WATERSHED-BASED PLAN

Southwest Branch Housatonic River and Richmond Pond

May 10, 2024

Berkshire Regional Planning Commission
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With support from Housatonic Valley Association

Prepared For:

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

MASSACHUSETTS
watershed·based plans

Contents

Executive Summary

The Southwest Branch of the Housatonic Watershed extends 15,045 acres and is a sub-watershed in the upper Housatonic River watershed in Berkshire County, western Massachusetts. The watershed includes portions of the City of Pittsfield and the towns of Richmond and Hancock, and one Great Pond, Richmond Pond, with a size of 228 acres and a watershed just over 5,000 acres. The City of Pittsfield is a designated MS4 community (Municipal Separate Storm Sewer System) and is regulated by the Massachusetts MS4 general permit under the Clean Water Act National Pollutant Discharge Elimination System (NPDES).

There are two waterbodies in this watershed that are designated as impaired in the *2022 Integrated List of Impaired Waters* (MassDEP, 2023). The Southwest Branch of the Housatonic River (SWB) is designated Category 5 and is impaired for primary recreation due to E. *coli and fecal coliform.* It is also impaired for fish, other aquatic life and wildlife due to temperature and sedimentation. A total maximum daily load (TMDL) for pathogens is currently being drafted and is expected to be released in 2024. Richmond Pond is designated Category 4c due to the presence of three non-native aquatic plant species: Eurasian water milfoil, *Myriophyllum spicatum* and curly leaf pondweed. Waterbodies designated Category 4c do not require the development of a TMDL as the impairment is not caused by a pollutant. For a full list of impairments, refer to **Table A-8**.

In 2019, the Housatonic Valley Association (HVA) completed a draft watershed-based plan (WBP) for the SWB which was reviewed by Mass DEP. Berkshire Regional Planning Commission (BRPC) built upon that draft to finalize the SWB and Richmond Pond watershed-based plan (SWB WBP) with funding from the Massachusetts Department of Environmental Protection (MassDEP) Clean Water Act Section 319 Regional Coordinator Program. The WBP includes conceptual design plans for several BMPs primarily developed by Comprehensive Environmental Inc. (CEI). Meetings with stakeholders including city and town officials and representatives of Richmond Pond Association, Richmond Shores Civic Association, and Berkshire Environmental Action Team helped identify potential Best Management Practices (BMPs), both structural and non-structural, in order to address *E. coli* and nitrogen pollutant loading.

A draft SWB WBP was shared with key stakeholders and their comments have been integrated into this final plan. For more information, questions, or to provide input, please contact Courteny Morehouse, Energy & Environmental Principal Planner at Berkshire Regional Planning Commission at cmorehouse@berkshireplanning.org.

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 (EPA'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. (https://www.mass.gov/info-details/grants-financial-assistance-watersheds-water-quality)

EPA guidelines promote the use of CWA Section 319 funding for developing and implementing WBPs. WBPs are required for all projects implemented with CWA 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 includes nine elements (a through i) in accordance with EPA 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 (NPS) 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 CWA Section 319 programs, State Revolving Funds, United States Department of Agriculture's (USDA's) Environmental Quality Incentives Program 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 NPS management measures that will be implemented.

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

g) A description of **interim, measurable milestones** for determining whether NPS 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 toward attaining water quality standards and, if not, the criteria for determining whether this WBP needs to be revised or, if a NPS 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 plan would not have been possible without the funding support of the MassDEP Clean Water Act 319 Regional Coordinator Program.

This Plan was first drafted by Housatonic Valley Association and reviewed by MassDEP in 2019. Advisors to the first draft included:

Dennis Regan, Berkshire Director, HVA
Alison Dixon, Berkshire Outreach Manager, HVA
Jane Winn, Executive Director, Berkshire Environmental Action Team (BEAT)
Elia del Molino, Stewardship Manager & GIS Analyst, BEAT
Rob Van der Kar, Pittsfield Conservation Commission Agent
Ricardo Morales, Pittsfield City Engineer
Michael Makes, SW Branch Community Resident

As BRPC worked to complete the SWB WBP, information and input was gathered at meetings held with key stakeholders including the City of Pittsfield, Town of Richmond, Berkshire Environmental Action Team, Richmond Pond Association, Richmond Shores Civic Association, Berkshire Community College, and Central Berkshire Habitat for Humanity.

BMP siting, conceptual designs, and alternative BMP considerations were completed by engineering consultants Comprehensive Environmental, Inc (CEI) with input from the City of Pittsfield's City Engineer and Conservation Agent and Berkshire Regional Planning Commission.

A special thanks to Dennis Regan, former Berkshire Director of the Housatonic Valley Association, for initiating the Southwest Branch Watershed Based Plan in 2019.

Data Sources

- This WBP was developed using the framework and data sources provided by MassDEP's WBP Tool. (https://prj.geosyntec.com/MassDEPWBP)
- Project areas for high-priority structural stormwater BMPs were selected through site reconnaissance and design plans funded by the MassDEP Clean Water Act 319 Regional Coordinator position.
- Water quality data was provided by HVA, City of Pittsfield and the Richmond Pond Association. Lakes and Pond Association of Western Massachusetts (LAPA West) provided cyanobacteria counts through their annual lakes and ponds monitoring program.
- Resources used to support the development of stormwater BMP conceptual designs include the Massachusetts Stormwater Handbook Volume 2[1] and the New England Stormwater Retrofit Manual (July 2022)[2]

Summary of Completed Work

1. Structural BMPs

Several stormwater best management practices (BMPs) have been constructed in the SWB watershed. Most of these projects were constructed on private properties, both commercial and residential. Several BMPs were installed around Richmond Pond as a result of a MassDEP CWA Section 319 Non-Point Source grant awarded to the Town of Richmond in 2002 and implemented from 2004 – 07 *(02-04/319: Implementing Nonpoint Source BMPs at Richmond Pond)* A map and summary of the constructed BMPs are provided in Appendix B. **Table 1** provides a summary of the known stormwater BMPs in the SWB watershed.

A major improvement in the water quality of Richmond Pond occurred in 2004 when septic systems were decommissioned, some of which had been leaching into the waterbody. The constructed wastewater system which serves the private residential developments (Richmond Shores, Branch Farm Cottages and Whitewood) and Camp Russell directs the wastewater to the City of Pittsfield's wastewater treatment plant. Following the completion of this project and the 319 project, the water quality of the pond, as documented by the RPA's water monitoring, improved substantially. (Source: https://richmondpondassociation.org/lake-mgmt)

[1] https://www.mass.gov/doc/massachusetts-stormwater-handbook-vol-2-ch-2-stormwater-best-management-practices/download
[2] https://www3.epa.gov/region1/npdes/stormwater/tools/snep-stormwater-retrofit-manual-july-2022-508.pdf

Table Intro-1: Existing Stormwater BMPs in the Richmond Pond and Southwest Branch Watershed

Ownership	Location	BMP	Installation Date	Notes
Private	Cobblestone Cove, Pittsfield	Detention Basin (Wet)	Approx. 1987	Serves runoff from approx. 19 residential properties
Private	Amy Court, Pittsfield	Detention Basin (Wet)	Designed, not installed	Residential Development (8 properties)
Private	Lilly Brook Road, Pittsfield	Detention Basin (Wet)	Approx 1989	Residential Development (8 properties)
Private	U-Haul, West Housatonic Street	Constructed wetlands	unknown	Commercial property
Private	Premier Waters	Detention Basin (Dry)	unknown	Commercial property
Private	Interprint	Detention Basin (Dry)	unknown	Commercial property
Private	Camp Russell – Branch Farm Road	East and West Detention Basins	2004 – 2007	Property owned by Boys and Girls Club – BMPs installed through the 319 grant funded project awarded to the Town of Richmond (2002).
Private	Richmond Shores	3 small catch basins, 5 deep sump catch basins, drainage swales	2004 - 2007	BMPs installed through the 319 grant funded project awarded to the Town of Richmond (2002). Development managed by Richmond Shores Civic Association. Inlets cleaned regularly by residents. Hired contractor cleans out the catch basins 1 – 2 x / year.
Private	Richmond Shores	Vegetative buffer and fencing at the Richmond Shores beach area	2004 - 2007	BMPs installed through the 319 grant funded project awarded to the Town of Richmond (2002).

Table Intro-1: Existing Stormwater BMPs in the Richmond Pond and Southwest Branch Watershed, continued

Ownership	Location	BMP	Installation Date	Notes
Town of Richmond	Town Beach and Boat Access sites	Vegetative Buffer	2004 - 2007	Native trees and shrubs planted adjacent to the boat launch. BMPs installed through the 319 grant funded project awarded to the Town of Richmond (2002).
Town of Richmond and Residential Properties	Richmond Shores, Camp Russell, Branch Farm Cottages and Whitewood	Wastewater sewer system	Approx. 2007	Private septic systems decommissioned and converted to a wastewater collection system. The residents funded the conversion and pay an annual "betterment fee" to cover the sewer system costs charged by the City of Pittsfield to the Town of Richmond.
State	Berkshire Community College Campus	Two bio-infiltration basins. Vegetated swale	2017	180-acre campus built in1972 located on West Street, Pittsfield. Serves approximately 2000 students annually. Stormwater from the campus is infiltrated on site.
Private	Whitewood, Richmond Pond	Bio-infiltration swale	2022	Infiltrates runoff from the driveway which was converted to asphalt. Maintained by the resident

2. Non-Structural BMPs – Ongoing

Outreach and Engagement:

The City of Pittsfield is an MS4 Community governed by the EPA under the Clean Water Act. The MS4 regulated area includes portions of the SWB watershed, in particular, the land on either side of the mainstem. The city, with support from stakeholders such as HVA and Berkshire Environmental Action Team, provide annual messaging to residents and businesses that include:

- Proper disposal of pet waste
- Proper operation and maintenance of septic systems
- Proper management of grass clippings and leaves
- Minimize fertilizer usage and never before storms

The Richmond Pond Association submits articles to the monthly local newsletter the ***Richmond Record*** during the summer season. These articles inform and educate residents about good stewardship to support water health of the Pond and current lake management projects.

The Town of Richmond hires boat launch monitors to educate people about the risk of invasives and how to properly clean their boats and gear.

Signage at Richmond Pond Boat Access provides information to residents and visitors about proper boat washing and where they can go to get their boat washed. This will be updated for the 2024 season.

Richmond Pond Association's website provides a variety of information for pond residents and visitors.[3]

City of Pittsfield's Street Sweeping Protocols

The entire City is swept at least two times a year, once in the fall and once in the spring. Main streets and parking lots are swept at a higher frequency (1-2 times a month). The city has increased street sweeping frequency of all municipal owned streets and parking lots which have potential for high pollutant loads (City of Pittsfield's MS4 2022 Report[4]).

Catch Basin Cleaning Protocols

City of Pittsfield

The City of Pittsfield has established catch basin cleaning protocols in accordance with the MS4 permit requirements. The City prioritizes inspection and maintenance of the 73 municipally managed catch basins located in the Southwest Branch watershed, to ensure that no sump shall be more than 50 percent full. Cleaning of catch basins is completed more frequently, if inspection and maintenance activities indicate excessive sediment or debris loadings. In 2021, 25 Catch basins were anecdotally identified as historically having sumps fill to and past 50% full. These catch basins were cleaned and rebuilt by the Highway Department. The city has a list of low-lying catch basins that are prone to flooding. These catch basins are more routinely inspected and maintained to ensure proper drainage.

Richmond Shores Private Development

[3] Richmond Pond Association's website link: https://richmondpondassociation.org/

[4] Pittsfield's 2022 MS4 Report link: https://tinyurl.com/PittsfieldMS4report

The existing catch basins are regularly maintained. Volunteers regularly check the catch basins for any accumulated debris removing it as necessary especially before and after a storm. The Richmond Shores Civic Association hires a contractor to clean out the catch basins annually or biannually as needed.

Town of Richmond

Catch basins are routinely cleaned out on an annual basis by a hired contractor.

3. Non-Structural BMPs – Completed Projects

Storm Drain Stenciling – City of Pittsfield

The Housatonic Valley Association (HVA) has worked with the Housatonic watershed communities to glue decals adjacent to storm drains to inform people not to dump anything down the storm drain. In the City of Pittsfield, the focus was to decal neighborhoods where they are most visible. HVA has decaled some of the drains in the SWB neighborhoods. These decals need to be replaced every 1 – 3 years.

Fifth Grade Watershed Education – Richmond and Pittsfield

HVA and Mass Audubon provided watershed focused education programs to fifth grade classes. During the past three years, Richmond Elementary School's fifth grade students learned about the water cycle, water quality, the impact of polluted stormwater, green infrastructure and nature-based solutions in multiple hands-on engaging programs. The fifth-grade classes in the Pittsfield elementary schools, Stearns and Crosby, also participated. These school programs were primarily funded by the Natural Resources Damages Fund for the Housatonic River.

Educational Outreach Materials

Pittsfield River Smart brochure: HVA worked with the City of Pittsfield to develop the River Smart brochure to educate and inform residents about stormwater and suggestions for minimizing stormwater impacts. These brochures were printed in both English and Spanish and distributed at multiple public places and tabling events.

Educational Yard and Pet Waste messaging**:** The City of Pittsfield included inserts in the utility bills to inform residents about proper management of yard and pet waste. In addition, HVA created slides that were included in the advertisements shown at the local cinema on North Street, Pittsfield.

Tri-fold stormwater display developed by HVA for use at tabling events in the City of Pittsfield shared the message about the impacts of stormwater and tips for people to reduce their impact.

Landscaping for Climate Change Webinars and Fact Sheet – *Richmond-West Stockbridge*: In 2022, the Town of Richmond partnered with West Stockbridge to complete a Regional MVP Action Grant focused on climate resilience. Under this grant, a fact sheet and two webinars titled "Landscaping for Climate Change: Practical Solutions for Your Yard" were made available to residents. These outreach materials include information about stormwater solutions such as rain gardens, porous pavement, riparian buffers and rain barrels. Information about the webinars was sent directly to stream- and lakeside property owners.

(Contact BRPC for digital copies of the outreach materials and access to the webinar recordings)

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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

The Southwest Branch of the Housatonic River Watershed is a sub-watershed of the Housatonic River located in Berkshire County. The watershed covers 23.5 square miles and encompasses portions of three municipalities: the City of Pittsfield (population 43,461), the Town of Richmond (population 1,407) and the Town of Hancock (population 757).[5]

The 5.8-mile main stem of the Southwest Branch of the Housatonic watershed is located entirely in Pittsfield, Massachusetts and originates at the dammed outlet of Richmond Pond. It flows through land occupied by Camp Arrowhead through wetlands and gradually moves into more developed residential and industrial riparian land use, until it terminates at the confluence with the West Branch of the Housatonic River which is located in an undeveloped area of Pittsfield's Clapp Park access on West Housatonic Street. The Southwest Branch of the Housatonic River (MA21-17) is classified as a Class B, Cold Water Fishery (CFR) by MassDEP.[6]

The SWB watershed's western tributaries, including Lilly, Shaker, May, Seace, and Mount Lebanon Brooks (aka Clark's Brook), arise in the predominantly undeveloped Taconic Mountains. This area of the watershed is mostly protected as much of it is encompassed within Pittsfield State Forest. In the valley, Shaker Brook flows through wetlands whereas Lilly and May Brooks flow through lightly developed residential areas. Shaker, Seace and Mount Lebanon Brooks are all classified as Class B, CFRs by MassDEP.

Additional tributaries in the watershed include Jacoby Brook, fed by Lilly and May Brooks, Smith (Class B, Category 2) and Maloy Brooks. Apart from Maloy Brook which does not appear to have been assessed, all these tributaries are designated CFRs. The Jacoby and Smith Brook sub-watersheds have minimal housing and business development. However, each of these tributaries has active agricultural operations that border their banks. Maloy Brook originates in a wetland but then flows into a developed commercial area, Pittsfield Plaza, where it has been redirected around development. Maloy Brook flows under Route 20 and is surrounded by commercial businesses before it converges with the Southwest Branch.

The east side of the watershed is a more developed urban landscape. There are two unnamed tributaries on the east side of the mainstem, both of which have wetlands and relatively undeveloped land use. The headwater for one tributary is Mud Pond. The City of Pittsfield's Wild Acre Park is the headwaters for the other tributary.

[5] Source: 2020 Census Data
[6] https://www.mass.gov/info-details/coldwater-fish-resources

Apart from Maloy Brook and the unnamed tributary rising from Mud Pond, all the watershed's tributaries and the mainstem are classified by the Division of Fish and Wildlife as coldwater fish resources (CFR) defined as a stream, river or tributary in which reproducing coldwater fish are found.[7]

Table A-1: Southwest Branch General Watershed Information

Watershed Name (Assessment Unit ID):	Mount Lebanon Brook (MA21-70); Seace Brook (MA21-71); Shaker Brook (MA21-69); Smith Brook (MA21-72); Southwest Branch Housatonic River (MA21-17); Richmond Pond (MA21088)
Major Basin:	HOUSATONIC
Watershed Area (within MA):	15043.9 (ac)

Table A-2: Richmond Pond General Watershed Information

Watershed Name (Assessment Unit ID):	Richmond Pond (MA21088)
Major Basin:	HOUSATONIC
Watershed Area (within MA):	5006 (ac)
Water Body Size:	228 (ac)

[7] extracted 11/10/2023 -https://www.mass.gov/info-details/coldwater-fish-resources

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

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

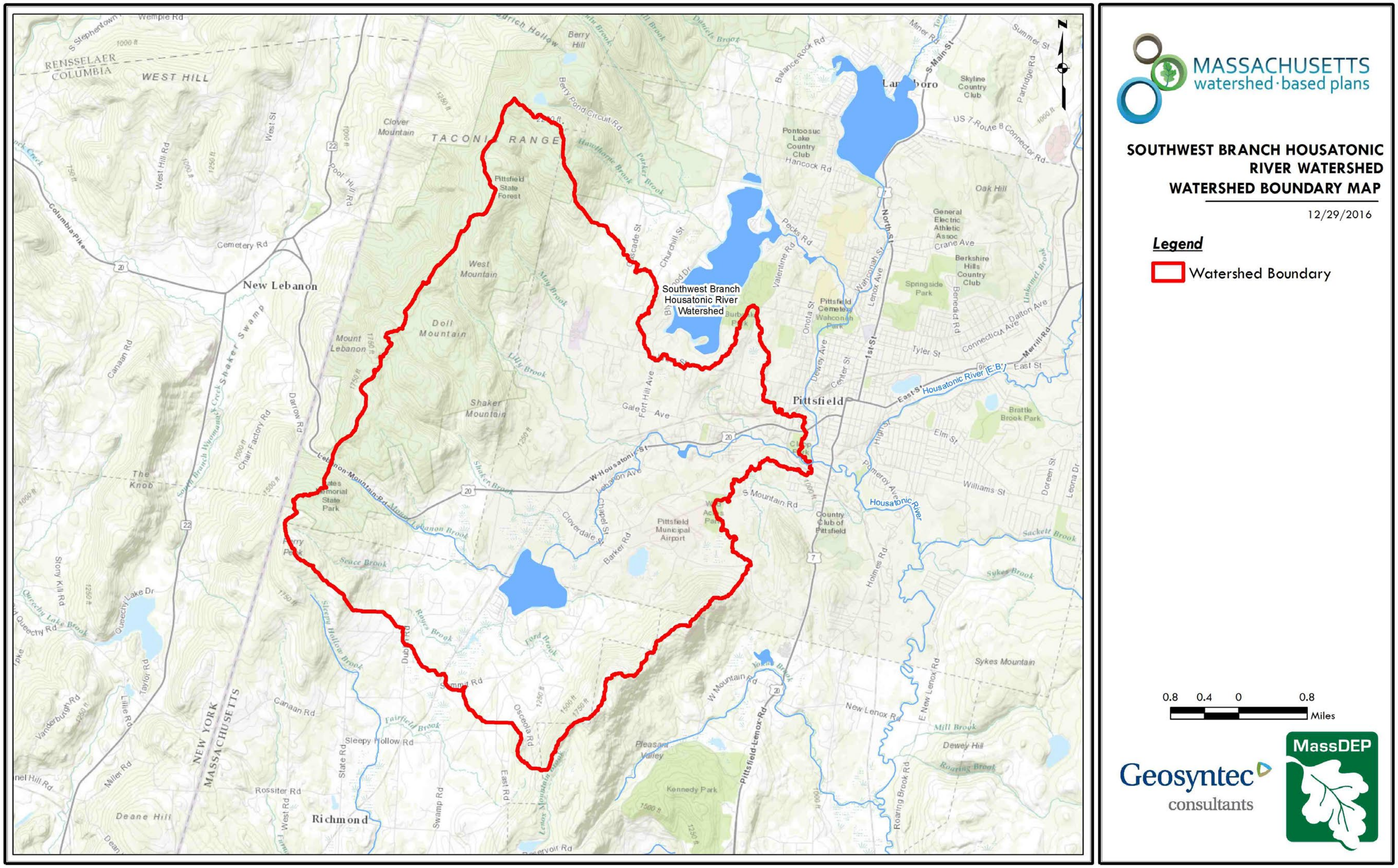
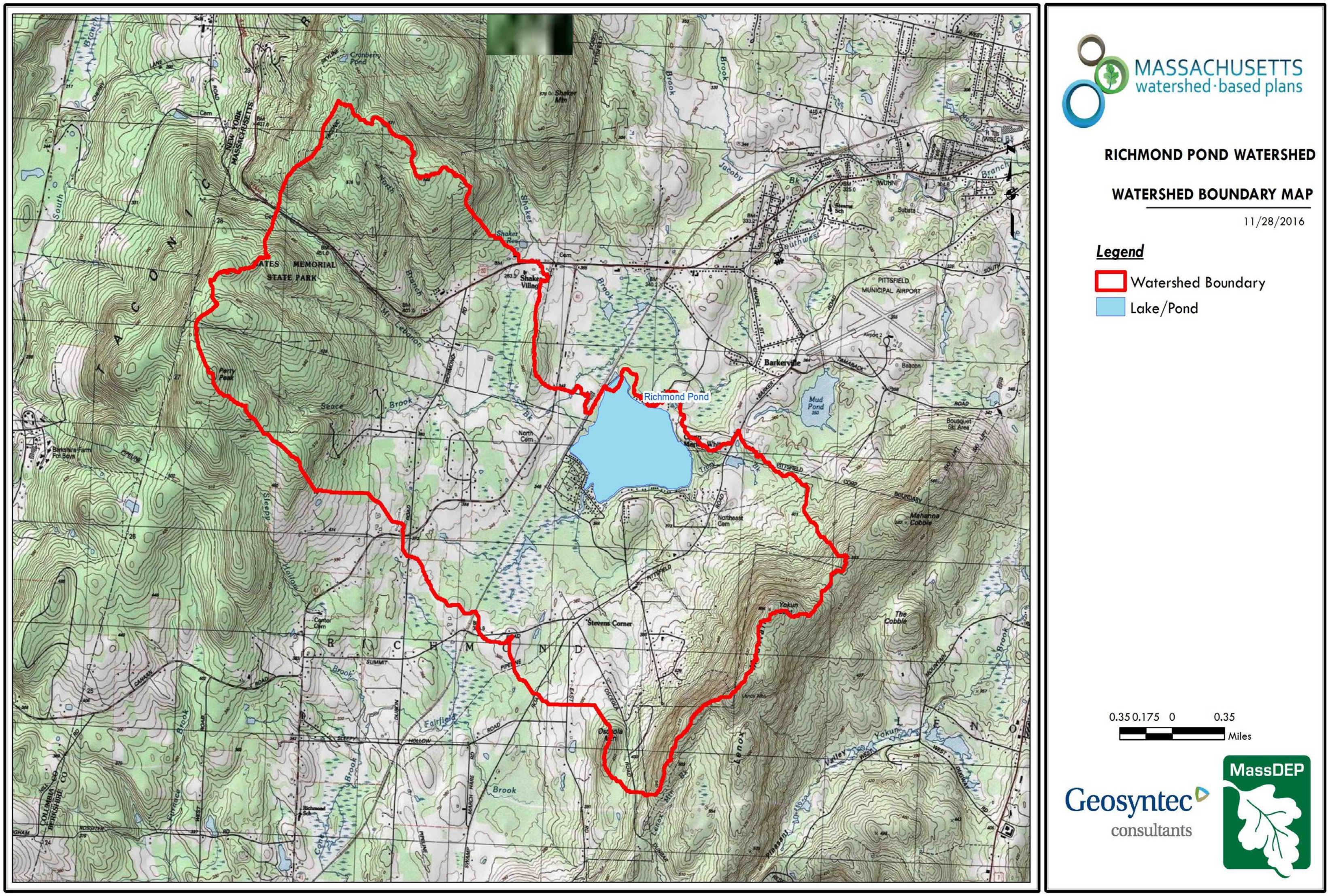


Figure A-2: Richmond Pond Watershed Boundary Map (MassGIS, 2007; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

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



Richmond Pond, at 228 acres, is the only “Great Pond” in the watershed. Under Massachusetts law (MGL Chapter 131, Section 45), Great Ponds are defined as ponds or lakes at least 10 acres in size. The average depth of Richmond Pond is 13 feet with a maximum depth is 54 feet in an area sometimes referred to as the “Deep Hole,” located in the southeastern section of the lake (see Figure A-3 Richmond Pond Bathymetric map). The watershed of Richmond Pond extends 5006 acres, approximately one third of the Southwest Branch watershed. The 15 foot privately owned dam was rebuilt in 1951 after washing out twice in the late 1800’s. The dam is located at the head of the Southwest Branch and supports the control of the water level. [8] Richmond Pond is drawn down annually to support weed management and prevent shoreline erosion. A complete history of Richmond Pond, “The Gem of Richmond,” is available for purchase. For more information visit: https://richmondpondassociation.org/pond-history-book-project.

Richmond Pond is in both the City of Pittsfield and the Town of Richmond in the southern part of the watershed. Four tributaries feed into the pond: Mount Lebanon Brook, also known as Clark’s Brook (west shore also known as Mount Lebanon Brook), Ford Brook (southern shore), Whitewood Brook, and Tracy Brook (eastern shore). The pond is a recreational asset for the Town of Richmond residents and visitors with a Town Beach located on the northwest shore.

Richmond Pond is used for swimming, fishing, boating, birding, walking, and hiking, camp waterside activities, ice skating, bird and fish habitat and visual enjoyment. Fishing is supported by MassWildlife’s trout stockings (rainbow, brown and brook) every spring and fall. The following fish species were found during MassWildlife surveys: Largemouth Bass, Pumpkinseed, Bluegill, Black Crappie, Rock Bass, Yellow Perch, Chain Pickerel, Brown Bullhead, and Golden Shiner. Richmond Pond is also stocked with trout every spring and fall.

Much of the southern and western shoreline is heavily developed, with approximately 182 seasonal cottages and year-round dwellings around the pond. There are two camps on the lake: Camp Russell which is owned and operated by the Boys & Girls Club of the Berkshires and Camp Arrow Wood which is owned and operated by Mill Town Capital. Public access to Richmond Pond is available at the state boat launch located on the west shore and is suitable for car top and shallow draft trailer boats. The Town of Richmond manages a beach area just north of the state boat launch on that western shore. The land for the beach was purchased by the Town of Richmond from the City of Pittsfield. The watershed land around Richmond Pond is lightly developed with a mix of agricultural operations and low to high density residential development with very few larger commercial ventures.

The Richmond Pond Association formed in 2000 out of concern for the lake, provides oversight of the pond and manages various lake management programs including weed management and water quality monitoring. Members of the Richmond Pond Association are the key stakeholders and include representatives from both the town of Richmond and the city of Pittsfield, private residential developments and camps. A comprehensive lake management plan for Richmond Pond was approved in 2016. The plan provides background information on the lake and its watershed, a brief description of “stakeholders” organizations, a brief review of past and current lake preservation initiatives, a discussion of current and future issues and concerns, a statement of goals for dealing with the issues and a set of recommendations for management actions to ameliorate the identified

[8] https://data.citizen-times.com/dam/massachusetts/berkshire-county/richmond-pond-dam/ma00017/

issues.[9] Weed management on Richmond Pond has been occurring since 1981. It is currently controlled with annual draw downs and permitted herbicide applications. The permit for aquatic weed treatment of Richmond Pond for invasive weeds has lapsed and efforts are underway to obtain a more comprehensive permit for 2024, one that may include aquatic herbicide treatment, mechanical weed-harvesting, & weed pulling. Natural Heritage now prohibits use of aquatic herbicide treatment for invasive weeds in Richmond Pond out of concern for our bridle shiners, a species of concern in Massachusetts. A summary of Richmond Pond weed management is provided in Appendix C.

Notable business operations in the watershed include the Pittsfield Municipal Airport (owned and managed by City of Pittsfield), Berkshire Community College (state-owned), Hancock Shaker Village (private non-profit) and Interprint (private, commercial).

The Pittsfield Municipal Airport (PSF) is a regional general aviation airport owned and operated by the City of Pittsfield, offering business and casual travelers' access to the region via private and chartered aircraft. In addition to business-related flights, the airport also serves medical air-ambulance flights, freight charters, military training operations, and flight training.[10] Additional municipally owned building and operations in the watershed include the City of Pittsfield's, Department of Public Works - West Housatonic Street site, Pittsfield Fire Department Engine One, Stearns and Crosby Elementary Schools and the Town of Hancock's #2 Fire Station. State owned buildings and operations in the watershed include Berkshire Community College campus and buildings.

Protected lands in the watershed include the Pittsfield State Forest (Massachusetts Department of Conservation and Recreation, Richmond Fen Wildlife Management Area (Mass Wildlife), Tracy Brook Wildlife Sanctuary and a portion of the Pleasant Valley Wildlife Sanctuary (Mass Audubon), Hollow Fields and a portion of the Mahana Cobble Reserve (Berkshire Natural Resources Council). Clapp and Osceola Parks, Barkerville Conservation Area (74 acres), Tierney Conservation Area (47 acres) and Wild Acres Park (84 acres) are owned and managed by the City of Pittsfield's Open Space Program. [11] There are multiple identified natural heritage data sites in the watershed. These are depicted in Figure A-4.

A major concern for the municipalities in the watershed is climate resilience. Berkshire County is experiencing more frequent and intense storms resulting in flooding, loss, or threat of loss to road infrastructure. The Town of Richmond and the City of Pittsfield have both completed Municipal Vulnerability Preparedness (MVP) Plans and have updated Hazard Mitigation Plans.[12] Both municipalities have completed projects to further their climate resilience. The Town of Hancock is in the process of completing their Hazard Mitigation and MVP Plan. With support from HVA and other partners, both the Town of Richmond and the City of Pittsfield have completed Road Stream Crossing Management Plans (RSCMPs). These plans assess the aquatic connectivity and climate

[9] https://richmondpondassociation.org/lake-mgmt
[10] Extracted 11/16/2023 https://www.cityofpittsfield.org/departments/airport/index.php
[11] https://www.cityofpittsfield.org/departments/community_development/open_space_program/index.php
[12] More information about Massachusetts Municipal Vulnerability Preparedness program is available at this website: https://www.mass.gov/municipal-vulnerability-preparedness-mvp-program

resilience of public and many private road-stream crossings and prioritize their replacement. Recommendations for nature-based solution locations were included in the City of Pittsfield's RSCMP.

Figure A-3: Richmond Pond Bathymetric Map

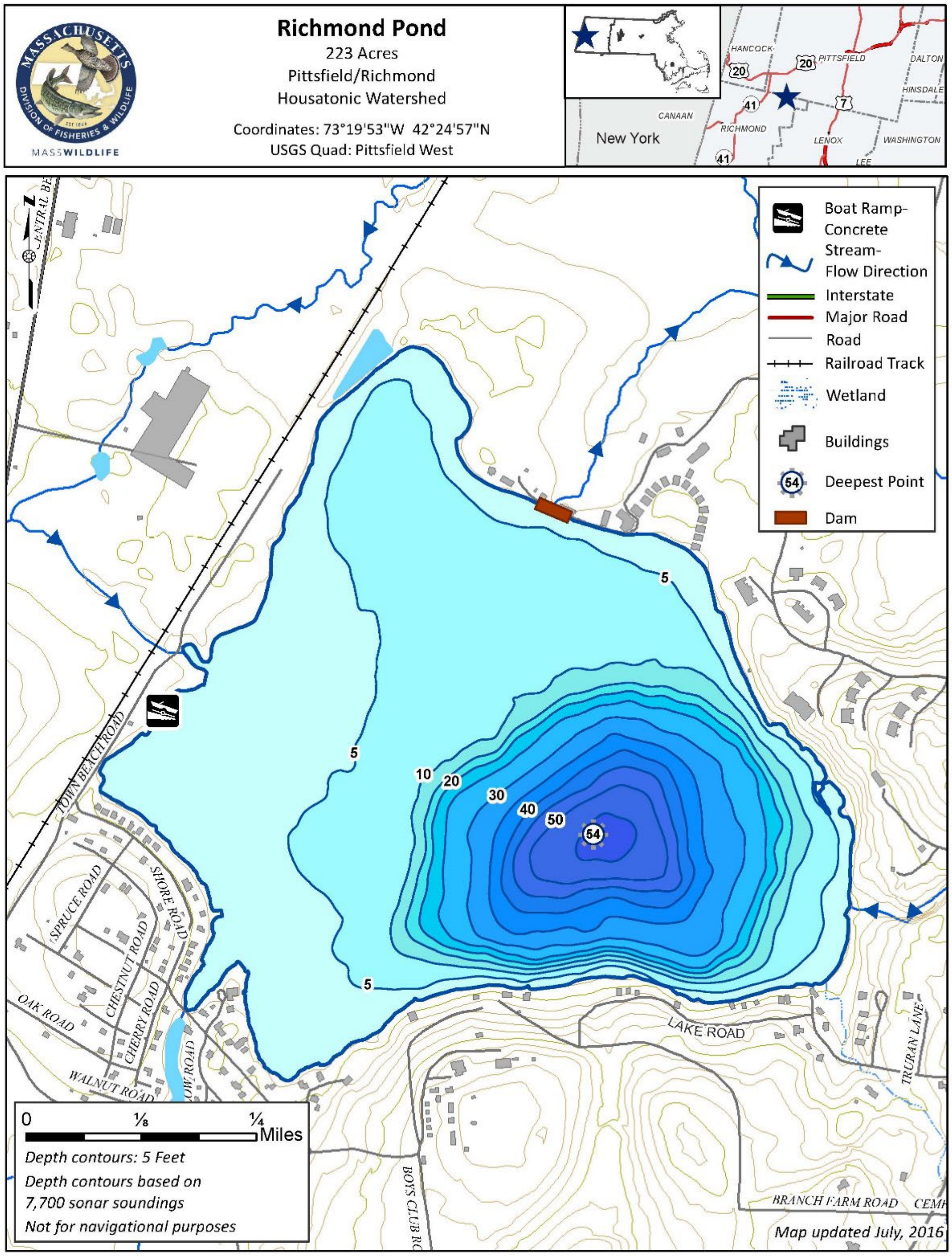
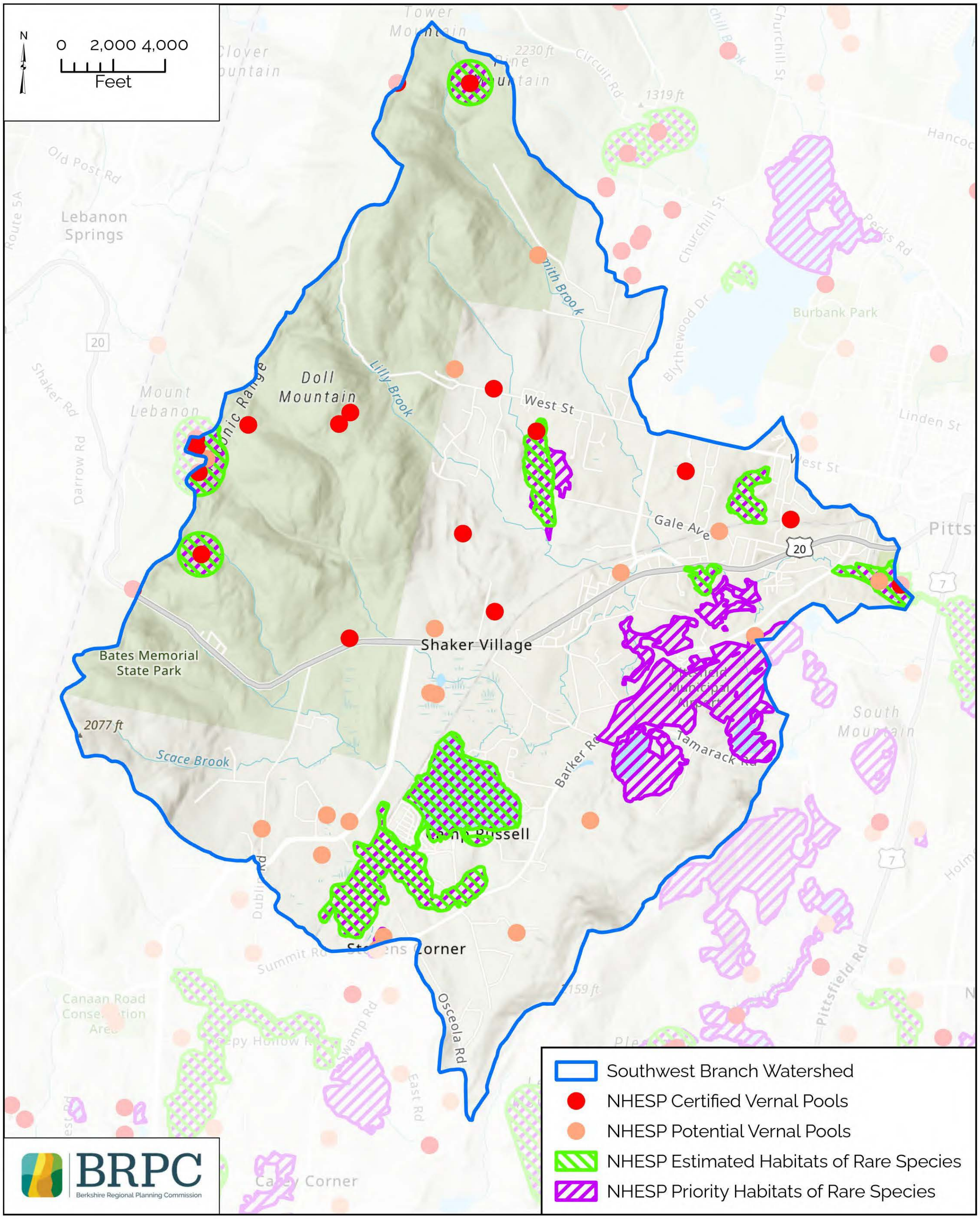


Figure A-4:

Natural Heritage Data Site Map - Southwest Branch Watershed



MassDEP Water Quality Assessment Report and TMDL Review

The 1972 Clean Water Act is a federal law enforced by the Environmental Protection Agency (EPA) that regulates the water quality of surface waters throughout the United States. One of the many ways the Clean Water Act does this is to set federal water quality standards that in turn are adopted and/or revised by each state. The Massachusetts Water Quality Standards establish the foundation of waterbody management across the state, including pollution discharge permits, impairment listings, and the development of Total Maximum Daily Loads (TMDL). Under Section 303 of the Clean Water Act, Massachusetts is required to list waters that do not meet state and/or federal water quality standards according to designated uses (ex. drinking, swimming, fishing). A review of the state water quality standards is conducted every three years by MassDEP and waters are given a classification for appropriate use (AA, A, B, and C for freshwater).

Waterbodies in the SWB watershed are identified as Class B and therefore designated as habitat for fish, other aquatic life, and wildlife as well as primary (swimming) and secondary (boating) recreational contact. Class B waters are required to remain healthy enough for irrigation and other agricultural uses and compatible industrial cooling and process use. For more on the water quality requirements of Class B waters visit the Mass.gov website for the 314 CMR 4: The Massachusetts Surface Water Quality Standards.

> **Total Maximum Daily Load (TMDL)**
>
> *A TMDL is a calculation of the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet water quality standards. In effect, the TMDL is a "pollution diet" that restricts a certain pollutant to ensure that the waterbody is and remains healthy. For more information on TMDLs, visit EPA's website: www.epa.gov/owow/tmdl.*

Currently there are no existing TMDLs for waterbodies in the SWB. An inland pathogen TMDL for the Southwest Branch of the Housatonic River is being drafted and is expected to be released in 2024. At the April 2022 ***Pathogen and Nutrient Reduction Stakeholder meeting***, MassDEP shared the expectation that the Southwest Branch of the Housatonic River TMDL will require a 92% reduction in *E. coli* from the highest *E. coli* geomean.

The following reports are available:

- 2003 Water Quality Report: The Housatonic River
- City of Pittsfield Critical Facilities - MAP
- Housatonic River Watershed 2002 Water Quality Assessment Report
- Review of WQ Results - West and SW Branches - 2004
- Town of Richmond Critical Facilities - MAP
- Water Quality Data from the Southwest Branch, Housatonic River - 2003
- DIAGNOSTIC FEASIBILTY STUDY FOR THE MANAGEMENT OF RICHMOND POND RICHMOND PITTSFIELD, MASSACHUSETT

Additional reports and studies that helped inform this watershed-based plan are summarized in **Table A-3**. Links are provided where available. For information about the other reports, please contact BRPC.

Table A-3: Additional Reports that include information about the Southwest Branch Watershed

Year	Title	Author	Description	Link
2002	2002 Water Quality Report for the East, West and Southwest Branches of the Housatonic River	HVA	Report includes results and summary for one site monitored on the Southwest Branch	https://hvatoday.org/wp-content/uploads/2018/04/2002WQReport.pdf
2017	Southwest Branch Assessment Report and Action Plan (2017)	HVA	Conducted by HVA, this assessment provides a summary of observations and recommendations for the mainstem of the watershed	https://hvatoday.org/wp-content/uploads/2018/03/SouthwestBranch-2018update.pdf
2019	City of Pittsfield Hazard Mitigation Update	Jamie Caplan Consulting, LLC	This plan is part of an ongoing effort to reduce the negative impacts and costs from damage associated with natural hazards, such as nor'easters, floods, and hurricanes. (To be updated every 5 years)	Link to Pittsfield's Hazard Mitigation plan is available at this website: https://www.cityofpittsfield.org/departments/community_development/mvp.php
2019	City of Pittsfield Municipal Vulnerability Preparedness Plan	Fuss & O'Neill	A climate resilience study and action plan	Link to Pittsfield's Hazard Mitigation plan is available at this website: https://www.cityofpittsfield.org/departments/community_development/mvp.php
2021	Town of Richmond Municipal Vulnerability Preparedness and Hazard Mitigation Plan	Town of Richmond	A climate resilience study and action plan	https://www.richmondma.org/news_detail_T5_R94.php
2022	Town of Richmond Road Stream Crossing Management Plan	HVA	Includes an inventory of public and private road-stream crossings and a prioritization of culvert replacement projects based on condition, climate resilience and aquatic connectivity.	Contact BRPC for a digital copy. Currently this Plan is not available on the world-wide web.
2022	MS4 Annual Report	Kleinfelder for the City of Pittsfield	Provides information and updates about the City's stormwater management tasks completed to be in compliance with the Clean Water Act Small MS4 requirements	https://cms2.revize.com/revize/pittsfieldma/city_hall/public_works_and_utilities/docs/Pittsfield%20MS4%20SWMP%20Compiled%20Report_DRAFT_2022.06.21.pdf https://www.epa.gov/npdes-permits/regulated-ms4-massachusetts-communities

Table A-3: Additional Reports that include information about the Southwest Branch Watershed, continued

Year	Title	Author	Description	Link
2022	Richmond Pond Final Water Quality and Cyanobacteria Report 2022	LAPA – West	Provides a summary of the "Deep Hole" water quality monitoring results. Contact Richmond Pond Association for a copy of the report.	Contact BRPC for a digital copy. Currently this Plan is not available on the internet.
2022	2022_FINAL_Berkshire County Water Quality Monitoring Coalition Summary Report.pdf	HVA	Summarizes the water quality monitoring completed in 2022 in both the Housatonic and Hoosic watersheds	https://hvatoday.sharepoint.com/:b:/s/test_sharepoint/ETCXeMvU_ORPlsz2bxlEu-kBq3xsunwhJSesX2Nz90nNzA?e=4feIRL
2022	Pathogen and Nutrient Reduction in the Housatonic Watershed	Matthew Reardon, MassDEP	PDF of meeting slides presented to the Housatonic watershed stakeholders	https://www.mass.gov/doc/appendix-b-housatonic-river-basin/download
2023	City of Pittsfield Road Stream Crossing Management Plan	HVA and Trout Unlimited	Includes an inventory of public and private road-stream crossings and prioritization of culvert replacement projects based on condition, climate resilience and aquatic connectivity.	Contact BRPC for a digital copy. Currently this Plan is not available on the internet.
2023	City of Pittsfield's Nitrogen and Phosphorous Identification Report	Kleinfelder	Identifies and provides conceptual designs of BMPs for city owned properties within the MS4 designated area based on the phosphorous and nitrogen loading catchment area analysis	Contact BRPC for a digital copy. Currently this Plan is not available on the internet.
2023	Richmond-West Stockbridge Climate Resilient Stormwater Action and Implementation Plan	Weston and Sampson	Plan is based on the findings gathered during Municipal Vulnerability Preparedness (MVP) Planning and Action Grant activities	https://cms6.revize.com/revize/richmondma/resilient_stormwater_action_implementation_plan.pdf

The section below summarizes the findings of any available Water Quality Assessment Report and/or TMDL that relate to water quality and water quality impairments. Select excerpts from these documents relating to the water quality in the watershed are included below (note: relevant information is included directly from these documents for informational purposes and has not been modified).

Historical and current Technical Memoranda (TM) 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.

The TM completed for the Housatonic provides information about just one site in the Southwest Branch Watershed which was sampled by MassDEP in 2007. The site sampled was located on the Southwest Branch of the Housatonic River downstream of the railroad bridge and was accessed at Clapp Park. This site is just upstream of the confluence with the West Branch of the Housatonic River. It was sampled once a month from May to September for a variety of parameters. The *E. coli* results exceeded state standards in June (368 CFU/100ml), July (256 CFU/100ml) and August (250 CFU/100 ml).

Additional Water Quality Information

In addition to the sampling conducted by MassDEP, stakeholders have conducted various water quality monitoring programs that have collected data from the Southwest Branch mainstem and several of its tributaries for many years. **Table A-4** summarizes the water quality programs and notable results.

E. coli Surface Water Sampling

HVA, under its volunteer water quality sampling program, has conducted sampling on the Southwest Branch and its tributaries most recently since 2018. Sampling results confirmed elevated *E. coli* levels in the Southwest Branch and consistently elevated (about 400 CFU/100ml) downstream of agricultural operations on Jacoby Brook. To a lesser extent Smith Brook had elevated levels and, at times, Maloy Brook. Results of 2023 sampling up and downstream of Route 20 in Maloy Brook indicated less of an impact than observed in prior years as only one sample exceeded 410 CFU/100 ml.

Dry Weather Stormwater Outfall Analysis

There are 82 stormwater outfalls that have been identified within the City of Pittsfield's portion of the watershed. Under the MS4 program, the City of Pittsfield has conducted sampling at 10 outfalls with observed discharge in dry weather (less than 0.1 inch of rainfall in 72 hours). The results indicate that three of these outfalls do have slightly elevated levels of *E. coli* and therefore likely contribute to the *E. coli* levels in the Southwest Branch. Total Nitrogen levels were also elevated. Sampling results are shared in **Table A-5** with the *E.coli* results depicted in Figure A-5.

Figure A-5

Southwest Branch Watershed E. Coli Monitoring Results (2017-2023)

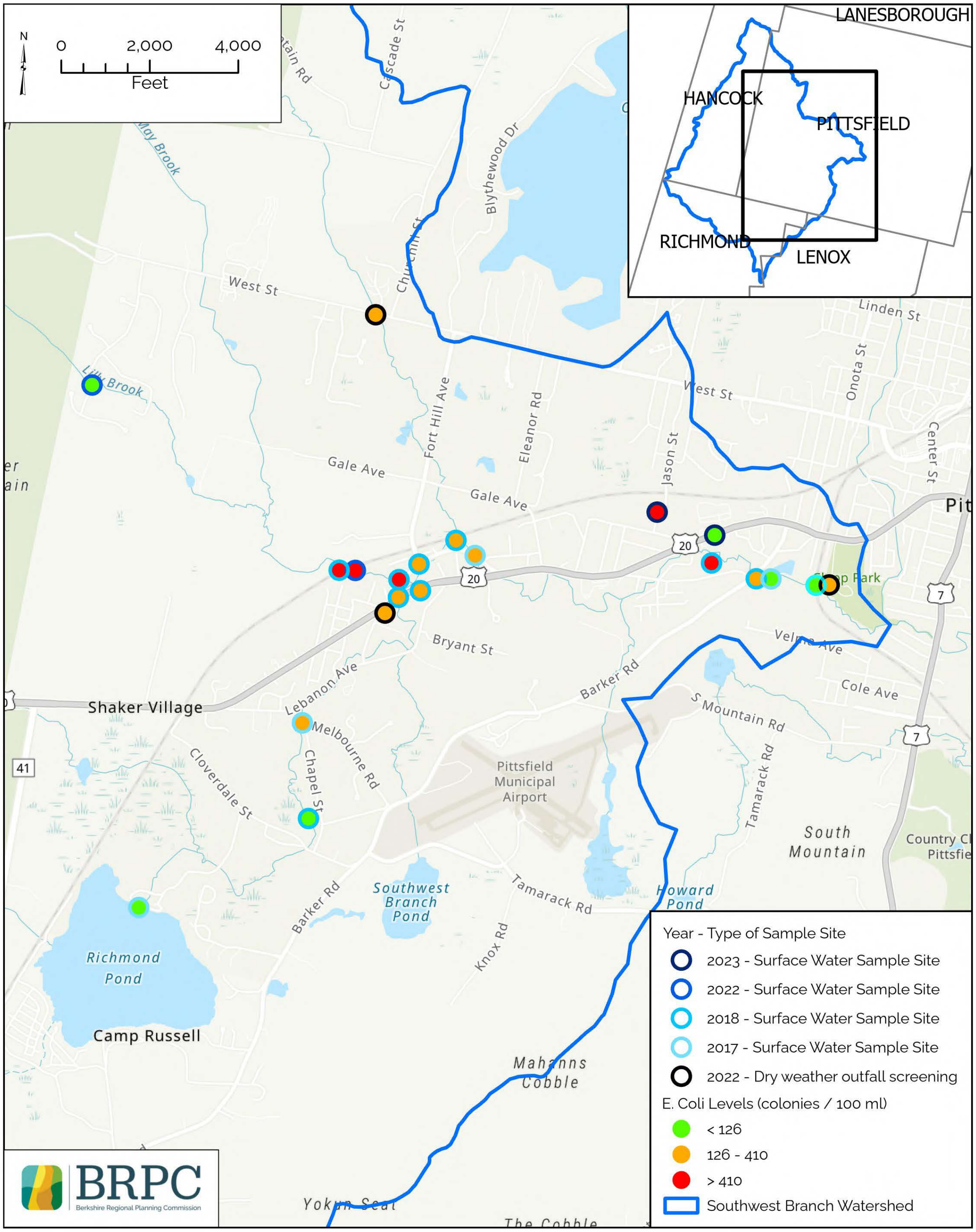


Table A-4: Summary of Water Quality Monitoring Programs

Year	Program Description	Site Locations	Program Coordinator	Funding / Protocols /Results
2023	**E. coli* surface water sampling in the Upper Housatonic Watershed	Two sites were sampled on Maloy Brook. The sites were located upstream and downstream of the commercial Route 20 section	Housatonic Valley Association	Partially funded by a MassDEP Water Quality Grant/From June through September, sites were sampled every other week eight times in wet and dry weather. At the downstream site, only 1 out of the 8 sampling events exceeded the 410 colonies/100 ml level threshold. The geometric mean of the eight sampling events was 104 MPN for the upstream site and 192.86 MPN for the downstream site. (See Appendix D for results table)
2022	Stormwater outfall sampling	82 outfalls in the SWB watershed 10 outfalls analyzed for dry weather discharge	City of Pittsfield/BEAT	MS4 requirement funded by the City of Pittsfield/Dry weather discharge from stormwater were analyzed for *E. coli*, Total Nitrogen, Surfactants, etc./ Results indicated elevated levels of *E. coli* and Total Nitrogen at three SWB watershed sites: SW135, SW570 and SB110. See Table A-5 below.
2022	Richmond Pond Monitoring	The “Deep Hole” (54ft) was sampled 7 times from June - September	Richmond Pond Association	Parameters included Cyanobacteria counts, Dissolved Oxygen and Temperature. No algal blooms have occurred on Richmond Pond, but cell counts of cyanobacteria increased from 2021. 2023 report not available.
2022	**E. coli* surface water sampling in the Upper Housatonic Watershed	Two sites were sampled in the Jacoby Brook watershed. The sites were located upstream and downstream of active agricultural operations. One site on Maloy Brook, located downstream of Route 20, was sampled two times	Housatonic Valley Association	MassDEP Water Quality Grant/Sites sampled from June through September, every other week 8 times in wet and dry weather/On Jacoby Brook the sampling site upstream of the agricultural operations met the state standards (126 colonies / 100 ml) for 7 out of the 8 sampling events with a geometric mean of 58.3 MPN. The downstream site exceeded state standards for all of the 8 sampling events with 7 out of the 8 sampling events exceeding the 410 colonies / 100 ml threshold. Three results were at the upper limit of 2419 MPN after a significant rain event. Maloy Brook sampling results exceeded the state 410 MPN threshold for both sampling events. (See Appendix E for results table)

Table A-4: Summary of Water Quality Monitoring Programs, *continued*				
Year	**Program Description**	**Site Locations**	**Program Coordinator**	**Funding / Protocols /Results**
2021	**E. coli* surface water sampling in the Upper Housatonic Watershed	Two sites were sampled in the Jacoby Brook watershed. The sites were located upstream and downstream of active agricultural operations.	Housatonic Valley Association	Partially funded by a MassDEP Water Quality Grant/From June through September, sites were sampled every other week seven times in wet and dry weather/Downstream of agricultural operations, results exceeded the 410 colonies/100 ml threshold 6 out of the 7 sampling events. The geometric mean for the season was 500 colonies/100 ml.
2018	**E. coli* Surface Water Sampling in the Southwest Branch of the Housatonic River.	7 sampling sites on the Southwest Branch of the Housatonic River; 2 sampling sites on each of the following tributaries: Jacoby, Smith and Maloy Brooks	BRPC/HVA	604b funded / Samples collected under a state approved QAPP. Dry weather sampling (defined as less than 0.1 inches of precipitation in 72 hours) / Results indicated *E. coli* levels above state standards in multiple locations on the Southwest Branch and on all three tributaries. (See Appendix F for results and sampling locations)
2017	**E. coli* Dry Weather Surface Water sampling	5 sampling sites on the Southwest Branch of the Housatonic River	BRPC/HVA	604b funded / Samples collected under a state approved QAPP. Dry weather sampling (defined less than 0.1 inches of precipitation in 72 hours) / The geometric mean of the sampling events were above state standards in two locations (See Appendix F for results and sampling locations)
2014	*Benthic Macroinvertebrate Investigation on Southwest Branch of the Housatonic River.	One sample site located on the Southwest Branch - downstream of the Barker Road bridge.	Housatonic Valley Association	Results analyzed indicated a 'Moderate' rating for Biological Condition/Degree Impact
2001 - 2007	*Surface water sampling in the Southwest Branch of the Housatonic River (Fecal Coliform and Temperature)	Multiple sites on the Southwest Branch of the Housatonic River	Housatonic Valley Association	Various funding sources / Monthly samples analyzed by certified lab/ Fecal coliform results were above state standards in multiple locations. (See Page 5 for links to the monitoring results reports. Appendix G provides fecal coliform results in graph format)
2002 - 2023	Surface water sampling in Richmond Pond tributaries.	Sample sites located just upstream of the confluence on Whitewood, Tracy and Clark's Brooks and at the outlet below the Richmond Pond Dam	Richmond Pond Association	Funded by Richmond Pond Association. / Sampling conducted twice a year. Current parameters measured include *E. coli*, nitrates, and phosphorous. Samples analyzed by local lab. Monitoring of temperature, pH and dissolved oxygen were discontinued in 2014 / Low levels of nitrates with many phosphorous samples at levels above the 0.010 mg /liter desired threshold (See Appendix H for results.)

**Sampling completed under a MassDEP approved Quality Assurance Project Plan.*

Table A-5: Significant Dry Weather Outfall Sampling Results

Sampling Date	*Outfall ID*	*Latitude*	*Longitude*	*E. coli (CFU/100ml)*	*Total Nitrogen (mg/l)*
5/11/2022	SW135	42.43985	-73.266252	261.3	2.13
10/4/2022	SW570	42.43795	-73.303057	184.2	2.77
4/11/2022	SB110	42.45601	-73.304692	135.4	1.93

***SW135** outfalls on the Southwest Branch at one of the outfalls from Clapp Park that carries stormwater from West Housatonic Street to the Southwest Branch.*
***SW570** outfalls into the Southwest Branch at the Route 20/Southwest Branch Road stream crossing where Hungerford Street intersects Route 20.*
***SB110** outfalls on Smith Brook at the West Street/Smith Brook Road Stream Crossing.*

Richmond Pond Cyanobacteria Monitoring

Richmond Pond Association initiated water quality monitoring of the deepest part of the lake in 2021. LAPA-West is contracted to complete the sampling which includes monthly sampling and analysis conducted June through September. The primary goal is to assess the cyanobacteria levels and determine if an algal bloom is imminent or occurring. No algal blooms have been recorded in Richmond Pond, but cyanobacteria counts did increase from 2021 to 2022. The 2022 report recommended sampling phosphate levels at the lake bottom. There is also concern that nutrient laden stormwater entering the lake via the tributaries will increase the likelihood for future elevated cell counts and potential algal blooms as the cyanobacteria needs these nutrients to grow. In 2023, cyanobacteria testing was done bi-weekly by the Lakes & Ponds Association of Western MA, paid for by the RPA. The levels for cyanobacteria have been well below the state threshold. Ongoing monitoring is again planned for 2024.[13]

Richmond Pond Tributary Monitoring

Richmond Pond Association has monitored the tributaries just upstream of where they enter Richmond Pond and the Southwest Branch of the Housatonic River, at the outlet of Richmond Pond, just below the dam since 2002. Sampling is conducted twice a year. Parameters sampled include *E. coli*, nitrates, and phosphates. From 2002 to 2013, dissolved oxygen and pH measurements were recorded. A summary of the results is provided in **Table A-6**. Appendix H provides the full results. In 2023, The *E. coli* and nitrate sampling results were low, below warning levels. Phosphates continued to be high in Clark's Brook, which has been observed to promote algal growth in the northwestern part of the pond.[12]

[13] Source: 2023 Annual Report for Richmond Pond Association accessed at https://richmondpondassociation.org/annual-reports

Table A-6: Tributary Sampling Summary

Tributary	**Nitrate Range (mg/liter)*	*Highest Result (Year) (mg/liter)*	**Phosphate Results Range (mg/liter)*	*Highest Result (mg/liter) (Year)*	*E. coli CFU/100ml Range*	***Highest Result CFU/100ml (Year)*
Whitewood	*0.49 – 1.07*	*1.09 (2003)*	*0.01 – 0.0149*	*0.105 (2004)*	*17.3 – 275.5*	*2418.2 (2014)*
Clark's	*0.05*	*0.17 (2007)*	*0.021-0.023*	*0.107 (2007)*	*37.7 - 285*	*1413.6 (2014)*
Tracy	*0.05 – 0.41*	*0.41 (2022)*	*0.01 – 0.054*	*0.098 (2007)*	*7.4 – 365.4*	*2400 (2009)*

*__Range reflects results for only the most recent years: 2019 – 2023__

** Results do not indicate if sampling was conducted in wet or dry weather, weather history recorded at Pittsfield Municipal airport indicated that on the sampling date, October 23, 2014, 0.87 inches of precipitation were recorded and on the prior day, 0.42 inches of precipitation were recorded indicating that the *E. coli* levels were elevated due to stormwater input.

Richmond Pond Association representatives have observed significant amounts of sediment entering Richmond Pond at the tributaries, especially at Whitewood Brook.

Photo A–1 – Southwest Branch Wetland (HVA)

Water Quality Impairments

The Clean Water Act requires states to adopt water quality standards equal to or more stringent than the Federal Water Quality Standards. These standards are delineated by different uses, for example recreation or aquatic life. The Clean Water Act also requires states to perform water quality testing and issue a report on water quality results every two years. Water quality impairments are pollutant(s) that cause the waterbody to fall below state and/or federal water quality standards.

Known water quality impairments, as documented in the *2022 Massachusetts Integrated List of Waters* (MassDEP, 2023), are listed in **Table A-8** below. Impairment categories from the Integrated List for the waterbodies within the Southwest Branch of the watershed are presented in **Table A-7**. An Inland Pathogen TMDL is required for the Southwest Branch of the Housatonic watershed and is currently being drafted by the TMDL program within the MassDEP Watershed Planning Program. Its release is expected sometime in 2024. (Massachusetts 2022 Final Integrated List of Waters, MassDEP 2023)

Richmond Pond is also listed as Category 4c. This segment was assessed as impaired due to exotic species, which is not a pollutant requiring calculation of a TMDL. The non-native aquatic macrophytes *Myriophyllum spicatum* and *Najas minor* were documented in Richmond Pond during the 1997 DWM synoptic survey (Kennedy and Weinstein 2000). *Myriophyllum spicatum* and *Potamogeton crispus* were also identified in a recent application submitted to MassDEP to apply herbicides to the pond (MassDEP 2005b). The “Aquatic Life Use” is assessed as impaired because of the presence of the non-native aquatic macrophytes.

The approved Long Island Sound TMDL for Nitrogen requires MS4 communities that include contributing rivers, such as the City of Pittsfield, to meet the requirements laid out in *Massachusetts MS4 General Permit Appendix F - “Requirements for Discharges to Impaired Waters with an Approved TMDL.”* Requirements include analysis of the nitrogen loading from the urbanized area, implementation of a stormwater BMP focused on nitrogen removal, and annual public messaging about proper management of leaf litter, grass clippings and dog waste. As part of the requirements, the City of Pittsfield’s engineering consultants, Kleinfelder, completed a Nitrogen and Phosphorous Source Identification Report in 2023. This report provides key City-owned locations where the most effective BMPs can be implemented that will provide the greatest reduction of nitrogen and phosphorous loading.

Table A-7: 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.

Table A-8: Water Quality Impairments (MassDEP 2023)

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA21-17	**Southwest Branch Housatonic River**	**5**	Fish, other Aquatic Life and Wildlife	Sedimentation/siltation	Source Unknown
MA21-17	**Southwest Branch Housatonic River**	**5**	Fish, other Aquatic Life and Wildlife	Temperature	Dam Or Impoundment
MA21-17	**Southwest Branch Housatonic River**	**5**	Fish, other Aquatic Life and Wildlife	Temperature	Source Unknown
MA21-17	**Southwest Branch Housatonic River**	**5**	Primary Contact Recreation	Escherichia Coli (*E. coli*)	Source Unknown
MA21-17	**Southwest Branch Housatonic River**	**5**	Primary Contact Recreation	Fecal Coliform	Source Unknown
MA21088	**Richmond Pond**	**4C**	Fish, other Aquatic Life and Wildlife	Brittle Naiad, Najas Minor	Introduction Of Non-native Organisms (accidental Or Intentional)
MA21088	**Richmond Pond**	**4C**	Fish, other Aquatic Life and Wildlife	Curly-leaf Pondweed	Introduction Of Non-native Organisms (accidental Or Intentional)
MA21088	**Richmond Pond**	**4C**	Fish, other Aquatic Life and Wildlife	Eurasian Water Milfoil, Myriophyllum Spicatum	Introduction Of Non-native Organisms (accidental Or Intentional)

Water Quality Goals

Water quality goals may be established for a variety of purposes, including the following:

a.) For water bodies with known impairments, a Total Maximum Daily Load (TMDL) is established by MassDEP and the United States Environmental Protection Agency (USEPA) as the maximum amount of the target pollutant that the waterbody can receive and still safely meet water quality standards. If the waterbody has a TMDL for total phosphorus (TP) or total nitrogen (TN), or total suspended solids (TSS), that information is provided below and included as a water quality goal.

While there are no existing TMDLs for any waterbody in this watershed, note:

(i) As the Southwest Branch of the Housatonic River is designated as impaired for *E. coli,* MassDEP is preparing a Pathogen TMDL and expects to issue a draft in 2024 for *E. coli* which will likely require a 92% reduction from the highest geomean.

(ii) The City of Pittsfield, as an MS4 regulated community, is subject to the Long Island Sound TMDL for Nitrogen and must meet certain requirements as outlined in the Massachusetts MS4 General Permit (pages 55 – 59). Agricultural and urban runoff and atmospheric deposition are the most likely sources of nitrogen contribution in the Southwest Branch and Richmond Pond watershed.

b.) For water bodies without a TMDL for total phosphorus (TP), a default water quality goal for TP is based on target concentrations established in the Quality Criteria for Water (USEPA, 1986) (also known as the “Gold Book”). The Gold Book states that TP should not exceed 50 ug/L in any stream at the point where it enters any lake or reservoir, nor 25 ug/L within a lake or reservoir. For the purposes of developing WBPs, MassDEP has adopted 50 ug/L as the TP target for all streams at their downstream discharge point, regardless of which type of water body the stream discharges to.

c.) Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021) prescribe the minimum water quality criteria required to sustain a waterbody’s designated uses. The entire length of the Southwest Branch is classified as Class B, Cold Water and High quality Water.[14] Shaker, Mount Lebanon, Seace and Smith Brooks are also Class 'B' waterbodies. The water quality goal for *E. coli* bacteria is based on the Massachusetts Surface Water Quality Standards.

[14] Class B Waters or Class B. Those Inland Waters so designated pursuant to 314 CMR 4.06; including, without limitation, certain wetlands designated in 314 CMR 4.06(2), certain other waters designated in 314 CMR 4.06(5), and certain qualified waters designated in 314 CMR 4.06(6)(b). These waters are 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(1)(d)6. and (6)(b) as a "Treated Water Supply" these waters shall be suitable as a source of public water supply with appropriate treatment. 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.

Table A-9: Surface Water Quality Classification by Assessment Unit

Assessment Unit ID	Waterbody	Class
MA21-17	Southwest Branch Housatonic River	B (CFR)
MA21-69	Shaker Brook	B (CFR)
MA21-70	Mount Lebanon Brook	B (CFR)
MA21-71	Seace Brook	B (CFR)
MA21-72	Smith Brook	B (CFR)
MA21088	Richmond Pond	B (CFR)

Table A-10: Water Quality Goals

Pollutant	Goal	Source
Total Phosphorus (TP)	Total phosphorus should not exceed: --50 ug/L in any stream --25 ug/L within any lake or reservoir	Quality Criteria for Water (USEPA, 1986)
Bacteria	**Class B Standards** ***Inland Waters:*** Concentrations of bacteria concentrations for: 1. *E. coli* shall (i) not exceed 126 colony-forming units (cfu) per 100 mL, calculated as the geometric mean of all samples collected within any 90-day or smaller interval; and (ii) no more than 10% of all such samples shall exceed 410 cfu per 100 mL (a statistical threshold value); 2.*enterococci*: (i) concentrations shall not exceed 35 cfu per 100 mL, calculated as the geometric mean of all samples collected within any 90-day or smaller interval; and (ii) no more than 10% of all such samples shall exceed 130 cfu per 100 mL (the statistical threshold value). ***Public Bathing Beaches:*** The geometric mean and statistical threshold value used for calculating the minimum criteria for bacteria set forth as above shall be calculated and assessed, respectively, over a 30-day or smaller interval in *lieu* of any otherwise applicable longer interval;	Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021)

Table A-11: Water Quality Goals, continued

Pollutant	Goal	Source
Sedimentation/Siltation	https://neiwpcc.org/our-programs/pollution-control/water-quality-standards/wqs-matrix/ No applicable goal: It is difficult to measure the amount of sediment entering the waterbodies and how much sedimentation is reduced by implemented stormwater management measures. The proposed stormwater BMPs are designed, for the most part, to capture sediment which will reduce the volume of sediment entering the waterbodies overall.	Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021)
Nitrogen	Total Nitrogen should not exceed: --2 mg/l in any stream or river or outfall	Community goal based on EPA MS4 stormwater threshold
Cyanobacteria	No algal blooms	Community Goal
Aquatic Non-native Invasive plants	Invasive species coverage reduced and maintained at healthy levels that do not impede recreation.	Community Goal

d.) **Other water quality goals set by the community**

The additional goals identified by the community to support the health of the Southwest Branch and Richmond Pond watersheds are provided in **Table A-11**.

Photo A-2: Kayakers on the Southwest Branch (HVA)

Land Use and Impervious Cover Information

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

1. Watershed Land Uses

Table A-12: Southwest Branch Watershed Land Uses

Land Use	Area (acres)	% of Watershed
Forest	11057.47	73.5
Agriculture	1141.11	7.6
Low Density Residential	896.02	6
Open Land	639.89	4.3
Water	304.18	2
High Density Residential	263.44	1.8
Medium Density Residential	261.03	1.7
Commercial	230.83	1.5
Highway	163.02	1.1
Industrial	86.88	0.6

Table A-13: Richmond Pond Watershed Land Uses

Land Use	Area (acres)	% of Watershed
Forest	3792.38	75.8
Agriculture	420.45	8.4
Low Density Residential	338.52	6.8
Water	234.7	4.7
Open Land	138.62	2.8
Medium Density Residential	30.64	0.6
Commercial	27.05	0.5
Industrial	8.82	0.2
High Density Residential	7.53	0.2

2. 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 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. 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. Within each subwatershed, the total area of each land use was summed and used to calculate the percent TIA

Photo A-3: Breached dam on the SW Branch upstream of Rte. 20 Bridge near Hungerford Avenue (Photo by Diane Wetzel for HVA)

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Figure A-6: Southwest Branch 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

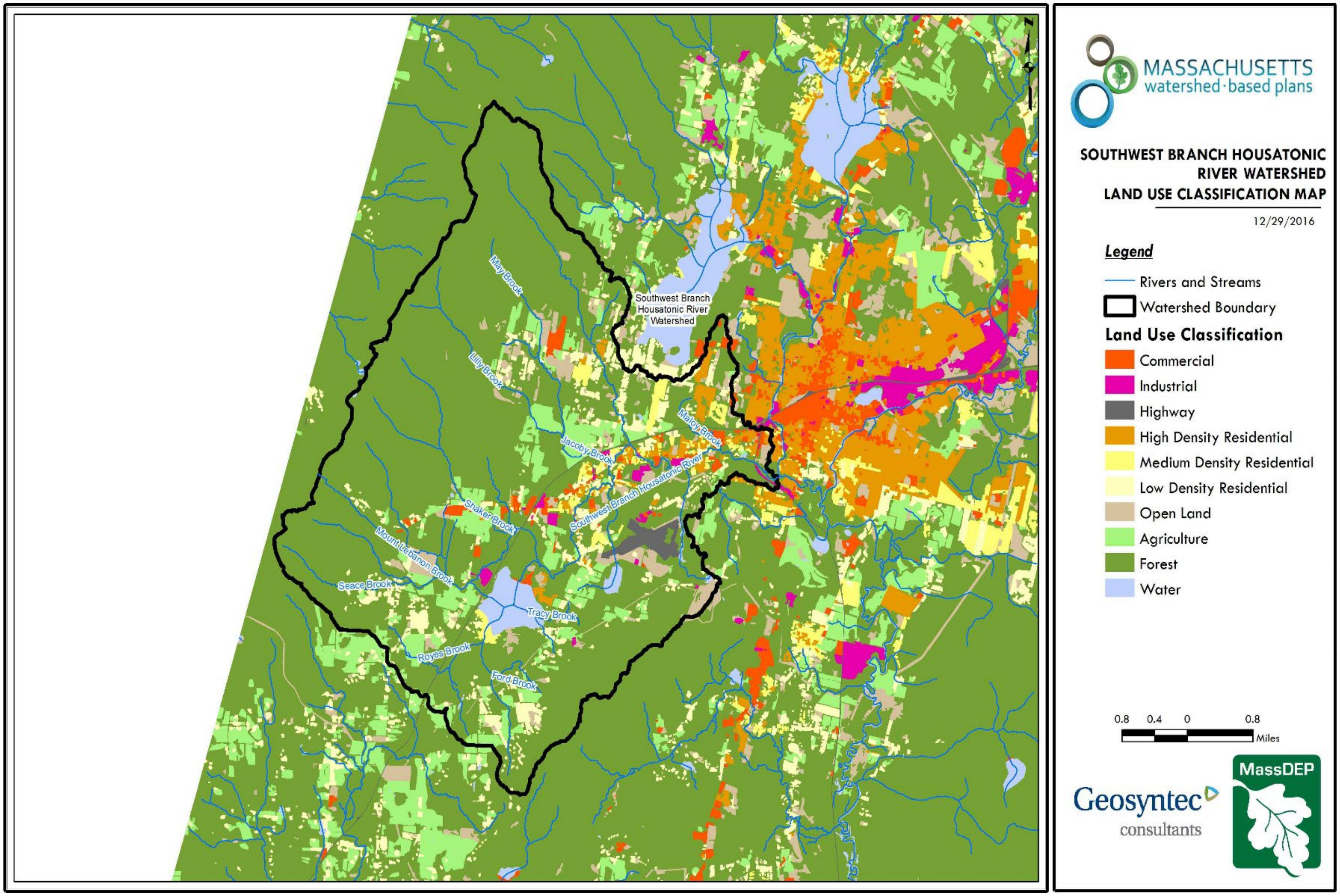


Figure A-7: Richmond Pond Watershed Land Use Map (MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

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

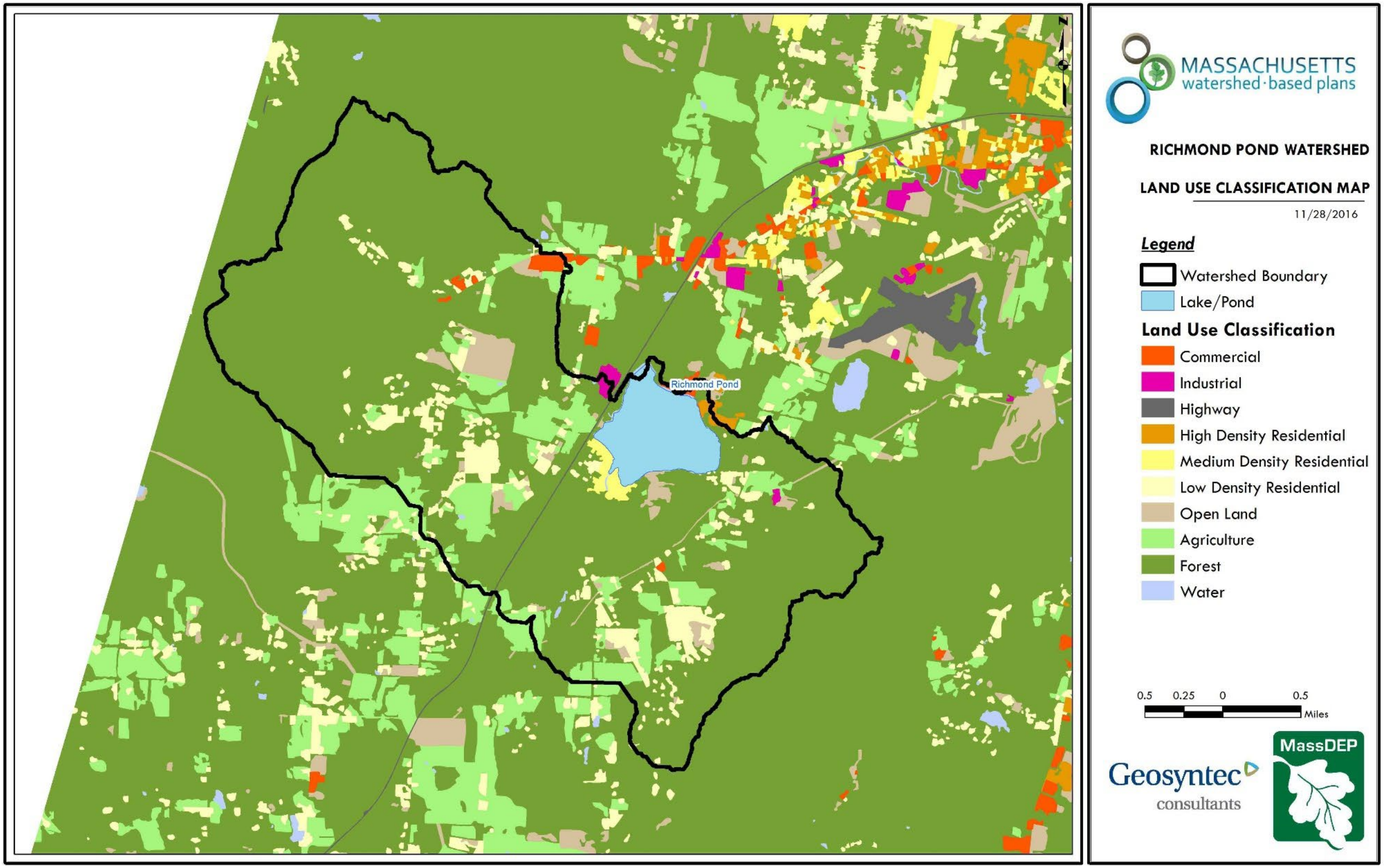


Table A-14: TIA and DCIA Values for the Watershed

	Estimated TIA (%)	Estimated DCIA (%)
Southwest Branch Housatonic River	4.7	3.7
Richmond Pond	3.6	2.6

The relationship between TIA and water quality can generally be categorized as shown in **Table A-15** (Schueler et al. 2009):

Table A-15: Relationship between Total Impervious Area (TIA) and Water Quality (Schueler et al. 2009)

% Watershed Impervious Cover	Stream Water Quality
0-10%	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.
11-25%	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.
26-60%	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-8: Watershed 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.

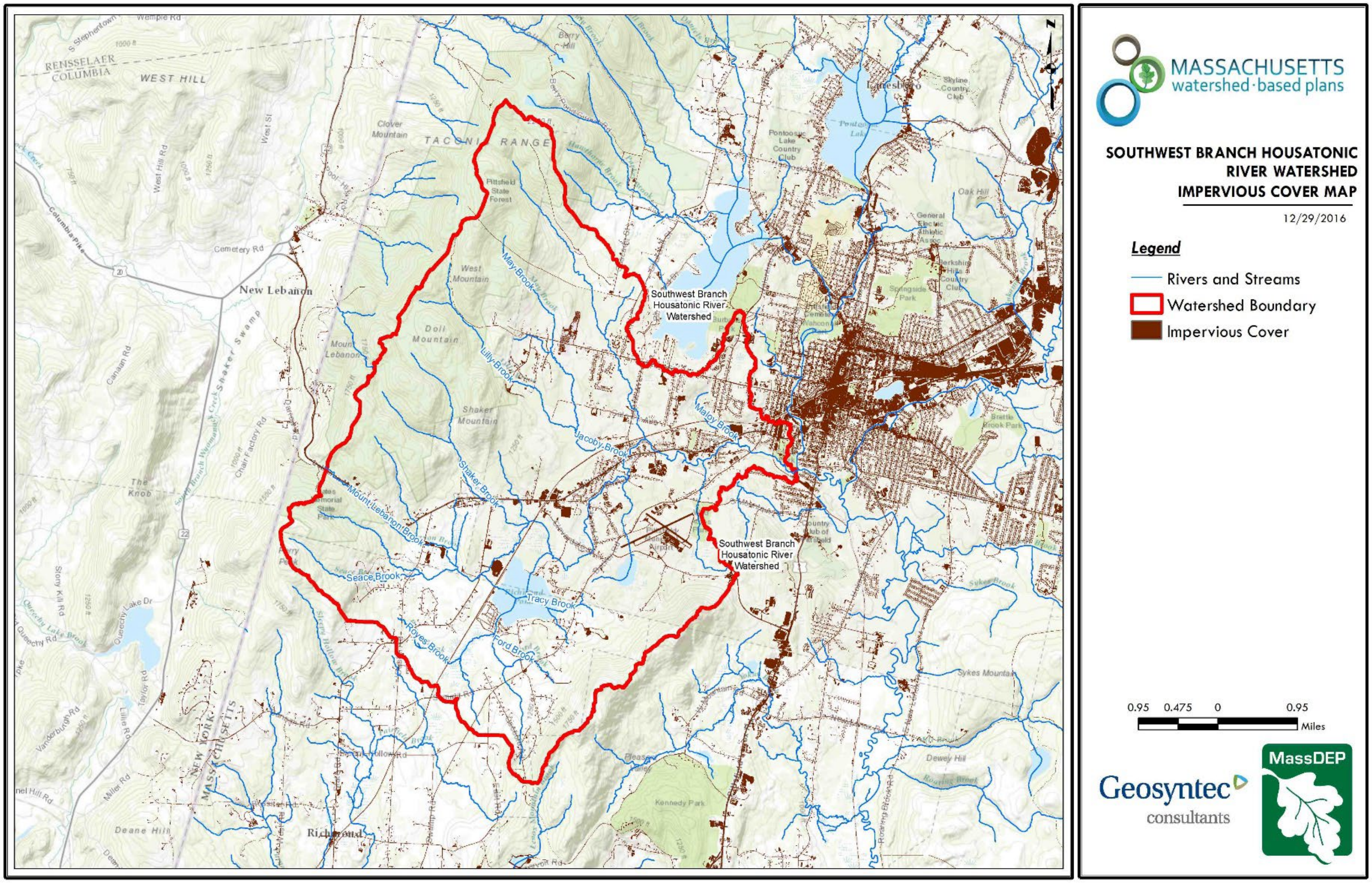
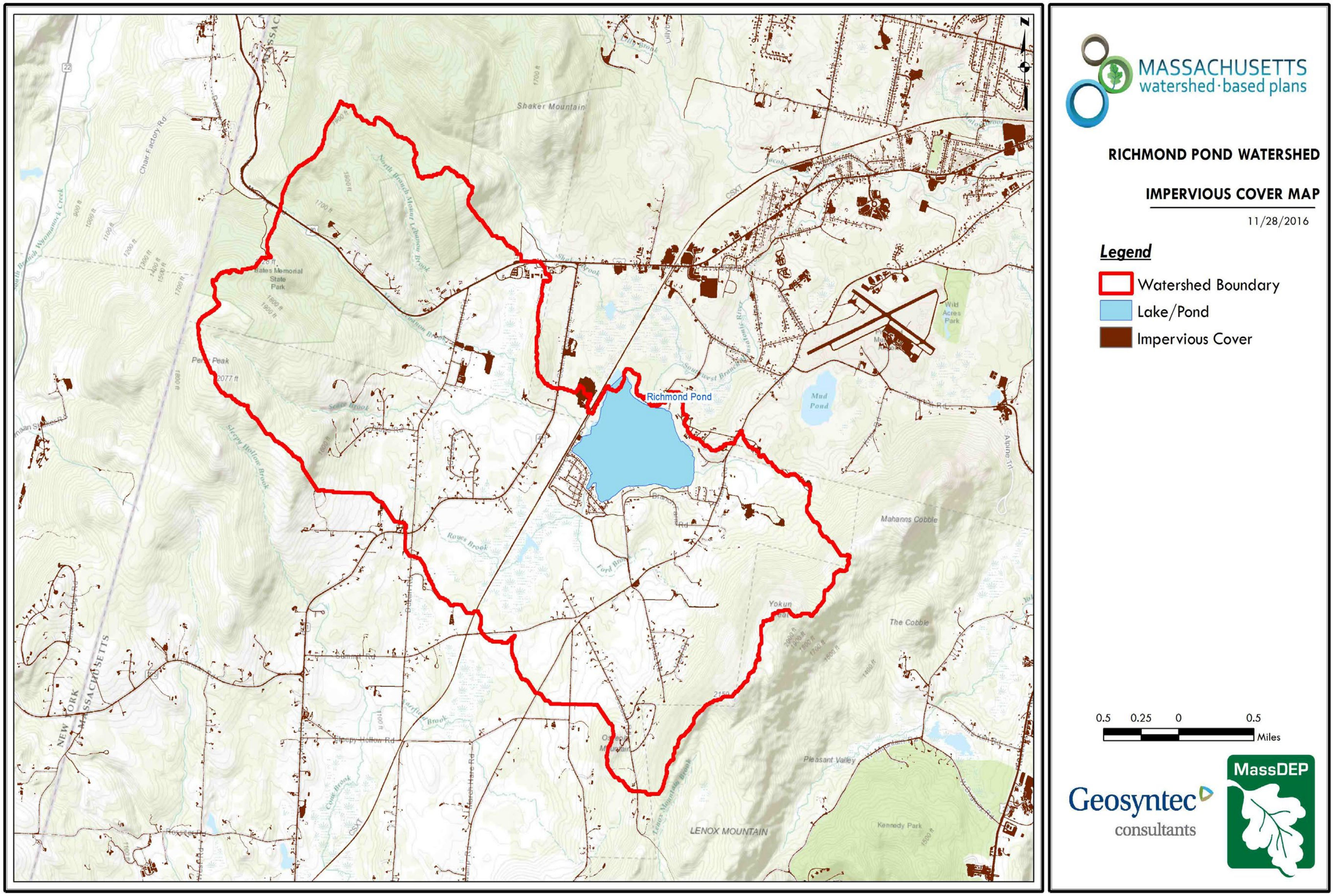


Figure A-9: Watershed Impervious Surface Map (MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

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



3. Land use information:

As outlined previously, land use of the upper reaches of the Southwest Branch are mainly protected forest (Pittsfield State Forest). Western tributaries Jacoby and Smith Brook both have active agricultural land use, and Maloy Brook flows through heavy development both commercial and industrial. As a general rule, land use closer to the Southwest mainstem as it flows toward its confluence with the West Branch Housatonic is more highly developed. Areas nearer to the headwaters are less developed.

Richmond Pond watershed within the Southwest Branch is also mainly forested with an almost equal amount of agricultural operations and low density residential area filling out the top three land uses. The greatest residential density is located on the southern border of Richmond Pond in the private residential developments of Richmond Shores and Whitewood.

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 (lb/yr); A_n = area of land use/cover type n (acres);
P_n = pollutant load export rate of land use/cover type n (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 A). **Tables A-14 and 15** present the estimated land-use based TN, TP and TSS pollutant loading in the watershed.

Pollutant Loading Information

Table A-16: Southwest Branch: Estimated Pollutant Loading for Key Nonpoint Source Pollutants

Land Use Type	Pollutant Loading[1]					
	Total Phosphorus (TP) (lbs/yr)	% Total Phosphorus Load	Total Nitrogen (TN) (lbs/yr)	% Total Nitrogen Load	Total Suspended Solids (TSS) (tons/yr)	% Total TSS Load
Forest	1,465	48.1	7,325	36.9	413.38	68.4
Agriculture	540	17.7	3,205	16.2	30.96	5.1
Low Density Residential	234	7.7	2,337	11.8	31.6	5.2
Commercial	209	6.8	1,811	9.1	22.66	3.7
Open Land	165	5.4	1,740	8.8	33.62	5.6
High Density Residential	167	5.5	1,132	5.7	16.77	2.8
Industrial	92	3.0	795	4	9.95	1.6
Highway	90	3.0	762	3.8	35.46	5.9
Medium Density Residential	85	2.8	735	3.7	10.17	1.7
TOTAL	3,047	100.0	19,841	100	604.57	100

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

Table A-17: Richmond Pond: Estimated Pollutant Loading for Key Nonpoint Source Pollutants

Land Use Type	Pollutant Loading[1]					
	Total Phosphorus (TP) (lbs/yr)	% Total Phosphorus Load	Total Nitrogen (TN) (lbs/yr)	% Total Nitrogen Load	Total Suspended Solids (TSS) (tons/yr)	% Total TSS Load
Forest	518	57	2,630	46.9	146.76	77.4
Agriculture	201	22.1	1,194	21.3	12.9	6.8
Low Density Residential	86	9.5	884	15.8	11.72	6.2
Open Land	52	5.7	459	8.2	9.05	4.8
Commercial	15	1.7	134	2.4	1.68	0.9
Industrial	13	1.4	110	2	1.37	0.7
Medium Density Residential	12	1.3	109	1.9	1.49	0.8
Highway	8	0.9	66	1.2	4.33	2.3
High Density Residential	3	0.3	22	0.4	0.32	0.2
TOTAL	908	100	5,608	100	189.61	100

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

Sources of Impairment

Pathogens:

In determining the sources of bacteria, HVA conducted monitoring on the Southwest Branch under a CWA 604(b) grant in 2017 and 2018. Additional sampling was conducted in subsequent years to monitor suspected problem locations. The bacteria source tracking indicates that agricultural operations on Jacoby Brook and possibly Smith Brook are likely contributing to the impairment of the Southwest Branch. Under the Section 319 Mass DEP grant program focused on agricultural nonpoint source pollution and recently awarded to HVA, willing farmers will be able to receive support to reduce their impact on the tributaries of the Southwest Branch. There is also likely *E. coli* impairment due to a very active beaver population throughout the watershed. The next step to further evaluate the source of *E. coli* would be to conduct DNA sampling at key sites in the watershed.

Nitrogen:

1. ***Watershed Wide***: The agricultural operations scattered throughout the watershed are a likely source of nitrogen. Developing relationships with the farmers and providing support to implement appropriate BMPs will likely reduce the nitrogen inputs.
2. ***City of Pittsfield***: Under the MS4 regulations, the City of Pittsfield has completed sampling dry weather discharge from stormwater outfalls. Notable results for three outfalls with elevated total nitrogen are provided in **Table A-5.** As required by the MS4 regulations, the City of Pittsfield's consulting engineer completed a Nitrogen and Phosphorous Identification Report. Conceptual designs for stormwater BMPs have been completed for the city owned DPW site on West Housatonic Street. Long Island Sound Futures Fund awarded to the City of Pittsfield in 2023 will move this site through final design, permitting and construction of multiple stormwater BMPs to reduce the nitrogen impact. The City of Pittsfield will continue to look for funding to implement stormwater BMPs in the SWB. In addition, there are three stormwater outfalls with dry weather sampling results that were close to or above 2.0 mg/L. The city with support of stakeholders will review these sites and figure out the nitrogen source with the goal of mitigation.
3. ***Richmond Pond*** tributaries sampling results for nitrates have been low and therefore there has been less concern about nitrogen input to and from Richmond Pond. However, a review of RPA's monitoring program may help determine if the sampling protocol is sufficient or alterations necessary to determine if nitrogen input is a concern. RPA tests for cyanobacteria and there have not been any algal blooms.

Phosphorous:

Richmond Pond Association has concerns about the high phosphate sampling results in Clark's Brook. Further investigation is needed to determine the source. High phosphorous levels can contribute to algal blooms. A review of the monitoring program may be recommended to ensure that the protocol is helping determine any phosphorous input concerns. A phosphorous modeling study would help key stakeholders such as RPA understand the current status of phosphorous levels in Richmond Pond and identify appropriate management strategies to support the reduction of phosphorous and improve the health of the pond.

Sediment:

1. ***Watershed -Wide:*** While no definitive studies have been conducted, the most obvious source of sediment entering the tributaries and the mainstem rivers in the Southwest Branch watershed is due to sediment-laden stormwater runoff as well as stream bank erosion. Several residential properties abutting the Southwest Branch which have been eroded were identified in HVAs 2017 Southwest Branch Stream Assessment which also recommended implementing a ***River Smart*** education program. Residents would learn how they can positively impact the health of the river through appropriate lawn and yard debris management and implementation of a riparian buffer.
2. ***Richmond Pond:*** Many of the roads around Richmond Pond are gravel. Eroded gravel road sediment entering both tributaries and Richmond Pond has been observed by members of the Richmond Pond Association and residents. Specific locations include:
    a. ***Whitewood Brook –*** Lake Road, the entrance to the Richmond Pond residential development, Whitewood, is steep and during storms stormwater laden with gravel has been observed to

runoff into Whitewood Brook. In Richmond Pond at the tributaries confluence so much sediment has accumulated that an island has formed.

b. ***Spruce, Chestnut, and Cherry Roads*** are gravel roads within the Richmond Shores residential development. Despite BMPs constructed in 2004 – 07, the Richmond Shores Civic Association continues to have problems with gravel eroding from the roads into stormwater infrastructure and this gravel may, during heavy precipitation, reach Richmond Pond.

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

Table B-1 lists estimated pollutant loads for the following primary nonpoint source (NPS) pollutants: total phosphorus (TP), total nitrogen (TN), total suspended solids (TSS). These estimated loads are based on the pollutant loading analysis presented in Section 4 of Element A.

Water Quality Goals

Water quality goals for primary NPS pollutants are listed in **Table B-1** based on the following:

- TMDL water quality goals (if a TMDL exists for the water body);
- For all water bodies, including impaired waters that have a pathogen TMDL, the water quality goal for bacteria is based on the Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) that apply to the Water Class of the selected water body.
- If the water body does not have a TMDL for TP, a default target TP concentrations is provided which is based on guidance provided by the USEPA in Quality Criteria for Water (1986), also known as the "Gold Book". Because there are no similar default water quality goals for TN and TSS, goals for these pollutants are provided in **Table B-1** only if a TMDL exists or alternate goal(s) have been optionally established by the WBP author.
- According to the USEPA Gold Book, total phosphorus 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 phosphorus concentration (50 ug/L) by the estimated annual watershed discharge for the

selected water body. 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. This method includes the following assumptions/limitations:

a. For lakes and ponds, the estimate of annual TP loading is averaged across the entire watershed. However, a given lake or reservoir may have multiple tributary streams, and each stream may drain land with vastly different characteristics. For example, one tributary may drain a highly developed residential area, while a second tributary may drain primarily forested and undeveloped land. In this case, one tributary may exhibit much higher phosphorus concentrations than the average of all streams in the selected watershed.

b. The estimated existing loading value only accounts for phosphorus due to stormwater runoff. Other sources of phosphorus may be relevant, particularly phosphorus from on-site wastewater treatment (septic systems) within close proximity to receiving waters. Phosphorus does not typically travel far within an aquifer, but in watersheds that are primarily unsewered, septic systems and other similar groundwater-related sources may contribute a significant load of phosphorus that is not captured in this analysis. As such, it is important to consider the estimated TP loading as "the expected TP loading from stormwater sources."

c. If the calculated water quality goal is higher than the existing estimated total load; the water quality goal is automatically set equal to the existing estimated total load.

Table B-1: Pollutant Load Reductions Needed

Pollutant	Existing Estimated Total Load	Water Quality Goal	Required Load Reduction
Total Phosphorus	3,047 lbs/yr	1,107 lbs/yr (Goal calculated as 70% reduction of the estimated load from all land uses excluding forested land)	0 lbs/yr
Total Nitrogen	19,841 lbs/yr	8,761 lbs/yr (Goal calculated as 70% reduction of the estimated load from all land uses excluding forested land)	13,889 lbs/yr
Total Suspended Solids	605 ton/yr	182 tons/yr (70% reduction of existing estimated total TSS load)	424 tons/yr
Bacteria	*MSWQS for bacteria are concentration standards (e.g., colonies of fecal coliform bacteria per 100 ml), which are difficult to predict based on estimated annual loading.*	**Class B Standards** ***Inland Waters:*** Concentrations of bacteria concentrations for: 1. *E. coli* shall (i) not exceed 126 colony-forming units (cfu) per 100 mL, calculated as the geometric mean of all samples collected within any 90-day or smaller interval; and (ii) no more than 10% of all such samples shall exceed 410 cfu per 100 mL (a statistical threshold value); 2.*enterococci*: (i) concentrations shall not exceed 35 cfu per 100 mL, calculated as the geometric mean of all samples collected within any 90-day or smaller interval; and (ii) no more than 10% of all such samples shall exceed 130 cfu per 100 mL (thestatistical threshold value). ***Public Bathing Beaches:*** The geometric mean and statistical threshold value used for calculating the minimum criteria for bacteria set forth as above shall be calculated and assessed, respectively, over a 30-day or smaller interval in *lieu* of any otherwise applicable longer interval	The Draft Pathogen TMDL(issued April 2024) is recommending a 92% reduction in *E. coli* levels to meet the TMDL target of 126 colonies/100 ml (Appendix I)
Cyanobacteria	1,500 cells/mL	Maintain low levels of cyanobacteria in Richmond Pond. <1,500 cells/mL	None
Aquatic Invasive Species	5 acres	Reduce invasive aquatics plants enough to not impede recreation in Richmond Pond. Eradication has been determined infeasible.	4 acres

TMDL Pollutant Load Criteria

No TMDL Pollutant Load Criteria Data Found

Pollutant load reduction information:

MassDEP is currently developing a TMDL for the upper Housatonic including the Southwest Branch Housatonic watershed. The target reductions presented in **Table B-1** will be updated when the TMDL is approved.

The approved Long Island Sound TMDL requires the City of Pittsfield, as an MS4 community, to reduce and track nitrogen pollution through public messaging and BMP implementation, but a specific load reduction is not required.

Water Quality Goal Calculation: While there is not a requirement to reduce phosphorous and nitrogen loading, there is a community goal to reduce these nutrients for the health of our lakes, ponds and rivers. The water quality goal for the load reduction of phosphorous and nitrogen was calculated using the land use estimated load numbers provided in **Tables A-16 and 17**. Excluding the estimated nutrient inputs from the forest, the load reduction goal is calculated as 70% of the estimated pollutant load from the remaining land uses.

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.

BMP Hotspot Map:

The following GIS-based analysis was performed within the watershed to identify high priority parcels for best management practice (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.

Table C-1 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-1** presents the resulting BMP Hotspot Map for the watershed. The following link includes a Microsoft Excel file with information for all parcels that have a score above 60: hotspot spreadsheet. 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.

GIS data used for the BMP Hotspot Map analysis included:

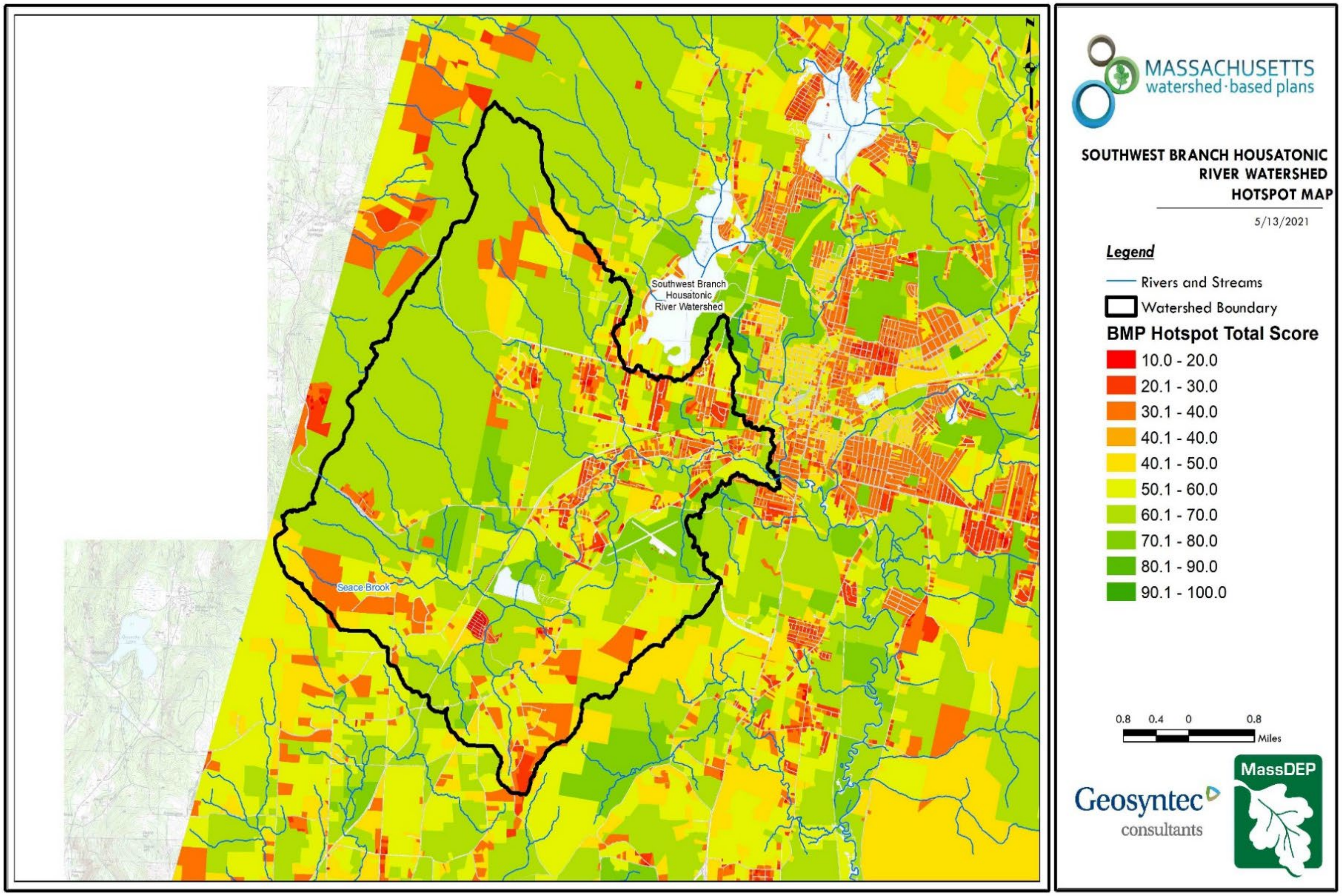
- MassGIS (2015a);
- MassGIS (2015b);
- MassGIS (2017a);
- MassGIS (2017b);
- MassGIS (2020);
- MA Department of Revenue Division of Local Services (2016);
- MassGIS (2005);
- ArcGIS (2020);
- MassGIS (2009b);
- MassGIS (2012); and
- ArcGIS (2020b).

Table C-1: 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

Note 1: **X** denotes that parcel is excluded

Figure C-1: 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 (2009b), MassGIS (2012), ArcGIS (2020b))**



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

Proposed Management Measures:

The following pages outline the proposed management measures for structural and non-structural BMPs and the ongoing and recommended future management measures.

Structural BMPs

The locations for the structural BMPs were identified through a combination of stakeholder meetings and a review of aerial imagery, water quality data and existing reports. Site visits were conducted to determine the feasibility of the site first by BRPC and then with CEI. Unless otherwise noted, CEI completed the conceptual designs and provided the estimated costs and pollutant load reduction for Total Nitrogen, Total Phosphorous and Total Suspended Solids. CEI did not complete site investigations for geotechnical details such as depth to groundwater or conduct hydrologic soil group identification. Therefore, these conceptual designs could require design modifications if moved forward to a final design phase.

For the proposed management measures completed by BRPC, the cost estimates and pollutant load reduction estimates and estimates of BMP footprint were based off information obtained using the Massachusetts web template for watershed based plans. The template uses the following sources for estimating costs and pollutant load reduction. Note the cost estimates completed by BRPC were adjusted up from the supplied 2016 template values which are based on the Consumer Price Index (CPI) (United States Bureau of Labor Statistics, 2016):

1. Pittsfield Department of Public Works, Pittsfield

Location: 42.443453, -73.270247
232 West Housatonic Street, Pittsfield

Property Ownership: City of Pittsfield

Site description:
The 6.3-acre DPW site is approximately 90% impervious (Figure C-2). The site slopes generally toward three low points, located at the northeastern, eastern, and southern perimeter of the site. As indicated in *Figure C-2*, bio-infiltration basins would be located in each of these areas. Infiltration BMPs such as infiltration trenches and basins are cost effective BMPs suitable for implementation at this site. These BMPs will facilitate runoff reduction at the exit points of the parcel, providing TSS removal and removal of total nitrogen and phosphorus up to 60% and 70%, respectively. There are five strategic locations on this site that can be used for BMP implementation: the northeast exit onto Hawthorne Avenue, the east exit to Hawthorn Avenue, and the south exit onto West Housatonic Street, as shown in *Figure C-2*. (Source: *City of Pittsfield's Nitrogen and Phosphorus Identification Source Identification*, *Kleinfelder 2023*)

In 2023, the city of Pittsfield received $637,500 Long Island Futures Fund (LISFF) implementation funding to support this and another project. Completion of the final design and permitting is expected by May 2024 with construction expected to occur between August 2024 and October 2025. The City of Pittsfield will be responsible for ongoing maintenance of the installed BMPs.

Photos C-1: DPW site, West Housatonic Street, Pittsfield. Upper photo shows the front parking lot where existing stormwater infrastructure could not be located. Bottom photo of parking lot entrance where asphalt is eroding and spalling.

Estimated Costs: **$260,000 – $320,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.94 tons/year
- Total Phosphorous 8.89 lbs/year
- Total Nitrogen 77.2 lbs/year

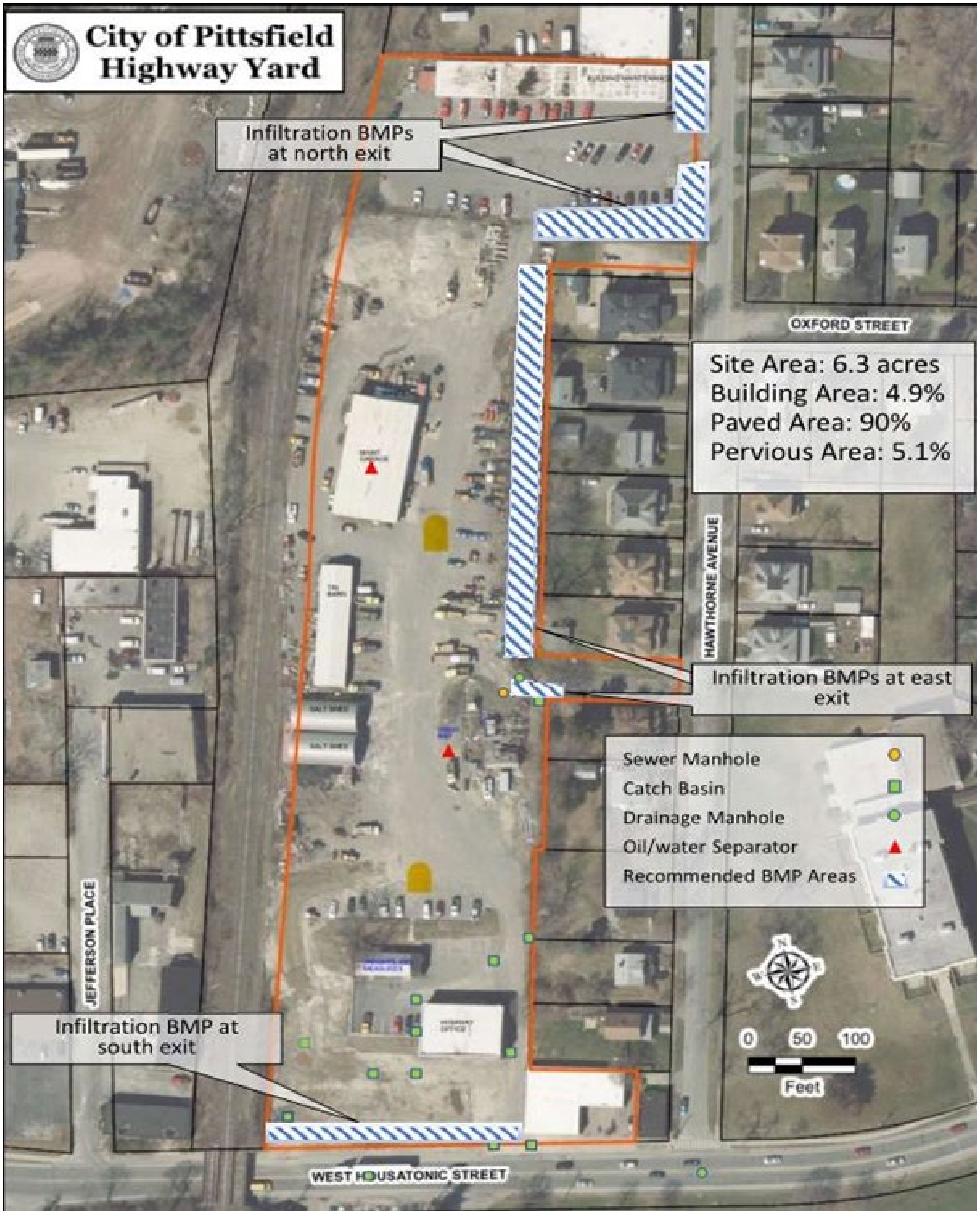


Figure C-2: City of Pittsfield, DPW site, 232 West Housatonic Street

2. Clapp Park, Pittsfield

Location: 233 West Housatonic Street (42.441192, -73.264354)
Property Ownership: City of Pittsfield

Site description: Clapp Park sits in a low point, abutted by hills to the east and the west and the SWB to the south. It is a well-used park by neighborhood residents with a sledding hill, track, baseball fields and splash park and playground. Stormwater is directed from West Housatonic Street to two outfalls into the Southwest Branch of the Housatonic River. Runoff from an approximately 1000-foot section of West Housatonic Street as well as the city Department of Public Works yard north of the park and an 800-foot section of Hawthorne Street is collected via a system of catch basins without treatment. Collected runoff is directed towards the West Branch of the Housatonic by 36" and a 27" stormwater pipes that run along the access road to Clapp Park. The outfalls discharge to the Southwest Branch of the Housatonic River. The site experiences flooding during larger storm events. The flood waters cover parts of the walking track, parking area, access road and grassy areas.

The gravel parking area is located at the southern end of the park adjacent to the SWB and is separated by a shallow swale that floods during storm events. The swale's flow is directed under the access road via a culvert that appears to be approximately 50% filled with sediment. The parking area has a minimal buffer to the SWB. There are signs of erosion and sediment transport from the parking lot, along the southwestern edge.

Two projects are proposed for this site at the location of the parking area. The goal of these projects is to reduce sediment and nutrients reaching the SWB, reduce flooding, and use the site as a demonstration project with interpretive signage.

Project #1 Proposed stormwater BMPs:

1. Install a bioretention area where the drainage swale currently sits (8,500 SF)
2. Install a Flow splitter in the 27" stormwater pipe
3. Install a grass swale to direct runoff from the access way to bioretention basin
4. Install interpretive sign adjacent to the bioretention basin.

Estimated Costs:	**$91,000 - $136,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	1.14 ton/yr
• Total Phosphorus:	7.44 lb/yr
• Total Nitrogen:	58.57 lb/yr

Project #2 Proposed stormwater BMPs

1. Pave the parking lot with permeable asphalt (approx. 3,200 SF).
2. Increase the width of the riparian buffer along the southwestern portion of the parking lot.

Estimated Costs:	**$141,000 - $212,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	0.23 ton/yr
• Total Phosphorus:	0.83 lb/yr
• Total Nitrogen:	6.37 lb/yr

Figure C-3: Clapp Park Project 1 - BMP locations and existing stormwater infrastructure.

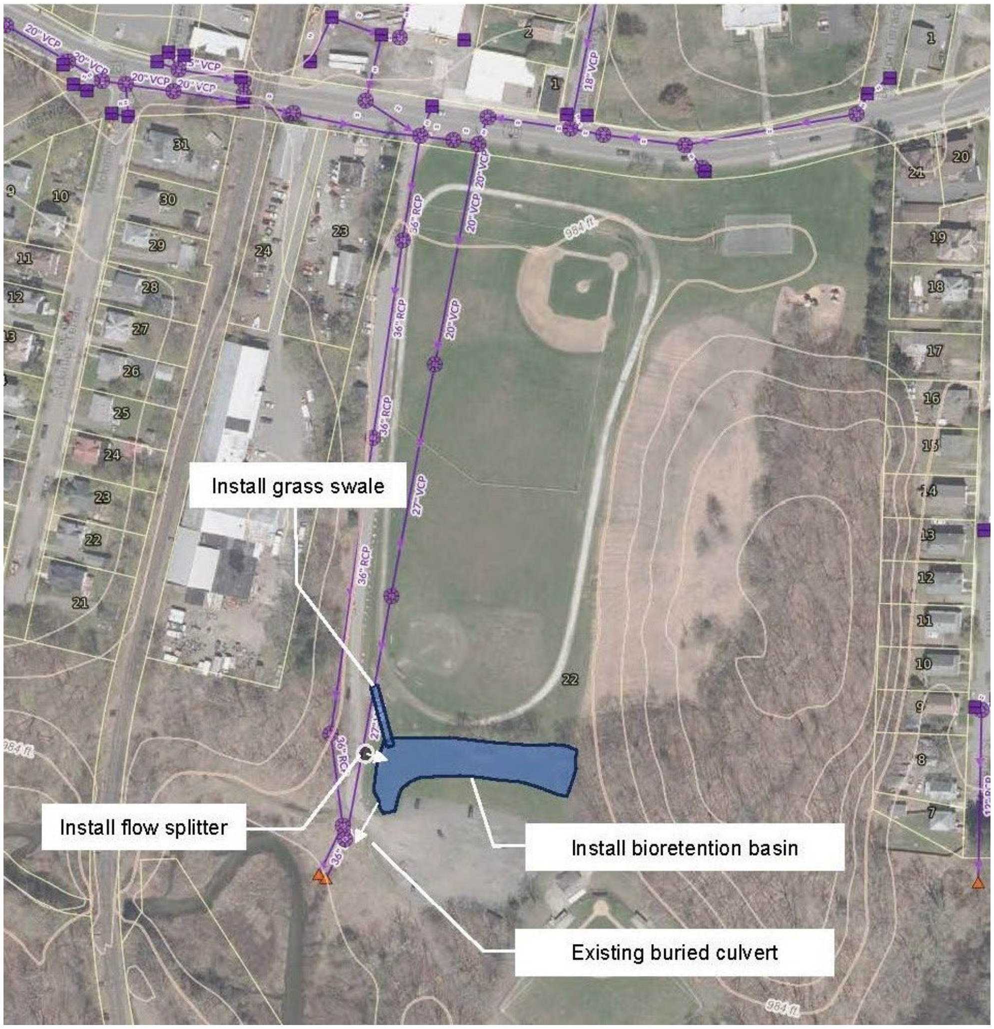
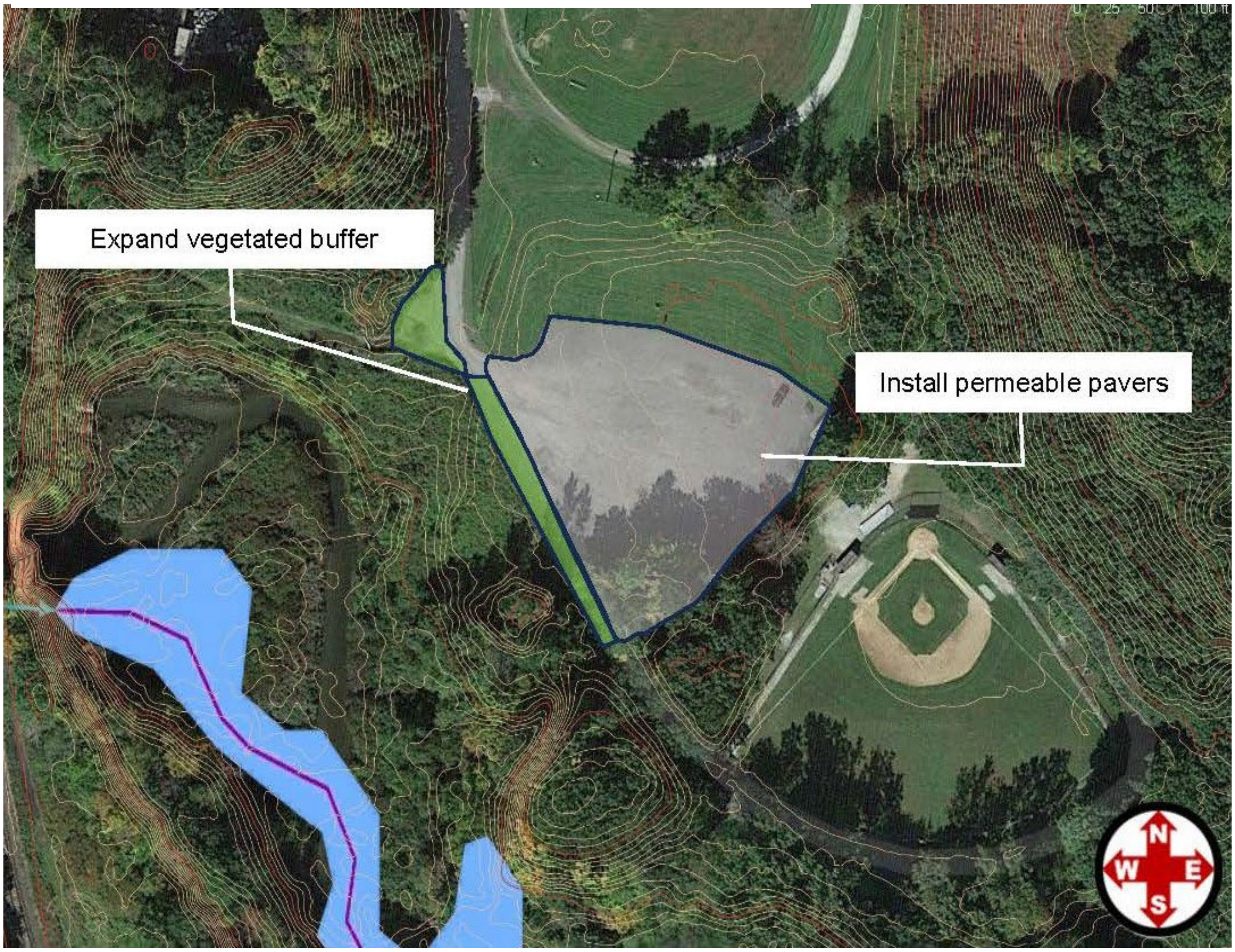


Photo C-2: Clapp Park Project 1: Bioretention Basin

Figure C-4: Clapp Park Project 2 BMP locations



Photos C-3: Clapp Park Project 2: Parking area northern edge (left) and southwestern corner (right)

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3. Gale Avenue, Pittsfield

Location: 270 Fort Hill Avenue (42.441192, -73.264354)
Property Ownership: City of Pittsfield, existing Right-of-Way along Gale Avenue

Site Description:
This project site is the city ROW along Gale Avenue in front of the property at 270 Fort Hill Avenue and includes the southwest corner of the Fort Hill Avenue and Gale Avenue intersection. Stormwater runoff from Gale Avenue runs along the grassed shoulder of the roadway towards an asphalted swale which leads to a catch basin set below the road level within a grassy basin. The abutting property on Gale Avenue is agricultural, and currently has horses on the property. There is evidence of scouring and sediment deposition at the end of Gale Avenue and the asphalt swale is clogged with sediment. A portion of Gale Avenue has recently been paved increasing runoff to this catch basin. Some of the Gale Avenue driveways remain gravel and the stormwater becomes laden with driveway sediment.

Proposed stormwater BMPs:
The stormwater BMPs will be designed to capture the stormwater from Gale Avenue and the agricultural fields into a sediment forebay first and then direct it to a grassed infiltration trench approximately 1100 feet long. The stormwater will be slowed with check dams. This infiltration trench will connect with an improved grassed basin that will function as a bio-infiltration basin. Overflow will be captured by a raised catch basin which will connect with the existing stormwater infrastructure that leads to a vegetated swale that outfalls at Smith Brook.

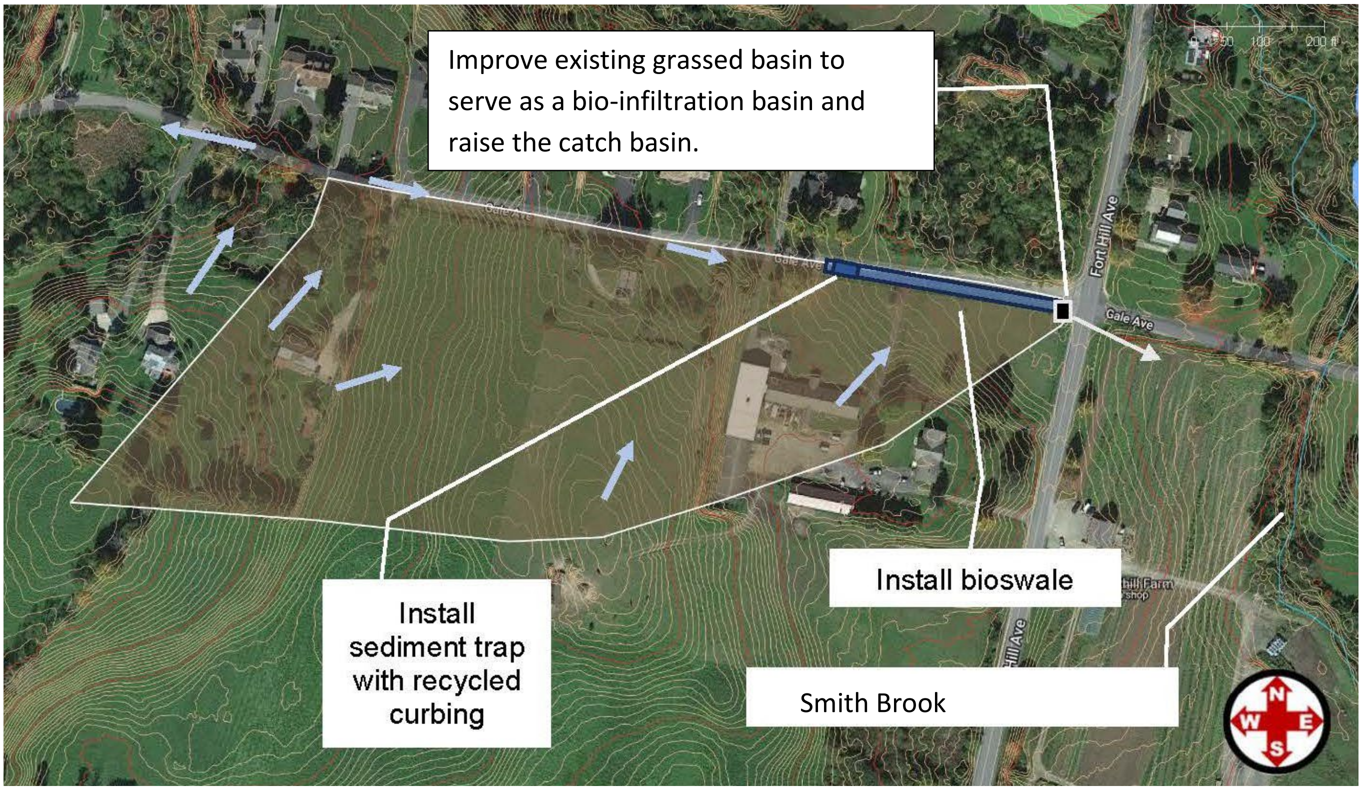
1. Install a bioswale with check dams along the southern side of Gale Hill Avenue that ties into existing catch basin (1,100 square foot).

2. Install a sediment trap, stabilized /paved with recycled granite curbing to ease maintenance, at the start of the bioswale to capture any upstream sediment.

3. Raise existing catch basin to encourage infiltration and improve the existing grassed basin.

Estimated Costs:	**$15,000 - $22,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	0.84 ton/yr
• Total Phosphorus:	1.91 lb/yr
• Total Nitrogen:	7.75 lb/yr

Figure C-5: Gale Avenue stormwater BMP locations showing drainage area and flow



Photos C-4: Gale Avenue BMP visual looking west (left photo) looking east (right photo)

4. Vista Street, Pittsfield

Location: 97 Vista Street, (42.424494, -73.307328)
Property Ownership: City of Pittsfield, existing Right of Way along the road

Site Description:
Stormwater from Chapel and Vista Streets is conveyed to the SWB via storm drains located at the intersection of Chapel and Vista Streets. Vista Street lacks storm drain infrastructure. The runoff runs along the road eroding the road and edges. During heavy precipitation the stormwater overwhelms the stormwater infrastructure and flooding occurs at the intersection of Chapel and Vista Streets. The existing stormwater pipe that directs the stormwater from Chapel Street to the Southwest Branch is degraded and in need of replacement. The city has an easement on this property.

Proposed Stormwater BMPs:
The goal of this stormwater BMP is to infiltrate the stormwater generated on Vista Street prior to entering the stormwater infrastructure. In addition, replacement of the degraded stormwater pipe that leads to the Southwest Branch from Chapel Street has been identified as a high priority of the city. It is recommended to be replaced with a larger pipe to fully resolve flooding issues. No geotechnical investigation was completed for the conceptual design. The water table is likely too high to allow infiltration of any stormwater along the pipe's length, but additional possibilities for infiltrating stormwater at this location should be considered at the time of final design and permitting.

1. Install infiltration trench along the right of way on Vista Street (1250 SF).
2. Upsize existing 12" drainage pipes to ensure adequate capacity.
3. Repairing sliding headwall at the outlet to the Southwest Branch.

Estimated Costs:	**\$53,000 - \$79,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	0.10 ton/yr
• Total Phosphorus:	0.68 lb/yr
• Total Nitrogen:	5.11 lb/yr

Photos C-5: Vista Street BMP visual looking east

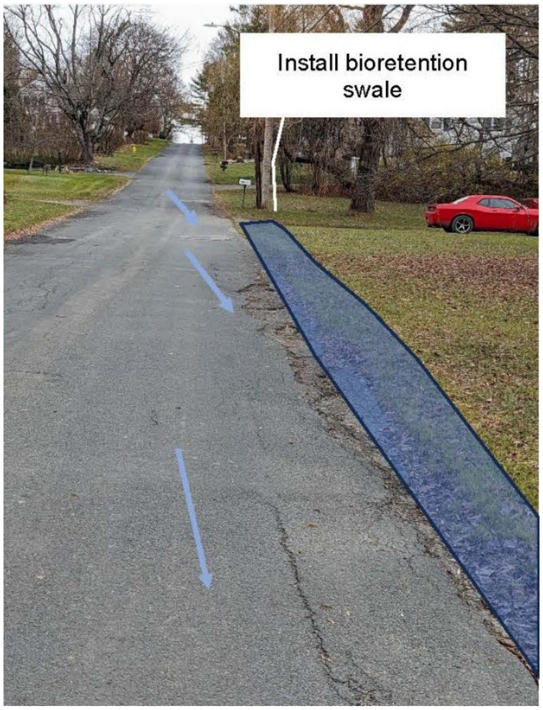
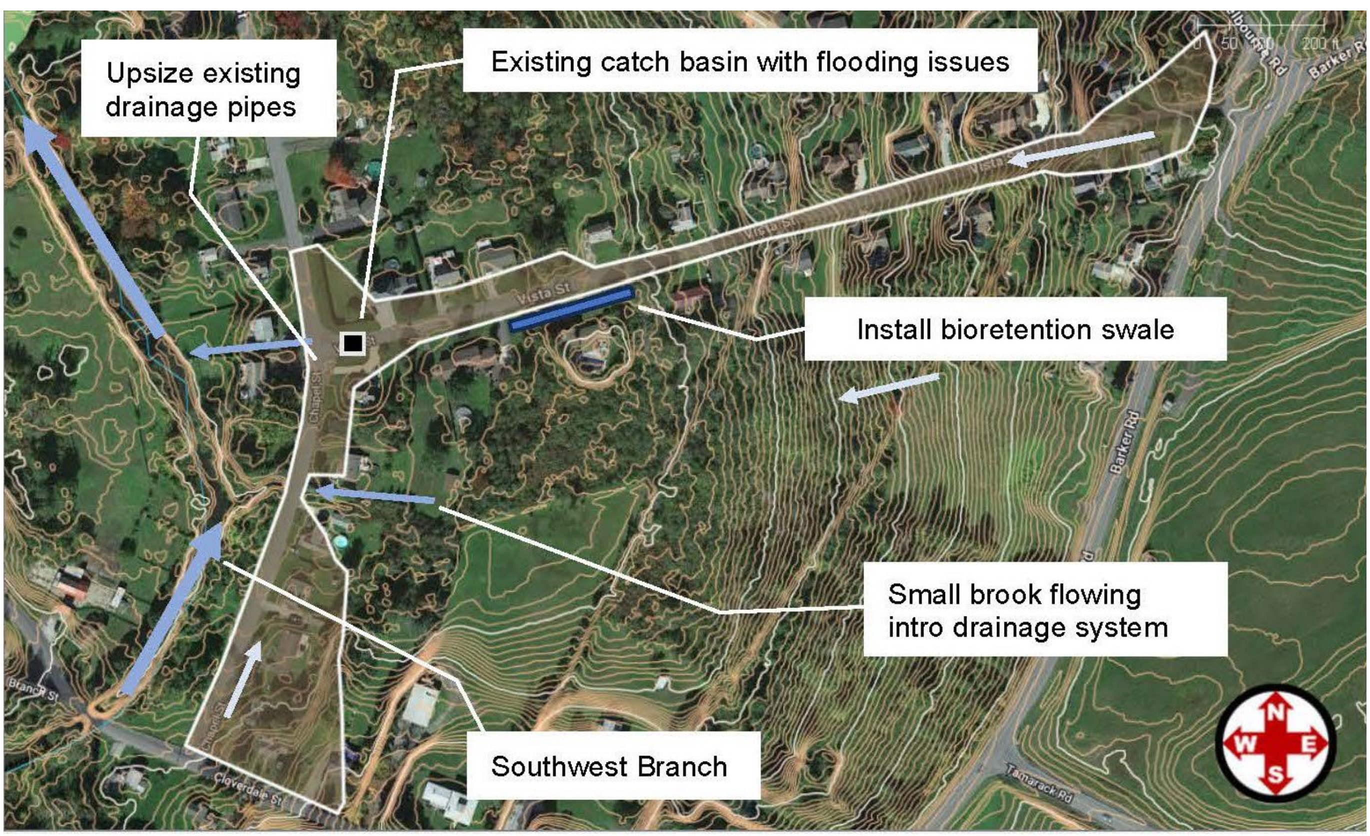


Figure C-6: Chapel and Vista Street BMP location



5. West Street, Pittsfield

Location: Intersection of West and Churchill Streets (42.4560558, -73.303542)
Property Ownership: City of Pittsfield, existing Right of Way along the roads

Site Description:
West Street crosses Smith Brook, a tributary of the SWB, just west of the intersection of West and Churchill Streets. Stormwater from both West and Churchill is directed through the existing stormwater infrastructure to four outfalls (3 pipes and one swale) directly discharging to Smith Brook. The swale is partially filled with sediment. This intersection floods in heavy rains due to stormwater generated from the streets and an adjacent private development, Churchill Estates. Runoff from West Street travels down the south side of West Street and is directed to a catch basin that is located just off the street in a grassed depression in front of 1161 West Street. During the site visit, the swale and catch basin were clogged resulting in flooding and erosion of the driveway to1161 Churchill Street. As a result, an eroded channel which directs stormwater into Smith Brook adjacent to an outfall pipe has formed on this property.

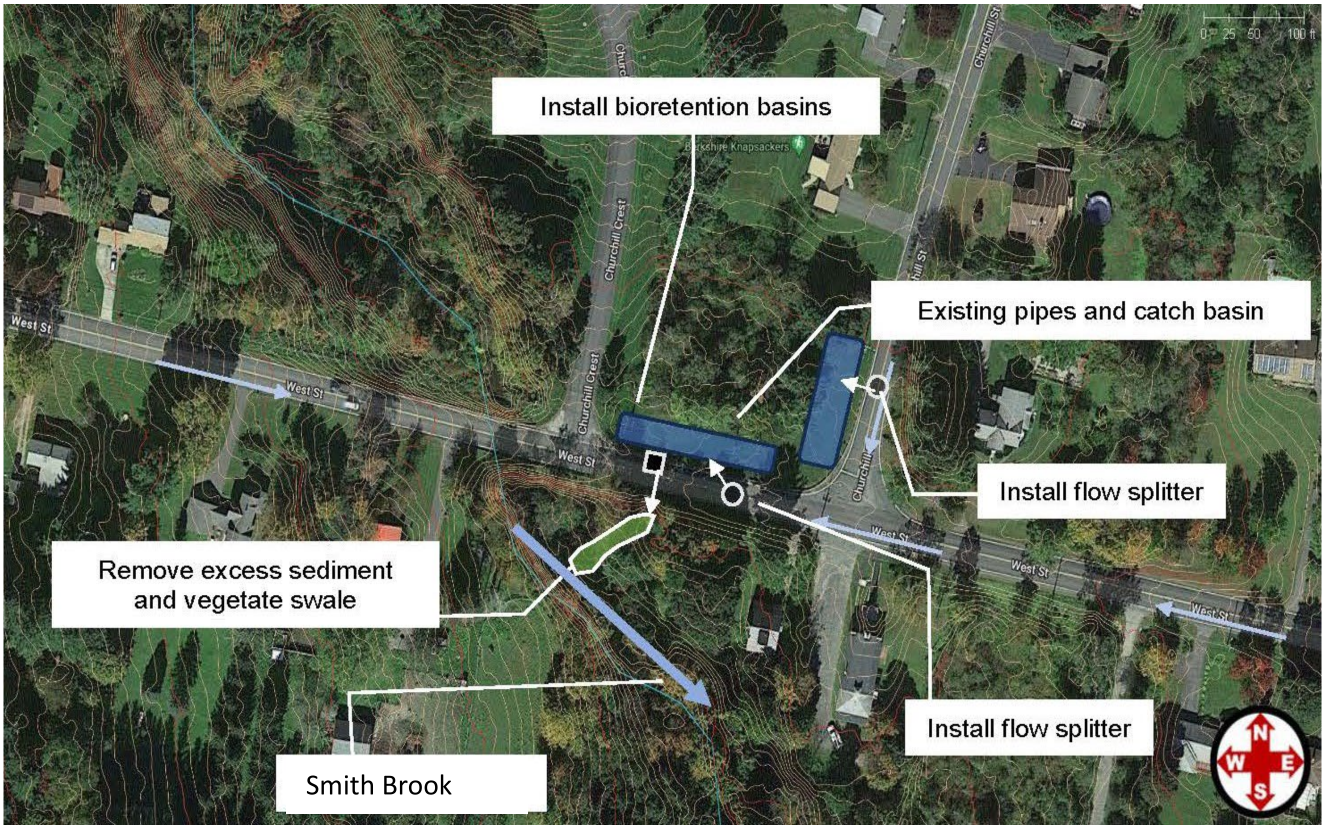
CEI created the Project #1 conceptual design for this site and BRPC developed the preconceptual design for Project #2. The flooding issue likely would be partially resolved by implementing these projects, but to fully resolve the flooding issue, it is recommended to add stormwater BMPs on Churchill Crest Estates and upsize the West Street/Smith Brook culvert, which is a top 10% priority culvert and one of the top priorities for the City of Pittsfield.

Proposed Stormwater BMPs – Project #1:
The goal of the stormwater BMPs is to direct stormwater generated from both Churchill and West Streets into bioretention areas at the corner of Churchill and West Streets. The nearest storm drain on West Street discharges to a swale on the south side of West Street. This swale would be repaired, the sediment removed and vegetated.

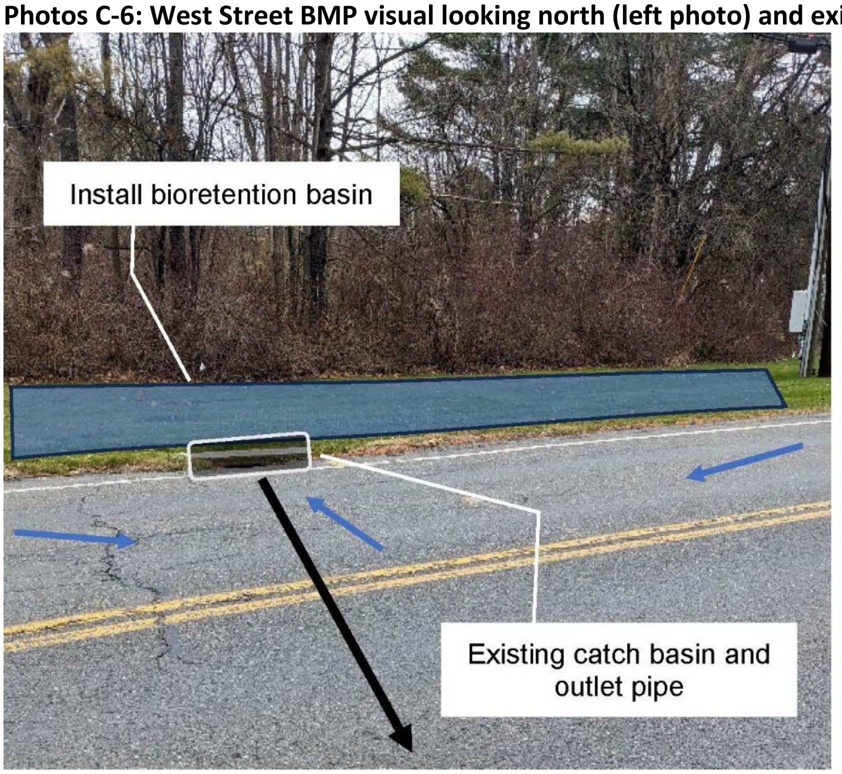
1. Install bioretention facility at the low point of West Street (Approx. 2500 SF)
2. Install bioretention facility at the end of Churchill Street (Approx. 6000 SF)
3. Install flow splitters in Churchill and West Street drainage systems to direct flow to bioretention basins.
4. Remove excess sediment and re-vegetate the swale at the drainage outlet.

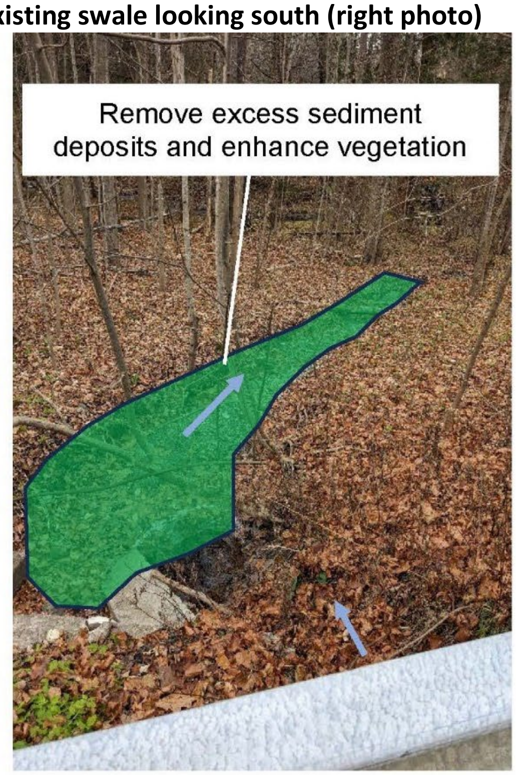
Estimated Costs:	**$105,000 - $158,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	0.20 ton/yr
• Total Phosphorus:	1.32 lb/yr
• Total Nitrogen:	9.83 lb/yr

Figure C-7: West Street Project #1 BMP locations.



Photos C-6: West Street BMP visual looking north (left photo) and existing swale looking south (right photo)





Proposed Stormwater BMPs – Project #2:
The goal of the stormwater BMPs is to reduce the volume of stormwater and the associated sediment and nutrients discharging to Smith Brook as well as resolving the flooding and erosion issue at 1161 West Street.

The stormwater generated would be directed from West Street into grassed swales along the city's right-of-way along the south side of West Street. The grassed swales will lead to an enlarged grassed infiltration basin at the location of the existing catch basin off-set from the street in the front yard of 1161 West Street. Raising this catch basin would allow additional infiltration before overflow would discharge to a drainage pipe leading under the driveway of 1161 West Street. Culverts would be installed under two driveways. The eroded channel formed on the stream bank of Smith Brook at 1161 West Street would be repaired and native plantings would revegetate the streambank.

1. Install grassed swale on the south side of West Street (approx. 300 feet).
2. Enlarge existing grassed basin to act as a bio-infiltration basin (approx. 176 SF).
3. Raise the existing catch basin in the basin (replace with a deep sump catch basin, if necessary).
3. Install culvert pipes under the driveways of 1161 and 1165 West Street to direct flow to grassed swale and drainage pipe.
4. Repair and revegetate the eroded channel that has formed on the property of 1161 West Street.
5. Plant a riparian buffer along the bank of Smith Brook.

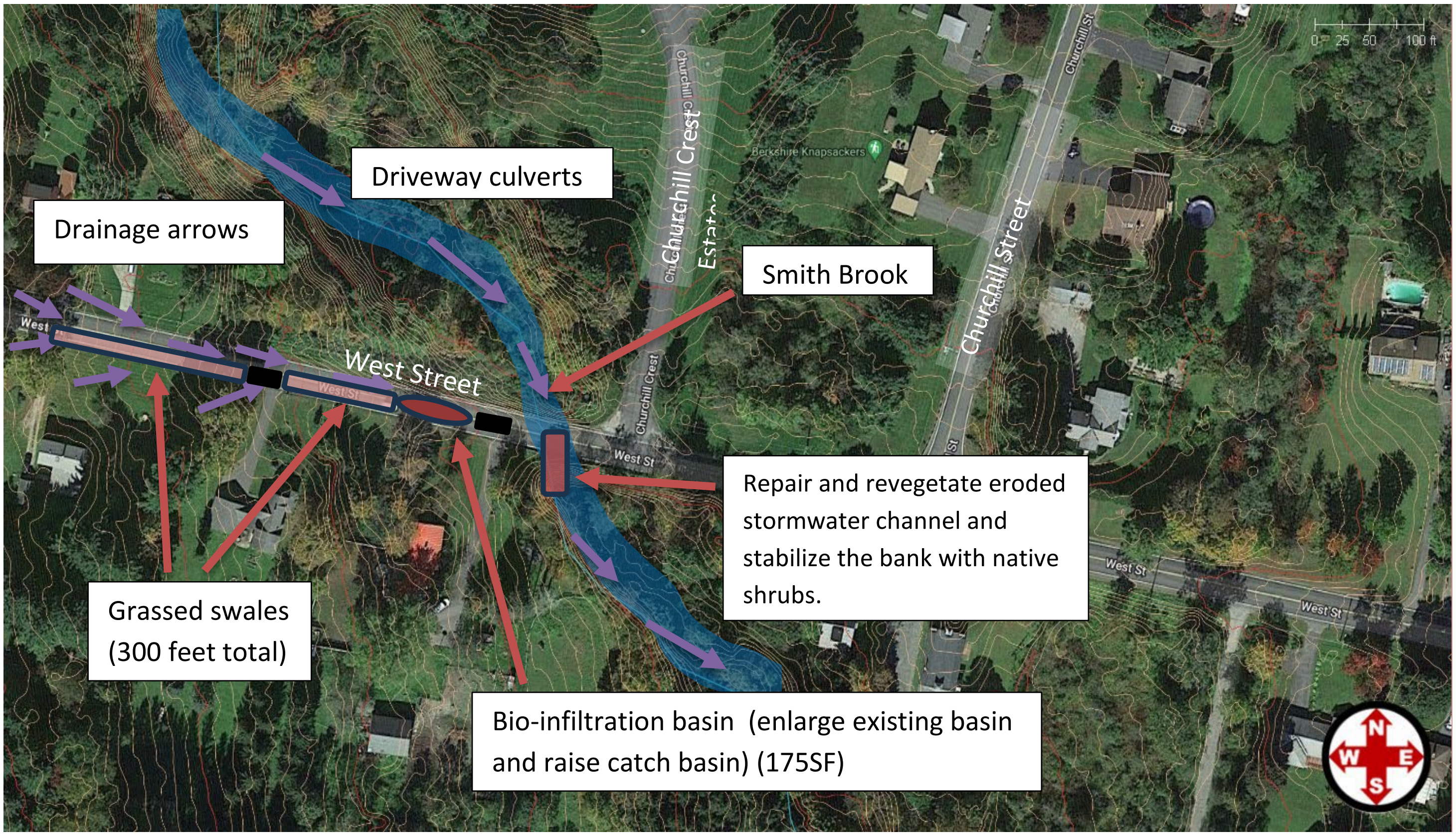
Estimated Cost: $23,000 – $40,000

Estimated Nutrient Load Reduction:

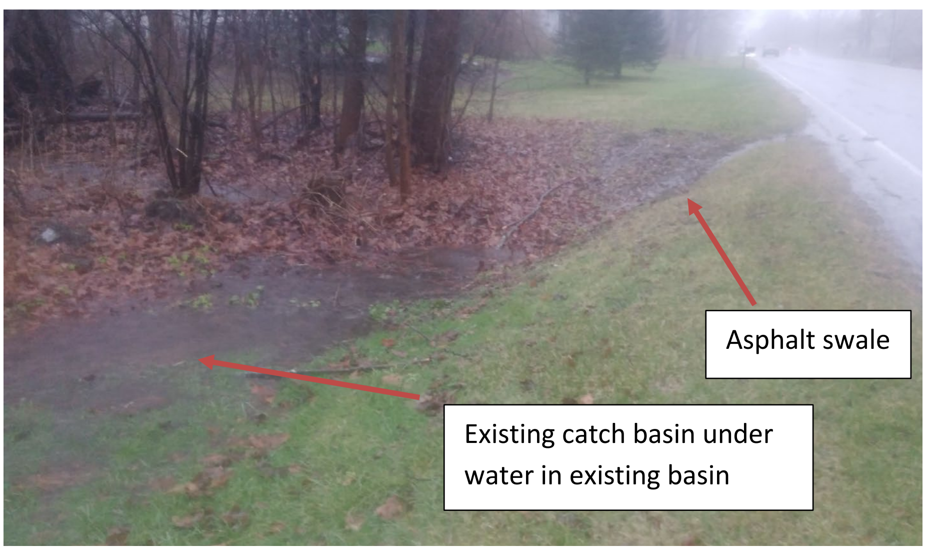
- Total Suspended Solids: 94 lbs/year
- Total Phosphorous 0.16 lbs/year
- Total Nitrogen 1.07 lbs/year

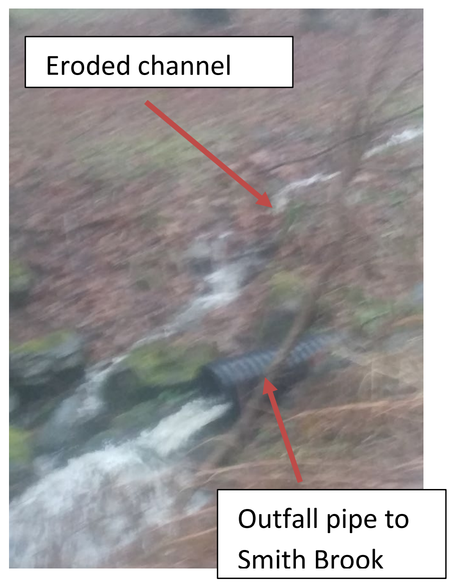
Photo C-7: Driveway of 1161 West Street during recent storm

Figure C-8: West Street Project #2 BMP locations



Photos C-8: Looking west along West Street shows existing basin (left) and eroded drainage channel which has formed off flowing off the driveway next to outfall pipe on property of 1161 West Street





6. Pittsfield Fire Department, Engine No 1, Pittsfield

Location: 331 West Housatonic Street (42.443419, -73.2701967)
Property Ownership: City of Pittsfield

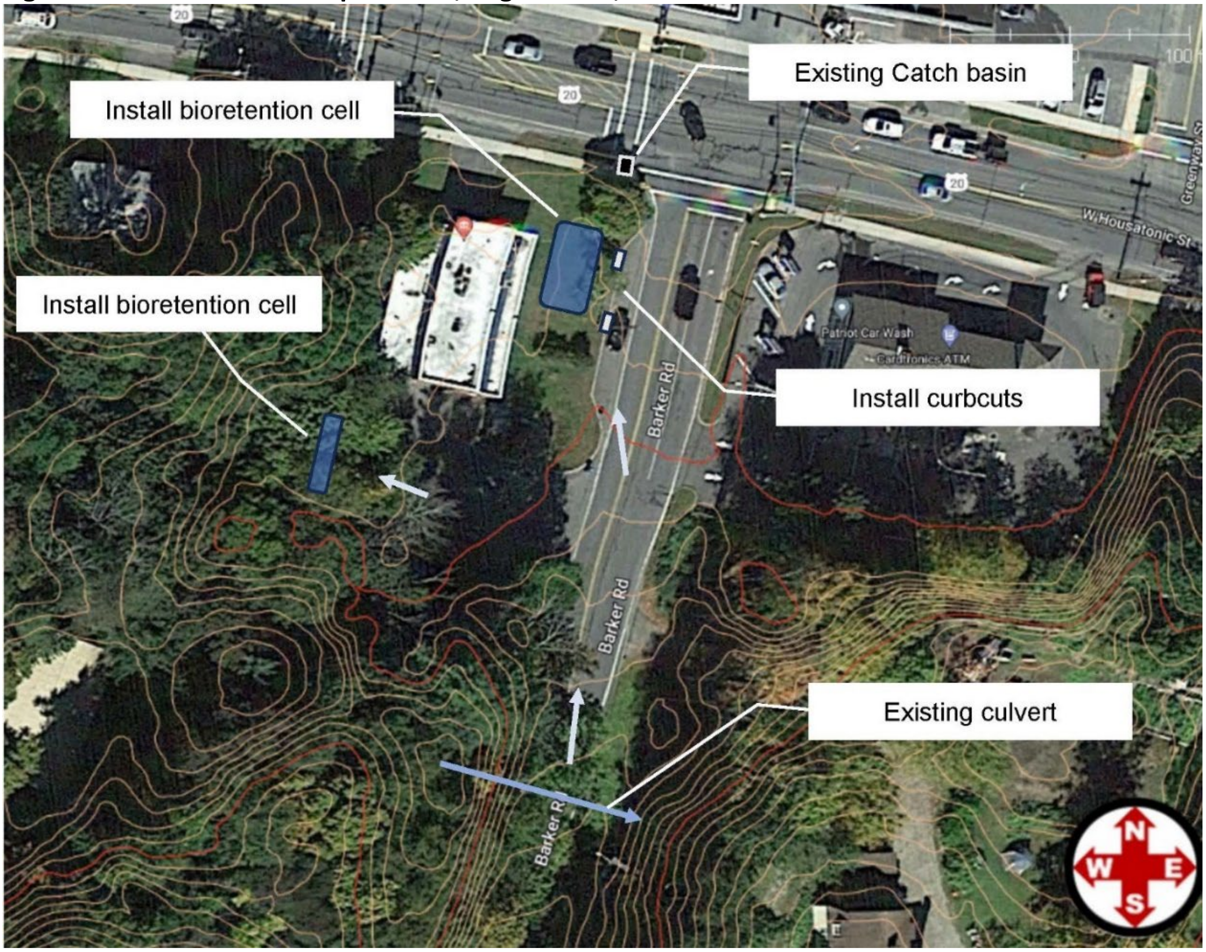
Site Description:
The Pittsfield Fire Department building sits at the corner of Barker Road and West Housatonic Street. Barker Road has limited drainage infrastructure and open grass shoulders along a majority of the road. Runoff from Barker Road sheds to the northwest and into the parking lot of the Fire Department. The parking lot is graded to drain to the northwest to a local wooded depression.

Proposed Stormwater BMPs:
Two bioretention basins would be constructed to infiltrate the stormwater from both the parking lot and, with curb cuts, from Barker Road. A 575-square foot bioretention basin would be constructed in the grassed area to the east of the building with a smaller 300-square foot bioretention basin constructed in the northwestern corner of the parking lot capturing parking lot runoff. The bioretention areas could be vegetated with grass to ensure easy maintenance for the city. This is a lower priority project for the City of Pittsfield and would be a consideration when it comes time to repave the parking. Filter strips adjacent to the bioretention basins would help to capture the sediment.

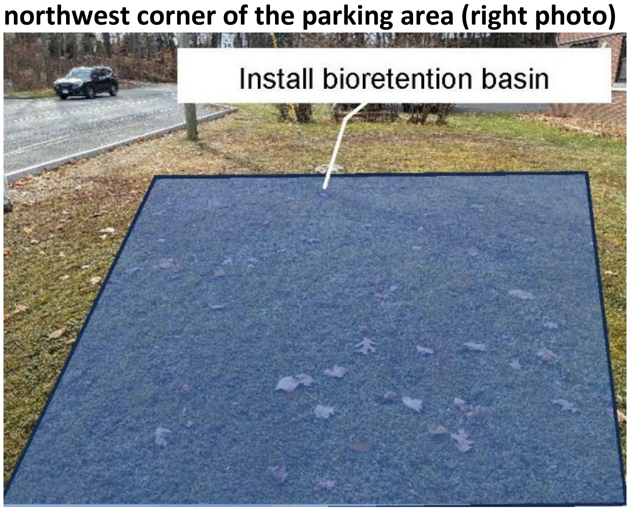
1. Install a bioretention area at the northwest corner of the parking lot to capture runoff from Barker Road and the parking lot (approx. 300 SF).
2. Remove a tree stump and install a biofiltration area at the corner of Housatonic Street and Barker Road (approx. 575 SF).
3. Add curb cuts to the existing curb along Barker Road.

Estimated Costs:	**$32,000-$47,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	0.07 ton/yr
• Total Phosphorus:	0.27 lb/yr
• Total Nitrogen:	2.03 lb/yr

Figure C-8: Pittsfield Fire Department, Engine No 1, BMP locations



Photos C-7: Pittsfield Fire Dept, BMP visuals: Bioretention basin along Barker Road (left photo) and the northwest corner of the parking area (right photo)



7. Richmond Town Beach on Richmond Pond, Richmond

Location:	End of Beech Road (42.419730, -73.3288448)
Property Ownership:	Town of Richmond

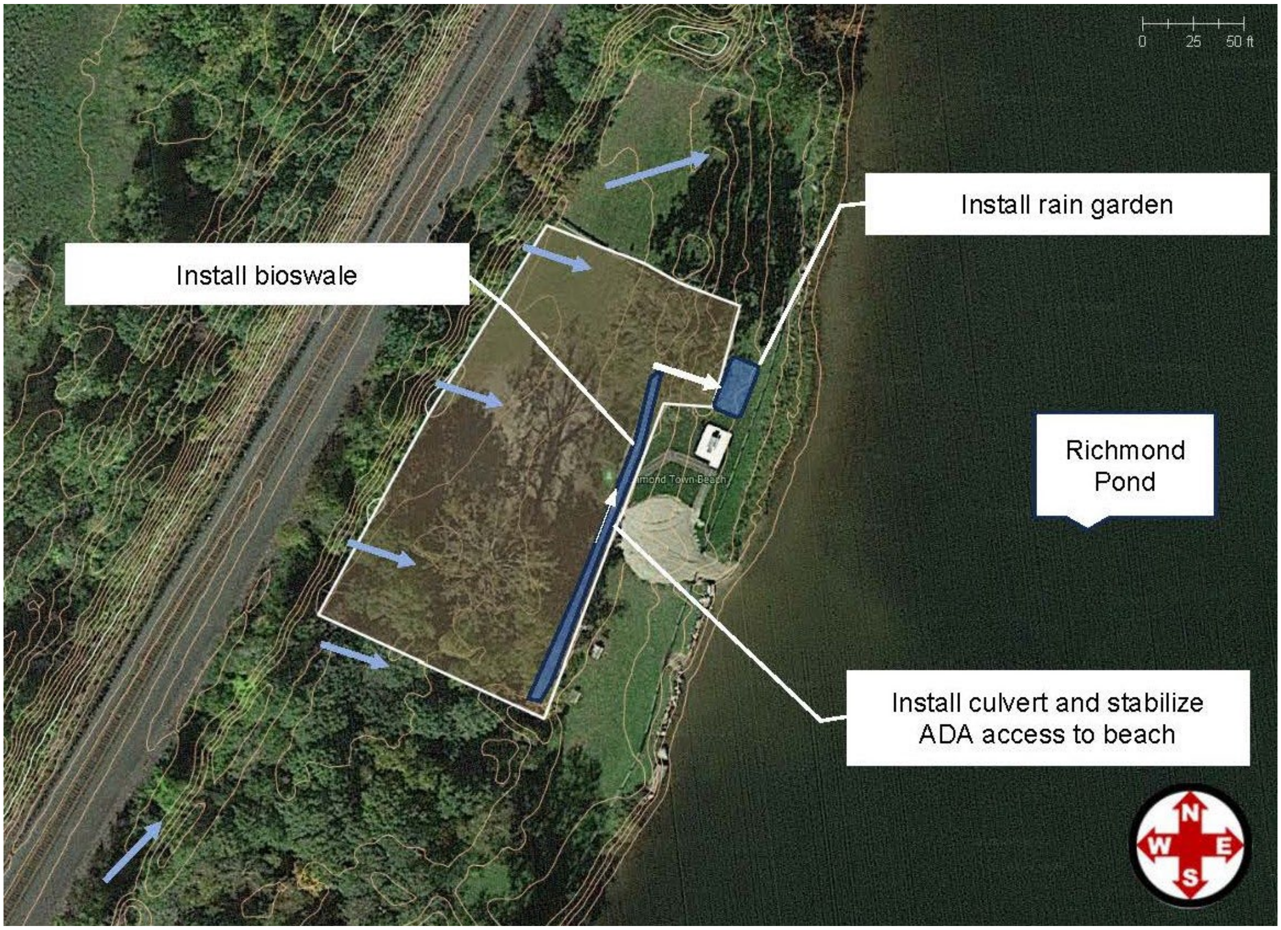
Site Description:
Richmond Town Beach sits at the end of Beech Road, an access road beyond the town boat ramp, and has an unimproved dirt parking lot. The parking lot sheds southeast towards Richmond Pond. Runoff flows off the parking lot and through the artificial sand beach area causing erosion and sediment transport at accelerated levels into Richmond Pond. There are clear channels and undercut slopes in the sandy area of the beach. The erosion is also reducing the accessibility of the beach area.

Proposed BMPs:
The proposed BMPs will capture the parking lot stormwater into a vegetated swale approximately 750 feet long. The installation of a culvert at the point of the beach access would prevent the runoff from entering the beach area and stabilize this access and the beach area. Stormwater would be directed towards a 500-square foot rain garden in the currently grassed area. The bioretention basin (rain garden) vegetation could be grass to facilitate maintenance.

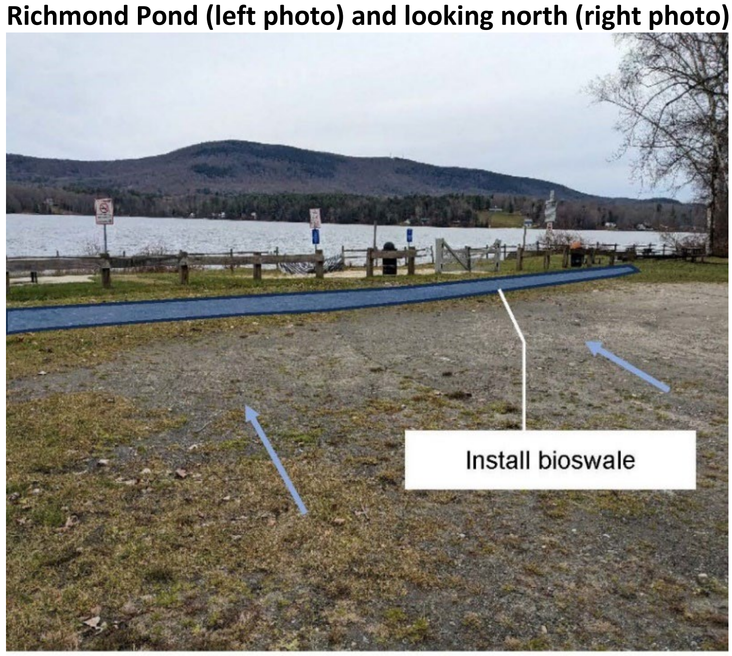
1. Install a bioswale along the eastern side of the parking lot to direct runoff away from the sand beach (approx. 750 SF).
2. Direct runoff from the bioswale to a bioretention basin (approx. 500 SF) along the northwest side of Sheehy Road.

Estimated Costs:	**$33,000 - $49,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	0.01 ton/yr
• Total Phosphorus:	0.06 lb/yr
• Total Nitrogen:	0.61 lb/yr

Figure C-9: Richmond Town Beach BMP locations



Photos C-8: Town Beach BMP visual: Looking towards Richmond Pond (left photo) and looking north (right photo)



8. Richmond Boat Access parking area, Richmond

Location: Beech Road (42.415574, -73.331925)
Property Ownership: Town of Richmond

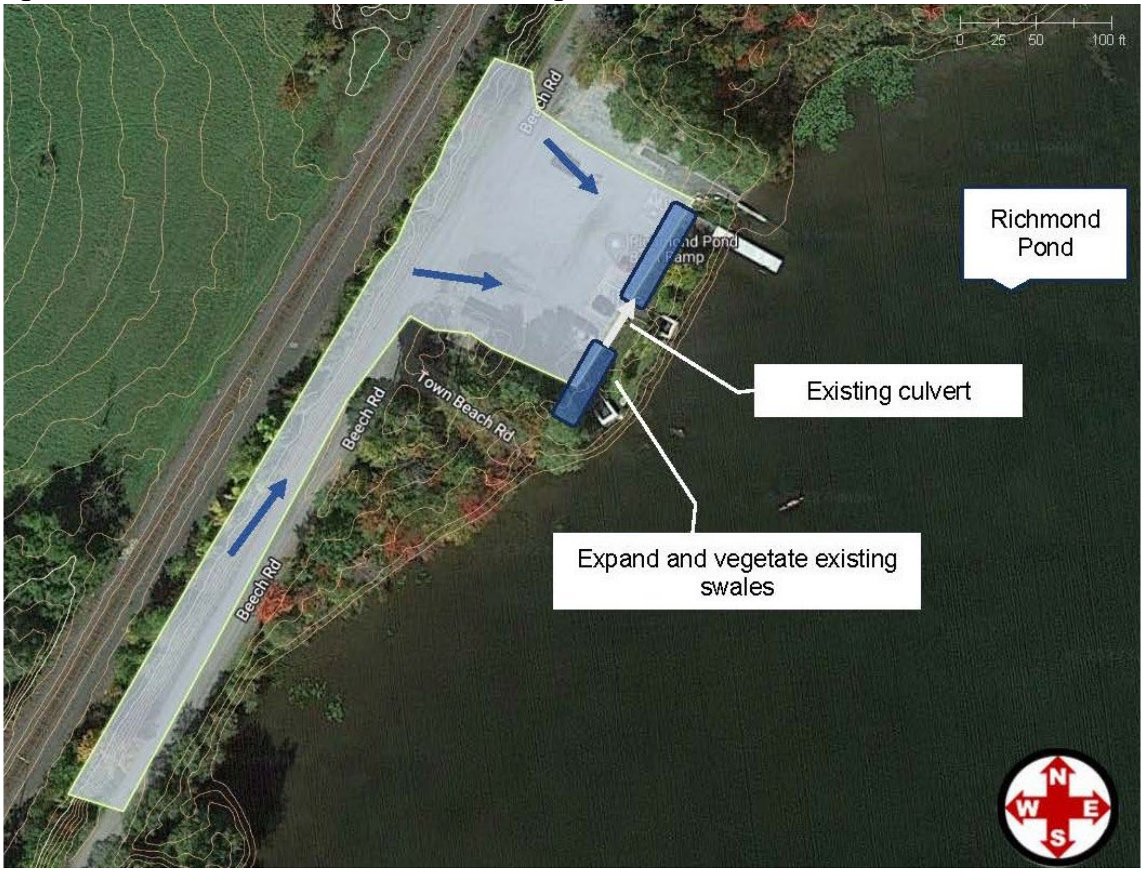
Site Description:
Native trees and shrubs were planted along the lakefront at this site under a previous CWA Section 319 project (2004-07). Unfortunately, not all plantings survived. Additional improvements can be made to ensure that all of the stormwater from the parking lot is infiltrated and the riparian buffer is improved. An existing grassed channel separates the parking lot of the Richmond Pond Boat Ramp and Richmond Pond. The swale is separated by a series of culverts that connect the swales across access points.

Proposed BMPs:
The existing grassed channel would be expanded and planted with native plantings. Riprapped inlets would help direct the parking lot runoff into the bioswale. Additional shrubs and trees planted on the lake side of the bioswale would enhance the riparian buffer.

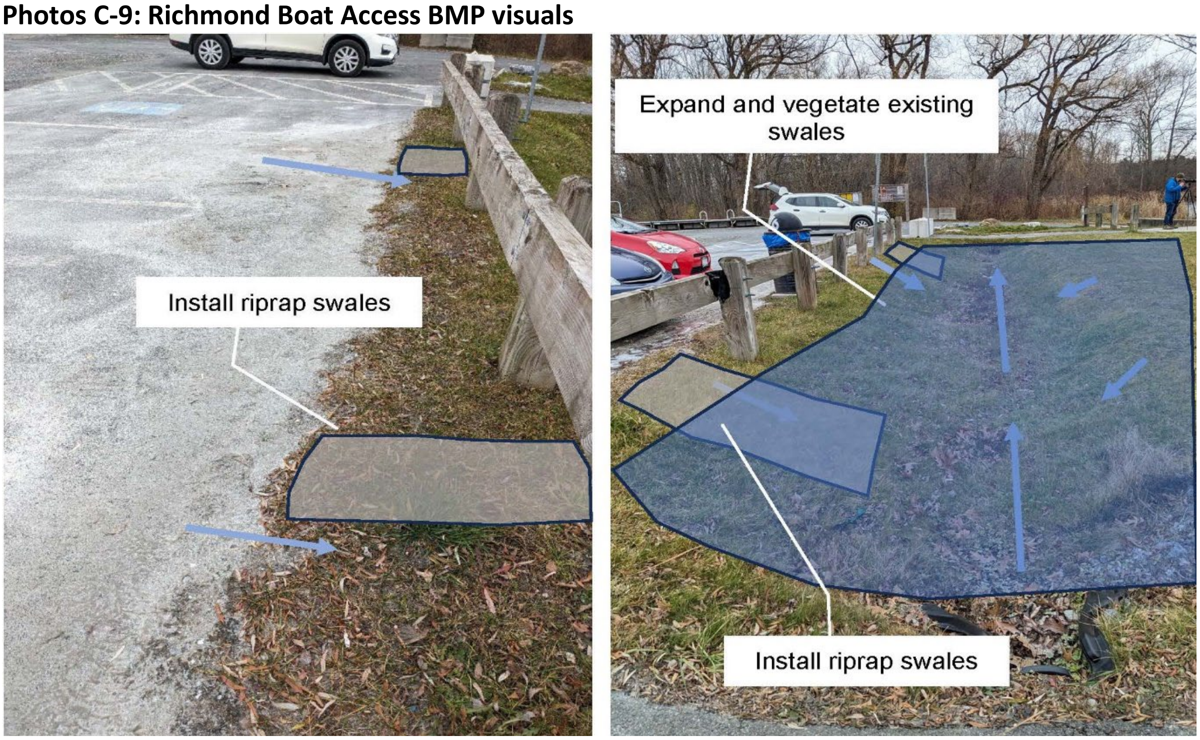
1. Expand the existing grass swale to utilize unused grassed area (approx. 1650 SF).
2. Plant native vegetation along the swale.
3. Install check dams to encourage further detention and infiltration.

Estimated Costs:	**$33,000 - $49,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	0.01 ton/yr
• Total Phosphorus:	0.06 lb/yr
• Total Nitrogen:	0.61 lb/yr

Figure C-10: Richmond Boat Access Parking area BMP locations



Photos C-9: Richmond Boat Access BMP visuals



9. Richmond Shores Gravel Roads, Richmond

Location: Richmond Shores (42.4130948, -73.332761)
Property Ownership: Richmond Shores Civic Association

Site Description:
Richmond Shores is a private residential development located on Richmond Pond. The roads serving Richmond Shores are all gravel. A culvert located on Shore Road (42.411111, -73.330984) thought to date back to the original culvert installed (date unknown) serves as a primary entrance to the bulk of the development.

The Town of Richmond received a CWA Section 319 grant to support work in Richmond Shores which installed 3 small catch basins, 5 deep sump catch basins, and drainage swales (2004-2007). (See Appendix B for a BMP locus map) The Association, with significant volunteer support, town assistance and private funds, has maintained their infrastructure to the best of their ability. However, because of both winter road maintenance and the increased intensity of storms due to climate change the Association is experiencing severe road erosion and flooding issues that are impacting the health of Richmond Pond and are also a public safety concern. The exponential cost increase to maintain and replace infrastructure is making it increasingly difficult for the Association to afford improvements that would stabilize the roads, reduce flooding and assess the safety of the existing culvert. Additional funding will support the climate resiliency of this private residential development.

Key issues noted by the Association include the following *(Source: stakeholder meeting with Richmond Shores Civic Association President John O'Leary):* Additional site visits have provided additional information which is provided in Appendix J. Richmond Shores Civic Association members have also indicated that the eastern section of Shore Road from the intersection west of the bridge until the end of the dirt section is the most problematic stretch of gravel road. This is the main access road and needs to be kept accessible for residents' access and public safety.

1. Spruce Road and Chestnut Road
As a result of plowing, Spruce Road has widened or shifted to the point that the main catch basin is no longer in the gutter or at a low point on the road. In addition to the shift, the under-road drainage pipe from the catch basin to a ditch has collapsed. The catch basin routinely fills and overflows. The lower portion of Spruce completely washes out and pours water down the hill flooding the house at the bottom and dumping sediment-laden stormwater into the pond.

2. Hemlock Road and Spruce Road
Problems exist with 2 catch basins. One large concrete catch basin has an inlet hole that is too small and regularly clogs up causing water to run across the road. The other catch basin fills and overflows. Water from both failed basins runs down the street and floods the lot and home at the end of the Hemlock Road.

3. East Beach Road and Shore Road
Over time the road level on East Beach has dropped considerably. The drainage catch basin is relatively new but sits higher than the road. Water pools year-round and often spills out onto Shore Road contributing to an almost annual washout of that section.

4. Bridge Street, Shore Road & Cherry Road intersection
Busy intersection frequently ruts and washes out causing rainwater and snowmelt to run downhill around the bridge and directly into the pond. The road is only graded once a year.

5. Southwest portion of Richmond Shores

There is little or no drainage in this area of the development. There is standing water virtually all year potentially draining directly into the channel or surrounding wetlands.

Proposed BMPs:

These BMPs focused on Spruce Road are designed to reduce road erosion and reduce the sediment and pollutant load entering Richmond Pond. A long-term solution needs to be determined for all of the issues outlined above.

Proposed improvements to the northern portion of Spruce Road:

1. Stabilize Spruce Road to minimize erosion and sedimentation (5,500 sf)
2. Regrade the area surrounding the catch basin at the intersection of Chestnut and Spruce roads to improve runoff interception.

Estimated Costs:	**$32,000 - $47,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	3.50 ton/yr
• Total Phosphorus:	3.50 lb/yr
• Total Nitrogen:	7.00 lb/yr

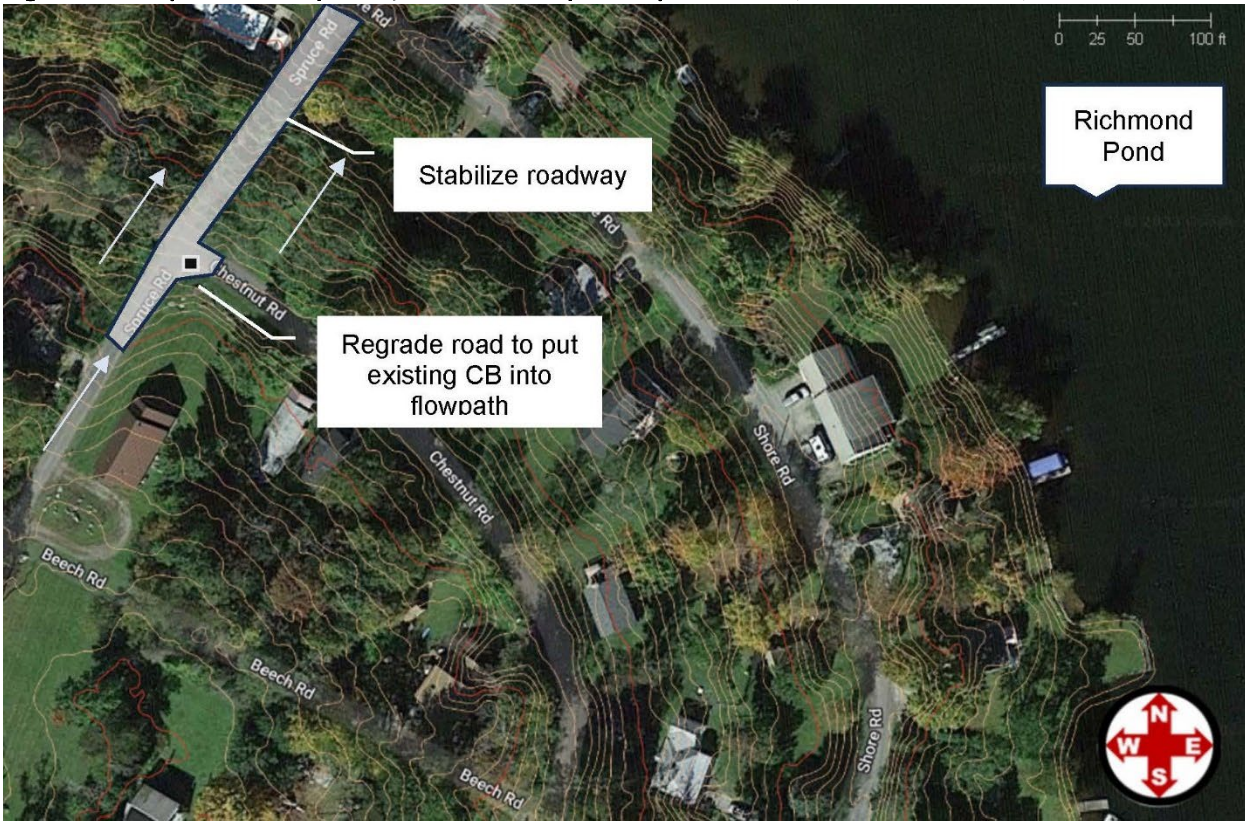
Proposed improvements to the southern portion of Spruce Road:

1. Stabilize Spruce Road to minimize erosion and sedimentation (4,000 SF)
2. Install deep sump catch basins at intersection of Spruce Road and Bridge Street and Spruce and Hemlock Streets.

Spruce Street sheds to the southwest from the intersection with Bridge Street. Runoff from Spruce Street causes erosion and sedimentation along and in the road. Spruce Street ends at Hemlock Road where there are two existing drop inlets. One drop inlet is completely buried in sediment and appears to be no longer functional.

Estimated Costs:	**$44,000 - $66,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	3.10 ton/yr
• Total Phosphorus:	3.10 lb/yr
• Total Nitrogen:	6.10 lb/yr

Figure C-11: Spruce Road (lower/northern half) Conceptual BMPs, Richmond Shores, Richmond



Photos C-10: Spruce Road BMPs, looking north towards Richmond Pond (left photo) looking south, uphill (right photo)

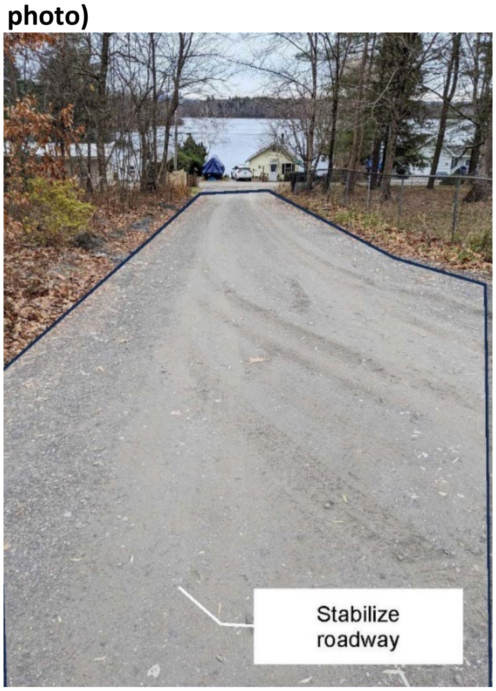
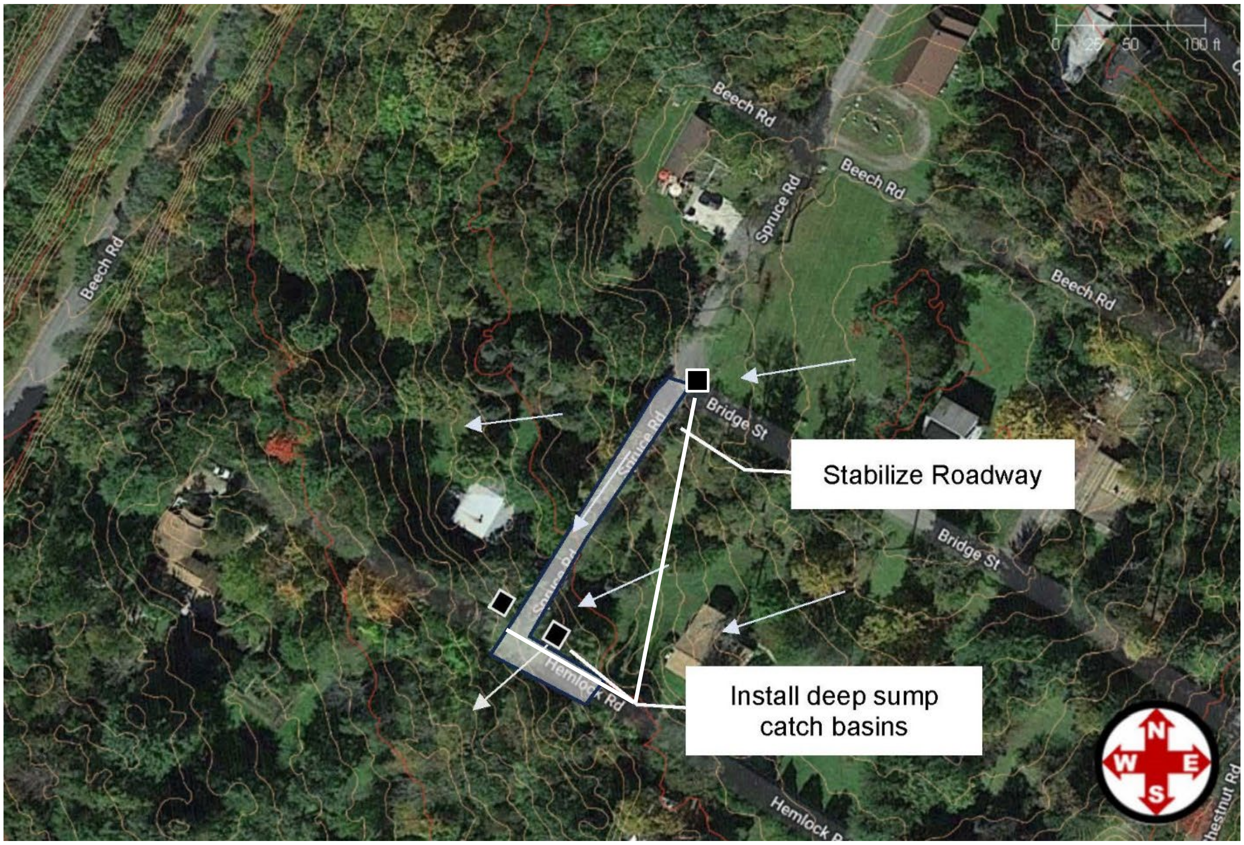
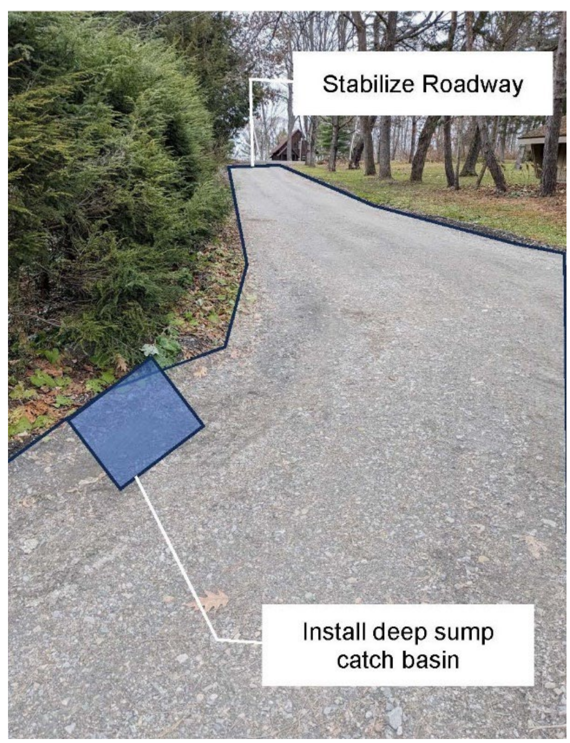


Figure C-12: Spruce Road (upper/southerly portion) conceptual BMPs, Richmond Shores, Richmond



Photos C-11: Spruce Road BMPs: deep sump catch basin location at the intersection of Bridge Street (left photo) and catch basin location at corner of Spruce and Hemlock Streets (right photo)



These BMPs focused on Spruce Road are designed to reduce road erosion and reduce the sediment and pollutant load entering Richmond Pond. Improvements that stabilize the gravel roads to prevent washouts and flooding needs to be considered for all of the Richmond Shores roads. Alternative options could also be considered such as repaving all of the roads with permeable or impermeable asphalt and adding additional drainage structures that support reduction in pollutant loads and improve the climate resilience of this community.

Richmond Shores has approximately two miles of gravel roads serving the community. **Table C-2** below provides a summary of each road's length, area, estimated costs for stabilizing the roads and the associated pollutant reduction. This information is based on the conceptual design for Spruce Road. The estimated costs do not include any additional recommended drainage infrastructure.

Table C-2: Richmond Shores Road Stabilization Estimated Costs and Pollutant Load Reduction

Road Name	Road Length (feet)	Road area (square feet)	Estimated Cost ($)	Total Phosphorous (lbs/year)	Total Nitrogen (lbs/year)	Total Suspended Solids (tons/year)
Spruce Road, South	520	10920	64,000 - 93,400	6.95	14.20	6.95
Spruce Road, North	260	5460	32,000 - 47,000	3.47	7.10	3.47
Shore Road	2,650	55,650	325,000 - 476,000	72.35	72.35	35.40
Chestnut Street	1600	33,600	196,000 - 287,000	21.37	43.68	21.37
Beech Road	500	10,500	61,000 - 90,000	6.68	13.65	6.68
Bridge Street	625	13,125	76,400 - 112,000	8.35	17.06	8.35
Hemlock Road	873	18,333	107,000 - 157,000	11.66	23.83	11.66
Cherry Street	720	15,120	88,000 - 130,000	9.62	19.66	9.62
Maple Road	260	5,460	32,000 - 47,000	3.47	7.109	3.47
Oak Road	1050	22,050	13,000 - 189,000	14.02	28.67	14.02
Willow Road	615	12,915	75,000 - 110,000	8.21	16.79	8.21
Pine Road	380	7,980	46,400 - 68,000	5.08	10.37	5.08
Elm Road	570	11,970	70,000 - 102,000	7.61	15.56	7.61
East Beach Road	430	9,030	52,500 - 77,000	5.74	11.74	5.74
TOTALS	**11,053**	**232,113**	**1,238,300 - 1,985,400**	**185**	**302**	**148**

10. Lake Road, Whitewood, Richmond

Location: Lake Road from Barker Road to Lake Road Extension (42.410325, -73.315222)
Property Ownership: Whitewood Homeowners Association

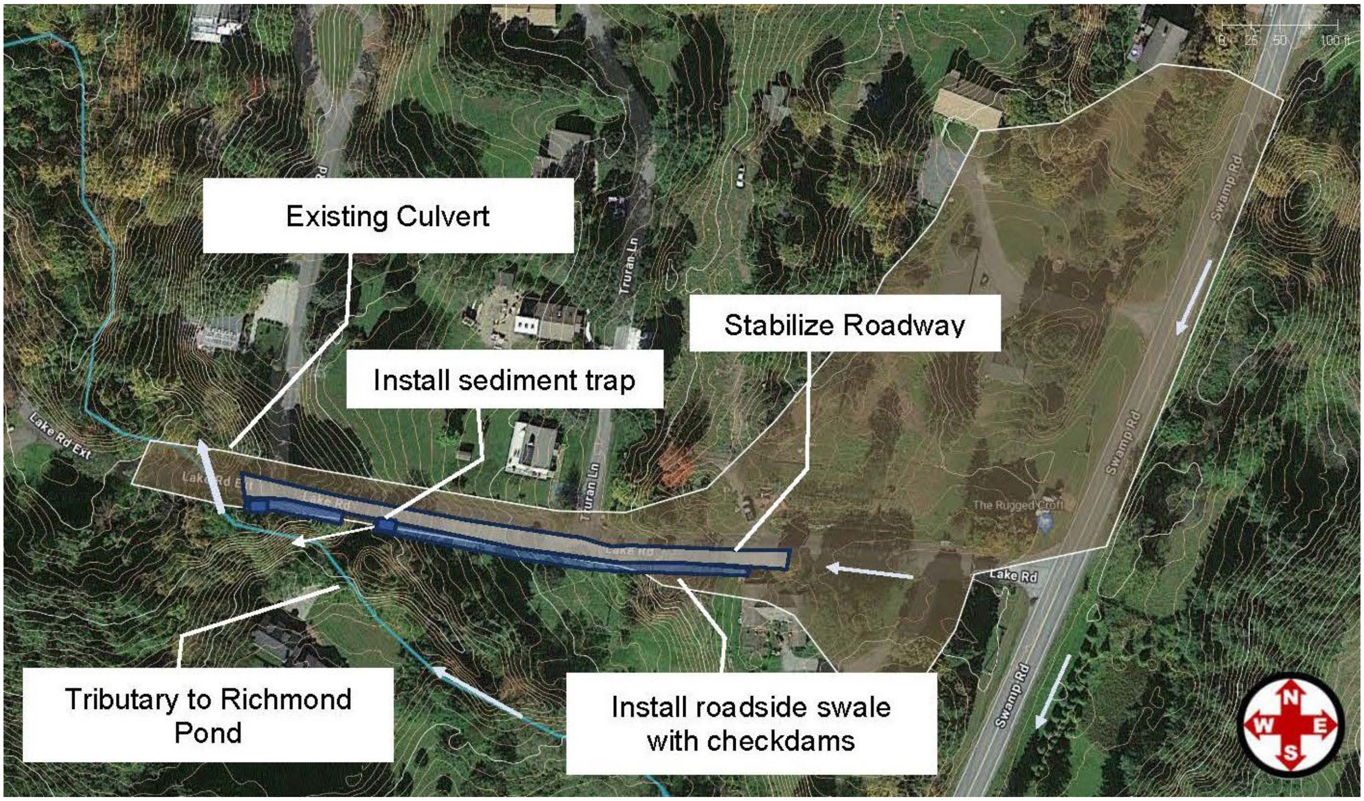
Site Description:
Lake Road is the main access to the private residential development, Whitewood in Richmond. It is a gravel road which is particularly steep coming off Barker Road. The existing drainage infrastructure is on the north side of the road and consists of a grassed swale with culvert pipes under driveways and roads. The steepness of the initial section of Lake Street results in concentrated runoff along both sides of the road and eroded channels are visible in the roadway. At the bottom of Lake Road before it turns right is the Richmond Pond tributary, known as Whitewood Brook. Road sediment enters the brook during every storm. Residents have observed a pile of sediment forming at the confluence of Whitewood Brook and Richmond Pond as a result of repeated erosion of this gravel road.

Proposed improvements include:

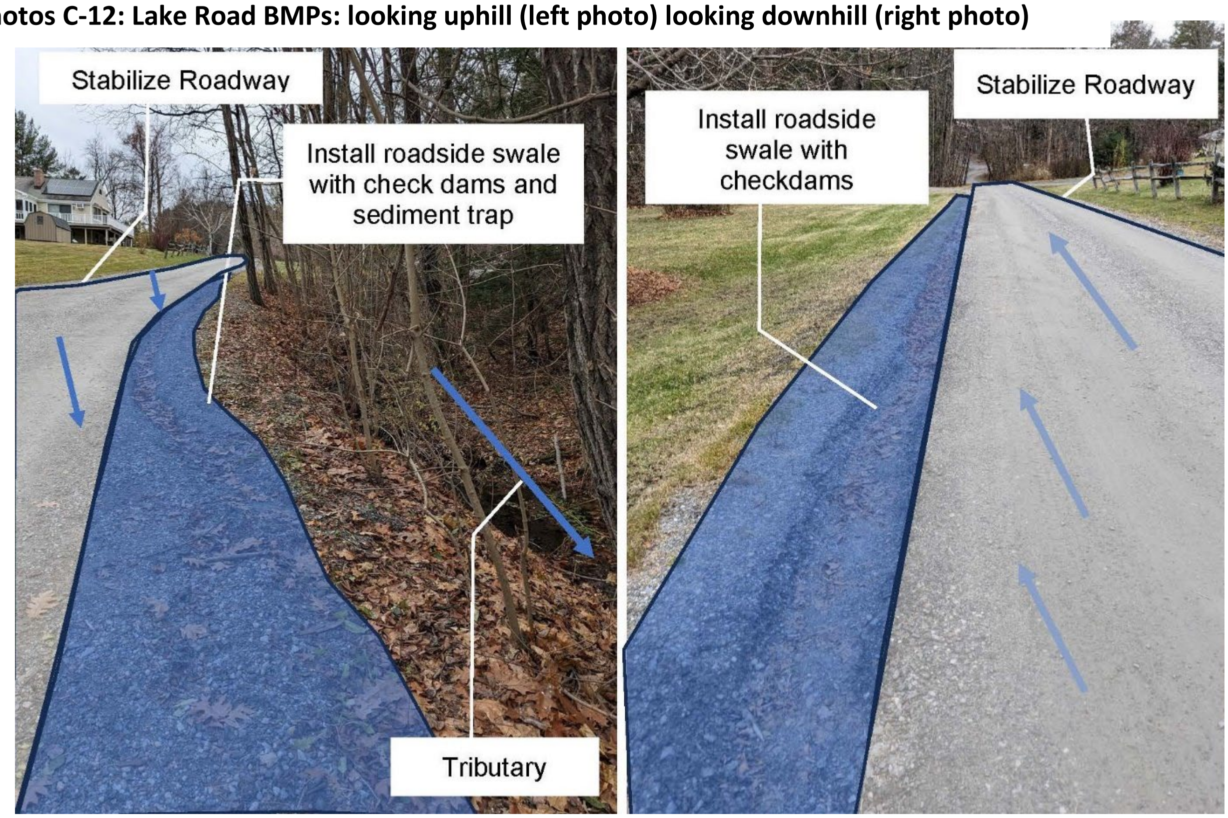
1. Stabilize roadway with crushed stone or pavement (approx. 6,750 SF).
2. Install roadside swales with check dams to reduce roadside erosion (approx. 2,250 SF).
3. Install sediment traps at the bottom of the swales.

Estimated Costs:	**$32,000 - $47,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	3.75 ton/yr
• Total Phosphorus:	3.96 lb/yr
• Total Nitrogen:	9.68 lb/yr

Figure C-13: Lake Road conceptual BMPs, Whitewood, Richmond



Photos C-12: Lake Road BMPs: looking uphill (left photo) looking downhill (right photo)



11. Maloy Brook, Route 20, Pittsfield

Location: West Housatonic Street, Adjacent to McDonalds (42.4428398, -73.275524)
Property Ownership: Central Berkshire Habitat for Humanity

Site Description:
Stormwater from Route 20 is discharged directly into Maloy Brook via asphalted swales and an outfall pipe severely degrading the brook with accumulated sediment and pollutants. Abutting the eastern side of the brook is a privately owned, undeveloped 3.96-acre parcel with deed easements for a billboard and sewer line for McDonalds. The current property owner, Central Berkshire Habitat for Humanity, recently removed much of the asphalt on the property and planted native species as compensatory credit for a development on the East Branch. There are no plans to ever develop this lot, as the property is in the riverfront of both Maloy Brook and the Southwest Branch. The owner is willing to donate the property to a conservatory or MassDOT. With about 90 feet of road frontage on a section of Route 20 managed by MassDOT, this property could be used to infiltrate stormwater from Route 20 that is currently discharged to Maloy Brook. This project will require the cooperation of MassDOT and the property owner and the willingness for MassDOT to take responsibility for ongoing maintenance of BMPs and management of the property.

Proposed BMPs:

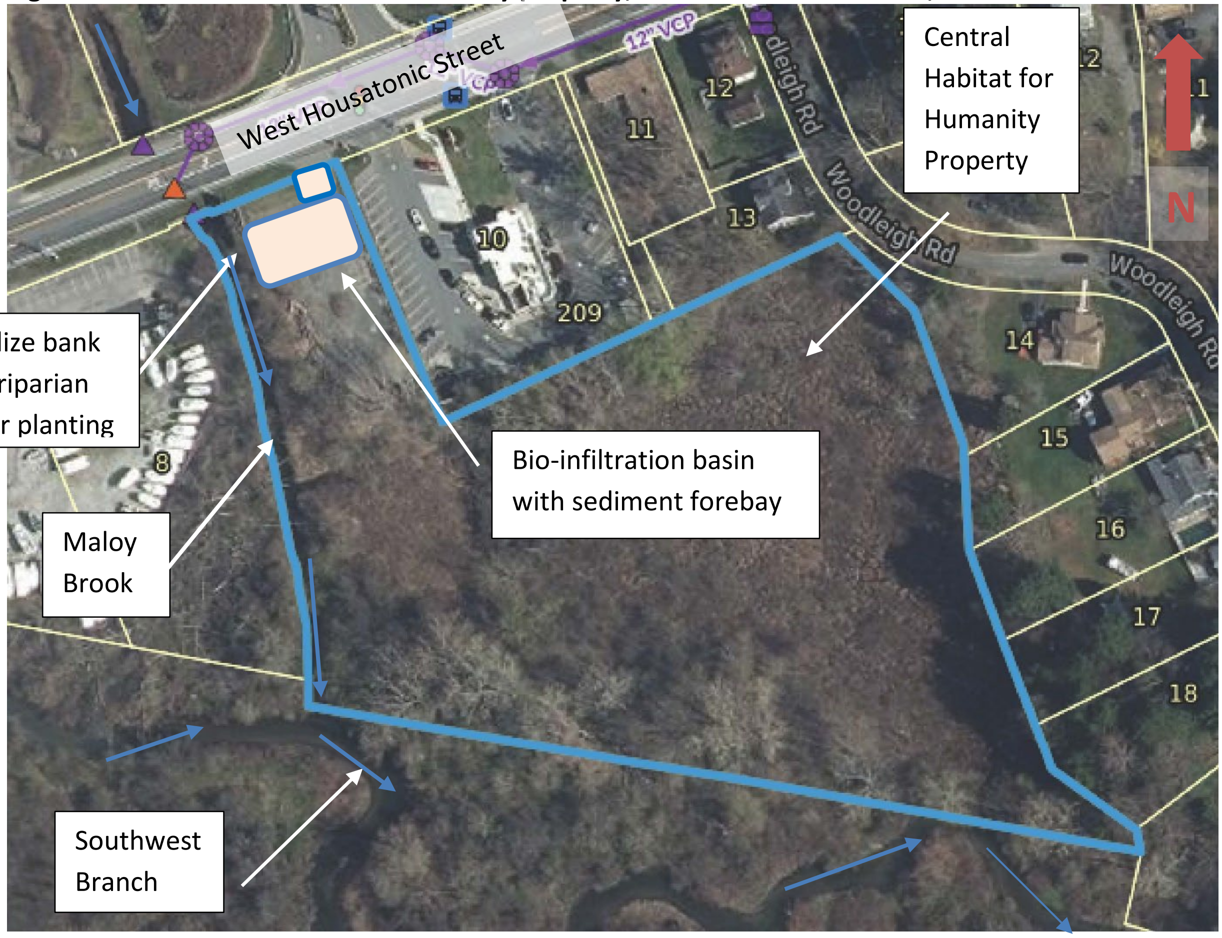
1. Remove the remaining asphalt
2. Install a 1,225 square foot bio-infiltration basin with a sediment forebay incorporating the current driveway entrance into the design.
3. A riparian planting along the eastern side of Maloy Brook would help stabilize the bank and provide shade.

Estimated Cost : **$20,000**

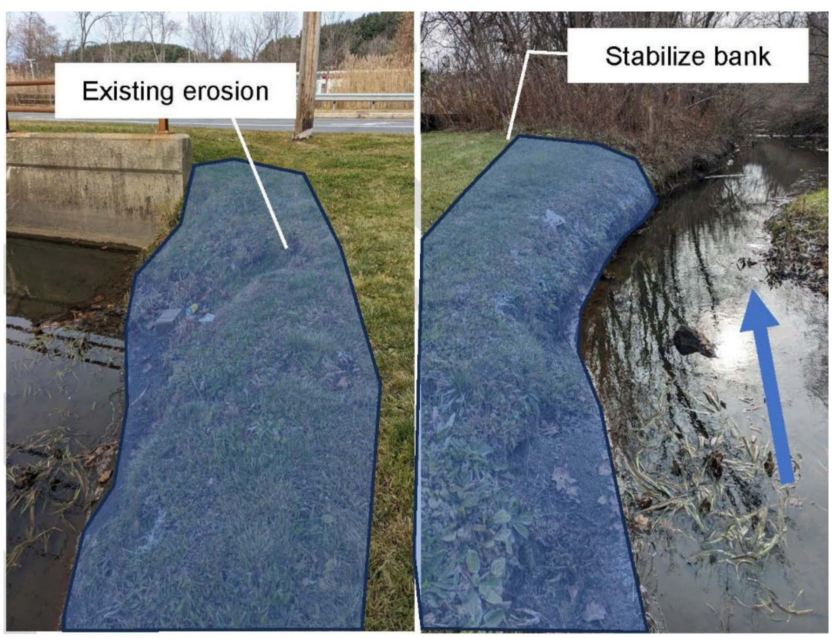
Estimated Nutrient Load Reduction:

- Total Suspended Solids: 263.8 tons/year
- Total Phosphorous 1.16 lbs/year
- Total Nitrogen 10.33 lbs/year

Figure C-16: Central Habitat for Humanity property, West Housatonic Street, Pittsfield



Photos C-13: Eastern bank of Maloy Brook



12. 703 West Housatonic Street

Location: Blue Q /Nash Building (42.439112, -73.284980)
Property Ownership: Seven Oh Three Nominee Trust and Seth Nash Trust

Site Description:
This commercial property located at 703 West Housatonic Street is the home of Blue Q. The property abuts the SWB and while much of it has a significant riparian buffer of about 80 – 90 feet, a 300-foot section of the riverfront northeast of the solar array has only a 25 – 50-foot buffer. The goal of this project would be to increase the width of the riparian buffer and improve the bank stability to reduce future erosion as well as increase the amount of shading for the river.

Proposed BMPs:
By delimiting mowing to encourage growth of trees and shrubs as well as planting native shrubs and trees, the riparian buffer width could be expanded up to 90 feet. This would add about 20,000 square feet or 0.4 acres of buffer and potentially reduce mowing costs. Native plants will also support wildlife biodiversity. If the remaining "field" was planted with native pollinator friendly plants this will increase the beauty, the diversity and the wildlife benefits of this area of the property. As noted in the riparian buffer fact sheet from the Massachusetts Clean Water Tool Kit:

> *"Wetlands and riparian areas provide a source of food, nesting material, habitat, and nursery areas for a variety of terrestrial and aquatic wildlife. Other important functions of wetlands and riparian areas include floodwater storage, erosion control, groundwater recharge, and maintenance of biological diversity. The ability of a riparian forest 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 (Cohen 1997). Effectiveness increases with increased detention time, and is reduced significantly in the absence of sheet flow. If the buffer is intended to function as a stormwater BMP, it should be used in conjunction with other BMPs, such as grass filter strips on the outer edge of the buffer to help diffuse runoff. This practice may achieve up to 75% sediment removal, 40% total nitrogen removal, 50% total phosphorus removal and 60 to 70% removal of trace metals (Schueler 1995)."*
> *(Source:https://megamanual.geosyntec.com/npsmanual/riparianforestbuffers.aspx)*

An additional consideration is the stormwater which flows downhill from Essex and Plymouth Streets to this site. With the property owner's permission, the potential exists for constructing bio-infiltration basins to infiltrate the stormwater from Essex, Plymouth and West Housatonic Streets.

Estimated Cost: $5,000 - $10,000

Estimated Nutrient Load Reduction:

- Total Suspended Solids: unknown
- Total Phosphorous 1.6 lbs/year
- Total Nitrogen 10.33 lbs/year

Figure C-15: 703 West Housatonic Street, Pittsfield

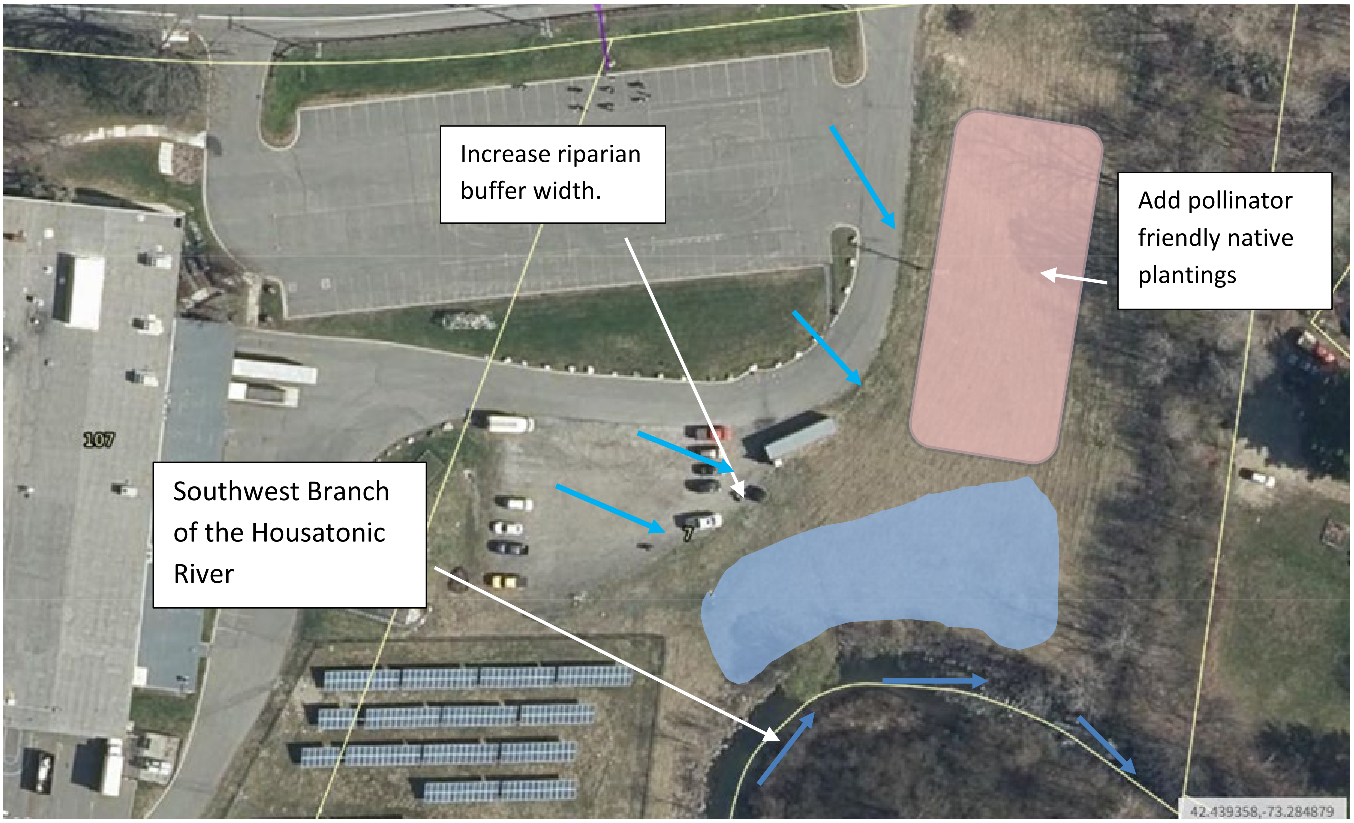


Table C-3: Proposed Structural BMPs Summary

SITE #	SITE NAME	BMP TYPE	BMP LOCATION	Total Suspended Solids (ton/yr)	Total Phosphorus (lb/yr)	Total Nitrogen (lb/yr)	ESTIMATED COST ($)
1	Pittsfield DPW Site	5 Bio-infiltration basins	232 West Housatonic Street, Pittsfield	0.94	8.89	77.22	262,000 - 320.000
2	Clapp Park #1	Grassed swale, Bioretention basin, flow splitter	Clapp Park, West Housatonic Street, Pittsfield	1.14	7.44	58.57	136,000
3	Clapp Park #2	Permeable pavement; improved riparian buffer	Clapp Park, West Housatonic Street, Pittsfield	0.12	0.83	6.37	212,000
4	Chapel and Vista Streets	Infiltration trench	Vista and Chapel Streets, Pittsfield	0.1	6.8	5.11	79,000
5	West and Churchill Street Intersection	Bioretention basin and improved swale	West and Churchill Street intersection, Pittsfield	0.2	1.32	9.83	158,000
6	Pittsfield Fire Department, Engine No 1	Bio-infiltration Basins	331 West Housatonic Street, Pittsfield	0.07	0.27	2.03	47,000
7	Richmond Town Beach on Richmond Pond	Bioswale and rain garden	Town Beach Road, Richmond	0.01	0.06	0.61	49,000
8	Richmond Pond Boat Access Parking Area	Improved bio-infiltration swale	Town Beach Road, Richmond	0.16	0.2	0.91	42,000
9	Spruce Road (lower/northern half), Richmond Shores	Gravel Road Stabilization	Spruce Road, Richmond	3.5	3.5	7	47,000
10	Spruce Road (upper/southerly portion), Richmond Shores	Gravel Road Stabilization	Spruce Road, Richmond	0.0015	3.1	6.1	66,000
11	Lake Street, Whitewood, Richmond	Vegetated Swales with check dams and sediment trap	Lake Street, Richmond	3.75	3.96	9.68	47,000
12	Central Berkshire Habitat Route 20 property	Bioretention basin; Stabilize stream bank	On Route 20 just east of Maloy Brook, Pittsfield	3.2	21.57	0.73	20,000
13	703 West Housatonic Street	Improved Riparian Buffer	703 West Housatonic Street, Pittsfield	unknown	1.6	10.33	10,000
			TOTAL	**13.2**	**56.4**	**188.4**	**913,000**

Non-Structural BMPs

Richmond Pond Weed Management, Richmond	
BMP TYPE	Implement an Updated Richmond Pond Weed Management Plan
BMP LOCATION	Richmond Pond
DESCRIPTION	Under an existing NOI approved by both the Town of Richmond and City of Pittsfield Conservation Commissions, various measures to reduce the growth of invasive aquatic plants have been undertaken including: an annual draw down of 2 feet between October 15 and February 15th; herbicidal treatments and manual removal of aquatic invasives. The current permit for weed management on Richmond Pond is expiring. An updated and approved weed management plan is necessary.
ESTIMATED POLLUTANT LOAD REDUCTIONS	NA
ESTIMATED COST ($)	20,000
Phosphorous Modeling Richmond Pond, Richmond	
BMP TYPE	Phosphorous Modeling for Richmond Pond
BMP LOCATION	Richmond Pond
DESCRIPTION	Phosphorus is an essential element for plant life, but when there is too much of it in water, it can speed up eutrophication. The sediment in Richmond Pond and the adjoining Canal may be rich in nutrients such as phosphorous. However, the current relationship between the phosphorous load and the pond's water chemistry is not fully understood and therefore it is difficult to make sound recommendations. Collecting nutrient samples in the pond for a season would first be necessary to inform an in-lake modeling analysis. The results of this analysis will inform the implementation of BMPs that will minimize algal blooms and support overall lake health. The cost includes developing a water quality monitoring program and lake modelling analysis.
ESTIMATED POLLUTANT LOAD REDUCTIONS	NA
ESTIMATED COST ($)	40,000
Water Quality Monitoring Review/Update Program, Richmond Pond Tributaries	
BMP TYPE	Water sampling
BMP LOCATION	Richmond Pond Tributaries
DESCRIPTION	Currently Richmond Pond Association is

ESTIMATED POLLUTANT LOAD REDUCTIONS	Sampling is currently conducted twice a year upstream of the confluence with Richmond Pond of each of the tributaries (Whitewood, Clark's, Tracy, the inlet and the outlet below the dam in the Southwest Branch). Current parameters measured include *E. coli*, nitrates, and phosphorous. Richmond Pond Association is interested in reviewing the current water quality monitoring and determine the nutrient inputs and how best to respond. There is also concern about the amount of sediment load being carried into Richmond Pond via Clark's Brook. The brook's level rises significantly after a storm and investigating and sampling this brook further during storms may be recommended.
ESTIMATED COST ($)	5,000 – 10,000

E. coli DNA analysis

BMP TYPE	DNA analysis of *E. coli* samples
BMP LOCATION	Southwest Branch of the Housatonic River and its Tributaries
DESCRIPTION	The Southwest Branch is listed as impaired for *E. coli*. However, reducing the stormwater and agricultural impacts may not be sufficient to reduce the *E. coli* levels in the Southwest Branch sufficiently to delist it for this impairment. The Southwest Branch watershed includes extensive wetlands and an active beaver population. HVA's water quality report recommended completing DNA analysis on multiple *E. coli* samples from the Southwest Branch and its tributaries. (This should be completed under a MassDEP approved QAPP) If the results show that the impairment is the result of a natural condition such as beavers, then the case can be made to the state to delist the SW Branch for *E. coli* impairment.
ESTIMATED POLLUTANT LOAD REDUCTIONS	N/A
ESTIMATED COST ($)	unknown

Storm Drain Decaling, Pittsfield

BMP TYPE	Storm Drain Decaling: Pittsfield
BMP LOCATION	Various locations within Pittsfield portion SWB watershed
DESCRIPTION	Reinitiate a program to decal storm drains that have high public visibility in the City of Pittsfield. Existing decals and glue are housed at HVA. Funding is needed to organize storm drain decaling by interns and volunteers with the support of paid staff. The estimated annual cost of this management measure is for the purchase of any additional supplies and contractor costs.
ESTIMATED POLLUTANT LOAD REDUCTIONS	NA
ESTIMATED COST ($)	5,000

Ongoing Management Measures:

1. City of Pittsfield's Street Sweeping Protocols

The entire City is swept at least two times a year, once in the fall and once in the spring. Main streets and parking lots are swept at a higher frequency (1-2 times a month). The city has increased street sweeping frequency of all municipal owned streets and parking lots which have potential for high pollutant loads. (City of Pittsfield's MS4 2022 Report)

2. Catch Basin Cleaning Protocols

City of Pittsfield

The City of Pittsfield has established catch basin cleaning protocols in accordance with the MS4 regulations. The City prioritizes inspection and maintenance of the 73 municipally managed catch basins located in the Southwest Branch watershed, to ensure that no sump shall be more than 50 percent full. Cleaning of catch basins is completed more frequently, if inspection and maintenance activities indicate excessive sediment or debris loadings. In 2021, 25 Catch basins were anecdotally identified as historically having sumps fill to and past 50% full. These catch basins were cleaned and rebuilt by the Highway Department. The city has a list of low-lying catch basins that are prone to flooding. These catch basins are more routinely inspected and maintained to ensure proper drainage.

Richmond Shores Private Development

The existing catch basins are regularly maintained. Volunteers regularly check the catch basins for any accumulated debris removing it as necessary especially before and after a storm. The Richmond Shores Civic Association hires a contractor to clean out the catch basins annually or biannually as needed.

Town of Richmond

Catch basins are routinely cleaned out on an annual basis by a hired contractor.

It is recommended that the above ongoing activities be evaluated to determine potential improvements to achieve higher pollutant load reductions such as increased frequency or improved technology.

Recommended Future Management Measures:

The narratives below outline additional structural and non-structural stormwater BMPs that could be considered. It should be noted that the two key municipalities in the SWB watershed, the City of Pittsfield and Town of Richmond have made a commitment to incorporate stormwater management BMPs wherever feasible.

As a high priority for climate resilience, the ***City of Pittsfield*** established a goal in their MVP Plan that the City will *"Assess cost-effective green infrastructure opportunities for stormwater management to develop a list of specific priority projects where reduction of stormwater runoff could mitigate flooding risk without the need to conduct expensive culvert replacement and resizing projects. Assess feasibility and cost, rank priority projects in terms of climate resilience potential, and develop concept designs for key projects. Review City regulations and update as necessary to support green infrastructure and low-impact development approaches."* (Source: Pittsfield MVP report).

As a part of the City of Pittsfield's MS4 requirements, the city's community development department has committed to the:

1. Review of existing regulations to determine the feasibility of making green infrastructure practices allowable when appropriate site conditions exist.
2. With regard to street design and parking lot guidelines, the city has committed to developing a report assessing requirements that affect the creation of impervious cover. The assessment will help determine if changes to design standards for streets and parking lots can be modified to support low impact design options.

The Town of Richmond underwent an analysis of flooding and stormwater issues in 2023 through a joint MVP Regional Action Grant with West Stockbridge. This report identified key locations for the Town of Richmond to construct bio-infiltration basins that will improve climate resilience. These infiltration basins will also improve water quality by reducing sediment and pollutants entering rivers. The Town of Richmond has plans to construct several bio-infiltration basins over the next few years and engage students in the process. Students will learn about stormwater and learn about plantings appropriate for the basins. Using their knowledge, they will design planting plans for the Town's bio-infiltration basins. (Source: Stakeholder meeting, Town of Richmond, 11/14/2023; Richmond West Stockbridge Climate Resilience Plan, 2023).

1. Stormwater BMPs on Private Properties

Private properties will provide additional locations for effective stormwater control measures that may also reduce existing flooding and erosion issues. Working with private property owners to remediate and infiltrate stormwater on-site can reduce the volume of stormwater entering and often overwhelming the municipally managed stormwater infrastructure. Several key sites have been identified as having potential for effective stormwater BMPs:

Springside Rehabilitation and Skilled Care Facility, Lebanon Avenue, Pittsfield: This facility is located on a hill and runoff from the parking lot and driveway flows downhill to Lebanon Avenue flooding of at least one residential property and the road in heavy rainstorms. Some of the runoff is directed to the Southwest Branch via an asphalted swale. There are potential locations on the property to infiltrate the stormwater and reduce the volume of runoff reaching Lebanon Avenue and the SWB. These BMPs may have the added benefit of eliminating flooding issues.

Churchill Crest Estates, West Street Pittsfield: As with the nursing home, this private residential development is located at the top of a hill. The stormwater runoff from the driveway is flooding West Street and is directed via City stormwater infrastructure directly to the tributary, Smith Brook, down a catch basin to a severely eroded channel. While a BMP conceptual design is proposed for this area, implementing BMPs on Churchill Crest will reduce the volume of stormwater from this private residential development and increase the effectiveness of the city's proposed BMPs.

703 West Housatonic Street: This property abuts the Southwest Branch and while much of it has a significant riparian buffer of about 80 – 90 feet, a 300-foot section of the riverfront has only a 25 – 50-foot buffer. Much of this section is periodically mowed. By delimiting mowing to encourage growth of trees and shrubs as well as planting native shrubs and trees, the riparian buffer width could be expanded up to 90 feet. This would add about 15,000 - 18,000 square feet of buffer and potentially reduce mowing costs. In addition, stormwater flows downhill from Essex and Plymouth Streets to this site. With the property owner's permission, the potential exists for siting bio-infiltration basins to infiltrate the stormwater from West Housatonic Street.

Commercial Properties on Richmond Pond: Two of the commercial properties on Richmond Pond are summer camps and operate seasonally. These are sizeable properties on Richmond Pond that may provide locations for effective stormwater control measures such as riparian buffers, infiltration basins and gravel road best management practices.

i. Camp Russell already implemented two stormwater BMPs, detention basins and rip-rapped swales as part of a former CWA Section 319 project (See Element A). A conversation with the current administration to update them about stormwater issues, review the effectiveness of the constructed BMPs and discuss any concerns or issues that they are having is warranted and may lead to a review of the site to consider any upgrades or locations for additional BMPs to reduce sediment and pollutants entering Richmond Pond. A review of the existing BMPs should include a discussion about their maintenance. At least one of the rip-rapped swales is being maintained manually by volunteers. Figuring out a long-term maintenance plan that can be sustainably funded is key to maintaining the BMPs effectiveness.
ii. Camp Arrowhead is under new management. Setting up a meeting to discuss the impacts of stormwater and any issues they have concerning their property is timely and may lead to potential stormwater BMP locations like the ones recommended for homeowners.

Richmond Pond "Be Pond Smart" Program: Locations where structural BMPs would be most effective are often on private individual residential properties. Funding would support a residential outreach program similar to the one currently being conducted by the Friends of Lake Garfield in Monterey, Massachusetts. With funding and administrative support, the Richmond Pond Association (RPA) would work with the homeowner associations (Whitewood, South Pond Farm, Richmond Shores and Branch Farm Cottages) to identify priority properties for siting stormwater BMPs based on the location and hydrology. RPA would work with property owners to sign a "Pond Smart Pledge" commitment in which homeowners agree to be included in a joint siting study that looks at where structural stormwater BMPs should go to maximize nutrient reduction. Once sited, homeowners within the program will commit to allowing BMP implementation on their property and assist with long-term, ongoing maintenance. Potential homeowner BMPs are outlined in Figure C-3.

Richmond Pond Riparian Buffers & Geese Management: *An added benefit of lake-front buffers is reduction in geese nuisance and bacterial loading from geese fecal matter*. Many properties on Richmond Pond, are impacted by a sizeable Canada goose population. Richmond Pond Association has initiated geese control methods including regularly chasing the geese away using dogs. While these methods have provided some success, improving riparian buffers is a more permanent method for reducing the geese nuisance. Replacing lawns that go right up to the lakefront with trees and shrubs reduces the attraction for geese to frequent these properties and also reduces bacterial loading from geese fecal matter. The installation of riparian buffers would be a key BMP promoted under the *Richmond Pond "Be Pond Smart" Program*

Figure C-17: Example BMPs for Homeowners (BRPC, 2022)

2. Recommended Solutions for Agricultural Impacts*:*

A watershed-wide initiative to implement farm conservation practices and agricultural BMPs is recommended to reduce the pollutant loading from agricultural land uses within the Southwest Branch of the Housatonic watershed.

After forested land, most of the acreage in this watershed is used for agriculture. According to **Tables A-16 and A-17** pollutants from these agricultural operations have the greatest impact on the water quality of the rivers, streams and ponds in this watershed. For example, results of *E. coli* samples collected on tributaries with agricultural operations, such as Jacoby and Smith Brooks, have indicated probable agricultural impact as the downstream *E. coli* levels exceed the state standards. Jacoby Brook sample results are typically elevated with readings of about 400 CFU /100 ml. In addition, a nature-based solutions analysis conducted by Trout Unlimited for the City of Pittsfield in 2023 recommended increasing the riparian buffer in agricultural fields that abut Jacoby, Lilly, Smith and May Brooks to reduce erosion and non-point source pollution (*Pittsfield Road-Stream Crossing Management Plan,* 2021-23 Lenox Regional MVP Action Grant).

It will be important to work with farmers and property owners (where farmers are leasing land) to identify locations and the willingness to install and adapt best management practices that will reduce agricultural non-point source pollution. HVA, the watershed organization for the Housatonic watershed, has initiated an agricultural non-point source pollution program and will have a dedicated Agricultural Non-Point Source Coordinator that will work closely with NRCS to support implementation of BMPs to improve water quality.

Examples of Agricultural BMPs that could be implemented include[15]:

- **Adopting Nutrient Management Techniques:** Farmers can improve nutrient management practices by applying nutrients (fertilizer and manure) in the right amount, at the right time of year, with the right method and with the right placement.
- **Using Conservation Drainage Practices:** Subsurface tile drainage is an important practice to manage water movement on and through many soils, typically in the Midwest. Drainage water can carry soluble forms of nitrogen and phosphorus, so strategies are needed to reduce nutrient loads while maintaining adequate drainage for crop production. Conservation drainage describes practices including modifying drainage system design and operation, woodchip bioreactors, saturated buffers, and modifications to the drainage ditch system.
- **Ensuring Year-Round Ground Cover:** Farmers can plant cover crops or perennial species to prevent periods of bare ground on farm fields when the soil and nutrients it contains are most susceptible to erosion and loss into waterways.
- **Planting Field Buffers:** Farmers can plant trees, shrubs, and grasses along the edges of fields; this is especially important for a field that borders water bodies. Planted buffers can help prevent nutrient loss from fields by absorbing or filtering out nutrients before they reach a water body. An added benefit is the added shade to keep streams cool and reduce evaporation.
- **Implementing Conservation Tillage:** Farmers can reduce how often and how intensely the fields are tilled. Doing so can help to improve soil health, and reduce erosion, runoff, and soil compaction, and therefore the chance of nutrients reaching waterways through runoff.
- **Managing Livestock Access to Streams:** Farmers and ranchers can install fences along streams, rivers, and lakes to block access from animals to help restore stream banks and prevent excess nutrients from entering the water.

[15] *Source:* https://www.epa.gov/nutrientpollution/sources-and-solutions-agriculture

- *Another source of information about agricultural BMPs which includes effectiveness, impacts to surface waters, advantages for farms, cost and operation and maintenance considerations, estimated system lifespan, and NRCS Standards that could be used is available at https://extapps.dec.ny.gov/docs/water_pdf/agriculturebmp.pdf*

3. Implement BMPs at Road-Stream Crossing Replacements

City of Pittsfield: In line with the goal of incorporating stormwater BMPs whenever feasible, the City of Pittsfield will consider options and include stormwater BMPs when reviewing and permitting culvert replacement projects, if cost effective and feasible. Priority culvert replacement projects located in the City of Pittsfield portion of the watershed include:

i. Cloverdale / Southwest Branch of the Housatonic River (42.42307, -73.30985)
ii. Melbourne / Southwest Branch of the Housatonic River (42.43071, -73.31014)
iii. West Street / May Brook (42.45822, Long: -73.31925)
iv. West Street / Smith Brook (42.45614, -73.30466)

Town of Richmond: Richmond could consider incorporating stormwater BMPs as they proceed with the design and permitting of culvert replacements. The current priorities include:

i. Sleepy Hollow Road/Cone Brook (42.38820, -73.35943)
ii. Beach Road/Clark's Brook (42.41671, -73.33134)

Richmond Shores: Shore Road/Canal road-stream crossing (42.41105, Long: -73.33103). The Richmond Shores Civic Association has concerns about their road crossing and have indicated that sediment enters the canal and Richmond Pond via this road stream crossing. When this crossing is replaced, it is an opportunity to include stormwater BMPs to greatly reduce the sediment input to the pond. The greatest obstacle is funding the replacement as it is a private association which struggles to fund the maintenance of current infrastructure.

4. Gravel Road Maintenance and Upgrades

Stabilizing gravel roads provides long-term maintenance and public safety benefits and benefits the water quality of our rivers and lakes by minimizing the sediment deposits which can carry pollutants to the waterbody.

Town of Richmond: Fifty percent of all the roads in the Town of Richmond are gravel. With increasing intensity of storms, Richmond is experiencing more instances of roads eroding and washing out. Very often the road sediment is deposited into waterbodies in the process. Using recommendations proposed in the recent climate resilience study, the Town of Richmond is working to upgrade the most critical sections of gravel roads. Due to the prohibitive costs to upgrade the gravel roads, the Town must prioritize the upgrades and phase them in over the years. Additional funding support would increase the pace of upgrades and reduce the impact of sediment-laden stormwater on streams and lakes.

Private Developments (Richmond Shores, Branch Farm Cottages and Whitewood, Richmond):
These private developments all use gravel for their road substrate and are experiencing road erosion issues that lead to excessive amounts of road gravel being deposited into Richmond Pond tributaries and ultimately Richmond Pond. In addition, gravel roads require costly regular maintenance. Funding would support the homeowner associations develop a plan for stabilizing the existing roads and provide

a sustainable maintenance plan. Once implemented, this plan would improve the water quality of Richmond Pond and the climate resilience of these private communities.

5. **Berkshire Community College (BCC) Stormwater Management Improvements**

   BCC has begun a conversation about improving their stormwater management on campus including implementing infiltration basins that will absorb the stormwater from parking lots and converting expanses of lawn areas into pollinator meadows.

6. **Identify Additional Locations for Stormwater BMPs**

   As work progresses on implementing stormwater BMPs in the Southwest Branch Watershed, additional sites are likely to be identified. For example, there is concern about Clark's Brook and the amount of sediment being carried into Richmond Pond via the brook. This could be due to the input of stormwater and further investigation may reveal stormwater solutions upstream of the confluence with Richmond Pond.

BMP Maintenance Oversight

The effectiveness of BMPs is reduced if they are not properly maintained. Operations & Maintenance Plans will be developed for all BMPs, and the responsible parties for BMP maintenance will be clearly stated and trained by the contractor which installed the BMP(s) to conduct proper maintenance according to the O&M Plan.

Whether private or municipally owned, it would behoove the stakeholders to maintain a database and put in place a plan that ensures that implemented BMPs are being maintained properly. This may require the municipalities to take on the responsibility of oversight.

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.

Tables D-1 through D-4 presents the funding needed to implement the management measures presented in this watershed plan. The table includes costs for structural and non-structural BMPs, operation and maintenance activities, information/education measures, and monitoring/evaluation activities.

Guide to Funding Sources to Address NonPoint Source Pollution

Structural BMP Funding Needed

Table D-1: Summary of Funding Needed to Implement the Watershed Plan Structural BMPs (Element C)

Management Measures	Location	Capital Costs	Operation & Maintenance Costs (Annual)	Relevant Authorities	Technical Assistance Needed	Funding Needed
Bio-infiltration Basins (5)	Pittsfield DPW, 232 West Housatonic Street	$320,000	$7,000	City of Pittsfield	Engineering Consulting Firm	$0 (LISFF funding obtained)
Grassed swale, Bioretention basin, flow splitter	Clapp Park, West Housatonic Street, Pittsfield	$136,000	$5,200	City of Pittsfield	Berkshire Regional Planning Commission; Engineering Consulting Firm	$136,000
Permeable pavement; improved riparian buffer	Parking area, Clapp Park, West Housatonic Street, Pittsfield	$212,000	$1,000	City of Pittsfield	Berkshire Regional Planning Commission; Engineering Consulting Firm; City of Pittsfield	$212,000

Table D-1: Summary of Funding Needed to Implement the Watershed Plan Structural BMPs (Element C)						
Management Measures	**Location**	**Capital Costs**	**Operation & Maintenance Costs (Annual)**	**Relevant Authorities**	**Technical Assistance Needed**	**Funding Needed**
Sediment Forebay, infiltration trench and bio-infiltration basin	Gale Avenue, Pittsfield (at and west of intersection with Fort Hill Avenue	$22,000	$6,000	City of Pittsfield	Engineering Consultant	$22,000
Bio-infiltration Basins	Pittsfield Fire Department, Engine No 1, West Housatonic Street, Pittsfield	$47,000	$6,400	City of Pittsfield	Engineering Consultant	$47,000
Infiltration trench	Vista and Chapel Streets, Pittsfield	$79,000	$3,200	City of Pittsfield	Engineering Consultant	$79,000
Bioretention basin and improved swale	West and Churchill Street intersection, Pittsfield	$158,000	$5,000	City of Pittsfield	Engineering Consultant	$158,000
Grassed Swales, Bio-infiltration basin	West Street	40,000	5,000	City of Pittsfield	Engineering Consultant	40,000
Bio-infiltration Basin with French Drain	Richmond Town Beach on Richmond Pond	$49,000	$4,000	Town of Richmond	Engineering Consultant	$49,000
Improved bio-infiltration swale	Richmond Pond Boat Access, Richmond	$26,000	$4000	Town of Richmond	Engineering Consultants	$26,000
Gravel Road Stabilization	Spruce Road (lower/northern half) Richmond Shores	$47,000	$6,000 (for all roads)	Richmond Shores Civic Association	Engineering Consultant, Berkshire Regional Planning Commission	$47,000

Table D-1: Summary of Funding Needed to Implement the Watershed Plan Structural BMPs (Element C)						
Management Measures	**Location**	**Capital Costs**	**Operation & Maintenance Costs (Annual)**	**Relevant Authorities**	**Technical Assistance Needed**	**Funding Needed**
Gravel Road Stabilization	Spruce Road (upper/southerly portion), Richmond Shores, Richmond	$66,000	$6,000 (for all roads)	Richmond Shores Civic Association	Town of Richmond, BRPC	$66,000
Vegetated S wales with check dams and sediment trap	Lake Road, Whitewood, Richmond	$47,000	$2,000	Whitewood (HOA)	Town of Richmond, BRPC, Engineering Consultants	47,000
Bioretention basin; Stabilize stream bank	Central Berkshire Habitat property on Route 20 just east of Maloy Brook, Pittsfield	20,000	7,000	Central Berkshire Habitat for Humanity; Massachusetts Department of Transportation	Engineering Consultant; MassDOT	20,000
Improved Riparian Buffer	703 West Housatonic Street	$10,000	$0	703 Nominee Trust	HVA, BRPC, BEAT, Native Plant Nursery	$10,000
					STRUCTURAL BMP TOTAL	**$959,000**

Non Structural BMP Funding Needed

Table D-2: Summary of Funding Needed to Implement the Watershed Plan Non-Structural BMPs (Element C)						
Management Measures	**Location**	**Capital Costs**	**Operation & Maintenance Costs (Annual)**	**Relevant Authorities**	**Technical Assistance Needed**	**Funding Needed**
DNA Analysis of *E. coli* samples	Southwest Branch and key tributaries	Unknown	Unknown	HVA, BRPC	Mass DEP, BRPC, Technical Consultant, Identified lab	Unknown (estimated at $25,000)
Implement an Updated Weed Management Plan	Richmond Pond	$20,000	Estimated between $5000 - $15,000	City of Pittsfield; Town of Richmond; Richmond Pond Association	Natural Heritage; MassDEP; BRPC; Technical Consultants	$35,000
Phosphorous Modelling for Richmond Pond	Richmond Pond	$40,000	$0	City of Pittsfield, Town of Richmond, Richmond Pond Association	MassDEP; Lakes and Ponds Specialist.	$40,000
Water Quality Monitoring Review/Update Program	Richmond Pond Tributaries	$10,000	See D-4	Richmond Pond Association, HVA	Mass DEP	$5,000
Storm Drain Decaling: Pittsfield	Various locations within Pittsfield portion SWB watershed		$5,000	City of Pittsfield	HVA	$5,000
					NON-STRUCTURAL BMP TOTAL	**$110,000**

Information/Education Funding Needed

Table D-3: Summary of Funding Needed to Implement the Watershed Plan Information/Education (Element E)						
Management Measures	**Location**	**Capital Costs**	**Operation & Maintenance Costs (Annual)**	**Relevant Authorities**	**Technical Assistance Needed**	**Funding Needed**
Boat Monitors	Richmond Pond Boat Access, Richmond	$0	$30,000	Town of Richmond	Trained Monitors	18,000
Richmond Record news articles	Richmond Pond		$4,000	Richmond Pond Association	HVA; Berkshire Regional Planning Commission	$4,000
Richmond Pond Smart - Residential Program	Richmond Pond - multiple private properties	$8,000	$15,000	Richmond Pond Association, Richmond Conservation Commission	Engineering and Landscaping; Housatonic Valley Association and Berkshire Regional Planning Commission	$23,000
River Smart Education Program	Throughout the watershed		$25,000	Town of Richmond, City of Pittsfield, Richmond Pond Association	Housatonic Valley Association and Berkshire Regional Planning Commission	$25,000
Watershed Education for Fifth Grades	Elementary Schools in Pittsfield and Richmond		$15,000	City of Pittsfield; Town of Richmond	Mass Audubon	$15,000
Signage at Constructed BMPs	Various		Estimated at $1000/sign	Respective Property Owners or Municipality	Graphic Artist, Berkshire Regional Planning Commission	$3,000
					INFORMATION/EDUCATION TOTAL	**$88,000**

Monitoring and Evaluation Funding Needed

Table D-4: Summary of Funding Needed to Implement the Watershed Plan Monitoring and Evaluation (Elements H & I)

Management Measures	Location	Capital Costs	Operation & Maintenance Costs (Annual)	Relevant Authorities	Technical Assistance Needed	Funding Needed
Water Quality Monitoring for Richmond Pond	Richmond Pond		$7,000	Richmond Pond Association	Housatonic Valley Association and Berkshire Regional Planning Commission	$7,000
Cyanobacteria/Algal Bloom Monitoring	Richmond Pond		$3,500	Richmond Pond Association, City of Pittsfield, Town of Richmond	Lakes and Ponds Association - West	$3,500
Water Quality Monitoring (N, P, *E. coli*, DO) Southwest Branch and Tributaries	Watershed wide		$15,000	Housatonic Valley Association, Richmond Pond Association	MassDEP	$15,000
MONITORING AND EVALUATION TOTAL:						**$25,500**

Potential Funding Sources:

- DEP-319: MassDEP Clean Water Act Section 319 Grant Program
- DEP-604b: MassDEP Clean Water Act Section 604b Grant Program
- MADEP-WQ: MassDEP Water Quality Grant Program
- EOEEA-MVP: EOEEA Municipal Vulnerability Program (MVP) Action Grant
- BTCF-Crane: Crane Family Fund, Berkshire Taconic Community Foundation Grants
- MET: Massachusetts Environmental Trust
- LISFF: National Wildlife's Long Island Sound Futures Fund
- MADER-BCCC: MA DER - Berkshires Clean Cold and Connected Partnership
- MA-BIG: Massachusetts Boating Infrastructure Grant Program
- LAPA-West: Western Massachusetts Lakes and Ponds Association

Summary of Funding Needed to Implement the Watershed Based Plan

Table D-5: Summary of Total Funding Needed by Management

Proposed Management Measure	Total Funding Needed
Structural BMPs	$959,000
Non- Structural BMPs	$110,000
Information/Education	$88,000
Monitoring and Evaluation	$25,500
Total Funding Needed:	**$1,182,500**

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.

Step 1: Goals and Objectives

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

Watershed - wide

1. Provide information about proposed stormwater improvements and their anticipated water quality benefits.
2. Provide information to promote watershed stewardship.

Richmond Pond

1. Promote the reduced use of fertilizers and pesticides
2. Promote the planting of lake-front vegetation buffers
3. Mitigate, manage, and reduce the prevalence and spread of aquatic invasives (particularly Eurasian milfoil) through a comprehensive weed management program.

Step 2: Target Audience

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

Watershed Wide:

1. All watershed residents
2. Lakefront/Riverfront property owners
3. Larger Businesses within the watershed.
4. Watershed organizations and other user groups: Richmond Pond Association, Housatonic Valley Association (Berkshire Members), Berkshire Environmental Action Team, Mass Audubon (Berkshire members), and Taconic Chapter of Trout Unlimited.

On Richmond Pond

Around Richmond Pond the primary audiences to target are residents and seasonal homeowners, especially those located nearest to the Lake. Outlined below are specific groups, organizations, and membership that reach that audience along with additional audiences targeted through education efforts:

1. Richmond Pond Association
2. Richmond Shores Civic Association

3. Western Massachusetts Lakes and Ponds Association Members
4. Recreational users of Richmond Pond (boaters, beachgoers)
5. Second homeowners/Seasonal residents
6. Camp Owners, Operators, Administrative staff, and campers
7. Lakeside Homeowner's Associations (Whitewood, Branch Farm, Richmond Shores and South Pond Farm Association)

Step 3: Outreach Products and Distribution

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

Watershed and water quality related issues have been a source of outreach for many years as outlined in Element A. Much of the activities listed below describe ongoing efforts to educate Southwest Branch and Richmond Pond residents as well as the wider community in the City of Pittsfield and Town of Richmond.

Watershed – Wide:

1. **Watershed Education for Fifth Grades:** Stakeholders such as HVA and Mass Audubon will work with the Town of Richmond and City of Pittsfield School Districts to present a watershed-based curriculum developed for 5th graders during their water unit. This series of lessons teaches students about stormwater runoff, nonpoint source pollution and green infrastructure solutions through stormwater modeling. Where possible, students will have an opportunity to visit implemented BMPs.

2. **Signage at BMP locations:** For notably public locations, such as Clapp Park in Pittsfield and the Town Beach in Richmond, interpretive signage explaining the stormwater practices that have been installed will help further educating the public about stormwater and stormwater control measures.

3. **River Smart program**: This program would be designed to reach residents with various messages using multiple avenues and social media platforms:
    a. Review existing outreach materials such as the ***Pittsfield River Smart*** brochure and the ***Landscaping for Climate Change fact sheet, and the City of Pittsfield's utility inserts*** and develop outreach materials that includes practicable suggestions and designs for small stormwater BMPs that property owners can implement on their property as well as climate resilient solutions. These will need to be printed in Spanish as well as English. Work on messaging multiple times a year. Key messages include proper pet waste disposal; proper yard waste management; proper use of fertilizers and encouraging minimal use of fertilizers.
    b. Distribute developed materials:
        i. Pass out brochures and other materials at public events such as farmers markets to reach people that may not normally receive this information.
        ii. Complete a direct mailing to stream-side property owners.
        iii. Include information notices in utility inserts.
        iv. Create or locate existing ad slides or short videos that can be used on websites at the local Beacon Cinema and social media platforms to educate residents.

4. **Website Information:** the watershed-plan and water quality improvement efforts will be posted and linked to websites hosted by but not limited to Richmond Pond Association, Lakes and Ponds Association of Western Massachusetts, Housatonic Valley Association, and the City of Pittsfield's and the Town of Richmond website when appropriate.

5. **Create outreach materials supporting structural BMPs** outlined in Element C. This would include many of the above outreach methods and additionally include direct mailings to neighbors of structural BMPs and the larger watershed community in both Richmond and Pittsfield; information sessions open to the public providing updates to BMP implementation.

Richmond Pond:

1. **Richmond Record News articles** - Richmond Pond Association will continue to submit articles to the Richmond Record and include topics that range from water quality health, ways residents can help improve water quality, progress on the watershed-based plan and implementation of stormwater control measures, and green infrastructure installments aimed toward reducing pollutants.

2. **Boat Access Signage -** Richmond Pond boat launch has a kiosk in place and traditionally includes signage informing visitors who pass by or recreate at the lake of the risk of invasives and how to prevent spread. The boat access site is not an appropriate site for a boat wash station, therefore directions to the closest boat wash station have in the past been included. The signage should be reviewed and updated. The boat wash station that had been recommended in Pittsfield is no longer a viable option and an alternative boat wash may need to be proposed.

3. **Boat monitors educate** and distribute flyers on proper boat washing techniques that will reduce / prevent aquatic invasive dispersal via boat management.

Step 4: Evaluate Information/Education Program

Information and education efforts and how they will be evaluated.
The above outreach methods will be measured by the following metrics:

Watershed – Wide:

1. **Watershed Education for Fifth Grades:** Watershed Education: Number of classrooms reached and # of student hours.
2. **Signage at BMP locations:** number of watershed signs installed, number that already exist.
3. **River Smart program:**
    a. Number of brochures distributed
    b. Number of people who have engaged in River Smart Activities
    c. Number of hits on any social media postings.
4. **Websites**: number of website visitors to water quality specific pages and information
5. **Create outreach materials supporting structural BMPs:** number of flyers distributed, number of people reached.

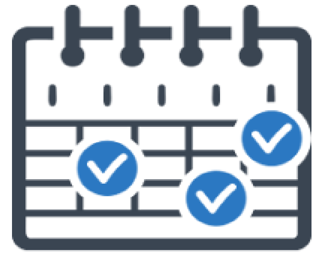
Richmond Pond:

4. **Richmond Record News articles** - number and frequency of articles written.
5. **Boat Monitoring Program**: number of boaters engaged, number of flyers distributed

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.

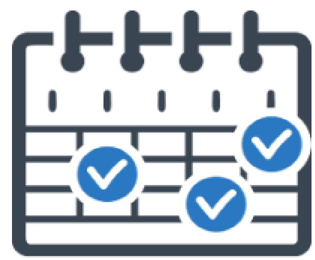
Element G: A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.



Tables FG-1 through FG-4 provide a preliminary schedule for implementation of the recommendations made in this WBP for structural and non-structural BMPs and the associated public education and outreach and water quality monitoring programs. It is expected that the WBP will be reevaluated and updated every five years, or as needed, based on ongoing monitoring results and other ongoing efforts. New projects for further implementation of the WBP will be identified through future data analysis and stakeholder engagement and will be included in updates to the implementation schedule.

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.



Tables FG-1 to FG-4 provide a preliminary schedule for implementation of the recommendations made in this WBP for structural and non-structural BMPs and the associated public education and outreach and water quality monitoring programs. It is expected that the WBP will be reevaluated and updated every five years, or as needed, based on ongoing monitoring results and other ongoing efforts. New projects for further implementation of the WBP 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

Structural BMPs					
Proposed Stormwater BMPs	**Interim Milestone #1**	**Interim Milestone #2**	**Interim Milestone #3**	**Interim Milestone #4**	**Interim Milestone #5**
Bio-infiltration basins *DPW Site, West Housatonic Street*	Final Design and Engineering	Complete construction	Monitoring and Maintenance		
	2024	2025	Annually		
French Drain; Bio-infiltration basin; porous paving *Clapp Park, West Housatonic Street, Pittsfield*	Apply for funding and gather project team	Develop preliminary designs with Community input	Final Engineering and Permitting	Complete Construction	Monitoring and maintenance
	Within 2 years	Within 4 years	Within 6 years	Within 10 years	Ongoing
Sediment Forebay, infiltration trench and basin *Gale Avenue, Pittsfield (at and west of intersection with* *Fort Hill Avenue*	Apply for funding and gather project team	Develop preliminary designs with Community input	Final Engineering and Permitting	Complete Construction	Monitoring and maintenance
	Within 2 years	Within 4 years	Within 6 years	Within 10 years	Ongoing
Bio-infiltration Basins *Pittsfield Fire Department, Engine No 1, West Housatonic Street, Pittsfield*	Apply for funding	Final Engineering and Permitting	Complete Construction	Monitoring and maintenance	
	Within 4 years	Within 6 years	Within 8 years	Ongoing	
Bioretention basin *Vista and Chapel Street intersection, Pittsfield*	Apply for funding and gather project team	Develop preliminary designs with Community input	Final Engineering and Permitting	Complete Construction	Monitoring and maintenance
	Within 1 year	Within 2 years	Within 4 years	Within 6 years	Ongoing
Bioretention basin; Stabilize stream bank *Central Berkshire Habitat property on Route 20 just*	Obtain MassDOT support for the project	Apply for funding and gather project team	Develop preliminary designs with Community input	Final Engineering and Permitting	Complete Construction

Structural BMPs					
Proposed Stormwater BMPs	**Interim Milestone #1**	**Interim Milestone #2**	**Interim Milestone #3**	**Interim Milestone #4**	**Interim Milestone #5**
east of Maloy Brook, Pittsfield	Within 2 years	Within 3 years	Within 4 years	Within 5 years	Within 6 years
Bio-infiltration Basin with French Drain *Richmond Town Beach on Richmond Pond*	Apply for funding and gather project team	Develop preliminary designs with Community input	Final Engineering and Permitting	Complete Construction	Monitoring and maintenance
	Within 2 years	Within 4 years	Within 6 years	Within 10 years	Ongoing
Improved bio-infiltration swale *Richmond Pond Boat Access, Richmond*	Apply for funding and gather project team	Develop preliminary designs with Community input	Final Engineering and Permitting	Complete Construction	Monitoring and maintenance
	Within 2 years	Within 4 years	Within 6 years	Within 10 years	Ongoing
Gravel Road Stabilization *Spruce Road (lower/northern half) Richmond Shores*	Apply for funding and gather project team	Develop preliminary designs with Community input	Final Engineering and Permitting	Complete Construction Develop maintenance plan	Monitoring and maintenance
	Within 1 year	Within 3 years	Within 4 years	Within 6 years	Ongoing
Gravel Road Stabilization *Spruce Road (upper/southerly portion), Richmond Shores, Richmond*	Apply for funding and gather project team	Develop preliminary designs with Community input	Final Engineering and Permitting	Complete Construction Develop maintenance plan	Monitoring and maintenance
	Within 1 year	Within 3 years	Within 4 years	Within 6 years	Ongoing
Improved Riparian Buffer *703 West Housatonic Street*	Apply for funding and gather project team	Develop preliminary designs with property owner	Final Engineering and Permitting	Complete Construction Develop maintenance plan	Monitoring and maintenance
	Within 2 years	Within 3 years	Within 4 years	Within 6 years	Ongoing

Table FG-2: Implementation Schedule and Interim Measurable Milestones

Non-Structural BMPs					
Proposed Stormwater BMPs	**Interim Milestone #1**	**Interim Milestone #2**	**Interim Milestone #3**	**Interim Milestone #4**	**Interim Milestone #5**
DNA Analysis of *E. coli* samples	Develop a plan and budget	Obtain funding	Complete QAPP and conduct sampling	Propose delisting, if the results indicate justification	
	Within 1 year	Within 2 years	Within 3 years	Within 3 years	
Implement an Updated Weed Management Plan *Richmond Pond*	Develop and gain Conservation Commission and MassDEP approval	Implement plan	Review and update		
	Within 1 year	Annually - Ongoing	Every three years		
Phosphorous Modelling for Richmond Pond *Richmond Pond*	Obtain funding	Collect necessary data for one season	Modelling Plan completed and recommendations reviewed	Results and recommendations added to the SWB WBP	
	Within 2 years	Within 3 years	Within 4 years	At the 5-year review	
Water Quality Monitoring Review / Update program	Develop clear water quality goals and obtain technical assistance from Mass DEP. Figure out funding required to implement.	Obtain funding	Implement plan	Update SWB WBP with any changes, results and recommendations	Continue monitoring as recommended
	Within 1 year	Within 1 year	2025 season	End of 2025 season	Annually - ongoing
Storm Drain Decaling: Pittsfield *Various locations within Pittsfield portion SWB watershed*	City of Pittsfield contract with an organization such as HVA to complete decaling program				
	Annually - Ongoing				

Table FG-3: Implementation Schedule and Interim Measurable Milestones

Public Education & Outreach						
Proposed Stormwater BMPs	**Interim Milestone #1**	**Interim Milestone #2**	**Interim Milestone #3**	**Interim Milestone #4**	**Interim Milestone #5**	**Interim Milestone #6**
Boat Monitors	Hire Seasonal Monitors					
	Annually / Ongoing					
Richmond Record News Articles	6 Articles (May – Oct)					
	Ongoing-Annually					
Richmond Pond Smart – Residential Outreach Program	Program funding obtained	Pamphlets & outreach materials created and distributed	10 properties identified for rain garden and/or buffer planting	500 linear feet of vegetative buffer installed	6 rain gardens installed and property owners trained in maintenance	Project reflection and review
	Within 2 years	Within 3 years	Within 4 years	Within 6 years	Within 6 years	Within 7 years
River Smart Education Program	Program funding obtained	Advisory Group formed/Graphic artist hired	Outreach materials created Additional outlets identified	Outreach materials distributed		
	Within 1 year	Within 1 years	Within 2 years	Within 3 years		
Watershed Education for Fifth Grades	6 Pittsfield elementary schools and Richmond Elementary served					
	Annually – Ongoing as funding allows					
Signage at Constructed BMPs	3 signs installed					
	Within 5 years					

Table FG-4: Implementation Schedule and Interim Measurable Milestones

Monitoring and Evaluation						
Proposed Stormwater BMPs	**Interim Milestone #1**	**Interim Milestone #2**	**Interim Milestone #3**	**Interim Milestone #4**	**Interim Milestone #5**	**Interim Milestone #6**
Richmond Pond Tributary Monitoring Program	Secure funding	Consultant hired to review and develop an updated water quality monitoring program	Updated water quality monitoring program implemented			
	Within 1 year	Within 18 months	Within 2 years			
Richmond Pond Cyanobacteria/Algal Bloom Monitoring	Continue Monitoring parameters such as cyanobacteria cell counts to evaluate algal bloom potential					
	Annually during summer- Ongoing					
Water Quality Monitoring (N, P, *E. coli*, DO) Southwest Branch and Tributaries excluding Richmond Pond tributaries	Review and update water quality monitoring with key stakeholders	Updated water quality monitoring program implemented	Review results and determine if any changes are needed			
	2024	2025	Annually – at the end of each monitoring season			

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 water quality target concentration(s) is presented under Element A of this plan. To achieve this target concentration, the annual loading must be reduced to the amount described in Element B. Element C of this plan describes the various management measures that will be implemented to achieve this targeted load reduction. The evaluation criteria and monitoring program described below will be used to measure the effectiveness of the proposed management measures (described in Element C) in improving the water quality of the impaired waterbodies in the Southwest Branch of the Housatonic Watershed.

Indirect Indicators of Load Reduction

Street Sweeping and Catch Basin Cleaning

Potential load reductions from these nonstructural BMPs can be estimated from indirect indicators, such as the number of miles of streets swept or the number of catch basins cleaned. Attachment 2 to Appendix F of the 2016 Massachusetts Small MS4 General Permit provides specific guidance for calculating nitrogen and phosphorus removal from these practices.

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.

Project-Specific Indicators

Water quality monitoring data will provide up-to-date information on the effectiveness of the BMPs installed and the educational efforts towards improving the health of the SW Branch. All BMPs proposed include a planned evaluation and monitoring program where appropriate.

Stormwater Outfall Monitoring
At key sites such as Clapp Park, Gale Avenue and Lebanon Avenue the stormwater discharge will be tested 2 – 3 times before and after BMP installation in wet weather to determine their effectiveness. Additional annual monitoring will be conducted, if deemed necessary.

TMDL Criteria
The Southwest Branch of the Housatonic River (MA21-17) will be included in the upcoming "Massachusetts Statewide TMDL for Pathogen-Impaired Inland Freshwater Rivers," which is currently being drafted.

Direct Measurements
Direct measurements are generally expected to be performed as described below. Prior to implementing a direct measurement program, the Berkshire County Water Quality Coalition's current quality assurance project plan (QAPP) and/or standard operating procedures (SOPs) will be reviewed and amended as necessary to ensure best practices for sample collection and analysis. Water quality monitoring will be performed through a volunteer training program similar to the one HVA has conducted for many years and which is fashioned after MassDEP's environmental monitoring for volunteers.

River Sampling
Sampling is recommended approximately once per month from May through October to understand the water quality in the Southwest Branch of the Housatonic Watershed, including determining sources for pollution and tracking achievements toward water quality goals. At a minimum, parameters tested should include analysis of *E. coli,* TSS and TN. Additional parameters such as TP, dissolved oxygen, temperature, conductivity, pH, and flow rate could provide additional data for consideration.

The sampling would be focused on the mainstem and key tributaries such as Mount Lebanon, Whitewood, Clark's and Tracy Brooks at Richmond Pond and Jacoby, Smith, Shaker and Maloy Brooks. Monitoring locations will be selected following installation of stormwater BMPs based on accessibility and representativeness and shall be appropriate to quantify water quality improvements in the watershed.

Richmond Pond Cyanobacteria Monitoring
Richmond Pond Association will continue to complete water quality monitoring of the "Deep Hole" to assess for cyanobacteria and the potential for algal blooms. Parameters will include temperature, cyanobacteria cell counts, dissolved oxygen and phosphorous.

Provided funding is obtained to complete a phosphorous modeling study, in-lake phosphorous sampling will be completed to obtain appropriate data necessary to complete the modeling.

Richmond Pond Tributary Monitoring
The tributaries are currently monitored twice a year for nitrates, phosphorous and *E. coli*. A review of the current program will determine if changes are necessary to ensure an accurate understanding of the nutrient inputs to Richmond Pond. In addition, the sample sites and parameters will be reviewed to ensure that the monitoring completed will inform the effectiveness of installed or existing BMPs.

Beach Bacteria (*E. coli)* Sampling: There are five public and semi-public beaches located on Richmond Pond that are monitored weekly during the bathing season. **(Table HI-1)**

Table HI-1: Richmond Pond Beaches monitored for *E. coli*

Site Description	Monitoring Authority
Richmond Town Beach	Board of Health, Town of Richmond
Camp Arrowhead beach	Camp Arrowhead (Mill Town Capital)
Camp Russell beach	Camp Russell (Boys & Girls Club, Pittsfield)
Richmond Shores Beach	Richmond Shores Civic Association
South Pond Farm Beach	South Pond Farm Condominium Association

Adaptive Management

The Richmond Pond Association meets monthly from June through September and its members include representatives of many of the Southwest Branch watershed's stakeholders. A special meeting will be scheduled annually to discuss the health of the Southwest Branch and Richmond Pond watersheds and develop appropriate actions. Additional stakeholders not usually present will be invited to participate. These stakeholders would include BEAT, HVA, BRPC, and community organizations such as Westside Legends.

Post-construction testing will give continuous data on whether the BMPs are functioning as intended. If it is determined that any of the BMPs are not reducing pollutants as intended, communication about the BMP will help address any issues early on and lead to more constructive and permanent solutions.

This watershed-based plan will be reviewed and updated every five years based on monitoring results, additional information, BMP performance and progress toward water quality goals.

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Water Quality Assessment Reports

No Water Quality Assessment Reports Found

TMDL

No TMDL Found

Appendix A: Pollutant Load Export Rates (PLERs)

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
AGRICULTURE, HSG A	0.45	7.14	2.6
AGRICULTURE, HSG B	0.45	29.4	2.6
AGRICULTURE, HSG C	0.45	59.8	2.6
AGRICULTURE, HSG D	0.45	91	2.6
AGRICULTURE, IMPERVIOUS	1.52	650	11.3
COMMERCIAL, HSG A	0.03	7.14	0.3
COMMERCIAL, HSG B	0.12	29.4	1.2
COMMERCIAL, HSG C	0.21	59.8	2.4
COMMERCIAL, HSG D	0.37	91	3.7
COMMERCIAL, IMPERVIOUS	1.78	377	15.1
FOREST, HSG A	0.12	7.14	0.5
FOREST, HSG B	0.12	29.4	0.5
FOREST, HSG C	0.12	59.8	0.5
FOREST, HSG D	0.12	91	0.5
FOREST, HSG IMPERVIOUS	1.52	650	11.3
HIGH DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.3
HIGH DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.2
HIGH DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.4
HIGH DENSITY RESIDENTIAL, HSG D	0.37	91	3.7
HIGH DENSITY RESIDENTIAL, IMPERVIOUS	2.32	439	14.1

Appendix A: Pollutant Load Export Rates (PLERs), continued

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
HIGHWAY, HSG A	0.03	7.14	0.3
HIGHWAY, HSG B	0.12	29.4	1.2
HIGHWAY, HSG C	0.21	59.8	2.4
HIGHWAY, HSG D	0.37	91	3.7
HIGHWAY, IMPERVIOUS	1.34	1,480	10.5
INDUSTRIAL, HSG A	0.03	7.14	0.3
INDUSTRIAL, HSG B	0.12	29.4	1.2
INDUSTRIAL, HSG C	0.21	59.8	2.4
INDUSTRIAL, HSG D	0.37	91	3.7
INDUSTRIAL, IMPERVIOUS	1.78	377	15.1
LOW DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.3
LOW DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.2
LOW DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.4
LOW DENSITY RESIDENTIAL, HSG D	0.37	91	3.7
LOW DENSITY RESIDENTIAL, IMPERVIOUS	1.52	439	14.1
MEDIUM DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.3
MEDIUM DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.2
MEDIUM DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.4
MEDIUM DENSITY RESIDENTIAL, HSG D	0.37	91	3.7
MEDIUM DENSITY RESIDENTIAL, IMPERVIOUS	1.96	439	14.1
OPEN LAND, HSG A	0.03	7.14	0.3

Appendix A: Pollutant Load Export Rates (PLERs), continued

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
OPEN LAND, HSG B	0.12	29.4	1.2
OPEN LAND, HSG C	0.21	59.8	2.4
OPEN LAND, HSG D	0.37	91	3.7
OPEN LAND, IMPERVIOUS	1.52	650	11.3
[1]HSG = Hydrologic Soil Group			

Appendix B: Richmond Pond CWA Section 319 Grant Information

Stormwater Improvements at Richmond Pond
Richmond, Massachusetts

TO: Linda Kay

FROM: David Partridge and Tracy Adamski

DATE: June 2007

Project Description

The purpose of the recently completed stormwater improvements at Richmond Shores is to reduce the amount of total suspended solids (TSS) in storm runoff at various discharge points to Richmond Pond and its tributaries. TSS is the target pollutant under the Massachusetts Stormwater Management Policy due to its widespread contribution to water quality and aquatic habitat degradation. In addition, many other pollutant constituents including heavy metals, bacteria, and organic chemicals sorb to sediment particles; therefore, reduction of TSS also reduces other pollutants in stormwater runoff.

Stormwater Best Management Practices (BMPs) implemented included catch basins and sediment forebays to remove solids in the stream flow, and plantings to trap solids and promote the uptake of pollutants. Ground stabilization BMPs implemented included channel lining of eroded channel. Catch basins also acted as ground stabilization BMPs by intercepting runoff along road edges prior to the flows becoming significant enough to cause scour and erosion of shoulders and adjacent yards.

The improvements at each area are described below. Please refer to the Site Locus Plan that shows the improvement locations and contributing landscapes as well as the site photographs that include before and after images.

1. Boys Club/West off Branch Farm Road – A sediment forebay was installed to remove TSS from runoff emanating from a 4.93-acre watershed that is comprised of a recreational camp area with gravel roads. The forebay volume also provides some stormwater runoff detention during rain events. Downstream of the sediment forebay, the previously-eroded channel which flows to Richmond Pond was lined and stabilized with modified rock fill (small stone rip-rap). The rock fill was placed with considerable care without further disturbance to adjacent trees and vegetation. A sediment marker is proposed in the forebay to facilitate observations of accumulated sediments that will trigger cleanings.

2. Boys Club/ East off Branch Farm Road – The existing sediment forebay at this location was enlarged to improve TSS removal capacity and provide additional stormwater runoff detention from a 8.75-acre watershed that is generally comprised of wooded area and athletic fields. Similar to Boys Club / West area, the previously-eroded channel downstream of the forebay which flows to Richmond Pond was stabilized with modified

- 1 -

rock fill (small stone rip-rap). The rock fill was placed with extreme care by the property owner without further disturbance to adjacent trees and vegetation. A sediment marker is proposed in the forebay to facilitate observations of accumulated sediments that will trigger cleanings.

3. Chestnut Street – Three catch basins and associated pipe were installed along Chestnut Street, one each at the intersection of cross streets Hemlock Road, Maple Road, and Oak Road. The catch basins now intercept runoff which originally flowed eastward along the steep cross streets to Cherry Road causing shoulder erosion.

4. Cherry Road – Three catch basins and associated pipe were installed along Cherry Street one each at the intersection of cross streets: Maple Road, Oak Road, and Walnut Road. The catch basins now intercept runoff which originally flowed southward along Cherry Street causing shoulder erosion.

5. Shore Road – An undersized catch basin and associated pipe was replaced on Shore Road at the intersection of Spruce Road. The catch basin now intercepts runoff which originally overflowed Shore Road across private property northward causing shoulder and yard erosion.

6. East Beach Road – An undersized catch basin and associated pipe was replaced on Shore Road at the intersection of East Beach Road. The catch basin now intercepts runoff which originally overflowed East Beach Road and flowed along Shore Road westward causing shoulder erosion.

7. Boat Launch Area off Town Beach Road – Various native shrubs were planted adjacent to the boat launch area, including two (2) river birches (*Betula nigra*); two (2) American elms (*Ulmus americanus*) and one (1) steeplebush (*Spiraea tomentosa*) and two (2) sweet pepperbush/summer sweet (*Clethra alnifolia*). An information signboard was also installed for public awareness purposes.

8. Richmond Shores Civic Association Beach Area off Shore Road – Various native shrubs were planted adjacent to the public-access beach area, including one (1) flowering dogwood (*Cornus florida*); eight (8) lowbush blueberries (*Vaccinium cassinoides*); three (3) red osier dogwoods (*Cornus sericea*); and three (3) winterberry holly (*Ilex verticillata*). A short fence with a gate was also installed along the shore edge to deter geese access from the adjacent lawn area.

Operation and Maintenance Plan

The following operation and maintenance activities should be undertaken to ensure that BMPs continue to function as intended.

A. All BMPs including catch basins, the sediment forebays, stone-lined channels should be inspected at least twice per year.

B. If BMPs are found to have impaired function due to the accumulation of sediment trash or debris, they shall be cleaned to provide adequate function. Sediment forebays shall be cleaned when sediment depths accumulate to the pre-determined threshold levels. At a minimum, catch basins should be cleaned twice per year, and the sediment forebays and stabilized channels should be cleaned once per year.

C. If a BMP is damaged, it should be repaired or replaced.

Estimate TSS Removal for Best Management Practices

The actual volume of TSS removal is dependent on various factors including but not limited to:

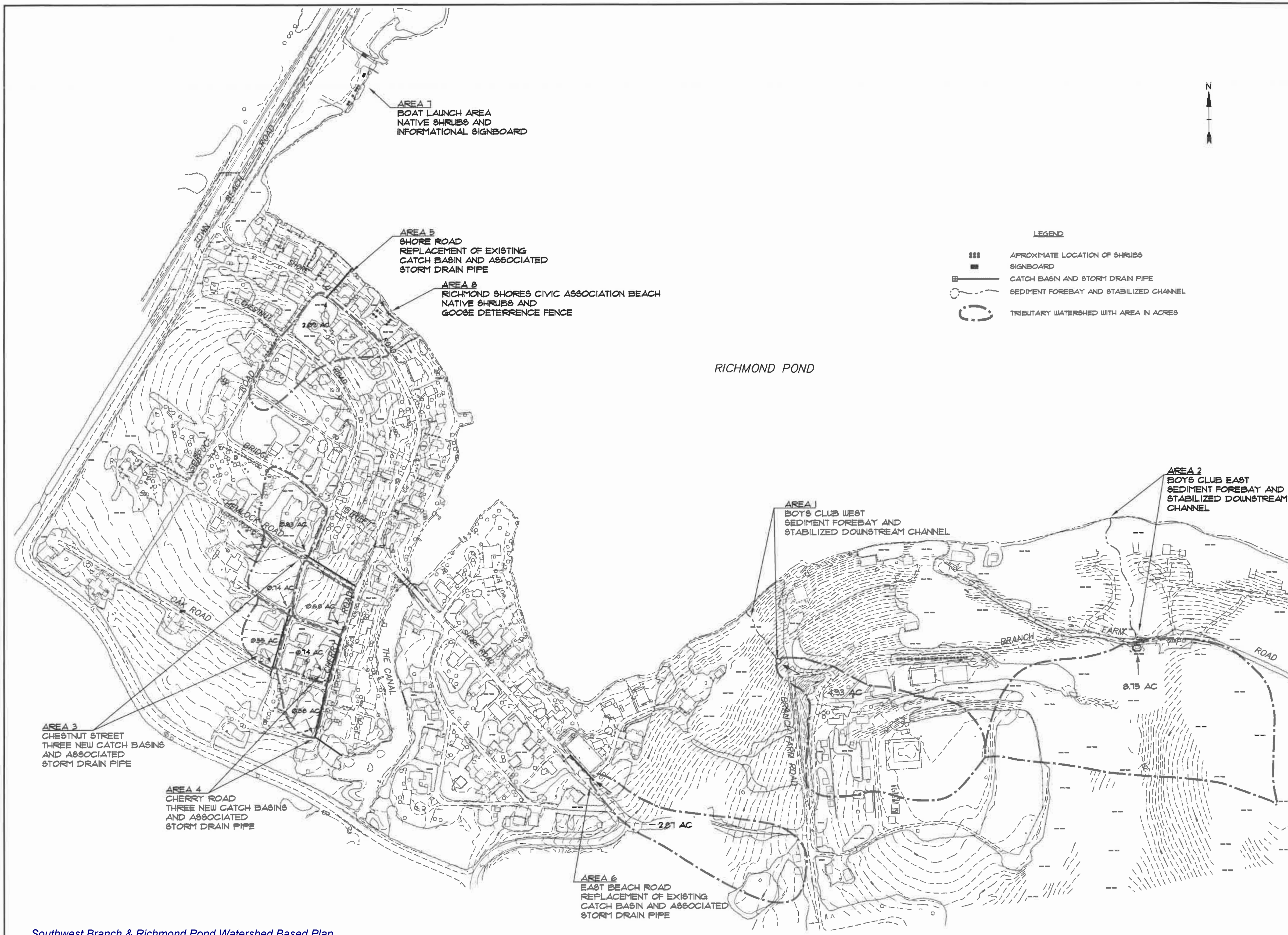
- the number of rainfall events and total annual rainfall
- the intensity, frequency and duration of each rainfall event,
- road maintenance activities (gravel road grading, winter sanding) in the tributary area
- changes in land use in the tributary area
- the maintenance and cleaning frequency of the BMP

However, with proper operation and maintenance activities, the stormwater BMPs should remove TSS consistent with estimated rates referenced in the Volume 1 of the Massachusetts Stormwater Policy as follows:

- Deep-sumped catch basins – 25% TSS Removal
- Sediment Forebay - 25% TSS Removal

More importantly, the ground stabilization BMPs (catch basins, plantings and stabilized channels) will reduce TSS in storm flow by deterring scour and erosion which are significant contributors to TSS that has impacted Richmond Pond.

J:\R\R0121\REPORT\Richmond Stormwater BMP.doc



Tighe&Bond
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Westfield, Massachusetts
(413) 562-1600
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Town of Richmond

Stormwater Improvements At Richmond Pond

Richmond, Massachusetts

Mark	Date	Description
0	7/07	Initial Issue

PROJECT NO:	R121
FILE:	dwg\design (PROP)
DRAWN BY:	LPT
CHECKED:	TJA
APPROVED BY:	DP1

SITE LOCUS PLAN

SCALE: 1"=150'

SHEET 1 OF 1

Appendix C: Richmond Pond Weed Management Summary
Richmond Pond Association

1838-43 – First dam built by Stearns, Plummer & Society of Shakers
1865 – Barker Brothers rebuilt & raised the dam
1868 – Dam gave way
1876 – Dam washed out again & rebuilt
1950 - Hurricane breached spillway & earthen dam
1951 – Dam rebuilt

1981 – Aquatic Nuisance Control project approved by MA Water Resources Commission for a "de-weed" project involving excavation of muck & weeds from bottom of pond & a one-time dredging project at the inlet canal connecting Noreen Marsh & the pond

1990 - Richmond's Diagnostic Feasibility Study determined that 90% of septic systems around the pond were failed systems

1996 – Deep winter draw-downs ended – they had been used for many years to draw the pond down as much as 5 feet in late fall to prevent spring flooding in West Pittsfield & assist with pond weed control. Natural Heritage subsequently has allowed only 2-foot winter draw-downs.

1996 – Bruce Garlow formed Richmond Pond Study Committee.

2000 – Richmond Pond Association was formed, with representation from Richmond & Pittsfield (1/3 of the pond is in Pittsfield). RPA's water quality monitoring program was initiated in 2002 & maintained through the present, recently adding testing for cyanobacteria. Concerns addressed subsequently by the RPA include efforts to limit additional development along the pond, educational efforts about swimming safety, eutrophication, nutrient loading (fertilizer chemical runoff from lawns & farms), preventing the introduction & proliferation of nonnative plants, etc.

2000 – MA state regulation required that all public & semi-public beaches must be tested weekly for *E. coli*.

2006 - Town of Richmond required that all septic systems around the pond be decommissioned & tied into the Town's sewer system that circled the pond; the effluent is piped to Pittsfield's treatment plant. RPA's water quality monitoring program documented subsequent significant improvement in the pond's water quality.

2009 – Invasive Zebra mussels confirmed in nearby Laurel Lake & the Housatonic River downstream. Some lakes in Connecticut & NY state also have zebra mussels. Boat launch monitoring programs were subsequently enacted at Richmond Pond & many other MA lakes that have lake chemistry favorable to zebra mussels. (Once in a lake, they can never be eradicated.)

2010 – Diagnostic Feasibility Study by Dr. Ken Wagner, conducted under Clean Lakes Act, Section 319, Non-point Source Pollution matching grant. The study resulted in installation of drop-inlets, detention basins, rip-rapped channels, planting of buffer vegetation in several areas, & strategies for maintaining same.

2016 - Comprehensive 5-year lake management plan developed by RPA (needs updating & endorsement by both the Town of Richmond & City of Pittsfield). It includes continuation of annual herbicide treatment for invasive plants: Eurasian milfoil, curly-leaf pondweed, & spiny naiad, including pre- & post-treatment weed surveys. (See RPA website.) Exploration of hydro-raking for the canal, though expensive, should perhaps be incorporated into the new plan.

2019 – Goose management plan was implemented, in response to the proliferation of resident Canada geese the prior year (about 200 geese), & the resulting *E. coli* impact at the pond's beaches. This continued for 3 more years, but then was discontinued.

2021 – RPA obtained a Notice of Intent & permit for an inlet restoration program involving hand-pulling of native & invasive weeds from the canal (implemented in 2021 & 2022, half of canal each year; abandoned in 2023). The RPA also explored in 2021 seeking a permit from Natural Heritage to treat a test area for the native weed tapegrass (which sends its curly tendrils to the surface in August & September, choking boat propellers & interfering with swimmers & paddlers). But communication & permitting issues with Natural Heritage prevented implementation.

2022 & 2023 – The permit for aquatic weed treatment of Richmond Pond for invasive weeds lapsed & has not been issued since, though efforts are underway to obtain a more comprehensive permit for 2024, one that may include aquatic herbicide treatment, mechanical weed-harvesting, & weed pulling. Also, Natural Heritage now prohibits use of aquatic herbicide treatment for invasive weeds in Richmond Pond out of concern for our bridle shiners, unless we halve the concentration used (which Solitude Lake Management says is a waste of time & money, as that concentration won't kill the weeds). Bridle shiners are found in eastern North America, from eastern Lake Ontario to Maine and south to South Carolina. Wikipedia's description of the species indicates that, "The densely growing Eurasian watermilfoil plant hinders spawning areas for the minnow and may contribute to its decline." This appears to argue for, rather than against, treating our milfoil. Also, it appears that there's a new aquatic herbicide that was used successfully in one of Pittsfield's lakes, resulting in effective impact on the invasives & recovery of the native weeds that had been crowded out; Jim McGrath will likely have info about this.

Sources: Chapter 2, *The Gem of Richmond – A History of Richmond Pond*; other RPA files; Wikipedia (re bridle shiner)

Appendix D – HVA's 2023 Water Quality Results

WaterBody	StationID	StationDescription	Latitude	Longitude	SampleDate	Analyte	Units	Result	OtherNotes
Maloy Brook	MAL200	Upstream of Jason Street crossing	42.44414	-73.28078	06/15/2023	*Escherichia coli*	MPN/100ml	298.7	Precipitation: 24hr 1.13"; 48 hr 1.13"; 72hr 1.35"
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	06/15/2023	*Escherichia coli*	MPN/100ml	689.3	Precipitation: 24hr 1.13"; 48 hr 1.13"; 72hr 1.35"
Maloy Brook	MAL200	Upstream of Jason Street crossing	42.44414	-73.28078	07/06/2023	*Escherichia coli*	MPN/100ml	228.2	Precipitation: 24hr 1.13"; 48 hr 1.13"; 72hr 1.35"
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	07/06/2023	*Escherichia coli*	MPN/100ml	167	Precipitation: 24hr 1.13"; 48 hr 1.13"; 72hr 1.35"
Maloy Brook	MAL200	Upstream of Jason Street crossing	42.44414	-73.28078	07/13/2023	*Escherichia coli*	MPN/100ml	325.5	Precipitation: 24hr 1.13"; 48 hr 1.13"; 72hr 1.35"
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	07/13/2023	*Escherichia coli*	MPN/100ml	98.7	Precipitation: 24hr 1.13"; 48 hr 1.13"; 72hr 1.35"
Maloy Brook	MAL200	Upstream of Jason Street crossing	42.44414	-73.28078	07/27/2023	*Escherichia coli*	MPN/100ml	69.7	Precipitation: 24hr 1.13"; 48 hr 1.13"; 72hr 1.35"
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	07/27/2023	*Escherichia coli*	MPN/100ml	209.8	Precipitation: 24hr 1.13"; 48 hr 1.13"; 72hr 1.35"
Maloy Brook	MAL200	Upstream of Jason Street crossing	42.44414	-73.28078	08/09/2023	*Escherichia coli*	MPN/100ml	396.8	Precipitation: 24hr 1.13"; 48 hr 1.13"; 72hr 1.35"
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	08/09/2023	*Escherichia coli*	MPN/100ml	218.7	Precipitation: 24hr 1.13"; 48 hr 1.13"; 72hr 1.35"
Maloy Brook	MAL200	Upstream of Jason Street crossing	42.44414	-73.28078	08/24/2023	*Escherichia coli*	MPN/100ml	42	Precipitation: 24hr 0"; 48 hr 0"; 72hr 0"

Appendix D – HVA's 2023 Water Quality Results, continued

WaterBody	StationID	StationDescription	Latitude	Longitude	SampleDate	Analyte	Units	Result	OtherNotes
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	08/24/2023	*Escherichia coli*	MPN/100ml	98.7	Precipitation: 24hr 0"; 48 hr 0"; 72hr 0"
Maloy Brook	MAL200	Upstream of Jason Street crossing	42.44414	-73.28078	09/07/2023	*Escherichia coli*	MPN/100ml	25.6	Precipitation: 24hr 0"; 48 hr 0"; 72hr 0"
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	09/07/2023	*Escherichia coli*	MPN/100ml	93.3	Precipitation: 24hr 0"; 48 hr 0"; 72hr 0"
Maloy Brook	MAL200	Upstream of Jason Street crossing	42.44414	-73.28078	09/20/2023	*Escherichia coli*	MPN/100ml	21.1	Precipitation: 24hr 0.01"; 48 hr 0.7"; 72hr 0.72"
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	09/20/2023	*Escherichia coli*	MPN/100ml	117.8	Precipitation: 24hr 0.01"; 48 hr 0.7"; 72hr 0.72"

Appendix E

HVA's 2022 Water Quality Results

WaterBody	StationID	Station Description	Latitude	Longitude	SampleDate	Analyte	Units	Result
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/07/2022	Ammonia-nitrogen	ppm	0.1
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/28/2022	Ammonia-nitrogen	ppm	0.1
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/11/2022	Ammonia-nitrogen	ppm	0.05
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/25/2022	Ammonia-nitrogen	ppm	0.05
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/07/2022	Chlorine	mg/L	0.01
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/28/2022	Chlorine	mg/L	0.01
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/11/2022	Chlorine	mg/L	0.06
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/25/2022	Chlorine	mg/L	0.03
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/07/2022	Conductivity	µS	334.3
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/28/2022	Conductivity	µS	397.4

HVA's 2022 Water Quality Results, continued

WaterBody	StationID	Station Description	Latitude	Longitude	SampleDate	Analyte	Units	Result
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/11/2022	Conductivity	µS	376.3
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/25/2022	Conductivity	µS	375.4
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	06/16/2022	Escherichia coli	MPN	410.6
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	06/30/2022	Escherichia coli	MPN	980.4
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/14/2022	Escherichia coli	MPN	579.4
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/28/2022	Escherichia coli	MPN	>2419.6
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/11/2022	Escherichia coli	MPN	2419.6
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/25/2022	Escherichia coli	MPN	1732.9
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	09/08/2022	Escherichia coli	MPN	251.3
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	9/22/2022	Escherichia coli	MPN	>2419.6
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/07/2022	Salinity	ppt	0.2

HVA's 2022 Water Quality Results, continued

WaterBody	StationID	Station Description	Latitude	Longitude	SampleDate	Analyte	Units	Result
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/28/2022	Salinity	ppt	0.2
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/11/2022	Salinity	ppt	0.2
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/25/2022	Salinity	ppt	0.2
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/07/2022	Specific conductance	µS	359.7
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/28/2022	Specific conductance	µS	418.1
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/11/2022	Specific conductance	µS	437.8
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/25/2022	Specific conductance	µS	452.2
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/07/2022	Surfactants, anionic	mg/L	0.2
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/28/2022	Surfactants, anionic	mg/L	0.1
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/11/2022	Surfactants, anionic	mg/L	0.05
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/25/2022	Surfactants, anionic	mg/L	0.1

HVA's 2022 Water Quality Results, continued

WaterBody	StationID	Station Description	Latitude	Longitude	SampleDate	Analyte	Units	Result
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/07/2022	Temperature, water	°C	21.3
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	07/28/2022	Temperature, water	°C	22.5
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/11/2022	Temperature, water	°C	17.8
Jacoby Brook	JCB300	Downstream of the Railroad Bridge	42.4401347	-73.30594	8/25/2022	Temperature, water	°C	16.1
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	07/07/2022	Ammonia-nitrogen	ppm	0.05
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	07/07/2022	Chlorine	mg/L	0.11
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	07/07/2022	Conductivity	µS	86
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	06/16/2022	Escherichia coli	MPN	<1
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	06/30/2022	Escherichia coli	MPN	15.2
Lilly Brook	LLB200	Upstream of the Westbrook	42.45128	-73.32831	07/14/2022	Escherichia coli	MPN	17.3

HVA's 2022 Water Quality Results, continued

WaterBody	StationID	Station Description	Latitude	Longitude	SampleDate	Analyte	Units	Result
		Terrace Road bridge						
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	07/28/2022	Escherichia coli	MPN	<1
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	8/11/2022	Escherichia coli	MPN	187.2
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	8/25/2022	Escherichia coli	MPN	55.4
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	09/08/2022	Escherichia coli	MPN	33.1
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	9/22/2022	Escherichia coli	MPN	435.2
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	07/07/2022	Salinity	ppt	0.1
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	07/07/2022	Specific conductance	µS	109.3
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	07/07/2022	Surfactants, anionic	mg/L	0.1
Lilly Brook	LLB200	Upstream of the Westbrook Terrace Road bridge	42.45128	-73.32831	07/07/2022	Temperature, water	°C	13.9
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/11/2022	Ammonia-nitrogen	ppm	0.5

HVA's 2022 Water Quality Results, continued

WaterBody	StationID	Station Description	Latitude	Longitude	SampleDate	Analyte	Units	Result
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/25/2022	Ammonia-nitrogen	ppm	0.3
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/11/2022	Chlorine	mg/L	0.08
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/25/2022	Chlorine	mg/L	0.1
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/11/2022	Conductivity	µS	662
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/25/2022	Conductivity	µS	616
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/11/2022	Escherichia coli	MPN	613.3
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/25/2022	Escherichia coli	MPN	816.4
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from	42.442788	-73.27592	8/11/2022	Salinity	ppt	0.4

HVA's 2022 Water Quality Results, continued

WaterBody	StationID	Station Description	Latitude	Longitude	SampleDate	Analyte	Units	Result
		Roasted Garlic parking lot						
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/25/2022	Salinity	ppt	0.3
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/11/2022	Specific conductance	µS	726
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/25/2022	Specific conductance	µS	676
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/11/2022	Surfactants, anionic	mg/L	0.1
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/25/2022	Surfactants, anionic	mg/L	0.2
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/11/2022	Temperature, water	°C	20.3
Maloy Brook	SW06	Downstream of Route 20 crossing. Access from Roasted Garlic parking lot	42.442788	-73.27592	8/25/2022	Temperature, water	°C	20.3

Appendix F: 2017-2018 Water Quality Results

BRPC/HVA SW Branch Water Quality Bacteria Monitoring Results (604bfunded)

E-Coli Bacteria Monitoring Data on Southwest Branch 2017 & 2018									
2017		**6/13/2017**	**8/1/2017**	**8/30/2017**	**9/12/2017**	**9/26/2017**	**10/4/2017**		**Geometric Mean**
SW 07.1	Richmond Pond Dam	21.6	2	3.1	3	7.5	3.1		4.6
SW 04	Melbourne & Chapel	81.3	**325.5**	214.3	111.2	70.6	74.9		122.2
SW 03.8	Hungerford&Caroline	**387.3**	**298.7**	214.2	110.6	**816.4**	73.8		234.2
SW 01.1	Barker Rd	133.4	152.5	**298.7**	186	128.1	44.1		136.2
SW 02	Clapp Park	124.3	149.7	165.8	186	101.2	56.5		121.9
2018		**6/7/2018**	**7/5/2018**	**8/21/2018**	**8/29/2018**	**9/6/2018**	**10/1/2018**	**10/10/2018**	
SW 2.1	Downstream of Pasture behind 166 Chapel	117.8	129.1			93.3	24.6	25.9	76.9
SW 04	Melbourne/Chapel	410.6	686.7			261.3	28.8	47.1	214.6
SW 4.3	Stearns School			201.4	59.1	187.2	25	43.2	86.4
SW 4.5	Rt 20 bridge,Upstrm			157.4	98.8	461.1	50.4	648.8	137.9
SW 05.0	Upstream of Jacoby	275.5	1553.1			410.6	25.6	435.2	259
SW 5.5	Jacoby off Grape St			325.5	435.2	1299.7	261.3	285.1	468.3
SW 05.2	Jacoby Brook	410.6	686.7	435.2	365.4	648.8	260.3		492.9
SW 05.3	Fort Hill Rd	228.2	816.4			571.2	172.3	218.7	368
SW 3.5	Smith Brk @ Gale			104.3	125	172.3	55.6	167	105.7
SW 03	Smith Brk @ RR	248.1	686.7	141.4	201.4	275.5	43.5		266.2
SW 03.8	Hungerford/Caroline	435.2	613.1	248	435.2	228.2	77.1		366
SW 06.5	Maloy Brk at Jason			209.8	727	770.1	21.1	24.3	223.1
SW 06	Maloy Brk, Rt 20	579.4	2419.6	410.6	920.8	816.4	88.4	410.6	845.8
SW 01.1	Barkers Rd	260.3	435.2			285.1	85.5	98.7	229.2
Geometric mean - at least 5 samples taken in 6 months (until 10/15) shall not exceed 126 colonies per 100ml**									
No samples shall exceed 235 colonies per 100m/									
Red numbers signifies site exceeds the healthy designation limit based on Massachusetts water quality standards in 2017 /18									

2017 Southwest Branch Monitoring Locations

SITE ID	*Location Description*	*GPS Coordinates*	*Municipality*
SW 07.1	On Southwest Branch below Richmond Pond Dam	42.47629, -73.26686	Pittsfield
SW 03.8	On Southwest Branch upstream of Hungerford Street bridge, the one near Caroline Street	42.441227, -73.295945	Pittsfield
SW 04	On Southwest Branch, upstream of Melbourne Street bridge	42.25837, -73.18610	Pittsfield
SW 01.1	On the Southwest Branch, ~ 250 feet downstream of Barker Road	42.44394, -73.26104	Pittsfield
SW 02	On Southwest Branch at Clapp Park, downstream of railroad bridge	42.26240, -73.15595	Pittsfield

2018 Southwest Branch Watershed Monitoring Locations

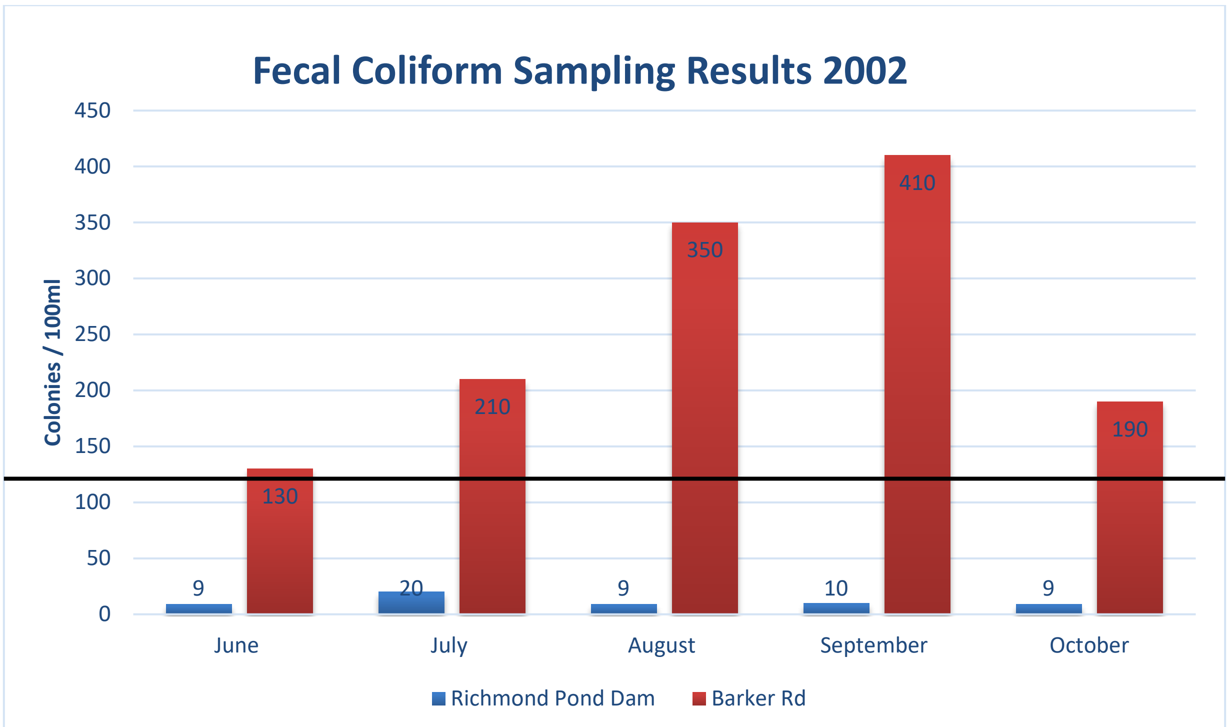
SITE ID	***Location Description***	***GPS Coordinates***	***Municipality***
SW 02	On the Southwest Branch, upstream of Cloverdale Street Bridge	42.42275, -73.30966	Pittsfield
SW 02.1	On the Southwest Branch, downstream of active, small agricultural operation, behind 166 Chapel Street	42.42469, -73.30942	Pittsfield
SW 04	On the Southwest Branch, 5 feet upstream of Melbourne Street bridge at Chapel Street intersection. 2017 QAPP site	42.430604, -73.310101	Pittsfield
SW 05.0	On the Southwest Branch, upstream of the Jacoby Brook and Southwest Branch confluence	42.4392, -73.30125	Pittsfield
SW 05.2	On Jacoby Brook, upstream of Hungerford Street / Jacoby Brook Bridge	42.43962, -73.30227	Pittsfield
SW 05.3	On the Southwest Branch, downstream of the confluence of Jacoby and Southwest Branch, at Fort Hill Avenue intersection	42.440609, -73.300623	Pittsfield
SW 03	On Smith Brook, just upstream of the Southwest Branch and Smith Brook confluence in railroad culvert	42.44213, -73.29757	Pittsfield
SW 03.8	On the Southwest Branch, upstream of Hungerford Street bridge (the one near Caroline Street) 2017 QAPP site.	42.441217, -73.295939	Pittsfield
SW 06	On Maloy Brook, downstream of Route 20 / Maloy Brook bridge	42.44273, -73.27574	Pittsfield
SW 01.1	On the Southwest Branch, ~ 250 feet downstream of Barker Road bridge 2017 QAPP site	42.440138, -73.271638	Pittsfield

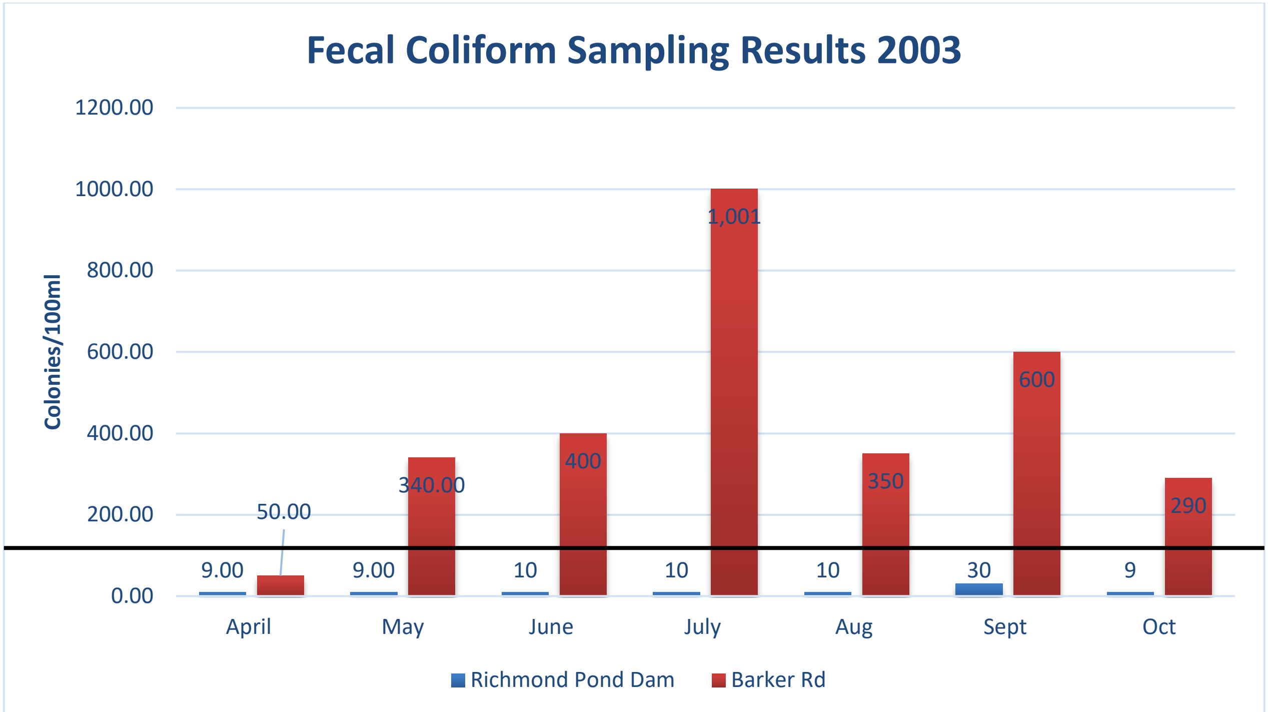
Appendix G: 2002-2007 Water Quality Results

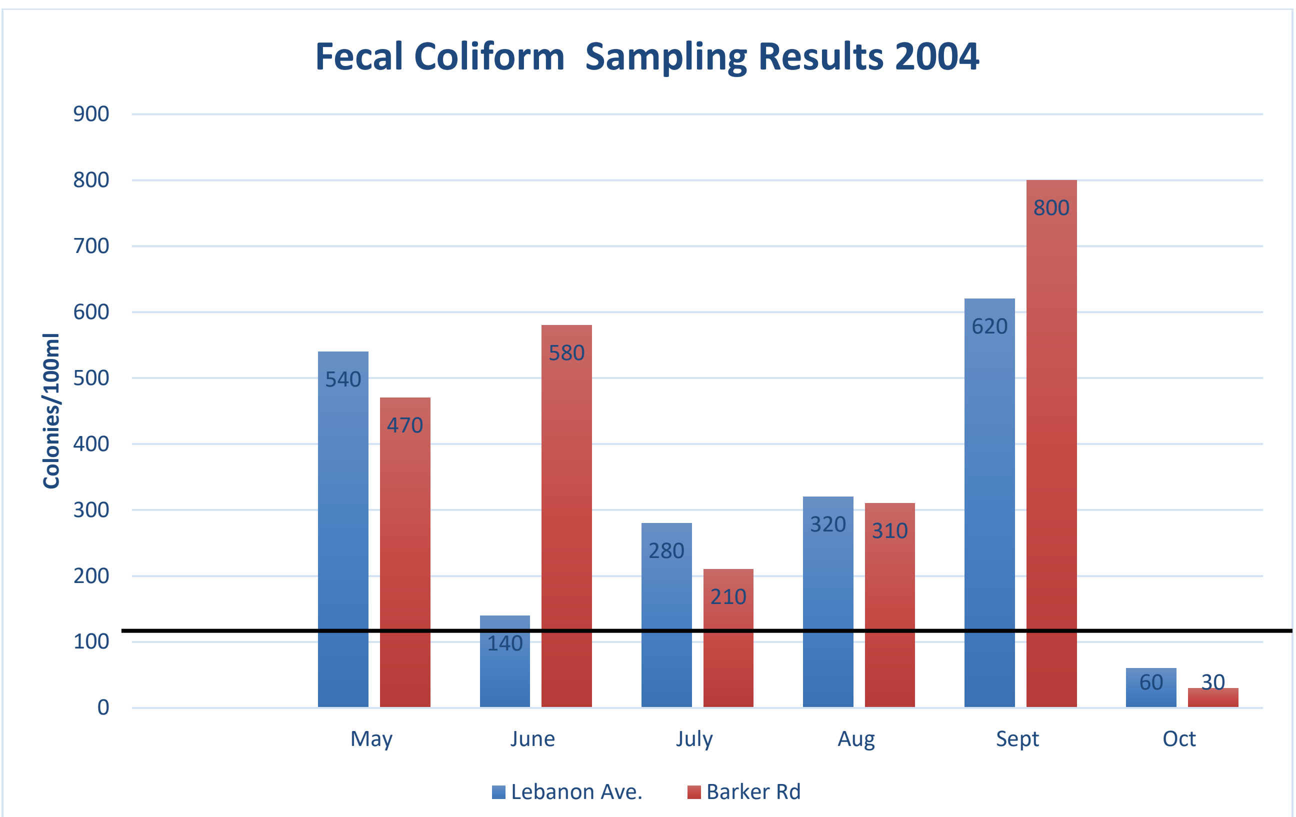
HVA's Southwest Branch of the Housatonic River

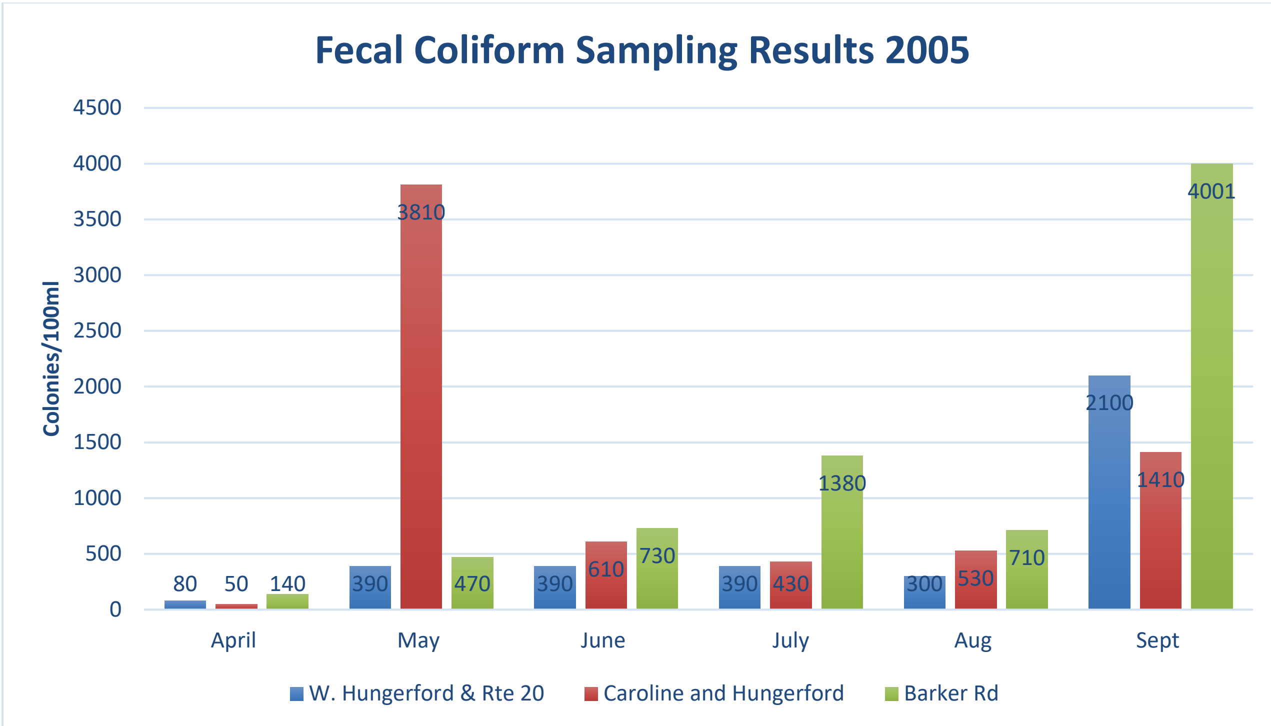
Fecal Coliform Monitoring Results

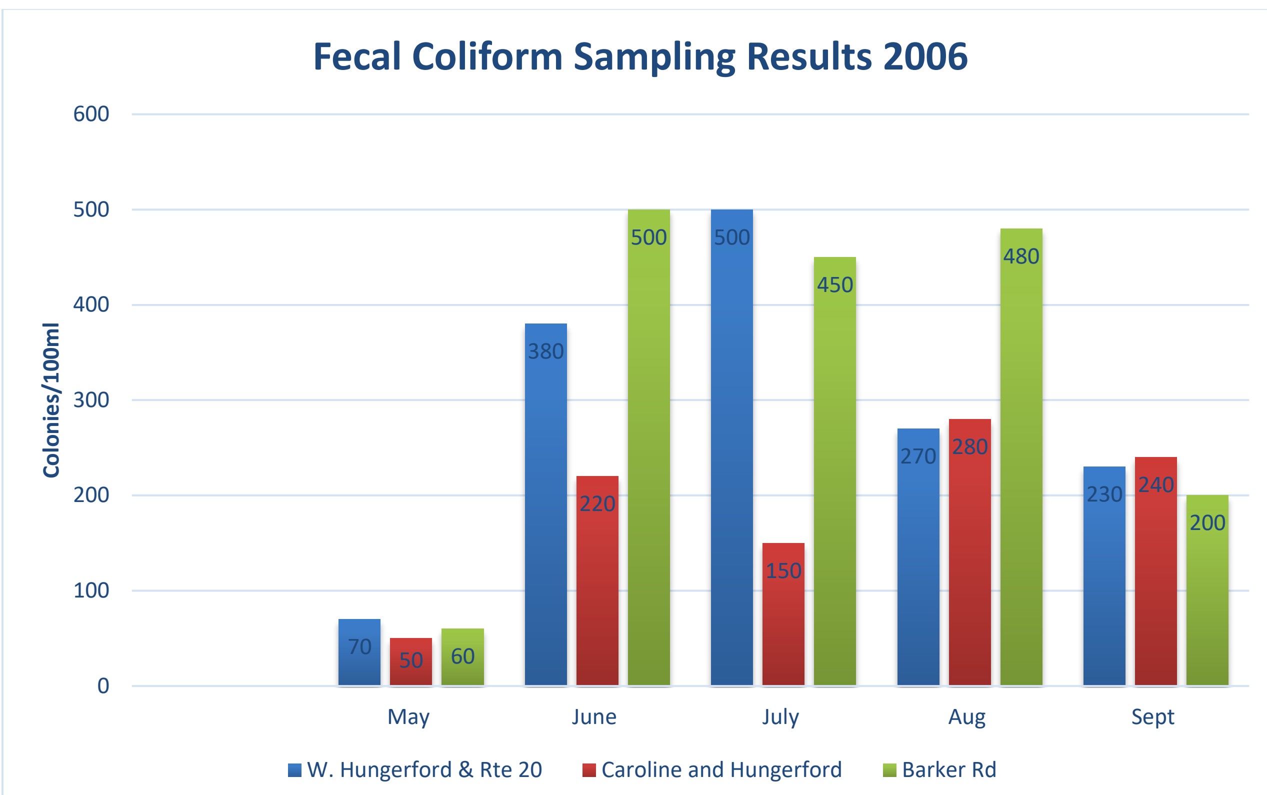
All sampling sites were located on the Southwest Branch of the Housatonic River.
Samples were collected under a MassDEP approved QAPP

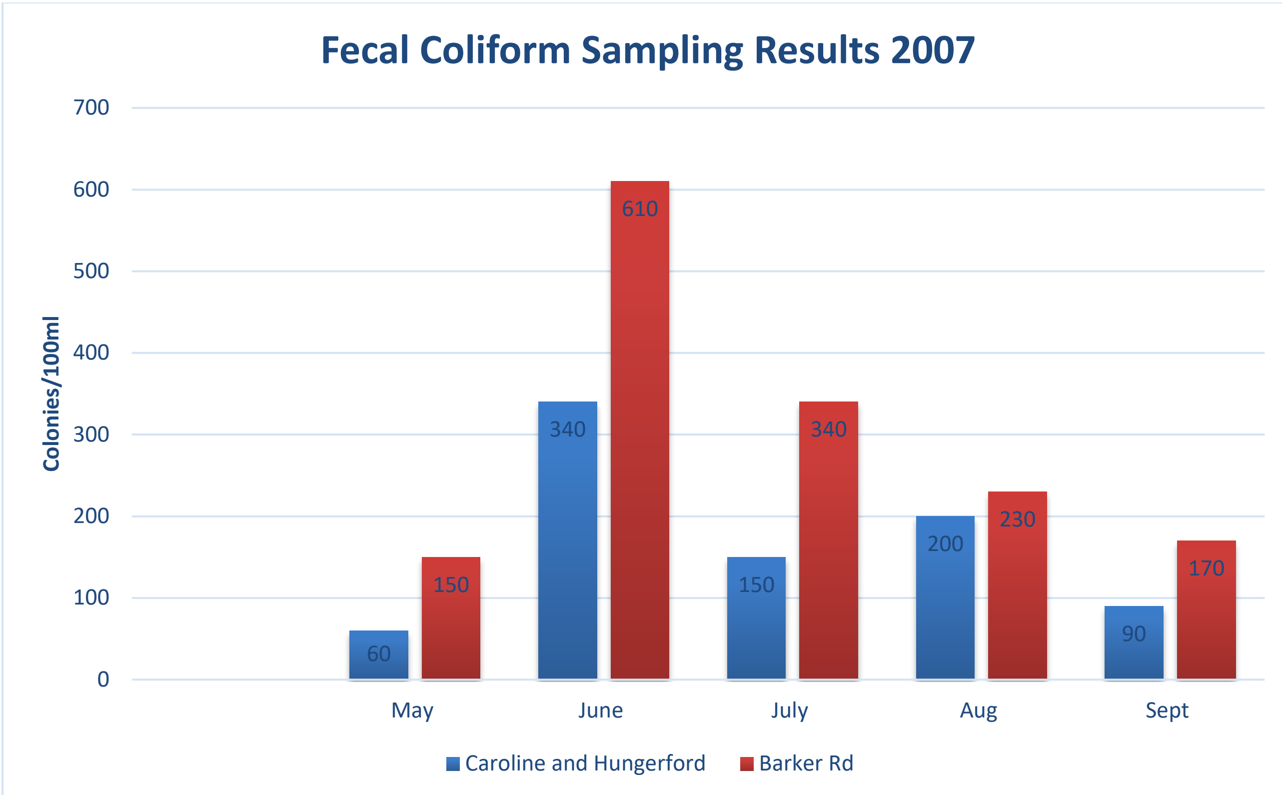



Fecal Coliform Sampling Results 2003
Colonies/100ml
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
9.00
50.00
9.00
340.00
10
400
10
1,001
10
350
30
600
9
290
April
May
June
July
Aug
Sept
Oct
Richmond Pond Dam
Barker Rd


Fecal Coliform Sampling Results 2004
Colonies/100ml
900
800
700
600
500
400
300
200
100
0
540
470
140
580
280
210
320
310
620
800
60
30
May
June
July
Aug
Sept
Oct
Lebanon Ave.
Barker Rd


Fecal Coliform Sampling Results 2005
Colonies/100ml
4500
4000
3500
3000
2500
2000
1500
1000
500
0
80
50
140
390
3810
470
390
610
730
390
430
1380
300
530
710
2100
1410
4001
April
May
June
July
Aug
Sept
W. Hungerford & Rte 20
Caroline and Hungerford
Barker Rd


Fecal Coliform Sampling Results 2006
Colonies/100ml
600
500
400
300
200
100
0
70
50
60
380
220
500
500
150
450
270
280
480
230
240
200
May
June
July
Aug
Sept
W. Hungerford & Rte 20
Caroline and Hungerford
Barker Rd


Fecal Coliform Sampling Results 2007
Colonies/100ml
700
600
500
400
300
200
100
0
60
150
340
610
150
340
200
230
90
170
May
June
July
Aug
Sept
Caroline and Hungerford
Barker Rd

Appendix H: Richmond Pond Association Water Quality Data 2003- 2023

Whitewood Brook

(sampled before confluence with Richmond Pond)

Date	Nitrate mg/L	Total Phosphorous mg/L	E.coli colonies/100ml	Dissolved Oxygen mg/L	pH
6/23/2003	0.63	0.022	30		
7/29/2003	1.09	0.01	580		
9/20/2003	1.01	0.01	60		
8/4/2004	0.68	0.105	120	5	8.05
8/30/2004	1.01	0.011	50	8	8.08
7/19/2005	0.84	0.027	320	9.7	8.12
8/24/2005	0.99	0.019	117	9.1	7.89
9/27/2005	0.7	0.021	173		7.8
6/28/2006	0.76	0.01	249		8.09
7/26/2006	1.08	0.001	75	3.6	8.23
10/16/2006	1.03	0.014	12	4.5	8.01
6/21/2007	1.07	0.02	19	6	7.92
7/24/2007	1.07	0.023	525	3.8	7.91
8/27/2007	0.01	0.085	7	7.3	8.22
9/25/2007	0.01	0.062	2	9.8	8.17
7/14/2009	0.77	0.015	54	4.7	8.18
8/13/2009	0.43	0.01	155	3.3	8.22
9/10/2009	0.13	0.005	13	4.3	8.24
7/27/2010	0.8	0.012	50	4.4	7.78
9/28/2010			135		
6/28/2011	0.06	0.058	69	3	7.89
9/14/2011	0.72	0.015	28	5	7.79
6/20/2012	0.01	0.009	10	4	8.53
9/14/2012	0.14	0.04	9	3	7.12
7/22/2013	0	0.062	26	8.8	8.1
10/8/2013	0.86	0	66.9		8.1
9/4/2014	0.95	0	55.6		
10/23/2014	0.14	0.011	2418.2		
7/8/2015	0.83	0	86.2		
8/22/2016	0.95	0	133.3		
8/17/2017	1.01	0.011	121.1		
9/12/2017	0.983	0.01	64.5		

Richmond Pond - Whitewood Brook continued

Date	Nitrate mg/L	Total Phosphorous mg/L	E.coli colonies/100ml	Dissolved Oxygen mg/L	pH
6/20/2018	1.02	0.012	33.2		
8/2/2018	0.94	0.011	139.6		
7/2/2019	0.49	0.01	17.3		
9/4/2019	0.96	0.01	83.6		
6/16/2020	0.98	0.019	7.4		
8/17/2020	0.91	0.011	214.3		
7/20/2021	0.686	0.014	275.5		
8/16/2021	0.77	0.01	59.4		
8/10/2022	1.07	0.01	42.2		
5/15/2023	0.659	0.0117	36.4		
7/19/2023	0.721	0.0149	44.3		

No Data = 0, <0.01=0.01

Tracy Brook (sampled before confluence with Richmond Pond)					
Date	**Nitrate mg/L**	**Total Phosphorous mg/L**	**E.coli colonies/100ml**	**Dissolved Oxygen mg/L**	**pH**
6/23/2003	0.04	0.036	70		8.23
7/29/2003	0.19	0.01	10		
9/20/2003	0.11	0.013	150		
8/4/2004	0.06	0.08	30	4.5	8.09
8/30/2004	0.09	0.019	10	5.2	8.07
7/19/2005	0.12	0.033	110	8.2	8.09
8/24/2005	0.19	0.027	15		7.93
9/27/2005			51		
6/28/2006	0.06	0.027	72	4.9	8.2
7/26/2006	0.09	0.01	38		8.23
10/16/2006	0.07	0.014	7	5.4	8.01
6/21/2007	0.18	0.02	20	8.3	7.96
7/24/2007	0.19	0.015	143	4.1	8.02
8/27/2007	0.01	0.098	90	5.4	8.18
9/25/2007	0.01	0.065	8	6.7	8.22
7/14/2009	0.06	0.03	6	6.3	8.08
8/13/2009	0.02	0.013	2400	3.9	8.16
9/10/2009	0.08	0.01	15	6.4	8.25
7/27/2010	0.13	0.018	51	5	7.89
9/28/2010	0.04	0.013	125	5.1	8.18
6/28/2011	0.02	0.024	36	4.6	7.81
9/14/2011	0.04	0.02	8	8	7.65
6/20/2012	0.25	0.031	111	6.8	8.18
9/14/2012	0.19	0.009	24	3.8	7.99
7/22/2013	0.18	0.083	14	8.4	7.8
10/8/2013	0.057	0	37.3		8
9/4/2014	0.18	0	34.5		
10/23/2014	0.052	0.096	410.6		
7/8/2015	0.12	0.028	31.3		
8/22/2016	0.18	0	77.6		
8/17/2017	0.22	0.011	8.5		
9/12/2017	0.11	0.011	4.1		
6/20/2018	0.3	0.035	248.1		
8/2/2018	0.06	0.031	72.3		
7/2/2019	0.12	0.049	9.6		
9/4/2019	0.22	0.01	29.2		
6/16/2020	0.16	0.011	161.6		

Richmond Pond - Tracy Brook, continued					
Date	Nitrate mg/L	Total Phosphorous mg/L	E.coli colonies/100ml	Dissolved Oxygen mg/L	pH
8/17/2020	0.05	0.036	47.3		
7/20/2021	0.05	0.036	365.4		
8/16/2021	0.16	0.018	32.7		
8/10/2022	0.41	0.01	14.6		
5/15/2023	0.108	0.0542	7.4		
7/19/2023	0.05	0.017	40.4		
No Data = 0, <0.01=0.01					

Clark’s Brook (sampled before confluence with Richmond Pond)					
Date	Nitrate mg/L	Total Phosphorous mg/L	E.coli colonies/100ml	Dissolved Oxygen mg/L	pH
7/8/2002		0.01			
8/14/2002	0.07	0.03	310		
9/24/2002	0.02	0.03	260		
6/23/2003	0.04	0.025	240		
7/29/2003	0.06	0.026	120		
9/20/2003	0.04	0.013	30		
8/4/2004	0.06	0.041	150		
8/30/2004	0.03	0.026	70	3.6	7.63
7/19/2005	0.1	0.052	280	6.2	
8/24/2005	0.03	0.049	70	5.8	7.37
9/27/2005	0.02	0.085	124	4.9	7.46
6/28/2006	0.05	0.011	114	3.9	7.54
7/26/2006	0.1	0.036	214	3.8	7.88
10/16/2006	0.03	0.052	24	5.4	7.55
6/21/2007	0.05	0.033	88	3.6	7.57
7/24/2007	0.09	0.107	210	7.1	7.38
8/27/2007	0.17	0.078	313	4	7.47
9/25/2007	0.13	0.072	10	8.2	7.45
7/14/2009	0.03	0.037	31	5.1	7.89
8/13/2009	0.04	0.034	362	3.1	7.67
9/10/2009	0.04	0.012	104	3.6	7.86
7/27/2010	0.08	0.026	179	3.5	7.24
9/28/2010	0.01	0.023	613	4	7.69
6/28/2011	0.03	0.035	78	3.7	
9/14/2011	0.02	0.031	222	6	7.02
6/20/2012	0.06	0.035	86	6.7	7.58
9/14/2012	0.06	0.042	308	6.6	7.29
7/22/2013	0.07	0	206	7	7
10/8/2013	0	0.017	410	7.2	7.5
9/4/2014	0	0.016	54.6		
10/23/2014	0.05	0.069	1413.6		
7/8/2015	0	0.012	238.2		
8/22/2016	0.073	0.026	1046.2		
8/17/2017	0.05	0.016	78.5		
9/12/2017	0.05	0.012	70.5		
6/20/2018	0.05	0.03	79.4		
8/2/2018	0.05	0.029	648		

Richmond Pond – Clark's Brook, continued					
Date	Nitrate mg/L	Total Phosphorous mg/L	E.coli colonies/100ml	Dissolved Oxygen mg/L	pH
7/2/2019	0.05	0.021	37.7		
9/4/2019	0.05	0.023	218.7		
6/16/2020	0.05	0.027	137.6		
8/17/2020	0.05	0.02	224.7		
7/20/2021	0.05	0.02	185		
8/16/2021	0.05	0.02	36.4		
8/10/2022	0.05	0.041	31.8		
5/15/2023	0.05	0.0244	24.6		
7/19/2023	0.05	0.0234	285.1		

Richmond Pond – Inlet (under Shore Road, Richmond Shores aka Canal)					
Date	Nitrate mg/L	Total Phosphorous mg/L	E.coli colonies/100ml	Dissolved Oxygen mg/L	pH
8/14/2002	0.01	0.03	10		
9/24/2002	0.01	0.02	10		
6/23/2003	0.04	0.018	280		
7/29/2003	0.01	0.016	20		
9/20/2003	0.01	0.011	50		
8/4/2004	0.05	0.027	150	1.1	7.38
8/30/2004	0.07	0.022	120	0.8	7.52
7/19/2005	0.06	0.034	380	4.4	7.69
8/24/2005	0.01	0.046	47		
9/27/2005	0.02	0.029	517	3.8	7.76
6/28/2006	0.05	0.01	114	2.1	7.48
7/26/2006	0.09	0.012	81	3.7	7.76
10/16/2006	0.03	0.018	27	2.2	7.38
6/21/2007	0.17	0.041	58	3.3	7.38
7/24/2007	0.14	0.047	378	1.5	7.19
8/27/2007	0.07	0.085	84	3.4	7.48
9/25/2007	0.01	0.066	36	8.1	7.4
7/14/2009	0.01	0.023	23	1.2	7.67
8/13/2009	0.01	0.013	260	1.2	7.78
9/10/2009	0.01	0.009	55	2	7.82
7/27/2010	0.02	0.028	249	3	7.35
9/28/2010	0.01	0.031	35	3.5	7.8

Richmond Pond – Inlet (under Shore Road, Richmond Shores aka Canal), continued

Date	Nitrate mg/L	Total Phosphorous mg/L	E.coli colonies/100ml	Dissolved Oxygen mg/L	pH
6/28/2011	0.01	0.021	98	1.1	7.16
9/14/2011	0.02	0.034	85	2	6.83
6/20/2012	0.01	0.016	54	5.6	7.83
9/14/2012	0.13	0.019	62	0	7.76
7/22/2013	0	0.1	210	4.1	7.2
10/8/2013	0	0.011	248		
9/4/2014	0	0.012	2851		
10/23/2014	0.05	0.03	249.1		
7/8/2015	0	0.057	117.8		
8/26/2015	0	0.021	261.3		
8/22/2016	0	0.022	387.3		
8/17/2017	0.05	0.016	157.6		
9/12/2017	0.05	0.014	325.5		
6/20/2018	0.05	0.04	114.5		
8/2/2018	0.05	0.024	816.4		
7/2/2019	0.05	0.019	36.4		
9/4/2019	0.05	0.02	48.9		
6/16/2020	0.05	0.028	25.9		
8/17/2020	0.08	0.084	30.1		
7/20/2021	0.05	0.038	143.9		
8/16/2021	0.05	0.05	47.9		
8/10/2022	0.05	0.024	160.7		
5/15/2023	0.05	0.0234	53.7		
7/19/2023	0.05	0.406	261.3		
No Data = 0, <0.01=0.01					

Richmond Pond Outlet (below dam on the Southwest Branch)			
Date	Nitrate mg/L	Total Phosphorous mg/L	E.coli colonies/100ml
7/8/2002		0.01	
8/14/2002	0.01	0.01	
10/8/2013	0	0.012	
9/4/2014	0	0	1
10/23/2014	0.05	0.01	60.9
7/8/2015	0	0	9.2
8/22/2016	0	0	88.9
8/17/2017	0.05	0.011	1
9/12/2017	0.05	0.01	1
6/20/2018	0.05	0.023	2
8/2/2018	0.05	0.017	57.1
7/2/2019	0.05	0.014	3.1
9/4/2019	0.05	0.021	23.8
6/16/2020	0.05	0.011	7.5
8/17/2020	0.05	0.018	18.3
7/20/2021	0.05	0.038	42
8/16/2021	0.05	0.037	7.4
8/10/2022	7.5	0.013	7.5
5/15/2023	0.05	0.0138	13.5
7/19/2023	0.05	0.01	8.5
No Data = 0, <0.01=0.01			

Appendix I: Draft Pathogen TMDL for Massachusetts-Appendix B: Housatonic River Basin

CN 515.0.02

1. Introduction

This appendix to the Massachusetts Statewide Total Maximum Daily Load (TMDL) for Pathogen-Impaired Waterbodies provides additional information to support the determination of the Total Maximum Daily Load (TMDL) for four pathogen-impaired river segments in the Housatonic River watershed (Figure 1-1). The core document and appendix together complete the TMDL for each of these pathogen-impaired river segments.

This appendix includes a description of the watershed and maps to identify the segments for the TMDLs; the Massachusetts Surface Water Quality Standards (SWQS, 314 CMR 4.00) water classification, impaired designated uses, qualifiers and the applicable water quality standards; the data supporting the pathogen impairment determination; and a description of the sources of pathogen loading with supporting maps. For water quality data, the Method Detection Limit (MDL) is reported and used for values below the MDL when calculating geometric means.

This appendix includes a summary of the allocation of the current indicator bacteria load into two categories: point sources (waste load allocation, WLA) and nonpoint sources (load allocation, LA), based on an analysis of watershed percent impervious cover. This appendix also identifies the percent reduction in indicator bacteria pollutant load from current conditions required to meet the TMDL, based on the highest levels of indicator bacteria recorded in the monitoring data. Refer to Table 1-1.

Finally, for each impaired segment, this appendix presents existing local management efforts to reduce pathogen pollutant loading. General recommended next steps for implementation of this TMDL are provided in the Housatonic River Watershed Overview section.

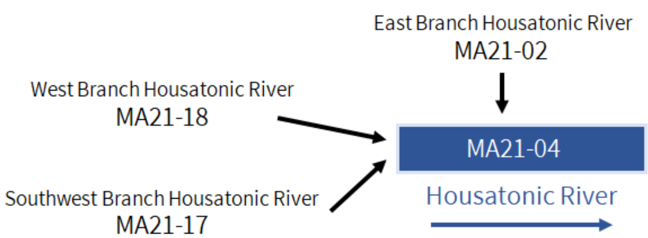


Figure 1-1. Conceptual diagram of water flow routing through the Housatonic River watershed for the 4 pathogen-impaired river segments. The mainstem Housatonic River is highlighted in blue. Tributary segments to the major rivers are shown with arrows to the blue mainstem. Not to scale.

Table 1-1. ***E. coli*** Total Maximum Daily Loads (TMDLs), the percent reductions needed to meet the TMDL target (126 CFU/100ml) based on the Massachusetts Surface Water Quality Standards (SWQS), and the flow-based TMDL allocations for pathogen-impaired **freshwater** assessment units in the Housatonic River Basin

Waterbody & Assessment Unit	Class (Qualifier)	TMDL Type	SWQS-Based TMDL target (CFU/100ml)	Maximum Geomean (CFU/100ml)	Geomean Percent Reduction	TMDL Allocation	Flow (cfs) *1*	*10*	*100*	*1,000*	*10,000*	*100,000*
							Flow-Based Target TMDL (CFU/day*10^9)					
East Branch Housatonic River MA21-02	B (WW)	R	126	328 (90 day)	62%	WLA (7%)	0.2	2.1	20.6	205.8	2,058.5	20,584.8
						LA (93%)	2.9	28.8	287.7	2,876.8	28,768.3	287,683.2
Housatonic River MA21-04	B (WW)	R	126	536 (30 day)	76%	WLA (6%)	0.2	1.8	17.6	176.2	1,762.3	17,623.4
						LA (94%)	2.9	29.1	290.6	2,906.4	29,064.5	290,644.6
Southwest Branch Housatonic River MA21-17	B (CW, HQW)	R	126	1,586 (90 day)	92%	WLA (5%)	0.2	1.5	15.5	154.6	1,545.6	15,456.1
						LA (95%)	2.9	29.3	292.8	2,928.1	29,281.2	292,811.9
West Branch Housatonic River MA21-18	B (CW, HQW)	R	126	314 (90 day)	60%	WLA (6%)	0.2	2.0	19.7	196.9	1,968.7	19,687.3
						LA (94%)	2.9	28.9	288.6	2,885.8	28,858.1	288,580.7

Table 1-2. Enterococci Total Maximum Daily Loads, the percent reductions needed to meet the TMDL target (35 CFU/100ml) based on the Massachusetts Surface Water Quality Standards (SWQS), and the flow-based TMDL allocations for pathogen-impaired **freshwater** assessment units in the Housatonic River Basin

Waterbody & Assessment Unit	Class (Qualifier)	TMDL Type	SWQS-Based TMDL target (CFU/100ml)	Maximum Geomean (CFU/100ml)	Geomean Percent Reduction	TMDL Allocation	Flow (cfs) *1*	*10*	*100*	*1,000*	*10,000*	*100,000*
							Flow-Based Target TMDL (CFU/day*10^9)					
East Branch Housatonic River MA21-02	B (WW)	P	35	NA	-	WLA (7%)	0.1	0.6	5.7	57.2	571.8	5,718.0
						LA (93%)	0.8	8.0	79.9	799.1	7,991.2	79,912.0
Housatonic River MA21-04	B (WW)	P	35	NA	-	WLA (6%)	-	0.5	4.9	49.0	489.5	4,895.4
						LA (94%)	0.8	8.1	80.7	807.3	8,073.5	80,734.6
Southwest Branch Housatonic River MA21-17	B (CW, HQW)	P	35	NA	-	WLA (5%)	-	0.4	4.3	42.9	429.3	4,293.4
						LA (95%)	0.8	8.1	81.3	813.4	8,133.7	81,336.6
West Branch Housatonic River MA21-18	B (CW, HQW)	P	35	NA	-	WLA (6%)	0.1	0.5	5.5	54.7	546.9	5,468.7
						LA (94%)	0.8	8.0	80.2	801.6	8,016.1	80,161.3

Class *defined in the Massachusetts Surface Water Quality Standards (SWQS) at 314 CMR 4.02.*
Qualifiers *that identify segments with special characteristics are defined at 314 CMR 4.06(1)(d).*
- ***CW*** *= Cold Water; waters that meet the cold water fisheries (CWF) definition at 314 CMR 4.02 and are subject to CWF dissolved oxygen and temperature criteria*
- ***HQW*** *= High Quality Water; waters designated for protection under 314 CMR 4.04(2)*
- ***WW*** *= Warm Water; waters that meet the warm water fisheries (WWF) definition at 314 CMR 4.02 and are subject to WWF dissolved oxygen and temperature criteria*

Pathogen bacteria units are presented in colony-forming units or CFU.
TMDL Type *identifies the restorative or protective action approach:*
- ***R*** *= Restorative TMDL addressing a pathogen impairment identified in the 2018/2020 Integrated List of Waters*
- ***R**** *= Restorative TMDL addressing a historic impairment of former indicator bacteria for which no current applicable criteria are available. See Section 2.3 of the core document for summary of water quality criteria and designated uses.*
- ***P*** *= Protective TMDL addressing all applicable uses, regardless of impairment status, for the associated pathogen (refer to the Massachusetts SWQS: 314 CMR 4.00)*

Target TMDL or Total Maximum Daily Load is presented as both SWQS-Based and Flow-Based.
- ***SWQS-Based TMDL Target*** *is the target concentration applicable to the TMDL pollutant indicator bacteria based on the Surface Water Quality Standards (314 CMR 4.00).* ***Flow-Based Target TMDL*** *is the target concentration (CFU/100mL) multiplied by the standard flow volume (cubic feet per second or cfs). See Section 4.2.2 in core document for full equation and conversion factors.*

Maximum Geomean *is the highest calculated 30- or 90- day rolling geometric mean for TMDL pollutant indicator bacteria associated with the segment.*
Geomean Percent Reduction *is the percent reduction from the highest calculated 30- or 90- day rolling geomean needed to achieve the target concentration. Percent reductions are for planning purposes only.*

2. Housatonic River Watershed Overview

The entire Housatonic River watershed covers an area of approximately 545 square miles in southwestern Massachusetts (Figure 2-1). The Housatonic River begins at the confluence of the West and Southwest branches in Clapp Park, Pittsfield, MA. Another major tributary, the East Branch Housatonic River, joins the Housatonic River at Fred Garner Park in Pittsfield (MassDEP, 2007). Large portions of these three tributaries and the mainstem of the Housatonic River are pathogen-impaired. Within the pathogen-impaired watersheds, there are 50 named rivers, approximately 161 named river miles; many smaller unnamed rivers; and 34 named lakes, ponds, and impoundments (USGS, 2019).

The Southwest Branch Housatonic River begins along the border of Richmond and Pittsfield at the outlet of Richmond Pond and flows generally northeast. The Southwest Branch watershed drains 24 square miles, flowing about six miles before meeting the Housatonic River in Pittsfield. There is one pathogen-impaired river segment in the Southwest Branch Housatonic River watershed.

The West Branch Housatonic River begins in Lanesborough at the outlet of Pontoosuc Lake and flows generally south. The West Branch watershed drains 37 square miles, flowing about 4 miles before meeting the Housatonic River in Pittsfield. There is one pathogen-impaired river segment in the West Branch Housatonic River watershed.

The East Branch Housatonic River begins on the border of Washington and Hinsdale at the outlet of Muddy Pond and flows generally southwest. The East Branch watershed drains 71 square miles, flowing about 8 miles before meeting the Housatonic River in Pittsfield. The East Branch Housatonic River has historically been used for waterpower and contains many impoundments and hydroelectric dams. Power was still generated in 2002 by the Pittsfield Development Authority (formerly known as the General Electric Company) (MassDEP, 2007). There is one pathogen-impaired river segment in the East Branch Housatonic River watershed.

The Housatonic River flows approximately 150 miles to the south from Pittsburg through Massachusetts and Connecticut before discharging into the Long Island Sound near Bridgeport, CT. Of the total 150 miles, the Housatonic River flows approximately 54 miles within Massachusetts. The Housatonic River watershed has been characterized by its many dams and consequent flow alterations in addition to many withdrawals and inputs (MassDEP, 2007). Within the pathogen-impaired segment watersheds (described in detail in the following sections), there are three active NPDES major and/or minor permits for wastewater discharge to surface waters along the Housatonic River (2) and East Branch Housatonic River (1). A portion of the Housatonic River in Connecticut is being considered by the National Park Service for designation under the Wild and Scenic Rivers Act (NWSRS, 2020).

The pathogen-impaired portion of the Housatonic River watershed overlaps at least partially with 13 municipalities. Of these, 10 were identified as being direct sources of pathogen loading to the impaired river segments in this TMDL. The efforts of these municipalities contributing to pollutant loading are described in the segment-specific sections below. For each segment, the cities and towns that contain or border the impaired segment were identified. Towns comprising more than 10% of the impaired stream segment's sub-basin (that portion of its watershed not shared with upstream segments) were also included. In addition, towns which may not meet the above characteristics, but which have land area in the sub-basin near the impaired segment (e.g., Town of Lenox for the Housatonic River segment MA21-04), were included on a case-by-case basis. See Figure 2-1 for a map showing pathogen-impaired segments and municipalities.

Many municipalities operate and maintain municipal separate storm sewer systems (MS4s) in urban areas. These networks of drains and pipes convey polluted runoff from streets and developed areas to streams. In addition, these networks are sometimes subject to direct wastewater inflows through illegal cross-connections, leaks from sewer pipes or septic systems, dumping, or other unauthorized wastewater sources, and together these sources are termed illicit discharges.

EPA and MassDEP jointly issued the General Permits for Stormwater Discharges from MS4s, which became effective July 1, 2018. Communities that discharge to pathogen-impaired waterbodies with approved TMDLs are required to implement enhanced best management practices (BMPs) for public education and designate the catchments as Problem Catchments or High Priority under the Illicit Discharge Detection and Elimination (IDDE) Program, in addition to the requirement to reduce pollutants to the Maximum Extent Practicable (USEPA, 2016; Appendix F).

In addition to municipalities, there is one Regional Planning Agency (RPA) in the Housatonic River watershed, the Berkshire Regional Planning Commission. These are public organizations advising municipalities, private business groups, and state and federal governments on a range of matters. Their research, coordination, and technical assistance is especially valuable on watershed issues such as pathogen pollutants and stormwater that cross town boundaries.

- Berkshire Regional Planning Commission (BRPC), http://www.berkshireplanning.org/ (BRPC, 2020)

The following RPA initiatives and tools are especially noteworthy:

- There are regional stormwater coalitions within some RPAs, and these are noted in the segment-specific sections below.

Beyond these activities, the Massachusetts Statewide Municipal Stormwater Coalition (MSMSC), composed of about 10 stormwater groups around the state, further coordinates with and assists municipalities on pathogen pollutant concerns in the "Think Blue" campaign. (Think Blue Massachusetts, 2019).

Additional watershed scale initiatives are carried out by several organizations including:

The **Housatonic Valley Association (HVA)** developed a Housatonic River Paddle Guide, https://hvatoday.org/ (HVA, 2020).

The **Riverways Instream Flow Stewards (RIFLS),** https://eeaonline.eea.state.ma.us/DFG/RIFLS/#/home (MassDER, 2016)

Great Barrington Housatonic River Walk from the Great Barrington Land Conservancy, https://gbriverwalk.org/ (GBLC, 2020)

Massachusetts Watershed Coalition, http://www.commonwaters.org/ (MWC, 2020)

Upper Housatonic Valley Natural Heritage Area, https://housatonicheritage.org/ (HH, 2020)

The following actions will help reduce pathogen loads to the streams. The list is a starting point and is not comprehensive. For a more detailed discussion of pollutant reduction actions, see Section 5 "Implementation" of the core TMDL document.

- Collect additional water quality data for all segments for which existing data are all older than five years.
- **Municipalities:** Continue to implement requirements of the MS4 permit, which includes specific requirements for waterbodies with an approved Bacteria/Pathogen TMDL, such as prioritization and reporting, enhanced BMPs, IDDE work, and education (USEPA 2016).
- **Regional Planning Agencies (RPAs) and municipalities:** Continue and expand collaboration on MS4 and stormwater issues. Cooperatively developing tools and sharing knowledge has many advantages, including reduced costs, increased innovation, and more consistent and effective stream restoration efforts at the watershed scale.
  - Two tools developed by Metropolitan Area Planning Council (MAPC) are potentially valuable in all MS4 communities in the state. Municipalities and other RPAs (with permission from MAPC) should consider adapting and/or expanding on these tools in their area:
    - Stormwater Utility/Funding Starting Kit (MAPC 2014).
    - MAPC and the Neponset River Watershed Association created a GIS toolkit to calculate MS4 outfall catchments, which is a requirement under the MS4 General Permit (MAPC 2018).
- **USDA NRCS and landowners:** Develop comprehensive nutrient management plans for agriculture, using local connections to farmers for outreach.
- **Parks departments, schools, private landowners, and others** who maintain large, mowed fields with direct access to water should consider maintaining a vegetative buffer along the water's edge. Buffers

slow and filter stormwater runoff, provide a visual screen that can reduce large aggregations of waterfowl, and have many other water quality benefits at low cost.

MassDEP Technical and Planning Support for the Implementation of Pathogen and Total Nitrogen Pollution Reduction in the Housatonic River Watershed

In April 2022, MassDEP supported a planning project that prioritized and ranked stormwater catchments for pathogen and nutrient removal within the Housatonic River Watershed. The project characterized the watershed through geographic data analysis and explored potential pollutant removal scenarios with the EPA OptiTool. Based on the results of the analysis, communication with municipal staff, and site investigations, the project team identified a list of potential sites for the development stormwater control mechanism (SCM) retrofit opportunities. Concept designs were then developed for 10 sites across the municipalities of Dalton, Lanesborough, and Pittsfield. The preliminary designs were presented to the municipalities and the Berkshire Environmental Action Team (BEAT), Berkshire Regional Planning Commission (BRPC), and Housatonic Valley Association (HVA).

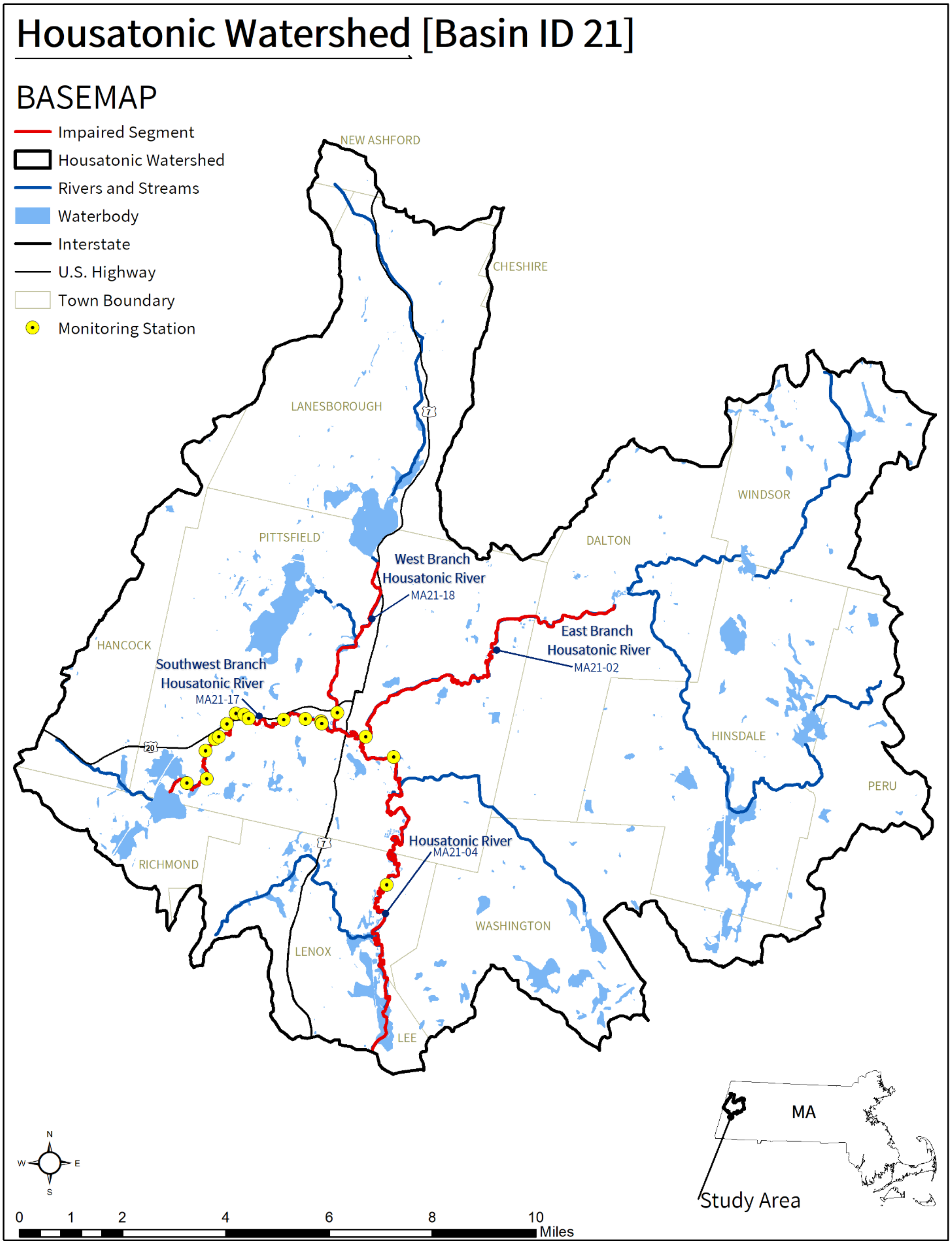


Figure 2-1: Map of all pathogen-impaired river segments, water quality monitoring stations, municipal borders, waterbodies, and roads in the Housatonic River watershed.

3. MA21-02 East Branch Housatonic River

3.1. Waterbody Overview

The East Branch Housatonic River segment MA21-02 is 8 miles long and begins at the outlet of Center Pond in Dalton, MA. The segment flows southwest to end at its confluence with the Housatonic River in Pittsfield, MA.

Tributaries to the East Branch Housatonic River segment MA21-02 includes an unimpaired section of the East Branch Housatonic River, Walker Brook, Barton Brook, Unkamet Brook, Brattle Brook, and other unnamed streams. Named lakes and ponds within the watershed include Ashmere Lake, the Cleveland Brook Reservoir, Plunkett Reservoir, Muddy Pond, Belmont Reservoir, Fernwood Reservoir, Windsor Reservoir, and others.

Key landmarks in the watershed include the town centers of Hinsdale, Dalton, and Pittsfield, along with the Wahconah Country Club and golf course, the Allendale Shopping Center, and residential neighborhoods of Pittsfield between Elm Street and Pomeroy Avenue. The segment is crossed by West Housatonic Street and South Street in Dalton; and Hubbard Avenue, East Street, Newell Street, Lyman Street, Elm Street, Pomeroy Avenue, and Dawes Avenue in Pittsfield.

The East Branch Housatonic River (MA21-02) drains an area of 71 square miles, of which 5 mi^2 (7%) is impervious and 3 mi^2 (4%) is directly connected impervious area (DCIA). The watershed is partially[1] served by public sewer and 18% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA 2016). There is one NPDES permit on file governing point source discharges of pollutants to surface waters within the direct drainage area to the watershed (Table 3-1) but no MassDEP discharge to groundwater permit for on-site wastewater discharge within the watershed. There are five NPDES industrial stormwater discharge permits in the segment watershed (Table 3-2). There are also no combined sewer overflows, five landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 3-1.

Reduction from Highest Calculated Geomean: 62%

Watershed Area (Acres): 45,344

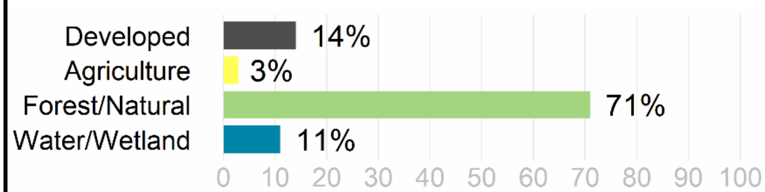
Segment Length (Miles): 8.0

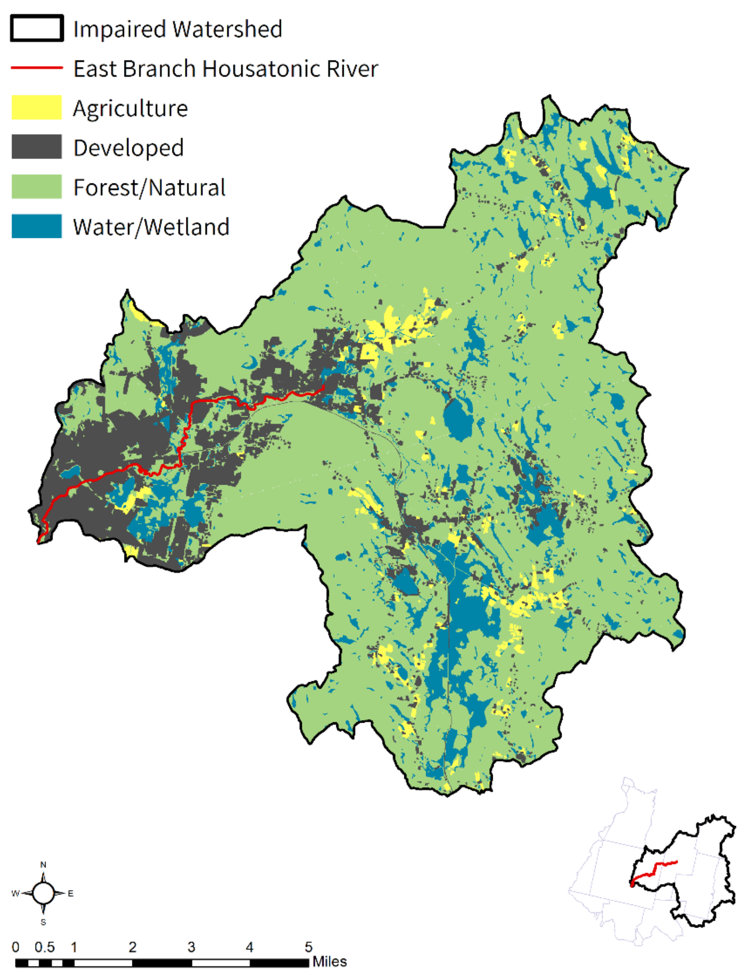
Impairment(s): *E. coli*, fecal coliform (Primary Contact Recreation)

Class (Qualifiers): B (Warm Water)

Impervious Area (Acres, %): 3,028 (7%)

DCIA Area (Acres, %): 1,744 (4%)





[1] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project https://www.mass.gov/guides/water-utility-resilience-program (MassDEP, 2020), MS4 reports, and local knowledge.

Table 3-1. National Pollutant Discharge Elimination System (NPDES) permits for Wastewater Treatment Facilities (WWTF) in the segment watershed. Only permits unique to this segment watershed are shown. WWTF are identified as either municipal (MUN) or other (OTH), if applicable.

NPDES ID	NAME	TOWN	WWTF
MA0000671	CRANE & CO INC WWTP	PITTSFIELD	OTH

Table 3-2. National Pollutant Discharge Elimination System (NPDES) permits for Industrial Stormwater in the segment watershed. Only permits within this watershed are listed.

NPDES ID	NAME	TOWN
MA0000671	CRANE & CO INC WWTP	PITTSFIELD
MA0003891	GENERAL ELECTRIC PITTSFIELD	PITTSFIELD
MA0040312	PITTSFIELD SAND & GRAVEL	PITTSFIELD
MA0000671	CRANE & CO INC WWTP	PITTSFIELD
MA0003891	GENERAL ELECTRIC PITTSFIELD	PITTSFIELD

The East Branch Housatonic River (MA21-02) watershed is predominantly forested (71% of land use); however, the developed areas (14%) are concentrated around the segment itself. Portions of Cleveland Brook and the East Branch Housatonic River upstream of Center Pond (where the segment begins) flows through a golf course which has little to no wooded buffer around the stream. The segment flows through medium density mixed residential and commercial areas in downtown Dalton, then a commercial district with expansive parking lots near the MA-9/MA-8 intersection in Pittsfield, MA. The downstream portions of the segment flow through areas of dense residential development, open recreational fields, and additional commercial districts in Pittsfield.

In the East Branch Housatonic River (MA21-02) watershed, under the Natural Heritage and Endangered Species Program, there are 2,686 acres (6%) of Priority Habitats of Rare Species and 279 acres (1%) of Priority Natural Vegetation Communities. There are 10,436 acres (23%) under Public Water Supply protection and 14,057 acres (31%) of Areas of Critical Environmental Concern in the watershed. Over 6,927 acres (15%) of land protected in perpetuity[2] exist within the segment watershed, which is part of a total of 17,248 acres (38%) of Protected and Recreational Open Space[3]. See Figure 3-1.

[2] Land protected in perpetuity include several interests such as conservation restriction, agricultural preservation, private deed restrictions, wetland restrictions, aquifer protection, historic preservation, etc. Refer to Mass GIS metadata for the Protected and Recreational Open Space data layer.

[3] Only land protected in perpetuity is shown on the natural resources map. Protected and Recreational Open Space estimates reflect areas in the State of Massachusetts only (and thus reflect only a portion of the total open space for watersheds that extend outside the State of Massachusetts).

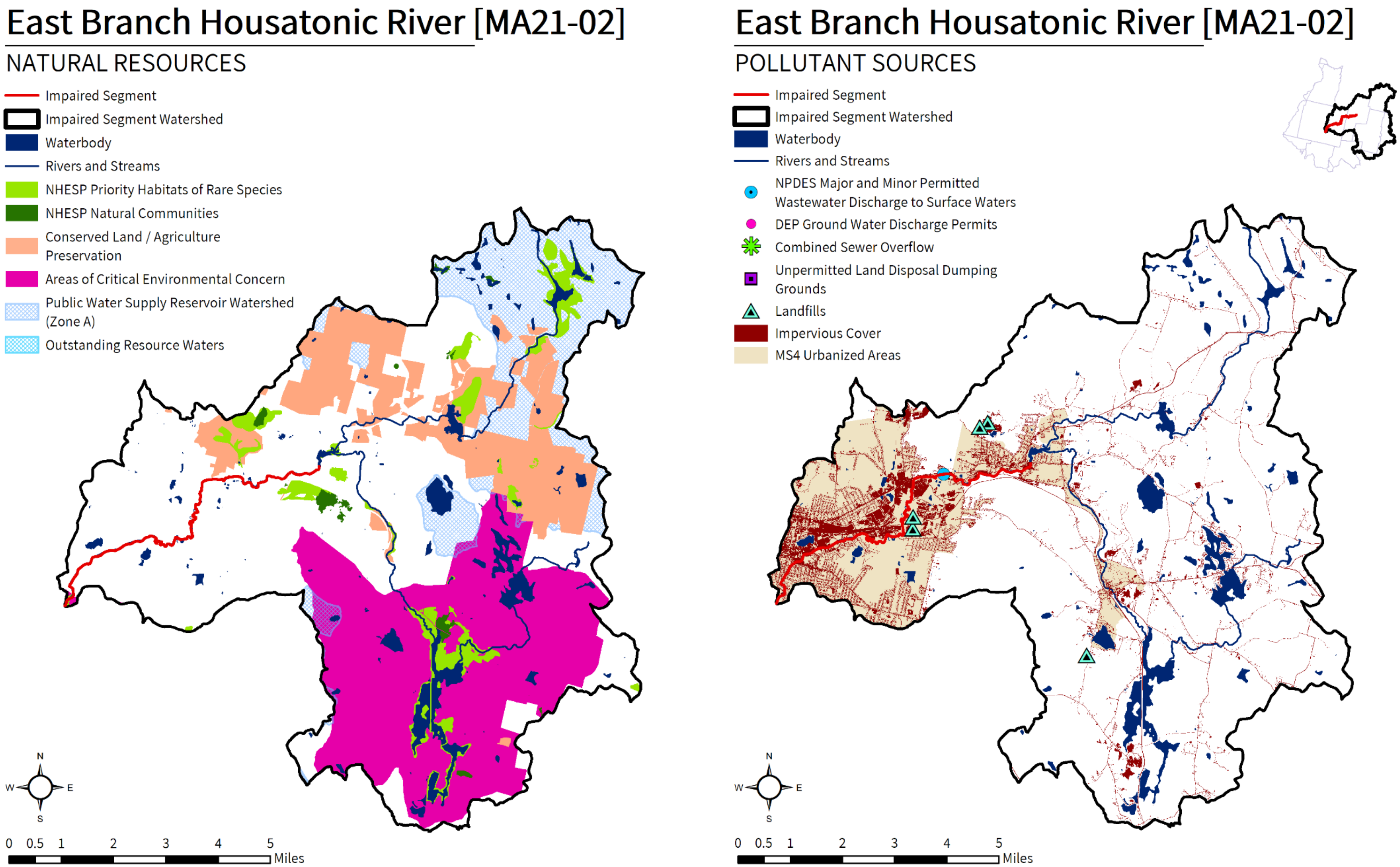


Figure 3-1. Natural resources and potential pollution sources draining to the East Branch Housatonic River segment MA21-02. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

3.2. Waterbody Impairment Characterization

The East Branch Housatonic River (MA21-02) is a Class B, Warm Water (MassDEP, 2021).

The Primary Contact Recreation use was assessed for attainment of SWQS using the indicator bacteria *E. coli* at the station listed below (refer to Tables 3-3, 3-4; Figure 3-2). Data were evaluated against the SWQS geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria and the Statistical Threshold Value (STV) criterion of 410 CFU/100 mL for *E. coli*. The geomean and STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

- In 2007, five samples were collected at W1107, resulting in two days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of five samples, one exceeded the STV criterion during dry weather.

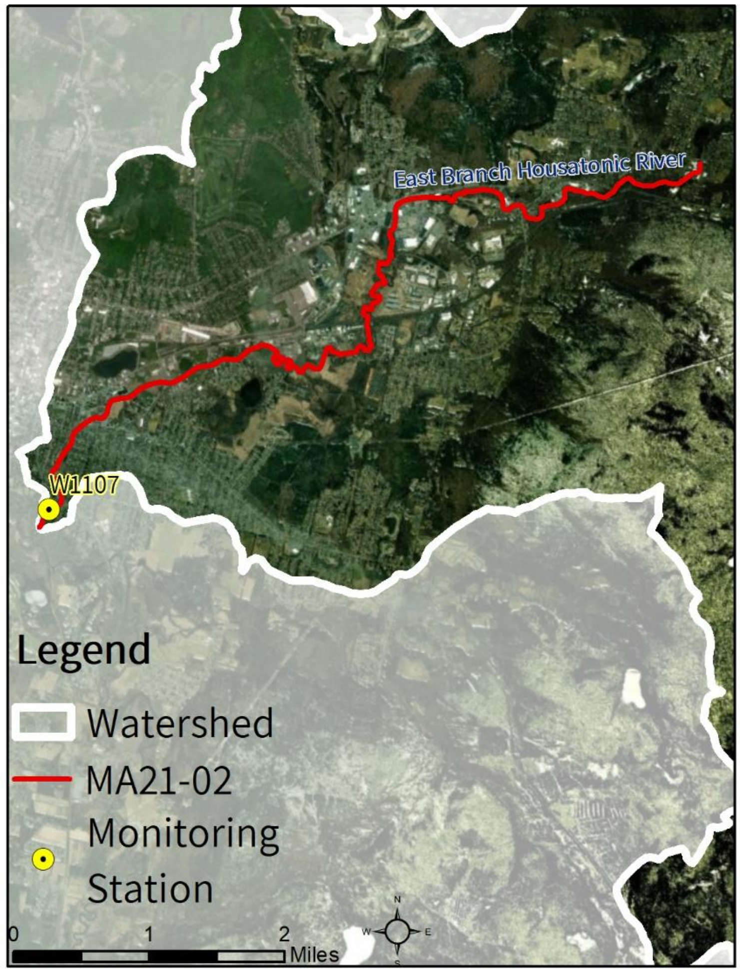


Figure 3-2. Location of monitoring station(s) along the impaired river segment.

Table 3-3. Summary of indicator bacteria sampling results by station for the East Branch Housatonic River (MA21-02). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria, and the number of single samples exceeding the Statistical Threshold Value (STV) criterion of 410 CFU/100 mL for *E. coli* indicator bacteria are shown. The STV criterion is applied to the single sample results if less than 10 samples were collected within a calendar year at a site. The highest maximum 90-day rolling geomean of the sites is used to calculate the percent load reduction required to meet SWQS.

Unique Station ID	First Sample	Last Sample	Count	Maximum 90-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1107	5/8/2007	9/25/2007	5	328	2	1

Table 3-4. Indicator bacteria data by station, indicator, and date for the East Branch Housatonic River (MA21-02). Each sample date was designated wet or dry weather with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text highlights criteria exceedances of 410 CFU/100 mL (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the Statistical Threshold Value or STV) and 126 CFU/100 mL (applied to rolling 90-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1107	*E. coli*	5/8/2007	DRY	22	22	
W1107	*E. coli*	6/12/2007	WET	368	90	
W1107	*E. coli*	7/17/2007	DRY	200	117	
W1107	*E. coli*	8/21/2007	DRY	480	328	
W1107	*E. coli*	9/25/2007	DRY	160	249	

3.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

The indicator bacteria data for the East Branch Housatonic River (MA21-02) were elevated during dry weather. Given the relatively small sample set, additional sampling under both wet and dry conditions, ideally at more than one location, would likely help to identify pollutant sources. Elevated indicator bacteria during dry weather suggest that baseflow sources, such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, are likely to be major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Portions of the watershed are heavily developed and include the town centers of Dalton and Pittsfield. The watershed has 18% of land area in MS4 and 4% as DCIA. The developed areas within the watershed include many areas of high density mixed residential, commercial, and industrial development. Stormwater runoff from urban areas is likely a major source of pathogens.

Illicit Sewage Discharges: Most of the downstream portion of the watershed is served by public sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows, which may be caused by undersized infrastructure, blockages, or excessive infiltration of groundwater or rainwater into pipes, exceeding system capacity. Illicit connections of wastewater to stormwater drains are also a risk.

On-Site Wastewater Disposal Systems: Nearly all development in the upstream portions of the watershed relies on septic systems for wastewater treatment. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities account for 3% of the total land use area within the watershed. Those visible on recent aerial photos include open fields, hayfields, row crops, and pastureland. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: There are many conservation and recreational lands, parks, ballfields, and dense residential neighborhoods near or along the segment which may be popular for dog-walking. These areas, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens from pet waste.

Wildlife Waste: There are large open recreational fields along the river between Newell and Elm streets in Pittsfield, and many high-density residential neighborhoods further downstream. Just upstream of the segment, the river flows through a golf course which in places has no wooded buffer around the river channel. Large open mowed areas such as conservation and recreational lands, fields, golf courses, and wetlands with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

3.4. Existing Local Management

This section identifies the municipalities immediately surrounding the impaired segment and its sub-basin. For a complete view of upstream municipalities and waterbodies, see the map in Figure 2-1.

City of Pittsfield

Most of Pittsfield is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Pittsfield (Permit ID #MAR041018) has an EPA approved Notice of Intent (NOI). The town does not have a Stormwater Management Plan. The town has mapped all of its stormwater outfall system, available online at https://arcg.is/1OSTCa. (City of Pittsfield, 2019). The town adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2008. According to the NOI, there are 67 stormwater outfalls into the pathogen-impaired East Branch Housatonic (MA21-02); 84 stormwater outfalls into the pathogen-impaired West Branch Housatonic (MA21-18); 42 stormwater outfalls into the pathogen-impaired Housatonic River (MA21-04); and 42 stormwater outfalls into the pathogen-impaired Southwest Branch Housatonic River (MA21-17).

Pittsfield has the following ordinances and bylaws:

- Stormwater Ordinance: https://ecode360.com/30744151 (City of Pittsfield, n.d., a)
- Pittsfield does not have any supplementary regulations beyond the MassDEP regulations for wetland protection.
- Title 5 Supplementary Regulations: None found.
- Stormwater Utility: None found.
- Pet Waste: https://ecode360.com/15966545 (City of Pittsfield, n.d., b)

The Pittsfield Master Plan has a Water Resources section in Chapter 6 – Open Space and Recreation and Natural Resource Protection – which includes information on surface waters, wetlands, groundwater, and floodplains (City of Pittsfield 2009). One of the three goals of the Master Plan -- to promote sustainable practices in all development projects -- incorporates reducing stormwater runoff. The plan also mentions the Housatonic River throughout the Natural Resources chapter. In the Public Facilities chapter, the plan explains that the urbanized areas of Pittsfield comply with stormwater management regulations under Phase II of the NPDES program. Approximately 95% of Pittsfield residents have access to the sanitary sewer service.

Town website: https://www.cityofpittsfield.org/ (City of Pittsfield, 2020)

Master Plan: https://www.cityofpittsfield.org/city_hall/community_development/planning_and_development/master_plan.php (City of Pittsfield 2009)

Stormwater page: https://ecode360.com/30744151 (City of Pittsfield, n.d., a.)

Open Space and Recreation Plan: https://www.cityofpittsfield.org/city_hall/community_development/open_space_program/docs/Final%20OSRP.pdf (City of Pittsfield and BRPC, 2009)

Town of Dalton

Approximately 10% of Dalton is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Dalton (Permit ID #MAR041004) has an EPA approved Notice of Intent (NOI). Dalton has a webpage (link below) dedicated to stormwater management and has mapped all of its MS4 stormwater systems. Dalton adopted illicit discharge detection and elimination (IDDE) in 2007, as well as erosion and sediment control (ESC) and post-construction stormwater regulations in 2006. There are 48 stormwater outfalls to the East Branch Housatonic River (MA21-01) (formerly impaired due to fecal coliform, now in attainment), 56 stormwater outfalls to the pathogen-impaired East Branch Housatonic River (MA21-02), and 8 stormwater outfalls to Waconah Falls Brook.

Dalton stormwater management program: https://dalton-ma.gov/wp-content/uploads/2020/09/Dalton-Final-2019-SWMP.pdf (Town of Dalton, 2019)

Dalton has the following relevant ordinance and bylaw:

- Stormwater Management and Erosion Control: Chapter 280 https://ecode360.com/9537082
- Title V Supplemental Regulations: None found.
- Stormwater Utility: None found.
- Pet Waste Ordinance: None found.

The Town of Dalton has a Master Plan that mentions stormwater and has a section dedicated to water under the Environmental Inventory as well as a section dedicated to Open Space and Recreation.

- Town website: https://dalton-ma.gov/
- Master Plan: https://dalton-ma.gov/wp-content/uploads/2019/07/Final_Dalton_Master_Plan_160720_Compressed.pdf (Town of Dalton and BRPC, 2016)

Town of Hinsdale

A small portion of Hinsdale falls within the MS4 study area, and the town was granted a MS4 General Permit waiver by the EPA.

Hinsdale has the following relevant ordinances and bylaws:

- Hinsdale does not have any supplementary regulations beyond the MassDEP regulations for stormwater management or wetland protection.
- Title V Supplemental Regulations: None found.
- Stormwater Utility: None found.
- Pet Waste Ordinance: None found.

The Town of Hinsdale Master Plan provides information on town water resources in the Natural Resources chapter, starting on page 9-2 (Town of Hinsdale and BRPC 2017). Stormwater is specifically mentioned as a threat to the quality of the town water supply. The plan provides information on the town sewer in the Infrastructure chapter. The Hazard Mitigation plan notes the town's plans to develop a stormwater mitigation plan, though no stormwater management ordinance has been adopted.

Town website: https://www.hinsdalemass.com/ (Town of Hinsdale, 2020)

Master Plan (draft): https://docs.wixstatic.com/ugd/f35351_1f630cf701794133ba015362702c367d.pdf (Town of Hinsdale and BRPC, 2017)

Hazard Mitigation Plan: https://docs.wixstatic.com/ugd/b84944_2cd3f9862ae94ea7becaca63471744a0.pdf (Town of Hinsdale, 2019)
Open Space and Recreation Plan:
https://docs.wixstatic.com/ugd/c1f318_ee15a042a066459eb692c5ae6151b326.pdf (Town of Hinsdale and BRPC, 2018)

Town of Peru

Peru is not within the MS4 area.

Peru has the following relevant ordinances and bylaws:

- Wetlands bylaw: https://www.townofperuma.com/sites/g/files/vyhlif3671/f/pages/town_of_peru_general_by_laws-_as_amended_through_september_14._2018_pdf.pdf (Town of Peru, 2018)
- Article 19 Animal Control bylaw, Section II part C https://www.townofperuma.com/sites/g/files/vyhlif3671/f/pages/town_of_peru_general_by_laws-_as_amended_through_september_14._2018_pdf.pdf (Town of Peru, 2018)

Peru does not have a Master Plan available.
Peru does not have an Open Space and Recreation Plan available.

Town of Windsor

Windsor is not within the MS4 area. Windsor has no relevant ordinances and bylaws. Windsor has no Master Plan and no Open Space and Recreation Plan available.

4. MA21-04 Housatonic River

4.1. Waterbody Overview

The Housatonic River segment MA21-04 is 12.3 miles long and begins at the confluence of the Southwest Branch Housatonic River and the West Branch Housatonic River in Pittsfield, MA. The segment flows south into Lenox, MA to end at the Woods Pond dam (NATID: MA00731) (pond was formerly segment MA21120) on the border of Lenox and Lee, MA.

Tributaries to the Housatonic River segment MA21-04 includes the pathogen-impaired segments of Southwest Branch Housatonic River (MA21-17), West Branch Housatonic River (MA21-18), and East Branch Housatonic River (MA21-02). Additional tributaries, proceeding downstream, are Wampenum Brook, Sackett Brook, Sykes Brook, Roaring Brook, Yoku Brook, Sawmill Brook, and Felton Lake Brook. Named lakes and ponds within the watershed include Pontoosuc Lake, Onota Lake, Richmond Pond, Sandwash Reservoir, Ashley Lake, Ashmore Lake, Cleveland Brook Reservoir, and others.

Key landmarks in the watershed near the segment include the Country Club of Pittsfield and golf course, the Mass Audubon Canoe Meadows Wildlife Sanctuary, Sandwash Reservoir, Ashley Lake, Farnham Reservoir, Mill Brook Reservoir, Ashley Reservoir, and Upper Sackett Reservoir. The segment is crossed by Housatonic Street and New Lenox Road in Lenox; and Holmes Road, Pomeroy Avenue, and South Street/US-7/MA-20 in Pittsfield.

The Housatonic River (MA21-04) drains an area of 170 square miles, of which 10 mi^2 (6%) is impervious and 5 mi^2 (3%) is directly connected impervious area (DCIA). The watershed is partially[4] served by public sewer and 17% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA 2016). There are two NPDES permits on file governing point source discharges of pollutants to surface waters within the immediate drainage area and one additional NPDES permit within the entire watershed (Table 4-1). There

Reduction from Highest Calculated Geomean: 76%

Watershed Area (Acres): 109,022

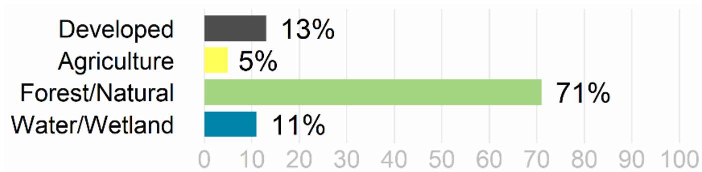
Segment Length (Miles): 12.3

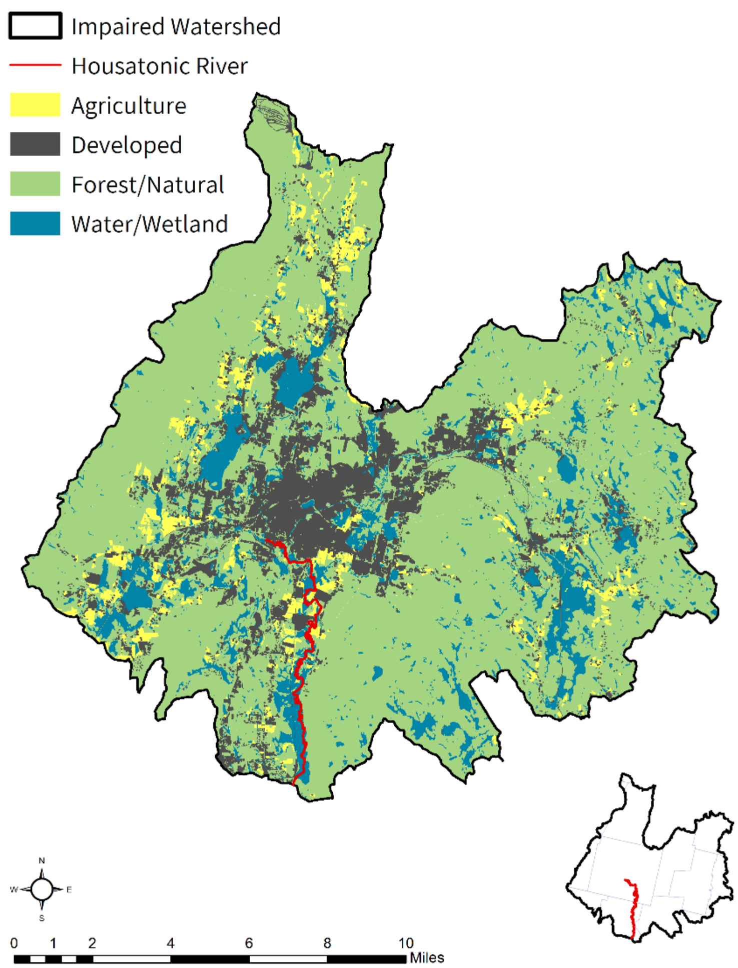
Impairment(s): *E. coli,* fecal coliform (Primary Contact Recreation)

Class (Qualifier): B (Warm Water)

Impervious Area (Acres, %): 6,233 (6%)

DCIA Area (Acres, %): 3,254 (3%)





[4] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project https://www.mass.gov/guides/water-utility-resilience-program (MassDEP, 2020), MS4 reports, and local knowledge.

are no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, nine landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 4-1.

Table 4-1. National Pollutant Discharge Elimination System (NPDES) permits for Wastewater Treatment Facilities (WWTF) in the segment watershed. Only permits unique to this segment watershed are shown. WWTF are identified as either municipal (MUN) or other (OTH), if applicable.

NPDES ID	NAME	TOWN	WWTF
MA0101681	PITTSFIELD WWTP	PITTSFIELD	MUN
MA0100935	LENOX CENTER WWTP	LENOX	MUN

The segment watershed is mostly forested (71%); however, the developed areas (13%) are concentrated along the tributaries immediately upstream of the segment in urbanized Pittsfield. Development consists of medium to high density mixed residential, commercial, and industrial development, with several expansive parking lots in proximity to the upstream tributaries. The segment itself flows primarily through low density development and wooded areas south of Pittsfield. Agricultural land uses along the segment appear to be used for row crops and hay.

In the Housatonic River (MA21-04) watershed, under the Natural Heritage and Endangered Species Program, there are 9,164 acres (8%) of Priority Habitats of Rare Species and 704 acres (1%) of Priority Natural Vegetation Communities. There are 15,900 acres (15%) under Public Water Supply protection and 23,739 acres (22%) of Areas of Critical Environmental Concern in the watershed. Over 8,728 acres (8%) of land protected in perpetuity[5] exist within the segment watershed, which is part of a total of 46,400 acres (43%) of Protected and Recreational Open Space[6]. See Figure 4-1.

[5] Land protected in perpetuity include several interests such as conservation restriction, agricultural preservation, private deed restrictions, wetland restrictions, aquifer protection, historic preservation, etc. Refer to Mass GIS metadata for the Protected and Recreational Open Space data layer.

[6] Only land protected in perpetuity is shown on the natural resources map. Protected and Recreational Open Space estimates reflect areas in the State of Massachusetts only (and thus reflect only a portion of the total open space for watersheds that extend outside the State of Massachusetts).

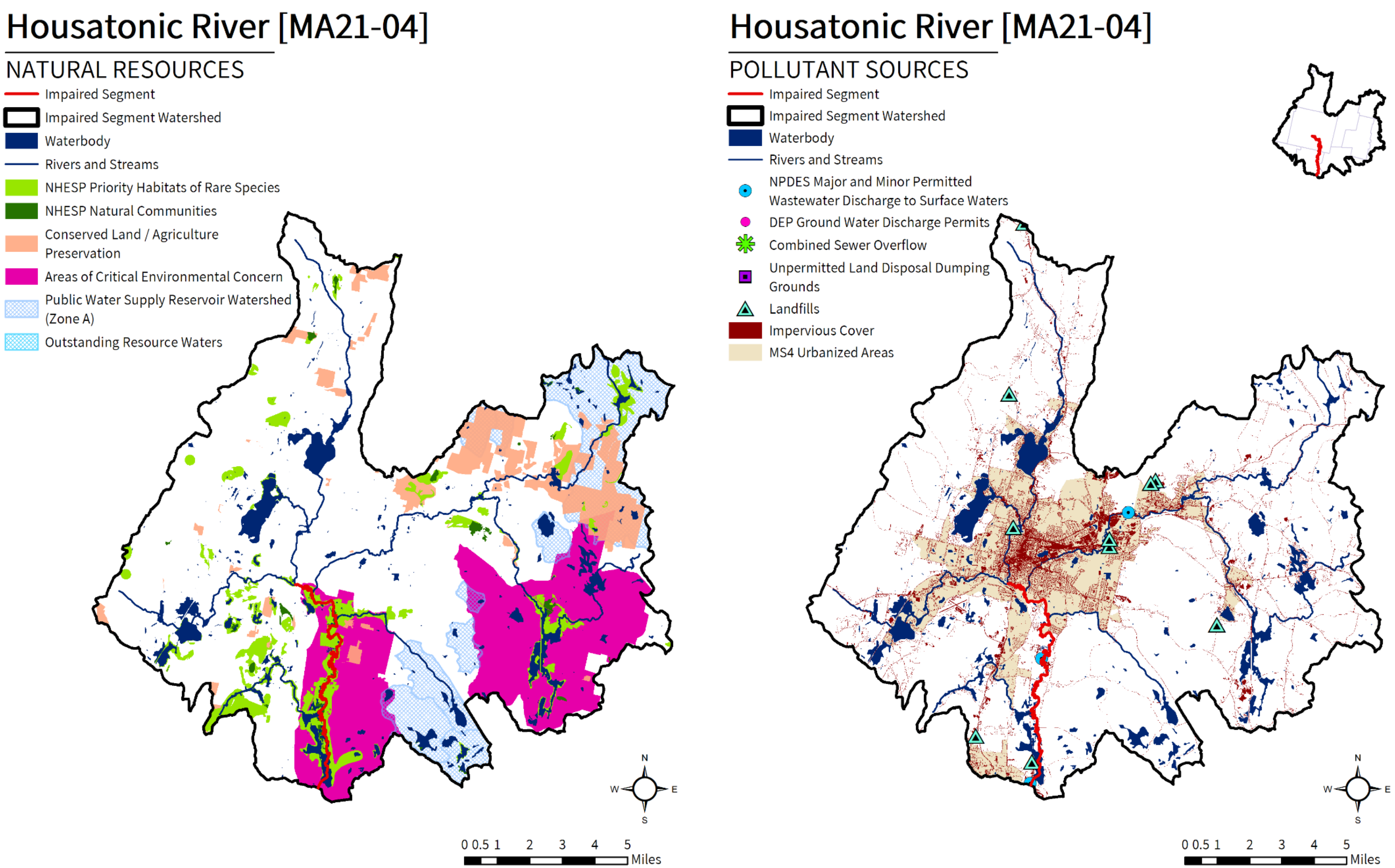


Figure 4-1. Natural resources and potential pollution sources draining to the Housatonic River segment MA21-04. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

4.2. Waterbody Impairment Characterization

The Housatonic River (MA21-04) is a Class B, Warm Water (MassDEP, 2021).

The Primary Contact Recreation use was assessed for attainment of SWQS using the indicator bacteria *E. coli* at the station listed below (refer to Tables 4-2, 4-3; Figure 4-2). Data were evaluated against the SWQS geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria and the Statistical Threshold Value (STV) criterion of 410 CFU/100 mL for *E. coli.* The geomean and STV criteria for the impaired segment apply to data on a year-round, 30-day rolling basis.

- In 2007, five samples were collected at W1104, resulting in three days when the 30-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of five samples, one exceeded the STV criterion during wet weather.
- In 2007, five samples were collected at W1105, resulting in 4 days when the 30-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of five samples, one exceeded the STV criterion during wet weather.

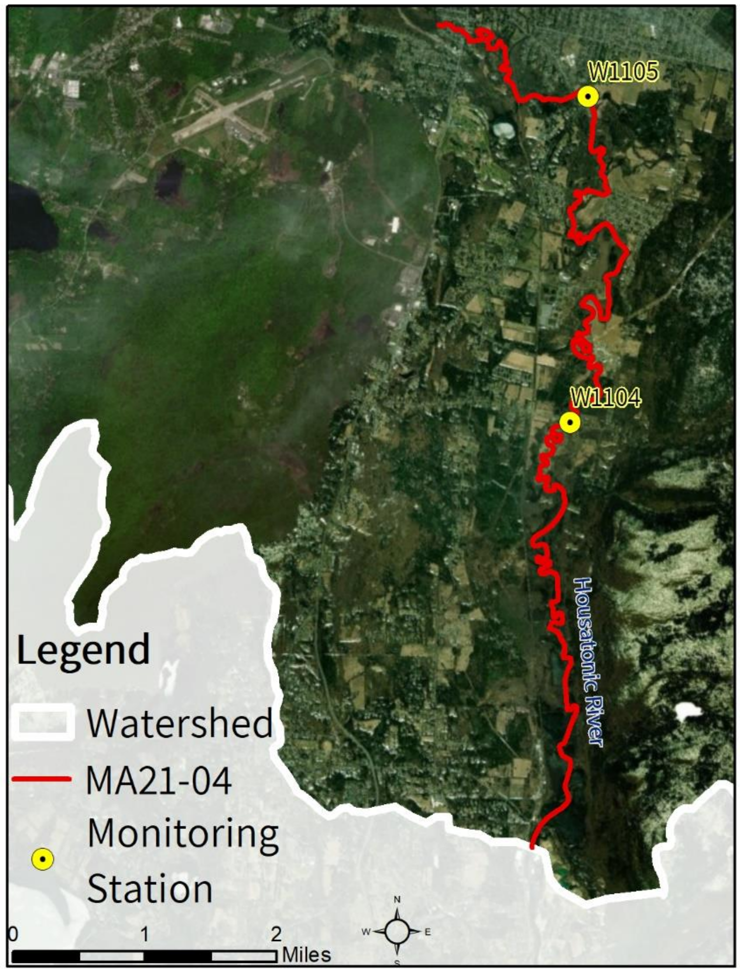


Figure 4-2. Location of monitoring station(s) along the impaired river segment.

Table 4-2. Summary of indicator bacteria sampling results by station for the Housatonic River (MA21-04). The maximum 30-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria, and the number of single samples exceeding the Statistical Threshold Value (STV) criterion of 410 CFU/100 mL for *E. coli* indicator bacteria are shown. The STV criterion is applied to the single sample results if less than 10 samples were collected within a calendar year at a site. The highest maximum 30-day rolling geomean of the sites is used to calculate the percent load reduction required to meet SWQS.

Unique Station ID	First Sample	Last Sample	Count	Maximum 30-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1104	5/8/2007	9/25/2007	5	536	3	1
W1105	5/8/2007	9/25/2007	5	416	4	1

Table 4-3. Indicator bacteria data by station, indicator, and date for the Housatonic River (MA21-04). Each sample date was designated wet or dry weather with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text highlights criteria exceedances of 410 CFU/100 mL (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the Statistical Threshold Value or STV) and 126 CFU/100 mL (applied to rolling 30-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	30-Day Rolling Geomean (CFU/100mL)	30-Day Rolling STV (CFU/100mL)
W1104	*E. coli*	5/8/2007	DRY	30	30	
W1104	*E. coli*	6/12/2007	WET	536	536	
W1104	*E. coli*	7/17/2007	DRY	256	256	
W1104	*E. coli*	8/21/2007	DRY	100	100	
W1104	*E. coli*	9/25/2007	DRY	200	200	
W1105	*E. coli*	5/8/2007	DRY	16	16	
W1105	*E. coli*	6/12/2007	WET	416	416	
W1105	*E. coli*	7/17/2007	DRY	200	200	
W1105	*E. coli*	8/21/2007	DRY	140	140	
W1105	*E. coli*	9/25/2007	DRY	220	220	

4.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

The indicator bacteria data for the Housatonic River (MA21-04) were elevated during wet weather. Elevated indicator bacteria during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels. Due to the small sample size (and limited wet weather conditions), more data are needed to accurately target the sources of pathogens to the segment.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Although most of the segment flows through low to medium density developed land uses, portions of the watershed are heavily developed especially around the upstream end of the segment in Pittsfield. The watershed has 17% of land area in MS4 and 3% as DCIA. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: The downstream areas of the watershed, especially surrounding the segment, are mostly served by public sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows, which may be caused by undersized infrastructure, blockages, or excessive infiltration of groundwater or rainwater into pipes, exceeding system capacity. Illicit connections of wastewater to stormwater drains are also a risk.

On-Site Wastewater Disposal Systems: Nearly all development in the upstream portions of the watershed relies on septic systems for wastewater treatment. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities account for 5% of the total land use area within the watershed. Those agricultural activities visible on recent aerial photos within the immediate drainage area include open fields, hayfields, row crops, and pastureland. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: Conservation and recreational lands, parks, ballfields, and residential neighborhoods near or along the segment which may be popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Large open mowed areas such as conservation and recreational lands, fields, golf courses, and wetlands with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

4.4. Existing Local Management

This section identifies the municipalities immediately surrounding the impaired segment and its sub-basin (excludes upstream impaired segment watersheds). For a complete view of upstream municipalities and waterbodies, see the map in Figure 2-1.

City of Pittsfield. See Section 3.4

Town of Dalton. See Section 3.4

Town of Hinsdale. See Section 3.4

Town of Lanesborough

A small portion of Lanesborough is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit. Lanesborough (Permit ID #MAR041012) has an EPA approved Notice of Intent (NOI). The town does not have a Stormwater Management Plan. The town has mapped all of its stormwater outfall system which is available at http://berkshire.maps.arcgis.com/apps/webappviewer/index.html?id=ded45f5daaee412db24afc34500cd0c6 (Town of Lanesborough, n.d., a). The town adopted illicit discharge detection and elimination (IDDE), erosion and sediment control (ESC), and post-construction stormwater regulations in 2008. According to the NOI, there are seven stormwater outfalls into the pathogen-impaired Hoosic River (MA11-03).

Lanesborough has the following relevant ordinances and bylaws:

- Lanesborough does not have any supplementary regulations beyond the MassDEP regulations for stormwater management or wetland protection.
- Title V Supplemental Regulations: None found.
- Pet Waste Bylaw: None found.
- Stormwater Utility: None found.

The Town of Lanesborough does not have a Master Plan. The Economic Development Plan provides a brief description of the geography of the Town of Lanesborough, noting Pontoosuc Lake, the Cheshire reservoir, and the headwaters of the Hoosic River (Town of Lanesborough and BRPC, 2017). The plan also notes the goal of eliminating septic systems through expanding the sewer system for water quality protection.

Town Website: https://www.lanesborough-ma.gov/ (Town of Lanesborough, 2020)

Economic Development Plan:
https://www.lanesborough-ma.gov/sites/g/files/vyhlif761/f/uploads/economic_development_plan_2017.pdf
(Town of Lanesborough and BRPC, 2017)

Stormwater Management Plan:
https://www.lanesborough-ma.gov/town-manager/pages/storm-water-management-program (Town of Lanesborough, n.d., b)
Lanesborough does not have an Open Space and Recreation Plan available.

Town of Lee

Lee is not within the MS4 area.

Lee has the following relevant ordinances and bylaws:

- Stormwater Ordinance and/or Bylaws: Nothing beyond state regulations.
- Stormwater Utility: None found.
- Title 5 Supplementary Regulation: Nothing beyond State of Massachusetts Title V Regulations.
- Wetland Protection Bylaw: https://www.lee.ma.us/conservation-commission/pages/wetlands-protection-act (Town of Lee, n.d.)
- Pet Waste Ordinance: None found.
- Contact Recreation Ordinance: None found.

The Lee Master Plan chapter on Natural Resources, Open Space, and Outdoor Recreation includes a section on Water, Wetlands and Floodplains (Town of Lee and BRPC, 2000). This section notes that one waterbody within the town, Laurel Lake, has dealt with eutrophication due to septic system water contamination. Beyond this, the plan does not mention waterway impairment, bacteria, or pathogens. The plan includes information on stormwater drains, though does not provide information on Lee's Storm Drain System. The plan has a wastewater section in the municipal utilities chapter, and notes that over 85% of Lee's households are on public sewer. Septic system maintenance is aggressively enforced by the town's Board of Health.

Lee Town Website: https://www.lee.ma.us/ (Town of Lee, 2020)

Master Plan: https://semspub.epa.gov/work/01/211805.pdf (Town of Lee and BRPC, 2000)

Open Space and Recreation Plan:
https://www.lee.ma.us/sites/g/files/vyhlif771/f/uploads/lee_osrp_january_2016_published.pdf (Town of Lee and BRPC, 2016)

Town of Lenox

Lenox received a MS4 General Permit waiver on October 31, 2017:
https://www3.epa.gov/region1/npdes/stormwater/ma/waivers/lenox-epa-waiver-response.pdf (Hamjian, 2017)

Lenox has the following relevant ordinances and bylaws:

- Regulation of Sewer Use: Chapter VII, pg. 13
https://www.townoflenox.com/sites/lenoxma/files/uploads/town_of_lenox_bylaws_2018_edition_0.pdf
(Town of Lenox, 2014)
- Pet waste bylaw: Chapter XVII Dogs, Section 9 Removal of Dog Litter pg. 29
https://www.townoflenox.com/sites/lenoxma/files/uploads/town_of_lenox_bylaws_2018_edition_0.pdf
(Town of Lenox, 2014)

Lenox's Master Plan has a section on Wastewater (page 80): https://semspub.epa.gov/work/01/211777.pdf (Town of Lenox and BRPC, 1999)

Lenox has an Open Space and Recreation Plan:
https://www.townoflenox.com/sites/g/files/vyhlif3341/f/uploads/lenox_open_space_recreation_plan.pdf (Town of Lenox, 2015)

5. MA21-17 Southwest Branch Housatonic River

5.1. Waterbody Overview

Reduction from Highest Calculated Geomean: 92%

Watershed Area (Acres): 15,069

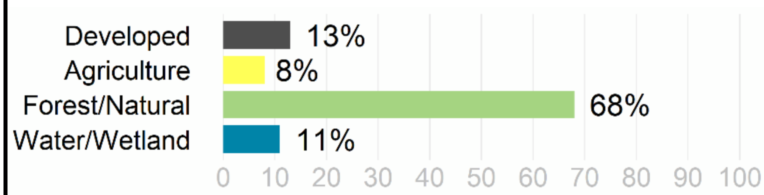
Segment Length (Miles): 5.8

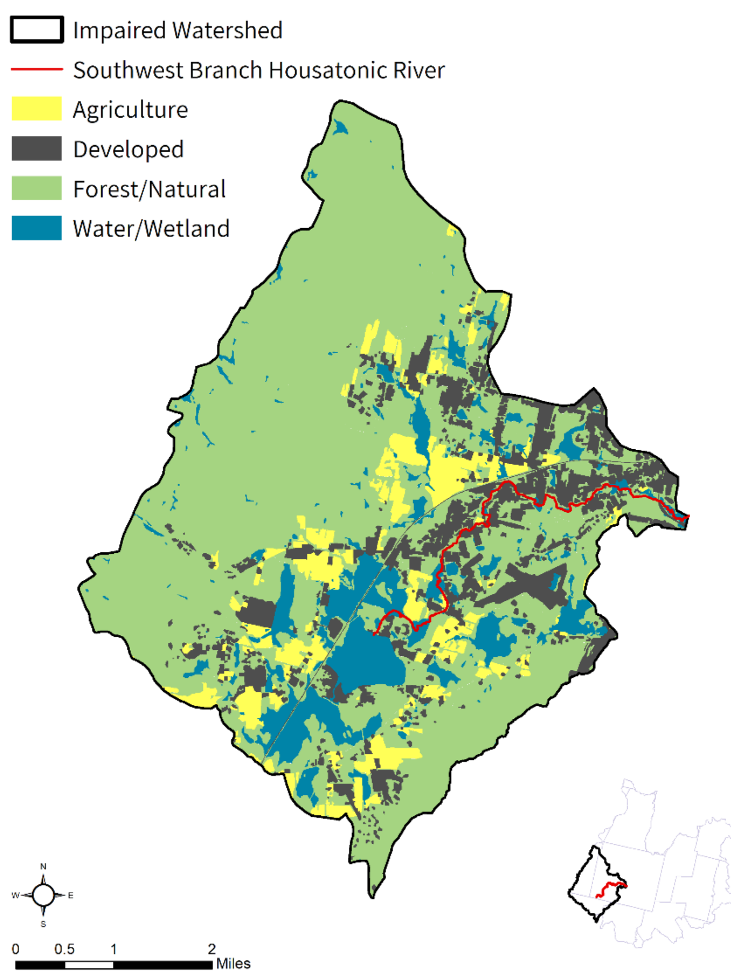
Impairment(s): *E. coli,* fecal coliform (Primary Contact Recreation)

Class (Qualifier): B (Cold Water, High Quality Water)

Impervious Area (Acres, %): 756 (5%)

DCIA Area (Acres, %): 326 (2%)





The Southwest Branch Housatonic River segment MA21-17 is 5.8 miles long and begins at the outlet of Richmond Pond in Pittsfield, MA. The segment generally flows to the northeast to US-20 before flowing east, ending at its confluence with the West Branch Housatonic River (forming the headwaters for the Housatonic River) in Pittsfield, MA.

Tributaries to segment MA21-17 include an unimpaired portion of the Southwest Branch Housatonic River, Jacoby Brook, Smith Brook, Maloy Brook, and several unnamed streams. Named lakes and rivers within the watershed include Richmond Pond and Mud Pond.

Key landmarks in the watershed include Smith, Doll, Holy, and Shaker mountains to the west. The watershed also includes Berkshire Community College and the Pittsfield Municipal Airport. The segment is crossed by Lakeside Drive (twice), Cloverdale Street, Melbourne Road, Lebanon Avenue, Hungerford Street (twice), Barker Road, West Housatonic Street/US-20 (twice), and Cadwell Road in Pittsfield.

The Southwest Branch Housatonic River (MA21-17) drains an area of 24 square miles, of which 1.2 mi^2 (5%) is impervious and 0.5 mi^2 (2%) is directly connected impervious area (DCIA). The watershed is partially[7] served by public sewer and 19% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA 2016). There are no NPDES permits on file governing point source discharges of pollutants to surface waters and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, no landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 5-1.

The segment watershed is mostly forested (68%), though the developed areas (13%) are concentrated around the segment. The segment itself flows through large, wooded tracts, several

[7] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project https://www.mass.gov/guides/water-utility-resilience-program (MassDEP, 2020), MS4 reports, and local knowledge.

large wooded and meadow wetlands, and low and medium density residential neighborhoods west of downtown Pittsfield. Agricultural practices within the segment watershed include grazing livestock, row crops, and hayfields.

In the Southwest Branch Housatonic River (MA21-17) watershed, under the Natural Heritage and Endangered Species Program, there are 1,226 acres (8%) of Priority Habitats of Rare Species and 31 acres (<1%) of Priority Natural Vegetation Communities. There are 0.03 acres (<1%) under Public Water Supply protection in the watershed. Over 238 acres (2%) of land protected in perpetuity[8] exist within the segment watershed, which is part of a total of 5,674 acres (38%) of Protected and Recreational Open Space[9]. See Figure 5-1.

[8] Land protected in perpetuity include several interests such as conservation restriction, agricultural preservation, private deed restrictions, wetland restrictions, aquifer protection, historic preservation, etc. Refer to Mass GIS metadata for the Protected and Recreational Open Space data layer.

[9] Only land protected in perpetuity is shown on the natural resources map. Protected and Recreational Open Space estimates reflect areas in the State of Massachusetts only (and thus reflect only a portion of the total open space for watersheds that extend outside the State of Massachusetts).

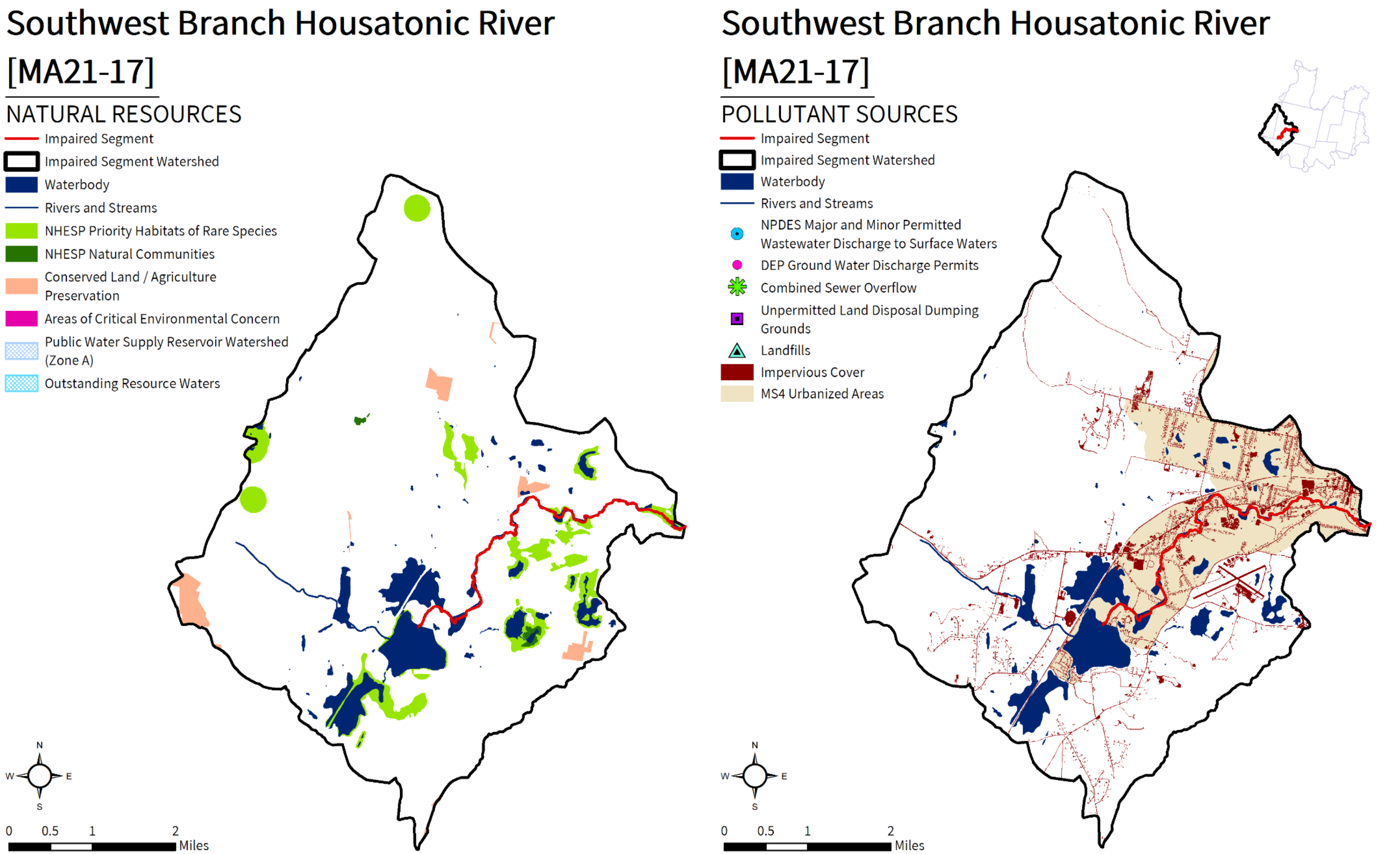


Figure 5-1. Natural resources and potential pollution sources draining to the Southwest Branch Housatonic River segment MA21-17. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

5.2. Waterbody Impairment Characterization

The Southwest Branch Housatonic River (MA21-17) is a Class B, Cold Water and High Quality Water (MassDEP 2021).

The Primary Contact Recreation use was assessed for attainment of SWQS using the indicator bacteria *E. coli* at the stations listed below (refer to Tables 5-1, 5-2; Figure 5-2). Data were evaluated against the SWQS geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria and the STV criterion of 410 CFU/100 mL for *E. coli*. The geomean STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

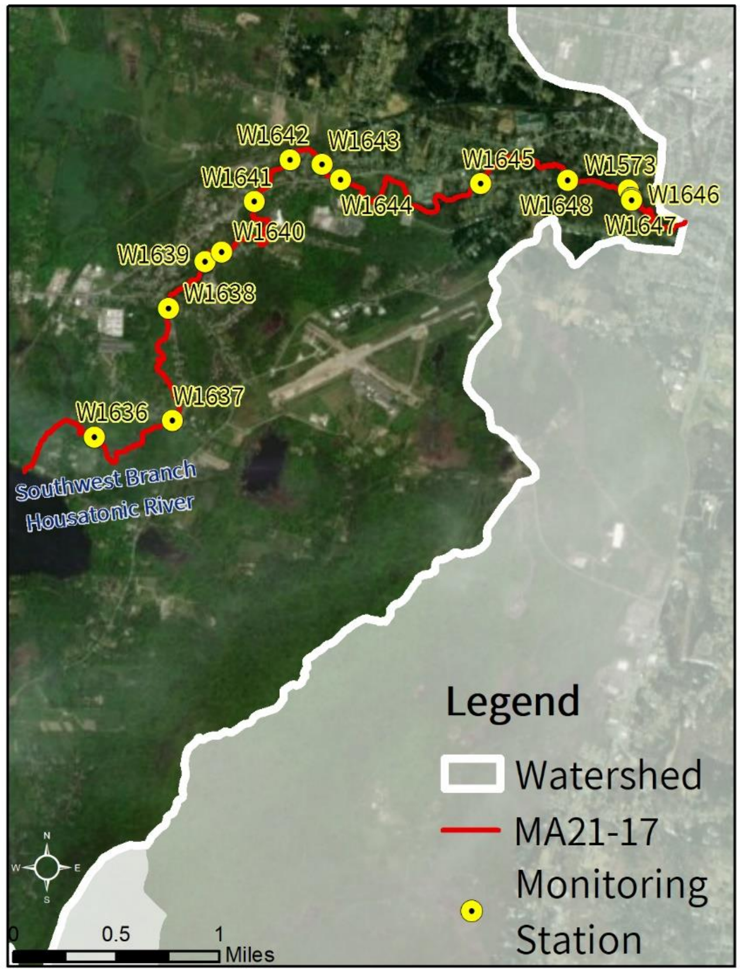


Figure 5-2. Location of monitoring station(s) along the impaired river segment.

- In 2007, five samples were collected at W1573, resulting in two days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of five samples, none exceeded the STV criterion.
- In 2006, four samples were collected at W1636, resulting in one day when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, none exceeded the STV criterion.
- In 2006, four samples were collected at W1637, resulting in two days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, none exceeded the STV criterion.
- In 2006, four samples were collected at W1638, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, one exceeded the STV criterion during wet weather.
- In 2006, four samples were collected at W1639, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, two exceeded the STV criterion during dry weather.
- In 2006, four samples were collected at W1640, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, three exceeded the STV criterion during both wet and dry weather.
- In 2006, four samples were collected at W1641, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, two exceeded the STV criterion during both wet and dry weather.

- In 2006, four samples were collected at W1642, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, one exceeded the STV criterion during wet weather.
- In 2006, four samples were collected at W1643, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, one exceeded the STV criterion during wet weather.
- In 2006, four samples were collected at W1644, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, two exceeded the STV criterion during wet and dry weather.
- In 2006, four samples were collected at W1645, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, two exceeded the STV criterion during wet and dry weather.
- In 2006, four samples were collected at W1646, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, two exceeded the STV criterion during wet and dry weather.
- In 2006, four samples were collected at W1647, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, two exceeded the STV criterion during wet and dry weather.
- In 2006, four samples were collected at W1648, resulting in 4 days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of four samples, one exceeded the STV criterion during wet weather.

Table 5-1. Summary of indicator bacteria sampling results by station for the Southwest Branch Housatonic River (MA21-17). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria, and the number of single samples exceeding the Statistical Threshold Value (STV) criterion of 410 CFU/100 mL for *E. coli* indicator bacteria are shown. The STV criterion is applied to the single sample results if less than 10 samples were collected within a calendar year at a site. The highest maximum 90-day rolling geomean of the sites is used to calculate the percent load reduction required to meet SWQS.

Unique Station ID	First Sample	Last Sample	Count	Maximum 90-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1573	5/8/2007	9/25/2007	5	287	2	0
W1636	6/26/2006	9/18/2006	4	240	1	0
W1637	6/26/2006	9/18/2006	4	250	2	0
W1638	6/26/2006	9/18/2006	4	461	4	1
W1639	6/26/2006	9/18/2006	4	515	4	2
W1640	6/26/2006	9/18/2006	4	579	4	3
W1641	6/26/2006	9/18/2006	4	517	4	2
W1642	6/26/2006	9/18/2006	4	435	4	1
W1643	6/26/2006	9/18/2006	4	461	4	1
W1644	6/26/2006	9/18/2006	4	1586	4	2
W1645	6/26/2006	9/18/2006	4	613	4	2
W1646	6/26/2006	9/18/2006	4	687	4	2
W1647	6/26/2006	9/18/2006	4	727	4	2
W1648	6/26/2006	9/18/2006	4	613	4	1

Table 5-2. Indicator bacteria data by station, indicator, and date for the Southwest Branch Housatonic River (MA21-17). Each sample date was designated wet or dry weather with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text highlights criteria exceedances of 410 CFU/100 mL (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the Statistical Threshold Value or STV) and 126 CFU/100 mL (applied to rolling 90-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1573	*E. coli*	5/8/2007	DRY	6	6	
W1573	*E. coli*	6/12/2007	WET	368	47	
W1573	*E. coli*	7/17/2007	DRY	256	83	
W1573	*E. coli*	8/21/2007	DRY	250	287	
W1573	*E. coli*	9/25/2007	DRY	100	186	
W1636	*E. coli*	6/26/2006	WET	240	240	
W1636	*E. coli*	7/10/2006	DRY	10	49	
W1636	*E. coli*	8/2/2006	DRY	9	28	
W1636	*E. coli*	9/18/2006	DRY	20	26	
W1637	*E. coli*	6/26/2006	WET	250	250	
W1637	*E. coli*	7/10/2006	DRY	83	144	
W1637	*E. coli*	8/2/2006	DRY	29	84	
W1637	*E. coli*	9/18/2006	DRY	46	73	
W1638	*E. coli*	6/26/2006	WET	461	461	
W1638	*E. coli*	7/10/2006	DRY	140	254	
W1638	*E. coli*	8/2/2006	DRY	105	189	
W1638	*E. coli*	9/18/2006	DRY	114	167	
W1639	*E. coli*	6/26/2006	WET	365	365	
W1639	*E. coli*	7/10/2006	DRY	727	515	
W1639	*E. coli*	8/2/2006	DRY	67	261	
W1639	*E. coli*	9/18/2006	DRY	488	305	
W1640	*E. coli*	6/26/2006	WET	461	461	
W1640	*E. coli*	7/10/2006	DRY	727	579	
W1640	*E. coli*	8/2/2006	DRY	86	307	
W1640	*E. coli*	9/18/2006	DRY	461	340	
W1641	*E. coli*	6/26/2006	WET	517	517	
W1641	*E. coli*	7/10/2006	DRY	411	461	
W1641	*E. coli*	8/2/2006	DRY	72	248	
W1641	*E. coli*	9/18/2006	DRY	109	202	
W1642	*E. coli*	6/26/2006	WET	435	435	
W1642	*E. coli*	7/10/2006	DRY	108	217	
W1642	*E. coli*	8/2/2006	DRY	91	162	
W1642	*E. coli*	9/18/2006	DRY	178	166	
W1643	*E. coli*	6/26/2006	WET	461	461	
W1643	*E. coli*	7/10/2006	DRY	84	197	
W1643	*E. coli*	8/2/2006	DRY	107	161	
W1643	*E. coli*	9/18/2006	DRY	104	144	
W1644	*E. coli*	6/26/2006	WET	488	488	
W1644	*E. coli*	7/10/2006	DRY	73	189	
W1644	*E. coli*	8/2/2006	DRY	111990	1586	
W1644	*E. coli*	9/18/2006	DRY	126	842	
W1645	*E. coli*	6/26/2006	WET	613	613	
W1645	*E. coli*	7/10/2006	DRY	178	330	
W1645	*E. coli*	8/2/2006	DRY	411	355	
W1645	*E. coli*	9/18/2006	DRY	365	358	
W1646	*E. coli*	6/26/2006	WET	687	687	
W1646	*E. coli*	7/10/2006	DRY	214	383	
W1646	*E. coli*	8/2/2006	DRY	816	493	

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1646	*E. coli*	9/18/2006	DRY	219	403	
W1647	*E. coli*	6/26/2006	WET	727	727	
W1647	*E. coli*	7/10/2006	DRY	124	300	
W1647	*E. coli*	8/2/2006	DRY	613	381	
W1647	*E. coli*	9/18/2006	DRY	179	315	
W1648	*E. coli*	6/26/2006	WET	613	613	
W1648	*E. coli*	7/10/2006	DRY	101	249	
W1648	*E. coli*	8/2/2006	DRY	199	231	
W1648	*E. coli*	9/18/2006	DRY	249	235	

5.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

The indicator bacteria data for the Southwest Branch Housatonic River (MA21-17) were elevated during both wet and dry weather. Elevated indicator bacteria during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels. Elevated indicator bacteria during dry weather suggest that baseflow sources, such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, are likely to be major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Portions of the watershed are heavily developed, especially around the segment. The watershed has 19% of land area in MS4 and 2% as DCIA. The developed areas within and surrounding the river corridor consist of medium to high density mixed residential, commercial, industrial, and transportation development, including the Pittsfield Municipal Airport. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: Most of the southern and some of the northeastern portions of the watershed, including some areas along the segment, are served by public sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows which may be caused by undersized infrastructure, blockages, or excessive infiltration of groundwater or rainwater into pipes, exceeding system capacity. Illicit connections of wastewater to stormwater drains are also a risk.

On-Site Wastewater Disposal Systems: A portion of the watershed relies on septic systems for wastewater treatment. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities account for 8% of the total land use area within the watershed. Those activities visible on recent aerial photos within the watershed include open fields, hayfields, row crops, orchards, and pastureland. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: The segment flows through many low and medium residential neighborhoods with several road crossings. Conservation and recreational lands, parks, ballfields, and residential streets near or along the segment which may be popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Most of the segment benefits from at least some wooded buffer; however, there are large lawns mowed to the water's edge near the intersection of Vista and Chapel streets in Pittsfield. Large open mowed areas such as conservation and recreational lands, fields, and wetlands with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

5.4. Existing Local Management

This section identifies the municipalities immediately surrounding the impaired segment and its sub-basin. For a complete view of upstream municipalities and waterbodies, see the map in Figure 2-1.

Town of Hancock

Hancock is not within the MS4 area.

Hancock has the following relevant ordinances and bylaws:

- Stormwater Ordinance and/or Bylaws: No information available online.
- Stormwater Utility: No information available online.
- Title 5 Supplementary Regulation: Nothing beyond State of Massachusetts Title V Regulations.
- Wetland Protection Bylaw: No information available online.
- Pet Waste Ordinance: No information available online.
- Contact Recreation Ordinance: No information available online.

Hancock Town Website: http://town.hancock.ma.us/ (Town of Hancock, 2020)

The Town of Hancock has not made a Master Plan or town planning documents available online.

The Town of Hancock does not have an Open Space and Recreation Plan available.

City of Pittsfield. See Section 3.4

Town of Richmond

Richmond is not within the MS4 area.

Richmond has the following relevant ordinances and bylaws:

- Stormwater Ordinance and/or Bylaws: None found.
- Title 5 Supplementary Regulation: Nothing beyond State of Massachusetts Title V Regulations.
- Wetland Protection Bylaw: Nothing beyond State of Massachusetts wetland protection regulations.
- Pet Waste Ordinance: None found.
- Contact Recreation Ordinance: None found.

The Town of Richmond does not have a master plan available. The Open Space and Recreation Plan has an extensive Water Resources section in the Environmental Inventory and Analysis chapter. The plan does not include detailed information on bacteria or pathogen impairments. The plan briefly mentions the threat of stormwater runoff. The Community Development Plan notes that the town planned a sewer extension project adjacent to Richmond Pond to address water pollution problems. The Open Space Plan notes that this project was completed but recommends further sewer service connections to other dense communities in order to address water quality.

Richmond Town Website: http://www.richmondma.org/ (Town of Richmond, 2020)

Community Development Plan:
http://www.richmondma.org/document_center/Boards%20&%20Commissions/Planning%20Board/2003_Community_Development_Plan.pdf (BRPC, 2003)

Open Space and Recreation Plan:
http://www.richmondma.org/Bylaws%20&%20Regulations/Richmond_OSRP_-_11-9.pdf (BRPC and Town of Richmond, 2016)

6. MA21-18 West Branch Housatonic River

6.1. Waterbody Overview

The West Branch Housatonic River segment MA21-18 is 4.1 miles long and begins at the outlet of Pontoosuc Lake in Pittsfield, MA. The segment flows to the south to end at its confluence with Southwest Branch Housatonic River (forming the headwaters to the Housatonic River) in Pittsfield.

Tributaries to the West Branch Housatonic River segment MA21-18 include Onota Brook and several unnamed streams. Named lakes and ponds within the watershed include Pontoosuc Lake, Onota Lake, and Pecks Pond.

Key landmarks in the watershed include the Donnybrook Country Club, Mount Greylock State Reservation, Balance Rock State Park, the Skyline Country Club and GE Athletic Association golf courses, and commercial and residential neighborhoods surrounding the US-7/US-20 intersection. The segment is crossed by Hancock Road, Keller Street, New Road, Taconic Island Road, Wahconah Street (twice), Pontoosuc Avenue, Linden Street, Columbus Avenue, West Street, Hawthorne Avenue, West Housatonic Street/US-20, Atwood Avenue (twice), and Boylston Street in Pittsfield.

The West Branch Housatonic River (MA21-18) drains an area of 37 square miles, of which 2.3 mi^2 (6%) is impervious and 1.3 mi^2 (3%) is directly connected impervious area (DCIA). The watershed is partially[10] served by public sewer and 19% is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA 2016). There are no NPDES permits on file governing point source discharges of pollutants to surface waters and no MassDEP discharge to groundwater permits for on-site wastewater discharge within the watershed. There are also no combined sewer overflows, two landfills, and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 6-1.

The watershed is mostly forested (69%), especially the mountainous western side. The developed areas, however, concentrate around the segment just north of Pittsfield. These developed areas comprise medium to high density residential

Reduction from Highest Calculated Geomean: 60%

Watershed Area (Acres): 23,481

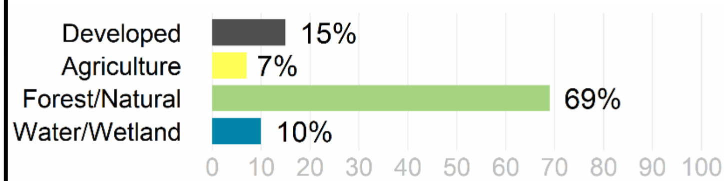
Segment Length (Miles): 4.1

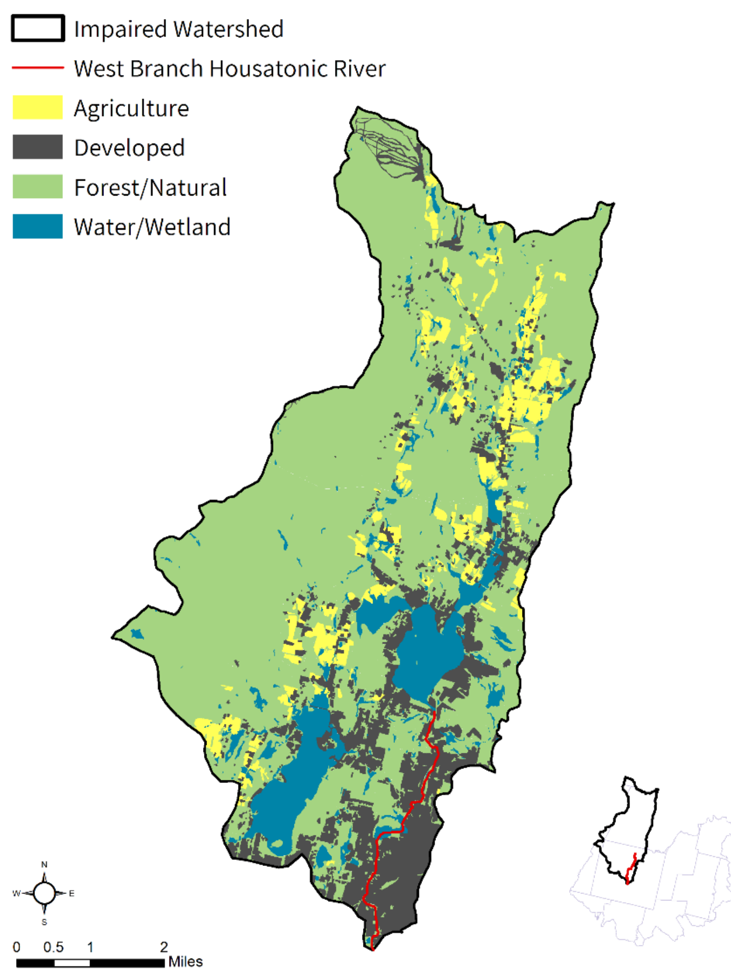
Impairment(s): *E. coli,* fecal coliform (Primary Contact Recreation)

Class (Qualifier): B (Cold Water, High Quality Water)

Impervious Area (Acres, %): 1,500 (6%)

DCIA Area (Acres, %): 813 (3%)





[10] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project https://www.mass.gov/guides/water-utility-resilience-program (MassDEP, 2020), MS4 reports, and local knowledge.

neighborhoods, large commercial developments with expansive parking, and industrial areas. Agriculture in the watershed consists of farms with livestock, hayfields, and row crops. While most of the river corridor has at least some wooded buffer, many roads and buildings are within a few meters of the river.

In the West Branch Housatonic River (MA21-18) watershed, under the Natural Heritage and Endangered Species Program, there are 814 acres (3%) of Priority Habitats of Rare Species and 61 acres (<1%) of Priority Natural Vegetation Communities. There are no Areas of Critical Environmental Concern, no areas under Public Water Supply protection, and no areas identified as Outstanding Resource Waters in the watershed. Over 874 acres (4%) of land protected in perpetuity[11] exist within the segment watershed, which is part of a total of 8,261 acres (35%) of Protected and Recreational Open Space[12]. See Figure 6-1.

[11] Land protected in perpetuity include several interests such as conservation restriction, agricultural preservation, private deed restrictions, wetland restrictions, aquifer protection, historic preservation, etc. Refer to Mass GIS metadata for the Protected and Recreational Open Space data layer.

[12] Only land protected in perpetuity is shown on the natural resources map. Protected and Recreational Open Space estimates reflect areas in the State of Massachusetts only (and thus reflect only a portion of the total open space for watersheds that extend outside the State of Massachusetts).

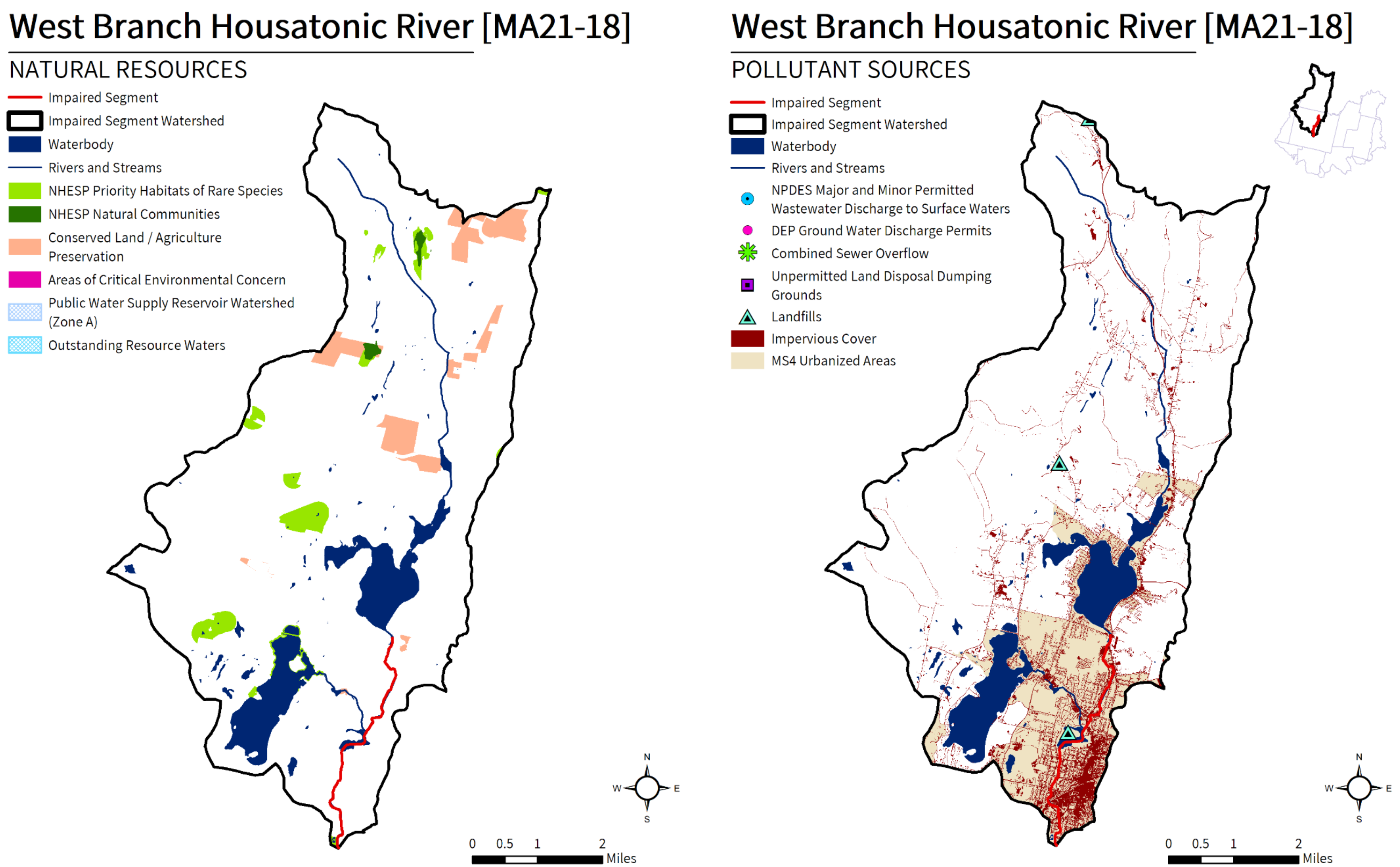


Figure 6-1. Natural resources and potential pollution sources draining to the West Branch Housatonic River segment MA21-18. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollution sources, including impervious cover, MS4 areas, and permitted facilities.

6.2. Waterbody Impairment Characterization

The West Branch Housatonic River (MA21-18) is a Class B ,Cold Water and High Quality Water (MassDEP, 2021).

The Primary Contact Recreation use was assessed for attainment of SWQS using the indicator bacteria *E. coli* at the station identified below (refer to Tables 6-1, 6-2; Figure 6-2). Data were evaluated against the SWQS geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria and the STV criterion of 410 CFU/100 mL for *E. coli*. The geomean STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

- In 2007, five samples were collected at W1575, resulting in three days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the STV criterion was applied to single sample results. Out of five samples, two exceeded the STV criterion during both wet and dry weather.

Figure 6-2. Location of monitoring station(s) along the impaired river segment.

Table 6-1. Summary of indicator bacteria sampling results by station for the West Branch Housatonic River (MA21-18). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria, and the number of single samples exceeding the Statistical Threshold Value (STV) criterion of 410 CFU/100 mL for *E. coli* indicator bacteria are shown. The STV criterion is applied to the single sample results if less than 10 samples were collected within a calendar year at a site. The highest maximum 90-day rolling geomean of the sites is used to calculate the percent load reduction required to meet SWQS.

Unique Station ID	First Sample	Last Sample	Count	Maximum 90-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1575	5/8/2007	9/25/2007	5	314	3	2

Table 6-2. Indicator bacteria data by station, indicator, and date for the West Branch Housatonic River (MA21-18). Each sample date was designated wet or dry weather with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text highlights criteria exceedances of 410 CFU/100 mL (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the Statistical Threshold Value or STV) and 126 CFU/100 mL (applied to rolling 90-day geomean) for *E. coli* indicator bacteria.

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1575	*E. coli*	5/8/2007	DRY	30	30	
W1575	*E. coli*	6/12/2007	WET	448	116	
W1575	*E. coli*	7/17/2007	DRY	432	180	
W1575	*E. coli*	8/21/2007	DRY	160	314	
W1575	*E. coli*	9/25/2007	DRY	140	213	

6.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present and information that can be used to focus pollutant reduction activities. Pathogen levels (as estimated by indicator bacteria) are usually higher in wet weather conditions as storm sewer systems overflow and/or stormwater runoff carries fecal matter that has accumulated on the landscape to the river via overland flow and stormwater conduits. Wet weather sources include wildlife and domesticated animal waste (including pets), urban stormwater runoff (including MS4 areas), CSOs, and SSOs. In other cases, dry weather pathogen and associated indicator bacteria concentrations can be high when there is a constant flow of pollutants during dry weather, which then becomes diluted during periods of precipitation. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational use (such as swimmers), and direct wildlife and domesticated animal waste (including pets).

The indicator bacteria data for the West Branch Housatonic River (MA21-18) were elevated during both wet and dry weather. Elevated indicator bacteria during wet weather is consistent with urban stormwater, pet waste, and wildlife pathogen sources. Certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation, may also result in elevated wet weather indicator bacteria levels. Elevated indicator bacteria during dry weather suggest that baseflow sources, such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, are likely to be major sources of pathogens. Given the relatively small sample set, additional sampling under both wet and dry conditions, ideally at more than one location, would likely help to identify pollutant sources.

Each potential pathogen source is described in further detail below.

Urban Stormwater: Portions of the watershed are heavily developed. The watershed has 19% of land area in MS4 and 3% as DCIA. The developed areas within the watershed include medium to high density mixed residential, commercial, industrial, and transportation development. Stormwater runoff from urban areas is likely a significant source of pathogens.

Illicit Sewage Discharges: Most of the downstream portion of the watershed along the segment is served by public sewer. Sewer related risks include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows, which may be caused by undersized infrastructure, blockages, or excessive infiltration of groundwater or rainwater into pipes, exceeding system capacity. Illicit connections of wastewater to stormwater drains are also a risk.

On-Site Wastewater Disposal Systems: Most development in the upstream and northeastern portions of the watershed rely on septic systems for wastewater treatment. It is likely that a portion of septic systems are not being properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities account for 7% of the total land use area within the watershed, though most are well upstream of the segment. Those visible on recent aerial photos within the watershed include open fields, hayfields, row crops, and pastureland. Agricultural activities related to manure storage and spreading, if not well managed, are a possible source of pathogens to waterbodies.

Pet Waste: The segment flows through many dense residential neighborhoods, and several recreational lands are adjacent to the segment, such as Wahconah Park (ballfield), Carrie Bak Park, and Dorothy Amos Park. Conservation and recreational lands, parks, ballfields, and residential neighborhoods near or along the segment which may be popular for dog-walking, especially where paths are adjacent to rivers, ponds, or wetlands, represent a possible source of pathogens.

Wildlife Waste: Most of the segment benefits from at least some wooded buffer along its banks, though there are a few isolated mowed areas close to the river's edge. Large open mowed areas such as conservation and recreational lands, fields, golf courses, and wetlands with a clear sightline to a waterbody may attract excessive waterfowl and elevate indicator bacteria counts in the water.

6.4. Existing Local Management

This section identifies the municipalities immediately surrounding the impaired segment and its sub-basin. For a complete view of upstream municipalities and waterbodies, see the map in Figure 2-1.

Town of Lanesborough. See section 4.4.

City of Pittsfield. See Section 3.4

7. References

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Appendix J: Richmond Shores Priority Project Summary

NOTES:

i. Most of the Richmond Shores' soil is classified as 516C – stony and well drained - 80 inches to water table)
ii. Previously completed 319 projects in Richmond Shores (2004 – 2007) include the following. (*Source: Richmond Pond 319 report and BMP locus map)*
   a. Type of BMP: Chestnut Road – Three catch basins and associated pipe were installed along Chestnut Road, one each at the intersection of cross streets Hemlock Road, Maple Road, and Oak Road. The catch basins now intercept runoff which originally flowed eastward along the steep cross streets to Cherry Road causing shoulder erosion. Date of Implementation: November 2004 (The plan indicates that the CBs on Maple and Oak discharge at the southern end of Chestnut into a swale – and that's what residents understand, but the Hemlock drain connects with an underground pipe down Hemlock to Cherry and it is unclear where it discharges to – residents showed me a concrete lidded round basin which they said takes stormwater from the drains at the intersection of Cherry and Hemlock – it sounds a bit like it acts like a leaching catch basin.
   b. Type of BMP: Cherry Road-Three catch basins and associated pipe were installed along Cherry Road one each at the intersection of cross streets Maple Road, Oak Road, and Walnut Road. The catch basins now intercept runoff which originally flowed southward along Cherry Road causing shoulder erosion. Date of Implementation: November 2006 *(The plan indicates that the stormwater discharges to a pipe at the end of Cherry Road. I observed this pipe and it is functioning – it is set back several feet from the canal so it discharges into a kind of vegetated wetland.)*
   c. Type of BMP: Shore Road corner of Spruce Road – A homemade undersized catch basin and associated pipe was replaced on Shore Road at the intersection of Spruce Road. The catch basin now intercepts runoff which originally overflowed Shore Road across private property northward causing shoulder and yard erosion. Date of Implementation: June 2007 (*Note: the report does not indicate where the stormwater is discharged. The aforementioned plan indicates that it outfalls to Richmond Pond)*
   d. Type of BMP: Richmond Shores Civic Association beach off Shore Road – Various native shrubs were planted adjacent to the public-access beach area, including one (1) flowering dogwood (Cornus florida); eight (8) lowbush blueberries (Vaccinium cassinoides); three (3) red osier dogwoods (Cornus sericea); and three (3) winterberry holly (Ilex verticillata). A short fence with a gate was also installed along the shore edge to deter geese access from the adjacent lawn area. Date of Implementation: June 2007

The following three project areas are considered high priority by the Richmond Shores Civic Association. Projects 1 and 2 were both project areas in the original 319 grant, but it does not appear that all of the work proposed for the Cherry/Bridge/Shore Road nor the Spruce and Chestnut intersection was completed. Each project location is divided up into multiple sites with proposed BMP recommendations.

Project 1 – From Bridge/Chestnut intersection to Shore Road Bridge

Overall goal of the BMPs: Prevent sediment laden stormwater runoff entering Richmond Pond and the Canal at the Shore Road bridge*. Includes sites 1, 2 and 3 on attached Map 1.*

1. ***Bridge Street and Chestnut Road Intersection***

Site Description: The existing infrastructure at the Bridge/Chestnut intersection includes 2 "hand made" round drains connected by an underground pipe (size unknown) on the NE and SE corners of the Bridge/Chestnut Road intersection. The NE drain is connected to the storm drain on the NW corner of the intersection of Bridge and Shore Road by an underground pipe. While some stormwater runoff from Bridge Street west of the intersection enters the drains, the existing catch basins are too small and stormwater skips these drains and flows down the middle of Bridge Street to Shore Road and the bridge. Bridge Street and Shore Road become eroded and sediment laden stormwater enters the canal and Richmond Pond at the bridge on Shore Road.

BMP Recommendations: The goal of the BMPS is to capture all of the stormwater generated west, north and south of the Bridge/Chestnut intersection with the following BMPs. This will prevent erosion of Bridge Street and Shore Road east of this intersection.

(i) Install a deep sump catch basin on the NW corner to direct the Bridge Street runoff west of the intersection of Bridge and Chestnut. This deep sump would connect with the NW upgraded deep sump catch basin (or could be directed to the proposed infiltration basin.

(ii) Upgrade the two existing catch basins at the Bridge and Chestnut intersection to deep sump catch basins.

(iii) Direct the stormwater runoff from the three deep sump catch basins to a filtration basin located on the NE corner of the Chestnut/Bridge Street intersection. For overflow, connect a raised inlet in the filtration basin to the existing underground pipe that leads to the NW drain at Bridge and Shore Rd.

2. ***Section of Bridge Street from the intersection with Chestnut Road to Shore Road***

Site Description: The section of Bridge Street from Chestnut to Shore Road requires frequent maintenance due to the frequency of storms that cause erosion. Sediment from the road clogs the existing catch basins located at the base of Bridge Street and overflow is carried to the pond. There is a pipe under the driveway of 7 Bridge Street, which may be crushed.

BMP Recommendations: The work completed under (a) would eliminate additional runoff from the Chestnut and Bridge intersection eroding this section of road. The following BMPs will repair the road and ensure that the runoff generated along this section is shed to drainage channels along the road and then to upgraded catch basins at the base of the road.

(i) Stabilize this section of Bridge Street and include stabilized drainage channels on each side of the road.
(ii) Crown the road to shed the runoff towards the road edges into stabilized drainage channels directing the runoff to storm drains at the base of Bridge Street where it intersects with Shore Road.
(iii) The pipe under the driveway of 7 Bridge Street may need to replaced or a shallow drainage channel formed and maintained at the head of the driveway. Discussion with the property owner would be necessary.

3. Intersection of Bridge Street, Cherry and Shore Roads

Site Description: There are three existing catch basins located on the corners of this intersection. The two catch basins on the NW and SW corners connect with the drop inlet on the NE corner. (It is unclear if work was completed at this intersection during the 2003-07 319 project – no information about this intersection recorded in the final report documents.) The catch basin on the NE corner outfalls to a trench which extends close to the pond and bridge. The existing catch basins are not deep sump catch basins. While stormwater is observed in the trench and some of it is infiltrating, stormwater is observed skirting these catch basins and eroding down Shore Road where it enters the pond and canal at the bridge. (*Diagrams for the original plan are available in "N:\Current Projects\Dept 592 DEP 319 REGC\Project Delivery\Task 3 - Watershed-Based Plans\Southwest Branch\Richmond Shores\3. tighe bond ric shores bmps.pdf"*

BMP Recommendations: Goal of the BMPs is to capture the stormwater at this intersection and improve infiltration of the existing trench thereby preventing sediment laden runoff reaching the pond and canal at the Shore Road bridge.

(i) Upgrade the existing catch basins to deep sump catch basins
(ii) Enlarge the trench to a vegetated swale (plant with “thirsty plants?”)
(iii) Install a rain garden at the lower end of the vegetated swale (will need property owner’s permission).
(iv) Plant "thirsty plants" – willows and dogwoods in the rain garden and along the lake front to improve the existing narrow riparian buffer.

Project 2 – Spruce Road from Chestnut to Shore Road

Overall goal of the BMPs: Reduce the volume of sediment laden stormwater running down and eroding Spruce Road and continuing across Shore Road to Richmond Pond.

(*The following paragraph is from the 319 RDA*

“Spruce Road is a steeply sloping gravel road. During rain events, gravel from the roadway washes away. The proposed stormwater management for this roadway is the collection of stormwater runoff in a catchbasin at the southeast corner of the intersection of Chestnut Street and Spruce Road,

directing flows to an armored swale along the eastern side of Spruce Road. The flows would then be directed into a catchbasin at the intersection of Spruce Road and Shore Road. The catch basin would connect into an existing drain line that exists to the east of -#290 Shore Road..")

1. ***Chestnut and Spruce Road Intersection***

   Site Description: There is an existing catch basin at the SE corner which residents understand connects with an underground pipe under Spruce heading west to the south side of Chestnut and discharging into an open trench/swale on the south side of Chestnut. This pipe may have been crushed although it still seems to be functioning. Through road maintenance, the existing catch basin is now in the road and stormwater runoff skips by it and down Spruce Road to Shore Road.

   Runoff from Chestnut also flows around the northeast corner of the intersection and down Spruce Road. At the NE corner there is a pile of accumulated road debris and a couple of large rocks.

   BMP Recommendations:

   (i) Stabilize and crown Spruce Road south of the intersection. Create drainage channels on each side of this section of Spruce Road to ensure stormwater enters the existing drain and swale.
   (ii) Upgrade existing drain on SE corner to a deep sump catch basin.
   (iii) Add a deep sump on the SW corner of the intersection? Or make sure there is a channel that allows the stormwater on the western side of Spruce to enter the existing swale rather than continuing down Spruce to Shore.
   (iv) Replace pipe that leads to the swale on Chestnut.
   (v) Improve swale by digging it out and vegetating it. (Need to confirm that this CB does not connect with a pipe going down Spruce Road to Shore Road on the eastern side.)
   (vi) Potential for a vegetated swale with check dams to be installed along the northern side of Chestnut Road east of the intersection directing stormwater to a new deep sump CB at the NE corner OR to an infiltration basin at the NE corner. This would require removing existing rocks and the pile of road gravel accumulated from plowing. The infiltration basin outlet could be directed to the armored drainage channel on the eastern side of Spruce Road.

2. ***Section of Spruce Road from Chestnut to Shore Road***

   Site Description: Stormwater runoff flows down Spruce skipping the catch basin at the intersection and continuing to Shore Road eroding the road and the eastern road edge from Chestnut to Shore Road. Most of the runoff comes down the eastern side.

   BMP Recommendations:

   (i) Stabilize Spruce Road and crown it to shed stormwater to road edges. (Consider asphalting this section of road?)
   (ii) Create an armored drainage channel along the eastern road edge
   (iii) Consider formalizing an infiltration basin on the western side of Spruce Road where residents are currently directing stormwater off and into. Requires property owners' permission.

3. ***Location: Spruce and Shore Road Intersection***
   Site Description: According to the 319 final report documents, the existing catch basin at the SE corner of this intersection is a deep sump catch basin that connects to an underground pipe that discharges at the edge of Richmond Pond.

   BMP Recommendations: Pull back outfall pipe and infiltrate runoff before reaching the pond. *(Need to check with John and maybe revisit – I did not see the outfall but plan indicates it outfalls at the pond edge – not sure if possible to pull this back) Plan stored: "N:\Current Projects\Dept 592 DEP 319 REGC\Project Delivery\Task 3 - Watershed-Based Plans\Southwest Branch\Existing BMP information\Richmond_RPA_319_2004\BMPSiteLocusPlan.pdf"*

Project 3 - Shore Road from Town Beach Road to 235 Shore Road

Overall goal of the BMPs: Reduce the volume of sediment laden stormwater being discharged to Richmond Pond*. Includes sites 11, 12, 13 and 14 on the attached Map 1.*

1. ***Location: Section of Shore Road from the Town Beach Road intersection to 263 Shore Road.***
   Site Description: The section of Shore Road from the intersection with Town Beach Road and 263 Shore Road is pitched towards Richmond Pond causing runoff to flow towards the pond and also floods basements.

   BMP Recommendations: Regrade road to pitch towards the existing catch basins.

2. ***Location: 302 Shore Road***

   Site Description: In front of 302 Shore Road, there is an existing "hand-made" drain that leads to an outfall pipe discharging directly to Richmond Pond.

   BMP Recommendations: Upgrade existing drain to a deep sump catch basin and direct the discharge to an improved vegetated swale or a bioinfiltration basin.

3. ***Location: 314 Shore Road***

   Site Description: In front of 314 Shore Road, a hand-made drain directs stormwater via a pipe under Shore Road which outfalls west of 314 Shore Road driveway into a trench discharging close to the lake. This drain doesn't see much runoff (maybe due to the grading of the road. It is unclear how much runoff reaches the lake – but likely does in heavy storms. Reportedly the area around drain is constantly wet in the summer but this might be due to poor road grade.

BMP Recommendations: Upgrade existing drain to a deep sump catch basin and discharge stormwater to an improved vegetated swale or bioinfiltration basin on Town-owned property adjacent to 314 Shore Road. (Would need to obtain Town's permission.)

4. ***Location: 263 Shore Road***

   Site Description: In front and west of 263 Shore Road is an existing drain with a pipe that directs stormwater under Shore Road and outfalls to a trench that is along the eastern edge of Shores Beach area.

   BMP Recommendations: Upgrade existing drain to a deep sump catch basin and discharge stormwater to an improved vegetated swale or bioinfiltration basin developed on Shores Road Beach property.

5. ***Location: 235 Shore Road***

   Site Description: In front and east of 235 Shore Road is an existing "hand-made" drain with a pipe (about 6") that directs stormwater under Shore Road and outfalls to a trench that is between 230 and 220 Shore Road.

   BMP Recommendations: Upgrade existing drain to a deep sump catch basin and discharge stormwater to an improved vegetated swale in place of the existing trench.