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

Appendix Z: Buzzards Bay Coastal Drainage Area

Commonwealth of Massachusetts
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December 2024

CN 515.1.26

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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

References to trade names, commercial products, manufacturers, or distributors in this report constituted neither endorsement nor recommendations by the Massachusetts Department of Environmental Protection.

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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 11 pathogen-impaired segments in the Buzzards Bay Coastal Drainage Area, hereinafter referred to as the Buzzards Bay 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 freshwater segments were calculated with the flow-based equation, and those for the four estuarine segments were calculated with the load-based equation developed to address conditions specific to Cape Cod, the Islands and the segments on the eastern side of Buzzards Bay i.e., on Cape Cod. Refer to Tables 1-1 through 1-4.

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 Buzzards Bay Watershed Overview section.

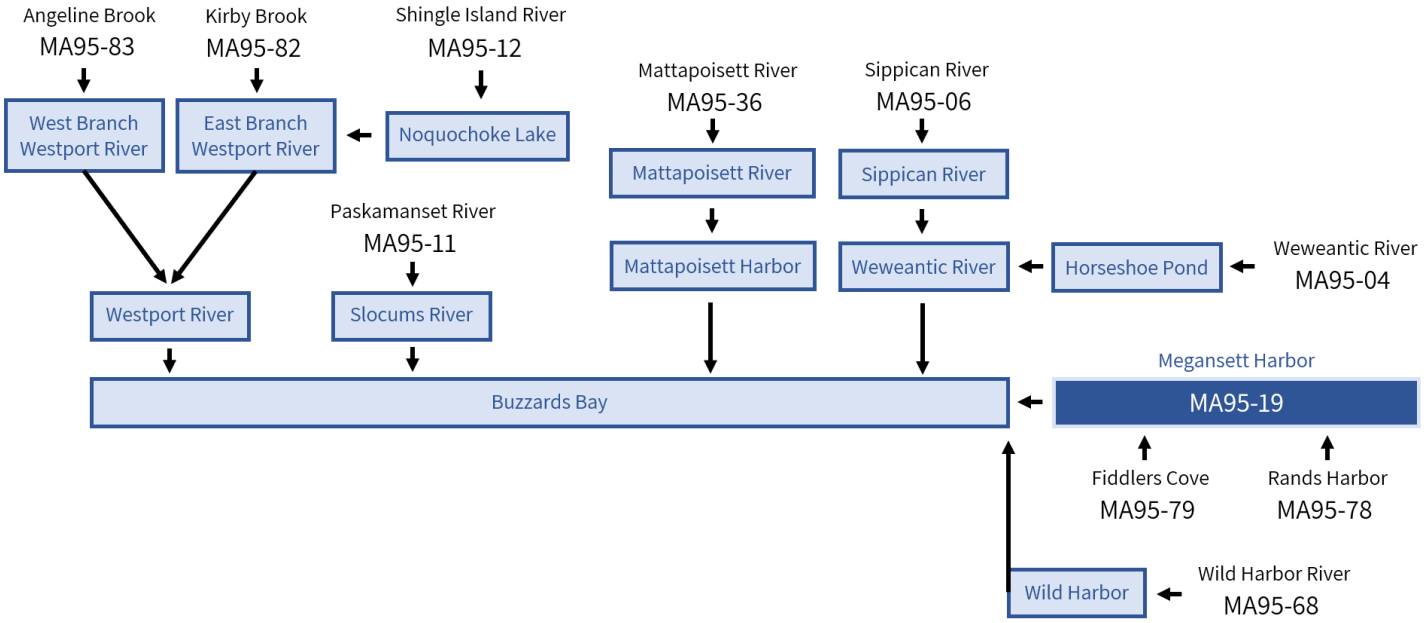


Figure 1-1. Conceptual diagram of water flow through the Buzzards Bay watershed for the eleven pathogen-impaired segments. Connections between waterbodies are shown with black arrows. Not to scale. Impaired segments are shown with the assessment unit.

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 Buzzards Bay 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)					
Weweantic River		P	126	197	36%	WLA (6%)	0.2	1.8	17.7	177.3	1,773.5	17,734.8
MA95-04	B (WW, HQW)			(90 day)		LA (94%)	2.9	29.1	290.5	2,905.3	29,053.3	290,533.2
Sippican River		P	126	156	19%	WLA (4%)	0.1	1.1	11.4	113.5	1,135.5	11,354.6
MA95-06	B (WW, HQW)			(90 day)		LA (96%)	3.0	29.7	296.9	2,969.1	29,691.3	296,913.4
Paskamanset River		R	126	1,104	89%	WLA (13%)	0.4	3.9	39.1	391.2	3,911.6	39,116.3
MA95-11	B			(90 day)		LA (87%)	2.7	26.9	269.2	2,691.5	26,915.2	269,151.7
Shingle Island River		P	126	222	43%	WLA (3%)	0.1	0.9	8.8	87.6	876.5	8,765.0
MA95-12	A (PWS, ORW)			(90 day)		LA (97%)	3.0	30.0	299.5	2,995.0	29,950.3	299,503.0
Mattapoisett River		R	126	307	59%	WLA (3%)	0.1	1.0	10.5	104.6	1,045.9	10,459.5
MA95-36	B			(90 day)		LA (97%)	3.0	29.8	297.8	2,978.1	29,780.9	297,808.5
Kirby Brook		P	126	214	41%	WLA (6%)	0.2	1.9	19.1	191.3	1,913.1	19,131.0
MA95-82	B			(90 day)		LA (94%)	2.9	28.9	289.1	2,891.4	28,913.7	289,137.0
Angeline Brook		P	126	166	24%	WLA (3%)	0.1	1.0	9.7	97.1	971.1	9,710.9
MA95-83	B			(90 day)		LA (97%)	3.0	29.9	298.6	2,985.6	29,855.7	298,557.1

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 Buzzards Bay 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)					
Weweantic River		R	35	170	79%	WLA (6%)	-	0.5	4.9	49.3	492.6	4,926.3
MA95-04	B (WW, HQW)			(90 day)		LA (94%)	0.8	8.1	80.7	807.0	8,070.4	80,703.7
Sippican River		R	35	100	65%	WLA (4%)	-	0.3	3.2	31.5	315.4	3,154.1
MA95-06	B (WW, HQW)			(90 day)		LA (96%)	0.8	8.2	82.5	824.8	8,247.6	82,476.0
Paskamanset River		R	35	202	83%	WLA (13%)	0.1	1.1	10.9	108.7	1,086.6	10,865.6
MA95-11	B			(90 day)		LA (87%)	0.7	7.5	74.8	747.6	7,476.4	74,764.4
Shingle Island River		R	35	78	55%	WLA (3%)	-	0.2	2.4	24.3	243.5	2,434.7
MA95-12	A (PWS, ORW)			(90 day)		LA (97%)	0.8	8.3	83.2	832.0	8,319.5	83,195.3
Mattapoisett River		R	35	186	81%	WLA (3%)	-	0.3	2.9	29.1	290.5	2,905.4
MA95-36	B			(90 day)		LA (97%)	0.8	8.3	82.7	827.2	8,272.5	82,724.6
Kirby Brook		R	35	295	88%	WLA (6%)	0.1	0.5	5.3	53.1	531.4	5,314.2
MA95-82	B			(90 day)		LA (94%)	0.8	8.0	80.3	803.2	8,031.6	80,315.8
Angeline Brook		R	35	56	38%	WLA (3%)	-	0.3	2.7	27.0	269.7	2,697.5
MA95-83	B			(90 day)		LA (97%)	0.8	8.3	82.9	829.3	8,293.3	82,932.5

Table 1-3. 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 TMDL allocations for pathogen-impaired **marine** assessment units in the Buzzards Bay 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	Watershed Area (acres)	Impervious Area in 200-foot Buffer (acres)	TMDL (CFU/day*10^9)
Megansett Harbor MA95-19	SA (SF)	P	35	NA	-	WLA (100%) LA (0%)	5,301	9.3	0.041 -
Wild Harbor River MA95-68	SA (SF)	P	35	NA	-	WLA (100%) LA (0%)	1,583	6.2	0.027 -
Rands Harbor MA95-78	SA (SF)	P	35	NA	-	WLA (100%) LA (0%)	1,255	3.8	0.017 -
Fiddlers Cove MA95-79	SA (SF)	P	35	NA	-	WLA (100%) LA (0%)	282	12.9	0.057 -

Table 1-4. Fecal Coliform Total Maximum Daily Loads, the percent reductions needed to meet the TMDL target (14 CFU/100ml for Class SA) based on the Massachusetts Surface Water Quality Standards (SWQS), and the TMDL allocations for pathogen-impaired **marine** assessment units in the Buzzards Bay 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	Watershed Area (acres)	Impervious Area in 200-foot Buffer (acres)	TMDL (CFU/day*10^9)
Megansett Harbor MA95-19	SA (SF)	R	14	NA	-	WLA (100%) LA (0%)	5,301	9.3	0.017 -
Wild Harbor River MA95-68	SA (SF)	R	14	NA	-	WLA (100%) LA (0%)	1,583	6.2	0.011 -
Rands Harbor MA95-78	SA (SF)	R	14	NA	-	WLA (100%) LA (0%)	1,255	3.8	0.007 -
Fiddlers Cove MA95-79	SA (SF)	R	14	NA	-	WLA (100%) LA (0%)	282	12.9	0.023 -

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)*
- ***ORW*** *= Outstanding Resource Waters; waters designated for protection under 314 CMR 4.04(2);*
- ***PWS*** *=Public Water Supply; may be subject to more stringent criteria in accordance with 310 CMR 22.00, and may have restricted use;*
- ***SF*** *= Shellfishing; waters subject to more stringent regulation by Massachusetts Division of Marine Fisheries (DMF) pursuant to M.G.L. c. 130, § 75*
- ***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*

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. Buzzards Bay Watershed Overview

The Buzzards Bay watershed is a coastal drainage area covering approximately 425 square miles (mi^2) in southeastern Massachusetts (Figure 2-1). Unlike many Massachusetts watersheds, Buzzards Bay does not feature a central mainstem river flowing to a single point; rather, it includes streams from both the mainland and Cape Cod that flow into Buzzards Bay through numerous estuaries, from both the north/west and south/east. Major streams in the watershed include the Agawam, Copicut, Mattapoisett, Paskamanset, Shingle Island, Sippican, Wankinco, Westport, and Weweantic rivers (MassDEP, 2003). Overall, the Buzzards Bay watershed includes: 71 named freshwater rivers with a combined length of approximately 167 river miles; numerous coastal embayments and estuaries encompassing 40.60 mi^2; and 173 lakes and ponds comprising 7,106 acres (MassDEP, 2003).

The Buzzards Bay watershed overlaps a portion of 19 municipalities in Massachusetts, including three municipalities on Cape Cod. Of these, the towns of Acushnet, Dartmouth, Fairhaven, Mattapoisett, Marion, and Wareham are completely contained 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 except for the town of Rochester. These networks of drains and pipes convey polluted runoff from streets and developed areas to streams. In addition, these networks are sometimes subject to direct wastewater inflows through illegal cross-connections, leaks from sewer pipes or septic systems, dumping, or other unauthorized wastewater sources, and together these 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 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 three Regional Planning Agencies (RPAs) includes portions of the Buzzards Bay watershed. 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 on watershed issues such as pathogen pollutants and stormwater that cross town boundaries. These Buzzards Bay RPAs include:

- Cape Cod Commission (CCC; CCC, 2022)
- Old Colony Planning Council (OCPC; OCPC, 2022)
- Southeast Regional Planning & Economic Development District (SRPEDD, SRPEDD, 2022)

The following RPA initiatives and tools utilized in the Buzzards Bay watershed are especially noteworthy:

- Regional stormwater coalitions operate within the RPAs, including CCC's Cape Cod Stormwater Managers Group.
- The OCPC administers a Community Septic Management Program that assists homeowners in addressing septic system failures.

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 (Think Blue Massachusetts, 2019).

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

- **Buzzards Bay Coalition** (BBC) is "dedicated to the restoration, protection, and sustainable use and enjoyment of our irreplaceable Bay and its watershed" (BBC, 2022).
- **Buzzards Bay National Estuary Program** (BBNEP) has a mission to "protect and restore water quality in Buzzards Bay and its surrounding watershed through the implementation of the Buzzards Bay Comprehensive Conservation and Management Plan" (BBNEP, 2022).

- **Lloyd Center for the Environment** has a mission "to instill a life-long respect and affection for nature in all people through research and education; to advance a scientific and public understanding of our coastal ecosystems and the need to protect them; and to promote a legacy of natural diversity largely in, but not restricted to, the coastal environments of southeastern New England" (Lloyd Center, 2022).
- **Massachusetts Office of Coastal Zone Management** (CZM) has a South Coastal Region that "serves coastal communities from Wareham to Seekonk located in the Buzzards Bay, Mt. Hope Bay, Taunton, and Narragansett Bay watersheds" (CZM, 2022a).
- **Southern New England Program** (SNEP) is a technical assistance network that "provides training and assistance to municipalities, organizations, and tribes to advance stormwater and watershed management, ecological restoration, and climate resilience in Rhode Island and Massachusetts" (SNEP, 2022).
- **Trout Unlimited (TU)** operates two chapters in the geographic area of the Narragansett Bay watershed in Massachusetts, including the Greater Boston (GBTU) and Southeastern Mass (SEMASS). 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).
- **Watershed Action Alliance of Southeastern Massachusetts** (WAA) works with member organizations to "protect and improve the health of the waterways and watersheds of southeastern Massachusetts" (WAA, 2022). These organizations include many watershed associations in the region. WAA helps these associations by "sharing resources and ideas with member organizations, raising public awareness of watershed issues, and building effective relationships with our state and local decision-makers" (WAA, 2022).
- **Westport River Watershed Alliance** (WRWA) whose mission is "working together to protect and preserve the Westport River Watershed now and for future generations" (WRWA, 2022).
- **Massachusetts Association of Conservation Districts** (MACD) represents the 13 Conservation Districts of the Commonwealth, from the tip of Cape Cod to the Berkshire Highlands. A watershed-based plan has been created for the Westport River watershed by the MACD and Geosyntec Consultants, Inc. (Geosyntec, 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.
    - Two tools developed by the Metropolitan Area Planning Council (MAPC) are potentially valuable in all MS4 communities across the state; municipalities and other RPAs (with permission from MAPC) should consider adapting and/or expanding these tools in their area:
        - Stormwater Utility/Funding Starting Kit (MAPC, 2014); and
        - a GIS toolkit to calculate MS4 outfall catchments, which is a requirement under the MS4 General Permit, created by MAPC and the Neponset River Watershed Association (MAPC, 2018).
- **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 access to 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 (CZM, 2022b). 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*. Any sewage discharges from boats or boating infrastructure in the waters covered by this TMDL are therefore illicit discharges.

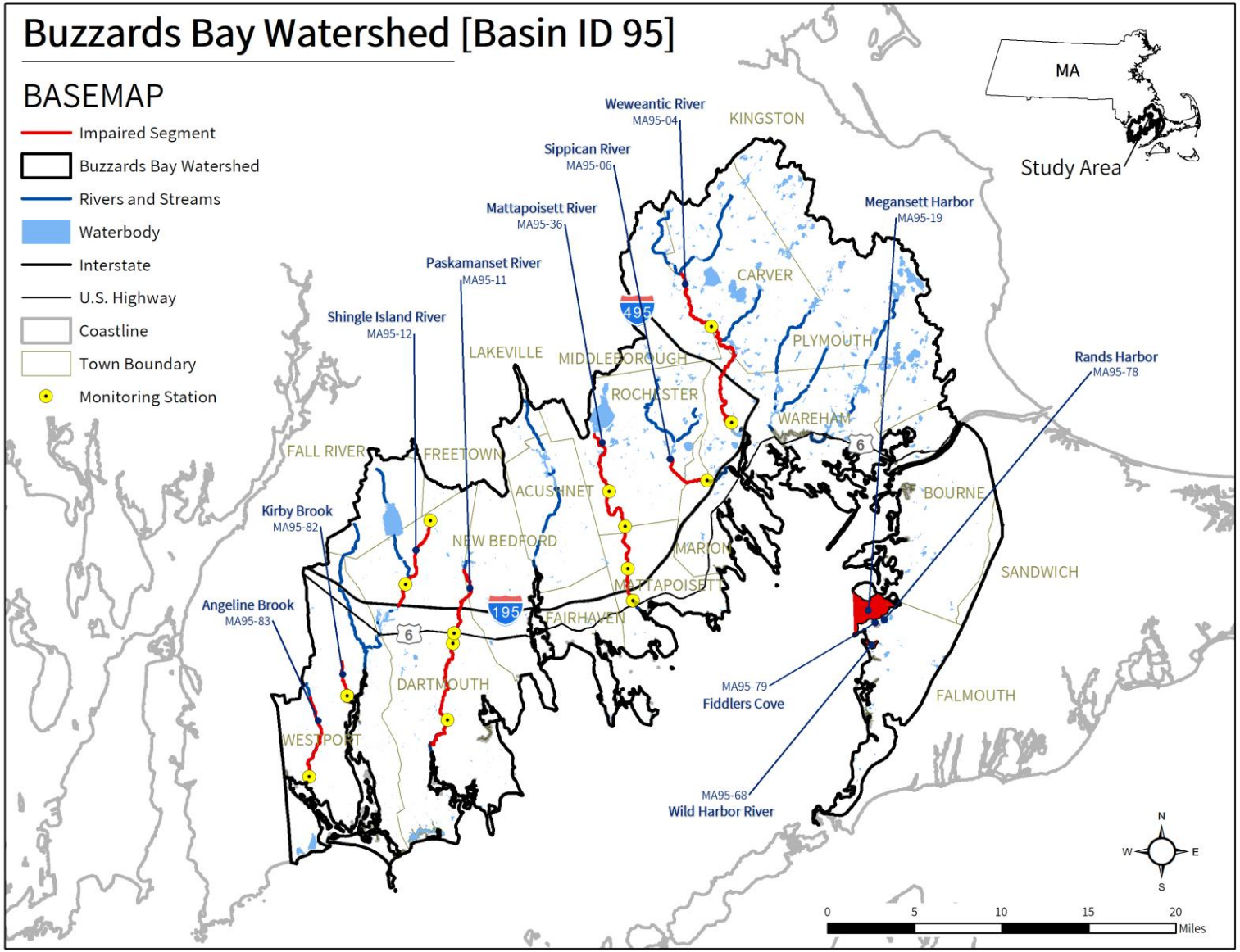


Figure 2-1: Map of all pathogen-impaired segments, water quality monitoring stations, municipal borders, waterbodies, and major roads in the Buzzards Bay watershed.

3. MA95-04 Weweantic River

3.1. Waterbody Overview

Weweantic River segment MA95-04 is 11.5 miles long and begins at the confluence of Rocky Meadow and South Meadow brooks in Carver, MA. The segment flows south before ending at the inlet of Horseshoe Pond in Wareham, MA.

Tributaries to Weweantic River segment MA95-04 include Crane Brook and a few unnamed streams. Lakes and ponds in the watershed include Darby Pond, Little Clear Pond, Clear Pond, Little West and Big West ponds, Grassy West Pond, Micajahs Pond, Kings Pond, Sabys Pond, Widgeon Pond, Curlow Pond, Rocky Pond, Federal Pond, South Meadow Pond, Vaughn Pond, Wenham Pond, Sampsons Pond, Durham Pond, Bates Pond, Clear Pond, Cedar Pond, Tremont Mill Pond (MA95150), and a few other unnamed waterbodies. Much of the river flows through agricultural areas, while the headwaters primarily flow through wetlands.

Key landmarks in the watershed include the King Richard's Faire grounds; Edaville Family Theme Park; Plymouth Municipal Airport (PYM); R.D. Williams Sawmill; Wareham District Court; Carver Elementary and High schools; West Wareham Academy; Wareham Crossing shopping mall; Village Links Golf Club, Squirrel Run Country Club, Southers Marsh Golf Club; Rocky Gutter Wildlife Management Area; Rocky Pond Conservation Area; South Meadow Great Cedar Swamp; portions of Boot Pond Conservation Area; and Myles Standish State Forest. From upstream to downstream, segment MA95-04 is crossed by Rochester Road (Carver), Tremont Street/MA-58 (Carver), Interstate 195 (Wareham), Cranberry Highway/MA-28 (Wareham), Main Street (Wareham), an unnamed road (Wareham), Papermill Road (Wareham), and Fearing Hill Road (Wareham).

Weweantic River (MA95-04) drains a total area of 56.8 square miles (mi^2), of which 3.3 mi^2 (6%) are impervious and 1.7 mi^2 (3%) are directly connected impervious area (DCIA). The watershed is partially served by public sewer systems in Middleborough and Wareham; Plymouth and Carver may be served by a public

Reduction from Highest Calculated Geomean: 79%

Watershed Area (Acres): 36,369

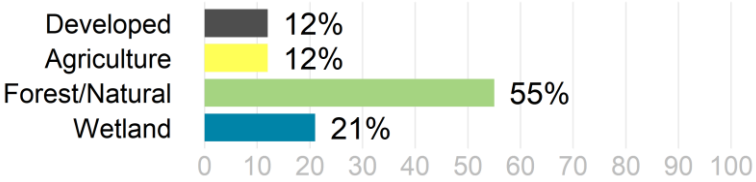
Segment Length (Miles): 11.5

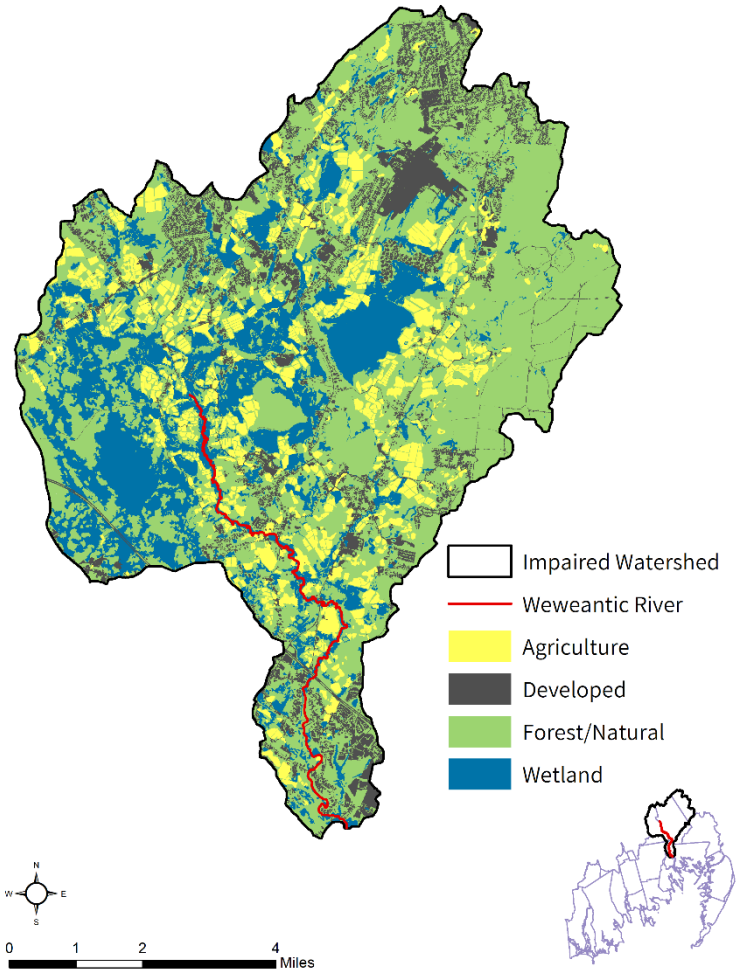
Impairment(s): Enterococci (Primary Contact Recreation)

Class (Qualifiers): B (Warm Water, High Quality Water)

Impervious Area (Acres, %): 32,092 (6%)

DCIA Area (Acres, %): 1,086 (3%)





sewer system also[1]. 35% 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, two MassDEP discharge-to-groundwater permits for on-site wastewater discharge (Table 3-1), and no combined sewer overflows (CSOs) within the watershed. There is one landfill and no unpermitted land disposal dumping grounds. See Figure 3-1.

The Weweantic River segment MA95-04 watershed is located in a moderately-undeveloped part of Massachusetts. More than half of the watershed consists of forest and natural lands (51%) and 21% consists of wetland areas. The remainder of the watershed is covered by development (12%) and agricultural activity (12%). Most of the development consists of residential areas with some industrial and commercial development. Virtually all of the agricultural activity consists of cranberry bogs located directly adjacent to wetland and forest areas in the watershed.

In the Weweantic River (MA95-04) watershed, under the Natural Heritage and Endangered Species Program, there are 5,234 acres (14%) of Priority Habitats of Rare Species and 3,428 acres (9%) of Priority Natural Vegetation Communities. There are also two acres (<1%) under Public Water Supply protection, none within Areas of Critical Environmental Concern, and 58 acres (<1%) of Outstanding Resource Waters. Overall, there are 8,212 acres (23%) of land protected in perpetuity[2], part of 9,340 acres (26%) of Protected and Recreational Open Space[3]. See Figure 3-1.

Table 3-1. Groundwater discharge permits in the segment watershed. Only permits unique to this segment are shown. 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)
720-2	PLYMOUTH AIRPORT	PLYMOUTH	Sanitary Discharge	25,000
903-0M1	DECAS CRANBERRY PRODUCTS	CARVER	Industrial	0

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

[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.

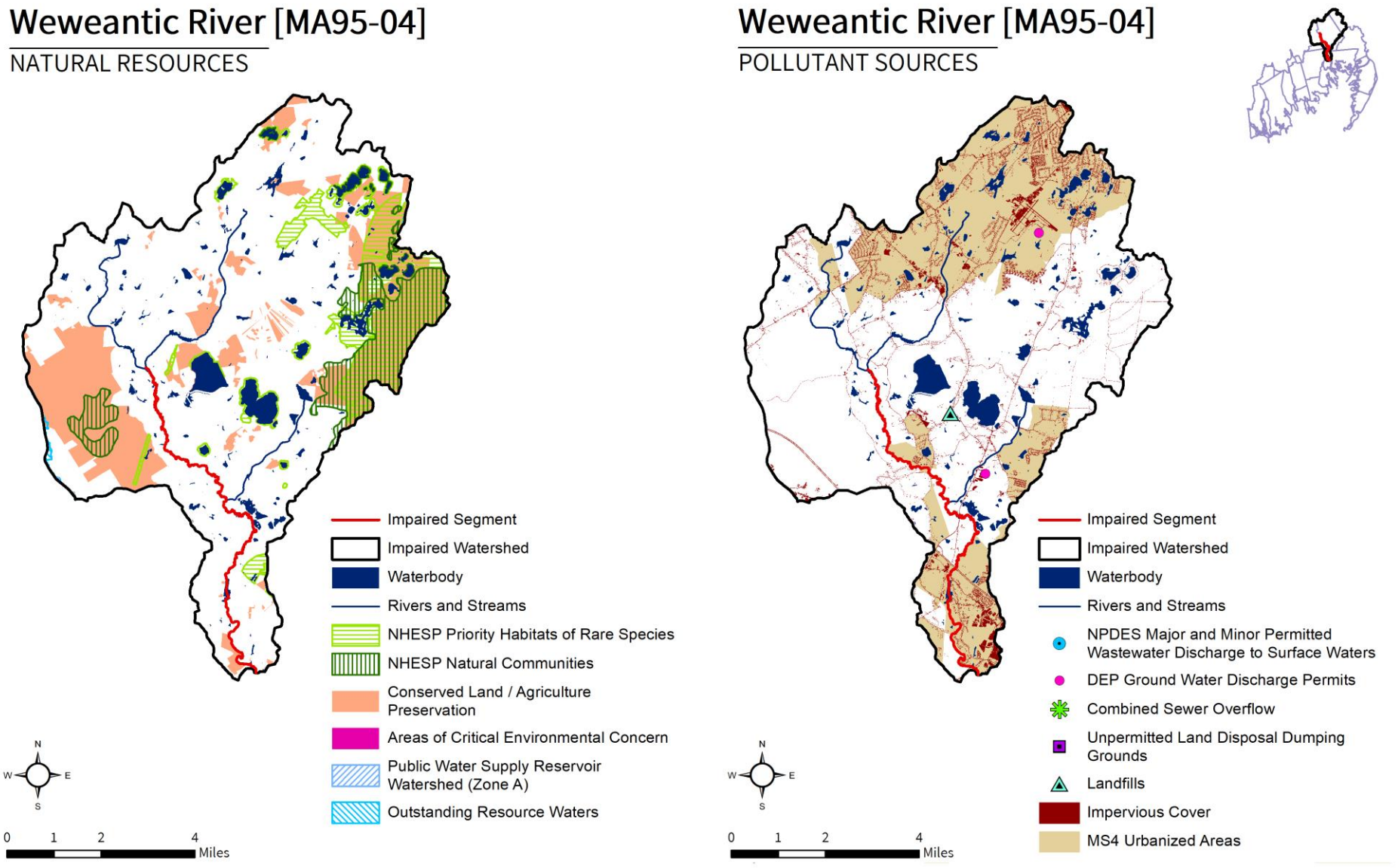


Figure 3-1. Natural resources and potential pollution sources draining to the Weweantic River segment MA95-04. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

3.2. Waterbody Impairment Characterization

The Weweantic River (MA95-04) 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 3-2, 3-3; Figure 3-2) using the indicator bacteria enterococci. Data were evaluated against the SWQS geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria and the STV criterion of 130 CFU/100 mL for enterococci. The geomean and STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

- In 2005, five samples were collected at W1385; 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, two exceeded the STV criterion, one during wet weather and one during dry weather.
- In 2005, five samples were collected at W1386; 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 STV criterion was applied to single sample results. Out of five samples, two exceeded the STV criterion, one during wet weather and one during dry weather.

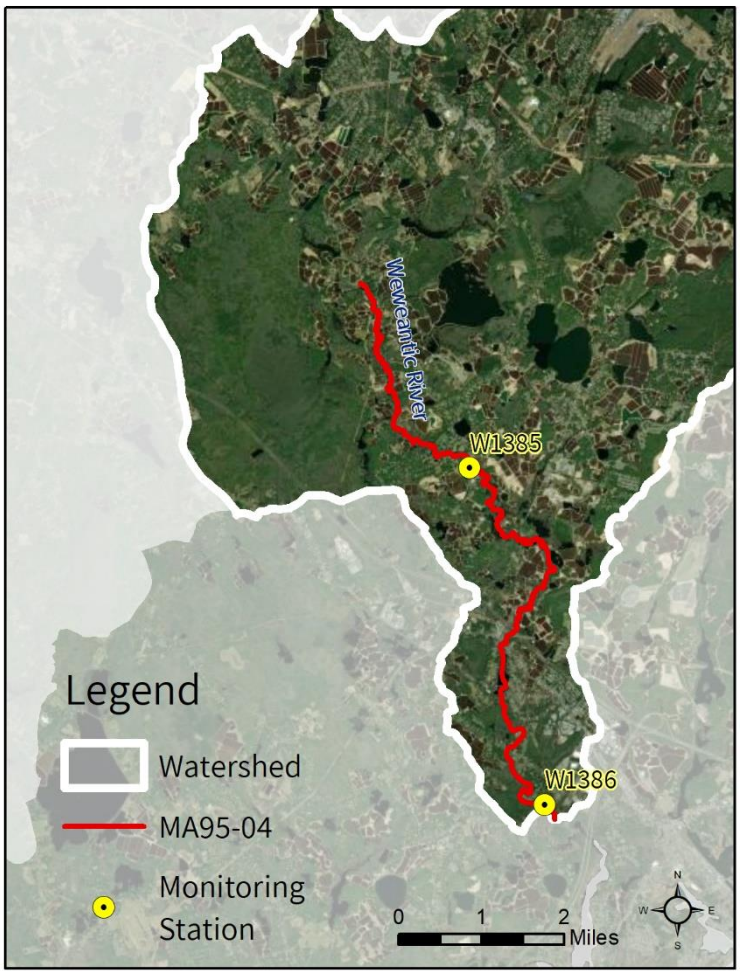


Figure 3-2. Location of monitoring station(s) along the impaired segment.

Table 3-2. Summary of indicator bacteria sampling results by station for the Weweantic River (MA95-04). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria, and the number of single samples exceeding the STV criterion of 130 CFU/100 mL for enterococci indicator bacteria are shown. The STV criterion is applied to the single sample results if less than 10 samples were collected within a calendar year at a site. The highest maximum 90-day rolling geomean of the sites is used to calculate the percent load reduction required to meet SWQS.

Unique Station ID	First Sample	Last Sample	Count	Maximum 90-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1385	5/3/2005	8/30/2005	5	97	2	2
W1386	5/3/2005	8/30/2005	5	170	2	2

Table 3-3. Indicator bacteria data by station, indicator, and date for the Weweantic River (MA95-04). 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 for *E. coli* and 130 CFU/100 mL for enterococci indicator bacteria (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the STV); and red text in the Geomean column highlights exceedances of 126 CFU/100 mL for *E. coli* and 35 CFU/100 mL for enterococci indicator bacteria (applied to rolling 90-day geomean).

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1385	Enterococci	5/3/2005	WET	10	10	
W1385	Enterococci	6/9/2005	DRY	3*	5	
W1385	Enterococci	6/28/2005	DRY	55	11	
W1385	Enterococci	8/2/2005	DRY	395	38	
W1385	Enterococci	8/30/2005	WET	1,600‡	97	
W1385	*E. coli*	5/3/2005	WET	10	10	
W1385	*E. coli*	6/9/2005	DRY	25	16	
W1385	*E. coli*	6/28/2005	DRY	75	27	
W1385	*E. coli*	8/2/2005	DRY	180	70	
W1385	*E. coli*	8/30/2005	WET	1,600‡	152	
W1385	*E. coli*	9/12/2005	DRY	70	197	
W1385	Fecal Coliform	5/3/2005	WET	40		
W1385	Fecal Coliform	6/9/2005	DRY	25		
W1385	Fecal Coliform	6/28/2005	DRY	40		
W1385	Fecal Coliform	8/2/2005	DRY	80		
W1385	Fecal Coliform	8/30/2005	WET	1,600‡		
W1385	Fecal Coliform	9/12/2005	DRY	55		
W1386	Enterococci	5/3/2005	WET	10	10	
W1386	Enterococci	6/9/2005	DRY	20	14	
W1386	Enterococci	6/28/2005	DRY	70	24	
W1386	Enterococci	8/2/2005	DRY	370	80	
W1386	Enterococci	8/30/2005	WET	1,600‡	170	
W1386	*E. coli*	5/3/2005	WET	20	20	
W1386	*E. coli*	6/9/2005	DRY	3*	7	
W1386	*E. coli*	6/28/2005	DRY	65	15	
W1386	*E. coli*	8/2/2005	DRY	235	34	
W1386	*E. coli*	8/30/2005	WET	1,600‡	88	
W1386	*E. coli*	9/12/2005	DRY	3*	88	
W1386	Fecal Coliform	5/3/2005	WET	20		
W1386	Fecal Coliform	6/9/2005	DRY	3*		
W1386	Fecal Coliform	6/28/2005	DRY	85		
W1386	Fecal Coliform	8/2/2005	DRY	390		
W1386	Fecal Coliform	8/30/2005	WET	1,600‡		
W1386	Fecal Coliform	9/12/2005	DRY	3*		

* Value below the Method Detection Limit (MDL) of 5 CFU/100mL; a value of half the MDL is reported and used to calculate the geometric means for *E. coli* and enterococci.

‡ Value above the Method Detection Limit (MDL) of 1,600 CFU/100mL; the MDL is reported and used to calculate the geometric means for *E. coli* and enterococci.

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 wildlife and domesticated animal waste (including pets).

Indicator bacteria data for Weweantic River (MA95-04) were elevated during both wet and dry weather. Elevated results during wet weather are consistent with urban stormwater, pet waste, and wildlife pathogen sources, as are certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation. Elevated results during dry weather suggest that ongoing 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- to low-level of development in the watershed (12%), most of which consists of residential areas with some industrial and commercial development as well. Within the watershed, 35% of the land area is subject to MS4 permit conditions, 6% is classified as impervious area, and 3% 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 Middleborough and Wareham, and portions of the watershed in Plymouth and Carver may be served by public sewer systems. 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: Most of the development in the watershed utilizes 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 moderate portion (12%) of the total land use. Virtually all of this agriculture consists of cranberry bogs located next to wetland and forest 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 and parks near the downstream portion of the Weweantic River segment MA95-04. 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.

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 Carver

The majority of Carver is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041099), 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. The town completed an illicit discharge detection and elimination (IDDE) plan in 2012, an erosion and sedimentation

control (ESC) plan in 2007, and post-construction stormwater regulations in 2007. The town of Carver does not identify any impaired waterbodies in its NOI.

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

- Wetland protection bylaw
- Stormwater bylaw
- Stormwater Utility: None found
- Pet Waste: None found

Carver's 2017 Master Plan has respective sections for open space and recreation, natural and cultural resources, and agriculture. The environment is broadly mentioned in these sections, but waterbodies and stormwater are not addressed. No specific impaired streams are mentioned in the Master Plan. The town's 2010 Open Space and Recreation Plan goes into depth about stormwater runoff and management. This plan features sections on nonpoint source contamination and stormwater infrastructure (Town of Carver, 2021).

Town of Middleborough

About 60% of Middleborough is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041134), 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 2013, Middleborough completed an illicit discharge detection and elimination (IDDE) plan, an erosion and sedimentation control (ESC) plan, and post-construction stormwater regulations. No pathogen impaired waterbodies were reported on the town's NOI.

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

- Stormwater control bylaws and utility fees
- Pet waste disposal by law
- Wetland Protection Bylaw: None Found

Middleborough has a 2002 Master Plan, which includes an inventory of waterbodies and environmental problems with each waterbody identified, intended to inform planning efforts related to the town's land use. This plan also discusses increasing the implementation of environmental regulatory standards, such as stormwater management requirements (pg. 36). Middleborough has a public sewer system which, as of 2002, served about 30% of the population (pg. 179). Middleborough also has a 2008 Open Space and Recreation Plan (Town of Middleborough, 2021).

Town of Plymouth

The majority of Plymouth is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041150), 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. Plymouth completed an illicit discharge detection and elimination (IDDE) plan in 2019, and an erosion and sedimentation control (ESC) plan and post-construction stormwater regulations in 2009. No pathogen impaired waterbodies within the Buzzards Bay watershed were reported on the town's NOI.

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

- Stormwater control bylaw and utility fee
- Wetland protection bylaw
- Pet waste control bylaws

Plymouth has a 2004 Master Plan, which includes the goal and objective of natural resources conservation, specifically waterbodies. The plan also includes separate sections on waterbodies and water quality. The water quality section focuses on stormwater management, and mentions TMDLs and identifies impaired streams (pg. 49). The city has a sewer system as well as access to multiple options for wastewater treatment. Plymouth has

an Open Space and Recreation Plan from 2017, which also identifies impaired surface waters within the town. This plan also mentions reducing stormwater runoff to increase water quality (Town of Plymouth, 2021).

Town of Wareham

The majority of Wareham is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041168), 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. Wareham completed an illicit discharge detection and elimination (IDDE) plan and post-construction stormwater regulations in 2019 in 2019, an erosion and sedimentation control (ESC) plan in 2004. According to the town's NOI, fecal coliform-impaired MS4 receiving waters include 87 stormwater outfalls into the Weweantic River (MA95-05), 12 outfalls into the Sippican River (MA95-07), 10 outfalls into the Wankinco River (MA95-50), 57 outfalls into the Agwam River (MA95-29), 20 outfalls into the Beaverdam River (MA95-53), nine outfalls into Cedar Island Creek (MA95-52), 50 outfalls into the Wareham River (MA95-03), 51 outfalls into the Broad Marsh River (MA95-49), 25 outfalls into the Crooked Neck River (MA95-51), eight outfalls into Onset Bay (MA95-02), and eight outfalls into Buttermilk Bay (MA95-01).

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

- Wetland protection bylaw
- Pet waste disposal bylaws
- Stormwater Control Bylaw and Utility: None Found

Wareham has a 2020 Master Plan, which provides planning objectives and goals rather than in-depth analysis of existing features within the town. The document contains goals specifically addressing environmental protection, such as further protecting Wareham's water resources. There is mention of both sewer systems and stormwater, but no specifics are provided. Wareham also has an Open Space and Recreation Plan from 2017, intended to guide planning to 2024. This plan includes an in-depth inventory and analysis of existing resources, including water resources. In the analysis of needs section, the town's bacterial impairments of waterbodies are discussed (Town of Wareham, 2021).

4. MA95-06 Sippican River

4.1. Waterbody Overview

Sippican River segment MA95-06 is 3.0 miles long and begins at the outlet of Leonards Pond in Rochester, MA. The segment flows southeast for a short distance before ending at County Road in Marion/Wareham, MA.

Tributaries to Sippican River segment MA95-06 include Doggett Brook, Benson Brook, an unnamed tributary, and Hales Brook. Lakes and ponds in the watershed include Hathaway Pond, Mary's Pond, and a few other unnamed waterbodies. Much of the river flows through wetland and forested areas.

Key landmarks in the watershed include industrial businesses such as Shea Concrete Products, Inc., New England Sandblasting, Rochester Bituminous Products, all in the watershed's headwaters; municipal buildings including Wareham Town Transfer Station, Rochester Town Hall, and Joesph H Plumb Memorial Library; Rochester Golf Club and Dexter Lane Field; many farms, including Engelnook, Canterberry, Copperfox, Sunnynook, Harmony, and East Over Farms, and Sippican River Alpaca Farm; Old Tuck Cranberry Corp is upstream of Leonards Pond; and many wildlife reservations and preserves. From upstream to downstream, segment MA95-06 is crossed by Mary's Pond Road (Rochester), Bates Road (Rochester), and Country Road (Marion).

Sippican River (MA95-06) drains a total area of 28.1 square miles (mi^2), of which 1.0 mi^2 (4%) is impervious and 0.5 mi^2 (2%) is directly connected impervious area (DCIA). The watershed is partially served by public sewer systems in Middleborough, Marion, and Mattapoisett, and may be served by a public sewer system in Wareham[4]. 3% 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

Reduction from Highest Calculated Geomean: 65%

Watershed Area (Acres): 17,987

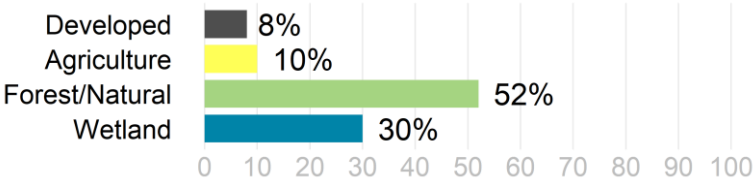
Segment Length (Miles): 3.0

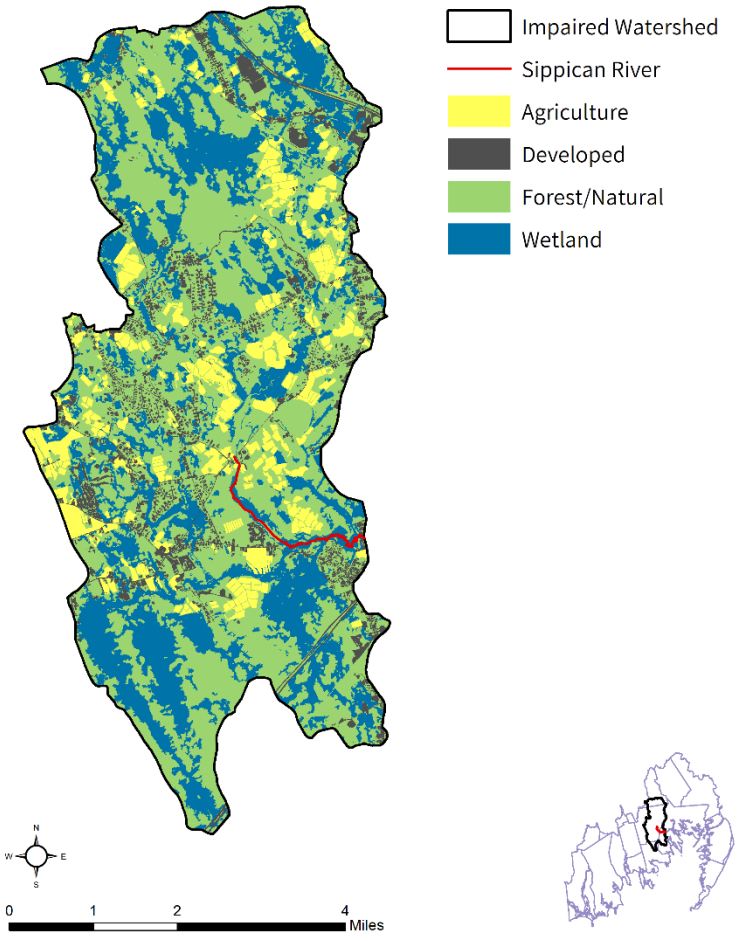
Impairment(s): Enterococci (Primary Contact Recreation)

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

Impervious Area (Acres, %): 663 (4%)

DCIA Area (Acres, %): 322 (2%)





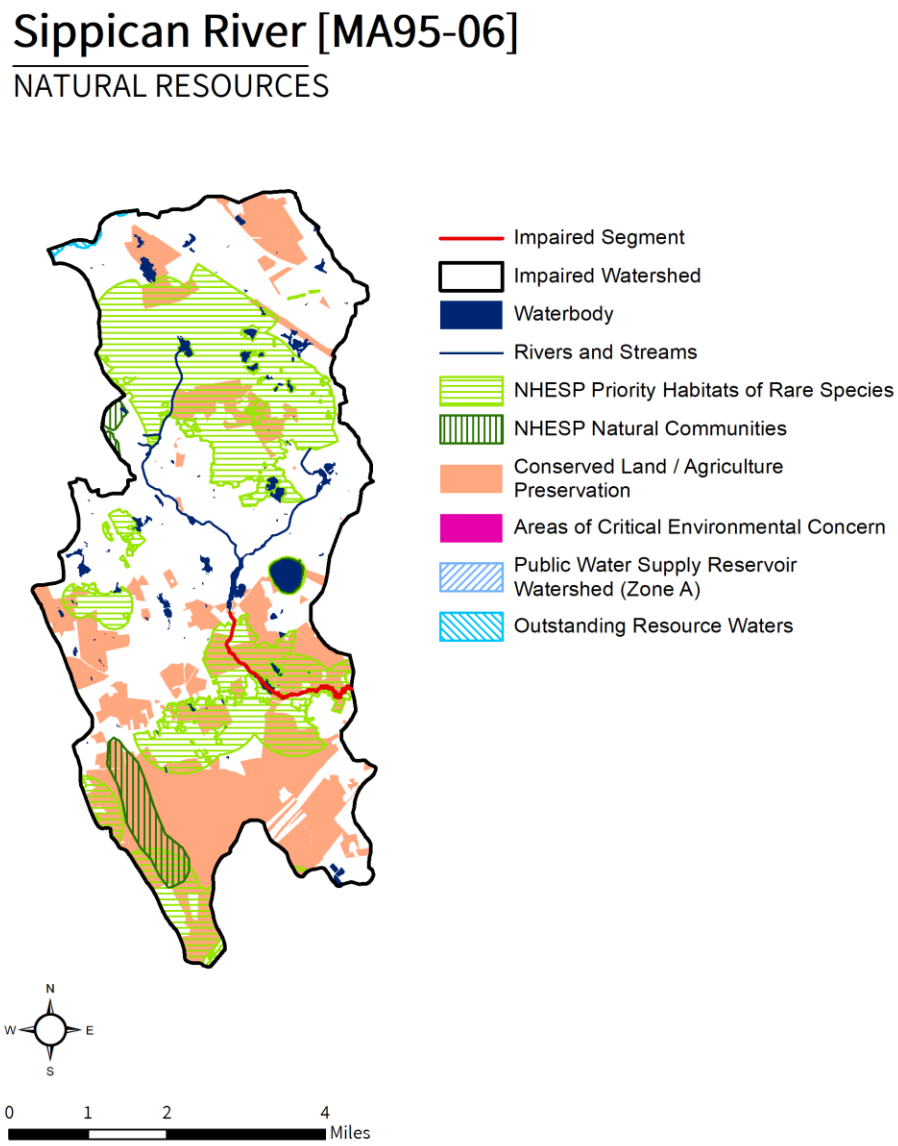
[4] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service area, MassDEP's Water Utility Infrastructure Mapping Project (MassDEP, 2021b), MS4 reports, and local knowledge.

three landfills and no unpermitted land disposal dumping grounds. See Figure 4-1.

The Sippican River segment MA95-06 watershed is located in a lightly developed part of Massachusetts. More than half of the watershed consists of forest and natural lands (52%) and 30% consists of wetland areas. The remainder of the watershed is covered by agricultural activity (10%) and development (8%). Most of the development consists of residential areas with some industrial and commercial development. Most of the agricultural activity consists of cranberry bogs located directly adjacent to wetland areas in the watershed.

In the Sippican River (MA95-06) watershed, under the Natural Heritage and Endangered Species Program, there are 5,991 acres (33%) of Priority Habitats of Rare Species and 521 acres (3%) of Priority Natural Vegetation Communities. There are also no acres under Public Water Supply protection or within Areas of Critical Environmental Concern, and 33 acres (0%) of Outstanding Resource Waters. Overall, there are 5,458 acres (30%) of land protected in perpetuity[5], part of 5,818 acres (32%) of Protected and Recreational Open Space[6]. See Figure 4-1.

[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.



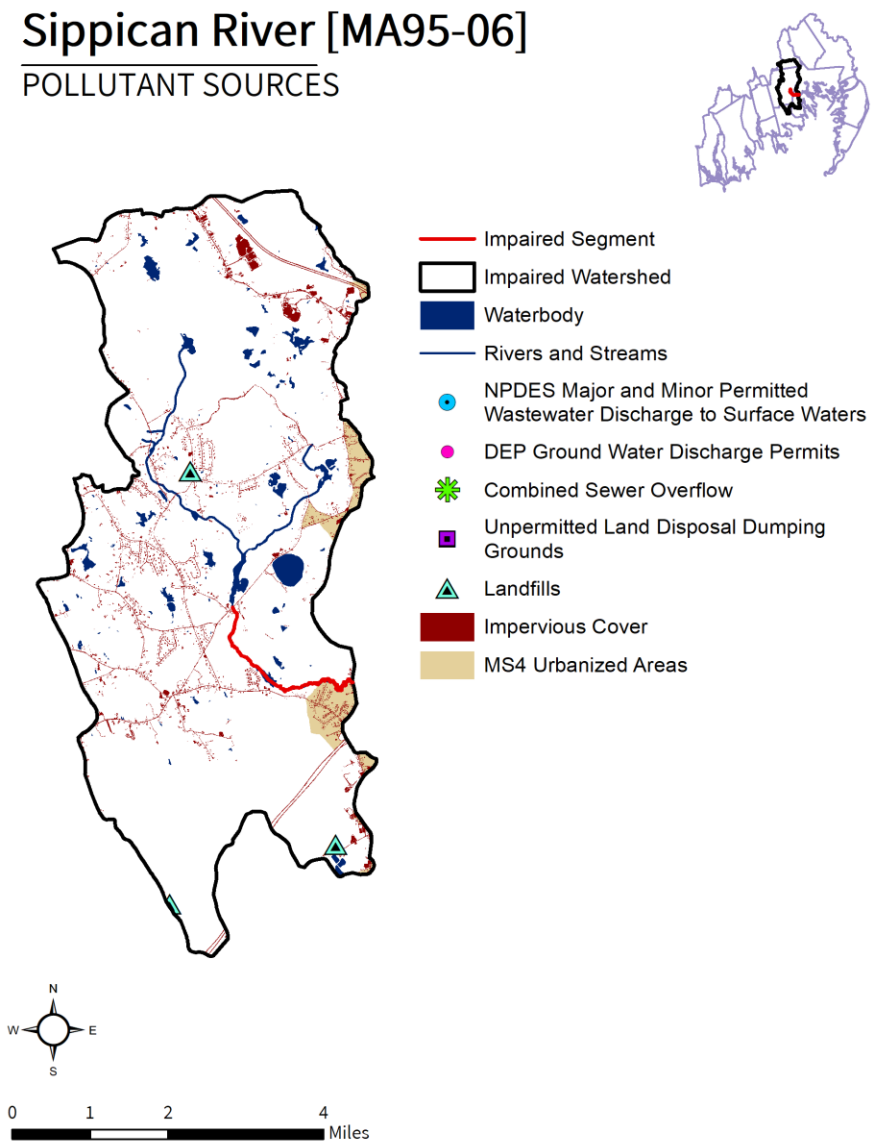


Figure 4-1. Natural resources and potential pollution sources draining to the Sippican River segment MA95-06. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

4.2. Waterbody Impairment Characterization

The Sippican River (MA95-06) 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 station listed below (refer to Tables 4-1, 4-2; Figure 4-2) using the indicator bacteria enterococci. Data were evaluated against the SWQS geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria and the STV criterion of 130 CFU/100 mL for enterococci. The geomean and STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

- In 2005, five samples were collected at W1387; 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, two exceeded the STV criterion, one during wet weather and one during dry weather.

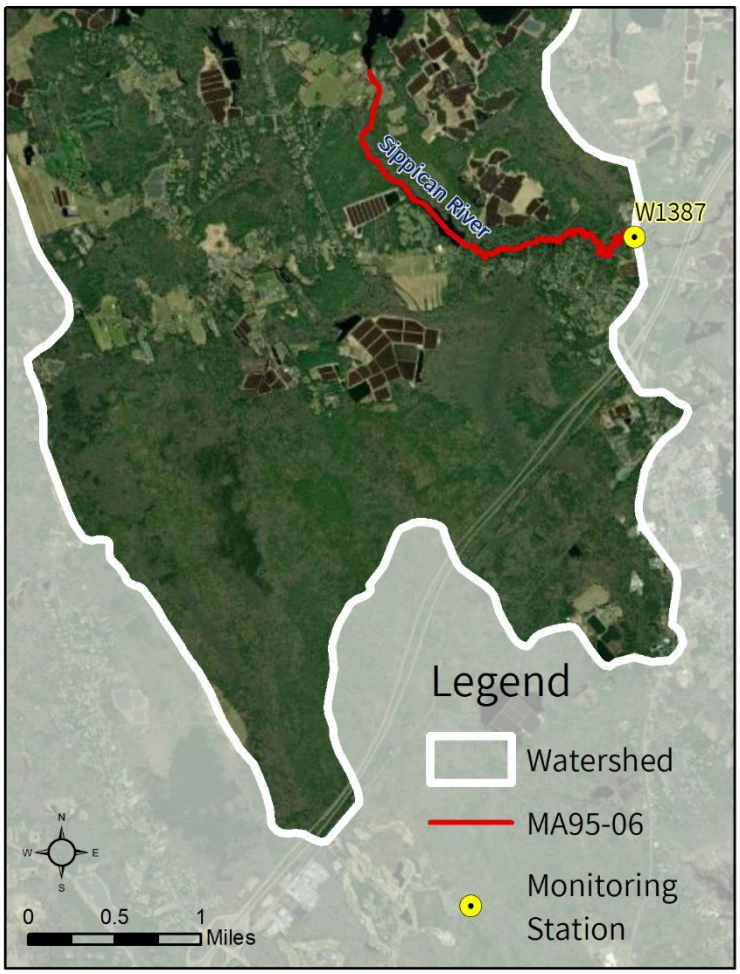


Figure 4-2. Location of monitoring station(s) along the impaired segment.

Table 4-1. Summary of indicator bacteria sampling results by station for the Sippican River (MA95-06). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria, and the number of single samples exceeding the STV criterion of 130 CFU/100 mL for enterococci 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
W1387	5/3/2005	8/30/2005	5	100	2	2

Table 4-2. Indicator bacteria data by station, indicator, and date for the Sippican River (MA95-06). 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 for *E. coli* and 130 CFU/100 mL for enterococci indicator bacteria (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the STV); and red text in the Geomean column highlights exceedances of 126 CFU/100 mL for *E. coli* and 35 CFU/100 mL for enterococci indicator bacteria (applied to rolling 90-day geomean).

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1387	Enterococci	5/3/2005	WET	20	20	
W1387	Enterococci	6/9/2005	DRY	15	17	
W1387	Enterococci	6/28/2005	DRY	20	18	
W1387	Enterococci	8/2/2005	DRY	210	38	
W1387	Enterococci	8/30/2005	WET	1,600‡	100	
W1387	*E. coli*	5/3/2005	WET	5	5	
W1387	*E. coli*	6/9/2005	DRY	15	9	
W1387	*E. coli*	6/28/2005	DRY	85	19	
W1387	*E. coli*	8/2/2005	DRY	220	65	
W1387	*E. coli*	8/30/2005	WET	1,600‡	146	
W1387	*E. coli*	9/12/2005	DRY	20	156	
W1387	Fecal Coliform	5/3/2005	WET	40		
W1387	Fecal Coliform	6/9/2005	DRY	20		
W1387	Fecal Coliform	6/28/2005	DRY	90		
W1387	Fecal Coliform	8/2/2005	DRY	160		
W1387	Fecal Coliform	8/30/2005	WET	1,600‡		
W1387	Fecal Coliform	9/12/2005	DRY	50		

‡Value above the Method Detection Limit (MDL) of 1,600 CFU/100mL; the MDL is reported and used to calculate the geometric means for *E. coli* and enterococci.

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 wildlife and domesticated animal waste (including pets).

Indicator bacteria data for Sippican River (MA95-06) were elevated during both wet and dry weather. Elevated results during wet weather are consistent with urban stormwater, pet waste, and wildlife pathogen sources, as are certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation. Elevated results during dry weather suggest that ongoing 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 low amount of development in the watershed (8%), most of which consists of residential areas with some industrial and commercial development as well. Within the watershed, 3% of the

land area is subject to MS4 permit conditions, 4% is classified as impervious area, and 2% is classified as DCIA. Stormwater runoff from urban areas is likely a minor source of pathogens.

Illicit Sewage Discharges: Public sewer service is available in the watershed within the towns of Middleborough, Marion, and Mattapoisett, and portions of the watershed may be served by a public sewer system in Wareham. 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 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 (10%) of the total land use, however, several large pasture/hay fields are adjacent to the river. Most other agriculture in the watershed consists of cranberry bogs 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 Sippican River segment MA95-06. 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.

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 Marion

The majority of Marion is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041127), 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. Marion completed an illicit discharge detection and elimination (IDDE) plan in 2014, an erosion and sedimentation control (ESC) plan in 2016, and post-construction stormwater regulations in 2016. According to the NOI, fecal coliform-impaired MS4 receiving waters include 26 stormwater outfalls into the Sippican River (MA95-06), six outfalls into the Weweantic River (assessment unit(s) not specified), 15 outfalls into Aucoot Creek (MA95-72), 18 outfalls into Hammett Cove (MA95-56), and 37 outfalls into Inner Sippican Harbor (MA95-75). The Town also reported four outfalls into Sippican Harbor, identified in their NOI as an impaired water, however, the 2018/2020 Integrated List indicates attainment of primary and secondary recreation use (MassDEP, 2022). No assessment units were provided in the NOI, but were added here for segments with unique names.

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

- Stormwater control bylaw
- Wetland protection bylaw
- Stormwater Regulations and Utility: None found
- Pet Waste: None found

The 2017 Marion Master Plan addresses environmental issues, specifically the natural and cultural resources section (pg.85). Low impact development stormwater planning is discussed briefly in the land use section of this plan. No specific sewer section was found in the plan, but water and sewer access are mentioned in the economic

development section. There is also an open space and recreation section of the Master Plan (2017), which includes an in-depth environmental inventory and analysis (Town of Marion, 2021).

Town of Middleborough. See Section 2.4

Town of Rochester

Rochester has an EPA approved MS4 waiver, dated October 31, 2017, as the town has a population of less than 1,000 within its urbanized area.

Rochester has the following ordinances and bylaws, mostly accessible online via the town website https://www.townofrochestermass.com/ (Town of Rochester, 2021):

- Wetland protection bylaw
- Stormwater bylaw: None found
- Stormwater Utility: None found
- Pet Waste: None found

No master plan for Rochester was found online. The town has an Open Space & Recreation Plan (2019) which includes an environmental inventory and analysis, within which water resources are discussed. Bacterial contamination from (flocks of) Canada goose (*Branta canadensis)* is specifically identified as a cause of water quality degradation within the town (Town of Rochester, 2021).

5. MA95-11 Paskamanset River

5.1. Waterbody Overview

Paskamanset River segment MA95-11 is 10.5 miles long and begins at the outlet of Turners Pond in Dartmouth/New Bedford, MA. The segment flows southwest, meandering and bending, before ending at the confluence with Slocums River at Rock O'Dundee Road in Dartmouth, MA.

Tributaries to Paskamanset River segment MA95-11 include many unnamed streams. Lakes and ponds in the watershed include Cedar Dell Pond and a few other unnamed waterbodies. Much of the river flows through large wetland areas.

Key landmarks in the watershed include a portion of downtown New Bedford and its municipal offices, Dartmouth's Fire Department, Highway Department, and Public Works; New Bedford High School, Dartmouth Middle School, portions of Dartmouth High School and Bishop Stang High School; The University of Massachusetts Dartmouth and the UMass Law School; New Bedford Regional Airport; Dartmouth Mall and shopping center; the Country Club of New Bedford, Whaling City Golf Club, and Allendale Country Club; New Bedford Park, University Highlands, and several areas of conservation land; and a few cemeteries and open fields. From upstream to downstream, segment MA95-11 is crossed by Old Plainville Road (New Bedford), Interstate 195 (Dartmouth), US Route 6 (Dartmouth), Eddy Street (Dartmouth), Russells Mills Road (Dartmouth), and Rock Odundee Road (Dartmouth).

Paskamanset River (MA95-11) drains a total area of 28.6 square miles (mi^2), of which 3.6 mi^2 (13%) are impervious and 2.1 mi^2 (7%) are directly connected impervious area (DCIA). The watershed is partially served by public sewer systems in Dartmouth and may be partially served by a public sewer system in New Bedford[7]. 46% 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,

Reduction from Highest Calculated Geomean: 89%

Watershed Area (Acres): 18,333

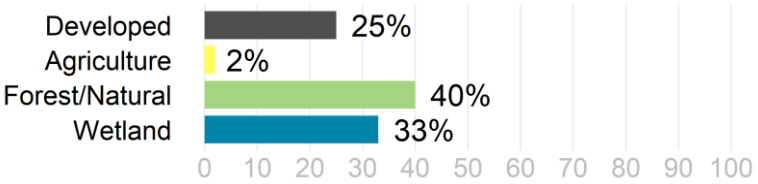
Segment Length (Miles): 10.5

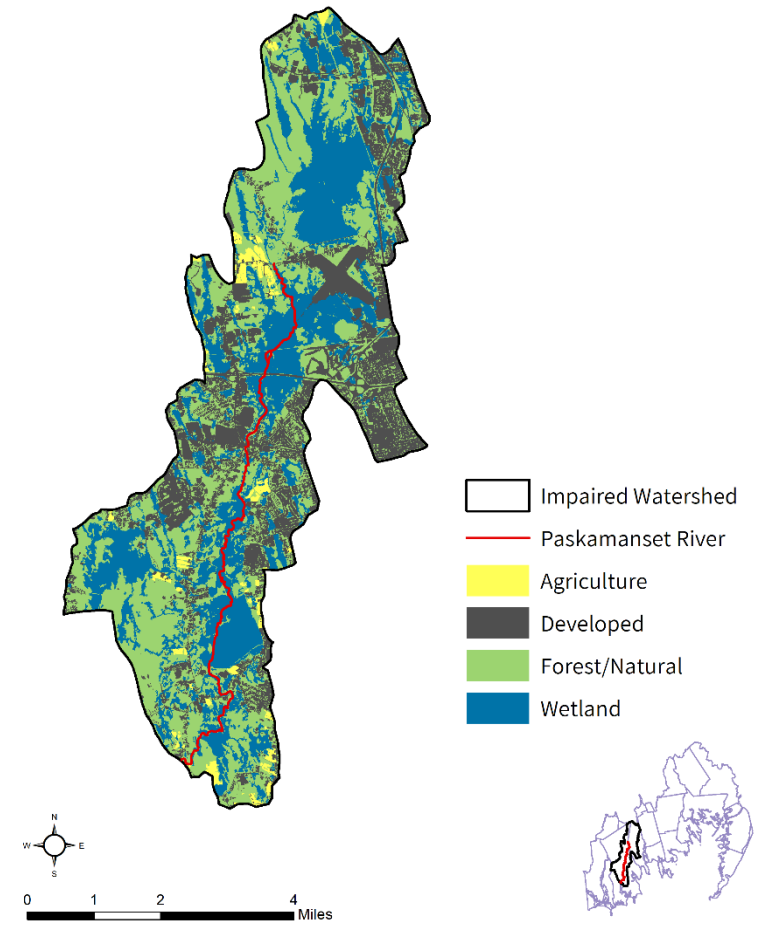
Impairment(s): Enterococci and *E. coli* (Primary Contact Recreation)

Class (Qualifier): B

Impervious Area (Acres, %): 2,326 (13%)

DCIA Area (Acres, %): 1,337 (7%)





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

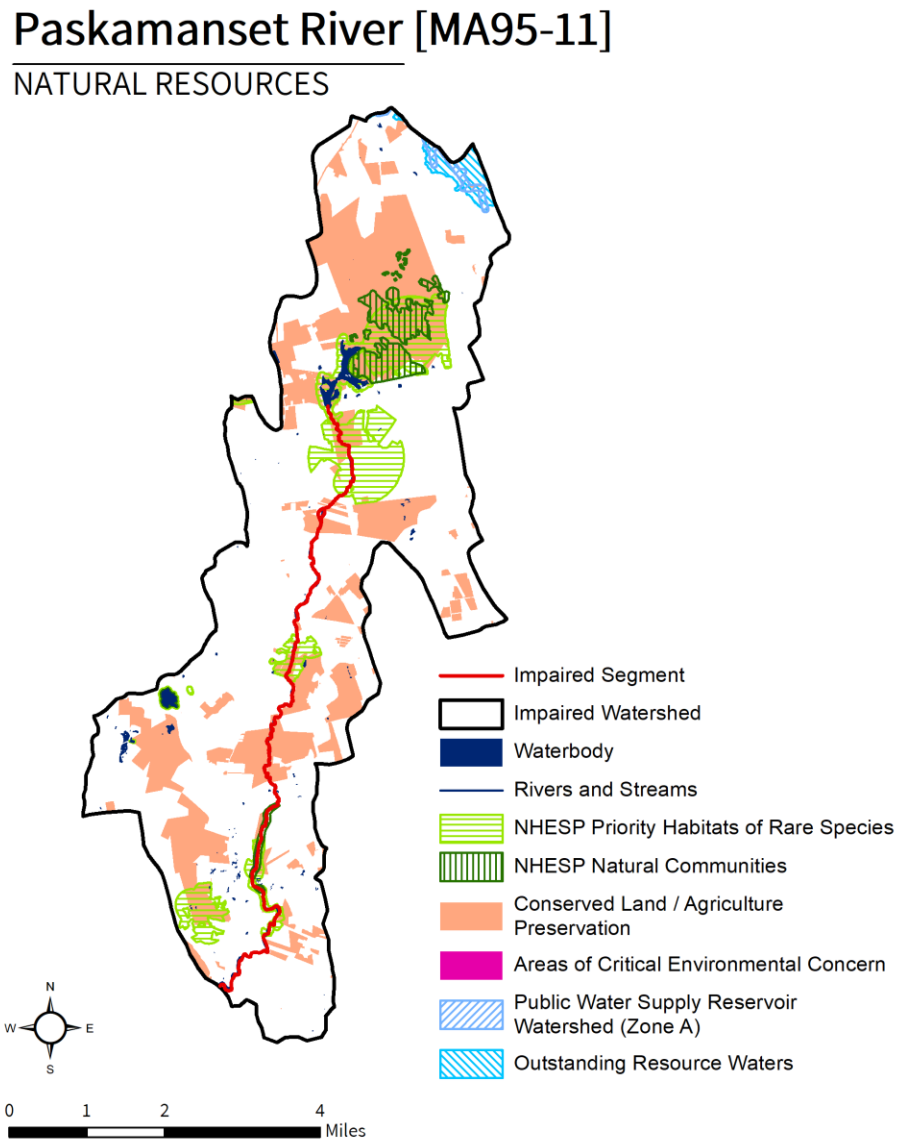
MassDEP discharge-to-groundwater permits for on-site wastewater discharge, or combined sewer overflows (CSOs) within the watershed. There are four landfills and no unpermitted land disposal dumping grounds. See Figure 5-1.

The Paskamanset River segment MA95-11 watershed is located in a moderately-developed part of Massachusetts. The land use within the watershed is fairly evenly distributed between forest and other natural areas (40%), wetlands (33%), and development (25%). There is very little agricultural activity (2%); most of the development consists of residential areas, high density urban development, and industrial and commercial development. Most of the agricultural activity consists of pasture/hay and cultivated fields located directly adjacent to wetland areas in the watershed.

In the Paskamanset River (MA95-11) watershed, under the Natural Heritage and Endangered Species Program, there are 1,849 acres (10%) of Priority Habitats of Rare Species and 525 acres (3%) of Priority Natural Vegetation Communities. There are 78 acres (<1%) under Public Water Supply protection, none within Areas of Critical Environmental Concern, and 222 acres (1%) of Outstanding Resource Waters. Overall, there are 4,190 acres (23%) of land protected in perpetuity[8], part of 4,914 acres (27%) 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.



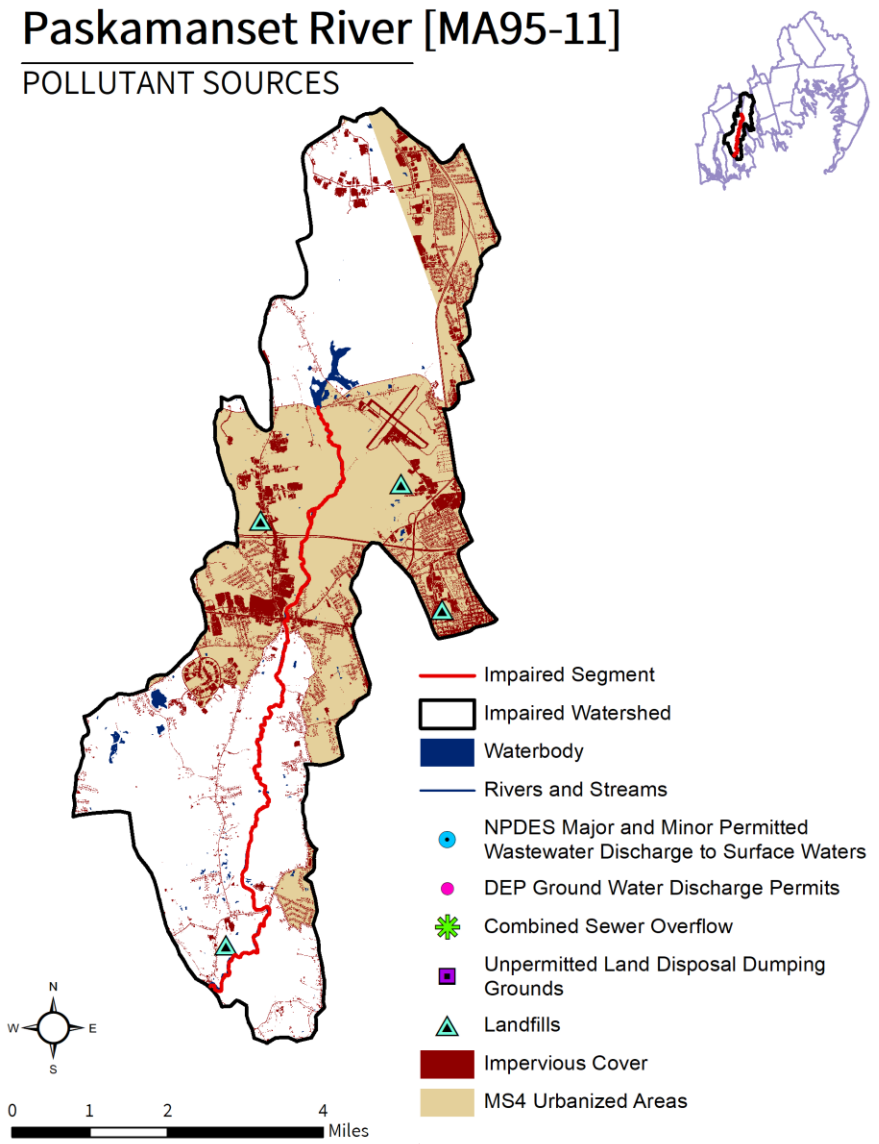


Figure 5-1. Natural resources and potential pollution sources draining to the Paskamanset River segment MA95-11. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

5.2. Waterbody Impairment Characterization

The Paskamanset River (MA95-11) 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, 5-3; Figure 5-2) using the bacterial indicators, *E. coli* and enterococci. Data were evaluated against the SWQS geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria and the STV criterion of 410 CFU/100 mL for *E. coli*. And data were evaluated against the SWQS geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria and the STV criterion of 130 CFU/100 mL for enterococci. The geomean and STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

In 2005, five *E. coli* samples were collected at W1376; 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.

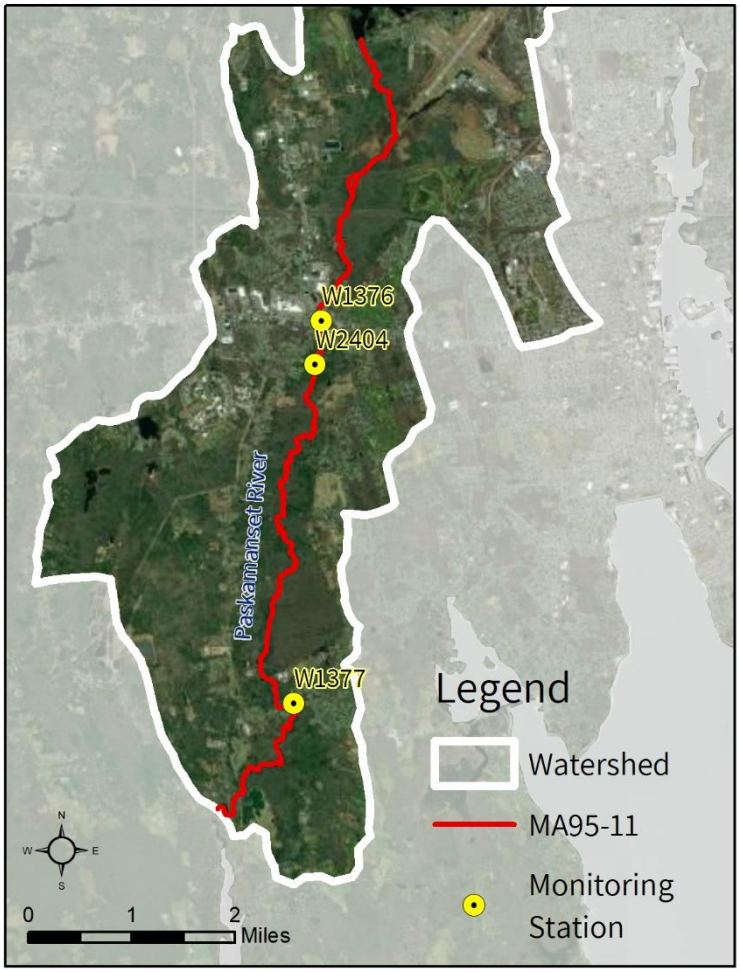


Figure 5-2. Location of monitoring station(s) along the impaired segment.

- In 2005, six *E. coli* samples were collected at W1377; 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 STV criterion was applied to single sample results. Out of six samples, one exceeded the STV criterion during wet weather.
- In 2013, five *E. coli* samples were collected at W2404; 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 STV criterion was applied to single sample results. Out of five samples, two exceeded the STV criterion during wet weather.
- In 2005, four enterococci samples were collected at W1376; 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 STV criterion was applied to single sample results. Out of four samples, one exceeded the STV criterion during dry weather.
- In 2005, five enterococci samples were collected at W1377; 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 STV criterion was applied to single sample results. Out of five samples, two exceeded the STV criterion, one during wet weather and one during dry weather.

Table 5-1. Summary of *E. coli* sampling results by station for the Paskamanset River (MA95-11). 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 sites is used to calculate the percent load reduction required to meet SWQS.

Unique Station ID	First Sample	Last Sample	Count	Maximum 90-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1376	5/3/2005	9/12/2005	5	234	2	1
W1377	5/3/2005	9/12/2005	6	342	3	1
W2404	5/30/2013	9/23/2013	5	1104	5	2

Table 5-2. Summary of enterococci sampling results by station for the Paskamanset River (MA95-11). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria, and the number of single samples exceeding the STV criterion of 130 CFU/100 mL for enterococci 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.

Unique Station ID	First Sample	Last Sample	Count	Maximum 90-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1376	5/3/2005	8/2/2005	4	78	2	1
W1377	5/3/2005	8/30/2005	5	202	5	2

Table 5-3. Indicator bacteria data by station, indicator, and date for the Paskamanset River (MA95-11). 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 for *E. coli* and 130 CFU/100 mL for enterococci indicator bacteria (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the STV); and red text in the Geomean column highlights exceedances of 126 CFU/100 mL for *E. coli* and 35 CFU/100 mL for enterococci indicator bacteria (applied to rolling 90-day geomean).

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1376	*E. coli*	5/3/2005	WET	3*	3	
W1376	*E. coli*	6/9/2005	DRY	110	17	
W1376	*E. coli*	6/28/2005	DRY	1,300	71	
W1376	*E. coli*	8/2/2005	DRY	90	234	
W1376	*E. coli*	9/12/2005	DRY	30	152	
W1376	Enterococci	5/3/2005	WET	3*	3	
W1376	Enterococci	6/9/2005	DRY	60	12	
W1376	Enterococci	6/28/2005	DRY	400	39	
W1376	Enterococci	8/2/2005	DRY	20	78	
W1376	Fecal Coliform	5/3/2005	WET	30		
W1376	Fecal Coliform	6/9/2005	DRY	80		
W1376	Fecal Coliform	6/28/2005	DRY	1,500		
W1376	Fecal Coliform	8/2/2005	DRY	85		
W1376	Fecal Coliform	9/12/2005	DRY	35		
W1377	*E. coli*	5/3/2005	WET	30	30	
W1377	*E. coli*	6/9/2005	DRY	55	41	
W1377	*E. coli*	6/28/2005	DRY	300	79	
W1377	*E. coli*	8/2/2005	DRY	150	135	
W1377	*E. coli*	8/30/2005	WET	1,600‡	251	
W1377	*E. coli*	9/12/2005	DRY	190	342	
W1377	Enterococci	5/3/2005	WET	55	55	
W1377	Enterococci	6/9/2005	DRY	30	41	
W1377	Enterococci	6/28/2005	DRY	500	94	
W1377	Enterococci	8/2/2005	DRY	70	102	
W1377	Enterococci	8/30/2005	WET	1,600‡	202	
W1377	Fecal Coliform	5/3/2005	WET	100		
W1377	Fecal Coliform	6/9/2005	DRY	105		
W1377	Fecal Coliform	6/28/2005	DRY	460		
W1377	Fecal Coliform	8/2/2005	DRY	110		
W1377	Fecal Coliform	8/30/2005	WET	1,600‡		
W1377	Fecal Coliform	9/12/2005	DRY	160		
W2404	*E. coli*	5/30/2013	WET	185	185	
W2404	*E. coli*	6/26/2013	DRY	134	157	
W2404	*E. coli*	7/31/2013	DRY	186	166	
W2404	*E. coli*	8/28/2013	WET	17,330	756	
W2404	*E. coli*	9/23/2013	WET	3,440	1,104	

*Value below the Method Detection Limit (MDL) of 5 CFU/100mL; a value of half the MDL is reported and used to calculate the geometric means for *E. coli* and enterococci.
‡Value above the Method Detection Limit (MDL) of 1,600 CFU/100mL; the MDL is reported and used to calculate the geometric means for *E. coli* and enterococci.

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 wildlife and domesticated animal waste (including pets).

Indicator bacteria data for Paskamanset River (MA95-11) were elevated during both wet and dry weather. Elevated results during wet weather are consistent with urban stormwater, pet waste, and wildlife pathogen sources, as are certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation. Elevated results during dry weather suggest that ongoing 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, highly-developed urbanized areas, with industrial and commercial development as well. Within the watershed, 46% of the land area is subject to MS4 permit conditions, 13% is classified as impervious area, and 7% is classified as DCIA. Stormwater runoff from urban areas is likely a source of pathogens.

Illicit Sewage Discharges: Public sewer service is available in the watershed within the town of Dartmouth; the portion of the watershed in New Bedford may be partially served by a public sewer system as well. 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 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 (2%) of the total land use. A few pasture/hay and cultivated fields are located next to wetland areas within the watershed, especially around the headwaters of the segment. Manure storage and spreading activities, if not properly conducted, are possible sources of pathogens to waterbodies.

Pet Waste: There are many residential neighborhoods and natural areas near the Paskamanset River segment MA95-11. 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.

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.

City of New Bedford

The majority of New Bedford is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041140), and the city has an EPA-approved Notice of Intent (NOI). The city has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. In 2016, New Bedford 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, fecal coliform-impaired MS4 receiving waters include 12 stormwater outfalls into the Acushnet River (MA95-33), 18 outfalls into Buttonwood Brook (MA95-13), seven outfalls into Clarks Cove (MA95-38), 22 outfalls into the New Bedford Inner Harbor (MA95-42), 14 outfalls into the Outer New Bedford Harbor (MA95-63), and 10 outfalls into Sassaquin Pond (MA62232).

New Bedford has the following ordinances and bylaws, mostly accessible online via the city website https://www.newbedford-ma.gov/ (City of New Bedford, 2021):

- Wetland protection bylaw
- Stormwater control bylaw and utility fee
- Pet Waste: None found

New Bedford has a 2020 Master Plan, which includes discussion of environmental challenges that the city is likely to face in the future. These challenges include loss of open space and the presence of two superfund sites within the city limits (8-4). This section also identifies the public sewer system as an environmental challenge, as the sewer is currently a combined system, with some untreated waste flow discharging directly into the harbor through outfalls (8-4). Stormwater management is mentioned throughout the plan, frequently relating to future construction planning and road guidelines (7-7). No separate Open Space and Recreation Plan was found online (City of New Bedford, 2021).

Town of Dartmouth

About 80% of Dartmouth is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR0401102), 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. Dartmouth completed an illicit discharge detection and elimination (IDDE) plan in 2017, and an erosion and sedimentation control (ESC) plan and post-construction stormwater regulations in 2018. According to the NOI, no receiving waters were impaired by pathogens.

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

- Wetland protection bylaw
- Stormwater control bylaw
- Pet Waste: None found

Dartmouth has a 2023 Master Plan containing chapters about Natural and Cultural resources (Dartmouth Master Plan, Ch. 7) and the Climate Change and Resilience (Dartmouth Master Plan, Ch. 11). Additionally, the plan includes an environmental inventory and analysis which contains a list and description of waterbodies within the town's jurisdiction (Dartmouth Master Plan, Ch. 7: pgs. 4 - 10). There is an additional Environmental Challenges section that lists all the impairments and existing TMDLs for those impairments (Dartmouth Master Plan, Ch. 7: pgs. 18 - 20). Dartmouth depends on town wells for most of its water supply. The town has a 2023 Open Space and Recreation Plan (OSRP) designed to inform planning until 2030. This plan includes more in-depth environmental inventories and analysis on water resources, specifically, watersheds, surface waters, wetlands, and aquifer protection zones (Dartmouth OSRP, pgs. 67 – 77; Town of Dartmouth, 2024).

6. MA95-12 Shingle Island River

6.1. Waterbody Overview

Shingle Island River segment MA95-12 is 5.0 miles long and begins at the outlet of a small unnamed pond northeast of Flag Swamp Road in Dartmouth, MA. The segment flows southwest before ending at the inlet of Noquochoke Lake's north basin in Dartmouth, MA.

Tributaries to Shingle Island River segment MA95-12 include Copicut River and several unnamed streams. Lakes and ponds in the watershed include Copicut Reservoir and a few small unnamed waterbodies. Much of the river flows through wetland areas.

Key landmarks in the watershed include Crapo Hill Landfill; Copicut Rifle Association and Rod & Gun Club of New Bedford; many reserves with associated recreational trails such as Dartmouth Regional Park and Trail, Copicut Woods; and several conservation lands. From upstream to downstream, segment MA95-12 is crossed by Flag Swamp Road, Old Fall River Road, Hixville Road, and Interstate 195, all in Dartmouth.

Shingle Island River (MA95-12) drains a total area of 21.1 square miles (mi^2), of which 0.6 mi^2 (3%) are impervious and 0.2 mi^2 (1%) are directly connected impervious area (DCIA). The watershed is partially served by public sewer systems in Dartmouth and Fall River, and may be partially served by a public sewer system in Freetown[10]. 7% 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 three landfills and no unpermitted land disposal dumping grounds. See Figure 6-1.

The Shingle Island River segment MA95-12 watershed is located in a fairly undeveloped part of Massachusetts. More than half of the watershed consists of forest and natural lands (66%) and 24% consists of wetland areas. The remainder of the watershed is covered by development (7%) as

Reduction from Highest Calculated Geomean: 55%

Watershed Area (Acres): 13,503

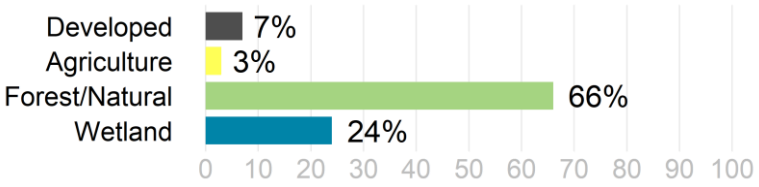
Segment Length (Miles): 5.0

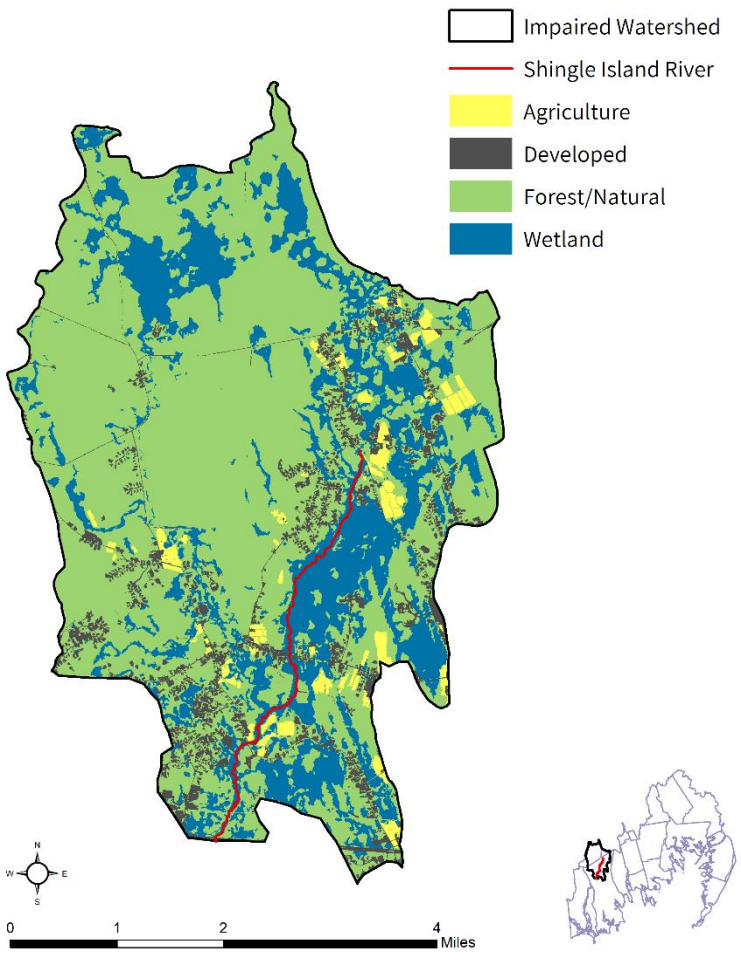
Impairment(s): Enterococci (Primary Contact Recreation)

Class (Qualifier): A (Public Water Supply, Outstanding Resource Water)

Impervious Area (Acres, %): 384 (3%)

DCIA Area (Acres, %): 156 (1%)





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

there is very little agricultural activity (3%). 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 some cranberry bogs located directly adjacent to wetland areas in the watershed.

In the Shingle Island River (MA95-12) watershed, under the Natural Heritage and Endangered Species Program, there are 7,814 acres (58%) of Priority Habitats of Rare Species and 122 acres (1%) of Priority Natural Vegetation Communities. There are also 999 acres (7%) under Public Water Supply protection, none within Areas of Critical Environmental Concern, and 4,313 acres (32%) of Outstanding Resource Waters. Overall, there are 6,580 acres (49%) of land protected in perpetuity[11], part of 6,886 acres (51%) 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.

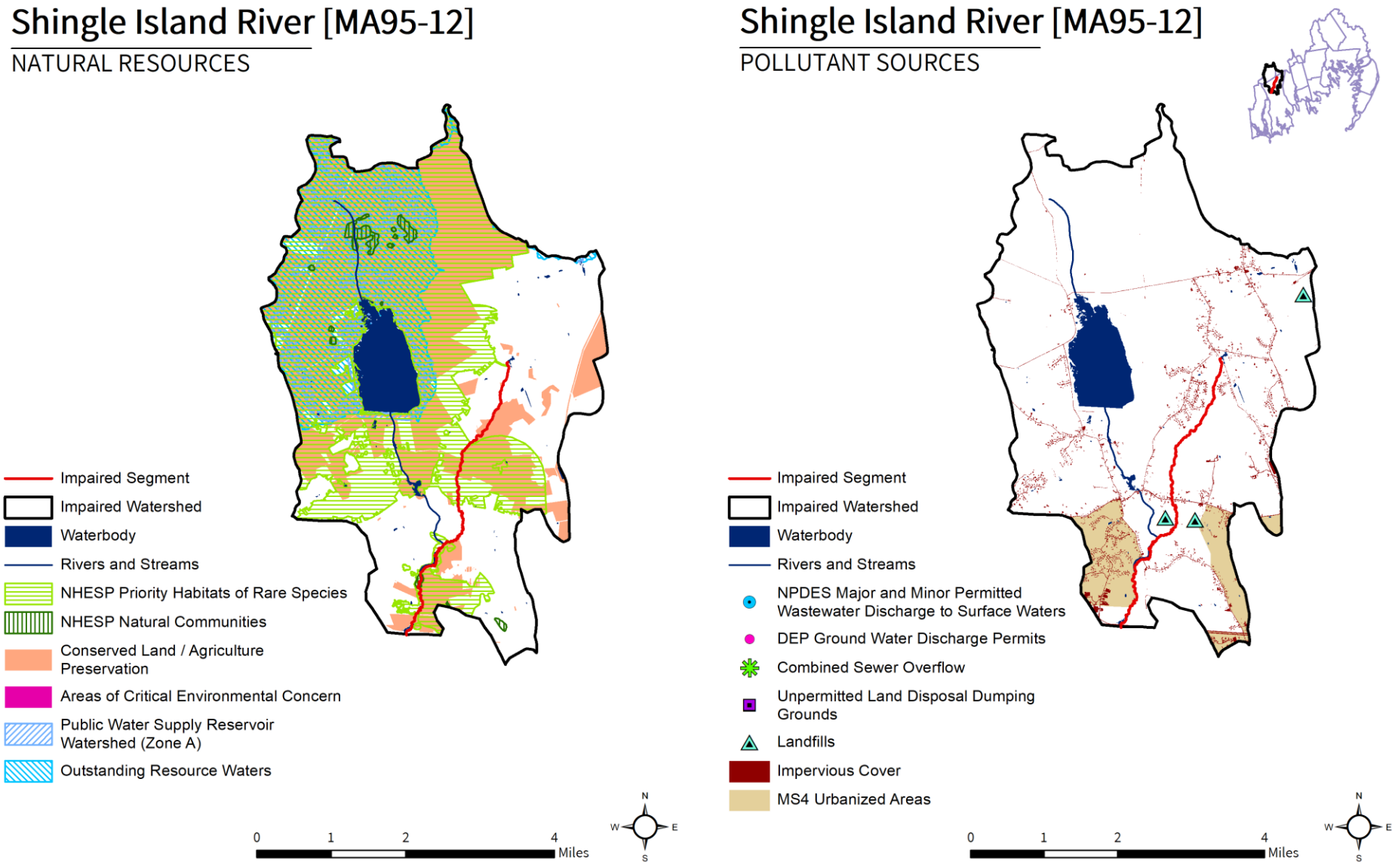


Figure 6-1. Natural resources and potential pollution sources draining to the Shingle Island River segment MA95-12. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

6.2. Waterbody Impairment Characterization

The Shingle Island River (MA95-12) is a Class A, Public Water Supply, and Outstanding Resource Water (MassDEP, 2021a).

The Primary Contact Recreation use was assessed for attainment of SWQS at the stations listed below (refer to Tables 6-1, 6-2; Figure 6-2). using the indicator bacteria enterococci. Data were evaluated against the SWQS geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria and the STV criterion of 130 CFU/100 mL for enterococci. The geomean and STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

In 2005, four samples were collected at W1366; 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 Statistical Threshold Value (STV) criterion was applied to single sample results. Out of four samples, one exceeded the STV criterion during dry weather.

- In 2005, four samples were collected at W1367; 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 STV criterion was applied to single sample results. Out of four samples, one exceeded the STV criterion during dry weather.

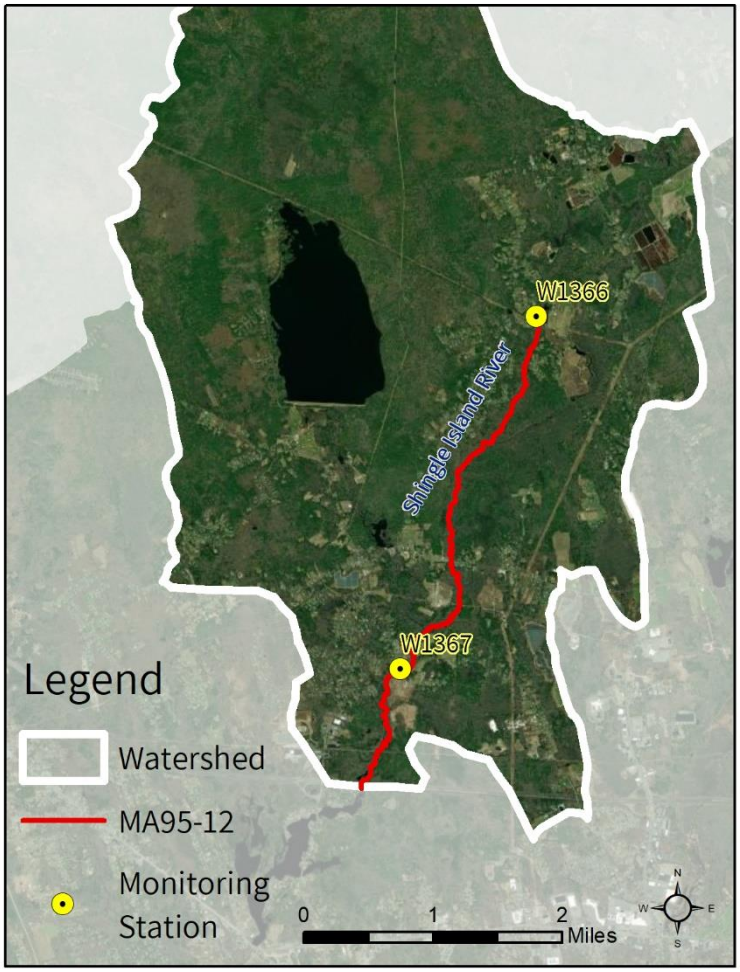


Figure 6-2. Location of monitoring station(s) along the impaired segment.

Table 6-1. Summary of indicator bacteria sampling results by station for the Shingle Island River (MA95-12). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria, and the number of single samples exceeding the STV criterion of 130 CFU/100 mL for enterococci indicator bacteria are shown. The STV criterion is applied to the single sample results if less than 10 samples were collected within a calendar year at a site. The highest maximum 90-day rolling geomean of the sites is used to calculate the percent load reduction required to meet SWQS.

Unique Station ID	First Sample	Last Sample	Count	Maximum 90-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1366	5/3/2005	8/2/2005	4	20	0	1
W1367	5/3/2005	8/2/2005	4	78	2	1

Table 6-2. Indicator bacteria data by station, indicator, and date for the Shingle Island River (MA95-12). 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 for *E. coli* and 130 CFU/100 mL for enterococci indicator bacteria (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the STV); and red text in the Geomean column highlights exceedances of 126 CFU/100 mL for *E. coli* and 35 CFU/100 mL for enterococci indicator bacteria (applied to rolling 90-day geomean).

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1366	Enterococci	5/3/2005	WET	3*	3	
W1366	Enterococci	6/9/2005	DRY	3*	3	
W1366	Enterococci	6/28/2005	DRY	20	5	
W1366	Enterococci	8/2/2005	DRY	150	20	
W1366	*E. coli*	5/3/2005	WET	5	5	
W1366	*E. coli*	6/9/2005	DRY	30	12	
W1366	*E. coli*	6/28/2005	DRY	45	19	
W1366	*E. coli*	8/2/2005	DRY	10	24	
W1366	*E. coli*	9/12/2005	DRY	35	25	
W1366	Fecal Coliform	5/3/2005	WET	5		
W1366	Fecal Coliform	6/9/2005	DRY	15		
W1366	Fecal Coliform	6/28/2005	DRY	40		
W1366	Fecal Coliform	8/2/2005	DRY	30		
W1366	Fecal Coliform	9/12/2005	DRY	130		
W1367	Enterococci	5/3/2005	WET	20	20	
W1367	Enterococci	6/9/2005	DRY	25	22	
W1367	Enterococci	6/28/2005	DRY	105	37	
W1367	Enterococci	8/2/2005	DRY	180	78	
W1367	*E. coli*	5/3/2005	WET	20	20	
W1367	*E. coli*	6/9/2005	DRY	45	30	
W1367	*E. coli*	6/28/2005	DRY	440	73	
W1367	*E. coli*	8/2/2005	DRY	125	135	
W1367	*E. coli*	9/12/2005	DRY	200	222	
W1367	Fecal Coliform	5/3/2005	WET	35		
W1367	Fecal Coliform	6/9/2005	DRY	40		
W1367	Fecal Coliform	6/28/2005	DRY	500		
W1367	Fecal Coliform	8/2/2005	DRY	130		
W1367	Fecal Coliform	9/12/2005	DRY	205		

*Value below the Method Detection Limit (MDL) of 5 CFU/100mL; a value of half the MDL is reported and used to calculate the geometric means for *E. coli* and enterococci.

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 wildlife and domesticated animal waste (including pets).

Indicator bacteria data for Shingle Island River (MA95-12) were elevated solely during dry weather. 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. Additional sampling under wet 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 relatively small amount of development in the watershed (7%), most of which consists of residential areas with some industrial and commercial development as well. Within the watershed, 7% 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 likely a minor source of pathogens.

Illicit Sewage Discharges: Public sewer service is available in the watershed within the Massachusetts municipalities of Dartmouth and Fall River; and Freetown may be partially served by a public sewer system. 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 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 (3%) 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 and parks near the Shingle Island River segment MA95-12, including a dog park. 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.

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.

City of Fall River

The majority of Fall River is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041113), and the city has an EPA-approved Notice of Intent (NOI). The city has mapped 100% of its MS4 system and the year-one and year-two Annual Reports have been submitted. In 2009, Fall River completed an illicit discharge detection and elimination (IDDE) plan, which was updated in 2019. The city completed an erosion and sedimentation control (ESC) plan in 2015 and post-construction stormwater regulations in 2018. The city also has a 2018 Stormwater Management Plan (SWMP). No pathogen-impaired waterbodies within the Buzzards Bay watershed were reported on the city's NOI.

Fall River has the following ordinances and bylaws, mostly accessible online via the city website https://www.fallriverma.org/ (City of Fall River, 2021):

- Stormwater and stormwater fee ordinance
- Pet waste disposal ordinance
- Wetland Protection Bylaw: None Found

Fall River's Master Plan was adopted in 2009 and is meant to inform planning up until the year 2030. This plan has an extensive section on natural resources and the environment in the city (pg. 13). Stormwater is only

mentioned in the plan's section on utilities and infrastructure (pg. 45). There is no mention of MS4 regulations or impairment within the city. Additionally, Fall River has a 2010 Open Space and Recreation Plan (OSRP), with a more extensive inventory of conserved lands and natural resources. The OSRP also identifies and analyzes future conservation needs within the community (City of Fall River, 2021).

Town of Dartmouth. See Section 4.4

7. MA95-19 Megansett Harbor

7.1. Waterbody Overview

The Megansett Harbor segment MA95-19 is 1.4 square miles (mi^2) and is tidally influenced. The segment begins at the outlet of Squeteague Harbor in Falmouth and extends to Buzzards Bay from the tip of Scraggy Neck in Bourne to the southern tip of Nyes Neck in Falmouth.

Tributaries to the Megansett Harbor segment MA95-19 include Squeteague Harbor, which is fed by an unnamed stream. Lakes and ponds in the watershed include Cuffs Pond, Long Pond, Osbourne Pond, Edmunds Pond, and a few small unnamed waterbodies. Much of the estuary is surrounded by forest.

Key landmarks in the watershed include the Megansett Yacht Club and Cataumet Club; Megansett Beach, Eustis Beach, Sunrise Beach, and Southwest Beach; the North Falmouth Library; a small portion of the Cape Cod US Coast Guard Base; and a very small portion of the Cape Golf Club. Segment MA95-19 is crossed by Waterside Drive in Falmouth.

Megansett Harbor (MA95-19) drains a total area of 8.3 mi^2, of which 0.9 mi^2 (10%) are impervious area. A 200-foot buffer around the segment covers an area of 0.24 mi^2, of which 0.02 mi^2 (6%) are impervious area. The watershed may be partially served by a public sewer system in Falmouth, Bourne, and Sandwich[13], and 45% 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. See Figure 7-1.

The Megansett Harbor segment MA95-19 watershed is located in a moderately-developed part of Massachusetts. The majority of the watershed is covered by forest and natural areas (75%) while only 1% is covered by wetlands. The remainder of the watershed is developed (23%)

Reduction from Highest Calculated Geomean: NA

Watershed Area (Acres): 5,301

Segment Area (mi^2): 1.4

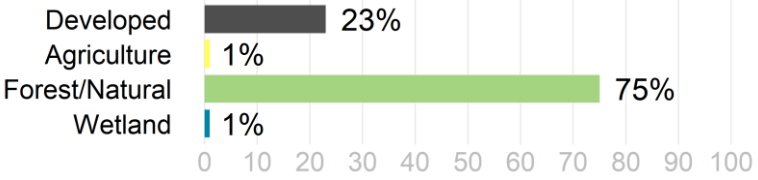
200-foot Buffer Area (Acres): 154

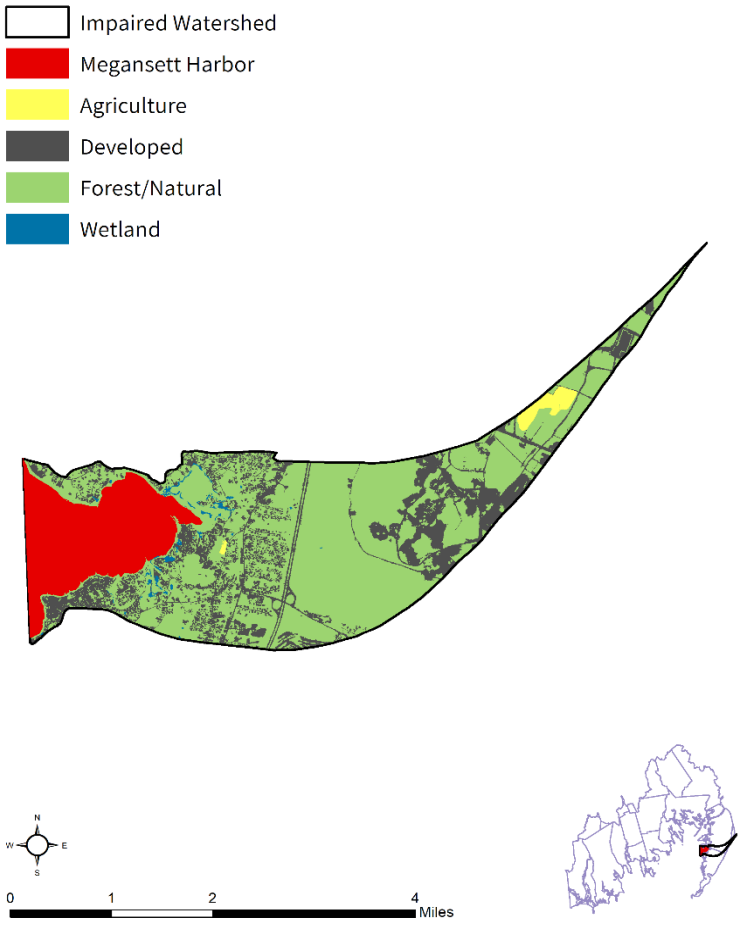
Impairment(s): Fecal coliform (Shellfish)

Class: SA (Shellfishing)

Impervious Area (Acres, %): 548 (10%)

Impervious Area Within 200-foot Buffer (Acres, %): 9 (6%)





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

with a small area in agricultural use (1%). Forest and natural areas, small wetlands and development surround the impaired segment. Development is interspersed throughout the southern portion of the impaired segment watershed and dense in the upper watershed. The majority of the agricultural land is in the headwaters of the watershed.

In the Megansett Harbor (MA95-19) watershed, under the Natural Heritage and Endangered Species Program, there are 3,018 acres (57%) of Priority Habitats of Rare Species and 417 acres (8%) of 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 880 acres (16%) of land protected in perpetuity[14], part of 1,212 acres (23%) 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.

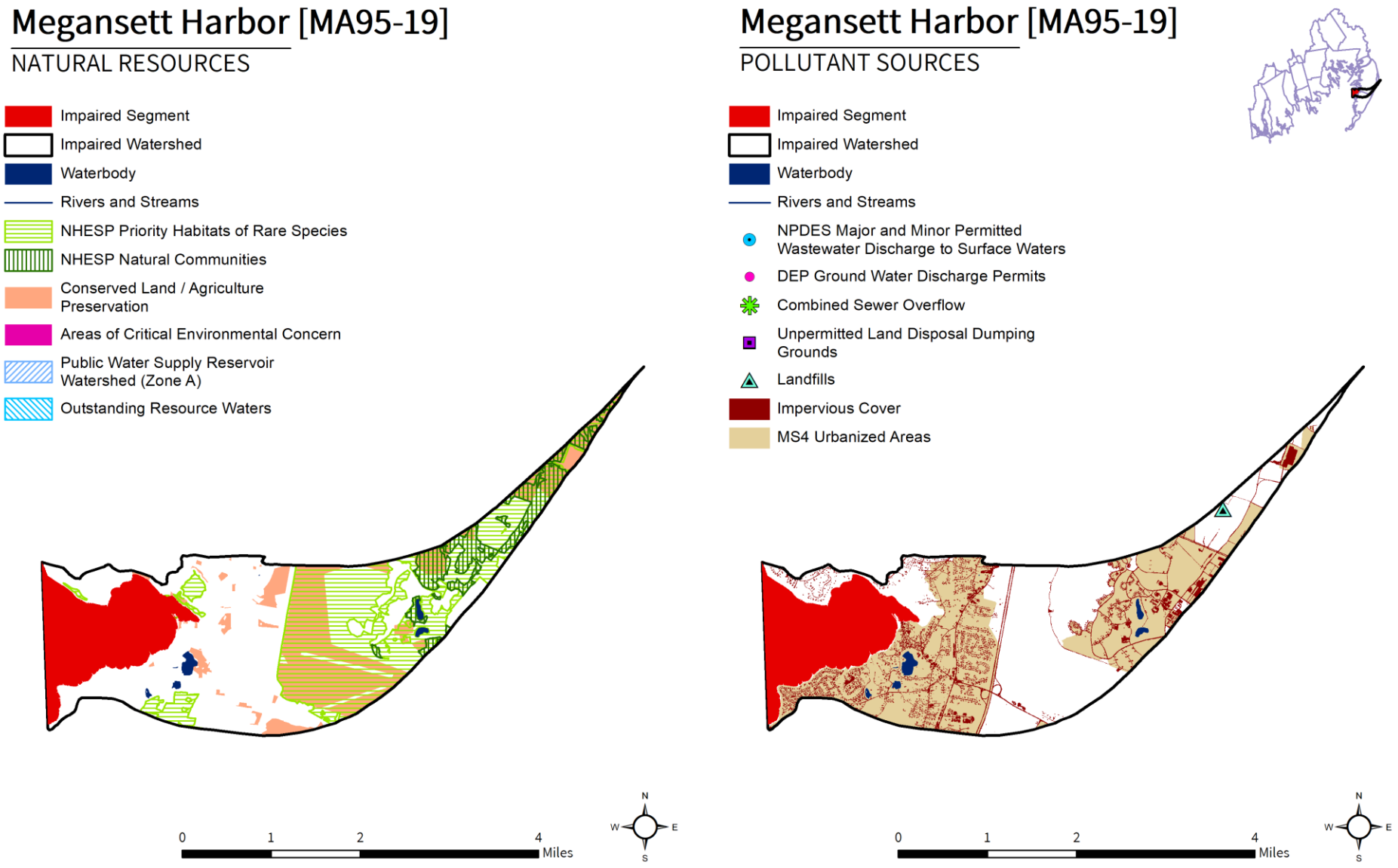


Figure 7-1. Natural resources and potential pollution sources draining to the Megansett Harbor segment MA95-19. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

7.2. Waterbody Impairment Characterization

Megansett Harbor (MA95-19) is a Class SA tidal estuary, with a Shellfishing qualifier (MassDEP, 2021a).

The Shellfish Harvesting use was assessed for attainment of SWQS using fecal coliform indicator bacteria at three shellfish growing areas that cover 1.42 mi^2 (100% of the segment area; refer to Figure 7-2). MassDEP assessed the Shellfish Harvesting use as not supporting since the growing area normalized to the segment area is less than 100% approved for shellfishing by the Massachusetts Division of Marine Fisheries (Table 7-1).

This segment also includes four beaches with sufficient beach posting data within the DPH Beach Posting Database (2005-2013 data) to assess the contact recreational uses. Both the Primary and Secondary Contact Recreation Uses were assessed as Support since postings rarely, if ever, exceeded 10% of the days within any swimming season (MassDEP, 2022).

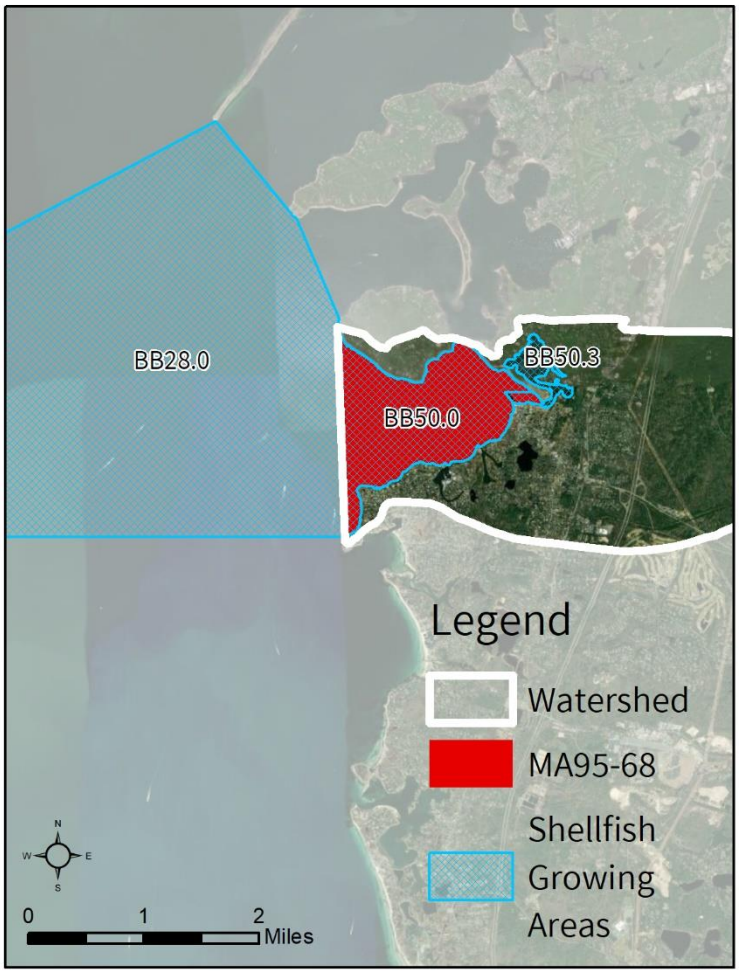


Figure 7-2. Location of the shellfish growing areas associated with the impaired segment.

Table 7-1. Summary of MA DFG Division of Marine Fisheries classification data from January 2014 for three shellfish growing areas in the Megansett Harbor segment MA95-19. Percentage indicates the relative area within the segment covered by each shellfish growing area. Shellfish Harvesting is classified as not supporting if the growing area normalized to the segment area is less than 100% approved for shellfishing by the Massachusetts Division of Marine Fisheries.

Name	Area Description	Class	Area (mi^2)	Percentage
BB28.0	North Buzzards Bay	Approved	0.0029	<1%
BB50.0	Megansett Harbor	Approved	1.3977	98%
BB50.3	Squeteague Harbor	Conditionally Approved	0.0222	2%

7.3. Potential Pathogen Sources

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a moderate amount of development in the watershed (23%), most of which consists of residential areas with some industrial and commercial development as well. Within the watershed, 45% of the land area is subject to MS4 permit conditions, 10% is classified as impervious area, and 6% of the land area within a 200-foot buffer of the segment is classified as impervious area. Stormwater runoff from urban areas is a likely source of pathogens.

Illicit Sewage Discharges: Public sewer service may be partially available in the watershed within the towns of Falmouth, Borne, and Sandwich. 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 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.

Illicit Boat Discharges: The segment is navigable by marine vessels. Vessels with onboard toilets are required to have a marine sanitation device (MSD) to treat or store wastewater. MSDs that treat wastewater may be improperly maintained or malfunctioning and therefore could discharge untreated sewage to coastal waterbodies. For MSDs that store wastewater, this sewage can either be pumped out at shore-based pump-out facilities or discharged directly into the water when the vessel is more than three miles offshore, outside of the designated No Discharge Zone (NDZ). Negligent boaters who ignore these laws and discharge untreated sewage to coastal waterbodies may be a source of pathogen pollution.

Vessel Pump-Out Facilities: There is one vessel sewage pump-out facility near Megansett Harbor segment MA95-19: Brewer's Fiddler Cove (Falmouth). Although pump-out facilities provide boaters with a means of disposing of onboard sewage without discharging it into coastal waters, these facilities are generally associated with high boating activity. Pump-out facilities which malfunction or leak also represent a potential pathogen source. As a result, waterbodies adjacent to pump-out facilities are likely at high risk of illicit boat (or facility) discharges.

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 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, natural areas, and beaches near the Megansett Harbor segment MA95-19. 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 small open wetland areas are directly adjacent to the impaired segment, and residential development is concentrated along the segment's shoreline. 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 Bourne

The majority of Bourne is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041094), 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. Bourne completed an illicit discharge detection and elimination (IDDE) plan in 2005, and an erosion and sedimentation control

(ESC) plan and post-construction stormwater regulations in 2017. The town reports 39 outfalls into the Cape Cod Canal (MA95-14), one outfall into the Back River (MA95-47), five outfalls into the Pocasset River (MA95-16[16]), and four outfalls into Eel Pond (MA95-48), all impaired by pathogens (indicator not specified in the NOI). Additionally, the town reports 15 outfalls into Buttermilk Bay (MA95-01), three outfalls into Pocasset Harbor (MA95-17), 18 outfalls into Red Brook Harbor[17] (MA95-18), four outfalls into Phinneys Harbor (MA95-15), and four outfalls into Buzzards Bay (MA95-62), all impaired by fecal coliform.

Bourne has the following ordinances and bylaws, mostly accessible online via the town website https://www.townofbourne.com/ (Town of Bourne, 2021):

- Wetland protection ordinance
- Pet waste disposal ordinance
- No stormwater ordinance found
- Stormwater Utility: None found

Bourne's 2019 Master Plan includes many sections related to environmental protection and related activities, in particular, a section titled "Water Resources". This section notes both active stormwater management and sewer/septic regulations. No specific pathogen impairments, or impaired waterbodies in general, were listed. The town of Bourne also has a current Open Space and Recreation Plan (2018), which identifies water bodies within the town as susceptible to contamination (Town of Bourne, 2021).

Town of Falmouth

The majority of Falmouth is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041114), 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. Falmouth completed an illicit discharge detection and elimination (IDDE) plan in 2019; the erosion and sedimentation control (ESC) plan is included in the IDDE plan. Post-construction stormwater regulations, required under MS4, were completed by June 30, 2021. According to the NOI, Falmouth has four waterbodies draining to Buzzards Bay impaired by fecal coliform which are receiving waters for its MS4 system. These waterbodies are Quissett Harbor (MA95-25) with one outfall, West Falmouth Harbor (MA95-22) with one outfall, Wild Harbor (MA95-20) with two outfalls, and Herring Brook (MA95-21) with three outfalls.

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

- Stormwater protection bylaw
- Wetland Protection bylaw
- Stormwater Utility: None found
- Pet Waste: None found

Falmouth has a Local Comprehensive Plan created in 2016, with sections focusing on the environment, coastal resiliency, water and wastewater, and land use, though stormwater runoff is not specifically mentioned. The water and wastewater section focuses predominantly on drinking water and public sewer service, which is provided by the town's municipal systems (pg. 18). Falmouth also has an Open Space and Recreation Plan from 2014 which contains an inventory of existing environmental resources and conserved lands within the town (Town of Falmouth, 2021).

[16] Listed incorrectly as MA95-76 on the town's NOI.

[17] Listed incorrectly as Red Brook on the town's NOI.

8. MA95-36 Mattapoisett River

8.1. Waterbody Overview

Mattapoisett River segment MA95-36 is 10.4 miles long and begins at the outlet of Snipatuit Pond in Rochester, MA. The segment flows generally south and ends at the Mattapoisett River Dam at Fairhaven Road/US-6 in Mattapoisett, MA.

Tributaries to Mattapoisett River segment MA95-36 include Branch Brook and many unnamed streams. Lakes and ponds in the watershed include Long Pond, Snows Pond, Tinkham Pond, and a few unnamed waterbodies. Much of the river flows through wetland or forested and natural areas.

Key landmarks in the watershed include the Rochester Memorial School, Old Hammondtown Elementary School, and Old Colony Regional Vocational Technical High School; Rochester Fire Department and the Mattapoisett Transfer Station; Sterling Point and Edgewood Farms; Chipaway Stables; the Rochester Country Fairgrounds; the Ponderosa Sportsman's Club; the Greenbrier Girl Scouts Camp, Rochester Wildlife Management Area, Shoolman Nature Preserve, and Mattapoisett River Valley Lands; Snipatuit Pond Fisherman's Landing and Boat Launch; and several solar farms. From upstream to downstream, segment MA95-36 is crossed by Snipatuit Road (Rochester), Hartley Road (Rochester), Rounseville Road/ MA-105 (Rochester), New Bedford Road (Rochester), Wolf Island Road (Rochester), an unnamed road (Mattapoisett), Tinkham Lane (Mattapoisett), Acushnet Road (Mattapoisett), Interstate 195 (Mattapoisett), River Road (Mattapoisett), Kyla Way (Mattapoisett), and Fairhaven Road/ US-6 (Mattapoisett).

Mattapoisett River (MA95-36) drains a total area of 24.3 square miles (mi^2), of which 0.8 mi^2 (3%) are impervious and 0.4 mi^2 (1%) are directly connected impervious area (DCIA). The watershed is partially served by public sewer systems in Mattapoisett and Acushnet, and may be partially served by a public sewer system in Rochester[18], and 2% of the total land area is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit

Reduction from Highest Calculated Geomean: 59%

Watershed Area (Acres): 15,568

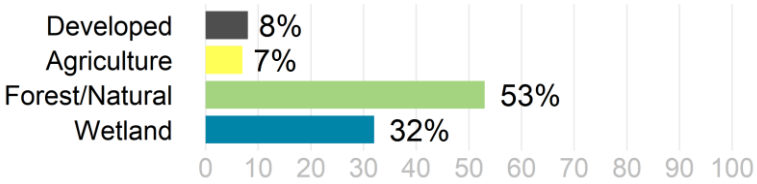
Segment Length (Miles): 10.4

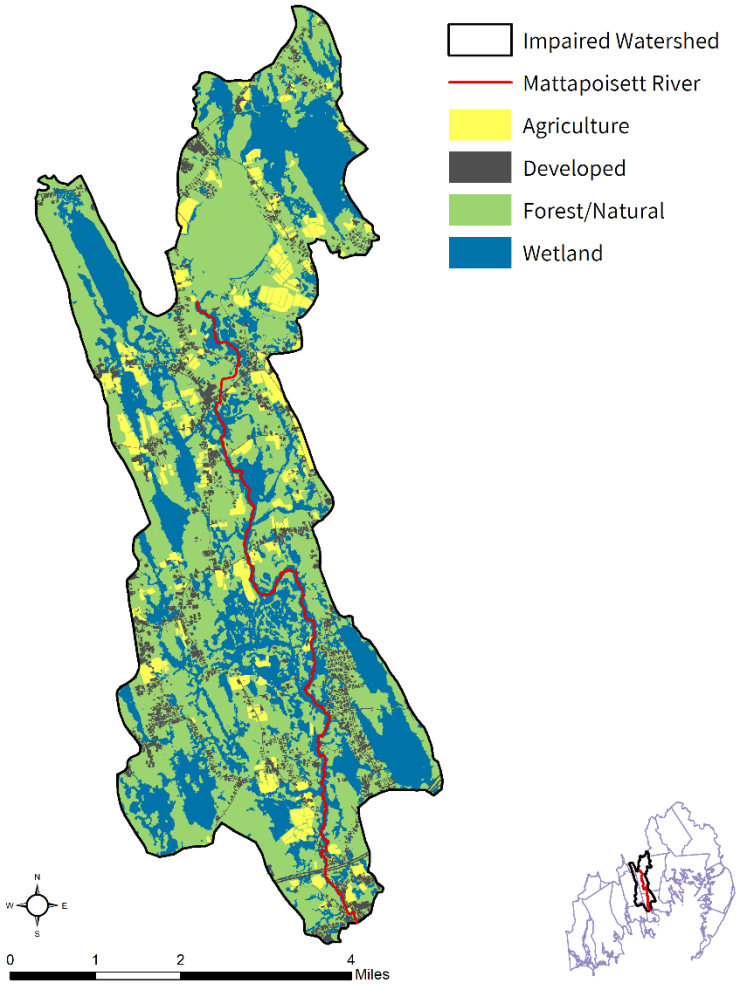
Impairment(s): Enterococci and *E. coli* (Primary Contact Recreation)

Class: B

Impervious Area (Acres, %): 528 (3%)

DCIA Area (Acres, %): 225 (1%)





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

(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. See Figure 8-1.

The Mattapoisett River segment MA95-36 watershed is located in a fairly undeveloped part of Massachusetts. More than half of the watershed consists of forest and natural lands (53%) and 32% consists of wetland areas. The remainder of the watershed is covered fairly evenly by development (8%) and agricultural activity (7%). 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 directly adjacent to wetland areas, with some cranberry bogs in the upper watershed as well.

In the Mattapoisett River (MA95-36) watershed, under the Natural Heritage and Endangered Species Program, there are 6,893 acres (44%) of Priority Habitats of Rare Species and 768 acres (5%) of Priority Natural Vegetation Communities. There are also nine acres (<1%) under Public Water Supply protection, none within Areas of Critical Environmental Concern, and 74 acres (<1%) of Outstanding Resource Waters. Overall, there are 4,468 acres (18%) of land protected in perpetuity[19], part of 5,447 acres (22%) of Protected and Recreational Open Space[20]. See Figure 8-1.

[19] 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.

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

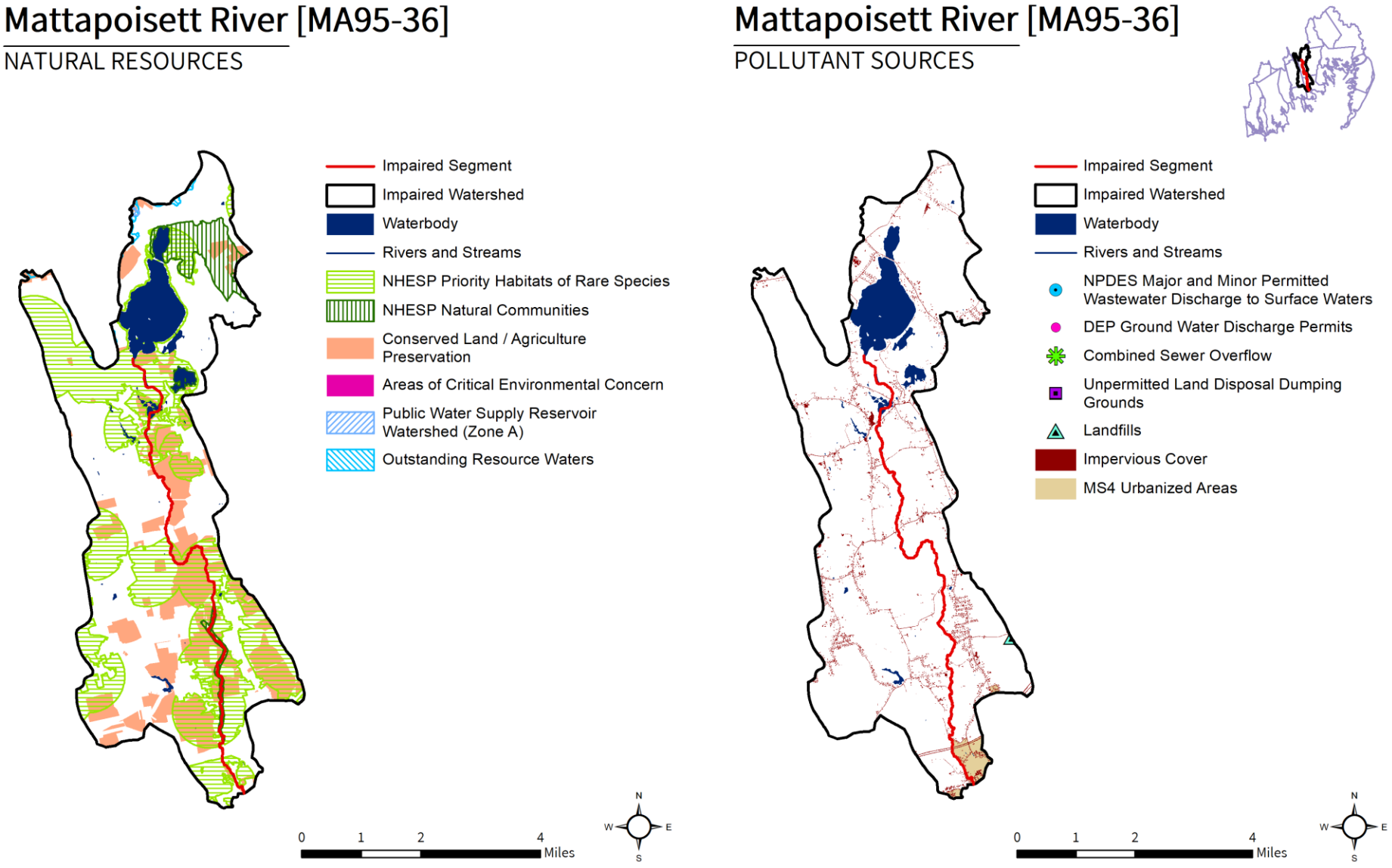


Figure 8-1. Natural resources and potential pollution sources draining to the Mattapoisett River segment MA95-36. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

8.2. Waterbody Impairment Characterization

The Mattapoisett River (MA95-36) 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 8-1, 8-2, 8-3; Figure 8-2) using the bacterial indicators, *E. coli* and enterococci. Data were evaluated against the SWQS geomean criterion of 126 CFU/100 mL for *E. coli* indicator bacteria and the STV criterion of 410 CFU/100 mL for *E. coli*. And data were evaluated against the SWQS geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria and the STV criterion of 130 CFU/100 mL for enterococci. The geomean and STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

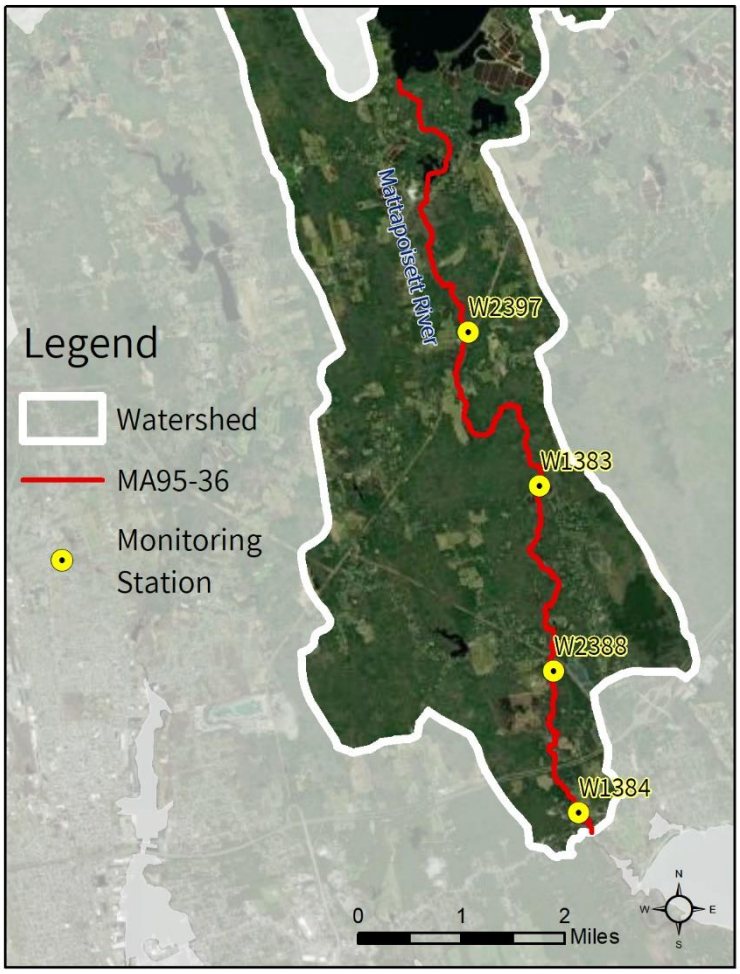


Figure 8-2. Location of monitoring station(s) along the impaired segment.

- In 2005, six *E. coli* samples were collected at W1383; 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 six samples, one exceeded the STV criterion during wet weather.
- In 2005, six *E. coli* samples were collected at W1384; 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 six samples, one exceeded the STV criterion during wet weather.
- In 2013, five *E. coli* samples were collected at W2397; 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 STV criterion was applied to single sample results. Out of five samples, one exceeded the STV criterion during wet weather.
- In 2013, five *E. coli* samples were collected at W2388; 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.
- In 2005, five enterococci samples were collected at W1383; 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 STV criterion was applied to single sample results. Out of five samples, three exceeded the STV criterion, one during wet weather and two during dry weather.
- In 2005, five enterococci samples were collected at W1384; 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 STV criterion was applied to single sample results. Out of five samples, two exceeded the STV criterion, one during wet weather and one during dry weather.

Table 8-1. Summary of *E. coli* sampling results by station for the Mattapoisett River (MA95-36). 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 sites is used to calculate the percent load reduction required to meet SWQS.

Unique Station ID	First Sample	Last Sample	Count	Maximum 90-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1383	5/3/2005	9/12/2005	6	307	3	1
W1384	5/3/2005	9/12/2005	6	117	0	1
W2397	5/16/2013	9/9/2013	5	138	2	1
W2388	5/16/2013	9/9/2013	5	106	0	0

Table 8-2. Summary of enterococci sampling results by station for the Mattapoisett River (MA95-36). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria, and the number of single samples exceeding the STV criterion of 130 CFU/100 mL for enterococci 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.

Unique Station ID	First Sample	Last Sample	Count	Maximum 90-Day Rolling Geomean (CFU/100mL)	Number Geomean Exceedances	Number STV Exceedances
W1383	5/3/2005	8/30/2005	5	186	3	3
W1384	5/3/2005	8/30/2005	5	102	2	2

Table 8-3. Indicator bacteria data by station, indicator, and date for the Mattapoisett River (MA95-36). 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 for *E. coli* and 130 CFU/100 mL for enterococci indicator bacteria (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the STV); and red text in the Geomean column highlights exceedances of 126 CFU/100 mL for *E. coli* and 35 CFU/100 mL for enterococci indicator bacteria (applied to rolling 90-day geomean).

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1383	*E. coli*	5/3/2005	WET	20	20	
W1383	*E. coli*	6/9/2005	DRY	80	40	
W1383	*E. coli*	6/28/2005	DRY	360	83	
W1383	*E. coli*	8/2/2005	DRY	140	159	
W1383	*E. coli*	8/30/2005	WET	1,600‡	283	
W1383	*E. coli*	9/12/2005	DRY	110	307	
W1383	Enterococci	5/3/2005	WET	30	30	
W1383	Enterococci	6/9/2005	DRY	20	24	
W1383	Enterococci	6/28/2005	DRY	135	43	
W1383	Enterococci	8/2/2005	DRY	280	91	
W1383	Enterococci	8/30/2005	WET	1,600‡	186	
W1383	Fecal Coliform	5/3/2005	WET	20		
W1383	Fecal Coliform	6/9/2005	DRY	45		
W1383	Fecal Coliform	6/28/2005	DRY	310		
W1383	Fecal Coliform	8/2/2005	DRY	130		
W1383	Fecal Coliform	8/30/2005	WET	1,600‡		
W1383	Fecal Coliform	9/12/2005	DRY	145		
W1384	*E. coli*	5/3/2005	WET	15	15	
W1384	*E. coli*	6/9/2005	DRY	30	21	
W1384	*E. coli*	6/28/2005	DRY	65	31	
W1384	*E. coli*	8/2/2005	DRY	60	49	
W1384	*E. coli*	8/30/2005	WET	1,600‡	117	
W1384	*E. coli*	9/12/2005	DRY	30	117	

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1384	Enterococci	5/3/2005	WET	25	25	
W1384	Enterococci	6/9/2005	DRY	10	16	
W1384	Enterococci	6/28/2005	DRY	30	20	
W1384	Enterococci	8/2/2005	DRY	225	41	
W1384	Enterococci	8/30/2005	WET	1,600‡	102	
W1384	Fecal Coliform	5/3/2005	WET	40		
W1384	Fecal Coliform	6/9/2005	DRY	45		
W1384	Fecal Coliform	6/28/2005	DRY	105		
W1384	Fecal Coliform	8/2/2005	DRY	100		
W1384	Fecal Coliform	8/30/2005	WET	1,600‡		
W1384	Fecal Coliform	9/12/2005	DRY	40		
W2388	*E. coli*	5/16/2013	DRY	70	70	
W2388	*E. coli*	6/11/2013	WET	161	106	
W2388	*E. coli*	7/17/2013	DRY	84	98	
W2388	*E. coli*	8/14/2013	DRY	80	103	
W2388	*E. coli*	9/9/2013	DRY	86	83	
W2397	*E. coli*	5/16/2013	DRY	22	22	
W2397	*E. coli*	6/11/2013	WET	798	132	
W2397	*E. coli*	7/17/2013	DRY	41	90	
W2397	*E. coli*	8/14/2013	DRY	80	138	
W2397	*E. coli*	9/9/2013	DRY	52	55	

‡Value above the Method Detection Limit (MDL) of 1,600 CFU/100mL; the MDL is reported and used to calculate the geometric means for *E. coli* and enterococci.

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 wildlife and domesticated animal waste (including pets).

Indicator bacteria data for Mattapoisett River (MA95-36) were elevated during both wet and dry weather. Elevated results during wet weather are consistent with urban stormwater, pet waste, and wildlife pathogen sources, as are certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation. Elevated results during dry weather suggest that ongoing 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 relatively small amount of development in the watershed (8%), most of which consists of residential areas with some industrial and commercial development as well. Within the watershed, 2% 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 likely a minor source of pathogens.

Illicit Sewage Discharges: Public sewer service is available in the watershed within the towns of Mattapoisett and Acushnet, and may be partially served by a municipal system in Rochester. 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 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 (7%) of the total land use. A few pasture/hay and cultivated fields are located next to wetland areas and cranberry bogs are present in the upper 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 Mattapoisett River segment MA95-36. 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: Several 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.

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 Acushnet

About two thirds of Acushnet is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041085), 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. Acushnet has completed an erosion and sedimentation control (ESC) plan, an illicit discharge detection and elimination (IDDE) plan and post-construction stormwater regulations. According to the NOI, three segments of the Acushnet River (MA95-33, MA95-32, MA95-31) impaired by fecal coliform receive flow from the MS4 area. There are a total of 60 stormwater outfalls into these three segments of the Acushnet River.

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

- Stormwater bylaws and stormwater utility fees
- Wetland bylaws are present
- Pet Waste: None found
- No supplementary regulations beyond Mass DEP regulations for both stormwater management and wetland protection

Acushnet's Master Plan completed in 2008 has a large section dedicated to natural resources, and a section on open space and recreation planning, but does not make any specific mention of MS4, impaired streams, or bacterial impairment.

Acushnet has an entire page of their website with comprehensive stormwater information (Town of Acushnet, 2021).

Town of Mattapoisett

About 70% of Mattapoisett is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041136), 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. Mattapoisett completed an illicit discharge detection and elimination (IDDE) plan, and their website indicates that an erosion and sedimentation control (ESC) plan and post-construction stormwater regulations "will be uploaded shortly." According to the NOI, fecal coliform-impaired MS4 receiving waters include 32 stormwater outfalls into Mattapoisett Harbor (MA95-35), 61 outfalls into Eel Pond (MA95-61), 36 outfalls into the Mattapoisett River (MA95-60), 11 outfalls into Hiller Cove (MA95-10), and an unspecified number of outfalls into Aucoot Cove (MA95-71).

Mattapoisett has the following ordinances and bylaws, mostly accessible online via the town website https://www.mattapoisett.net/ (Town of Mattapoisett, 2021):

- Wetland protection bylaw
- Pet Waste: None found
- Stormwater Regulations and Utility: None found

Mattapoisett has a 2000 Master Plan, with an updated Master Plan underway. The existing plan (2000) mentions the environment in the open space section and specifically identifies improved water quality as a goal. This plan also addresses needed improvements to the town's sewer systems (as of 2000). No separate Open Space and Recreation Plan was found online (Town of Mattapoisett, 2021).

Town of Rochester. See Section 4.4

9. MA95-68 Wild Harbor River

9.1. Waterbody Overview

The Wild Harbor River segment MA95-68 is 0.03 square miles (mi^2) in area and is tidally influenced. It begins adjacent to Dam Pond in Falmouth and extends to the mouth of Wild Harbor, Falmouth.

Tributaries to the Wild Harbor River segment MA95-68 include an unnamed stream. Lakes and ponds in the watershed include Dam Pond, Wings Pond, and a few small unnamed waterbodies. Much of the river is surrounded by wetlands.

Key landmarks in the watershed include the Cape Golf Club and the Sacconnesset Golf Club; a thin section of the Cape Cod US Coast Guard Base; Highlander Farm; the North Falmouth Wooded Parcel, Roskovics Preserve, and a portion of the Frances Crane Wildlife Management area. Segment MA95-68 is not crossed by any roads.

The Wild Harbor River (MA95-68) drains a total area of 2.5 mi^2, of which 0.3 mi^2 (13%) are impervious area. A 200-foot buffer around the segment covers an area of 0.10 mi^2, of which 0.01 mi^2 (10%) is impervious area. The watershed is partially served by a public sewer system in Falmouth and Borne[21], and 75% 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. See Figure 9-1.

The Wild Harbor River segment MA95-68 watershed is located in a moderately-developed part of Massachusetts. The majority of the watershed is covered by forest and natural areas (67%) while only 2% is covered by wetlands. The remainder of the watershed is split between developed (30%) and agricultural (1%) areas. Wetland, forested areas, and development surround the impaired segment. Development is distributed throughout the watershed, with denser

Reduction from Highest Calculated Geomean: NA

Watershed Area (Acres): 1,583

Segment Area (mi^2): 0.03

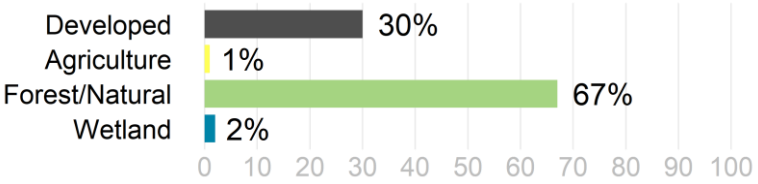
200-foot Buffer Area (Acres): 64

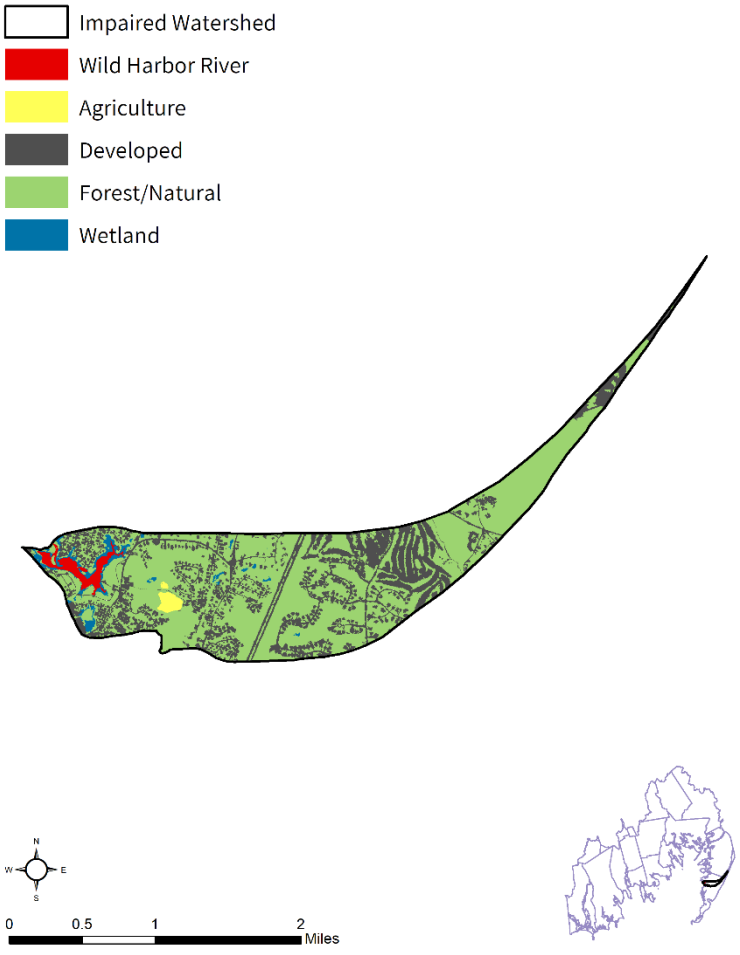
Impairment(s): Fecal coliform (Shellfish)

Class (Qualifier): SA (Shellfishing)

Impervious Area (Acres, %): 205 (13%)

Impervious Area Within 200-foot Buffer (Acres, %): 6 (10%)



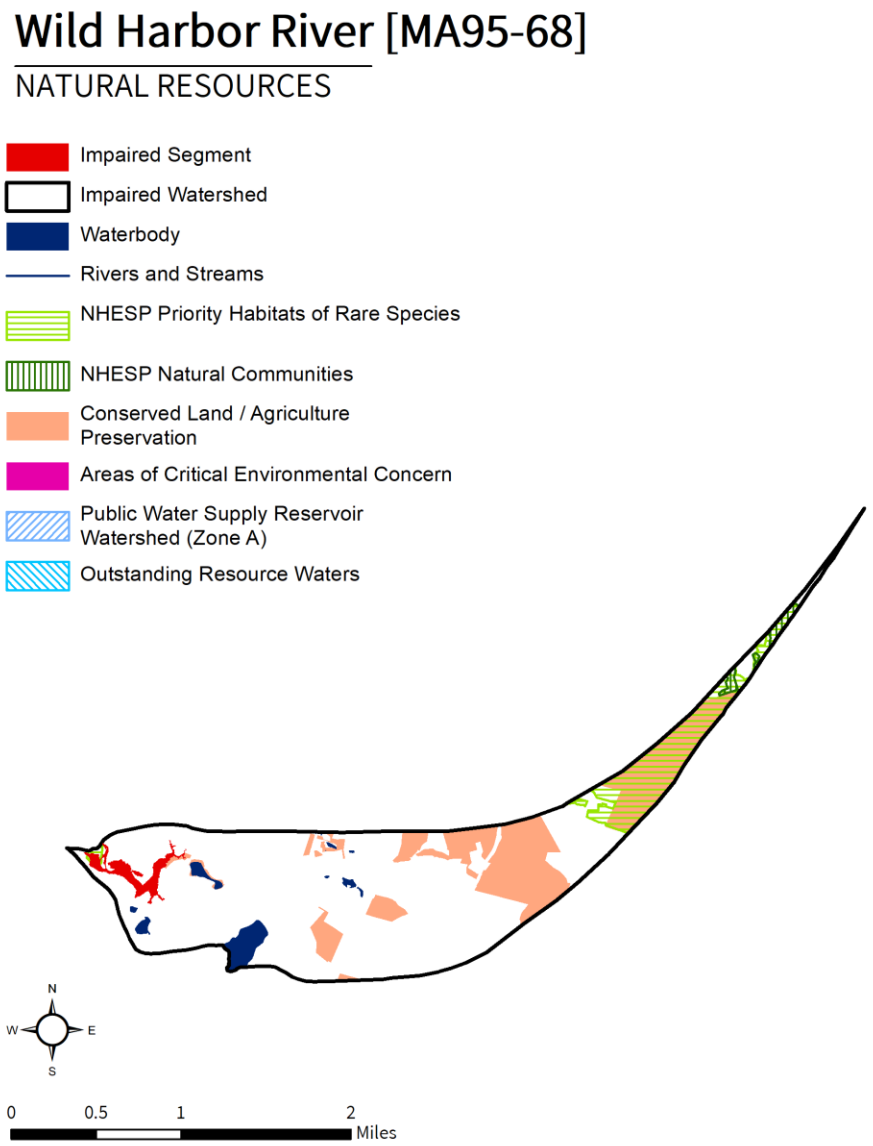


[21] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service area, MassDEP's Water Utility Infrastructure Mapping Project (MassDEP, 2021b), MS4 reports, and local knowledge.

development in the upper portions. The one agricultural area in the watershed is a cranberry bog located near the impaired segment.

In the Wild Harbor River (MA95-68) watershed, under the Natural Heritage and Endangered Species Program, there are 175 acres (11%) of Priority Habitats of Rare Species and 15 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 309 acres (20%) of land protected in perpetuity[22], part of 359 acres (23%) of Protected and Recreational Open Space[23]. See Figure 9-1.

[22] 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.
[23] All Protected and Recreational Open Space land is shown on the natural resources map.



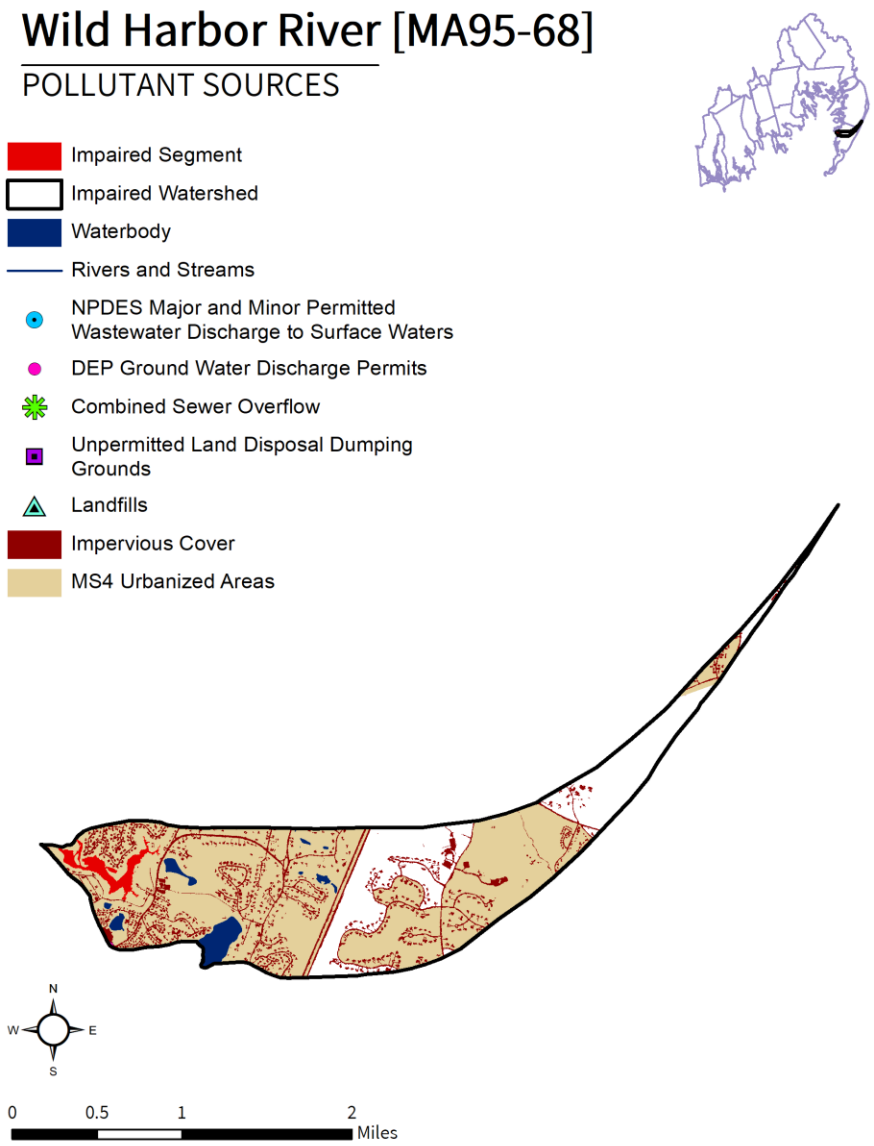


Figure 9-1. Natural resources and potential pollution sources draining to the Wild Harbor River segment MA95-68. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

9.2. Waterbody Impairment Characterization

The Wild Harbor River (MA95-68) is a Class SA tidal estuary, with a Shellfishing qualifier (MassDEP, 2021a).

The Shellfish Harvesting use was assessed for attainment of SWQS using fecal coliform indicator bacteria at one shellfish growing area that covers 0.0375 mi^2 (82% of the segment area; refer to Figure 9-2). MassDEP assessed the Shellfish Harvesting use as not supporting since the growing area normalized to the segment area is less than 100% approved for shellfishing by the Massachusetts Division of Marine Fisheries (Table 9-1).

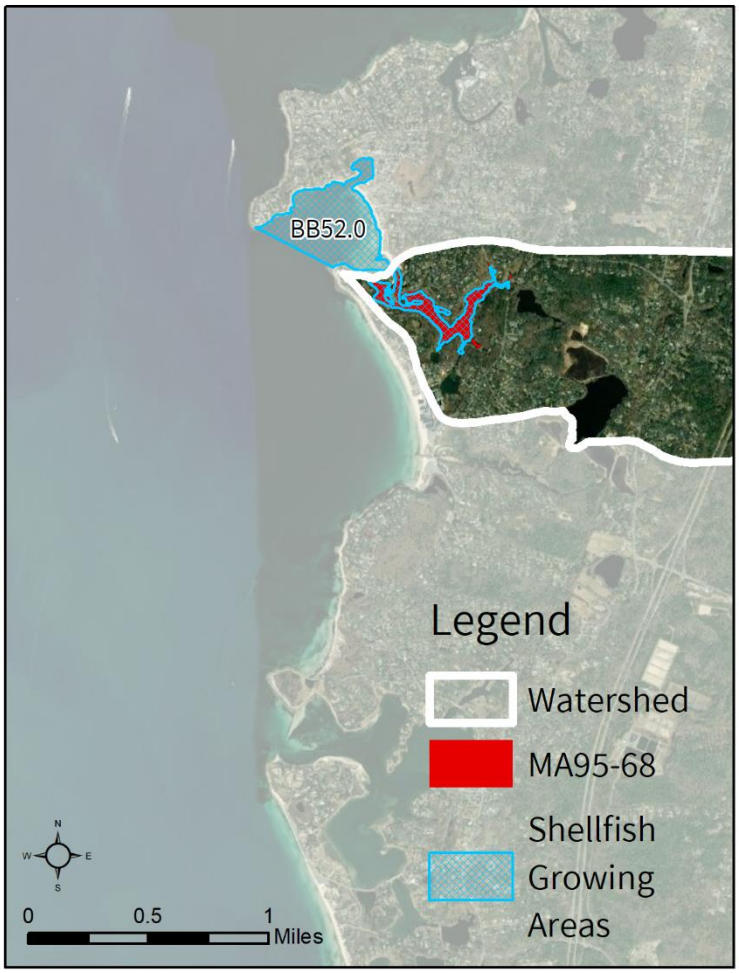


Figure 9-2. Location of the shellfish growing area associated with the impaired segment.

Table 9-1. Summary of MA DFG Division of Marine Fisheries classification data from January 2014 for one shellfish growing area in the Wild Harbor River segment MA95-68. Percentage indicates the relative area within the segment covered by each shellfish growing area. Shellfish Harvesting is classified as not supporting if the growing area normalized to the segment area is less than 100% approved for shellfishing by the Massachusetts Division of Marine Fisheries.

Name	Area Description	Class	Area (mi^2)	Percentage
BB52.0	Wild Harbor / Wild Harbor River	Prohibited	0.0375	82%

9.3. Potential Pathogen Sources

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a moderate amount of development in the watershed (30%), most of which consists of residential areas with some industrial and commercial development as well. Within the watershed, 75% of the land area is subject to MS4 permit conditions, 13% is classified as impervious area, and 10% of the land area within a 200-foot buffer of the segment is classified as impervious area. Stormwater runoff from urban areas is likely a minor source of pathogens.

Illicit Sewage Discharges: Public sewer service is available in the watershed within the towns of Falmouth and Borne. 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 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.

Illicit Boat Discharges: The segment is navigable by marine vessels. Vessels with onboard toilets are required to have a marine sanitation device (MSD) to treat or store wastewater. MSDs that treat wastewater may be improperly maintained or malfunctioning and therefore could discharge untreated sewage to coastal waterbodies. For MSDs that store wastewater, this sewage can either be pumped out at shore-based pump-out facilities or discharged directly into the water when the vessel is more than three miles offshore, outside of the designated No Discharge Zone (NDZ). Negligent boaters who ignore these laws and discharge untreated sewage to coastal waterbodies may be a source of pathogen pollution.

Vessel Pump-Out Facilities: There are no vessel sewage pump-out facilities directly adjacent to the Wild Harbor River segment MA95-68. Although pump-out facilities provide boaters with a means of disposing of onboard sewage without discharging it into coastal waters, these facilities are generally associated with high boating activity. Pump-out facilities which malfunction or leak also represent a potential pathogen source. As a result, waterbodies adjacent to pump-out facilities are likely at high risk of illicit boat (and facility) discharges.

Agriculture: Agricultural activities in the watershed account for a small portion (1%) of the total land use. This agriculture consists of a cranberry bog located near the impaired segment. 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 Wild Harbor River segment MA95-68. 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 small open wetland areas and residential development 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 Falmouth. See Section 7.4

10. MA95-78 Rands Harbor

10.1. Waterbody Overview

The Rands Harbor segment MA95-78 is 0.02 square miles (mi^2) in area, and is a tidally-influenced harbor south of Megansett Harbor and adjacent to Cedar Lake in Falmouth, MA.

Tributaries to the Rands Harbor segment MA95-78 include a few unnamed streams. Lakes and ponds in the watershed include Cedar Lake, Flax Pond, and Edmunds Pond. The river flows through wetland areas.

Key landmarks in the watershed include portions of the Otis Air Force Base and the Massachusetts Regional Training Institute. Segment MA95-78 is not crossed by any roads.

Rands Harbor (MA95-78) drains a total area of 2.0 mi^2, of which 0.2 mi^2 (13%) are impervious area. A 200-foot buffer around the segment covers an area of 0.05 mi^2, of which 0.01 mi^2 (12%) is impervious area. The watershed is served by a public sewer system in Falmouth and Borne, and Sandwich may be partially sewered[24]. 62% 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 also no landfills or unpermitted land disposal dumping grounds. See Figure 10-1.

The Rands Harbor segment MA95-78 watershed is located in a moderately-developed part of Massachusetts. The majority of the watershed is covered by forest and other natural areas (72%) while only 1% is covered by wetlands (no agricultural areas were identified). The remainder of the watershed is developed (27%) with the highest density within the upper reaches.

In the Rands Harbor (MA95-78) watershed, under the Natural Heritage and Endangered Species Program, there are 561 acres (45%) of Priority Habitats of Rare Species and 34 acres (3%) of Priority Natural Vegetation Communities. There are also no acres under Public Water Supply

Reduction from Highest Calculated Geomean: NA

Watershed Area (Acres): 1,255

Segment Area (mi^2): 0.02

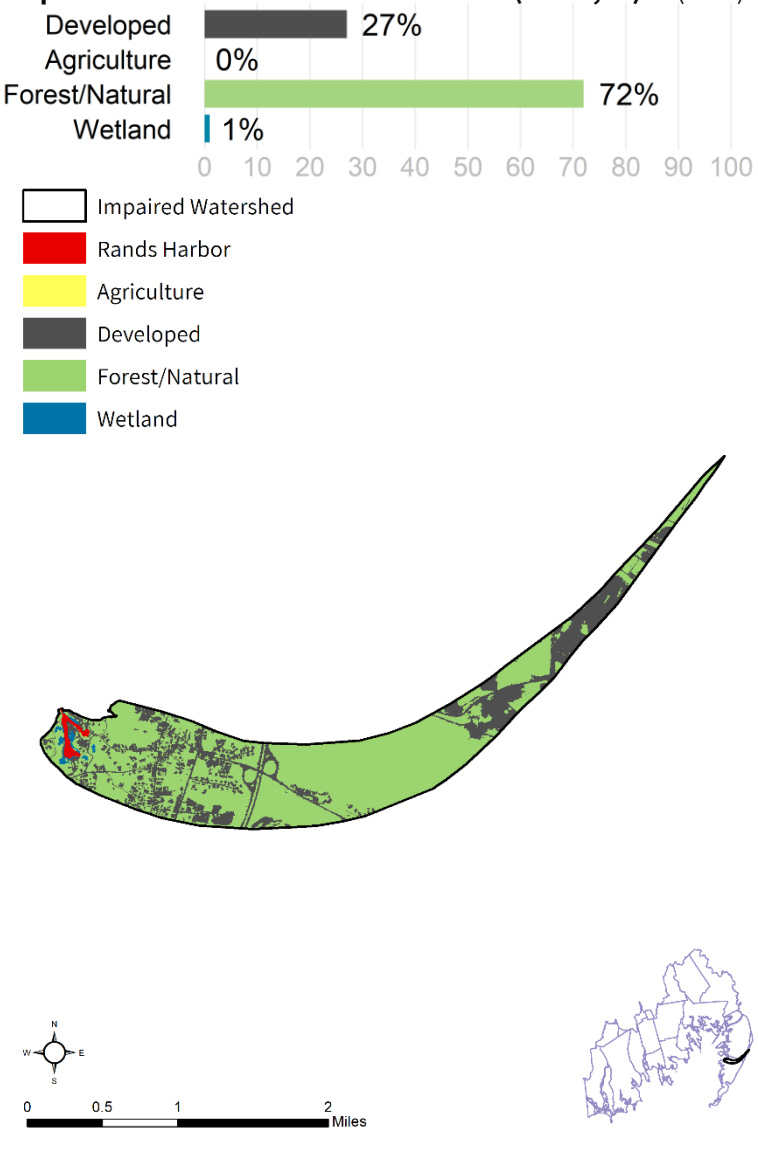
200-foot Buffer Area (Acres): 33

Impairment(s): Fecal coliform (Shellfish)

Class: SA (Shellfishing)

Impervious Area (Acres, %): 158 (13%)

Impervious Area Within 200-foot Buffer (Acres, %): 4 (12%)



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

protection, within Areas of Critical Environmental Concern, or Outstanding Resource Waters. Overall, there are 269 acres (21%) of land protected in perpetuity[25], part of 362 acres (29%) of Protected and Recreational Open Space[26]. See Figure 10-1.

[25] 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.
[26] All Protected and Recreational Open Space land is shown on the natural resources map.

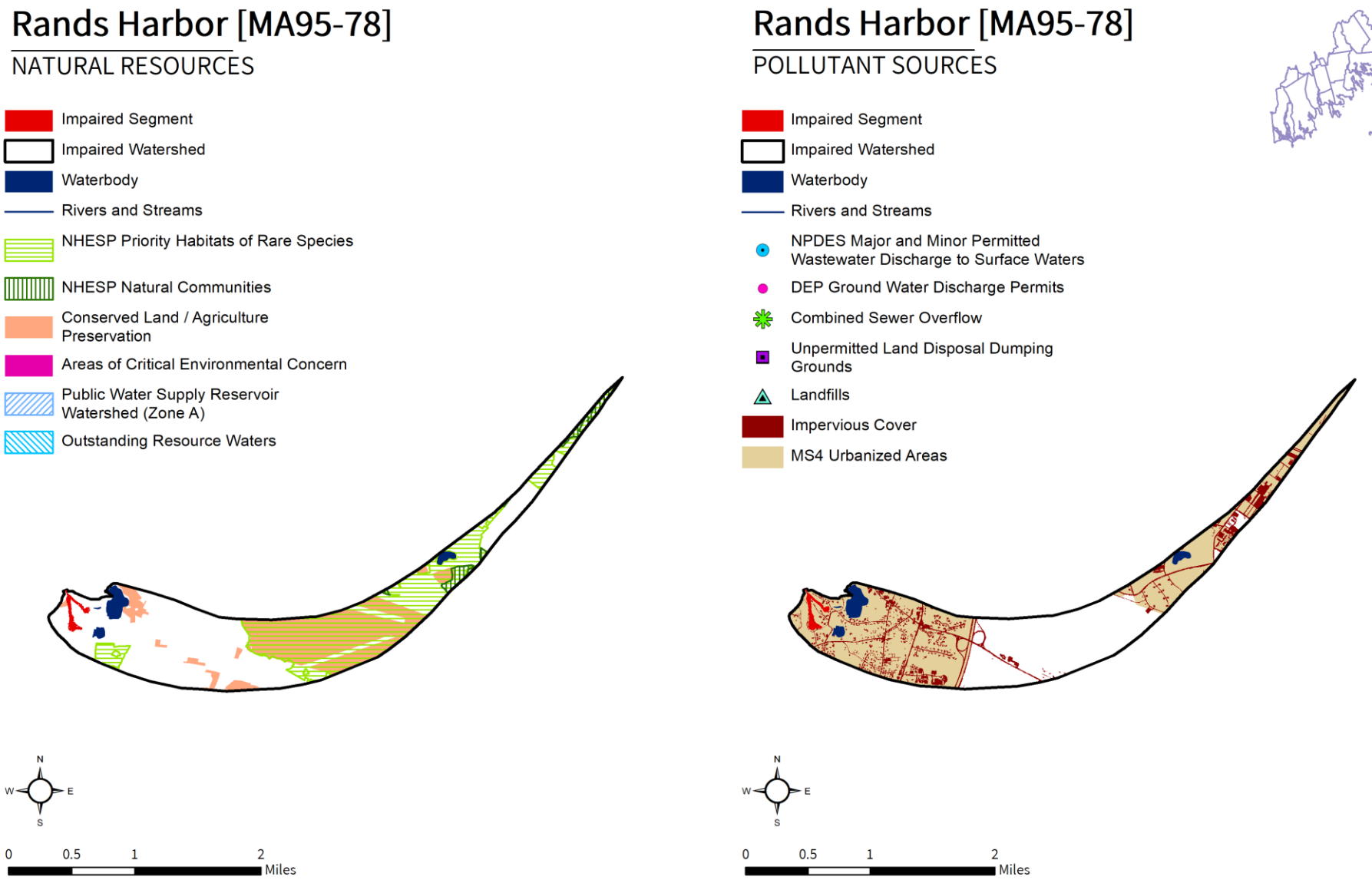


Figure 10-1. Natural resources and potential pollution sources draining to the Rands Harbor segment MA95-78. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

10.2. Waterbody Impairment Characterization

Rands Harbor (MA95-78) is a Class SA tidal estuary, with a Shellfishing qualifier (MassDEP, 2021a).

The Shellfish Harvesting use was assessed for attainment of SWQS using fecal coliform indicator bacteria at one shellfish growing area that covers 0.0142 mi^2 (82% of the segment area; refer to Figure 10-2). MassDEP assessed the Shellfish Harvesting use as not supporting since the growing area normalized to the segment area is less than 100% approved for shellfishing by the Massachusetts Division of Marine Fisheries (Table 10-1).

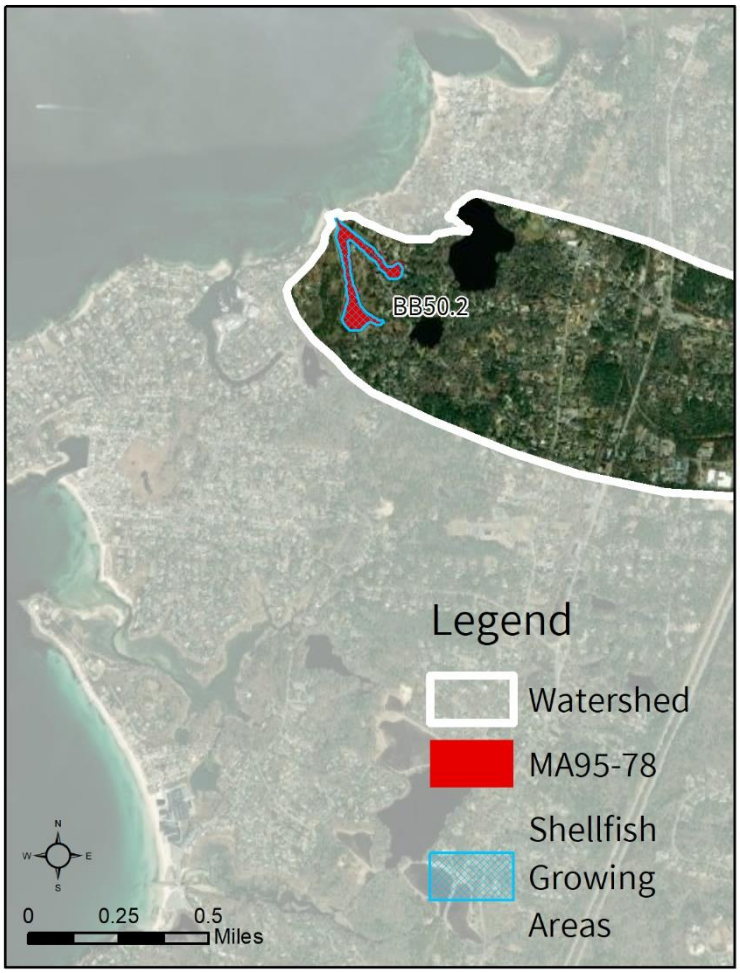


Figure 10-2. Location of the shellfish growing area associated with the impaired segment.

Table 10-1. Summary of MA DFG Division of Marine Fisheries classification data from January 2014 for one shellfish growing area in the Rands Harbor segment MA95-78. Percentage indicates the relative area within the segment covered by each shellfish growing area. Shellfish Harvesting is classified as not supporting if the growing area normalized to the segment area is less than 100% approved for shellfishing by the Massachusetts Division of Marine Fisheries.

Name	Area Description	Class	Area (mi^2)	Percentage
BB50.2	Rands Canal	Conditionally Approved	0.0142	82%

10.3. Potential Pathogen Sources

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a moderate amount of development in the watershed (27%), most of which consists of residential areas with some industrial and commercial development as well. Within the watershed, 62% of the land area is subject to MS4 permit conditions, 13% is classified as impervious area, and 12% of the land area within a 200-foot buffer of the segment is classified as impervious area. Stormwater runoff from urban areas is a likely source of pathogens.

Illicit Sewage Discharges: Sewer service is available in the watershed within the towns of Falmouth, Borne, and Sandwich. 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 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.

Illicit Boat Discharges: The segment is navigable by marine vessels. Vessels with onboard toilets are required to have a marine sanitation device (MSD) to treat or store wastewater. MSDs that treat wastewater may be improperly maintained or malfunctioning and therefore could discharge untreated sewage to coastal waterbodies. For MSDs that store wastewater, this sewage can either be pumped out at shore-based pump-out facilities or discharged directly into the water when the vessel is more than three miles offshore, outside of the designated No Discharge Zone (NDZ). Negligent boaters who ignore these laws and discharge untreated sewage to coastal waterbodies may be a source of pathogen pollution.

Vessel Pump-Out Facilities: There are no vessel sewage pump-out facilities directly adjacent to Rands Harbor segment MA95-78. Although pump-out facilities provide boaters with a means of disposing of onboard sewage without discharging it into coastal waters, these facilities are generally associated with high boating activity. Pump-out facilities which malfunction or leak also represent a potential pathogen source. As a result, waterbodies adjacent to pump-out facilities are likely at high risk of illicit boat (and facility) discharges.

Agriculture: 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 and parks near the Rands Harbor segment MA95-78. 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 small open wetland areas are directly adjacent to the impaired segment, as well as residential development. 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.

10.4. 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 Bourne. See Section 7.4

Town of Falmouth. See Section 7.4

11. MA95-79 Fiddlers Cove

11.1. Waterbody Overview

The Fiddlers Cove segment MA95-79 is 0.01 square miles (mi^2) in area. It begins adjacent to Trout Pond along Five Gate Lane in Falmouth and is located to the south of Megansett Harbor. Fiddlers Cover is a tidally-influenced waterbody surrounded by dense residential development.

Tributaries to the Fiddlers Cove segment MA95-79 include Plumbush Creek, Little Pine Island Creek, and an unnamed stream. Lakes and ponds in the watershed include Trout Pond and a few small unnamed waterbodies and wetlands.

Key landmarks in the watershed include the Safe Harbor Fiddler's Cove Marina; and a portion of the Cape Club golf course. Segment MA95-79 is not crossed by any roads.

Fiddlers Cove (MA95-79) drains a total area of 0.4 mi^2, of which 0.1 mi^2 (15%) is impervious area. A 200-foot buffer around the segment covers an area of 0.05 mi^2, of which 0.02 mi^2 (38%) are impervious area. The watershed is served by a public sewer system in Falmouth[27], and 80% 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 also no landfills or unpermitted land disposal dumping grounds. See Figure 11-1.

The Fiddlers Cove segment MA95-79 watershed is located in a moderately-developed part of Massachusetts. The majority of the watershed is covered by forest and other natural areas (68%) while only 1% is covered by wetland areas; the remainder of the watershed is developed (31%). There are no agricultural areas (0%). Development completely surrounds the impaired segment. Other residential and commercial development is intermixed throughout the watershed and surrounded by forest and other natural areas.

Reduction from Highest Calculated Geomean: NA

Watershed Area (Acres): 282

Segment Area (mi^2): 0.01

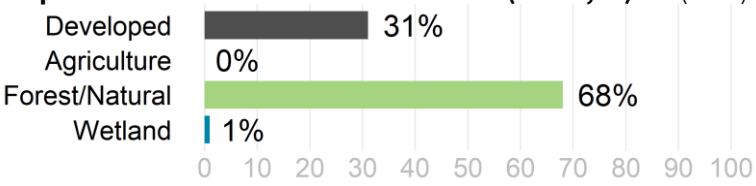
200-foot Buffer Area (Acres): 34

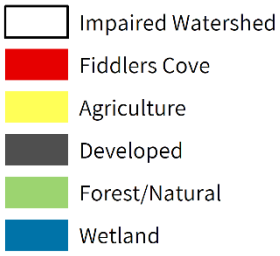
Impairment(s): Fecal coliform (Shellfish)

Class (Qualifier): SA (Shellfishing)

Impervious Area (Acres, %): 41 (15%)

Impervious Area Within 200-foot Buffer (Acres, %): 13 (38%)





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

In the Fiddlers Cove (MA95-79) watershed, under the Natural Heritage and Endangered Species Program, there are 75 acres (27%) of Priority Habitats of Rare Species and no 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 nine acres (3%) of land protected in perpetuity[28], part of 41 acres (15%) of Protected and Recreational Open Space[29]. See Figure 11-1.

[28] 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.
[29] All Protected and Recreational Open Space land is shown on the natural resources map.

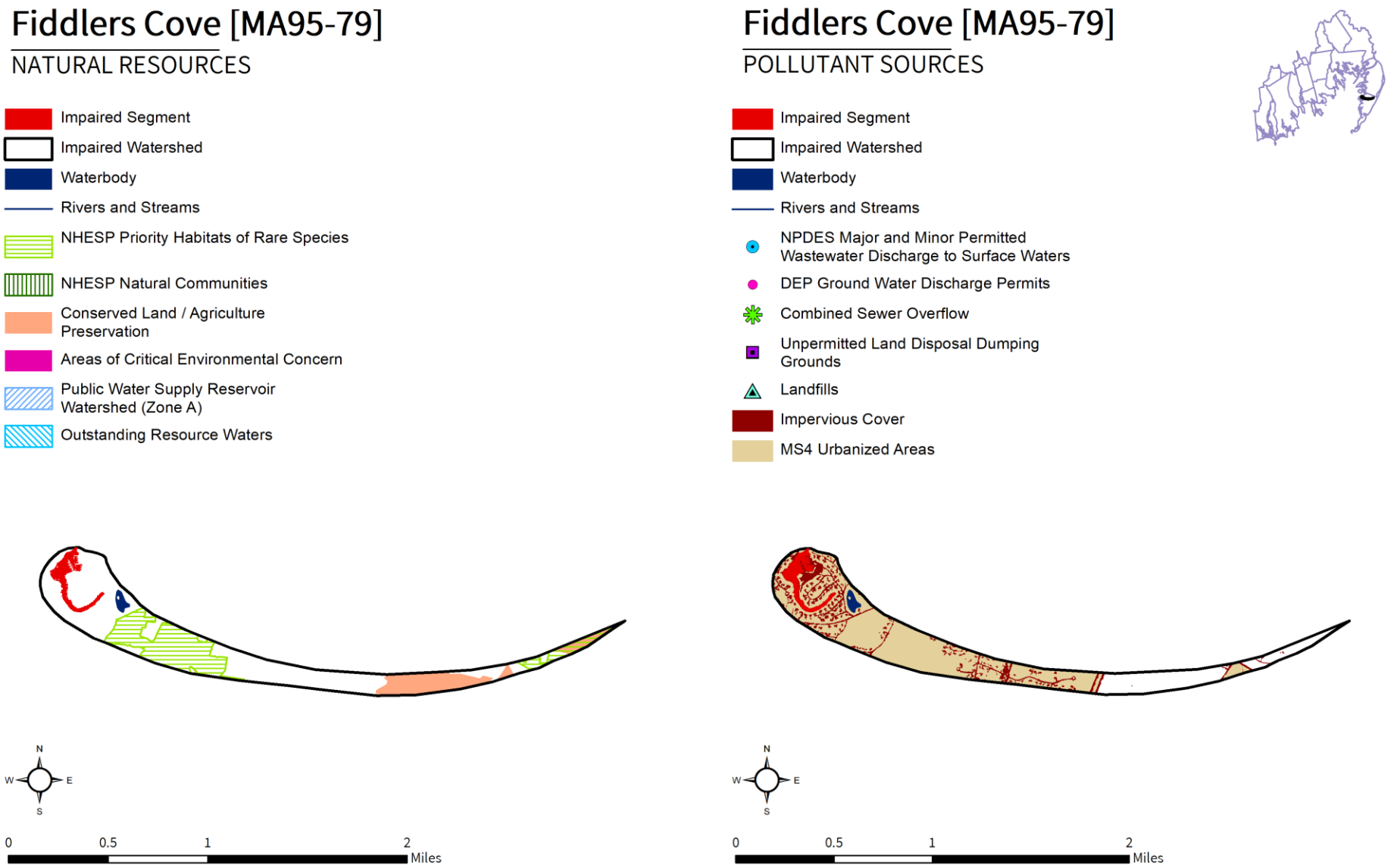


Figure 11-1. Natural resources and potential pollution sources draining to the Fiddlers Cove segment MA95-79. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

11.2. Waterbody Impairment Characterization

Fiddlers Cove (MA95-79) is a Class SA tidal estuary, with a Shellfishing qualifier (MassDEP, 2021a).

The Shellfish Harvesting use was assessed for attainment of SWQS using fecal coliform indicator bacteria at one shellfish growing area that covers 0.0191 mi^2 (91% of the segment area; refer to Figure 11-2). MassDEP assessed the Shellfish Harvesting use as not supporting since the growing area normalized to the segment area is less than 100% approved for shellfishing by the Massachusetts Division of Marine Fisheries (Table 11-1).

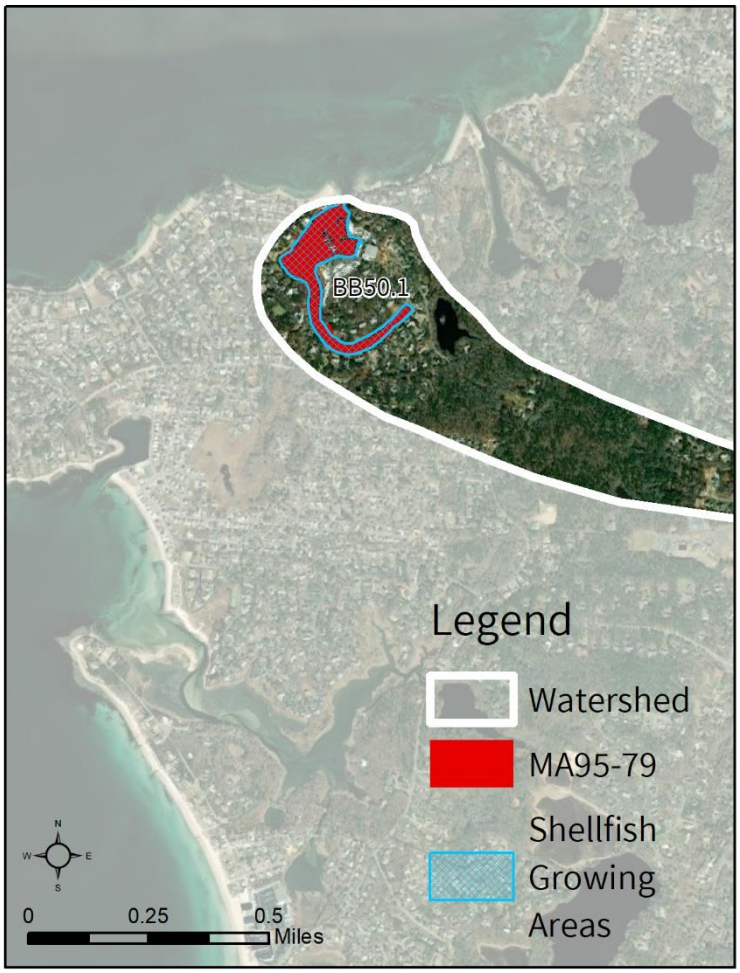


Figure 11-2. Location of the shellfish growing area associated with the impaired segment.

Table 11-1. Summary of MA DFG Division of Marine Fisheries classification data from January 2014 for one shellfish growing area in the Fiddlers Cove segment MA95-79. Percentage indicates the relative area within the segment covered by each shellfish growing area. Shellfish Harvesting is classified as not supporting if the growing area normalized to the segment area is less than 100% approved for shellfishing by the Massachusetts Division of Marine Fisheries.

Name	Area Description	Class	Area (mi^2)	Percentage
BB50.1	Fiddlers Cove	Conditionally Approved	0.0191	91%

11.3. Potential Pathogen Sources

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a moderate amount of development in the watershed (31%), most of which consists of residential areas with some industrial and commercial development as well. Within the watershed, 80% of the land area is subject to MS4 permit conditions, 15% is classified as impervious area, and 38% of the land area within a 200-foot buffer of the segment is classified as impervious area. Stormwater runoff from urban areas is a likely source of pathogens.

Illicit Sewage Discharges: Public sewer service is available in the watershed within the town of Falmouth. 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 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.

Illicit Boat Discharges: The segment is navigable by marine vessels. Vessels with onboard toilets are required to have a marine sanitation device (MSD) to treat or store wastewater. MSDs that treat wastewater may be improperly maintained or malfunctioning and therefore could discharge untreated sewage to coastal waterbodies. For MSDs that store wastewater, this sewage can either be pumped out at shore-based pump-out facilities or discharged directly into the water when the vessel is more than three miles offshore, outside of the designated No Discharge Zone (NDZ). Negligent boaters who ignore these laws and discharge untreated sewage to coastal waterbodies may be a source of pathogen pollution.

Vessel Pump-Out Facilities: There is one vessel sewage pump-out facility directly adjacent to Fiddlers Cove segment MA95-79: Brewer's Fiddler's Cove (Falmouth). Although pump-out facilities provide boaters with a means of disposing onboard sewage without discharging it into coastal waters, these facilities are generally associated with high boating activity. Pump-out facilities which malfunction or leak also represent a potential pathogen source. As a result, waterbodies adjacent to pump-out facilities are likely at high risk of illicit boat (and facility) discharges.

Agriculture: 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 and a few natural areas adjacent to the impaired 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: The land directly adjacent to the impaired segment is predominately developed, although there are very few wetlands or open fields. Large mowed or other open areas with a clear sightline to a waterbody may attract large congregations of waterfowl, resulting in elevated indicator bacteria counts in the water.

11.4. 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 Falmouth. See Section 7.4

12. MA95-82 Kirby Brook

12.1. Waterbody Overview

Kirby Brook segment MA95-82 is 2.0 miles long and begins just south of Old County Road in Westport, MA. The segment flows south before ending at the mouth of the East Branch of the Westport River in Westport.

Tributaries to Kirby Brook segment MA95-82 include unnamed streams. Lakes and ponds in the watershed include a few small unnamed waterbodies. Much of the river flows through forested and other natural areas and wetlands.

Key landmarks in the watershed include the Westport School Administration; Excel Recycling Center; Harry's Country Store; Brownell Corner, Giffords Corner, Kirby's Corner; and a few recreational fields. From upstream to downstream, segment MA95-82 is crossed by MA-88 and Drift Road, all in Westport.

Kirby Brook (MA95-82) drains a total area of 3.8 square miles (mi^2), of which 0.2 mi^2 (6%) are impervious and 0.1 mi^2 (3%) is directly connected impervious area (DCIA). The watershed is not served by public sewer systems[30], and 13% 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 also no landfills or unpermitted land disposal dumping grounds. See Figure 12-1.

The Kirby Brook segment MA95-82 watershed is located in a moderately-developed part of Massachusetts. More than half of the watershed consists of forest and natural lands (55%) and 25% consists of wetland areas. The remainder is primarily covered by development (15%) and a small portion is used for agricultural activity (5%). Most of the development consists of residential areas with some commercial development. Most of the agricultural activity consists of pasture/hay and cultivated fields located directly adjacent to wetland areas in the watershed.

Reduction from Highest Calculated Geomean: 88%

Watershed Area (Acres): 2,447

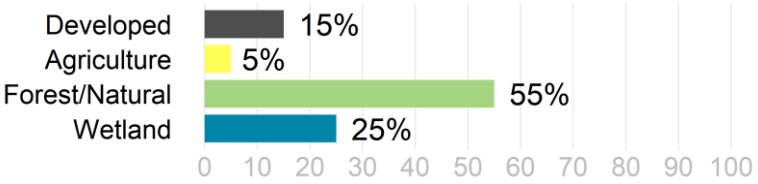
Segment Length (Miles): 2.0

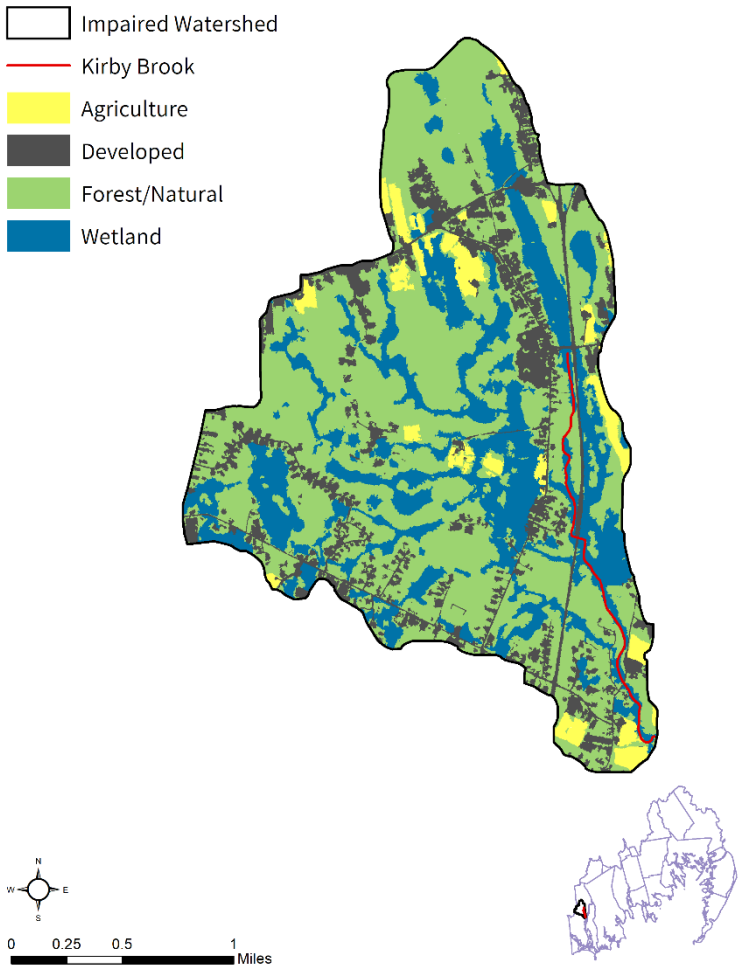
Impairment(s): Enterococci (Primary Contact Recreation)

Class: B

Impervious Area (Acres, %): 152 (6%)

DCIA Area (Acres, %): 70 (3%)



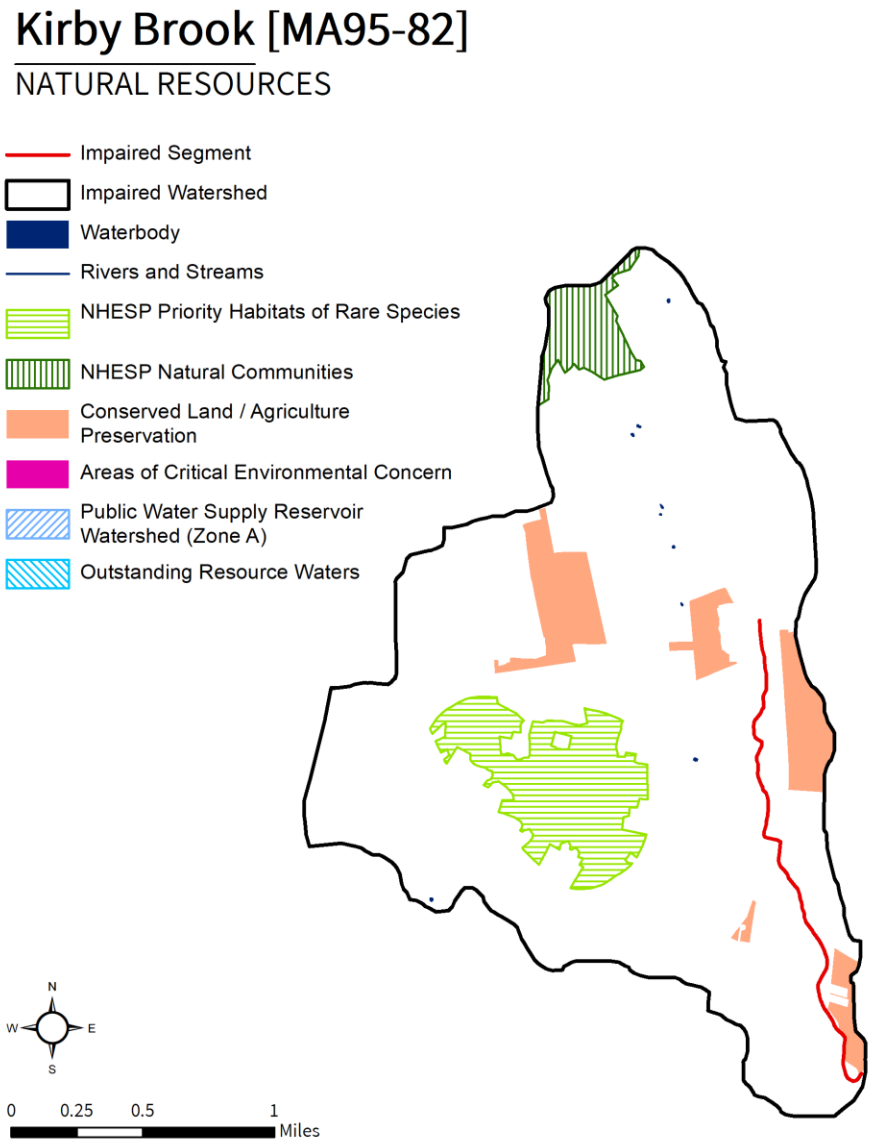


[30] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service area, MassDEP's Water Utility Infrastructure Mapping Project (MassDEP, 2021b), MS4 reports, and local knowledge.

In the Kirby Brook (MA95-82) watershed, under the Natural Heritage and Endangered Species Program, there are 194 acres (8%) of Priority Habitats of Rare Species and 67 acres (3%) 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 72 acres (3%) of land protected in perpetuity[31], part of 168 acres (7%) of Protected and Recreational Open Space[32]. See Figure 12-1.

[31] 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.

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



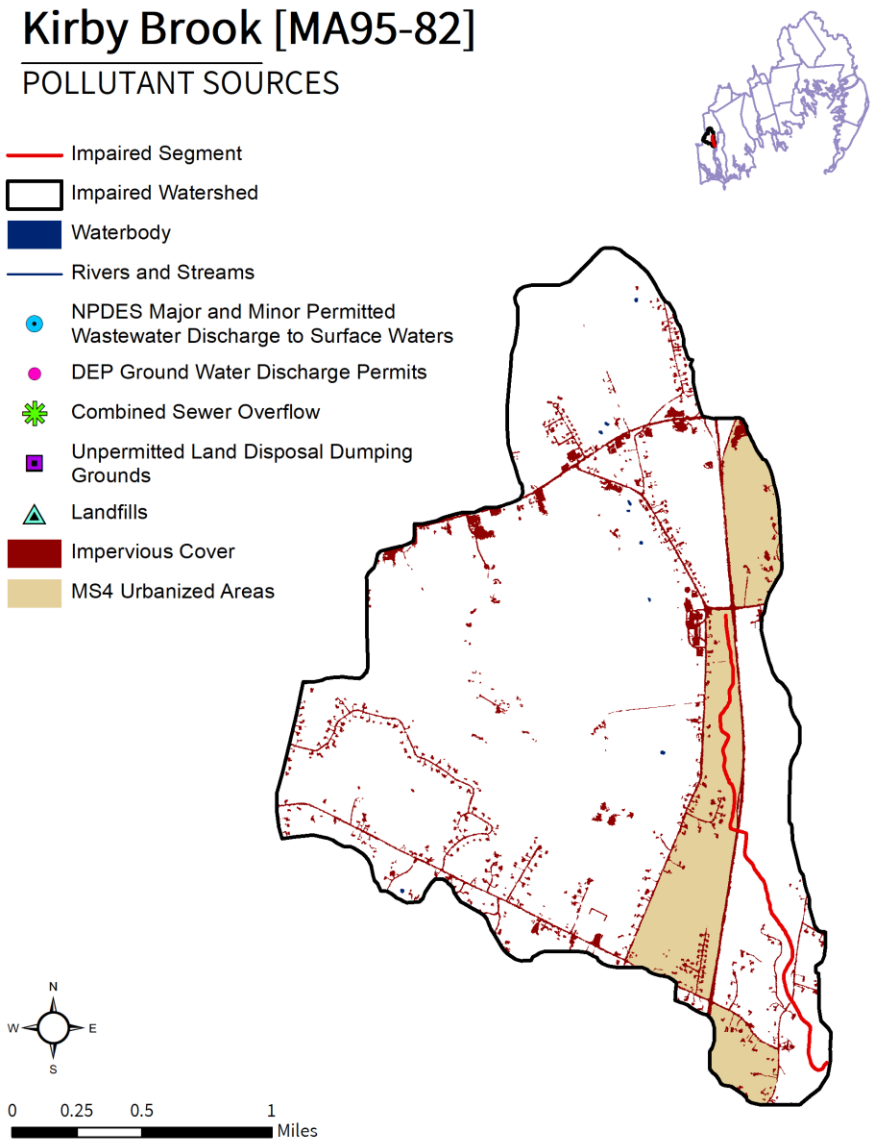


Figure 12-1. Natural resources and potential pollution sources draining to the Kirby Brook segment MA95-82. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

12.2. Waterbody Impairment Characterization

Kirby Brook (MA95-82) 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 12-1, 12-2; Figure 12-2) using the indicator bacteria enterococci. Data were evaluated against the SWQS geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria and the STV criterion of 130 CFU/100 mL for enterococci. The geomean and STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

- In 2005, four samples were collected at W1374 [Drift Road Westport]; 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 four samples, two exceeded the STV criterion during dry weather.
- While not summarized here, Westport River Watershed Alliance collected water quality samples for fecal coliform at their station K4 [Drift Road, Westport] and it is presented below in Table 12-2 (WRWA, n.d.)

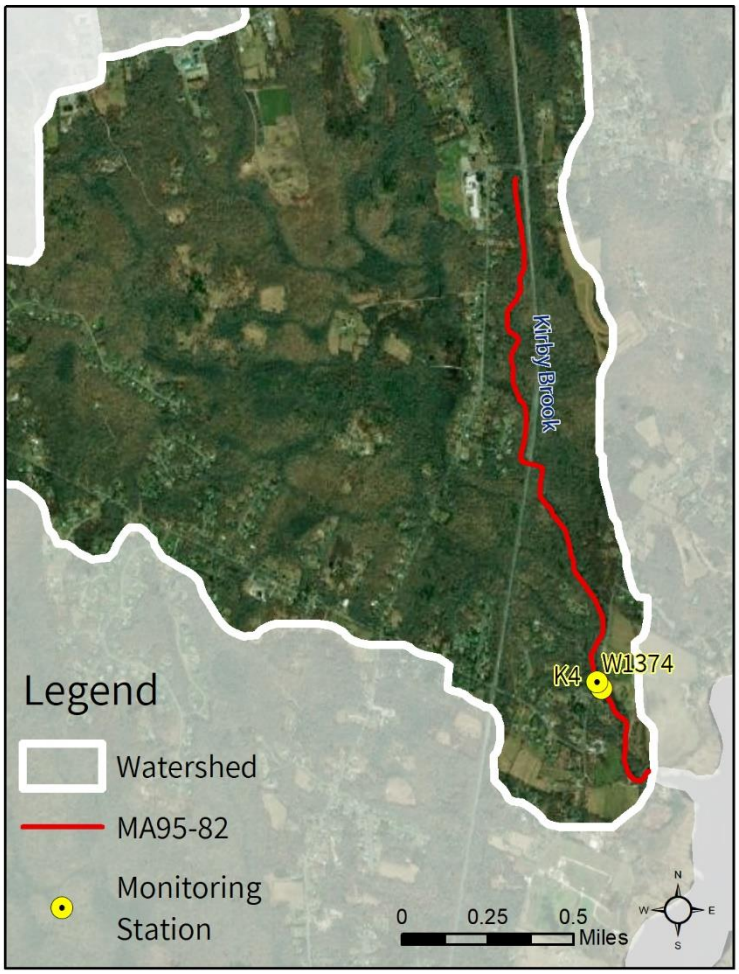


Figure 12-2. Location of monitoring station(s) along the impaired segment.

Table 12-1. Summary of indicator bacteria sampling results by station for Kirby Brook (MA95-82). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria, and the number of single samples exceeding the STV criterion of 130 CFU/100 mL for enterococci 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
W1374	5/3/2005	8/2/2005	4	295	2	2

Table 12-2. Indicator bacteria data by station, indicator, and date for Kirby Brook (MA95-82). 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 for *E. coli* and 130 CFU/100 mL for enterococci indicator bacteria (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the STV); and red text in the Geomean column highlights exceedances of 126 CFU/100 mL for *E. coli* and 35 CFU/100 mL for enterococci indicator bacteria (applied to rolling 90-day geomean).

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1374	Enterococci	5/3/2005	WET	10	10	
W1374	Enterococci	6/9/2005	DRY	35	19	
W1374	Enterococci	6/28/2005	DRY	1,600‡	82	
W1374	Enterococci	8/2/2005	DRY	460	295	
W1374	*E. coli*	5/3/2005	WET	5	5	
W1374	*E. coli*	6/9/2005	DRY	65	18	
W1374	*E. coli*	6/28/2005	DRY	1,500	79	
W1374	*E. coli*	8/2/2005	DRY	100	214	
W1374	*E. coli*	9/12/2005	DRY	50	196	
W1374	*E. coli*	6/20/2012	DRY	25	25	
W1374	*E. coli*	9/11/2012	DRY	219	74	
W1374	Fecal Coliform	5/3/2005	WET	50		
W1374	Fecal Coliform	6/9/2005	DRY	25		
W1374	Fecal Coliform	6/28/2005	DRY	1,600		
W1374	Fecal Coliform	8/2/2005	DRY	60		
W1374	Fecal Coliform	9/12/2005	DRY	85		
K4	Fecal Coliform	5/28/2008	DRY	16		
K4	Fecal Coliform	6/4/2008	DRY	2,500		
K4	Fecal Coliform	6/11/2008	DRY	190		
K4	Fecal Coliform	6/18/2008	WET	200		
K4	Fecal Coliform	6/25/2008	WET	322		
K4	Fecal Coliform	7/1/2008	DRY	244		
K4	Fecal Coliform	7/9/2008	DRY	38		
K4	Fecal Coliform	7/16/2008	DRY	104		
K4	Fecal Coliform	7/23/2008	DRY	336		
K4	Fecal Coliform	7/30/2008	WET	48		
K4	Fecal Coliform	8/13/2008	WET	624		
K4	Fecal Coliform	8/20/2008	DRY	124		
K4	Fecal Coliform	8/27/2008	DRY	12		
K4	Fecal Coliform	9/17/2008	DRY	168		
K4	Fecal Coliform	6/2/2009	DRY	20		
K4	Fecal Coliform	6/10/2009	DRY	8		
K4	Fecal Coliform	6/17/2009	DRY	66		
K4	Fecal Coliform	6/30/2009	DRY	32		
K4	Fecal Coliform	7/8/2009	WET	90		
K4	Fecal Coliform	7/15/2009	DRY	19		
K4	Fecal Coliform	7/22/2009	WET	160		
K4	Fecal Coliform	7/29/2009	DRY	1,210		
K4	Fecal Coliform	8/19/2009	DRY	34		
K4	Fecal Coliform	9/2/2009	DRY	128		
K4	Fecal Coliform	5/26/2010	DRY	20		
K4	Fecal Coliform	6/2/2010	DRY	114		
K4	Fecal Coliform	6/9/2010	DRY	100		
K4	Fecal Coliform	6/16/2010	DRY	62		
K4	Fecal Coliform	6/23/2010	DRY	278		
K4	Fecal Coliform	6/30/2010	DRY	434		
K4	Fecal Coliform	7/7/2010	DRY	64		
K4	Fecal Coliform	7/21/2010	DRY	100		

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
K4	Fecal Coliform	8/4/2010	DRY	192		
K4	Fecal Coliform	8/11/2010	DRY	60		
K4	Fecal Coliform	8/25/2010	WET	2,600		
K4	Fecal Coliform	9/1/2010	DRY	470		

‡Value above the Method Detection Limit (MDL) of 1,600 CFU/100mL; the MDL is reported and used to calculate the geometric means for *E. coli* and enterococci.

12.3. 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 wildlife and domesticated animal waste (including pets).

Indicator bacteria data for Kirby Brook (MA95-82) collected by MassDEP were elevated solely during dry weather. Elevated results during dry weather suggest that ongoing 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 (15%), most of which consists of residential areas with some commercial development as well. Within the watershed, 13% of the land area is subject to MS4 permit conditions, 6% is classified as impervious area, and 3% is classified as DCIA. Stormwater runoff from urban areas is a likely source of pathogens.

Illicit Sewage Discharges: Public sewer service is not available in the watershed within the town of Westport. Surrounding towns outside of the segment's watershed may have public sewer systems. 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: 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 (5%) 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 many residential neighborhoods and parks near the Kirby Brook segment MA95-82. 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.

12.4. 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 Westport

About half of Westport is subject to stormwater regulations under the NPDES General MS4 Stormwater Permit (Permit ID # MAR041174), and the town has an EPA-approved Notice of Intent (NOI), which expired on June 30, 2022. The town has mapped 20% of its MS4 system and the year-one and year-two Annual Reports have been submitted. Westport completed an illicit discharge detection and elimination (IDDE) plan in 2017, an erosion and sedimentation control (ESC) plan in 2006, and post-construction stormwater regulations in 2012. According to the town's NOI, pathogen-impaired MS4 receiving waters include 139 stormwater outfalls into Bread and Cheese Brook (MA95-58) and five outfalls into Snell Creek (MA95-44 & MA95-45). All of the above-mentioned waterbodies are impaired by *E. coli*. Additionally, there are 31 outfalls into the East Branch Westport River (MA95-40, freshwater segment) impaired by enterococci and fecal coliform and 67 outfalls into the East Branch of the Westport River (MA95-41, estuarine segment) impaired by fecal coliform only.

Westport has the following ordinances and bylaws, mostly accessible online via the town website https://www.westport-ma.com/ (Town of Westport, 2021):

- Wetland protection bylaw
- Stormwater control bylaw
- Stormwater Utility: None found
- Pet Waste: None found

Westport has a 2016 Master Plan, which includes a natural resources section that identifies meeting TMDL targets as a goal for the Westport River. No specific bacterial impairments are mentioned in this plan. The town lacks public water and sewer systems, which limits growth. No Open Space and Recreation Plan, outside of the section included in the 2016 Master Plan, was found online (Town of Westport, 2021).

13. MA95-83 Angeline Brook

13.1. Waterbody Overview

Angeline Brook segment MA95-83 is 4.4 miles long and consists of the perennial portion of the stream beginning south of Charlotte White Road in Westport, MA. The segment flows south and ends at the mouth of West Branch Westport River at Angeline Cove in Westport.

Tributaries to Angeline Brook segment MA95-83 include several unnamed streams. Lakes and ponds in the watershed include a few small unnamed waterbodies. Much of the river flows through wetland areas.

Key landmarks in the watershed include many large farms including Weatherlow Farms and Orr's Farm; Westport Village Apartments; and Herb Hadfield Conservation Area. From upstream to downstream, segment MA95-83 is crossed by Adamsville Road and Cornell Road, all in Westport.

Angeline Brook (MA95-83) drains a total area of 3.5 square miles (mi^2), of which 0.1 mi^2 (3%) are impervious and 0.1 mi^2 (2%) are directly connected impervious area (DCIA). The watershed is not served by public sewer systems[33], and none of the watershed 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 also no landfills or unpermitted land disposal dumping grounds. See Figure 13-1.

The Angeline Brook segment MA95-83 watershed is located in a fairly undeveloped part of Massachusetts. More than half of the watershed consists of forest and natural lands (51%) and 26% consists of wetland areas. The remainder of the watershed is covered by a moderate amount of agricultural activity (15%) and development (8%). Most of the development consists of residential areas with some commercial

Reduction from Highest Calculated Geomean: 38%

Watershed Area (Acres): 2,216

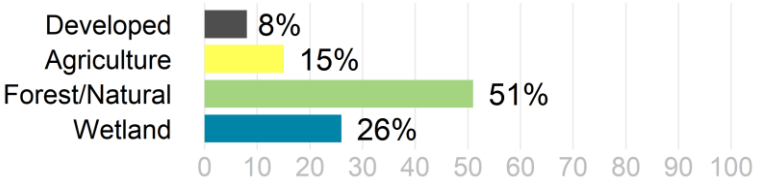
Segment Length (Miles): 4.4

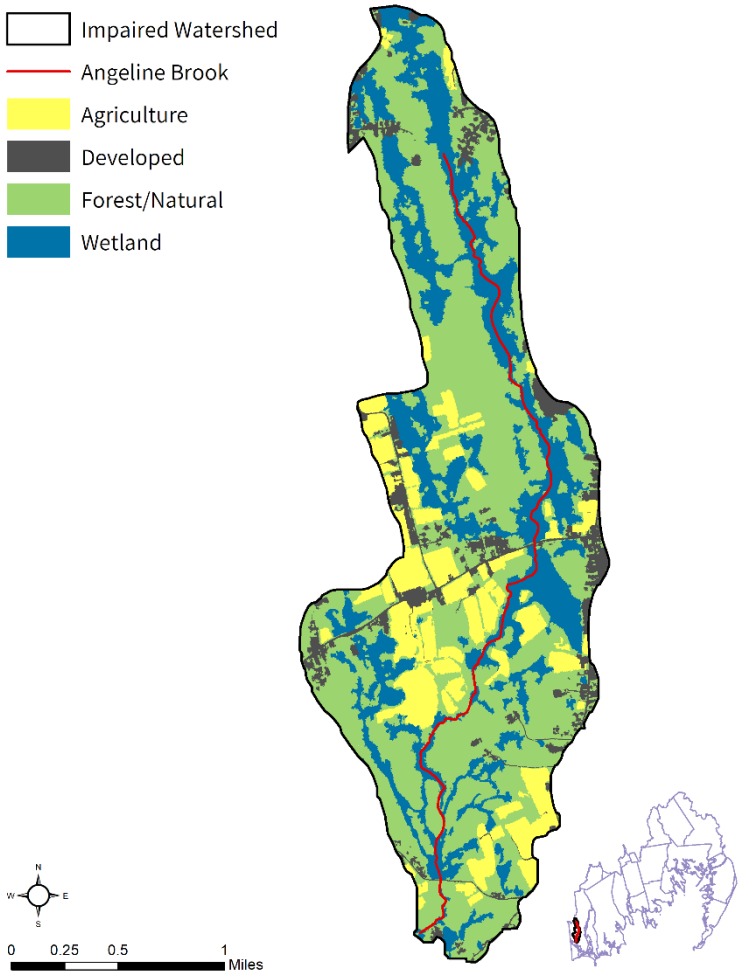
Impairment(s): Enterococci (Primary Contact Recreation)

Class: B

Impervious Area (Acres, %): 70 (3%)

DCIA Area (Acres, %): 33 (2%)



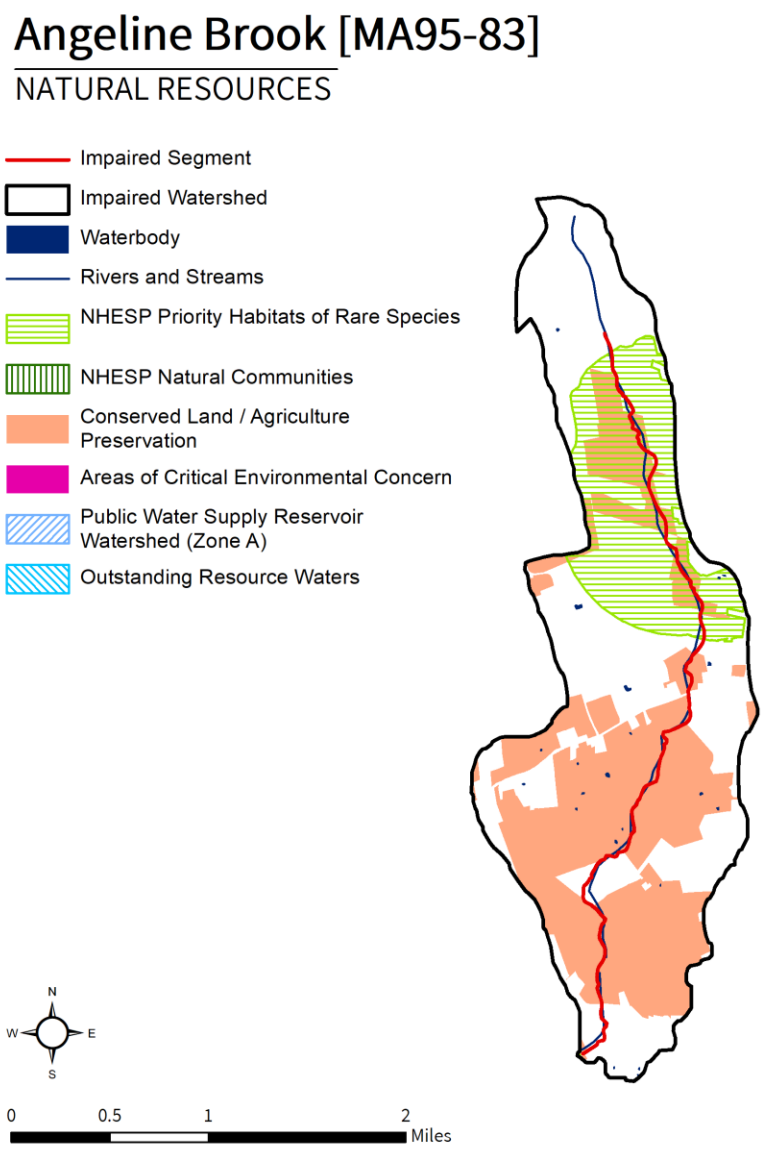


[33] Estimated percentage of developed areas with wastewater infrastructure in the watershed was based on available information: MWRA service area, MassDEP's Water Utility Infrastructure Mapping Project (MassDEP, 2021b), MS4 reports, and local knowledge.

development. Most of the agricultural activity consists of pasture/hay and cultivated fields located directly adjacent to wetland areas in the watershed.

In the Angeline Brook (MA95-83) watershed, under the Natural Heritage and Endangered Species Program, there are 501 acres (23%) of Priority Habitats of Rare Species and no 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 949 acres (43%) of land protected in perpetuity[34], part of 953 acres (43%) of Protected and Recreational Open Space[35]. See Figure 13-1.

[34] 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.
[35] All Protected and Recreational Open Space land is shown on the natural resources map.



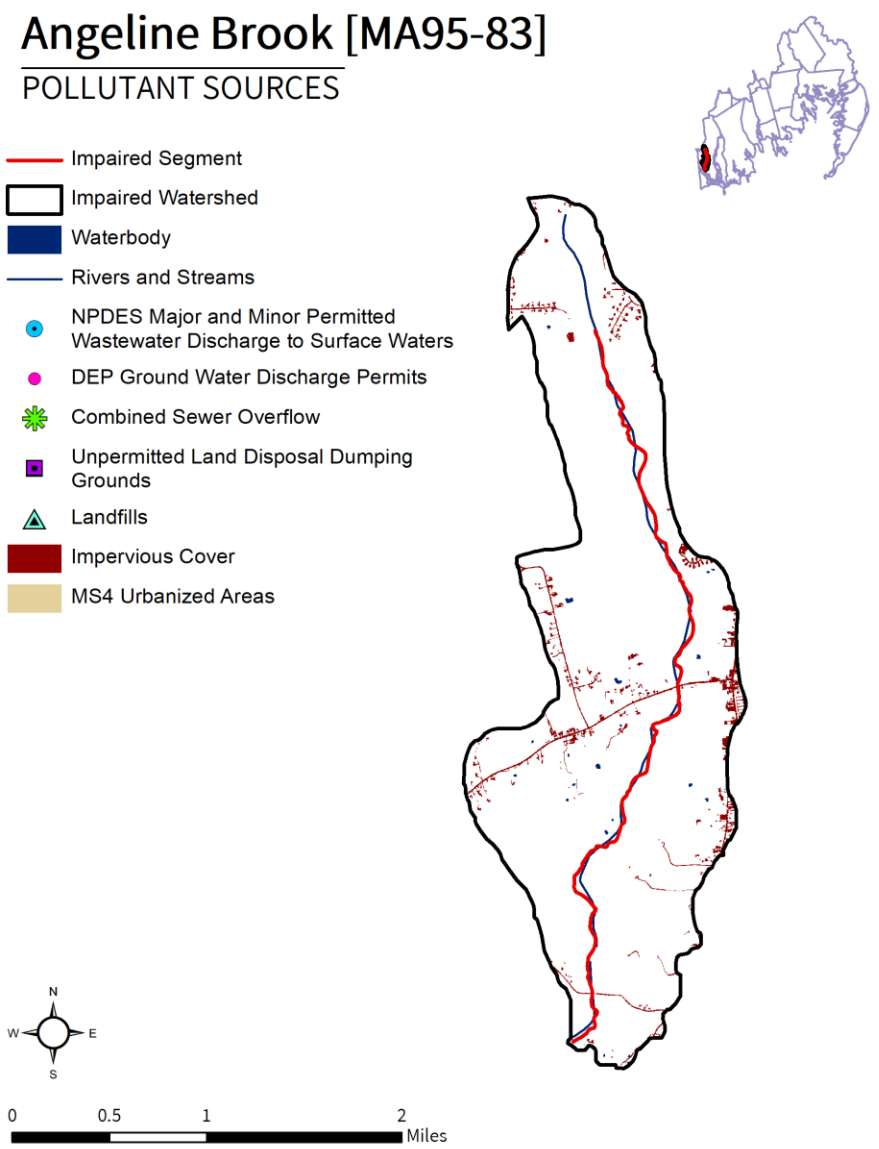


Figure 13-1. Natural resources and potential pollution sources draining to the Angeline Brook segment MA95-83. The map on the left shows critical habitat, water features, and conserved land. The map on the right indicates potential and known pollutant sources, including impervious cover, MS4 areas, permitted facilities, etc.

13.2. Waterbody Impairment Characterization

Angeline Brook (MA95-83) 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 13-1, 13-2; Figure 13-2) using the indicator bacteria enterococci. Data were evaluated against the SWQS geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria and the STV criterion of 130 CFU/100 mL for enterococci. The geomean and STV criteria for the impaired segment apply to data on a year-round, 90-day rolling basis.

- In 2005, four samples were collected at W1375; 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 four samples, one exceeded the STV criterion during dry weather.

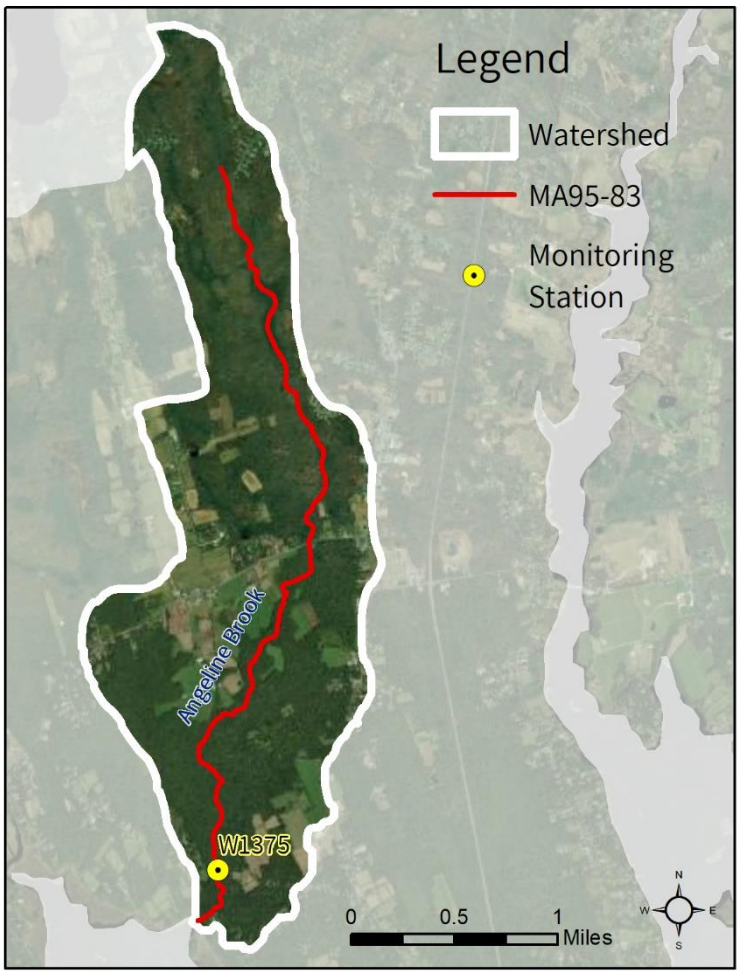


Figure 13-2. Location of monitoring station(s) along the impaired segment.

Table 13-1. Summary of indicator bacteria sampling results by station for Angeline Brook (MA95-83). The maximum 90-day rolling geometric mean (geomean), the number of days exceeding the geomean criterion of 35 CFU/100 mL for enterococci indicator bacteria, and the number of single samples exceeding the STV criterion of 130 CFU/100 mL for enterococci 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
W1375	5/3/2005	8/2/2005	4	56	3	1

Table 13-2. Indicator bacteria data by station, indicator, and date for Angeline Brook (MA95-83). 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 for *E. coli* and 130 CFU/100 mL for enterococci indicator bacteria (applied to single-sample "Result" since there were no more than 10 samples in a year to calculate the STV); and red text in the Geomean column highlights exceedances of 126 CFU/100 mL for *E. coli* and 35 CFU/100 mL for enterococci indicator bacteria (applied to rolling 90-day geomean).

Unique Station ID	Indicator	Date	Wet/Dry	Result (CFU/100mL)	90-Day Rolling Geomean (CFU/100mL)	90-Day Rolling STV (CFU/100mL)
W1375	Enterococci	5/3/2005	WET	45	45	
W1375	Enterococci	6/9/2005	DRY	3*	11	
W1375	Enterococci	6/28/2005	DRY	1,600‡	56	
W1375	Enterococci	8/2/2005	DRY	40	54	
W1375	*E. coli*	5/3/2005	WET	115	115	
W1375	*E. coli*	6/9/2005	DRY	25	54	
W1375	*E. coli*	6/28/2005	DRY	1,600‡	166	
W1375	*E. coli*	8/2/2005	DRY	3*	46	
W1375	*E. coli*	9/12/2005	DRY	45	56	
W1375	Fecal Coliform	5/3/2005	WET	145		
W1375	Fecal Coliform	6/9/2005	DRY	3*		
W1375	Fecal Coliform	6/28/2005	DRY	1,600‡		
W1375	Fecal Coliform	8/2/2005	DRY	5		
W1375	Fecal Coliform	9/12/2005	DRY	100		

* Value below the Method Detection Limit (MDL) of 5 CFU/100mL; a value of half the MDL is reported and used to calculate the geometric means for *E. coli* and enterococci.

‡ Value above the Method Detection Limit (MDL) of 1,600 CFU/100mL; the MDL is reported and used to calculate the geometric means for *E. coli* and enterococci.

13.3. 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 wildlife and domesticated animal waste (including pets).

Indicator bacteria data for Angeline Brook (MA95-83) were elevated during both wet and dry weather. Elevated results during wet weather are consistent with urban stormwater, pet waste, and wildlife pathogen sources, as are certain types of septic system malfunctions, such as rainwater infiltration or saturated disposal fields which overflow during precipitation. Elevated results during dry weather suggest that ongoing sources such as leaking pipes, illegal cross connections, other illicit discharges, and failing septic systems, are likely to be major sources of pathogens.

Each potential pathogen source is described in further detail below.

Urban Stormwater: There is a relatively small amount of development in the watershed (8%), most of which consists of residential areas with some commercial development as well. Within the watershed, no area is subject to MS4 permit conditions, 3% is classified as impervious area, and 2% is classified as DCIA. Stormwater runoff from urban areas is likely a minor source of pathogens.

Illicit Sewage Discharges: Public sewer service is not available in the watershed within the town of Westport. Surrounding towns outside of the segment's watershed may have public sewer systems. 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: 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 (15%) of the total land use. Many 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 many residential neighborhoods near the Angeline Brook segment MA95-83. 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.

13.4. 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 Westport. See Section 12.4

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