Final Massachusetts Statewide Total Maximum Daily Load for Pathogen-Impaired Waterbodies

Appendix P: Charles River Basin & Coastal Drainage Area

Commonwealth of Massachusetts
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December 2024

CN 515.1.16

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December 2024

CN 515.1.16

Suggested Citation
MassDEP. 2024. Final Massachusetts Statewide Total Maximum Daily Load for Pathogen-Impaired Waterbodies. CN 515.1, Massachusetts Department of Environmental Protection, Bureau of Water Resources, Division of Watershed Management, Watershed Planning Program. Worcester, MA.

Available Online

https://www.mass.gov/lists/total-maximum-daily-loads-by-watershed

Massachusetts Department of Environmental Protection

The mission of the Massachusetts Department of Environmental Protection (MassDEP) is to protect and enhance the Commonwealth's natural resources – air, water, and land – to provide for the health, safety, and welfare of all people, and to ensure a clean and safe environment for future generations. In carrying out this mission MassDEP commits to address and advance environmental justice and equity for all people of the Commonwealth; provide meaningful, inclusive opportunities for people to participate in agency decisions that affect their lives; and ensure a diverse workforce that reflects the communities we serve.

Watershed Planning Program

The mission of the Watershed Planning Program (WPP) in the Massachusetts Department of Environmental Protection is to protect, enhance, and restore the quality and value of the waters of the Commonwealth. Guided by the federal Clean Water Act, WPP implements this mission statewide through five Sections that each have a different technical focus: (1) Surface Water Quality Standards; (2) Surface Water Quality Monitoring; (3) Data Management and Water Quality Assessment; (4) Total Maximum Daily Load; and (5) Nonpoint Source Management. Together with other MassDEP programs and state environmental agencies, WPP shares in the duty and responsibility to secure the environmental, recreational, and public health benefits of clean water for all people of the Commonwealth.

Acknowledgements

FB Environmental Associates, under contractual agreements with MassDEP, previously prepared two separate documents for the Watershed Planning Program: (1) *Massachusetts TMDL for Pathogen-Impaired Inland Fresh Water Rivers* and (2) *Massachusetts Statewide TMDL for Pathogen-Impaired Coastal Waterbodies*. MassDEP combined these two documents into a single statewide approach encompassing both inland fresh water and coastal impairments to prepare the *Final Massachusetts Statewide Total Maximum Daily Load for Pathogen-Impaired Waterbodies*.

Disclaimer

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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 TMDL for the seven pathogen-impaired segments in the Charles River Basin & Coastal Drainage Area, hereinafter referred to as the Charles River watershed (Figure 1-1). The core document and appendix together complete the TMDL for each of these pathogen-impaired segments.

This appendix includes a description of the watershed and maps to identify the segments of focus for the TMDLs; the impaired uses, and the water classification and qualifiers as designated by the Massachusetts Surface Water Quality Standards (SWQS, 314 CMR 4.00); the water quality standards applicable to the impaired uses; the data supporting the pathogen impairment determination; and a description of the sources of pathogen loading with supporting maps.

This appendix also 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 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, if applicable. The TMDLs for the seven Charles River segments were calculated with the flow-based equation. Refer to Tables 1-1 & 1-2.

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 Charles River Watershed Overview section.

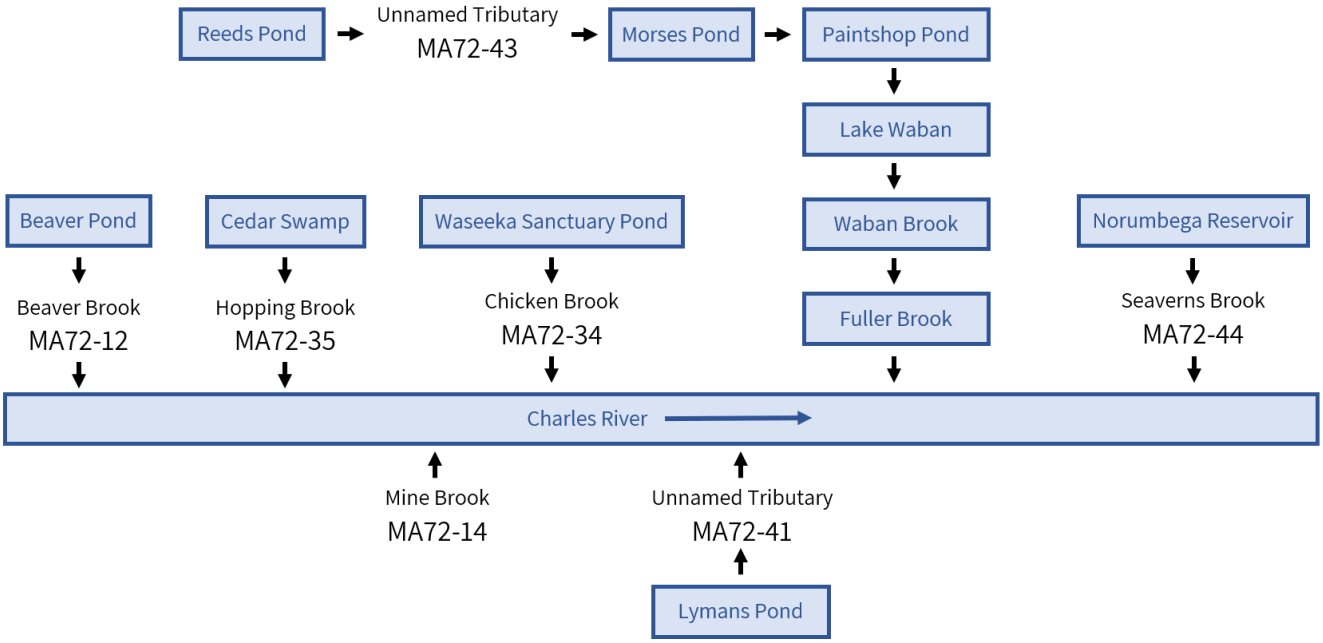


Figure 1-1. Conceptual diagram of water flow through the Charles River watershed for the seven pathogen-impaired segments. Connections between waterbodies are shown with black arrows. Not to scale. Impaired segments are shown with the assessment unit.

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 Charles River Basin and Coastal Drainage Area

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)					
Beaver Brook		R	126	411	69%	WLA (10%)	0.3	3.1	31.0	310.4	3,103.9	31,039.5
MA72-12	B			(90 day)		LA (90%)	2.8	27.7	277.2	2,772.3	27,722.9	277,228.5
Mine Brook		R	126	182	31%	WLA (16%)	0.5	5.1	50.6	505.9	5,059.2	50,592.0
MA72-14	B (WW, HQW*)			(90 day)		LA (84%)	2.6	25.8	257.7	2,576.8	25,767.6	257,676.0
Chicken Brook		R	126	363	65%	WLA (11%)	0.3	3.3	32.7	326.5	3,265.0	32,650.2
MA72-34	B			(90 day)		LA (89%)	2.8	27.6	275.6	2,756.2	27,561.8	275,617.8
Hopping Brook		R	126	397	68%	WLA (8%)	0.2	2.4	24.4	244.4	2,443.9	24,438.8
MA72-35	B			(90 day)		LA (92%)	2.8	28.4	283.8	2,838.3	28,382.9	283,829.2
Unnamed Tributary		R	126	402	69%	WLA (3%)	0.1	0.9	9.1	90.7	907.3	9,072.9
MA72-41	B			(90 day)		LA (97%)	3.0	29.9	299.2	2,992.0	29,919.5	299,195.1
Unnamed Tributary		R	126	278	55%	WLA (20%)	0.6	6.0	60.2	602.4	6,023.6	60,236.4
MA72-43	B			(90 day)		LA (80%)	2.5	24.8	248.0	2,480.3	24,803.2	248,031.7
Seaverns Brook		R	126	839	85%	WLA (12%)	0.4	3.6	35.7	357.0	3,569.7	35,696.6
MA72-44	B			(90 day)		LA (88%)	2.7	27.3	272.6	2,725.7	27,257.1	272,571.4

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 Charles River Basin and Coastal Drainage Area

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)					
Beaver Brook		P	35	NA	-	WLA (10%)	0.1	0.9	8.6	86.2	862.2	8,622.1
MA72-12	B					LA (90%)	0.8	7.7	77.0	770.1	7,700.8	77,007.9
Mine Brook		P	35	NA	-	WLA (16%)	0.1	1.4	14.1	140.5	1,405.3	14,053.3
MA72-14	B (WW, HQW*)					LA (84%)	0.7	7.2	71.6	715.8	7,157.7	71,576.7
Chicken Brook		P	35	NA	-	WLA (11%)	0.1	0.9	9.1	90.7	906.9	9,069.5
MA72-34	B					LA (89%)	0.8	7.7	76.6	765.6	7,656.1	76,560.5
Hopping Brook		P	35	NA	-	WLA (8%)	0.1	0.7	6.8	67.9	678.9	6,788.6
MA72-35	B					LA (92%)	0.8	7.9	78.8	788.4	7,884.1	78,841.4
Unnamed Tributary		P	35	NA	-	WLA (3%)	-	0.3	2.5	25.2	252.0	2,520.3
MA72-41	B					LA (97%)	0.8	8.3	83.1	831.1	8,311.0	83,109.7
Unnamed Tributary		P	35	NA	-	WLA (20%)	0.2	1.7	16.7	167.3	1,673.2	16,732.3
MA72-43	B					LA (80%)	0.7	6.9	68.9	689.0	6,889.8	68,897.7
Seaverns Brook		P	35	NA	-	WLA (12%)	0.1	1.0	9.9	99.2	991.6	9,915.7
MA72-44	B					LA (88%)	0.8	7.6	75.7	757.1	7,571.4	75,714.3

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).*

HQW *= High Quality Water; waters designated for protection under 314 CMR 4.04(2); (*) designation only applies to a portion of the segment*

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 per 100 milliliter or ml.

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 TMD*L 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. Charles River Watershed Overview

The Charles River watershed covers an area of approximately 311 square miles (mi^2) in eastern Massachusetts (Figure 2-1). It includes the mainstem of the Charles River, which generally flows northeast from Hopkinton, MA to Boston Harbor in Boston, MA. There are numerous other tributaries in the watershed that drain into the Charles River including, most notably, Mine Brook, Mill River, Stop River, Stony Brook, and Muddy River.

The mainstem of the Charles River begins at its headwaters north of Echo Lake in Hopkinton, MA, and flows in a highly meandering route for 79 miles before reaching Boston Harbor. In this course, the river drops 310 feet in elevation, most of which occurs in the river's headwaters (MassDEP, 2011). The Charles River is generally viewed as three distinct sections: the Upper Charles, from its headwaters to the Cochrane Dam, in Dover and Needham; the Middle Charles, from the Cochrane Dam to the Watertown Dam in Watertown; and the Lower Charles, from the Watertown Dam to its confluence with Boston Harbor (MassDEP, 2011).

In addition to numerous dams, prominent features along the mainstem of the Charles River include Echo Lake, Milford Pond, Box Pond, Populatic Pond, the "Dedham Loop", the Mother Brook Diversion (constructed to divert flow into the Neponset River for flood control), and "the Basin" from the Watertown Dam to the Charles River Dam (Fiorentino, et al., 2000). Streamflow in the Charles is generally slow due to the many dams and wetland areas that widen the river and act as water storage areas. This storage helps to buffer the effects of extreme precipitation in the watershed, absorbing flow during flood events and sustaining flow during periods of drought (Fiorentino, et al., 2000).

The Charles River watershed overlaps a portion of 35 municipalities in Massachusetts. Of these municipalities, seven are completely contained within the watershed (Brookline, Medway, Millis, Needham, Newton, Waltham, and Wellesley). Large portions of the densely-populated communities around Boston are located within the watershed. See Figure 2-1 for a map showing impaired segments and watershed municipalities.

All municipalities in the watershed operate and maintain municipal separate storm sewer systems (MS4s) in urban areas. The networks of drains and pipes in MS4 systems convey polluted runoff from streets and developed areas to surface waters. 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 on July 1, 2018, with modifications effective on January 6, 2021 (USEPA, 2020). Communities that discharge to pathogen-impaired waterbodies with approved TMDLs are required to implement enhanced best management practices (BMPs) for public education and to designate the catchments as Problem Catchments or High Priority under the Illicit Discharge Detection and Elimination (IDDE) Program, in addition to the MS4 requirement to reduce pollutants to the Maximum Extent Practicable (USEPA, 2020).

The geographic range of two Regional Planning Agencies (RPA) includes the Charles River watershed, although the Central Massachusetts Regional Planning Commission only encompasses a small fraction. RPAs are public organizations advising municipalities, private business groups, and state and federal governments on a range of matters. Their research, coordination and technical assistance are especially valuable in addressing watershed-level issues such as pathogen pollutants and stormwater that cross town boundaries. These Charles watershed RPAs include:

- Central Massachusetts Regional Planning Commission (CMRPC, 2022)
- Metropolitan Area Planning Council (MAPC, 2022)

The following RPA initiatives and tools utilized in the Charles River watershed are especially noteworthy:

- The MAPC utilizes the Integrated Water Management (IWM) approach to coordinate planning across the wastewater, drinking water, and stormwater sectors.
- The MAPC has developed two tools that assist MS4 regulated communities in fulfilling the requirements of the permit. These tools are:
    - Stormwater Utility/Funding Starting Kit (MAPC, 2014)

- GIS toolkit to calculate MS4 outfall catchments, a requirement under the MS4 General Permit, created by MAPC and the Neponset River Watershed Association (MAPC, 2018).

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 through their "Think Blue" campaign **Invalid source specified.**.

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

- **Charles River Conservancy** (CRC) launched the Charles River Swimming Initiative to improve water quality in the river to support recreational swimming (CRC, 2022).
- **Charles River Watershed Association** (CRWA) whose mission is "to protect, restore and enhance the Charles River and its watershed through science, advocacy and the law" (CRWA, 2022).
- **Conservation Law Foundation** (CLF) is urging municipalities to better control stormwater runoff to the Charles River by ensuring that state-issued permits are strict and also pressuring the EPA to continue to uphold the Clean Water Act (CLF, 2022).
- **Massachusetts Office of Coastal Zone Management** (CZM) has a Boston Regional office that "serves the coastal communities from Winthrop to Weymouth." (CZM, 2022a).
- **Massachusetts Water Resources Authority** (MWRA) conducts routine water quality monitoring in the Lower Charles River for nutrients and bacteria (MWRA, 2022).
- **Trout Unlimited (TU)** operates two chapters in the geographic area of the Charles watershed, the Central Massachusetts and the Greater Boston. Their mission is" to conserve, protect and restore our country's coldwater fisheries and their watersheds"; some of their activities include river cleanups, scientific assessments (e.g., trout habitat, culvert connectivity) and restoration projects (TU, 2022). The Central MA chapter website indicates activities including the protection and restoration of native brook trout coldwater habitat in Central Massachusetts (CMTU, 2022). The Greater Boston chapter makes monthly habitat assessments throughout the summer as part of their Embrace A Stream project, to evaluate and protect populations of native brook trout in the Neponset River Watershed (GBTU, 2022).
- **U.S. Environmental Protection Agency** (USEPA) launched the Charles River Initiative in 1995 with the goal of making the river both fishable and swimmable (USEPA, 2022).

The following actions by identified stakeholders will help reduce pathogen loads to the impaired segments. The list represents a starting point and is not intended to be comprehensive. For a more detailed discussion of pollutant reduction actions, see Section 5, "Implementation" of the Pathogen TMDL core document.

- **Municipalities:** Continue to implement the MS4 permit, which includes specific requirements for waterbodies with an approved Bacteria/Pathogen TMDL, such as prioritization and reporting, enhanced BMPs, IDDE, and education (USEPA, 2020).
- **Regional Planning Agencies (RPAs) and municipalities:** Continue and expand collaboration on MS4 and stormwater issues. Cooperatively develop tools and share knowledge to reduce costs, increase innovation, and generate consistent and effective stream restoration efforts at the watershed scale.
- **USDA NRCS and landowners:** Develop comprehensive nutrient management plans for agriculture, reaching farmers through local connections.
- **Parks departments, schools, private landowners, and others** who maintain large, mowed fields with direct connections to surface water should consider maintaining a vegetated buffer along the shoreline. Buffers slow and filter stormwater runoff, provide a visual screen that can discourage large aggregations of waterfowl, and offer many other water quality benefits at low cost.

Sanitary wastes associated with boating activities are a potential source of pathogens to surface waters. Since 2014, all Massachusetts waters are designated as a No-Discharge Zone (NDZ) in which the discharge of boat sewage is prohibited. Many free boat pump-out services are available at various sites along the coast, funded by the Clean Vessel Act. The Massachusetts CZM webpage maintains online maps of these boat pump-out facilities, and the Clean Vessel Act Program offers a *Boaters Pocket Guide to Pumpout Facilities* (CZM, 2022b). Any sewage discharges from boats or boating infrastructure in the waters covered by this TMDL are therefore illicit discharges.

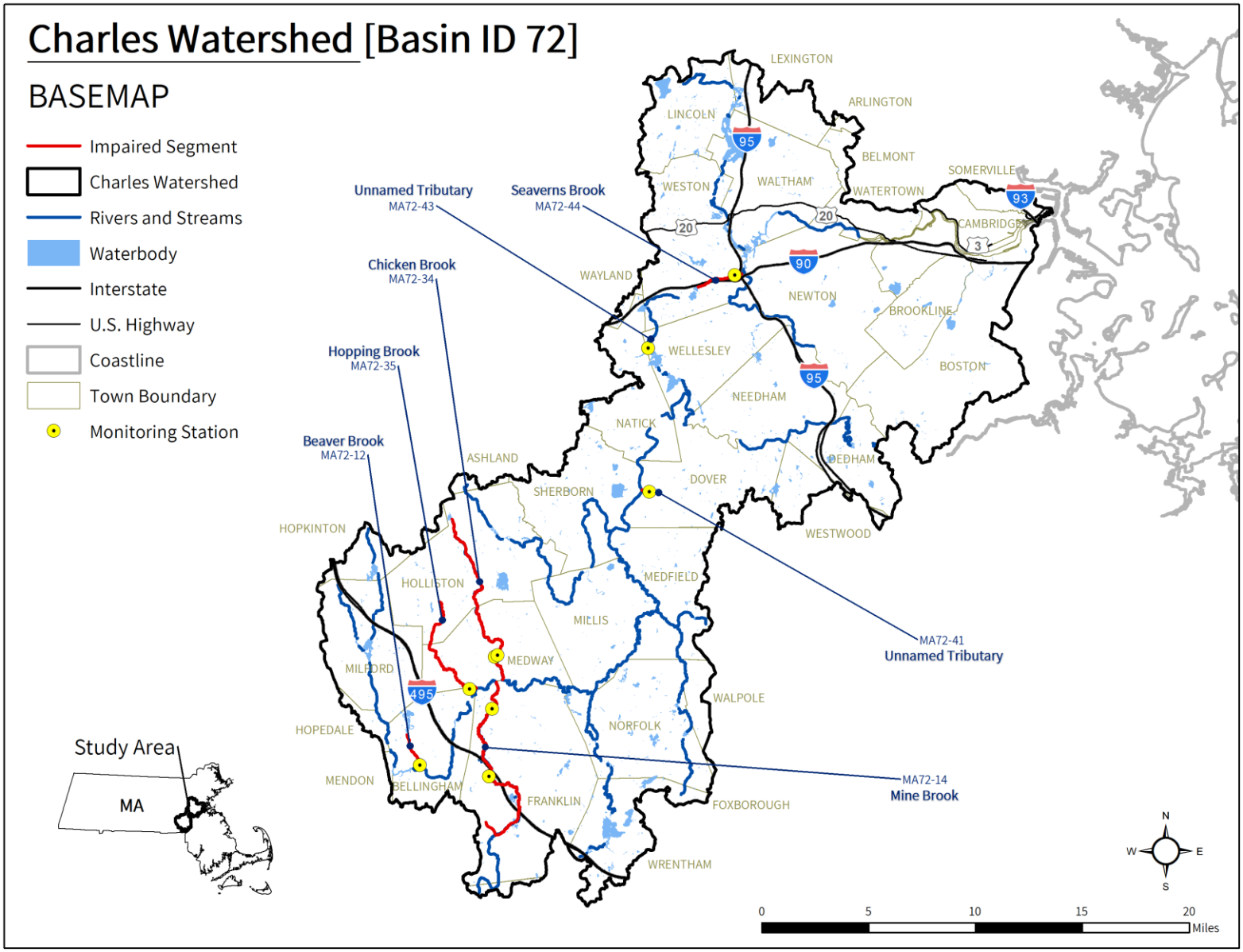


Figure 2-1: Map of all pathogen-impaired segments, water quality monitoring stations, municipal borders, waterbodies, and major roads in the Charles River watershed.

3. MA72-12 Beaver Brook

3.1. Waterbody Overview

Beaver Brook segment MA72-12 is 1.4 miles long and begins at the outlet of Beaver Pond in Bellingham, MA. The tributary then flows south to its confluence with the Charles River in Bellingham.

Tributaries to Beaver Brook segment MA72-12 include several unnamed streams. Lakes and ponds in the watershed include Beaver Pond and several unnamed waterbodies. Most of the segment flows through wetlands.

Key landmarks in the watershed include the Wethersfield residential neighborhood in Bellingham in the southern watershed, and multiple industrial and commercial landmarks in the northern watershed, including Dauphinais Concrete, Chestnut Grove Stables, and an industrial park with a Massachusetts National Guard office. Segment MA72-12 is crossed only by Hartford Avenue, in Bellingham.

Beaver Brook (MA72-12) drains a total area of 2.9 square miles (mi^2), of which 0.3 mi^2 (10%) are impervious and 0.2 mi^2 (6%) are directly connected impervious area (DCIA). The watershed may be partially served by public sewer systems in Bellingham[1], and 56% of the total land area is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, MassDEP discharge-to-groundwater permits for on-site wastewater discharge, or combined sewer overflows (CSOs) within the watershed. There are no landfills or unpermitted land disposal dumping grounds within the segment watershed. See Figure 3-1.

The Beaver Brook segment MA72-12 watershed is located in a moderately-developed part of Massachusetts. More than half of the watershed consists of forest and natural lands (63%) and 15% consists of wetland areas. The remainder of the watershed is primarily covered by development (22%) as there is no agricultural activity (0%). Most of the development consists of residential areas in

Reduction from Highest Calculated Geomean: 69%

Watershed Area (Acres): 1,825

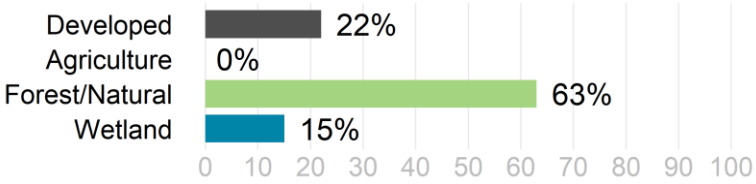
Segment Length (Miles): 1.4

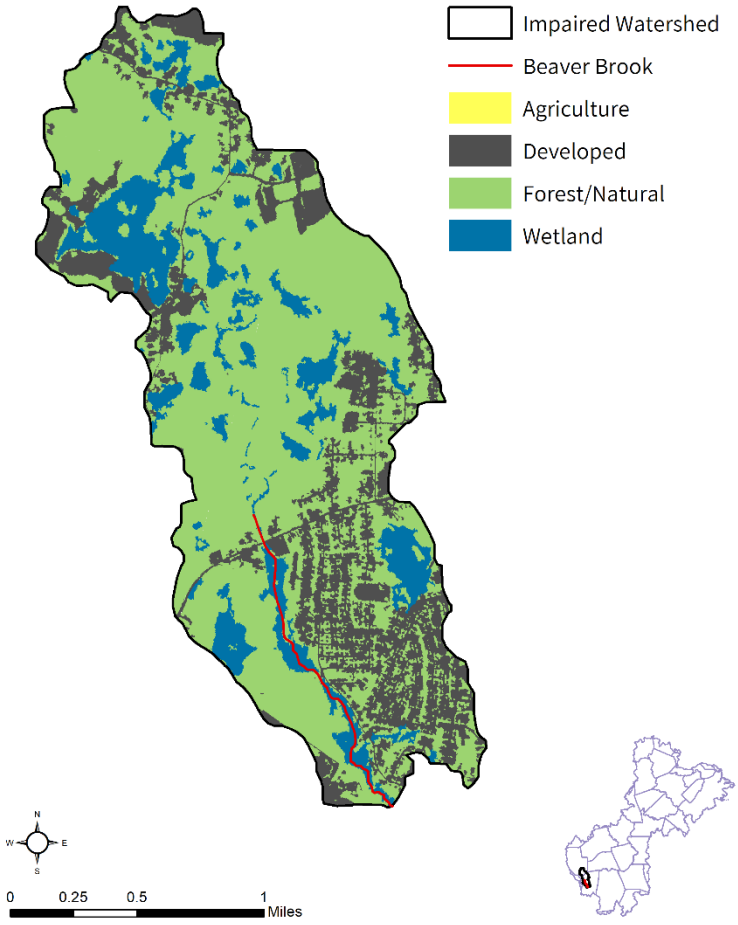
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 184 (10%)

DCIA Area (Acres, %): 101 (6%)





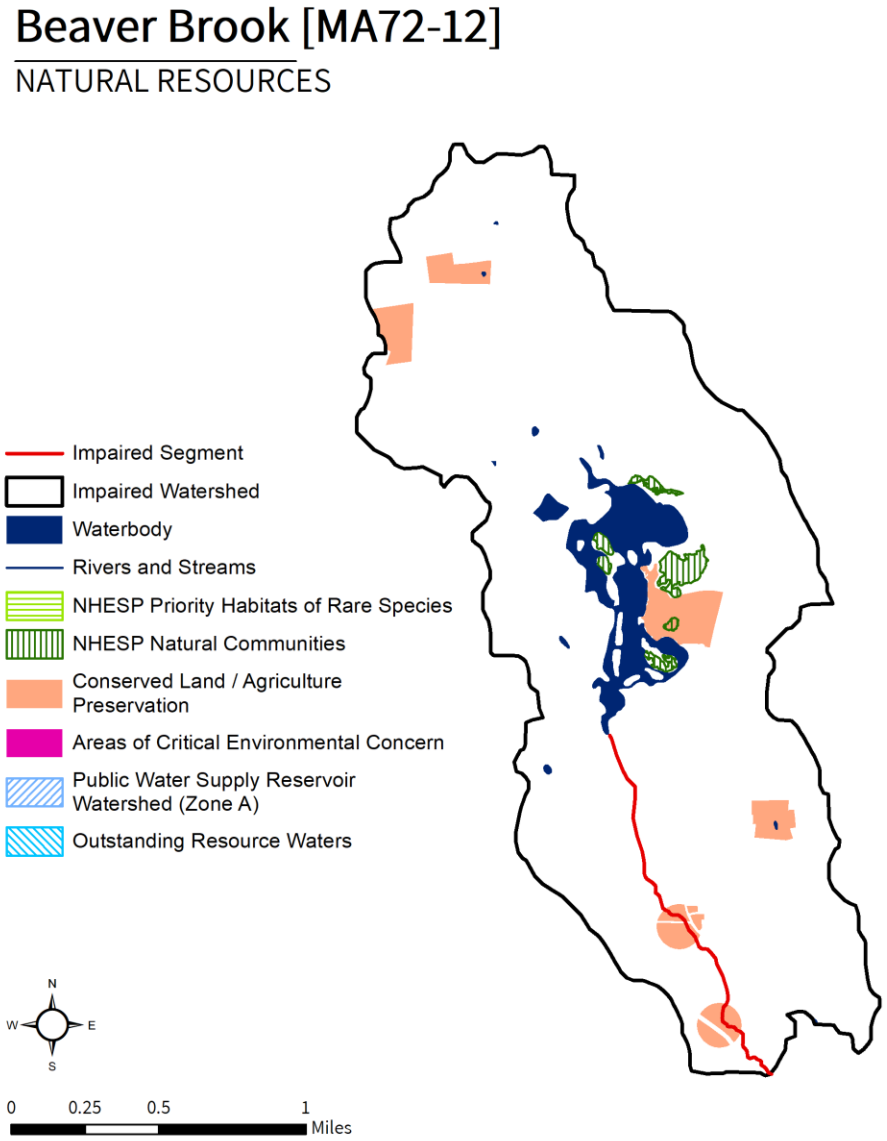
[1] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service areas, MassDEP's Water Utility Infrastructure Mapping Project (MassDEP, 2021b), MS4 reports, and local knowledge.

the southern half of the watershed, and some industrial and commercial development, mainly in the northern portion of the watershed.

In the Beaver Brook (MA72-12) watershed, under the Natural Heritage and Endangered Species Program, there are no Priority Habitats of Rare Species and 18 acres (1%) of Priority Natural Vegetation Communities. There are no acres under Public Water Supply protection, within Areas of Critical Environmental Concern, or Outstanding Resource Waters. Overall, there are 49 acres (3%) of land protected in perpetuity[2], part of 84 acres (5%) of Protected and Recreational Open Space[3]. See Figure 3-1.

[2] Land protected in perpetuity includes conservation restrictions, 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] All Protected and Recreational Open Space land is shown on the natural resources map.



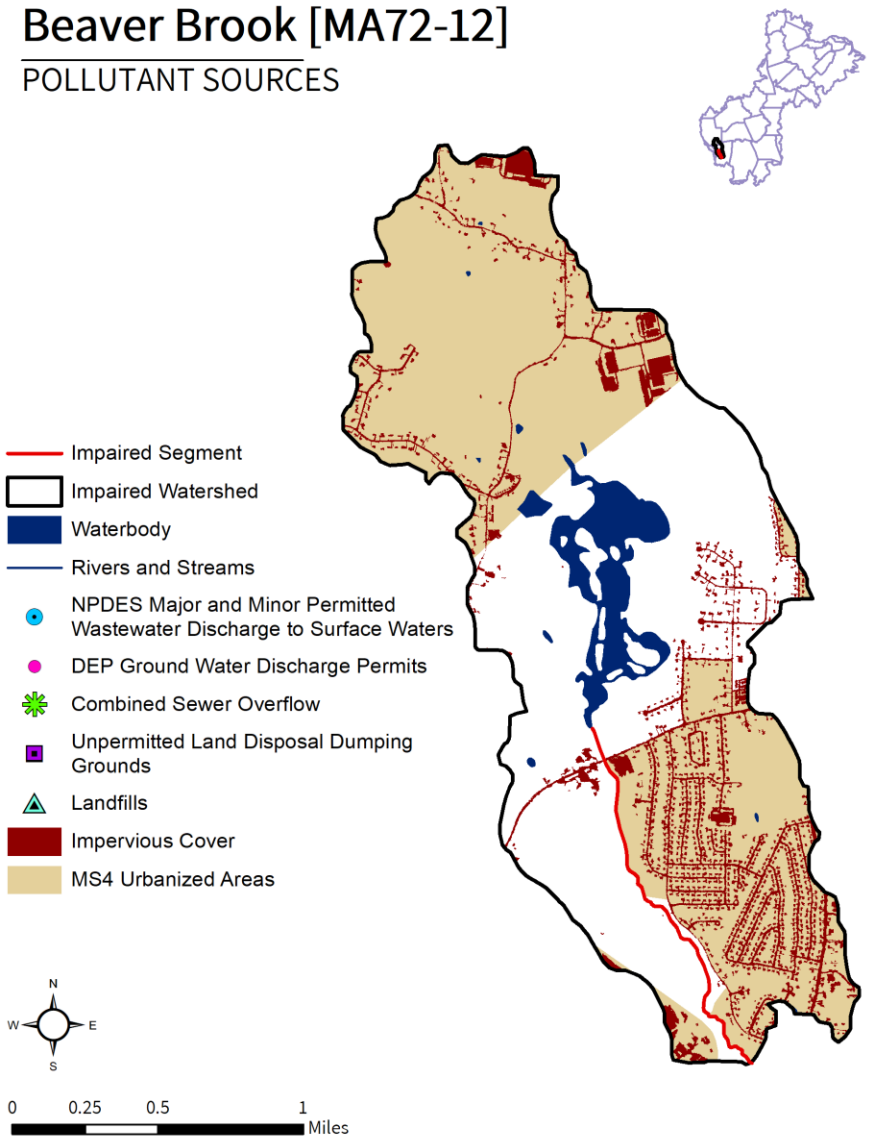


Figure 3-1. Natural resources and potential pollution sources draining to the Beaver Brook segment MA72-12. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

3.2. Waterbody Impairment Characterization

Beaver Brook (MA72-12) is a Class B Water (MassDEP, 2021a).

The Primary Contact Recreation use was assessed for attainment of SWQS at the station listed below (refer to Tables 3-1, 3-2; Figure 3-2) using the indicator bacteria *E. coli*. 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 W1142; data indicated five days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the Statistical Threshold Value (STV) criterion was applied to single sample results. Out of five samples, two exceeded the STV criterion during dry weather.

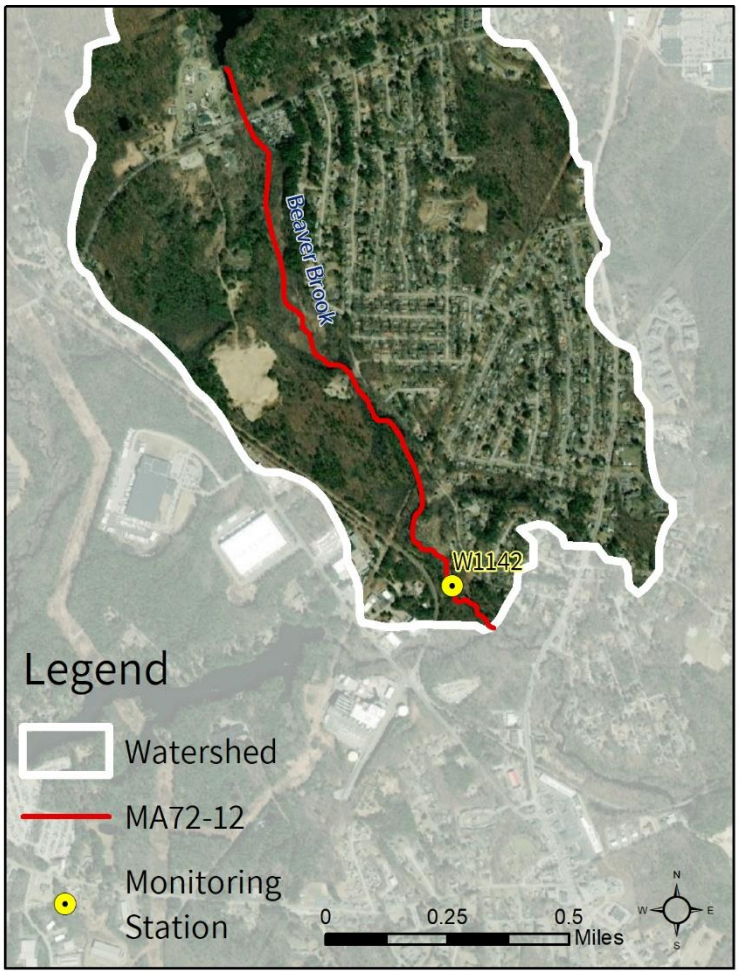


Figure 3-2. Location of monitoring station(s) along the impaired segment.

Table 3-1. Summary of indicator bacteria sampling results by station for Beaver Brook (MA72-12). 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 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 site 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
W1142	5/15/2007	10/2/2007	5	411	5	2

Table 3-2. Indicator bacteria data by station, indicator, and date for Beaver Brook (MA72-12). Each sample date was designated as representing wet or dry weather conditions with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text in the Results column 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 STV) for *E. coli* indicator bacteria; and red text in the Geomean column highlights exceedances of the 126 CFU/100 mL criterion (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)
W1142	*E. coli*	5/15/2007	DRY	140	140	
W1142	*E. coli*	6/19/2007	DRY	510	267	
W1142	*E. coli*	7/24/2007	DRY	340	290	
W1142	*E. coli*	8/28/2007	DRY	400	411	
W1142	*E. coli*	10/2/2007	DRY	410	382	

3.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present, 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 surface waters 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 sanitary sewer overflows (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).

Indicator bacteria data for Beaver Brook (MA72-12) were elevated during dry weather (wet weather data were not available). Elevated results 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 the major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a moderate amount of development in the watershed (22%), most of which consists of residential areas and industrial and commercial development. 56% of the land area is subject to MS4 permit conditions, 10% is classified as impervious area, and 6% is classified as DCIA. Stormwater runoff from urban areas is a likely source of pathogens.

Illicit Sewage Discharges: Public sewer service may be available in the watershed within the town of Bellingham. Sewer-related risks to water quality include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSOs), 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 conveyances are also a potential source of pathogens.

On-Site Wastewater Disposal Systems: Some of the development in the watershed utilizes on-site systems for wastewater treatment. It is likely that some septic systems are not properly maintained and are discharging untreated effluent to groundwater.

Agriculture: According to land use maps, there is no agricultural activity in the watershed. As a result, stormwater runoff from agricultural land is not a likely source of pathogens to the impaired segment.

Pet Waste: There are many residential neighborhoods near the Beaver Brook segment MA72-12. Conservation lands and parks popular for dog-walking, especially where paths or residential neighborhoods are adjacent to rivers, ponds, or wetlands, represent possible sources of pathogens.

Wildlife Waste: A few large open wetland areas (emergent wetlands) are directly adjacent to the impaired segment. Large mowed areas, fields, or wetlands with a clear sightline to a waterbody may attract large congregations of waterfowl, resulting in elevated indicator bacteria counts in the water.

3.4. Existing Local Management

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

Town of Bellingham

About 85% of Bellingham is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041091), and the town has an EPA-approved Notice of Intent (NOI). The town has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. Bellingham has completed an illicit discharge detection and elimination (IDDE) plan (2006), an erosion and sedimentation control (ESC) plan (2007), and post-construction stormwater regulations (2007). According to Bellingham's NOI, there are four outfalls to a direct discharge to Beaver Brook (MA72-12) and 16 outfalls to a tributary/wetland flowing to Beaver Brook (MA72-12), which is impaired by *E. coli*.

Bellingham has the following ordinances and bylaws, mostly accessible online via the town website https://www.bellinghamma.org/ (Town of Bellingham, 2022):

- Wetland protection bylaw
- A stormwater bylaw and utility
- Pet Waste Control bylaw: None found

Bellingham has a 2020 Master Plan that contains a Natural Resources, Open Space, and Recreation section. The section includes a discussion of the town's surface waters and identification of threats thereto. The MS4 program is explained within the Infrastructure section of this master plan, as Bellingham has two historic water filtration sites. Municipal wastewater systems serve only about 27% of the town's population, with the other 73% utilizing on-site treatment. Recommendations to further protect water resources include conserving more lands abutting waters of concern, strengthening town regulations to ensure that adequate buffers are maintained, and improving stormwater recharge through zoning changes (Town of Bellingham, 2022).

Town of Milford

About 84% of Milford is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041135), and the town has an EPA-approved Notice of Intent (NOI). The town has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. Milford completed an illicit discharge detection and elimination (IDDE) plan, an erosion and sedimentation control (ESC) plan, and post-construction stormwater regulations, all in 2005. According to Milford's NOI, there are 10 stormwater outfalls to the pathogen impaired Charles River (MA72-01, MA72-33, MA72-03), the latter two are impaired by *E. coli*.

Milford has the following ordinances and bylaws, mostly accessible online via the town website https://www.milfordma.gov/ (Town of Milford, 2022):

- Wetland protection bylaw
- A stormwater bylaw
- Pet Waste Control bylaw
- Stormwater Utility: None found

Milford has a 2003 Master Plan that contains a Natural Resources and an Open Space and Recreation section. Within the Natural Resources section, non-point source pollution is identified as the main source of water pollution. Current measures taken to protect surface waters are also discussed. Within the Open Space and Recreation section, connectivity and greater protection are identified as major issues concerning land conservation. About 95% of Milford's population is served by the public sewer system. Recommendations to further protect water resources include adjusting zoning to increase protection, repairing damaged stormwater infrastructure, and limiting pollutant loads through detaining and filtering stormwater (Town of Milford, 2022).

4. MA72-14 Mine Brook

4.1. Waterbody Overview

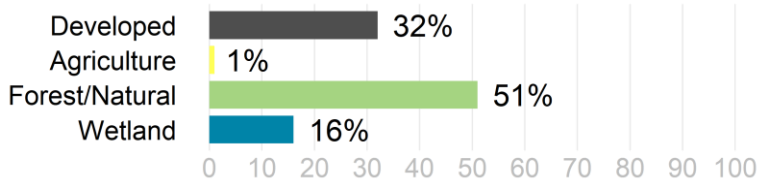
Mine Brook segment MA72-14 is 8.9 miles long and begins at its headwaters in Franklin State Forest in Franklin, MA. The segment flows briefly south, before generally flowing north to its confluence with the Charles River in Franklin. The segment flows through the former segment Mine Brook Pond MA72077. The HQW qualifier applies upstream of the former Franklin WWTP discharge, approximately four miles upstream of the segment mouth.

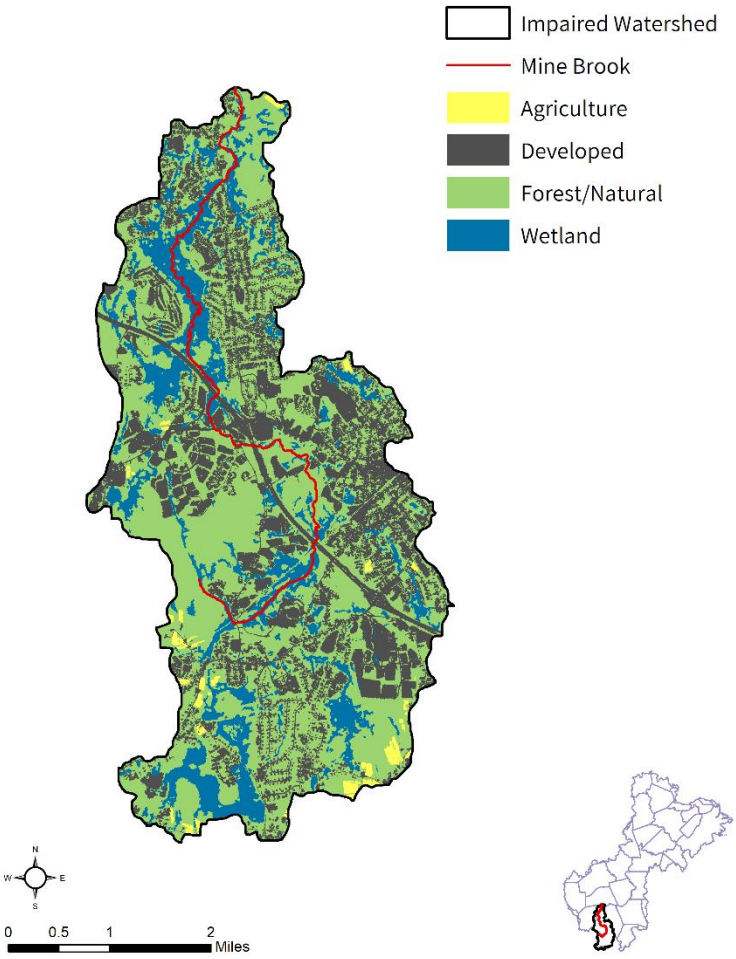
Tributaries to Mine Brook segment MA72-14 include Dix Brook, and several unnamed streams. Lakes and ponds in the watershed include Beaver Pond, Rays Pond, Spring Pond, and a few other unnamed waterbodies. Much of the tributary flows through wetland areas, especially in the downstream reaches. There are two named wetland complexes, Miscoe Meadow and Woodward Swamp, both in the southern part of the watershed.

Key landmarks in the watershed include Franklin State Forest, Chilson Park, Franklin High School, Franklin Village Shopping Center, St. Mary's Cemetery, Maplegate Country Club, the Brushwood Neighborhood in Franklin, the Westview Neighborhood in Franklin, and Franklin Country Day Camp. From upstream to downstream, segment MA72-14 is crossed by Grove Street, Blue Star Memorial Highway/Route 495, an unnamed road off Public Works Way, Beaver Street, Blue Star Memorial Highway/Route 495 (2nd), Grove Street again, Old Forge Hill Road, Route 140, West Central Street, Blue Star Memorial Highway/Route 495 (3rd, at the ramp-RT 495 southbound to RT 140), Beech Street, and Pond Street, all in Franklin.

Mine Brook (MA72-14) drains a total area of 15.7 square miles (mi^2), of which 2.6 mi^2 (16%) are impervious and 1.7 mi^2 (11%) are directly connected impervious area (DCIA). The watershed is partially served by public sewerage in Franklin[4], and 93% of the total land area is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on

Reduction from Highest Calculated Geomean: 31%
Watershed Area (Acres): 10,065
Segment Length (Miles): 8.9
Impairment(s): *E. coli* (Primary Contact Recreation)
Class (Qualifier): B (Warm Water, High Quality Water*)
Impervious Area (Acres, %): 1,652 (16%)
DCIA Area (Acres, %): 1,067 (11%)





[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 (MassDEP, 2021b), MS4 reports, and local knowledge.

file governing point source discharges of pollutants to surface waters, one MassDEP discharge-to-groundwater permit for an on-site wastewater discharge (Table 4-1), and no combined sewer overflows (CSOs). There is one landfill and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 4-1.

The Mine Brook segment MA72-14 watershed is located in a fairly well-developed part of Massachusetts. Just over half of the watershed consists of forest and natural lands (51%) and 16% consists of wetland areas. The remainder of the watershed is primarily covered by development (32%) as there is very little agricultural activity (1%). The development consists of residential neighborhoods, and industrial and commercial development. Most of the agricultural activity consists of pasture/hay and cultivated fields.

In the Mine Brook (MA72-14) watershed, under the Natural Heritage and Endangered Species Program, there are two acres (<1%) of Priority Habitats of Rare Species and no Priority Natural Vegetation Communities. There are no acres under Public Water Supply protection, within Areas of Critical Environmental Concern, or Outstanding Resource Waters. Overall, there are 1,900 acres (19%) of land protected in perpetuity[5], part of 2,188 acres (22%) of Protected and Recreational Open Space[6]. See Figure 4-1.

Table 4-1. Groundwater discharge permits in the segment watershed. PERR = permit number plus renewal number. TYPE = type of groundwater discharge. FLOW = permitted effluent in gallons per day (gpd).

PERR	NAME	TOWN	TYPE	FLOW (GPD)
744-2	VILLAGES AT OAK HILL WWTF	FRANKLIN	Sanitary Discharge	23,000

[5] Land protected in perpetuity includes conservation restrictions, 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] All Protected and Recreational Open Space land is shown on the natural resources map.

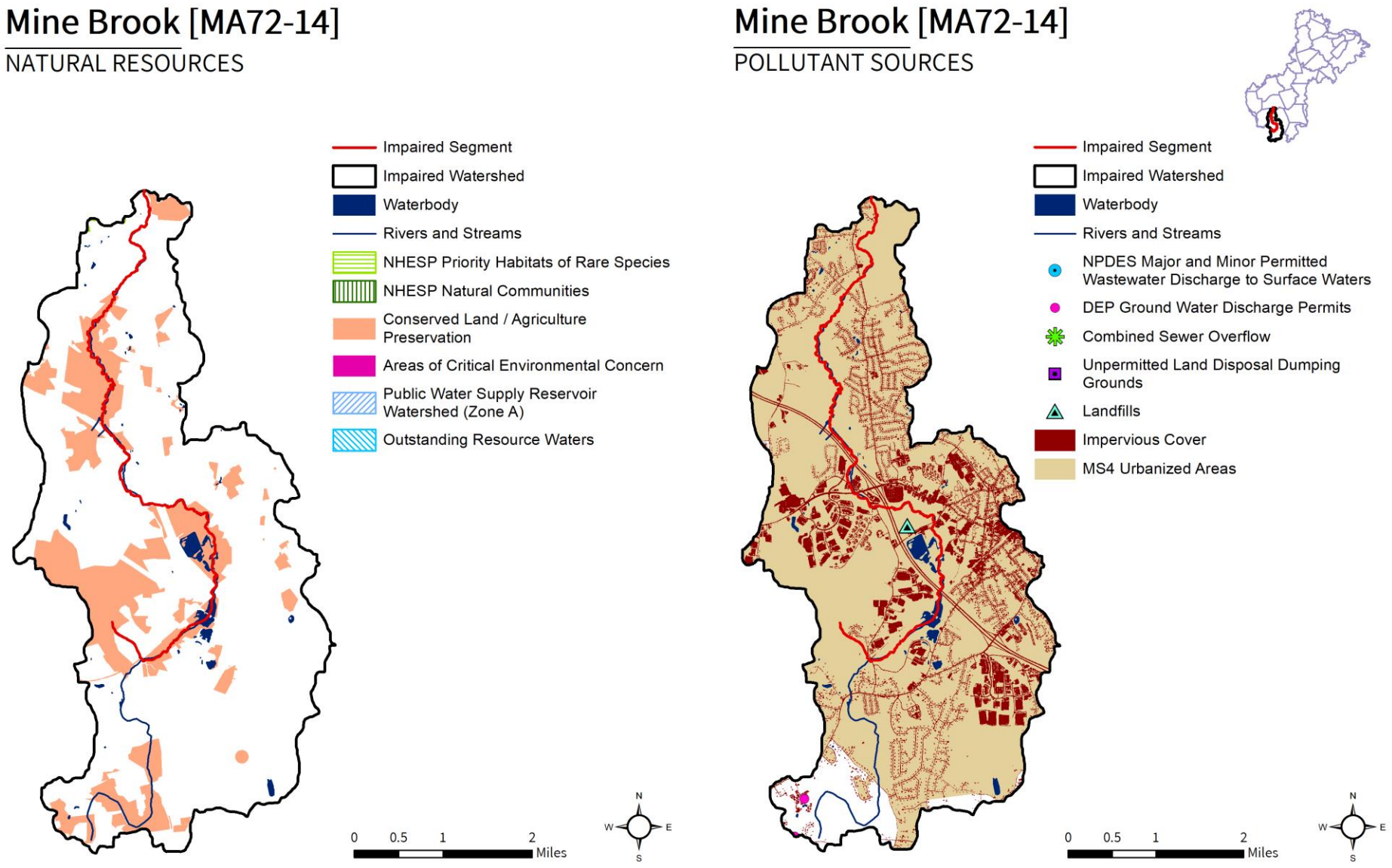


Figure 4-1. Natural resources and potential pollution sources draining to the Mine Brook segment MA72-14. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

4.2. Waterbody Impairment Characterization

Mine Brook (MA72-14) is a Class B, Warm Water, and High Quality Water (MassDEP, 2021a).

The Primary Contact Recreation use was assessed for attainment of SWQS at the stations listed below (refer to Tables 4-2, 4-3; Figure 4-2) using the indicator bacteria *E. coli*. 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 W1147; data indicated three days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the Statistical Threshold Value (STV) criterion was applied to single sample results. Out of five samples, none exceeded the STV criterion.
- In 2007, five samples were collected at W1588; data indicated that the 90-day rolling geomean did not exceed 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.

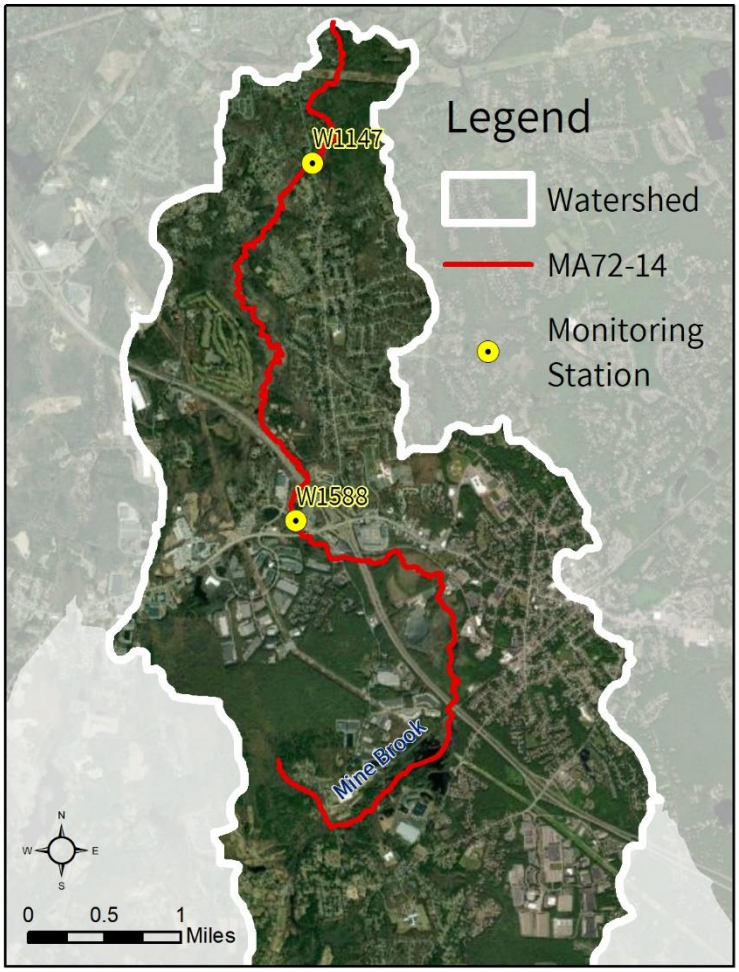


Figure 4-2. Location of monitoring station(s) along the impaired segment.

Table 4-2. Summary of indicator bacteria sampling results by station for Mine Brook (MA72-14). 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 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 site 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
W1147	5/15/2007	10/2/2007	5	182	3	0
W1588	5/15/2007	10/2/2007	5	104	0	0

Table 4-3. Indicator bacteria data by station, indicator, and date for Mine Brook (MA72-14). Each sample date was designated as representing wet or dry weather conditions with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text in the Results column 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 STV) for *E. coli* indicator bacteria; and red text in the Geomean column highlights exceedances of the 126 CFU/100 mL criterion (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)
W1147	*E. coli*	5/15/2007	DRY	110	110	
W1147	*E. coli*	6/19/2007	DRY	160	133	
W1147	*E. coli*	7/24/2007	DRY	110	125	
W1147	*E. coli*	8/28/2007	DRY	340	182	
W1147	*E. coli*	10/2/2007	DRY	100	155	
W1588	*E. coli*	5/15/2007	DRY	57	57	
W1588	*E. coli*	6/19/2007	DRY	190	104	
W1588	*E. coli*	7/24/2007	DRY	43	78	
W1588	*E. coli*	8/28/2007	DRY	33	65	
W1588	*E. coli*	10/2/2007	DRY	52	42	

4.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present, 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 surface waters 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 sanitary sewer overflows (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).

Indicator bacteria data for Mine Brook (MA72-14) was elevated during dry weather (wet weather data were not available). Elevated results 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 the major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a moderately high amount of development in the watershed (32%), which consists of residential areas and industrial and commercial development. 93% of the land area is subject to MS4 permit conditions, 16% is classified as impervious area, and 11% is classified as DCIA. Stormwater runoff from urban areas is a likely source of pathogens.

Illicit Sewage Discharges: Public sewer service is partially available in the watershed within the town of Franklin. Sewer-related risks to water quality include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSOs), 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 conveyances are also a potential source.

On-Site Wastewater Disposal Systems: Some of the development in the watershed may utilize on-site systems for wastewater treatment. Additionally, there is one MassDEP permit for on-site wastewater discharge to groundwater. In addition to this permitted point source, it is likely that some septic systems are not properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities in the watershed account for a relatively small portion (1%) of the total land use. A few pasture/hay and cultivated fields are located near wetland areas within the watershed. Manure storage and spreading activities, if not properly conducted, are possible sources of pathogens to waterbodies.

Pet Waste: There are many residential neighborhoods near the Mine Brook segment MA72-14, as well as several parks and conservation lands. Conservation lands, parks, and ballfields popular for dog-walking, especially where paths or residential neighborhoods are adjacent to rivers, ponds, or wetlands, represent possible sources of pathogens.

Wildlife Waste: Many large open wetland areas are directly adjacent to the impaired segment. Large mowed areas, fields, or wetlands with a clear sightline to a waterbody may attract large congregations of waterfowl, resulting in elevated indicator bacteria counts in the water.

4.4. Existing Local Management

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

Town of Franklin

The majority of Franklin (a city, but formally named "Town of") is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041117), and the town has an EPA-approved Notice of Intent (NOI). The town has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. Franklin has not completed an illicit discharge detection and elimination (IDDE) plan (although a 2019 bylaw may function as such, available at https://ecode360.com/35105004; (Town of Franklin, 2019)), but did complete an erosion and sedimentation control (ESC) plan and post-construction stormwater regulations in 2007. The town also has a 2020 Stormwater Management Plan (SWMP). According to the NOI, only one impaired waterbody in Franklin is a receiving water for its MS4 system, the pathogen-impaired Charles River (MA72-04) with 17 outfalls.

Franklin has the following ordinances and bylaws, mostly accessible online via the town website https://www.franklinma.gov/ (Town of Franklin, 2021):

- Stormwater control bylaw and stormwater utility fees
- Wetland protection bylaws
- Pet waste disposal bylaw

Franklin's 2013 Master Plan includes information about land use and natural resources, mentions the town's environment extensively, and has a section dedicated to sustainability. The natural resources section discusses stormwater and describes how the town is zoned to control stormwater runoff (LU-3). The town operates its own water and sewer systems, and the plan has an extensive section about the sewer system. No current Open Space and Recreation Plan was found online (Town of Franklin, 2021).

5. MA72-34 Chicken Brook

5.1. Waterbody Overview

Chicken Brook segment MA72-34 is 7.4 miles long and begins at the outlet of Waseeka Sanctuary Pond, Holliston, MA. The segment generally meanders south and east to its confluence with the Charles River in Medway, MA.

Tributaries to Chicken Brook segment MA72-34 include numerous unnamed streams. Lakes and ponds in the watershed include Park Pond, Milk Pond, Kirby Swamp, and a few other unnamed waterbodies. Much of the tributary flows through wetland areas.

Key landmarks in the watershed include Choate Park, Shady Oaks Farm, Medway High School, Medway Community Farm, Idylbrook Recreation Area, Pinecrest Golf Club, Holliston High School, and a portion of the Mass Audubon Waseeka Wildlife Sanctuary. From upstream to downstream, segment MA72-34 is crossed by Prentice Street (Holliston), an unnamed road (Holliston), Washington Street (Holliston), Cross Street (Holliston), Lovering Street (Medway), Winthrop Street twice (Medway), Oak Street (Medway), Main Street/Route 109 (Medway), Wellington Street (Medway), Guernsey Street (Medway), Cottage Street (Medway), and Village Street (Medway).

Chicken Brook (MA72-34) drains a total area of 7.2 square miles (mi^2), of which 0.8 mi^2 (11%) are impervious and 0.4 mi^2 (6%) are directly connected impervious area (DCIA). The watershed may be served by public sewer systems in Holliston and Medway[7], and the entire land area is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, MassDEP discharge-to-groundwater permits for on-site wastewater discharge, or combined sewer overflows (CSOs) within the watershed. There is one landfill and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 5-1.

The Chicken Brook segment MA72-34 watershed is located in a moderately-developed part of

Reduction from Highest Calculated Geomean: 65%

Watershed Area (Acres): 4,601

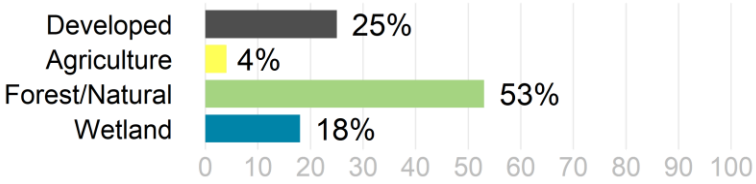
Segment Length (Miles): 7.4

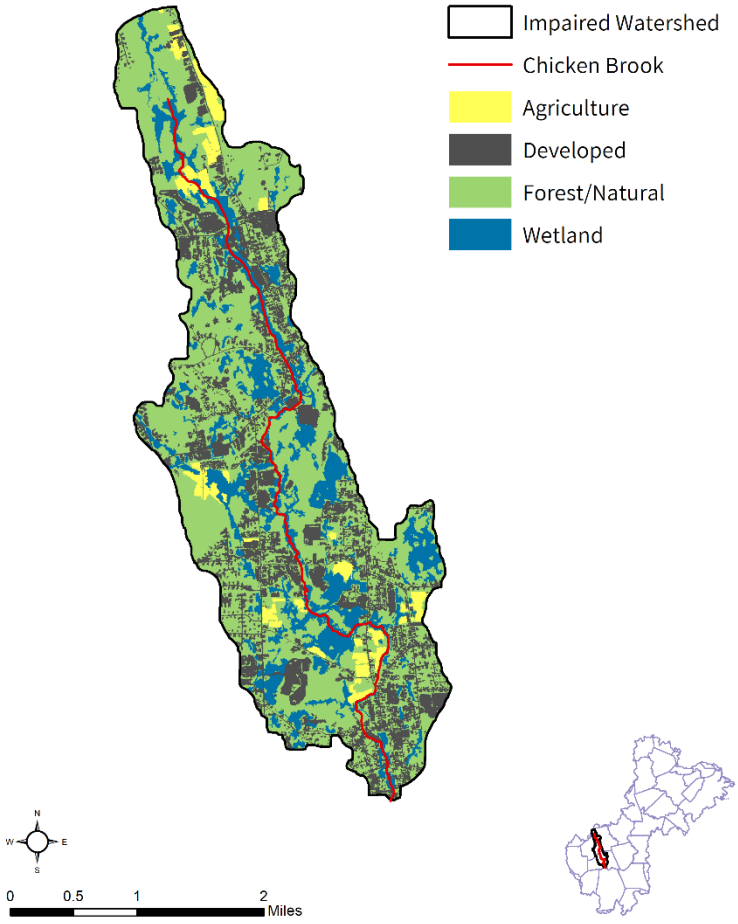
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 487 (11%)

DCIA Area (Acres, %): 272 (6%)





[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 (MassDEP, 2021b), MS4 reports, and local knowledge.

Massachusetts. More than half of the watershed consists of forest and natural lands (53%) and 18% consists of wetland areas. The remainder of the watershed is primarily covered by development (25%) as there is little agricultural activity (4%). Most of the development consists of residential areas with some industrial and commercial development. Most of the agricultural activity consists of pasture/hay and cultivated fields, and potentially some livestock grazing areas. Much of the agriculture is located directly adjacent to the segment or wetland areas in the watershed.

In the Chicken Brook (MA72-34) watershed, under the Natural Heritage and Endangered Species Program, there are no Priority Habitats of Rare Species or Priority Natural Vegetation Communities. There are also no acres under Public Water Supply protection, within Areas of Critical Environmental Concern, or Outstanding Resource Waters. Overall, there are 882 acres (19%) of land protected in perpetuity[8], part of 949 acres (21%) of Protected and Recreational Open Space[9]. See Figure 5-1.

[8] Land protected in perpetuity includes conservation restrictions, 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] All Protected and Recreational Open Space land is shown on the natural resources map.

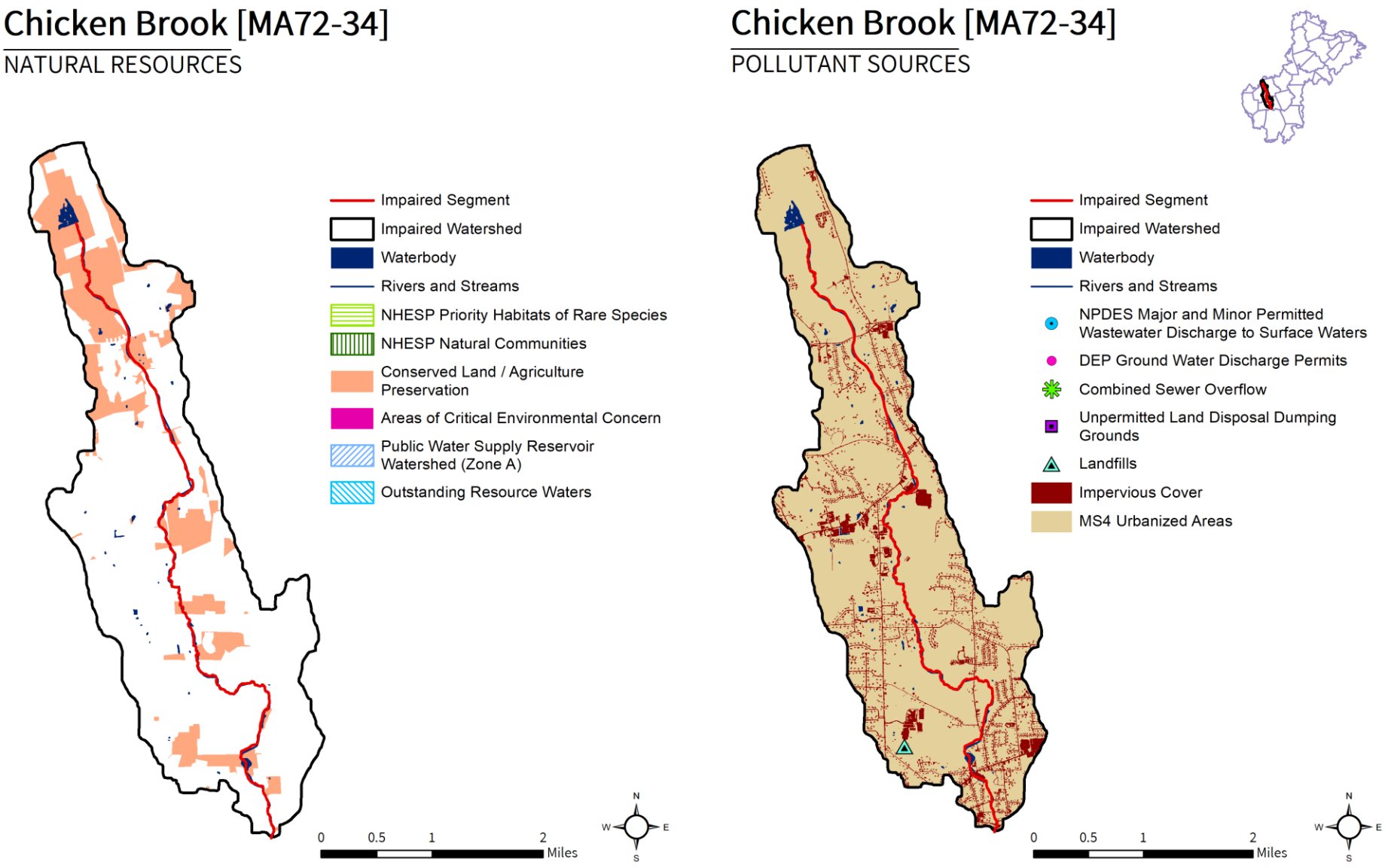


Figure 5-1. Natural resources and potential pollution sources draining to the Chicken Brook segment MA72-34. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

5.2. Waterbody Impairment Characterization

Chicken Brook (MA72-34) is a Class B Water (MassDEP, 2021a).

The Primary Contact Recreation use was assessed for attainment of SWQS at the stations listed below (refer to Tables 5-1, 5-2; Figure 5-2) using the indicator bacteria *E. coli*. 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 W1583; data indicated one day when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the Statistical Threshold Value (STV) criterion was applied to single sample results. Out of five samples, none exceeded the STV criterion.
- In 2010, six samples were collected at W2152; data indicated four 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 six samples, two exceeded the STV criterion during dry weather.

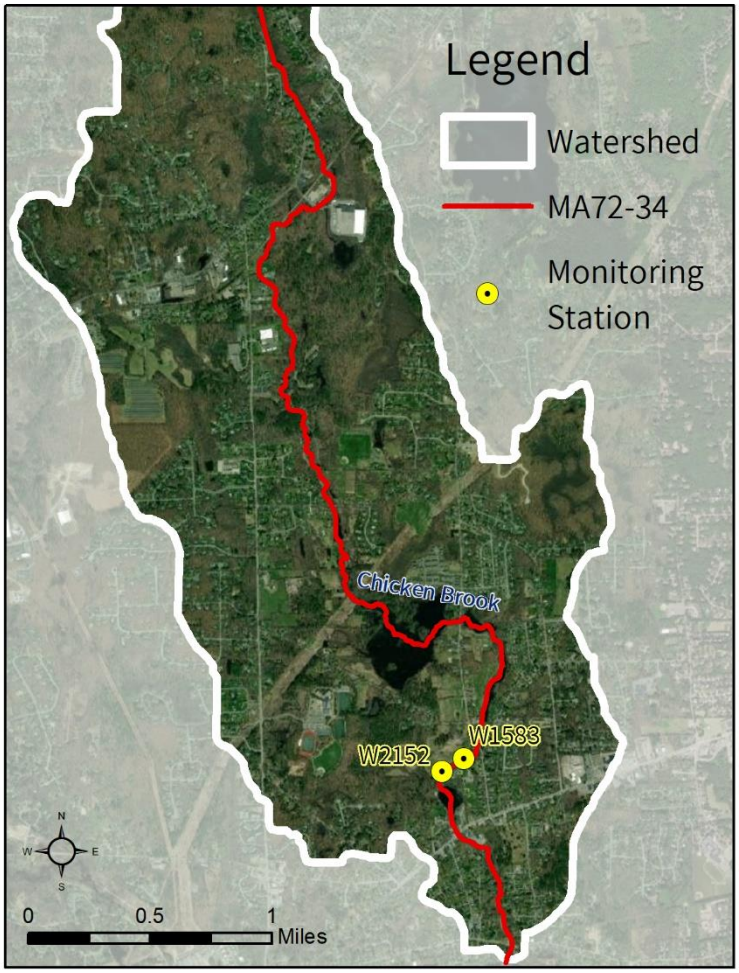


Figure 5-2. Location of monitoring station(s) along the impaired segment.

Table 5-1. Summary of indicator bacteria sampling results by station for Chicken Brook (MA72-34). 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 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 site 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
W1583	5/15/2007	10/2/2007	5	167	1	0
W2152	5/4/2010	9/13/2010	6	363	4	2

Table 5-2. Indicator bacteria data by station, indicator, and date for Chicken Brook (MA72-34). Each sample date was designated as representing wet or dry weather conditions with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text in the Results column 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 STV) for *E. coli* indicator bacteria; and red text in the Geomean column highlights exceedances of the 126 CFU/100 mL criterion (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)
W1583	*E. coli*	5/15/2007	DRY	33	33	
W1583	*E. coli*	6/19/2007	DRY	86	53	
W1583	*E. coli*	7/24/2007	DRY	360	101	
W1583	*E. coli*	8/28/2007	DRY	43	110	
W1583	*E. coli*	10/2/2007	DRY	300	167	
W2152	*E. coli*	5/4/2010	DRY	30	30	
W2152	*E. coli*	6/8/2010	DRY	190	75	
W2152	*E. coli*	6/24/2010	DRY	730	161	
W2152	*E. coli*	7/13/2010	DRY	520	216	
W2152	*E. coli*	8/9/2010	DRY	240	363	
W2152	*E. coli*	9/13/2010	DRY	120	323	

5.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present, 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 surface waters 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 sanitary sewer overflows (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).

Indicator bacteria data for Chicken Brook (MA72-34) were elevated during dry weather (wet weather data were not available). Elevated results 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 the major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a moderate amount of development in the watershed (25%), most of which consists of residential areas with some industrial and commercial development as well. The entire land area is subject to MS4 permit conditions, 11% is classified as impervious area, and 6% is classified as DCIA. Stormwater runoff from urban areas is a likely source of pathogens.

Illicit Sewage Discharges: Public sewer service may be available in the watershed within the towns of Holliston and Medway. Sewerage-related risks to water quality include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSOs), 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 conveyances are also a potential source.

On-Site Wastewater Disposal Systems: Some of the development in the watershed may utilize on-site systems for wastewater treatment. It is likely that some septic systems are not properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities in the watershed account for a small portion (4%) of the total land use. A few pasture/hay and cultivated fields are located next to the segment and next to wetland areas within the watershed. Manure storage and spreading activities, if not properly conducted, are possible sources of pathogens to waterbodies.

Pet Waste: There are many residential neighborhoods and parks near the Chicken Brook segment MA72-34, including parks and recreation fields in very close proximity to the segment. Conservation lands, parks, and ballfields popular for dog-walking, especially where paths or residential neighborhoods are adjacent to rivers, ponds, or wetlands, represent possible sources of pathogens.

Wildlife Waste: A few large open wetland areas are directly adjacent to the impaired segment. Large mowed areas, fields, or wetlands with a clear sightline to a waterbody may attract large congregations of waterfowl, resulting in elevated indicator bacteria counts in the water.

5.4. Existing Local Management

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

Town of Holliston

The majority of Holliston is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041122), and the town has an EPA-approved Notice of Intent (NOI). The town has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. Holliston completed an illicit discharge detection and elimination (IDDE) plan in 2020, and an erosion and sedimentation control (ESC) plan and post-construction stormwater regulations in 2008. According to the NOI, pathogen-impaired MS4 receiving waters include one stormwater outfall into Bogastow Brook (MA72-16) which is impaired by fecal coliform.

Holliston has the following ordinances and bylaws, mostly accessible online via the town website https://www.townofholliston.us/ (Town of Holliston, 2021):

- Stormwater control bylaw and stormwater utility fee
- Dog waste disposal ordinances
- Wetland protection bylaw

Holliston has a 1999 Master Plan with some discussion of water resources issues, including non-point source pollution, erosion and sedimentation, and building within the floodplain. This plan also features an inventory of current sewer infrastructure and an in-depth plan for future water and sewer services within the town. Holliston has a 2013 Open Space and Recreation Plan, intended to inform planning efforts until 2020. This plan includes respective sections on hazardous waste, erosion and sedimentation, and surface water pollution (Town of Holliston, 2021).

Town of Medway

The majority of Medway is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041132), and the town has an EPA-approved Notice of Intent (NOI). The town has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. In 2005, Medway completed an illicit discharge detection and elimination (IDDE) plan, an erosion and sedimentation control (ESC) plan, and post-construction stormwater regulations. According to the NOI, pathogen-impaired MS4 receiving waters include 27 stormwater outfalls into an unnamed tributary flowing into Bogastow Brook (no Assessment Unit ID provided), impaired by fecal coliform. Additionally, there are 61 outfalls into the Charles River (MA72-04), 115 outfalls into Chicken Brook (MA72-34), and 82 outfalls into Hopping Brook (MA72-35), all impaired by *E. coli*.

Medway has the following ordinances and bylaws, mostly accessible online via the town website https://www.townofmedway.org/ (Town of Medway, 2021):

- Wetland protection bylaw

- Stormwater control bylaws
- Stormwater Utility: None found
- Pet Waste: None found

Medway has a 2009 Master Plan which includes goals to implement more sustainable and environmentally conscious policies, mostly through strong building standards and by setting an example in municipal buildings (pg. 60). In the sewer system section, stormwater is cited as entering the system (pg. 68), and a goal of improving water quality through controlling stormwater is set (pg. 68). An Open Space and Recreation Plan is also included in the Master Plan, with an inventory of current conditions, as well as goals and objectives (pg. 28) (Town of Medway, 2021).

6. MA72-35 Hopping Brook

6.1. Waterbody Overview

Hopping Brook segment MA72-35 is 4.9 miles long and begins in Cedar Swamp in Holliston, MA. The segment flows generally south before its confluence with the Charles River at the Bellingham/Medway town line.

Tributaries to Hopping Brook segment MA72-35 include Beaver Brook and a few unnamed streams. Lakes and ponds in the watershed include Weston Pond and numerous other unnamed waterbodies. Much of the segment flows through wetland areas.

Key landmarks in the watershed include the Exelon Power West Medway Generating Station, the Weston Pond Recreation Area, and portions of the MTP Trails at Milford, Rocky Woods, and the Mass Audubon Waseeka Wildlife Sanctuary. From upstream to downstream, segment MA72-35 is crossed by Washington Street (Holliston), Hopping Brook Road (Holliston), Fisher Street (Holliston), Milford Street (Medway), West Street (Medway), Beech Street (Bellingham), Hartford Avenue (Bellingham), and Cook Avenue (Medway).

Hopping Brook (MA72-35) drains a total area of 11.0 square miles (mi^2), of which 0.9 mi^2 (8%) are impervious and 0.4 mi^2 (4%) are directly connected impervious area (DCIA). The watershed may be partially served by public sewer systems in Bellingham, Medway, and Holliston[10], and 72% of the total land area is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, MassDEP discharge-to-groundwater permits for on-site wastewater discharge, or combined sewer overflows (CSOs) within the watershed. There is one landfill and no unpermitted land disposal dumping grounds within the segment watershed. See Figure 6-1.

The Hopping Brook segment MA72-35 watershed is located in a moderately-developed part of Massachusetts. More than half of the watershed consists of forest and natural lands (57%) and 23% consists of wetland areas. The remainder of the

Reduction from Highest Calculated Geomean: 68%

Watershed Area (Acres): 7,045

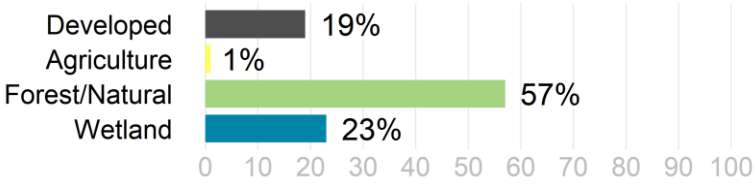
Segment Length (Miles): 4.9

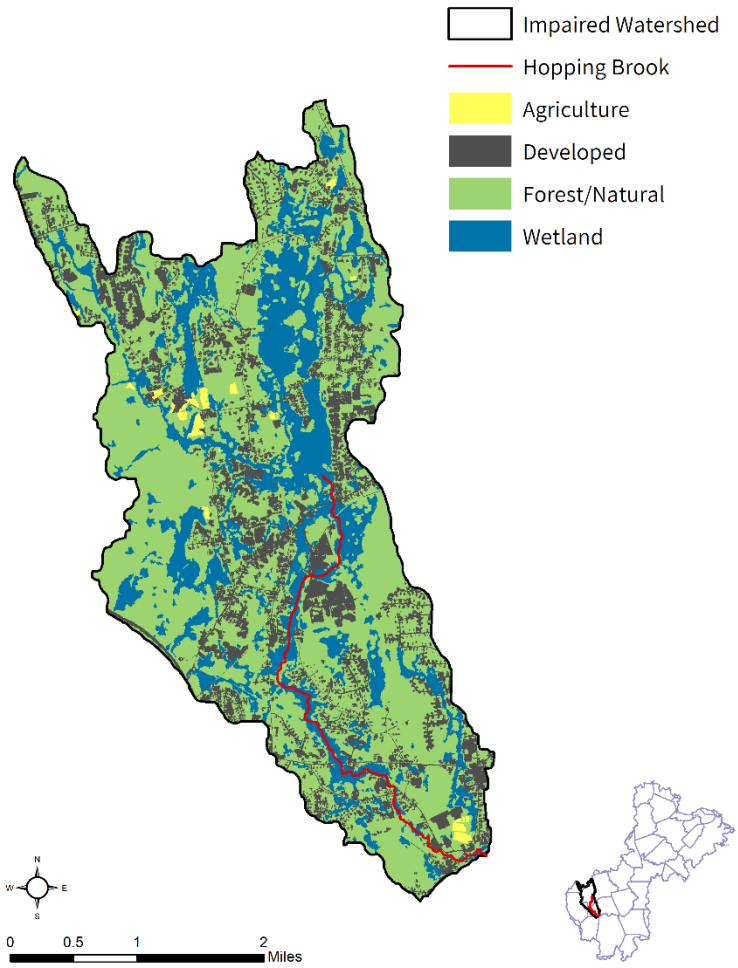
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 559 (8%)

DCIA Area (Acres, %): 279 (4%)





[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 (MassDEP, 2021b), MS4 reports, and local knowledge.

watershed is primarily covered by development (19%), and there is very little agricultural activity (1%). Most of the development consists of residential areas, with some commercial and industrial areas in the central and southern watershed. Most of the agricultural activity consists of pasture/hay and cultivated fields located in the upper watershed.

In the Hopping Brook (MA72-35) watershed, under the Natural Heritage and Endangered Species Program, there are 332 acres (5%) of Priority Habitats of Rare Species and 291 acres (4%) of Priority Natural Vegetation Communities. There are 13 acres (<1%) under Public Water Supply protection, no acres within Areas of Critical Environmental Concern, and 38 acres (1%) of Outstanding Resource Waters. Overall, there are 1,337 acres (19%) of land protected in perpetuity[11], part of 1,339 acres (19%) of Protected and Recreational Open Space[12]. See Figure 6-1.

[11] Land protected in perpetuity includes conservation restrictions, 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] All Protected and Recreational Open Space land is shown on the natural resources map.

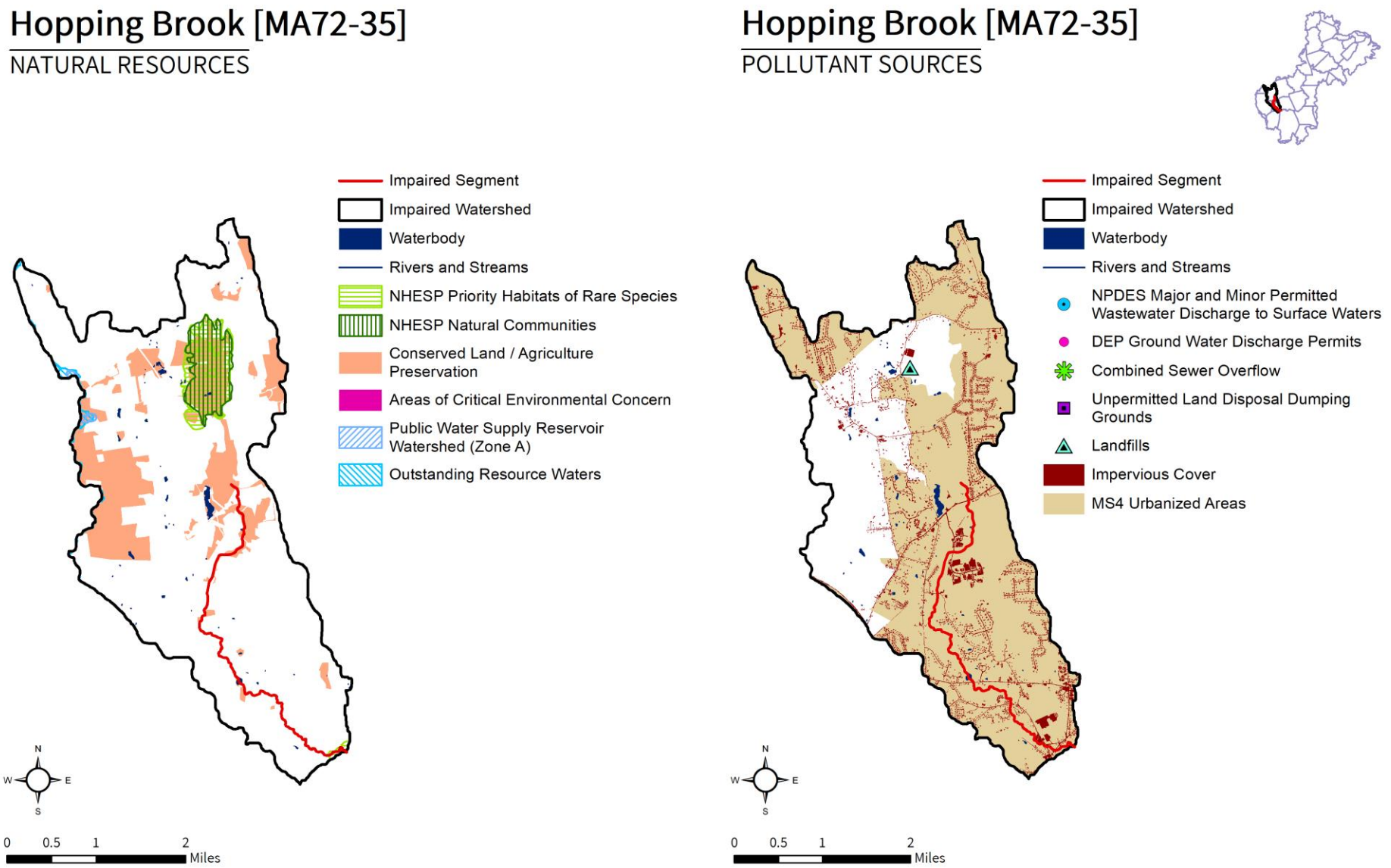


Figure 6-1. Natural resources and potential pollution sources draining to the Hopping Brook segment MA72-35. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

6.2. Waterbody Impairment Characterization

Hopping Brook (MA72-35) is a Class B Water (MassDEP, 2021a).

The Primary Contact Recreation use was assessed for attainment of SWQS at the station listed below (refer to Tables 6-1, 6-2; Figure 6-2) using the indicator bacteria *E. coli*. 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 W1584; data indicated three days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the Statistical Threshold Value (STV) criterion was applied to single sample results. Out of five samples, one exceeded the STV criterion during dry weather.

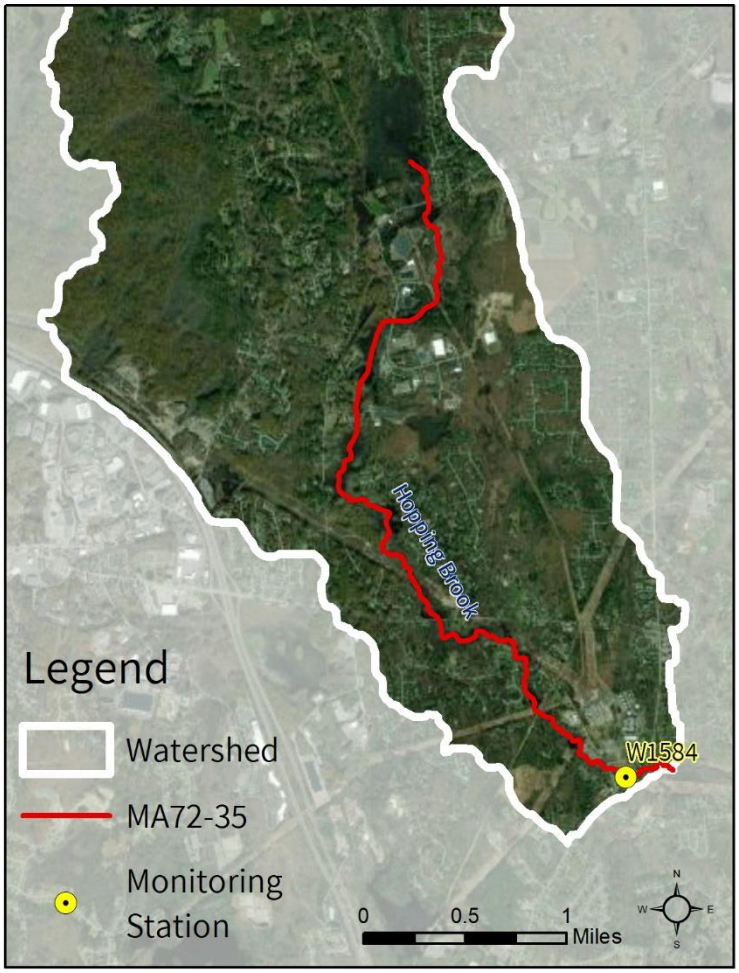


Figure 6-2. Location of monitoring station(s) along the impaired segment.

Table 6-1. Summary of indicator bacteria sampling results by station for Hopping Brook (MA72-35). 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 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 site 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
W1584	5/15/2007	10/2/2007	5	397	3	1

Table 6-2. Indicator bacteria data by station, indicator, and date for Hopping Brook (MA72-35). Each sample date was designated as representing wet or dry weather conditions with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text in the Results column 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 STV) for *E. coli* indicator bacteria; and red text in the Geomean column highlights exceedances of the 126 CFU/100 mL criterion (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)
W1584	*E. coli*	5/15/2007	DRY	86	86	
W1584	*E. coli*	6/19/2007	DRY	120	102	
W1584	*E. coli*	7/24/2007	DRY	260	139	
W1584	*E. coli*	8/28/2007	DRY	730	283	
W1584	*E. coli*	10/2/2007	DRY	330	397	

6.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present, 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 surface waters 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 sanitary sewer overflows (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).

Indicator bacteria data for Hopping Brook (MA72-35) were elevated during dry weather (wet weather data were not available). Elevated results 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 the major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a moderate amount of development in the watershed (19%), most of which consists of residential areas with some industrial and commercial development as well. 72% of the land area is subject to MS4 permit conditions, 8% is classified as impervious area, and 4% is classified as DCIA. Stormwater runoff from urban areas is likely a source of pathogens.

Illicit Sewage Discharges: Public sewer service may be available in the watershed within the towns of Bellingham, Medway, and Holliston. Sewer-related risks to water quality include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSOs), 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 conveyances are also a potential source.

On-Site Wastewater Disposal Systems: Some of the development in the watershed may utilize on-site systems for wastewater treatment. It is likely that some septic systems are not properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities in the watershed account for a relatively small portion (1%) of the total land use. A few pasture/hay and cultivated fields are located near wetland areas within the watershed. Manure storage and spreading activities, if not properly conducted, are possible sources of pathogens to waterbodies.

Pet Waste: There are many residential neighborhoods near the Hopping Brook segment MA72-35. Conservation lands, parks, and ballfields popular for dog-walking, especially where paths or residential neighborhoods are adjacent to rivers, ponds, or wetlands, represent possible sources of pathogens.

Wildlife Waste: A few large open wetland areas are directly adjacent to the impaired segment. Large mowed areas, fields, or wetlands with a clear sightline to a waterbody may attract large congregations of waterfowl, resulting in elevated indicator bacteria counts in the water.

6.4. Existing Local Management

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

Town of Bellingham. See Section 3.4

Town of Holliston. See Section 5.4

Town of Medway. See Section 5.4

7. MA72-41 Unnamed Tributary

7.1. Waterbody Overview

The unnamed tributary segment MA72-41 is 0.5 miles long and begins at the outlet of Lymans Pond in Dover, MA. The segment flows west to its confluence with the Charles River in Dover.

There is one tributary to the unnamed tributary segment MA72-41. Lakes and ponds in the watershed include Lymans Pond and a few other unnamed waterbodies. Much of the segment flows through wetland areas.

Key landmarks in the watershed include the Chase Woodlands Park and Peters Reservation nature preserve. Segment MA72-41 is crossed by only one road, Farm Street in Dover.

Unnamed tributary (MA72-41) drains a total area of 0.7 square miles (mi^2), of which 0.02 mi^2 (3%) are impervious and 0.01 mi^2 (1%) are directly connected impervious area (DCIA). The watershed is not served by a public sewer system in Dover[13], and none of the land area is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, MassDEP discharge-to-groundwater permits for on-site wastewater discharge, or combined sewer overflows (CSOs) within the watershed. There are no landfills or unpermitted land disposal dumping grounds within the segment watershed. See Figure 7-1.

The unnamed tributary segment MA72-41 watershed is located in a lightly-developed part of Massachusetts. More than half of the watershed consists of forest and natural lands (69%) and 15% consists of wetland areas. The remainder of the watershed is covered by almost equal parts development (9%) and agricultural activity (7%). The development consists of residential areas. Most of the agricultural activity consists of pasture/hay and cultivated fields, as well as some livestock grazing areas in the center-eastern area of the watershed.

In the unnamed tributary (MA72-41) watershed, under the Natural Heritage and Endangered Species Program, there are no Priority Habitats of

Reduction from Highest Calculated Geomean: 69%

Watershed Area (Acres): 429

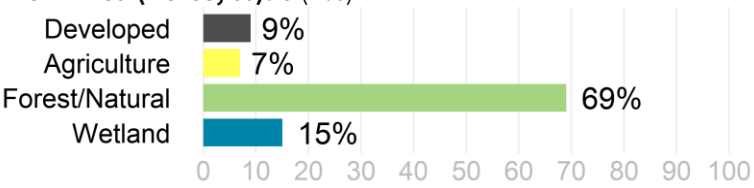
Segment Length (Miles): 0.5

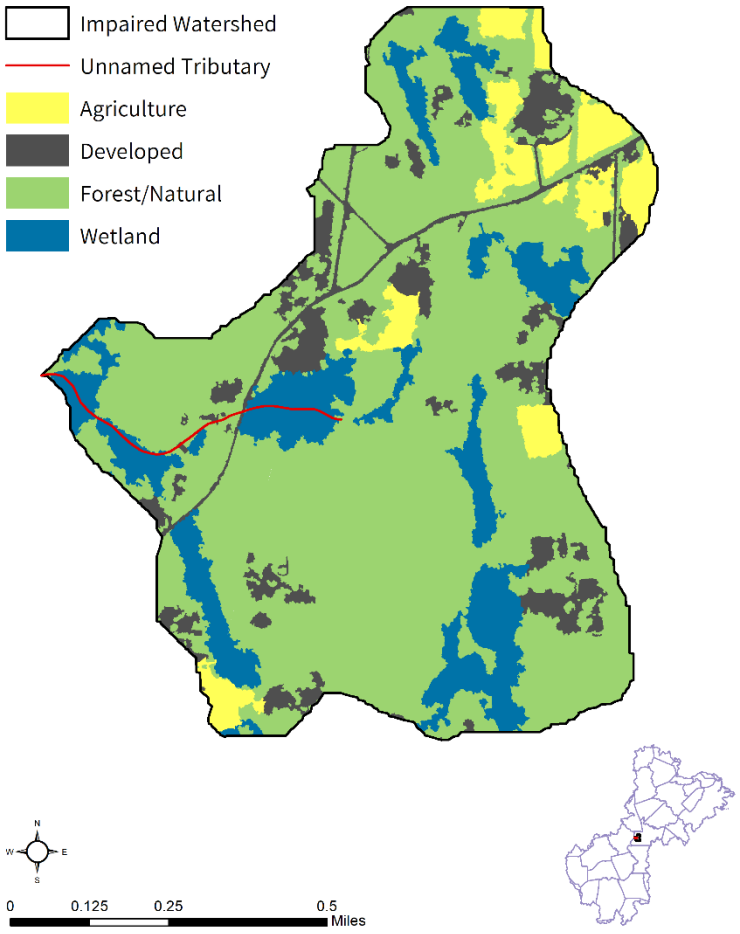
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 13 (3%)

DCIA Area (Acres, %): 6 (1%)





[13] 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 (MassDEP, 2021b), MS4 reports, and local knowledge.

Rare Species or Priority Natural Vegetation Communities. There are also no acres under Public Water Supply protection, within Areas of Critical Environmental Concern, or Outstanding Resource Waters. Overall, there are 131 acres (31%) of land protected in perpetuity[14], part of 137 acres (32%) of Protected and Recreational Open Space[15]. See Figure 7-1.

[14] Land protected in perpetuity includes conservation restrictions, 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.
[15] All Protected and Recreational Open Space land is shown on the natural resources map.

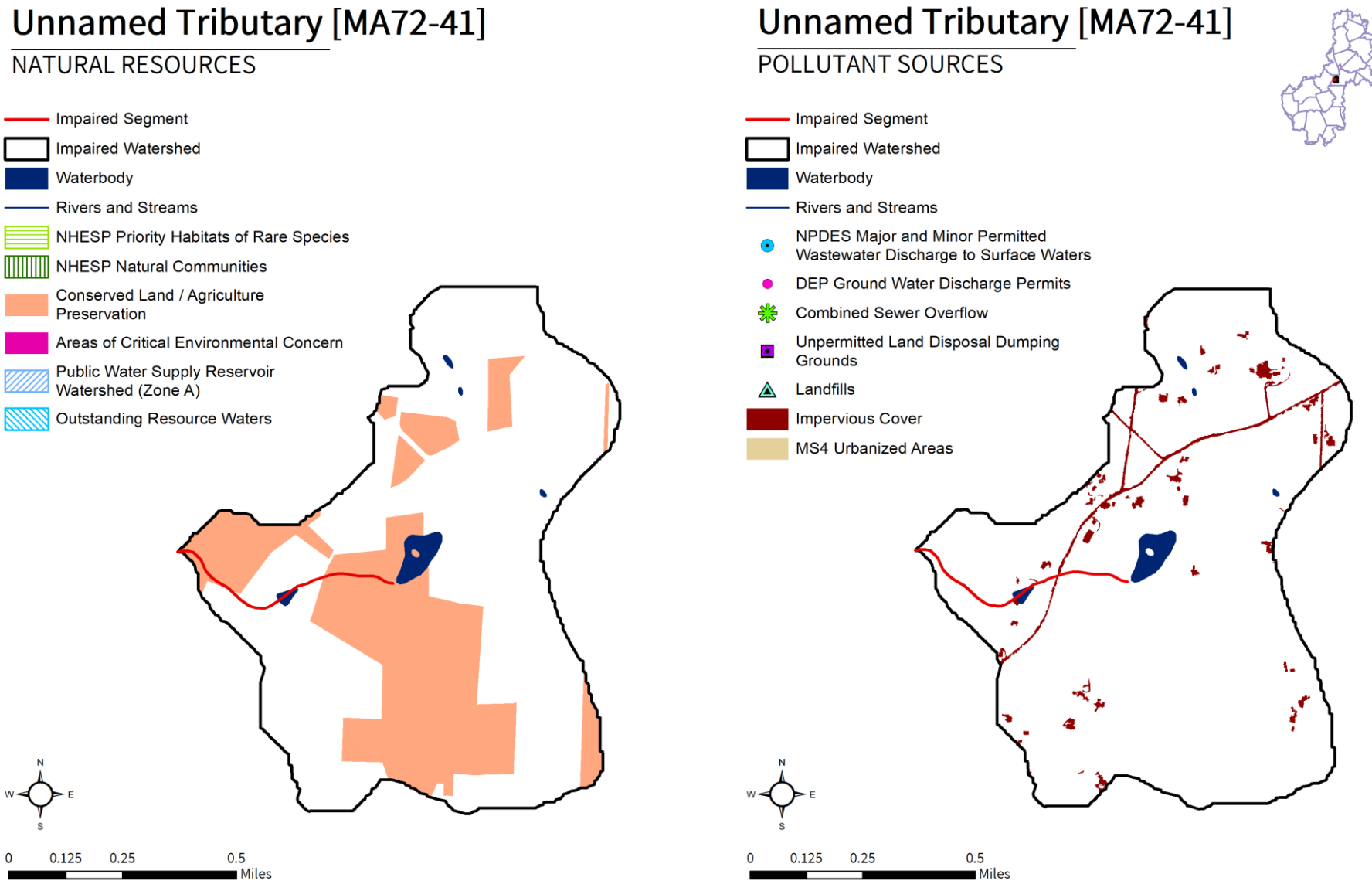


Figure 7-1. Natural resources and potential pollution sources draining to the unnamed tributary segment MA72-41. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

7.2. Waterbody Impairment Characterization

The unnamed tributary (MA72-41) is a Class B Water (MassDEP, 2021a).

The Primary Contact Recreation use was assessed for attainment of SWQS at the station listed below (refer to Tables 7-1, 7-2; Figure 7-2) using the indicator bacteria *E. coli*. 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 2010, six samples were collected at W2155; data indicated four days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the Statistical Threshold Value (STV) criterion was applied to single sample results. Out of six samples, two exceeded the STV criterion during dry weather.

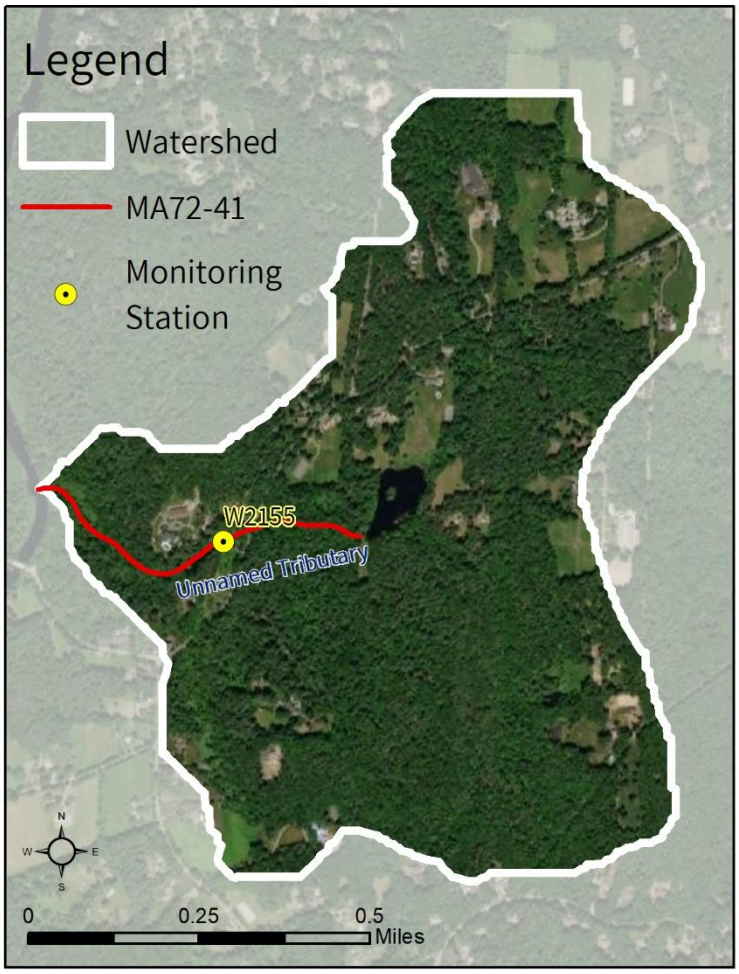


Figure 7-2. Location of monitoring station(s) along the impaired segment.

Table 7-1. Summary of indicator bacteria sampling results by station for the unnamed tributary (MA72-41). 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 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 site 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
W2155	5/4/2010	9/13/2010	6	402	4	2

Table 7-2. Indicator bacteria data by station, indicator, and date for the unnamed tributary (MA72-41). Each sample date was designated as representing wet or dry weather conditions with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text in the Results column 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 STV) for *E. coli* indicator bacteria; and red text in the Geomean column highlights exceedances of the 126 CFU/100 mL criterion (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)
W2155	*E. coli*	5/4/2010	DRY	30	30	
W2155	*E. coli*	6/8/2010	DRY	90	52	
W2155	*E. coli*	6/24/2010	DRY	2,600	191	
W2155	*E. coli*	7/13/2010	DRY	240	203	
W2155	*E. coli*	8/9/2010	DRY	440	396	
W2155	*E. coli*	9/13/2010	DRY	95	402	

7.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present, 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 surface waters 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 sanitary sewer overflows (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).

Indicator bacteria data for the unnamed tributary segment (MA72-41) were elevated during dry weather (wet weather data were not available). Elevated results 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 the major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: The watershed is lightly developed (9%), almost all residential. None of the land area is subject to MS4 permit conditions, 3% is classified as impervious area, and 1% is classified as DCIA. Stormwater runoff from urban areas is possibly a minor source of pathogens.

Illicit Sewage Discharges: Sewer-related risks to water quality include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSOs), which may be caused by undersized infrastructure, blockages, or excessive infiltration of groundwater or rainwater into pipes, exceeding system capacity. As public sewer service is not available in the watershed within the town of Dover, sewerage issues are not a potential source of pathogens.

On-Site Wastewater Disposal Systems: All of the development in the watershed utilizes on-site systems for wastewater treatment. It is likely that some septic systems are not properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities in the watershed account for a moderate portion (7%) of the total land use. A few pasture/hay and cultivated fields are located next to wetland areas. Manure storage and spreading activities, if not properly conducted, are possible sources of pathogens to waterbodies.

Pet Waste: There are some residential neighborhoods near the unnamed tributary segment MA72-41 as well as conservation walking trails in Chase Woodlands, adjacent to the tributary segment. Conservation lands, parks,

and ballfields popular for dog-walking, especially where paths or residential neighborhoods are adjacent to rivers, ponds, or wetlands, represent possible sources of pathogens.

Wildlife Waste: There are minimal large open wetland areas directly adjacent to the impaired segment. Large mowed areas, fields, or wetlands with a clear sightline to a waterbody may attract large congregations of waterfowl, resulting in elevated indicator bacteria counts in the water.

7.4. Existing Local Management

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

Town of Dover

About 34% of Dover is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041107), though none of it is in the unnamed tributary MA72-41 watershed. The town has an EPA-approved Notice of Intent (NOI). The town has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. Dover completed an illicit discharge detection and elimination (IDDE) plan in 2016, an erosion and sedimentation control (ESC) plan in 2007, and post-construction stormwater regulations in 1995. The town also updated their Stormwater Management Program (SWMP) plan in 2023. According to the NOI, no receiving waters in Dover are impaired by pathogens.

Dover has the following ordinances and bylaws, mostly accessible online via the town website https://www.doverma.gov/ (Town of Dover, 2021):

- Wetland protection bylaw
- Stormwater bylaw.
- Pet waste removal bylaw.
- Stormwater Utility: None found.

Dover has a 2012 Master Plan which includes a natural resources section (V-1) and an open space and recreation section (VI-1). This plan includes an inventory of water resources (V-1) and a section on surface waters (V-7). The open space section recommends researching whether currently protected areas include key resources, like groundwater (VI-7). Additionally, Dover has a 2011 Open Space and Recreation Plan, with sections about water resources and ground and surface water pollution (Town of Dover, 2021).

8. MA72-43 Unnamed Tributary

8.1. Waterbody Overview

The unnamed tributary segment MA72-43, also known as Bogle Brook, is 0.2 miles long and begins at the outlet of Reeds Pond in Wellesley, MA. The stream flows south to its confluence with Morses Pond, in Wellesley.

There is one unnamed tributary to segment MA72-43. Lakes and ponds in the watershed include Pickerel Pond, Nonesuch Pond, Mud Pond, Jennings Pond, and a few other unnamed waterbodies.

Key landmarks in the watershed include Lilia Elementary School, the Henry S Hunnewell Town Forest, Ferrelli Field, The Rivers School, and Weston High School. From upstream to downstream, segment MA72-43 is crossed by Cedar Brook Road and Worcester Road, both in Wellesley.

The unnamed tributary (MA72-43) drains a total area of 7.2 square miles (mi^2), of which 1.4 mi^2 (20%) are impervious and 0.8 mi^2 (11%) are directly connected impervious area (DCIA). The watershed is served by public sewer systems in Wellesley and Natick, and may be partially served in Wayland, but there is no public sewerage in Weston[16]. The entire land area is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There are no NPDES permits on file governing point source discharges of pollutants to surface waters, two MassDEP discharge-to-groundwater permits for on-site wastewater discharge (Table 8-1), and no combined sewer overflows (CSOs) within the watershed. There are no landfills or unpermitted land disposal dumping grounds within the segment watershed. See Figure 8-1.

The unnamed tributary segment MA72-43 watershed is located in a moderately-developed part of Massachusetts. Just over half of the watershed consists of forest and natural lands (51%) and 16% consists of wetland areas. The remainder of the watershed is primarily covered by development (33%) and there is very little agricultural activity (<1%). Most of the development consists of residential areas with

Reduction from Highest Calculated Geomean: 55%

Watershed Area (Acres): 4,582

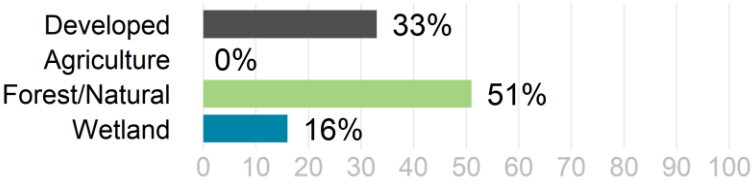
Segment Length (Miles): 0.2

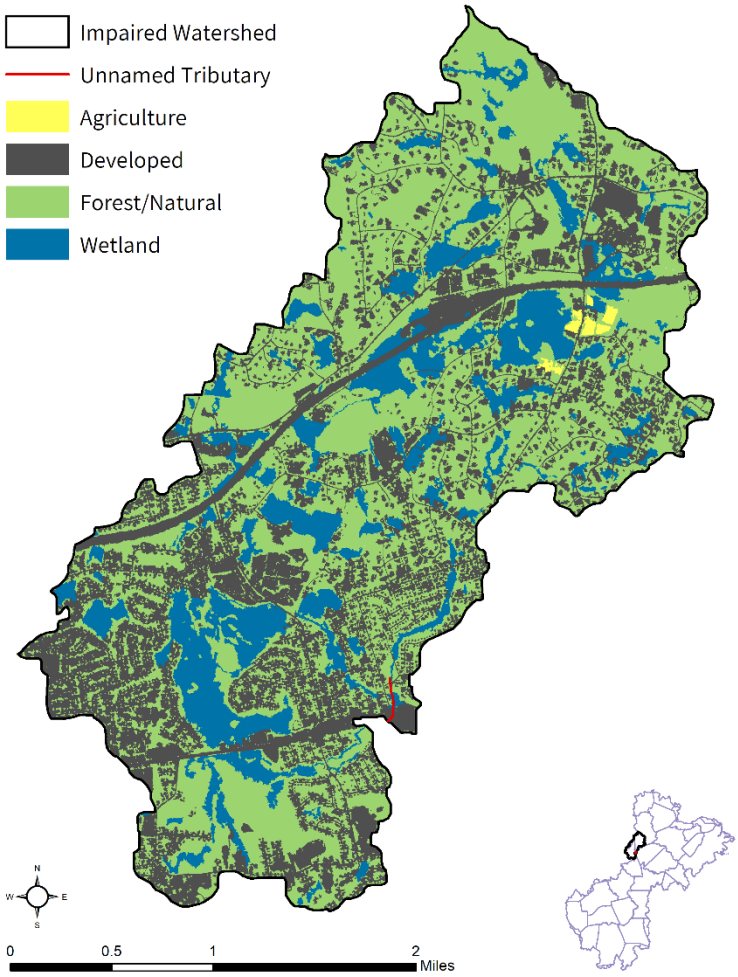
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 895 (20%)

DCIA Area (Acres, %): 520 (11%)





[16] 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 (MassDEP, 2021b), MS4 reports, and local knowledge.

some industrial and commercial development, while most of the agricultural activity consists of pasture/hay and cultivated fields located directly adjacent to wetland areas in the watershed.

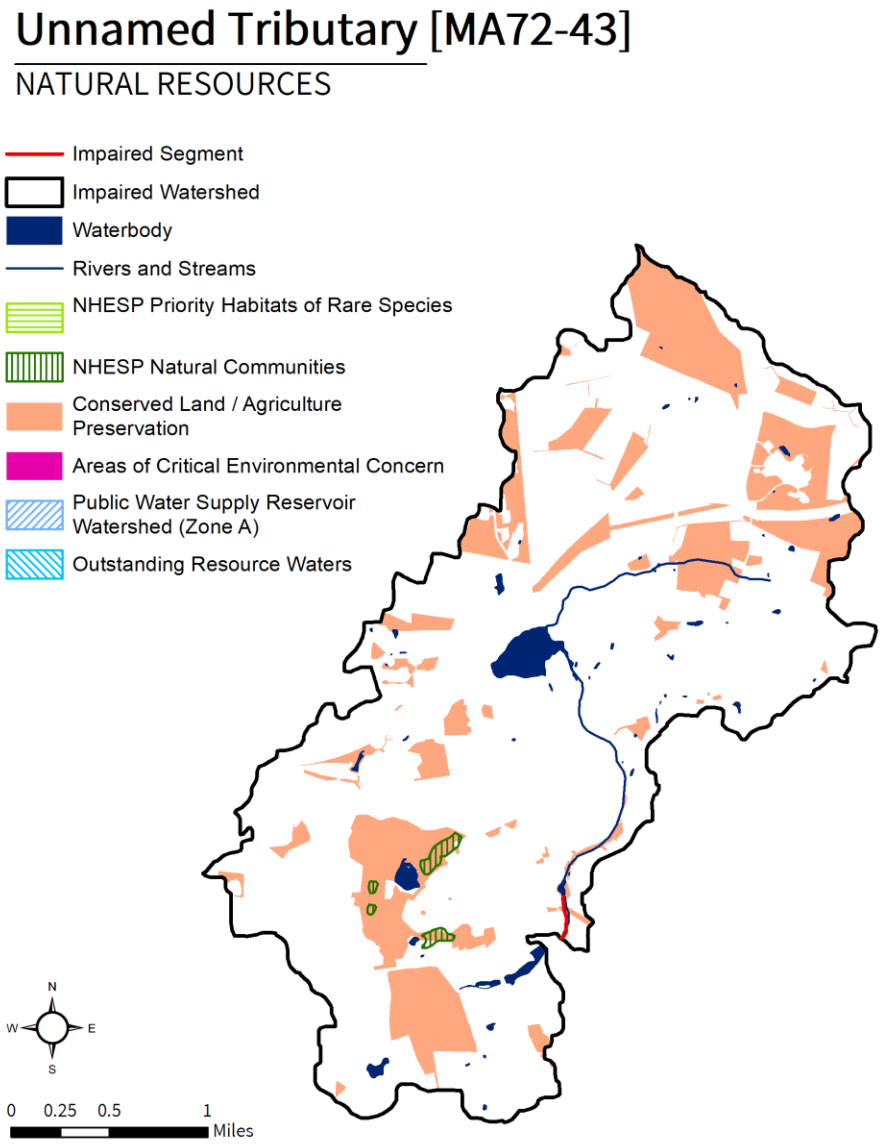
In the unnamed tributary (MA72-43) watershed, under the Natural Heritage and Endangered Species Program, there are no Priority Habitats of Rare Species and 19 acres (<1%) of Priority Natural Vegetation Communities. There are also no acres under Public Water Supply protection or within Areas of Critical Environmental Concern, and one acre (<1%) of Outstanding Resource Waters. Overall, there are 804 acres (18%) of land protected in perpetuity[17], part of 905 acres (20%) of Protected and Recreational Open Space[18]. See Figure 8-1.

Table 8-1. Groundwater discharge permits in the segment watershed. PERR = permit number plus renewal number. TYPE = type of groundwater discharge. FLOW = permitted effluent in gallons per day (gpd).

PERR	NAME	TOWN	TYPE	FLOW (GPD)
629-3	WESTON SCHOOLS	WESTON	Sanitary Discharge	28,900
763-2	RIVERS SCHOOL	WESTON	Sanitary Discharge	12,000

[17] Land protected in perpetuity includes conservation restrictions, 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.

[18] All Protected and Recreational Open Space land is shown on the natural resources map.



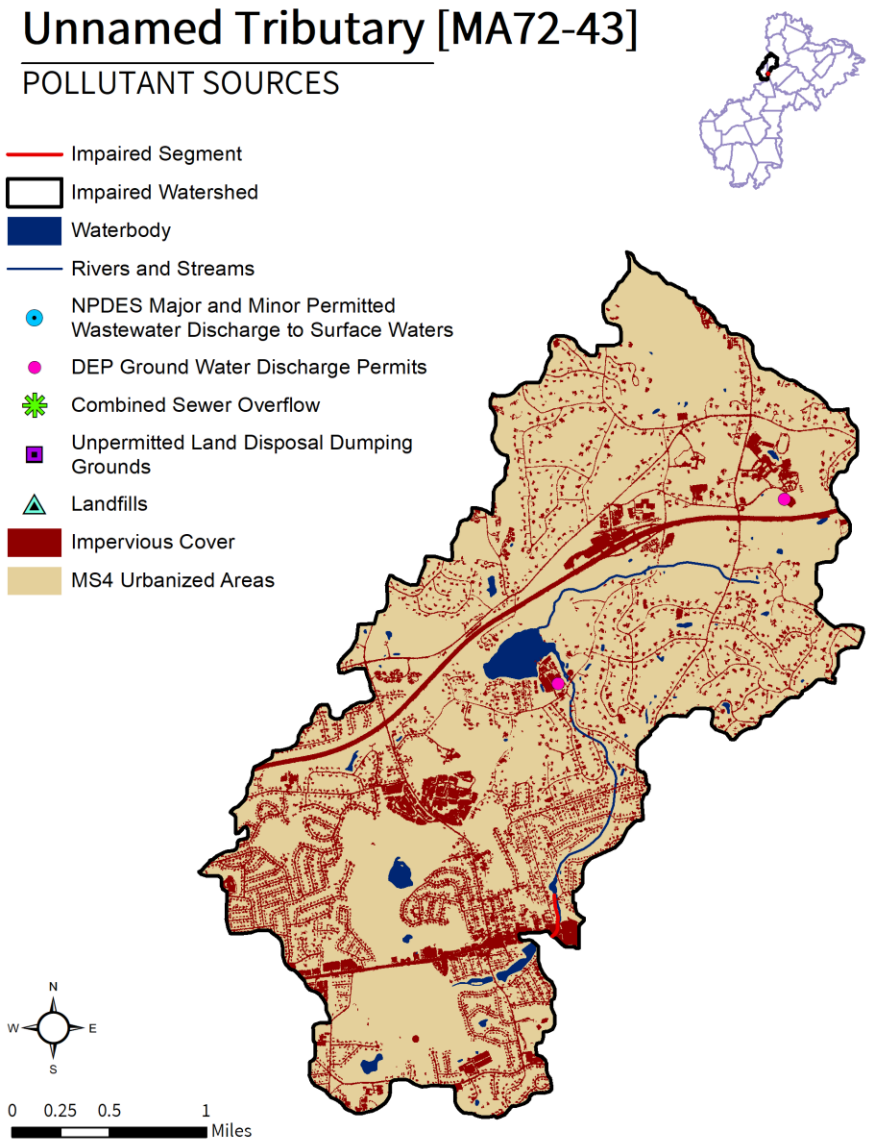


Figure 8-1. Natural resources and potential pollution sources draining to the unnamed tributary segment MA72-43. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

8.2. Waterbody Impairment Characterization

The unnamed tributary (MA72-43) is a Class B Water (MassDEP, 2021a).

The Primary Contact Recreation use was assessed for attainment of SWQS at the station listed below (refer to Tables 8-2, 8-3; Figure 8-2) using the indicator bacteria *E. coli*. 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 W1582; data indicated four days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the Statistical Threshold Value (STV) criterion was applied to single sample results. Out of five samples, one exceeded the STV criterion during dry weather.

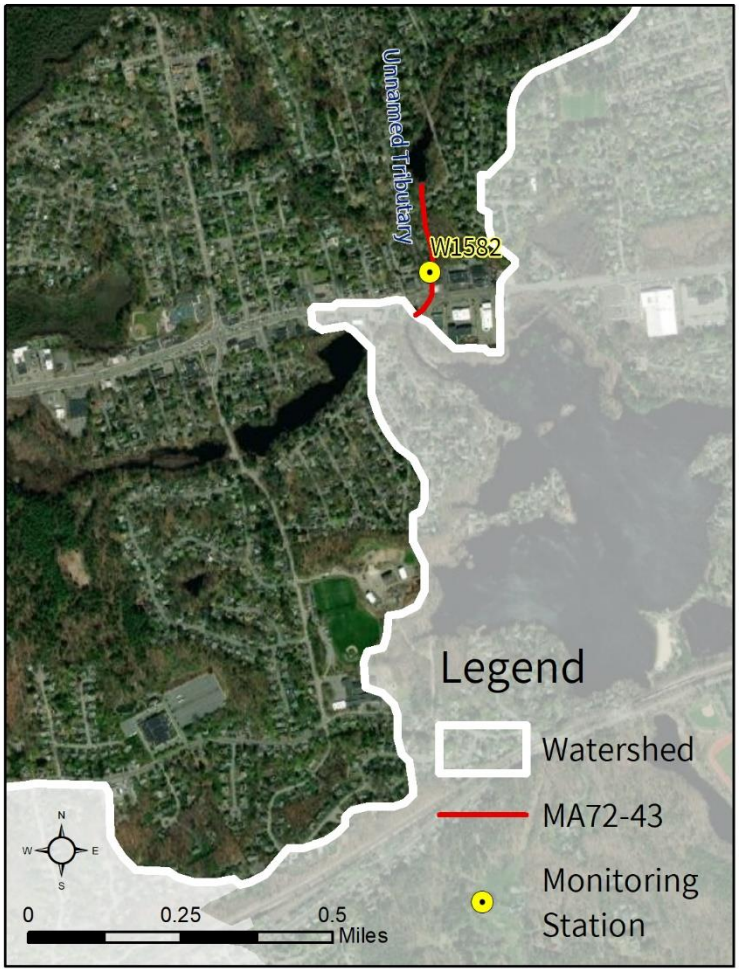


Figure 8-2. Location of monitoring station(s) along the impaired segment.

Table 8-2. Summary of indicator bacteria sampling results by station for the unnamed tributary (MA72-43). 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 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 site 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
W1582	5/15/2007	10/2/2007	5	278	4	1

Table 8-3. Indicator bacteria data by station, indicator, and date for the unnamed tributary (MA72-43). Each sample date was designated as representing wet or dry weather conditions with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text in the Results column 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 STV) for *E. coli* indicator bacteria; and red text in the Geomean column highlights exceedances of the 126 CFU/100 mL criterion (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)
W1582	*E. coli*	5/15/2007	DRY	180	180	
W1582	*E. coli*	6/19/2007	DRY	430	278	
W1582	*E. coli*	7/24/2007	DRY	81	184	
W1582	*E. coli*	8/28/2007	DRY	160	177	
W1582	*E. coli*	10/2/2007	DRY	33	75	

8.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present, 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 surface waters 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 sanitary sewer overflows (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).

Indicator bacteria data for unnamed tributary (MA72-43) were elevated during dry weather (wet weather data were not available). Elevated results 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 the major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a large amount of development in the watershed (33%), most of which consists of residential areas with some industrial and commercial development as well. The entire land area is subject to MS4 permit conditions, 20% is classified as impervious area, and 11% is classified as DCIA. Stormwater runoff from urban areas is a likely source of pathogens.

Illicit Sewage Discharges: Public sewer service is available in the watershed within the towns of Wellesley and Natick, may be available in Wayland, and is not available in Weston. Sewer-related risks to water quality include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSOs), 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 conveyances are also a potential source.

On-Site Wastewater Disposal Systems: Some of the development in the watershed may utilize on-site systems for wastewater treatment. Additionally, there are two MassDEP permits for on-site wastewater discharges to groundwater. In addition to these permitted point sources, it is likely that some septic systems are not properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities in the watershed account for a very small portion (<1%) of the total land use. A few pasture/hay and cultivated fields are located next to wetland areas within the watershed. Manure storage and spreading activities, if not properly conducted, are possible sources of pathogens to waterbodies.

Pet Waste: There are some residential neighborhoods near the unnamed tributary segment MA72-43. Conservation lands, parks, and ballfields popular for dog-walking, especially where paths or residential neighborhoods are adjacent to rivers, ponds, or wetlands, represent possible sources of pathogens.

Wildlife Waste: There are no large open wetland areas directly adjacent to the impaired segment, though there are such areas upstream. Large mowed areas, fields, or wetlands with a clear sightline to a waterbody may attract large congregations of waterfowl, resulting in elevated indicator bacteria counts in the water.

8.4. Existing Local Management

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

Town of Natick

About 92% of Natick is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041139), and the town has an EPA-approved Notice of Intent (NOI). The town has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. Natick completed an illicit discharge detection and elimination (IDDE) plan, an erosion and sedimentation control (ESC) plan, and post-construction stormwater regulations, all in 2006. No pathogen-impaired waterbodies within the Charles watershed were reported on the town's NOI.

Natick has the following ordinances and bylaws, mostly accessible online via the town website https://www.natickma.gov/ (Town of Natick, 2022):

- Wetland protection bylaw
- A stormwater bylaw
- Pet Waste Control bylaw: None found
- Stormwater Utility: None found

Natick has a 2019 Master Plan that contains an Open Space, Recreation, and Natural Resources section. Impaired waterbodies are identified within this section, and Lake Cochituate is listed as pathogen-impaired. This section also stresses the importance of efforts to improve the condition of impaired waterbodies. The town does have a public sewer system, but no usage statistics are provided in the master plan. Natick also has a 2020 Open Space and Recreation Plan with a similar water resource subsection. Recommendations to further protect water resources include installing stormwater BMPs on town owned lands, protecting surface water buffers through zoning setbacks, and implementing appropriate TMDLs for Lake Cochituate (Town of Natick, 2022).

Town of Wellesley

All of Wellesley is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041067), and the town has an EPA-approved Notice of Intent (NOI). The town has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. In 2005, Wellesley completed an illicit discharge detection and elimination (IDDE) plan, an erosion and sedimentation control (ESC) plan, and post-construction stormwater regulations. According to the town's NOI, pathogen-impaired MS4 receiving waters include 79 stormwater outfalls into Fuller Brook and 27 outfalls into the Charles River (no Assessment Unit IDs provided).

Wellesley has the following ordinances and bylaws, mostly accessible online via the town website https://www.wellesleyma.gov/ (Town of Wellesley, 2021):

- Wetland protection bylaw
- Pet Waste: None found
- Stormwater Control Bylaw: None Found, board of public works has authority to regulate
- Stormwater utility fee adopted in 2023

Wellesley has a Comprehensive Plan from 1994, which was replaced in 2019 by Wellesley's Unified Plan. The Unified Plan includes action items to manage stormwater through additional BMPs and green infrastructure (pg 4-12); to create concept plans that include stormwater upgrades for redevelopment of office districts (pg 7-18);

to incentivize green approaches to stormwater management through zoning, bylaw, and regulatory amendments (pg 9-9); to roll out a series of stormwater focused initiatives including a study evaluating the creation of a stormwater utility and the promotion of Low Impact Development practices (pg 11-13); and to raise public awareness of stormwater issues (pg 12-10). Wellesley also has an Open Space and Recreation Plan (2015), meant to inform planning through 2022. This plan features a detailed inventory of water resources within the town, with respective sections covering stormwater regulations and surface water pollution sources (Town of Wellesley, 2021).

Town of Weston

The entirety of Weston is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041068), and the town has an EPA-approved Notice of Intent (NOI). The town has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. In 2011, Weston completed an illicit discharge detection and elimination (IDDE) plan, an erosion and sedimentation control (ESC) plan, and post-construction stormwater regulations. According to the town's NOI, *E. coli* impaired MS4 receiving waters include two stormwater outfalls into the Charles River (MA72-07).

Weston has the following ordinances and bylaws, mostly accessible online via the town website https://www.weston.org/ (Town of Weston, 2021):

- Wetland protection bylaw
- Stormwater control bylaw and utility fee
- Pet waste control bylaw
- Contact Recreation: No swimming is allowed on town conserved land

Weston has a Town Plan from 1965, which does not include information relating to environmental protection, and a more recent Master Plan was not found online. Weston has many additional recent studies and plans, each more narrowly focused, including a 2018 Culvert Replacement, Hydrologic & Hydraulic Analysis, and a 2019 Water System Master Plan. Weston's 2017 Open Space and Recreation Plan features a section dedicated to surface water resources. Stormwater runoff is cited as a contributor to the pollution of surface waters. Weston does not have a public sewer system, which is identified as a barrier to growth within the town. Multiple freshwater beaches are identified in the environmental inventory section (Town of Weston, 2021).

9. MA72-44 Seaverns Brook

9.1. Waterbody Overview

Seaverns Brook segment MA72-44 is 1.6 miles long and begins at the outlet of the Norumbega Reservoir in Weston, MA. The segment flows generally northeast to its confluence with the Charles River in Weston.

Tributaries to Seaverns Brook segment MA72-44 include a few unnamed streams. Lakes and ponds in the watershed include Weston Reservoir, Norumbega Reservoir (the North Basin is locally known as Schencks Pond), and a few unnamed waterbodies.

Key landmarks in the watershed include Doublet Hill Conservation Area, Pine Brook Country Club, Beginnings School, and a portion of the Regis College campus. From upstream to downstream, segment MA72-44 is crossed by Oak Street, the Massachusetts Turnpike/Interstate 90, Shaylor Lane, Ridgeway Road, Park Road, and Interstate 95, as well as six access ramps from the junctions of Interstates 95 and 90 and Route 128. All road crossings are within Weston.

Seaverns Brook (MA72-44) drains a total area of 2.5 square miles (mi^2), of which 0.3 mi^2 (12%) are impervious and 0.1 mi^2 (6%) are directly connected impervious area (DCIA). The watershed is not served by a public sewer system in Weston[19], and 100% of the total land area is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (USEPA, 2020). There is one additional NPDES permit (minor) on file governing the point source discharge of pollutants to surface waters from a wastewater treatment facility (Table 9-1). There are no MassDEP discharge-to-groundwater permits for on-site wastewater discharge, combined sewer overflows (CSOs), landfills or unpermitted land disposal dumping grounds within the segment watershed. See Figure 9-1.

The Seaverns Brook segment MA72-44 watershed is moderately developed. More than half of the watershed consists of forest and natural lands (66%) and 7% consists of wetland areas. The remainder of the watershed is primarily covered by development (27%), as there is very

Reduction from Highest Calculated Geomean: 85%

Watershed Area (Acres): 1,593

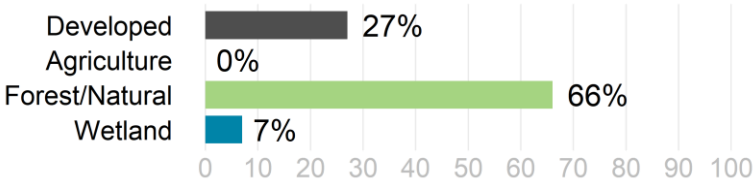
Segment Length (Miles): 1.6

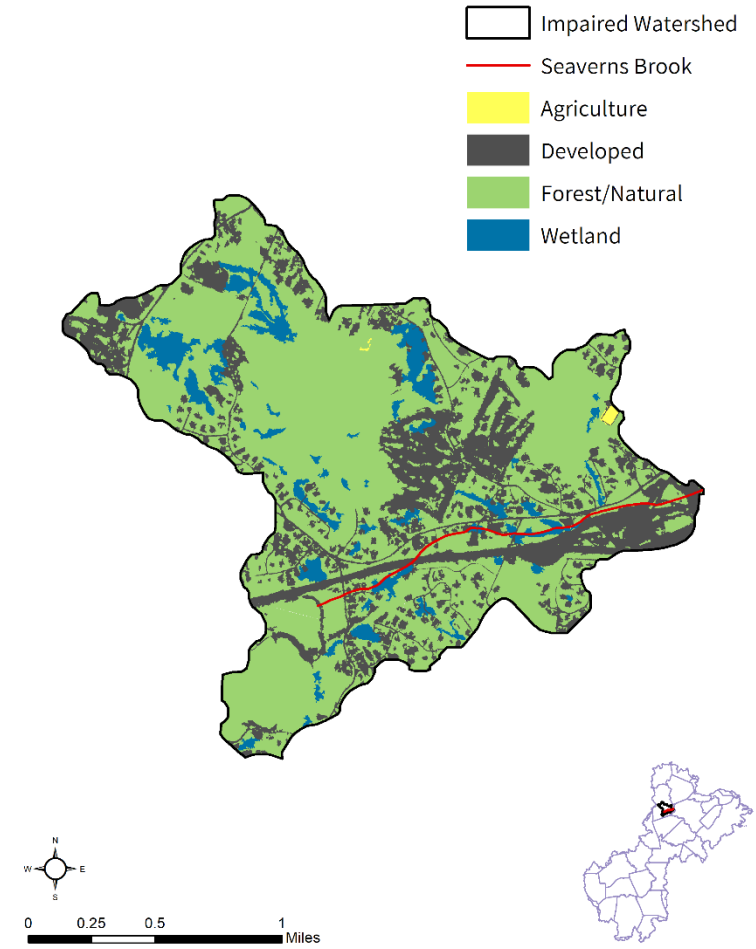
Impairment(s): *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 184 (12%)

DCIA Area (Acres, %): 92 (6%)





[19] 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 (MassDEP, 2021b), MS4 reports, and local knowledge.

little agricultural activity (<1%). Most of the development consists of residential areas with some industrial and commercial development, although the segment itself is flanked by large impervious areas associated with the interchange of Interstate 90/Route 128 and Interstate 95. The scant amount of agricultural activity consists of pasture/hay and cultivated fields located away from the segment in the northern section of watershed.

In the Seaverns Brook (MA72-44) watershed, under the Natural Heritage and Endangered Species Program, there are no Priority Habitats of Rare Species or Priority Natural Vegetation Communities. There are also no acres under Public Water Supply protection or within Areas of Critical Environmental Concern, and 12 acres (1%) of Outstanding Resource Waters. Overall, there are 474 acres (30%) of land protected in perpetuity[20], part of 594 acres (37%) of Protected and Recreational Open Space[21]. See Figure 9-1.

Table 9-1. 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
MA0032212	PINE BROOK COUNTRY CLUB	WESTON	OTH

[20] Land protected in perpetuity includes conservation restrictions, 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.

[21] All Protected and Recreational Open Space land is shown on the natural resources map.

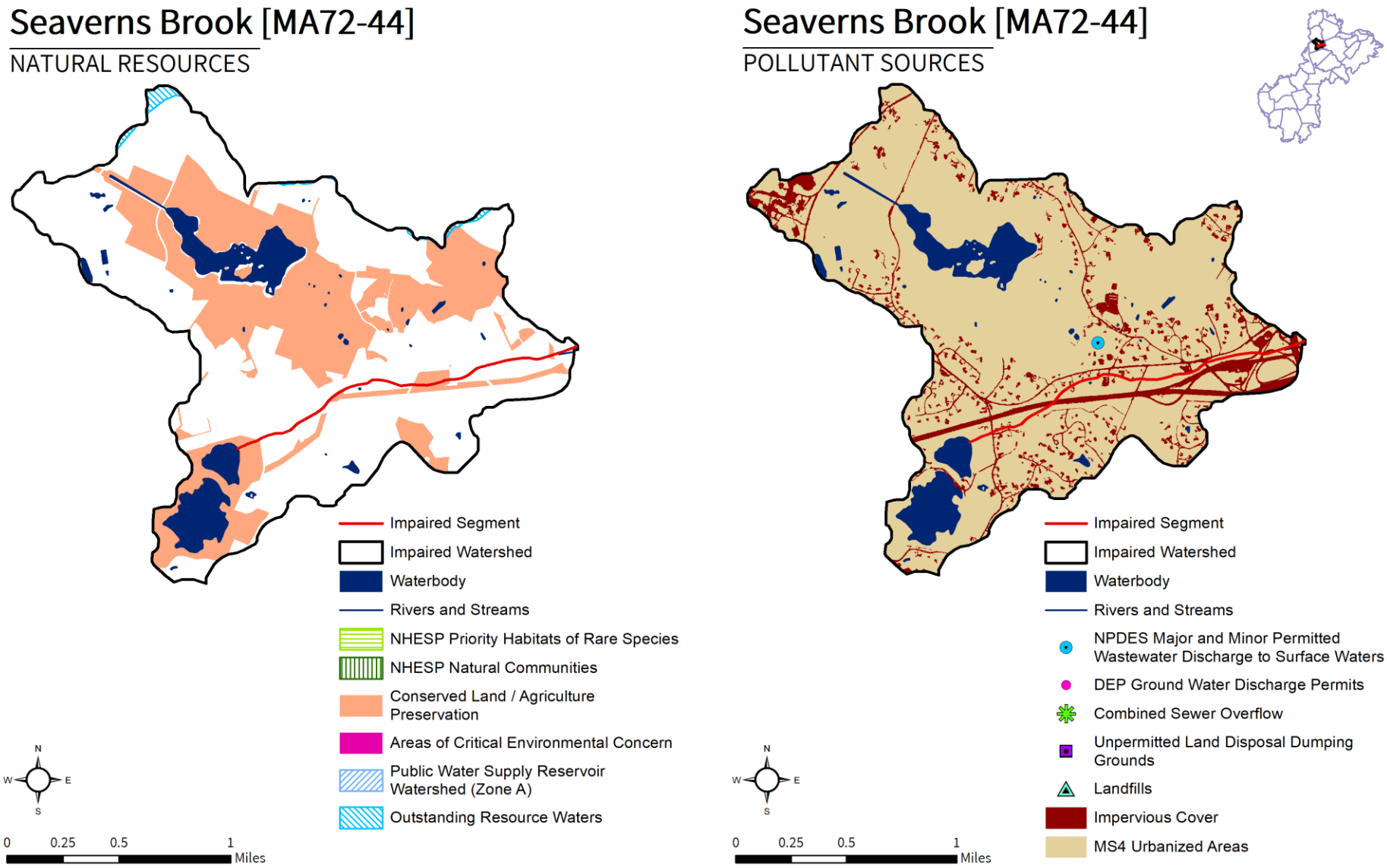


Figure 9-1. Natural resources and potential pollution sources draining to the Seaverns Brook segment MA72-44. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

9.2. Waterbody Impairment Characterization

Seaverns Brook (MA72-44) is a Class B Water (MassDEP, 2021a).

The Primary Contact Recreation use was assessed for attainment of SWQS at the station listed below (refer to Tables 9-2, 9-3; Figure 9-2) using the indicator bacteria *E. coli*. 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 W1590; data indicated two days when the 90-day rolling geomean exceeded the criterion. Since there were no stations and years with more than 10 samples, the Statistical Threshold Value (STV) criterion was applied to single sample results. Out of five samples, one exceeded the STV criterion during dry weather. Sampling notes indicated that the brook was dry on September 28th and very low on the October 2nd sampling date.

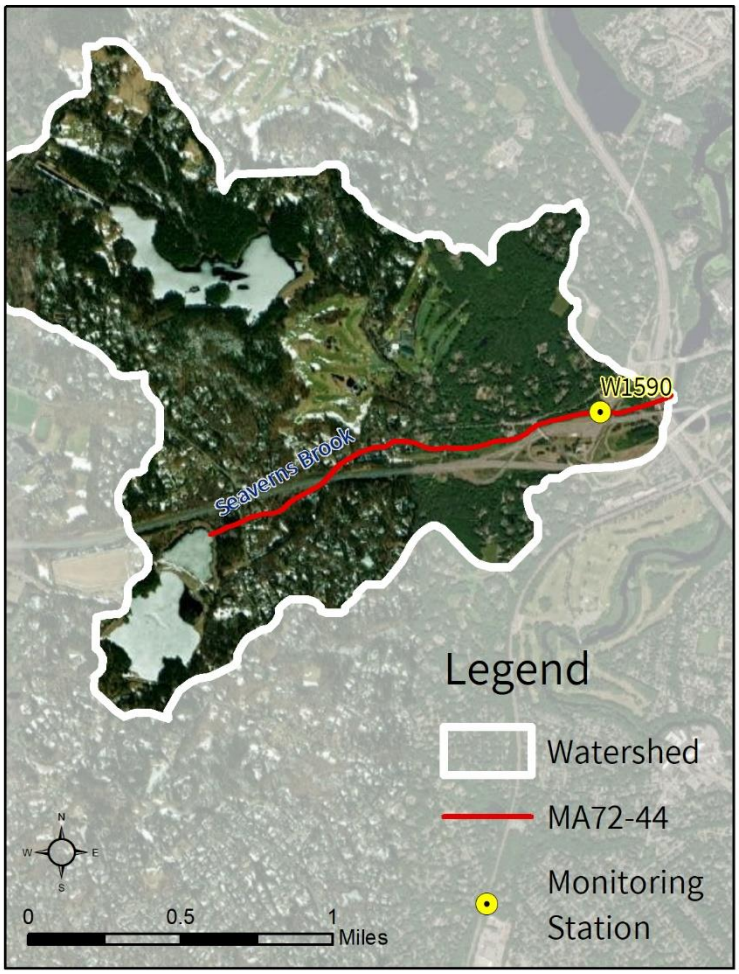


Figure 9-2. Location of monitoring station(s) along the impaired segment.

Table 9-2. Summary of indicator bacteria sampling results by station for Seaverns Brook (MA72-44). 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 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 site 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
W1590	5/15/2007	10/2/2007	5	839	2	1

Table 9-3. Indicator bacteria data by station, indicator, and date for Seaverns Brook (MA72-44). Each sample date was designated as representing wet or dry weather conditions with wet weather defined as more than 0.5 inches of precipitation in the previous 72 hours. Red text in the Results column 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 STV) for *E. coli* indicator bacteria; and red text in the Geomean column highlights exceedances of the 126 CFU/100 mL criterion (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)
W1590	*E. coli*	5/15/2007	DRY	57	57	
W1590	*E. coli*	6/19/2007	DRY	52	54	
W1590	*E. coli*	7/24/2007	DRY	270	93	
W1590	*E. coli*	8/28/2007	DRY	230	148	
W1590	*E. coli*	10/2/2007	DRY	9,500	839	

9.3. Potential Pathogen Sources

Comparing data collected during wet weather versus dry weather conditions provides an indication of the types of sources present, 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 surface waters 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 sanitary sewer overflows (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).

Indicator bacteria data for Seaverns Brook (MA72-44) were elevated during dry weather (wet weather data were not available). Elevated results 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 the 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 identify specific pollutant sources.

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a large amount of development in the watershed (27%), most of which consists of residential areas interspersed with industrial and commercial areas, though there is also a substantial concentration of major highway development adjacent to the segment itself. The entire land area is subject to MS4 permit conditions, 12% is classified as impervious area, and 6% is classified as DCIA. Stormwater runoff from urban areas is a likely source of pathogens.

Illicit Sewage Discharges: Public sewer-related risks to water quality include leaking infrastructure (pipes, pump stations, etc.) and sanitary sewer overflows (SSOs), which may be caused by undersized infrastructure, blockages, or excessive infiltration of groundwater or rainwater into pipes, exceeding system capacity. Sewer service is not available in the watershed within the town of Weston, therefore sewer-related risks to water quality are not a likely source of pathogens.

On-Site Wastewater Disposal Systems: All of the development in the watershed utilizes on-site systems for wastewater treatment. It is likely that some septic systems are not properly maintained and are discharging untreated effluent to groundwater.

Agriculture: Agricultural activities in the watershed account for a relatively small portion (<1%) of the total land use. Manure storage and spreading activities, if not properly conducted, are possible sources of pathogens to waterbodies.

Pet Waste: There are a few residential neighborhoods and parks near the Seaverns Brook segment MA72-44, as well as conservation area and walking trails around Norumbega reservoir. Conservation lands, parks, and ballfields popular for dog-walking, especially where paths or residential neighborhoods are adjacent to rivers, ponds, or wetlands, represent possible sources of pathogens.

Wildlife Waste: There are a few large open wetland areas are directly adjacent to the impaired segment. Large mowed areas, fields, or wetlands with a clear sightline to a waterbody may attract large congregations of waterfowl, resulting in elevated indicator bacteria counts in the water.

9.4. Existing Local Management

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

Town of Weston. See Section 8.4

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