MASSACHUSETTS watershed·based plans

WATERSHED-BASED PLAN

Deerfield Mainstem - North River to Mouth (MA33-04)

(HUC-12 watershed 010802030502)

September 2024

Prepared By:

Massachusetts Association of Conservation Districts
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Prepared For:

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

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Contents

Executive Summary

Introduction: The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds and present the information in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows the United States Environmental Protection Agency's (USEPA's) recommended format for "nine-element" watershed plans. This WBP was developed by Geosyntec Consultants, Inc. (Geosyntec) under the direction of the Massachusetts Association of Conservation Districts (MACD) with funding, input, and collaboration from the Massachusetts Department of Environmental Protection (MassDEP).

This WBP was prepared for the Deerfield Mainstem - North River to Mouth watershed (12-digit hydrologic unit code [HUC-12] 010802030502), which is in the Towns of Deerfield, Shelburne, Buckland, Ashfield, Conway, and City of Greenfield, Massachusetts. The total area of the Deerfield Mainstem - North River to Mouth watershed is approximately 31,898 acres (approximately 49.8 square miles). The Deerfield River extends for a total of 18.2 miles within the Deerfield Mainstem - North River to Mouth watershed prior to discharging to the Connecticut River and includes two assessment unit identification numbers (MA33-03 and MA33-04). The Deerfield River (MA33-03) extends 16.2 miles from the confluence with the North River in Charlemont/Shelburne Falls to the confluence with the Green River in Greenfield. Five hydroelectric stations (dams) are located along the Deerfield Mainstem (MA-33-03). The Deerfield River (MA33-04) extends an additional 2 miles from the confluence with the Green River to discharge into the Connecticut River in Greenfield. The watershed has numerous tributaries, including an Unnamed Tributary (MA33-133) from Goodnow Road Pond (MA33007), Sluice Brook (MA33-83), Schneck Brook (MA33-113), Bear River (MA33-17), Dragon Brook (MA33-20), Shingle Brook (MA33-22), South River (MA33-102), and Sheldon Brook (MA33-81). The watershed also receives flow from waterbodies located outside the Deerfield Mainstem - North River to Mouth watershed, including the Deerfield River (MA33-02), the South River (MA33-102), the North River (MA33-06), and the Green River (MA33-30).

Impairments and Pollution Sources: Three segments in the Deerfield Mainstem North River to Mouth watershed are identified as impaired (category 5) on the on the 2022 Massachusetts Integrated List of Waters (303(d) list). The downstream 2-mile stretch of the Deerfield River (MA33-04), extending from the confluence with Green River to the Connecticut River, is identified as a category 5 waterbody due to Escherichia coli (*E. coli*) from unknown sources. Bear River (MA33-17) is identified as a category 5 waterbody due to temperature from unknown sources. Dragon Brook (MA33-20) is identified as a category 5 waterbody due to temperature from agricultural, loss of riparian habitat, and unknown sources.

There are also three Category 5 impaired segments that discharge into the Deerfield Mainstem – North River to Mouth watershed. North River, South River, and the Green River discharge into the Deerfield River but are located outside of the Deerfield Mainstem - North River to Mouth watershed.

E. coli data available from 2005 and 2017--2023 indicated elevated levels of *E. coli* (above the Massachusetts Water Quality Standards) mainly in the impaired Deerfield River segment (MA33-04); data from 2005 indicated elevated *E. coli* levels in Dragon Brook as well as Bear River.

Goals, Management Measures, and Funding: The long-term goal of this WBP is to reduce *E. coli* and Total Phosphorus (TP) loading in the Deerfield Mainstem North River to Mouth watershed, eventually leading to delisting of impaired waterbodies in the study area from the 303(d) list. It is expected that these pollutant load reductions will result in improvements to other water quality parameters throughout the watershed as well.

It is expected that these goals will be accomplished through implementation of structural and non-structural Best Management Practices (BMPs) to capture runoff and reduce *E. coli* loading as well as implementation of watershed education and outreach to achieve additional pollutant load reductions. MACD was a recipient of Clean Water Act (CWA) Section 319 funding in Fiscal Year 2022 for its Agricultural Nonpoint Source Regional Coordinators for Franklin, Hampshire, Hampden Counties program. Under this program, MACD is supporting the Massachusetts Nonpoint Source Program through regional agricultural coordinators. The coordinators focus their efforts to restore impaired waters and protect unimpaired/high quality and threatened waters within Western Massachusetts watersheds including the Deerfield Mainstem North River to Mouth watershed.

It is expected that future funding for management measures will be obtained from a variety of sources including CWA Section 319 Grant Funding, , Massachusetts Environmental Trust (MET) grants, Massachusetts Department of Agricultural Resources (MDAR) [such as Climate Smart Agricultural Program (CSAP) and the Agricultural Produce Safety Improvement Program (APSIP)], Town capital funds, volunteer efforts, and United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) programs including the Environmental Quality Incentives Program (EQIP) and the Agricultural Management Assistance (AMA) program.

Public Education and Outreach: Goals of public education and outreach are to provide information to farmers on funding resources for BMP implementation; provide information about farm conservation plans and agricultural BMPs and their anticipated benefit to farm operations as well as water quality benefits; provide information to all residents within the watershed to promote watershed stewardship; and to provide information to all residents in the watershed about proposed stormwater improvements and their anticipated water quality benefits.

An initial stakeholder meeting was held on May 15, 2024, which included core stakeholders in the Deerfield Mainstem North River to Mouth watershed. The purpose of the meeting was to introduce stakeholders to one another and gain consensus on elements of this WBP.

Implementation Schedule and Evaluation Criteria: The implementation schedule includes milestones for monitoring, farmer outreach for implementation of structural and non-structural BMPs, public education and outreach, and plan updates.

This WBP recommends continuing and possibly expanding the current water quality monitoring program that is managed by Connecticut River Conservancy (CRC) and Deerfield River Watershed Association (DRWA). The program could be expanded to include additional sampling location along Bear River and Dragon Brook. This would help deepen an understanding of water quality trends in the Deerfield Mainstem North River to Mouth watershed including determining sources of pollution, evaluating the effectiveness of implemented BMPs, and tracking compliance with the water quality goals identified in this WBP.

This WBP is meant to be a living document, re-evaluated at least once every three years and adjusted as needed based on ongoing efforts (e.g., based on monitoring results, funding, etc.). It is recommended that a working group of watershed stakeholders be established to meet at least biannually to implement and update this WBP, and track progress. A stakeholder should also be designated for maintaining this WBP and coordinating periodic plan evaluations and updates. The Franklin Regional Council of Governments (FRCOG) is the regional planning agency for Franklin County and may be aware, through other funded projects, of work that may inform ongoing or planned projects for the Deerfield River Mainstem North River to Mouth watershed. As part of planning future nonpoint source management work within the watershed, project proponents should contact FRCOG staff for updates and opportunities to leverage funding and coordinate project activities.

Introduction

What is a Watershed-Based Plan?

Purpose & Need

The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds and present the information in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows the United States Environmental Protection Agency's (USEPA's) recommended format for "nine-element" watershed plans, as described below.

All states are required to develop WBPs, but not all states have taken the same approach. Most states develop WBPs only for selected watersheds. Massachusetts Department of Environmental Protection's (MassDEP's) approach has been to develop a tool to support statewide development of WBPs, so **that good projects in all areas of the state may be eligible for federal watershed implementation grant funds** under Section 319 of the Clean Water Act.

USEPA guidelines promote the use of Section 319 funding for developing and implementing WBPs. WBPs are required for all projects implemented with Section 319 funds, and are recommended for all watershed projects, whether they are designed to protect unimpaired waters, restore impaired waters, or both.

Watershed-Based Plan Outline

This WBP for the Deerfield Mainstem - North River to Mouth watershed includes nine elements (a through i) in accordance with USEPA Guidelines:

a) An **identification of the causes and sources** or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this WBP (and to achieve any other watershed goals identified in the WBP), as discussed in item (b) immediately below.

b) An **estimate of the load reductions** expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time).

c) A **description of the nonpoint source management measures** needed to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this WBP), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

d) An **estimate of the amounts of technical and financial assistance needed**, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, United States Department of Agriculture's (USDA's) Environmental Quality Incentives Program (EQIP) and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

e) An **information/education component** that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.

f) A **schedule for implementing the nonpoint source management measures** identified in this plan that is reasonably expeditious.

g) A description of **interim, measurable milestones** for determining whether nonpoint source management measures or other control actions are being implemented.

h) A set of **criteria to determine if loading reductions are being achieved** over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this WBP needs to be revised or, if a nonpoint source total maximum daily load (TMDL) has been established, whether the TMDL needs to be revised.

i) A **monitoring component** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Project Partners and Stakeholder Input

This WBP was developed by Geosyntec under the direction of the Massachusetts Association of Conservation Districts (MACD) with funding, input, and collaboration from MassDEP, with funding from the Section 319 program. MACD was a recipient of Section 319 funding in Fiscal Year 2022 for its Agricultural Nonpoint Source Regional Coordinators for Franklin, Hampshire, Hampden Counties program. Under this program, MACD is supporting the Massachusetts Nonpoint Source Program through regional agricultural coordinators. The coordinators focus their efforts to restore impaired waters and protect unimpaired/high quality and threatened waters within Western Massachusetts watersheds including the Deerfield Mainstem – North River to Mouth watershed.

The following are core project stakeholders:

- Michael Leff – MACD
- Judith Rondeau – MassDEP
- Meghan Selby – MassDEP
- Ryan O'Donnell – Connecticut River Conservancy (CRC)
- Kimberly MacPhee – Franklin Regional Council of Governments (FRCOG)
- Tricia Yacovone-Biagi – Town of Shelburne
- Jim Perry – Deerfield River Watershed Association (DRWA)
- Alain Peteroy – Franklin Land Trust
- Matthew Cole – Great River Hydro
- Lisa Gilbert – United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS)
- Brian Comfort – Deerfield Fly Shop
- Erin Rodgers – Trout Unlimited
- Kate Conlin – New England Forestry Foundation
- Miley Kinney – Patriot Hydro
- Amy Hahn – Town of Deerfield Conservation Commission
- Carolyn Shores Ness – Franklin Conservation District (FCD)

This WBP was developed as part of an iterative process as outlined below:

- The Geosyntec project team first collected and reviewed existing data from MACD and other available sources.
- Subsequently, a stakeholder meeting was held on May 15, 2024, to solicit additional input and gain consensus on elements included in the plan (identifying problem areas, BMP projects, water quality goals, public outreach activities, etc.). The meeting minutes from the stakeholder conference call are included in **Appendix A**.
- Next, a WBP was drafted and reviewed by MACD and FRCOG staff.
- The WBP was updated and finalized based on MACD and FRCOG input and submitted to MassDEP for review.

This WBP is meant to be a living document. It should be reevaluated at least once every three years and adjusted as needed based on ongoing efforts (e.g., based on monitoring results, 319 funding, etc.). It is strongly recommended that a working group including additional stakeholders be established to meet at least biannually to implement and update this WBP, and track progress.

Data Sources

This WBP was developed using the framework and data sources provided by MassDEP's WBP Tool and supplemented by information provided in the Section 319 grant application for "Agricultural Nonpoint Source Regional Coordinators for Franklin, Hampshire, Hampden Counties" (MACD, 2021). Additional data sources were reviewed and are included in subsequent sections of this WBP.

Element A: Identify Causes of Impairment & Pollution Sources

Element A: Identify the causes and sources or groups of similar sources that need to be controlled to achieve the necessary pollutant load reductions estimated in the watershed based plan (WBP).

General Watershed Information

This WBP was prepared for the Deerfield Mainstem - North River to Mouth watershed (12-digit hydrologic unit code [HUC-12] 010802030502), which is in the Towns of Deerfield, Shelburne, Buckland, Ashfield, Conway, and City of Greenfield, Massachusetts. The total area of the Deerfield Mainstem - North River to Mouth watershed is approximately 31,898 acres (approximately 49.8 square miles).

The Deerfield River extends for a total of 18.2 miles within the Deerfield Mainstem - North River to Mouth watershed prior to discharging to the Connecticut River. The Deerfield River (MA33-03) extends 16.2 miles from the confluence with the North River in Charlemont/Shelburne Falls to the confluence with the Green River in Greenfield. Five hydroelectric stations (dams) are located along the Deerfield Mainstem (MA-33-03) (FRCOG, 2015). In this segment (MA33-03), the river is also joined by various tributaries, including an Unnamed Tributary (MA33-133) from Goodnow Road Pond (MA33007), Sluice Brook (MA33-83), Schneck Brook (MA33-113), Bear River (MA33-17), Dragon Brook (MA33-20), Shingle Brook (MA33-22), and Sheldon Brook (MA33-81). Bear River (MA33-17) flows west to east and receives inputs from Sids Brook (MA33-82) and Drakes Brook (MA33-23) prior to discharging to the Deerfield River. Dragon Brook (MA33-20) flows north to south and receives inputs from Great Brook (MA33-54) and Hawkes Brook (MA33-112) prior to discharging into the Deerfield River. The river also receives inputs from waterbodies located outside the Deerfield Mainstem - North River to Mouth watershed, including the Deerfield River (MA33-02), the South River (MA33-102), the North River (MA33-06), and the Green River (MA33-30). The Deerfield River extends an additional 2 miles from the confluence with the Green River to discharge into the Connecticut River in Greenfield (MA33-04).

Table A-1 presents the general watershed information for the Deerfield Mainstem - North River to Mouth watershed and **Figure A-1** includes a map of the watershed boundary.

Table A-1: Deerfield Mainstem - North River to Mouth General Watershed Information

Waterbody Names with Assessment Unit IDs:	Deerfield River (MA33-03) Deerfield River (MA33-04) Bear River (MA33-17) Unnamed Tributary (MA33-133) Goodnow Road Pond (MA33007) Sluice Brook (MA33-83) Schneck Brook (MA33-113) Dragon Brook (MA33-20) Shingle Brook (MA33-22) Sheldon Brook (MA33-81) Hawkes Brook (MA33-112) Great Brook (MA33-54) Drakes Brook (MA33-23) Sids Brook (MA33-82)
Major Basin:	Deerfield River
Watershed Area:	31,898 acres (49.8 square miles)

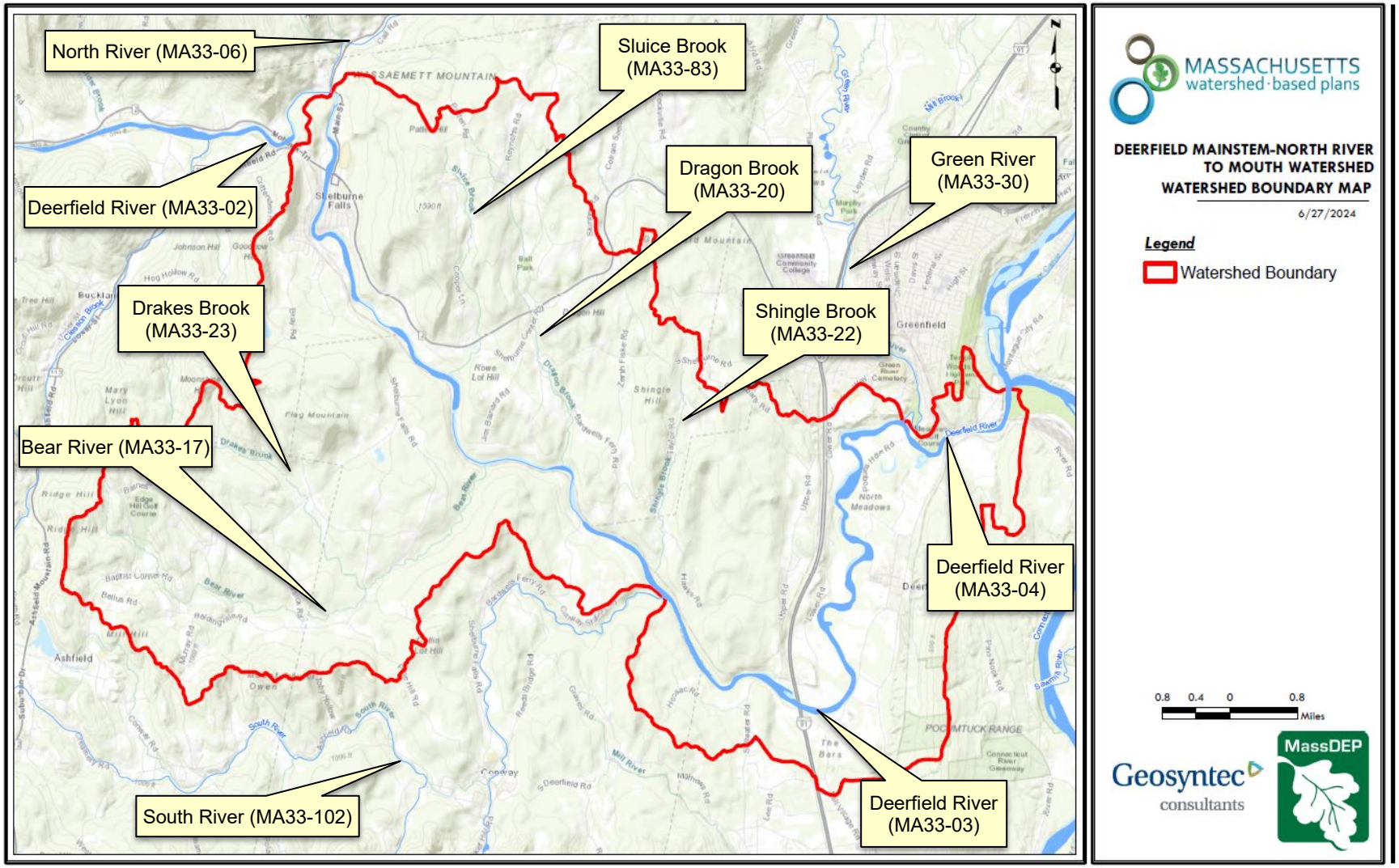

Figure A-1: Deerfield River Watershed Boundary Map
(MassGIS, 2007; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

MassDEP Water Quality Assessment Report and TMDL Review

The section below summarizes the findings of the available Water Quality Assessment Reports and/or TMDLs that relate to water quality and water quality impairments.

The following water quality assessment report is available:

- *Deerfield River Watershed 2000 Water Quality Assessment Report* (MassDEP, 2000)

The Deerfield Mainstem - North River to Mouth watershed does not have a TMDL[1]. Select excerpts from the water quality assessment report relating to the water quality in the Deerfield Mainstem - North River to Mouth watershed are included in **Appendix B** (note: relevant information is included directly from these documents for informational purposes and has not been modified).

Water Quality Impairments and Pollution Sources

Impairment categories from the MassDEP 2022 Massachusetts Integrated List of Waters (303(d) List) (MassDEP, 2023) are listed in **Table A-2**. Known water quality impairments, as documented in the 2022 303(d) List are illustrated in **Figure A-2** and listed in **Table A-3.** The downstream 2-mile stretch of the Deerfield River (MA33-04), extending from the confluence with Green River to the Connecticut River, is identified as a category 5 waterbody due to *Escherichia coli* (*E. coli*) from unknown sources. Bear River (MA33-17) is identified as category 5 waterbody due to temperature from unknown sources. Dragon Brook (MA33-20) is identified as a category 5 waterbody due to temperature from agricultural, loss of riparian habitat, and unknown sources. Other waterbodies within the Deerfield Mainstem - North River to Mouth watershed, including the upstream 16.2-mile stretch of the Deerfield River (MA33-03), are identified as category 2.

Table A-2: 2022 MA Integrated List of Waters Categories

Integrated List Category	Description
1	Unimpaired and not threatened for all designated uses.
2	Unimpaired for some uses and not assessed for others.
3	Insufficient information to make assessments for any uses.
4	Impaired or threatened for one or more uses, but not requiring calculation of a Total Maximum Daily Load (TMDL), including: 4a: TMDL is completed 4b: Impairment controlled by alternative pollution control requirements 4c: Impairment not caused by a pollutant - TMDL not required
5	Impaired or threatened for one or more uses and requiring preparation of a TMDL.

[1] Deerfield River is part of the Connecticut River watershed; the Connecticut River flows into the Long Island Sound. The Long Island Sound has a TMDL: "A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound" (NYSDEC & CTDEEP, 2000).

Additionally, the "DRAFT Massachusetts Statewide Total Maximum Daily Load for Pathogen-Impaired Waterbodies" (MassDEP, 2024) includes segments within the Deerfield Mainstem North River to Mouth watershed. This WBP should be updated with information from this TMDL after it is finalized.

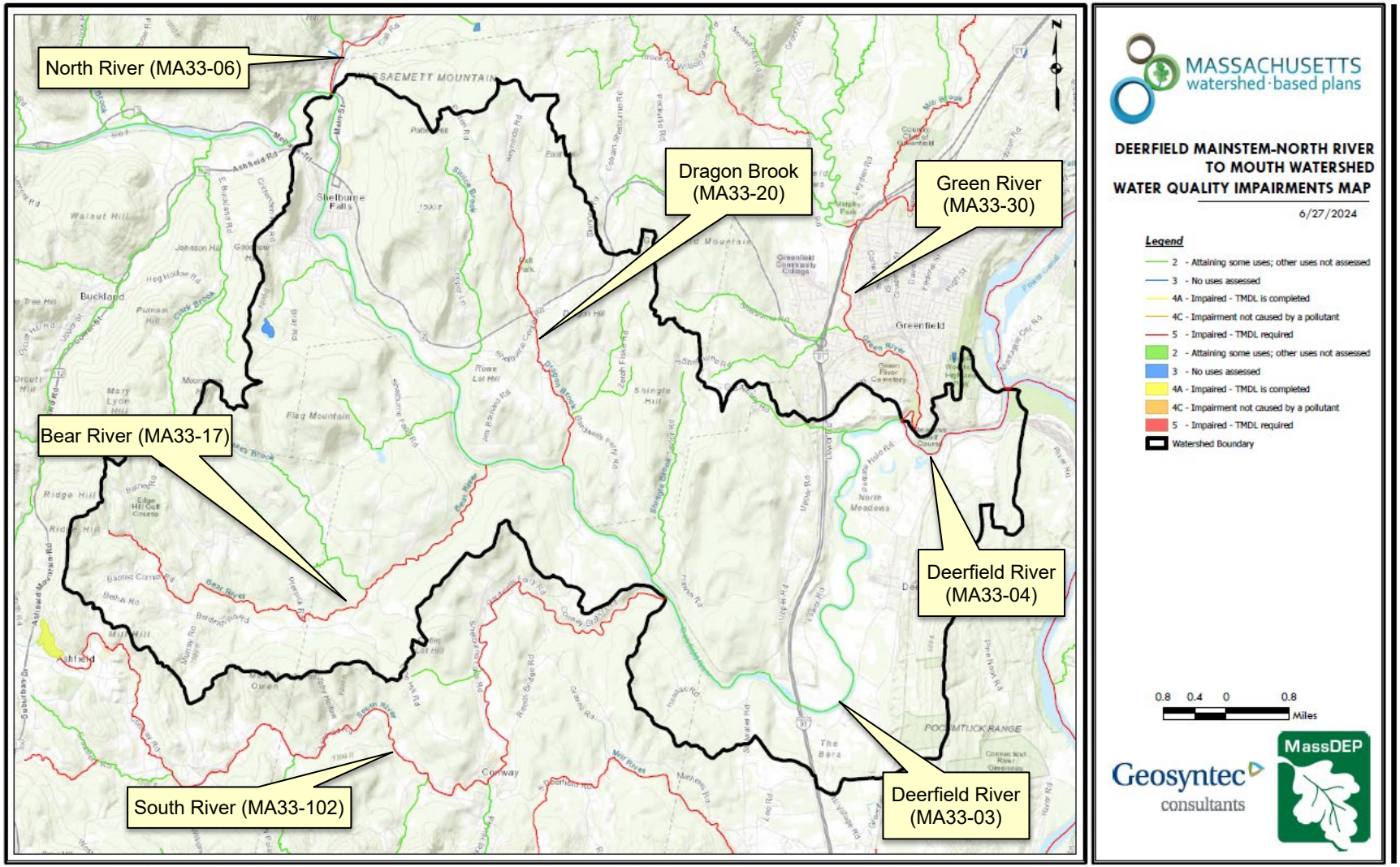

Figure A-2: Deerfield Mainstem - North River to Mouth Water Quality Impairments Map
(MassGIS, 2022a; MassGIS, 2022b; ESRI et al., 2023)

Table A-3: Water Quality Impairments in the Deerfield Mainstem – North River to Mouth Watershed (MassDEP, 2021)

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA33-04	Deerfield River	5	Primary Contact	*E. coli*	Source Unknown
MA33-17	Bear River	5	Fish, other Aquatic Life and Wildlife	Temperature	Source Unknown
MA33-20	Dragon Brook	5	Fish, other Aquatic Life and Wildlife	Temperature	Agriculture
			Fish, other Aquatic Life and Wildlife	Temperature	Loss of Riparian Habitat
			Fish, other Aquatic Life and Wildlife	Temperature	Source Unknown

There are three Category 5 impaired segments that discharge into the Deerfield Mainstem – North River to Mouth watershed. North River, South River, and the Green River discharge into the Deerfield River but are located outside of the Deerfield Mainstem - North River to Mouth watershed. Although these impaired waters may contribute to the pollutant load in the Deerfield Mainstem – North River to Mouth, they are outside of the target watershed of this WBP and are not evaluated in this WBP. The South River (MA33-102) and the North River discharge to the Deerfield River (MA33-03). The Green River (MA33-30) discharges to the Deerfield River (MA33-04). Impairment categories from the MassDEP 2022 Massachusetts Integrated List of Waters (303(d) List) (MassDEP, 2023) for these segments, which are potential pollutant sources to the Deerfield Mainstem – North River to Mouth watershed are listed in **Table A-4**. It should be noted that the segments in **Table A-4** also have impaired tributaries, which are not included in the table.

Table A-4: Water Quality Impairments for Segments that Discharge Directly into the Deerfield Mainstem – North River to Mouth Watershed (MassDEP, 2021)

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA33-102	South River	5	Fish, other Aquatic Life and Wildlife	Temperature	Dam or Impoundment
			Fish, other Aquatic Life and Wildlife	Temperature	Source unknown
			Fish, other Aquatic Life and Wildlife	Temperature	Agriculture
			Fish, other Aquatic Life and Wildlife	Physical substrate habitat alterations	Source Unknown
			Primary Contact Recreation	*E. coli*	Source Unknown
			Primary Contact Recreation	Fecal Coliform	Source Unknown
MA33-30	Green River	5	Primary Contact Recreation	*E. coli*	Source Unknown
			Primary Contact Recreation	Fecal Coliform	Source Unknown
			Primary Contact Recreation	Turbidity	Source Unknown
			Secondary Contact Recreation	*E. coli*	Source Unknown
			Secondary Contact Recreation	Fecal Coliform	Source Unknown
			Secondary Contact Recreation	Turbidity	Source Unknown
			Aesthetic	Turbidity	Source Unknown
			Fish, other Aquatic Life and Wildlife	Temperature	Dam or impoundment
			Fish, other Aquatic Life and Wildlife	Lack of Coldwater Assemblage	Dam or impoundment
MA33-06	North River	5	Fish, other Aquatic Life and Wildlife	Lack of Coldwater Assemblage	Source Unknown
		5	Fish, other Aquatic Life and Wildlife	Temperature	Agriculture
		5	Fish, other Aquatic Life and Wildlife	Temperature	Dam or impoundment
		5	Fish, other Aquatic Life and Wildlife	Temperature	Source Unknown

Local Hazard Mitigation Plans

Deerfield River is identified in the Town of Buckland's Hazard Mitigation Plan (Buckland Hazard Mitigation Committee and FRCOG 2021), the Town of Deerfield's Hazard Mitigation Plan (Deerfield Hazard Mitigation Committee and FRCOG 2020), and the Town of Greenfield's Hazard Mitigation Plan (Greenfield Hazard Mitigation Committee and FRCOG 2020) as having the potential for the following hazards:

- Ice jams have occurred historically on the Deerfield River and present a potential flood risk in the Towns of Buckland and Deerfield.
- A dam failure at one of the major hydroelectric dams on the Deerfield River would result in devasting flooding in the Towns of Deerfield and Greenfield and catastrophic flooding in the Town of Buckland.
- The main freight line of the Pan Am Systems Railroad runs for less than a mile adjacent to the Deerfield River in the Town of Buckland. Train derailment and the potential for hazardous material spills during severe weather is a concern given the history of derailments in town and the close proximity of the Deerfield River.
- A stretch of the Deerfield River upstream of the Gardner Falls Dam on the Shelburne side is prone to landslides and erosion.
- Japanese knotweed forms monocultures along stream and riverbanks in the Town of Buckland and is poor erosion control compared to native vegetation. The banks of the Deerfield River are dominated by this plant, which severely restricts access to the river from the village of Shelburne Falls and elsewhere in Buckland.
- Severe flood events have significantly eroded riverbanks and degraded riparian habitat on the Deerfield River in the Town of Deerfield. Adjacent roads, farms, homes and businesses throughout the Town are more vulnerable to future flooding.
- Silt and flood debris from the Deerfield River is affecting facilities and drainage ditches in many areas of the Town of Deerfield, contributing to poor drainage, and providing habitat for mosquitos. During Summer 2019, Massachusetts Department of Public Health detected West Nile Virus positive mosquitoes in the Town of Deerfield for the seventh year.

2015 Deerfield River Watershed-Based Plan

Urban land use, forested land, and rural land, including agriculture land use, were identified as the primary sources of pollutant loads in the Deerfield Mainstem – North River to Mouth watershed in the 2015 Deerfield River Watershed Based Plan (FRCOG, 2015). Stream channel erosion was estimated to account for 45% of the modeled annual sediment load and septic systems were estimated to account for an estimated 17-18% of the annual fecal coliform load. Impervious surfaces and agricultural sources, particularly within the stream corridors, were cited as factors that make the watershed vulnerable to water quality degradation (FRCOG, 2015).

May 15, 2024, Stakeholder Meeting Pollutant Sources Identification

Three potential pollution sources to Deerfield River Mainstem North River to Mouth watershed discussed during the stakeholder meeting on May 15, 2024 (meeting minutes included in **Appendix A**) were golf

courses, dirt roads, and agricultural operations in the watershed. The FRCOG indicated that field work and assessment associated with identifying pollutant sources has been minimal within the watershed and is needed to further understand pollutants sources. The Deerfield River Watershed Based Plan (FRCOG, 2015) recommended conducting fluvial geomorphic assessments, conducting upland tributary and watershed assessments, and mapping river corridors to better understand pollution sources in the watershed (see **Element C** for more detail).

Water Quality Data

MassDEP Water Quality Monitoring Program Data

Historical and current Technical Memoranda ™ produced by the MassDEP Watershed Planning Program are available here: Water Quality Technical Memoranda | Mass.gov and are organized by major watersheds in Massachusetts. Most of these TMs present the water chemistry and biological sampling results of WPP monitoring surveys. The TMs pertaining primarily to biological information (e.g., benthic macroinvertebrates, periphyton, fish populations) contain biological data and metrics that are currently not reported elsewhere. The data contained in the water quality TMs are also provided on the "Data" page (Water Quality Monitoring Program Data | Mass.gov). Many of these TMs have helped inform Clean Water Act 305(b) assessment and 303(d) listing decisions.

Water quality monitoring data for *E. coli* is available for Deerfield River from the year 2005 (MassDEP, 2022). The *E. coli* data is presented in **Table A-5 and Figure A-3**. The data collected in 2005 exceeded the Massachusetts Surface Water Quality Standards (Massachusetts Surface Water Quality Standards (MSWQS) (MassDEP, 2021) for *E. coli*, which states that *E. coli* concentrations shall not exceed 126 colony-forming units per 100 milliliters (CFU/100mL), calculated as the geometric mean of all samples collected within any 90-day or smaller interval; and no more than 10 percent of all such samples shall exceed 410 CFU/100 mL (a statistical threshold value).

Table A-5: MassDEP Water Quality Monitoring Program *E. coli* Data for Deerfield Mainstem - North River to Mouth Watershed (MassDEP, 2022)

Unique ID	Waterbody (Assessment Unit ID)	Sampling Location	Date	*E. coli* (CFU/100 mL or MPN/100 mL)	90-Day Geometric Mean (CFU/100 mL or MPN/100 mL)	Geometric Mean Criterion Exceeded? (126 CFU/100 mL)	STV Criterion Exceeded ? (410 CFU/100 mL)	Meets MSWQS /Water Quality Goal?
W0002	Deerfield River (MA33-03)	[approximately 200 feet upstream of the south bound lane of Route 91, Deerfield]	5/17/2005	37	37	No	No	Yes
			6/7/2005	435	127	Yes	Yes	No
			7/19/2005	2050	321	Yes	Yes	No
			8/16/2005	770	399	Yes	Yes	No
			9/21/2005	9	242	Yes	Yes	**No**
W0757	Deerfield River (MA33-04)	[Route 5-10 bridge, Deerfield (southern side of river)]	5/17/2005	40	40	No	No	**Yes**
			6/7/2005	777	176	Yes	Yes	**No**
			7/19/2005	2910	449	Yes	Yes	**No**
			8/16/2005	387	433	Yes	Yes	**No**
			9/21/2005	132	530	Yes	Yes	**No**
W0017	Bear River (MA33-17)	[approximately 250 feet upstream of Shelburne Falls Road (above unnamed tributary), Conway]	5/17/2005	14	14	No	No	**Yes**
			6/7/2005	52	27	No	No	**Yes**
			7/19/2005	1410	101	No	Yes	**No**
			8/16/2005	291	131	Yes	Yes	**No**
			9/21/2005	33	238	Yes	Yes	**No**
W1364	Dragon Brook (MA33-20)	[Bassett Road, Shelburne]	5/17/2005	4	4	No	No	**Yes**
			6/7/2005	157	25	No	No	**Yes**
			7/19/2005	326	59	No	No	**Yes**
			8/16/2005	1300	128	Yes	Yes	**No**
			9/21/2005	33	241	Yes	Yes	**No**

Sources: MassDEP, 2022

"MPN/100 mL" = most probable number per 100 milliliters

"CFU/100 mL" = colony forming units per 100 milliliters

"STV" = statistical threshold value

"MSWQS" = Massachusetts Surface Water Quality Standards (MassDEP, 2021)

Samples collected in 2005 were reported in CFU/100 mL.

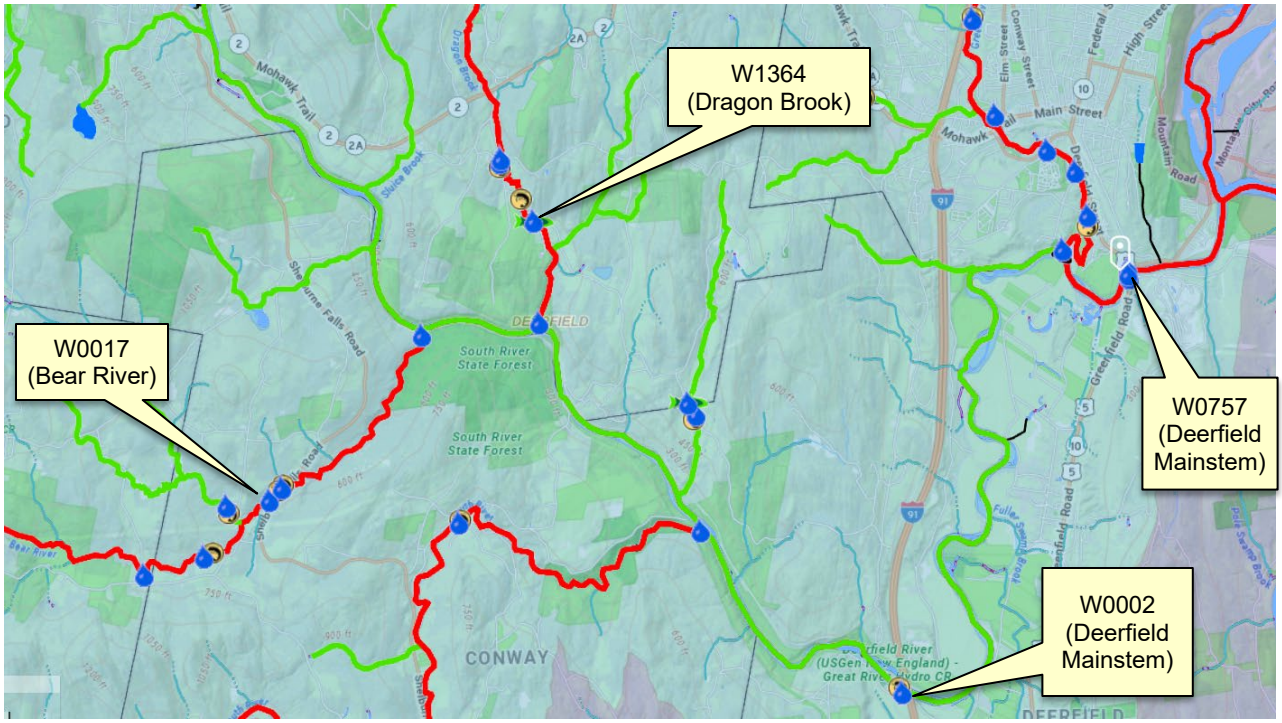

Figure A-3 MassDEP Water Quality Monitoring Program *E. coli* Data Stations for Deerfield Mainstem - North River to Mouth Watershed (MassDEP, 2022)

Connecticut River Conservancy / Deerfield River Watershed Association Monitoring Program

The CRC partnered with DRWA have been documenting the water quality in the Deerfield River and tributaries intermittently since 1990. The most recent iteration of the DRWA water quality monitoring program has been running since 2017 and includes four sampling locations on the Deerfield River within the Deerfield Mainstem – North River to Mouth watershed (identified on **Figure A-4**). Volunteers visit these sites on alternate weeks from June through September to collect samples that are tested for *E. coli*, TN, TP, turbidity, Total Chloride and conductivity. Available *E. coli* data from 2017—2023 is presented in **Table A-6**. One of the locations (MA-DFR_01.1) is located within the impaired Deerfield River segment (MA33-04). This location also had the most consistent data and showed the most exceedances of the MSWQS. The three other sampling locations are located within Deerfield River segment MA33-03, which is not currently listed as impaired on the 303(d) list (it was listed as impaired on prior years 303(d) lists, but it has been removed); the data for these three locations mostly met the MSWQS with a few exceedances in 2021 and 2023.

TP data was only available at one location (MA-DFR_01.1 located within the impaired Deerfield River segment MA33-04) for the years 2017, 2018, and 2019. This data is presented in **Table A-7**, and the and TP concentrations were all below the TP USEPA "Gold Book" (USEPA, 1986) standard of 50 micrograms per liter (µg/L), except for one date in 2019 where the concentration was slightly above at 51 µg/L.

Table A-6: CRC/DRWA Water Quality Monitoring Program *E. coli* Data for Deerfield Mainstem - North River to Mouth Watershed (CRC, 2024a)

Site ID	Assessment Unit ID	Sampling Location	Date	*E. coli* (CFU/100 mL or MPN/100 mL)	90-Day Geometric Mean (CFU/100 mL or MPN/100 mL)	Geometric Mean Criterion Exceeded? (126 CFU/100 mL)	STV Criterion Exceeded? (410 CFU/100 mL)	Meets MSWQS/Water Quality Goal?
MA-DFR_01.1	MA33-04	Deerfield River, 5 & 10 Bridge	6/28/2017	93.2	93.2	No	No	Yes
			7/12/2017	68.3	79.8	No	No	Yes
			7/26/2017	98.5	85.6	No	No	Yes
			8/9/2017	71.7	81.9	No	No	Yes
			8/23/2017	980.4	134.5	Yes	Yes	**No**
			9/6/2017	1046.2	189.4	Yes	Yes	**No**
MA-DFR_01.1	MA33-04	Deerfield River, 5 & 10 Bridge	6/27/2018	110	110.0	No	No	Yes
			7/11/2018	63.1	83.3	No	No	Yes
			7/25/2018	275.5	124.1	No	No	Yes
			8/8/2018	99	117.3	No	No	Yes
			8/22/2018	461.1	154.2	Yes	No	**No**
			9/5/2018	111.2	146.1	Yes	No	**No**
MA-DFR_01.1	MA33-04	Deerfield River, 5 & 10 Bridge	6/26/2019	1732.9	1732.9	Yes	Yes	**No**
			7/10/2019	96	407.9	Yes	Yes	**No**
			7/24/2019	1203.3	585.0	Yes	Yes	**No**
			8/7/2019	> 2419.6	834.2	Yes	Yes	**No**
			8/21/2019	261.3	661.4	Yes	Yes	**No**
			9/4/2019	307.6	582.2	Yes	Yes	**No**
MA-DFR_01.1	MA33-04	Deerfield River, 5 & 10 Bridge	7/8/2020	56.3	56.3	No	No	Yes
			7/22/2020	75.9	65.4	No	No	Yes
			8/19/2020	54.6	61.6	No	No	Yes
			9/2/2020	105	70.4	No	No	Yes
			9/16/2020	58.1	67.7	No	No	Yes
MA-DFR_01.1	MA33-04	Deerfield River, 5 & 10 Bridge	6/23/2021	193.5	193.5	Yes	No	**No**
			7/7/2021	275.5	230.9	Yes	No	**No**
			7/21/2021	275.5	244.9	Yes	No	**No**
			8/4/2021	58.3	171.1	Yes	No	**No**
			8/18/2021	78.9	146.5	Yes	No	**No**
			9/1/2021	<1	146.5	Yes	No	**No**

Site ID	Assessment Unit ID	Sampling Location	Date	*E. coli* (CFU/100 mL or MPN/100 mL)	90-Day Geometric Mean (CFU/100 mL or MPN/100 mL)	Geometric Mean Criterion Exceeded? (126 CFU/100 mL)	STV Criterion Exceeded? (410 CFU/100 mL)	Meets MSWQS/Water Quality Goal?
MA-DFR_01.1	MA33-04	Deerfield River, 5 & 10 Bridge	5/17/2022	686.7	686.7	Yes	Yes	**No**
			5/17/2022	980.4	820.5	Yes	Yes	**No**
			6/22/2022	115.3	426.6	Yes	Yes	**No**
			7/6/2022	191.8	349.3	Yes	Yes	**No**
			7/21/2022	81.3	261.0	Yes	Yes	**No**
			8/3/2022	52.9	200.0	Yes	Yes	**No**
			8/17/2022	83.3	176.5	Yes	Yes	**No**
			8/31/2022	201.4	108.1	No	No	Yes
MA-DFR_01.1	MA33-04	Deerfield River, 5 & 10 Bridge	6/21/2023	130.9	130.9	Yes	No	**No**
			7/5/2023	290.9	195.1	Yes	No	**No**
			7/19/2023	488.4	264.9	Yes	No	**No**
			8/16/2023	920.8	361.7	Yes	No	**No**
			8/30/2023	172.5	311.9	Yes	No	**No**
MA-DFR_05.1	MA33-03	Deerfield River, Behind Deerfield Academy	7/8/2020	38.4	38.4	No	No	Yes
			7/22/2020	45	41.6	No	No	Yes
			8/19/2020	29.8	37.2	No	No	Yes
			9/2/2020	43.5	38.7	No	No	Yes
			9/16/2020	47.3	40.3	No	No	Yes
MA-DFR_05.1	MA33-03	Deerfield River, Behind Deerfield Academy	6/23/2021	75.4	75.4	No	No	Yes
			7/7/2021	209.8	125.8	No	No	Yes
			7/21/2021	145	131.9	Yes	No	**No**
			8/4/2021	52.8	104.9	No	No	Yes
			8/18/2021	52.9	91.5	No	No	Yes
			9/1/2021	86	90.5	No	No	Yes

Site ID	Assessment Unit ID	Sampling Location	Date	*E. coli* (CFU/100 mL or MPN/100 mL)	90-Day Geometric Mean (CFU/100 mL or MPN/100 mL)	Geometric Mean Criterion Exceeded? (126 CFU/100 mL)	STV Criterion Exceeded? (410 CFU/100 mL)	Meets MSWQS/Water Quality Goal?
MA-DFR_05.1	MA33-03	Deerfield River, Behind Deerfield Academy	6/22/2022	52.1	52.1	No	No	Yes
			7/6/2022	114.5	77.2	No	No	Yes
			7/20/2022	143	94.8	No	No	Yes
			8/3/2022	42.2	77.5	No	No	Yes
			8/17/2022	55.2	72.4	No	No	Yes
			8/31/2022	95.9	75.9	No	No	Yes
MA-DFR_05.1	MA33-03	Deerfield River, Behind Deerfield Academy	6/21/2023	43.9	43.9	No	No	Yes
			7/5/2023	275.5	110.0	No	No	Yes
			7/19/2023	579.4	191.4	Yes	Yes	No
			8/2/2023	37.9	127.7	Yes	Yes	No
			8/16/2023	517.2	168.9	Yes	Yes	No
			8/30/2023	214.3	175.7	Yes	Yes	No
MA-DFR_08.0	MA33-03	Deerfield River, Stillwater Bridge	7/8/2020	19.7	19.7	No	No	Yes
			7/22/2020	22.8	21.2	No	No	Yes
			8/19/2020	48	27.8	No	No	Yes
			9/2/2020	95.9	37.9	No	No	Yes
			9/16/2020	25.6	35.1	No	No	Yes
MA-DFR_08.0	MA33-03	Deerfield River, Stillwater Bridge	6/23/2021	102.2	102.2	No	No	Yes
			7/7/2021	238.2	156.0	Yes	No	No
			7/21/2021	127.4	145.8	Yes	No	No
			8/4/2021	21.6	90.5	No	No	Yes
			8/18/2021	48	79.7	No	No	Yes
			9/1/2021	121	85.4	No	No	Yes
MA-DFR_08.0	MA33-03	Deerfield River, Stillwater Bridge	6/22/2022	21.3	21.3	No	No	Yes
			7/6/2022	27.9	24.4	No	No	Yes
			7/20/2022	19.9	22.8	No	No	Yes
			8/3/2022	42.2	26.6	No	No	Yes
			8/17/2022	45.7	29.6	No	No	Yes
			8/31/2022	42.6	31.5	No	No	Yes

Site ID	Assessment Unit ID	Sampling Location	Date	*E. coli* (CFU/100 mL or MPN/100 mL)	90-Day Geometric Mean (CFU/100 mL or MPN/100 mL)	Geometric Mean Criterion Exceeded? (126 CFU/100 mL)	STV Criterion Exceeded? (410 CFU/100 mL)	Meets MSWQS/Water Quality Goal?
MA-DFR_08.0	MA33-03	Deerfield River, Stillwater Bridge	6/21/2023	29.2	29.2	No	No	Yes
			7/19/2023	261.3	87.3	No	No	Yes
			8/2/2023	34.5	64.1	No	No	Yes
			8/16/2023	435.2	103.5	No	No	Yes
			8/30/2023	78.9	98.0	No	No	Yes
			6/21/2023	83.3	95.4	No	No	Yes
			7/5/2023	77.6	92.6	No	No	Yes
			7/19/2023	365.4	109.9	No	No	Yes
			8/2/2023	37.9	97.7	No	No	Yes
			8/30/2023	146.7	101.7	No	No	Yes
MA-DFR_16.1	MA33-03	Deerfield River, Gardeners Falls	6/21/2023	83.3	83.3	No	No	Yes
			7/5/2023	77.6	80.4	No	No	Yes
			7/19/2023	365.4	133.2	Yes	No	**No**
			8/2/2023	37.9	97.3	No	No	Yes
			8/30/2023	146.7	105.6	No	No	Yes

Sources: CRC, 2024

"*E. coli*" = *Escherichia coli*

"MPN/100 mL" = most probable number per 100 milliliters

"CFU/100 mL" = colony forming units per 100 milliliters

"STV" = statistical threshold value

"MSWQS" = Massachusetts Surface Water Quality Standards (MassDEP, 2021)

All samples collected were reported in MPN/100 mL.

Table A-7: CRC/DRWA Water Quality Monitoring Program TP Data for Deerfield Mainstem - North River to Mouth Watershed (CRC, 2024a)

Date	Site ID	Sampling Location	TP (µg/L)
6/28/2017	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	29
7/12/2017	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	23
7/26/2017	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	24
8/9/2017	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	24
8/23/2017	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	38
9/6/2017	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	41
6/27/2018	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	24
7/11/2018	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	20
7/25/2018	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	29
8/8/2018	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	16
8/22/2018	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	37
9/5/2018	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	11
6/26/2019	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	51
7/10/2019	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	29
7/24/2019	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	32
8/7/2019	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	17
8/21/2019	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	23
9/4/2019	MA-DFR_01.1	Deerfield River, 5 & 10 Bridge	15

Sources: CRC, 2024
"TP" = Total Phosphorus
"µg/L" = micrograms per liter

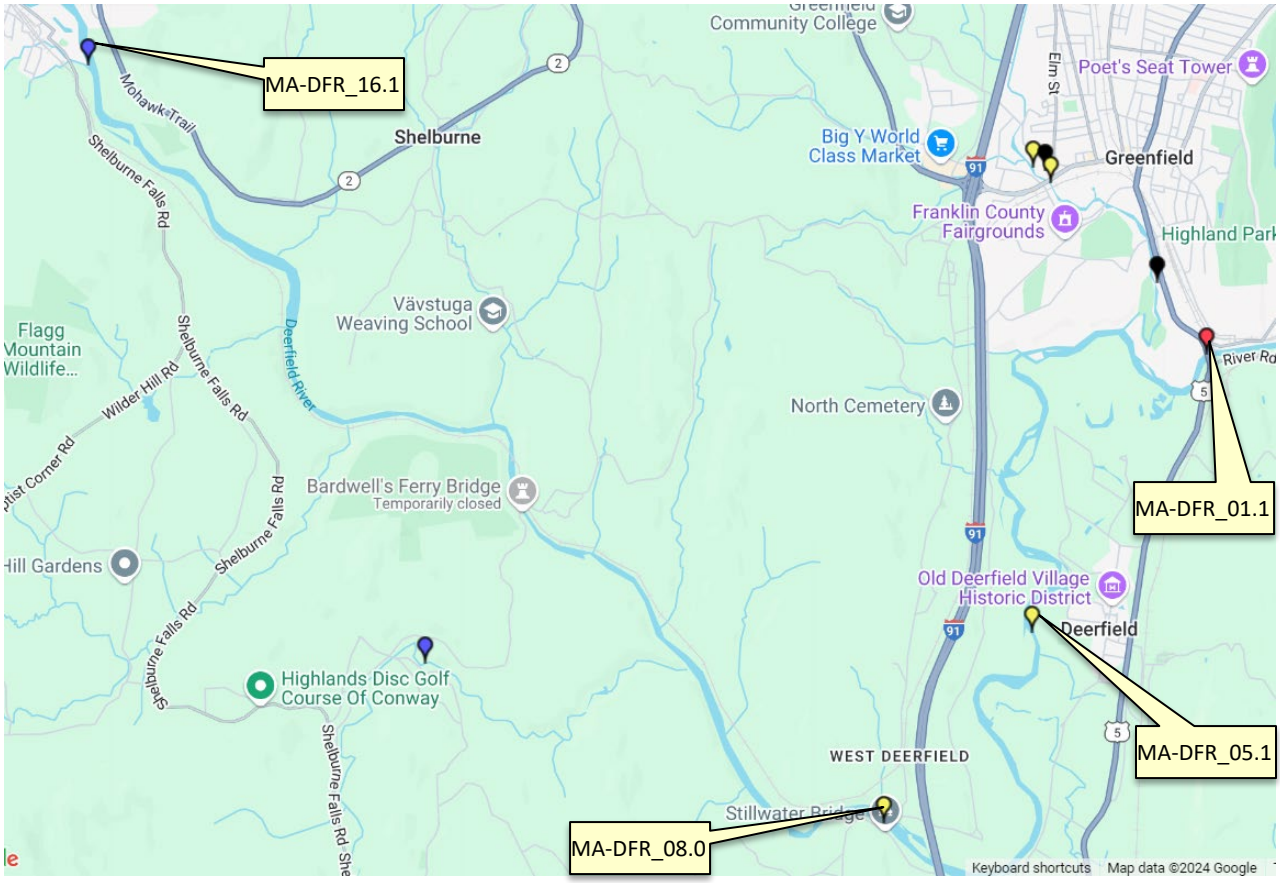

Figure A-4: CRC/DRWA Water Quality Monitoring Program Stations for Deerfield Mainstem - North River to Mouth Watershed (CRC, 2024b)

Deerfield River Watershed Association (DRWA) Macroinvertebrate Assessment (Cole, 2009).

Deerfield River Watershed Association (DRWA) conducted a macroinvertebrate assessment in the Deerfield River tributaries in September 2008. The objectives of the program were to augment MA DEP/DWM biomonitoring efforts to assess surface waters in the watershed with respect to their aquatic-life-use status and to familiarize citizens of the watershed with biological monitoring to increase support for and participation in watershed enhancement and protection activities. One of the sampling stations (BRRM01) was located along Bear River, by Shelburne Falls Road, within the Deerfield Mainstem - North River to Mouth watershed. The assessment noted that sediment levels increased significantly since 2006, when the reach was last sampled. While increased sediment was noted in the Bear River in 2008, the benthic community appeared to be minimally affected by the disturbance. While scoring in the non-impacted range, it is worth noting that the Bear River sample (and its duplicate sample) was dominated by the mayfly, *Eurylophella,* which is potentially tolerant of elevated sediment levels (Cole, 2009).

Water Quality Goals

Based on the impairments and water quality data identified above, the long-term water quality goal in the Deerfield Mainstem – North River to Mouth watershed is to reduce bacteria loading to the Deerfield Mainstem – North River to Mouth the watershed so that it meets its designated uses for fish, other aquatic life, and wildlife; and primary contact recreation. Since there is minimal TP data for the watershed, a TP goal is also included. A water quality goal is included for temperature in the Bear River specifically since it is

identified as a Cold Water Fishery (see below) and listed on the 303(d) list as impaired for temperature. A water quality goal is also included for temperature in Dragon Brook since it is listed on the 303(d) list as impaired for temperature.

As noted above, the Deerfield River watershed does not have a TMDL, but it is within the Connecticut River watershed, which flows into the Long Island Sound. The Long Island Sound has a TMDL: "A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound", which has a target to attain a 58.5 percent reduction in nitrogen discharges to Long Island Sound from Connecticut and New York (and a standard of 0.34 mg/L for TN in waters entering the Long Island Sound) and a 10 percent reduction target for discharges to the Connecticut River from Massachusetts (NYSDEC, 2000). It is expected that progress made toward achieving the water quality goals will also result in reductions in nitrogen discharges to the Connecticut River stemming from the Deerfield Mainstem – North River to Mouth watershed.

The water quality goals for bacteria and temperature are based on the MSWQS (MassDEP, 2021), which prescribe the minimum water quality criteria required to sustain a waterbody's designated uses. **Table A-8** includes the Massachusetts surface water classifications by assessment unit within the Deerfield Mainstem – North River to Mouth watershed. All the assessment units in the watershed are designated as Class 'B' waterbodies. Class B is assigned to waters designated as a habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth, and other critical functions, and for primary and secondary contact recreation. Where designated in 314 CMR 4.06 (of the MSWQS), they shall be suitable as a source of public water supply with appropriate treatment ("Treated Water Supply"). Class B waters 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 (MassDEP, 2021). Bear River, Drakes Brook, Hawkes Brook, and Sheldon Brook are also identified as Cold Water Fisheries, which indicates "waters in which the mean of the maximum daily temperature over a seven day period generally does not exceed 68°F (20°C) and, when other ecological factors are favorable (such as habitat), are capable of supporting a year-round population of cold water stenothermal aquatic life such as trout (Salmonidae)" (MassDEP, 2021)[2].

[2] The Department of Fish and Wildlife has also designed the tributaries in the Deerfield Mainstem North River to Mouth watershed as Coldwater Fish Resources.

Table A-8: Surface Water Quality Classification by Assessment Unit

Assessment Unit ID	Waterbody	Class	Qualifier (If Applicable)
MA33-03	Deerfield River	B	Warm Water Fishery
MA33-04	Deerfield River	B	Warm Water Fishery
MA33-17	Bear River	B	Cold Water Fishery
MA33-133	Unnamed Tributary	B	
MA33007	Goodnow Road Pond	B	
MA33-83	Sluice Brook	B	
MA33-113	Schneck Brook	B	
MA33-20	Dragon Brook	B	
MA33-54	Great Brook	B	
MA33-23	Drakes Brook	B	Cold Water Fishery
MA33-82	Sids Brook	B	
MA33-112	Hawkes Brook	B	Cold Water Fishery
MA33-22	Shingle Brook	B	
MA33-81	Sheldon Brook	B	Cold Water Fishery

The water quality goal for TP is based on target concentrations established in the Quality Criteria for Water (EPA, 1986) (also known as the "Gold Book"). The Gold Book states that TP should not exceed 50 µg/L in any stream at the point where it enters any lake or reservoir, nor should TP exceed 25 µg/L within a lake or reservoir. For the purposes of developing WBPs, MassDEP has adopted 50 µg/L as the TP target for all streams (that do not have a TP TMDL) at their downstream discharge point, regardless of which type of water body the stream discharges to.

Refer to **Table A-9** for a list of water quality goals for TP, bacteria, temperature, and TN. Element C of this WBP includes proposed management measures to address these water quality goals.

Table A-9: Water Quality Goals for Deerfield River (MA33-04)

Pollutant	Waterbody Name (Assessment Unit ID)	Goal	Source
Bacteria (*E. coli*)	All Assessment Units within the watershed	**Class B Standards** • *E. coli* concentrations shall not exceed 126 CFU/100mL, calculated as the geometric mean of all samples collected within any 90-day or smaller interval; and • No more than 10 percent of all such samples shall exceed 410 CFU/100 mL (a statistical threshold value).	Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021)
Total Phosphorus (TP)	All Assessment Units within the watershed	TP should not exceed 50 µg/L	Quality Criteria for Water (USEPA, 1986)
Temperature	Bear River (MA33-17) Dragon Brook (MA33-20)	Temperature shall not exceed 68°F (20°C) based on the mean of the daily maximum temperature over a seven-day period, unless naturally occurring.	Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021)
Total Nitrogen (TN)	All Assessment Units within the watershed	10% reduction in TN	A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound (NYSDEC, 2000)

Land Use and Impervious Cover Information

Land use information and impervious cover is presented by the below tables and figures. Land use source data is from 2005 and was obtained from MassGIS (2009b).

Watershed Land Uses

Land use in the Deerfield River Mainstem – North River to Mouth watershed is mostly forested (approximately 73 percent); approximately 15 percent is agricultural; approximately 4 percent is low-density residential; approximately 3 percent is open land; approximately 2 percent is water; approximately 1 percent is commercial; and the remaining less than 2.5 percent of the watershed is industrial, highway, medium or high density residential (**Table A-10**; **Figure A-5**).

Table A-10: Subwatershed Land Uses

Land Use	Area (acres)	% of Watershed
Forest	23,385	73.3%
Agriculture	4,627	14.5%
Low Density Residential	1,169	3.7%
Open Land	1,002	3.1%
Water	597	1.9%
Commercial	323	1.0%
Highway	264	0.8%
Industrial	255	0.8%
Medium Density Residential	139	0.4%
High Density Residential	137	0.4%

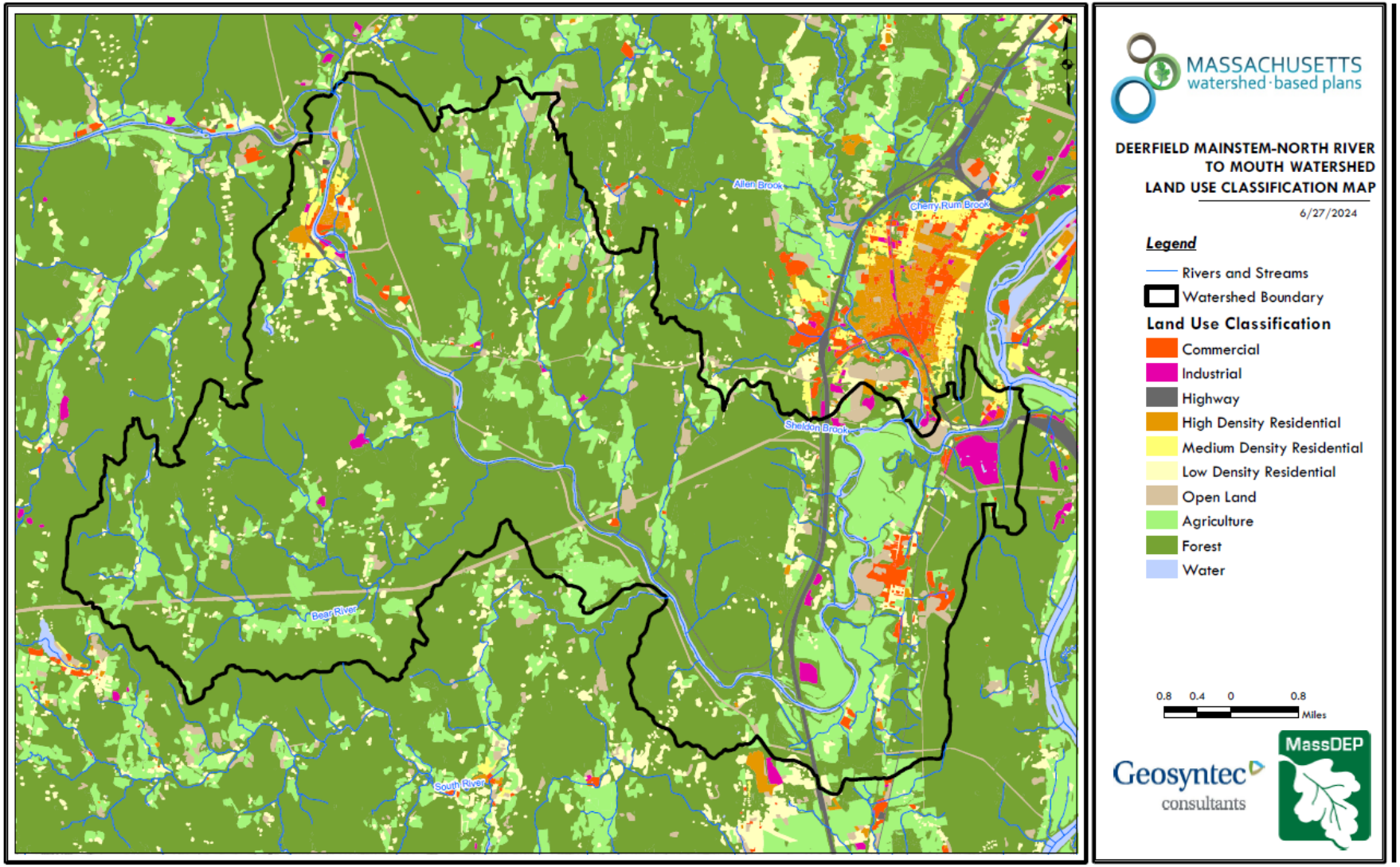

Figure A-5: Deerfield Mainstem – North River to Mouth Watershed Land Use Map
(MassGIS, 2007; MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)
Ctrl + Click on the map to view a full-sized image in your web browser.

Watershed Impervious Cover

There is a strong link between impervious land cover and stream water quality. Impervious cover includes land surfaces that prevent the infiltration of water into the ground, such as paved roads and parking lots, roofs, basketball courts, etc. Impervious area in the Deerfield Mainstem – North River to Mouth watershed is mainly associated with roads and the industrial and commercial areas of the watershed. **Figure A-6** is an impervious cover map for the Deerfield Mainstem – North River to Mouth watershed.

Impervious areas that are directly connected (DCIA) to receiving waters (via storm sewers, gutters, or other impervious drainage pathways) produce higher runoff volumes and transport stormwater pollutants with greater efficiency than disconnected impervious cover areas which are surrounded by vegetated, pervious land. Runoff volumes from disconnected impervious cover areas are reduced as stormwater infiltrates when it flows across adjacent pervious surfaces.

An estimate of DCIA for the watershed was calculated based on the Sutherland equations[3]. USEPA provides guidance (USEPA, 2010) on the use of the Sutherland equations to predict relative levels of connection and disconnection based on the type of stormwater infrastructure within the **total impervious area (TIA)** of a watershed. The estimated TIA and DCIA for the Deerfield Mainstem – North River to Mouth watershed is 3.6 percent and 2.7 percent, respectively.

The relationship between TIA and water quality can generally be categorized as listed by **Table A-11** (Schueler et al. 2009). The TIA value for the watershed range is 3.6 percent; therefore, the river and surrounding tributaries would be expected to show good to excellent water quality. However, as indicated above, the downstream segment of the Deerfield River is impaired for *E. coli* and two tributaries (Bear River and Dragon Brook are impaired for temperature (MassDEP, 2021). The Green River, North River and South River, which have various listed impairments, also flow into the Deerfield River – North River to Mouth watershed.

[3] The Sutherland equations are a set of empirical equations used to calculate the percentage of directly connected DCIA in urban watersheds. The equations were developed by R.C. Sutherland in 1995 and are based on USGS data. The USEPA uses the equations to estimate DCIA based on land use types.

Table A-11: Relationship between Total Impervious Area (TIA) and water quality (Schueler et al. 2009)

% Watershed Impervious Cover	Stream Water Quality
0% to 10%	Typically high quality, and typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects.
11% to 25%	These streams show clear signs of degradation. Elevated storm flows begin to alter stream geometry, with evident erosion and channel widening. Streams banks become unstable, and physical stream habitat is degraded. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with most sensitive fish and aquatic insects disappearing from the stream.
26% to 60%	These streams typically no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, downcutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated and the substrate can no longer provide habitat for aquatic insects, or spawning areas for fish. Biological quality is typically poor, dominated by pollution tolerant insects and fish. Water quality is consistently rated as fair to poor, and water recreation is often no longer possible due to the presence of high bacteria levels.
>60%	These streams are typical of “urban drainage”, with most ecological functions greatly impaired or absent, and the stream channel primarily functioning as a conveyance for stormwater flows.

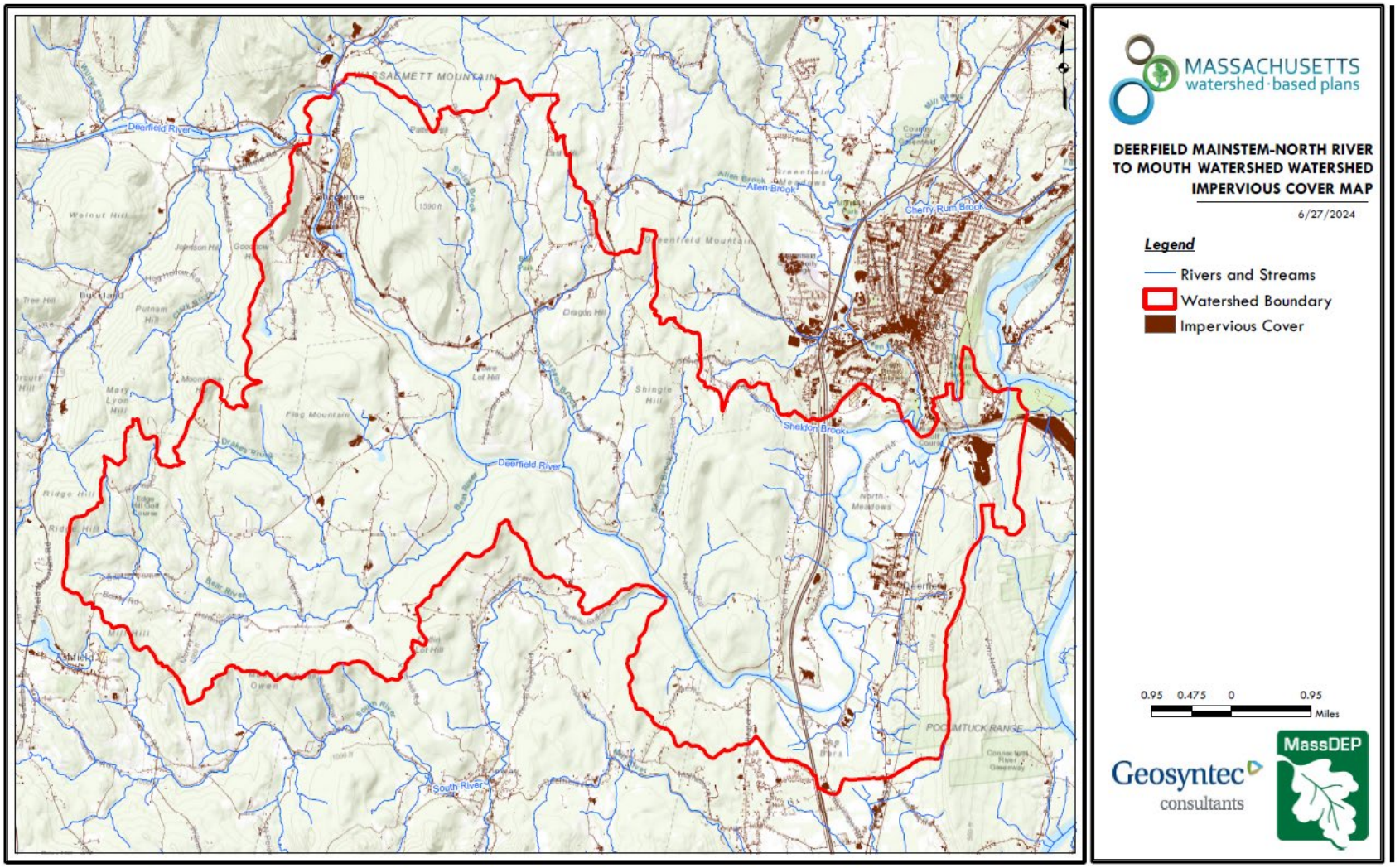

Figure A-6: Deerfield Mainstem – North River to Mouth Impervious Surface Map

(MassGIS, 2007; MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Ctrl + Click on the map to view a full-sized image in your web browser.

Pollutant Loading

Geographic Information Systems (GIS) was used for the pollutant loading analysis. The land use data (MassGIS, 2009b) was intersected with impervious cover data (MassGIS, 2009a) and United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soils data (USDA NRCS and MassGIS, 2012) to create a combined land use/land cover grid. The grid was used to sum the total area of each unique land use/land cover type.

The amount of DCIA was estimated using the Sutherland equations as described above and any reduction in impervious area due to disconnection (i.e., the area difference between TIA and DCIA) was assigned to the pervious D soil category for that land use to simulate that some infiltration will likely occur after runoff from disconnected impervious surfaces passes over pervious surfaces.

Pollutant loading for key nonpoint source pollutants in the watershed was estimated by multiplying each land use/cover type area by its pollutant load export rate (PLER) as follows:

$$L_n = A_n * P_n$$

Where:

L_n = Loading of land use/cover type n (pounds per year (lb/yr));
A_n = area of land use/cover type n (acres);
P_n = pollutant load export rate of land use/cover type n (pound per acre per year (lb/acre/yr))

The PLERs are an estimate of the annual total pollutant load exported via stormwater from a given unit area of a particular land cover type. The PLER values for TN, TP and TSS were obtained from USEPA (USEPA, 2020; UNHSC, 2018, Tetra Tech, 2015) (see values provided in **Appendix C**).

Table A-12 presents the estimated land-use based TP, TN and TSS within the Deerfield River Mainstem – North River to Mouth watershed. The largest contributor of the land use-based pollutant load originates from areas designated as forested. TP and TN generated from forested areas is generally a result of natural processes such as decomposition of leaf litter and other organic material; the forested portions of the watershed therefore are unlikely to provide opportunities for nutrient load reductions through best management practices. Agricultural areas are the second largest contributors of land-use based pollutant load in the watershed. Agricultural areas provide excellent opportunities for nutrient load reductions through agricultural BMPs as described in the following sections.

Table A-12: Estimated Pollutant Loading in the Deerfield River – North River to Mouth Watershed for Key Nonpoint Source Pollutants

Land Use Type	Pollutant Loading[1]		
	Total Phosphorus (TP) (lb/yr)	Total Nitrogen (TN) (lb/yr)	Total Suspended Solids (TSS) (tons/yr)
Forest	3,064	15,229	544
Agriculture	2,223	13,271	146
Low Density Residential	311	3,121	42
Commercial	252	2,203	28
Open Land	226	2,141	36
Industrial	223	1,958	24
Highway	156	1,354	62
High Density Residential	93	623	9
Medium Density Residential	47	401	6
TOTAL	6,595	40,302	898

[1]These estimates do not consider loads from point sources or septic systems.

"lb / yr" = pounds per year

It is important to note pollutant loads presented in **Table A-12** do not consider loads from point sources or septic systems. Septic system sources should be separately evaluated to determine whether septic system upgrades or sanitary sewer system conversion would cost-effectively reduce bacteria and nutrient sources in the watershed.

Element B: Determine Pollutant Load Reductions Needed to Achieve Water Quality Goals

Element B of your WBP should:

Determine the pollutant load reductions needed to achieve the water quality goals established in Element A. The water quality goals should incorporate Total Maximum Daily Load (TMDL) goals, when applicable. For impaired water bodies, a TMDL establishes pollutant loading limits as needed to attain water quality standards.

Estimated Pollutant Loads

Estimated land use-based pollutant loads for TP (6,595 lb/yr), TN (40,302 lb/yr), and TSS (898 tons/yr) were previously presented in **Table A-12** of this WBP. *E. coli* land use-based loading has not been estimated for this WBP, as there are not yet established PLERs available for *E. coli*; this may be updated in future revisions to this WBP.

Water Quality Goals and Required Load Reduction

There are many methodologies that can be used to set pollutant load reduction goals for a WBP. Goals can be based on water quality criteria, surface water standards, existing monitoring data, existing TMDL criteria, or other data. As discussed in Element A, water quality goals for this WBP are focused on reducing *E. coli* and TP loading to the Deerfield River Mainstem – North River to Mouth watershed.

While *E. coli* loads are not estimated, *E. coli* reductions may be determined by comparing monitored water quality concentrations to the goals for *E. coli* presented in Element A and **Table B-1**.

The TN load reduction goal is based on the 10 percent reduction goal for Massachusetts in the Long Island Sound TMDL (NYSDEC, 2000).

The method used[4] for calculating a TP loading goal produces a loading value that is greater than the estimated TP load of 6,595 lb/yr. Given the iterative and adaptive nature of this WBP, the monitoring portion of this WBP (**Element I**) recommends that monitoring be performed to better understand the existing TP loading to the Deerfield Mainstem – North River to Mouth, which may help establish a specific TP related water quality goal with

[4] According to the EPA Gold Book, TP should not exceed 50 ug/L in any stream at the point where it enters any lake or reservoir. The water quality loading goal was estimated by multiplying this target maximum TP concentration (50 ug/L) by the estimated annual watershed discharge for the Deerfield River Mainstem – North River to Mouth watershed. To estimate the annual watershed discharge, the mean flow was used, which was estimated based on United States Geological Survey (USGS) "Runoff Depth" estimates for Massachusetts (Cohen and Randall, 1998). Cohen and Randall (1998) provide statewide estimates of annual Precipitation (P), Evapotranspiration (ET), and Runoff (R) depths for the northeastern U.S. According to their method, Runoff Depth (R) is defined as all water reaching a discharge point (including surface and groundwater), and is calculated by: P - ET = R. A mean Runoff Depth R was determined for the watershed by calculating the average value of R within the watershed boundary.

the next update of the WBP (expected in 2027). In the interim, a 10 percent reduction in the estimated watershed loading to 5,935 lb/yr is proposed to improve the water quality within Deerfield River Mainstem – North River to Mouth watershed.

The water quality goals, and corresponding required loading reductions are included in **Table B-1**. The proposed projects described in this WBP are expected to reduce *E. coli* ,TP, and TN loads to Deerfield River Mainstem – North River to Mouth watershed; however, additional load reductions may be required to meet the water quality goals.

The following adaptive sequence is recommended to sequentially track and meet these load reduction goals:

1. Continue and expand on the baseline water quality monitoring program in accordance with **Element I**. Results from the monitoring program should advise if **Element C** management measures have been effective at addressing listed water quality impairments or water quality goals for other indicator parameters established by **Table A-9** of this WBP. Results can further be used to periodically inform or adjust load reduction goals presented in **Table B-1**.

2. Based on monitoring data, establish additional long-term reduction goal(s), if needed, to lead to delisting of Dragon Brook (MA33-20), Bear River (MA33-17), and Deerfield River (MA33-04) from the 303(d) list over the next 15 years.

Table B-1: Pollutant Load Reductions Needed for Deerfield Mainstem North River to Mouth Watershed

Pollutant	Existing Estimated Total Load	Water Quality Goal	Required Load Reduction
Total Phosphorus	6,595 lb/yr	5,935 lb/yr	660 lb/yr
Bacteria (*E. coli*)	*MSWQS for bacteria are concentration standards (CFU/100 mL), which are difficult to predict based on estimated annual loading.*	• *E. coli* concentrations shall not exceed 126 colony-forming units per 100 milliliters (CFU/100mL), calculated as the geometric mean of all samples collected within any 90-day or smaller interval; and • no more than 10 percent of all such samples shall exceed 410 CFU/100 mL (a statistical threshold value).	N/A Concentration-based
Total Nitrogen	40,302 lb/yr	36,272 lb/yr	4,030 lb/yr

"E. coli" = Escherichia coli
"CFU/100 mL" = colony forming units per 100 milliliters
"lb/yr" = pounds per year
"MSWQS" = Massachusetts Surface Water Quality Standards (MassDEP, 2021)
"N/A" = Not applicable

Element C: Describe management measures that will be implemented to achieve water quality goals

Element C: A description of the nonpoint source management measures needed to achieve the pollutant load reductions presented in Element B, and a description of the critical areas where those measures will be needed to implement this plan.

Management measures, also referred to as stormwater best management practices (BMPs) manage stormwater runoff by reducing peak runoff rates, managing runoff volume, and improving water quality by reducing nutrients and pollutants. There are two main types of BMPs: structural BMPs that are engineered systems such as (but not limited to) rain gardens, water quality swales, and subsurface infiltration units; and non-structural BMPs that are practices such as street sweeping and catch basin cleaning which indirectly reduce the pollutant load to waterbodies.

Ongoing and Future Management Measures

Agricultural Nonpoint Source Regional Coordinators for Franklin, Hampshire, Hampden Counties

MACD was awarded Fiscal Year 2022 Section 319 grant funding for its "Agricultural Nonpoint Source Regional Coordinators for Franklin, Hampshire, Hampden Counties". The MACD agricultural regional coordinators worked with the Hampden Hampshire Conservation District (HHCD), the FCD, the FRCOG, and the Pioneer Valley Planning Commission (PVPC) to develop a database of prioritized impaired watersheds for restoration. In addition to waterbody impairment, the group used desktop and dashboard surveys as well as informal interviews with farmers to assess the level of agricultural activity in the watersheds. The database of watersheds created from this effort will provide guidance for future efforts focused on agricultural areas in addition to identifying at least three watersheds to advance to watershed-based planning; Deerfield Mainstem – North River to Mouth watershed was one of the selected prioritized watersheds for WBP development (MACD, 2021).

MACD's general strategy is to conduct outreach and education to farmers; support the development of conservation plans outlining BMPs to reduce pollutant runoff; assist landowners in obtaining access to technical and financial resources to implement the BMPs; and ensure farmers follow operation and maintenance practices recommended by MACD and/or NRCS. MACD has applied for additional grant funding to continue this work into the future. Numerous farms in the Deerfield Mainstem – North River to Mouth watershed have been identified for outreach and possible implementation of agricultural BMPs. Agricultural BMPs can be structural or non-structural.

Appendix D includes a list of agricultural BMPs, with estimated TN pollutant load reduction numbers, that are included in MACD conceptual projects for agricultural properties in the Deerfield Mainstem – North River to Mouth watershed. The estimated pollutant load reduction (TP, TN and/or *E. coli*) that may be achieved from implementing BMPs is site-specific, can be fine-tuned once BMPs are closer to completion, and may be updated in future iterations of this WBP.

A list of typical agricultural BMPs is also included below.

1. **Livestock Exclusion:** This practice involves the fencing of an area not intended for grazing to exclude livestock from accessing that area. Livestock exclusion may improve water quality by preventing livestock from being in the water, preventing access to steep or highly erodible banks, and by preventing animal waste deposition in surface waters. This practice prevents compaction of the soil by livestock and prevents losses of vegetation and undergrowth. This may maintain or increase evapotranspiration. Increased soil permeability may reduce erosion and decrease the transport of sediment and other pollutants to surface waters. By protecting existing vegetation, this practice also promotes shading along streams and may reduce surface water temperature.

2. **Riparian Buffers:** A riparian buffer is the area of trees, shrubs and grasses adjacent to a river that can intercept pollutants from both surface and shallow groundwater before reaching a river or stream. This practice involves the protection, maintenance, and restoration of riparian forest areas. The ability of a riparian buffer to remove pollutants is dependent on the width of the buffer, the type of vegetation, the manner in which runoff traverses the vegetated areas, the slope and the soil composition within the riparian area. Riparian buffers also provide habitat for wildlife and enhance fish habitat by reducing water temperature.

3. **Alternative Livestock Water Supply:** An alternate livestock drinking water supply located away from surface waters can reduce stream bank erosion, prevent the deposition of animal waste within water bodies, protect riparian vegetation, and provide a dependable, clean source of water for livestock. In some locations, artificial shade may also be constructed to encourage use of upland sites for shading and loafing. Alternative livestock water can be provided through the following practices:

    - Pond: A water impoundment made by constructing a dam or an embankment or by excavation of a pit or dugout.
    - Trough or Tank: By the installation of troughs or tanks, livestock may be better distributed over the pasture, grazing can be better controlled, and surface runoff reduced, thus reducing erosion.
    - Well: A drinking water supply well can be constructed or improved to provide water for livestock.
    - Spring Development: This practice includes improving springs and seeps by excavating, cleaning, capping, or providing collection and storage facilities. Temporary erosion and sedimentation may occur from any disturbed areas during and immediately following any related construction activities.
    - Pipeline/Pump System: A gravity pipeline or pump system can be developed in combination with the practices described above to increase to distance between a water source (e.g., well, spring) and targeted water supply areas within the pasture.

4. **Rotational Grazing Systems and Improved Pasture Management:** Rotational grazing systems and improved pasture management are recommended in conjunction with livestock exclusion and alternative livestock water supply projects. Grazing systems and improved pasture management allow farmers to better use grazing land and includes:

    a. managing livestock rotation to maintain minimum grazing height recommendations and sufficient rest periods for plant recovery;
    b. locating feeding and watering facilities away from sensitive areas (see alternative livestock water supply above);

c. designating a sacrifice lot/paddock (that does not drain directly into ponds, creeks, etc.) to locate livestock during the rainy season or when pastures are not growing actively to prevent overgrazing and trampling[5];
d. using compost-bedded pack barns (large, open resting area, under covered housing, usually bedded with sawdust or dry, fine wood shavings and manure composted into place and mechanically stirred on a regular basis) for dairy cows; and
e. chain harrowing pastures (at least twice a year) to break up manure piles and uniformly spread manure, after livestock are removed.

5. **Afforestation of Hay and Pastureland:** Using a small portion of hay and pastureland for tree planting. This converts pasture that is not well suited for grazing due to slope and other characteristics, optimizes the use of suitable pastureland in the watershed, and prevents runoff and soil loss from marginal pastures.

6. **Cropland Management Practices:** Cropland management practices include, among others, continuous no till, cover crops, and fertilizer management.

    a. Continuous no till is used to encourage procedures to convert fields under some degree of tillage to a system of minimal soil disturbance that will maintain a minimum a 60% rain drop intercepting residue cover.
    b. Cover crops keep cover on fields during times of year when they would otherwise be left barren in order to minimize runoff and erosion from the soil surface and also decrease leaching of nitrogen through the soil.
    c. Farmers can implement fertilizer management practices to help maintain high yields and save money on fertilizers while reducing nonpoint source pollution. A Crop Nutrient Management Plan[6]; is a tool that farmers can use to achieve these goals.

7. **Stormwater Runoff Management Practices on Agricultural Properties:** Stormwater runoff management practices on agricultural properties include structural BMPs such as gutters, downspouts, pipes, catch basins, french drains, to divert runoff and prevent it from intermingling with runoff from areas that store manure, chemicals, or other potential pollutants.

MACD references guidance from USDA when planning and implementing BMPs with farm owners. The Massachusetts "Field Office Technical Guide" provides detailed information on agricultural BMPs that may be implemented at farms in the watershed[7]. **Appendix E** also includes a list, provided by FRCOG, of potential agricultural BMPs that may be implemented in the watershed. An additional tool that may help for estimating pollutant load reductions of implemented agricultural BMPs is the (Pollutant Load Estimation Tool) PLET tool[8].

[5] See here for more information and recommended footing materials recommended for sacrifice areas: https://ag.umass.edu/sites/ag.umass.edu/files/fact-sheets/pdf/horse_footing_materials_15_05.pdf
[6] See here for ten key components to include in a crop nutrient management plan: megamanual.geosyntec.com/npsmanual/cropnutrient.aspx
[7] The Massachusetts "Field Office Technical Guide" can be accessed at: https://efotg.sc.egov.usda.gov/#/state/MA/documents/section=4&folder=-3 ; the list of BMPs, as well as detailed information on each, is found under "Section 4 - Practice Standards and Supporting Documents" > "Conservation Practice Standards & Support Documents".
[8] The PLET tool is accessible here: https://www.epa.gov/nps/plet#Model%20Documentation.

Lower Bear River Conservation Area and Upper Bear River Conservation Area/Geomorphic Restoration

The Deerfield River WBP (FRCOG, 2015) recommended conservation and permanent protection of 500-plus contiguous acres along the lower two miles of the Bear River. The Deerfield River WBP (FRCOG, 2015) also recommended conservation and geomorphic restoration (wood addition) on the upper Bear River; this project would protect a 200-foot-wide river corridor through portions of the Upper Bear River. The benefits of both these projects would include sediment storage, flood attenuation, and habitat enhancement (FRCOG, 2015). The conceptual designs for these two projects are included in **Appendix F**.

The Bear River is also a conservation priority area of the Franklin Land Trust, which recently protected (since 2021) a total of 192 acres of farmland, forest land, and river frontage along the Bear River. The Franklin Land Trust also purchased the 154-acre Edge Hill Golf Course (now known as the Edge Hill Conservation Area) in 2023, which is located at the headwaters of Bear River. The goal for this conservation area will be to restore the on-site wetlands and uplands primarily for watershed rare species and wildlife habitat.

Deerfield WBP Findings and Recommendations for the Deerfield Mainstem North River to Mouth Watershed

Figure C-1 includes findings and recommendations for the Deerfield Mainstem North River to Mouth watershed from the Deerfield River WBP[9]. The list included in **Figure C-1** was discussed during the stakeholder meeting on May 15, 2024. **Table C-1** includes the current status (i.e., not yet started, in progress, or completed) of the fifteen action items with any relevant notes.

[9] Some of the management measure recommendations on the list were also included in the 2000 Water Quality Assessment Report (**Appendix B**)

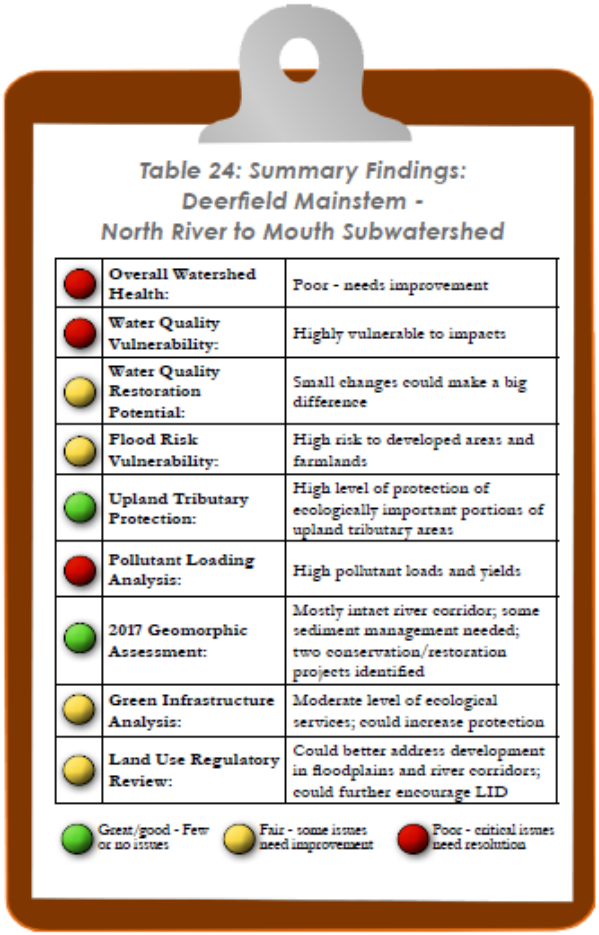

Table 24: Summary Findings: Deerfield Mainstem - North River to Mouth Subwatershed

🔴	**Overall Watershed Health:**	Poor - needs improvement
🔴	**Water Quality Vulnerability:**	Highly vulnerable to impacts
🟡	**Water Quality Restoration Potential:**	Small changes could make a big difference
🟡	**Flood Risk Vulnerability:**	High risk to developed areas and farmlands
🟢	**Upland Tributary Protection:**	High level of protection of ecologically important portions of upland tributary areas
🔴	**Pollutant Loading Analysis:**	High pollutant loads and yields
🟢	**2017 Geomorphic Assessment:**	Mostly intact river corridor; some sediment management needed; two conservation/restoration projects identified
🟡	**Green Infrastructure Analysis:**	Moderate level of ecological services; could increase protection
🟡	**Land Use Regulatory Review:**	Could better address development in floodplains and river corridors; could further encourage LID

🟢 Great/good - Few or no issues 🟡 Fair - some issues need improvement 🔴 Poor - critical issues need resolution

Table 25: Summary Recommendations: The Deerfield River Watershed Action Plan, beginning on page 63, contains recommendations and action items applicable to the entire watershed. In addition to the Action Plan, high priority recommendations specific to the Deerfield Mainstem - North River to Mouth Subwatershed are described on the previous page and summarized here:

- **Action Item #1:** Assess vulnerability of critical facilities to flooding, and update and coordinate recommendations in local hazard mitigation plans for flooding and critical facilities.
- **Action Item #2:** Update existing municipal land use and subdivision regulations to better protect the floodplain and other sensitive areas, ensuring consistency between towns.
- **Action Item #3:** Conduct fluvial geomorphic assessments to better refine the location, severity, and likelihood of erosion hazards and the potential impacts restoration/ mitigation projects might have on channel stability and aquatic habitat, not only at the proposed site but also to downstream and upstream locations.
- **Action Item #4:** Conduct upland tributary and watershed assessments; develop a project implementation schedule for conservation and management recommendations based upon assessment findings.
- **Action Item #5:** Map river corridors using Active River Area or results from fluvial geomorphic assessments.
- **Action Item # 6:** Implement river corridor recommendations based upon the field geomorphic assessment.
- **Action Item # 7:** Work with farmers to implement agricultural BMPs to protect water quality.
- **Action Item #8:** Work with landowners to protect upland tributary areas and BioMap2 Core Habitats from development through land acquisition, conservation easements, and other mechanisms.
- **Action Item #9:** Provide incentives for forest owners - through carbon trusts or other mechanisms - to protect their land for carbon storage.
- **Action Item #10:** Consider implementing River Corridor Protection bylaws that would limit development within areas of river corridors susceptible to erosion and flooding.
- **Action Item #11:** Amend or adopt Open Space Residential / Natural Resource Protection zoning to balance new development in rural areas with land protection.
- **Action Item #12:** Encourage the use of LID site planning and stormwater techniques in new development and redevelopment.
- **Action Item #13:** Identify opportunities for LID and green infrastructure retrofits on public lands in the Village of Shelburne Falls to reduce and treat stormwater runoff from impervious areas.
- **Action Item #14:** Conduct a Rural Roads Assessment to identify road drainage and stormwater management problems and to determine priority projects and BMPs. Include training for DPW.
- **Action Item #15:** Secure funding to implement conservation/restoration projects identified in 2017 geomorphic assessment. See conceptual designs beginning on page 79.

Figure C-1: Deerfield River Watershed Based Plan Summary of Findings and Recommendations for Deerfield Mainstem – North River to Mouth Watershed (copied from FRCOG, 2015)

Table C-1: Current Status of 2015 Deerfield Watershed Based Plan Action Items

Action Item #	Action Item Description	Status	Notes
1	Assess vulnerability of critical facilities to flooding, and update and coordinate recommendations in local hazard mitigation plans for flooding and critical facilities.	Completed	Local Hazard Mitigation Plans
2	Update existing municipal land use and subdivision regulations to better protect the floodplain and other sensitive areas, ensuring consistency between towns.	In Progress	- Currently FRCOG is working on updating Town of Shelburne subdivision regulation to incorporating LID (22-01/604b) - The Town of Deerfield has adopted the "Green Infrastructure and Climate Resiliency Policy": https://deerfieldma.us/DocumentCenter/View/1567/Deerfields-Green-Infrastructure-Policies-and-Bylaws
3	Conduct fluvial geomorphic assessments to better refine the location, severity, and likelihood of erosion hazards and the potential impacts restoration/mitigation projects might have on channel stability and aquatic habitat, not only at the proposed site but also to downstream and upstream locations.	Not yet started	
4	Conduct upland tributary and watershed assessments; develop a project implementation schedule for conservation and management recommendations based upon assessment findings.	Not yet started	
5	Map river corridors using Active River Area or results from fluvial geomorphic assessments.	Not yet started	
6	Implement river corridor recommendations based upon the field geomorphic assessment.	Not yet started	
7	Work with farmers to implement agricultural BMPs to protect water quality.	In Progress	Agricultural Nonpoint Source Regional Coordinators for Franklin, Hampshire, Hampden Counties
8	Work with landowners to protect upland tributary areas and BioMap2 Core Habitats from development through land acquisition, conservation easements, and other mechanisms.	In Progress	Franklin Land Trust conserved land along Bear River
9	Provide incentives for forest owners -through carbon trusts or other mechanisms - to protect their land for carbon storage.	In Progress	May need some updating on the language for this Action item
10	Consider implementing River Corridor Protection bylaws that would limit development within areas of river corridors susceptible to erosion and flooding.	Not yet started	
11	Amend or adopt Open Space Residential / Natural Resource Protection zoning to balance new development in rural areas with land protection.	In Progress	Currently FRCOG is working on updating City of Greenfield Open Space Cluster Development Ordinance to encourage LID and stormwater BMPs and promote additional land conservation (22-01/604b)
12	Encourage the use of LID site planning and stormwater techniques in new development and redevelopment	In Progress	(see above)
13	Identify opportunities for LID and green infrastructure retrofits on public lands in the Village of Shelburne Falls to reduce and treat stormwater runoff from impervious areas.	In Progress	Buckland Green Streets (2018-02/604)

Action Item #	Action Item Description	Status	Notes
14	Conduct a Rural Roads Assessment to identify road drainage and stormwater management problems and to determine priority projects and BMPs. Include training for DPW.	In Progress	Currently FRCOG is working on Unpaved Roads Stormwater Toolkit (22-05/319 MVP Action grant awarded August 2024 to continue developing unpaved roads stormwater management guidance and training.
15	Secure funding to implement conservation/restoration projects on Lower Bear River	Not yet started	See conceptual designs in **Appendix F**

Identification of Priority Locations for Structural BMPs.

Implementing agricultural BMPs, along with incorporating structural BMPs (e.g., low impact development practices) on new and existing development, and investigation and remediation of potential other sources such as failing septic systems will be necessary to achieve a measurable and sustainable improvement in water quality in the Deerfield Mainstem – North River to Mouth watershed.

The following general sequence is recommended to identify and implement future structural BMPs[10]. Examples of structural BMPs include (but not limited to):

- bioretention areas and rain gardens,
- deep sump catch basins,
- dry wells,
- constructed stormwater wetlands (e.g., gravel wetland),
- porous pavement,
- sand filters,
- vegetated filter strips,
- wet ponds,
- infiltration basins and trenches,
- oil/grit separators, and water quality swales.

Pollutant load reduction estimates for the BMPs listed above (in percent) can be found on the Clean Water Toolkit website accessible here: **https://megamanual.geosyntec.com/npsmanual/bmpfactsheetmenu.aspx**

Note this approach applies largely to non-agricultural BMPs that might be implemented by other watershed stakeholders (such as any of the stakeholders listed in the Introduction section of this WBP), as MACD's work focuses on building relationships with the agricultural community to guide agricultural BMP implementation.

1. **Identify Potential Implementation Locations:** Perform a desktop analysis using aerial imagery and GIS data to develop a preliminary list of potentially feasible implementation locations based on land use; soil type (i.e., hydrologic soil groups A and B); available public open space (e.g., lawn area in front of a police station);

[10] For detailed information on BMP selection, siting and sizing, refer to the following document: https://prj.geosyntec.com/prjMADEPWBP_Files/Files/BMP%20Selection,%20siting%20and%20sizing%20Guidance_FINAL.pdf.
An additional reference for developing BMP concepts in unpaved road areas/eroded streambanks is "Massachusetts Unpaved Roads BMP Manual" (Berkshire Regional Planning Commission, 2001): https://megamanual.geosyntec.com/npsmanual/Unpaved%20Road.pdf

potential redevelopment sites where additional public-private partnerships may be leveraged; and other factors such as proximity to receiving waters, known problem areas, or publicly owned right of ways or easements. See BMP Hotspot Map analysis below, which helps identify potential implementation locations.

2. **Visit Potential Implementation Locations:** Perform field reconnaissance, preferably during a period of active runoff-producing rainfall, to evaluate potential implementation locations, gauge feasibility, and identify potential BMP ideas. During field reconnaissance, assess identified locations for space constraints, potential accessibility issues, presence of mature vegetation that may cause conflicts (e.g., roots), potential utility conflicts, site-specific drainage patterns, and other factors that may cause issues during design, construction, or long-term maintenance.

3. **Develop BMP Concepts:** Once potential BMP locations are conceptualized, use the BMP-selector tool on the watershed-based planning tool to help develop concepts. Concepts can vary widely. One method is to develop 1-page fact sheets for each concept that includes a site description, including definition of the problem, a description of the proposed BMPs, annotated site photographs with conceptual BMP design details, and a discussion of potential conflicts such as property ownership, O&M requirements, and permitting constraints. The fact sheet can also include information obtained from the BMP-selector tool including cost estimates, load reduction estimates, and sizing information (i.e., BMP footprint, drainage area, etc.).

4. **Rank BMP Concepts:** Once BMP concepts are developed, perform a priority ranking based on site-specific factors to identify the implementation order. Ranking can include many factors including cost, expected pollutant load reductions, implementation complexity, potential outreach opportunities and visibility to public, accessibility, expected operation and maintenance effort, and others. Prioritized BMP concepts should focus on reducing *E. coli* and TP loading to Deerfield Mainstem North River to Mouth watershed as summarized by **Element B.**

BMP Hotspot Map

The following GIS-based analysis[11] was performed within the watershed to identify high priority parcels for BMP (also referred to as management measure) implementation:

- Each parcel within the watershed was evaluated based on ten different criteria accounting for the parcel ownership, social value, and implementation feasibility (See **Table C-1** for more detail below);
- Each criterion was then given a score from 0 to 5 to represent the priority for BMP implementation based on a metric corresponding to the criterion (e.g., a score of 0 would represent lowest priority for BMP implementation whereas a score of 5 would represent highest priority for BMP implementation);
- A multiplier was also assigned to each criterion, which reflected the weighted importance of the criterion (e.g., a criterion with a multiplier of 3 had greater weight on the overall prioritization of the parcel than a criterion with a multiplier of 1); and
- The weighted scores for all the criteria were then summed for each parcel to calculate a total BMP priority score.

[11] GIS data used for the BMP Hotspot Map analysis included: MassGIS (2015a); MassGIS (2015b); MassGIS (2017a); MassGIS (2017b); MassGIS (2020); MA Department of Revenue Division of Local Services (2016); MassGIS (2005); ArcGIS (2020); MassGIS (2009b); MassGIS (2012); and ArcGIS (2020b).

Table C-2 presents the criteria, indicator type, metrics, scores, and multipliers that were used for this analysis. Parcels with total scores above 60 are recommended for further investigation for BMP implementation suitability. **Figure C-2** presents the resulting BMP Hotspot Map for the Deerfield Mainstem – North River to Mouth watershed.

This analysis solely evaluated individual parcels for BMP implementation suitability and likelihood for the measures to perform effectively within the parcel's features. This analysis does not quantify the pollutant loading to these parcels from the parcel's upstream catchment. When further evaluating a parcel's BMP implementation suitability and cost-effectiveness of BMP implementation, the existing pollutant loading from the parcel's upstream catchment and potential pollutant load reduction from BMP implementation should be evaluated.

Table C-2: Matrix for BMP Hotspot Map GIS-based Analysis

Criteria	Indicator Type	METRICS																										Multiplier	Maximum Potential Score
		Yes or No?		Hydrologic Soil Group				Land Use Type								Water Table Depth				Parcel Area			Parcel Average Slope						
		Yes	No	A or A/D	B or B/D	C or C/D	D	Low and Medium Density Residential	High Density Residential	Commercial	Industrial	Highway	Agriculture	Forest	Open Land	Water	101-200 cm	62-100 cm	31-61 cm	0-30 cm	Greater than 2 acres	Between 1-2 acres	Less than 1 acre	Less than 2%	Between 2% and 15%	Greater than 15%	Less than 50%	Between 51% and 100%		
Is the parcel a school, fire station, police station, town hall or library?	Ownership	5	0																									2	10
Is the parcel's use code in the 900 series (i.e., public property or university)?	Ownership	5	0																									2	10
Is parcel fully or partially in an Environmental Justice Area?	Social	5	0																									2	10
Most favorable Hydrologic Soil Group within Parcel	Implementation Feasibility			5	3	0	0																					2	10
Most favorable Land Use in Parcel	Implementation Feasibility							1	2	4	2	4	5	1	4	X[1]												3	15
Most favorable Water Table Depth (deepest in Parcel)	Implementation Feasibility																5	4	3	0								2	10
Parcel Area	Implementation Feasibility																				5	4	1					3	15
Parcel Average Slope	Implementation Feasibility																							3	5	1		1	5
Percent Impervious Area in Parcel	Implementation Feasibility																										5	2.5	1	5
Within 100 ft buffer of receiving water (stream or lake/pond)?	Implementation Feasibility	5	2																									2	10

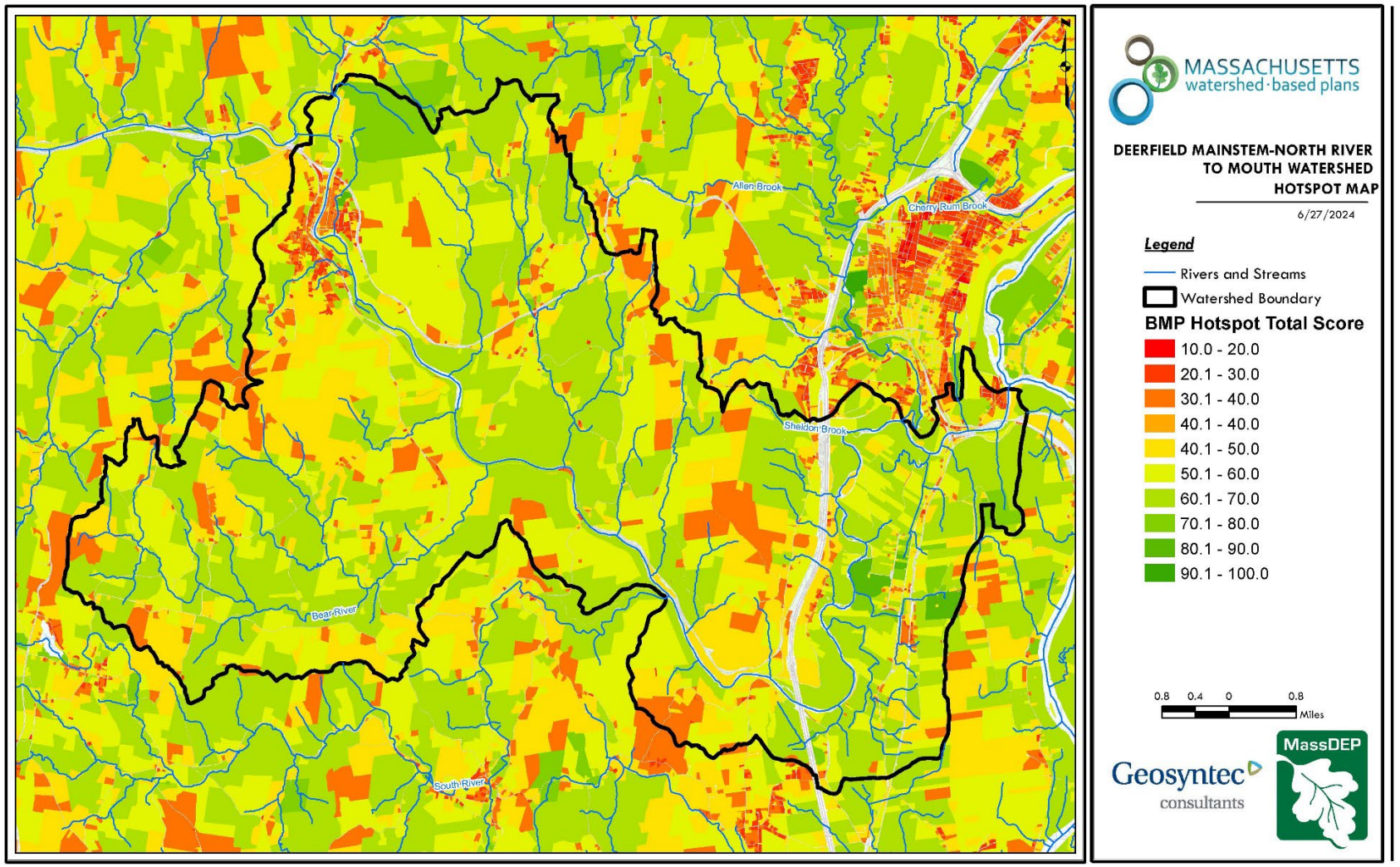

Figure C-2: Deerfield Mainstem – North River to Mouth Watershed BMP Hotspot Map (MassGIS (2015a), MassGIS (2015b), MassGIS (2017a), MassGIS (2017b), MassGIS (2020), MA Department of Revenue Division of Local Services (2016), MassGIS (2005), ArcGIS (2020), MassGIS (2009a), MassGIS (2012), ArcGIS (2020b))

Additional Non-structural BMPs

It is recommended, if it has not already been done, that nonstructural BMPs currently implemented in the Towns of Deerfield, Shelburne, Buckland, Ashfield, Conway, and City of Greenfield, including street sweeping and catch basin cleaning, be evaluated and potentially optimized for removal of TP and *E. coli*. First, it is recommended that potential pollutant load removals from ongoing activities be calculated in accordance with **Elements H and I** of this document. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions, such as increased frequency or improved technology. Other nonstructural BMPs that are recommended to be implemented include (but not limited to):

- septic system maintenance,
- pet waste management,
- municipal sewer system inspection and maintenance,
- land use regulation revision (e.g., construction erosion and sediment control requirements),
- protection and conservation of open space, riparian buffers, wetlands and stream corridors,
- impervious cover reduction,
- impervious cover disconnection (e.g., disconnecting roof downspouts from impervious areas),
- municipal adoption and enforcement of construction practices that incorporate temporary erosion and sediment control BMPs.
- adoption of good housekeeping practices (e.g., yard waste management, leaf litter disposal, fertilizer application best practices), and
- public education and outreach (see Element E).

WBP Implementation

As stated in the introduction, this WBP is meant to be a living document. It should be reevaluated at least once every three years and adjusted as needed based on ongoing efforts (e.g., based on monitoring results, 319 funding, etc.). It is strongly recommended that a working group including additional stakeholders be established to meet at least biannually to implement and update this WBP, and track progress. FRCOG is the regional planning agency for Franklin County and may be aware, through other funded projects, of work that may inform ongoing or planned projects for the Deerfield River Mainstem North River to Mouth watershed. As part of planning future nonpoint source management work within the watershed, project proponents should contact FRCOG staff for updates and opportunities to leverage funding and coordinate project activities.

Element D: Identify Technical and Financial Assistance Needed to Implement Plan

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.

Future Management Measures

Conservation on Lower Bear River

The estimated cost for conservation of an area on the lower Bear River was presented in the Deerfield River WBP (FRCOG, 2015) and is included in **Table D-1**. Please note this cost does not account for inflation since 2015. The concept from the Deerfield River WBP for this project is included in **Appendix F**.

Table D-1: Conservation of reference reach area on lower Bear River Estimated Probable Cost (FRCOG, 2015)

Treatment/Item	Unit	Quantity	Unit Cost ($)	Task Cost ($)
Land acquisition / undeveloped land	acre	370	$1,500	$555,000
Land acquisition / residential land	acre	284	$2500	$710,000
Parking area construction	unit	1	$35,000	$35,000
Walking trail construction	mile	2	$15,000	$30,000
Operation and maintenance	year	2	$15,000	$30,000
Treatment Subtotal				$1,355,000
20% Contingency				$271,000
Construction subtotal				$1,626,000
Surveying, permitting and legal costs				$100,000
Project total				**$1,726,000**

Conservation on Upper Bear River and Geomorphic Restoration

The estimated cost for conservation and geomorphic restoration of an area on the upper Bear River was presented in the Deerfield River WBP (FRCOG, 2015) and is included in **Table D-2**. Please note this cost does not account for inflation since 2015. The concept from the Deerfield River WBP for this project is included in **Appendix F**.

Table D-2: Conservation and Geomorphic Restoration of area on lower Bear River Estimated Probable Cost (FRCOG, 2015)

Treatment/Item	Unit	Quantity	Unit Cost ($)	Task Cost ($)
Corridor easement (200 feet wide)	acre	109	$1,500	$163,500
Chop and drop wood addition (200 pieces per mile)	mile	2	$15,000	$30,000
Marginal log jam / engineered log structures	unit	8	$2,500	$20,000
Machinery	day	3	$4,000	$12,000
Construction Oversight	day	3	$1,680	$5,040
Pre and post-implementation monitoring: Monumented surveying and photo logs, fish and invertebrate surveys, water stage, turbidity, pebble counts, temperature profiles, tracking wood mobility	year	5	$7,500	$37,500
Treatment Subtotal				$268,040
20% Contingency				$53,608
Construction subtotal				$321,648
Surveying, permitting and legal costs				$70,000
Project total				**$391,648**

Agricultural BMPs

As noted in Element C, MACD will be performing outreach to farms in the watershed for potential implementation of agricultural BMPs. The estimated costs of these projects are currently unknown but can be updated in future iterations of this WBP.

Additional Structural and Non-structural Management Measures

Funding for future BMP installations to further reduce loads within the watershed may be provided by a variety of sources including Section 319 funding, Climate Smart Agricultural Program (CSAP), Massachusetts Environmental Trust (MET) grants, the Agricultural Produce Safety Improvement Program (APSIP), Town and City capital funds, volunteer efforts, and NRCS grants including the Environmental Quality Incentives Program (EQIP) and the Agricultural Management Assistance (AMA) program. MACD has previously been successful with and will continue to pursue securing grant funding through various sources. Guidance is available to provide additional information on potential funding sources for nonpoint source pollution reduction efforts[12].

[12] Guidance on funding sources to address nonpoint source pollution: http://prj.geosyntec.com/prjMADEPWBP_Files/Guide/Element%20D%20-%20Funds%20and%20Resources%20Guide.pdf

Monitoring

As described in Element H&I, it is recommended that the current water quality monitoring program continue and be expanded. This program is run by the CRC and DRWA and the cost associated with this is determined by these entities.

Element E: Public Information and Education

Element E: Information and Education (I/E) component of the watershed plan used to:

1. Enhance public understanding of the project; and
2. Encourage early and continued public participation in selecting, designing, and implementing the NPS management measures that will be implemented.

Public information and education was a topic discussed during the stakeholder meeting of May 15, 2024 (**Appendix A**). A component of the MACD Agricultural Nonpoint Source Regional Coordinators Program involves outreach to farmers. Farmer outreach through this program includes building relationships with farm owners through phone calls, farm visits, direct mailings, workshops, farm tours, newsletter/newspaper articles, and social media.

Additional components of the watershed public information and education program are described below. Additional outreach efforts will be determined when future management measures and activities are planned for implementation in the watershed. This section of the WBP will be updated when the plan is reevaluated in 2027 in accordance with Elements F&G of this document.

Step 1: Goals and Objectives

The goals and objectives for the watershed information and education program.

1. Provide information to farmers on funding resources for BMP implementation.
2. Provide information about farm conservation plans and agricultural BMPs and their anticipated benefit to farm operations as well as water quality benefits.
3. Provide information to promote watershed stewardship.
4. Provide information to all residents in the watershed about proposed stormwater improvements and their anticipated water quality benefits.

Step 2: Target Audience

Target audiences that need to be reached to meet the goals and objectives identified above.

1. Farmers and agricultural landowners in the watershed.
2. Watershed organizations and other user groups, including the CRC and the DRWA.
3. Businesses, schools, and local government within the watershed.
4. Indigenous community (e.g., No Loose Braids and Ohketeau Cultural Center) and environmental justice (EJ) communities (EJ area in Shelburne and Greenfield)
5. Developers (construction) within the watershed.

6. All watershed residents.

Step 3: Outreach Products and Distribution

The outreach product(s) and distribution form(s) that will be used for each.

1. MACD representatives will conduct one-on-one meetings with farmers and support the development of farm conservation plans.
2. MACD will conduct outreach and education activities, including farm tours highlighting agricultural BMPs.
3. CRC and the DRWA provide information about the Connecticut River watershed and Deerfield River watershed including the Deerfield Mainstem – North River to Mouth watershed on their websites (https://www.ctriver.org/; https://deerfieldriver.org/) and typically host events such as annual river clean up days.
4. Informational signs will be developed and posted at implemented BMP locations.

Step 4: Evaluate Information/Education Program

Information and education efforts and how they will be evaluated.

1. Track the number of farm tours and the attendance at each.
2. Track the number of farmers participating in outreach and education efforts, conservation plans, and implementation of BMPs.
3. Track the number of materials and information, such as fact sheets and emails, and the size of the lists receiving these materials.

Resources for Additional Outreach Products

Other public education and outreach activities and topics should also be considered, such as (but not limited to) yard waste management (leaf litter and fertilizer), pet waste management, and septic system maintenance and pump outs, as discussed in the Non-structural BMP section in Element C.

The EPA's "Nonpoint Source Outreach Toolbox" (www.epa.gov/nps/toolbox) provides information, tools, and more than 700 outreach materials that can be used or adapted to develop an outreach campaign. The toolbox focuses on six nonpoint source pollution categories:

- stormwater
- household hazardous waste
- septic systems
- lawn care
- pet care
- automotive care

Outreach products in the Toolbox include print ads, public service announcements, and a variety of materials for billboards, signage, kiosks, posters, brochures, fact sheets, and giveaways that help to raise awareness and promote non-polluting behaviors. Permission-to-use information is included for outreach products, which makes

it easy to tailor them to local priorities. Evaluations of several outreach campaigns also offer real-world examples of what works best in terms of messages, communication styles, and formats. Other helpful resources include:

- MassDEP's Clean Water Toolkit (https://megamanual.geosyntec.com/npsmanual/default.aspx)
- USEPA's Soak Up the Rain materials (https://www.epa.gov/soakuptherain)
- USEPA's Green Infrastructure Collaborative (https://www.epa.gov/green-infrastructure/green-infrastructure-federal-collaborative#Green%20Infrastructure%20Collaborative%20Resources)

Elements F & G: Implementation Schedule and Measurable Milestones

Element F: Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.

Element G: A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

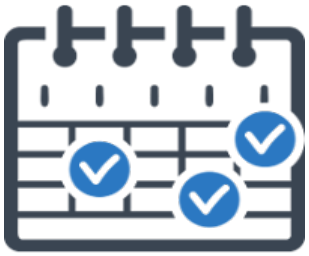

Table FG-1 provides a preliminary schedule for implementation of recommendations provided by this WBP. It is expected that the WBP will be re-evaluated and updated in 2026, or as needed, based on ongoing monitoring results and other ongoing efforts. New projects will be identified through future data analysis and stakeholder engagement and will be included in updates to the implementation schedule.

Table FG-1: Implementation Schedule and Interim Measurable Milestones[13]

Category	Measurable Milestones	Year(s)
Agricultural Nonpoint Source Regional Coordinators	Conduct outreach to build relationships and scope potential implementation sites for agricultural BMPs.	2021--2024
	Support the development of conservation plans outlining BMPs to reduce pollutant and nutrient runoff. Implement agricultural BMPs at farms in the watershed (contingent on available funding)	2025--2028
Nonstructural BMPs	Conservation of areas along Lower and Upper Bear River	To be determined
	Document potential pollutant removals from nonstructural BMPs (i.e., street sweeping, catch basin cleaning). The methodology is included in the 2016 Massachusetts Small MS4 Permit and in Elements H&I of this WBP.	Annually
	Evaluate ongoing nonstructural BMPs and determine if modifications can be made to optimize pollutant removals (e.g., increase frequency).	Annually
	Routinely implement optimized nonstructural BMPs.	Annually
Structural BMPs	Identify locations, develop and rank structural BMP concepts	To be determined
Public Information and Education	Conduct outreach and education activities including farm tours highlighting agricultural BMPs.	2021—2027
	River clean up events	Annually
Monitoring (CRC and DRWA)	Perform water quality sampling at key locations in the Deerfield Mainstem North River to Mouth watershed as part of the existing water quality monitoring per Element H&I	2024 and annually
Adaptive Management and Plan Updates	Establish a working group that includes stakeholders and other interested parties to implement recommendations and track progress. Meet at least twice per year.	2024
	Reevaluate WBP at least once every three years and adjust, as needed, based on ongoing efforts (e.g., based on monitoring results, 319 funding, etc.). – Next update, August 2027	2027
	Use monitoring results to reevaluate BMP effectiveness at reducing *E. coli* and TP and/or other indicator parameters in Deerfield Mainstem North River to Mouth watershed and establish additional long-term reduction goal(s), if needed.	**2034**
	Delist all segments within the Deerfield Mainstem North River to Mouth watershed from the 303(d) list.	**2039**

[13] Note that goals and milestones of this WBP are intended to be adaptable and flexible. Stakeholders will perform tasks contingent on available resources and funding.

Elements H & I: Progress Evaluation Criteria and Monitoring

Element H: A set of criteria used to determine (1) if loading reductions are being achieved over time and (2) if progress is being made toward attaining water quality goals. Element H asks "**how will you know if you are making progress towards water quality goals?**" The criteria established to track progress can be direct measurements (e.g., E. coli bacteria concentrations) or indirect indicators of load reduction (e.g., number of beach closings related to bacteria).

Element I: A monitoring component to evaluate the effectiveness of implementation efforts over time, as measured against the Element H criteria. Element I asks "**how, when, and where will you conduct monitoring?**"

The loading reduction goal is presented in Element B of this WBP. Element C of this plan describes management measures that will be implemented to help achieve this targeted load reduction. The evaluation criteria and monitoring program described below will be used to establish a baseline and measure the effectiveness of the proposed management measures (described in Element C) in improving the water quality of Deerfield Mainstem North River to Mouth watershed and in making progress toward achieving the water quality goals.

Direct Measurements

River Sampling

The CRC and the DRWA have been documenting the water quality in the Deerfield River and tributaries intermittently since 1990. The most recent iteration of the CRC/DRWA water quality monitoring program has been running since 2017 and includes four sampling locations along the Deerfield River within the Deerfield Mainstem North River to Mouth watershed. The CRC/DRWA water quality monitoring program is a volunteer program. Before the start of each season, each volunteer is required to attend a training session with the program coordinator. Training sessions are held riverside so that each volunteer can practice under the supervision of the coordinator before going out into the field. The monitoring is conducted under an approved Quality Assurance Project Plan (QAPP). Sites are tested on the Deerfield mainstem and its tributaries in both Vermont and Massachusetts. Volunteers visit these sites on alternate Wednesday mornings from June to September to collect samples that are tested for *E. coli*, TN, TP, total chloride, turbidity, and conductivity.

It is suggested that water quality monitoring in the Deerfield Mainstem North River to Mouth watershed continue under this program and expand[14] to include locations along Dragon Brook and Bear River downstream of suspected *E. coli* and/or TP sources. If possible, samples should be collected in locations directly downstream of implemented BMPs to determine the impact of BMPs within the watershed (samples at these locations prior to BMP implementation should also be collected to establish a baseline). Monitoring locations should ultimately be

[14] MassDEP also provides support for water quality monitoring efforts through its Water Quality Monitoring Grant Program

selected based on accessibility and representativeness and shall be appropriate to quantify water quality improvements in the watershed. BMP performance monitoring locations will be selected after BMPs have been identified for implementation.

Indirect Indicators of Load Reduction

Non-Structural BMPs

Potential load reductions from non-structural BMPs (i.e., street sweeping and catch basin cleaning) can be estimated from indirect indicators, such as the number of miles swept, or the number of catch basins cleaned. As summarized by **Figure HI-1** and **Figure HI-2**, Appendix F of the 2016 Massachusetts Small MS4 General Permit provides specific guidance for calculating TP removal from these practices. As indicated by **Element C**, it is recommended that potential TP removal from these ongoing actives be estimated. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions such as increased frequency or improved technology.

$$Credit_{sweeping} = IA_{swept} \times PLE_{IC\text{-}land\ use} \times PRF_{sweeping} \times AF \qquad \textbf{(Equation 2-1)}$$

Where:

$Credit_{sweeping}$	=	Amount of phosphorus load removed by enhanced sweeping program (lb/year)
IA_{swept}	=	Area of impervious surface that is swept under the enhanced sweeping program (acres)
$PLE_{IC\text{-}land\ use}$	=	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr) (see Table 2-1)
$PRF_{sweeping}$	=	Phosphorus Reduction Factor for sweeping based on sweeper type and frequency (see Table 2-3).
AF	=	Annual Frequency of sweeping. For example, if sweeping does not occur in Dec/Jan/Feb, the AF would be 9 mo./12 mo. = 0.75. For year-round sweeping, AF=1.0[1]

As an alternative, the permittee may apply a credible sweeping model of the Watershed and perform continuous simulations reflecting build-up and wash-off of phosphorus using long-term local rainfall data.

Table 2-3: Phosphorus reduction efficiency factors ($PRF_{sweeping}$) for sweeping impervious areas

Frequency[1]	Sweeper Technology	$PRF_{sweeping}$
2/year (spring and fall)[2]	Mechanical Broom	0.01
2/year (spring and fall)[2]	Vacuum Assisted	0.02
2/year (spring and fall)[2]	High-Efficiency Regenerative Air-Vacuum	0.02
Monthly	Mechanical Broom	0.03
Monthly	Vacuum Assisted	0.04
Monthly	High Efficiency Regenerative Air-Vacuum	0.08
Weekly	Mechanical Broom	0.05
Weekly	Vacuum Assisted	0.08
Weekly	High Efficiency Regenerative Air-Vacuum	0.10

Figure HI-1. Street Sweeping Calculation Methodology

$$\text{Credit}_{CB} = IA_{CB} \times PLE_{IC\text{-land use}} \times PRF_{CB} \qquad \textbf{(Equation 2-2)}$$

Where:

Credit_{CB}	=	Amount of phosphorus load removed by catch basin cleaning (lb/year)
IA_{CB}	=	Impervious drainage area to catch basins (acres)
$PLE_{IC\text{-and use}}$	=	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr) (see Table 2-1)
PRF_{CB}	=	Phosphorus Reduction Factor for catch basin cleaning (see Table 2-4)

Table 2-4: Phosphorus reduction efficiency factor (PRF_{CB}) for semi-annual catch basin cleaning

Frequency	Practice	PRF_{CB}
Semi-annual	Catch Basin Cleaning	0.02

Figure HI-2. Catch Basin Cleaning Calculation Methodology

Macroinvertebrate and Fisheries Assessments

Macroinvertebrate and fisheries assessment are another indirect indicator that could be conducted, especially in the Temperature impaired segments of Dragon Brook and Bear River[15].

Project-Specific Indicators

Number of BMPs Installed and Pollutant Reduction Estimates:

Anticipated pollutant load reductions from future BMPs will be estimated and tracked as BMPs are installed; this information should be included in future iterations of this WBP.

Adaptive Management

It is recommended that a working group be established that includes stakeholders and other interested parties to implement recommendations and track progress and meet at least twice per year.

As discussed in **Element B**, the baseline monitoring program will be used to evaluate if **Element C** management measures have been effective at addressing listed water quality impairments or water quality goals for other indicator parameters established by **Table A-9** of this WBP. Monitoring results can further be used to periodically inform or adjust load reduction goals presented in **Table B-1**. Based on monitoring data, additional long-term reduction goal(s) may be established, if needed, to lead to delisting of Dragon Brook (MA33-20), Bear River (MA33-17), and Deerfield River (MA33-04) from the 303(d) list over the next 15 years. It is recommended that this evaluation be conducted at least once every three years.

If monitoring results and indirect indicators do not show improvement to the *E. coli* and TP concentrations and other indicators measured within the watershed, the management measures and loading reduction analysis (Elements A through D) should be revisited and modified accordingly.

It is also recommended that a stakeholder be identified that will lead implementation and updates to this WBP. As noted in Element C, FRCOG is the regional planning agency for Franklin County and may be aware, through other funded projects, of work that may inform ongoing or planned projects for the Deerfield River Mainstem North River to Mouth watershed. As part of planning future nonpoint source management work within the

[15] MassDEP guidance can be found here: https://www.mass.gov/guides/surface-water-quality-monitoring#-bioassessment-

watershed, project proponents should contact FRCOG staff for updates and opportunities to leverage funding and coordinate project activities.

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Appendices

Appendix A – Stakeholder Meeting Minutes

Meeting Minutes

Project Name:	Deerfield Mainstem (North River to Mouth) Watershed-Based Plan		
Location:	Deerfield River Mainstem (North River to Mouth) Watershed (Deerfield, Shelburne, Greenfield, Conway, Ashfield, Buckland)		
Meeting Date, #:	May 15, 2024	Meeting Time:	10:00 – 11:30 PM
Prepared By:	Bella D'Ascoli	Meeting Location:	Teams videoconference per Geosyntec invitation
Distribution:	All listed below		

Attendees:

Name	Organization	Contact Information
Bella D'Ascoli	Geosyntec Consultants, Inc	idascoli@Geosyntec.com
Julia Keay	Geosyntec Consultants, Inc	jkeay@Geosyntec.com
Michael Leff	Massachusetts Association of Conservation Districts (MACD)	mleffmacd@gmail.com
Meghan Selby	Massachusetts Department of Environmental Protection (MassDEP)	Meghan.Selby@mass.gov
Judith Rondeau	MassDEP	Judith.Rondeau@mass.gov
Ryan O'Donnell	Connecticut River Conservancy (CRC)	rodonnell@ctriver.org
Kimberly MacPhee	Franklin Regional Council of Governments (FRCOG)	kmacphee@frcog.org
Tricia Yacovone-Biagi	Town of Shelburne	shelburnemassmvp@gmail.com
Jim Perry	Deerfield River Watershed Association (DRWA)	drwa@deerfieldriver.org
Alain Peteroy	Franklin Land Trust	apeteroy@franklinlandtrust.org
Matthew Cole	Great River Hydro	mcole@greatriverhydro.com
Lisa Gilbert	United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS)	Lisa.gilbert@usda.gov
Brian Comfort	Deerfield Fly Shop	brian@deerfieldflyshop.com
Erin Rodgers	Trout Unlimited	Erin.Rodgers@tu.org
Kate Conlin	Woodlands Partnership of Northwest Massachusetts	kconlin@newenglandforestry.org
Miley Kinney	Patriot Hydro	Mkinney@patriothydro.com
Amy Hahn	Town of Deerfield Conservation Commission	bldgasst@town.deerfield.ma.us

Minutes to be considered final unless comments are received within five (5) business days.

Agenda

- Greeting
- 319 Grant Project Spotlight
- Brief Introductions from All Participants
- Watershed & Goals Overview
- Findings/Recommendations from 2017 Subwatershed Plan
- Discussion
  - Past, current, or planned stormwater best management practice (BMP) projects in the watershed
  - Pollutant load reduction estimates for BMP projects

- Water quality monitoring efforts
- Potential pollution sources or problem areas
- Public education and outreach
- Additional grant funding available

Greeting/319 Grant Project Spotlight

Julia Keay. Good morning, thank you very much for joining. The purpose of this meeting is to get input from stakeholders for the Deerfield Mainstem (North River to Mouth) watershed-based plan (WBP). We will start with a summary of the current project from MACD, then brief introductions of everyone, followed by an introduction to the watershed and goals that we have identified for the WBP. Then we will review the findings and recommendations from the 2017 Deerfield River watershed-based plan for the Deerfield Mainstem (North River to Mouth) HUC-12, and see if there's been any updates or progress on those items. Then we can finish with discussion.

Michael Leff. Director of MACD. Presented slide with 319 Grant funding spotlight information. This project is looking into developing a WBP for this subwatershed and stems from one of a few different initiatives we've had going on with various partners through the MassDEP 319 program, Section 319 of the EPA's Clean Water Act Non-point source pollution program. MACD's focus has been largely agriculture related, but WBPs can encompass anything and everything that might impact water quality in the priority watersheds and this is one of them. We have a couple projects going on right now in Western Massachusetts that have to do with our consultants reaching out to various farmers and helping them get access to and be able to implement agricultural best management practices that protect water quality but also help their farm sustainably operate. This is coming up to its conclusion in September, the agricultural Regional Coordinators 319 project, in which MACD is partnering with a couple of the conservation districts, one for Franklin and the other for Hampden, Hampshire, as well as the regional planning agencies FRCOG and Pioneer Valley Planning Commission Hampden/Hampshire. We've been doing a lot of exploration and collaboration in the past couple of years leading to selection of priority watersheds, this is one of them. So now seeing the development creation of the WBP, which becomes a foundation for all the good work that can be done following that through other grant programs, some of it probably implementation 319 projects, but it could also be the basis for any stakeholders to use as you're trying to advance the water quality in the watershed.

Brief introductions from all participants

Michael Leff: I am the director of MACD and through the 319 grant program, MACD is able to provide funding for priority watersheds to develop WBPs such as this one.

Bella D'Ascoli: Geosyntec. My connection is that I'm working on this WBP and other WBPs in Western Massachusetts with MACD and Geosyntec, as well as MassDEP.

Julia Keay: Geosyntec, Project Manager. I live in Western Massachusetts in Easthampton.

Meghan Selby: I work with MassDEP in the nonpoint source management section. I coordinate the 604B water quality management planning grant, which focuses on determining water quality issues and developing solutions to rectify those issues. I also help coordinate the WBP review process that we have at MassDEP.

Judy Rondeau: I am the nonpoint source outreach coordinator at MassDEP. I work with Megan in the nonpoint source management section and we provide the grant funding for the two projects that Michael was referencing in his introduction earlier.

Kimberly MacPhee: I'm the land use Natural Resources Program Manager at the Franklin Regional Council of Governments (FRCOG). One of the functions of the FRCOG is to serve as the Regional Planning agency for the 26 communities in Franklin County. We have two projects going on right now. Both are 319 funded, one is a watershed scale zoning project we've been working with the Town of Shelburne and the other one is a dirt roads toolkit that we have been working with some communities in the Deerfield Watershed to pilot some of the components of the toolkit. As a regional planning agency, we're routinely engaged in a wide variety of projects for all of our communities in Franklin County.

Ryan O'Donnell: I'm the water quality program manager at the Connecticut River Conservancy (CRC), and as part of that role, I am the staff liaison to the Deerfield River Watershed Association (DRWA), and I coordinate a volunteer monitoring program in the Deerfield watershed. And I also am a resident of, not this portion, but within the Deerfield watershed.

Tricia Yacovone-Biagi: I am the MVP (Municipal Vulnerability Preparedness) coordinator for the Town of Shelburne.

Jim Perry: I'm the President of the DRWA. We coordinate with Ryan O'Donnell of CRC and bacteria monitoring for the Deerfield River and its tributaries.

Alain Peteroy: I am conservation director at the Franklin Land Trust, which works primarily in Franklin County and parts of Hampshire and Hampden. The whole watershed is within our region and we are very much supportive of any of these projects that can work on water quality issues and we team up with a lot of other groups that work on cold-water fisheries resources as it relates to land conservation. So, happy to hear what's going on and how we can be helpful.

Matthew Cole: Great River Hydro. We operate the hydroelectric stations. Two of the three hydroelectric stations South of the North River, not including Gardner Falls. That's another operating company that has been working on the River here. Those plants were built in the 1910s and running and working ever since, and we're interested in in the workings of this group.

Lisa Gilbert: I am covering for Catherine Magee and Mark Defley and part of the USDA NRCS. We are very much interested in all resource concerns, especially as it relates to agriculture, and we cover the whole state. So, we're very much interested in learning about this plan.

Brian Comfort: I own the Deerfield Fly shop in South Deerfield and I'm here to see what the plan is for the Deerfield. Obviously I like to fish down there, so excited to hear what you guys have in store.

Erin Rodgers: I'm a project manager for Trout Unlimited which is interested in all cold-water resource concerns and flood resiliency.

Kate Conlin: I'm the coordinator for The Woodlands Partnership of Northwest Massachusetts, which is 21 towns in the northwest corner of the state calling in from Buckland. The most relevant work that we've been doing is some riparian restoration tree planting and potentially getting some remediation at Hawlemont Elementary and Charlemont with the knotweed.

Miley Kinney: Patriot Hydro, I'm a compliance specialist. We have hydroelectric projects along there as well, including Gardner Falls. We have some recreation projects and they also do some water quality studies as well. We're just listening in to learn more about this as well.

Amy Hahn: I am the Deerfield Conservation Commission Administrative Assistant.

Watershed & Goals Overview

Julia Keay: I just wanted to run through a brief overview of our understanding, currently of the watershed. I am going to pull up Google Earth Map as it is a good visual. So the watershed is 49 square miles, the turquoise outline is the boundary of the watershed. It is the most downstream HUC 12 in the Deerfield River Watershed.

There are three segments within the watershed that are currently listed as impaired on the 2022 integrated list and those include Bear River, which is this red segment on the FRCOG 2017 subwatershed map and Dragon Brook. Those two are impaired for temperature. The Bear River sources that are listed are unknown, and the Dragon Brook sources are listed as agricultural and loss of riparian habitat as well as unknown sources. The other impaired segment is this downstream section of the Deerfield mainstem where the Green River comes in. From the Green River to the Connecticut River is listed as impaired for E coli (Escherichia coli) and the sources listed are unknown. The upstream segment of the Deerfield mainstem was listed in the previous integrated list, but it was moved to a category two, indicating it's attaining some uses. That was based on some more recent water quality data for E. coli. that moved it to category two, which is good news.

Presented land use information. It has a pretty high percentage of impervious cover for the Deerfield according to the FRCOG Deerfield River WBP from 2017. It had the most percentage of impervious cover out of all the sub watersheds. This subwatershed additionally has the largest amount of working agricultural lands within the Deerfield River watershed. This also has the highest amount of developed land within the Deerfield River watershed and the third highest flood risk within the

Deerfield River watershed. Based on the information available, we think the goals will be focused on E. coli. and temperature, and also Total Phosphorus (TP) based on the EPA Gold book standard.

I also wanted to show the figures from the 2017 FRCOG Deerfield River WBP that show the developed land use is concentrated in the downstream portion as well as up in this area (Northwestern portion of the watershed) and then a lot of agricultural land use and there's a lot of protected land in the watershed which is indicated by the green and then this smaller figure is kind of hard to see. It does show the 100-year floodplain is largely concentrated in this downstream segment.

Presented list of overall health of the sub watershed indicators figure from FRCOG 2017 WBP that range from poor condition, fair to great. Additionally presented recommendations for this sub watershed from the FRCOG 2017 WBP. I thought maybe we could go through them and see if there are any comments on any of these or any progress that has been made. There is a good amount of action items that came out of that plan for the Deerfield Mainstem (North River to Mouth).

Findings/Recommendations from 2017 Subwatershed Plan

Julia Keay: Starts by presenting Action item 1. Action item #1 was to assess the vulnerability of critical facilities to flooding and update and coordinate recommendations and local hazard mitigation plans for flooding and critical facilities. Is there anything anyone knows of that has been done towards that action item that we could include in this plan?

Kimberley MacPhee: I think this plan was done about or was released about the same time as the states Municipal Vulnerability Preparedness (MVP) program started. I think all the communities in this section of the watershed have MVP plans and have been designated MVP Communities. Also they have current local hazard mitigation plans. So to the extent that we were able in those two planning processes, we did some assessment work regarding critical facilities and we tried to, when we were working on either both plans for a community or one of the plans for a community, integrate the findings of the two plans, but beyond just kind of a high level screening and mapping. That's where we are, at least with my knowledge with action item number one.

Julia Keay: Anything anyone wanted to add for that one? Ok, action #2 was to update existing municipal land use and subdivision regulations to better protect the floodplain and other sensitive areas, ensuring consistency between towns.

Kimberly MacPhee: It's a 319 funded grant, so I've been working with the town of Shelburne. We spent time exploring a stormwater bylaw, a general stormwater bylaw with regulations. Now we're pivoting to look at ways to strengthen the existing zoning and subdivision regulations that the town has to incorporate some stormwater management provisions. I'm currently working with the town of Conway on a River Corridor Protection overlay district. But so I think the South River is, is it outside this segment that we're focused on now? I think it is the South River.

We do river corridor protection for our towns, but not necessarily within the segment of the Deerfield. I know that the town of Deerfield has done a lot of work. You should definitely look at their stormwater management regulations, their other zoning regulations. They've done a lot of work on requiring green infrastructure and stormwater management. We have been working to help our communities adopt the states model floodplain bylaw so that they can be in compliance with the National Flood Insurance program.

Julia Keay: Action item #3 was to conduct fluvial geomorphic assessments to better refine the location, severity and likelihood of erosion hazards and the potential impacts restoration mitigation projects might have on channel stability and aquatic habitat not only at the proposed site, but also to downstream and upstream locations. Also just want to mention these recommendations were specific to the area that we are looking at in this plan. So that's helpful because I know it's kind of confusing but we are more focused on the HUC 12 that I presented on the Google Earth rather than the full Deerfield River.

Kimberly MacPhee: Can you list out the towns or the portion of the towns that are within this watershed?

Julia Keay: Deerfield, Conway, Shelburne, Ashfield, Buckland, Greenfield.

Kimberly MacPhee: So regarding that third action item, the fluvial geomorphic assessments. I will mention we do have a mapped river corridor for the Green River in Greenfield, but that's outside this watershed. Same for Buckland for Clesson Brook,

but that's outside. In terms of there, there hasn't been that work done in this watershed yet, although if Tricia wanted to speak to the project that was envisioned for Dragon Brook.

Tricia Yacovoe-Biagi: We were looking to develop a sub watershed resilience plan for Dragon Brook with the MVP action grant. Unfortunately, the timeline for developing the entire proposal after we learned that there was no match for Shelburne was too short to get the whole proposal together as we're volunteers. So we are planning on still working towards that for the next MVP grant cycle with our partners that have agreed already to participate, including the school District, Mohawk Trail, Regional School District, the Franklin Land Trust, Mass Audubon, Deerfield River Watershed Authority, and others. So that is our hope to really develop an entire plan for Dragon Brook. We're going to hopefully propose it next year to MVP.

Julia Keay: Anything else on that one?

Kiimberly MacPhee: I would just say 3, 4, and 5, that level of assessment and level of field work is very needed and we haven't been able to do any work on 4 and 5 in this particular section of the watershed at this point.

Julia Keay: And 6 also hasn't been done based on implementation of those recommendations? **Kimberly MacPhee** confirms**.** Did the two conceptualized projects in the overall plan move past conceptual stage for Bear River?

Kimberly MacPhee: I am not aware but Erin and Alain might have more information about that.

Julia Keay: It is actually related to this number 15, there were two segments of the Bear River where there was actually cost estimates that were done for these two different projects. Just curious if that's advanced at all.

Kimberly MacPhee: Not to my knowledge.

Julia Keay: Is it still on the table to do those? **Kimberly MacPhee** confirms. I am just wondering if we should include it in this plan as potential future projects.

Kimberly MacPhee: I would definitely include it in this plan because we did the work to identify it and have the conceptual designs.

Alain Peteroy: Just as a point to the Bear River, that is one of our conservation priority areas, the Bear River watershed. We have just protected 157 acres at the headwaters of the Bear River and are looking at the purchase of the Edge Hill golf course, which we will be restoring the wetlands and uplands primarily for watershed rare species and wildlife habitat. Then down on the lower portion we are looking at that in general as one of our priority areas.

Julia Keay: Action item 7 I think we got through this project as MACD's project covers that item working with farmers to implement agricultural BMP's to protect water quality. Anything specific to this sub watershed Michael?

Michael Leff: Nothing more specific to mention.

Julia Keay: Action item #8 was working with land owners to protect upland tributary areas and Biomap2 Core Habitats from development through land acquisition, conservation easements and other mechanisms. I think that also goes in hand with what Alain, you were just speaking to on the Bear River. Any other examples we should include on that, either that have occurred or that are potentially going to occur being planned?

Alain Peteroy: I can send you a map of the additional conservation we've done along the Bear River because in the last three years we've done another 190 acres that all had Bear River on it, so I'll just send you that after the meetings over.

Julia Keay: Action item #9 was to provide incentives for forest owners through carbon trusts or other mechanisms to protect their land for carbon storage. Any thoughts on that one?

Kate Conlin: I guess I would add that carbon is part of a larger web of indicators of forest health and goals, and the Woodlands Partnership has been piloting some climate smart forestry in the region. I would caution the use of the word protection with carbon because a lot of times there are other priorities in a piece of land such as habitat or natural communities. And to maybe broaden that objective rather than narrow it.

Kimberly MacPhee: Kate might be more familiar with this than I am, but also aren't there some initiatives at the State level that maybe have a broader application or could help update this action item and or maybe Alain, maybe Emily would have some ideas about this one? **Kate Conlin** confirms. I would say Emily Boss would have better, more accurate information on that and she had taken a few days off so she's not on the meeting.

Kimberly MacPhee: I agree with Kate that this one needs some updating on the language.

Kate Conlin: DCR has the CSIP (Climate Stewardship Incentive Practices) and it provides funding for various practices on the land. I can send you information about that but Emily would be the one to know things more completely.

Julia Keay: Action item #10 is consider implementing river corridor protection bylaws that would limit development within areas of river corridors susceptible to erosion and flooding.

Kimberly MacPhee: I would definitely keep this and once we get some river corridors delineated in the watershed, this would be a next step.

Kate Conlin from chat: information on CSIP. https://www.mass.gov/doc/c-sip-landowner-info-sheet/download

Julia Keay: Action item #11 was to amend or adopt open space residential or natural resource protection zoning to balance new development in rural areas with land protection. Is that in line with your 319 project as well?

Kimberly MacPhee: Yes, it is in line with 319 but that contract ends September 30th. I would keep all action items related to zoning and maybe update them to include LID (low impact design) site planning. Like I mentioned earlier with Shelburne under this current grant to look at their zoning and subdivision regulations. So that's really 11, 12 and 13. We've been doing the same with Greenfield, because Shelburne and Greenfield share a portion of a watershed, which a little bit of it is in this particular one that we're focused on right now. But the idea going back to one of the earlier action items where you know ideally you would have land use regulations have some similar components in communities that share a watershed. And so that's kind of the goal of the current work that we're doing.

Julia Keay: Action item #14 also you (**Kimberly MacPhee**) mentioned the rural road assessment.

Kimberly MacPhee: We have a current grant 319 grant to develop this Dirt Roads toolkit. And then we also recently teamed up with Berkshire Regional Planning Commission and Pioneer Valley Planning Commission and submitted a regional application to the MVP program to do some more piloting of components of the Dirt Roads Toolkit and expand the toolkit to include more robust sections on maintenance. Because the toolkit that we're developing right now, the focus is on water quality and we want to expand that to include discussions that also address water quality. But we are focused on climate resiliency as well. I think that and also with our transportation funding, we've been doing drainage culvert assessments in our communities and I think that is related to this action item. We're also going to be, if we get the MVP funding, providing training for the DPW.

Julia Keay: I was thinking we would include list and include what progress has been made since this plan was created for each of the action items. Is the dirt road toolkits is that a website or PDF?

Kimberly MacPhee: It is available as PDF after September 30.

Julia Keay: Action item #15 is two conceptual designs for Bear River.

Discussion

Julia Keay: I think we can open to discussion now. These are just some topics to touch on. (Presented slide with discussion points including: past, current, or planned stormwater BMP projects in the watershed, pollutant load reduction estimates for BMP projects, water quality monitoring efforts, potential pollution sources or problem areas, public education and outreach, and additional grant funding). I was wondering Ryan what monitoring has been done if any by the CRC?

Ryan O'Donnell: We have monitored the past couple years for E. coli, conductivity, and turbidity. A few on the main stem which would be at Still Water Bridge behind the Deerfield Academy and at the 5 and 10 bridge. We've been doing the 5 and 10 bridge for our whole program since 2017.

Julia Keay: Is that why this segment was taken off as a category five? **Ryan O'Donnell** confirms.

Julia Keay: Are there any other water quality monitoring efforts to include in plan? We will include what Ryan mentioned and then also any MassDEP data. But I was curious if there's anything else I didn't know if the hydro dams do their own water quality monitoring.

Ryan O'Donnell: Not that I know of, I don't think that MassDEP has sampled in the Deerfield Watershed recently. Trout Unlimited did continuous conductivity monitoring last summer. Eric Halloran I think ran that project.

Julia Keay: We mentioned this project focused on agriculture but we would really like to include anything in regards to addressing nonpoint source pollution. So if there's any other types of conservation or River restoration or stormwater best management practices in the watershed that we haven't talked about that would be great to know so we can include that in the plan. No comments.

This one is kind of tricky, but pollutant load reduction estimates. That would be something we would try to estimate based on the projects that are planned or that have been done, but generally kind of depends on what the project is for that. So even if there's no plan project, but if there's any specific problem areas that we should focus on, if anyone wanted to mention anything that we haven't touched on.

Julia Keay: Another part of the plan is public education and outreach element. Anything we should include on that that is planned or that has been done?

Tricia Yacovone-Biagi: From Shelburne. Part of the MVP action grant proposal will have a significant public education and outreach and working with the school district and getting the children involved in doing some of the work. I neglected to mention earlier that the other partners include FRCOG and Trout Unlimited doing a lot of the outreach and public education focusing on the Dragon Brook.

Kimberly MacPhee: Are there any environmental justice (EJ) communities in the watershed?

Tricia Yacovone-Biagi: I know that with the Shelburne MVP proposal, we're hoping to also work with No Loose Braids and the other partner that Mass Audubon has, which is the Ohketeau Cultural Center.

Kimberly MacPhee: That's great to make sure to involve the indigenous community and EJ communities.

Tricia Yacovone-Biagi: Shelburne meets some of the criteria of EJ communities in the Village.

Julia Keay: Present MassMapper EJ communities.

Kimberly MacPhee: Yes, the villages in Shelburne Falls. I would include this in discussions about outreach.

Julia Keay: Megan and Judy I was just wondering if you could maybe touch on the 319 and 604B grants.

Meghan Selby: 604b grant also called the water quality management planning grant. So, we look to support projects that identify water quality issues and then also identify solutions that can be implemented to remedy those impairments and issues. We just had our RFP, a request for proposals; it just ended last week on the 8th. We are starting to review the applications that we got in and we anticipate releasing our next RFP around the same time next year probably early Spring. If anybody has any questions or project ideas that they want to chat about, feel free to reach out to me and we can have a discussion.

Judy Rondeau: 319 grant program is geared more towards implementation, so we're looking for projects that will be implementing management practices that will reduce pollutant loading and either move impaired waters towards delisting or in a rarer case treating a pollutant source to the point where the water can be delisted. We do also fund a smaller amount of projects that we call capacity building projects. I think Michael had mentioned the agricultural Regional Coordinator program and so that's a perfect example of one of our capacity building projects where we fund projects to help communities build the capacity of that they need to treat impaired waters. Our current grant cycle is open. It closes, I think next week the 24th. We were anticipating it'll be a year before we offer that program again.

Julia Keay: Are there any other grants we should be aware of?

Lisa Gilbert: We have continuous funding through our USDA programs that help with conservation practice implementation. Our planners are currently working with farmers and private landowners to do conservation planning on the ground, and then see if there's any kind of money that we can get into contracts to support some of these conservation practices. There's a lot of farmlands I see on your map, and I know that we have historically worked a lot with clients along those corridors. We continue to do that as we move forward, but we do have various programs that offer financial assistance.

Julia Keay: Is that mainly EQIP (environmental quality incentive program)?

Lisa Gilbert: We've had EQIP for many years now and there's quite a lot of money in that program to support some of these kinds of national practices. I know a lot of cover crop is being worked on throughout the State. And one of the programs is called EQIP Act Now, and we've had that program for a couple years now. It's looking at accepting applications at any point and implementing some of those practices right away. So, cover crop would be one that would be implemented later after the crops are harvested. But there is funding and we're working on getting those projects planned and implemented. We can accept applications for these programs throughout the year.

Julia Keay: Do you generally work directly with the farmer?

Lisa Gilbert: Yes. We would get contacted by the farmers and work with them directly. Go out and walk the land, make recommendations on certain kinds of conservation practices that they could consider and they would be the ones that would approach us and directly apply for our programs.

Julia Keay: And the other is CSP?

Lisa Gilbert: Conservation Stewardship Program (CSP). There's been a growing interest in that program and that program is designed to help maintain good stewardship on the lands. So typically, we work with landowners who would start with EQIP and they could have a contract for up to five years. If they continue that good stewardship, it might be a good opportunity for conservation stewardship program and then we can look at different enhancements and so forth with that program.

Michael Leff: Thanks Lisa for that overview. For the projects that MACD is working on: our on the ground consulting team, New England Consulting Services, including Iain Ward and Zoe Fox, help make those connections for the grant programs including the NRCS ones. They help be part of the outreach that makes the farmers aware of the programs and helps get them started on that process.

Kate Conlin: Lead organizations could apply for RCPP (Regional Conservation Partnership Program) to support that facilitation. Masswildlife has one currently where there's a private lands biologist who will come out and make that connection to NRCS

funding, but that it's a five-year grant cycle round so that will be ending. There's a lot of NRCS funding and not enough people to make that connection sometimes. So that could be an interesting thing to promote specifically for this region.

Micheal Leff: RCPP is also hosting webinars, one on May 16th and a repeat session May 30th. We intend to attend those webinars to see how we might collaborate on one of those programs and those recordings, those webinars are recorded. So if anyone is interested in learning more about the RCPP, this is a good time to tap in.

Julia Keay: A question for Kimberly on pollutant load modeling as there was some conducted in 2017. Can I reach out to you directly?

Kimberly MacPhee: We had a consultant that helped with that. Fuss and O'Neill.

Kate Conlin: From the chat for webinar registration: Microsoft Virtual Events Powered by Teams.

Michael Leff: Easement specific Webinar from RCPP tomorrow (5/16). Michael provides in chat. https://events.gcc.teams.microsoft.com/event/0fb9e56b-64dd-49db-ac84-61a546d6ee7e@ed5b36e7-01ee-4ebc-867e-e03cfa0d4697

Julia Keay: Any other grants that we didn't cover that we should bring up, make people aware of? I think it's useful to just touch on them, not everyone may be aware of all the grant opportunities that are out there.

Kate Conlin: There are through the Executive Office of Energy and Environmental Affairs, the Woodlands Partnership implementation grants that are available to the municipalities in the 21-town region and organizations working within the that region that grant round the application round just closed like a week ago. They are a $25,000 per limit per town being worked in. Conway and Buckland are eligible for that. Deerfield and Greenfield are not in it. If you want to talk about that more with me about how to apply for that, I'm happy to do that offline.

Judy Rondeau: I can also add that through the Watershed Planning Program we have a water quality monitoring grant program. It's typically offered in the fall, and it provides funding for volunteer water quality monitoring groups to conduct monitoring. I will drop the link to that in the chat it's offered through another section in our program so I don't have a lot of details but folks that want to expand their water quality monitoring efforts or will begin water quality monitoring might find it useful. (From chat: https://www.mass.gov/info-details/grants-financial-assistance-watersheds-water-quality#water-quality-monitoring-grant-program-)

Ryan O'Donnell from chat: We have received that grant this year and last year and that helped fund our monitoring efforts. That is what funded the Trout Unlimited conductivity monitoring last year.

Lisa Gilbert from chat: https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/massachusetts. Link to programs within the state from NRCS.

Thank you for your time and for joining and participating, we really appreciate it!

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Appendix B – Select excerpts from the Deerfield River Watershed 2000 Water Quality Assessment Report (MassDEP, 2000) relating to the water quality in the Deerfield Mainstem – North River to Mouth watershed (note: relevant information is included directly from these documents for informational purposes and has not been modified).

Deerfield River Watershed 2000 Water Quality Assessment Report (MA33-20 - Dragon Brook)

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.

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%

MA DFWELE has recommended that Dragon Brook and its tributary Hawkes Brook be protected as cold water fishery habitat (MassWildlife 2001).

Report Recommendations:
• 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.

Deerfield River Watershed 2000 Water Quality Assessment Report (MA33-22 - Shingle Brook)

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.

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%

MA DFWELE has recommended that Shingle Brook be protected as cold water fishery habitat (MassWildlife 2001).

Report Recommendations:
• 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.

Deerfield River Watershed 2000 Water Quality Assessment Report (MA33-17 - Bear River)

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.

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%

MA DFWELE has proposed that the Bear River be protected as a cold water fishery habitat (MassWildlife 2001).

Report Recommendations:
• 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.

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 mi2. 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 >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 (LC50 >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 (LC50 >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.

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%

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).
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.

Report Recommendations:

• 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.

Deerfield River Watershed 2000 Water Quality Assessment Report (MA33-04 - Deerfield River)

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 (LC50 >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.

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

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.

Report Recommendations:
• 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.

Appendix C – Pollutant Load Export Rates (PLERs)

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
AGRICULTURE, HSG A	0.45	7.14	2.59
AGRICULTURE, HSG B	0.45	29.4	2.59
AGRICULTURE, HSG C	0.45	59.8	2.59
AGRICULTURE, HSG D	0.45	91.0	2.59
AGRICULTURE, IMPERVIOUS	1.52	650	11.3
COMMERCIAL, HSG A	0.03	7.14	0.27
COMMERCIAL, HSG B	0.12	29.4	1.16
COMMERCIAL, HSG C	0.21	59.8	2.41
COMMERCIAL, HSG D	0.37	91.0	3.66
COMMERCIAL, IMPERVIOUS	1.78	377	15.1
FOREST, HSG A	0.12	7.14	0.54
FOREST, HSG B	0.12	29.4	0.54
FOREST, HSG C	0.12	59.8	0.54
FOREST, HSG D	0.12	91.0	0.54
FOREST, HSG IMPERVIOUS	1.52	650	11.3
HIGH DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
HIGH DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
HIGH DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
HIGH DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
HIGH DENSITY RESIDENTIAL, IMPERVIOUS	2.32	439	14.1
HIGHWAY, HSG A	0.03	7.14	0.27
HIGHWAY, HSG B	0.12	29.4	1.16
HIGHWAY, HSG C	0.21	59.8	2.41
HIGHWAY, HSG D	0.37	91.0	3.66
HIGHWAY, IMPERVIOUS	1.34	1,480	10.2
INDUSTRIAL, HSG A	0.03	7.14	0.27
INDUSTRIAL, HSG B	0.12	29.4	1.16
INDUSTRIAL, HSG C	0.21	59.8	2.41

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
INDUSTRIAL, HSG D	0.37	91.0	3.66
INDUSTRIAL, IMPERVIOUS	1.78	377	15.1
LOW DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
LOW DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
LOW DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
LOW DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
LOW DENSITY RESIDENTIAL, IMPERVIOUS	1.52	439	14.1
MEDIUM DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
MEDIUM DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
MEDIUM DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
MEDIUM DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
MEDIUM DENSITY RESIDENTIAL, IMPERVIOUS	1.96	439	14.1
OPEN LAND, HSG A	0.12	7.14	0.27
OPEN LAND, HSG B	0.12	29.4	1.16
OPEN LAND, HSG C	0.12	59.8	2.41
OPEN LAND, HSG D	0.12	91.0	3.66
OPEN LAND, IMPERVIOUS	1.52	650	11.3

[1]HSG = Hydrologic Soil Group

Appendix D – Summary of Agricultural BMPs included in Conceptual Projects and associated Planning-level Nitrogen Load Reductions in the Deerfield Mainstem –North River to Mouth Watershed

Deerfield Mainstem Conceptual Projects and Potential Nitrogen Load Reductions

- **Composting Facility (317)**
  - Definition – A structure or device to contain and facilitate an aerobic microbial ecosystem for the decomposition of manure and/or other organic material into a final product sufficiently stable for storage, on farm use and application to land as a soil amendment.
  - Purpose – This practice is used to accomplish one or more of the following purposes–
    - To reduce the pollution potential and odors generated by organic waste solids;
    - To improve the handling characteristics of organic waste solids;
    - To reuse organic waste as animal bedding;
    - To produce a soil amendment that provides soil conditioning, slow-release plant-available nutrients, and plant disease suppression.

      ➢ The estimated nitrogen load reduction of a composting facility for a herd of 50 cattle is approximately 6,750 lbs/year.

- **Roofs and Covers (367)**
  - Definition - A rigid, semi-rigid, or flexible manufactured membrane, composite material, or roof structure placed over a waste management facility.
  - To provide a roof or cover for:
    - water quality improvement
    - diversion of clean water from animal management areas (i.e. barnyard, feedlot or exercise area), waste storage facilities, waste treatment facilities, or agrichemical handling facilities.
    - capture of biogas for energy production
    - reducing net effect of greenhouse gas emissions
    - air quality improvement and odor reduction

      ➢ Typically paired with a roof runoff structure, in conjunction with a composting facility, waste storage facility or heavy use area.
      ➢ When paired with Heavy Use Area Protection and functioning as a "bedded pack" system, the estimated nitrogen load reduction for a herd of 50 cattle is approximately 6,750 lbs/year.

- **Fence (382)**
  - Definition - A constructed barrier to animals or people.
  - Purpose - This practice facilitates the accomplishment of conservation objectives by providing a means to control movement of animals and people, including vehicles.

    - This practice is typically paired with heavy use areas and stream crossings.
    - The estimated nitrogen load reduction for a herd of 50 cattle is approximately 900 lbs/year.

- **Roof Runoff Structure (558)**
  - Definition - Structures that collect, control, and transport precipitation from roofs.
  - Purpose - To improve water quality, reduce soil erosion, increase infiltration, protect structures, and/or increase water quantity.

    ➢ Typically paired with a roof/cover in conjunction with a composting facility, waste storage facility, or heavy use area.
    ➢ The estimated nitrogen load reduction for a herd of 50 cattle is approximately 2,700 lbs/year.

- **Heavy Use Area Protection (561)**
  - Definition - The stabilization of areas frequently and intensively used by people, animals or vehicles by establishing vegetative cover, by surfacing with suitable materials, and/or by installing needed structures.
  - Purpose -
    - Reduce soil erosion
    - Improve water quantity and quality
    - Improve air quality
    - Improve aesthetics
    - Improve livestock health

      - Typically paired with a roof runoff structures in conjunction with a waste storage facility or heavy use area.
      - When paired with roof/cover and functioning as a "bedded pack" system, the estimated nitrogen load reduction for a herd of 50 cows is approximately 6,750 lbs/year.

- **Stream Crossing (578)**
  - Definition - A stabilized area or structure constructed across a stream to provide controlled access for people, livestock, equipment, or vehicles.
  - Purpose – This practice is used to accomplish one or more of the following purposes:
    - Improve water quality by reducing sediment, nutrient, or organic loading to a stream
    - Reduce streambank and streambed erosion

      - This practice is typically paired with fencing.
      - The estimated nitrogen for a herd of 50 cattle, is approximately 900 lbs/year.

- **Nutrient Management (590)**
  - Definition – Manage rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts.
  - Purpose – This practice is used to accomplish one or more of the following purposes:
    - Improve plant health and productivity
    - Reduce excess nutrients in surface and ground water
    - Reduce emissions of objectionable odors
    - Reduce emissions of particulate matter (PM) and PM precursors
    - Reduce emissions of greenhouse gases (GHG)
    - Reduce emissions of ozone precursors
    - Reduce the risk of potential pathogens from manure, biosolids, or compost application from reaching surface and ground water
    - Improve or maintain soil organic matter

      - Nutrient Management plans are developed according to the amount of cropland and animal manure associated with a farm. These plans can help determine which practices at which amounts could be implemented to ensure proper manure storage and application of nutrients to farmland.

*Nitrogen reduction estimates are variable based on animal numbers, location, and final design of the practice.

Appendix E – List of Potential Agricultural BMPs with USDA NRCS Code (Provided by FRCOG).

The Massachusetts "Field Office Technical Guide" can be accessed at: https://efotg.sc.egov.usda.gov/#/state/MA/documents/section=4&folder=-3 .Detailed information on each BMP can be found under "Section 4 - Practice Standards and Supporting Documents" > "Conservation Practice Standards & Support Documents"

207-Site Assessment and Soil Testing for Contaminants Activity	656-Constructed Wetland
216-Soil Health Testing	309-Agrichemical Handling Facility
217-Soil and Source Testing for Nutrient Management	311-Alley Cropping
309-Agrichemical Handling Facility	314-Brush Management
311-Alley Cropping	315-Herbaceous Weed Control
313-Waste Storage Facility	338-Prescribed Burning
316-Animal Mortality Facility	350-Sediment Basin
317-Composting Facility	351-Water Well Decommissioning
327-Conservation Cover	356-Dike
328-Conservation Crop Rotation	362-Diversion
329-Residue and Tillage Management, No Till/Strip Till/Direct Seed	367-Roofs and Covers
330-Contour Farming	378-Pond
332-Contour Buffer Strips	380-Windbreak/Shelterbelt Establishment
340-Cover Crop	381-Silvopasture Establishment
342-Critical Area Planting	382-Fence
345-Residue and Tillage Management, Reduced Till	402-Dam
355-Water Well Testing	422-Hedgerow Planting
360-Waste Facility Closure	430-Irrigation Pipeline
366-Anaerobic Digester	441-Irrigation System, Micro irrigation
386-Field Boarder	442-Sprinkler System
390-Riparian Herbaceous Cover	443-Irrigation System, Surface & Subsurface
391-Riparian Forest Buffer	462-Preision Land Forming
393-Filter Strip	464-Irrigation Land Leveling
395-Stream Habitat Improvement and Management	468-Lined Waterway or Outlet
410-Grade Stabilization Structure	484-Mulching
412-Grassed Waterway	511-Forage Harvest Management
436-Irrigation Reservoir	512-Forage and Biomass Planting
449-Irrigation Water Management	516-Livestock Pipeline
472-Access Control	558-Roof Runoff Structure
528-Prescribed Grazing	560-Access Road
561-Heavy Use Area Protection	574-Spring Development
575-Trails and Walkways	578-Stream Crossing
580-Streambank and Shoreline Protection	582-Open Channel
590-Nutrient Management	585-Stripcropping
600-Terrace	587-Structure for Water Control
601-Vegetative Barrier	595-Integrated Pest Management
612-Tree/Shrub Establishment	603-Herbaceous Wind Barriers
629-Waste Treatment	607-Surface Drain, Field Ditch
634-Waste Transfer	608-Surface Drain, Main or Lateral
635-Vegetative Treatment Area	614-Watering Facility
638-Water and Sediment Control Basin	620-Underground Outlet
632-Solid/Liquid Waste Separation Facility	650-Windbreak/Shelterbelt Renovation
642-Water Well	657-Wetland Restoration
643-Restoration and Management of Declining Habitats	658-Wetland Creation
644-Wetland Wildlife Habitat Mangement	659-Wetland Enhancement

Appendix F – Lower Bear River and Upper Bear River Conceptual Designs from the Deerfield River WBP (FRCOG, 2015)

Lower Bear River Conservation Area

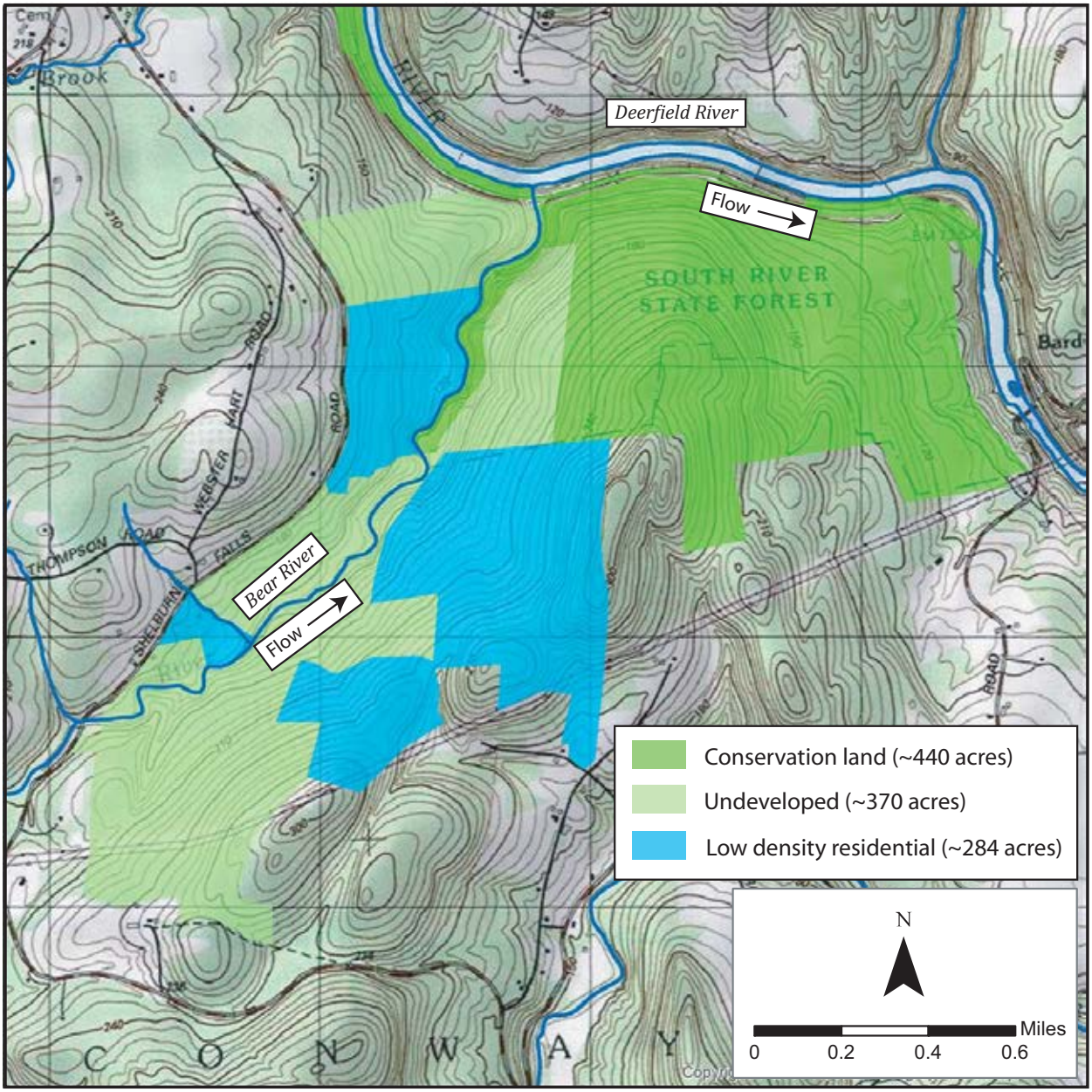
Project Benefits: Sediment Storage, Flood Attenuation, and Conservation of Green Infrastructure.

Project Description: Conservation of reference reach area on lower Bear River.

The permanent protection of 500-plus contiguous acres adjacent to the South River State Forest in Conway. These lands, which include both banks of the lower two miles of the Bear River down to its confluence with the Deerfield River, contain a mix of pristine forested habitats including previously identified rare and endangered plant species. The steep, confined stream channel ranges from cobble riffle-pool, to boulder step-pool and bedrock cascade morphologies and represents a relatively natural reference condition with little evidence of past human manipulation. As envisioned this project should rank highly for a competitive Land Partnership Grant. Land acquisition costs for this project, included in the following pages, are based on the assessed land values from the Town's tax assessment. From these values, the median value per acre for the undeveloped parcels was calculated ($1500 per acre). An additional $1000 per acre was added for residential parcels (based on a breakdown of increases in value in the data set).

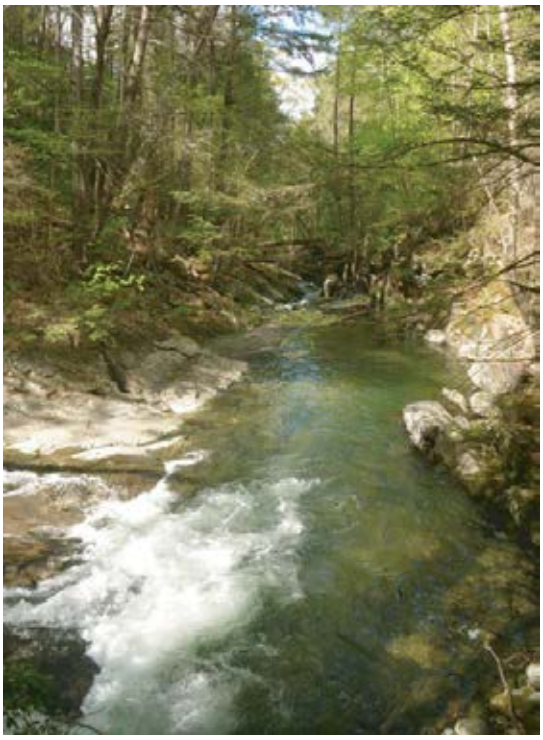
Estimate of probable costs:

Treatment/Item	Unit	Quantity	Unit Cost ($)	Task Cost ($)
Land acquisition - undeveloped land	acre	370	$1,500.00	$555,000.00
Land acquisition - residential land	acre	284	$2,500.00	$710,000.00
Parking area construction includes grading, gravel lot, interpretive signs, etc	unit	1	$35,000.00	$35,000.00
Clear and establish walking trails	mile	2	$15,000.00	$30,000.00
Site upkeep and trail maintenance	year	5	$5,000.00	$25,000.00
TREATMENT SUBTOTAL				$1,355,000.00
20% Contingency				$271,000.00
Construction subtotal				**$1,626,000.00**
Surveying, permitting and legal costs				$100,000.00
Project total				$1,726,000.00



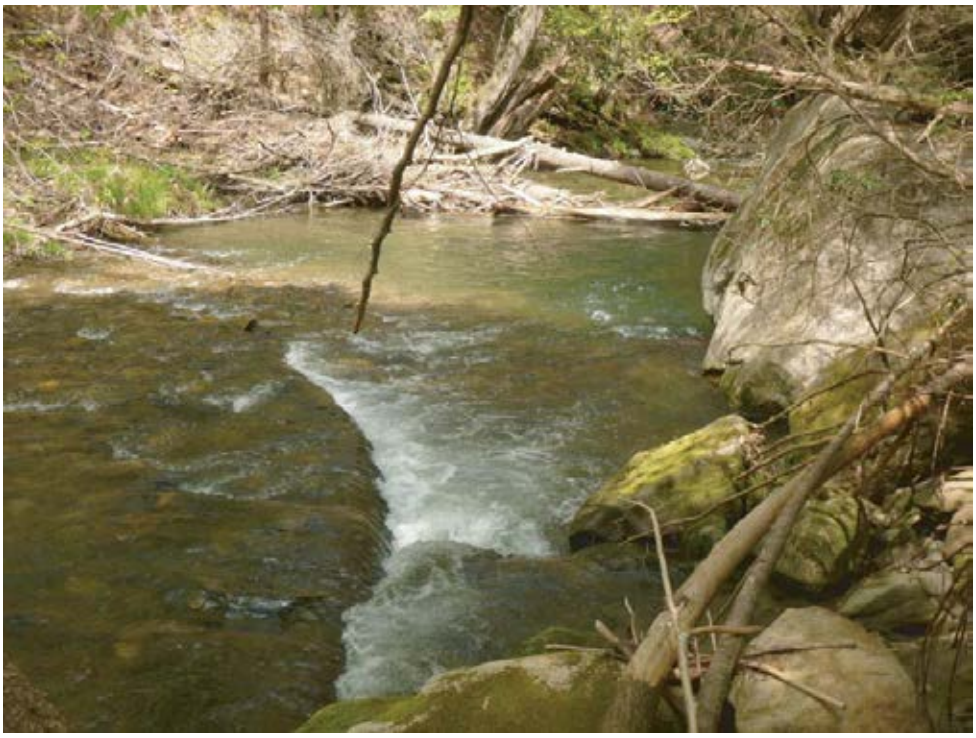
Lower Bear River Conservation Area - site map.

a)



b)

c)



Lower Bear River Conservation Area. The a) bedrock cascade, b) boulder step-pool, and c) cobble riffle-pool stream morphologies of the lower Bear River represent a relatively natural reference condition with little evidence of past human manipulation.

a)

b)

Lower Bear River Conservation Area. a) Public access to the stream and surrounding land adjacent to South River State Forest is part of the proposed conservation; b) channel-spanning log jam maintaining deep pool and providing cover in this cold water fishery.

Upper Bear River Conservation and Geomorphic Restoration

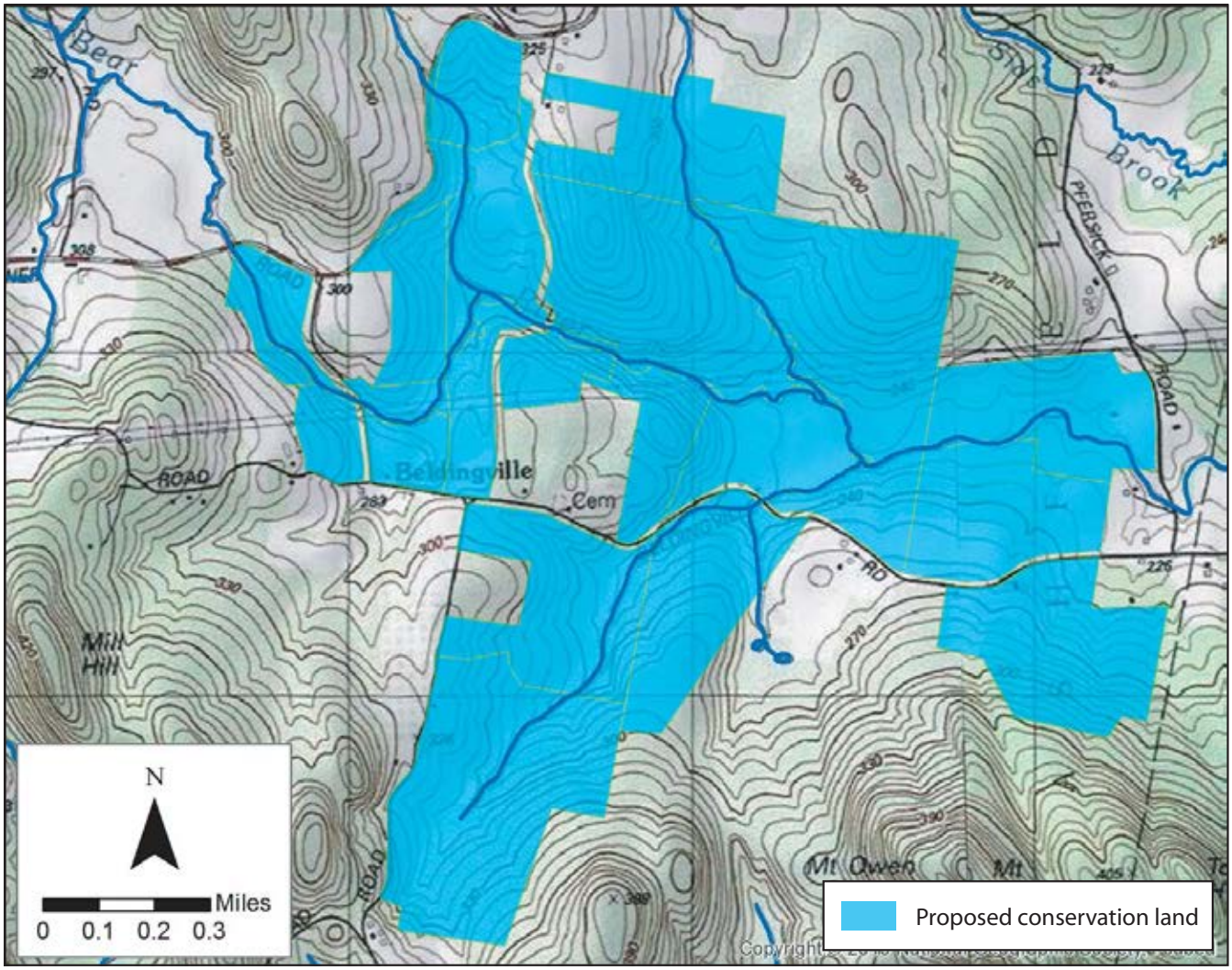
Project Benefits: Sediment Storage, Flood Attenuation, Habitat Enhancement and Conservation of Green Infrastructure.

Project Description: Conservation and geomorphic restoration (wood addition) on upper Bear River.

Using the Franklin Land Trust's Crowningshield Conservation Area as a model for conservation paired with geomorphically-compatible stream restoration and management, this project seeks to protect a 200-foot wide river corridor through portions of the upper Bear River. As with the Crowningshield project, these predominantly forested parcels contain historically-altered stream channels in the upper portions of the watershed where wood addition projects have been shown to effectively trap sediment, depress flood peaks, increase base flow and enhance habitat. The proposed "chop and drop" treatment, where trees are strategically cut from the riparian zone and directionally-felled into and across the stream channel, has had a great deal of success in forested reaches throughout New England. The design calls for the addition of a minimum of 200 pieces of large wood per mile through chop and drop, although wood-loading density could be increased if desired. Additionally, marginal log jams and/or instream engineered log structures to be constructed with trees sourced from the river corridor will provide additional sediment storage and habitat benefits. Several of these structures could be built with the intention of recruiting any wood mobilized from the chop and drop reaches upstream. Monitoring, included as part of this project, will consist of tracking and mapping the recruitment and movement of wood through the stream system and measuring its effects on pool depth, channel dimensions, substrate composition, temperature profiles, and invertebrate and fish populations. Water stage and turbidity monitoring, an analogue for suspended sediment load, will attempt to assess the influence of wood addition on suspended sediment load. These studies have the potential to demonstrate the benefits of wood addition projects to trap sediment and enhance habitat.

Estimate of probable costs:

Treatment/Item	Unit	Quantity	Unit Cost ($)	Task Cost ($)
Corridor easement (200 feet wide)	acre	109	$1,500.00	$163,500.00
Chop and drop wood addition (200 pieces per mile)	mile	2	$15,000.00	$30,000.00
Marginal log jam / engineered log structures	EA	8	$2,500.00	$20,000.00
Machinery	day	3	$4,000.00	$12,000.00
Construction Oversight	day	3	$1,680.00	$5,040.00
Pre and Post-implementation monitoring: Monumented surveying and photo logs, fish and invertebrate surveys, water stage, turbidity, pebble counts, temperature profiles, tracking wood mobility	year	5	$7,500.00	$37,500.00
TREATMENT SUBTOTAL				$268,040.00
20% Contingency				$53,608.00
Construction subtotal				**$321,648.00**
Surveying, permitting and legal costs				$70,000.00
Project total				$391,648.00



Upper Bear River conservation and geomorphic restoration - site map.

a)

b)

Upper Bear River conservation and geomorphic restoration. a) Artificially straightened channels in the upper Bear River are appropriate targets for conservation and restoration through wood addition, where b) naturally recruited wood can be seen storing sediment.

a)

b)

Upper Bear River conservation and geomorphic restoration. The proposed design includes a) Chop and drop wood additions (photo from Griffith Brook, Green Mountain National Forest, VT) and b) marginal log jams (photo from Nash Stream, NH).