold water fishery habitat (Legate Hill, Bozrah, Rice, Mill and its tributaries Heath and Maxwell, Albee, First, Second, Third, Wilder, and East Oxbow Brooks).

CHICKLEY RIVER (SEGMENT MA33-11)
Location: Headwaters, Savoy Mountain State Forest, Savoy, to confluence with Deerfield River, Charlemont.
Segment Length: 11.1 miles.
Classification: Class B.



The drainage area of this segment is approximately 27.41 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	92.8%
Agriculture	3.5%
Residential	1.6%

This segment is on the 1998 303(d) List of Waters needing confirmation for pathogens (Table 2).

The headwaters of the Chickley River begin on the southeastern slopes of Borden Mountain in the Savoy Mountain State Forest in Savoy. The river flows in an easterly direction as a high gradient stream until it reaches West Hawley where it changes direction to the north. Here the gradient lessens and there is some flood plain development, which has allowed some agricultural development in the river valley. From West Hawley the river parallels Route 8A to its confluence with the Deerfield River in Charlemont.

MA DFWELE has recommended that the Chickley River and the following tributaries in its subwatershed - Basin, King, North, and Mill brooks - be protected as cold water fishery habitat (MassWildlife 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.

OTHER
Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Savoy Landfill. This site is over 25 years old and is not capped and is partially lined. It underwent MA DEP closure in the early 1990s. The site contains municipal waste and lies within 0.8 miles of a public water supply and 1,000 feet from Tilton Brook in this subwatershed. Screening level sampling was not recommended for this site as part of the study.

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow
The Chickley River was sampled by DWM 900 m upstream from its confluence with the Deerfield River in Charlemont (Station CH01) in September 2000. At the time of the survey the river was roughly 12 m wide with depths ranging from 0.1 m to 0.9 m. The substrates were comprised primarily of cobble and boulder. The overall habitat score was 163 (Appendix B). Habitat quality was limited most by sedimentation and bank erosion and the marginal channel flow status (between 25 and 75% of the stream channel was filled with water). Aquatic vegetation was absent in the primarily open canopied stream reach and algal growth was minimal (small patches of filamentous green forms on rock substrates).

DWM biologists collected periphyton samples from Station CH01 (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 1% and percent algal cover was <1%. The predominant algal types and forms were greens/diatoms/filamentous. No nuisance algal growth was documented.

Biology

Compared to both the Cold River reference station (Station CR01) and the Bear River reference station (VP11BEA), the RBP III analyses indicated the benthic community was slightly impacted in the Chickley River 900 m upstream from the confluence with the Deerfield River, Charlemont (Station CH01) in September 2000 (Appendix B). Although the fish sampling efficiency was rated as poor (sampling was limited by deep pools, fast-moving deep runs, and heavy downpours, which limited both visibility and accessibility) fish species captured in order of abundance included Atlantic salmon (*Salmo salar),* slimy sculpin (*Cottus cognatus*), longnose dace (*Rhinichthys cataractae*), blacknose dace (*Rhinichthys atratulus*), brown trout (*Salmo trutta*) and rainbow trout (*Onchorynchus mykiss)* (Appendix B). Four of the species collected are considered to be intolerant of pollution. Although the fish sampling efficiency was poor all fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

Chemistry – water

Water quality sampling was conducted by DWM in the Chickley River at the bridge on Tower Road in Charlemont (Station CH) in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9). This location was also sampled by DWM between September 1995 and June 1996 (n = 10 sampling events) (Appendix G, Tables G3 and G4). Additionally, five locations upstream from the main sampling station (Stations CH2, CH3, CH4, CH5, and CH7) were sampled on 27 September 1995.

DO

DO in the Chickley River at Station CH ranged from 9.3 to 11.6 mg/L and saturation was not less than 90% on the three sampling events conducted in the summer of 2000. It should be noted that these data represent the worst-case (pre-dawn) conditions.

Temperature

The maximum temperature in the Chickley River was 15.8°C.

pH

Instream pH ranged between 6.9 and 7.2 SU

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community analysis, the fish population information and the limited recent water quality data.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from the Chickley River at the bridge on Tower Road in Charlemont (Station CH) between September 1995 and June 1996 (n = 10 sampling events) (Appendix G, Table G4). Five additional locations upstream from the main sampling station (Stations CH2, CH3, CH4, CH5, and CH7) were also sampled on 27 September 1995 (Appendix G, Table G4).

No objectionable deposits, odors or conditions were noted during the biological monitoring survey conducted by DWM biologists in the Chickley River in September 2000 (Appendix B).

Although too limited current bacteria data are available to assess the recreational uses the *Aesthetics Use* is assessed as support.

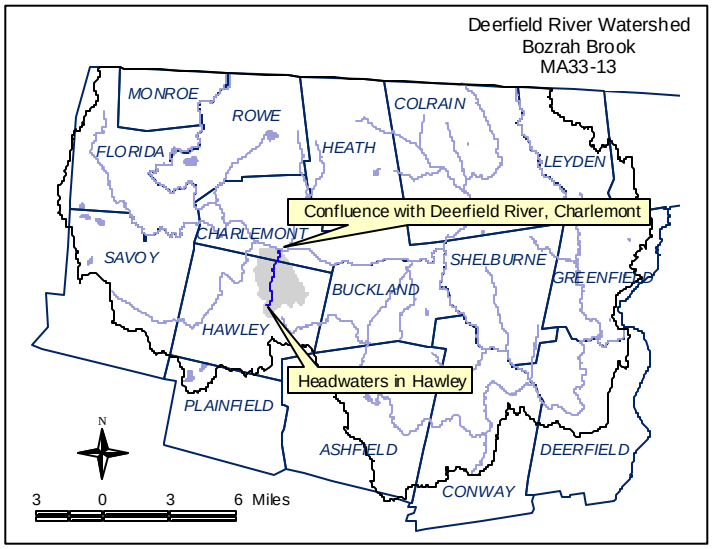
Chickley River (MA33-11) Use Summary Table

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

RECOMMENDATIONS CHICKLEY RIVER (MA33-11)

- Continue to perform DWM water quality and biological monitoring in this segment during the next monitoring year cycle (2005). In particular, biomonitoring and fish population sampling are recommended here in 2005. Fish population assessments should be conducted using multiple crews or a barge-mounted electrofishing unit. In addition, water quality monitoring throughout the Chickley River subwatershed, especially nutrient and bacteria sampling, may help to isolate sources of nutrient/organic loads.
- Based on MA DFWELE recommendations, the Chickley River and the following tributaries in its subwatershed - Basin, King, North, and Mill brooks - should be protected as cold water fishery habitat.
- 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 Towns of Charlemont, Hawley, Plainfield, and Savoy should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Chickley River subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Charlemont, Hawley, Plainfield, and Savoy should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- Work with NRCS, DFA and landowners to protect riparian buffers and encourage use of agricultural BMPs.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices as described in Unpaved Roads BMP Manual (BRPC 2001) should then be encouraged, as appropriate.
- The results of the volunteer monitoring surveys to locate and map Japanese knotweed stands conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Chickley River subwatershed should be consulted to help manage current and future infestations of this invasive plant which was found to be well established between West Hawley and Forge Hill (Serrentino 2003).

BOZRAH BROOK (SEGMENT MA33-13)
Location: Headwaters, located west of East Hawley Road, Hawley (drains wetland), to confluence with Deerfield River, Charlemont.
Segment Length: 3.0 miles.
Classification: Class B.



The drainage area of this segment is approximately 4.15 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	84.3%
Open Land	7.3%
Agriculture	5.2%

Bozrah Brook forms in the Town of Hawley and flows north down steep terrain until it flows by the Berkshire East Ski Area where the gradient lessens. It then enters an area of highly erodible soils before its confluence with the Deerfield River in Charlemont.

The Natural Heritage and Endangered Species Program has certified three vernal pools in this subwatershed (MassGIS 1999).

MA DFWELE has recommended that Bozrah Brook be protected as a cold water fishery habitat (MassWildlife 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

Chemistry-water

DWM collected water quality samples from Bozrah Brook off of South River Road near the Berkshire East Ski Area in Charlemont (Station BO) in September, November and December 1995 and April 1996 (Appendix G, Tables G3 and G4).

Too limited data are available so the *Aquatic Life Use* is not assessed for Bozrah Brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from Bozrah Brook off of South River Road near the Berkshire East Ski Area in Charlemont (Station BO) in September, November and December 1995 and April 1996 (Appendix G, Table G4). It should also be noted that DWM field crews noted erosion, siltation and the dumping of building materials along the banks in lower Bozrah Brook during the 1995/1996 surveys.

Too limited data are available so the *Recreational* and *Aesthetics* uses are not assessed for Bozrah Brook. However, the *Aesthetics Use* is identified with an Alert Status because of the historic reported dumping of building materials.

Bozrah Brook (MA33-13) Use Summary Table

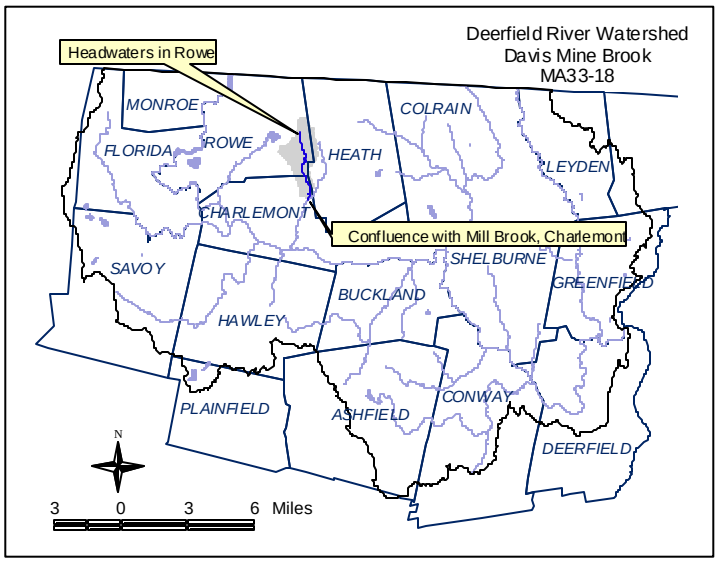
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED*

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

RECOMMENDATIONS BOZRAH BROOK (MA33-13)

- Conduct water quality and biological monitoring in this segment to more completely assess the designated uses during the next monitoring year cycle (2005). In particular, evaluate the extent and impact of observed dumping, siltation, and erosion on biota and habitat quality.
- Based on MA DFWELE recommendations, Bozrah Brook should be protected as a cold water fishery habitat.
- The Towns of Charlemont and Hawley should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Bozrah Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Charlemont and Hawley should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

DAVIS MINE BROOK (SEGMENT MA33-18)
Location: Headwaters, just south of Dell Road, Rowe, to confluence with Mill Brook, Charlemont.
Segment Length: 3.3 miles
Classification: Class B.



The drainage area of this segment is approximately 3.11 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	91.3%
Agriculture	5.0%
Open land and Residential	1.5% each

This segment is on the 1998 303(d) List of Waters needing confirmation for pH and other habitat alterations (Table 2).

The headwaters of Davis Mine Brook originate just south of the intersection of Dell Road and Cyrus Stage Road in Rowe. The brook flows in a southerly direction through steep terrain and passes just east of the old Davis Mine where runoff from the mine is flowing into it. The brook then enters into Charlemont where it flows into a steep valley until it reaches the confluence with Mill Brook in Charlemont.

The University of Massachusetts, Department of Geosciences, is currently conducting a five year study funded by the National Science Foundation to characterize the old Davis Mine site in detail and examine the processes of natural attenuation of acid mine drainage through field studies, modeling, and laboratory experiments, and to quantify the roles of acidophilic and acid-tolerant anaerobic microorganisms (Yuretich, *et al*. in preparation).

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

Davis Mine Brook was sampled by DWM upstream from its confluence with Mill Brook in Charlemont (Station DM00) in September 2000. At the time of the survey the river was roughly 4 m wide with depths ranging from 0.1 m to 0.5 m. The substrates in this very high-gradient system were comprised primarily of boulders and cobble material that appeared reddish in color (probably the result of ferric inputs from upstream mining activities). The overall habitat score was 174 (Appendix B). The riparian zone was heavily forested along the right bank but was disturbed on the left bank (long-term disposal site).

DWM biologists collected periphyton samples from Station DM00 (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 50% and percent algal cover was <5%. The dominant algal type and form was greens/mat. No nuisance algal growth was documented (Appendix D).

Biology

Too few macroinvertebrates were collected in Davis Mine Brook, although the instream habitat was adequate to support a sound community. Therefore, the RBP III analysis could not be calculated (Appendix B). Despite adequate fish habitat and extensive sampling effort, no fish were collected from Davis Mine Brook. It does appear that acidic mine drainage has eliminated fish and many invertebrates from this stream (Appendix B).

Chemistry-water

Water quality sampling was conducted by DWM in the Davis Mine Brook system in July 1996 (Stations DMB-1, UKN, DMB-2, and DMB-B)). The effects of acid mine drainage on pH were evident from the low (3.7) pH reading in the brook below the drainage from the mine (Appendix G, Table G3).

The *Aquatic Life Use* for Davis Mine Brook is assessed as impaired based on the depauperate benthic macroinvertebrate community and the lack of fish. The effects of acid mine drainage (from the abandoned Davis Mine) is responsible for the poor state of macroinvertebrate and fish community health.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

Although no bacteria data are available, the *Recreational Uses* are assessed as impaired in the lower 1.7 miles because of objectionable deposits in this section of Davis Mine Brook. These uses are not assessed for the upper 1.6 miles of Davis Mine Brook.

Although no oils, turbidity nor odors were observed/detected, objectionable deposits of ferric (iron) oxides were noted during the biological monitoring survey conducted by DWM biologists in Davis Mine Brook in September 2000 (Appendix B). A large auto/junk yard also extended along the left bank of the brook although no obvious impacts from this area to the brook were observed.

The *Aesthetics Use* is not assessed in the upper 1.6 miles of Davis Mine Brook. This use is assessed as impaired in the lower 1.7 miles because of objectionable deposits/precipitate on the streambed that results from the acid mine drainage.

Davis Mine Brook (MA33-18) Use Summary Table

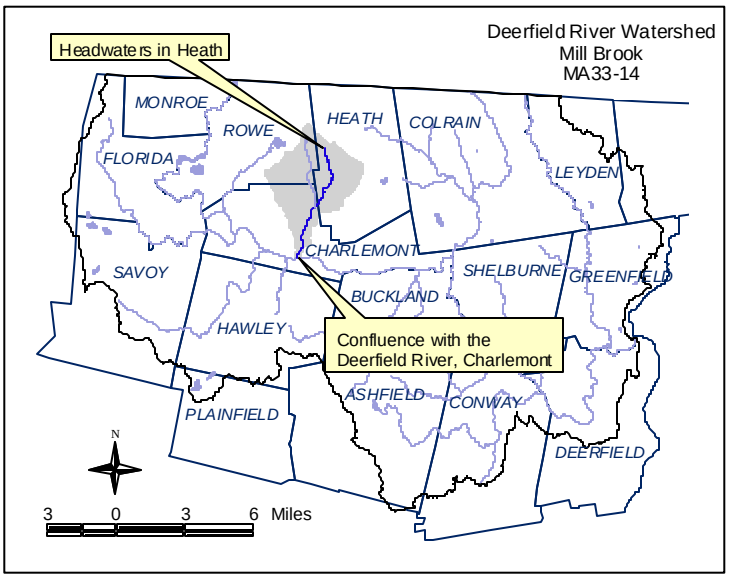
Designated Uses		Status	Causes	Sources
Aquatic Life		NOT ASSESSED upper 1.6 miles IMPAIRED lower 1.7 miles	Benthic macroinvertebrate bioassessment, fishes bioassessments (streams), and pH	Acid Mine Drainage
Fish Consumption		NOT ASSESSED		
Primary Contact		NOT ASSESSED upper 1.6 miles IMPAIRED lower 1.7 miles	Iron	Acid Mine Drainage
Secondary Contact		NOT ASSESSED upper 1.6 miles IMPAIRED lower 1.7 miles	Iron	Acid Mine Drainage
Aesthetics		NOT ASSESSED upper 1.6 miles IMPAIRED lower 1.7 miles	Combined biota/habitat bioassessment (streams), and Iron	Acid Mine Drainage

RECOMMENDATIONS DAVIS MINE BROOK (MA33-18)

- Continue to conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005). In particular, coordinate sampling effort with ongoing University of Massachusetts, Department of Geosciences study at this site. When the results of this National Science Foundation funded study are available (expected in 2005/2006) (Yuretich, *et al.* in preparation) a Section 319 grant should be pursued for remediation of the acid mine drainage. In addition, the Franklin County NRCS field office has offered to request assistance from their Interdisciplinary Research Team (IRT) for BMP recommendations and conceptual design ideas for acid mine drainage remediation.
- The Towns of Charlemont and Rowe should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent further degradation of water quality in the Davis Mine Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Charlemont and Rowe should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.

MILL BROOK (SEGMENT MA33-14)

Location: Headwaters, originating north of Rowe Road, Heath, to confluence with the Deerfield River, Charlemont.
Segment Length: 5.7 miles.
Classification: Class B.



The drainage area of this segment is approximately 11.94 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	88.3%
Agriculture	6.3%
Residential	2.9%

The headwaters of Mill Brook form in the Town of Heath and flow south through a steep, narrow valley that parallels Route 8A. Davis Mine Brook enters Mill Brook just south of the Charlemont border. Mill Brook flows southwest and then flows into an impounded area formed by a partially breached dam. The brook continues into Charlemont Center crossing under Route 2 before its confluence with the Deerfield River in Charlemont.

MA DFWELE has recommended that Mill Brook and Maxwell Brook, a tributary to Mill Brook, be protected as cold water fishery habitat (MassWildlife 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.

OTHER

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified two historic landfills in the watershed of this segment; the Charlemont Landfill and a former Town of Charlemont brush dump. The Charlemont landfill is over 25 years old and is not capped or lined. The site received municipal waste, is close to private water supplies, and is within 10 feet of Tatro Brook, a tributary to Mill Brook. This landfill was recommended for screening level sampling by Fuss and O'Neill (2003) due to its potential to impact sensitive environmental receptors, however, suitable sampling locations were not found so no samples were collected. The brush dump, located along Warner Hill Road, was discovered during field reconnaissance and no additional information was available from the Town on this dump.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

Mill Brook was sampled by DWM downstream from Harris Mountain Road, Charlemont (Station MB01) in September 2000. At the time of the survey the brook was roughly 8 m wide with depths ranging from 0.1 m to 0.5 m. The substrates were comprised primarily of boulders and cobble. The overall habitat score was 181 (Appendix B). The steep banks within this reach exhibited some signs of erosion.

Biology

Compared to the Bear River reference station (Station VP11BEA) the RBP III analysis indicated the benthic community was slightly impacted in Mill Brook downstream from Harris Mountain Road, Charlemont (Station MB01) in September 2000 (Appendix B). Fish species captured in order of abundance included Atlantic salmon (*Salmo salar),* brook trout (*Salmo trutta*), and blacknose dace (*Rhinichthys atratulus*) (Appendix B). Two of the species collected are considered to be intolerant of

pollution. However, both the low number of fish collected and the absence of slimy sculpin and longnose dace were noted to be of concern given the available habitat quality in Mill Brook. MA DFWELE documented multiple age classes of both Atlantic salmon and brook trout in Mill Brook upstream from its confluence with Davis Mine Brook in August 2000 (Richards 2003). All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat quality and stable flow regimes.

Chemistry-water

DWM collected water quality samples in Mill Brook just upstream from its confluence with the Deerfield River in Charlemont (Station MI) in September, November and December 1995 and April 1996 (Appendix G, tables G3 and G4). Limited sampling was also conducted at an upstream location (Station MIL2 upstream from the covered bridge in Charlemont); from Heath Brook (a tributary to Mill Brook in August 1995, and upstream and downstream from the confluence with Davis Mine Brook (Stations MB-A and MB-B, respectively) (Appendix G, Tables G3 and G4).

The *Aquatic Life Use* in Mill Brook is assessed as support based on the benthic macroinvertebrate community analysis and fish population information. However, this use is identified with an "Alert Status" because of the slightly impaired benthic community and the fish population survey results that reported a low number of fish collected as well as absence of slimy sculpin and longnose dace despite available suitable habitat (also see concerns in Appendix B). It is possible that some effects of the acid mine drainage from Davis Mine Brook may still be influencing the benthos in Mill Brook, but taxa most vulnerable to acidified conditions (e.g., scrapers, mayflies) were well represented in the Mill Brook sample. Other potential stressors to this system include the junkyard near the mouth of Davis Mine Brook and the old Charlemont Landfill. And, while much of the upper portion of the Mill Brook subwatershed is relatively undeveloped, other potential sources of anthropogenic perturbation may exist as well.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from Mill just upstream of its confluence with the Deerfield River in Charlemont (Station MI) in September, November and December 1995 and April 1996. One sample was also collected by DWM from Mill Brook upstream from the covered bridge in Charlemont and Heath Brook in September 1995 (Appendix G, Table G4).

No objectionable deposits, odors or conditions were noted during the biological monitoring survey conducted by DWM biologists in Mill Brook in September 2000 (Appendix B).

Although no recent bacteria data are available to assess the recreational uses the *Aesthetics Use* is assessed as support.

Mill Brook (MA33-14) Use Summary Table

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

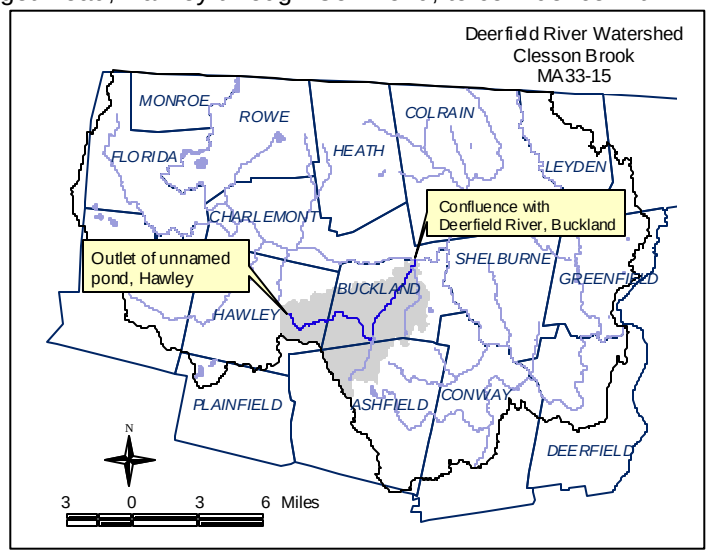
* Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS MILL BROOK (MA33-14)

- Since water quality, rather than habitat quality appears to limit biological integrity in this portion of Mill Brook, additional monitoring of various physico-chemical parameters would be helpful in determining the causes and sources of water quality degradation present here. In addition, biomonitoring and fish population sampling should be conducted by DWM in 2005.
- Based on MA DFWELE recommendations, Mill Brook and Maxwell Brook (a tributary to Mill Brook) should be protected as cold water fishery habitat.
- 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 Towns of Charlemont, Heath and Rowe should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Mill Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Charlemont, Heath and Rowe should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- Support the recommendations of the Fuss and O'Neill (2003) landfill assessment study for management of the Charlemont Landfill in the watershed of this segment, including removal of the exposed bulky waste on a steep slope adjacent to Tatro Brook, and for additional field investigation to further assess the environmental risk from the landfill and to determine the need for corrective/remedial action. Inspection and additional field investigation of the former municipal brush dump on Warner Hill Road is also recommended.

CLESSON BROOK (SEGMENT MA33-15)

Location: Outlet of unnamed pond south of Forget Road, Hawley through Cox Pond, to confluence with Deerfield River, Buckland.
Segment Length: 10.3 miles.
Classification: Class B.



The drainage area of this segment is approximately 21.24 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	81.4%
Agriculture	9.6%
Open Land	4.7%

The headwaters of Clesson Brook begin at an unnamed pond in Hawley and then flow through Cox Pond. From the outlet of Cox Pond the brook flows easterly through steep terrain entering the Town of Buckland and then bends around Drake Hill to flow southeast until it reaches Buckland Four Corners. From here the brook flows northeast with a lower gradient and the floodplain widens, which allows for farming. The brook parallels Route 112 through Buckland until it reaches a small, unnamed impoundment where it joins Clark Brook. Clesson Brook then continues a short distance from the outlet to its confluence with the Deerfield River in Buckland.

NRCS provided best management practice guidance to selected land owners in the Clesson Brook subwatershed following DWM's 1995/1996 Deerfield River Watershed monitoring survey. Several agricultural BMPs were implemented in this subwatershed (Leone 1999).

The Natural Heritage and Endangered Species Program has certified five vernal pools in this subwatershed (MassGIS 1999).

MA DFWELE has recommended that Clesson Brook and several tributaries in its subwatershed - Cooley, Ruddock, and Sheperd brooks - be protected as cold water fishery habitat (MassWildlife 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.

OTHER

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Buckland Landfill. The Buckland Landfill is over 25 years old and received municipal, demolition, and industrial waste as well as sludge from Shelburne Falls WWTP. Fly ash and bottom ash were used as daily cover material. The landfill underwent MA DEP closure and capping in the late 1990s, but is not lined. Environmental monitoring has been conducted at this site since 1991, including an Initial Site Assessment, a Comprehensive Site Assessment, and post-closure monitoring. Since this site is already being monitored it was not recommended for screening level sampling by Fuss and O'Neill (2003).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

DWM biologists sampled one stream reach in Clesson Brook in September 1996 (Appendix G, Tables G3 and G4). The reach was located downstream from Hog Hollow Road off of the east side of Route 112 in Buckland (Station VP10CLE) and was surveyed as part of the MA DEP Biocriteria Development

Project. The left side of Clesson Brook is channelized and riprapped due to the adjacent Route 112. Periphyton was very abundant and covered approximately 50% of the reach (Appendix D). Instream cover was suboptimal. A horse farm was located on the right bank and impacted the riparian zone. Habitat quality was limited because of the minimal riparian zone width and vegetative cover and the limited channel flow status. The total habitat assessment score was 149.

Biology

As part of the MA DEP Biocriteria Development Project benthic macroinvertebrate samples were collected by DWM biologists from Clesson Brook at Station VP10CLE (described above) on 5 September 1996. DWM also conducted fish population sampling on 26 September 1996 in Clesson Brook. Fish collected in order of abundance included: blacknose dace (*Rhinichthys atratulus*), longnose dace *(Rhinichthys cataractae),* white sucker (*Catostomus commersoni*), slimy sculpin (*Cottus cognatus*), and creek chub (*Semotilus atromaculatus*). One of the species collected is considered intolerant of pollution. All fish species collected in this brook are fluvial specialists/dependants. The absence of macrohabitat generalists and the presence of slimy sculpin (intolerant) are indicative of generally good habitat and water quality conditions and stable flow regimes.

Chemistry - Water

In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of Clesson Brook downstream from Hog Hollow Road off the east side of Route 112 in Buckland (Station VP10CLE) were made on 26 September 1996 as part of the MA DEP Biocriteria Development Project (Appendix G, Table G3). DWM also collected water quality samples from Clesson Brook at Route 112 bridge northeast of Depot Road in Buckland (Station CL) between September 1995 and June 1996 (n = 9) and two upstream locations (Stations CL02 and SH01) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Tables G3 and G4).

Water quality samples were collected from Clesson Brook at three stations on as many as six occasions between August and November 2000 by ESS (ESS 2002):

- Station DW21 at the confluence of Sheperd Brook and Clesson Brook, Buckland Four Corners;
- Station DW20 adjacent to the intersection of Route 112 and Charlemont Road, upstream of agricultural areas, midway to Smith Brook, Buckland; and
- Station DW19 near the confluence with the Deerfield River, Buckland.

DO and % saturation

Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 11.5 mg/L or 90.6% saturation. Saturation was as high as 105.2%.

Temperature

The maximum instream temperature was 17.1°C.

pH

The pH ranged from 7.0 to 7.3 SU at all three locations.

Turbidity

Turbidity ranged from 0.08 to 1.92 NTU.

Conductivity

Specific conductivity measurements ranged from 13.2 to 132.6 µS/cm.

The *Aquatic Life Use* for Clesson Brook is assessed as support based on the limited water quality data and best professional judgment. It is noteworthy that although temperature and oxygen levels met cold water fishery standards, salmonids were not collected during sampling of this proposed cold water fishery. This use is, therefore, identified with an "Alert Status" because of the absence of salmonids in the fish population sample and because the habitat assessment identified a number of potential concerns that may be impacting the habitat.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from Clesson Brook at Route 112 bridge northeast of Depot Road in Buckland (Station CL) between September 1995 and June 1996 (n = 8) and several upstream locations (Stations SH01, CL02, CL03, and UB01) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4).

Fecal coliform bacteria samples were collected from Clesson Brook at three stations on six occasions representing both wet and dry weather sampling between August and November 2000 by ESS (ESS 2002). Four of the sampling events were conducted during the *Primary Contact Recreational* season of April 15 through October 15. Results were:

- Station DW21 at the confluence of Sheperd Brook and Clesson Brook, Buckland Four Corners - fecal coliform bacteria counts ranged from 6 to 70 col/100 mL;
- DW20 adjacent to the intersection of Route 112 and Charlemont Road, upstream of agricultural areas, midway to Smith Brook, Buckland - fecal coliform bacteria counts ranged from 6 to 100 col/100 mL; and
- DW19 near the confluence with the Deerfield River, Buckland - fecal coliform bacteria counts ranged from 8 to 60 col/100 mL.

With the exception of some decomposing algae and associated strong odors no other objectionable deposits, sheens or conditions were noted during the biological monitoring survey conducted by DWM biologists in Clesson Brook in September 1995 (Appendix C).

The *Recreational* and *Aesthetics* uses are assessed as support for Clesson Brook based on the low fecal coliform bacteria counts and the habitat quality information.

Clesson Brook (MA33-15) Use Summary Table

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

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

RECOMMENDATIONS CLESSON BROOK (MA33-15)

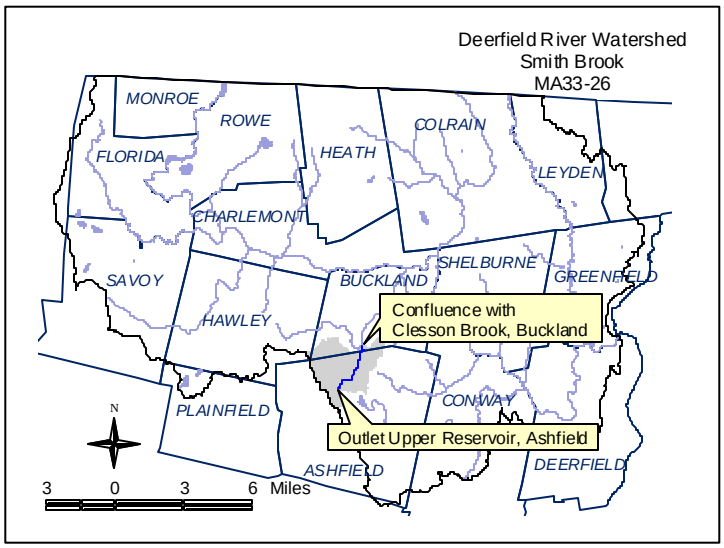
- Water quality monitoring in Clesson Brook should be conducted during the next monitoring year cycle (2005) to assess whether or not nutrient enrichment is occurring in this subwatershed from nonpoint sources of pollution, including agricultural inputs. In addition, fish population sampling should be conducted in Clesson Brook to document the presence of salmonids.
- Between the 1995 and 2000 year surveys on this stream NRCS worked with several landowners to implement agricultural BMPs in this subwatershed. These activities may have contributed to the drop in coliform bacteria measured in the stream below the agricultural areas. It is recommended that NRCS and DFA continue to work with landowners to maintain and expand the use of BMPS to protect riparian areas and prevent agricultural runoff and streambank erosion.
- Based on MA DFWELE recommendations, Clesson Brook and several tributaries in its subwatershed - Cooley, Ruddock, and Sheperd brooks - should be protected as cold water fishery habitat.
- The Towns of Ashfield, Buckland and Hawley should participate in the Deerfield River Watershed Regional Open Space Planning Projects, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these projects these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Clesson Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Ashfield, Buckland and Hawley should support recommendations of their recently developed individual municipal open space plans and/or

Community Development Plans to protect important open space and maintain their communities' rural character.

- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Clesson Brook subwatershed identified and mapped extensive patches of this plant growing between Buckland Four Corners and Clesson Brook's confluence with the Deerfield River. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).

SMITH BROOK (SEGMENT MA33-26)

Location: Headwaters, outlet Upper Reservoir, Ashfield, to confluence with Clesson Brook, Buckland.
Segment Length: 2.7 miles.
Classification: Class B.



The drainage area of this segment is approximately 5.77 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	80.8%
Agriculture	7.5%
Open Land	6.8%

The headwaters of Smith Brook begin at Bear Swamp in Ashfield and then flow into Upper Reservoir. Smith Brook then flows north to its confluence with Upper Branch near the intersection of Apple Valley Road and Smith Road in Ashfield. The brook then flows along Route 112 to its confluence with Clesson brook in Buckland Four Corners (Buckland).

MA DFWELE has recommended that Smith Brook and its tributary Upper Branch be protected as cold water fishery habitat (MassWildlife 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.

OTHER

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Ashfield Landfill/Demolition /Wood Waste Landfill. The Ashfield Landfill/Demolition/Wood Waste Landfill is over 25 years old and is capped and lined. The site contains municipal waste and wood waste, is within one-half mile of private water supplies, 0.9 miles from of a community wellhead protection area, and approximately 2000 feet from Smith Brook. In 2002 MA DEP required the Town of Ashfield to prepare an Initial Site Assessment including test borings, monitoring wells, and soil and water sampling. Since this sampling is planned, Fuss and O'Neill did not recommend that screening level sampling be performed at this site under their study.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

Smith Brook was sampled by DWM biologists downstream from the confluence with Upper Branch in Ashfield (Station VP04SMI) in September 1996 as part of the MA DEP Biocriteria Development Project. At the time of the survey the brook was roughly 10 m wide with depths ranging from 0.25 m to 0.5 m. The substrates were comprised primarily of cobble, sand and boulders. The overall habitat score was 147 (MA DEP 1996b). The instream habitat was limited most by the channel flow status, the riparian vegetative zone width and bank vegetative cover.

Biology

Smith Brook was sampled by DWM downstream from the confluence with Upper Branch in Ashfield (Station VP04SMI) in September 1996 as part of the DWM Biocriteria Development Project (Appendix C). Fish species captured in order of abundance included slimy sculpin (*Cottus cognatus*), rainbow trout (*Onchorynchus mykiss*), longnose dace (*Rhinichthys cataractae),* blacknose dace (*Rhinichthys atratulus*), and brook trout (*Salvelinus fontinalis*) (MA DEP 1996b). Multiple age classes of both rainbow and brook trout were present. All fish species collected in this brook are fluvial

specialists/dependants. The presence of multiple age classes of brook and rainbow trout, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

Chemistry-water

In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) in Smith Brook were taken downstream from the confluence with Upper Branch in Ashfield (Station VP04SMI) on 24 September 1996 and near the confluence with Clesson Brook in Buckland (Four Corners) and Upper Branch (Station UB01) on 27 September 1995 (Appendix G, Table G3).

No recent data are available so the *Aquatic Life Use* is not assessed.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected one fecal coliform bacteria sample each from Smith Brook near the confluence with Clesson Brook in Buckland (Four Corners) and from Upper Branch (Station UB01) on 27 September 1995 (Appendix G, Table G4).

With the exception of a sewage odor noted in the upper area of the stream reach sampled by DWM biologists in Smith Brook in September 1996, no other objectionable deposits, or conditions were noted (MA DEP 1996b).

No recent data are available to assess the *Recreational* and *Aesthetic* uses, so they are not assessed.

Smith Brook (MA33-26) Use Summary Table

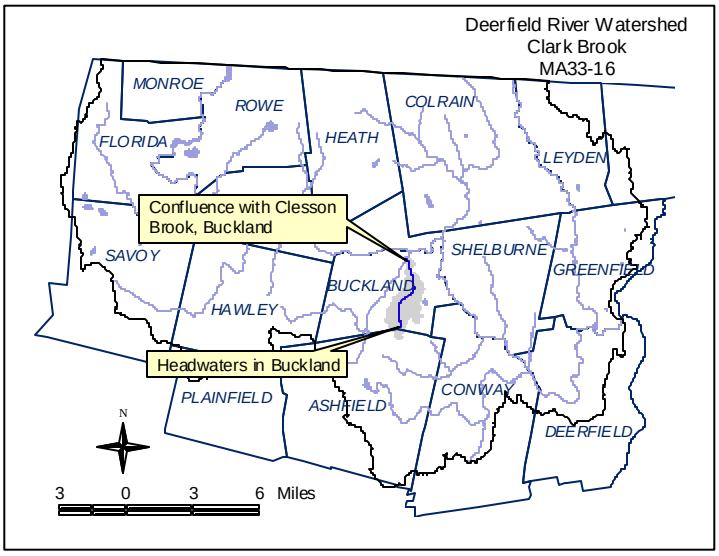
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS SMITH BROOK (MA33-26).

- Conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005) to assess the status of designated uses.
- Smith Brook and its tributary Upper Branch should be protected as cold water fishery habitat as recommended by MA DFWELE.
- The Town of Ashfield should participate in the Deerfield River Watershed Regional Open Space Planning Projects, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these projects the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Smith Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Town of Ashfield should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

CLARK BROOK (SEGMENT MA33-16)

Location: Headwaters, near Moonshine Road (Howes Road)/East Buckland Road, Buckland, to confluence with Clesson Brook, Buckland.
Segment Length: 3.8 miles.
Classification: Class B.



The drainage area of this segment is approximately 2.88 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	88.0%
Agriculture	6.3%
Residential	3.2%

Clark Brook originates in Buckland and flows through a steep narrow valley between Mary Lyon Hill and Moonshine Hill. The brook parallels East Buckland Road until it flows under Route 112 and then joins Clesson Brook in a small, unnamed pond just before the confluence of Clesson Brook with the Deerfield River in Buckland.

MA DFWELE has recommended that Clark Brook be protected as a cold water fishery habitat (MassWildlife 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

One stream reach in Clark Brook was sampled by DWM biologists between September 1996 and September 2000. The reach was located upstream from Route 112 in Buckland (Station VP09CLA) and was surveyed as part of the MA DEP biocriteria development project in September 1996, 1997 and 2000. In September 2000 the river was approximately 4 m wide with depths ranging from 0.1 to 0.3m in riffle habitat (Appendix B, MA DEP 1996b, and MA DEP 1997). The total habitat assessment score was 179.

Biology

As part of the MA DEP biocriteria development project, benthic macroinvertebrate samples were collected by DWM biologists from Clark Brook upstream of Route 112 in Buckland (Station VP09CLA) on 5 September 1996, 24 September 1997 and again on 25 September 2000 (Appendices B, MA DEP 1996b, and MA DEP 1997). The fish population in Clark Brook (Station VP09CLA) was comprised of multiple age classes of brook trout (*Salvelinus fontinalis*), rainbow trout (*Onchorynchus mykiss*) and an individual creek chub (*Semotilus atromaculatus*) in 1996 and multiple age classes of brook trout, rainbow trout (multiple age classes) and blacknose dace (*Rhinichthys atratulus*) in 1997 (MA DEP 1996b and MA DEP 1997). MA DFWELE also conducted fish population sampling in Clark Brook using backpack shocking on 9 August 2000 near the most downstream East Buckland Road bridge crossing. Brook trout (multiple age classes), blacknose dace, white sucker (*Catostomus commersoni*) creek chub (*Semotilus atromaculatus*), rainbow trout, and one each of longnose dace (*Rhinichthys cataractae*) and slimy sculpin (*Cottus cognatus*) were captured. Four of the species collected are considered intolerant of pollution. All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook and rainbow trout, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

Chemistry-water

DWM collected water quality samples from Clark Brook at the Route 112 Bridge (Station CK) in November and December 1995 and April, May and June 1996 (n = 6) as part of the 1995/1996 Deerfield River monitoring survey (Appendix G, Tables G3 and G4). DWM also sampled one station on Clark Brook in Buckland (Station VP09CLA) on 26 September 1996 and 8 October 1997 as part of the MA DEP Biocriteria Development Project (Appendix G, Table G3). *In-situ* measurements included DO, %saturation, pH, temperature, conductivity, and turbidity.

The *Aquatic Life Use* in Clark Brook is assessed as support based primarily on the fish population information. The presence of multiple age classes of brook and rainbow trout is indicative of excellent habitat and water quality. Furthermore, these fish are fluvial specialists, which suggests that the flow regime has not been compromised in this brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from Clark Brook at Route 112 bridge in Buckland (Station CK) between November 1995 and June 1996 (n = 6) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4).

No objectionable deposits, odors or conditions were noted during the biological monitoring surveys conducted by DWM biologists in Clark Book in September 1996, 1997 and 2000 (Appendix B, MA DEP 1996b, and MA DEP 1997).

Although too limited current bacteria data are available to assess the recreational uses the *Aesthetics Use* is assessed as support.

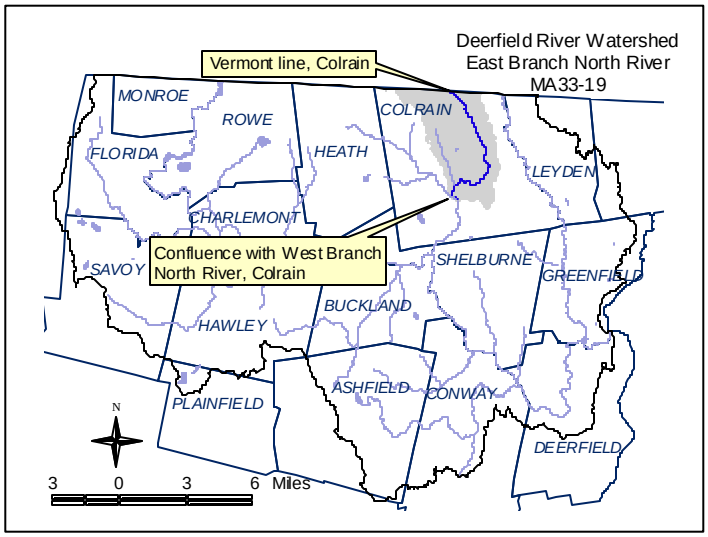
Clark Brook (MA33-16) Use Summary Table

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

RECOMMENDATIONS CLARK BROOK (MA33-16)

- Conduct water quality and biological monitoring in Clark Brook during the next monitoring year cycle (2005) to more completely assess the status of designated uses.
- Clark Brook should be protected a cold water fishery habitat as recommended by MA DFWELE.
- The Town of Buckland should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these projects the Town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Clark Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Town of Buckland should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

EAST BRANCH NORTH RIVER (SEGMENT MA33-19)
Location: Vermont/Colrain line, to confluence with West Branch North River, Colrain.
Segment Length: 7.6 miles
Classification: Class B, Cold Water Fishery



The Massachusetts portion of the drainage area of this segment is approximately 13.82 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	82.5%
Agriculture	11.4%
Residential	3.1%

The East Branch of the North River is formed by the confluence of three streams in the Town of Jacksonville, VT. The East Branch parallels Route 112 and enters Massachusetts in the Town of Colrain. The stream continues to follow Route 112 and joins the West Branch of the North River in the Village of Lyonsville. The segment ends at this point and the river becomes the North River proper. Most of the agricultural activities in this subwatershed are in close proximity to the river.

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.

OTHER
Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Colrain Brush Landfill/Former Town Dump. This landfill is over 25 years old. The former town dump portion received demolition waste, industrial waste and municipal solid waste. This portion, closed in 1976, is not capped or lined. The brush dump was closed and capped in 1989. The site is within 50 feet of the North River and within one half mile of public and private water supplies and potentially productive aquifers. Fuss and O'Neill (2003) concluded that this site ranked high for the potential to impact sensitive environmental receptors and recommended it for screening level sampling. Samples collected in April 2003 from a groundwater seep on the bank of the North River downgradient of the landfill were high in iron (95,400 µg/L), manganese (8,250 µg/L), and cadmium (1.8 µg/L). No VOCs were detected.

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow
The East Branch North River has been experiencing major erosion in localized areas. The river is naturally subject to high and flashy spring flows and spring ice jams that contribute to streambank erosion. There is also a past history of gravel mining in and near the river that likely has impacted the geomorphology and hydrology of this segment. A Section 319 bioengineering project was implemented in an area that was eroding and threatening town water supply wells in 1993 (MA DEP 1996c). The project failed several years after installation, but at the time of this report the water supply wells had not been damaged by further erosion in this area. Agricultural (i.e., small-scale farming) activities are common along the North River and its East Branch - in many cases crops are planted immediately adjacent (i.e., minimally buffered) to the river.

The East Branch North River was sampled by DWM downstream from the Route 112 bridge, Colrain (Station NOR02A) in September 2000. At the time of the survey the river was roughly 13 m wide with depths ranging from 0.3 m to 0.9 m. The substrates were comprised primarily of boulders and cobble. The overall habitat score was 190 (Appendix B). The stream banks, although steep, were stable.

Biology

Compared to the Cold River reference station (Station CR01), the RBP III analysis indicated the benthic community was non/slightly impacted in the East Branch North River downstream from the Route 112 bridge, Colrain (Station NOR02A) in September 2000. The presence of a certain macroinvertebrate species indicative of high concentrations of suspended organics provided evidence of nutrient enrichment of this stream (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in the East Branch North River in 1988 (Appendix C). Although fish sampling efficiency was rated as poor due to stream width and depth encountered, fish species captured by DWM in September 2000, in order of abundance, included Atlantic salmon (*Salmo salar*), longnose dace *(Rhinichthys cataractae)*, blacknose dace (*Rhinichthys atratulus*), and one each of yellow bullhead (*Ameiurus natalis),* banded killifish (*Fundulus diaphanous*), and tessellated darter (*Etheostoma olmstedi*) (Appendix B). Only the Atlantic salmon is considered to be intolerant of pollution.

DWM biologists collected periphyton samples from station NORO2A (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as <1% and percent algal cover was 100%. This site had a thin covering of coccoid green algae on 100% of the stable substrates, which is an indication of slightly enriched conditions but not considered nuisance algae growth (Appendix D).

Chemistry

DWM collected water quality samples from the East Branch North River approximately 700 feet upstream from the Route 112 bridge in Colrain (Station EBNR06) in August 1995 (Appendix G, Tables G3 and G4).

Water quality samples were collected from the East Branch North River below Lyonsville Village, north of the Arthur-Smith Covered Bridge, Colrain (Station DW6) on as many as six occasions between August and November 2000 by ESS as part of a study performed for the Deerfield Watershed Team (ESS 2002).

DO and % saturation

Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 11.2 mg/L or 93.9% saturation. Saturation was as high as 106.6%.

Temperature

The maximum instream temperature was 19.6°C.

pH

The pH ranged from 6.9 to 7.4 SU.

Turbidity

Turbidity ranged from 0.60 to 41.8 NTU although five of six measurements were less than 1.6 NTU. The elevated turbidity occurred during a wet weather event in October 2000.

Conductivity

Specific conductivity measurements ranged from 80.3 to 107.8 µS/cm.

The *Aquatic Life Use* is assessed as support for the East Branch North River based primarily on the benthic macroinvertebrate community analysis and the limited water quality data. It should be noted, however, that nutrient/organic loadings originating from various forms of runoff (especially upstream agriculture, road crossings, and NPS inputs originating from Colrain center) probably contribute to the slightly enriched nature of this stream system (Appendix B) so the *Aquatic Life Use* is identified with an Alert Status. Streambank erosion in localized areas along this segment is also of concern.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected one fecal coliform bacteria sample from the East Branch North River approximately 700 feet upstream from the Route 112 bridge in Colrain (Station EBNR06) in August 1995 as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4).

Fecal coliform bacteria samples were collected from the East Branch North River below Lyonsville Village, north of the Arthur-Smith Covered Bridge, Colrain (Station DW6), on six occasions between August and November 2000 by ESS (ESS 2002). The fecal coliform bacteria counts during the *Primary Contact Recreational* season (n=4) ranged from 50 to 280 cfu/100 mL, with only one of the four samples exceeding 200 cfu/100 mL. The elevated bacteria count was during a wet weather event in September.

No objectionable deposits, sheens, odors or other conditions were noted during the biological monitoring survey conducted by DWM biologists in the East Branch North River in September 2000 (Appendix B).

The *Recreational* and *Aesthetics Uses* are assessed as support for East Branch North River based on the generally low fecal coliform bacteria counts and the habitat quality information. The *Primary Contact Recreational Use*, however, is identified with an Alert Status because of the slightly elevated bacteria count documented by ESS during one wet weather event.

East Branch North River (MA33-19) Use Summary Table

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

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

RECOMMENDATIONS EAST BRANCH NORTH RIVER (MA33-19)

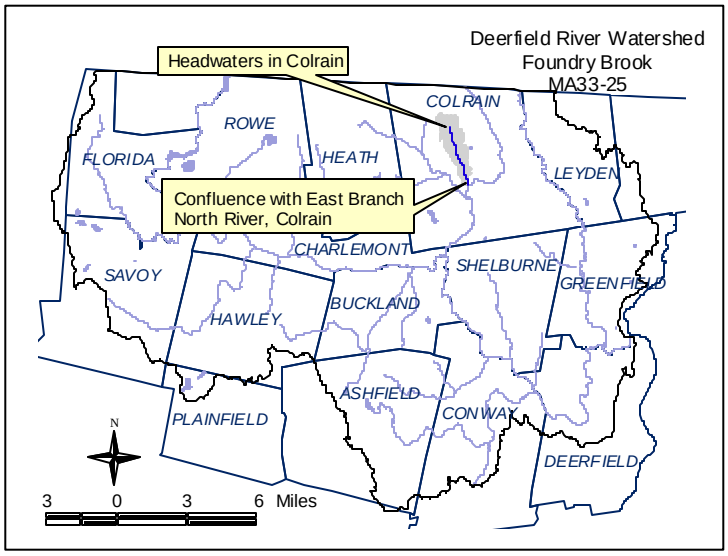
- Continue to conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005). In particular, biomonitoring is recommended here and fish population sampling should accompany the macroinvertebrate sampling effort. In addition, water quality monitoring throughout the East Branch subwatershed—especially nutrient and bacteria sampling—may help to isolate sources of nutrient/organic loads.
- Support local efforts to control streambank erosion. The NRCS and the Colrain Elementary School are currently collaborating on a streambank stabilization project on an eroding section of riverbank adjacent to the school.
- Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
- The Town of Colrain should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project the Town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the East Branch of the North River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Town of Colrain should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- Support the recommendations of the Fuss and O'Neill (2003) landfill assessment study for management of the Colrain Brush Landfill/Former Town Dump including: performing additional field investigation to assess environmental risk, identifying and characterizing the extent of any impacts that may be present, and determining the need for corrective action. The report identified significant quantities of exposed refuse within 50 feet of the North River and groundwater seeps hydraulically connected to the North River as major issues of concern.

FOUNDRY BROOK (SEGMENT MA33-25)

Location: Headwaters, north of Calvin Coombs Road, Colrain, to confluence with East Branch North River, Colrain.

Segment Length: 2.8 miles.

Classification: Class B.



The drainage area of this segment is approximately 2.18 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	82.8%
Agriculture	13.6%
Residential	2.2%

Foundry Brook originates on the southeastern slope of Christian Hill in Colrain. The brook then flows south, through a narrow valley, to Foundry Village. The brook then joins the East Branch of the North River in Foundry Village in the Town of Colrain.

MA DFWELE has recommended that Foundry Brook be protected as a cold water fishery habitat (MassWildlife 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

One stream reach in Foundry Brook was sampled by DWM biologists between September 1996 and September 2000. The reach was located approximately 1000 m upstream from its confluence with the East Branch North River in Colrain (Station VP07FOU) and was surveyed as part of the MA DEP Biocriteria Development Project in September 1996, 1997 and 2000 (Appendix B, MA DEP 1996b and MA DEP 1997). In September 2000 the river was approximately 3 m wide with depths ranging from 0.1 to 0.3 m in the riffle habitat. The total habitat assessment score was 158. Habitat was most limited by sediment deposition and lack of instream habitat diversity (i.e., limited velocity/depth combinations).

Biology

As part of the MA DEP Biocriteria Development Project benthic macroinvertebrate samples were collected by DWM biologists from Foundry Brook approximately 1000 m upstream from its confluence with the East Branch North River in Colrain (Station VP07FOU) on 5 September 1996, 25 September 1997 and again on 26 September 2000 (Appendix B, MA DEP 1996b and MA DEP 1997). No RBP III analysis is available from these samples. The fish population in Foundry Brook (Station VP09CLA) was comprised of multiple age classes of brook trout (*Salvelinus fontinalis*) and slimy sculpin (*Cottus cognatus*) in 1996 and 1997 (MA DEP 1996b and MA DEP 1997). Both fish species are considered intolerant of pollution and are indicative of excellent habitat and water quality conditions.

Chemistry-water

DWM sampled one station on Foundry Brook in Colrain (Station VP07FOU) on 25 September 1996 and 8 October 1997 as part of the Biocriteria Development Project (MA DEP 1996b and MA DEP 1997). *In-situ* measurements included: DO, %saturation, pH, temperature, conductivity, and turbidity.

Although the fish community is indicative of excellent water quality and habitat conditions, because of the lack of additional water quality and biological data the *Aquatic Life Use* is not assessed for Foundry Brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Foundry Brook during any of the three sampling events conducted by DWM biologists as part of the Biocriteria Development Project between September 1996 and September 2000 (Appendix B, MA DEP 1996b and MA DEP 1997).

Although no bacteria data are available to assess the *Recreational Uses* the *Aesthetics Use* is assessed as support.

Foundry Brook (MA33-25) Use Summary Table

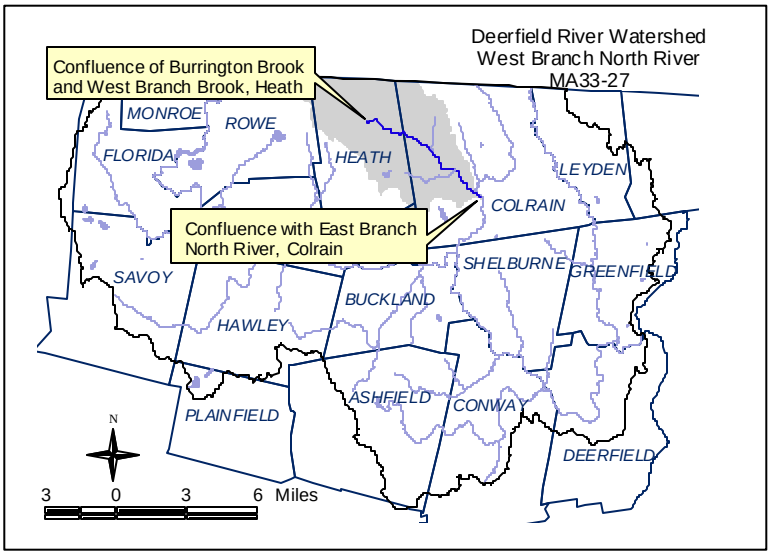
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS FOUNDRY BROOK (MA33-25)

- Conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005) to more completely assess the status of designated uses.
- Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
- Based on MA DFWELE recommendations Foundry Brook should be protected as a cold water fishery habitat.
- The Town of Colrain should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project the Town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Foundry Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Town of Colrain should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

WEST BRANCH NORTH RIVER (SEGMENT MA33-27)

Location: Confluence of Burrington Brook and West Branch Brook, Heath to confluence with East Branch North River, forming the North River, Colrain.
Segment Length: 7.1 miles
Classification: Class B, Cold Water Fishery



The Massachusetts portion of the drainage area of this segment is approximately 26.4 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	82.4%
Agriculture	9.4%
Open Land	4.4%

The West Branch of the North River is formed by the confluence of West Branch Brook and Burrington Brook on the border between the Towns of Heath and Colrain. The West Branch North River then parallels Adamsville Road as it flows southeast to its confluence with the East Branch North River, upstream from Griswoldville in the Town of Colrain.

MA DFWELE has recommended that West Branch and Underwood brooks, tributaries to the West Branch North River, be protected as cold water fishery habitat (MassWildlife 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

The West Branch North River has been experiencing major erosion in localized areas. The river is naturally subject to high and flashy spring flows and spring ice jams that contribute to streambank erosion.

Biology

MA DFWELE conducted fish population sampling in the West Branch North River between August 2000 and September 2001. At the most upstream station near the confluence with Sanders Brook, three species were collected in August 2000 including blacknose dace (*Rhinichthys atratulus*), slimy sculpin *(Cottus cognatus*), and longnose dace *(Rhinichthys cataractae)* (one intolerant species). Further downstream, above the confluence with Taylor Brook, fish collected in August 2000 in order of abundance included: slimy sculpin, blacknose dace, longnose dace, Atlantic salmon (*Salmo salar*) (multiple age classes), white sucker (*Catostomus commersoni*), brown trout (*Salmo trutta*), longnose sucker (*Catostomus catostomus*), eastern brook trout (*Salvelinus fontinalis*), and one brown bullhead (*Ameiurus nebulosus*). In September 2001 only three species (Atlantic salmon and brown and brook trout) were collected from the West Branch North River near to its confluence with Taylor Brook. Multiple age classes of Atlantic salmon and brook trout were documented (Richards 2003). All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

Chemistry

DWM collected water quality samples from the West Branch North River just upstream from the bridge across from Branch Cemetery on Adamsville Road, Colrain (Station WBNR05) in August 1995 (Appendix G, Tables G3 and G4).

The *Aquatic Life Use* is assessed as support for the West Branch North River based on best professional judgment of the fish community information. The species collected in the river are indicative of excellent water quality and habitat conditions.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected one fecal coliform bacteria sample from the West Branch North River just upstream from the bridge across from Branch Cemetery on Adamsville Road, Colrain (Station WBNR05) in August 1995 (Appendix G, Table G4).

No current data are available so the *Recreational* and *Aesthetics* uses are not assessed for the West Branch North River.

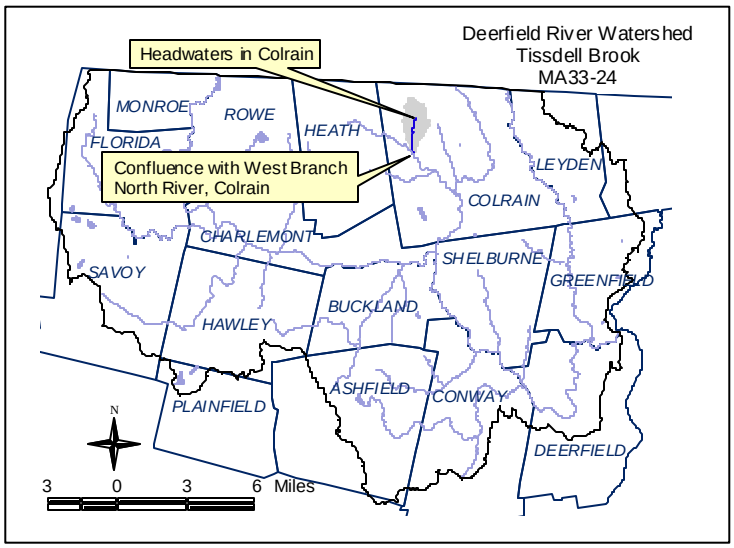
West Branch North River (MA33-27) Use Summary Table

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

RECOMMENDATIONS WEST BRANCH NORTH RIVER (MA33-27)

- Conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005) to more completely assess the status of designated uses. In particular, sampling should include biological monitoring as well as physicochemical, nutrient, and bacteria sampling to address impacts of potential nonpoint sources of pollution and riverbank erosion.
- West Branch and Underwood brooks, tributaries to the West Branch North River should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
- The Towns of Colrain and Heath should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these Towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the West Branch North River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Colrain and Heath should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

TISSDELL BROOK (SEGMENT MA33-24)
Location: Headwaters, west of Christian Hill, Colrain, to confluence with West Branch North River, Colrain.
Segment Length: 1.7 miles.
Classification: Class B.



The drainage area of this segment is approximately 1.73 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	79.7%
Agriculture	13.8%
Residential	5.6%

Tissdell Brook originates on the southern slope of Christian Hill, Colrain. The brook then flows south to its confluence with the West Branch of the North River, approximately 0.75 miles upstream from the Village of Adamsville in the Town of Colrain.

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
One stream reach in Tissdell Brook was sampled by DWM biologists between September 1996 and September 2000. The reach was located approximately 700 m upstream from Adamsville Road in Colrain (Station VP08TIS) and was surveyed as part of the MA DEP Biocriteria Development Project in September 1996, 1997 and 2000. In September 2000 the river was approximately 5 m wide with depths of approximately 0.1 m in the riffle habitat (Appendix B, MA DEP 1996b, and MA DEP 1997). The total habitat assessment score was 164. Habitat was most limited by sediment deposition, channel flow status and lack of instream habitat diversity (i.e., limited velocity/depth combinations).

Biology
As part of the MA DEP Biocriteria Development Project, benthic macroinvertebrate samples were collected by DWM biologists from Tissdell Brook approximately 700 m upstream from Adamsville Road in Colrain Station VP08TIS) on 5 September 1996, 25 September 1997 and 26 September 2000 (Appendix B, MA DEP 1996b, and MA DEP 1997). No RBP III analysis was available from these samples. The fish population in Tissdell Brook (Station VP08TIS) was comprised of multiple age classes of brook trout (*Salvelinus fontinalis*) and slimy sculpin (*Cottus cognatus*) in 1996 and 1997 (MA DEP 1996b and MA DEP 1997). Both fish species are considered intolerant of pollution and are fluvial specialists/dependants, which is indicative of excellent habitat and water quality conditions as well as stable flow regimes.

Chemistry-water
DWM sampled one station on Tissdell Brook approximately 700 m upstream from Adamsville Road in Colrain (Station VP08TIS) on 25 September 1996 and 8 October 1997 as part of the Biocriteria Development Project (Appendix G, Table G3). *In-situ* measurements included; DO, %saturation, pH, temperature, conductivity, and turbidity.

Although the fish community is indicative of excellent water quality and habitat conditions, because of the lack of sufficient water quality and biological data the *Aquatic Life Use* is not assessed for Tissdell Brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Tissdell Brook during any of the three sampling events conducted by DWM biologists as part of the Biocriteria Development Project between September 1996 and September 2000 (Appendix B, MA DEP 1996b, and MA DEP 1997).

Although no bacteria data are available to assess the *Recreational* uses the *Aesthetics Use* is assessed as support.

Tissdell Brook (MA33-24) Use Summary Table

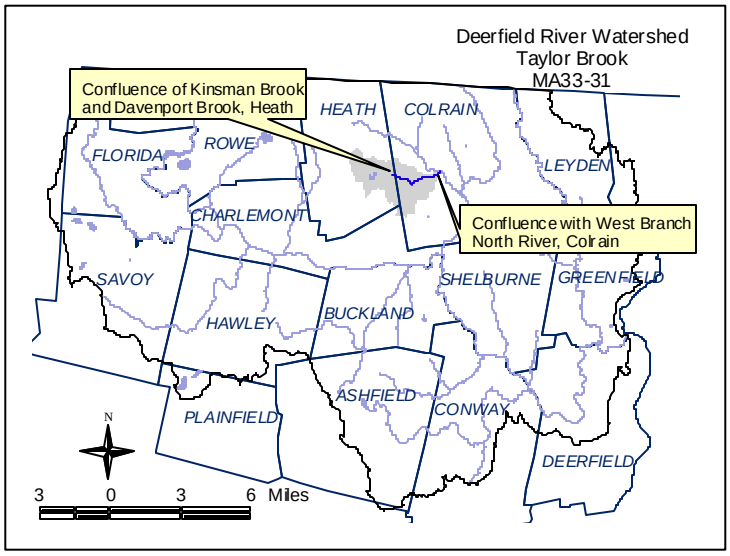
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS TISSDELL BROOK (MA33-24)

- Conduct water quality and biological monitoring in Tissdell Brook during the next monitoring year cycle (2005) to assess the status of designated uses.
- Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
- The Town of Colrain should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project the Town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Tissdell Brook subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Town of Colrain should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

TAYLOR BROOK (SEGMENT MA33-31)

Location: From confluence of Kinsman Brook and Davenport Brook, Heath to the confluence with West Branch North River, Colrain.
Segment Length: 2.6 miles.
Classification: Class B.



The drainage area of this segment is approximately 5.18 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	77.0%
Open land	10.6%
Agriculture	8.0%

Taylor Brook begins at the confluence of Kinsman and Davenport Brooks in the Town of Heath. The brook then flows east to its confluence with the West Branch North River in the Town of Colrain, approximately 0.5 miles downstream from Adamsville.

MA DFWELE has recommended that Taylor Brook and its tributary Kinsman Brook, be protected as cold water fishery habitat (MassWildlife 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

One stream reach in Taylor Brook was sampled by DWM biologists in September 2000 (Appendix B). The reach was located upstream from Heath Road in Colrain (Station TB00). At the time of the survey the brook was roughly 8 m wide with depths ranging from 0.1 m to 0.5 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 157 (Appendix B). Habitat quality was limited most by sediment deposition and the channel flow status. Both banks were well vegetated and the forested riparian zone provided ample stream shading. Instream sedimentation, presumably originating from streambank instability (i.e., erosion) and/or road runoff, was identified as being of concern in this subwatershed by DWM biologists (Appendix B).

Biology

Compared to the Bear River reference station (Station VP11BEA) the RBP III analysis indicated the benthic community was non-impacted in Taylor Brook upstream from Heath Road in Colrain (Station TB00) in September 2000 (Appendix B). Fish species present included slimy sculpin (*Cottus cognatus*), Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis),* white sucker (*Catostomus commersoni)*, longnose sucker (*Catostomus catostomus*), blacknose dace (*Rhinichthys atratulus*), and longnose dace *(Rhinichthys cataractae)* (Appendix B). Five of the species collected are considered to be intolerant of pollution and are all fluvial specialists/dependants. All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

DWM biologists collected periphyton samples from Station TB00 (described above) at the same time as the September 2000 macroinvertebrate/habitat assessment at this station was conducted.

Canopy cover was reported as 100% and percent algal cover was <5%. The dominant algal type and form was greens/thin film. No nuisance algal growth was documented (Appendix D).

> Note: Water quality samples were collected from Davenport Brook (Station DW5), a tributary at the headwaters of Taylor Brook on as many as six occasions between August and November 2000 by ESS (ESS 2002). Although the data were not used to assess Taylor Brook, results are summarized below.
>
> *DO and % saturation*
> Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 10.85 mg/L or 93.2% saturation. Saturation was as high as 99.4%.
>
> *Temperature*
> The maximum instream temperature was 16.2°C.
>
> *pH*
> The pH ranged from 6.7 to 7.1 SU.
>
> *Turbidity*
> Turbidity ranged from 0.29 to 1.57 NTU.
>
> *Conductivity*
> Specific conductivity measurements ranged from 18.5 to 66.9 µS/cm.

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community analysis and the fish population information. The *Aquatic Life Use* for Taylor Brook, however, is identified with an Alert Status because of the instream sedimentation concerns identified by DWM biologists.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

With the exception of some slight turbidity no other objectionable deposits, sheens or conditions were noted during the biological monitoring survey conducted by DWM biologists in Taylor Brook in September 2000 (Appendix B).

> Note: Fecal coliform bacteria samples were collected from Davenport Brook (Station DW5), a tributary at the headwaters of Taylor Brook on six occasions between August and November 2000 by ESS (ESS 2002). This sampling station was selected to evaluate any potential instream impacts due to septic system leachate from Heath Estates. Although the data were not used to assess Taylor Brook, fecal coliform bacteria ranged from <10 to 64 cfu/100 mL.

Although no bacteria data are available to assess the *Recreational uses,* the *Aesthetics Use* is assessed as support for Taylor Brook based on the habitat quality information.

Taylor Brook (MA33-31) Use Summary Table

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

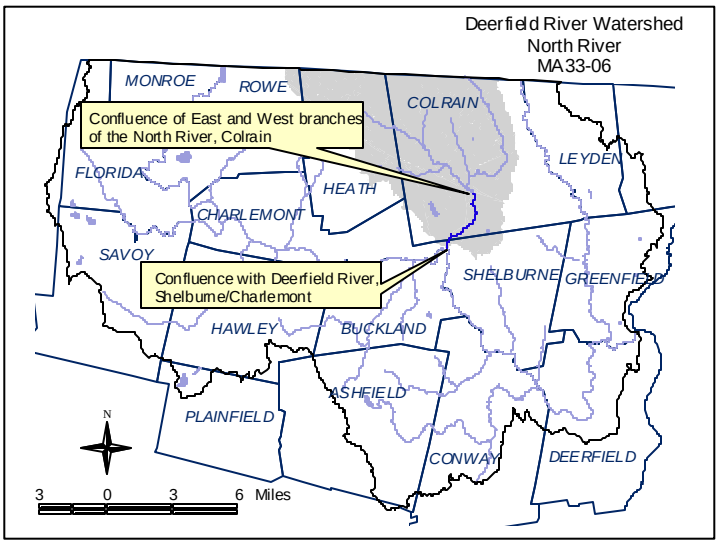
* Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS TAYLOR BROOK (MA33-31)

- While it is possible that the high-gradient nature of Taylor Brook allows for the "flushing through" of sediments before they can be a significant impediment to the integrity of resident biota, assessment of biological impairment related to increased sediment loads here, as well as impacts farther downstream in the West Branch North River, should be conducted during the next monitoring year (2005).
- Pursue 604b/319 or other sources of funding to evaluate and remediate areas of severe streambank erosion.
- Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
- Taylor Brook and its tributary Kinsman Brook should be protected as cold water fishery habitat as recommended by MA DFWELE.
- The Towns of Colrain and Heath should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these Towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Taylor Brook subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Colrain and Heath should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

NORTH RIVER (SEGMENT MA33-06)

Location: Confluence of East and West branches of the North River, Colrain to confluence with Deerfield River, Shelburne/Charlemont.
Segment Length: 3.3 miles
Classification: Class B, Cold Water Fishery



The drainage area of this segment is approximately 48.47 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	83.0%
Agriculture	9.4%
Open Land	3.3%

This segment is on the 1998 303(d) List of Waters for pathogens and taste, odor, and color (Table 2).

The North River is formed by the confluence of the East and West Branches of the North River in Colrain. This reach has been subject to severe erosion due primarily to spring ice jams. The river flows south and somewhat west, paralleling Route 112. A dam impounds the river a short distance below the confluence of the two branches. Below this the river enters the Village of Griswoldville where it receives treated waste, both domestic and industrial, from the BBA Nonwovens Simpsonville Incorporated Wastewater Treatment Facility. The floodplain narrows as the river flows toward its confluence with the Deerfield River. The North River flows by Shattuckville and enters the Deerfield River about a mile downstream, just south of River Road at the Buckland, Charlemont, and Shelburne town lines.

MA DFWELE has recommended that Houghton Brook (also referred to as Albee River), a tributary to the North River, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	PWS ID	WMA Permit #	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
						1998	1999	2000	2001
BBA Nonwovens	N/A	N/A	10306601	North River	0.89	0.37	0.40	0.26	0.22
Shelburne Falls Fire District	1268000	P10326801	10326801	Fox Brook Reservoir-01S Well #1 Replacement-03G Well #2-02G	0.21	0.18	0.18	0.18	0.18

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H1)

BBA Nonwovens Simpsonville, Inc. is authorized (MA0003697 March 2001) to discharge, via outfall # 001, 1.35 MGD of treated industrial and domestic wastewater to the North River. The ammonia-nitrogen concentration shall not exceed 63 lbs/day. The LC_{50} shall be 100% of the effluent. The C-NOEC shall be determined on a sliding scale depending on the quantity of discharge. The C-NOEC shall equal 9% at a discharge of less than or equal to 0.5 MGD. The C-NOEC shall equal 21% at a discharge of less than or equal to 1.35 MGD. The recently issued permit required that BBA Nonwovens, Inc. conduct a "Color evaluation study of wastewater discharge into the North River". The study was found by DWM to adequately address the color issue and that no further color treatment was required (Hogan 2003).

BBA Nonwovens Simpsonville, Inc. is also permitted (MAR05B746) to discharge stormwater to the North River. As part of this permit BBA Nonwovens Simpsonville, Inc. is required to develop a SWPPP (Stormwater Pollution Prevention Plan).

OTHER

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified three historic landfills in this segment; Kendall Mills Sludge Storage Site, Colrain Landfill, and the Slowinski Brush Dump. The Kendall Mills site is over 25 years old and received sludge for several years from the Kendall Mills Textile Plant treatment system. The site is unlined and not capped. The site was recommended for screening level sampling by Fuss and O'Neill (2003) due to its potential to impact sensitive environmental receptors. Sampling of a downgradient spring revealed low levels (below drinking water and surface water criteria) of barium, copper, manganese, and iron in the water. No further action was recommended for this site. The Colrain Landfill received municipal and industrial wastes and has been closed and capped since the late 1990s. Environmental monitoring has been conducted at the site since 1987, including a Comprehensive Site Assessment and post-closure monitoring. Because of extensive monitoring this site was not recommended for screening level sampling as part of the landfill study. The Slowinski Brush Dump received soil and stumps from a road construction project in the mid 1980s. In 1987 test pits were excavated to determine depth to groundwater and presence of an oxide layer. None were observed. The site is closed and was not recommended for screening level sampling by Fuss and O'Neill as part of their study.

Spills

An acid spill into the North River occurred at the BBA Nonwovens facility in September 1999. An extensive fish kill in the North River resulted from the spill of approximately 700 gallons of 93% sulfuric acid (Keller 1999). The reach affected was approximately 3 miles (to the confluence with the Deerfield River). Sodium bicarbonate (12 – 14 tons) was dumped into the river to help neutralize the acid. A Natural Resource Damage settlement was reached in 2003 for damages incurred.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The North River is impounded at the BBA Nonwovens, Inc. dam located just downstream from the confluence of the East and West Branches of the North River. Downstream fish passage is available at this dam. A canal at the dam runs along the eastern side of Route 112 and bypasses approximately 0.6 miles of the North River. The facility currently withdraws water from this canal for use in their plant. According to USGS (remarks noted from their gaging station on the North River near Shattuckville, Colrain - 01169000) diurnal fluctuations at times are caused by the mill upstream but, because storage capacity is small, daily flows are not affected appreciably. Data from the USGS gage revealed that the 2000 annual mean flow (244 cfs) was greater than the mean annual flow for the period of record (63 years) of 187 cfs (Socolow *et. al*. 2001). The estimated 7Q10 flow at the gage is 8.1 cfs (USGS 2003).

The North River was sampled by DWM upstream from the Route 112 bridge (below the Village of Shattuckville) in Colrain (Station NOR01) in September 2000. At the time of the survey the brook was roughly 16 m wide with depths ranging from 0.3 m to 1.0 m. The substrates were comprised primarily of cobble and boulder. The overall habitat score was 187 (Appendix B). The stream banks of this open canopied reach were stable and well vegetated.

Biology

Compared to the Cold River reference station (CR01) the RBP III analysis indicated the benthic community was non-impacted from the North River upstream from the Route 112 bridge (below the Village of Shattuckville) in Colrain (Station NOR01) in September 2000 (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in the North River in 1988 and 1995 (Appendix C). In September 2001, MA DFWELE conducted fish population sampling in the North River between North River and Frankton roads, Shelburne. The fish community was dominated by multiple age classes of Atlantic salmon (*Salmo salar*). One each of rainbow (*Onchorynchus mykiss*), brown (*Salmo trutta*) and brook trout (*Salvelinus fontinalis)* were also collected (Richards 2003). Although all four species present are considered intolerant of pollution, the dominance by Atlantic salmon and relative scarcity of the other salmonids is notable. Sampling efficiency was not specifically documented.

DWM biologists collected periphyton samples from Station NOR01 (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as <1% and percent algal cover was 90%. The dominant algal type and form was blue-greens/thin film. No nuisance algal growth (green filamentous) was documented (Appendix D).

Toxicity

Ambient

Water from this segment was collected approximately 125 feet upstream of the BBA Nonwovens Simpsonville, Inc. treated industrial and domestic wastewater discharge (Outfall #001) in Griswoldville for use as dilution water in the company's whole effluent toxicity tests. Between February 1997 and September 2002 survival of *C. dubia* and *P. promelas* exposed (7-day) to the river water ranged from 90 to 100% in the 21 tests conducted.

Effluent

A total of 21 definitive whole effluent toxicity tests were conducted on the BBA Nonwovens Simpsonville, Inc. effluent (Outfall #001) between February 1997 and September 2002 using *C. dubia* and *P. promelas*. The LC_{50} ranged from 50 to >100% for *C. dubia*. Eight of 21(38%) tests did not meet the permit requirements of LC_{50} = 100%. The whole effluent was not acutely toxic to *P. promelas*. The effluent was chronically toxic to C. dubia with CNOECs ranging from <6.25 to 50% effluent while the CNOEC results for *P. promelas* ranged between 50 and 100% effluent. *C. dubia* was consistently the most sensitive of the two species.

Chemistry-water

Water quality sampling was conducted by DWM in the North River at two locations; one site was located upstream from the BBA Nonwovens outfall at the Adamsville Road bridge in Colrain (Station NR04) and the other was downstream from the discharge near the Route 112 bridge in Griswoldville (Station NR03). These sites were sampled in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9). These two locations were also sampled by DWM in August 1995 (Appendix G, Tables G3 and G4). One additional location in the North River was sampled by DWM approximately 0.3 miles downstream from the USGS gaging station at Shattuckville in Colrain (Station NO) between June 1995 and June 1996 (n = 13 sampling events) (Appendix G, Tables G3 and G4).

Water quality samples were also collected from the North River at the two stations bracketing the BBA Nonwovens discharge (Stations NR04 and NR03, referred to by ESS as DW4 and DW3, respectively) on as many as six occasions between August and November 2000 by ESS (ESS 2002).

The Deerfield River Watershed Association (DRWA) performs volunteer water quality monitoring in this segment of the North River at two locations: upstream fro BBA Nonwovens in Colrain (NOR-010) and downstream from BBA Nonwovens in Colrain (NOR-015). Samples were collected for pH, DO, alkalinity, and temperature once during April in 2001 and 2002. However, due to the limited number of samples the results were not used in this assessment (DRWA 2001 and DRWA 2002).

Water from the North River upstream from the BBA Nonwovens discharge was collected for use as dilution water in the BBA Nonwovens Simpsonville, Inc. whole effluent toxicity tests on 21 occasions between February 1997 and September 2002. Data from these reports (maintained in the TOXTD database) are summarized below.

DO and % saturation

DO levels in the North River measured by DWM and ESS in 2000 were not less than 9.3 mg/L and were as high as 13 mg/L (Appendix A, Table A8 and ESS 2002). Percent saturation ranged from 89.3 to a high of 110%, although supersaturation occurred only once. It should be noted that these data represent both worst-case (pre-dawn) and daytime conditions.

Temperature

The maximum temperature in the North River measured by DWM and ESS in 2000 was 19°C (Appendix A, Table A8 and ESS 2002).

pH and Alkalinity
The pH of the North River upstream from the BBA Nonwovens discharge ranged between 6.5 and 7.8 SU and downstream from the discharge ranged from 6.9 to 7.4 SU (Appendix A, Tables A8 and A9, ESS 2002, and TOXTD database). No effects from the discharge on instream pH were documented. Alkalinity of the North River ranged from 12 to 54 mg/l (Appendix A, Table A9).

Suspended Solids
The highest reported suspended solids concentration in the North River was 18 mg/L (TOXTD). The maximum suspended solids concentration during the 2000 surveys was 5.4 mg/L (Appendix A, Table A9).

Ammonia-Nitrogen
The highest reported ammonia-nitrogen concentration was 0.21 mg/L (TOXTD). None of the measurements exceeded the Water Quality Criteria (WQC).

Total Residual Chlorine
With the exception of one measurement (0.12 mg/L) all of the 20 other TRC measurements were below the minimum quantification level of 0.05 mg/L (TOXTD).

Hardness
Hardness measurements of the North River ranged from 12 to 52 mg/L (Appendix A, Table A9 and TOXTD database).

Phosphorus
Total phosphorus measurements in the North River upstream from the BBA Nonwovens discharge ranged from <0.01 to 0.017 mg/L (Appendix A, Table A9). Downstream from the discharge they ranged from 0.019 to 0.038 mg/L. All of the measurements taken were below 0.05 mg/L.

Chemistry – sediment
Sediment grab samples were collected at Station DWS-6 from behind the BBA Nonwovens dam on the North River in July of 2000 by ESS (ESS 2002). Sediments were analyzed for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, PCB (polychlorinated biphenyls), PAH (polynuclear aromatic hydrocarbons), TPH (total petroleum hydrocarbons), TOC (total organic carbon), percent volatile solids, and percent water. With the exception of arsenic, all analytes fell below the low effects range (L-EL) as defined by Persaud et al. (1993). The arsenic concentration was measured at 12.6 ppm, which is approximately two times greater than the L-EL. Percent volatile solids, PAH, TPH, and PCB all were non-detectable.

The *Aquatic Life Use* for the North River is assessed as support based on the benthic macroinvertebrate community analysis, high survival of test organisms exposed to the river water, the water quality data, and the limited sediment quality data (with the exception of arsenic which was likely elevated due to natural background conditions typical of sediment from New England freshwater rivers (ESS 2002)). Of concern, however, are the whole effluent toxicity (both acute and chronic) in the BBA Nonwovens, Inc. discharge (near field affects from this discharge were not evaluated) and the potential impact on flow in the 0.6-mile reach of the river that is bypassed via a canal. Because of these issues, the *Aquatic Life Use* is identified with an Alert Status.

PRIMARY AND SECONDARY CONTACT RECREATION* AND *AESTHETICS
DWM collected fecal coliform bacteria samples from the North River approximately 0.3 m downstream from the USGS gaging station in Shattuckville in Colrain (Station NO) between June 1995 and June 1996 (n =13) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4).

Fecal coliform bacteria samples were collected from the North River at two stations on six occasions representing both wet and dry weather sampling between August and November 2000 by ESS. Four of the sampling dates fell within the *Primary Contact Recreational Season*.

- Station DW4 located at the bridge just north of Griswoldville on Adamsville Road; fecal coliform bacteria counts ranged from 50 to 180 col/100 mL during all sampling dates.
- Station DW3 located on the North River below BBA Nonwovens, Colrain; fecal coliform bacteria counts ranged from 22 to 240 col/100 mL. The single elevated bacteria count was during a wet weather event in September.

Fecal coliform bacteria sampling was also conducted by the DRWA in the North River at two locations between June and August 2001 and 2002 representing both wet and dry weather (DRWA 2001 and 2002).

- Station NOR-010 located upstream from BBA Nonwovens, Colrain; fecal coliform bacteria counts ranged from 42 to 773 in 2001 and 16 to 236 in 2002 (n = 6 wet and 4 dry weather sampling events).
- Station NOR-002 located just upstream from the confluence with the Deerfield River at Sunburn Beach in Colrain; fecal coliform bacteria counts ranges from 51 to 405 in 2001 and between 31 to 192 in 2002 (n = 7 wet and 4 dry weather sampling events).

No objectionable color (which was identified as a problem during the 1995/1996 Deerfield River surveys), deposits, sheens, odors or other conditions were noted during the biological monitoring survey conducted by DWM biologists in the North River in September 2000 (Appendix B) or by field crews during any of the water quality surveys conducted in 2000.

The *Recreational* and *Aesthetics* uses are assessed as support for North River based on the generally low fecal coliform bacteria counts and the habitat quality information. The *Primary Contact Recreational Use*, however, is identified with an Alert Status because of the slightly elevated bacteria counts documented by ESS and DRWA during wet weather.

North River (MA33-06) Use Summary Table

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

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

RECOMMENDATIONS NORTH RIVER (MA33-06)

- Water quality and biological monitoring should be conducted during the next assessment monitoring year (2005) to continue to assess designated uses. In particular, biomonitoring is recommended here and should include an upstream control station to continue to assess the potential impacts of the industrial discharge and various nonpoint source effects related to agriculture and urban runoff in this portion of the North River subwatershed. In addition to benthic macroinvertebrate biomonitoring, attempts should be made to conduct fish population sampling as well. Due to the wide and deep nature of the NOR01 sampling reach fish population sampling should utilize multiple crews or a barge-mounted electrofishing unit.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program.
- Evaluate the possibility of removing this segment from the 303(d) List for taste, odor and color (water quality monitoring observations do not indicate problem still exists from 1995).
- Houghton Brook (also referred to as Albee River), a tributary to the North River, should be protected as cold water fishery habitat as recommended by MA DFWELE.
- A Natural Resource Damage settlement was reached in 2003 for damages incurred from the acid spill in 1999. Approximately $30,000 will be available for environmental improvements in the watershed. Work with appropriate groups to help determine most effective way(s) to direct this money for environmental protection.
- Work with dam owner (currently BBA Nonwovens) to explore options and funding sources for dam removal.

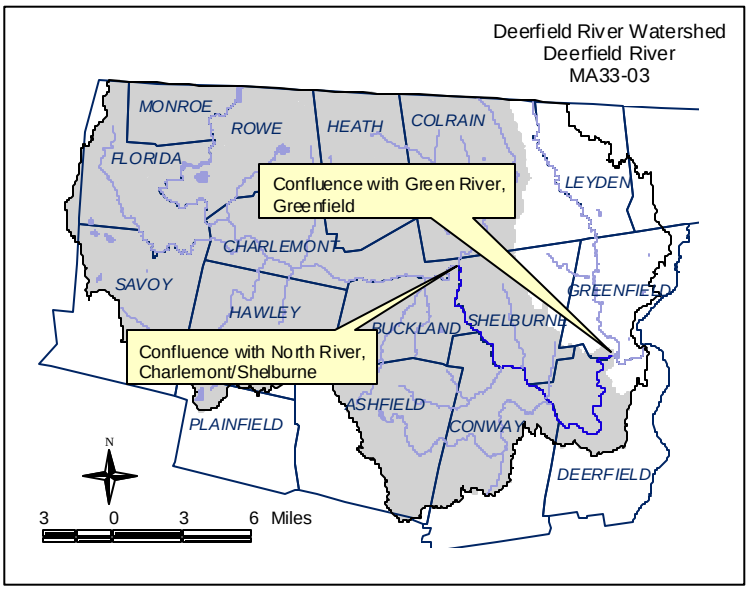
- The Town of Colrain should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the North River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Town of Colrain should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

DEERFIELD RIVER (SEGMENT MA33-03)

Location: Confluence with North River, Charlemont/Shelburne, to confluence with Green River, Greenfield.

Segment Length: 17.0 miles.

Classification: Class B, Warm Water Fishery.



The drainage area of this segment is approximately 291.49 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	83.3%
Agriculture	8.0%
Residential	3.4%

From the confluence with the North River the Deerfield River heads due south through the Towns of Buckland and Shelburne. Then it resumes a southeasterly course passing over three hydroelectric dams in the next three miles. The river continues to form the boundary between Buckland and Shelburne and then Conway and Shelburne and finally Conway and Deerfield before entering Deerfield. In this stretch the river is joined by the Bear and South Rivers. In Deerfield the river enters a broad valley where the bedrock changes from metamorphic and igneous rock to sedimentary sandstone and shale. The velocity in this stretch slows due to low gradient and backwater from the Connecticut River. As the river passes under Route 91 it meanders north again through South and North Meadows, paralleling the highway. At the border between Deerfield and Greenfield the river turns east again and is joined by the Green River near the golf course in south Greenfield.

MA DFWELE has recommended that two tributaries to this segment of the Deerfield River, Sluice and Hawks brooks, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	PWS ID#	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
					1998	1999	2000	2001
Deerfield Fire District	1074000	10307401	Harris Spring-04G Keats Spring-02G Stillwater Spring-06G Stillwater Well-05G Wells Spring-03G* GP Well Rt. 5/ Wapping Well-01G	0.1	0.12**	0.13**	0.15**	0.19**
Savage Farms Inc.		10307403	Savage Farm #1 Savage Farm #2 Savage Farm #3 Savage Farm #4	0.29	0.04	0.07	0.01	0.1
Williams Farm Inc.		10307402	Williams Farm #1 Williams Farm #2 Williams Farm #3 Williams Farm #4	0.08	Not reported	0.12**	0.01	0.12**

*This source (Wells Spring-03G) is located in the Connecticut River Basin (Segment MA34-04), **withdrawal did not exceed registration amount by more than 0.1MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H1, H2, AND H4)

USGenNE is authorized to discharge at the Deerfield No.4 Station via three outfalls to the Deerfield River in Buckland (NPDES permit MA0034860 issued in September 1997). The discharges are as follows:

- Outfall 001: 0.0015 MGD of floor drain water,
- Outfall 002: 0.06 MGD transformer cooling water, and
- Outfall 003: 0.0216 MGD bearing cooling water.

USGenNE is authorized to discharge at the Deerfield No.3 Station via four outfalls to the Deerfield River in Buckland (NPDES MA0034851 permit issued in September 1997). The discharges are as follows:

- Outfall 001: 0.0015 MGD of internal facility drainage,
- Outfall 002: 0.06 MGD transformer non-contact cooling water,
- Outfall 003: 0.0216 MGD bearing contact cooling water, and
- Outfall 004: 0.0432 MGD cooling water strainer backwash.

USGenNE is authorized to discharge at the Deerfield No.2 Station via four outfalls to the Deerfield River in Buckland (NPDES MA0034843 permit issued in September 1997). The discharges are as follows:

- Outfall 001: 0.0015 MGD of internal facility drainage,
- Outfall 002: 0.06 MGD non-contact transformer cooling water,
- Outfall 003: 0.0216 MGD bearing cooling water, and
- Outfall 004: 0.0432 MGD cooling water strainer backwash.

Consolidated Edison Energy Massachusetts, Inc. is authorized to discharge from the Gardner Falls Station (NDPES permit MA0035670 issued in September 1997) to the Deerfield River near the Deerfield No. 3. canal discharge in Buckland. The discharges are as follows:

- Outfall 001: 0.00864 MGD of bearing cooling water, and
- Outfall 002: 10 GPD boiler blowdown (90°F maximum).

The Town of Buckland is authorized to discharge from the Shelburne Falls Wastewater Treatment Facility to the Deerfield River off of Gardner Falls Road in Buckland (NPDES permit MA0101044 issued in December 2003). The permittee is authorized to discharge 0.25 MGD of treated sanitary wastewater via Outfall 001. The facility's acute whole effluent toxicity limits are $LC_{50} \geq 50\%$ with a monitoring frequency of twice per year. The facility utilizes chlorine for disinfection (TRC shall not exceed 1 mg/L).

The Town of Deerfield is authorized to discharge from the Old Deerfield Wastewater Treatment Facility to the Deerfield River off of Little Meadow Road in Deerfield (NPDES permit MA0101940 issued in December 2003). The permittee is authorized to discharge 0.25 MGD of treated sanitary wastewater via Outfall 001. The facility's acute whole effluent toxicity limits are $LC_{50} \geq 50\%$ with a monitoring frequency of twice per year. The facility utilizes chlorine for disinfection (TRC shall not exceed 1 mg/L).

OTHER

Hydropower (Federal Energy Regulatory Commission - FERC)

The Deerfield River Hydroelectric System along this segment of the Deerfield River is comprised of two FERC licensed projects; one owned by USGenNE, Inc. (FERC L.P. No. 2323) and the second owned by Consolidated Edison Energy Massachusetts, Inc. (FERC L.P. No. 2334). FERC L.P. No. 2323 consists of three developments in Vermont and five developments in Massachusetts, two of which are located in this segment of the Deerfield River and one which straddles this segment and the upstream Segment MA33-02). The FERC license for project No. 2323 was reissued in April 1997. There is one development on this segment of the Deerfield River authorized by FERC L.P. No. 2334 (This license was issued in 1997.).

- The most upstream hydropower development in this segment of the Deerfield River is the outfall from the Deerfield No. 4 development FERC L.P. No. 2323. The Deerfield No. 4 Development is located on the Deerfield River in Buckland/Charlemont (Segment MA33-02). This development has a power tunnel that conveys water from the intake structure at the impoundment via a 12.5-foot diameter, 1,514 feet long concrete and brick-lined horseshoe-shaped tunnel to a powerhouse. The powerhouse contains three horizontal Francis turbine units with a capacity of 1,600 KW each and a total hydraulic capacity of 1,490 cfs (FERC 1997). The power canal tunnel cuts through a bend in the river, which bypasses approximately 1.4 miles of the Deerfield River (the lower 0.9 miles of Segment MA33-02 and the upper 0.5 miles of this segment). A minimum flow of 100 cfs or inflow, whichever is less, is required from 1 October to 31 May and 125 cfs or inflow, whichever is less, is required from 1 June to 30 September at this development to the mainstem Deerfield River.
- The second development in this segment of the Deerfield River is the Deerfield No. 3 Development in Buckland/Shelburne located approximately 1.3 miles downstream from the outfall of the No. 4 Development. Deerfield No. 3 Development, also authorized by FERC L.P. No. 2323, includes a concrete dam 475 feet long, 15 feet high topped with six-foot-high wooden

flashboards that can impound a surface area of about 42 acres (FERC 1997). This development has a 677 -foot long (0.1 mile) power canal located to the west of the Deerfield River. Water from the Deerfield No. 3 Dam is diverted into the power canal and is conveyed to the powerhouse that holds three horizontal Francis turbine units with a capacity of 1,600 KW each, and a total hydraulic capacity of 1,490 cfs. The power canal bypasses approximately 0.4 miles of the Deerfield River. A minimum flow of 100 cfs or inflow, whichever is less, is required at this development year round. This facility is also obligated to provide downstream fish passage.

- The third development in this segment of the Deerfield River is the Gardner Falls Project, which is located on the Deerfield River in Buckland/Shelburne approximately 0.9 miles downstream from the Deerfield No. 3 Dam. This facility operates under FERC L.P. No. 2334. The development consists of a dam that is 30 feet high and 337 feet long and impounds about 0.6 miles of river with a surface area of approximately 21 acres. Water from the dam is diverted to the powerhouse via a 1,300 feet long (0.25 mile) power canal located to the west of the Deerfield River. The power canal bypasses approximately 0.3 miles of the Deerfield River. The powerhouse contains four turbine-generator units with a total generating capacity 3.58 MW. The total hydraulic capacity of these turbines is 1520 cfs. A minimum flow of 150 cfs or inflow, whichever is less, is required to be released to the mainstem Deerfield River at this development year-round. This facility is also obligated to provide downstream fish passage. Flows necessary for the operation of this fish bypass (150 cfs) should be provided during the periods of downstream migration (1 April to 15 June and 15 September to 15 November).
- The fourth development in this segment of the Deerfield River is the Deerfield No. 2 Development in Conway/Shelburne located approximately 1.9 miles downstream from the Gardner Falls Project Dam. Deerfield No. 2 Development, also authorized by FERC L.P. No. 2323, includes a concrete dam 447 feet long, 70 feet high topped with six-foot-high wooden flashboards and four sluice gates that can impound about 1.5 miles of the river with a surface area of about 63.5 acres (FERC 1997). There is a powerhouse located adjacent to the Deerfield No.2 Dam, which contains three horizontal Francis turbine units with a capacity of 1,600 KW each and a total hydraulic capacity of 1450 cfs. A minimum flow of 200 cfs is required year-round. This development is also required to provide downstream fish passage. Upstream passage of adult Atlantic salmon will be required in the future if the target return threshold of four adult salmon has been attained for two consecutive years at the dam.

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified seven historic landfills in this segment: Buckland Wood and Demolition Landfill, Lampson & Goodnow Manufacturing Company, Former Buckland Landfill, Former Conway/Buckland Landfill (Shelburne Town Landfill), Greenfield Landfill, Greenfield Tire Pile, Shelburne Stump/Brush Dump. These sites can be summarized as follows.

- The Buckland Wood and Demolition Landfill is over 25 years old and received demolition waste, including asbestos. The landfill is capped but not lined. It lies within 500 feet of the Deerfield River and one half mile of a public water supply and an Interim Wellhead Protection Area (IWPA). Fuss and O'Neill (2003) recommended this site for screening level sampling due to its proximity to and potential to impact sensitive environmental receptors. Issues identified from this study included exposed brush, bulky waste, tires and miscellaneous household waste on a steep slope, groundwater seeps with discoloration and oily sheen at the base of the landfill, which is hydraulically connected to the Deerfield River via a small unnamed tributary. This tributary contained elevated levels of cadmium and manganese and high pH.
- The Lampson & Goodnow site is over 25 years old. This company manufactures cutlery. A former waste disposal area is believed to be located behind the manufacturing building adjacent to the Deerfield River. Since this was never an officially recognized landfill no information exists in MA DEP's files. Fuss and O'Neill (2003) recommended this site for screening level sampling due to its proximity to and potential to impact sensitive receptors. Results from a soil sample collected at the location of the former process discharge indicate a chromium concentration of approximately 35,200 mg/kg, which exceeds the Massachusetts Reportable Concentration value of 1,000 mg/kg.

- The Former Buckland Landfill is over 25 years old and accepted municipal solid waste and possibly industrial waste from Lampson & Goodnow. No daily cover was used and open burning occurred. The Buckland WWTP was constructed in 1974 on top of this site. There is a public water supply and an IWPA within one-half mile and the Deerfield River is about 100 feet away. The site was recommended for screening level sampling by Fuss and O'Neill (2003) due to its proximity to and potential to impact sensitive receptors. Sampling revealed no visual evidence of exposed refuse, erosion or litter. A downgradient groundwater seep exhibited only minor exceedances of the Massachusetts Drinking Water Standard for iron and manganese, both of which are naturally-occurring metals. Most of the tested parameters were non-detect. Additional investigation of the site was not recommended.
- The Former Conway/Buckland Landfill (Shelburne Town Landfill) is also over 25 years old and received municipal solid waste. The landfill is not lined, but it is capped. The site lies on a steep hill on the banks of the Deerfield River and is within one-half mile of a public water supply and an IWPA. The site was recommended for screening level sampling due to its proximity to and potential to impact sensitive environmental receptors. Sampling revealed a large area with a significant quantity of exposed refuse on a very steep slope. Bulky waste is scattered up to 200 feet downgradient of the base of the landfill. Groundwater seeps contained elevated levels of lead, cadmium, copper, and mercury, based on the results of a screening level seep sample. Surface drainage does not appear to be impacted by landfill leachate based on the results of the surface water sample collected from the drainage ditch outfall pipe.
- The Greenfield Landfill is well over 25 years old – the site has been used for municipal solid waste disposal since 1928. It has also accepted, over the years, industrial waste (some hazardous), sludge from the Greenfield WWTP, ash, petroleum contaminated soils, wood waste, and asbestos. The site is capped and partially lined. Extensive environmental monitoring has been conducted at the site since 1982. Consequently, the site was not recommended for screening level sampling by this study.
- The Greenfield Tire Pile site is comprised of approximately 3,000 to 4,000 tires that lie in a ravine along the banks of the Deerfield River. Screening level sampling was not recommended for this site.
- The Shelburne Stump/Brush Dump is less than 25 years old and was used for disposal of wood waste, demolition material, household appliances and refuse, tires and metal. It is capped but not lined. It was not recommended for screening level sampling under this study.

USE ASSESSMENT SUMMARY

AQUATIC LIFE

Habitat and Flow

Please refer to the earlier descriptions of flow regulation imposed by the hydroelectric power developments in this segment.

According to USGS (remarks noted from their gaging station records on the Deerfield River near West Deerfield - 01170000) flows are regulated by Somerset Reservoir, since 1924 by Harriman Reservoir, and by several hydro-electric powerplants upstream. The drainage area at this gage is 557 mi^2. Data from the USGS gage revealed that the 2000 water year annual mean flow (1,709 cfs) was greater than the mean annual flow for the 96-year period of record (1,318 cfs) (Socolow *et al*. 2001). The estimated 7Q10 flow at the gage is 95.6 cfs (USGS 2003). With the renewed FERC licenses now in place for the hydropower projects upstream from the gage this estimate should increase because of the 200 cfs minimum flow required at the Deerfield No. 2 Project.

The Deerfield River was sampled by DWM downstream from Stillwater Bridge in Deerfield (Station LDR01) in September 2000. At the time of the survey the river was roughly 35 m wide with depths ranging from 0.3 to $\geq$1.0 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 192 (Appendix B). Habitat quality was limited most by velocity/depth combinations.

Biology

Compared to the Cold River reference station (Station CR01) the RBP III analysis indicated the benthic community was non-impacted in the Deerfield River downstream from Stillwater Bridge in Deerfield (Station LDR01) in September 2000 (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in 1988 and 1995 (Appendix C).

DWM biologists collected periphyton samples from Station LDR01, located downstream from Stillwater Bridge, Deerfield, at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 50% percent and algal cover was 90%. The dominant algal type and form were greens/thin film. No nuisance algal growth (filamentous green algae) was documented (Appendix D).

Toxicity

Ambient

Water from the Deerfield River was collected approximately 300 feet upstream from the Shelburne Falls Wastewater Treatment Facility discharge (Outfall #001) in Shelburne for use as dilution water in the facility's whole effluent toxicity tests. Eleven acute toxicity tests using *C. dubia* and *P. promelas* were conducted between April 1998 and April 2003. Survival of both test organisms exposed (48-hours) was greater than 90% in all tests conducted.

Water from the Deerfield River was collected approximately 250 feet upstream from the Old Deerfield Wastewater Treatment Plant discharge (Outfall #001B) in Deerfield for use as dilution water in the facility's whole effluent toxicity tests. Survival of *C. dubia* exposed (48-hours) to the river water was not less than 90% in the 13 tests conducted between October 1996 and 2002.

Effluent

Eleven definitive acute whole toxicity tests were conducted on the Shelburne Falls Wastewater Treatment Facility effluent using *C. dubia* and *P. promelas* between April 1998 and April 2003. The effluent was not acutely toxic (LC_{50} >100%) to either species during this period.

A total of 13 definitive acute whole effluent toxicity tests were conducted on the Old Deerfield WWTF effluent using *C. dubia* between October 1996 and October 2002. The effluent was not acutely toxic (LC_{50} >100%) to *C. dubia* during this period.

Chemistry-water

Water from the Deerfield River was collected approximately 300 feet upstream from the Shelburne Falls WWTP discharge for use as dilution water for the facility's whole effluent toxicity tests, as required by their NPDES permit, on 11 occasions between April 1998 and April 2003. Water from the Deerfield River was collected approximately 250 feet upstream from the Old Deerfield WWTP discharge for use as dilution water for the facility's whole effluent toxicity tests, as required by their NPDES permit, on 13 occasions between October 1996 and October 2002. Data from these reports, which are maintained in the TOXTD database by DWM, are summarized for the period indicated in parentheses below.

Water quality sampling was conducted by DWM at one location from this segment of the Deerfield River (approximately 2000 feet downstream from the Stillwater Bridge in Deerfield – Station LD) monthly between June 1995 and April 1996 (n = 13). These data are presented in Appendix G, Tables G3 and G4.

Water quality samples were also collected from the Deerfield River just upstream of the confluence with the Green River in Greenfield (station DW12) on as many as six occasions between August and November 2000 by ESS (ESS 2002).

The Deerfield River Watershed Association (DRWA) performs volunteer water quality monitoring for pH, DO, alkalinity, and temperature in this segment of the Deerfield River at two stations: upstream from the Gardner Falls Hydroelectric Project, Buckland (DER-016) and near the Stillwater Bridge in

West Deerfield (DER-015). Samples were collected once during April in 2001 and 2002. However, due to the limited number of samples the results were not used in this assessment (DRWA 2001 and DRWA 2002).

DO and % saturation
DO in the Deerfield River just upstream from the confluence with the Green River in Greenfield (Station DW12) measured by ESS in 2000 ranged from 9.28 to 11.78 mg/L and saturation was not less than 83.3% during the sampling events conducted. It should be noted that these data do not represent worst-case conditions.

Temperature
The maximum temperature in this segment of the Deerfield River recorded by ESS in 2000 was 20.5°C (ESS 2002).

pH and Alkalinity
The pH of the Deerfield River upstream from the Shelburne Falls WWTF discharge (recorded in the TOXTD database between April 1998 and April 2003) ranged between 6.2 and 7.6 SU (only one of the 11 measurements reported was less than 6.5 SU) and upstream from the Old Deerfield WWTP discharge ranged from 6.5 to 7.7 SU (recorded in the TOXTD database between October 1996 and October 2002). Alkalinity measurements upstream from Shelburne Falls WWTF ranged from 10 to 60 mg/L and upstream from the Old Deerfield WWTP discharge ranged from 7 to 82 mg/L. The pH of the Deerfield River just upstream from the mouth of the Green River (Station DW12) ranged from 6.8 to 7.0 SU (ESS 2002).

Specific Conductance
Conductivity measurements in the Deerfield River upstream from the Shelburne Falls WWTF discharge (recorded in the TOXTD database between April 1998 and April 2003) ranged between 53 and 75 µS/cm and upstream from the Old Deerfield WWTP discharge ranged from 53 to 136 µS/cm (recorded in the TOXTD database between October 1996 and October 2002). Measurements in the river near the confluence with the Green River (Station DW12) ranged from 54.2 to 90.3 µS/cm (ESS 2002).

Suspended Solids
The highest reported suspended solids concentration in this segment of the Deerfield River was 22 mg/L (recorded in the TOXTD database for Shelburne Falls WWTF and Old Deerfield WWTP).

Ammonia-Nitrogen
The highest reported ammonia-nitrogen concentration in this segment of the Deerfield River was 0.2 mg/L (recorded in the TOXTD database for Shelburne Falls WWTF and Old Deerfield WWTP). None of the measurements exceeded the WQC.

Total Residual Chlorine
None of the 24 TRC measurements recorded in the TOXTD database for Shelburne Falls WWTF and Old Deerfield WWTP were above the minimum quantification level of 0.05 mg/L (TOXTD).

Hardness
Hardness measurements upstream from the Shelburne Falls WWTF discharge (recorded in the TOXTD database between April 1998 and April 2003) ranged between 12 and 60 mg/L and upstream from the Old Deerfield WWTP discharge ranged from 11 to 36 mg/L (recorded in the TOXTD database between October 1996 and October 2002). Only four of the 24 hardness measurements were greater than 25 mg/L.

Chemistry - sediment
Three sediment grab samples were collected and composited from three locations on this segment of the Deerfield River in July of 2000 by ESS (ESS 2002). The sediment sample was analyzed for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, PCB (polychlorinated biphenyls), PAH (polynuclear aromatic hydrocarbons), TPH (total petroleum hydrocarbons), TOC (total organic

carbon), percent volatile solids, percent water, and grain size. The sampling station locations and the results of these analyses are summarized as follows.

- Station DWS-3 - behind USGenNE's Deerfield No.3 Dam in Buckland/Shelburne. With the exception of arsenic, all analytes fell below the low effects range (L-EL) as defined by Persaud et al. (1993). The arsenic concentration was measured at 10.7 ppm, which is approximately 1.8 times greater than the L-EL. The sediment was comprised primarily of medium sand (72%) and fine sand (19.6%). No PAH, TPH, VS or PCB were detected.
- Station DWS-4 - behind ConEdison's Gardner Falls Dam in Buckland/Shelburne. With the exception of arsenic and lead, all analytes fell below the low effects range (L-EL) as defined by Persaud et al. (1993). The arsenic concentration was measured at 10.3 ppm, which is approximately 1.7 times greater than the L-EL and the lead concentration was measured at 43.5 ppm, which is approximately 1.4 times greater than the L-EL, although the replicate lead analysis was low (8.5 ppm). The sediment was comprised primarily of medium sand (70%) and fine sand (21.6%). TPH were detected (41 ppm). No PAH, VS or PCB were detected.
- Station DWS-5 - behind USGenNE's Deerfield No.2 Dam in Conway/Shelburne. With the exception of arsenic, all analytes fell below the low effects range (L-EL) as defined by Persaud et al. 1993. The arsenic concentration was measured at 16.3 ppm, which is approximately 2.7 times greater than the L-EL. The sediment was comprised primarily of fine sand (69.1%) and silt and clay (17.9%) and the total volatile solids was 2.2% by weight. No PAH, TPH, or PCB were detected.

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community analysis, high survival of test organisms exposed to the river water, the water quality data, and with the exception of arsenic, the limited sediment quality data. The concentration of arsenic in sediment samples collected behind the Deerfield No.3 Gardner Falls, and Deerfield No.2 dams in this segment of the Deerfield River were slightly elevated, but is due likely to natural background conditions typical of sediment from New England freshwater rivers (ESS 2002). This use, however, is identified with an Alert Status because of concerns reported to the Deerfield River Watershed Team from river users regarding flow regulation (hydromodification) resulting from the operations of the hydroelectric generating facilities (EOEA 2001, 2002, 2003 and 2004). It is USGen New England, Inc.'s first priority to continue to operate hydro facilities on the Deerfield River in accordance with the FERC licenses, the Offer of Settlement and the Massachusetts Water Quality Certificate. However, the effect, if any, of the hydropower generating developments on instream habitat and aquatic life is of concern and merits further investigation.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria approximately 2000 feet downstream from the Stillwater Bridge in Deerfield (Station LD) between June 1995 and June 1996 (n = 11) (Appendix G, Table G4).

Fecal coliform bacteria sampling was conducted by the DRWA at five locations in this segment of the Deerfield River between June and August 2001 and 2002 (DRWA 2001 and DRWA 2002).

- At the glacial potholes in Shelburne Falls (Station DER-018) (n = 5 wet weather and 4 dry weather sampling events). Fecal coliform counts at this station ranged from 39 to 600 colonies/100 mL (only one wet weather sample exceeded 400).
- At Wilcox Hollow in Shelburne (Station DER-019) (n = 6 wet weather and 4 dry weather sampling events). Fecal coliform counts at this station ranged from 6 to 400 colonies/100 mL.
- At South River confluence in Conway (Station DER-014) (n = 6 wet weather and 5 dry weather sampling events). Fecal coliform counts at this station ranged from 8 to 800 colonies/100 mL (three counts exceeded 400, all associated with wet weather).
- At Stillwater in Deerfield (Station DER-015) (n = 5 wet weather and 4 dry weather sampling events). Fecal coliform counts at this station ranged from 12 to 740 colonies/100 mL (only one count exceeded 400 and was associated with wet weather).
- At Deerfield Academy in Deerfield (Station DER-012) (n = 4 wet weather and 4 dry weather sampling events). Fecal coliform counts at this station ranged from 17 to 114 colonies/100 mL.

The geometric mean calculated for the fecal coliform data at each of these five stations never exceeded 200 colonies/100 mL.

Fecal coliform bacteria samples were also collected from the Deerfield River just upstream from the confluence with the Green River in Greenfield (Station DW12) on six occasions between August and November 2000 by ESS representing both dry and wet weather conditions (ESS 2002). Four of the six samples were collected during the *Primary Contact Recreation Season.* Fecal coliform bacteria counts ranged from 10 to 80 colonies/100 mL.

No objectionable deposits, odors, turbidity, or other conditions were noted by DWM biologists in 2000 (Appendix B). While turbidity has often been observed in the Deerfield River during high spring flows and after rain events, these conditions were generally considered to be a natural result of the soil types in the watershed (Averill 2002).

The *Recreational* and *Aesthetics* uses are assessed as support for Deerfield River based on the fecal coliform bacteria counts and the aesthetic conditions. The *Primary Contact Recreational Use*, however, is identified with an Alert Status because of episodic elevated bacteria counts documented by DRWA during wet weather particularly at the confluence with the South River.

Deerfield River (MA33-03) Use Summary Table

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

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

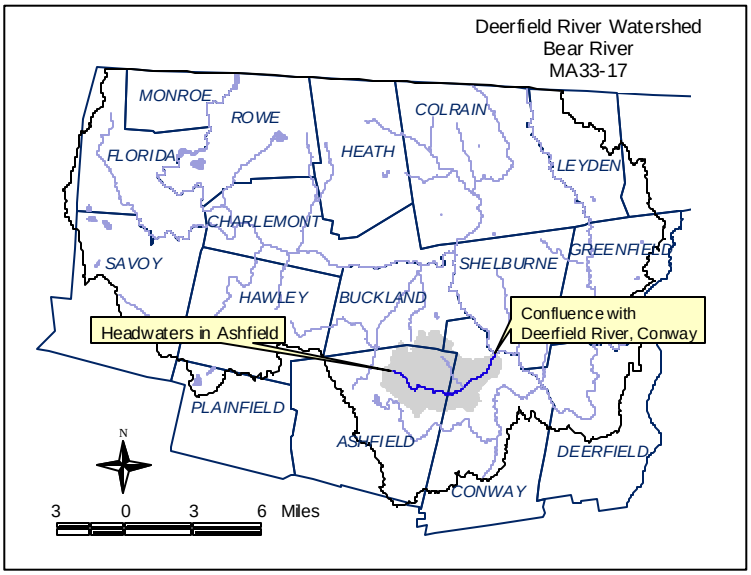
RECOMMENDATIONS DEERFIELD RIVER (MA33-03)

- Continue DWM water quality and biological monitoring in this segment during the next assessment monitoring year (2005). In particular, biomonitoring is recommended here to continue to assess biological health in this lower portion of the Deerfield River. Fish population sampling should accompany the macroinvertebrate sampling effort and will require multiple crews or a barge mounted electrofishing unit. Bacteria monitoring to isolate the source(s) of episodic elevated fecal coliform counts is also recommended.
- Address concerns voiced by members of the Deerfield Watershed Team that habitat and fish downstream of Deerfield Dam No. 2 may be affected by frequent water level changes and rapid ramping rates that result from hydropower production. Conduct biological surveys designed to assess impacts of hydroregulation on aquatic biota and/or pursue funding for USGS to study the effects of fluctuating water levels created by hydro-peaking on fish communities and other stream biota (Deerfield Team's FY '04 workplan priority project.)
- Work with USGen New England Inc. and settlement parties (including Massachusetts Executive Office of Environmental Affairs, Attorney General, MA DEP, MA DCR, MA DFG, US Fish and Wildlife Service, New England F.L.O.W., Trout Unlimited, and the Deerfield River Watershed Association) to ensure that releases from the hydropower dams are meeting the requirements of the FERC licenses, the Offer of Settlement, and the Massachusetts Water Quality Certification requirements.
- Two tributaries to this segment of the Deerfield River, Sluice and Hawks brooks, should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by DRWA, CRWC, Zoar Outdoor and Trout Unlimited.
- Work with NRCS, Massachusetts Department of Agricultural Resources and landowners to protect riparian buffers and encourage use of agricultural BMPs.
- The Towns of Buckland, Shelburne, Conway, Greenfield, and Deerfield should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with

other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.

- In order to prevent degradation of water quality in this segment of the Deerfield River it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The towns should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- As part of the five-year review process, MA DEP should continue to carefully monitor Deerfield Fire District's compliance with their WMA registration limit (close to exceeding registration threshold).
- Support the recommendations of the Fuss and O'Neill (2003) landfill assessment study.
  - For management of the Buckland Wood and Demolition Landfill additional field investigation is recommended to further assess the environmental risk posed by the landfill, identify and characterize the extent of any impacts that may be present, and determine the need for corrective/remedial action. Field measurement of hydraulic conductivity, depth to groundwater, confirmation of groundwater flow rate and direction, and collection of upgradient and downgradient groundwater samples and additional seep sampling should be performed.
  - For the Lampson & Goodnow site additional investigation is recommended to address potential contamination associated with the former process wastewater discharge and identified waste disposal area behind the manufacturing building. The vertical and lateral extent of impacted soils in the area should be delineated and remedial alternatives should be identified. Additional inspection and sampling of the historical waste disposal area is also recommended to further identify the nature and extent of the waste.
  - At the Former Conway/Buckland Landfill additional field investigation is recommended to further assess the environmental risk posed by the landfill, to identify and characterize the extent of any impacts that may be present, and to determine the need for corrective action. Field measurement of hydraulic conductivity, depth to groundwater, confirmation of groundwater flow rate and direction, and collection of upgradient and downgradient groundwater samples and additional seep sampling should be performed.
  - The Greenfield tire pile is now serving as a crude form of bank stabilization, but due to its size and proximity to the Deerfield River the tire pile should be removed and the ravine should be stabilized to reduce the potential for erosion and sedimentation in the Deerfield River. This effort should be coordinated with the Greenfield Board of Health and the property owner.

BEAR RIVER (SEGMENT MA33-17)
Location: Headwaters, west of Barnes Road, Ashfield, to confluence with Deerfield River, Conway.
Segment Length: 6.9 miles.
Classification: Class B.



The drainage area of this segment is approximately 11.78 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	79.2%
Agriculture	11.7%
Open Land	4.9%

The headwaters of the Bear River begin in Ashfield just east of Ridge Hill. The newly formed river flows through a golf course, where it is impounded, and then continues in a southeasterly direction until it passes into Conway. There it changes direction, flowing to the northeast. After passing under the Shelburne Falls Road the river enters a very steep valley before its confluence with the Deerfield River in Conway.

MA DFWELE has proposed that the Bear River be protected as a cold water fishery habitat (MassWildlife 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

The Bear River was sampled by DWM upstream of Shelburne Falls Road in Conway (Station VP11BEA) in September 2000. At the time of the survey the river was roughly 10 m wide with depths ranging from 0.1 m to 0.5 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 176 (Appendix B). Habitat quality was limited most by the small riparian zone width on the right bank and some limitations related to velocity/depth combinations.

Biology

The benthic sample collected by DWM from the Bear River upstream from Shelburne Falls Road in Conway (Station VP11BEA) in September 2000 was used as the reference station condition for the 2000 Deerfield River Watershed Biomonitoring Survey (Appendix B). Given its status as a reference condition the benthic community was considered to be non-impacted. Macroinvertebrate biomonitoring was also conducted at this station in the Bear River (Station BR01) in 1995 (Appendix C). As part of the MA DEP Biocriteria Development Project benthic macroinvertebrate samples were also collected by DWM biologists from the Bear River upstream of Shelburne Falls Road in Conway (Station VP11BEA) on 6 September 1996, 24 September 1997 (MA DEP 1996b and MA DEP 1997).

The fish population in the Bear River was sampled upstream and downstream from the confluence of Drakes Brook near Shelburne Falls Road, Conway (Stations VP12BEA and VP11BEA, respectively), in September 1996 as part of the Biocriteria Development Project (MA DEP 1996b and MA DEP 1997). Sampling upstream of the confluence (Station VP12BEA) resulted in the collection of brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), blacknose dace (*Rhinichthys atratulus*), slimy sculpin (*Cottus cognatus*) and Atlantic salmon (*Salmo salar)*. Multiple age classes of Atlantic salmon, brook and brown trout were present. These same species, less the slimy sculpin, were documented

in sampling conducted on 25 September 1997. The fish sample at VP11BEA in September 1996 and September 1997 was comprised of longnose dace *(Rhinicthys cataractae)*, slimy sculpin, blacknose dace, Atlantic salmon, creek chub *(Semotilus atromaculatus)*, brook trout and brown trout. Multiple age classes of Atlantic salmon and brook trout were collected. Four species are considered intolerant of pollution (MA DEP 1996b and MA DEP 1997). All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes. MA DFWELE also conducted fish population sampling in the Bear River at two locations upstream from Drakes Brook in August 2000. Brook trout, blacknose dace, Atlantic salmon, brown trout, longnose dace and pumpkinseed (*Lepomis gibbosus)* were present with multiple age classes present. In August 2001 Atlantic salmon, brook trout, brown trout (all with multiple age classes) were present (Richards 2003).

DWM biologists collected periphyton samples from Station VP11BEA, located upstream approximately 100 m from Shelburne Falls Road, at the same time as the September 2000 survey. Canopy cover was reported as 75% and percent algal cover was 50%. The dominant algal type and form were greens/filamentous, thin film. No nuisance algal growth (green filamentous algae) was documented. (Appendix D)

Chemistry-water

In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of the Bear River upstream from the confluence with Drakes Brook and downstream from the confluence with Pea Brook in Conway (Stations VP12BEA and VP11BEA, respectively) were made on 17 September 1996 and 25 September 1997 as part of the MA DEP Biocriteria Development Project (Appendix G, Table G3). DWM also collected water quality samples from the Bear River upstream from the bridge on Shelburne Falls Road in Conway (Station BE) between July 1995 and June 1996 (n = 12) and two upstream locations (Station BR03 and BR02) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Tables G3 and G4).

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community (reference station) and fish population information.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from the Bear River upstream from the bridge on Shelburne Falls Road in Conway (Station BE) between July 1995 and June 1996 (n = 12) and two upstream locations (Stations BR03 and BR02) as part of the 1995/1996 Deerfield 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 surveys in the Bear River in 1996, 1997 or 2000.

Although too limited current bacteria data are available to assess the recreational uses the *Aesthetics Use* is assessed as support.

Bear River (MA33-17) Use Summary Table

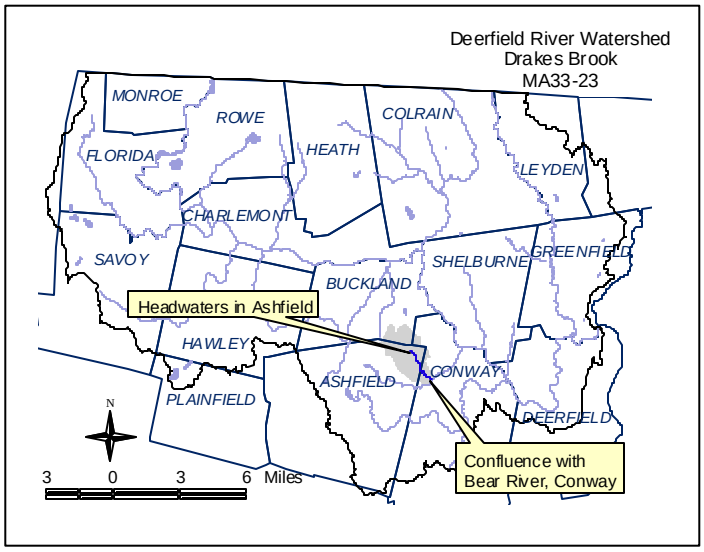
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS BEAR RIVER (MA33-17)

- Continue DWM water quality and biological monitoring in this segment during the next assessment monitoring year (2005). In particular, as a reference condition biomonitoring is recommended here especially if evaluations of first to third-order stream biota are planned. Fish population sampling should accompany the macroinvertebrate sampling.
- The Bear River should be protected as cold water fishery habitat as recommended by MA DFWELE.
- 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 Towns of Ashfield and Conway should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Bear River it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Ashfield and Conway should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- The volunteer monitoring surveys to locate and map infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Bear River subwatershed identified and mapped patches of this plant growing along the 3.4 km of the river that was surveyed between Pfersick Road and Shelburne Falls Road and where the Bear River flows into the Deerfield River. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).
- DRWA volunteers conducted a stream continuity survey in the fall of 2002 with the help of UMass Extension that identified many barriers to fish and wildlife in the Bear River subwatershed (Walk 2003). Support efforts of towns, local groups and state agencies (Riverways, MassHighway) to reduce frequency and impact of these barriers to stream biota.

DRAKES BROOK (SEGMENT MA33-23)

Location: Headwaters, west of North Warger Road, Ashfield, to confluence with Bear River, Conway.
Segment Length: 2.0 miles.
Classification: Class B.



The drainage area of this segment is approximately 3.46 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	84.7%
Agriculture	8.1%
Residential	2.9%

The Drakes Brook headwaters begin on the southeastern slope of Moonshine Hill in Buckland. These headwaters converge 0.35 miles northeast of Baptist Corner Road, Buckland. The brook then flows southeast under this road, and through an area of gravel extraction. Drakes Brook merges with Sids Brook just south of the Village of Shirkshire in Buckland. From there Drakes Brook joins the flow of the Bear River just before passing under South Shirkshire Road, Buckland.

MA DFWELE has recommended that Drakes Brook be protected as cold water fishery habitat (MassWildlife 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

One stream reach in Drakes Brook was sampled by DWM biologists between September 1996 and September 2000. The reach was located upstream from the confluence with the Bear River off South Shirkshire Road, Conway (Station VP13DRK), and was surveyed as part of the MA DEP Biocriteria Development Project in September 1996, 1997 and 2000 (Appendix B and MA DEP 1996b and MA DEP 1997). At the time of the survey in September 2000 the river was roughly 4 m wide with depths ranging from 0.1 to 0.3 m in the riffle areas. The substrates were comprised primarily of cobble and boulder. The overall habitat score was 183 (Appendix B). Habitat quality was limited most by slight limitations related to velocity/depth combinations.

Biology

As part of the MA DEP Biocriteria Development Project benthic macroinvertebrate samples were collected by DWM biologists from Drakes Brook upstream from the confluence with the Bear River off South Shirkshire Road, Conway (Station VP13DRK) on 6 September 1996, 24 September 1997 and again on 27 September 2000 (Appendix B and MA DEP 1996b and MA DEP 1997). The fish population in Drakes Brook (Station VP13DRK) was comprised of, in order of abundance, blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), slimy sculpin (*Cottus cognatus*), brook trout (*Salvelinus fontinalis*), longnose dace *(Rhinichthys cataractae)*, brown trout (*Salmo trutta*), and a brown bullhead (*Ameiurus nebulosus*) in September 1996. With the exception of the brown bullhead all of these species were captured in the same stream reach in September 1997 and Atlantic salmon (*Salmo salar*) and a *Lepomis* sp. were also documented (MA DEP 1996b and MA DEP 1997). A total of four fish species present in the brook are considered intolerant of pollution. With the exception of brown bullhead all fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species,

and the dominance by fluvial dependant/specialists indicated excellent habitat and water quality conditions as well as stable flow regimes. MA DFWELE also conducted fish population sampling in Drakes Brook at one location upstream from Baptist Road in Conway in August 2000. Fish species present in order of abundance were: multiple age classes of brook trout, blacknose dace, and one each of brown trout and slimy sculpin. In August 2001, MA DFWELE also conducted fish sampling near South Shirkshire Road in Shelburne. Fish species collected in order of abundance included: brook trout, Atlantic salmon and brown trout (all with multiple age classes) (Richards 2003).

Chemistry-water

DWM sampled one station on Drakes Brook in Conway (Station VP13DRK) on 25 September 1996 and 8 October 1997 as part of the MA DEP Biocriteria Development Project (Appendix G, Table G3). *In-situ* measurements included DO, %saturation, pH, temperature, conductivity, and turbidity.

The *Aquatic Life Use* in Drakes Brook is assessed as support based primarily on the fish population information and best professional judgment. The presence of multiple age classes of brook and rainbow trout is indicative of excellent habitat and water quality. Furthermore, these fish are fluvial specialists, which suggests that the flow regime has not been compromised in this brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Drakes Brook during any of the three sampling events conducted by DWM biologists as part of the Biocriteria Development Project between September 1996 and September 2000 (Appendix B, MA DEP 1996b and MA DEP 1997).

Although no bacteria data are available to assess the *Recreational* uses the *Aesthetics Use* is assessed as support.

Drakes Brook (MA33-23) Use Summary Table

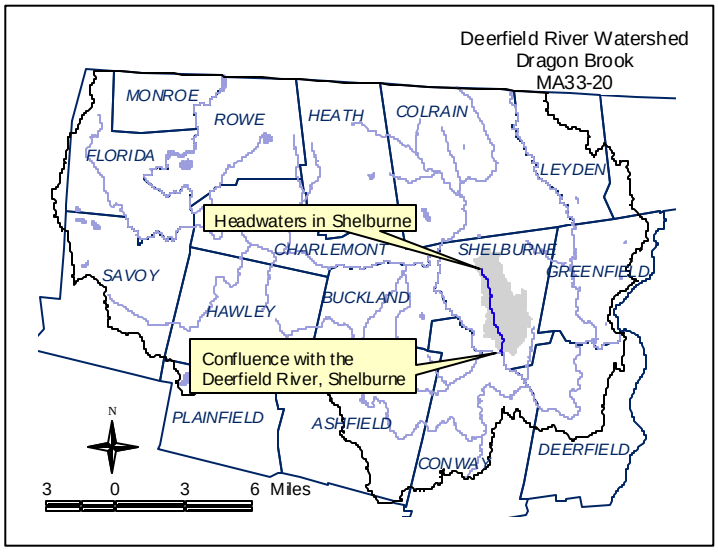
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS DRAKES BROOK (MA33-23)

- Continue DWM water quality and biological monitoring in this segment during the next assessment monitoring year (2005) to more completely assess the designated uses.
- Drakes Brook should be protected as cold water fishery habitat.
- 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 Towns of Buckland and Conway should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Drakes Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Buckland and Conway should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- DRWA volunteers conducted a stream continuity survey in the fall of 2002 with the help of UMass Extension that identified many barriers to fish and wildlife in the Bear River subwatershed including Drakes Brook (Walk 2003). Support efforts of towns, local groups and state agencies (Riverways, MassHighway) to reduce frequency and impact of these barriers to stream biota.

DRAGON BROOK (SEGMENT MA33-20)

Location: Headwaters, north of Patten Road, Shelburne, to confluence with the Deerfield River, Shelburne.
Segment Length: 4.4 miles.
Classification: Class B.



The drainage area of this segment is approximately 6.25 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	60.5%
Agriculture	21.4%
Open Land	9.3%

The headwaters of Dragon Brook begin on the southeastern slope of Patten Hill in Shelburne. The brook flows south where it receives the flow from an un-named stream in Shelburne Center. The brook then parallels Bardwell Ferry Road as it continues in a southerly direction. Dragon Brook receives the flow from Hawkes Brook approximately 0.65 miles upstream of the confluence of Dragon Brook and the Deerfield River.

MA DFWELE has recommended that Dragon Brook and its tributary Hawkes Brook be protected as cold water fishery habitat (MassWildlife 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

Dragon Brook was sampled by DWM biologists in September 1996 downstream from Bardwell Ferry Road in Shelburne (Station VP01DRG) as part of the MA DEP Biocriteria Development Project (MA DEP 1996b). At the time of the survey the brook was roughly 2.5 m wide with depths up to 0.25 m. The substrates were comprised primarily of boulder, cobble and gravel. The overall habitat score was 143 (MA DEP 1996b). The instream habitat was limited most by the channel flow status, the velocity/depth combinations, the lack of instream cover for fish and the riparian vegetative zone width.

Biology

Dragon Brook was sampled by DWM biologists downstream from Bardwell Ferry Road in Shelburne (Station VP01DRG) as part of the DEP Biocriteria Development Project in September 1996 (MA DEP 1996b). Fish species captured in order of abundance included: blacknose dace (*Rhinichthys atratulus*), brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) (MA DEP 1996b). Multiple age classes of both brook and brown trout were present. Brook and brown trout are both intolerant fluvial dependant species and their presence is indicative of excellent water and habitat quality conditions as well as a stable flow regime.

Chemistry-water

In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) in Dragon Brook were taken upstream and downstream from Bardwell Ferry Road in Shelburne (Station VP01DRG) on 24 September 1996 (Appendix G, Table G3).

Although the fish community is indicative of excellent water quality and habitat conditions, because of the lack of sufficient recent water quality and biological data the *Aquatic Life Use* is not assessed for Dragon Brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Dragon Brook in the stream reach sampled by DWM biologists in September 1996 (MA DEP 1996b).

No recent data are available to assess the *Recreational* and *Aesthetic* uses so they are not assessed.

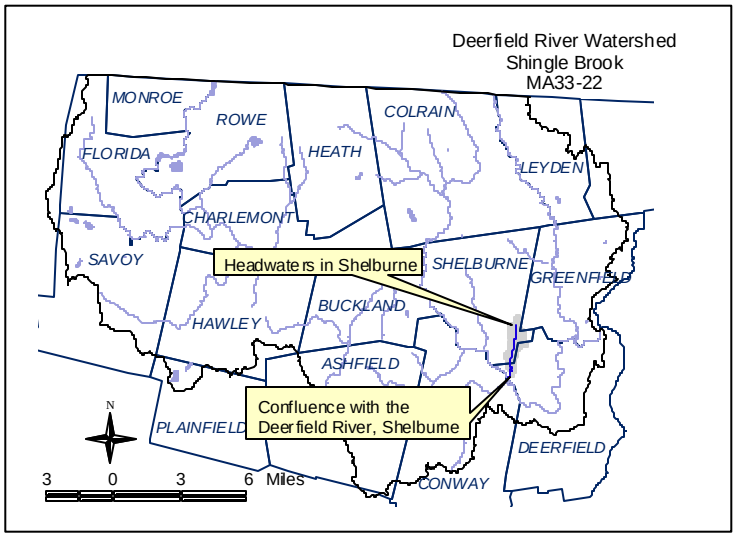
Dragon Brook (MA33-20) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS DRAGON BROOK (MA33-20)

- Conduct DWM water quality and biological monitoring in this segment to assess designated uses during the next monitoring year (2005).
- Dragon Brook and its tributary Hawkes Brook should be protected as cold water fishery habitat.
- The Town of Shelburne should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Dragon Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Town of Shelburne should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

SHINGLE BROOK (SEGMENT MA33-22)
Location: Headwaters, north of Guy Manners Road, Shelburne, to confluence with the Deerfield River, Shelburne.
Segment Length: 2.8 miles.
Classification: Class B.



The drainage area of this segment is approximately 1.57 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	68.4%
Agriculture	19.7%
Open Land	8.6%

Shingle Brook begins its run to the Deerfield River just south of South Shelburne Road in Shelburne. The brook flows south, paralleling Taylor Road to its confluence with the Deerfield River.

MA DFWELE has recommended that Shingle Brook be protected as cold water fishery habitat (MassWildlife 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
Shingle Brook was sampled by DWM biologists in September 1996 near Hawkes Road in Deerfield (Station VP02SHN) as part of the MA DEP Biocriteria Development Project (MA DEP 1996b). At the time of the survey the brook was roughly 2.5 m wide with depths up to 0.25 m. The substrates were comprised primarily of cobble and gravel. The overall habitat score was 120 (MA DEP 1996b). The instream habitat was limited most by the channel flow status, velocity/depth combinations, lack of instream cover, bank stability and sedimentation.

Biology
Shingle Brook was sampled by DWM biologists near Hawkes Road in Deerfield (Station VP02SHN) as part of the DEP Biocriteria Development Project in September 1996 (MA DEP 1996b). Fish species captured in order of abundance included blacknose dace (*Rhinichthys atratulus*) (n=211) and creek chub (*Semotilus atromaculatus*) (n=21) (MA DEP 1996b). Although fish abundance was high both species are considered tolerant to pollution.

Chemistry-water
In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) in Shingle Brook near Hawkes Road in Deerfield (Station VP02SHN) were taken on 24 September 1996 (Appendix G, Table G3).

Due to the lack of sufficient water quality and biological data the *Aquatic Life Use* is not assessed for Shingle Brook, but because the fish community information may indicate degraded water quality and habitat conditions, it is identified with an Alert Status.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Shingle Brook in the stream reach sampled by DWM biologists in September 1996 (MA DEP 1996b).

No recent data are available to assess the *Recreational* and *Aesthetic* uses so they are not assessed.

Shingle Brook (MA33-22) Use Summary Table

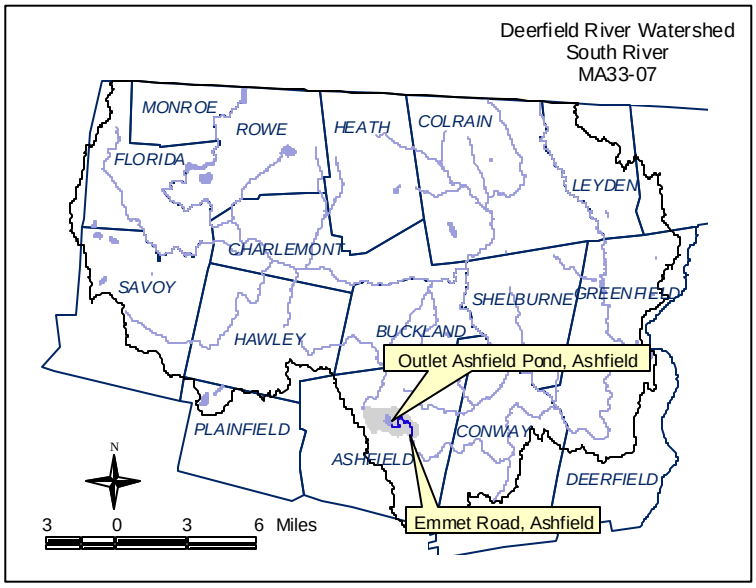
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED *	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

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

RECOMMENDATIONS SHINGLE BROOK (MA33-22)

- Conduct DWM water quality and biological monitoring in this segment to assess designated uses during the next monitoring year (2005).
- Although MA DFWELE has recommended that Shingle Brook should be protected as cold water fishery habitat, additional information (e.g., temperature, fish population, habitat quality, etc.) is needed in order to evaluate this recommendation.
- The Town of Shelburne should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Shingle Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Town of Shelburne should support recommendations of their recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

SOUTH RIVER (SEGMENT MA33-07)
Location: Outlet of Ashfield Pond to Emmet Road, Ashfield.
Segment Length: 2.3 miles.
Classification: Class B.



The drainage area of this segment is approximately 2.05 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	65.8%
Residential	10.6%
Agriculture	9.4%

The South River begins at the outlet of Ashfield Pond in the Town of Ashfield and flows east through part of Ashfield Center and then loops north and then southeast around part of the Center. The gradient is moderately steep and the valley narrow. Just north of Emmett Road, which marks the end of this segment, the river flows into a small impoundment and wetland.

It should be noted that sewering in Ashfield Center was completed in 1996. (See South River segment MA33-08 for a description of the facility).

MA DFWELE has recommended that the South River be protected as cold water fishery habitat (MassWildlife 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

Biology
Although these data are too old for assessment purposes it should be noted that DWM biologists conducted benthic macroinvertebrate sampling in the South River at Emmet's Road in Ashfield in 1988 (Station SOR02 in Appendix C).

Chemistry-water
In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) at four stations (SO-1, SO-2, SO-3 and SO-4) in this segment of the South River were taken on 20 July 1995 as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G3).

Water quality samples were collected from the South River at the second bridge crossing in Ashfield town center (Station DW11) on as many as six occasions between August and November 2000 by ESS (ESS 2002). These data are summarized below.

DO and % saturation
Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 8.39 mg/L or 68.3% saturation.

Temperature
The maximum instream temperature was 22.5°C.

pH
The pH ranged from 6.9 to 7.2 SU at all three locations.

Turbidity
Turbidity ranged from 0.41 to 3.00 NTU.

Conductivity
Specific conductivity measurements ranged from 151.7 to 235.0 µS/cm.

The *Aquatic Life Use* for this segment of the South River is not assessed because of the lack of sufficient water quality and biological data. Of concern, however, is a percent saturation of less than 75% and a maximum temperature measurement greater than 20°C if this river is to be protected as a cold water fishery habitat (as proposed by MA DFWELE). This use is, therefore, identified with an Alert Status because of this concern.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples at four stations (SO-1, SO-2, SO-3 and SO-4) in this segment of the South River on 20 July 1995 as part of the 1995/1996 Deerfield River Watershed monitoring survey, but these data were all censored (Appendix G, Table G4).

Fecal coliform bacteria samples were collected from the South River at the second bridge crossing in Ashfield town center (Station DW11) on six occasions representing both wet and dry weather sampling between August and November 2000 by ESS (ESS 2002). The fecal coliform bacteria counts ranged from <10 to 170 cfu/100 mL.

The *Recreational* uses are assessed as support for this segment of the South River based on the low fecal coliform bacteria counts. No data are available to assess the *Aesthetics Use*.

South River (MA33-07) Use Summary Table

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

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

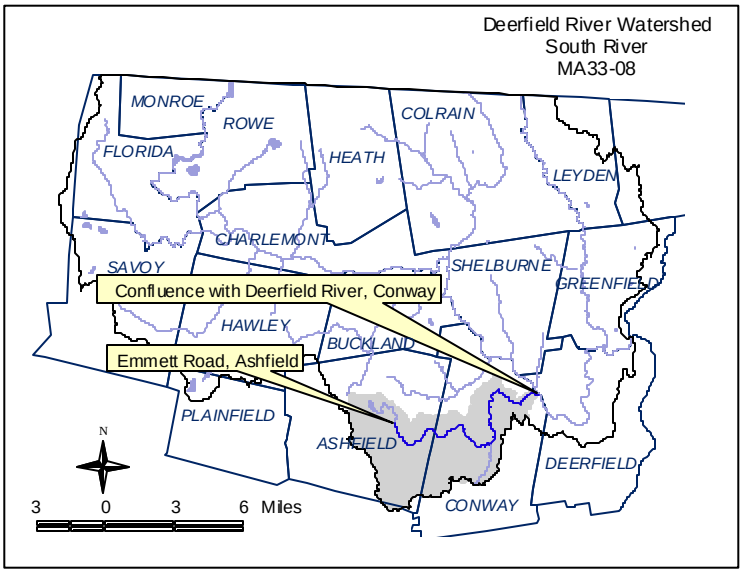
RECOMMENDATIONS SOUTH RIVER (MA33-07)

- Water quality monitoring including benthic macroinvertebrate sampling and physicochemical sampling should be conducted in this segment of the South River to document current water quality conditions and assess designated uses more completely during the next monitoring year cycle (2005).
- Additional information (e.g., fish population, instream water quality data including dissolved oxygen/percent saturation and temperature) should be collected from this segment of the South River. If appropriate, this segment should be protected as cold water fishery habitat as recommended by MA DFWELE.
- The Town of Ashfield should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the South River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Town of Ashfield should support recommendations of their recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and

habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the South River subwatershed identified and mapped small amounts of this plant growing in the headwater segment of the river. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).

SOUTH RIVER (SEGMENT MA33-08)
Location: Emmett Road, Ashfield, to confluence with Deerfield River, Conway.
Segment Length: 12.9 miles.
Classification: Class B.



The drainage area of this segment is approximately 26.37 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	77.1%
Agriculture	12.5 %
Residential	6.1%

This segment is on the 1998 303(d) List of Waters for causes unknown, other habitat alterations, and pathogens (Table 2).

From Emmett Road the South River flows south into South Ashfield where it takes an easterly direction following alongside Route 116 into Conway Center. Here the river turns north along Shelburne Falls Road and Bardwell Road, where the channel deepens and the floodplain widens allowing some agriculture, before turning east again along Reeds Bridge Road. From here to the confluence with the Deerfield River in Conway the river meanders and then flows through a deep narrow valley joined by other small streams.

MA DFWELE has recommended that the South River and several tributaries - Creamery, Chapel and Poland brooks - be protected as cold water fishery habitat (MassWildlife 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.

The Town of Ashfield uses a modified design of a Solar Aquatics facility to treat its municipal wastewater which discharges to groundwater in the South River subwatershed. This facility has a groundwater discharge (permit # GW-594-0). The discharge limit from this system is 0.025MGD and the effluent must meet groundwater permit nutrient limits for total nitrogen of 10 mg/l.

USE ASSESSMENT SUMMARY
AQUATIC LIFE

Habitat and Flow

There is a small dam on the South River near Shelburne Falls Road in Conway (downstream from the town center) and approximately 1.6 miles upstream from Reeds Bridge Road crossing in Conway.

The South River was sampled by DWM upstream from Truce Road, Conway (Station SOR01) in September 2000. At the time of the survey, the river was roughly 9 m wide with depths up to 0.3 m. The substrates were comprised primarily of cobble and boulder. The overall habitat score was 170 (Appendix B). Habitat quality was limited most by sediment deposition and velocity/depth combinations.

According to USGS (remarks from gaging station records on the South River at Reeds Bridge, Conway - 01169900) diurnal fluctuation was caused by a small powerplant on the above-described upstream dam since April 1982. Data from the USGS gage revealed that the mean annual flow for 2000 (72.3 cfs) was greater than the mean annual flow (53.2 cfs) for the period of record (37 years - 1966 to present) (Socolow, *et. al*. 2001). The estimated 7Q10 flow at the gage is 3.6 cfs (USGS 2003).

Further downstream in Conway there is a 77 ft high dam on the South River located approximately 0.6 miles upstream from the confluence with the Deerfield River. The dam, known as Conway Electric Dam, lies within Conway State Forest and is now owned by MA DCR, Division of State Parks and Recreation (formerly MA DEM). It is no longer used and in disrepair but still creates a major barrier to fish. A large volume of sediment has accumulated behind the dam.

Biology

Compared to both the Bear River reference station (Station VP11BEA) and the Cold River reference station (Station CR01) the RBP III analyses indicated the benthic community was non-impacted in the South River upstream from Truce Road, Conway (Station SOR01) in September 2000 (Appendix B). The South River was also sampled by DWM in 1988 and 1995 upstream from Reeds Bridge Road in Conway (Appendix C). While the fish sampling efficiency at SOR01 was rated poor, fish species captured in order of abundance included; blacknose dace (*Rhinichthys atratulus*), Atlantic salmon *(Salmo salar*), longnose dace *(Rhinichthys cataractae),* common shiner *(Luxilus cornutus)*, and creek chub (*Semotilus atromaculatus*) (Appendix B). Only the Atlantic salmon and longnose dace are considered to be intolerant of pollution. Due to the sampling inefficiencies it is unclear whether the fish community was truly dominated by tolerant species. All species present are considered to be fluvial specialists/dependants, which is indicative of a stable flow regime. In addition to these species, eastern brook trout (*Salvelinus fontinalis*), slimy sculpin (*Cottus cognatus*), and a pumpkinseed (*Lepomis gibbosus),* were documented in the South River by MA DFWELE in August 2000 (Richards 2003).

DWM biologists collected periphyton samples from Station SOR01, located upstream from Truce Road, Conway, at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 60% and percent algal cover was 90%. The dominant algal type and form were diatoms/thin film. No nuisance algal growth (green filamentous algae) was documented (Appendix D).

Chemistry-water

Water quality sampling was conducted by DWM in the South River at two locations; at the bridge at Bullitt Road in Ashfield (Station SO05) and at the bridge crossing between Shelburne Falls Road and Reeds Bridge Road in Conway (Station SO-8). These sites were sampled in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9). The South River was also sampled near these two locations by DWM in July 1995 (Appendix G, Tables G3 and G4). Additional locations in the South River were sampled by DWM in July 1995; near Riley Road in Conway (Station SO-6), and near Conway town center at Route 116 bridge (Station SO-7). The South River near the USGS gaging station near Reeds Bridge Road in Conway was also sampled by DWM between June 1995 and June 1996 (Station SO) on 13 sampling events (Appendix G, Tables G3 and G4).

Water quality samples were also collected from two stations on this segment of the South River on as many as six occasions between August and November 2000 by ESS (ESS 2002). Station DW8 was located downgradient from the Solar Aquatics WWTF groundwater discharge, along Route 116 before Emmet Street, Ashfield. The most downstream station sampled by ESS was Station DW7 and was located at the bridge crossing between Shelburne Falls Road and Reeds Bridge Road in Conway.

ESS also collected water quality samples in 2000 from two stations on Creamery Brook, a tributary to the South River. All of these stations were sampled six times during the study period. Station DW9 was located on Creamery Brook along Route 112, above dairy farms in Ashfield. Station DW10 was located downstream on Creamery Brook near the confluence with the South River and downstream from dairy farms in Ashfield.

The Deerfield River Watershed Association (DRWA) performed volunteer water quality monitoring in this segment of the South River at one location near Reeds Bridge Road in Conway (SOR). Samples were collected for pH, DO, alkalinity, and temperature once in April 2001 and 2002. However, due to the limited number of samples the results were not used in this assessment (DRWA 2001and DRWA 2002).

DO and % saturation
DO levels in the South River measured by DWM and ESS in 2000 were not less than 9.3 mg/L and were as high as 13.13 mg/L (Appendix A, Table A8 and ESS 2002). Percent saturation ranged from 88.4 to a high of 100.3%. It should be noted that these data represent both worst-case (pre-dawn) and daytime conditions.

Temperature
The maximum temperature in the South River measured by DWM and ESS in 2000 was 20°C (Appendix A, Table A8 and ESS 2002).

pH and Alkalinity
The pH of the South River ranged between 6.9 and 7.5 SU (Appendix A, Table A8 and ESS 2002). Alkalinity of the South River ranged from 37 to 43 mg/L (Appendix A, Table A9).

Suspended Solids
Suspended solids were below detection during the 2000 surveys (Appendix A, Table A9).

Ammonia-Nitrogen
No detectable concentrations of ammonia-nitrogen were detected in the South River during the 2000 DWM surveys (Appendix A, Table A9).

Hardness
Hardness measurements of the South River ranged from 45 to 49 mg/L (Appendix A, Table A9).

Phosphorus
Total phosphorus measurements in the South River ranged from <0.01 to 0.016 mg/L (Appendix A, Table A9).

The *Aquatic Life Use* for this segment of the South River is assessed as support based on the benthic macroinvertebrate community analysis and the water quality data. Of concern, however, is sediment deposition and associated substrate embeddedness, which can degrade habitat quality. The fish community may also be dominated by pollution tolerant species, although sampling efficiency was poor. Because of these issues the *Aquatic Life Use* is identified with an Alert Status.

PRIMARY AND SECONDARY CONTACT RECREATION

DWM collected fecal coliform bacteria samples from the South River near the USGS gaging station near Reeds Bridge Road in Conway between June 1995 and June 1996 (Station SO) (n =14) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4). DWM also collected fecal coliform bacteria from three additional stations (SO-5, SO-7, and SO-8), but these data were censored.

Fecal coliform bacteria samples were collected from the South River at two stations on six occasions representing both wet and dry weather sampling conditions between August and November 2000 by ESS (ESS 2002). Results are summarized below.

- Station DW8, located downstream from Solar Aquatics along Route 116 before Emmet Street in Ashfield - fecal coliform bacteria counts ranged from 10 to 1,800 col/100 mL. One of four counts during the *Primary Contact Recreational Season* exceeded 400 cfu/100 mL (the sample was representative of wet weather conditions).
- Station DW7, located at the bridge crossing between Shelburne Falls Road and Reeds Bridge Road in Conway - fecal coliform bacteria counts ranged from 40 to >2,000 col/100 mL. One of four counts during the *Primary Contact Recreational Season* exceeded 400 cfu/100 mL (the sample was representative of wet weather conditions).

Note: Fecal coliform samples were collected in 2000 by ESS at two stations on Creamery Brook, a tributary to the South River. Creamery Brook was sampled along Route 112 above dairy farms in Ashfield (Station DW9) and near the confluence with South River, downstream from the farms in Ashfield (Station DW10). Both stations were sampled on six occasions representing both wet and dry weather conditions between August and November 2000 by ESS (ESS 2002). Results are summarized below.

- Station DW9 - fecal coliform bacteria counts ranged from 20 to 8,660 col/100 mL. None of the counts from four samples collected during the *Primary Contact Recreational Season* exceeded 400 cfu/100 mL .
- Station DW10 - fecal coliform bacteria counts ranged from 10 to >2,000 col/100 mL. Counts from one of four samples collected during the *Primary Contact Recreational Season* exceeded 400 cfu/100 mLs (the sample was representative of wet weather conditions).

No objectionable deposits, sheens, odors or other conditions were noted during the biological monitoring survey conducted by DWM biologists in the South River in September 2000 (Appendix B) or by field crews during any of the water quality surveys conducted in 2000. It should also be noted that turbidity measurements from the South River reported by ESS (2002) were all low with the exception of one wet weather sample during the 15 September survey (54 NTU) collected at the Reeds Bridge Road in Conway (Station DW7).

The *Recreational* and *Aesthetics* uses are assessed as support for South River based on the limited fecal coliform bacteria data and the habitat quality information. The *Primary and Secondary Contact Recreational* uses, however, are identified with an Alert Status because of elevated bacteria counts documented by ESS during wet weather.

South River (MA33-08) Use Summary Table

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

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

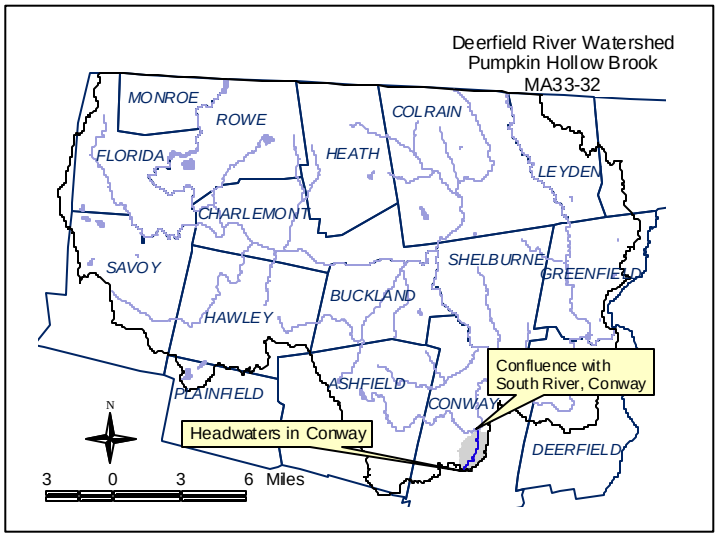
RECOMMENDATIONS SOUTH RIVER (MA33-08)

- Work with Conway Electric Dam owner (currently MA DCR), other agencies, and the Town of Conway to explore options and funding sources for improving fish passage at this site, including possible removal or breaching of the dam.
- Water quality monitoring, including bacteria and physicochemical sampling should be conducted in this segment of the South River to identify sources of high bacteria counts during wet weather and document current water quality more completely during the next monitoring year (2005). In addition, macroinvertebrate biomonitoring is recommended along with fish population sampling using multiple crews or a barge-mounted electrofishing unit. Bacteria monitoring is also recommended for Creamery Brook to identify sources of high bacteria counts during wet weather.
- An evaluation of habitat quality conditions related to erosion and instream deposition/sedimentation in the South River should be conducted. Pursue 604b and/or 319 funding to evaluate and remediate problem areas.
- Continue to monitor the fish population in the South River. Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable.
- MA DFWELE has recommended that the river be protected as cold water fishery habitat.
- The Towns of Ashfield and Conway should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans the towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.

- In order to prevent degradation of water quality in the South River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. Ashfield and Conway should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged as appropriate.
- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the South River subwatershed identified and mapped large patches of this plant growing near the confluence of the South and Deerfield Rivers. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).
- Work with NRCS, DAR (formerly DFA) and landowners to protect riparian buffers and encourage use of agricultural BMP's.
- Encourage local stewardship efforts by supporting the DRWA volunteer water quality monitoring program.

PUMPKIN HOLLOW BROOK (SEGMENT MA33-32)

Location: Headwaters, north of Conway State Forest and south of Old Cricket Hill Road, Conway, to confluence with South River, Conway.
Segment Length: 2.3 miles
Classification: Class B.



The drainage area of this segment is approximately 1.61 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	65.0%
Agriculture	20.4%
Residential	10.4%

The Pumpkin Hollow Brook headwaters begin on the north slope of Cricket Hill in Conway. The brook flows north, parallel with Whately Road. Pumpkin Hollow Brook then joins the South River in Conway Center.

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.

OTHER

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified two historic landfills in this segment, the Conway Landfill and the Conway Wood Waste Landfill. These landfills are both over 25 years old. It is believed that the Conway Landfill began operation around 1900. In the 1970s this dump accepted hazardous and liquid wastes and open burning was practiced. At that time a leachate plume was observed flowing from beneath the landfill, across a meadow, and into Pumpkin Hollow Brook. Sampling of surface water and groundwater were conducted on behalf of the Town of Conway by Fuss and O'Neill in July 2002. Surface water samples were collected from Pumpkin Hollow Brook upstream of the landfill and at the town swimming hole downstream of the landfill. Groundwater samples were also collected from a private well. All results were below the Massachusetts Maximum Contaminant Levels (MCLs) in the Massachusetts Drinking Water Standards according to a September 17, 2002 letter to MA DEP. This landfill is not lined but it is capped. Groundwater continues to be monitored by the town. The Conway Wood Waste Landfill received wood waste. It was closed and capped in 1991 and has been monitored since 1994. The most recent water quality results, collected in July 2002 for the town, are below MCLs of the Massachusetts Drinking Water Standards according to a September 17, 2002 letter to MA DEP. Because these sites have already been monitored, Fuss and O'Neill (2003) did not recommend these for screening level sampling under this study.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

Pumpkin Hollow Brook was sampled by DWM upstream from Academy Hill Road, Conway (Station PH00), in September 2000. At the time of the survey the brook was approximately 3 m wide with depths ranging from 0.25 to 0.5 m. The substrates were comprised primarily of cobble. The overall habitat score was 146 (Appendix B). Habitat quality was limited most by sediment deposition and embeddedness and by streambank instability.

Biology

Fish species captured, in order of abundance, included: creek chub (*Semotilus atromaculatus*), common shiner *(Luxilus cornutus)*, blacknose dace (*Rhinichthys atratulus)*, Atlantic salmon *(Salmo*

salar), longnose dace *(Rhinichthys cataractae),* and a brook trout (*Salvelinus fontinalis*) (Appendix B). While two species are considered to be intolerant of pollution their numbers were extremely low and the community was dominated by tolerant and moderately tolerant species. All species collected were fluvial dependant/specialists, which are indicative of a stable flow regime.

Chemistry-water

Water quality samples were collected from Pumpkin Hollow Brook just upstream from its confluence with the South River in Conway (Station DW23) in October and November 2000 by ESS (ESS 2002). Results are summarized below.

DO and % saturation

Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 11.82 mg/L or 88.4% saturation.

pH

The pH ranged between 7.0 and 7.1 SU.

Turbidity

Turbidity ranged between 0.31 and 21.1 NTU.

Conductivity

Specific conductivity measurements were 128.2 and 148.8 µS/cm.

The *Aquatic Life Use* for Pumpkin Hollow Brook is assessed as support based primarily on fish population information and best professional judgment. This use, however, is identified with an Alert Status, because of sediment deposition and associated substrate embeddedness, which can degrade habitat quality.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

Fecal coliform bacteria samples were collected from Pumpkin Hollow Brook just upstream of its confluence with the South River in Conway (Station DW23) in October and November 2000 by ESS (ESS 2002). The fecal coliform bacteria counts were 30 and 220 cfu/100 mL (both samples were representative of wet weather conditions).

The Massachusetts Department of Public Health beach closure report (MA DPH 2001b) states that the Conway Swimming Hole on Pumpkin Hollow Brook was never closed for elevated bacteria during the 2001 season.

Too limited bacteria data are available and, so the *Recreational* uses are not assessed for Pumpkin Hollow Brook. No objectionable deposits or conditions were reported at Pumpkin Hollow Brook by DWM biologists in 2000 so the *Aesthetics Use* is assessed as support.

Pumpkin Hollow Brook (MA33-32) Use Summary Table

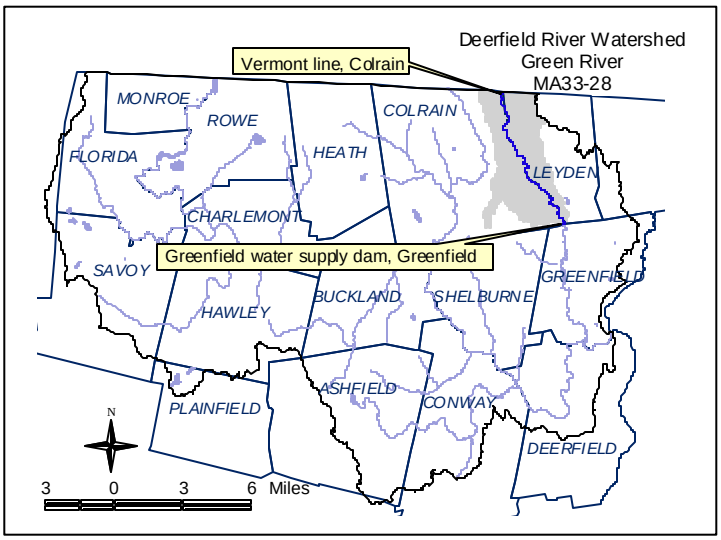
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT*	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

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

RECOMMENDATIONS PUMPKIN HOLLOW BROOK (MA33-32)

- Water quality monitoring throughout the Pumpkin Brook subwatershed is recommended, especially nutrient and bacteria sampling to help isolate potential sources of nutrient/organic loads and to document current water quality more completely during the next monitoring year (2005). In addition, fish population sampling should be conducted along with macroinvertebrate sampling in this segment.
- An evaluation of habitat quality conditions related to erosion and instream deposition/sedimentation in Pumpkin Hollow Brook should be conducted. Pursue 604b and/or 319 funding to evaluate and remediate problem areas.
- The Town of Conway should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Pumpkin Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Town of Conway should support recommendations of their recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain the communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

GREEN RIVER (SEGMENT MA33-28)
Location: Vermont line, Colrain, to Greenfield water supply dam (north of Eunice Williams Road), Greenfield (formerly part of segment MA33-09).
Segment Length: 8.5 miles.
Classification: Class B, (Cold Water Fishery).
Note: The MA DEP Drinking Water Program has recommended that this segment be reclassified as a Class A waterbody in the next revision of the Massachusetts Water Quality Standards.



The drainage area of this segment is approximately 14.8 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	80.2%
Agriculture	10%
Residential	4.6%

This segment (formerly part of Segment MA33-09) is on the 1998 303(d) List of Waters for causes unknown, metals and pathogens (Table 2).

The Green River flows from Vermont into Colrain, twisting southeast through a steep narrow valley, and quickly becomes the border between Colrain and Leyden. Many small streams contribute to its flow along the way. This segment ends at the Greenfield water supply dam just downstream from the Colrain/Greenfield town line near the covered bridge on Eunice Williams Drive.

The Town of Greenfield Department of Public Works is working with the Town of Guilford, VT to address concerns regarding an auto junkyard located along the banks of the Green River in Guilford, VT. The Town of Guilford has requested that vehicles be removed from the flood plain and that stormwater BMPs be implemented at this site (Shields 2001).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	PWS ID	WMA Permit #	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
						1998	1999	2000	2001
Greenfield Water Department*	1114000		10311401	Green River-03S	2.12	2.19**	2.23	2.07	2.18**

*not all sources necessarily within this segment, **withdrawal did not exceed registration amount by more than 0.1MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY
There are no known NPDES discharges to this segment of the Green River.

OTHER
Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified an area of historic (and current) chronic dumping in this segment along Green River Road in Colrain. The area of dumping is located along the eastern side of Green River Road and the western bank of the Green River, from approximately the intersection of Nelson Road southward to the Greenfield town line. Annual river cleanups by volunteers yield mostly household appliances, household trash, construction debris, paint cans, and furniture from this area. No screening level sampling was recommended by the Fuss and O'Neill report. The Town of Greenfield is concerned about potential

impact to its surface drinking water supply and has been working with several landowners to discourage access to some of the dumping spots.

ACOE Stream Ecosystem Restoration Feasibility Study

In 2000 the US Army Corps of Engineers began an Ecosystem Restoration Feasibility Study of the Green River with matching funds provided by the Executive Office of Environmental Affairs and the Town of Greenfield. The study is investigating the hydrologic, environmental, physical, cultural, and economic impacts of dam removal and/or installation of fish passage structures on four dams along the Green River, as well as other potential stream ecosystem restoration activities. The project is due to be completed in 2004. The Greenfield water supply dam is the most upstream dam on the Green River in Massachusetts and the only dam located in this segment (MA33-28). ACOE's report will likely provide specific recommendations and a cost/feasibility analysis of installing fish passage at the water supply dam. Implementation of the recommendations is optional, but Greenfield may request funding from ACOE for up to 65% of the cost if they decide to follow them (ACOE 2001).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The USGS operates a stream gaging station (01170100) within this segment. Data from this gage (period of record 1967 to present) revealed that the annual mean flow for 2000 (106 cfs) has been in excess of the annual mean flow recorded over the past 32 years (90.4 cfs) (Socolow, R. *et. al*. 2001). The seven-day, ten-year low flow estimate is 5 cfs (USGS 2003).

The Green River is stocked with Atlantic salmon fry, but no upstream fish passage is currently available at the Greenfield water supply dam. The dam, used by Greenfield for water supply purposes, is a new, approximately 14 feet high, concrete dam in good condition. Results of a US Army Corps of Engineers Green River Stream Ecosystem Restoration Feasibility Study to examine fish passage options are not yet available.

Biology

MA DFWELE conducted fish sampling in two reaches of this segment of the Green River in August 2000. Only three individuals of three different species of fish (slimy sculpin (*Cottus cognatus*), brown trout (*Salmo trutta*), and a longnose dace *(Rhinichthys cataractae*)) were captured in the reach sampled just south of the Vermont border. Only longnose and blacknose dace (*Rhinichthys atratulus)* (n=12) were captured in the reach of the Green River south of the confluence with Hibbard Brook in Leyden. Although all fish collected were fluvial dependants/specialists and at one location all were intolerant or moderately tolerant of pollution, the low number of fish are notable and worthy of further investigation. Richards (2003) attributes the low number of fish collected to poor sampling efficiency.

Chemistry-water

Water quality sampling was conducted by DWM in this segment of the Green River at the USGS gaging station just north of East Colrain (Station GR07). This site was sampled in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9). This station and Station GR08, located about 0.3 miles downstream from the confluence with Browning Brook, were also sampled by DWM in August 1995 (Appendix G, Tables G3 and G4).

DO and % saturation

DO levels in the Green River measured by DWM in 2000 were not less than 9.4 mg/L (Appendix A, Table A8). Percent saturation ranged from 91 to a high of 98%. It should be noted that these data represent worst-case (pre-dawn) conditions.

Temperature

The maximum temperature in the Green River measured by DWM in 2000 was 16°C (Appendix A, Table A8).

pH and Alkalinity
The pH of the Green River ranged between 7.3 and 7.7 SU (Appendix A, Table A8).
Alkalinity in the Green River ranged from 31 to 38 mg/L (qualified data omitted) (Appendix A, Table A9.

Suspended Solids
Suspended solids were below detection during the 2000 surveys (Appendix A, Table A9).

Ammonia-Nitrogen
No detectable concentrations of ammonia-nitrogen were measured in the Green River during the 2000 DWM surveys (Appendix A, Table A9).

Hardness
Hardness measurements of the Green River ranged from 36 to 44 mg/L (Appendix A, Table A9).

Phosphorus
No detectable concentrations of total phosphorus were measured in the Green River (Appendix A, Table A9).

The *Aquatic Life Use* for this segment of the Green River is assessed as support based on the limited water quality data. The low number of fish may be associated with poor sampling efficiency so further investigation is warranted.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected one fecal coliform bacteria sample in this segment of the Green River from both the USGS gaging station just north of East Colrain (Station GR07) and about 0.3 miles downstream from the confluence with Browning Brook (Station GR08) in August 1995, however, these data were censored (Appendix G, Table G4).

No objectionable deposits or turbidity have been observed (Duerring 2003). Because this segment of the Green River is so rural and easily accessible via Green River Road some areas have been used perennially for illegal dumping of household and construction waste (see description of this area under ***Landfills*** above).

The Primary and Secondary Contact *Recreational* uses are not assessed for this segment of the Green River. The *Aesthetics Use* is assessed as support but is identified with an Alert Status because of illegal dumping.

Green River (MA33-28) 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 the use assessment section

RECOMMENDATIONS GREEN RIVER (MA33-28)

- Conduct water quality and biological monitoring in this segment of the Green River to more completely assess designated uses. In particular, fish population sampling should accompany the macroinvertebrate sampling effort. Due to the wide nature of this segment reach fish sampling should employ multiple crews or a barge-mounted electrofishing unit.
- Investigate possible impacts to aquatic life from potential nonpoint sources of pollution, including the large auto junkyard along the Green River in Guilford VT.
- Support the recommendations of the ACOE Green River Feasibility Study and assist the Town of Greenfield and others in securing funding to implement the recommendations of the study.

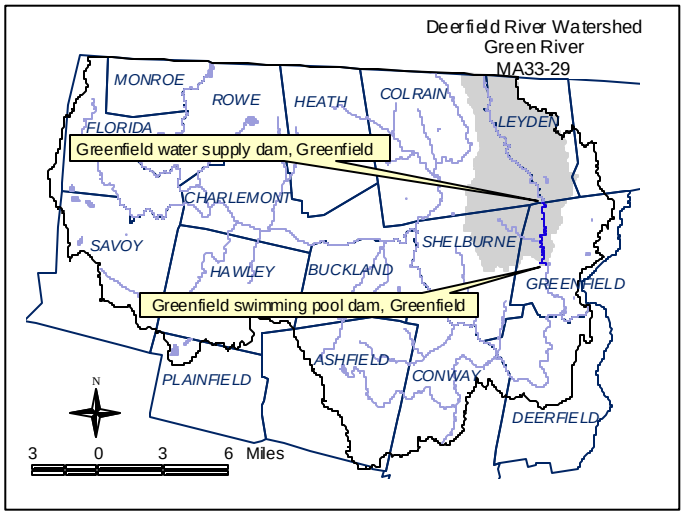
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by Greenfield Community College, DRWA and CRWC.
- Continue to address the trash dumping problem on Green River Road.
- The Towns of Leyden and Colrain should participate in the Deerfield River Watershed Regional Open Space Plan, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments. Through this plan the towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Green River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Leyden and Colrain should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged as appropriate.
- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the South River subwatershed identified and mapped patchy to dense distribution of this plant growing along the riverbanks. Upstream of West Leyden knotweed was found in small patches. In the lower portion of this segment (below Workman Brook confluence) the knotweed patches increased in both number and density. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).

GREEN RIVER (SEGMENT MA33-29)

Location: From the Greenfield water supply dam (north of Eunice Williams Road), Greenfield, to the Greenfield swimming pool dam (northwest of Nash's Mill Road), Greenfield (formerly part of Segment MA33-09).

Segment Length: 4.6 miles.

Classification: Class B, Cold Water Fishery.



The drainage area of this segment is approximately 33.8 square miles.

Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	71.4%
Agriculture	14.4%
Open Land	6.9%

This segment of the Green River (MA33-29) has a significantly different topology from the upstream segment (MA33-28). As the Green River leaves the Greenfield water supply at the northern border of the Town of Greenfield the gradient lessens and the flood plain widens. The channel also narrows and deepens because of the softer sedimentary bedrock and highly erodible unconsolidated deposits in that area. The river meanders through an area of open fields and agriculture and receives the flow from Glen Brook about 1.5 miles from the top of this segment. The Green River continues on its sinuous course, receiving the flow from Hinsdale Brook, to an impoundment by Nash's Mill Road. The pond created here is known as the "Greenfield Municipal Pool". This dam marks the downstream edge of this segment.

MA DFWELE has recommended that the Glen and Allen brooks, tributaries to this segment of the Green River, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	PWS ID#	WMA Permit #	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
						1998	1999	2000	2001
Greenfield Water Department	1114000		10311401	Glen Brook-Upper Reservoir-01S	2.12	2.19**	2.23	2.07	2.18**

*not all sources necessarily within this segment, **withdrawal did not exceed registration amount by more than 0.1MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

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

OTHER

ACOE Stream Ecosystem Restoration Feasibility Study

In 2000 the US Army Corps of Engineers began an Ecosystem Restoration Feasibility Study of the Green River with matching funds provided by the Executive Office of Environmental Affairs and the Town of Greenfield. The study is investigating the hydrologic, environmental, physical, cultural, and economic impacts of dam removal and/or installation of fish passage structures on four dams along the Green River, as well as other potential stream ecosystem restoration activities. The project is due to be completed in 2004. The Greenfield swimming pool dam marks the end of this segment and is the second most upstream dam on the Green River in Massachusetts. It is the only dam located in this segment (MA33-29). ACOE's report will likely provide specific recommendations and a cost/feasibility analysis of installing fish passage at the swimming pool dam. Implementation of the

recommendations is optional, but Greenfield may request funding from ACOE for up to 65% of the cost if they decide to follow them (ACOE 2001).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The Green River is stocked with Atlantic salmon fry by MA DFWELE, but no upstream fish passage is currently available at either the water supply dam (MA33-28) or the Greenfield swimming pool dam. Results of the ACOE Stream Ecosystem Restoration Feasibility Study on the Green River to examine fish passage and other ecosystem restoration options are not yet available (described above). The swimming pool dam is a 2 feet high concrete structure that is enhanced with flashboards during the swimming season to raise the pool behind the dam. These flashboards are removed during the non-swimming season.

The Green River was sampled by DWM downstream from Eunice Williams Drive in Greenfield (Station GR02) in September 2000. At the time of the survey the river was roughly 15 m wide with depths ranging from 0.2 to 0.4 m. The substrates were comprised primarily of cobble and pebble. The overall habitat score was 169 (Appendix B). Habitat quality was limited most by instream available cover and limitations related to velocity/depth combinations.

Biology

Compared to the Cold River reference station (Station CR01) the RBP III analysis indicated the benthic community was non-impacted in the Green River downstream from Eunice Williams Drive in Greenfield (Station GR02) in September 2000 (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in the Green River in 1988 (Appendix C).

DWM biologists collected periphyton samples from Station GR02, located downstream from Eunice Williams Bridge, Greenfield, at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 0% and percent algal cover was not reported. The dominant algal types were blue-greens. No nuisance algal growth was documented. (Appendix D)

The *Aquatic Life Use* for this segment of the Green River is assessed as support based on the benthic macroinvertebrate community information.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

Fecal coliform bacteria sampling was conducted by the DRWA in the Green River downstream from the public water supply dam in an informal swimming area in Greenfield (Station GRR-030) between June and August 2001 and 2002 (n = 7 wet weather sampling events and 4 dry weather sampling events). Fecal coliform counts at this station ranged from 9 to 140 colonies/100 mL (DRWA 2001 and DRWA 2002).

Note: ESS conducted some fecal coliform bacteria sampling in one tributary to this segment of the Green River. The fecal coliform bacteria counts in Allen Brook (Station DW17) at Plain Road bridge in Greenfield ranged from <10 to 3260 col/100 mL, with two of six counts greater than 200 cfu/100 mL. The two counts were both representative of wet weather conditions, but only one of the elevated counts was collected during the *Primary Contact Recreational Season*.

In addition to the station monitored by DRWA the Town of Greenfield also operates a swimming area on the impounded portion of the Green River near Nash's Mill Road immediately upstream of the aforementioned swimming pool dam at the end of this segment. The Greenfield Board of Health has sampled this beach weekly and no closings/postings were reported in 2001 and 2002 (Shields 2003a and MA DPH 2002c).

No objectionable deposits, odors, turbidity, or other conditions were noted by DWM biologists (Appendix B).

The *Primary* and *Secondary Contact Recreationa*l and *Aesthetics* uses are assessed as support for this segment of the Green River based on the low fecal coliform bacteria counts and the habitat quality information.

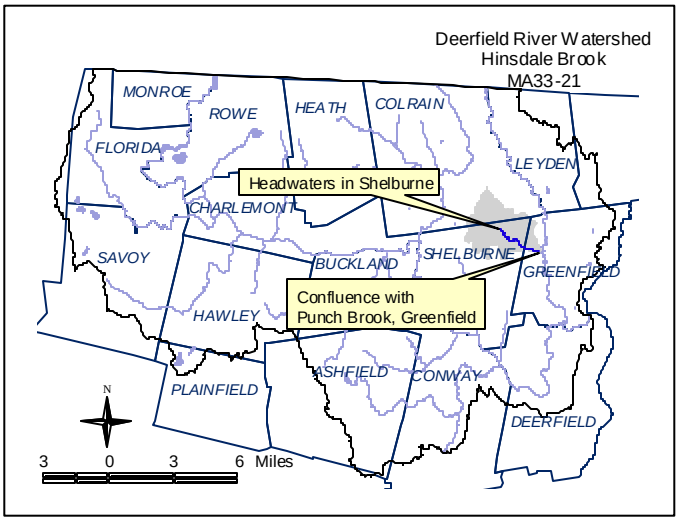
Green River (MA33-29) Use Summary Table

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

RECOMMENDATIONS GREEN RIVER (MA33-29)

- Conduct water quality and biological monitoring in this segment of the Green River during the next monitoring year (2005) to continue to assess designated uses. In particular, biomonitoring is recommended here to continue to assess biological health. Fish population sampling should accompany the macroinvertebrate sampling effort. Due to the wide nature of the segment, fish sampling may require multiple crews or a barge-mounted electrofishing unit. Bacteria monitoring in this segment as well as the Allen Brook tributary is also recommended.
- Support the recommendations of the ACOE Green River Feasibility Study and assist the Town of Greenfield and others in securing funding to implement the recommendations of the study.
- Glen and Allen Brooks, tributaries to this segment of the Green River, should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by Greenfield Community College, DRWA and CRWC.
- The Town of Greenfield should participate in the Deerfield River Watershed Regional Open Space Plan, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments. Through this plan Greenfield can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Green River subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. Greenfield should support recommendations of their recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their communities' character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Green River subwatershed identified and mapped patchy distribution of this plant growing along the riverbanks. The knotweed patches that were observed throughout this segment were found to be denser and more numerous than in the above segment. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).

HINSDALE BROOK (SEGMENT MA33-21)
Location: Headwaters, east of Fiske Mill Road, Shelburne, to confluence with Punch Brook, Greenfield.
Segment Length: 3.0 miles.
Classification: Class B.



The drainage area of this segment is approximately 6.49 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	59.3%
Agriculture	19.5%
Open Land	13.4%

Hinsdale Brook begins near the border between Colrain and Shelburne. The stream flows southeast within a narrow valley along Greenfield Road and receives the flow from Stewart Brook. After passing into Greenfield it joins with Punch Brook about 0.1 miles above the confluence of Punch Brook and the Green River.

MA DFWELE has recommended that Hinsdale Brook be protected as cold water fishery habitat (MassWildlife 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

Hinsdale Brook was sampled by DWM biologists in September 1996 downstream from Greenfield Road in Shelburne (Station VP05HIN) as part of the MA DEP Biocriteria Development Project (MA DEP 1996b). At the time of the survey the brook was roughly 2.5 m wide with depths ranging from 0.25 to 0.5 m. The substrates were comprised primarily of cobble and boulder/gravel. The overall habitat score was 117 (MA DEP 1996b). The instream habitat was limited most by poor bank stability on the right bank, lack of bank vegetative protection, sediment deposition and channel alteration as well as the channel flow status.

Biology

Hinsdale Brook was sampled by DWM biologists downstream from Greenfield Road in Shelburne (Station VP05HIN) as part of the MA DEP Biocriteria Development Project in September 1996 (MA DEP 1996b). Fish species captured, in order of abundance, included: Atlantic salmon *(Salmo salar*), slimy sculpin *(Cottus cognatus)*, blacknose dace *(Rhinicthys atratulus)*, brook (*Salvelinus fontinalis)* and brown trout (*Salmo trutta)* and an individual each of longnose dace (*Rhinicthys cataractae)* and golden shiner (*Notemigonus crysoleucas)* (MA DEP 1996b). Multiple age classes of Atlantic salmon were present. All fish species collected in this brook are fluvial specialists/dependants with the exception of an individual golden shiner. The presence of multiple age classes of Atlantic salmon, dominance by intolerant species, and the general absence of macrohabitat generalists indicated good habitat and water quality conditions as well as stable flow regimes.

Chemistry-water

In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) in Hinsdale Brook downstream from Greenfield Road in Shelburne (Station VP05HIN) were taken on 25 September 1996 (Appendix A, Table A8).

Although the fish community is indicative of good water quality conditions, because of the lack of additional water quality and biological data, the *Aquatic Life Use* is not assessed for Hinsdale Brook. This use is, however, identified with an Alert Status due to suboptimal habitat quality.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Hinsdale Brook in the stream reach sampled by DWM biologists in September 1996 (MA DEP 1996b).

No recent data are available to assess the *Recreational* and *Aesthetic* uses, therefore, they are not assessed.

Hinsdale Brook (MA33-21) Use Summary Table

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

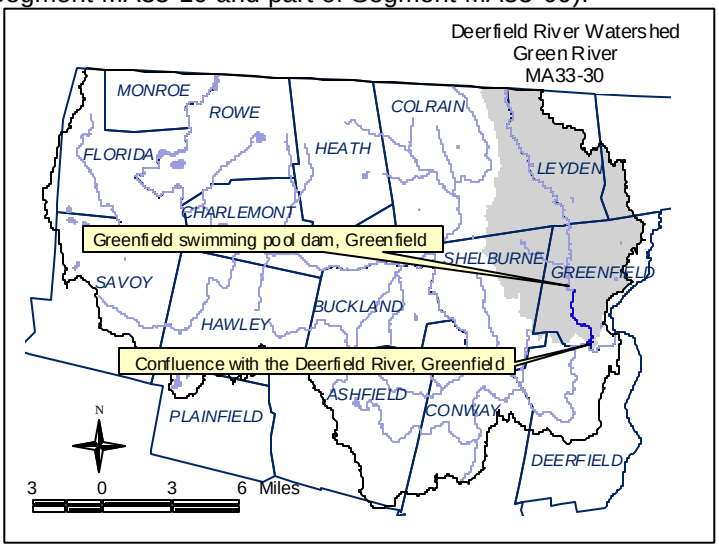
*Alert Status issues identified, see details in the use assessment

RECOMMENDATIONS HINSDALE BROOK (MA33-21)

- Conduct water quality and biological monitoring in this segment during the next monitoring year (2005) to assess designated uses.
- Hinsdale Brook should be protected as cold water fishery habitat as recommended by MA DFWELE.
- The Towns of Shelburne, Colrain, and Greenfield should participate in the Deerfield River Watershed Regional Open Space Plan, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments. Through this plan the communities can work cooperatively with other watershed towns to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Hinsdale Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. Shelburne, Colrain, and Greenfield should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

GREEN RIVER (SEGMENT MA33-30)

Location: From Greenfield swimming pool dam (northwest of Nash's Mill Road), Greenfield, to confluence with the Deerfield River, Greenfield (formerly Segment MA33-10 and part of Segment MA33-09).
Segment Length: 3.7 miles.
Classification: Class B, Cold Water Fishery.



The drainage area of this segment is approximately 52.1 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	65.2%
Agriculture	13.2%
Residential	10.7%

This segment of the Green River (one of three) begins as the outflow from the "Greenfield Municipal Pool". The river crosses under Route 91 and parallels this road for about 0.6 miles. The Green River then flows generally southeast, along the southern edge of the urbanized area of Greenfield. It finally flows into the Deerfield River just upstream from the outfall of the Greenfield Water Pollution Control Facility.

MA DFWELE has recommended that Mill Brook, a tributary in this subwatershed, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	PWS ID#	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
					1998	1999	2000	2001
Bernardston Fire & Water District	1029000	10302901	Dug Well-01G Gravel Dug Well #2-02G	0.17	0.28	0.28	0.18**	0.06
Greenfield Water Department*	1114000	10311401	Millbrook Well #1-04 Millbrook Well #2-05 Millbrook Well #3-06	2.12	2.19**	2.23	2.07	2.18**

*not all sources necessarily within this segment, **withdrawal did not exceed registration amount by more than 0.1MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H2)

The Greenfield WPCF discharge was moved from the Green River to the mainstem Deerfield River on 6 October 1999. There are no other permitted NPDES discharges to this segment of the Green River.

OTHER

ACOE Stream Ecosystem Restoration Feasibility Study

In 2000 the US Army Corps of Engineers began an Ecosystem Restoration Feasibility Study of the Green River with matching funds provided by the Executive Office of Environmental Affairs and the Town of Greenfield. The study is investigating the hydrologic, environmental, physical, cultural, and economic impacts of dam removal and/or installation of fish passage structures on four dams along the Green River, as well as other potential stream ecosystem restoration activities. The project is due to be completed in 2004. The first two dams located on the Green River lie in this segment. The upstream dam is known as the Mill Street Dam and the most downstream dam is called the Wiley Russell Dam. ACOE's report will likely provide specific recommendations and a cost/feasibility analysis of dam removal and/ or installation of fish passage structures at these dams. The report will also assess the feasibility of potential restorative actions along the riparian corridor such as erosion control and instream habitat restoration to improve habitat quality and reduce instream turbidity. Implementation of the recommendations is optional, but Greenfield may request funding from ACOE for up to 65% of the cost if they decide to follow them (ACOE 2001).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The Green River is stocked with Atlantic salmon fry, but no upstream fish passage is currently available at the two dams in this segment - the Mill Street Dam and the Wiley and Russell Dam. Mill Street Dam is a concrete dam about 12 feet high and was originally owned and used by Greenfield Electric Light and Power. The dam was recently reconstructed and is in good condition. The Wiley and Russell Dam is a timber crib and concrete dam about 14 feet high and 165 feet in length with a storage capacity of 10 acre feet. The dam was originally built for water supply purposes for a tap and die factory adjacent to the site (factory demolished in 2002). The dam has two inoperable low-level outlets and has fallen into disrepair. A 1998 MA DEM Dam Safety Inspection Report classifies this dam as Significant Hazard (Class II) potential. Section 10.06(3) of MA DEM Dam Safety Regulations (310 CMR 10.00) defines Significant Hazard as: *"Dams located where failure or miss-operation may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities."*

The Green River was sampled by DWM downstream from the footbridge off Route 5-10 (at the end of Petty Plain Road) in Greenfield (Station GR01) in September 2000. At the time of the survey the river was roughly 16 m wide with depths ranging from 0.1 to 0.8 m. The substrates were comprised primarily of cobble and sand/gravel. The overall habitat score was 135 (Appendix B). Habitat quality was limited most by bank stability, riparian vegetated zone width, embeddedness and channel flow status. Some areas of severe erosion were observed along the steeper portions of both banks (Appendix B).

Biology

Compared to the Cold River reference station (Station CR01) the RBP III analysis conducted by DWM in September 2000 indicated the benthic community was non-impacted in the Green River downstream from the footbridge off Route 5-10 (at the end of Petty Plain Road) in Greenfield (Station GR01) (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in the Green River in 1988 and 1995 (Appendix C). The most recent biological assessment of the benthic community in this portion of the Green River strongly suggests that water quality has improved.

DWM biologists collected periphyton samples from Station GR01, located downstream from the footbridge off Route 5-10 (at the end of Petty Plain Road) in Greenfield, at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 50% and percent algal cover was reported as 1%. The dominant algal types were blue-greens. No nuisance algal growth was documented. (Appendix D)

Chemistry – water

DWM collected water quality samples from two stations in this segment of the Green River; downstream from the Mill Street Dam in Greenfield (Station GR03) and just upstream from the confluence with the Deerfield River in Greenfield (Station GR02). These locations were sampled in July, August and October 2000 (n = 3) as part of the 2000 Deerfield River Watershed monitoring survey (Appendix A, Tables A8 and A9). Sampling was also conducted by DWM near the mouth of one tributary (locally known as Maple Brook – Station MB01). DWM also collected water quality samples from the Green River at the footbridge off Route 5-10 in Greenfield (at the end of Petty Plain Road) (Station GR) between June 1995 and June 1996 (n = 13) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Tables G3 and G4).

Water quality samples were collected from the Green River at the footbridge off Route 5-10 (at the end of Petty Plain Road) (Station DW14) on as many as six occasions between August and November 2000 by ESS (ESS 2002). It should be noted that ESS also conducted some water quality sampling in four tributaries (Cherry Rum, Arms, Maple, and Wheeler brooks – see text box below) to this segment of the Green River.

DO and % saturation

DO measurements in the Green River measured by DWM and ESS in 2000 were not less than 8.2 mg/L and were as high as 11.0 mg/L (Appendix A, Table A8 and ESS 2002). Percent saturation

ranged from 75.0 to a high of 103.2%. It should be noted that these data represent both worst-case (pre-dawn) and daytime conditions.

Temperature
The maximum temperature in the Green River measured by DWM and ESS in 2000 was 20°C (Appendix A, Table A8 and ESS 2002).

pH and Alkalinity
The pH of the Green River ranged between 7.1 and 7.5 SU (Appendix A, Table A8 and ESS 2002) Alkalinity of the Green River ranged from 41 to 46 mg/L (Appendix A, Table A9).

Suspended Solids
Suspended solids ranged from 1.6 to 4.4 mg/L during the 2000 surveys (Appendix A, Table A9).

Ammonia-Nitrogen
No detectable concentrations of ammonia-nitrogen were documented in the Green River during the 2000 DWM surveys (Appendix A, Table A9) (qualified data omitted).

Hardness
Hardness measurements of the Green River ranged from 49 to 53mg/L (Appendix A, Table A9).

Phosphorus
Total phosphorus measurements in the Green River ranged from 0.011 to 0.02 mg/L (Appendix A, Table A9).

The *Aquatic Life Use* for this segment of the Green River is assessed as support based on the benthic macroinvertebrate community information and the water quality data. Habitat quality conditions related to poor bank stability, limited riparian zone width and substrate embeddedness are of concern and, therefore, this use is identified with an Alert Status.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

Note: ESS conducted fecal coliform bacteria sampling in four tributaries (Cherry Rum, Arms, Maple, and Wheeler brooks) to this segment of the Green River that were upstream from their sampling location on the mainstem Green River (Station DW14) (ESS 2002). Results are summarized below.

- Cherry Rum Brook (Station DW18) was located near the confluence with Green River, Greenfield. Fecal coliform bacteria counts ranged from 40 to 500 cfu/100 mL with one of six counts greater than 400 cfu/100 mL. The high count was collected during the *Primary Contact Recreational Season* and representative of wet weather conditions. In the fall of 2002 a Greenfield Community College (GCC) student conducted an optical brightener study of Cherry Rum Brook. All optical brightener samples collected at three sites during a two-month period along the length of the brook were negative, indicating that sewage contamination is likely not the source of elevated bacteria counts in this brook (Metcalfe 2002).
- Arms Brook was sampled at Station DW22 and Station DW15. Station DW22 was located upstream from sampling Station DW15, along a private dirt drive, Greenfield. Station DW15 was located at Colrain Road bridge, Greenfield. Fecal coliform bacteria counts were 110 and 290 cfu/100 mL at Station DW22 and ranged from 270 to 5,790 cfu/100 mL at Station DW15. In 2001 another GCC student conducted an optical brightener study on Arms Brook (Lively 2001). Sampling at six sites along the length of the brook occurred during November and December and no optical brighteners were detected in any of the samples. Fecal coliform samples were collected at these sites by the student and analyzed by the Greenfield WWTP on two occasions. Counts ranged from 26 cfu/100 mL at the upstream station to TNTC (too numerous to count) at the downstream station. Cows were observed in and around this brook during the study, so consequently the study concluded that the source of the high bacteria counts to this brook were the cows. After the study in 2002 the cows were sold and the field is no longer being used for grazing.
- Maple Brook Station DW13 was located at the confluence with the Green River, Greenfield. Fecal coliform bacteria counts ranged from 1,700 to 2,250 cfu/100 mL and four of six counts were reported as >2,000 cfu/100 mL. In 1998, an optical brightener study was conducted on Maple Brook by a University of Massachusetts graduate student (Skalka 1999). Results collected over a three-month period (September – November) showed that eight of the 16 sites sampled in Maple Brook tested positive for optical brighteners. Maple Brook is culverted for most of its length through Greenfield. The Greenfield DPW is aware of the areas where contamination is occurring (likely from leaking sewer pipes) and is currently correcting the problem (Shields, 2003b).
- Wheeler Brook Station DW16 was located at Woodard Road bridge, Greenfield. Fecal coliform bacteria counts ranged from 10 to 1,700 cfu/100 mL with two of six counts greater than 200 cfu/100 mL. Both high counts were representative of wet weather conditions.

On the Green River fecal coliform bacteria samples were collected at the footbridge off Route 5-10 (at the end of Petty Plain Road) (Station DW14) on six occasions, representing both wet and dry weather sampling, between August and November 2000 by ESS (ESS 2002). Fecal coliform bacteria counts ranged from 80 to 6,870 cfu/100 mL. Two of the six counts were greater than 400 cfu/100 mL and occurred during wet weather conditions. The geometric mean of all six samples is 319. The geometric mean of the bacteria samples collected during the *Primary Contact Recreational Season* is 188, with only one of four samples exceeding 400 cfu/100 mL (1800 cfu/100 mL).

This segment of the Green River flows through the urbanized portion of Greenfield. There are isolated areas of trash and debris along the riverbank. Turbidity and trash were also observed in the sampling reach during the biosurvey and a petroleum odor from the sediment was noted. No other objectionable conditions (e.g., water odors, oils, deposits) were recorded by DWM biologists (Appendix B).

The *Primary and Secondary Contact Recreational* uses are assessed as support for this segment of the Green River. However, they are both identified with an "Alert Status" because of elevated fecal coliform bacteria counts associated with wet weather events. There are also several tributaries to this segment of the Green River that exhibited elevated fecal coliform bacteria counts during both dry and wet weather. The *Aesthetic Use* is assessed as support but it is also identified with an "Alert Status" because of instream turbidity, and isolated areas of trash and debris.

Green River (MA33-30) Use Summary Table

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

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

RECOMMENDATIONS GREEN RIVER (MA33-30)

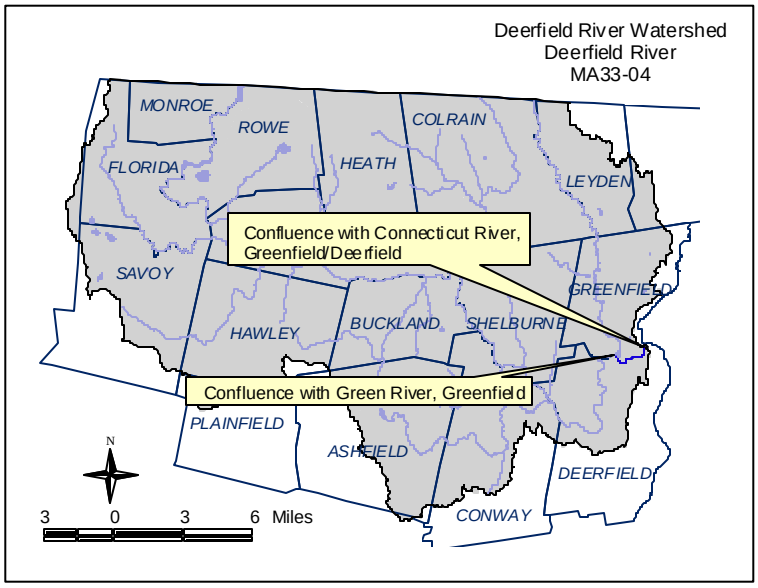
- Continue to conduct water quality and biological monitoring in this segment to assess the designated uses. In particular, biomonitoring is recommended here during the next MA DEP Deerfield River watershed survey in 2005 to continue to assess biological health in this low-gradient portion of the Green River, where both upstream agricultural activities and the urbanized nature of Greenfield potentially influence water quality and biological integrity. Fish population sampling, which has not historically been performed by MA DEP in the Green River, should accompany the macroinvertebrate sampling effort. Due to the wide nature of the GR01 sampling reach the fish population survey may require multiple crews or a barge-mounted electrofishing unit.
- Conduct frequent bacteria sampling in this segment of the Green River particularly during the *Primary Contact Recreational Season* to document current conditions and evaluate the effectiveness of any source reduction activities. For example, conduct fecal coliform sampling in Arms Brook to confirm that bacteria contamination is no longer occurring since cows were removed. If agricultural uses resume along this tributary and these uses contribute to elevated bacteria levels work with NRCS to encourage landowners to implement appropriate agricultural BMPs to protect the water quality.
- Support efforts by the Town of Greenfield in correcting leaking sewer lines (the likely source of bacteria contamination in Maple Brook) and implementing a proactive stormwater management plan.
- Support the recommendations of the ACOE Green River Feasibility Study. Assist the Town of Greenfield and others in securing funding to implement the recommendations of the study.
- Mill Brook, a tributary in this subwatershed should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by Greenfield Community College, DRWA and CRWC.
- The Town of Greenfield should participate in the Deerfield River Watershed Regional Open Space Plan, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments. Through this plan the town can work

cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.

- In order to prevent degradation of water quality in the Green River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. Greenfield should support recommendations of their recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their communities' character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Green River subwatershed identified and mapped significant stands of this plant growing along the riverbanks from the Route 2A bridge in Greenfield to the confluence with the Deerfield mainstem. The knotweed stands in this segment were found to be larger and more contiguous than in the above segments. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).
- Support formation of a stream team to identify and stencil stormdrains that flow into the Green River from the urbanized areas of the Town of Greenfield.

DEERFIELD RIVER (SEGMENT MA33-04)

Location: Confluence with Green River, Greenfield, to confluence with Connecticut River, Greenfield/Deerfield.
Segment Length: 2.0 miles.
Classification: Class B, Warm Water Fishery.



The drainage area of this segment (in Massachusetts) is approximately 346.61 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	80.4%
Agriculture	8.9%
Residential	4.6

From the confluence with the Green River in Greenfield the Deerfield River meanders in a generally northeasterly direction. As it passes under Route 5 the river valley narrows as the river cuts its way through basalt bedrock. The river then passes under a railroad bridge and turns north entering the Connecticut River approximately a mile further downstream.

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
				1998	1999	2000	2001
Trew Corporation	10307404	Trew Corp Well	0.14	0.15	0.02	0.01	0.01

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

As of November 1999 the Town of Greenfield is authorized to discharge from the Greenfield Water Pollution Control Plant (WPCP) to the Deerfield River downstream from the confluence with the Green River in Greenfield (NPDES permit MA0101214 issued October 2002). The permittee is authorized to discharge 3.2 MGD of treated sanitary wastewater via outfall 001. The facility's acute whole effluent toxicity limits are $LC_{50} \geq 100\%$ with a monitoring frequency of four times per year. The facility utilizes chlorine for disinfection (the maximum daily TRC shall not exceed 0.79 mg/L between 1 April and 31 October). The maximum TRC measurement recorded in the TOXTD database for this facility is 0.18 mg/L.

WTE Recycling is permitted (MAR05B674) to discharge stormwater from its facility on Southern Avenue, Greenfield to the Deerfield River.

OTHER

East Deerfield Railyard

The East Deerfield Railyard is approximately 129 acres and is located in a commercial/residential section of East Deerfield Massachusetts. The site, currently owned by Boston and Maine Railroad Corporation (B&M), has been an active railyard since the late 1800s. It is bounded to the north and east by open land and the Connecticut River, to the south by East Deerfield Road, and to the west by the Deerfield River. The site was classified as a Tier II Site on May 31, 2000 by MA DEP due to several incidences of oil and hazardous materials releases that have occurred at the railyard. Specific assessment and remedial activities were required under M.G.L. Chapter 21E for these releases. Although the Deerfield Watershed receives drainage from a relatively small part of the site, the railyard is very close to the Deerfield River (<200 m) and potential stormwater runoff and groundwater inputs are not known. The majority of the site lies within the Connecticut River Watershed.

USE ASSESSMENT
AQUATIC LIFE

Toxicity

Ambient

Water from the Deerfield River was collected approximately 50 feet upstream from the Greenfield WPCP discharge (or if the river is frozen upstream from the discharge Deerfield River water is collected near the Stillwater Bridge) in Deerfield for use as dilution water in the facility's whole effluent toxicity tests. Survival of *P. promelas* exposed (48-hours) to the river water was not less than 95% in the 13 tests conducted between November 1999 and December 2002.

Effluent

A total of 13 definitive acute whole effluent toxicity tests were conducted on the Greenfield WPCP effluent using *P. promelas* between November 1999 and December 2002. The effluent was not acutely toxic ($LC_{50} \geq 100\%$) to *P. promelas* during this period.

Chemistry - water

Water from the Deerfield River was collected approximately 50 feet upstream from the Greenfield WPCP discharge (or if the river was frozen upstream from the discharge Deerfield River water was collected near the Stillwater Bridge) for use as dilution water for the facility's whole effluent toxicity tests as required by their NPDES permit on 13 occasions between November 1999 and December 2002. Data from these reports, maintained in the TOXTD database by DWM, were summarized below.

DWM collected water quality samples from the Deerfield River downstream from the Route 5/10 bridge (southern channel of river) in Deerfield (Station DR10) in July August and October 2000 (n=3) as part of the 2000 Deerfield River Watershed monitoring survey (Appendix A, Tables A8 and A9). Sampling was also conducted by DWM downstream from the Route 5/10 bridge (on the northern channel) (Station 5-10) between September 1995 and June 1996 (n = 10) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Tables G3 and G4).

Water quality samples were also collected from the Deerfield River at the Route 5/10 bridge (downstream side over the north channel), Greenfield (Station DW1) on as many as six occasions between August and November 2000 by ESS (ESS 2002).

The DRWA performs volunteer water quality monitoring in this segment of the Deerfield River near the Route 5/10 bridge in Greenfield (DER-010). Samples were collected for pH, DO, alkalinity, and temperature once during April in 2001 and 2002. However, due to the limited number of samples the results were not used in this assessment (DRWA 2001 and DRWA 2002).

As part of the "1998-1999 Connecticut River Nutrient Loading" project, water quality samples were collected by DWM on a monthly basis from the Deerfield River at the downstream side of the Route 5/10 Bridge in Deerfield/Greenfield (Station CT04) from June 1998 through May 1999 (Dallaire 2000).

DO and % saturation

DO levels in the Deerfield River measured by DWM and ESS in 2000 were not less than 8.9 mg/L and were as high as 11 mg/L (Appendix A, Tables A8 and ESS 2002). Percent saturation ranged from 88 to a high of 95%. It should be noted that these data represent both worst-case (pre-dawn) and daytime conditions.

Temperature

The maximum temperature in the Deerfield River measured by DWM and ESS in 2000 was 20.2°C (Appendix A, Table A8 and ESS 2002).

pH and Alkalinity

The pH of the Deerfield River ranged between 7.0 and 7.6 SU and alkalinity ranged from 10 to 60 mg/L upstream of the Greenfield WPCP discharge (TOXTD). Further downstream (at the Route 5/10 bridge) the pH of the Deerfield River ranged between 6.8 and 7.0 SU (Appendix A, Tables A8 -

qualified data excluded and ESS 2002). Alkalinity of the Deerfield River at the Route 5/10 bridge ranged from 11 to 17 mg/L during the summer of 2000 (Appendix A, Table A9).

Suspended Solids
The highest reported suspended solids concentration in the Deerfield River upstream of the Greenfield WPCP discharge was 28 mg/L, but, it should be noted that only one of the 13 measurements at this location was greater than 25 mg/L (TOXTD). Suspended solids in the river at the Route 5/10 bridge ranged from 1.4 to 5.7 mg/L during the 2000 surveys (Appendix A, Table A9) and from <1.0 to 36 mg/L during the "1998-1999 Connecticut River Nutrient Loading" project. During this study two of the 13 measurements exceeded 25 mg/L (Dallaire 2000).

Ammonia-Nitrogen
The concentration of ammonia-nitrogen in the Deerfield River upstream from the Greenfield WPCP discharge ranged from 0.03 to 0.112 mg/L (TOXTD). No detectable concentrations of ammonia-nitrogen were documented in the Deerfield River at the Route 5/10 bridge during the 2000 DWM surveys (Appendix A, Table A9) and from <0.02 to 0.08 mg/L during the "1998-1999 Connecticut River Nutrient Loading" project (Dallaire 2000).

Total Residual Chlorine
All of the 13 TRC measurements in the Deerfield River upstream from the Greenfield WPCP discharge were less than or equal to the minimum quantification level of 0.05 mg/L (TOXTD).

Hardness
Hardness measurements in the Deerfield River upstream of the Greenfield WPCP discharge ranged from 12 to 40 mg/L (TOXTD). Hardness measurements of the Deerfield River at the Route 5/10 bridge ranged from 17 to 23 mg/L (Appendix A, Table A9).

Phosphorus
Total phosphorus measurements in the Deerfield River near the Route 5/10 bridge ranged from 0.018 to 0.022 mg/L and from 0.02 to 0.11 mg/L during the "1998-1999 Connecticut River Nutrient Loading" project (Dallaire 2000). With the exception of the one high measurement of 0.11 mg/L none of the other 14 measurements taken during the nutrient loading study exceeded 0.06 mg/L. The high total phosphorus sample was the second sample collected on 28 July 1998 (12:48 hours). The DWM field survey crew noticed that after they had collected the first sample (at which time the Deerfield River was clear) the entire river below the bridge was turbid so they collected a second sample. The total phosphorus concentration was elevated when the river was turbid. Attempts to locate the source of the problem and the extent of the turbid conditions were not successful (Mattson 2003a). This survey was representative of dry weather conditions.

The *Aquatic Life Use* for this segment of the Deerfield River is assessed as support based on the good survival of test organisms exposed to the river water and the water quality data. This use, however, is identified with an Alert Status because of concerns reported to the Deerfield River Watershed Team from river users regarding flow regulation (hydromodification) resulting from the operations of the upstream hydroelectric generating facilities. Whether or not minimum flow requirements are being met and the effect, if any, of the hydropower generating developments on instream habitat and aquatic life is of concern and merits further investigation. The one episode of elevated total phosphorus and instream turbidity is also of concern.

FISH CONSUMPTION

In October 2000 fish toxics monitoring (metals, PCB, and organochlorine pesticide in edible fillets) was conducted by DWM in the lower Deerfield River (Maietta and Colonna-Romano 2001). Electrofishing in the Deerfield River between the confluence with the Green River and the mouth (Station F0113) resulted in the collection of three white suckers. These fish were composited and the edible fillet sample was analyzed for the presence of heavy metals, PCB and chlorinated pesticides. PCB was not detected nor was mercury in excess of the MA DPH action level of 0.5 ppm (Appendix B).

No site-specific advisory was issued for the Deerfield River by MA DPH based on their review of these data and so, the *Fish Consumption Use* is not assessed (precluded by the statewide Fish Consumption Advisory for mercury).

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

Fecal coliform bacteria samples were collected from the Deerfield River at the Route 5/10 bridge (downstream side over the north channel), Greenfield (Station DW1) on six occasions between August and November 2000 by ESS (ESS 2002). Four of the sampling dates were during the Primary Contact Recreational Season. No elevated fecal coliform counts were reported (range <10 to 80 cfu/100 mL) during this time. The highest count (340 cfu/100 mL) was collected in November and was representative of wet weather conditions. It was also collected during the season when the Greenfield WPCP discharge is not chlorinated. Fecal coliform bacteria sampling was also conducted by DWM in the Deerfield River at the Route 5/10 bridge in Greenfield/Deerfield (Station 5-10) between September 1995 and June 1996 (n = 9 sampling events) (Appendix G, Table G4).

While turbidity has often been observed in the Deerfield River during high spring flows and after rain events these conditions were considered to be a natural result of the soil types in the watershed. (Averill 2002). However, on at least one occasion a DWM field survey observed turbidity in the Deerfield River at the Route 5-10 Bridge while they were sampling. Instream turbidity was also documented by a DWM field survey crew in August 1998 (see discussion in *Aquatic Life Use*). The cause of the turbidity was not associated with wet weather conditions, but, attempts to locate the source of the problem and the extent of the turbid conditions were not successful (Mattson 2003a).

The *Primary Contact Recreational Use* is assessed as support based on the low fecal coliform bacteria counts during the primary contact season. The *Secondary Contact Recreational Use* is also assessed as support, although it should be noted that higher counts (not in excess of the water quality standards) do occur in this section of the river when the Greenfield WPCP is not chlorinating its discharge. The *Aesthetics Use* is also assessed as support based on the generally high aesthetic quality of the river. This use, however, is identified with an Alert Status because of concerns about observations of high turbidity that could not be explained.

Deerfield River (MA33-04) Use Summary Table

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

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

RECOMMENDATIONS DEERFIELD RIVER (MA33-04)

- Continue DWM water quality and biological monitoring in this segment during the next monitoring year (2005). Investigate possible sources of occasional high turbidity.
- Evaluate biota, water and sediment quality impacts to the Deerfield River from the East Deerfield Railyard and WTE site.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by DRWA, CRWC, Zoar Outdoor and Trout Unlimited.
- The Towns of Greenfield and Deerfield should participate in the Deerfield River Watershed Regional Open Space Plan, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments. Through this plan the communities can work cooperatively with other watershed towns to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Deerfield River it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Greenfield and Deerfield should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.

DEERFIELD RIVER WATERSHED - LAKE ASSESSMENTS

A total of 29 lakes, ponds or impoundments (the term "lakes" will hereafter be used to include all) have been identified and assigned PALIS code numbers in the Deerfield River Watershed (Ackerman 1989 and MA DEP 2001a). However, three lakes from this PALIS list (Greenfield Reservoir in Leyden, Little Mohawk Pond in Shelburne, and Schneck Brook Pond in Conway) have not been included in this report because it has been determined that they no longer exist as lakes (dam removed and/or filled in with aquatic vegetation). Another lake (Paddy Hill Pond, Ashfield) on the Deerfield Watershed PALIS list was found to be located in the Westfield Watershed and two others (South River Impoundment in Conway and Lower Reservoir in Rowe/Florida) are being assessed as part of the river segments where they exist as run of the river impoundments so they are not included in the lakes assessment to avoid redundancy. As a result of these updates and omissions a total of 24 named ponds exist in the Deerfield Watershed. This report includes information on 22 Deerfield Watershed lakes that are in the WBS database (Figure 9). The remaining 2 lakes, Beaver Pond in Hawley and Browns Pond in Monroe (1.4 acres total) are unassessed and therefore are not currently included as segments in the WBS database.

The total surface area of these 24 Deerfield River Watershed lakes in Massachusetts is approximately 562 acres. They range in size from less than one acre to 108 acres; 2 lakes are greater than 100 acres (including VT portion of Sherman Reservoir), and 4 are greater than 50 acres.

The 22 lakes assessed in this report represent 560.6 of the 562 acres, or greater than 99% of the surface area in the Massachusetts portion of the Deerfield River Watershed (Figure 9). Baseline lake surveys were conducted on two of these lakes (TMDL sampling) in the summer of 2000 (Appendix F, Tables F2 and F3). Synoptic surveys were conducted by DWM at 13 of these lakes in 1995 (Appendix F, Table F1). Table 4 presents the use assessments for the individual lakes in the Deerfield River Watershed.

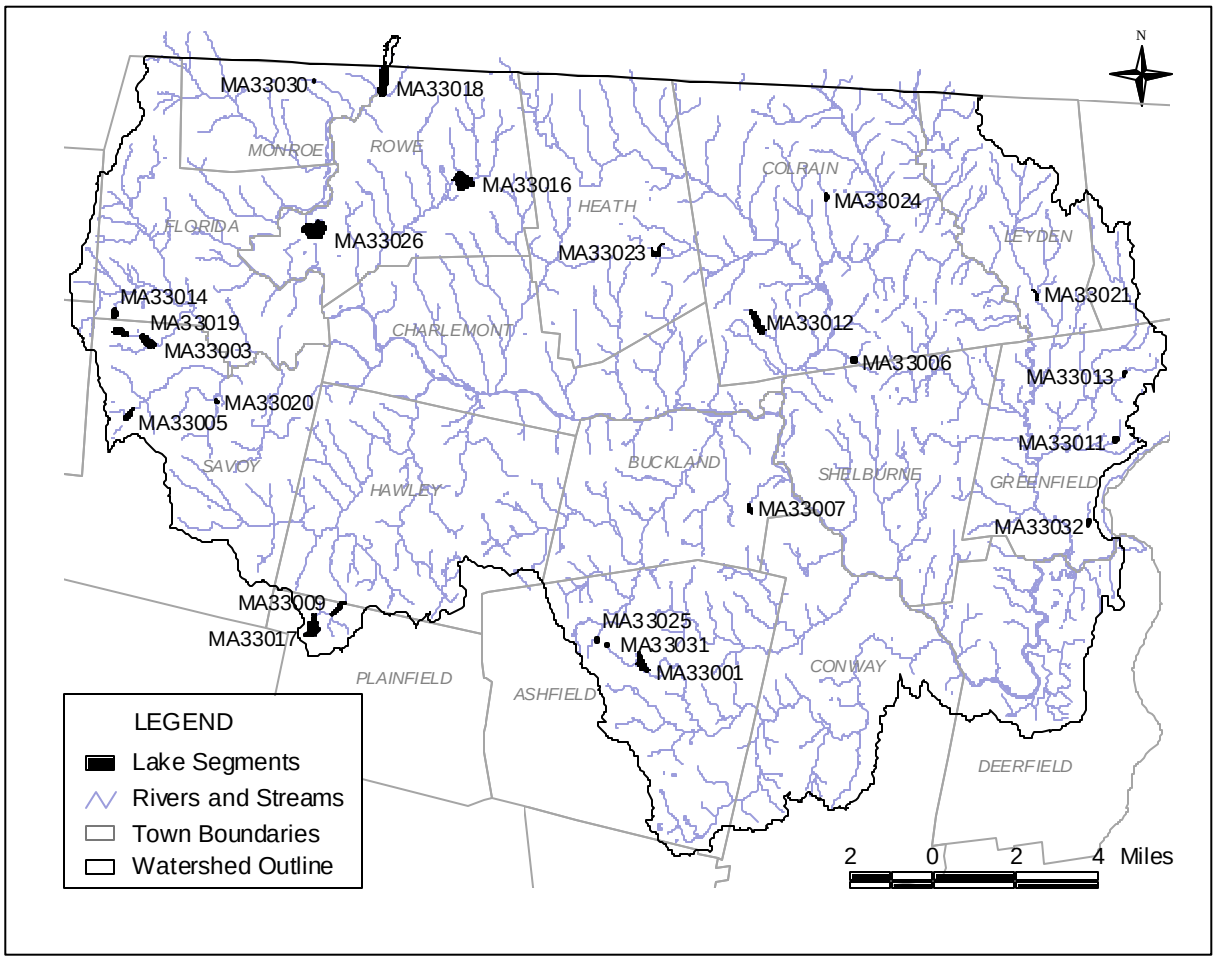


Figure 9. Deerfield River Watershed (Massachusetts Portion) – Lake Segment Locations Identified by WBID

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H1)
The Yankee Atomic Electric Company (YAEC) in Rowe, an electric generating power plant, was authorized to discharge via three outfalls to Sherman Reservoir (NPDES permit MA0004367 issued in September 1988). The discharges were as follows:

- Outfall 001 - up to 225 MGD of condenser cooling water (maximum allowable temperature rise of 23.5^{o}F over intake water temperature),
- Outfall 010 - 10.8 MGD of service water consisting of turbine lubricating oil, cooling water, generator hydrogen cooling water, and the primary plant effluent, and,
- Outfall 002 - 1.0 MGD of water treatment plant effluent, transformer cooling water, and floor drain water (maximum allowable rise of 35^{o}F over intake water temperature).

The YAEC ceased operations on 26 February 1992. A new permit has been developed to authorize the discharge of up to 0.22 MGD of wastewater (spent fuel pool heat exchanger and dilution test tank effluent, stormwater, and excavation de-watering), resulting from the plant decommissioning process to Sherman Reservoir. The facility submitted two NPDES renewal applications to MA DEP and EPA for coverage for the discharge of plant decommissioning waters including stormwater and construction dewatering. The new NPDES permit was reissued in 2003 and will expire July 2008 (Hogan 2003).

Yankee Atomic Electric Company Decommissioning Activities:
Yankee Atomic Electric Company (YAEC) permanently shut down the Yankee Nuclear Power Station (YNPS) in Rowe, MA in February 1992 and has been actively decommissioning the facility since that time. During decommissioning there is a need to operate certain plant systems, requiring continued water use and discharge under the NPDES permit (see above). YNPS continues to use Sherman Reservoir as the source of water for the plant's cooling water system. Water is withdrawn from the reservoir through a 10-foot diameter pipe, located about 200 feet from shore at a depth of 70 feet. Historically, this non-contact cooling water was discharged via three outfalls. Decommissioning activities have resulted in the elimination of two of these outfalls and now only Outfall 001 discharges non-contact cooling water from the spent fuel pool heat exchanger and dilution for test tank effluent. Two independent stormwater outfalls discharge stormwater collected from the parking areas and buildings into Sherman Reservoir (Outfall 003) and the Deerfield River downstream of Sherman dam (Outfall 004). Raw material storage areas and decommissioning activities in areas that may affect the quality of stormwater are controlled through a Stormwater Pollution Prevention Plan.

Currently, YAEC is transferring spent fuel from the spent fuel pool (wet storage) to the independent spent fuel storage installation pad (dry storage) in preparation for the final dismantlement phase of the YNPS decommissioning. Once this phase is completed, the spent fuel pool must be drained before the building can be dismantled. YAEC has proposed to treat and drain the spent fuel pool water through NPDES Outfall 001. The spent fuel pool contains approximately 145,000 gallons of water. An additional 20,000 gallons will be used to rinse the spent fuel pool walls while draining, bringing the total discharge volume to 165,000 gallons. Prior to discharge of the pool, which contains a concentration of non-radioactive boron (estimated at 850 mg/l) and low level radioactivity, water will pass through a purification system to minimize the release of any radioactive materials to the environment. Purification will reduce the radiological activity to ensure compliance with the Nuclear Regulatory Commission (NRC) requirements of 10 CFR Part 50. The treated pool water will then be discharged via Outfall 001.

The flow rate through the system is estimated to be approximately 10 gpm and draining of the rinse water may occur in a series of batch releases over a period of several weeks. The entire draining process is expected to occur over a one-month period. The treated water will be monitored with an in-line, real-time radiation monitor prior to its release to Outfall 001. Grab samples will also be collected to monitor the purification system performance and provide an additional data point to confirm any radiation activity release determinations and dose projections resulting from discharge to Sherman Reservoir.

The dismantling of buildings and related structures, including foundation excavation, will likely result in areas that fill with either groundwater or stormwater. The water-filled excavations must be dewatered to complete the dismantling activity. Dewatering will be intermittent and only performed when needed. The discharge will be to Sherman Reservoir and controlled using best management practices recommended for construction dewatering activities and regulatory requirements.

LAKE USE ASSESSMENTS

Lake assessments are based on information gathered during DWM surveys (recent and historic) as well as pertinent information from other reliable sources (e.g., abutters, herbicide applicators, diagnostic/feasibility studies, MA DPH, etc.). The 1995 DWM synoptic surveys focused on visual observations of water quality and quantity (e.g., water level, sedimentation, etc.), the presence of native and non-native aquatic plants (both distribution and areal cover) and presence/severity of algal blooms (Appendix F, Table F1). During 2000 more intensive in-lake sampling was conducted by DWM in two lakes (Pelham Lake and Plainfield Pond) in the Deerfield River Watershed as part of the TMDL program. This sampling included: in-lake measurements of dissolved oxygen, pH, temperature, Secchi disk transparency, nutrients, and chlorophyll *a* (Appendix F, Tables F2 and F3). Sediment samples were collected by ESS in 2000 in Sherman Reservoir (ESS 2002). The *Primary Contact Recreational* Use was only assessed in two MA DCR (formerly MA DEM) owned lakes with public bathing beaches (North and South Ponds) where bacteria data were reported to MA DPH as part of the public beach monitoring program. To determine the status of the *Fish Consumption Use* fish consumption advisory information was obtained from the MA DPH (MA DPH 2002a). 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 Deerfield River Watershed's public water suppliers.

The use assessments and supporting information were entered into the EPA Water Body System database. Data on the presence of non-native plants were entered into the MA DEP DWM informal non-native plant tracking database.

AQUATIC LIFE

Biology

No non-native aquatic macrophytes were observed in any of the 13 lakes surveyed by DWM in 1995 and/or 2000 (Appendix F, Table F1 and Mattson 2000). *Myriophyllum heterophyllum* (variable water milfoil) is the only non-native aquatic species suspected in the Deerfield River Watershed (Bog Pond). The mere presence of any non-native species is considered an imbalance to the native biotic community and so this lake is identified with an Alert Status. Additionally, this species has a high potential for spreading and can easily establish itself in downstream river segments in the Deerfield River Watershed.

Over a two-year period (2000-2002) the MA DFWELE conducted fish population sampling as part of the "Lakes Survey for TMDL Development" project (MA DFWELE 2002). This study included two lakes in the Deerfield River Watershed: Pelham Lake (Rowe - MA33016) and Plainfield Pond (Plainfield – MA33017).

Pelham Lake

Pelham Lake in Rowe was sampled by MA DFWELE for the above study using electrofishing, gillnetting and seining. The fish population was dominated by yellow perch (*Perca flavescens*). Other collected species included: pumpkinseed (*Lepomis gibbosus*), golden shiner (*Notemigonus crysoleucas*), chain pickerel (*Esox niger*), white sucker (*Catostomus commersoni*), largemouth bass (*Micropterus salmoides*), brown bullhead (*Ameiurus nebulosus*), black crappie (*Pomoxis nigromaculatus*), smallmouth bass (*Micropterus dolomieu*), and brown trout (*Salmo trutta*).

Plainfield Pond

Plainfield Pond in Plainfield was sampled by MA DFWELE for the above study using electrofishing, gillnetting and seining. The fish population was dominated by yellow perch (*Perca flavescens*). Other collected species included: chain pickerel (*Esox niger*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), largemouth bass (*Micropterus salmoides*), and golden shiner (*Notemigonus crysoleucas*).

Chemistry-water

Hypolimnetic oxygen depletion did not occur in either Pelham Lake or Plainfield Pond in September 2000 (Appendix F, Table F2). The total phosphorus concentrations were low to moderately high in Pelham Lake and were low in Plainfield Pond (Appendix F, Table F3). There are too little data (some data were censored) to assess the status of the *Aquatic Life Uses* for either of these ponds. Additional

data/information needs to be researched to determine if these conditions are naturally occurring or anthropogenically induced.

Chemistry – sediment

Three sediment grab samples were collected and composited from behind Sherman Reservoir Dam on the Deerfield River (Station DWS-1) in July of 2000 by ESS (ESS 2002). The sediment sample was analyzed for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, PCB (polychlorinated biphenyls), PAH (polynuclear aromatic hydrocarbons), TPH (total petroleum hydrocarbons), TOC (total organic carbon), percent volatile solids, percent water, and grain size. With the exception of arsenic and copper all analytes fell below the low effects range (L-EL) as defined by Persaud et al. (1993). The arsenic concentration was measured at 25.5 ppm, which is approximately four times greater than the L-EL and the copper concentration was measured at 32.3 ppm, which is approximately two times greater than the L-EL. The sediment was comprised primarily of silt and clay (45.5%) and fine sand (27.5%) and the total volatile solids was 14.0% by weight. No PAH, TPH, or PCB were detected.

The *Aquatic Life Use* was not assessed in any of the lakes in the Deerfield River Watershed because of the cursory nature of the 1995 synoptic surveys and/or the lack of dissolved oxygen data and other more recent observations. *Aquatic Life Use* is identified with an Alert Status in Sherman Reservoir because the concentration of arsenic and copper in the sediment sample collected behind the Sherman Dam was slightly elevated. Bog Pond is also identified with an Alert Status since there is a report of a unconfirmed non-native species present there (*Myriophyllum heterophyllum*) (Table 4).

FISH CONSUMPTION

In July, 2001 MA DPH issued new consumer advisories on fish consumption and mercury contamination. The MA DPH "…is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age (MA DPH 2001)." Additionally, MA DPH "…is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury (MA DPH 2001)." 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 so, the *Fish Consumption Use* for lakes in the Deerfield River Watershed cannot be assessed as support.

Fish from two lakes in the Deerfield River Watershed were sampled in either 1995 or 2000 as part of the DWM watershed monitoring surveys. The lakes sampled were Sherman Reservoir (Rowe, MA / Monroe, MA / Whitingham, VT) and Bog Pond (Savoy). Fish toxics monitoring (metals, PCB, and organochlorine pesticide in edible fillets) was conducted by DWM in Sherman Reservoir in October 1995 and in Bog Pond in November 2000. These data can be found in Appendix E, Table E1 and Appendix B, *Appendix A, Table A5*. Fish were also sampled in 1994 by Rose et. al. (1999) in three Deerfield Watershed lakes (Ashfield Lake, Bog Pond and Plainfield Pond) as part of a study to investigate fish mercury distribution in Massachusetts.

Sherman Reservoir, Rowe, MA / Monroe, MA / Whitingham, VT (formerly included as part of river Segment MA 33-01)

Mercury in the fish tissue from Sherman Reservoir ranged from 0.204 to 0.785 mg/kg wet weight. The mercury data triggered a site-specific advisory against the consumption of fish from Sherman Reservoir. Selenium levels ranged from 0.138 to 0.327 mg/kg wet weight. PCB arochlors and congeners, pesticides, cadmium, arsenic, and lead were not detected in the edible fillets of all samples analyzed from Sherman Reservoir.

Bog Pond, Savoy
Mercury ranged from 0.14 mg/kg in a sample of brown bullhead (Bog00-04-06) to 0.38 mg/kg in yellow perch (Bog00-01-03). Due to the fact that predator fishes tend to be highest in mercury worst case conditions have not been assessed. Predatory fish from Bog Pond likely contain mercury in concentrations at or near the MA DPH 'trigger level' of 0.5 mg/kg. Cadmium, lead, and arsenic were below MDL (minimum detection limits) in all samples analyzed and selenium concentrations were consistent with those found in waterbodies throughout the Commonwealth. Selenium does not appear to be of concern.

Plainfield Pond, Plainfield
Mercury (average concentration of 0.182 mg/kg) was detected in tissue samples of brown bullhead, largemouth bass, and yellow perch in a study of mercury distribution in fish in Massachusetts lakes performed by Rose *et. al.* (1999). The mercury data triggered a site-specific advisory against the consumption of fish from Plainfield Pond.

Ashfield Lake, Ashfield
The study by Rose et. al. (1999) did not detect elevated concentrations of mercury (average concentration 0.083 mg/kg) in brown bullhead, largemouth bass and yellow perch sampled from Ashfield Lake.

The most recent MA DPH Fish Consumption List recommends the following for lakes in the Deerfield River Watershed (MA DPH 2002a):

Sherman Reservoir (Rowe/Monroe) because of elevated mercury,

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this waterbody,
2. the general public should not consume any yellow perch from this waterbody, and
3. the general public should limit consumption of non-affected fish from this waterbody to two meals per month."

Plainfield Pond (Plainfield) because of elevated mercury,

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any Largemouth Bass from this waterbody, and
2. the general public should limit consumption of largemouth bass from this waterbody."

Sherman Reservoir (72 acres in MA out of a total of 162 acres representing both MA and VT acreage) and Plainfield Pond (60 acres) are assessed as impaired (due to mercury contamination) for the *Fish Consumption Use* (Table 4). The remaining 20 lakes, representing 430 acres, are not assessed for the *Fish Consumption Use*. [NOTE: The MA DPH fish consumption advisory list contains the status of each waterbody for which an advisory has been issued. If a waterbody 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.mass.gov/dph/beha/fishlist.htm. The source of mercury is unknown, although atmospheric deposition is suspected.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS
Bacteria samples were collected at two MA DEM (now known as MA DCR) beaches: North Pond in Florida and South Pond in Savoy in the Savoy State Forest. Elevated bacteria counts were documented infrequently in both of these ponds but neither were reported closed during the 2001 swimming season and were only closed or posted for short periods (2 days in North Pond and 1 day in South Pond) in the 2002 swimming season (Murphy 2002). Both the *Primary* and *Secondary Contact Recreational* uses are assessed as support for these two waterbodies.

There are three public beaches on lakes in the Deerfield River Watershed (Ashfield Pond in Ashfield, Pelham Lake in Rowe and Plainfield Pond in Plainfield). Although no beach closures/postings were recorded in the DPH beach closure database during the 2000/2001 seasons, too limited data are available and so, the Primary and Secondary Contact Recreational uses are not assessed.
The *Primary* and *Secondary Contact Recreational* uses are assessed as support in two lakes; North Pond and South Pond, representing a total of 48 acres. The *Aesthetics Use* for these waterbodies is not assessed. The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are not assessed in

the remaining 20 lakes (514 acres) in the Deerfield River Watershed because of a lack of bacteria, transparency and in-lake survey data.

SUMMARY

Only two of the 22 lakes (totaling 132 acres) in the Deerfield River Watershed listed in this report are impaired for the *Fish Consumption Use*. The cause of impairment is mercury contamination. Two other lakes, totaling 48 acres, supported the *Primary* and *Secondary Contact Recreational* uses. A total of 18 lakes (382 out of 562 acres) are not assessed for any uses. The Aquatic Life Use for Bog Pond was identified with an Alert Status because *Myriophyllum* sp. (a non-native aquatic macrophyte) is suspected. The Aquatic Life Use for Sherman Reservoir was also identified with an Alert Status because of slightly elevated concentrations of arsenic and copper in the sediments.

Table 4 presents the use assessments for the individual lakes in the deerfield river watershed.

RECOMMENDATIONS – LAKES

- Confirm the presence of *Myriophyllum heterophyllum*, which is suspected to occur in Bog Pond (Savoy).
- Coordinate with MA DCR and/or other groups conducting lake surveys to generate quality assured lakes data. Conduct more intensive lake surveys to better determine the lake trophic and use support status. As sources of impairment are identified within lake watersheds they should be eliminated or, at least, minimized through the application of appropriate non-point source control techniques.
- 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 draft Generic Environmental Impact Report 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. This draft aquatic plant report should be consulted prior to the development of any lake management plan to control non-native aquatic or wetland plant species.
- Prevent spreading of invasive 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.

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Table 4. Deerfield Watershed Lake Use Assessment Summary

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Ashfield Pond, Ashfield	MA33001	38	Not Assessed	Not Assessed	Not Assessed	Not assessed	Not assessed
Ashfield Pond has a public bathing beach and although no bathing beach closures were recorded during the 2001 /2002 seasons at the Ashfield public beach too limited data are available so the *Primary* and *Secondary Contact Recreational* and *Aesthetic* uses are not assessed. It should be noted that Ashfield Lakehouse, a private organization, also has a beach. Fish tissue from Ashfield Pond was analyzed for mercury as part of a study in 1994 by Rose *et. al.* (1999) to examine fish mercury distribution in Massachusetts lakes. Concentration of mercury in tissue did not exceed the MA DPH action level. No site specific advisory was issued and, so, the *Fish Consumption Use* is not assessed.							
Bog Pond, Savoy	MA33003	35	Not Assessed*	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Myriophyllum heterophyllum (variable water milfoil) may be present in Bog Pond, but, this needs confirmation. Because this non-native aquatic macrophyte may be present the *Aquatic Life Use* is identified with an Alert Status. Fish toxics monitoring for PCB, organochlorine pesticides and selected metals (including Hg, As, Se, Pb, and Cd) was conducted in Bog Pond as part of the Deerfield River Watershed survey in 2000. The concentrations of total mercury and PCB did not exceed MA DPH action levels of 0.5 and 1.0 mg/Kg, respectively, in the samples analyzed. No site specific advisory was issued and, so, the *Fish Consumption Use* is not assessed. However, all fish analyzed were small and top level predators were not collected, so, worst-case conditions for mercury were not evaluated. Fish tissue from Bog Pond was also analyzed for mercury as part of a study in 1994 by Rose *et. al.* (1999) to examine fish mercury distribution in Massachusetts lakes. Concentration of mercury in fish tissue did not exceed the MA DPH action level in this study.							
Burnett Pond, Savoy	MA33005	18	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Fox Brook Upper Reservoir, Colrain	MA33006	3	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Fox Brook Upper Reservoir is a Class A, Public Water Supply. Shelburne Falls Fire District is registered and permitted to withdraw water from Fox Brook Upper Reservoir (0.44 MGD). Additional information is provided in the Deerfield River Segment MA33-06 and Appendix H, Table H4.							
Goodnow Road Pond, Buckland	MA33007	11	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Hallockville Pond, Hawley/Plainfield	MA33009	19	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Highland Pond, Greenfield	MA33032	2	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Two MA DEM grants were awarded for this pond: In 1997 a management study was funded that was supposed to include water quality and sediment testing, an aquatic vegetation survey, species inventory and an assessment of watershed nutrient and sediment loading. In 1999 the second project was funded to control sedimentation and erosion by installing two sedimentation basins and an erosion control slope. Also included was water quality monitoring, development of an education brochure of the pond and developing a scope for dredging the pond.							
Lower Reservoir, Rowe	MA33028	107	Lower Reservoir is included as part of Deerfield River Segment MA33-01, where it exists as a run of the river impoundment, so it is not included in the lakes assessment (or acreage totals) to avoid redundancy.				
Maynard Pond, Greenfield	MA33011	3	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Table 4 Continued. Deerfield Watershed Lake Use Assessment Summary

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
McLeod Pond, Colrain	MA33012	41	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Mt. Brook Reservoir, Colrain	MA33024	1	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Mt. Brook Reservoir is a Class A, Water Supply.							
Newell Pond, Greenfield	MA33013	1	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
North Pond, Florida	MA33014	19	Not Assessed	Not Assessed	Support	Support	Not Assessed
North Pond is in the MA DEM Savoy State Forest in Florida. The pond has a public bathing beach. This beach was posted for two 2-day periods in June and July 2002 because of elevated bacteria and no postings were recorded for the 2001 swimming season. Because the beach was open for the all of the 2001 and the majority of the 2002 bathing seasons, the *Recreational* uses are assessed as support. The *Aesthetics Use* is not assessed.							
Papoose Lake, Heath	MA33023	14	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Pelham Lake, Rowe	MA33016	80	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
The fish population (MA DFWELE sampling in 2000) was dominated by yellow perch (*Perca flavescens*). Note: TMDL survey conducted in 2000 and synoptic survey in 1995 (Appendix F). This pond had adequate dissolved oxygen at all depths and pH was near neutral during a single September survey in 2000 (Appendix F). Alkalinity was low (<2-6 mg/l) during three surveys during the summer of 2000. Total phosphorus during the same period ranged between <0.009 to 0.043 mg/L in the surface waters. Biovolume density estimated as <10% dense/very dense cover and no non-native aquatic plants were identified (Appendix F). Since the data were limited the *Aquatic Life Use* is not assessed. The Secchi disk depths ranged from 1.3 to >3.0 m (meeting the bathing beach guidelines) even though the water was colored. Pelham Lake has a public bathing beach and, although no bathing beach closures were recorded during the 2001/2002 seasons at the public beach, too limited data are available, so the *Primary* and *Secondary Contact Recreationa*l and *Aesthetic* uses are not assessed. Pelham Lake is on the 1998 303(d) List of Waters because of noxious aquatic plants. However, after reevaluating past information and new data it was determined that the conditions in this lake were likely naturally occurring.							
Phelps Brook Reservoir, Monroe	MA33030	0.1	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Phelps Brook Reservoir is a Class A, Public Water Supply.							
Plainfield Pond, Plainfield	MA33017	60	Not Assessed	Impaired (Mercury, 274)	Not Assessed	Not Assessed	Not Assessed
Because of elevated mercury (Rose *et. al*, 1999), MA DPH issued a fish consumption advisory recommending "Children younger than 12 years, pregnant women, and nursing mothers should not eat any largemouth bass from this waterbody and the general public should limit consumption of largemouth bass from this waterbody." Because of the site-specific advisory the *Fish Consumption Use* is assessed as impaired. The fish population (MA DFWELE sampling in 2000) was dominated by yellow perch (*Perca flavescens*). TMDL survey conducted in 2000 and synoptic survey in 1995 (Appendix F). This pond had adequate dissolved oxygen at all depths and pH was near neutral during a single September survey in 2000 (Appendix F). Alkalinity was low (<3 – 5 mg/l) during three surveys during the summer of 2000. Total phosphorus during the same period ranged between 0.007 to 0.014 mg/L (qualified data omitted). Biovolume density was estimated as 25% dense/very dense cover and no non-native aquatic plants were identified (Appendix F). Since the data were limited the *Aquatic Life Use* is not assessed. The Secchi disk was visible to the lake bottom (meeting the bathing beach guidelines) even though the water was colored. Plainfield Pond has							

Table 4 Continued. Deerfield Watershed Lake Use Assessment Summary

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Plainfield Pond continued: a town-run public bathing beach and although no bathing beach closures were recorded during the 2001/2002 seasons at the Plainfield Town Beach too limited data are available, so the *Primary* and *Secondary Contact Recreational* and *Aesthetic* uses are not assessed. Pelham Lake is on the 1998 303(d) List of Waters because of noxious aquatic plants. However, after reevaluating past information and new data it was determined that the conditions in this lake were likely naturally occurring.							
Sherman Reservoir, Rowe and Monroe, MA and Whitingham, VT	MA33018	72 (MA portion only)	Not Assessed*	Impaired (Mercury, 274)	Not Assessed	Not Assessed	Not Assessed
Note: Fish toxics monitoring for PCB, organochlorine pesticides and selected metals (including Hg, As, Se, Pb, and Cd) was conducted in Sherman Reservoir as part of the Deerfield River Watershed survey in 1995 (Appendix E, Table E1). Because of elevated mercury, MA DPH issued a fish consumption advisory recommending "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this waterbody and the general public should not consume any yellow perch from this waterbody. The general public should limit consumption of non-affected fish from this waterbody to two meals per month." Because of the site-specific advisory the *Fish Consumption Use* is assessed as impaired. Sediment samples collected behind the dam revealed slightly elevated concentrations of arsenic and copper, so the *Aquatic Life Use* is identified with an Alert Status. Note: Vermont also identifies this lake as impaired for the Fish Consumption Use (VT DEC 2003). Note: No public bathing beaches on the Rowe or Monroe portion of the Sherman Reservoir, but boat access on the Monroe portion. Note: Sherman Reservoir was formerly included as part of Segment MA33-01.							
South Pond, Savoy	MA33019	29	Not Assessed	Not Assessed	Support	Support	Not Assessed
South Pond is in the MA DEM Savoy State Forest in Savoy. The pond has a public bathing beach. Although elevated bacteria counts were documented in this pond during one week in July 2001 no beach postings were recorded in the MA DPH database. During July 2002, the beach was posted for a two 2-day period because of elevated bacteria. Because the beach was open for the majority of both the 2001 and 2002 bathing seasons the *Recreational* uses are assessed as support. The *Aesthetic Use* is not assessed.							
South River Impoundment, Conway	MA33022	2	South River Impoundment is included as part of Deerfield River Segment MA33-08, where it exists as a run of the river impoundment, so it is not included in the lakes assessment (or acreage totals) to avoid redundancy.				
Tannery Pond, Savoy	MA33020	1	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Upper Greenfield Reservoir Leyden	MA33021	6	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Also known as Glen Brook Upper Reservoir or Leyden/Glen Reservoir. Upper Greenfield Reservoir is a Class A, Public Water Supply. Greenfield Water Department is registered to withdraw water from Upper Greenfield Reservoir (2.12 MGD). Additional information is provided in the Green River Segment MA33-29 and Appendix H, Table H4.							
Upper Highland Springs Reservoir, Ashfield	MA33025	2	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Upper Highland Springs Reservoir is a Class A, Public Water Supply.							
Upper Reservoir Bear Swamp, Rowe	MA33026	108	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed

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

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LIST OF APPENDICES WITH TABLES AND FIGURES