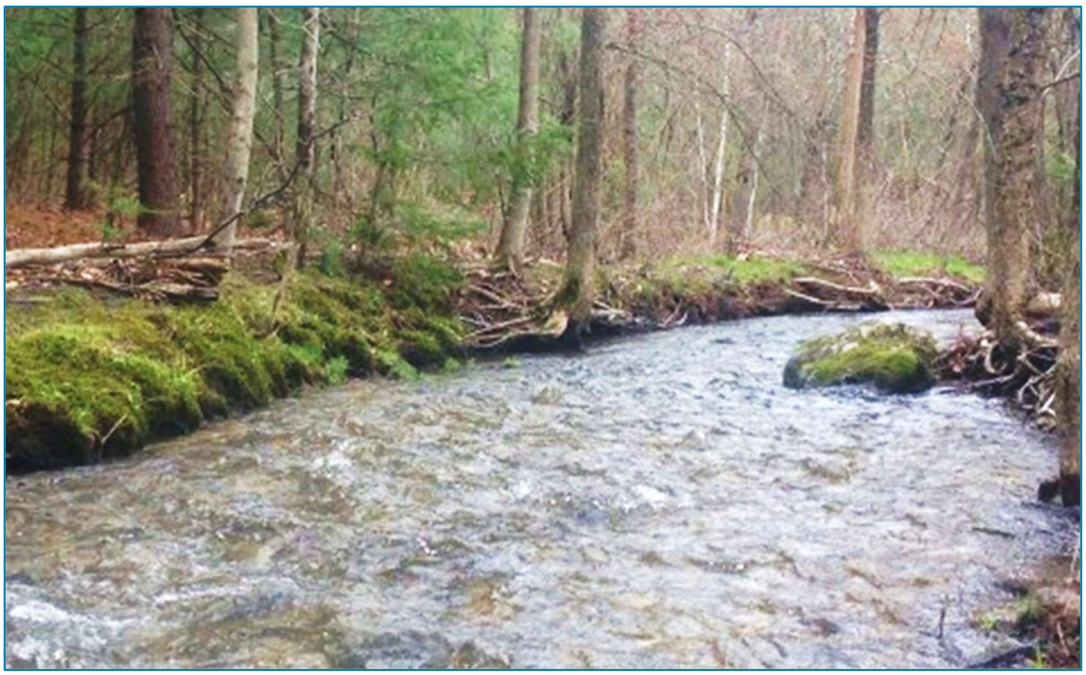
MASSACHUSETTS
watershed·based plans

Watershed-Based Plan for the

Mill River Watershed

April 2025



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Contents

Executive Summary

Introduction

The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds, and present it in a format that will enhance development and implementation of projects to restore water quality and beneficial uses in the Commonwealth. This WBP was developed by the Pioneer Valley Planning Commission (PVPC), the Town of Williamsburg, and Comprehensive Environmental, Inc. with funding, input, and collaboration with the Massachusetts Department of Environmental Protection (MassDEP).

Water Quality Impairments

The impairments listed below are included in the Massachusetts 2022 Integrated List of Waters:

Waterbody	AUID	Category	Size	Impairment
Mill River	MA34-28	5	10.0 miles	*E. coli*
Mill River Diversion	MA34-32	4c	2.5 miles	Water chestnut

Goals, Management Measures, and Funding

The Mill River watershed includes 53.8 square miles of land in the Connecticut River basin. The implementation actions described in Element C of this WBP focus on the activities in the upper Mill River watershed, and specifically within the Town of Williamsburg. Water quality goals for this WBP are focused on:

1. Protecting the quality of the Mill River and its tributaries as coldwater fishery habitat.
2. Eliminating the existing bacteria impairment as listed above.
3. Maintaining excellent water quality with regard to nutrient concentrations.

It is expected that goals will be accomplished primarily through installation of structural BMPs to capture runoff and reduce pollutant loading, as well as implementation of non-structural BMPs and watershed education and outreach. It is anticipated that structural BMPs will first be implemented at locations identified as high priority in Element C of this WBP. Additional implementation is expected to be performed in the future, focusing on sites identified in this WBP. It is expected that funding for management measures will be obtained from a variety of sources including grant funding, municipal capital improvement funds, volunteer efforts, and other sources.

Public Education and Outreach

Goals of public education and outreach are to promote watershed stewardship by emphasizing the benefits of a restored Mill River watershed and the importance of protecting the future health of the watershed. The Town aims to engage watershed residents, businesses, and other community stakeholders about the benefits of water quality protection efforts through a variety of outreach methods as described in Element E of this WBP, in conjunction with the MVP Action Grant project awarded to the Town of Williamsburg for *Mill River Watershed Planning*. These programs will be evaluated by tracking attendance at educational events, activity on online resources, and other tools applicable to the type of outreach performed.

Implementation Schedule and Evaluation Criteria

Project activities will be implemented based on information outlined in the WBP sections describing monitoring, implementation of structural BMPs, and public education and outreach activities. In addition to water quality monitoring, indirect evaluation metrics are recommended, including documentation of BMP construction and quantification of reduction in impervious area within the watershed. The WBP will be re-evaluated and adjusted, as needed, once every five years.

Introduction

What is a Watershed-Based Plan?

Purpose and Need

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

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

Watershed-Based Plan Outline

This WBP includes nine elements (a through i) in accordance with EPA Guidelines:

a) An **identification of the causes and sources** or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this WBP and other watershed goals identified in the WBP.

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

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

d) An **estimate of the amounts of technical and financial assistance needed**, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan

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

f) A **schedule for implementing the NPS management measures** identified in this WBP.

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

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

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

Project Partners and Stakeholder Input

This WBP was developed by the Pioneer Valley Planning Commission (PVPC) in collaboration with the Town of Williamsburg, with funding, input, and collaboration from MassDEP and technical assistance from Comprehensive Environmental, Inc. (CEI). This WBP was developed using matching funds from a Section 319 Program grant to the PVPC as part of a Regional Nonpoint Source Coordinator Program to, in part, assist grantees in developing technically robust WBPs using MassDEP's Watershed-Based Planning Tool.

Core project stakeholders included:

- Dan Bannister, Town of Williamsburg - Highway Superintendent
- Nick Caccamo, Town of Williamsburg - Town Administrator
- Paul Wetzel, Town of Williamsburg Selectboard
- Gaby Immerman, Mill River Greenway Committee
- Joseph Rogers and Melinda McCall, Williamsburg Conservation Commission
- Patty Gambarini, Pioneer Valley Planning Commission

This WBP was developed as part of an iterative process. The PVPC project team collected and reviewed existing data from the Town of Williamsburg. This information was then used to develop a preliminary WBP for review by core project stakeholders. A stakeholder conference call was then held to solicit input and gain consensus on elements included in the plan (e.g., water quality goals, public outreach activities, etc.). The WBP was finalized once stakeholder consensus was obtained for all elements.

Data Sources

This WBP was developed using the framework and data sources provided by MassDEP's WBP Tool, and supplemented with the following:

Title/Description	Source	Date
Final Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle	MassDEP	May 2023
Site-specific information from Town of Williamsburg staff and officials	Town of Williamsburg staff/officials	Various dates
Watershed field investigations conducted by CEI	CEI	May 2024
Information related to the Massachusetts Municipal Vulnerability Preparedness (MVP) Action Grant awarded to the Town of Williamsburg for Mill River Watershed Planning	Scope of Work and Budget for Williamsburg Mill River Watershed Planning MVP Action Grant	October 2023 (*updated "Spring 2024"*)

Element A: Identify Causes of Impairment and Pollution Sources

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

General Watershed Information

The Mill River watershed includes areas along the Mill River mainstem and its tributaries as shown in Figure 1 and as listed in Table 1.

This WBP is primarily focused on addressing water quality in the Upper Mill River watershed within the Town of Williamsburg. The watershed area shown on Figure 1 represents the area draining to the most downstream segment (MA34-28) of the Mill River that can be selected on the MA WBP Tool to generate a watershed specifically for the Upper Mill River. Clicking the next downstream segment (MA34-32), which joins the Connecticut River, results in a watershed for the Connecticut River.

Table 1: General Watershed Information

Watershed Name (Assessment Unit ID):	Beaver Brook ; Blake Brook ; Bradford Brook (MA34-71) ; Brewer Brook (MA34-69) ; Clark Brook ; Day Brook (MA34-67) ; East Branch Mill River (MA34-37) ; Granny Brook ; Grass Hill Brook (MA34-70) ; Joe Wright Brook (MA34-52) ; Marble Brook ; Meekin Brook (MA34-72) ; Mill River (MA34-28) ; Nungee Brook ; Potash Brook ; Roberts Meadow Brook (MA34-68) ; Rogers Brook (MA34-51) ; Town Lot Brook ; Unquomonk Brook ; West Branch Mill River (MA34-38) ; West Branch Mill River (MA34-39)
Major Basin:	Connecticut River
Watershed Area (within MA):	34,454.9 acres (53.8 square miles), based on the watershed in Figure1

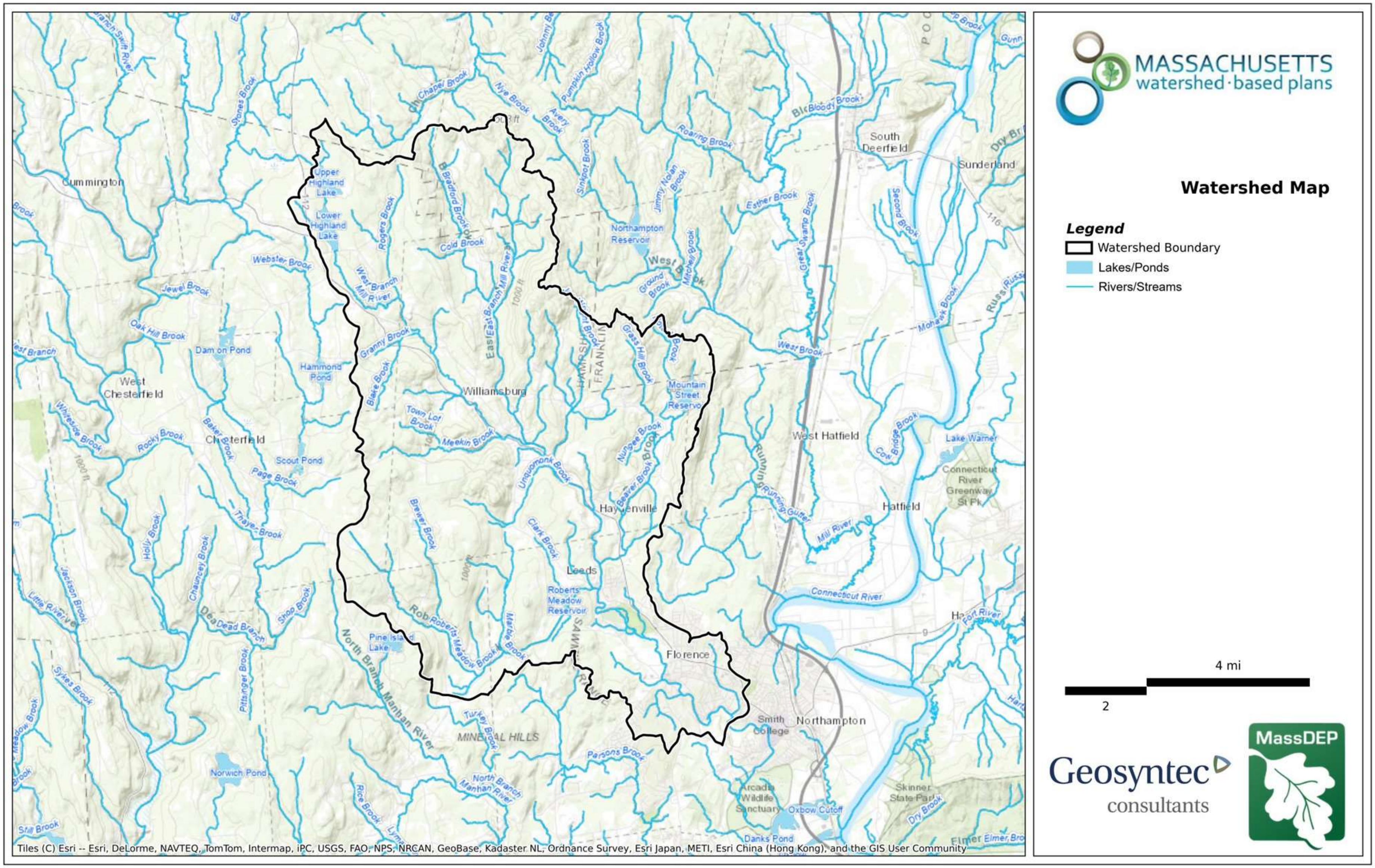


Figure 1: Watershed Boundary Map
(MassGIS, 2007; MassGIS, 1999; MassGIS, 2001; USGS, 2016)
Ctrl + Click on the map to view a full sized image in your web browser.

As noted in Williamsburg's Open Space and Recreation Plan (2021), the Mill River flows from Ashfield, Conway, and Goshen, through Williamsburg and Northampton to join the Connecticut River. Ninety-five percent of land within the Town of Williamsburg drains to the Mill River. Key tributaries include Bradford Brook (East Branch of Mill River), Rogers or Devil's Den Brook (West Branch of Mill River), Meekins Brook, Joe Wright Brook, Unquomonk Brook, and Beaver Brook, in addition to several unnamed streams and brooks.

- Beaver Brook is the only brook that flows out of Williamsburg before it joins the Mill River. Beaver Brook owes some of its flow to a pipeline that carries water from the Northampton water supply reservoirs in West Whately to the Mountain Street Reservoir on the Williamsburg-Whately line. Overflow from that reservoir joins with Grass Hill Brook, Potash Brook (both rising in Whately) and Nungee Brook to become Beaver Brook. The entire Beaver Brook drainage basin or watershed above the Williamsburg-Northampton line covers 5.5 square miles, 3.4 of them in Williamsburg.

- Bradford Brook has its headwaters in Ashfield and flows through Conway before joining the East Branch of the Mill River near the intersection of Judd Lane and Ashfield Road. The East Branch of the Mill River begins in Conway State Forest and flows through the southern part of Conway before entering Williamsburg just north of the site of the gigantic dam collapse that drowned much of the town in 1874, now marked by the historic dam trail. Together these streams form the East Branch of the Mill River which flows along Ashfield Road. Near the former Bullard Bridge (at Village Hill Avenue) the river is joined by a brook that flows south out of a small valley east of Carey Hill.

- The West Branch of the Mill River originates in the Highland Lakes in Goshen and is joined by Rogers (or Devil's Den) Brook, several unnamed streams, and Meekins Brook before its confluence with the East Branch in the center of Williamsburg. Joe Wright Brook, flowing south from Whately and northeastern Williamsburg, joins the Mill River at Depot Road, and Unquomonk Brook flows into the mainstem of the Mill River opposite Kellogg Road. One more unnamed stream flows from the highlands of the former Kellogg farm through the village of Haydenville (partly piped underground) and into the river below the old railroad bed, east of Fairfield Avenue. Finally, Beaver Brook joins the Mill River half a mile south of the Northampton town line

Flooding Concerns

It is important to note that increased frequency of downpours and resulting flood flows have serious implications for water quality with the occurrence of greater erosion and the greater potential for more contaminants from surrounding land uses to wash or seep into local waterways,

The Williamsburg Hazard Mitigation Plan Update (2016) notes that important infrastructure, public facilities, and businesses are concentrated along the Mill River, making floods a pressing concern. Approximately 35 structures are located within the areas of Williamsburg that have a documented history of flooding.

Through the Community Resilience Building Workshops completed as part of Williamsburg's MVP Plan, the Town identified flooding as the top natural hazard, with riverine flooding of the Mill River as the primary concern. The MVP Climate Resilience Building Workshop looked into the future with the latest climate change data to discuss the general direction of climate change, to identify the natural hazards affecting Williamsburg, and to predict how the town will be affected by climate change driven natural hazards.

The Mill River flows through Williamsburg's most developed areas along the Route 9 Corridor and unites the town's two villages, Williamsburg and Haydenville. A major storm event could have catastrophic impacts on Route 9 and devastate both village centers. In Williamsburg, a major flood (larger than current FEMA designated 500-year flood) on the Mill River could cause catastrophic destruction. During Hurricane Irene in 2011, the river's water level under the North St. bridge in Williamsburg center reached a record-breaking 16.42', and its velocity was recorded at over 7,000 cubic feet per second. A new stone cap on the wall at Meekins Library likely prevented the river from damaging the street, unlike in 1936 when the river spilled its banks and destroyed the street. In Haydenville, the Mill River is undermining the wall that supports Route 9 just upstream of the Brassworks. The Bridge Street and South Main Street bridges in Haydenville are at risk of scouring and occasional overtopping during severe storms.

Areas of concern along Route 9 include the bend where Williamsburg Snack Bar is located. This area usually floods in the spring, blocking the road for 12-24 hours. It is also subject to scouring and erosion. Flooding on this road contributes to ice in the winter. Automotive businesses on Route 9 located in the floodplain such as the Cumberland Farms gas station, Worthington Air Automotive, and Cichy's Garage are a concern because they could leak hazardous materials into the river in a flood event.

The MVP planning process identified that the Town should work with landowners and adjacent communities to reduce the quantity and velocity of stormwater entering the Mill River with recommendations related to Master Plan/Regulatory Review, Mill River Watershed Council, and Forest Management Plan). A thorough review of Town bylaws and regulations could ensure that they are in line with the Town's goals and support the Town's climate resiliency. The bylaw review could be combined with the creation of a master plan or it could be a standalone project. This review could address topics including, stormwater management, wetlands protection, large solar projects, other renewable energy projects, floodplain development, erosion control and sedimentation, water supply protection, low impact design, subdivision regulations, and open space residential development.

The Open Space Plan (2021) attributes nearly all soil erosion in Williamsburg as caused by people clearing vegetation that formerly slowed the movement of air and water across the ground. Erosion caused by water is of greater concern as it is much more prevalent than wind erosion. In this wet climate, the increasingly common building of new homes on steep, wooded hillsides exposes highly erosion-prone soils to fast-flowing water runoff. The impact on roads, waterways and otherwise undisturbed vegetation downhill from the clearing and excavation can be considerable and long-lasting if not caught in time. Soil and water washed onto roadways can damage the roads themselves; siltation in streams changes flow patterns and harms aquatic plants, animals, and the insects, amphibians, fish and birds that feed on them. Mud washed over the roots of healthy plants can suffocate and kill them.

The Open Space and Recreation Plan also recognizes the importance of floodplains and floodplain buffers in the goals and objectives section with: "Prioritize protection of floodplains and floodplain buffers to benefit water quality and wildlife habitat and reduce impacts of more frequent and severe flooding events." (p. 71)

Drinking Water Supply

According to the 2021 Open Space and Recreation Plan, Williamsburg's public water supply system draws very high-quality water from two gravel-packed wells located in the 1,330-acre drainage basin of Unquomonk Brook (USGS StreamStats, 2019). The entire drainage basin lies within the town's boundaries and its protection is thus entirely under local control. The public water supply system serves roughly half the dwelling units in town: those along South Street, in and near the village centers, along Route 9 between the villages, and along Fort Hill Road. Residents in outlying areas are served by private wells.

The aquifer is a semi-confined, buried valley, sand and gravel aquifer adjacent to the Unquomonk Brook in the south central part of Town. The Town received a Drinking Water Supply Protection Grant from the Massachusetts Department of Environmental Protection in FY2010 for $46,638 to purchase approximately four acres adjacent to the town's wellhead on South Street to protect the area from agricultural and residential development. The Water Department owns the entire 400-foot, Zone I protective radius around the wells and several acres of land within the Zone II and Zone III of the wells.

Two other items of note on drinking water in Williamsburg:

- Extended power outages have been identified as a significant public health concern because approximately half of the homes in town obtain drinking water from private wells with water extracted by electric pumps (Hazard Mitigation Plan, p. 65)
- Based on the hydrogeologic conditions surrounding the town's drinking water recharge area, the aquifer is considered to be highly vulnerable to contamination." (OSRP, p. 47)

Soils

The Open Space and Recreation Plan (2021) describes Williamsburg's highlands as thinly mantled with glacial till: an unlayered and highly variable jumbled mixture of clay, sand, gravel, silt, pebbles, cobbles and boulders deposited directly by ice. Glacial till covers about 90 percent of Williamsburg. There is much more surface runoff during rainy periods from till areas than from stratified drift areas where the surficial deposits are flatter and more porous. Because till lacks large pore spaces, it is incapable of storing large quantities of groundwater.

The Open Space and Recreation Plan also notes that unfavorable conditions for septic systems, along with physical constraints, have been partially responsible for the limited amount of development on Williamsburg's hillsides and near local wetlands. It is noted too that in recent years the Department of Environmental Protection (DEP) has approved several new technology designs for wastewater treatment that could enable more development in these areas.

Wetlands

The Open Space and Recreation Plan (2021) notes that wetlands include rivers, ponds, swamps, wet meadows, beaver ponds, and land within the FEMA-defined 100-year flood area. There are 742 acres of wetlands located throughout the town, with the largest occurring in the valley of Beaver, Nungee, and Grass Hill brooks along Mountain Street, which are tributaries to the East Branch of the Mill River. This area is mostly wooded swamp, with some scrub-shrub area and a bit of wet meadow that is grazed. Forested streambanks help maintain the high-quality habitat by shading the water to keep it cool; providing a natural energy source to the stream ecosystem in the form of leaves and sticks; and by controlling the runoff of sediments, excess nutrients, and water. Other relatively large wetlands appear near the Town Well east of South Street (shrub swamp, wooded swamp and wet pasture land), along Nash Hill Road near the Whately town line (wooded swamp, the source of Joe Wright Brook), at the Northampton town line west of South Street (shrub swamp, wet meadow and wooded swamp), in the Graves farm woodlot along and near Adams Road and Depot Road (wooded swamp, with a little shrub swamp and wet meadow), along with others.

The Open Space and Recreation Plan also notes that bordering vegetated wetlands' provide critical wildlife habitat and play an important role in maintaining water quality by serving as natural filters for nutrients, toxins, and sediment that would otherwise move directly into surface and ground waters.

Dams

The Mill River's narrow channel and steep drop provided a source of hydropower that supported four industrial mill villages during the 19th century: Haydenville, Williamsburg, Searsville, and Skinnerville. A dam failure in 1874 on the East Branch of the Mill River in Williamsburg destroyed homes, businesses and mills, and killed 139 people. It was the United States' first major dam disaster, and still the second worst in US history. Only Haydenville and Williamsburg centers remain today. The Town recognized this tragedy in spring of 2024 on the occasion of the 150th anniversary with a program of events.

Williamsburg's Hazard Mitigation Plan (2016) identifies eight dams currently within the Town. These are listed in Table below, to which is added information for 4 other dams in the Upper Mill River Watershed pulled from MassGIS - MassMapper, September 2024.

Dam name	Location	Ownership	Hazard index rating*
Mountain Street Reservoir Dam	Williamsburg	City of Northampton Conservation Committee	High
Upper Highland Lake Dam	Goshen	MA DCR	High
Lower Highland Lake Dam	Goshen	MA DCR	High
Brass Mill Pond Dam	Williamsburg	The Brassworks Associates	Low
Mountain Street Reservoir Dikes	Hatfield	City of Northampton Conservation Committee	Low
Unquomonk Upper Reservoir Dam	Williamsburg	Town of Williamsburg	Low
Graham Pond Dam	Williamsburg	Thomas Hodgkins	Low
Unquomonk Lower Reservoir Dam	Williamsburg	Town of Williamsburg	Non-jurisdictional
Fuller Pond Dam	Williamsburg	Roland M. Emerick	Non-jurisdictional
John P. Webster Dam	Williamsburg	Reverend John P. Webster	Non-jurisdictional
Williams Pond Dam	Goshen	Privately owned	Non-jurisdictional

* Hazard index rating does not refer to the condition of the dam, but rather reflects the extent of damage (loss of property and life) if the structure were to fail.

MassDEP Water Quality Assessment Report and TMDL Review

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

The following reports were summarized through MassDEP's WBP Tool:

- Connecticut River Watershed 2003 Water Quality Assessment Report

Connecticut River Watershed 2003 Water Quality Assessment Report (MA34-38 - West Branch Mill River)
AQUATIC LIFE Biology MA DFG collected fish community data at the Village Hill Road crossing in this segment of the West Branch Mill River in Williamsburg in 2004 and 2005 (Richards 2006). Site 965, sampled in 2004, was dominated by fluvial specialist species. A total of 214 fish were collected, representing 8 species, including: 69 Atlantic salmon, 57 blacknose dace, 44 longnose dace, 17 slimy sculpin, 11 brook trout (multiple age classes), 7 fallfish, 7 brown bullhead, and 2 white sucker. Site 1260, sampled in 2005, was also dominated by fluvial specialist species. A total of 327 fish were collected, represented by 14 species, including: 71 blacknose dace, 51 Atlantic salmon, 50 slimy sculpin, 46 longnose dace, 42 common shiner, 19 golden shiner, 14 pumpkinseed, 8 brook trout (multiple age classes), 7 brown trout (multiple age classes), 7 creek chubsucker, 5 brown bullhead, 4 bluegill, 2 white sucker, and 1 creek chub. This segment of the West Branch Mill River is assessed as support for the Aquatic Life Use based on the diverse cold water fish community. **Report Recommendations:** Conduct water quality monitoring to evaluate designated uses.

Connecticut River Watershed 2003 Water Quality Assessment Report (MA34-28 - Mill River-Northampton)
AQUATIC LIFE Habitat/Flow On 23 July 2003 MassDEP DWM biologists conducted a habitat assessment of Mill River – Northampton about 300m upstream from USGS Gage 01171500 in Northampton (Station B0509). The overall habitat score was 149 out of a possible 200, with channel alteration and bank vegetative protection limiting the habitat score the most (Appendix C). The USGS maintains a gage on the Mill River in Northampton, MA (Gage 01171500). The average annual discharge at this gage is 105.6 cfs (period of record 2000 to 2005). The maximum discharge at this gage occurred on 19 August 1955 (6,300 cfs). The minimum discharge occurred on 1 October 1950 (2.2 cfs)(period of record October 1938 to 2004) (Socolow et al. 2004). Biology DWM conducted benthic macroinvertebrate sampling in the Mill River- Northampton at Station B0509, upstream from USGS Gage 01171500 in Northampton on 23 July 2003. The Total Metric Score was 81% comparable to the reference condition, resulting in an assessment of "slightly impacted" (Appendix C). MA DFG collected fish community data on the Mill River – Northampton at two sites (Richards 2006). Site 814 was sampled at Main Street in Northampton in 2002, while Site 941 was sampled at the Look Park picnic area in 2003. The fish community at Site 814 was dominated by fish species tolerant or moderately tolerant of pollution, although two species intolerant to pollution were present in very low numbers. A total of 342 fish were collected at Site 814, including: 146 common shiner, 100 blacknose dace, 37 longnose dace, 28 tesselated darter, 21 white sucker, 4 brown trout, 3 creek chub, 2 pumpkinseed, and 1 Atlantic salmon. The fish community at Site 941 was also dominated by fish species tolerant or moderately tolerant of pollution, although only one individual brown trout was collected that is considered pollution intolerant. A total of 249 fish were collected at Site 941, including: 187 blacknose dace, 44 longnose dace, 12 common shiner, 4 white sucker, 1 brown trout, and 1 brown bullhead.

Toxicity
Ambient
The Berkshire Electric Cable Co. staff collected water from the Mill River for use as dilution water in the facility's whole effluent toxicity tests. Survival of both C. dubia and P. promelas exposed (7-day) to the river water was >80% (n=1).

Effluent
One modified acute and chronic whole effluent toxicity test was conducted on the Berkshire Electric Cable Co. treated effluent in June 2004. The effluent did not exhibit any acute or chronic toxicity to either C. dubia or P. promelas.

Chemistry - water
DWM conducted water quality sampling one mile downstream from Clement Street, Station 28B, on this segment of the Mill River- Northampton between April and October 2003 (Appendix B). All measurements were indicative of good water quality conditions.

USGS collected water quality data on the Mill River in Northampton in the vicinity of Clement Street at USGS Gage # 01171500. These data were reported within an upper Connecticut River Basin total nitrogen report (Deacon et al 2006). Water quality parameters were measured monthly at this station on 43 occasions between December 2002 and September 2005. Summary statistics provided for this station showed that the minimum DO measurement collected at this location was 7.7 mg/L. The maximum water temperature reported was 22.6 deg C. TSS was generally low with a maximum of 17 mg/L. The maximum ammonia was 0.022 mg/L, though the median ammonia level was <0.005 mg/L. The mean and median pH was 7.2, though a minimum of 6.3 was reported.

This segment of the Mill River - Northampton is assessed as support for the Aquatic Life Use based on the benthic and fish communities, and the good water quality data.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES
DWM collected E. coli samples from the Mill River - Northampton one mile downstream from Clement Street (Station 02A) between April and November 2003 (Appendix B). The geometric mean of these samples was 133 cfu/100ml.

MassDEP biologists observed the water quality at the Mill River – Northampton monitoring station (B0509) on 23 July 2003. The water was clear, slightly turbid (likely due to heavy rain in the past 24 hours), odorless, and without any surface oils. This area is heavily used by dog-walkers (Appendix C).

DWM personnel made field observations at Station 28B during surveys conducted between April and October 2003. No objectionable deposits, scums or water odors were recorded and water clarity was generally noted as clear or slightly turbid (MassDEP 2003).

The Primary Contact Recreational Use is assessed as impaired because of elevated E. coli bacteria counts, noted particularly during wet weather. The Secondary Contact Recreation and Aesthetics uses are assessed as support based upon bacteria counts that are acceptable for secondary contact and the lack of objectionable conditions.

Report Recommendations:
Conduct bacteria source tracking to determine the source(s) of elevated bacteria levels within this segment.

Connecticut River Watershed 2003 Water Quality Assessment Report (MA34-37 - East Branch Mill River)

AQUATIC LIFE
Habitat/Flow
On 23 October 2003 MassDEP DWM biologists conducted a habitat assessment of the East Branch Mill River along Mill Road in Williamsburg. The total habitat score for the East Branch Mill River was 166 out of a possible 200 (Appendix D). The streambanks within this reach were observed to be moderately unstable, with ~50% of the bank displaying signs of erosion. The Riparian Vegetative Zone Width was rated as "suboptimal" due to the proximity of lawns.

Biology
MA DFG collected fish community data on the East Branch Mill River at Site 1344 along Williamsburg Valley Road in Williamsburg in 2005 (Richards 2006). Four pollution intolerant fluvial specialist fish species were collected in this sample. A total of 190 individual fish were collected, including: 74 blacknose dace, 44 longnose dace, 28 slimy sculpin, 26 Atlantic salmon, 16 brook trout (multiple age classes), 1 brown trout, and 1 common shiner. The presence of slimy sculpin and brook trout are indicative of a cold water fishery.

DWM conducted fish population sampling in the East Branch Mill River just upstream from the confluence with the

West Branch mill River along Mill Road in Williamsburg on 23 October 2003 (Appendix D). Electro-fishing efficiency was rated as "excellent". Eight fish species were collected. The 60 individual fish collected during this survey were almost equally divided between pollution tolerant and intolerant species. Multiple age classes of brook trout, a pollution intolerant species, were collected in this sample. The presence of slimy sculpin and brook trout are indicative of a cold water fishery.

Chemistry - water
DWM conducted water quality sampling at East Main Street, Station EBMR01, on this segment of the East Branch Mill River between April and October 2003 (Appendix B). All measurements were indicative of excellent water quality conditions.

This segment of the East Branch Mill River is assessed as support for the Aquatic Life Use based on fish community data and the excellent water quality.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES
DWM collected E. coli samples from the East Branch Mill River at East Main Street Williamsburg between April and November 2003 (Appendix B). The geometric mean of these samples was 42 cfu/100ml.

DWM personnel made field observations at Station EBMR01 during surveys conducted between April and October 2003. No objectionable deposits, scums or water odors were recorded and water clarity was always noted as clear (MassDEP 2003).

The Primary Contact Recreation, Secondary Contact Recreation and Aesthetics uses are assessed as support due to the acceptable bacteria counts and the general lack of objectionable conditions.

Report Recommendations:
Conduct water quality monitoring to evaluate designated uses.

Connecticut River Watershed 2003 Water Quality Assessment Report (MA34-39 - West Branch Mill River)

AQUATIC LIFE
Habitat/Flow
On 23 October 2003 MassDEP DWM biologists conducted a habitat assessment of West Branch Mill River at the end of Mill Road in Williamsburg. The total habitat score was 162 out of a possible 200 (Appendix D).

Biology
DWM conducted fish population sampling in the West Branch Mill River at the end of Mill Road in Williamsburg on 23 October 2003 (Appendix D). Electro-fishing efficiency was rated as "excellent."
A total of 31 fish were collected, including 6 fish species. Included in the sample were eight Atlantic salmon and one brook trout. The sample was comprised of fluvial specialist and dependent species, and three were pollution intolerant cold water species.

Chemistry – water
DWM conducted water quality sampling at Mill Street in Williamsburg, Station WBMR01, on this segment of the West Branch Mill River between April and October 2003 (Appendix B). All measurements were indicative of good water quality conditions.

This segment of the West Branch Mill River is assessed as support for the Aquatic Life Use based on the fish community and the good water quality conditions.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES
DWM collected E. coli samples at Mill Street in Williamsburg, Station WBMR01, on this segment of the West Branch Mill River between April and October 2003 (Appendix B). The geometric mean of these samples was 75 cfu/100ml.

DWM personnel made field observations at Station WBMR01 during surveys conducted between April and October 2003. No objectionable deposits, scums or water odors were recorded and water clarity was always noted as clear (MassDEP 2003).

The Primary Contact Recreation, Secondary Contact Recreation and Aesthetics uses are assessed as support due to the acceptable bacteria counts and the general lack of objectionable conditions.

Report Recommendations:
NA

Water Quality Data

The MassDEP-DWM, Watershed Planning Program (WPP) provides water quality laboratory data for sampling conducted between 2005-2020 online at: https://www.mass.gov/guides/water-quality-monitoring-program-data.

Bacteria (*E. coli*) and total phosphorus data from samples collected within the Mill River (Station 1796, see Figure 2) between 2008-2019 are presented in Figures 3 and 4.

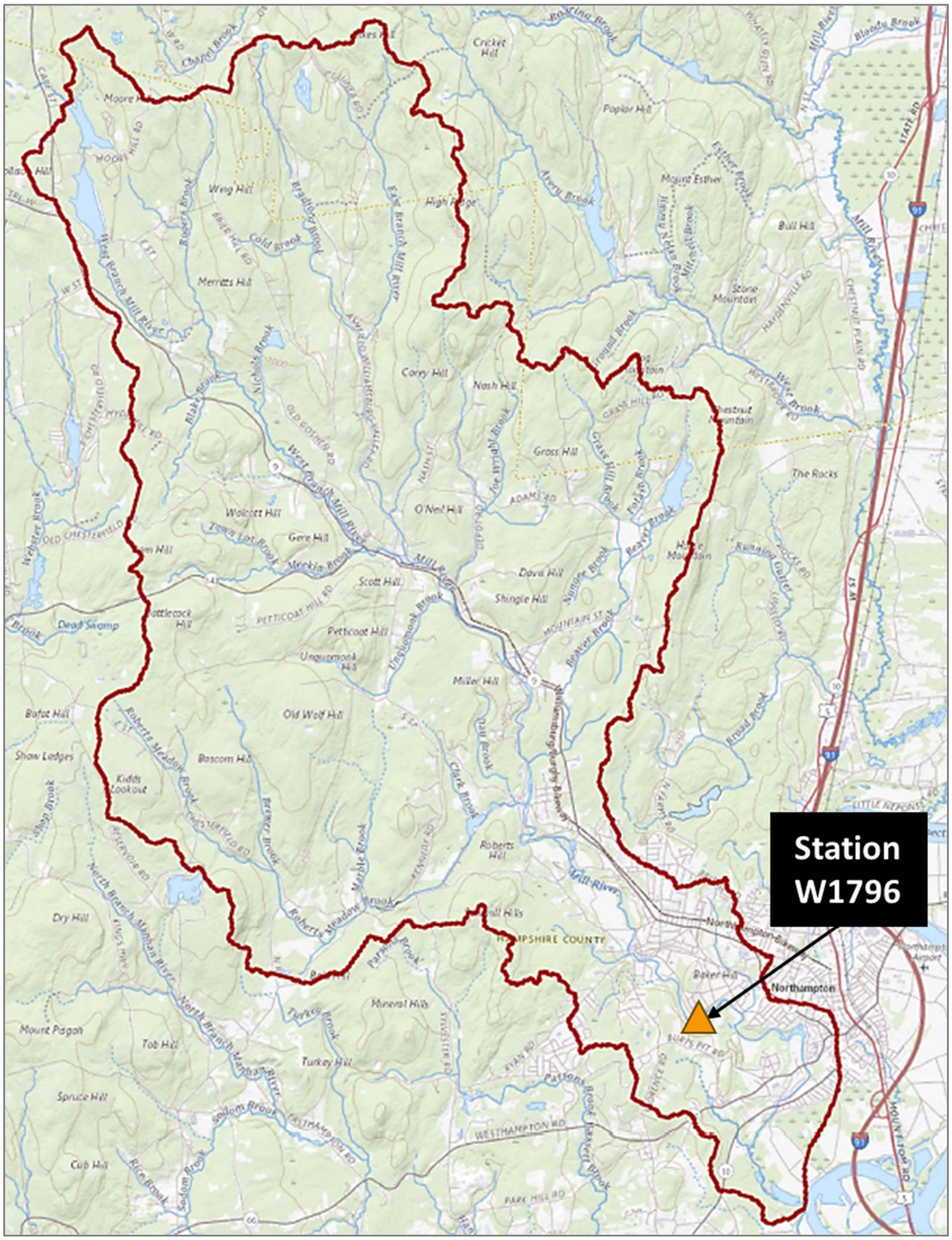


Figure 2. Location of Mill River sampling station W1796

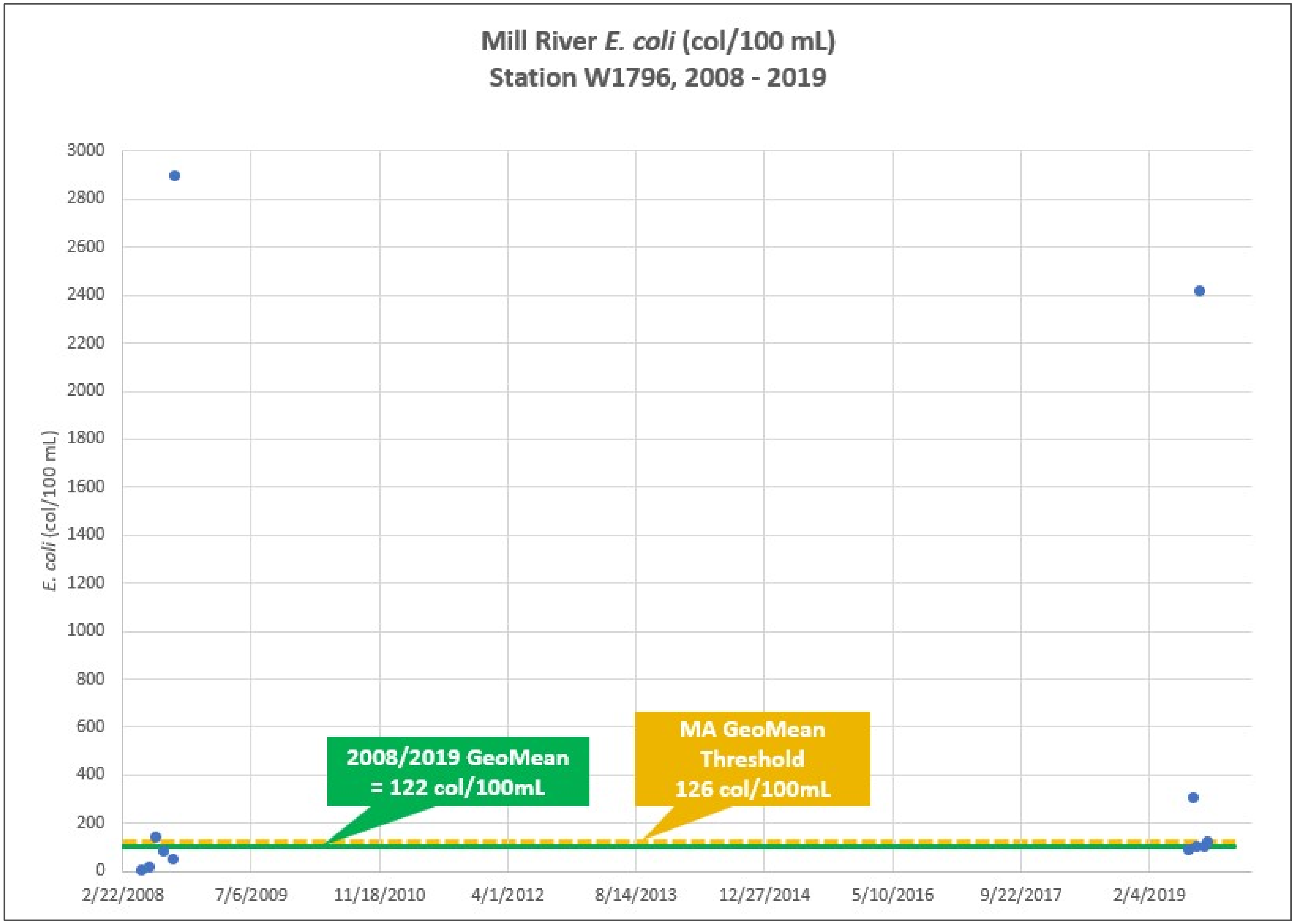


Figure 3. Mill River *E. coli* Data from 2008-2019 (Station W1796)

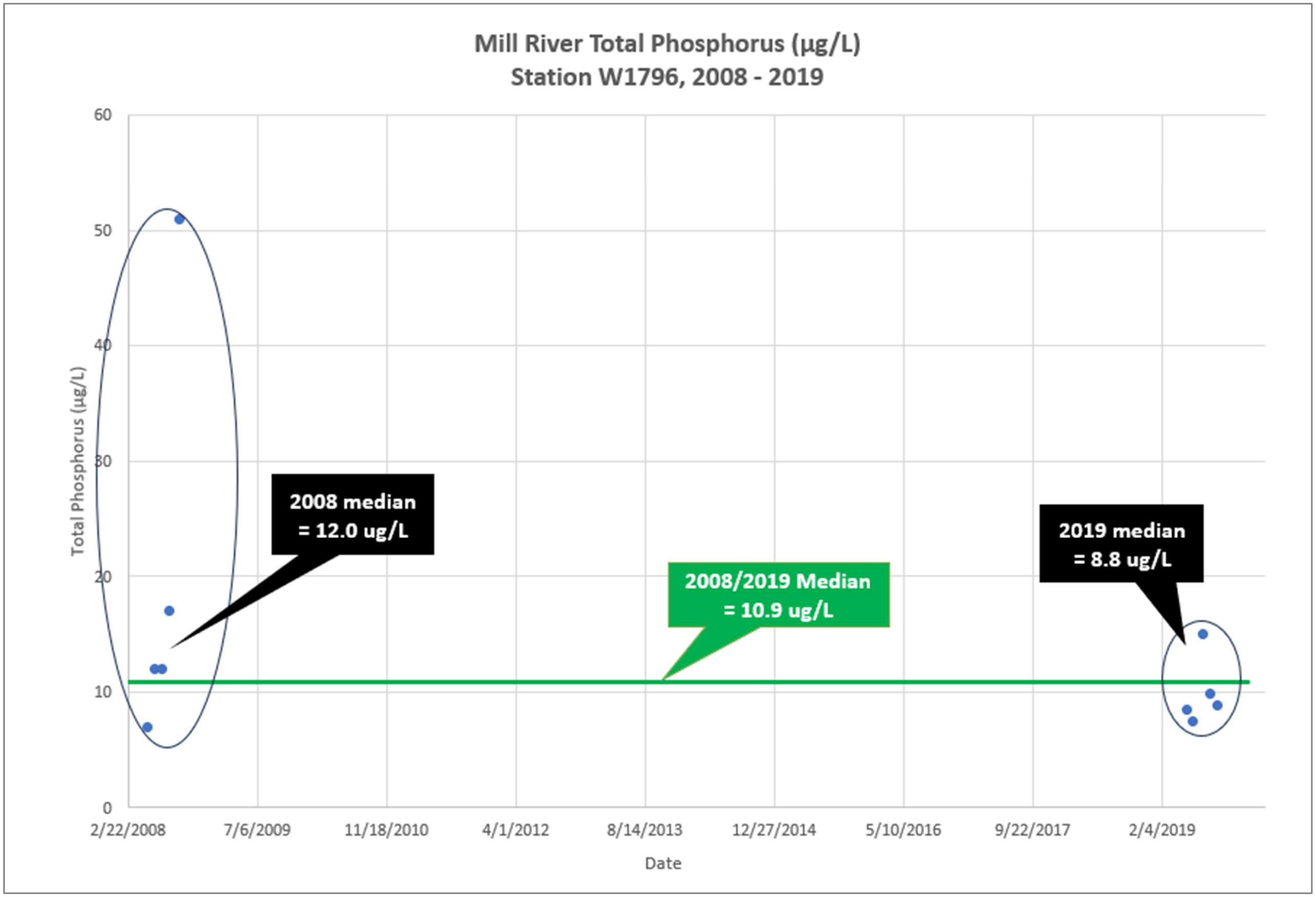


Figure 4. Mill River Total Phosphorus Data from 2008-2019 (Station W1796)

Water Quality Impairments

Known water quality impairments, as documented in the *Final 2022 Massachusetts Integrated List of Waters* (MassDEP, 2023a), are listed in Table 3. Impairment categories from the Integrated List are listed in Table 2.

Table 2: 2022 Massachusetts Integrated List of Waters Categories

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

Table 3: Water Quality Impairments (MassDEP, May 2023)

Waterbody	Assessment Unit ID	Category	Description	Size	Impairment
Mill River	MA34-28	5	Headwaters (confluence of East and West Branch Mill River, Williamsburg), to outlet Paradise Pond, Northampton	10.0 miles	*E. coli*
Mill River Diversion	MA34-32	4c	Headwaters, outlet Paradise Pond, Northampton to mouth at confluence with Oxbow (east of Old Springfield Road), Northampton (through former 2006 segment: Hulberts Pond MA34036)	2.5 miles	Water chestnut

Land Use and Impervious Cover Information

Land use information and impervious cover is presented in the tables and figures below. Land use source data is from 2016 and was obtained from MassGIS (2019). The land use and land cover categories were matched with the associated land use category using the methodology identified in the MassDEP guidance document “2016 Massachusetts Small MS4 Permit Pollutant Loading Export Rates applied to the 2016 Massachusetts Land Use/Land Cover GIS Dataset” (MassDEP, 2023b).

This 53.8 square mile area includes the Upper Mill River watershed from its headwaters to the confluence of the Mill River (MA 34-28) with the Mill River Diversion (MA 34-32) at Smith College’s Paradise Pond. This area is based on what can be selected from the MA Watershed Based Tool.

Table 4: Watershed Land Uses

Land Use	Area (acres)	% of Watershed
Agriculture	1260.42	3.7
Commercial	480.31	1.2
Forest	28404.69	82.4
High Density Residential	946.37	2.7
Highway	495.18	1.4
Industrial	102.17	0.3
Medium Density Residential	1295.91	3.8
Open Land	1064.63	3.1
Water	405.23	1.2
Total Area:	**34454.9**	**100**

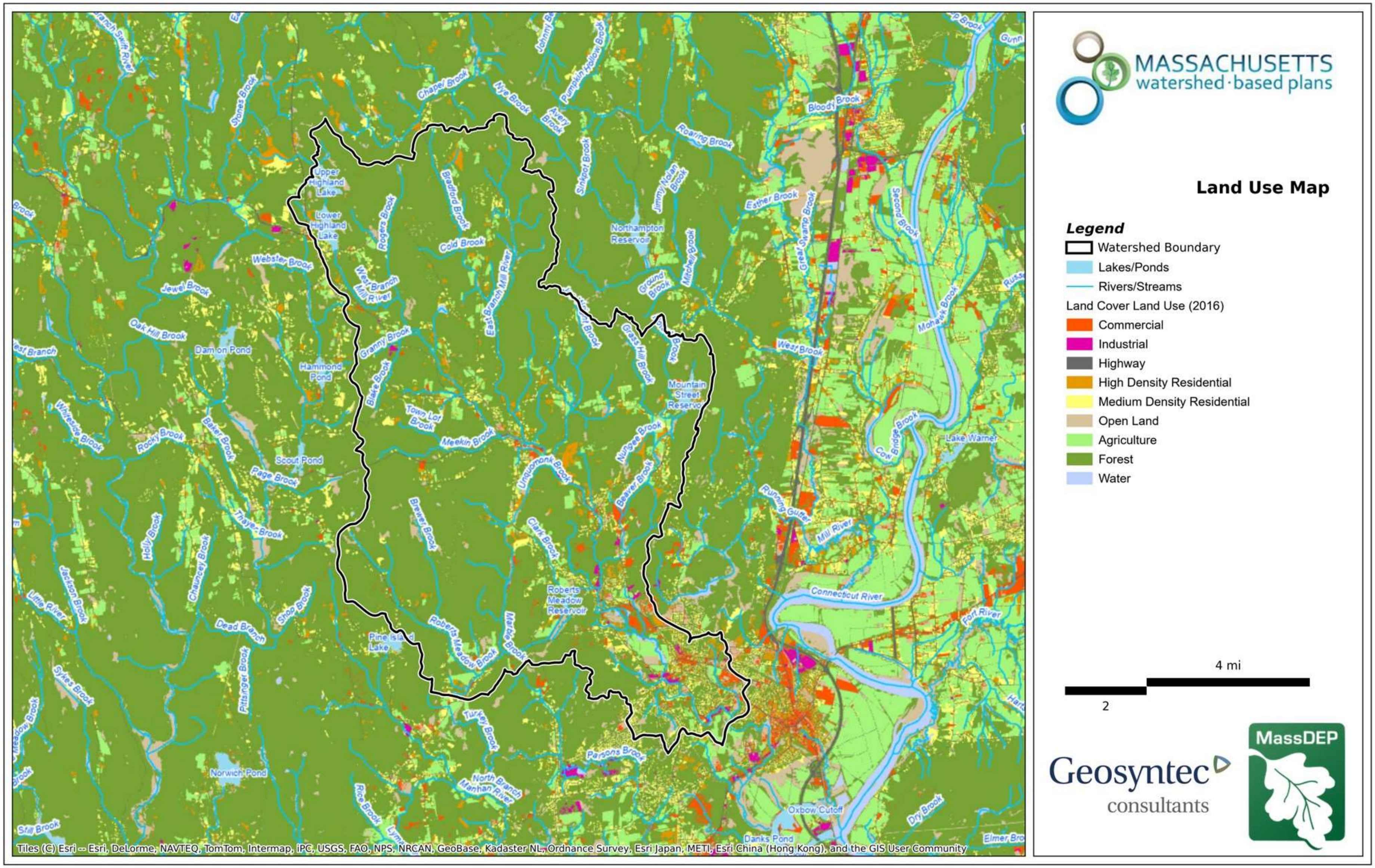


Figure 5: Watershed Land Use Map

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

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

Watershed Impervious Cover

There is a strong link between impervious land cover and stream water quality. Total Impervious Area (TIA) includes land surfaces that prevent the infiltration of water into the ground, such as paved roads and parking lots, roofs, basketball courts, etc.

Table 5: Estimated TIA for the Milll River Watershed

	Estimated TIA (%)
Mill River Watershed	3.5

The general relationship between TIA and water quality is categorized as shown in **Table 6** (Schueler et al. 2009). It is important to note that this impervious cover model developed by the Center for Watershed Protection in 1994 and affirmed through many studies since, correlates stream health to degree of imperviousness in a watershed. Although the model applies only to streams that are 3rd order or less, the model is often generalized to apply to larger watersheds. Given that the Mill River in Williamsburg is a 3rd order stream (but possibly 4th order stream depending on whether it is counted together with the Mill River Diversion), the application of this model seems appropriate. It is important, however, to note in stretches of the watershed that are more heavily impervious, such as downtown areas, there can be serious localized impacts[1].

Table 6: Relationship between Total Impervious Area (TIA) and water quality (Schueler et al. 2009)

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

1 To understand which streams in the region are 3rd order or less, see Table 1. in *Gazetteer of Hydrologic Characteristics of Streams in Massachusetts— Connecticut River Basin* by S. William Wandle, Jr. of the U.S. Geological Survey, 1984. In using this Table, note that the Connecticut River itself is 6th order. Thus order is as follows: CT River (6th) – Unnamed tributary (5th) – Mill River Diversion (4th) – Mill River (3rd or 4th) depending on whether counted with Mill River Diversion or not.

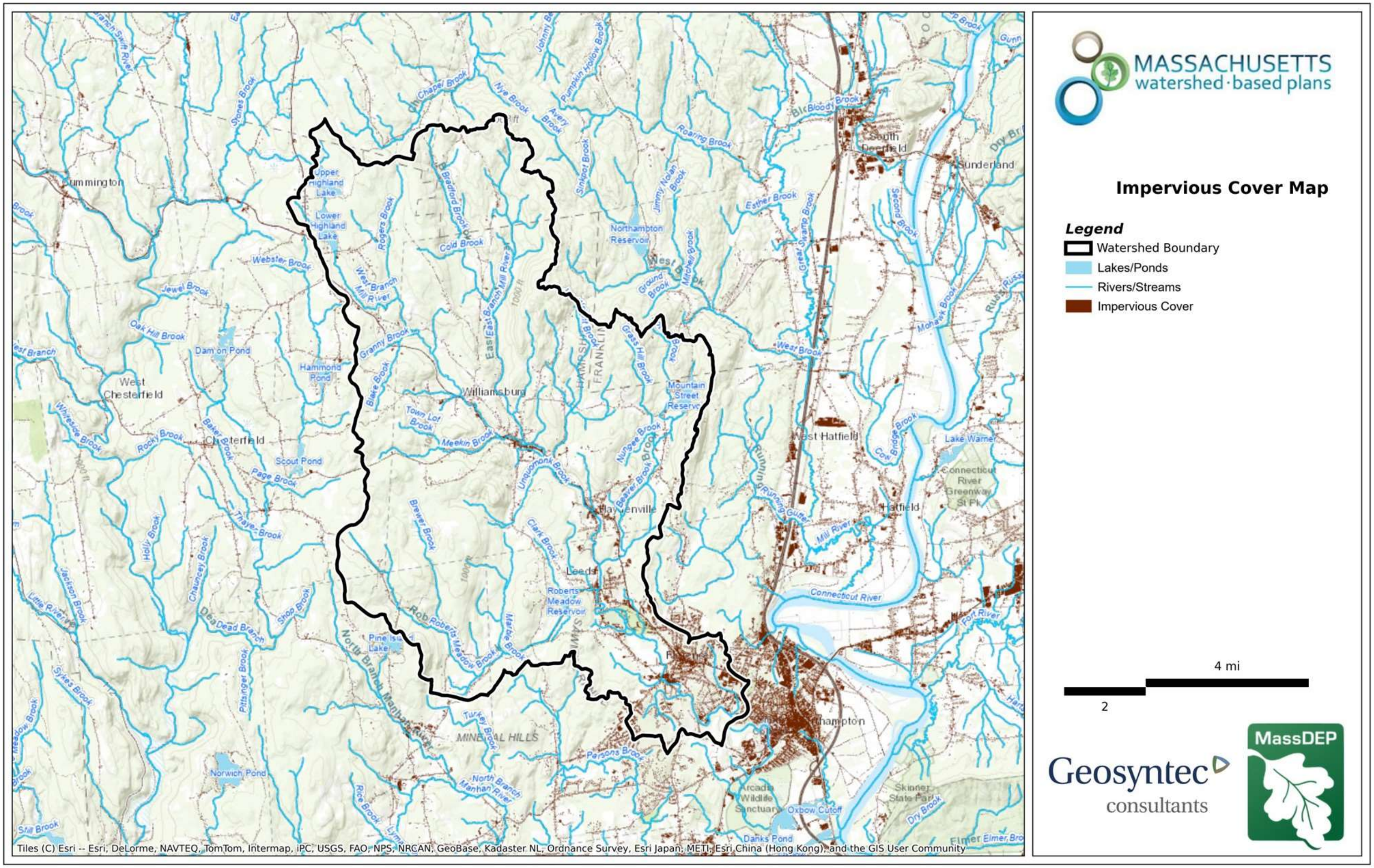


Figure 6: Watershed Impervious Surface Map (MassGIS, 2007; MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

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

Pollutant Loading

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

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

$$L_n = A_n * P_n$$

where L_n = Loading of land use/cover type n (lb/yr); A_n = area of land use/cover type n (acres);

P_n = pollutant load export rate of land use/cover type n (lb/acre/yr)

The PLERs are an estimate of the annual total pollutant load exported via stormwater from a given unit area of a particular land cover type. The PLER values for TN, TP and TSS were obtained from USEPA (USEPA, 2020; UNHSC, 2018, Tetra Tech, 2015) (see values provided in Appendix A). **Table 7** presents the estimated land-use based TN, TP and TSS pollutant loading in the watershed.

Table 7: Estimated Pollutant Loading for Key Nonpoint Source Pollutants

Land Use Type	Area (Acres)	Pollutant Loading[1]		
		Total Phosphorus (TP) (lbs/yr)	Total Nitrogen (TN) (lbs/yr)	Total Suspended Solids (TSS) (tons/yr)
Agriculture	1260.42	567	3,296	19.81
Commercial	480.31	454	3,894	49.00
Forest	28404.69	3,804	15,227	418.78
High Density Residential	946.37	506	3,714	53.23
Highway	495.18	832	5,945	309.96
Industrial	102.17	92	791	9.95
Medium Density Residential	1295.91	772	6,138	89.99
Open Land	1064.63	226	2,250	32.91
TOTAL	34049.67	7,252	41,256	983.62

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

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

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

Water Quality Goals

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

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

b. For **water bodies without a TMDL for total phosphorus** (TP), a default water quality goal for TP is based on target concentrations established in the Quality Criteria for Water (USEPA, 1986), which states that TP should not exceed 50 ug/L in any stream at the point where it enters any lake or reservoir. For the purposes of developing WBPs, MassDEP has adopted 50 ug/L as the TP target for all streams at their downstream discharge point, regardless of which type of water body the stream discharges to.

a. Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021) prescribe the minimum water quality criteria required to sustain a waterbody's designated uses. The Mill River and its tributaries are categorized with regard to these standards as shown in Table 8. The Mill River water quality goals for bacteria and temperature are based on the Massachusetts Surface Water Quality Standards.

b. **Other water quality goals set by the community** (e.g., protection of high quality waters, in-lake phosphorus concentration goal to reduce recurrence of cyanobacteria blooms, etc.).

Water quality monitoring is described in Sections H&I below.

Table 8: Surface Water Quality Classification by Assessment Unit

AUID	Waterbody	Class
MA34-28	Mill River	B
MA34-37	East Branch Mill River	B
MA34-38	West Branch Mill River	B
MA34-39	West Branch Mill River	B
MA34-51	Rogers Brook	B
MA34-52	Joe Wright Brook	B
MA34-67	Day Brook	B
MA34-68	Roberts Meadow Brook	A
MA34-69	Brewer Brook	A
MA34-70	Grass Hill Brook	B
MA34-71	Bradford Brook	B
MA34-72	Meekin Brook	B

Water Quality Goal-Setting Meeting

A water quality goal-setting meeting for the Mill River WBP was held on March 8, 2024. In attendance were PVPC staff, representatives from the Town of Williamsburg, and CEI staff. The primary objective of the meeting was to review the available water quality data, impairments, and other relevant watershed information and to discuss and establish water quality goals for the Mill River. A summary of the estimated watershed total phosphorus load (based on the Table 7 pollutant loading analysis), current water quality data and goals, and notes/sources used to set the water quality goals are shown in **Table 9**.

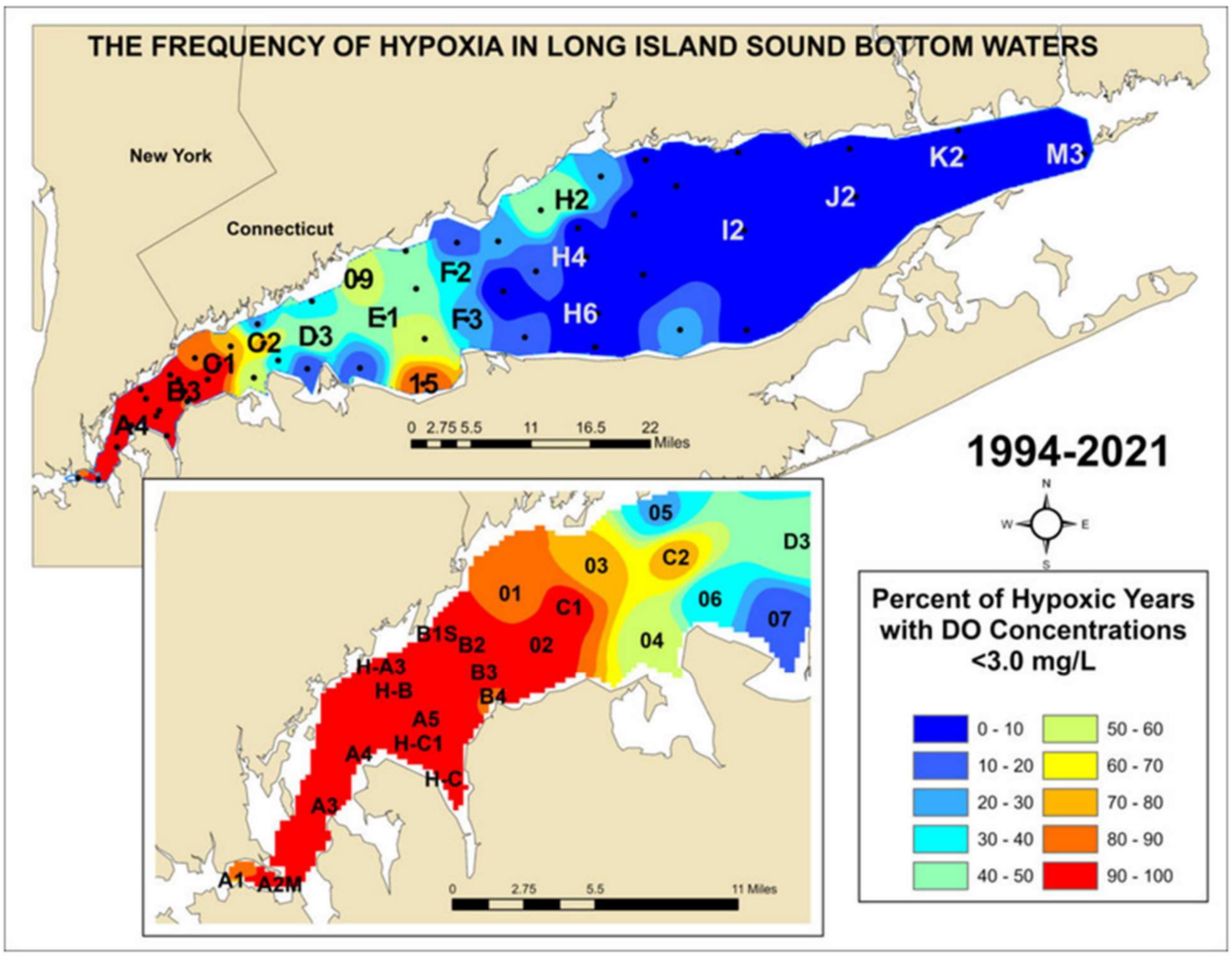
Table 9: Mill River Water Quality Goals

Pollutant	Existing Estimated Total Load	Water Quality Goal	Notes/Source
Total Phosphorus (TP)	7,252 lbs TP/yr	**Goal:** Median TP of **8.8 ug/L** The above goal represents maintaining the median based on data from the past 10 years. Pending additional data collection and loading/response modeling, this would mean **maintaining an annual TP load of 7,252 lbs/yr.**	MA does not have numeric nutrient criteria for phosphorus. Goal based on review of limited available data, which showed a TP median from the past 10 years of 8.8 ug/L (2019 data only). *Additional data collection recommended to confirm goal or modify as needed.*
Temperature	--	**Goal:** Consistently meet MA Class B water quality standards for cold water fisheries.	MA Class B temperature standard for cold water fisheries: Temperature shall not exceed 68F (20C) based on the mean of the daily maximum temperature over a seven-day period in cold water fisheries, unless naturally occurring. Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021)
Bacteria	--	2008/2019 geometric mean (Mill River Station 1796) for *E.coli* of 122 colonies/100mL **Goal:** Continue to meet MA Class B water quality standard for bacteria.	MA Class B water quality standard for bacteria: Geometric mean of *E.coli* samples (min of 5 samples) should not exceed 126 colonies/100mL; No more than 10% of all samples collected within 90 days shall exceed 410 colonies/100mL Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021)

As shown in Table 9, the water quality goal for bacteria and temperature are based on the Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) for Class B waters. As Massachusetts does not currently have numeric criteria for nutrients, the water quality goal for TP (8.8 ug/L) was established based on the limited available data for the Mill River from the past ten years (2019 only). Pending additional data collection and pollutant loading/response modeling, this would mean maintaining an annual TP load of 7,252 lbs/yr. *Additional water quality data collection is recommended to either confirm this goal or provide a basis for modifying the goal .*

Currently, the only TMDL for the Mill River exists in the Final Massachusetts Statewide TMDL for Pathogen-Impaired Waterbodies (Appendix E: Connecticut River Basin, Section 12). **Restoration of the Mill River to remove all existing impairments and maintain excellent water quality is a top priority.**

Because Williamsburg is in the Connecticut River watershed, which drains to Long Island Sound, there may be forthcoming requirements to reduce Nitrogen loading. New York and Connecticut have been involved in long-term work on loading reductions since the release of the Long Island Sound TMDL in December 2000. Nitrogen loading to Long Island Sound remains of concern as it contributes to low dissolved oxygen levels, which has harmful impacts on marine life. While there are no load reduction requirements in the 2016 NPDES MS4 permits in Massachusetts, load reductions are written into NPDES permits for Massachusetts Wastewater Treatment Plants located within the Connecticut River watershed. MassDEP and USGS have recently completed an analysis to provide data on actual loading of Nitrogen in Massachusetts. The study is forthcoming and may translate to requirements for greater control of Nitrogen for Massachusetts communities within the Connecticut River watershed.



Source: Long Island Sound Study.

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

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

Watershed Field Investigation

A watershed field investigation was conducted on May 16, 2024 to identify locations where structural BMPs and other restoration practices could be implemented to reduce pollutant loads in the Mill River watershed within Williamsburg. To identify known problem areas within the watershed, CEI worked with the PVPC staff and municipal officials from the Town of Williamsburg before the watershed field investigation to ensure known “hotspots” were identified and included in the field investigation. Based on this information, CEI conducted both a desktop analysis and field investigations. For most of the field investigations, CEI was accompanied by Town of Williamsburg Highway Superintendent, Town of Williamsburg Highway Foreman, and PVPC staff . The sections below (and in Appendix B) describe 15 potential structural retrofit improvements within the watershed, but they are not intended to be an all-inclusive listing of possibilities. Pending evaluation of the effectiveness of management practices implemented in Williamsburg, future iterations of this plan should evaluate pollutant sources throughout the watershed and recommend best management practices to address those additional sources.

Summary of BMP Recommendations

Potential BMP improvement sites were identified based on local knowledge and findings from the field watershed investigation as shown in **Figure 7**. A detailed description of each BMP recommendation is provided in Appendix B, including:

- A site summary that describes the current conditions and stormwater drainage patterns;
- A description of proposed structural BMP(s);
- Estimated construction and engineering costs;
- Estimated cost per pound of phosphorus removed;
- Estimated annual phosphorus, nitrogen, and TSS load reduction for the proposed structural BMP, assuming that the practice is properly designed, installed, maintained according to guidelines provided in the Massachusetts Stormwater Handbook; and
- Recommended priority for BMP implementation (low, medium or high).

Table 11 provides a summary of estimated costs, estimated nutrient load reductions, and recommended priority for each proposed BMP.

- Construction of all proposed BMPs would reduce the annual total phosphorus load to the watershed by an **estimated 11.8 pounds per year at an estimated cost range of $557,760 to $836,640.**
- Proposed BMPs for the four High Priority sites would reduce annual total phosphorus loading by approximately **2.4 pounds per year at an estimated cost of $57,120 - $85,680**.

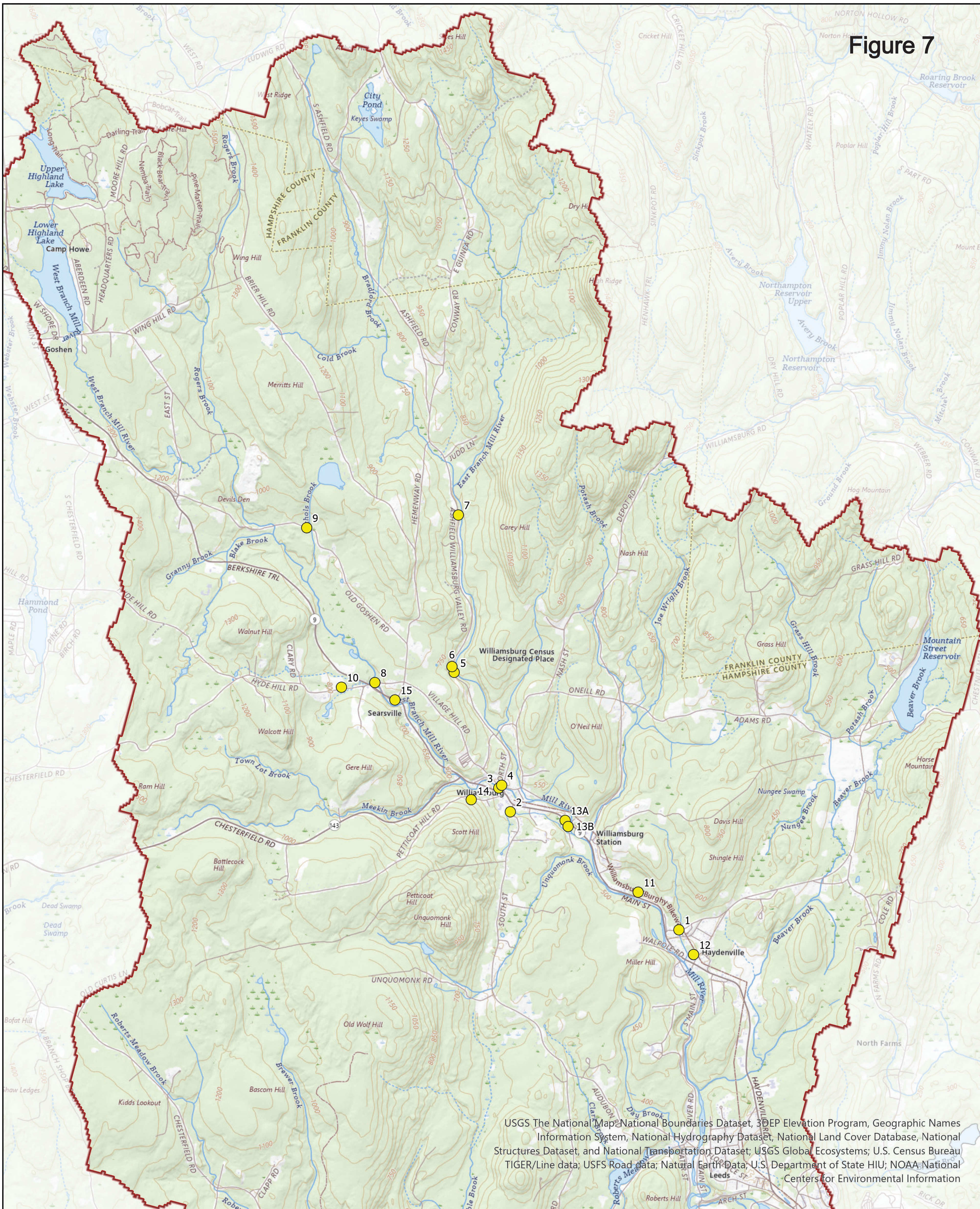


Figure 7

Proposed Structural BMP Locations Mill River Watershed

Williamsburg, MA

Comprehensive Environmental Incorporated

Legend

- Proposed BMP
- Mill River Watershed

Area ID	Coordinates	Location
1	42.378017, -72.704234	Hatfield Street
2	42.390711, -72.729426	Anne T Dunphy School
3	42.393297, -72.731188	Meekins Library
4	42.393604, -72.730761	North Main Street
5	42.405891, -72.738024	Ashfield Road
6	42.406517, -72.738357	Ashfield Road
7	42.423125, -72.737742	Ashfield Road
8	42.404646, -72.749714	Village Hill Area
9	42.421486, -72.760127	Old Goshen Road
10	42.404079, -72.754645	Hyde Road Fields
11	42.382075, -72.710326	Family Vets
12	42.375335, -72.702028	Town Hall
13A	42.389855, -72.721314	River Road
13B	42.389190, -72.720861	River Road
14	42.391975, -72.735228	Petticoat Hill Road
15	42.402775, -72.746718	Nichols Road

Data Sources: ESRI, MassGIS, CEI

7/4/2024

Methodology

Potential sizing, costs, and pollutant load reductions were calculated for each recommended BMP based on a combination of tools, as summarized below.

- **Step 1 – Delineate Drainage Area and Determine Land Use Information**. Where applicable, the drainage area to proposed BMPs was delineated using two-foot contours obtained from MassGIS, aerial imagery, and best professional judgement based on field observations (e.g., observed drainage patterns, roadway grading, etc.). The land use / cover type within each delineated drainage area was estimated using classifications from the National Land Cover Database (NLCD) using GIS tools. Soil types within each delineated drainage area were determined by using the National Resources Conservation Service (NRCS) online Web Soil Survey (WSS) tool.

- **Step 2 – Determine Design Criteria for Sizing.** Each proposed BMP was designed to capture and treat as much site runoff as feasible based on-site constraints. A design objective for each proposed BMP should be to size the BMP to treat and potentially infiltrate the water quality volume (WQV) to the maximum extent practicable. The WQV is the minimum amount of stormwater runoff from a rainfall event that should be captured and treated to remove a majority of target stormwater pollutants on an average annual basis. The WQV is defined in the Massachusetts Stormwater Handbook as **1.0 inch of runoff** times the total impervious area of the post-development project site for a discharge from the following:
    - from a land use with a higher potential pollutant load;
    - within an area with a rapid infiltration rate (greater than 2.4 inches per hour);
    - within a Zone II or Interim Wellhead Protection Area;
    - near or to the following Critical Areas: Outstanding Resource Waters, Special Resource Waters, bathing beaches, shellfish growing areas, and cold-water fisheries.

  The required water quality volume equals **0.5 inches of runoff** times the total impervious area of the post-development site for all other discharges. However, each proposed BMP should be designed to get the most treatment that is practical given the size and constraints of each site.

- **Step 3 – Perform BMP Sizing**. Applicable structural BMPs were sized using Watershed Based Plans Tool (WBPT)[2] developed by the Massachusetts Department of Environmental Protection (MassDEP). Required inputs include: BMP Type, storm size (i.e., treated runoff depth), drainage area, and land use. Outputs include: anticipated BMP footprint based on a typical cross section; estimated construction cost; and estimated load reduction for Total Suspended Solids (TSS), Total Phosphorus (TP), and Total Nitrogen (TN). All applicable BMPs were sized to treat a 1 inch or greater WQV.

- **Step 4 – Calculate Potential Pollutant Load Reductions.** The WBPT provides estimated pollutant load reductions for structural BMPs that have sufficient performance data. Pollutant loading estimates were calculated based on the WBPT for supported BMP types (i.e., bioretention). Bank and Gully stabilization are not supported by the MassDEP WBPT and were calculated based on the EPA Region 5 Spreadsheet Model for Estimating Load Reductions [2] or best professional judgement. The pollutant load reduction for implementation of riparian buffers was estimated based on performance curves from the *Credit for Going Green Project*[3]. The performance curves depict potential pollutant removal efficiency as a function of buffer width (i.e. 20 to 100 feet), soil type (HSG A, B, C, D), and buffer type (grassed or forested).

- **Step 5 – Estimate Costs.** Construction costs for structural BMPs were first estimated using output from the MassDEP WBPT, then adjusted based on best professional judgement based on site size and complexity (i.e., inflated upwards for conservatism). BMPs not supported by the MassDEP WBPT were estimated using

[2] MassDEP WBPT, Element C BMP Selector Tool: http://prj.geosyntec.com/MassDEPWBP/Home.

[3] 2019 Credit for Going Green Project (UNH Stormwater Center / Great Bay National Estuarine Research Reserve): https://www.unh.edu/unhsc/https%3A//www.unh.edu/unhsc/news/credit-going-green.

inflation-adjusted unit pricing from past projects. Once construction costs were calculated, engineering and design costs were **conservatively** calculated to be 40% of the estimated construction cost. Engineering and design costs represent approximate costs for engineering design and analysis, survey, design drawing preparation, and permitting. The 40% estimate may vary on a site-specific basis. An overall capital cost range for each structural BMP was then estimated by summing estimated construction and engineering costs and applying a contingency factor of ± 20%. Cost estimates do not include **engineering** services related to bidding and construction quality assurance.

- **Step 6 – Perform scoring and prioritization.** BMP recommendations were scored and prioritized based on factors described in Table 10. The lowest possible BMP score is 30 points, while the highest is 100 points. The top third of **BMPs** were assigned a priority ranking of "High", the middle third were assigned a priority ranking of "Medium", and the bottom third were assigned a priority ranking of "Low".

Table 10: Structural BMP Scoring Criteria

Factor	Criteria			Score		
	Low	Medium	High	Low	Medium	High
TP Removal	< 0.25 lb/yr	0..25 to 0.49 lb/yr	> 0.5 lb/yr	10	15	25
Capital Cost[1]	> $75k	$27k - $75k	< $27k	10	15	25
Waterbody Proximity	Not Near Waterbody	Within 100-ft of Waterbody	Within 50-ft of Waterbody	5	10	20
Implementation Complexity[2]	High	Moderate	Low	5	10	20
Public Visibility / Outreach	Low Potential Visibility	Moderate Potential Visibility	High Potential Visibility	0	5	10

Notes:

1. Capital cost is based on the high end of the estimate with a contingency factor of 20% applied.

2. Implementation complexity is a qualitative indicator based on the following criteria: property ownership, site access, potential for underground utility conflicts, potential for tree removal, potential for traffic impacts, and potential for wetland permitting. Scored based on professional judgement.

A summary of site-specific recommendations is provided in Table 11. A narrative description of each site, proposed improvements, photos, maps, and other information are provided as **Appendix B**.

Table 11: Structural BMP Scoring and Prioritization Summary *(See Appendix B for more detailed information on each site listed below)*

Area ID	Location	Existing Issues	Proposed Improvements	Estimated Load Reduction			Construction Cost ($)	Engineering Cost ($)	Capital Cost Range		Cost per lb of P ($)	Ranking Factors / Scoring					Score	Site Priority
				TP (lb/yr)	TN (lb/yr)	TSS (ton/yr)						TP Removal	Capital Cost	Waterbody Proximity	Complexity to Implement	Public Visibility		
1	Hatfield Street	Erosion along shoulder and around culvert.	Vegetate the northern shoulder and stabilize the shoulder around the culvert with riprap.	0.05	0.11	0.06	$8,000	$3,200	$8,960	$13,440	$224,000	L	H	H	M	L	65	Medium
2	Anne T Dunphy School	Erosion and sediment transport into nearby tributary.	Stabilize loose soil with vegetation and relocate the soil stockpile.	0.22	0.43	0.26	$10,000	$4,000	$11,200	$16,800	$63,636	L	H	H	M	H	75	High
3	Meekins Library	Erosion and sediment transport into nearby tributary.	Install bioretention basin with sediment forebay (approx. 400 sf) and stabilize roof drain outlets.	0.26	2.39	0.05	$14,000	$5,600	$15,680	$23,520	$75,385	M	H	H	M	H	80	High
4	North Main Street	Erosion along shoulder.	Install bioretention basin (approx. 450 sf).	0.11	0.53	0.23	$16,000	$6,400	$17,920	$26,880	$203,636	L	H	M	L	H	60	Medium
5	Ashfield Road	Erosion along shoulder and along steep embankment.	Install approx. 250 lf of curb and backing and stabilize embankment with riprap.	0.33	0.65	0.38	$11,000	$4,400	$12,320	$18,480	$59,231	M	H	H	M	L	70	High
6	Ashfield Road	N/A - opportunistic implementation area	Install vegetated water quality swale (approx. 1250 sf) where existing asphalt swale is.	0.26	1.18	0.10	$17,000	$6,800	$19,040	$28,560	$15,063	M	M	M	M	L	50	Low
7	Ashfield Road	Erosion along shoulder and around culvert.	Vegetate the swale and shoulder on the west side of Ashfield Road. Stabilize the culvert outlet with large riprap.	1.58	3.97	1.67	$16,000	$6,400	$17,920	$26,880	$14,177	H	H	H	L	L	75	High
8	Village Hill Area	Erosion along shoulder and opportunistic implementation area.	Install water quality swale along the southeastern shoulder and a bioretention basin (approx. 1500 sf) in the dirt parking lot.	0.37	2.53	0.35	$22,000	$8,800	$24,640	$36,960	$83,243	M	M	H	M	L	60	Medium
9	Old Goshen Road	Erosion along shoulder and flooding around culvert.	Install water quality swale (approx. 1500 sf); install additional culvert to ease issues with flooding.	0.10	0.40	0.18	$82,000	$32,800	$91,840	$137,760	$1,148,000	L	L	H	L	L	45	Low
10	Hyde Road Fields	Flooding along the road and erosion along the shoulder of Hyde Road.	Install approx. 7000 sf bioretention basin in grass field and vegetate the shoulder of Hyde Road.	1.28	7.42	0.06	$64,000	$25,600	$71,680	$107,520	$70,000	H	L	L	H	M	65	Medium
11	Family Vets	Sediment transport from dirt parking lot and flooding from nearby tributary.	Expand vegetative buffer and install pavers in dirt parking lot.	0.50	1.10	0.60	$86,000	$34,400	$96,320	$144,480	$240,800	H	L	H	M	L	65	Medium
12	Town Hall	N/A - opportunistic implementation area	Install approx. 500 sf bioretention basin in grass field.	0.11	0.88	0.03	$19,000	$7,600	$21,280	$31,920	$241,818	L	M	L	H	H	60	Medium
13A	River Road	Erosion along shoulder and opportunistic implementation area.	Install approx. 750 sf water quality swale and bioretention basin (approx. 750 sf) along the shoulder.	0.40	2.92	0.38	$32,000	$12,800	$35,840	$53,760	$113,188	M	M	M	M	H	60	Medium
13B	River Road	Erosion along shoulder and flooding around culvert.	Install additional culvert and stabilize shoulder with vegetation.	0.27	0.54	0.32	$56,000	$22,400	$62,720	$94,080	$290,370	M	L	H	L	L	50	Low
14	Petticoat Hill Road	Erosion and sedimentation along roadside conveyance swale.	Install check dams and erosion control fabric along the length of the swale and vegetate to stabilize the soil.	5.95	13.21	6.99	$45,000	$18,000	$50,400	$75,600	$10,588	H	L	L	L	M	50	Low
15	Nichols Road	Erosion along shoulder and opportunistic implementation area.	Install approx. 850 sf bioretention basin in grass field and stabilize the shoulder with riprap.	0.45	3.64	0.29	$31,000	$12,400	$34,720	$52,080	$96,444	M	M	L	M	M	50	Low
			TOTALS	**11.8**	**38.3**	**11.6**	**$498,000**	**$199,200**	**$557,760 -**	**$836,640**								

Non-Structural Best Management Practices

Unlike structural BMPs, non-structural BMPs do not involve construction of site-specific infrastructure and generally focus on reducing pollutant loads through the following:

1. **Public Information and Education:** Changing behavior and land use patterns through efforts to inform, educate, and engage the public on issues related to protection of water quality and aquatic habitat.
2. **Land Conservation:** Reducing pollutants at the source through natural systems, such as land conservation and protection of sensitive land areas through purchase, easements, etc.;
3. **Regulatory Tools:** Changing behavior and land use patterns through regulation (e.g., state laws, municipal ordinances)
4. **Institutional Practices and Programs:** Reducing pollutant loads through improved institutional practices such as enhanced street sweeping, catch basin cleaning, leaf litter pickup programs, etc.

The pollutant load reductions and costs associated with non-structural measures are generally more difficult to estimate than those for structural BMPs. Strategies for reducing pollutant loads in the Mill River watershed through non-structural BMPs are discussed in the sections below, including water quality monitoring, which is proposed pending available funding and is discussed in Element H & I (page 36).

Public Outreach

Public outreach to disseminate the Mill River WBP is important to both educate the public about NPS pollution and the Mill River watershed and to coordinate efforts of the various entities working within the watershed. Specific public information and education (I/E) efforts associated with the Mill River WBP are expected to include the following actions in conjunction with the MVP Action Grant project awarded to the Town of Williamsburg for *Mill River Watershed Planning*.

- Add more content on Mill River to the Mill River Greenway website, including information and updates about the project, and a form for contacting the project team with narrative, photo, and video of their experiences with the river and watershed.
- Provide regular **project updates and presentations** to communities in the upper Mill River watershed, including **two public forums and listening sessions** in FY25. Other activities will include postings to Williamsburg Facebook groups, public meetings, and updates to town committees/boards.
- Conduct a **design charette for the Mill River Greenway.** The charrette will bring together the regional Mill River Greenway Initiative, Williamsburg's Mill River Greenway Committee, members of town boards and committees, the local school community, property and business owners, renters, community members, non-profit organizations, local design, planning and engineering professionals, and students to develop community-based designs and a unified vision for the priority sites in the greenway corridor.
- **Dunphy School Curricular Grant 2024/2025 School Year**: To engage elementary school children, The Town is seeking funding for a curricular enhancement grant for a second year. This small grant would be awarded to teachers in the Williamsburg elementary school to incentivize and pay for supplies used to bring watershed concepts, forest ecology, river hydrology and flooding risk concepts into the curriculum. Part of the grant would be a stipend to the teacher and the remaining part of the grant used for supplies.

Land Conservation

Land conservation efforts can include strategies to protect and limit future development of highly sensitive parcels through purchase, donations, conservation easements, deed restrictions, and other real estate legal agreements. Efforts to protect land from future development can contribute to the long-term water quality goals established in this WBP by reducing these projected load increases associated with land development. Potential land conservation efforts may include:

- Prioritizing specific parcels for land conservation (working with local conservation groups).
- Acquiring specific parcels for conservation.

Costs for land conservation efforts are difficult to estimate. Prioritization can be done in house and specific costs for acquiring parcels depend on the actual cost of the parcel.

Regulatory Tools

Local ordinances can provide effective protection against nonpoint source pollution and other factors that impact water quality as they can be used to regulate and improve the quality of stormwater runoff from developed areas. The Town of Williamsburg is not currently regulated under EPA's 2016 National Pollutant Discharge and Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit. The MS4 Permit requires municipalities to have certain regulations in place to address stormwater pollution, including illicit discharge bylaws, construction-phase, and post-construction regulations.

The Town of Williamsburg requested and was granted a waiver from the requirements of the MS4 permit in 2019 based on having a "*population under 1,000 within the urbanized area as defined by the 2010 Census*".

Other ordinances that may be amended to address nonpoint source pollution include zoning ordinances, site plan regulations, and subdivision regulations. Model standards such as the Post-Construction Stormwater Management Standards developed by the Southeast Watershed Alliance (SWA) in cooperation with the UNH Stormwater Center were developed to help guide the development of stronger municipal stormwater standards for protection of surface waters for communities and should be discussed further with municipal Planning Boards for adoption of potential amendments to local regulations.

Costs related to regulatory are difficult to estimate, although most of the work can be done by Town staff.

Institutional Practices and Programs

The Town of Williamsburg currently addresses stormwater pollution through implementing institutional best practices and programs that reduce pollutant loading. These practices include annual catch basin cleaning on an as needed basis, springtime street sweeping, and enhanced street/pavement cleaning sweeping as needed for road projects or when there is debris from road washouts. Lawn and leaf debris is collected at the Transfer Station. operations, and enhanced organic waste and leaf litter collection programs. Costs for these programs vary from year to year based on town priorities.

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

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

Technical Support

The structural BMPs described under Element C will require varying levels of technical support related to implementation complexity. Implementation complexity is a qualitative indicator based on the level of detail required for engineering designs (e.g., conceptual designs vs. detailed site design plan prepared by a registered professional engineer), construction (e.g., underground utility conflicts, site access, traffic impacts, etc.), and other factors (e.g., property ownership, potential for wetland permitting).

Types of technical support that may be required for the nonstructural measures outlined under Element C include:

- Graphic design and printing support for public outreach and educational materials;
- Legal assistance for conservation land real estate transactions and development of regulatory language for future municipal ordinances.

Financial Support

Site improvements and management recommendations outlined under Element C will require funding for implementation, including construction and ongoing maintenance. Specific costs for the design and installation of each proposed structural BMP are shown in **Table 11**. The actual implementation of structural and non-structural BMPs will be dependent on available funding. Potential funding sources may include local municipal budgets and/or loans and grants offered at the state and federal level. A summary of potential state and federal funding sources is listed in **Table 12**. Additional resources can be found on the MassDEP Grant Program Directory webpage.

Table 12: Summary of Potential Funding Programs

Funding Program	Description
Planning and Implementation Programs	
MassDEP Stormwater MS4 Municipal Assistance Grant Program	The MassDEP Stormwater MS4 Municipal Assistance Grant program is available for Massachusetts municipalities, Regional Planning Agencies, stormwater coalitions, and non-profit organizations for innovative projects that will assist multiple communities in meeting the requirements of the MS4 permit. Eligible projects include assessment tools for prioritizing retrofit sites, tracking tools for regional stormwater retrofits, development of templates, formation of new regional stormwater coalitions, and other tasks that benefit multiple Massachusetts municipalities in seeking compliance with their MS4 permit.
MassDEP Clean Water State Revolving Fund	The SRF Clean Water program provides a low-cost financing method to help communities meet water quality standards. The program addresses issues such as watershed management priorities, stormwater management, and green infrastructure. SRF also supplies financial assistance to address communities with septic systems.
MassDEP Watershed Assistance Grants	Water Quality Planning and 604(b) grants are available for water quality planning purposes. Other eligible projects include development of preliminary designs and implementation plans to address water quality impairments, and the development of green infrastructure projects. MassDEP also provides funding appropriated through the USEPA under Section 319 of the Clean Water Act to support local initiatives to restore impaired waters or protect high quality waters. 319-grant funds are targeted toward implementation of completed watershed-based plans. A minimum of 40% non-federal match is required for these grants. While 319 funds may not be used to fund work that is specifically required in the MS4 permit, work in the non-regulated area of town is eligible for these funds.
MassDEP Water Quality Monitoring Grant Program	The WQMG program is available for federally recognized tribal nations in the Commonwealth, community water quality monitoring groups, and non-profit organizations. This program supports ongoing or new monitoring and/or data collection efforts to increase the amount of external data MassDEP uses for water quality assessments under the Clean Water Act.
Climate Resiliency Programs	
Massachusetts Municipal Vulnerability Preparedness (MVP) Grant Program	The MVP grant program provides support for cities and towns in Massachusetts to being the process of planning for climate change resiliency and implementing priority projects. The state awards communities with funding to complete vulnerability assessments and develop action-oriented resiliency plans. Communities who complete an MVP planning grant become certified as an MVP community and are eligible for MVP Action Grant funding and other opportunities.
Habitat Improvement Programs	
Massachusetts Division of Ecological Restoration (DER) Grant Programs	The Culvert Replacement Municipal Assistance Grant Program is for municipalities interested in replacing an undersized, perched, and/or degraded culvert located in an area of high ecological value. This funding is to encourage municipalities to replace aging culverts with better designed crossings that meet improved structural and environmental design standards and flood resiliency criteria. The Restoration and Revitalization Priority Projects Program selects projects that restore and protect Massachusetts rivers, wetlands, and watersheds for the benefit of people and the environment. The Priority Projects Program selects ecological and urban stream revitalization projects that present significant benefits to Massachusetts. Eligible

Funding Program	Description
	applicants include restoration project site landowners, non-profit and/or non-governmental organizations, regional planning organizations, municipalities, and state and federal agencies. Current project focus is on cranberry bog wetland restoration, stream restoration, and urban stream and river revitalization.
NOAA Community-Based Restoration Program Partnership	Grant funding provided for stream barrier removal projects that help restore riverine ecosystems, enhance public safety and community resilience, and have clear and identifiable benefits to diadromous fish populations.
National Fish and Wildlife Foundation (NFWF) Grant Programs	NFWF Five Star and Urban Waters Restoration Program provides funds to local partnerships for wetland, forest, riparian and coastal habitat restoration, with a focus on urban waters and watersheds. Funds approximately $1,500,000 annually, with average grants between $25,000 to $35,000 and 1:1 match requirement. NFWF New England Forests and Rivers Fund dedicated to restoring and sustaining healthy forests and rivers that provide habitat for diverse native bird and freshwater fish populations. Annually awards grants ranging from $50,000 to $200,000 each.
Recreation and Trail Programs	
MassTrails Grants	MassTrails provides grants to support recreational trail and shared-use pathway projects across the Commonwealth. The award maximum depends on the project type and needs and is generally $100,000 for recreational trails projects and up to $500,000 for shared-use path projects demonstrating critical network connections of regional or statewide significance.
Fields Pond Foundation	Funds trail making and other enhancement of public access to conservation lands, land acquisitions for conservation, and establishing funds for stewardship. Funding levels: $25,000 maximum, $2,000 - $10,000 typical.
National Park Service – Rivers and Trails Program	Funds projects focused on protection of natural resources and enhancement of outdoor recreational opportunities.
Agricultural Programs	
Natural Resource Conservation Service (NRCS) Grant Programs	Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to agricultural producers to address natural resources concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion, and improved wildlife habitat. Conservation Stewardship Program (CSP) is the largest conservation program in the United States with a goal of enhancing natural resources and improving agricultural operations. The program helps agricultural operations build on existing conservation efforts while strengthening their operations. The program focuses on improving grazing conditions, increasing crop yields, developing wildlife habitat, and increasing resilience to weather extremes.

Element E: Public Information and Education

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

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

Activities

As noted under Element C, specific Public Information and Education (I/E) efforts associated with the Mill River WBP are expected to include the following actions in conjunction with the MVP Action Grant project awarded to the Town of Williamsburg for *Mill River Watershed Planning* and other planned activities (if awarded additional MVP Action Grant funding.[3]

- Develop a Mill River resiliency website highlighting all the work to date, including flood inundation and uplands analysis, watershed-based planning work, and priority actions for the coming years.
- Provide regular project updates and presentations, including two public forums and listening sessions to share out findings and results from the Mill River analysis**.** Other activities will include postings to Williamsburg Facebook groups, public meetings, and updates to town committees/boards.
- Conduct a forum to advance understanding and engagement around priority actions for mitigating flood flow and water quality impacts on the Mill River. This event will bring together members of town boards and committees, the local school community, property and business owners, renters, community members, non-profit organizations, local design, planning and engineering professionals, and students.
- Seek a curricular enhancement grant for a second year 2024/2025 to engage elementary school children,. This small grant would be awarded to teachers in the Williamsburg elementary school to incentivize and pay for supplies used to bring watershed concepts, forest ecology, river hydrology and flooding risk concepts into the curriculum. Part of the grant would be a stipend to the teacher and the remaining part of the grant used for supplies.
- Facilitate a series of community learning and listening sessions to frame and facilitate conversation about the changes needed to address climate vulnerability. These sessions will combine storytelling, interviews, participatory dialogue, and visual tools, and will focus on topics such as: longer-term solutions to flooding, as opposed to short-term fixes; setting shared expectations about what the Town can and cannot do; bridging the gap between current conditions and future risks; developing affordable/mixed-income housing outside the floodplain; and exploring buyouts or other strategies to make room for the river where appropriate. All of these considerations are tied to securing water quality objectives for the Mill River.

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3 The Town of Williamsburg was hit especially hard during the heavy rains and high Mill River flows of July 2023. The search for meaningful ways to mitigate for the volume of flood flows to reduce risk and avert impacts with future events ties closely to important actions that also attend to water quality. Reducing erosion, soaking up rainfall with reduced imperviousness, improved forest health, green infrastructure stormwater management, and restoration and protection of lands are all important strategies.

- Host two workshops that use scenarios and visual facilitation to explore potential future pathways. These events will center on specific actions being considered by the Town (e.g., infrastructure changes, stormwater improvements, Beaver Brook Golf Club restoration, affordable housing), while also helping residents understand how public input is being used in decision-making. A final community validation and bridging event will support the transition from planning to action.

Target audience

The target audience for these activities includes a range of watershed stakeholders, as listed in the bullet items above. Specific metrics to evaluate the Information and Education Program include:

- Number of webpage views
- Number of attendees at public presentations, forums, and workshops
- Number of students engaged through the proposed school curricular grant, and any materials developed through the grant that can be re-used for future classroom programming.

Elements F & G: Implementation Schedule and Measurable Milestones

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

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

Table 13: Implementation Schedule and Interim Measurable Milestones

Structural and Non-Structural BMPs			
BMP	Interim Milestone 1	Interim Milestone 2	Interim Milestone 3
Select priority sites for implementation and seek funding: 2025-2026	Meet with Public Works Director to crosswalk projects for water quality improvements and local priorities	Prepare funding application for preliminary and final design and permitting of priority BMP sites.	
Prepare priority BMP sites designs and permitting (pending grant funding): 2025-2027	Obtain funding and hire engineer	Design and permit all BMPs	Secure estimated costs and design plans
Construct priority BMP sites: 2028-2029	Obtain funding and hire contractor	Construct priority BMPs	
Obtain grant funding for additional BMPs: 2028-2030	Revisit list from WBP and determine next BMPs for implementation	Apply for funding for design and permitting	Complete design and permitting; secure grants for construction
Catch basin cleaning and street sweeping: ongoing			

Public Education and Outreach			
BMP	Interim Milestone 1	Interim Milestone 2	Interim Milestone 3
Develop a Mill River resiliency website highlighting all the work to date, including flood inundation and uplands analysis, watershed-based planning work, and priority actions for the coming years: 2025	Draft prepared	Website becomes live	Website updated as needed

Provide regular project updates and presentations, including two public forums to share out findings and results from the Mill River analysis: 2024 - 2025	Plan for public forums	Hold public forums and share out findings	
Conduct a forum to advance understanding and engagement around priority actions for mitigating flood flow and water quality impacts on the Mill River. This event will bring together members of town boards and committees, the local school community, property and business owners, renters, community members, non-profit organizations, local design, planning and engineering professionals, and students: 2025	Plan for forum	Hold forum and share out findings	
Make small grant awards to teachers in the Williamsburg elementary school to incentivize and pay for supplies used to bring watershed concepts, forest ecology, river hydrology and flooding risk concepts into the curriculum. Part of the grant would be a stipend to the teacher and the remaining part of the grant used for supplies: 2025	Obtain funding for Dunphy School Curricular Grant 2024/2025 School Year	Make grants	
Facilitate a series of community learning and listening sessions to frame and facilitate conversation about the changes needed to address climate vulnerability. These sessions will combine storytelling, interviews, participatory dialogue, and visual tools, and will focus on topics such as: longer-term solutions to flooding, as opposed to short-term fixes; setting shared expectations about what the Town can and cannot do; bridging the gap between current conditions and future risks; developing affordable/mixed-income housing outside the floodplain; and exploring buyouts or other strategies to make room for the river where appropriate. All of these considerations are tied to securing water quality objectives for the Mill River: 2025 - 2026	Apply for and obtain MVP action grant funding	Draft and complete process design for learning and listening sessions, and organize to hold sessions	Hold series of learning and listening sessions and share out findings

Host two workshops that use scenarios and visual facilitation to explore potential future pathways. These events will focus on specific actions being considered by the Town (e.g., infrastructure changes, stormwater improvements, Beaver Brook Golf Club restoration, affordable housing), while also helping residents understand how public input is being used in decision-making. A final community validation and bridging event will support the transition from planning to action: 2026 - 2027	Apply for and obtain MVP action grant funding	Draft and complete process design for two workshops and organize to hold workshops	Hold two workshops and share out findings

Elements H & I: Progress Evaluation Criteria and Monitoring

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

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

Water quality goals for the Upper Mill River are presented under Element B of this WBP. Element C of this plan describes the various management measures that will be implemented to work towards achieving these goals. The evaluation criteria and monitoring program described below will be used to measure the effectiveness of the proposed management measures for improving and maintaining water quality for the Upper Mill River.

Indirect Indicators of Load Reduction

Potential load reductions from non-structural BMPs (i.e., impervious area reduction, street sweeping, and catch basin cleaning) can be estimated from indirect indicators, such as the acreage of impervious area reduced, number of miles of streets swept, or the number of catch basins cleaned.

Appendix F of the 2016 Massachusetts Small MS4 General Permit provides specific guidance for calculating phosphorus removal from these practices. As indicated by Element C, it is recommended that potential phosphorus removal from these ongoing actives be estimated. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions such as increased frequency or improved technology. The Town of Williamsburg currently performs street sweeping and catch basin cleaning, in addition to other non-structural BMPs.

Project-Specific Indicators

Future project-specific indicators related to structural BMPs will be quantified by documenting the number and installed sizing of each BMP. Estimated pollutant load reductions associated with these structural BMPs will be estimated as described in Element C and adjusted as needed based on as-built conditions.

Direct Measurements

Direct measurements are generally expected to be performed as described below. Prior to implementing a direct measurement program, an abbreviated QAPP and/or Standard Operating Procedures (SOPs) will be established to provide details of the program and establish best practices for sample collection and analysis. Water quality monitoring may be performed through a volunteer program to save on costs in accordance with established practices for MassDEP's environmental monitoring for volunteers.

Assuming that funding is available, water quality monitoring for bacteria (*E. coli*), total phosphorus, and temperature will be conducted approximately once per month from May - October at Station W1796 (and possibly other select locations based on funding availability) to provide updated water quality data for the Upper Mill River watershed, which will aid in determining sources for pollution and tracking achievements toward water quality goals (i.e., analysis of *E. coli*, total phosphorus, and temperature). Additional parameters such as chlorophyll-*a*, dissolved oxygen, and conductivity may also be considered.

As noted in Element B, the water quality goal for total phosphorus (8.8 ug/l) established in this WBP is based on limited data from the past ten years (2019 only). Additional water quality monitoring will be helpful in confirming the appropriateness of this goal or supporting future adjustments to this goal.

Adaptive Management

As discussed in Element B, a baseline monitoring program (pending available funding, as noted above under "Direct Measurements") will be used to establish a long-term (i.e., 15-year) water goals and provide information that will help in understanding water quality trends and watershed response to future WBP implementation efforts.

Long-term goals will be re-evaluated at least once every five years by the town of Williamsburg and PVPC, and adaptively adjusted based on additional monitoring results and other indirect indicators. If monitoring results and indirect indicators do not show improvement to the *E. coli* and total phosphorus concentrations and other indicators measured within the watershed, the management measures and loading reduction analysis (Elements A through D) will be revisited and modified accordingly.

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Water Quality Assessment Reports

"*Connecticut River Watershed 2003 Water Quality Assessment Report*"

Appendices

Appendix A: Pollutant Load Export Rates (PLERs)

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
AGRICULTURE, HSG A	0.45	29	2.6
AGRICULTURE, HSG B	0.45	29	2.6
AGRICULTURE, HSG C	0.45	29	2.6
AGRICULTURE, HSG D	0.45	29	2.6
AGRICULTURE, IMPERVIOUS	1.52	649	11.3
COMMERCIAL, HSG A	0.03	7.14	0.3
COMMERCIAL, HSG B	0.12	29.4	1.2
COMMERCIAL, HSG C	0.21	59.8	2.4
COMMERCIAL, HSG D	0.37	91	3.7
COMMERCIAL, IMPERVIOUS	1.78	377	15.0
FOREST, HSG A	0.13	29	0.5
FOREST, HSG B	0.13	29	0.5
FOREST, HSG C	0.13	29	0.5
FOREST, HSG D	0.13	29	0.5
FOREST, HSG IMPERVIOUS	1.52	650	11.3
HIGH DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.3
HIGH DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.2
HIGH DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.4
HIGH DENSITY RESIDENTIAL, HSG D	0.37	91	3.7
HIGH DENSITY RESIDENTIAL, IMPERVIOUS	2.32	439	14.1
HIGHWAY, HSG A	0.03	7.14	0.3
HIGHWAY, HSG B	0.12	29.4	1.2
HIGHWAY, HSG C	0.21	59.8	2.4
HIGHWAY, HSG D	0.37	91	3.7
HIGHWAY, IMPERVIOUS	1.95	1,477	13.9
INDUSTRIAL, HSG A	0.03	7.14	0.3
INDUSTRIAL, HSG B	0.12	29.4	1.2
INDUSTRIAL, HSG C	0.21	59.8	2.4
INDUSTRIAL, HSG D	0.37	91	3.7
INDUSTRIAL, IMPERVIOUS	1.78	377	15.0
MEDIUM DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.3
MEDIUM DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.2
MEDIUM DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.4
MEDIUM DENSITY RESIDENTIAL, HSG D	0.37	91	3.7

MEDIUM DENSITY RESIDENTIAL, IMPERVIOUS	1.96	439	14.1
OPEN LAND, HSG A	0.03	7.14	0.3
OPEN LAND, HSG B	0.12	29.4	1.2
OPEN LAND, HSG C	0.21	59.8	2.4
OPEN LAND, HSG D	0.37	91	3.7
OPEN LAND, IMPERVIOUS	1.52	650	11.3
[1]HSG = Hydrologic Soil Group			

Appendix B:

Site-Specific BMP Recommendations

AREA 1: Hatfield Street	
Location: Hatfield Street	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: Medium**

A small tributary to Mill River crosses Hatfield Street via a culvert. There is very limited drainage infrastructure around the crossing. Runoff from the road sheds around the shoulder towards the tributary. There is loose sediment and signs of sediment transport and erosion due to runoff along the shoulder of the street. There are no obvious signs of flooding in the area.

Photo 1-1: Erosion along the shoulder of Hatfield Street

Photo 1-2: Erosion at the culvert crossing of Hatfield Street

<u>Proposed Area 1 Improvements</u> (see Photo 1-3)

1. Vegetate the shoulder of Hatfield Street with New England Roadside Matrix Upland Seed Mix or similar.
2. Stabilize the area around the culvert with riprap (D_{50}= 5 in.).

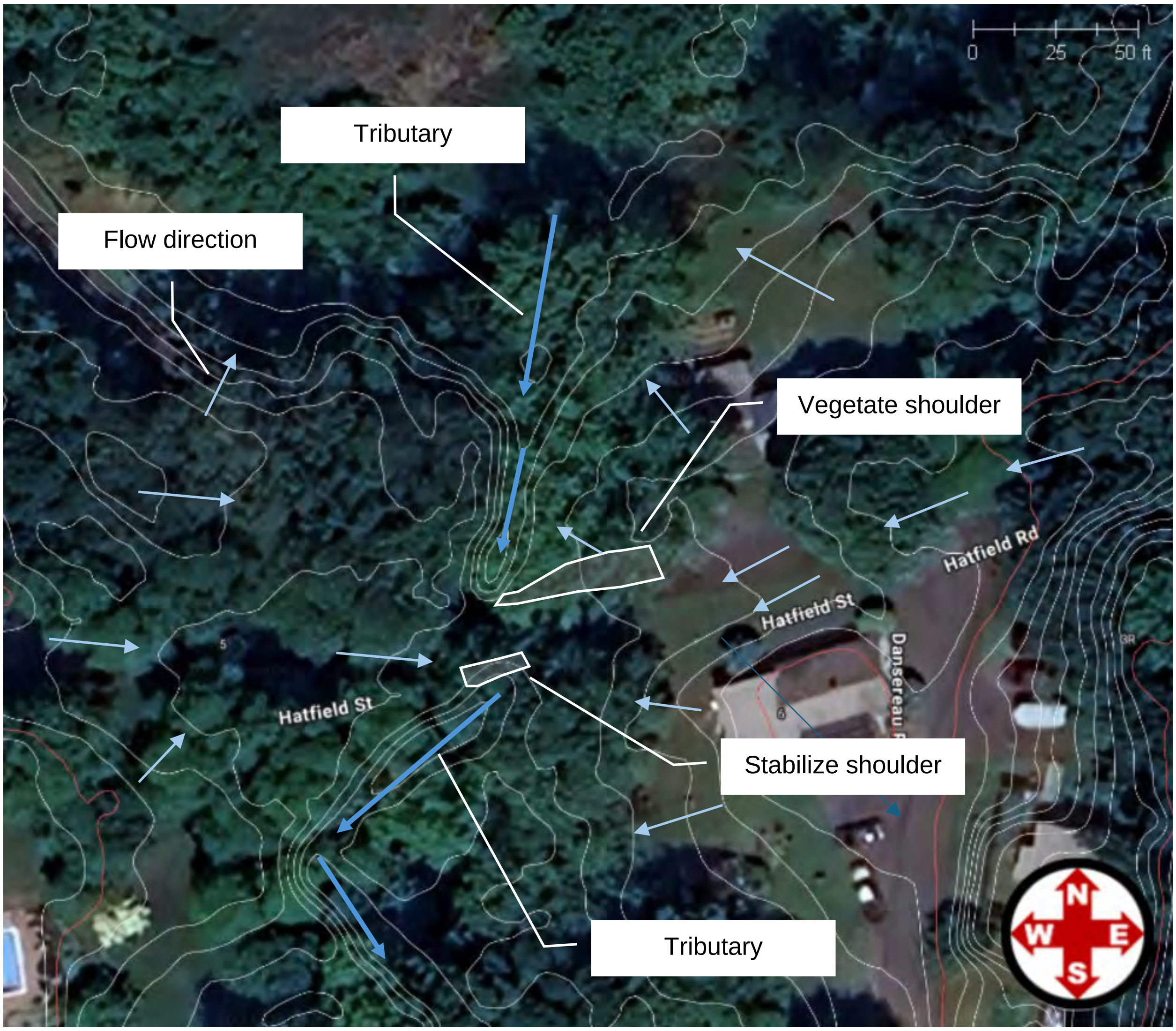

Photo 1-3: Topography and proposed soil stabilization along Hatfield Road

Estimated Costs: $9,000 - $14,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.05 lb/yr
- Total Nitrogen: 0.11 lb/yr
- Total Suspended Solids: 0.06 ton/yr

AREA 2: Anne T Dunphy School	
Location: South Street	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: High**

There are multiple areas of loose, bare sediment on the school property adjacent to South Street. These areas sit along the bank of a tributary to the Mill River and there are signs of sediment transportation into the stream. There are reported issues of sediment buildup in the tributary downstream as well as issues with flooding.

Photo 2-1: Loose soil that appears to be used as parking

Photo 2-2: Sediment stockpile along the bank of the tributary

<u>Proposed Area 2 Improvements</u> (see Photo 2-3)

1. Stabilize soil to reduce sediment transport by vegetating with New England Roadside Matrix Upland Seed Mix or similar (approx. 750 SF).
2. Relocate sediment stockpile away from the bank of the tributary.

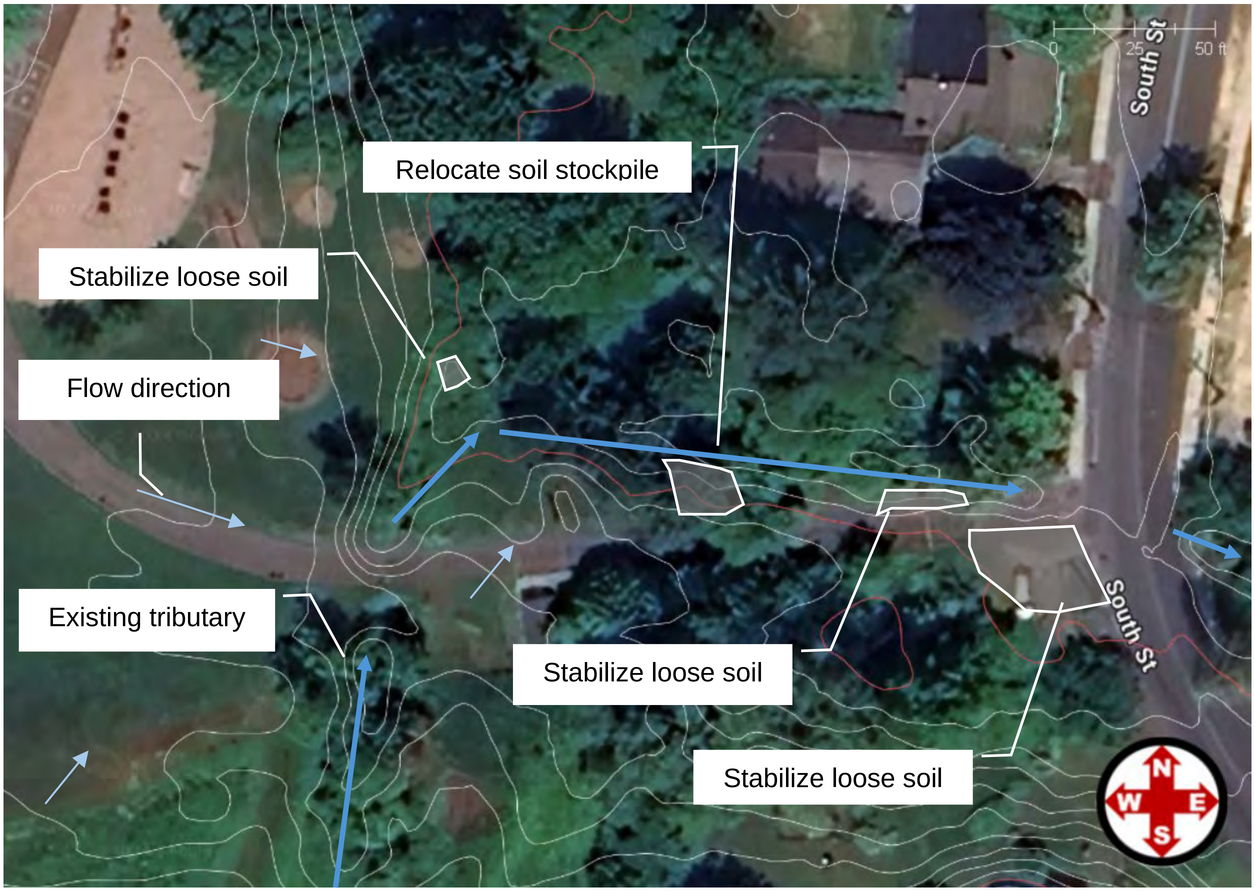

Photo 2-3: Topography around tributary to Mill River to the west of South Street

Estimated Costs: $11,000 - $17,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.22 lb/yr
- Total Nitrogen: 0.43 lb/yr
- Total Suspended Solids: 0.26 ton/yr

AREA 3: Meekins Library	
Location: South Street	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: High**

There appears to be an informal basin along the northern edge of the parking lot for the Meekins Library. There is a small curb cut to allow runoff from the parking lot to flow into the basin. There is also a small pipe that outlets to the basin that appears to be roof runoff. There is a small stockpile along the curb cut. There is minor erosion occurring within the basin.

Photo 3-1: Soil stockpile at the curb cut in the parking lot

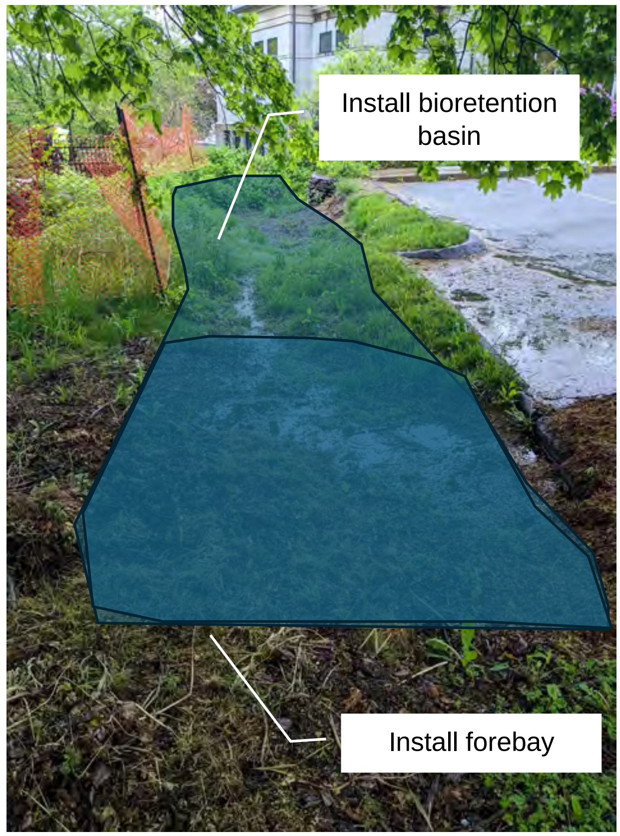

Photo 3-2: Erosion at the curb cut in the existing depression

<u>Proposed Area 3 Improvements</u> (see Photo 3-3)

1. Install bioretention basin along edge of parking lot (approx. 300 SF).
2. Install sediment forebay with bioretention basin (approx. 100 SF).
3. Add riprap splash pads to roof drain outlets (D_{50}= 10 in.).

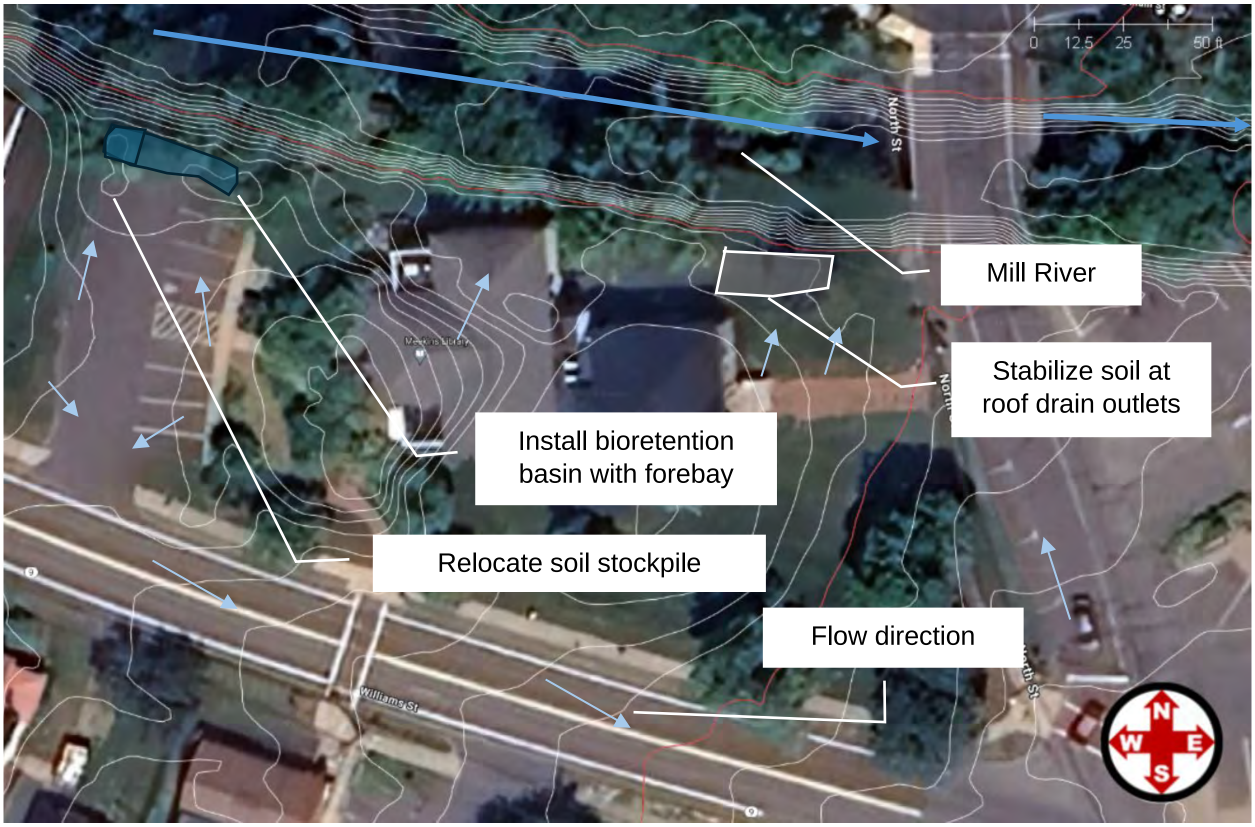

Photo 3-3: Proposed bioretention basin and drainage improvements around Meekins Library

Estimated Costs: $16,000 - $24,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.26 lb/yr
- Total Nitrogen: 2.39 lb/yr
- Total Suspended Solids: 0.05 ton/yr

AREA 4: North Main Street	
Location: North Main Street	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: Medium**

Runoff from North Main Street channelizes along the shoulder on the north side of the street. The channelized runoff is collected by a series of catch basins. North Main Street is a wide road with a width of about 48 feet and is often used as street parking for the nearby church. The channelized runoff is causing erosion along the shoulder of the road.

Photo 4-1: Channelization and erosion along the northern shoulder

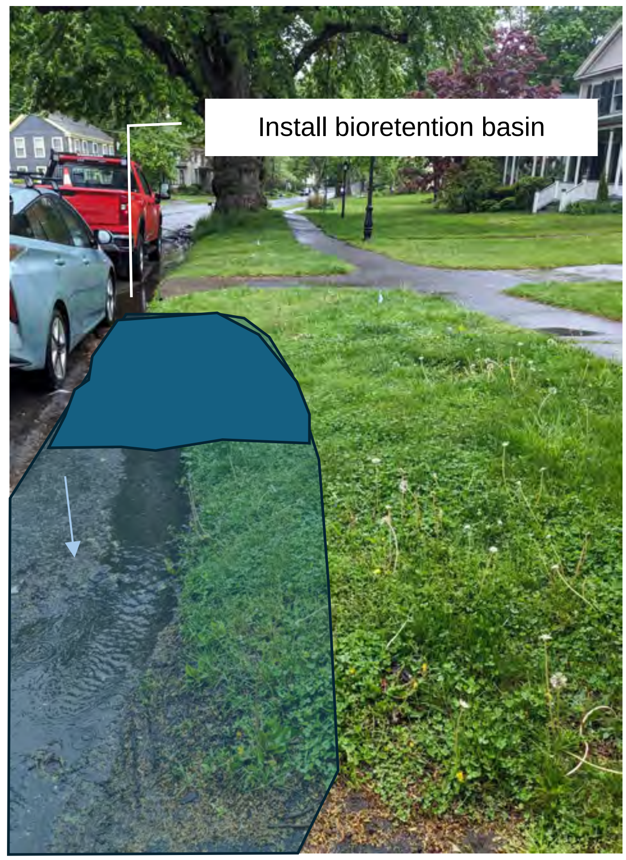

Photo 4-2: Channelization and erosion along the northern shoulder

<u>Proposed Area 4 Improvements</u> (see Photo 4-3)

1. Install a bioretention basin along edge of parking lot (approx. 350 SF).
2. Install sediment forebay with bioretention basin (approx. 100 SF).
3. Stabilize shoulder with New England Roadside Matrix Upland Seed Mix or similar.

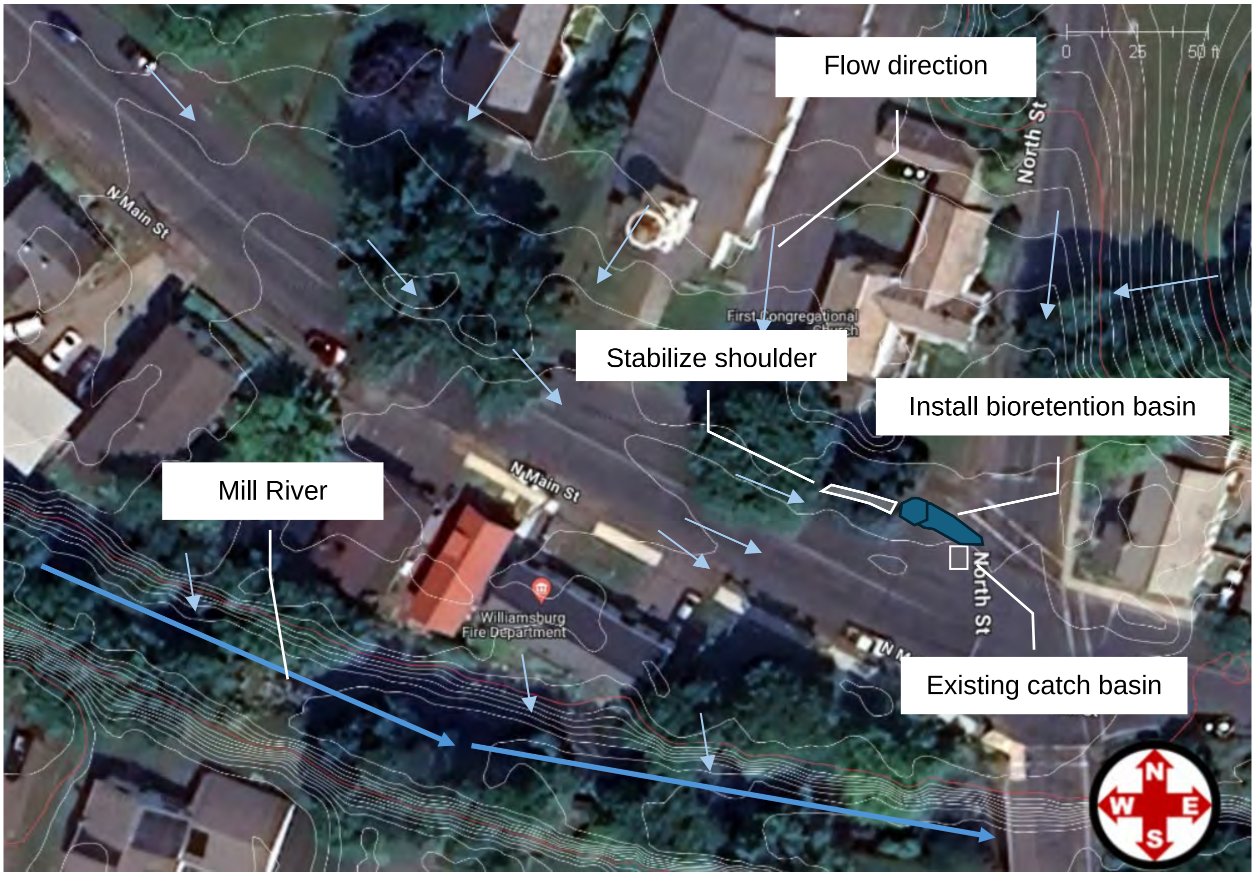

Photo 4-3: Existing topography around North Main Street and proposed bioretention basin

Estimated Costs: $18,000 - $27,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.11 lb/yr
- Total Nitrogen: 0.53 lb/yr
- Total Suspended Solids: 0.23 ton/yr

AREA 5: Ashfield Road	
Location: 26 Ashfield Road	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: High**

There is major erosion occurring along the northeast side of Ashfield Road along the embankment of the Mill River. The Williamsburg Highway Department reports that during heavy storm events, runoff flows over the road and down the embankment. Parts of the road are eroding down the embankment. There is an existing culvert that crosses Ashfield Road to the northwest of the area of erosion.

Photo 5-1: Erosion along the steep bank and shoulder

Photo 5-2: Runoff causing erosion along the shoulder

<u>Proposed Area 5 Improvements</u> (see Photo 5-3)

1. Install curb along the north-eastern edge of Ashfield Road (approx. 250 LF).
2. Add smaller riprap to stabilize soil around larger rocks along the steep embankment (D_{50}= 10 in.).

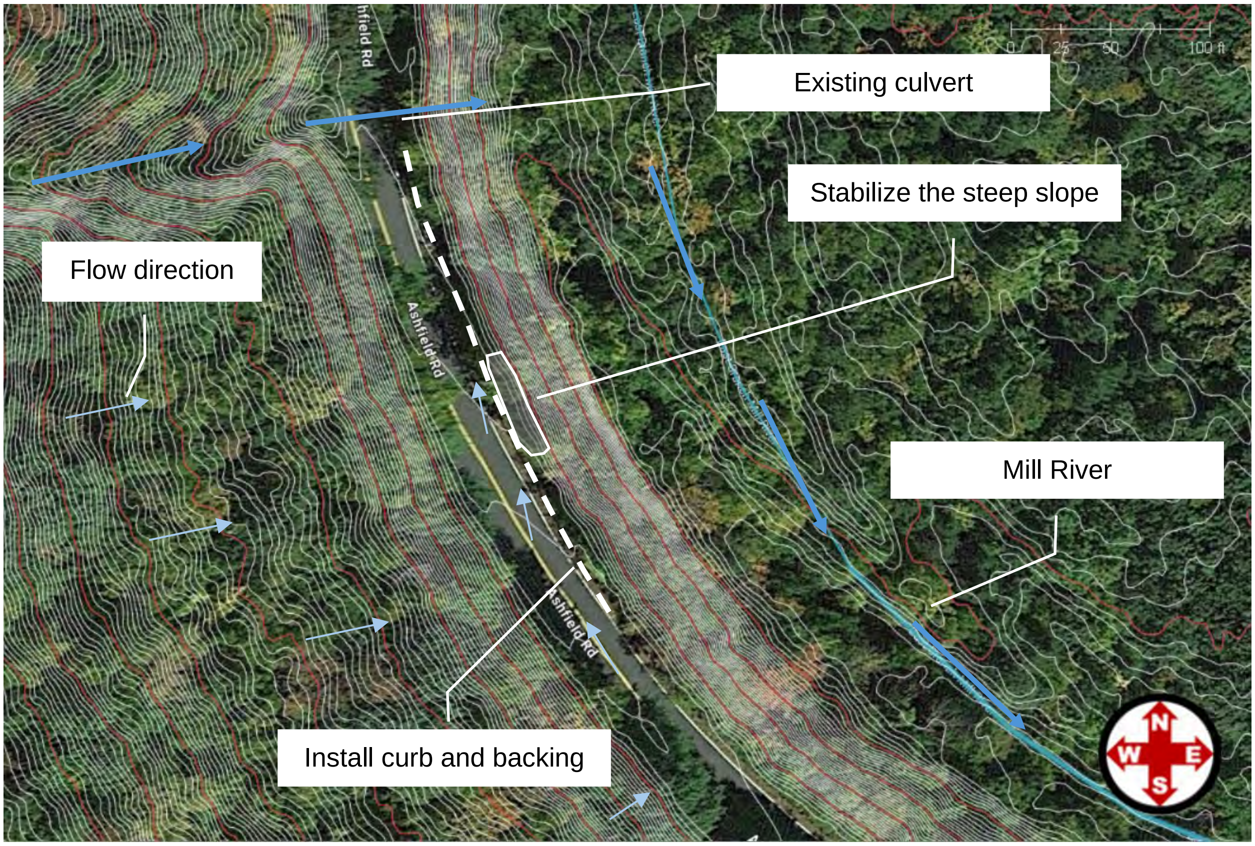

Photo 5-3: Proposed steep embankment stabilization and existing topography

Estimated Costs: $12,000 - $19,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.33 lb/yr
- Total Nitrogen: 0.65 lb/yr
- Total Suspended Solids: 0.38 ton/yr

AREA 6: Ashfield Road	
Location: 26 Ashfield Road	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: Low**

There is a paved swale along the western side of Ashfield Road. There is a large, forested embankment along the road that drains towards Ashfield Road and is collected via the existing paved swale. The swale outlets to a culvert that crosses Ashfield Road and into the Mill River. There are reports of flooding of the swale during large storm events that lead to water flowing across Ashfield Road.

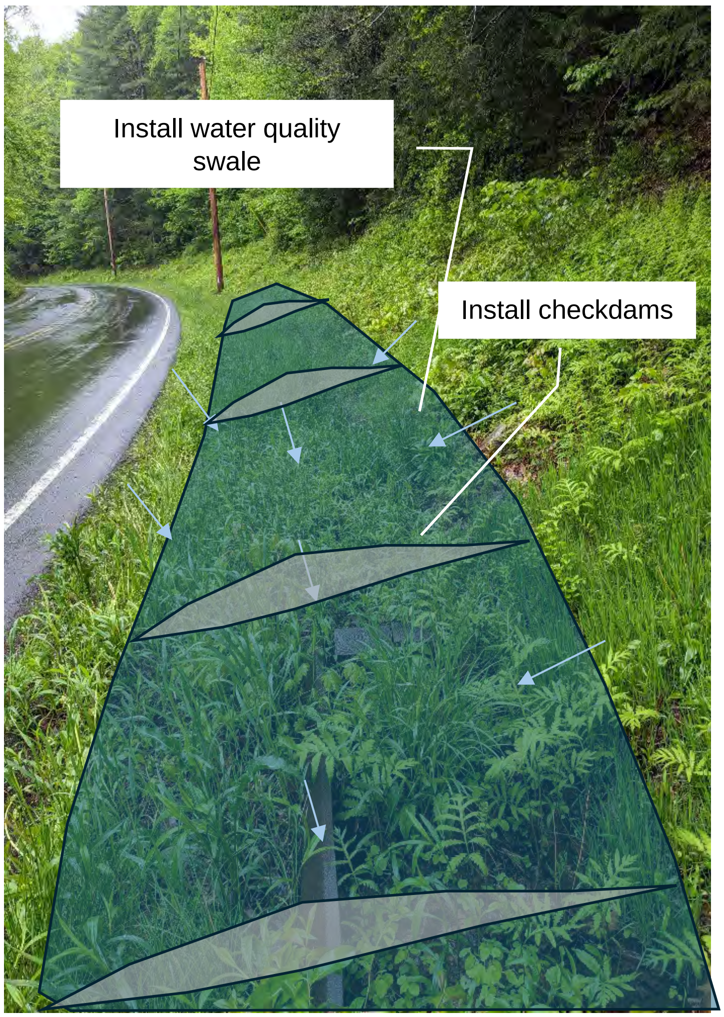

Photo 6-1: Existing swale with paved bottom

<u>Proposed Area 6 Improvements</u> (see Photo 6-2)

1. Expand the base of the swale by approximately two feet to increase capacity.
2. Remove asphalt within the swale and replace with a vegetated swale (approx. 1250 SF).
3. Incorporate erosion control fabric and check dams for soil stabilization.

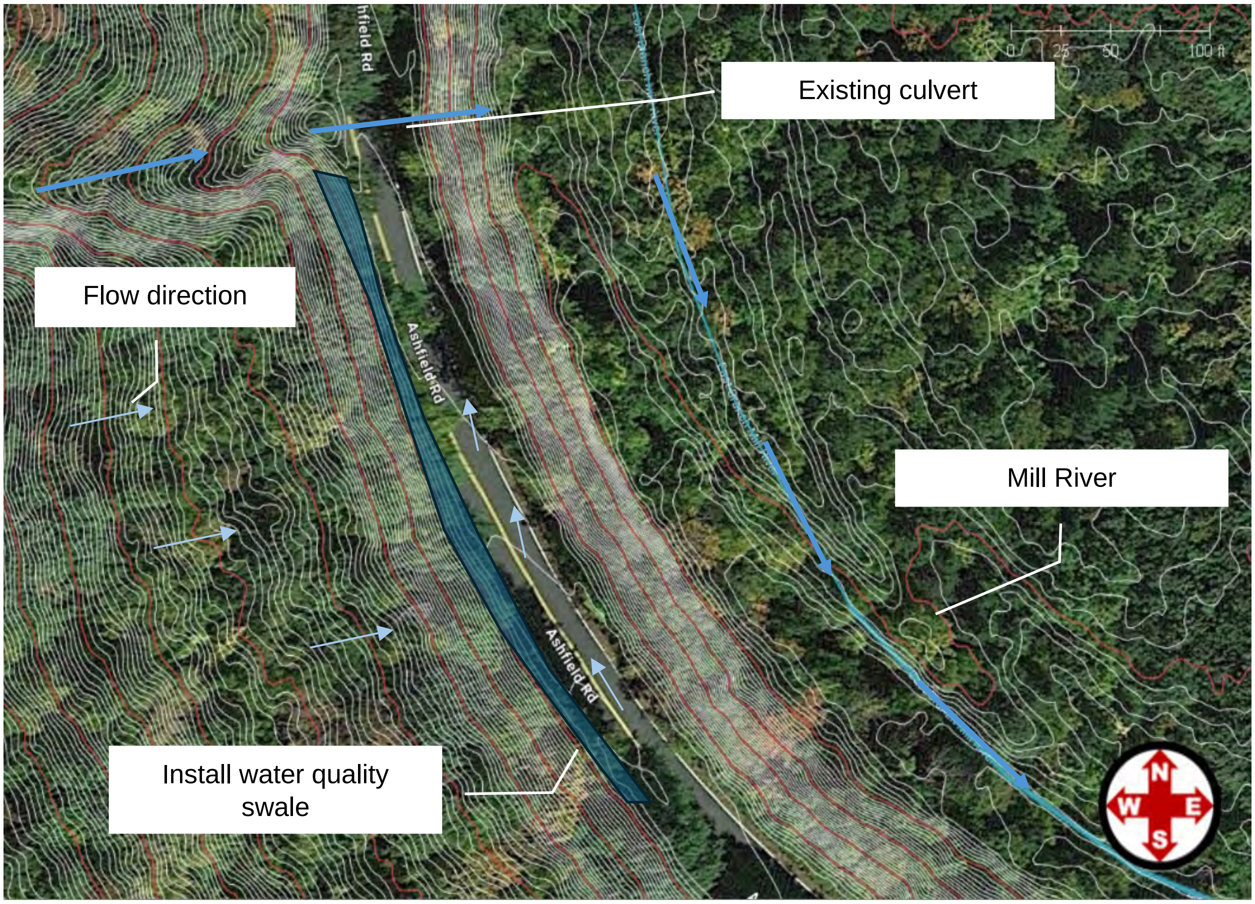

Photo 6-2: Existing topography around proposed water quality swale on Ashfield Road

Estimated Costs: $19,000 - $29,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.26 lb/yr
- Total Nitrogen: 1.18 lb/yr
- Total Suspended Solids: 0.10 ton/yr

AREA 7: Ashfield Road	
Location: 94 Ashfield Road	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: High**

The west side of the Ashfield Road is collected in a dirt swale with patchy vegetative cover. There are signs of erosion along the shoulder of the road with evidence of sediment buildup in the roadside ditch. The swale is directed to a culvert that outlets to the Mill River on the opposite side of Ashfield Road. The outlet of the culvert has signs of serious erosion and sediment buildup. The driveway bridge was recently replaced due to severe flooding of the East Branch of Mill River.

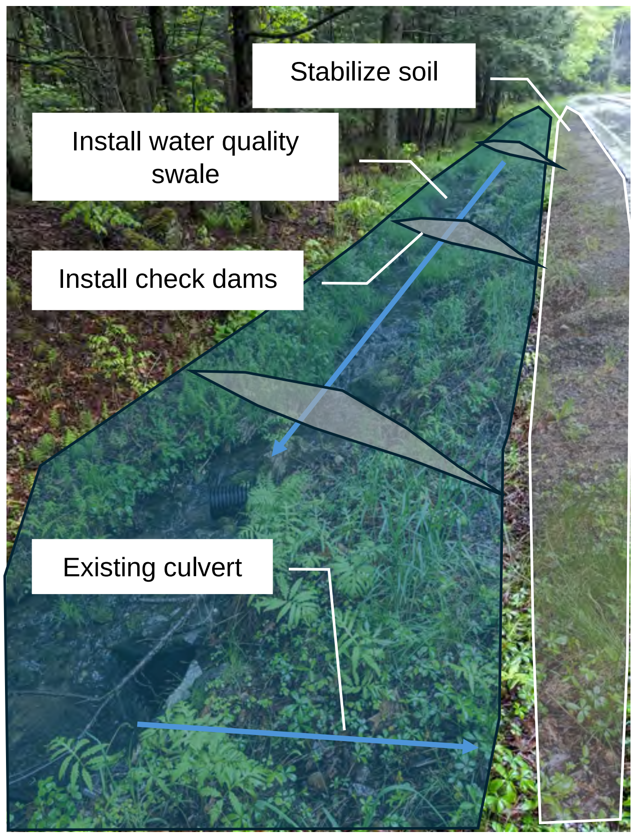

Photo 7-1: Roadside ditch along the western side of Ashfield Road

Photo 7-2: Outlet of culvert along Ashfield Road

<u>Proposed Area 7 Improvements</u> (see Photo 7-3)

1. Vegetate the roadside swale and the shoulder along the western side of Ashfield Road ditch New England Roadside Matrix Upland Seed Mix (or similar) and add check dams (approx. 400 SF).
2. Stabilize the outlet of the culvert with riprap (D_{50}= 22 in.).
3. Add check dams and erosion control fabric in roadside swale.

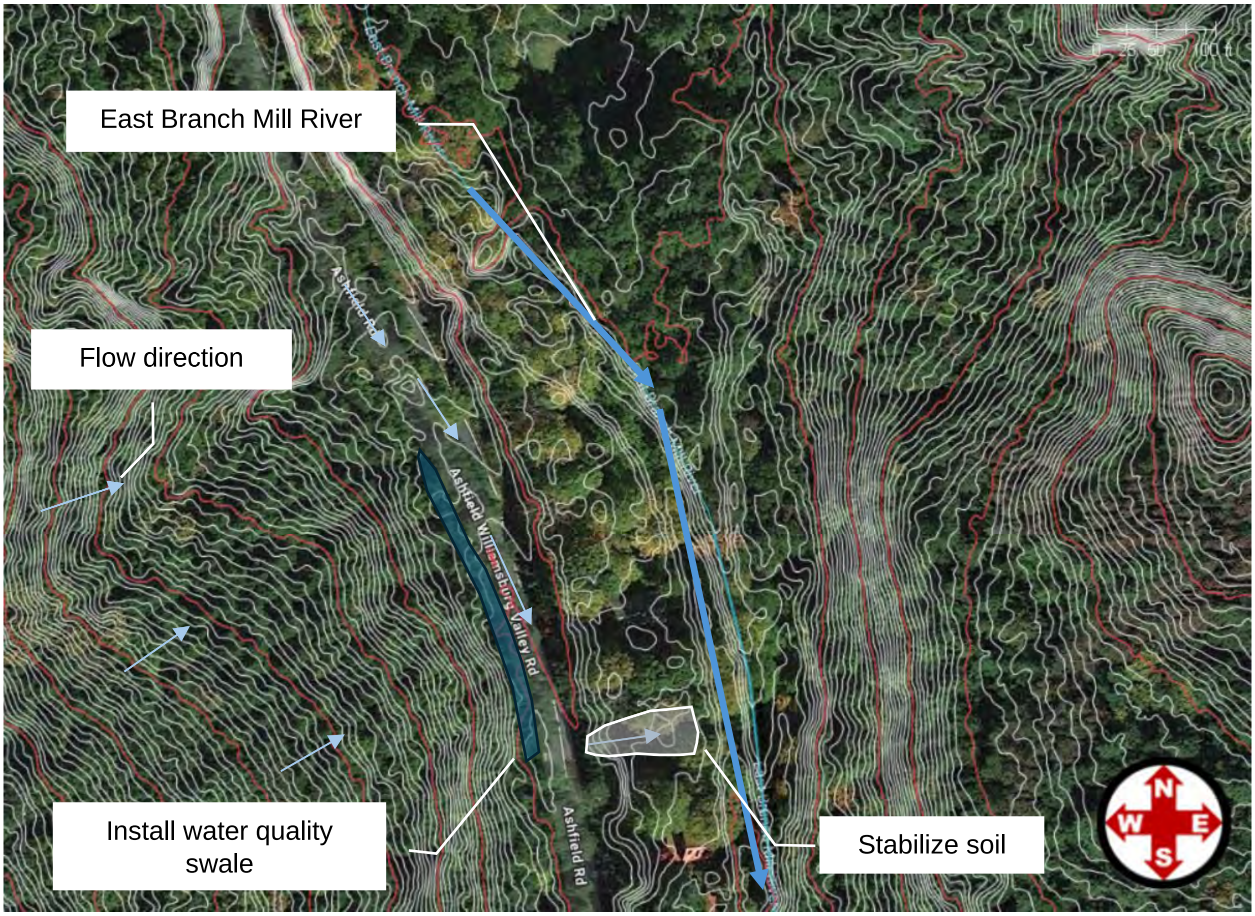

Photo 7-3: Topography around Ashfield Road and proposed stabilization and water quality swale

Estimated Costs: $18,000 - $26,000

Estimated Pollutant Reductions:

- Total Phosphorus: 1.58 lb/yr
- Total Nitrogen: 3.97 lb/yr
- Total Suspended Solids: 1.67 ton/yr

AREA 8: Village Hill Area	
Location: Village Hill Road	**Subwatershed: Nichols Brook**
Owner: Town of Williamsburg / Thomas Hodgkins	**Priority: Medium**

There is a large dirt area along Village Hill Road next to a bridge over Nichols Brook. It appears to be used as a parking lot. Runoff from Nichols Road and Route 9 drain towards the dirt along the shoulder of the road, causing some erosion along the shoulder. There is evidence of sediment transport from the lot into Nichols Brook.

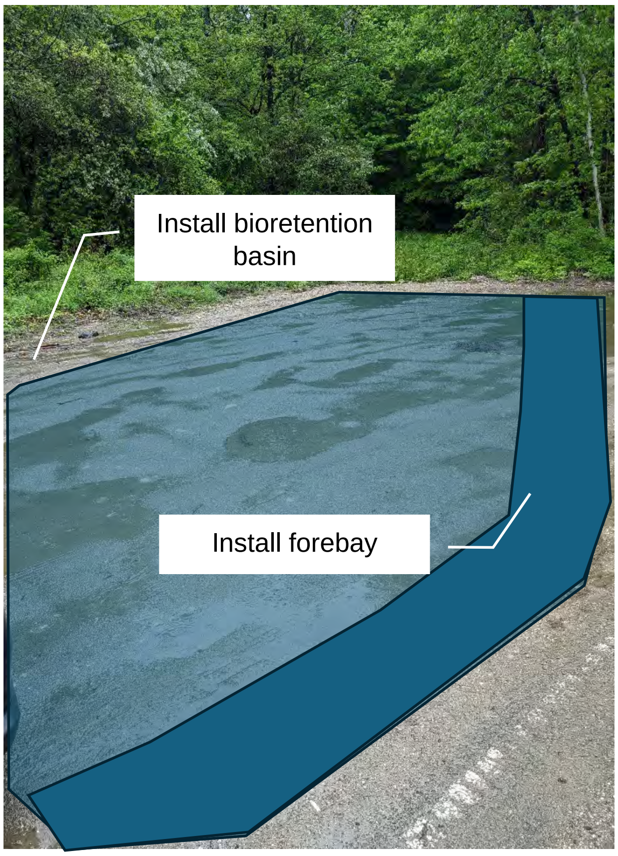

Photo 8-1: Loose sediment area that appears to be used as a parking lot

Photo 8-2: Erosion along the shoulder of the road

<u>Proposed Area 8 Improvements</u> (see Photo 8-3)

1. Install a bioretention basin with forebay in the area of loose sediment (approx. 1500 SF).
2. Install a water quality swale along the shoulder of Village Hill Road at the intersection of Goshen Road (approx. 400 SF).
3. Incorporate check dams and erosion control fabric for soil stabilization.

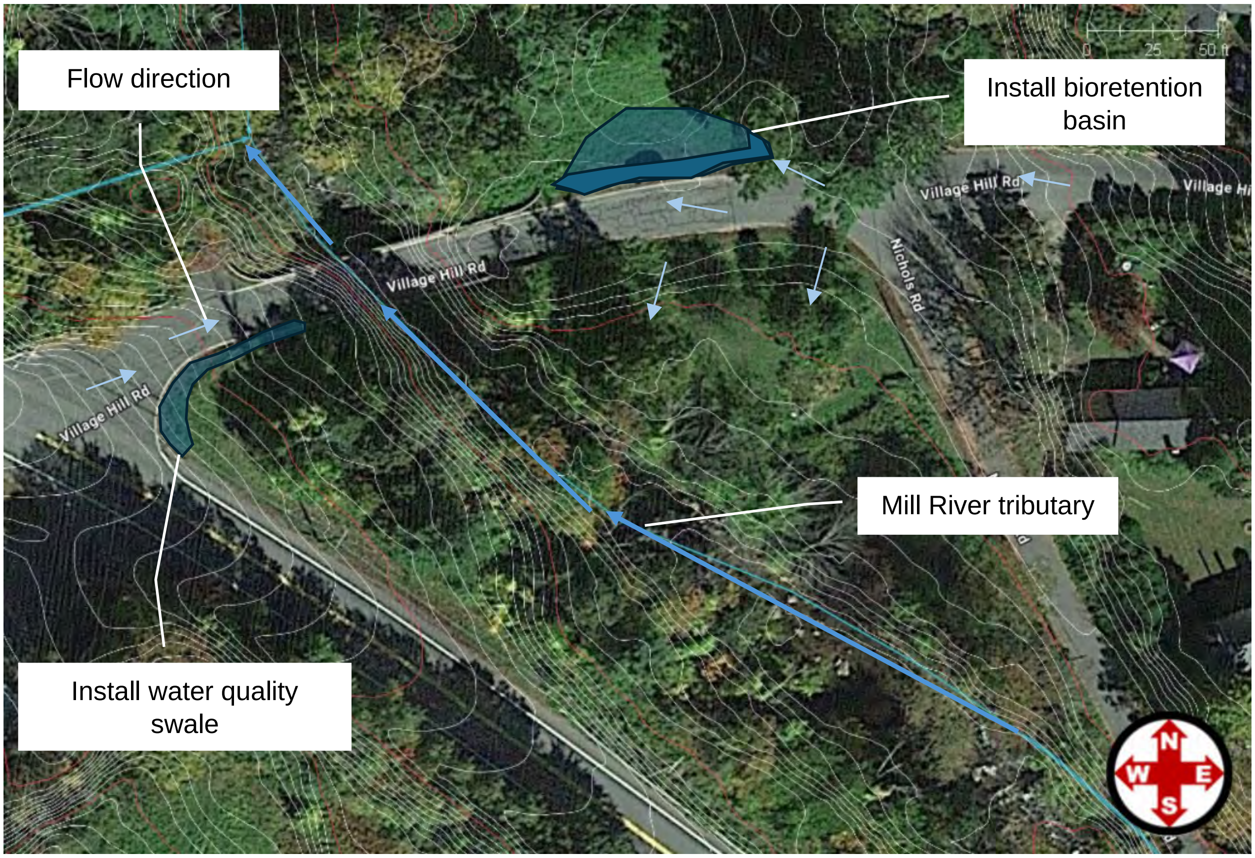

Photo 8-3: Topography at Village Hill Road and proposed bioretention basin and swale

Estimated Costs: $25,000 - $37,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.37 lb/yr
- Total Nitrogen: 2.53 lb/yr
- Total Suspended Solids: 0.35 ton/yr

AREA 9: Old Goshen Road	
Location: 88 Old Goshen Road	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: Low**

A tributary to Mill River is culverted across Old Goshen Road via an approximately 15” HDPE pipe. There is known flooding in the area with evidence of flood damage in the area. Runoff from Old Goshen Road sheds southeast towards the culvert and runs along the shoulder of the road. Water channelizes along the north side of the road. There is a collection of debris downstream of the culvert causing a blockage.

Photo 9-1: Erosion at the shoulder at the inlet for the culvert

Photo 9-2: Area to the northwest of the culvert that sheds along the shoulder

<u>Proposed Area 9 Improvements</u> (see Photo 9-3)

1. Remove downstream blockage within the tributary.
2. Stabilize the soil along the shoulder of Old Goshen Road with riprap (D_{50}= 5 in.).
3. Install a water quality swale with checkdams to the northwest of the stream crossing (approx. 1500 SF).
4. Install an additional culvert to the stream crossing to mitigate flooding of the roadway.

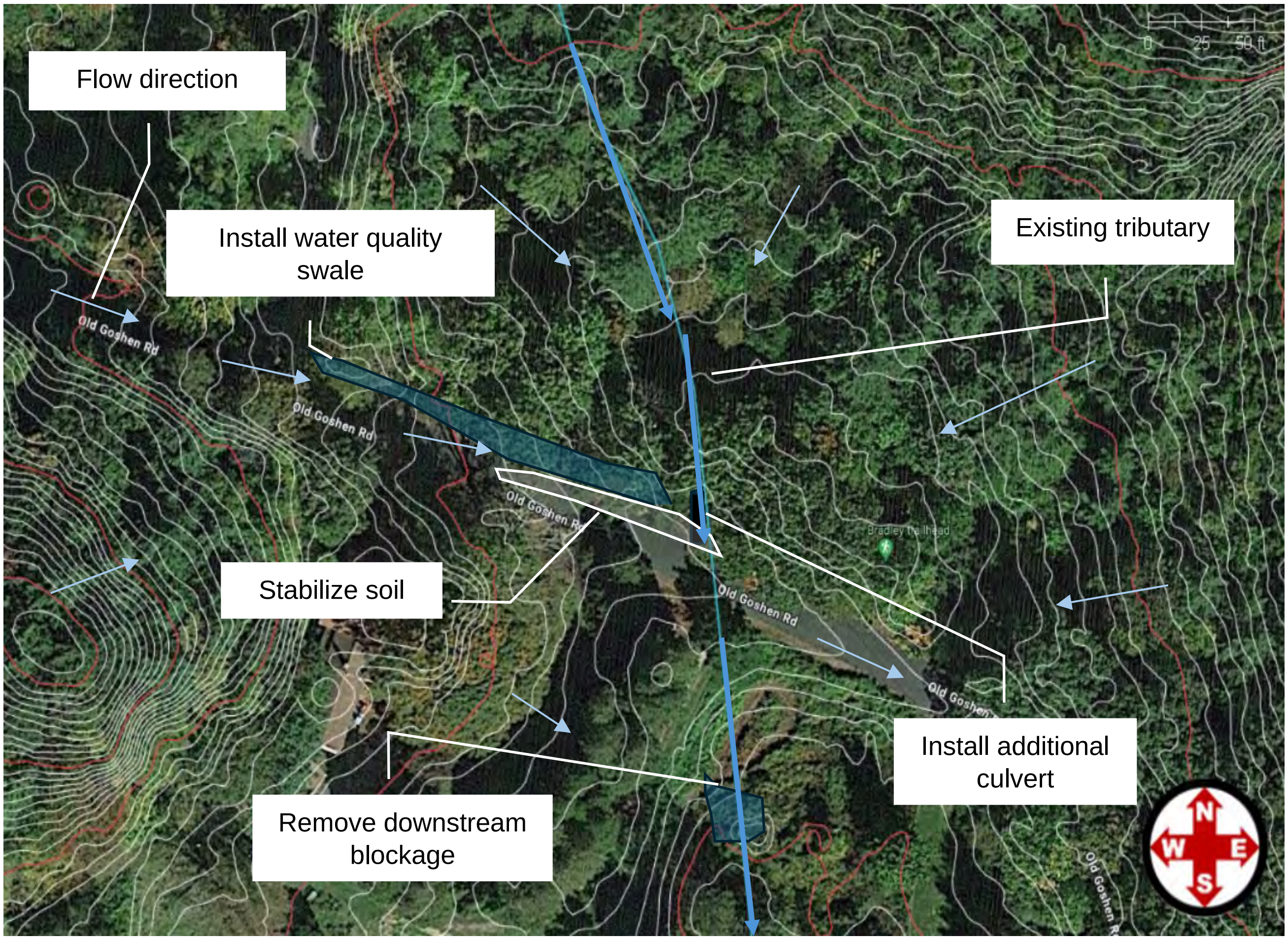

Photo 9-3: Topography and proposed water quality swale on Old Goshen Road

Estimated Costs: $92,000 - $138,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.10 lb/yr
- Total Nitrogen: 0.40 lb/yr
- Total Suspended Solids: 0.18 ton/yr

AREA 10: Hyde Road Fields	
Location: Hyde Road	**Subwatershed: Mill River**
Owner: Gloria Black/Town of Williamsburg	**Priority: Medium**

Hyde Road has reports of flooding during larger storm events. There is an existing small drainage ditch along the northern edge of the road the collects and conveys runoff to a series of catch basins. There is limited available area along the road. The field is known to flood and drainage outlets have been added to the field to allow the runoff to flow towards the existing catch basins.

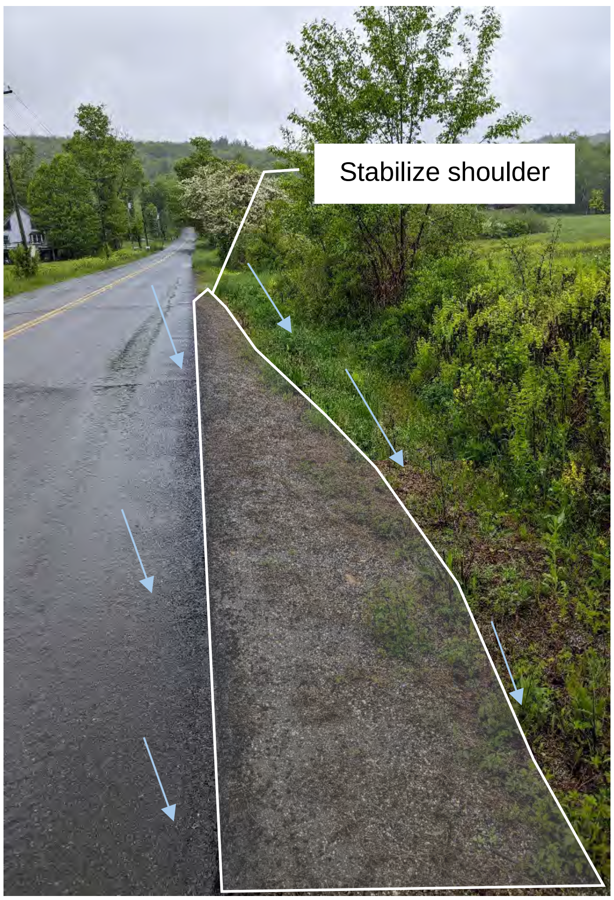

Photo 10-1: Shallow roadside conveyance ditches

Photo 10-2: Field drainage outlets with erosion

<u>Proposed Area 10 Improvements</u> (see Photo 10-3)

1. Vegetate the shoulder of Hyde Road to prevent further erosion with New England Roadside Matrix Upland Seed Mix or similar.
2. Install a large bioretention basin in the field abutting the road to the north (approx. 7000 SF).

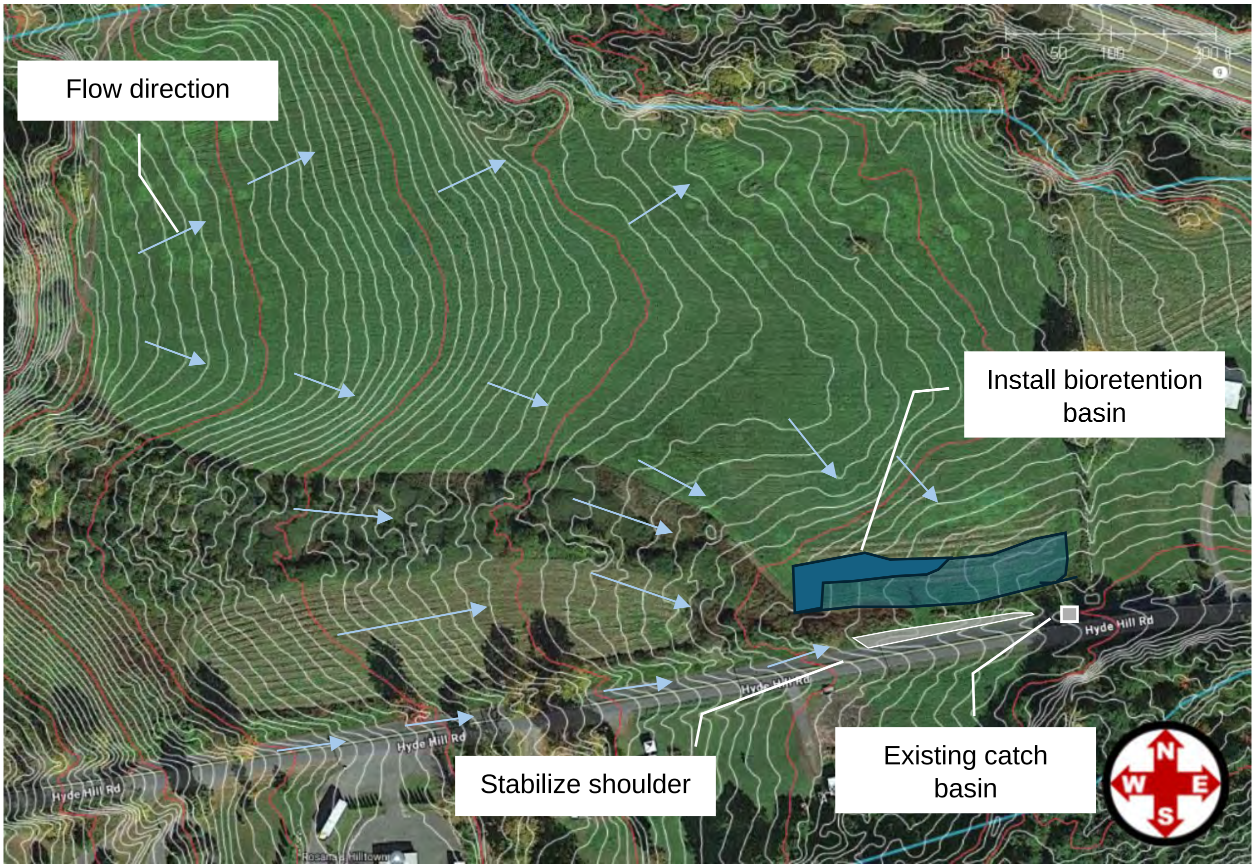

Photo 10-3: Drainage area collected by existing drainage infrastructure

Estimated Costs: $72,000 - $108,000

Estimated Pollutant Reductions:

- Total Phosphorus: 1.28 lb/yr
- Total Nitrogen: 7.42 lb/yr
- Total Suspended Solids: 0.06 ton/yr

AREA 11: Family Vets	
Location: 99 Main Street	**Subwatershed: Mill River**
Owner: Family Vets	**Priority: Medium**

Behind the Family Vets office at 99 Main Street there is an existing dirt parking lot. The dirt lot has reported history of flooding due to the nearby tributary to Mill River. Some runoff from the parking lot tends to pond in local depressions. The majority of runoff tends to shed towards the tributary. The runoff appears to be sediment laden with a cloudy appearance and evidence of erosion.

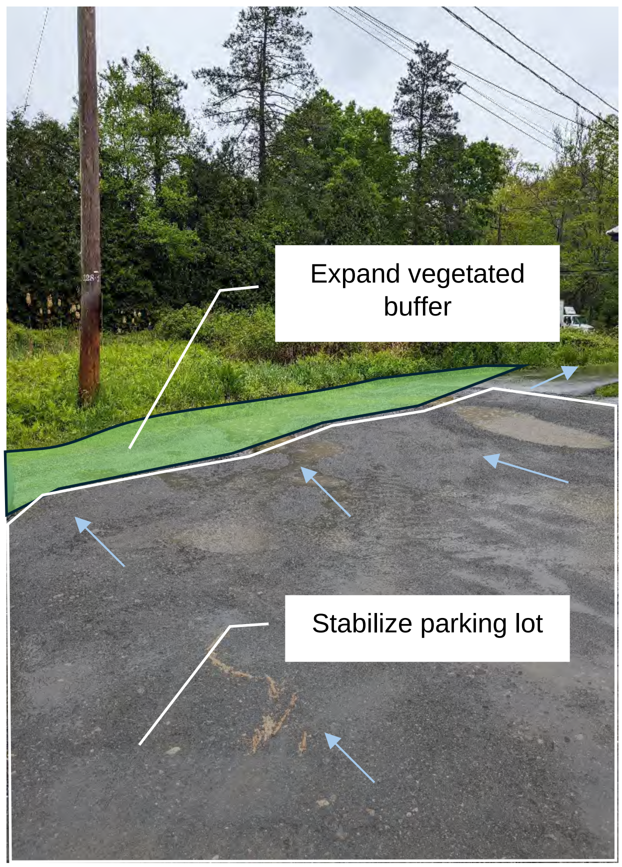

Photo 11-1: Dirt parking lot with a tributary to the northeast

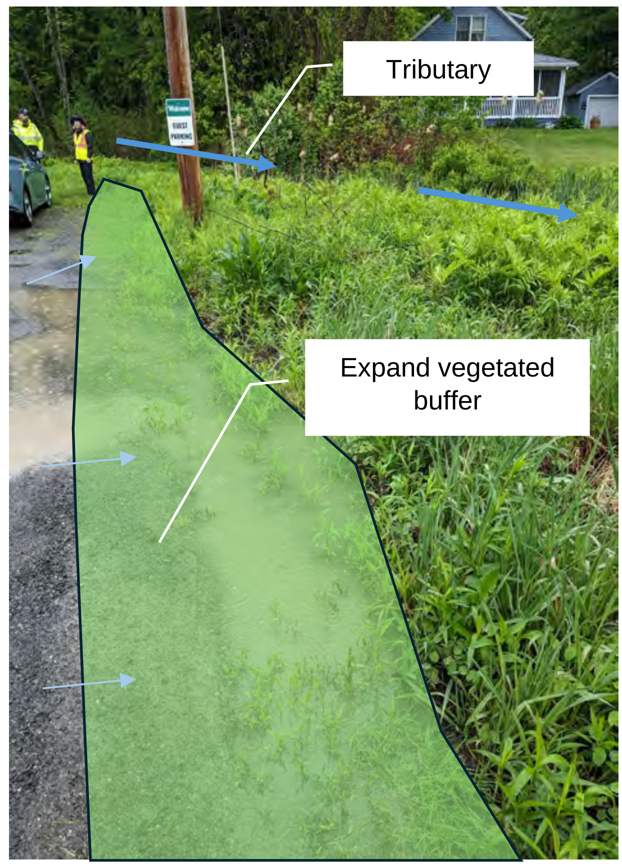

Photo 11-2: Sediment laden runoff at the edge of the parking lot

<u>Proposed Area 11 Improvements</u> (see Photo 11-3)

1. Stabilize parking lot with porous pavers (approx. 4750 SF).
2. Enhance stream bank buffer by expanding approximately ten feet.

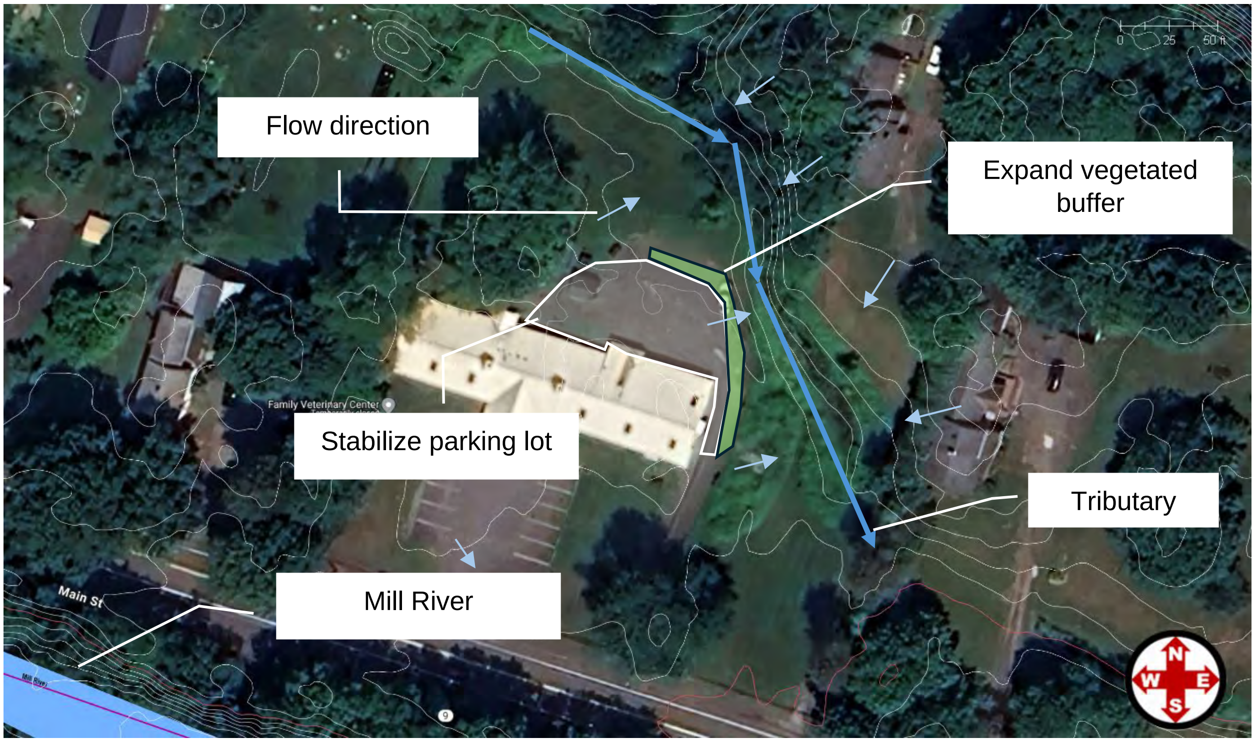

Photo 11-3: Surrounding topography around Family Vets on Main Street

Estimated Costs: $96,000 - $145,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.50 lb/yr
- Total Nitrogen: 1.10 lb/yr
- Total Suspended Solids: 0.60 ton/yr

AREA 12: Town Hall	
Location: 99 Main Street	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: Medium**

Along the edge of the parking lot for the Town Hall there is a small, grassed field. In the southwest corner of the field there is a tributary that is piped towards Mill River. There are a couple catch basins in the field and the parking lot that collect nearby runoff.

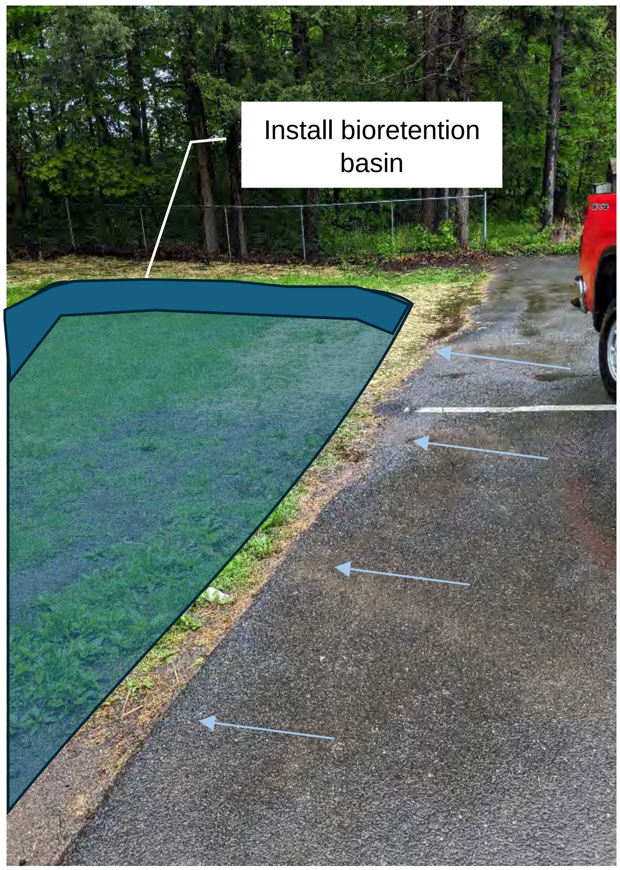

Photo 12-1: Runoff ponding along the edge of the parking lot

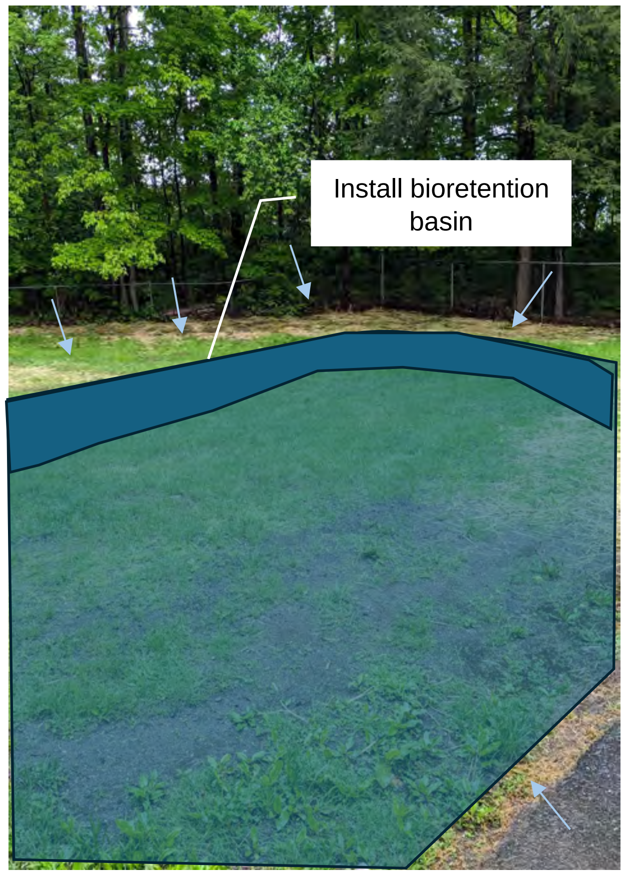

Photo 12-2: Empty grassed field north of the parking lot

<u>Proposed Area 12 Improvements</u> (see Photo 12-3)

1. Install a bioretention area in the grass field with forebay (approx. 500 SF).

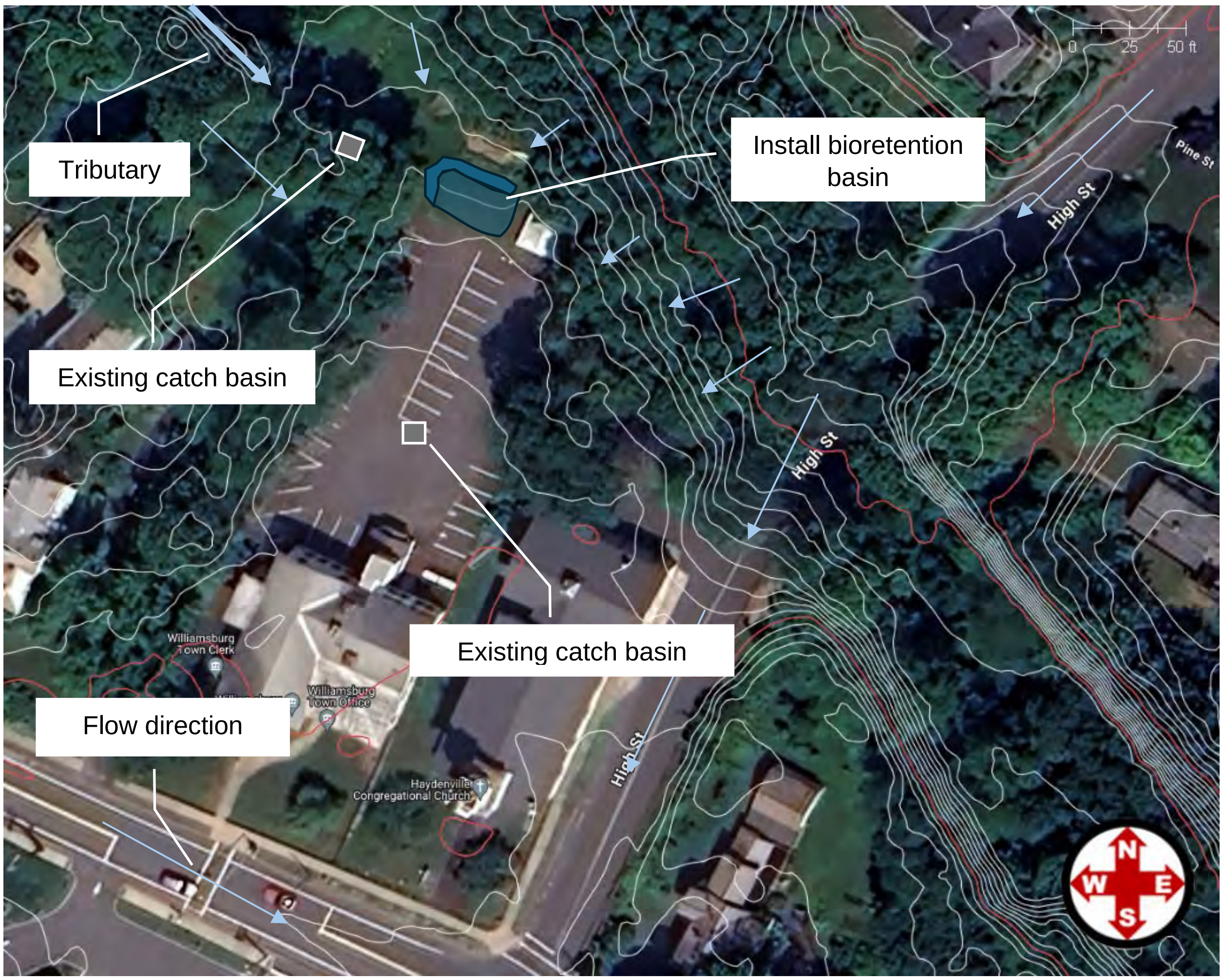

Photo 12-3: Topography and proposed bioretention basin at Town Hall

Estimated Costs: $21,000 - $32,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.11 lb/yr
- Total Nitrogen: 0.88 lb/yr
- Total Suspended Solids: 0.03 ton/yr

AREA 13A: River Road	
Location: River Road	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: Medium**

River Road receives runoff from Main Street and is located adjacent to Mill River. The runoff from Main Street flows along the shoulder of River Road, leading to erosion and sediment transport. There is visible evidence of loose soil along the shoulder, indicating ongoing erosion issues.

Further down River Road, there is a culvert crossing that frequently floods during storm events. This area shows signs of both flooding and sediment transport, exacerbating the erosion problem.

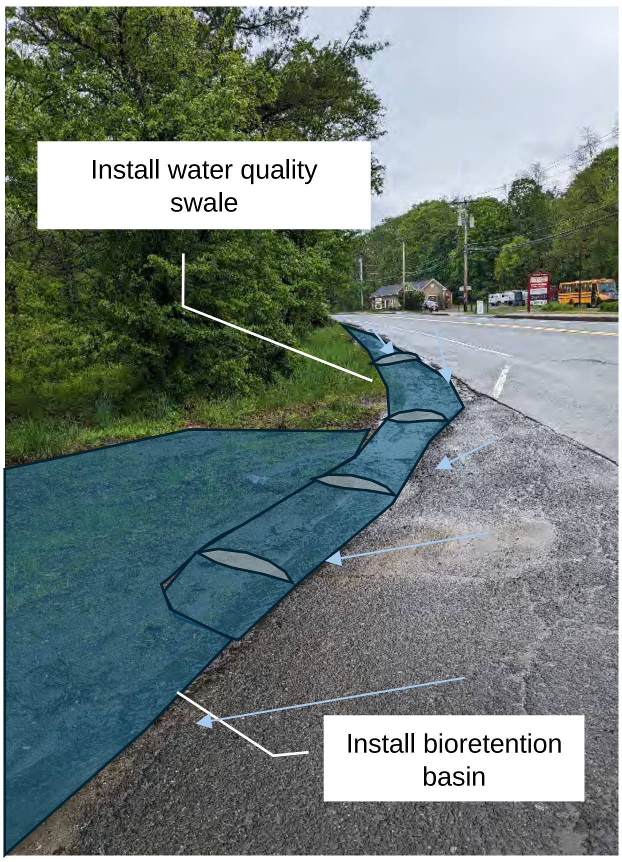

Photo 13A-1: Erosion and sediment transport along River Road

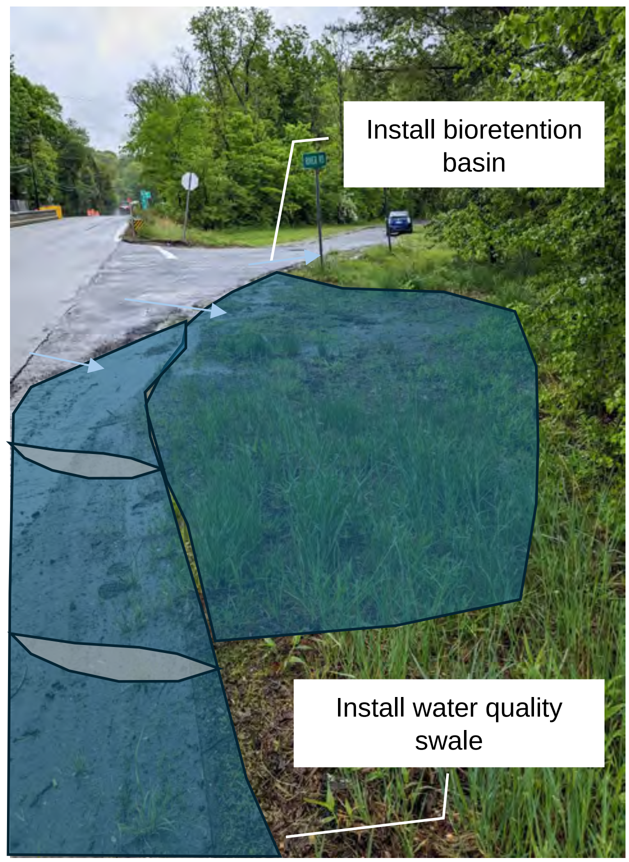

Photo 13A-2: Shoulder at the intersection of River Road and Main Street

<u>Proposed Area 13A Improvements</u> (see Photo 13A-3)

1. Install a water quality swale along Main Street with check dams and erosion control fabric (approx. 750 SF).
2. Install a bioretention basin at the corner of Main Street and River Road (approx. 750 SF).

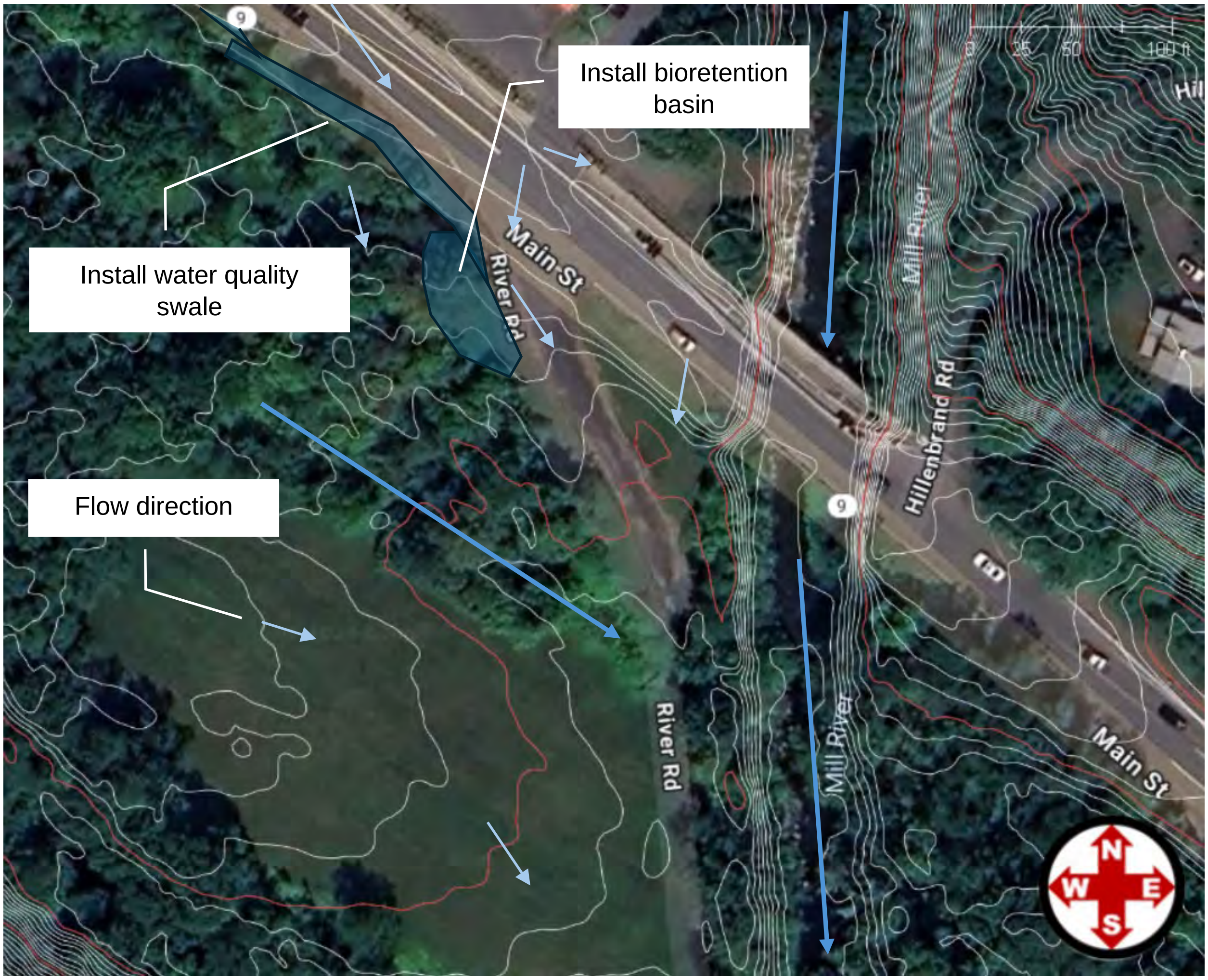

Photo 13A-3: Proposed swale and bioretention basin at River Road and Main Street

Estimated Costs: $36,000 - $54,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.40 lb/yr
- Total Nitrogen: 2.92 lb/yr
- Total Suspended Solids: 0.38 ton/yr

AREA 13B: River Road	
Location: River Road	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: Low**

River Road receives runoff from Main Street and is located right along Mill River. Runoff from Main Street channelizes along the shoulder and then sheds down River Road. There is evidence of loose soil along the shoulder and signs of erosion and sediment transport from runoff. There is a culvert crossing further down the road that is reported to experience flooding during storm events. There is evidence of flooding and sediment transport at this culvert crossing.

Photo 13B-1: Loose sediment along the eastern shoulder

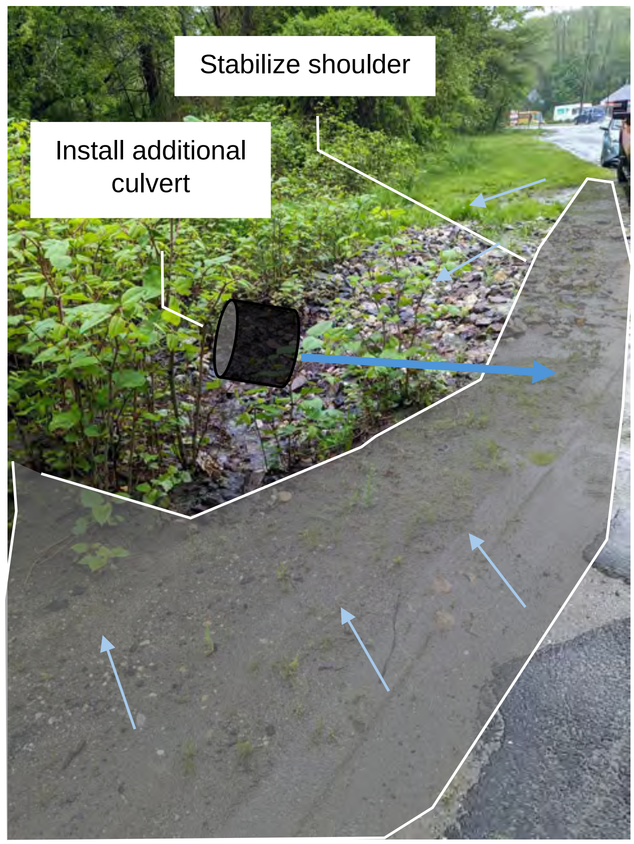

Photo 13B-2: Culvert inlet and erosion along shoulder of River Road

<u>Proposed Area 13B Improvements</u> (see Photo 13B-3)

1. Stabilize soil with New England Roadside Matrix Upland Seed Mix or similar to reduce erosion and sediment transport.
2. Install an additional culvert to reduce flooding over the roadway.

Photo 13B-3: Topography and proposed soil stabilization at River Road

Estimated Costs: $63,000 - $94,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.27 lb/yr
- Total Nitrogen: 0.54 lb/yr
- Total Suspended Solids: 0.32 ton/yr

AREA 14: Petticoat Hill Road	
Location: Petticoat Hill Road	**Subwatershed: Mill River**
Owner: Town of Williamsburg	**Priority: Low**

Petticoat Hill Road is a steep road with minimal drainage infrastructure. Runoff channelizes along the shoulder where a shallow dirt channel has been formed to convey runoff to a series of catch basins along the road. There is major erosion and sediment transport occurring within these dirt channels.

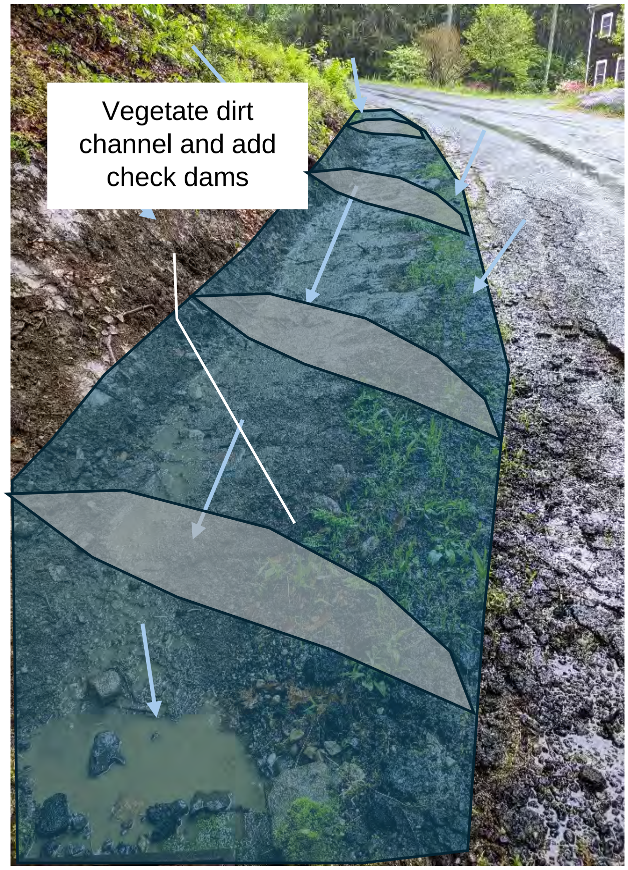

Photo 14-1: Sediment laden runoff and erosion along the existing ditch

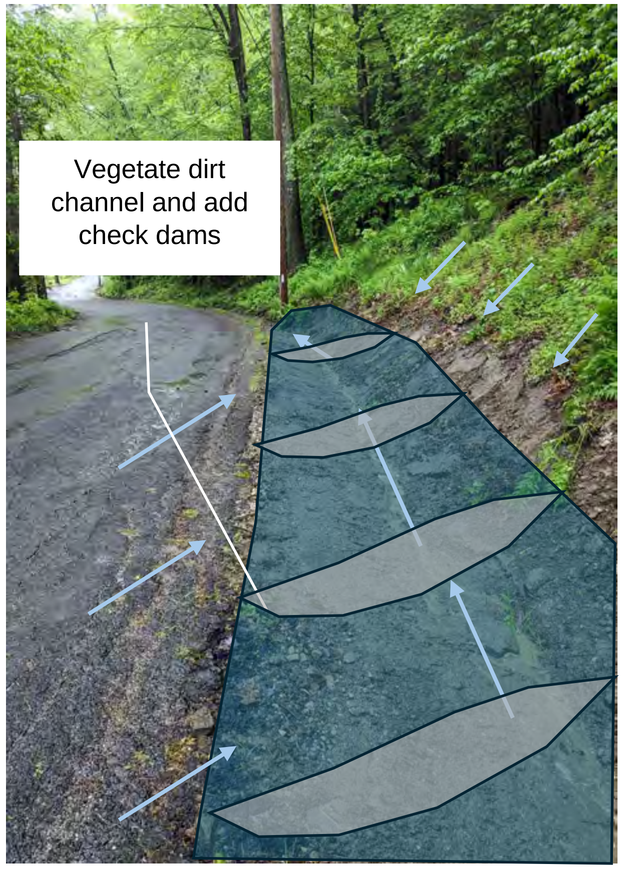

Photo 14-2: Sediment laden runoff and erosion along the existing ditch

<u>Proposed Area 14 Improvements</u> (see Photo 14-3)

1. Install check dams and erosion control fabric along the length of the swale for soil stabilization.
2. Vegetate the swale with New England Roadside Matrix Upland Seed Mix or similar (approx. 5000 SF).

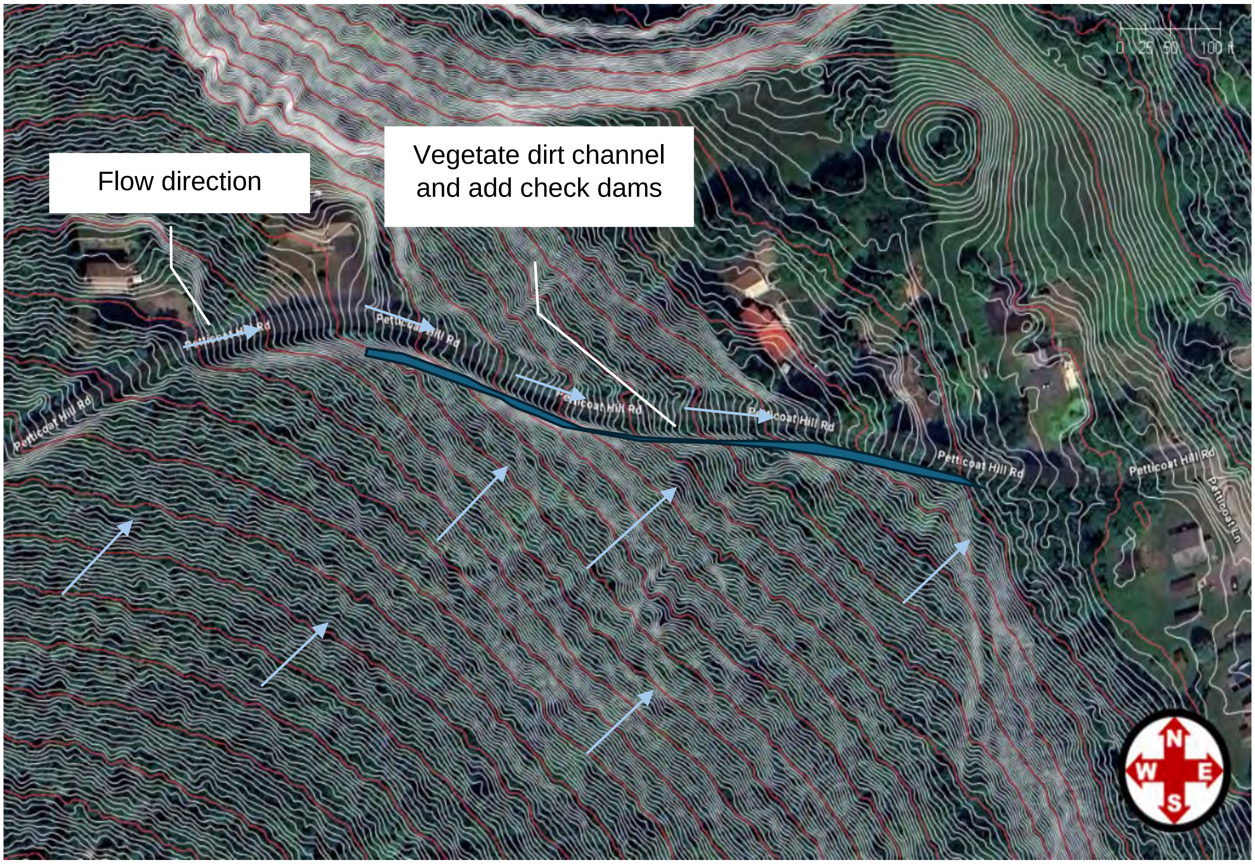

Photo 14-3: Steep topography of the area contributing runoff to Petticoat Hill Road

Estimated Costs: $51,000 - $76,000

Estimated Pollutant Reductions:

- Total Phosphorus: 5.95 lb/yr
- Total Nitrogen: 13.21 lb/yr
- Total Suspended Solids: 6.99 ton/yr

AREA 15: Nichols Road	
Location: Nichols Road	**Subwatershed: Mill River**
Owner: Town of Williamsburg/ Herman Dufresne	**Priority: Low**

Nichols Road is a small loop road that connects to Goshen Road. Runoff from Goshen Road channelizes along the shoulder and towards an existing catch basin on Nichols Road. The channelized runoff is causing erosion along the shoulder. There is a small, grassed area between Nichols Road and Goshen Road that is an existing low point. Nichols Road runs to the north of Mill River and runs adjacent to the river.

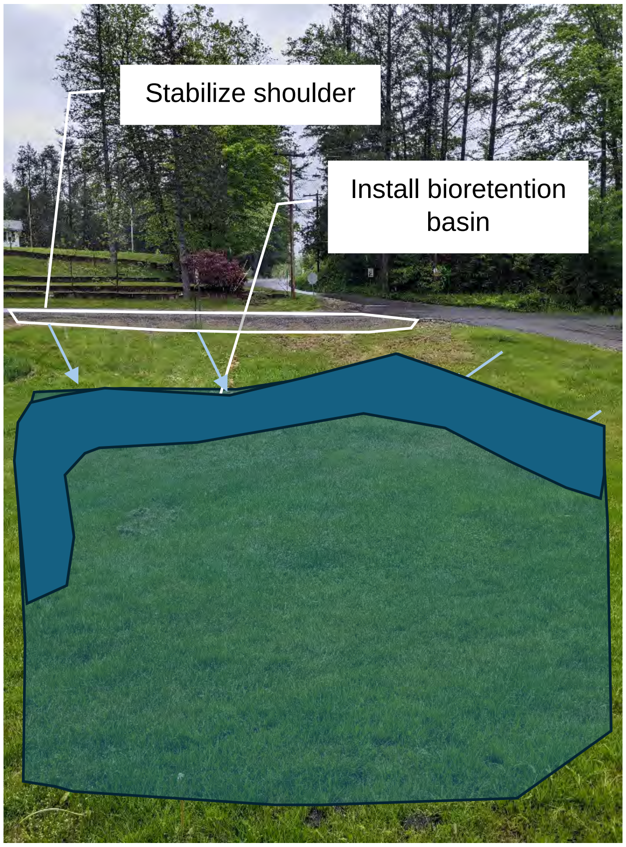

Photo 15-1: Grassed area between Goshen Road and Nichols Road

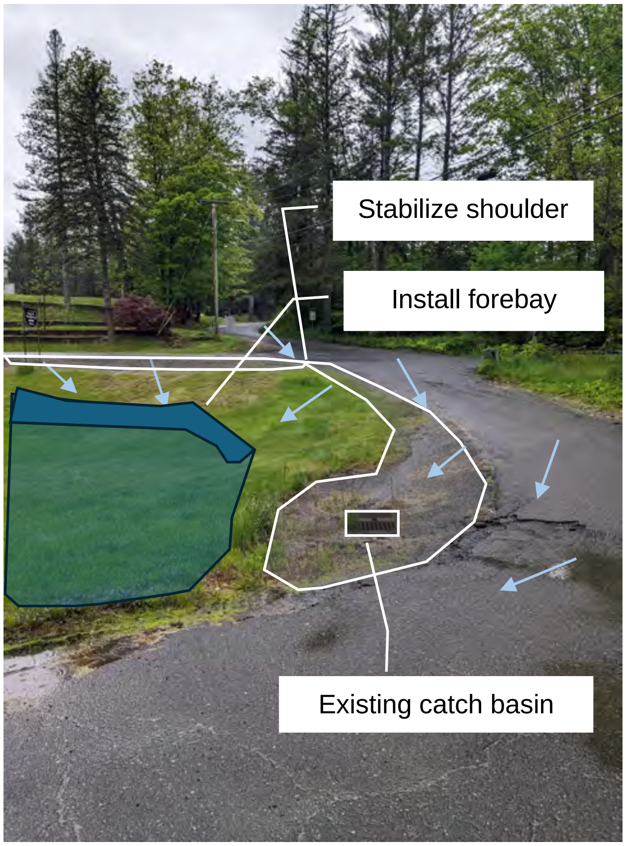

Photo 15-2: Erosion along the shoulder and existing catch basin

<u>Proposed Area 15 Improvements</u> (see Photo 15-3)

1. Stabilize the shoulder of Nichols Road and Goshen Road with riprap (D_{50} = 5 in).
2. Install bioretention basin with forebay in the grassed area (approx. 850 SF).

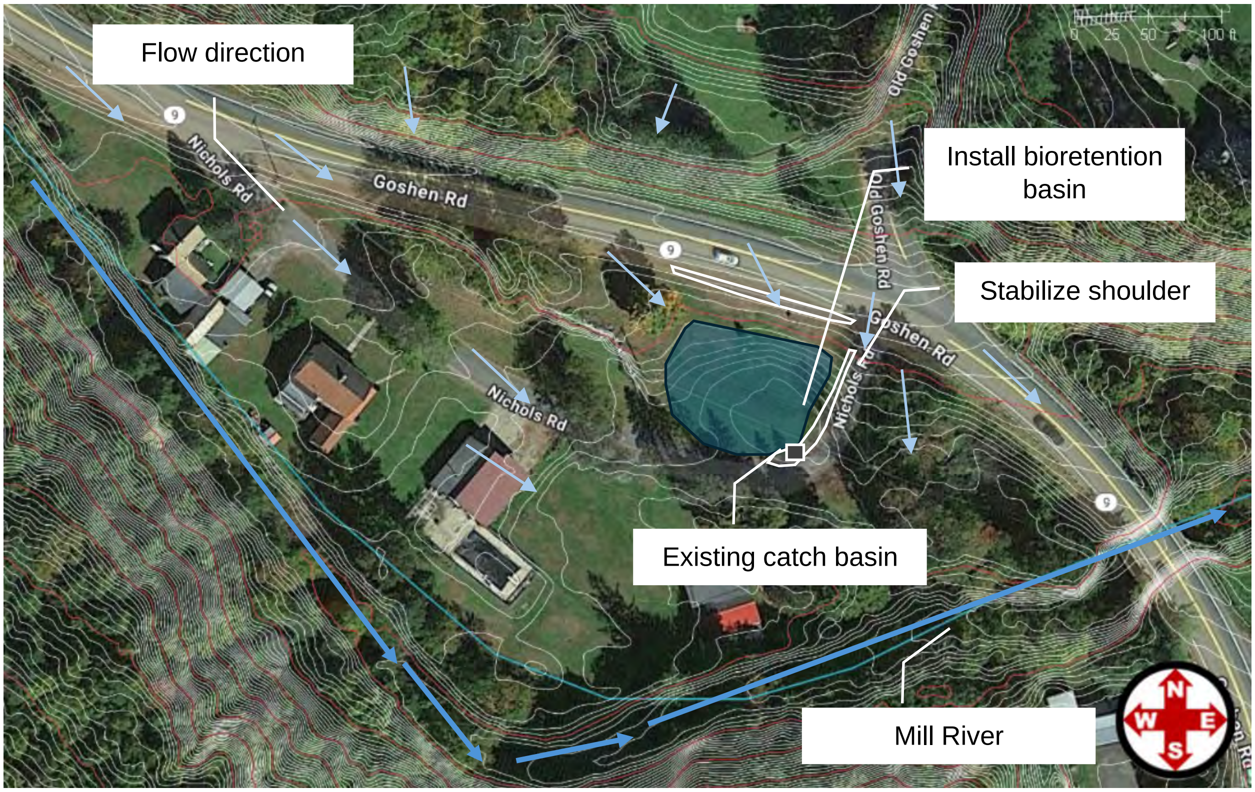

Photo 15-3: Topography and proposed bioretention basin along Nichols Road

Estimated Costs: $35,000 - $52,000

Estimated Pollutant Reductions:

- Total Phosphorus: 0.45 lb/yr
- Total Nitrogen: 3.64 lb/yr
- Total Suspended Solids: 0.29 ton/yr