Wood - Pawcatuck Rivers Watershed Plan

Rhode Island Department of Environmental Management

April 15, 2022

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Acknowledgements:
This watershed plan was prepared by Jon Zwarg, Sr. Environmental Scientist with the Rhode Island Department of Environmental Management. This document draws heavily on the work done by and for the Wood Pawcatuck Watershed Association with special thanks to Denise Poyer and Chris Fox. Additional information, guidance, and advice was provided by Ernie Panciera, Sue Kiernan, Jenny Paquet, David Augustin, Carol Murphy, Joseph Haberek, Crystal Charbonneau, Jane Sawyers, Katie DeGoosh, all of RI DEM. Thank you as well to Margherita Pryor of USEPA for her thoughtful review and constructive feedback.

The Wood-Pawcatuck Rivers Watershed Plan has been prepared by RI DEM to meet the purposes and provide the benefits of watershed planning outlined herein and to satisfy the planning requirements for eligibility for RI DEM Nonpoint Source Program Funding. In developing the Plan, RI DEM limited the scope as follows:

- The Plan does not address the Little Narragansett Bay estuary. The Little Narragansett Bay estuary is the subject of current planning and analysis separate from this watershed plan. See discussion box, "Managing Nutrients in the Pawcatuck River Watershed" in Section III.
- In keeping with the objective of eligibility for RI DEM Nonpoint Source Program Funding, the Plan focuses on the Rhode Island portion of the watershed. 81% of the watershed area is within Rhode Island.

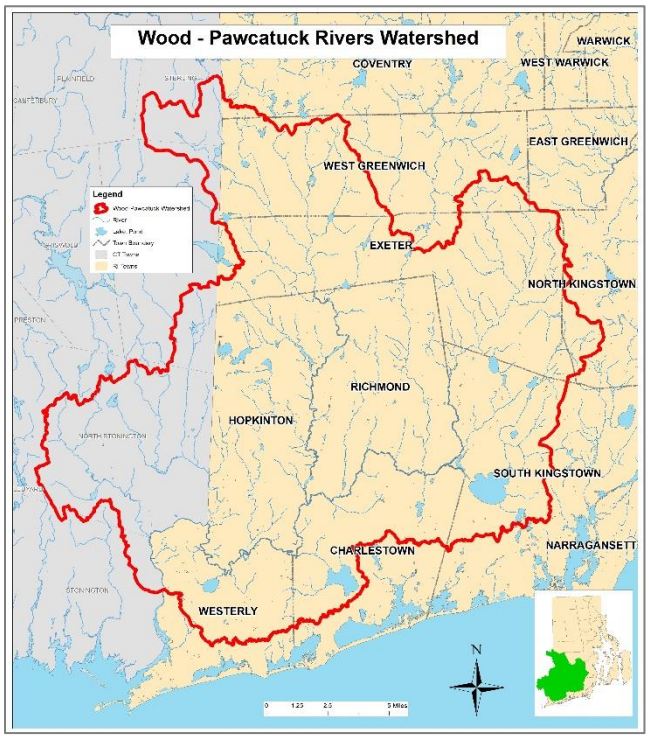


Figure 1

I. Introduction

The Wood-Pawcatuck watershed is a nationally recognized 'wild and scenic' waterway which encompasses approximately 300 square miles in southwestern Rhode Island and southeastern Connecticut. The watershed contains seven major river drainage areas including the Beaver, Chipuxet, Green Fall-Ashaway, Pawcatuck, Queen-Usquepaugh, Shunock, and Wood Rivers. It is one of the few remaining relatively pristine natural areas in southern New England between New York and Boston with high habitat and species diversity, an outstanding sports fishery, and tremendous opportunities for outdoor recreation. The water resources and aquatic habitat are generally of very high quality.

Watershed – A watershed is an area of land where all the rain or snow that falls on it drains off or seeps through the ground to a common outlet. Topography is the key element to establishing watershed boundaries.

A. Purpose

The purpose of this watershed-based plan is to address water quality and aquatic habitat within the Wood- Pawcatuck River Watershed in a holistic manner. A watershed plan provides a framework for managing efforts to both restore water quality in degraded areas and to protect water quality in healthy areas. By fully assessing the potential causes and sources of pollution, then prioritizing restoration and protection strategies to address these problems, the watershed plan serves to both make efficient use of financial resources and to coordinate the most effective benefits to water quality.

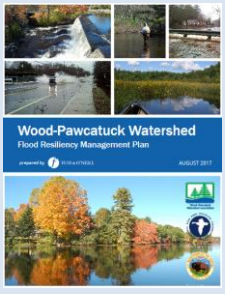
> **Watershed-Based Plan–** is a strategy and a work plan for achieving water resource goals in a watershed. It includes a description of the existing water quality conditions, identifies and prioritizes problems, and outlines what needs to be done to restore and/or protect the water resources.

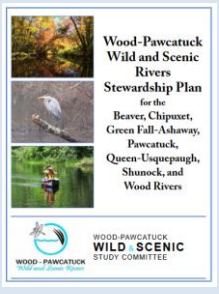
The watershed planning process provides an opportunity to:

- Identify partners and stakeholders;
- Identify and prioritize water quality issues within the watershed;
- Collaborate across all levels of the public and private sectors to determine and implement actions that are supported by sound science;
- Compile actions or initiatives from other plans and reports into one unifying and integrated vision and action plan for the protection and restoration of water quality and aquatic habitat in the watershed; and
- Identify and discuss long-term management and financial assistance opportunities needed to achieve the water quality goals

This watershed plan brings together the many existing State, local government, and non-government organization plans and efforts that address water quality, as spread throughout the

This plan depends greatly on the Wood-Pawcatuck Watershed Flood Resiliency Management Plan (2017) and the Wood-Pawcatuck Wild and Scenic Rivers Stewardship Plan (2018), both prepared by the Wood-Pawcatuck Watershed Association.





watershed, into one "upper level" plan. This plan presents an overview of the current conditions, existing pollution types and sources, existing efforts, and recommended prioritized actions to more effectively manage water quality in the watershed. Most specific fundable actions will require and will come out of a more specific planning effort. The Town of Richmond provides a good example of this concept. The Beaver River, a major tributary of the Pawcatuck River, has been included in the Wild and Scenic River designation as part of the Pawcatuck system. The Town of Richmond is currently (2020) engaged in a planning project to assess the impacts of existing and future land uses and prioritize land protection measures and restoration projects. One outcome of the project will be specific recommendations of actions such as land acquisition, culvert replacement, etc. that can be taken in the future to further protect water quality and aquatic habitat. The Wood-Pawcatuck watershed plan serves as a higher-level mechanism to integrate the full range of actions recommended for protecting and restoring water quality and aquatic habitat.

B. Vision and goals for the Wood-Pawcatuck watershed

The vision and goals for the Wood-Pawcatuck watershed are best articulated by the people living and working within the watershed. As part of the development of a flood resiliency plan (F&O 2017), municipal officials and other project partners were asked to identify the issues and concerns in the watershed and in their communities. Water quality, drinking water quality, and stormwater management were among the six most common areas of interest. The protection of groundwater as a drinking water supply was among the six desired outcomes of the planning process.

In March 2019, the Wood-Pawcatuck watershed was designated as a National Wild and Scenic River system. As part of this process, the communities within the watershed chose the following stewardship goals:

- Improve and conserve water quality and water quantity.
- Conserve open space, woodlands, wetlands and geologic features.
- Protect native plant and animal species.
- Preserve cultural, historical and archaeological sites.
- Enhance outdoor recreation opportunities.
- Encourage environmental education and watershed awareness.

Four of the six goals are directly related to maintaining and improving water quality and aquatic habitat in the watershed.

Wood-Pawcatuck Watershed Association– the Wood-Pawcatuck Watershed Association (WPWA) has fostered a mission to promote and protect the integrity of the lands and waters of the Pawcatuck Watershed for the benefit of our natural and human communities. WPWA is recognized as an outspoken voice working for those who use and enjoy the rivers. Many of WPWA's activities are directed toward educating and informing residents, visitors, and public officials about the watershed's pristine lands and water resources. WPWA plays an ongoing role in public policy formulation and debate within the watershed. As the state-recognized watershed council for the Pawcatuck River, WPWA has legal standing to advocate on behalf of the Wood-Pawcatuck Watershed. WPWA works in partnership with local, state, and federal agencies to encourage the watershed approach to environmental management.

WPWA has been instrumental in developing the Flood Resiliency Plan, Wild and Scenic Rivers Stewardship Plan, and other documents on which much of this Watershed Plan is based.

Learn more about the Wood-Pawcatuck Watershed Association at wpwa.org.

More broadly, the State of Rhode Island, through the State Guide Plan Water Quality Element, has also articulated a vision and goals for the waters of the state, including those within the Wood-Pawcatuck Watershed:

> *RI's water resources will support healthy aquatic ecosystems and meet the needs of current and future generations by protecting public health, supplying high quality drinking water, providing bountiful recreation opportunities and supporting a vibrant economy.*

Goals to achieve this vision include:

- *Protect the existing quality of RI's waters and aquatic habitats and prevent further degradation.*
- *Restore degraded waters and aquatic habitats to a condition that meets their water quality and habitat goals.*

Watershed advocacy groups such as the Wood-Pawcatuck Watershed Association play a valuable role in helping to channel energy into actions in pursuit of watershed goals. Such groups can also carry this Watershed Plan forward and use it to help guide future projects.

The Nature Conservancy- The Nature Conservancy (TNC) is a global environmental nonprofit working to conserve the lands and waters on which all life depends. In the Wood-Pawcatuck watershed, TNC has been a partner in numerous land conservation projects and has been instrumental in dam removal projects on the Pawcatuck River.

Learn more about The Nature Conservancy at www.nature.org

C. Compelling issues in the Watershed:

It is interesting to note the historic context of some of the compelling issues within the Watershed. In 1977, the Rhode Island Statewide Planning Program and the Rhode Island Department of Health published a report entitled the *Pawcatuck River Basin Water Quality Management Plan* as a component of the State Guide Plan. The planning area boundary used for this document is different from the hydrologic boundaries used today but many of the issues remain the same. At the time, there were several point sources of water pollution discharging to surface waters within the watershed. The University of Rhode Island campus in Kingston had a wastewater treatment plant that discharged to White Horn Brook. This plant has been decommissioned. Wastewater from the campus is now exported from the watershed for treatment at the South Kingstown regional treatment plant in Narragansett and is discharged to the Atlantic Ocean. Kenyon Mills and the Bradford Dye works were considered a threat to the water quality of the Pawcatuck River at the time. The uses of these industrial sites have changed over the years, and the treatment processes updated, but they remain potential water quality threats. In 1977 a number of the more densely developed areas within the watershed were highlighted as "requiring sewer service by 1990." It is interesting to note that, with the exception of the URI campus connection to the South Kingstown Plant and some modest extensions within downtown Westerly, very little additional sewer construction has been completed. Wastewater treatment issues remain in parts of the watershed and are a potential threat to surface and groundwater quality.

Over time, some issues have been resolved. A major interstate highway, Route 895, was in the early planning stages in the mid 1970's and was discussed in the plan. This roadway was to roughly parallel the existing state route 138 and would have dramatically altered the landscape in the heart of the watershed. Remnants of this proposed roadway can be seen today elsewhere in the state, for example the western approach to the Jamestown Bridge. The Rt. 895 project was abandoned in the 1980's in the face of strong opposition from the communities through which it would have been built.

In 1999 the Rhode Island Sea Grant Program published *Pawcatuck Watershed Water Resources: A Management Issues Profile*. This report, as the title suggests, focused more on the management issues at play in the watershed, issues like the cumulative effects of development, stormwater management, and the impacts of conflicting uses on habitat and water quality. In general, the overall quality of the surface and groundwaters in the watershed was high and, for the most part, remains so today. The potential threats remain as well.

Climate Change: All of the issues and actions presented in this watershed plan need to be considered in the context of a changing climate. A more detailed discussion of the potential impacts of climate change can be found in Section V: Aquatic Habitat Management. Climate change is also discussed in Sections I(C)(5), IV(A), and VI.

1) Protect Drinking Water Supplies

In 1988, the U.S. EPA designated groundwater in the Pawcatuck Basin Aquifer System as a Sole Source Aquifer. This means that the Pawcatuck Basin Aquifer System is the sole source of drinking water for the residents and businesses within the Wood-Pawcatuck Watershed. Furthermore, there are no viable alternative sources of sufficient supply and if contamination were to occur it would pose a significant public health hazard and a serious financial burden to the area's residents. While the quality of the Basin's ground water is rated as good to excellent, it is highly vulnerable to contamination due to the Basin's geological characteristics. Because of this, contaminants can be rapidly introduced into the aquifer system from a number of sources with minimal assimilation. This may include contamination from chemical spills, highway, urban and rural runoff, septic systems, leaking storage tanks, both above and underground, road salting operations, saltwater intrusion, and landfill leachate (EPA Sole Source Aquifer Designation, Federal Register, 5/13/88).

2) Protecting and Restoring Recreational Opportunities

Boating, swimming, and fishing are important to both residents of and visitors to the Wood-Pawcatuck Watershed. Water-based and natural resource based recreational activities have been identified in local Comprehensive Plans as important to the local quality of life for residents of towns within the Watershed. Visitors contribute economically to these communities. Aquatic resources in the watershed are highly prized for recreational activities, particularly paddling, fishing, and birding. Thirty-four miles of the Pawcatuck River and twenty-four miles of the Wood River present exceptionally scenic canoeing and kayaking. The Wood River and its tributaries are nationally known as outstanding trout fishing streams.

Swimming and fishing both depend on clean water. Opportunities for safe swimming decrease and habitat for native fish and wildlife becomes degraded as pollution increases from development

and agriculture. Improving the water quality to protect this designated use will improve opportunities for fishing and wildlife viewing, encourage other outdoor recreation in the watershed, and ensure there is adequate habitat for wildlife.

Many of the management practices that maintain or improve water quality also have benefits for forms of recreation that don't involve direct water contact. Good water quality makes canoeing and boating more enjoyable. Open space preservation benefits water quality but can also create opportunities for hiking, photography, and general enjoyment of nature. All of these activities contribute to the local economy and improve quality of life for residents.

3) Protecting water supplies for other uses – commercial, industrial, agricultural

Statewide water demand doubles during the low flow period when there is less water available; increase due in large part to agriculture and lawn watering. Withdrawals of water from certain streams or adjacent aquifers can severely impact the quantity and quality of stream water available during low flow periods. Impacts to the aquatic habitat occur due to loss of riverbed area covered by water, receding wetlands, loss of vernal pools and inadequate baseflow and in-stream water depth for a healthy, reproducing natural fish population. Additionally, lower flows increase pollutant concentrations downstream of dischargers and where discharge limits are based on certain flow assumptions, the limits may no longer prove protective.

4) Protecting and restoring healthy fish and wildlife habitat

Fish and wildlife habitat is vulnerable to not just pollution but also from other types of stressors that result in physical changes to the aquatic habitat, such as wetland alterations, invasive species, barriers to stream flow, and water withdrawal. Management efforts should include actions needed to protect, enhance and restore habitat conditions in support of aquatic life and healthy, and sustainable aquatic ecosystems. For example, the Wood-Pawcatuck watershed has 242 miles of stream that can be considered cold water habitat, important for populations of native fish and invertebrates dependent on cold water temperatures. Management should prioritize the prevention of further degradation of the existing, high quality habitat within the watershed (adapted from State Guide Plan, *Water Quality 2035*).

5) Flooding, climate change

Flood events have caused significant damage in the Wood-Pawcatuck watershed over the years. Several factors contribute to flooding in the watershed. Historical development in the watershed has resulted in filling of wetlands, floodplains, and floodways, which has reduced natural flood storage and placed development in flood-prone areas. Many of the streams in the watershed, as is common in New England, have also been physically modified (i.e., moved, straightened, hardened), which can increase riverine erosion hazards in certain areas. Development of the landscape with roads, parking lots, and buildings – impervious surfaces that prevent rainfall from

infiltrating into the ground naturally – has increased the amount of storm runoff. Stormwater drainage infrastructure in developed areas also conveys runoff quickly to rivers and streams. Undersized bridges and culverts have also contributed to flooding and erosion. Dams within the watershed create flood hazards by backing up water during major floods and by releasing very large quantities of flow, sediment, and debris in the event of a sudden failure.

The communities in the Wood- Pawcatuck watershed face an increasing risk of flooding and storm-related damages as large storms and floods become more common due to climate change. In addition to climate change, some parts of the watershed are susceptible to future development pressure that, if not appropriately controlled, could increase floodplain encroachments, reduce the natural water-absorbing capacity of the land, increase impervious surfaces and stormwater runoff, and worsen flooding impacts. (F&O 2017 Flood Resiliency Report)

II. Watershed Description

This Wood-Pawcatuck Watershed Plan focuses on the **fresh water** rivers, streams, and lakes within the watershed. The Little Narragansett Bay estuary is not directly addressed.

- The Little Narragansett Bay estuary is the subject of current planning and analysis separate from this watershed plan.
- The Estuary is strongly influenced by upstream activities in the watershed.

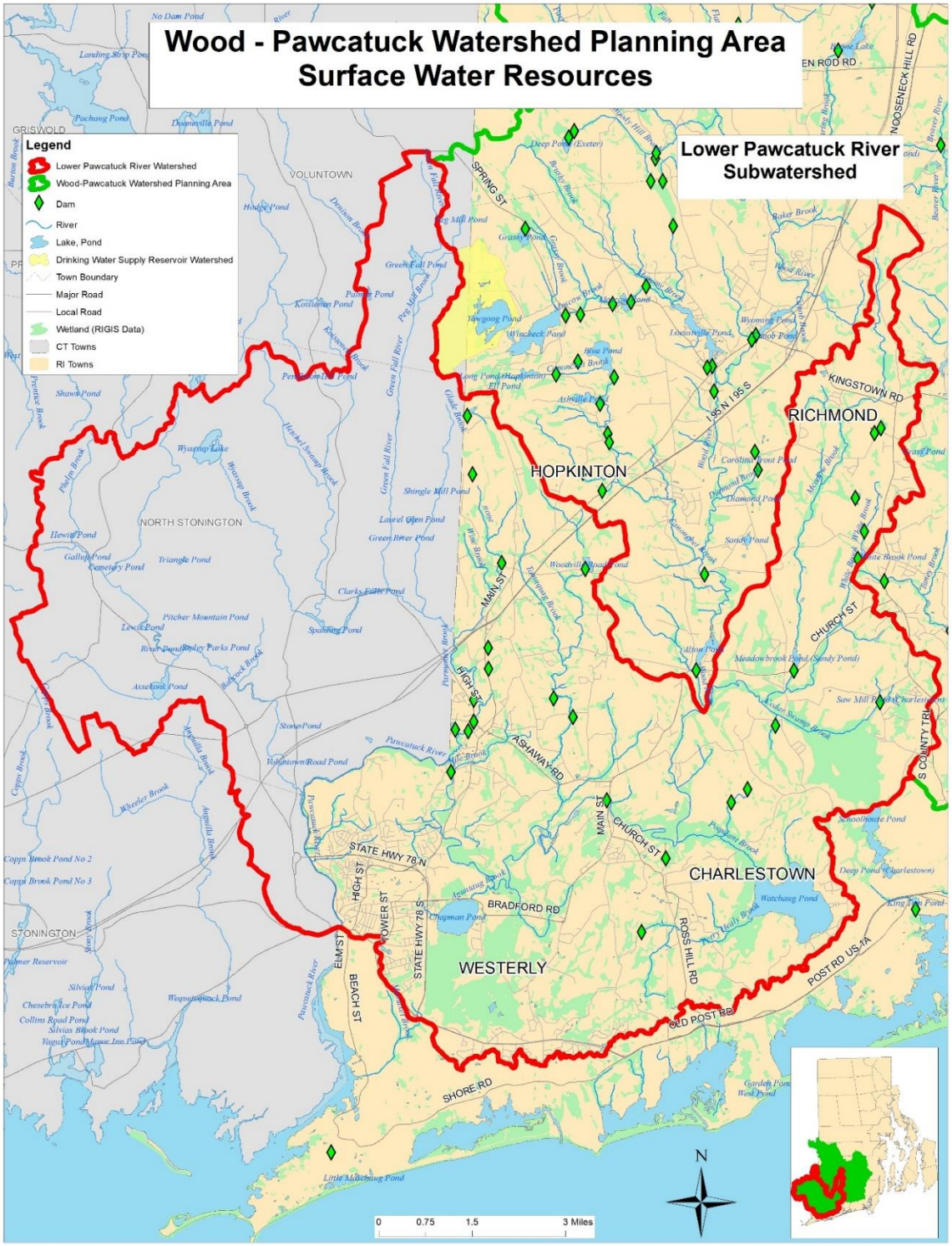
The Wood and Pawcatuck Rivers system lies in the southwestern region of Rhode Island and southeastern Connecticut. The source of the Pawcatuck River is in the Town of South Kingston, RI and its terminus is in the Town of Westerly, RI and Stonington, CT, where it drains to the Little Narragansett Bay (Long Island Sound). The Wood-Pawcatuck watershed is approximately 300 square miles in area, 241 of which are in Rhode Island, covering 22 percent of the state. The watershed includes many high-quality tributaries within seven major drainage areas including the Queen, Wood, Chickasheen, Chipuxet, Shunock, Green Falls, and Pawcatuck Rivers. For the purposes of this Plan and where appropriate, the watershed will be divided into three sub-regions: the Upper Pawcatuck, Lower Pawcatuck, and Wood River. Furthermore, as discussed earlier, this plan will focus on the Rhode Island portion of the watershed, which makes up 81 percent of the area. This watershed is one of the few remaining relatively pristine natural areas along the northeast corridor between New York and Boston and the rivers themselves have been given federal designation as Wild and Scenic. The Pawcatuck River is 38 miles long and the Wood River, its major tributary, is 27 miles long. The Pawcatuck River and its associated tributaries run through a rural wooded landscape amongst a series of towns that grew up on the banks of the watercourses, historically as mill villages. Vestiges of the textile and fabric dyeing industry can still be found on the banks of the rivers. The watershed is the most rural, least developed in Rhode Island with approximately 87 percent of the land undeveloped and approximately 75 percent forested. The estuary of the Pawcatuck River winds its way through the more densely developed communities of Pawcatuck,

Connecticut and Westerly, Rhode Island. Development pressure is high in this region as is typical in the states along the Atlantic coastline (adapted from *Wood & Pawcatuck Wild and Scenic River Reconnaissance Study*, WPWA).

Rhode Island Towns within the Wood-Pawcatuck Watershed:

Municipalities	Area within Watershed (Sq.Mi)	% of Watershed Area	% of Town Within Watershed Area
Charlestown	24.9	10.4%	65.7%
Coventry	0.9	0.4%	1.4%
East Greenwich	0.1	0.0%	0.6%
Exeter	53.4	22.2%	91.4%
Hopkinton	44.1	18.3%	100.0%
North Kingstown	3.2	1.3%	7.3%
Richmond	40.8	16.9%	100.0%
South Kingstown	27.9	11.6%	46.4%
West Greenwich	26.2	10.9%	51.1%
Westerly	19.2	8.0%	63.3%

Surface water resources are shown in the figures on the following pages.


Wood - Pawcatuck Watershed Planning Area
Surface Water Resources
Lower Pawcatuck River Subwatershed
Legend
Lower Pawcatuck River Watershed
Wood-Pawcatuck Watershed Planning Area
Dam
River
Lake, Pond
Drinking Water Supply Reservoir Watershed
Town Boundary
Major Road
Local Road
Wetland (RIGIS Data)
CT Towns
RI Towns
GRISWOLD
VOLUNTOWN
NORTH STONINGTON
HOPKINTON
RICHMOND
CHARLESTOWN
WESTERLY
STONINGTON
SPRING ST
KINGSTOWN RD
MAIN ST
CHURCH ST
HIGH ST
ASHAWAY RD
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STATE HWY 78 S
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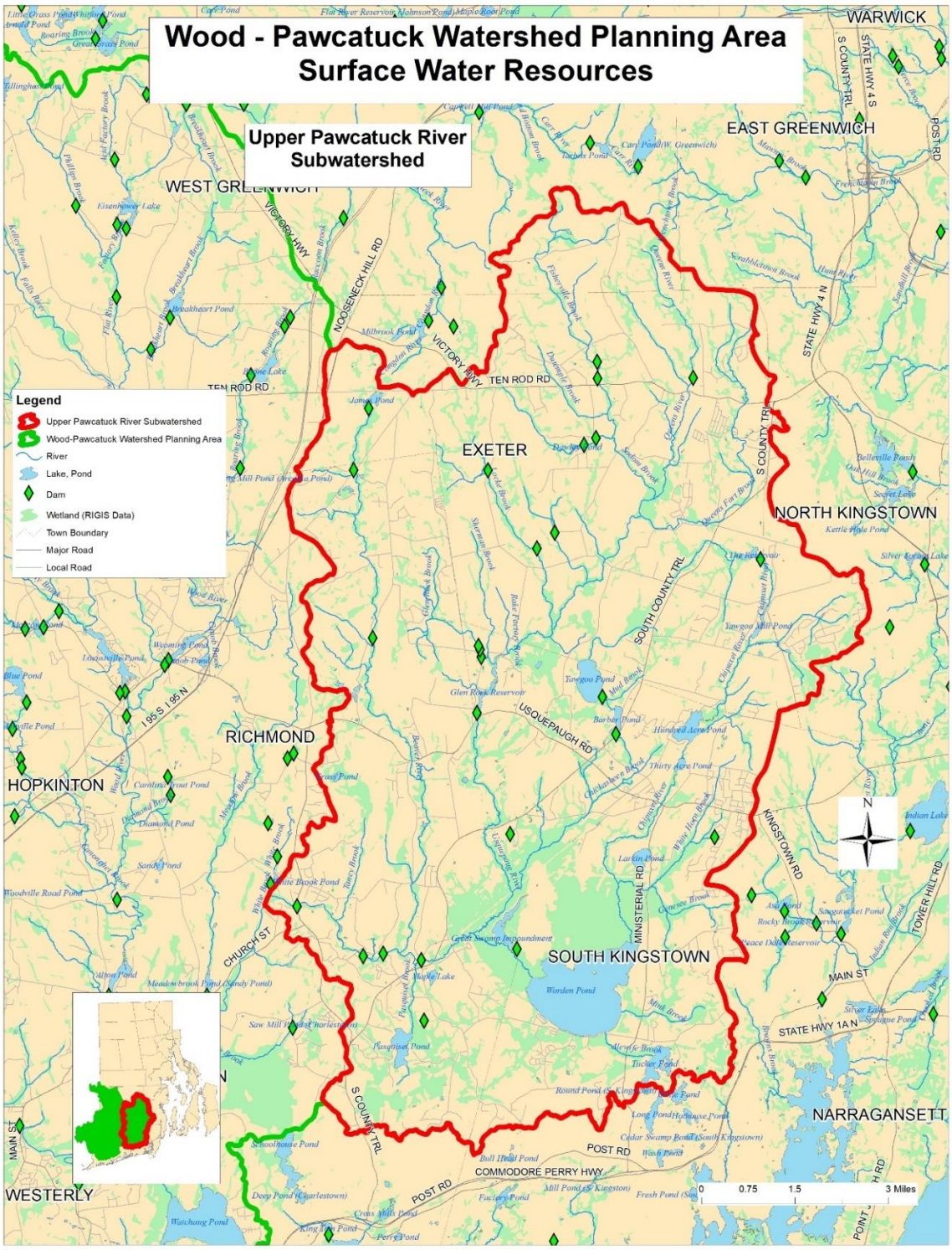
Figure 2


Wood - Pawcatuck Watershed Planning Area
Surface Water Resources
Upper Pawcatuck River Subwatershed
Legend
Upper Pawcatuck River Subwatershed
Wood-Pawcatuck Watershed Planning Area
River
Lake, Pond
Dam
Wetland (RIGIS Data)
Town Boundary
Major Road
Local Road
WARWICK
EAST GREENWICH
WEST GREENWICH
EXETER
NORTH KINGSTOWN
RICHMOND
HOPKINTON
SOUTH KINGSTOWN
NARRAGANSETT
WESTERLY
TEN ROD RD
VICTORY HWY
NOOSENECK HILL RD
SOUTH COUNTY TRL
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STATE HWY 4 S
STATE HWY 4 N
USQUEPAUGH RD
KINGSTOWN RD
MINISTERIAL RD
TOWER HILL RD
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Figure 3

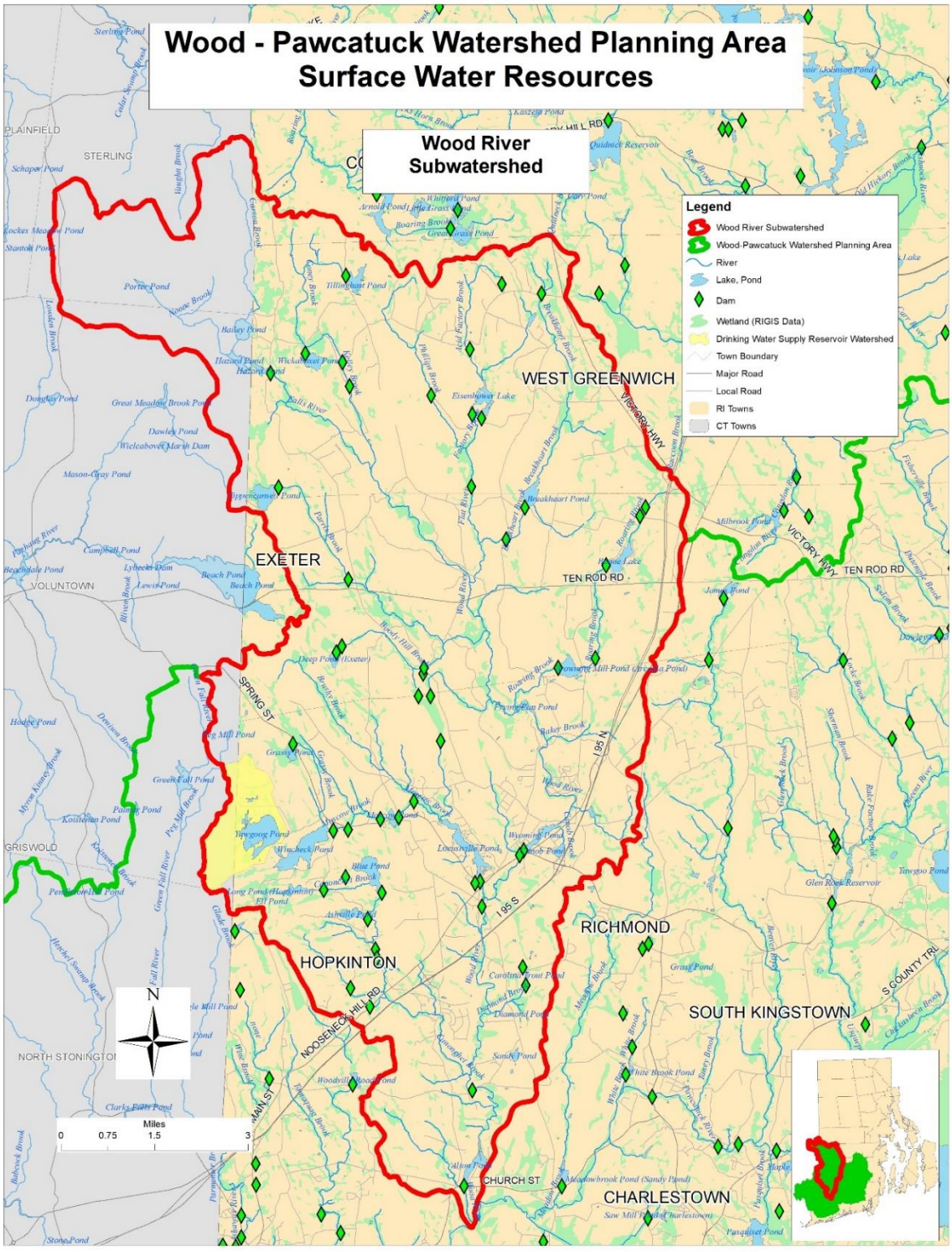
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Figure 4

A. Hydrology Overview: Surface water and groundwater are connected

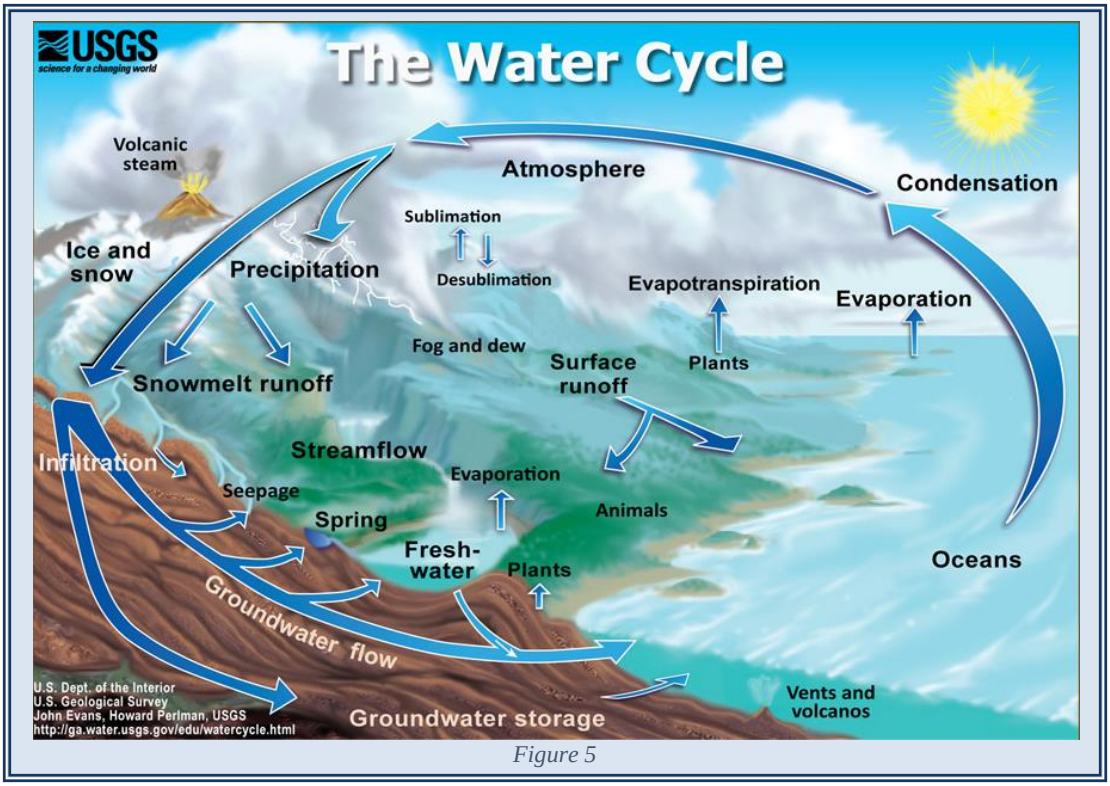


Figure 5

Groundwater and surface water quality and quantity in the Wood-Pawcatuck watershed are closely interconnected. Annual precipitation in the Wood-Pawcatuck watershed is, on average, approximately 52 inches per year. Approximately 50% of the average annual precipitation in the watershed leaves the basin as streamflow near the mouth of the Pawcatuck River in Westerly. The remaining 50% of the precipitation leaves the basin by a combination of evaporation, plant transpiration, and water withdrawals/transfers out of the basin. Groundwater is recharged by the precipitation that filters down through the soils and then moves underground to lower places in the landscape. At some point the groundwater will discharge to a river, stream, pond or wetland. During periods of drought, it is the groundwater that makes up the flow in the streams. Conversely, under certain circumstances water can move from the streambed into the groundwater. Groundwater wells with a high pump rate that are located near streams can reduce streamflow by intercepting the flow of groundwater to the streams and can actually pull water from the streambed (e.g., Westerly White Rock wells).

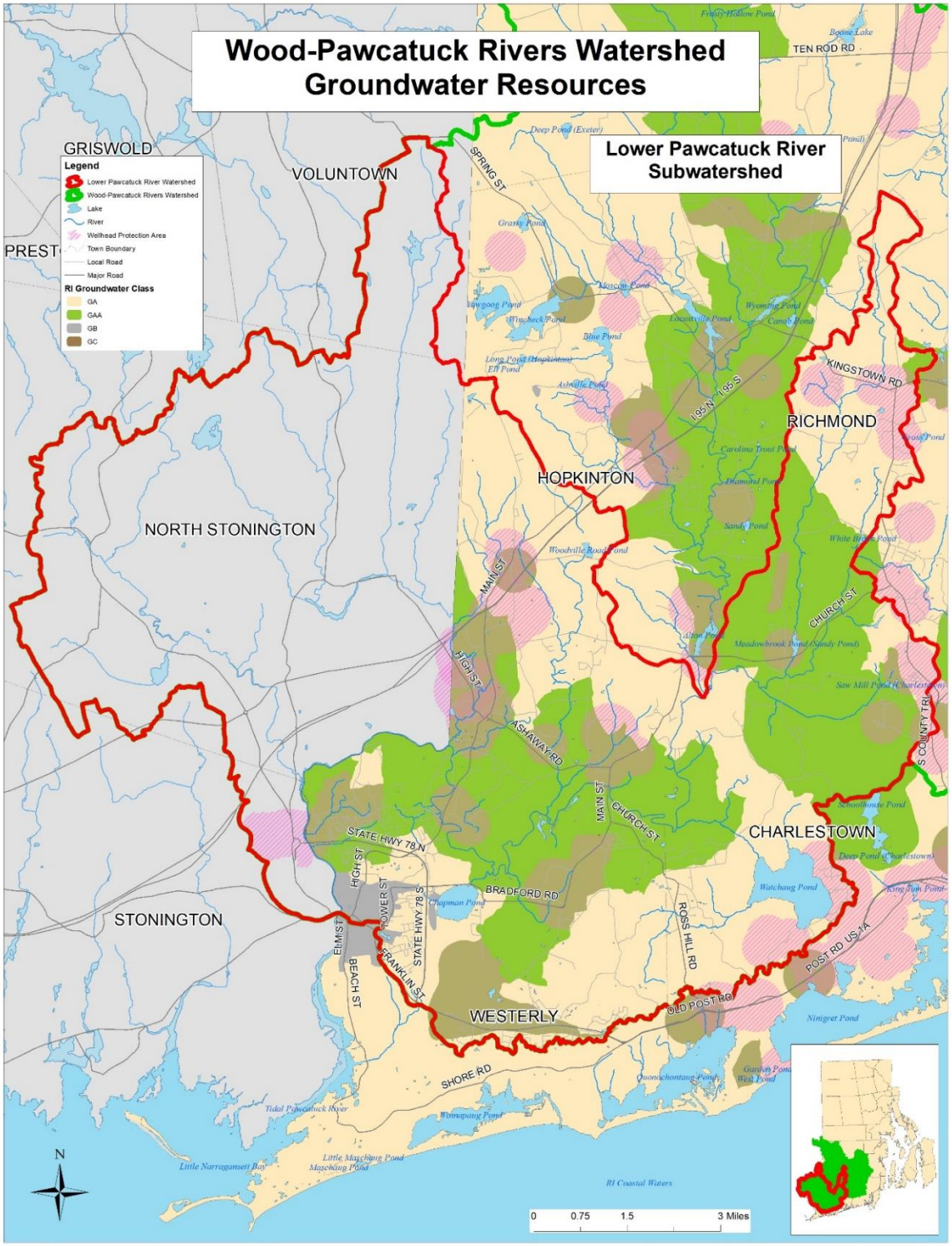
The most significant and productive aquifers are located in areas of stratified drift -- well-sorted layers of silt, sand and gravel laid down by glacial meltwater streams. These deposits are usually

located in existing stream valleys and in some cases they fill pre-glacial bedrock valleys. The stratified drift deposits are commonly 75 to 100 feet thick near the center of these valleys. Well yields vary depending on the thickness and permeability ranging from a few gallons per minute (gpm) to over 1000 gpm, which is equivalent to over one million gallons per day. These major stratified drift aquifers and their recharge areas are shown in figures 6-8 as groundwater classified as GAA. Groundwater serves as the sole source of drinking water for more than 60,000 residents of the watershed (CT and RI) and supplements water supplies outside of the watershed. As noted earlier in Section I.C.1, it has been federally designated as a Sole Source Aquifer. In addition to public water supply, water resources in the basin are also used for irrigation, particularly by the large number of turf farms in the watershed. In the Wood-Pawcatuck, drinking water is supplied solely from groundwater sources and irrigation is primarily withdrawn from surface water sources.

Glacial deposits also include areas of till, which consists of unsorted boulders, gravel, sand, silt and clay. This material is generally 20 feet thick or less, is often very compacted and has a very low permeability. It is generally found on hillsides and hilltops. Till deposits are not considered a suitable water supply source, and they function primarily to recharge underlying bedrock or downgradient stratified drift aquifers.

Underlying these glacial deposits of stratified drift and till is the bedrock. Bedrock outcrops are often exposed on the ridges in the watershed. The bedrock itself is an aquifer where water is stored and transmitted through fractures in the rock. Although wells in the bedrock are low yielding, they are adequate for individual domestic and commercial water use. The vast majority of private wells in the Wood-Pawcatuck watershed withdraw their water from the bedrock.

The following maps show groundwater resources within the watershed.


Wood-Pawcatuck Rivers Watershed
Groundwater Resources
Lower Pawcatuck River
Subwatershed
Legend
Lower Pawcatuck River Watershed
Wood-Pawcatuck Rivers Watershed
Lake
River
Wellhead Protection Area
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Local Road
Major Road
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Tidal Pawcatuck River
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Figure 6

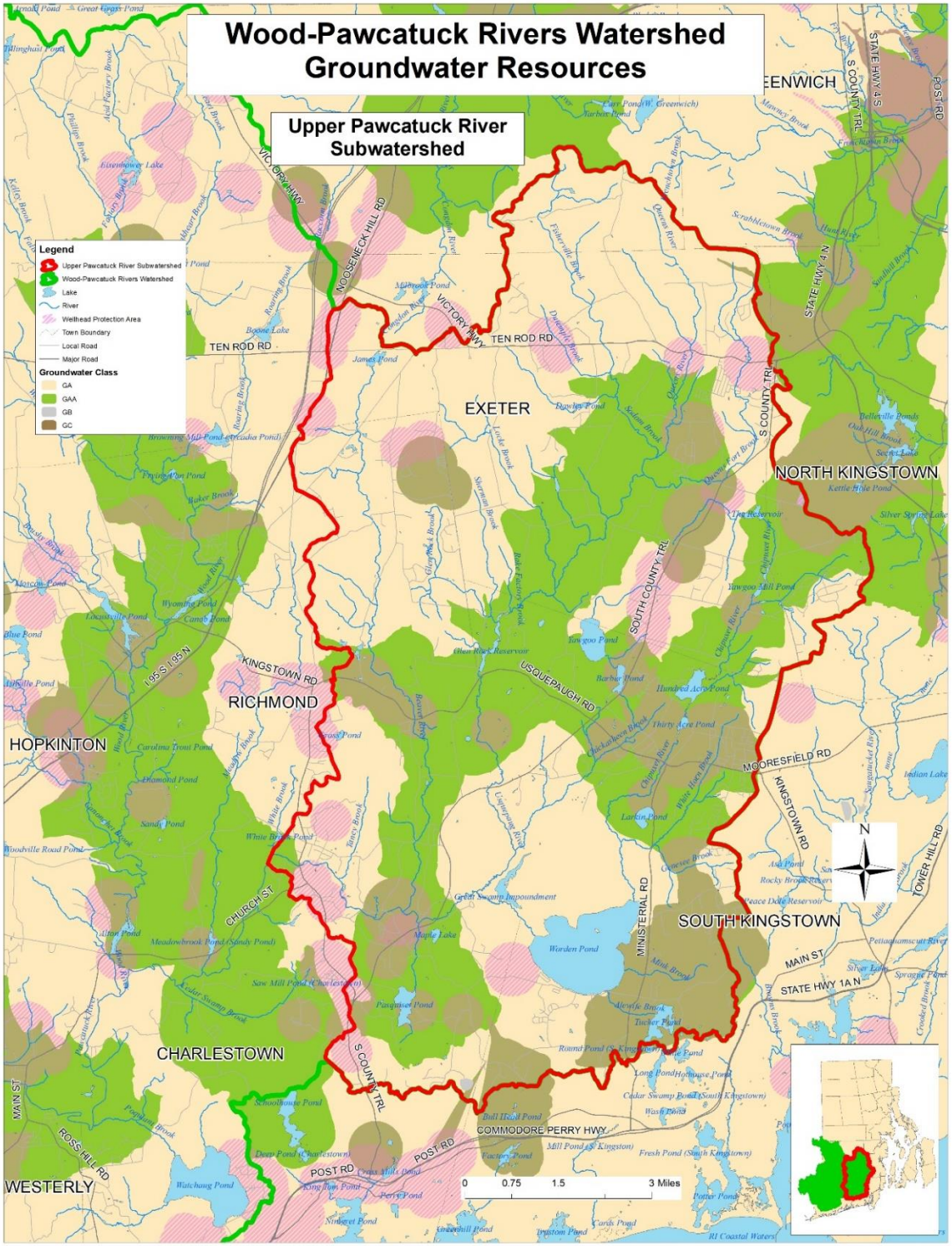
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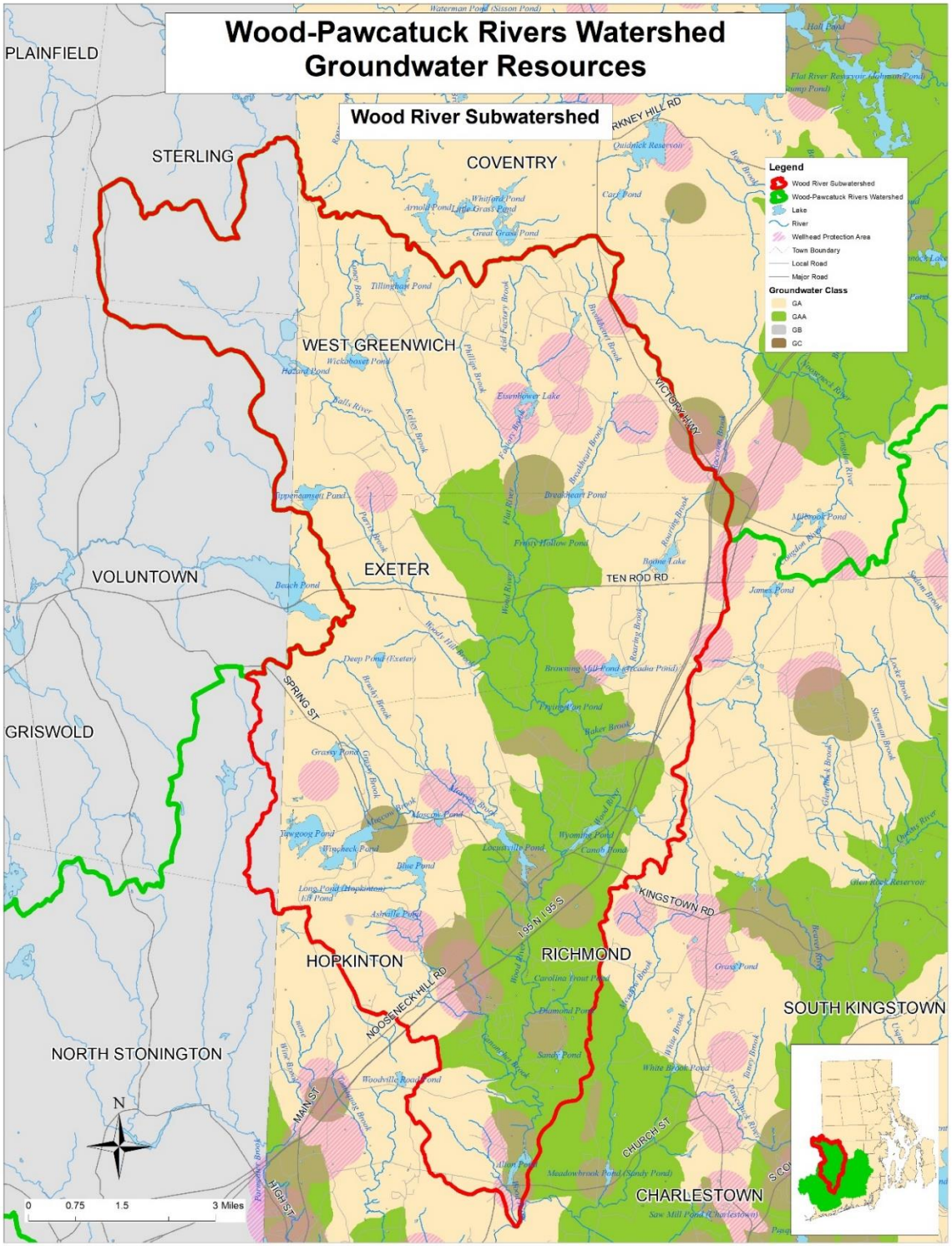
Figure 7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Major Road
Groundwater Class
GA
GAA
GB
GC
N
0
0.75
1.5
3 Miles

Figure 8

Groundwater Classification: The Rhode Island Department of Environmental Management (DEM) "Groundwater Quality Rules" classify all of the state's groundwater resources and establish groundwater quality standards for each class. The four classes are as follows:

- **GAA** Groundwater classified GAA are those groundwater resources that are known or presumed to be suitable for drinking water use without treatment and are located in priority areas. GAA includes the major stratified drift aquifers and their recharge areas and wellhead protection areas for year-round public water supplies.
- **GA** Groundwater classified GA are groundwater resources, which like GAA, are known or presumed to be suitable for drinking water use without treatment. However, groundwater classified GA does not fall within either of the priority areas described above under GAA.
- **GB** Groundwater classified GB is that groundwater which may not be suitable for drinking water use without treatment due to known or presumed degradation.
- **GC** Groundwater classified GC is or may be unsuitable for drinking water use due to certain waste disposal practices.

Wellhead Protection Area: Areas surrounding public drinking water wells merit special consideration. A "public well" includes both the municipal large-volume wells and wells serving the public at schools, businesses, factories, etc. A "Wellhead Protection Area" is the critical area surrounding a public well. The water produced by a well is assumed to be drawn from groundwater passing through the wellhead protection area. Wellhead protection areas can be either a circular area with the well at the center or an irregular shape based on models of how water moves through the aquifer into the well.

B. Land Use and Land Cover:

Land cover refers to what is present on the land surface, which differs from land use, which is what is permitted, practiced or intended for a given area. What is on the land, and the activities that occur on the land, influences the quality of our waters. In areas with good vegetation cover and little disturbance, most rainfall soaks into the soil rather than running off the ground, stream flows tend to be steady, and water quality is good. In developed areas with a lot of hard surfaces such as pavement and buildings however, water runs off quickly, so that little rainfall soaks into the soil, stream flows have high peaks (floods) during storms and low flows in between, and water

quality is much poorer. (See discussion of impervious cover under Stormwater Management in Section IV(A))

The type of activity will also influence the threat to water quality – for example, there is a far greater likelihood of chemical pollution of groundwater or surface water from spills, leaks in commercial and industrial areas than from residential areas. Conversely, residential areas will likely be a greater source of nutrients than commercial areas. (See discussion on specific pollutants in Section III.)

In the Rhode Island portion of the Wood-Pawcatuck Watershed, 77 percent of the land area is covered by forests and wetlands. This type of land cover is more common in the upper regions of the watershed than in the more developed, lower region surrounding Westerly, RI, and Pawcatuck, CT. 11% of the land is developed and the remainder is used for agriculture or is open, undeveloped land.

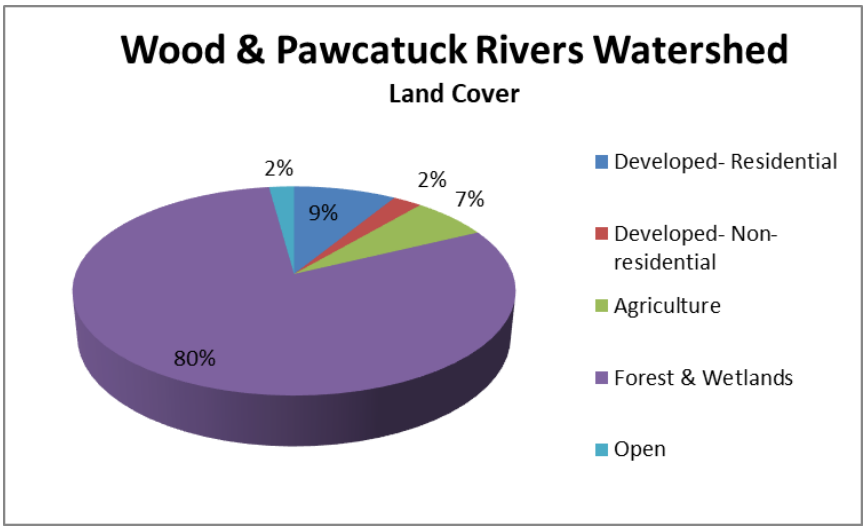


Figure 9

Using different data and a different watershed delineation that includes Connecticut and the Little Narragansett Bay estuary, the Wood Pawcatuck Flood Resiliency Project Baseline Report (2016) found similar land cover results.

Land Cover	Percent of Watershed	Watershed Area (Acres)
Water	2.4%	4,690
Urban Open Space	5.4%	10,445
Developed, Low Intensity	4.0%	7,694
Developed, Medium Intensity	2.4%	4,669
Developed, High Intensity	0.3%	587
Barren Land	0.5%	912
Deciduous Forest	47.8%	92,579
Evergreen Forest	6.7%	13,013
Mixed Forest	3.2%	6,214
Shrub/Scrub	0.8%	1,482
Grass/Fields	7.9%	15,323
Cultivated Crops	1.0%	1,981
Wetlands	17.6%	34,122

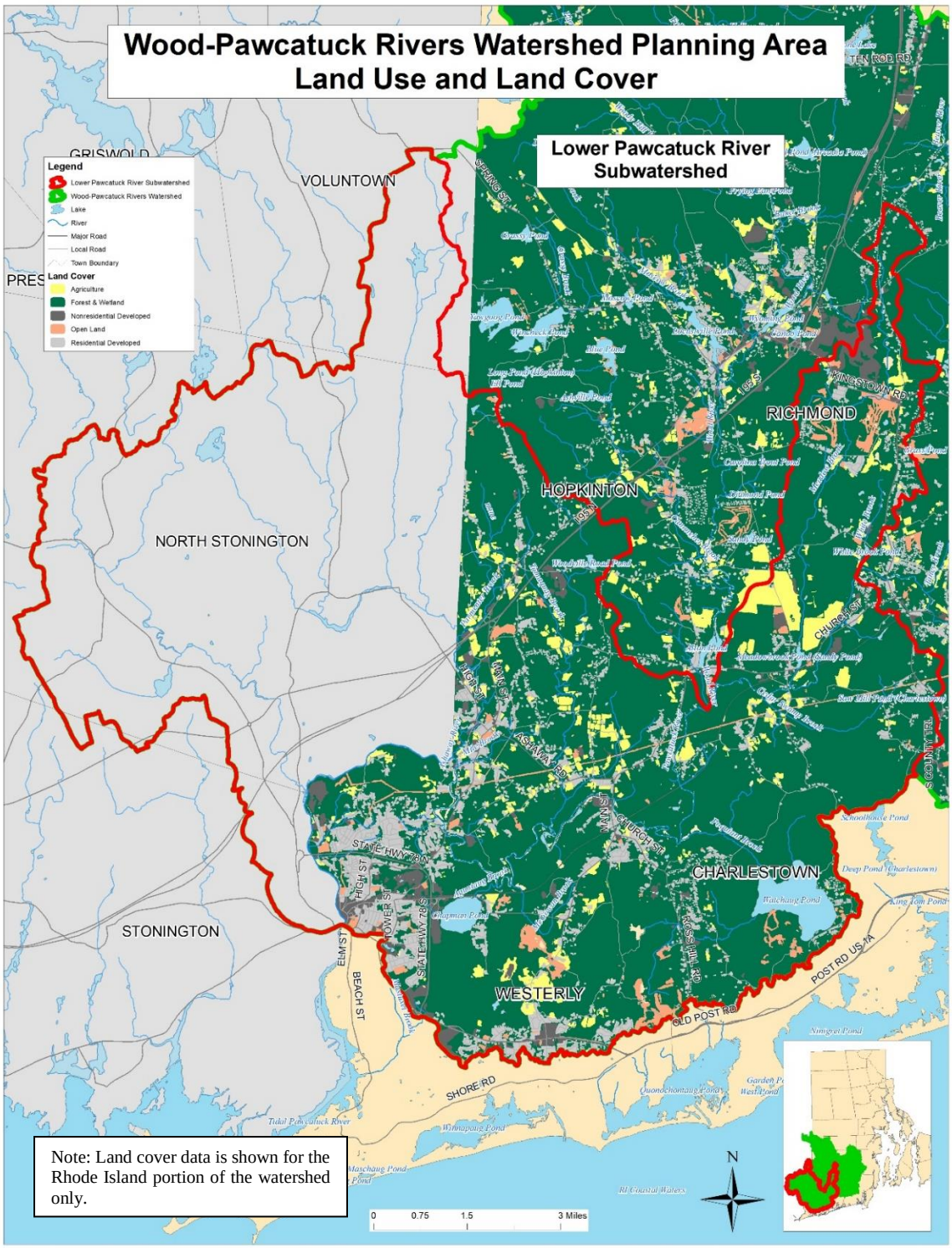

Wood-Pawcatuck Rivers Watershed Planning Area
Land Use and Land Cover
Lower Pawcatuck River Subwatershed
Legend
Lower Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Lake
River
Major Road
Local Road
Town Boundary
Land Cover
Agriculture
Forest & Wetland
Nonresidential Developed
Open Land
Residential Developed
VOLUNTOWN
NORTH STONINGTON
HOPKINTON
RICHMOND
CHARLESTOWN
STONINGTON
WESTERLY
Note: Land cover data is shown for the Rhode Island portion of the watershed only.
0 0.75 1.5 3 Miles
N

Figure 10

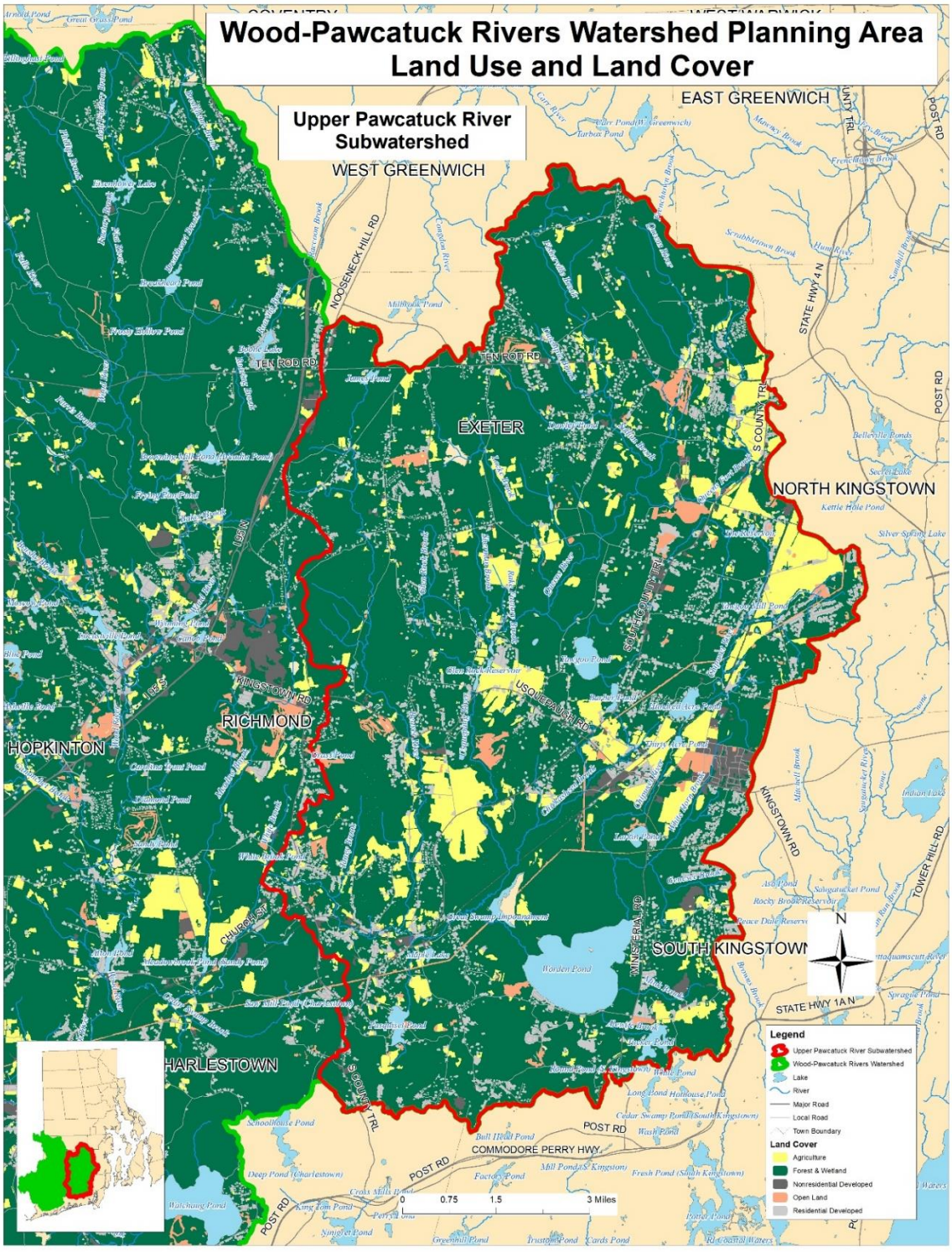

Wood-Pawcatuck Rivers Watershed Planning Area
Land Use and Land Cover
Upper Pawcatuck River Subwatershed
EAST GREENWICH
WEST GREENWICH
EXETER
NORTH KINGSTOWN
RICHMOND
HOPKINTON
HARLESTOWN
SOUTH KINGSTOWN
NOOSENECK HILL RD
TEN ROD RD
KINGSTOWN RD
USQUEPAUGH RD
CHURCH ST
POST RD
COMMODORE PERRY HWY
STATE HWY 4 N
STATE HWY 1A N
S COUNTY TRL
TOWER HILL RD
N
0 0.75 1.5 3 Miles
Legend
Upper Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Lake
River
Major Road
Local Road
Town Boundary
Land Cover
Agriculture
Forest & Wetland
Nonresidential Developed
Open Land
Residential Developed

Figure 11

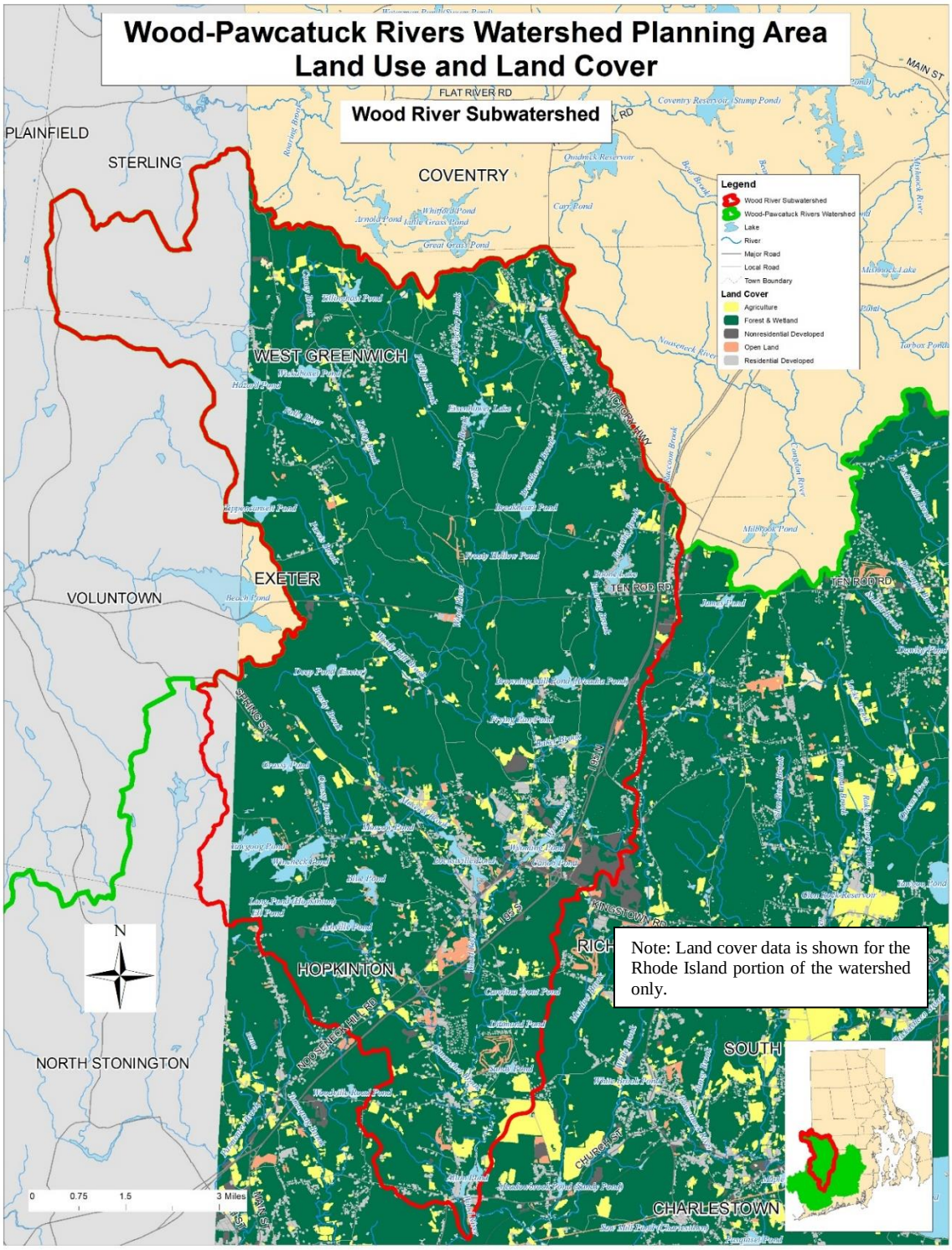

Wood-Pawcatuck Rivers Watershed Planning Area
Land Use and Land Cover
Wood River Subwatershed
PLAINFIELD
STERLING
COVENTRY
WEST GREENWICH
EXETER
VOLUNTOWN
HOPKINTON
NORTH STONINGTON
SOUTH
CHARLESTOWN
FLAT RIVER RD
MAIN ST
TEN ROD RD
KINGSTOWN RD
NOOSENECK HILL RD
CHURCH ST
Legend
Wood River Subwatershed
Wood-Pawcatuck Rivers Watershed
Lake
River
Major Road
Local Road
Town Boundary
Land Cover
Agriculture
Forest & Wetland
Nonresidential Developed
Open Land
Residential Developed
Note: Land cover data is shown for the Rhode Island portion of the watershed only.
N
0
0.75
1.5
3 Miles

Figure 12

C. Drinking Water:

Groundwater serves as the sole source of drinking water for the homes and businesses in the watershed and also supplies water to areas outside of the watershed. In 1988, the US Environmental Protection Agency acknowledged this groundwater dependence by designating the Wood-Pawcatuck watershed as a Sole Source Aquifer. Due to this designation, any project involving federal funds is subject to a review by US EPA to determine if there will be impacts to groundwater. The watershed boundaries were used to delineate the Sole Source Aquifer because of the strong interconnectedness between the groundwater and surface water (see hydrology discussion above). Drinking water within the Wood-Pawcatuck comes solely from within the watershed but the resource is shared between towns and even between states. The aquifer itself spans 14 towns in two states. There are public water systems spanning across municipal and state boundaries. The issue of protecting drinking water supplies spans political boundaries, making it well suited to management on a watershed basis.

Homes, businesses, schools, etc. are either provided drinking water from an on-site drinking water well or from a connection to a public water system with a well as the water source. In the Wood-Pawcatuck River watershed area, only 7.7% of the watershed area is served by a public water supplier with the remainder dependent on on-site wells, either private or public. Homeowners are responsible for testing their own water supply and taking actions to protect it. Private wells can be impacted by septic systems, lawn care, and other homeowner activities on their property that may involve potential pollutants. Public water suppliers are those systems that are monitored by the RI Department of Health to ensure they provide safe drinking water, and which have at least 15 service connections or regularly serve an average of at least 25 individuals daily at least sixty days out of a year. Public water systems include major municipal water systems and smaller systems serving individual private and public establishments and institutions (usually with an on-

Public Water Supplies: The Rhode Island Department of Health has established three categories of public water systems:

- Community water system:
  - Serves year-round residents;
  - At least 15 service connections or at least 25 individuals;
  - For example: municipal wells and wells serving nursing homes, condominiums, and mobile home parks, etc.
- Non-transient non-community system:
  - Regularly serves at least 25 of the same persons (not residents) over 6 months of the year;
  - For example: schools and places of employment.
- Transient non-community system:
  - Does not regularly serve the same persons;
  - Does serve at least 25 people at least 60 days of the year;
  - For example: restaurants and hotels.

site public well) such as nursing homes and schools, as well as restaurants and hotels.

The RI DEM has delineated the wellhead protection area (WHPA) for each of the 186 public wells in the RI portion of the watershed. A wellhead protection area is the critical portion of the area through which water moves underground to a public well. (See Groundwater Resources Map, Figures 6-8).

The WHPA delineation methodology differs depending if the well is completed in bedrock or stratified drift. The WHPA for bedrock wells is a circle with the radius dependent on the well's pump rate. The smallest circle used has a radius of 1,750 feet based on a 10 gallon per minute pump rate, and this is commonly applied to the transient non-community wells. The WHPA for stratified drift wells is irregular in shape and is determined by use of computer models and interpretations of surrounding topography. The community and non-community WHPAs in the watershed cover a total of 33,855 acres (22% of the RI portion of the watershed land area).

Public Drinking Water in the Wood-Pawcatuck Watershed

There are 186 public wells in RI within the Wood-Pawcatuck watershed:

- 52 Community wells;
- 39 Non-transient non-community wells; and
- 84 Transient non-community wells

Figures 13-15 show the general areas served by the major public water systems in the watershed listed below:

- Westerly
- Richmond
- South Kingstown
- Suez Water
- Kingston
- University of RI

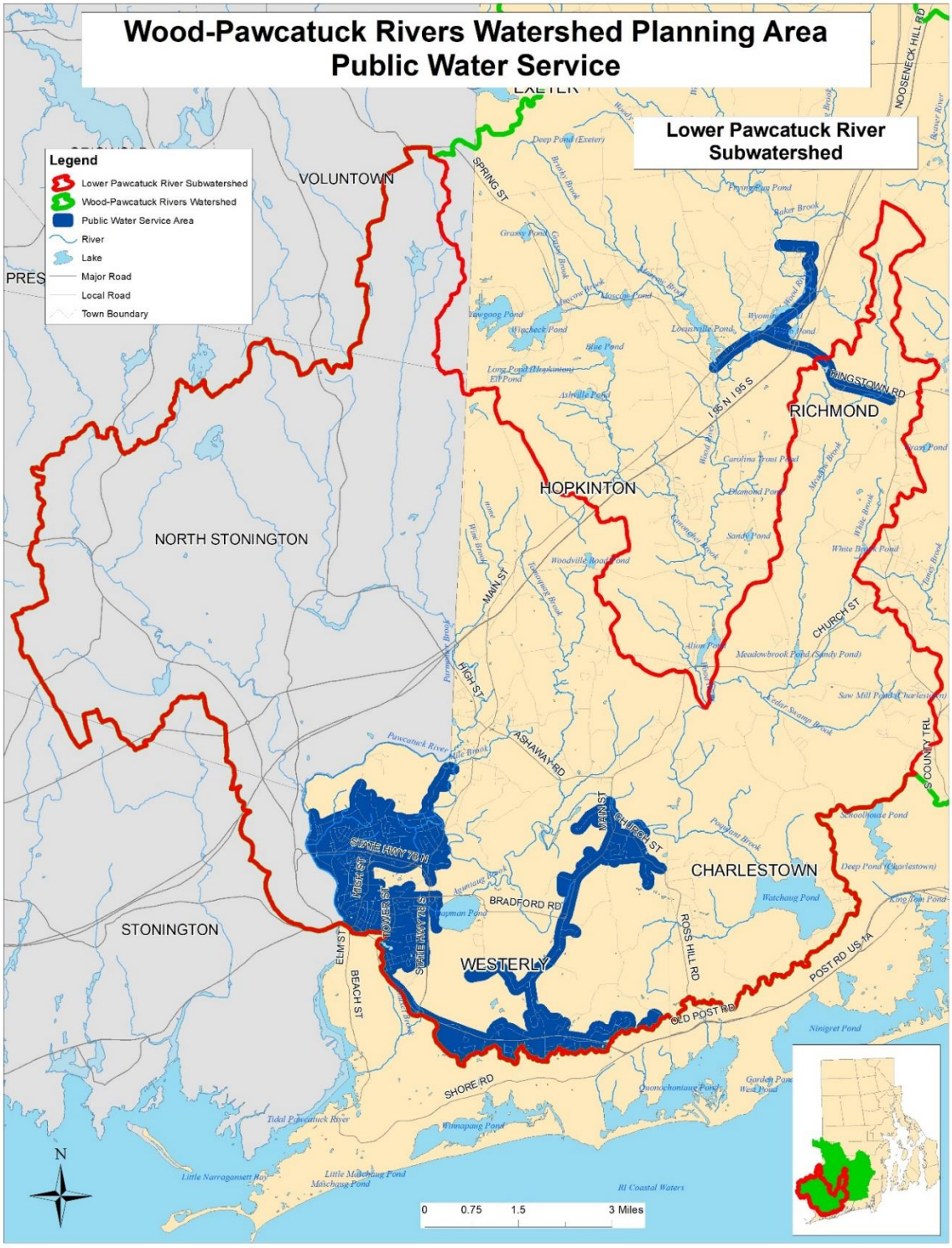

Wood-Pawcatuck Rivers Watershed Planning Area
Public Water Service
Lower Pawcatuck River Subwatershed
Legend
Lower Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Public Water Service Area
River
Lake
Major Road
Local Road
Town Boundary
VOLUNTOWN
NORTH STONINGTON
HOPKINTON
RICHMOND
CHARLESTOWN
WESTERLY
STONINGTON
SPRING ST
MAIN ST
HIGH ST
CHURCH ST
ASHAWAY RD
BRADFORD RD
ROSS HILL RD
POST RD US 1A
OLD POST RD
SHORE RD
BEACH ST
ELM ST
TOWER ST
RINGSTOWN RD
I 95 N
I 95 S
S COUNTY TRL
NOOSENECK HILL RD
N
0 0.75 1.5 3 Miles

Figure 13

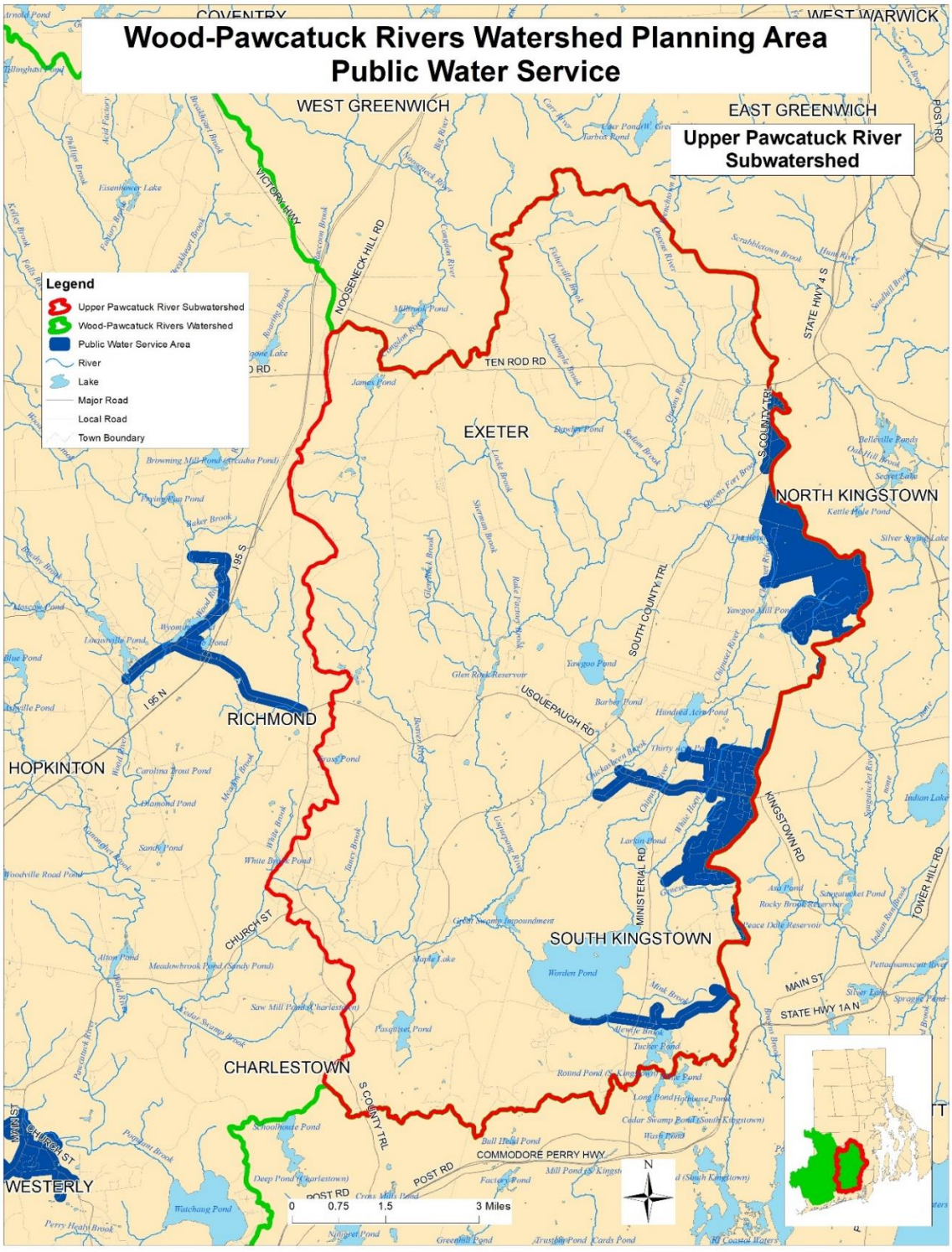

Wood-Pawcatuck Rivers Watershed Planning Area
Public Water Service
Upper Pawcatuck River Subwatershed
Legend
Upper Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Public Water Service Area
River
Lake
Major Road
Local Road
Town Boundary
WEST GREENWICH
EAST GREENWICH
EXETER
NORTH KINGSTOWN
RICHMOND
HOPKINTON
SOUTH KINGSTOWN
CHARLESTOWN
WESTERLY
TEN ROD RD
NOOSENECK HILL RD
VICTORY HWY
SOUTH COUNTY TRL
USQUEPAUGH RD
KINGSTOWN RD
MINISTERIAL RD
TOWER HILL RD
MAIN ST
STATE HWY 1A N
STATE HWY 4 S
COMMODORE PERRY HWY
CHURCH ST
POST RD
0 0.75 1.5 3 Miles
N

Figure 14

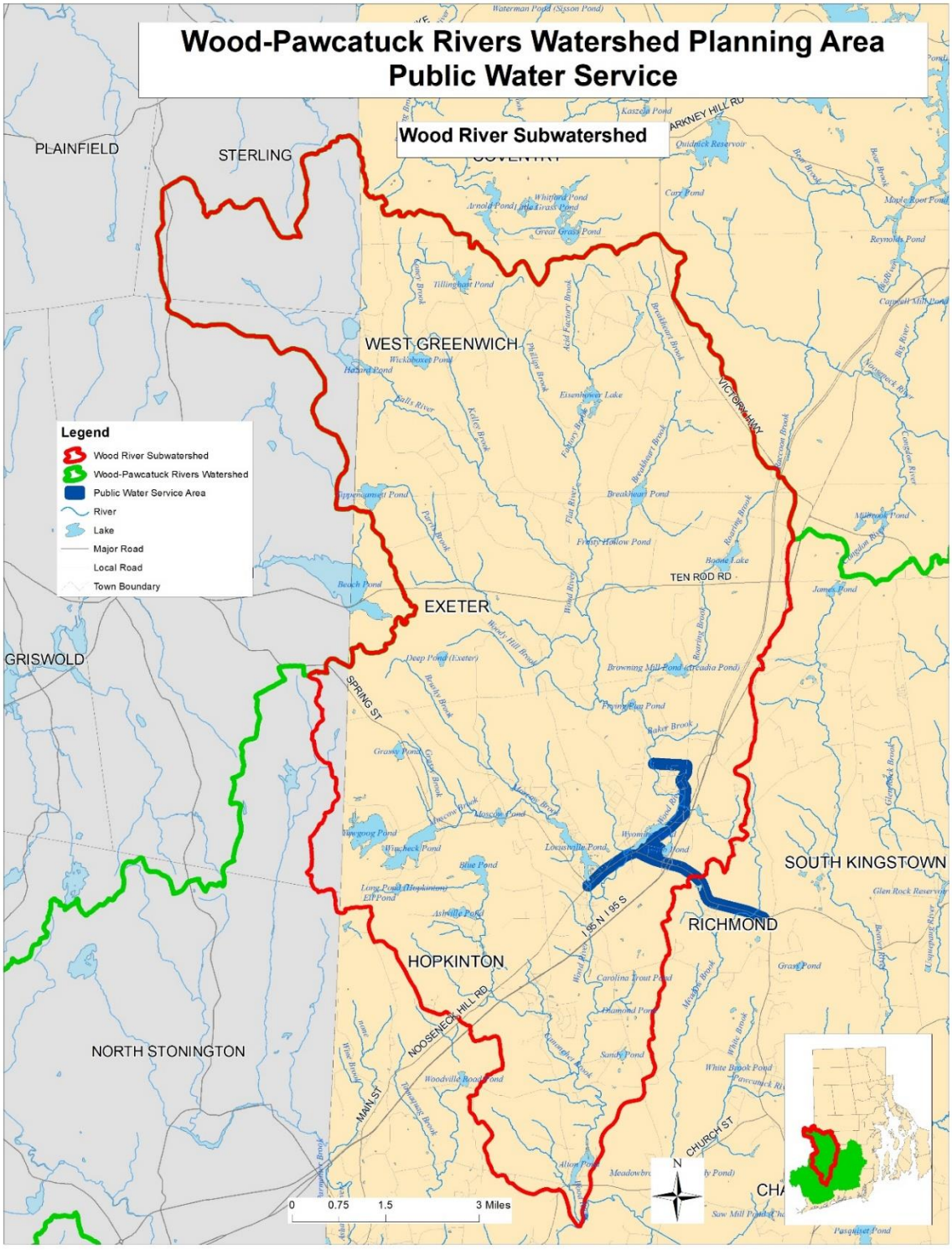

Wood-Pawcatuck Rivers Watershed Planning Area
Public Water Service
Wood River Subwatershed
PLAINFIELD
STERLING
WEST GREENWICH
EXETER
GRISWOLD
HOPKINTON
NORTH STONINGTON
SOUTH KINGSTOWN
RICHMOND
TEN ROD RD
SPRING ST
NOOSENECK HILL RD
MAIN ST
CHURCH ST
I 95 N
I 95 S
VICTORY HWY
ARKNEY HILL RD
Legend
Wood River Subwatershed
Wood-Pawcatuck Rivers Watershed
Public Water Service Area
River
Lake
Major Road
Local Road
Town Boundary
0 0.75 1.5 3 Miles
N

Figure 15

D. Wastewater Treatment:

Less than 3% of the Rhode Island portion of the Wood-Pawcatuck watershed is served by centralized sewers. The majority of this area is located in and around the downtown section of Westerly. Wastewater within this area is collected and conveyed to the Westerly wastewater treatment facility (WWTF) located on Margin Street. Treated effluent is discharged to the tidal portion of the Pawcatuck River. The WWTF is operated by Suez Environment under contract with the Town.

The University of Rhode Island campus is also served by public sewers. Wastewater from this area is conveyed out of the Wood-Pawcatuck watershed to the South Kingstown Regional Wastewater Treatment Facility, which is located in Narragansett. This plant discharges to Rhode Island Sound.

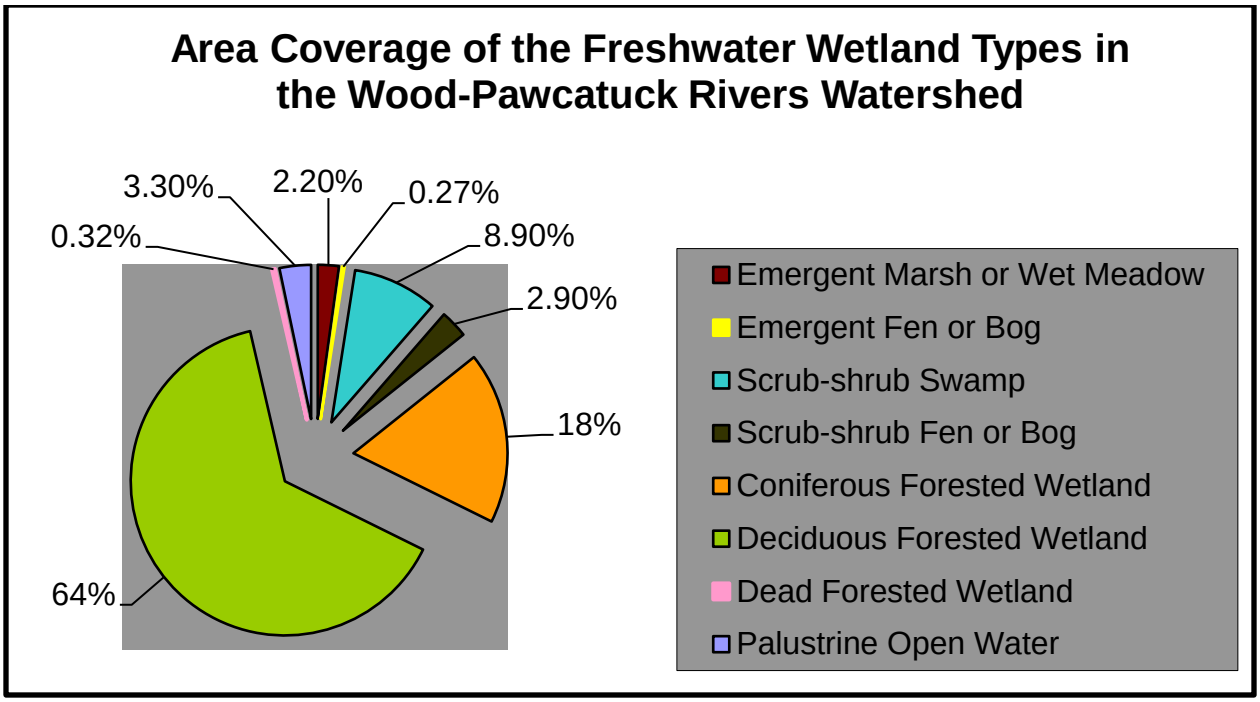
In Connecticut, the Town of Stonington operates a WWTF serving the village of Pawcatuck, across the river from downtown Westerly. The service area for this system extends beyond the Wood-Pawcatuck watershed boundary. This area overlaps the portion of Pawcatuck in which water is supplied by the Westerly Water Department. The WWTF effluent is discharged to the Pawcatuck River.

Wastewater from any structure not served by a sewer system is disposed of onsite using an onsite wastewater treatment system (OWTS, also referred to as a septic system). This is a system of pipes, tanks, and chambers used to treat and disperse sanitary wastewater into the soil (rather than into a river, bay or the ocean as with a sewage treatment plant). Sanitary wastewater is water from toilets, sinks, showers and baths. An OWTS most commonly serves an individual building (residence, business, industry or institution) and is located entirely on a single lot. One system may also be designed to serve groups of buildings or even a neighborhood.

In many areas of the state, it is not cost-effective or desirable to extend public sewer service. In addition, Land Use 2025 (RIDOA 2006) discourages the expansion of sewer service outside of the state's designated urban services boundary. Therefore, communities dependent on OWTS will continue to utilize them to treat their wastewater into the foreseeable future. The exceptions to this are the limited areas identified and targeted for future sewer service in facility plans prepared for public wastewater treatment systems.

E. Wetlands:

Freshwater wetlands are areas in Rhode Island that are flooded or that have water at or near the surface of the ground for part of most growing seasons (the parts of the year when rainfall and temperature enables plants to grow). They are generally found between uplands and water bodies; however, many also stand alone and are surrounded by upland.



Wetlands are critical to protect water quality, to provide wildlife habitat, to mitigate flooding, to recharge groundwater, and to provide other important natural functions. Wetlands comprise nearly 14 percent, or over 25,500 acres, of the Rhode Island portion of the Wood-Pawcatuck watershed. The watershed is dominated by forested wetlands yet is also is home to a variety of wetland types from forested swamps to marshes, bogs and fens. The watershed has one of the largest deciduous floodplain forests (forested wetlands) in Rhode Island, located where the Pawcatuck River originates at Worden's Pond-- the more than 3000-acre "Great Swamp" is a Rhode Island State Management Area and a National Natural Landmark. Red maple swamps are the largest category of wetland types in the watershed, although the watershed also contains some of the region's largest stands of Atlantic White Cedar evergreen swamps found in locations such as the Great Swamp, Indian Cedar Swamp, and Chapman's Swamp.

The information above is drawn from a draft Wetland Profile document in preparation by RI DEM and in partnership with other agencies and organizations. With grant support from the Environmental Protection Agency (EPA) RI DEM developed a plan for systematic monitoring of freshwater wetlands in Rhode Island. Effective monitoring requires a baseline of information about the quantity, location, and condition of wetlands for comparison in the future as wetland monitoring efforts are undertaken. The baseline assessment is being developed using existing data. Other projects, some of which are ongoing, build on the baseline assessment with new data. For example, vernal pools provide important habitat and yet are vulnerable to damage from human activities. Research has been completed to map these special wetlands, assess their habitat value, and prioritize areas for protection. Additional ongoing work will define and identify areas of

unfragmented freshwater wetlands and wetlands of high ecological value which can be prioritized for protection. Several of these projects are listed in Section X. References.

III. Water Quality Conditions

The Wood-Pawcatuck Watershed has some of the highest quality surface water, groundwater, and ecological resources in the State of Rhode Island given the high percentage of undeveloped and forested land in the watershed. However, surface water quality has been degraded in the more developed portions of the watershed, particularly the lower part of the Pawcatuck River, in other developed areas along the main stem of the Pawcatuck River and its major tributaries, and near the headwaters in South Kingstown. Excessive quantities of nutrients, sediment, and indicator bacteria from various point and nonpoint pollutant sources, including urban and agricultural stormwater runoff, are among the causes of water quality problems in the watershed. Pollutants originating within the watershed also have an impact on the Little Narragansett Bay estuary into which the Pawcatuck River discharges.

The EPA's Southeast New England Coastal Watershed Restoration Program, through its watershed implementation grant program, awarded a grant of $484,000 to CT Department of Energy and Environmental Protection (CTDEEP) and the RI Department of Environmental Management (RI DEM) to focus on the problem of nutrient loading into the Pawcatuck River estuary. Excessive nutrients can cause toxic algal blooms which rob oxygen from the water and also contaminate shellfish. This bi-state collaborative project aims to develop a watershed model that will help better identify sources of nutrient loading and outline strategies to reduce the input of nutrients that end up in Little Narragansett Bay. The strategies that are identified as a result of this project will likely result in the need for a reprioritization of the actions identified in the Wood-Pawcatuck Watershed Plan. RIDEM and CTDEEP have collaborated on an ArcGIS Story Map to highlight work done in both states as part of this project. Effective implementation of the actions suggested by modeling results will require ongoing coordination with CTDEEP.

Managing Nutrients in the Pawcatuck River Watershed

Significant portions of the Pawcatuck estuary are impacted by nutrient pollution. Excessive nutrients are causing nuisance macro-algae that contributes to conditions where eelgrass cannot grow. Under these conditions, habitat for fish (at all life stages) and other aquatic organisms suffers, as do recreational uses and even waterfront property values. State and federal regulators are addressing nutrient-caused impairments, but more information is needed to develop a plan. An EPA Southeast New England Program-funded collaboration between RI DEM, CT DEEP, USGS, and other partners will generate the information on sources of nutrient loading that contribute to the impairments in the Pawcatuck estuary.

Project Objectives

- Collect water quality data on the Pawcatuck River and tributaries;
- Develop and enhance a watershed model based on water quality data;
- Collaborate with invested groups and citizens, including municipalities; and
- Connect potential nutrient loading sources to Pawcatuck estuary.

Once complete, the nutrient model will be used to analyze and track water quality problems now and in the future. Models allow researchers to explore nutrient reduction scenarios and find out which strategies would work the best to attain water quality improvement goals. There are two major tasks included in this project. First, CTDEEP and RI DEM will develop HSPF (Hydrologic Simulation Program-FORTRAN) model. The HSPF model has been widely used throughout the country to track and improve water quality. It is a complex and dynamic model that can address soil, groundwater and surface water processes, storm events as well as impacts from point and nonpoint sources of pollution.
Second, increased water quality monitoring will be conducted in the estuary and in the upland watershed of the Pawcatuck River and its tributaries to supplement currently available data. RI DEM and CTDEEP will utilize the decades of water quality data collected by WPWA and others. For one year they will also collect new data at over 30 monitoring sites during a wide range of river flows to improve the calibration of the model. The project plans to utilize many of the stations already established and monitored by WPWA along with a few new ones that reflect land use. Sampling began in the spring of 2019 and will continue for one year.

Water quality is a primary indicator of the ecological health of a watershed and its ability to support specific uses such as drinking water supply, recreation, habitat, and industrial uses. Water quality is also inherently linked to the activities that take place in a watershed. This section summarizes the existing surface water and groundwater quality in the watershed.

A. RI Surface Waters:

<u>Impaired water quality segments: Where water quality is unacceptable</u>

Most water pollutants are invisible to the human eye, so water can't be determined to be "clean" by simply looking at it. Various types of pollutants affect water quality – in the Wood-Pawcatuck watershed, the most common are bacteria, nutrients, non-native aquatic plants, and metals. Some pollutants wash into or are released into rivers and streams on a daily basis and some entered our waterways many years ago and remain present today. Water quality can be difficult to measure, but being able to understand past and present land uses is one component that helps us monitor and become better at recognizing, taking action, and preventing future pollution problems.

Both the United States government and the state of Rhode Island have adopted water quality goals and standards that act as important tools that help protect Rhode Island's abundant and valuable water resources from pollution. Each waterbody has a set of water quality standards applied to it, based on its intended use. For example, drinking water reservoirs must be much cleaner than waterbodies that are used for recreation.

Scientists use information from water monitoring to indicate whether, or not, a waterbody is acceptable for its intended use (it "supports" its intended use). If monitoring indicates that water quality in a waterbody meets its standards ("good" water quality) then the waterbody can fully support its intended use(s). If, however, the monitoring results indicate that it does not meet its standards (a finding of "unacceptable" or "impaired") the waterbody cannot support one (or more) of its intended uses. When this happens, the intended uses (e.g., swimming, fishing, shellfishing, etc.) are restricted because the water quality is unsafe for those purposes. The Environmental Protection Agency requires that RIDEM prepare a report every 2 years documenting the waters that do not meet water quality standards and are therefore listed as impaired, i.e., have unacceptable water quality.

The following table summarizes the findings of water quality monitoring efforts. The table summarizes the river miles and acres of lakes and ponds that are impaired for any use (i.e. fish consumption, recreation, fish and wildlife habitat/aquatic life, and drinking water). Appendix 1 is a more specific listing of the waters in the Wood-Pawcatuck watershed that do not have acceptable water quality. Note that all of the recreational use impairments in Appendix 1 are caused by bacteria. The maps on the following pages show where in the watershed these waters are located.

Streams		
Category	Stream Miles	% of Total Miles
4a & 5	133	42.3
4c	18.4	5.8
Not assessed	32	10.1
Lakes		

Category	Acres	% of Total Area
4a & 5	1821	41.3
4c	84	1.9
Not assessed	346	7.8

Integrated Report Categories and Listing Methodology

Following procedures outlined in the state's Consolidated Assessment and Listing Methodology (CALM), each surface water body, or assessment unit, in the state is placed into one of the following categories. Some larger waterbodies include multiple assessment units. For more information, see http://www.dem.ri.gov/programs/benviron/water/quality/pdf/calm14.pdf.
The five categories are as follows:

Category 1: Attaining all designated uses and no use is threatened.

Category 2: Attaining some of the designated uses; no use is threatened; and insufficient or no data and information is available to determine if the remaining uses are attained or threatened.

Category 3: Insufficient or no data and information are available to determine if any designated use is attained, impaired, or threatened.

Category 4: Impaired or threatened for one or more designated uses but does not require development of a TMDL. (Three subcategories)

A. TMDL has been completed.

B. Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future.

C. Impairment is not caused by a pollutant, rather by insufficient flow, presence of invasive species, etc.

Category 5: Impaired or threatened for one or more designated uses by a pollutant(s) and requires a TMDL.

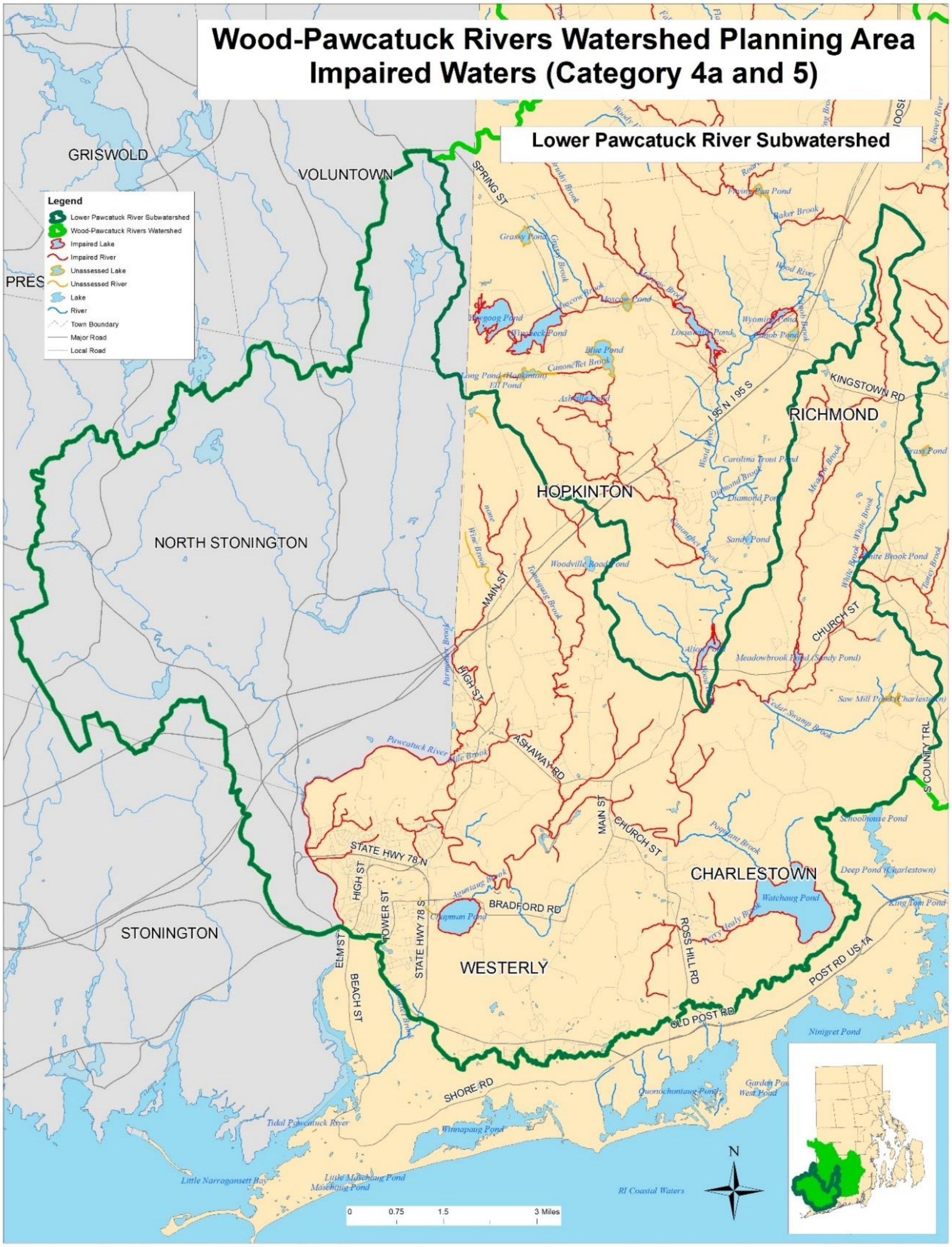
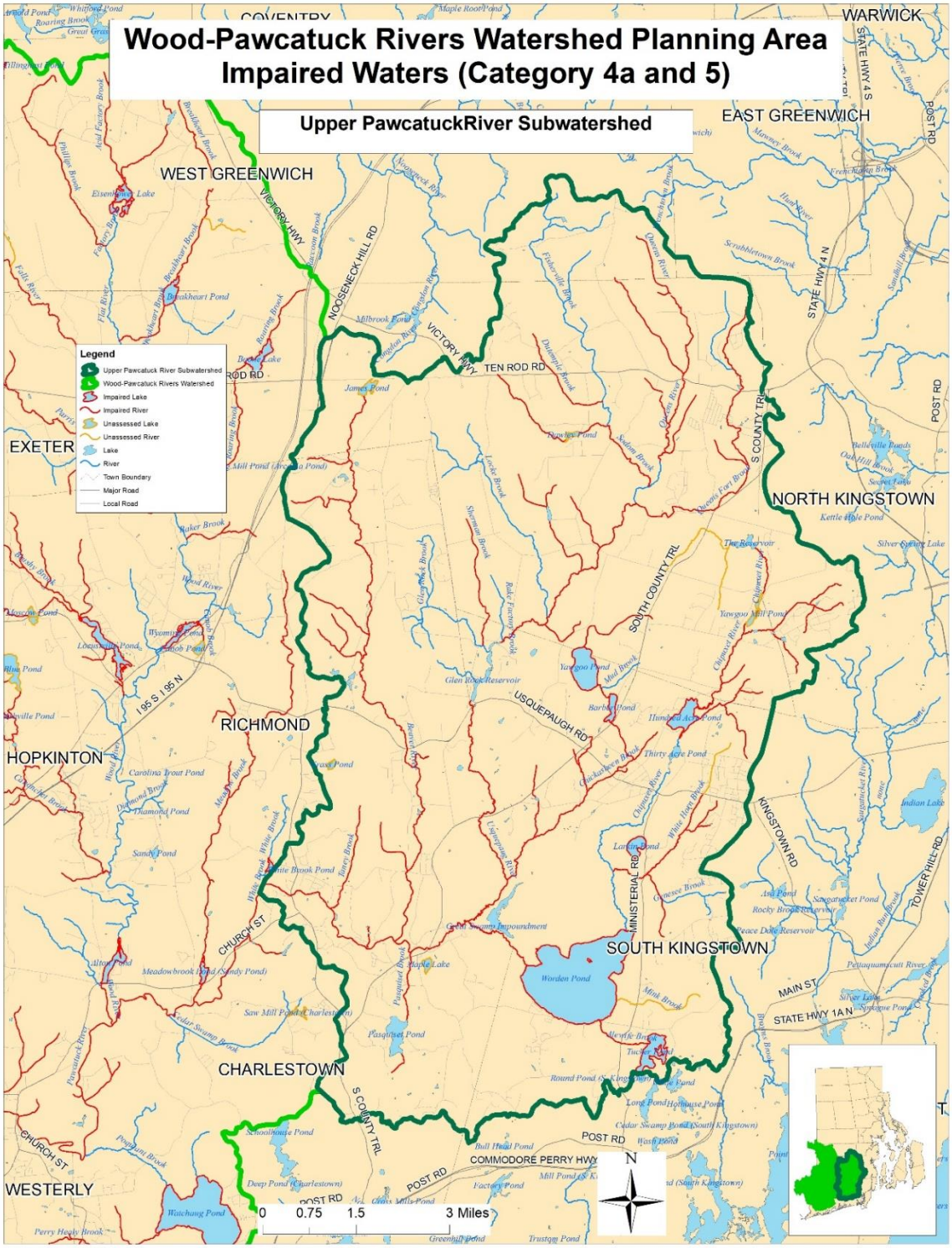

Wood-Pawcatuck Rivers Watershed Planning Area
Impaired Waters (Category 4a and 5)
Lower Pawcatuck River Subwatershed
Legend
Lower Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Impaired Lake
Impaired River
Unassessed Lake
Unassessed River
Lake
River
Town Boundary
Major Road
Local Road
GRISWOLD
VOLUNTOWN
NORTH STONINGTON
STONINGTON
HOPKINTON
RICHMOND
CHARLESTOWN
WESTERLY
SPRING ST
KINGSTOWN RD
MAIN ST
HIGH ST
ASHAWAY RD
CHURCH ST
STATE HWY 78 N
BRADFORD RD
ROSS HILL RD
POST RD US 1A
OLD POST RD
SHORE RD
S COUNTY TRL
0 0.75 1.5 3 Miles
N

Figure 16


Wood-Pawcatuck Rivers Watershed Planning Area
Impaired Waters (Category 4a and 5)
Upper PawcatuckRiver Subwatershed
Legend
Upper Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
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Impaired River
Unassessed Lake
Unassessed River
Lake
River
Town Boundary
Major Road
Local Road
WARWICK
EAST GREENWICH
WEST GREENWICH
EXETER
NORTH KINGSTOWN
RICHMOND
HOPKINTON
SOUTH KINGSTOWN
CHARLESTOWN
WESTERLY
TEN ROD RD
VICTORY HWY
NOOSENECK HILL RD
SOUTH COUNTY TRL
USQUEPAUGH RD
KINGSTOWN RD
MINISTERIAL RD
CHURCH ST
POST RD
MAIN ST
STATE HWY 1A N
COMMODORE PERRY HWY
TOWER HILL RD
0 0.75 1.5 3 Miles
N

Figure 17

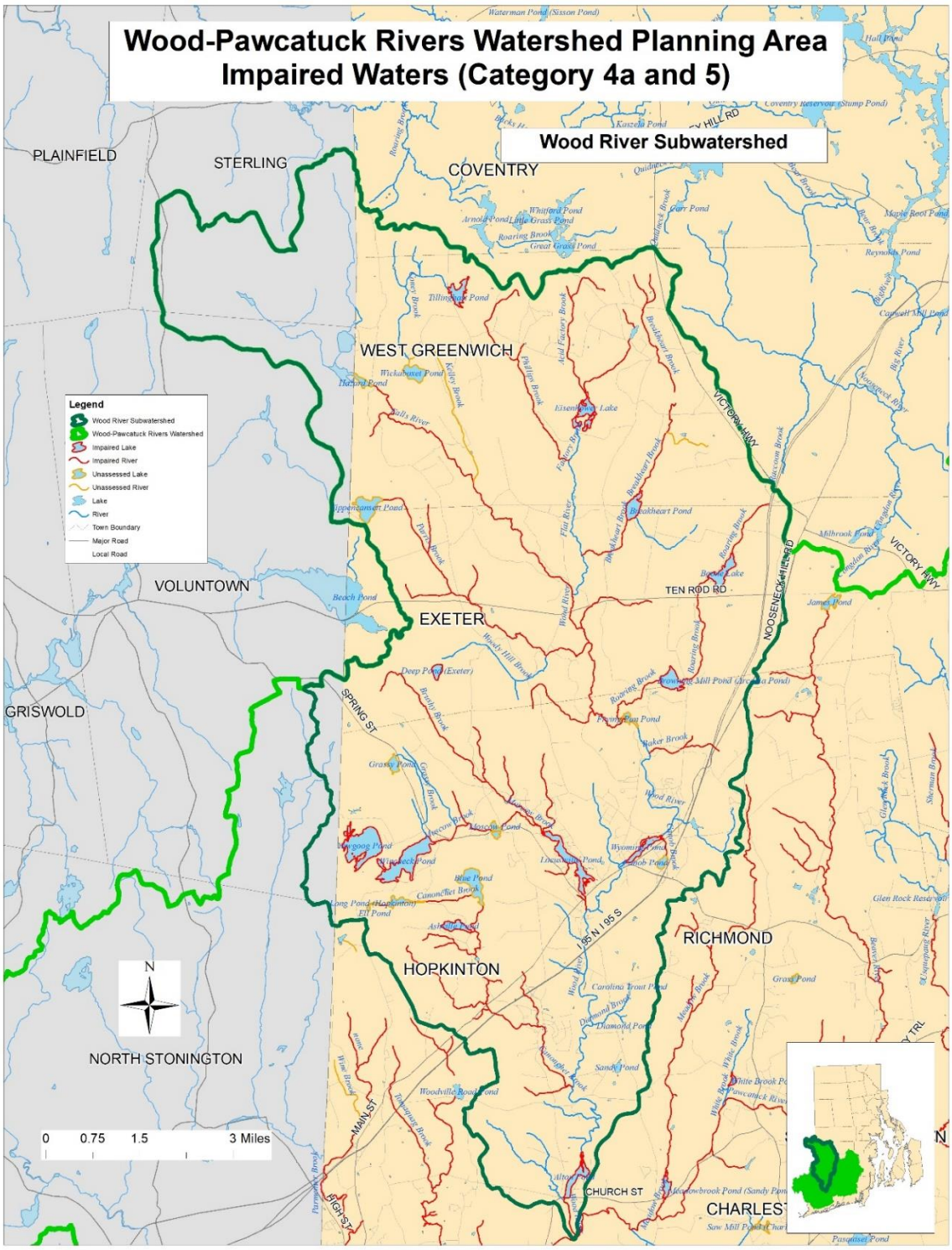

Wood-Pawcatuck Rivers Watershed Planning Area
Impaired Waters (Category 4a and 5)
Wood River Subwatershed
PLAINFIELD
STERLING
COVENTRY
WEST GREENWICH
VOLUNTOWN
EXETER
GRISWOLD
HOPKINTON
RICHMOND
NORTH STONINGTON
CHARLESTOWN
TEN ROD RD
CHURCH ST
MAIN ST
HIGH ST
SPRING ST
VICTORY HWY
NOOSENECK HILL RD
Legend
Wood River Subwatershed
Wood-Pawcatuck Rivers Watershed
Impaired Lake
Impaired River
Unassessed Lake
Unassessed River
Lake
River
Town Boundary
Major Road
Local Road
N
0 0.75 1.5 3 Miles

Figure 18

Consequences of Impaired Waterbodies:

Fishing:
All waters of the state are designated for fish and wildlife habitat, commonly referred to as aquatic life use. There are approximately 25 waterbodies stocked with trout within the Wood-Pawcatuck Rivers watershed, and recreational fishing is a popular activity for many people. Threats to healthy fish populations include loss of habitat due to erosion and sedimentation in waterbodies, removal of natural vegetation which buffers streams, changes to the pH and temperature of streams, reduced streamflow resulting from decreased infiltration of precipitation and increased runoff, disconnection of natural fish habitat due to the presence of dams, and the cumulative effects of harmful pollutants such as pesticides and other toxic substances such as mercury. Mercury comes primarily from atmospheric deposition from out-of-state sources and RI automobile emissions. Mercury is a state-wide impairment.

Swimming and other Contact Recreation:
The Rhode Island Department of Health (DOH) oversees water quality monitoring at all licensed public beaches in Rhode Island and is responsible for closing beaches if water quality fails to meet the water quality standards for primary contact recreation (swimming). There are 13 licensed freshwater beaches within the Wood-Pawcatuck Rivers Watershed boundary used in this plan. Based on RI Department of Health Data, there were 51 closure days in 2021 distributed among five beaches within the watershed. These beaches should be prioritized for investigation and management efforts to reduce bacteria.

DOH evaluates water samples for the presence of Enterococci bacteria. The concentration of these bacteria in beach water samples is measured in colony forming units per 100 milliliters (cfu/100ml). Beach closures are based on exceedances of more than 60 cfu/100 ml in saltwater and in freshwater.

Beach closures can be mapped online using the tool available at https://beaches.health.ri.gov/swim/. Beach closures are closely linked to precipitation events. Water quality restoration efforts in the areas that drain into the lakes and ponds, in addition to improving water quality more broadly, can also help reduce instances of beach closures.

In addition to bacteria, harmful algal blooms can also cause beach closures and warnings to avoid contact with waterbodies. Algae are a natural part of aquatic ecosystems and serve an important role in the food chain. However, excessive algae growth, called an algae bloom, can cause water quality to deteriorate. Swimming and other contact recreation types can be negatively impacted by these water quality and aesthetic problems. Algae blooms can also harm fish and other aquatic life by depleting oxygen in the water. Some types of algae can produce toxins dangerous to people and animals. Algal growth depends on the availability of sunlight and nutrients. When enough sunlight is available, excess nutrients, especially phosphorus, can trigger an algae bloom. While this issue tends to be more prevalent in lakes surrounded by higher levels of development than is

typically in the Wood-Pawcatuck watershed, Barber Pond in South Kingstown has been subject to a harmful algal bloom advisory in the past.

Pollutants Causing Impairments:

Bacteria • E. coli • Enterococcus • Fecal coliform	What is this? • Types of bacteria found in the intestines of warm blooded animals that indicate the presence of raw sewage. Where does it come from? • Leaking sewer lines • Failing septic systems/cesspools • Pet waste • Farm waste/manure • Wild animal/bird waste
Phosphorus	What is it? • A nutrient that is a natural part of the aquatic ecosystem. However, when there is too much phosphorus in a fresh water ecosystem, it can cause algae to grow out of control at a rate faster than the ecosystem can handle it. Where does it come from? • Both natural and human sources but elevated levels are generally caused by human activities. • Soil and rocks • Wastewater treatment • Plants • Runoff from fertilized lawns and cropland • Septic systems • Runoff from animal manure storage areas • Pet waste • Sediments from disturbed land areas • Drained wetlands • Water treatment • Commercial cleaning preparations.
Nitrogen	What is it? • A nutrient that is a natural part of the aquatic ecosystem. However, when there is too much nitrogen in a saltwater ecosystem, it can cause algae to grow out of control at a rate faster than the ecosystem can handle it. Where does it come from?

	• Both natural and human sources but elevated levels are generally caused by human activities. • Wastewater treatment • Atmospheric deposition • Runoff from fertilized lawns and cropland • Septic systems • Runoff from animal manure storage areas • Pet waste
Non-native aquatic plants	What is this? • Plants that have been introduced accidentally or intentionally into lakes and rivers outside of their native range. Non-native aquatic plants can out-compete native plants, thereby becoming 'invasive' and degrading habitat. Invasive plant species that live in fresh waters also interfere with recreational activities such as swimming, boating and fishing. Where do they come from? • Boats • Bait or bait buckets • Discarded garden or aquarium plants • Intentional planting • Once introduced, a non-native aquatic plant can be spread by wildlife or through stream flow out of infested lakes.
Mercury	What is this? • A heavy metal that is toxic to living organisms. Where does it come from? • Atmospheric deposition (coal fired power plants, vehicle exhaust, industrial processes) • Improper disposal of fluorescent light bulbs and older thermometers, thermostats.

Pollutant Load Reductions:

The following information is drawn from existing water quality restoration plans, referred to as "Total Maximum Daily Load" (TMDL) Reports, which provide the technical basis for most water quality restoration work. These reports analyze the existing conditions and quantify the pollutant load reductions necessary for the listed waterbody to support its designated use. TMDLs are part of a larger water quality framework established by the Clean Water Act. Under this program, Rhode Island waters are systematically assessed and impaired waters require a TMDL or restoration plan to determine restoration objectives to reduce pollutants. The recommendations in

a TMDL are then implemented through prescriptive permits and by implementing alternative approaches to reduce pollutant loads and achieve water quality goals.

There are four TMDL reports for waterbodies within the Wood/Pawcatuck watershed or, in the case of Little Narragansett Bay, affected by activities within the watershed. These reports apply to 28 waterbodies within the watershed. If new TMDL reports are developed for waterbodies within the watershed, this Watershed Plan can be updated to incorporate the new findings. The necessary pollutant reductions calculated in the existing TMDLs are summarized below. The pollutant load reduction required to meet water quality standards is an indication of how significantly the waters are impaired.

-Tidal Pawcatuck River and Little Narragansett Bay (Total Maximum Daily Load Analysis for the Pawcatuck River and Little Narragansett Bay Waters Bacteria Impairments (September 2010)):
This TMDL was developed to address the high levels of bacteria pollution identified in the lower, tidally influenced portion of the Pawcatuck River, including Little Narragansett Bay. Note that the TMDL addresses only the R.I. waters, although the recommended actions in Section VI.C. include items relevant to both Rhode Island and Connecticut.

-Bacteria pollution is calculated as concentrations found in the waterbody itself; the following are reductions to instream bacteria concentrations necessary to meet water quality standards:

For Fecal Coliform:		
Waterbody Name	Waterbody ID Number	Reduction
Pawcatuck River	RI0008038E-01A	94.9%
	RI0008038E-01B	95.3%
Little Narragansett Bay	RI0008038E-02A	79.6%
Watch Hill Cove	RI0008038E-02B	87.6%
Mastuxet Brook and Tributaries	RI0008039R-11	97.6%
For Enterococci:		
Mastuxet Brook	RI0008039R-11	72.1%

-Yawgoo Pond (Total Phosphorus TMDL for Chickasheen Brook, Barber Pond, and Yawgoo Pond, Rhode Island (May, 2004)):

This TMDL was developed in response to poor water quality and excessive algae growth observed in Yawgoo Pond, Barber Pond, and Chickasheen Brook. The pollutant identified as causing the problem was phosphorus.

Required phosphorus load reductions necessary to meet water quality standards by location:

Waterbody Name	Reduction
Chickasheen Brook (at entry to Yawgoo Pond)	368 kg/yr, or 87%
Yawgoo Pond	368 kg/yr, or 83%
Chickasheen Brook (at entry to Barber Pond)	52 kg/yr, or 54%
Barber Pond	64 kg/yr, or 43%

In this case, the phosphorus loading was found to be caused by the activity of beavers. The phosphorus was originally a result of shellfish processing activities along the Chickasheen Brook above Yawgoo Pond. Beaver activity resulted in the sediments being disturbed and allowing the phosphorus to be resuspended and flushed down into the Pond. The beaver dam was removed and, over time, the phosphorus in the Chickasheen Brook above Yawgoo Pond decreased by almost 90%. In Yawgoo Pond itself the phosphorus load was reduced by nearly 50%. (EPA 319 Program Success Story: Chickasheen Brook Watershed)

-Waterbodies Listed in the Rhode Island Statewide TMDL for Bacteria Impairments (Enterococci for all listed in this section)

Bacteria pollution is found in waterbodies throughout Rhode Island. Sources of bacteria pollution are also similar in watersheds throughout the state. RI DEM developed the Statewide Bacteria TMDL Report to address waterbody impairments from bacteria in a comprehensive way. The reductions in bacteria pollution needed for a particular waterbody to meet the water quality standard are summarized below. Recommended actions to achieve these reductions are presented in Section VI.

Bacteria pollution is calculated as concentrations found in the waterbody itself; the following are reductions to instream bacteria concentrations necessary to meet water quality standards:

Waterbody Name	Waterbody ID Number	Reduction
Ashaway River	RI0008039R-02A	78%
Chickasheen Brook	RI0008039R-05A	100%
Meadow Brook	RI0008039R-13	71%
Mile Brook	RI0008039R-14	12%
Pawcatuck River	RI0008039R-18B	75%
Pawcatuck River	RI0008039R-18C	66%
Taney Brook	RI0008039R-23	35%
Tomaquag Brook	RI0008039R-24	83%
White Horn Brook	RI0008039R-27B	52%
Dutemple Brook	RI0008039R-30	13%
Parmenter Brook	RI0008039R-37	10%
Spring Brook	RI0008039R-41	99.3%
Breakheart Brook	RI0008040R-02	74%
Canonchet Brook	RI0008040R-04B	50%

Phillips Brook	RI0008040R-14	29%
Wood River	RI0008040R-16A	35%

Reductions included in 2014 Amendment:

Waterbody Name	Waterbody ID Number	Reduction
Pawcatuck River	RI0008039R-18D	26%
Pawcatuck River	RI0008039R-18E	83%
Spring Brook	RI0008039R-41	99%
Acid Factory Brook	RI0008040R-01	56%
Baker Brook	RI0008040R-18	45%

-Waterbodies listed in the Northeast Regional Mercury Total Maximum Daily Load:

Mercury is a potent neurotoxin that poses risks to human health. Exposure to this toxic metal occurs when humans consume fish that contain mercury's most toxic form, methylmercury. In the Wood/Pawcatuck Watershed, the atmosphere is the primary pathway for mercury pollution. There are no significant atmospheric sources of mercury within the Wood/Pawcatuck watershed. 14 lakes and ponds within the watershed are listed as impaired for mercury and will require a 98% reduction of atmospheric deposition loads to meet fish consumption standards. Meeting water quality standards for mercury will require reductions from mercury sources within the Northeast region, U.S. states outside of the region, and global sources. As such, addressing mercury pollution is beyond the scope of this watershed plan.

B. Groundwater

Groundwater in the Wood/Pawcatuck Watershed is of very high quality due to the large undeveloped areas of forest and low-intensity land uses. However, the groundwater is vulnerable to contamination because of the generally shallow depth to groundwater from the land surface and the very permeable nature of much of the soils in the watershed.

Groundwater quality is evaluated based on the federal and state drinking water standards because the primary use of groundwater is for drinking water. As mentioned, groundwater quality in the Wood-Pawcatuck Watershed is generally good but there are localized areas where the groundwater does not meet drinking water standards. Generally, this contamination occurs on a localized basis originating from one specific source. Sources of potential groundwater contamination include underground fuel storage tanks, hazardous and industrial waste disposal sites, illegal or improper waste disposal, chemical and oil spills, landfills, septic systems, road salt storage and application practices, and fertilizer and pesticide applications.

Over time, federal and state regulatory programs have made great strides in preventing contamination from these sources and cleaning polluted groundwater. Thirty to forty years ago industrial sites and fuel storage were a common source of groundwater contamination. (See Historical Note) These sources still exist in the watershed and accidents will happen, but the threat has been significantly decreased due to more stringent regulatory standards for the storage and handling of chemicals and fuel. The contaminants that are now becoming more of a groundwater concern in the watershed are largely a result of continued development. The result is a more generalized degradation of groundwater quality in some areas of dense development from increased numbers of onsite wastewater treatment systems (OWTSs or septic systems), lawns, and road salting. Wastewater from an OWTS moves downward through the soil into groundwater carrying with it bacteria and viruses, nutrients (nitrogen and phosphorus), pharmaceuticals and personal care products and other contaminants improperly disposed of into the system. The level of treatment provided depends on many factors – system design and installation, system use and maintenance and the onsite soil characteristics. A properly sited, designed, installed and maintained OWTS will provide decades of use and provide treatment such that the system does not adversely impact public health or the environment.

Historically, two instances of groundwater contamination in the Wood-Pawcatuck Watershed were landmark events that contributed to federal and state efforts to take action to protect groundwater. A leaking underground storage tank at a gasoline station in Richmond that contaminated private drinking water wells made national news. The widespread use of the pesticide Temik on potato fields also was identified as polluting nearby wells and was one of the factors that lead to a strong RI Groundwater Protection Act (RIGL 46-13.1) passing in 1985.

Because groundwater contamination is usually localized in nature, no ambient groundwater monitoring network has been established in RI. Groundwater quality monitoring presents particular challenges associated with the manner in which pollutants move in different aquifer settings. In general, groundwater moves very slowly (only inches to feet per day) compared to flowing surface waters. Once introduced into an aquifer, groundwater contaminants may form plumes that move very slowly, with very little mixing and at different depths depending on the topography, subsurface geology, contaminant and types of soils. It can be difficult to predict contaminant movement, particularly in some bedrock aquifers. Contaminants are known to persist in groundwater for decades. The result is that groundwater quality can vary greatly and is often localized, which presents challenges within the landscape when designing groundwater quality monitoring programs. The best source of available information on ambient groundwater quality is the Department of Health's data on public drinking water wells that are regularly tested to ensure compliance with drinking water standards.

Nitrate (most commonly from OWTSs and fertilizer application) is used as an indicator of human impacts to groundwater. Natural background concentrations of nitrate are 0.2 mg/l or less. Five mg/l of nitrate (one–half the drinking water standard of 10 mg/l) is often used as a threshold for determining acceptable levels of impact from existing and proposed development. The data from public wells in the watershed sampled for nitrate over the past 10 years (Table 1) reveal that the annual percentage of wells that exceeded 5 mg/l averaged 3.2%. While this is a small percentage, the trend has been slightly increasing over the period. Furthermore, many wells show nitrate levels above ambient background levels, highlighting the importance of groundwater protection through good land-use planning.

What is an 'Indicator'?
An indicator pollutant is a substance or organism that is known to originate from human activity. If water tests show the presence of the indicator, we know that the waters have been impacted by human activity and we might expect to also find additional contaminants such as bacteria, pesticides, or pharmaceuticals and personal care products. If a well water test shows high nitrates, we should consider more testing for other contaminants and examine the landscape near the well to look for potential contaminant sources.

Table 1. Nitrate in RI Public Wells in the Wood-Pawcatuck Watershed.

	Number of Wells Sampled by Year												
Nitrate Concentration	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018 (Partial)
<=0.2	32	35	31	33	32	34	32	21	27	30	16	31	42
.21 - 3.0	87	99	99	93	104	106	110	81	95	64	63	83	60
3.1 - 5.0	9	4	10	13	5	6	5	5	5	5	5	5	8
5.1 - 10	2	4	2	3	3	4	3	4	5	2	5	12	12
>10	0	0	2	0	0	1	1	1	1	1	0	4	0
Total wells sampled:	130	142	144	142	144	151	151	112	133	102	89	135	122

Private well testing is the responsibility of the property owner. Testing is required at property transfers and prior to receiving a certificate of occupancy for a new home. The RI Department of Health has developed a map-based tool to assist property owners in determining which types of water tests should be conducted, and on what schedule, based on the location of the site and the

known factors contributing to groundwater contamination. In particular, homeowners should be aware of contaminants found in nearby public wells and should test for those substances. Private wells can be impacted by the same land use practices that impact public wells. For example, in the Wood/Pawcatuck Watershed, wells in village centers with dense development are more likely to be impacted by onsite wastewater treatment systems. Agriculture, specifically turf farming, can lead to higher nitrate levels in wells near fields.

C. Other Contaminants of Emerging Concern in the Watershed

Contaminants of emerging concern are compounds, such as pharmaceuticals and personal care products (PPCPs), that are not commonly monitored, therefore significant gaps in available water quality data exist. These contaminants may be found in groundwater or surface water or both. Additionally, their health and environmental impacts have not been completely determined due to their "emerging" nature. Currently there are no US EPA/state ambient water quality criteria, water quality standards, or drinking water standards for most of PPCPs or other emerging contaminants of concern. PPCPs and other emerging contaminants enter RI's waters primarily by means of wastewater treatment facility effluent, combined sewer overflows, and onsite wastewater treatment systems.

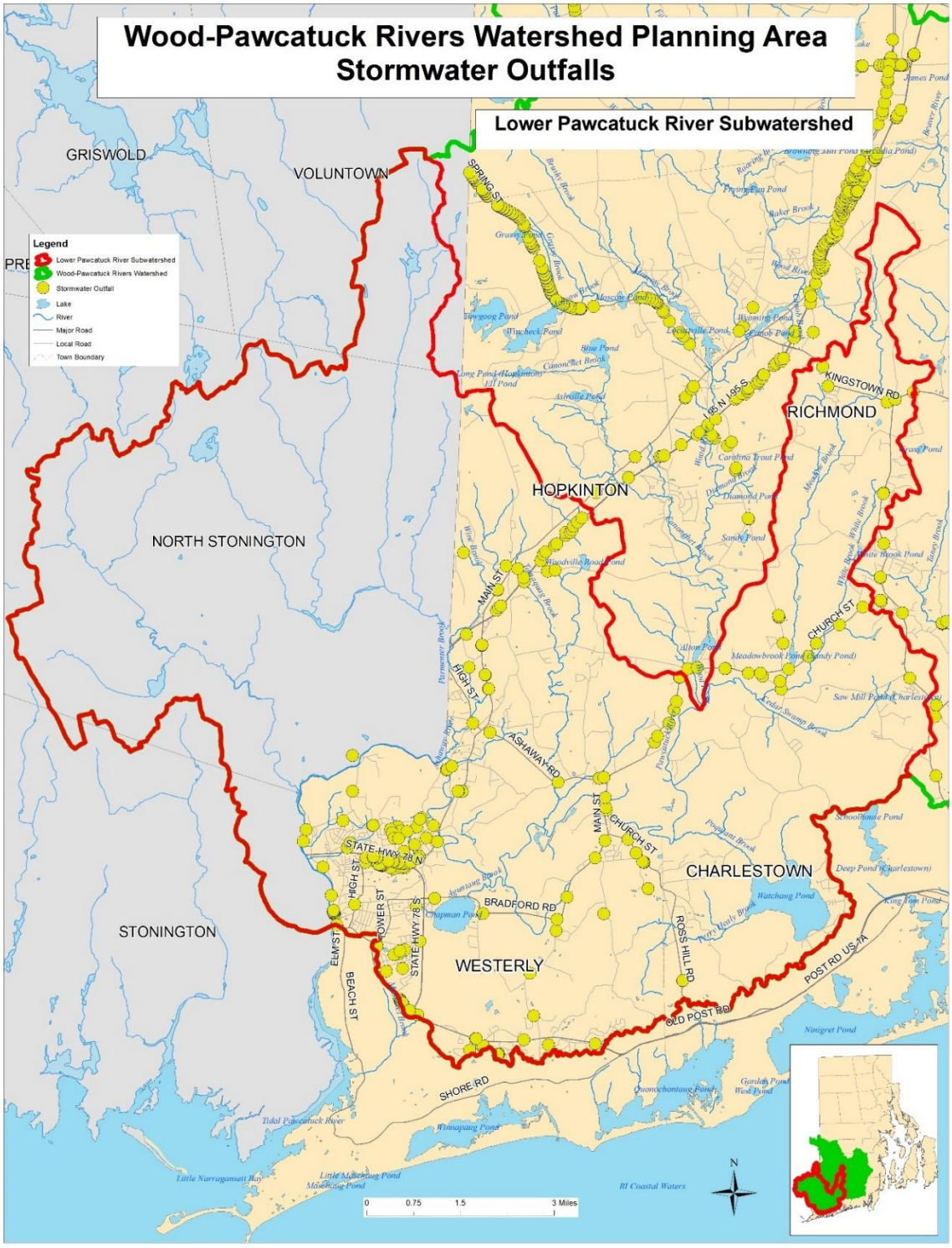
One large class of emerging contaminants that has actually been a concern for quite some time now is per and polyfluoralkyl substances (PFAS). PFAS are a class of chemicals that are widely used in a variety of products and applications including non-stick cookware, upholstered furniture, clothing, food packaging, and firefighting foam. EPA has adopted a drinking water health advisory for two of the thousands of PFAS chemicals –perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). Although PFOA and PFOS are no longer produced in the United States they remain in the environment due to their persistence and use in outdated products. Current areas of concern regarding PFAS are determining a national maximum contaminant level in drinking water for PFOA and PFOS, identifying the health effects and potential drinking water standards for some of the 1000's of other PFAS compounds in use, and determining ambient PFAS surface water quality standards and guidelines. RI DEM established a groundwater quality standard for PFOA and PFOS in 2017 at 70 ppt (individually and total), which is consistent with the federal health advisory. However, the RI Department of Health is currently reviewing the latest science to determine an appropriate PFAS drinking water standard for RI. These determinations will drive future efforts to regulate and remediate those facilities that may have or may be using or disposing of PFAS including numerous types of commercial and industrial operations, airports, fire training academies, landfills and other waste disposal facilities. PFAS compounds have been found at high levels at the former Bradford Dye facility along the Pawcatuck River in Westerly and will factor into site remediation efforts there.

IV. Pollution Source Management

Responsibility for restoring and protecting water quality in the watershed is shared among federal, state, and local governments, watershed organizations, private companies, and individuals. Among the management principles underlying this watershed plan is the tenet that we all share in the responsibility and duty to protect and restore RI's water resources. While acknowledging the State and Federal government's important role in this management framework, this plan recognizes the important role of local governments in implementing many of the actions in this plan and the meaningful roles of numerous public and private organizations as well as individuals in securing clean water and healthy aquatic habitats. This is especially true with respect to the implementation of the wide range of actions that are needed to achieve water quality goals. Pollution source management techniques include more than just regulatory actions. Best management practices, voluntary actions, and education/outreach are all useful to help parties understand their responsibilities and ability to play a part in managing pollution. Given resource limitations, collaboration and partnerships among those working on water quality and aquatic habitat management, are essential to enhancing progress. Below is a description of pollution sources and how they are managed.

A. Stormwater Management

Stormwater runoff transports pollutants originating across the landscape and is a widespread source of water quality degradation in RI as identified in all but one of the approved TMDL Reports in the state (the exception being the Northeast Regional Mercury TMDL). Stormwater impacts are varied and diffuse and can be caused by chemical or biological pollutants as well as physical damage caused by high water flows. Pathogen contamination results in beach closures and closure of shellfish growing areas. Nutrient enrichment of waterbodies results in algal blooms (including toxic cyanobacteria) that can lead to cloudiness in water and low dissolved oxygen that harms aquatic life. High flow rates caused by human alteration of the landscape can lead to aquatic habitat changes through erosion or sedimentation. Sediments can also contain elevated levels of other pollutants (e.g., metals). The degree to which stormwater impacts water quality in any particular watershed is primarily a function of the amount of impervious cover and how stormwater generated from the impervious cover is managed (State Guide Plan Water Quality Element, *Water 2035).*


Wood-Pawcatuck Rivers Watershed Planning Area
Stormwater Outfalls
Lower Pawcatuck River Subwatershed
GRISWOLD
VOLUNTOWN
NORTH STONINGTON
HOPKINTON
RICHMOND
CHARLESTOWN
WESTERLY
STONINGTON
Legend
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SPRING ST
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ASHAWAY RD
CHURCH ST
KINGSTOWN RD
I-95 N
I-95 S
STATE HWY 78 N
STATE HWY 78 S
BRADFORD RD
TOWER ST
ELM ST
BEACH ST
ROSS HILL RD
POST RD US 1A
OLD POST RD
SHORE RD
0 0.75 1.5 3 Miles
N

Figure 19

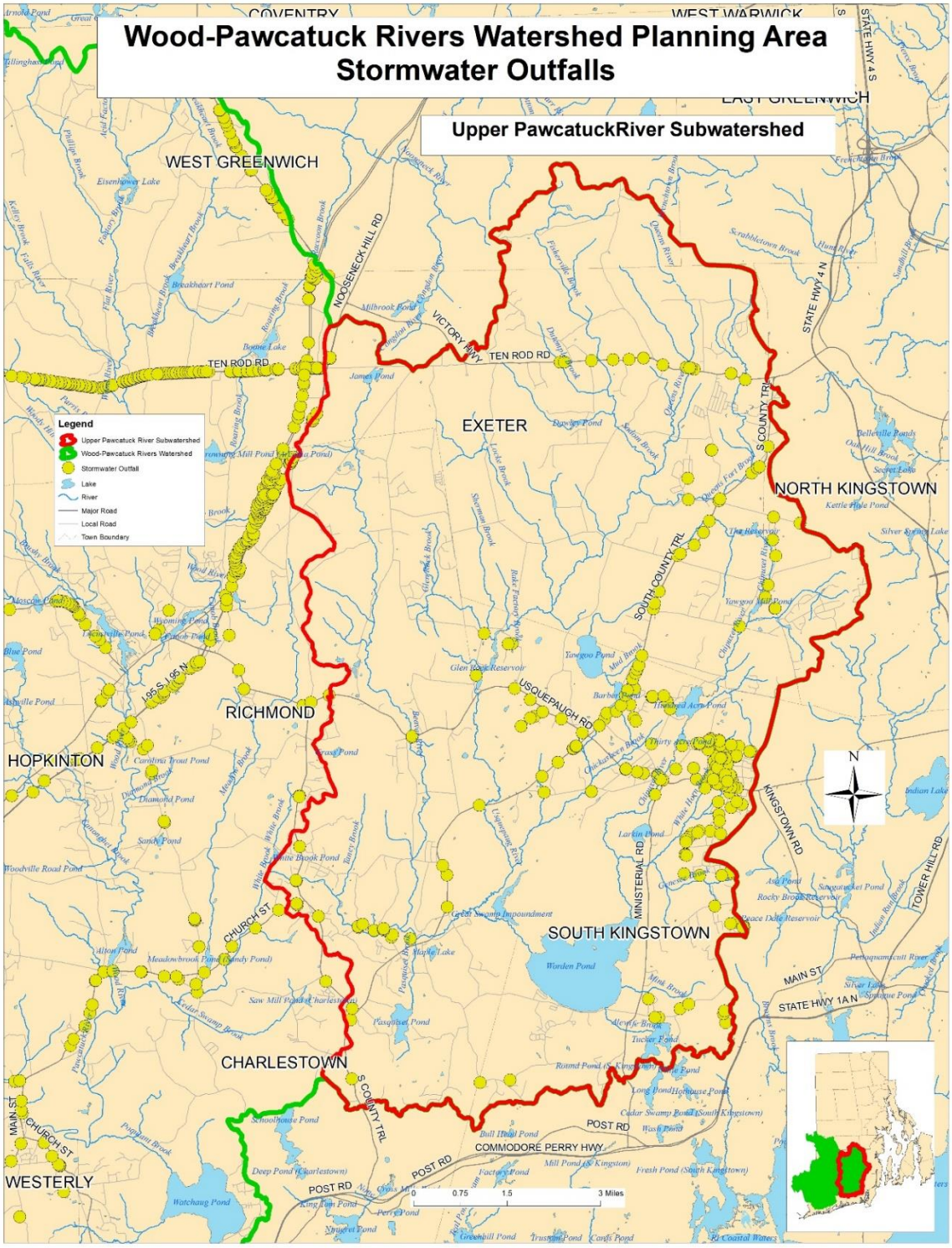
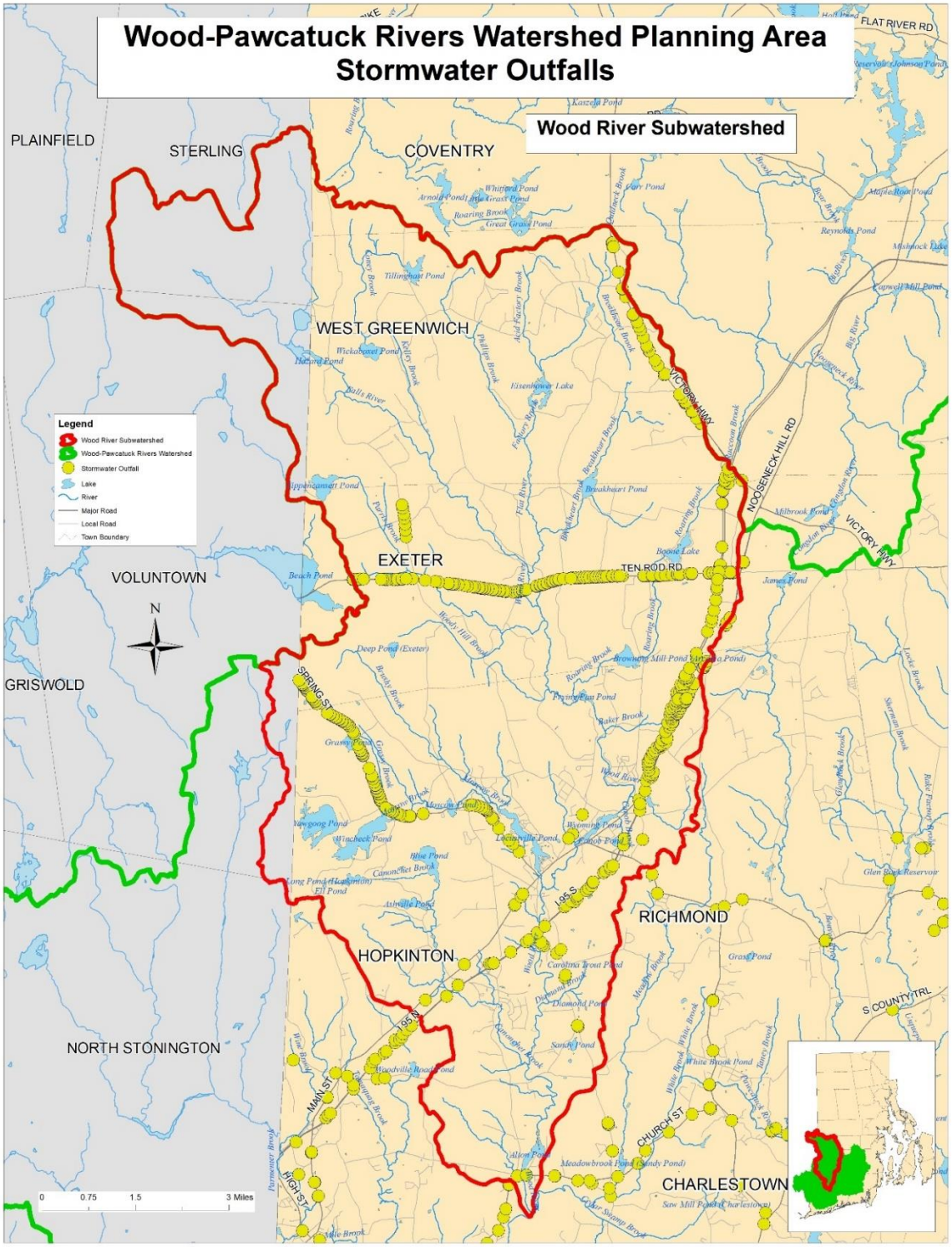

Wood-Pawcatuck Rivers Watershed Planning Area
Stormwater Outfalls
Upper PawcatuckRiver Subwatershed
WEST GREENWICH
EXETER
RICHMOND
HOPKINTON
CHARLESTOWN
WESTERLY
SOUTH KINGSTOWN
NORTH KINGSTOWN
Legend
Upper Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Stormwater Outfall
Lake
River
Major Road
Local Road
Town Boundary
NOOSENECK HILL RD
TEN ROD RD
VICTORY HWY
S COUNTY TRL
SOUTH COUNTY TRL
USQUEPAUGH RD
KINGSTOWN RD
MINISTERIAL RD
TOWER HILL RD
CHURCH ST
MAIN ST
POST RD
COMMODORE PERRY HWY
STATE HWY 1A N
STATE HWY 4 N
STATE HWY 4 S
I-95 S
I-95 N
N
0
0.75
1.5
3 Miles

Figure 20


Wood-Pawcatuck Rivers Watershed Planning Area
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VICTORY HWY
SPRING ST
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HIGH ST
CHURCH ST
S COUNTY TRL
I-95 S
I-95 N
Legend
Wood River Subwatershed
Wood-Pawcatuck Rivers Watershed
Stormwater Outfall
Lake
River
Major Road
Local Road
Town Boundary
N
0
0.75
1.5
3 Miles

Figure 21

Stormwater discharges are regulated under the R.I. Pollutant Discharge Elimination System Program (RIPDES). The Program issued the first General Permit for Stormwater Discharge from Small Municipal Separate Storm Sewer Systems (MS4s) in 2003. Areas subject to the General Permit requirements are those determined to be "Urbanized Areas" by the U.S. Census Bureau. Portions of all ten Rhode Island towns in the Wood-Pawcatuck Watershed are regulated as either a Municipal MS4 or are covered under the RIDOT divided highway (Interstate 95, State Route 3) MS4. Each entity regulated under the RIPDES MS4 program must prepare a Stormwater Management Program Plan (SWMPP) that describes the Best Management Practices (BMPs) for each of the following six minimum measures:

1. Public Education and Outreach
2. Public Involvement/Participation
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post Construction Runoff Control
6. Pollution Prevention/Good Housekeeping

The SWMPP must contain the measurable goals for each minimum control measure (narrative or numeric, used to measure the success of the program) as well as an implementation schedule including interim milestones and frequency of

MS4 Area in the Wood-Pawcatuck Watershed

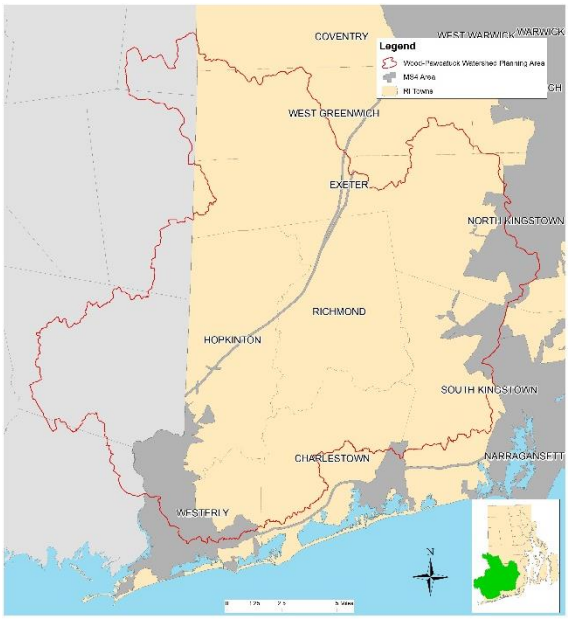

Figure 22

RIDOT has significant responsibilities for stormwater management associated with state roads, bridges and parking areas. As a regulated MS4, RIDOT is implementing a strategic program to comply with an EPA consent decree to improve stormwater management. RIDOT will prepare stormwater control plans where RIDOT outfalls have contributed to water quality impairments, improve maintenance of their system, and retrofit and construct stormwater BMPs. The consent decree's main goal is to reduce pollutants of concern in each watershed. Impervious cover was chosen as a surrogate for those watersheds where the primary pollutant of concern is bacteria, with a goal to reduce impervious cover below 10% of the land area. However, in the Wood-Pawcatuck watershed impervious surfaces cover around 4% of the land area and in some smaller catchment areas the impervious cover is even lower. For this reason, RIDOT conducted a desktop analysis in an effort to show that stormwater retrofits to reduce and/or treat runoff from impervious surfaces in the Wood-Pawcatuck Watershed would be of limited value in advancing the goal of the consent decree. 33 of these subwatershed analyses have been submitted to RI DEM for review as of May, 2020. Stormwater treatment is incorporated into every RIDOT project whenever practicable but the agency is arguing to focus its stormwater resources on more urbanized watersheds.

activities and reporting of results. RI DEM can also require additional permit requirements based on the recommendations of a TMDL Report.

Proper design, siting and installation of stormwater BMPs as property is developed or redeveloped are not enough to achieve state water quality goals. Two challenges associated with stormwater management include:

- Proper maintenance of BMPs: Maintenance of the existing stormwater infrastructure is a glaring weakness at the state, local and private sector levels. Stormwater management BMPs for improving water quality must be maintained or the water quality benefits of the BMP will largely be lost; and
- Improving treatment of stormwater from existing developed lands: Accelerating the pace at which performance of stormwater management on existing public and private property is improved continues to be a significant challenge. Many of the completed TMDL's identify the need to improve stormwater management from existing properties in the watershed to reduce pollutant loadings to impaired waters. The responsibility for upgrading stormwater infrastructure rests largely with municipal governments and the Rhode Island Department of Transportation. However, stormwater from private property often flows into the public system. In many watersheds it will also be necessary to reduce pollution from stormwater runoff generated from private properties by taking action to properly manage this stormwater on-site.

<u>Minimizing Stormwater Impacts: Impervious Cover-</u>

Impervious cover is used as an indicator of the intensity of land development and has been scientifically linked to adverse impacts on surface water quality. The negative impacts result from both the pollutant loadings transported by stormwater runoff and the physical changes that occur with increased volumes and velocities of runoff; e.g. eroded stream channels and reduced biodiversity of existing streams. Because water runs more rapidly off an impervious area, flooding also becomes both more common and more intense downstream. Meanwhile, because less water is soaking into the ground, water tables may be altered with potential impacts to wetlands, streams and wells fed by groundwater.

The Center for Watershed Protection developed the "Impervious Cover Model" which has been supported by over 200 scientific and technical studies. This Model is based on the average percentages of impervious cover at which stream quality declines, and classifies those impacts into three categories:

- Sensitive streams-watersheds that are below a 10% impervious cover. Impacts are generally minor and the water quality and habitat is generally good to excellent.
- Impacted streams - watersheds between 10 and 25% impervious cover. Impacts to water quality and habitat.

• Non-supporting streams - watersheds with over 25% impervious cover. Impacts are severe water quality and habitat degradation. The impacts are so significant that they are not considered suitable for restoration.

These ranges are part of a continuum, and there can be variation between individual streams. The model is most reliable when impervious cover exceeds 10%. In watersheds below 10%, water quality and habitat can be still be degraded, in fact recent studies by the Center, have shown water quality degradation at levels above 5% impervious cover.

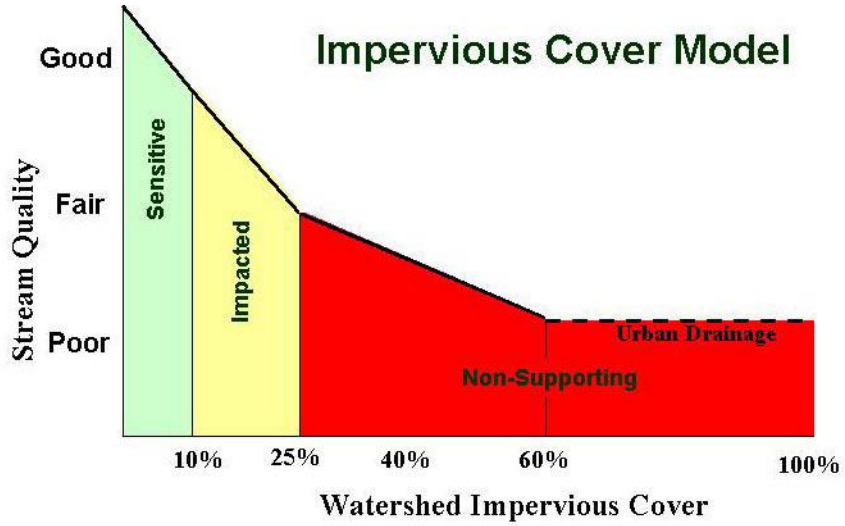

Figure 23

In the Rhode Island portion of the Wood and Pawcatuck Rivers watersheds, impervious surfaces cover 4.5% of the land area. Within the subwatersheds, impervious cover is 5.9% for the Lower Pawcatuck River, 4.7% for the Upper Pawcatuck River, and 3.2% for the Wood River. Overall these percentages are well below the 10% threshold supportive of high-quality streams. However within each subwatershed there are areas where impervious cover is more prevalent. The following maps show impervious cover for each subwatershed broadly as well as localized portions where impervious cover reductions should be prioritized.

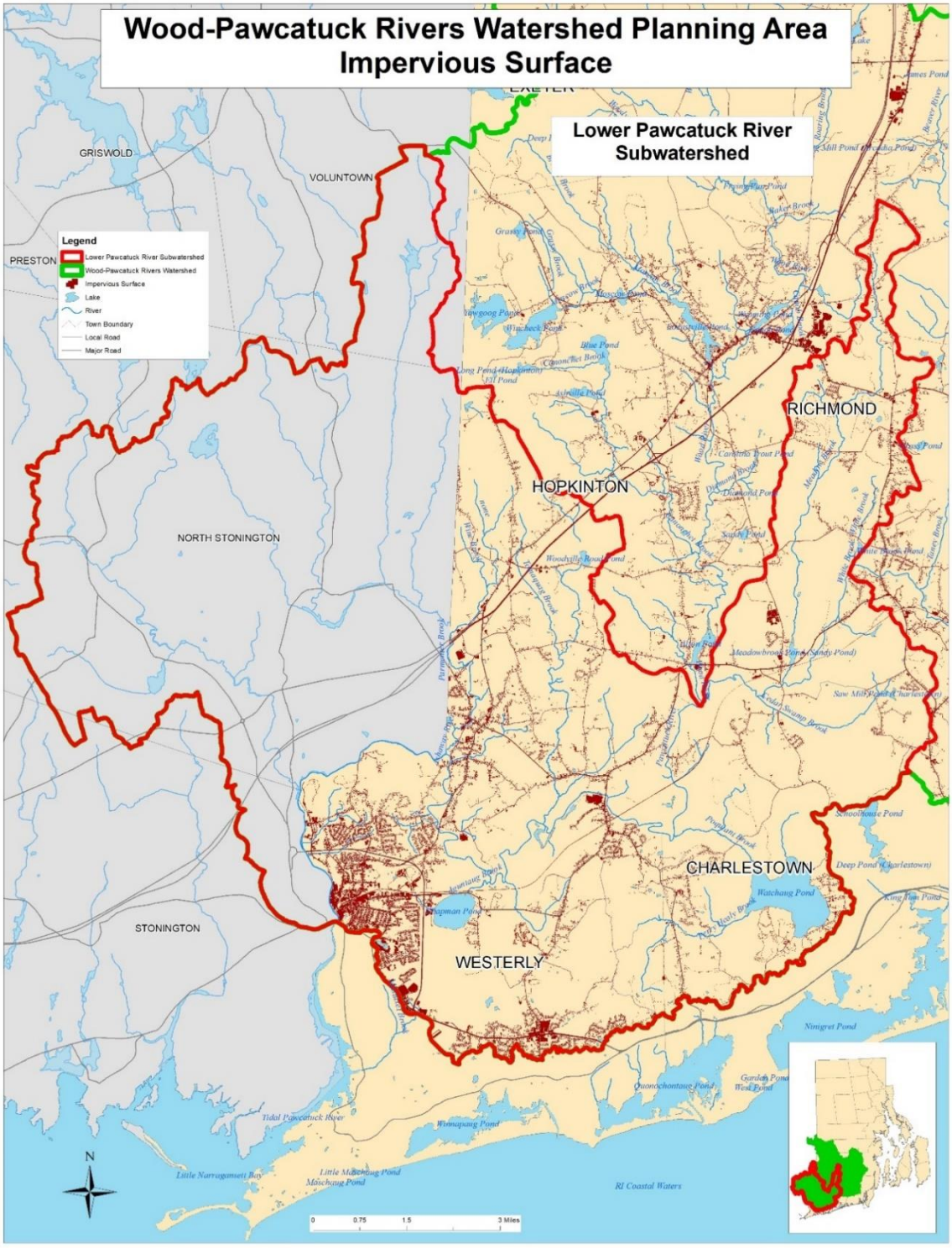
Wood-Pawcatuck Rivers Watershed Planning Area
Impervious Surface
Lower Pawcatuck River Subwatershed
GRISWOLD
VOLUNTOWN
PRESTON
NORTH STONINGTON
STONINGTON
HOPKINTON
RICHMOND
CHARLESTOWN
WESTERLY
Legend
Lower Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Impervious Surface
Lake
River
Town Boundary
Local Road
Major Road
N
0
0.75
1.5
3 Miles

Figure 24

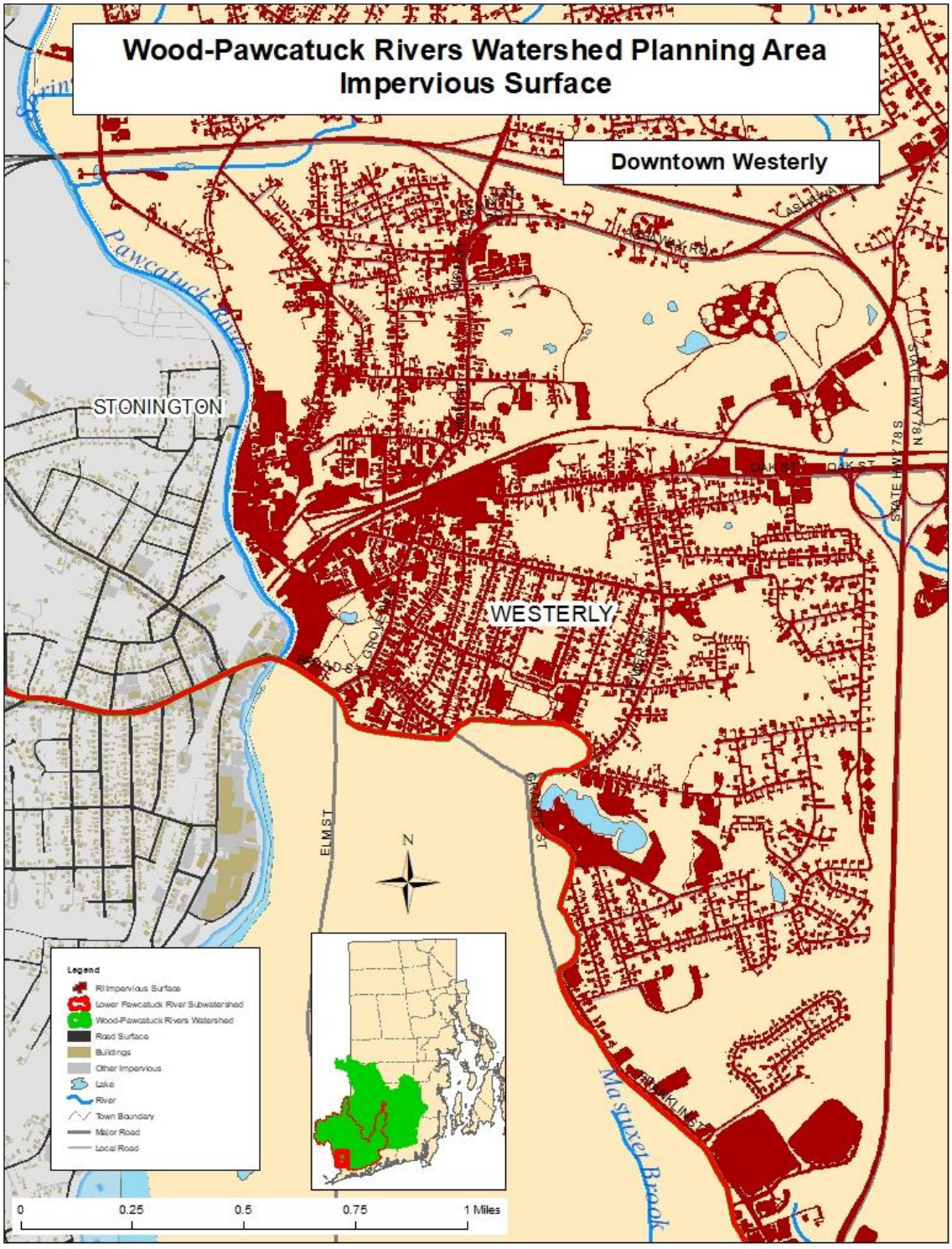
Wood-Pawcatuck Rivers Watershed Planning Area
Impervious Surface
Downtown Westerly
Pawcatuck River
STONINGTON
WESTERLY
ELM ST
OAK ST
STATE HWY 78 S
N
Legend
RI Impervious Surface
Lower Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Road Surface
Buildings
Other Impervious
Lake
River
Town Boundary
Major Road
Local Road
0
0.25
0.5
0.75
1 Miles

Figure 25

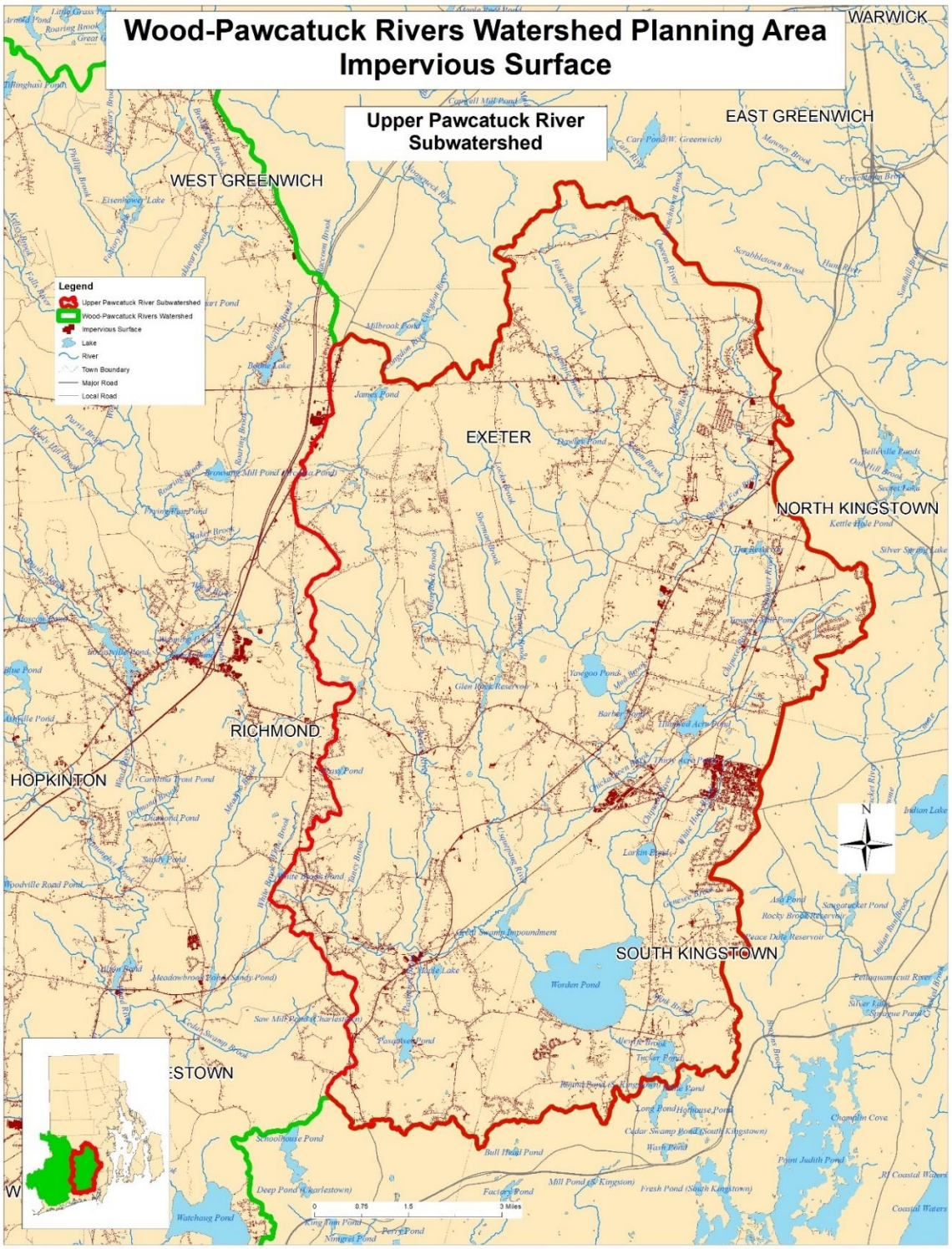
Wood-Pawcatuck Rivers Watershed Planning Area
Impervious Surface
Upper Pawcatuck River Subwatershed
WARWICK
EAST GREENWICH
WEST GREENWICH
EXETER
NORTH KINGSTOWN
RICHMOND
HOPKINTON
SOUTH KINGSTOWN
Legend
Upper Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Impervious Surface
Lake
River
Town Boundary
Major Road
Local Road
N
0 0.75 1.5 3 Miles

Figure 26

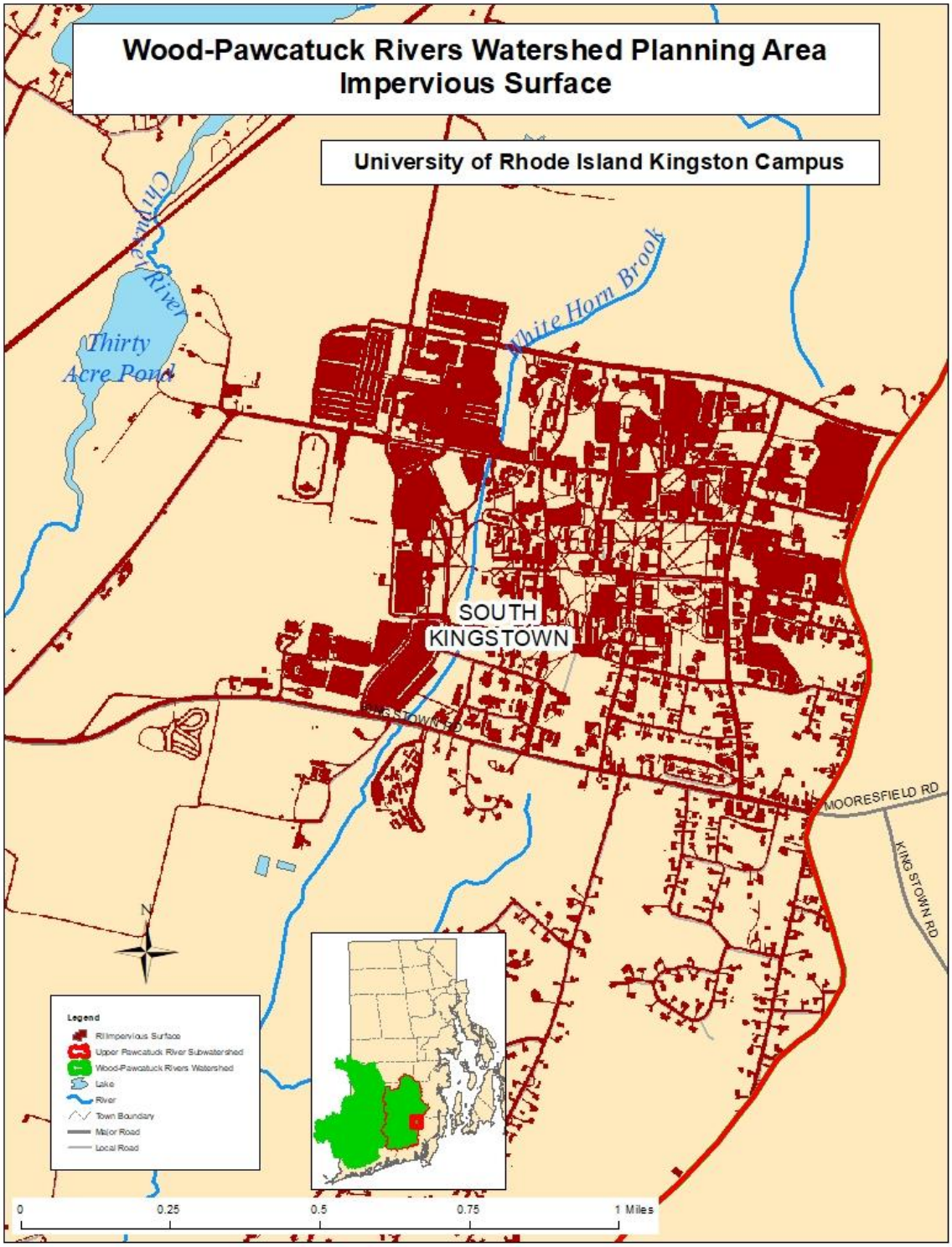
Wood-Pawcatuck Rivers Watershed Planning Area
Impervious Surface
University of Rhode Island Kingston Campus
Thirty Acre Pond
White Horn Brook
SOUTH KINGSTOWN
MOORESFIELD RD
KINGSTOWN RD
Legend
RI Impervious Surface
Upper Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Lake
River
Town Boundary
Major Road
Local Road
0
0.25
0.5
0.75
1 Miles

Figure 27

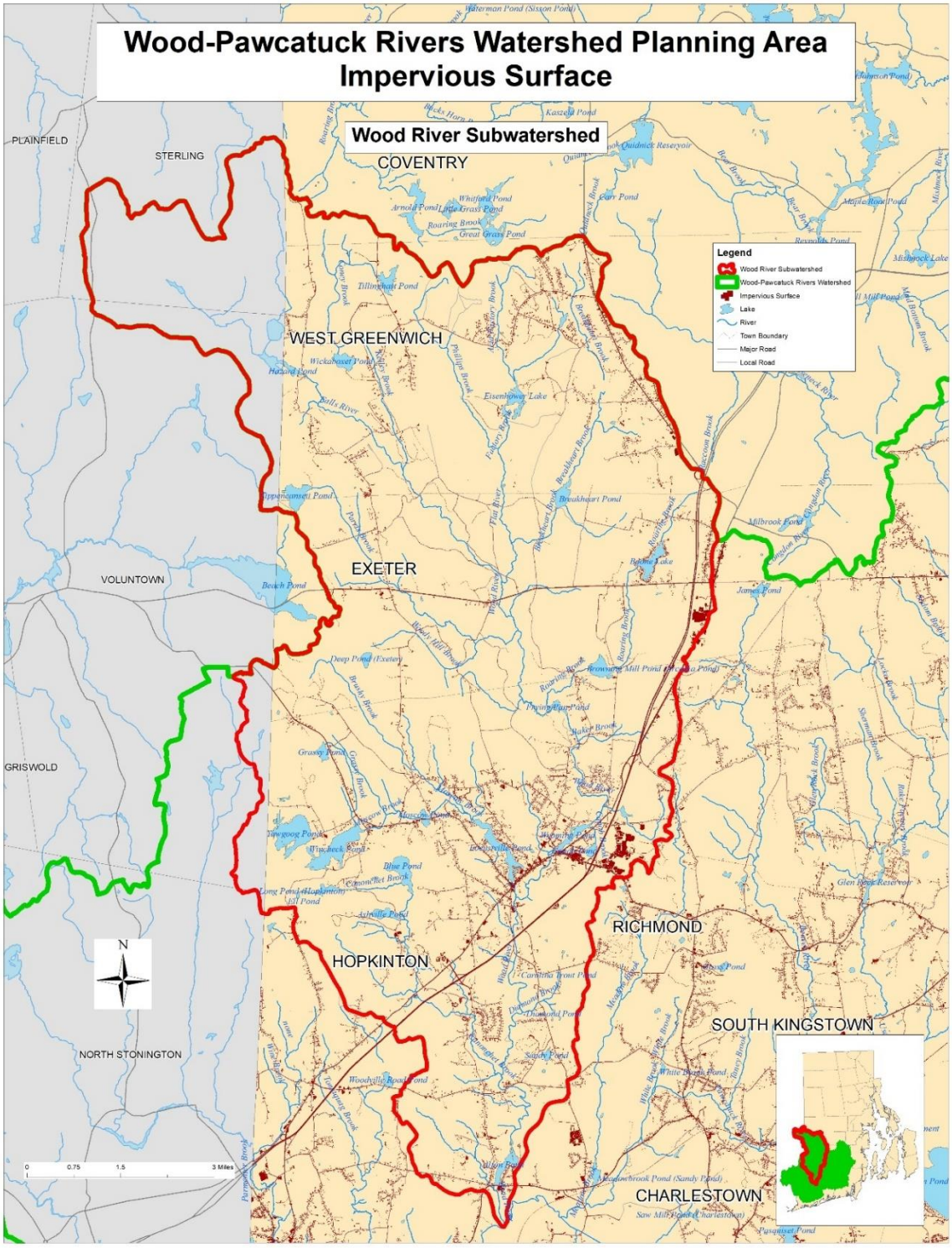
Wood-Pawcatuck Rivers Watershed Planning Area
Impervious Surface
Wood River Subwatershed
PLAINFIELD
STERLING
COVENTRY
WEST GREENWICH
EXETER
VOLUNTOWN
GRISWOLD
RICHMOND
HOPKINTON
SOUTH KINGSTOWN
NORTH STONINGTON
CHARLESTOWN
Legend
Wood River Subwatershed
Wood-Pawcatuck Rivers Watershed
Impervious Surface
Lake
River
Town Boundary
Major Road
Local Road
N
0
0.75
1.5
3 Miles

Figure 28

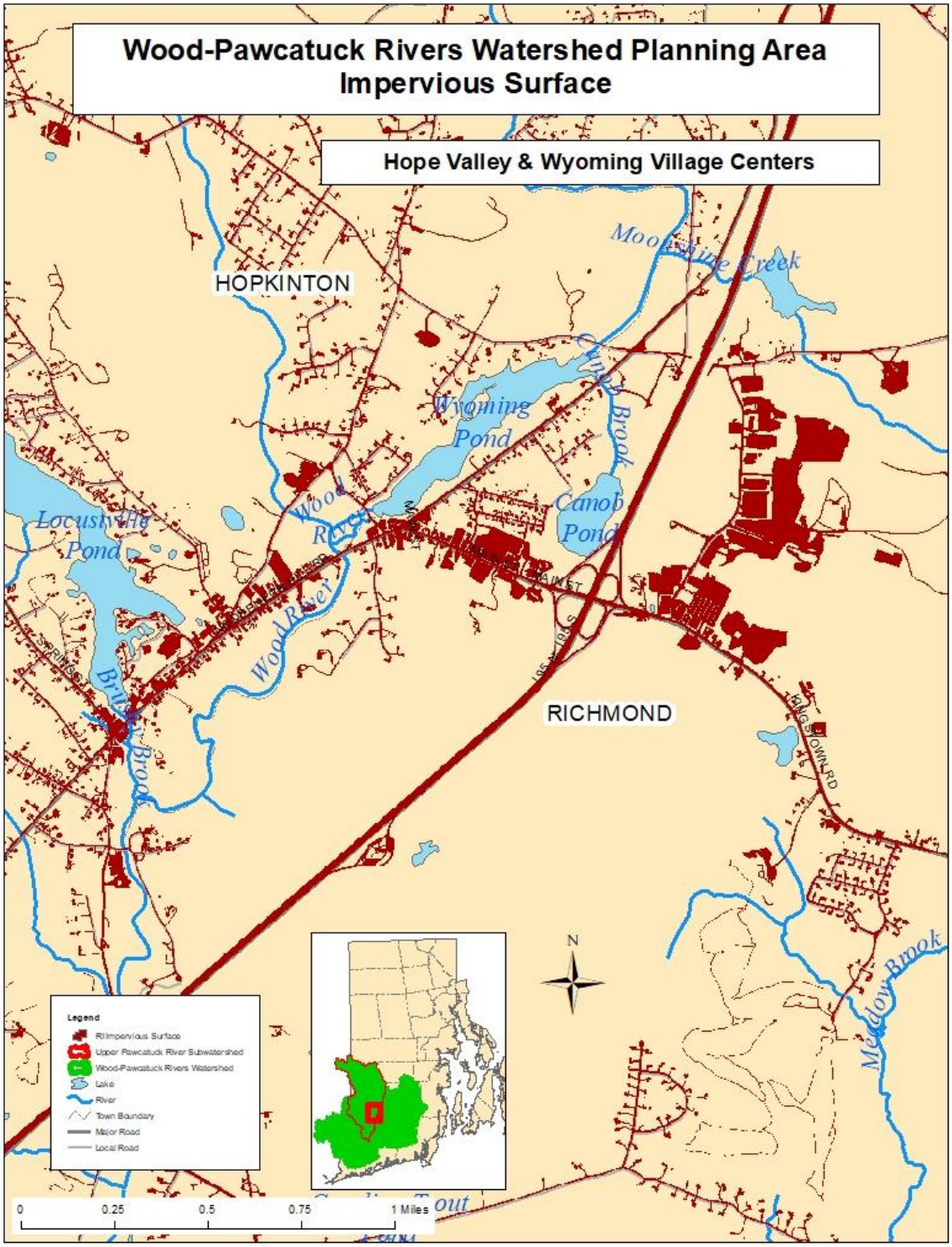
Wood-Pawcatuck Rivers Watershed Planning Area
Impervious Surface
Hope Valley & Wyoming Village Centers
HOPKINTON
RICHMOND
Wyoming Pond
Canob Pond
Locustville Pond
Wood River
Meadow Brook
Legend
RI Impervious Surface
Upper Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Lake
River
Town Boundary
Major Road
Local Road
N
0
0.25
0.5
0.75
1 Miles

Figure 29

Minimizing Stormwater Impacts: Low Impact Development, or LID-

Low impact development (LID) is a comprehensive approach to project design that minimizes the impacts of development or re-development on our water resources by improving stormwater management. It is different from conventional stormwater management that was designed to quickly move water off of a site (i.e., "pipe-to-pond" management). In the past, the landscape was altered to fit the style of the development. When using the LID process, the development is shaped to fit into the landscape.

The goal of LID is to design a site so that water moves over and through the site similarly to how it would move under natural conditions. Stormwater treatment practices are placed throughout the site to decrease, infiltrate, manage and treat runoff as close to the point where it is generated as possible. The RI Stormwater Management, Design, and Installation Rules (November, 2018) requires the use of LID as the primary method for stormwater control in new development and re-development construction.

To assist in incorporating LID into community planning processes, DEM, University of RI and RIDOT have developed "LID Site Planning and Design Techniques: A Municipal Self-Assessment." (See DEM webpage at http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/t4guide/lid-checklist-primer.pdf) The self-assessment contains questions covering a variety of topics related to low impact development (LID). These topics range from open space and land disturbance to impervious surfaces and soil erosion control. Working through the assessment allows an in-depth review of the local regulations that shape development in the community and a comparison to LID benchmark techniques and practices. The intent is to identify which LID techniques are in place and which techniques could be improved or employed.

Effective implementation of LID starts at the community planning level. The Rhode Island "*Low Impact Development Site Planning and Design Guidance Manual*" ("LID Manual, available online: http://www.dem.ri.gov/programs/bpoladm/suswshed/pdfs/lidplan.pdf) provides examples for local officials of how to amend their town's ordinances to incorporate LID requirements. The LID Manual contains over 45 specific techniques that can be used by communities to avoid and reduce the negative stormwater impacts to water quality from development. These techniques can also preserve community character, reduce flooding and save money.

The first step in integrating LID techniques into local development regulations involves municipal boards learning what the full range of LID techniques are. The next step is to perform an evaluation of local ordinances and development regulations (Land Development and Subdivision Regulations, Zoning Ordinance, etc.) to identify which techniques the town has already incorporated, and which techniques would be appropriate for the town to consider adopting or modifying. The next step is to amend the local regulations to integrate the LID site planning and dimensional design techniques so that they may be implemented in the development application

and planning process. Not all LID site planning and design techniques are applicable to every community.

A green infrastructure assessment was performed for the Wood-Pawcatuck watershed to identify green infrastructure retrofit opportunities that increase flood resiliency and improve or protect water quality. The assessment was done as part of the Wood-Pawcatuck Watershed Flood Resiliency Management Plan project in 2016 and consisted of three components:

1) A screening-level evaluation to identify areas of the watershed with the greatest feasibility for and potential benefits from green infrastructure retrofits;
2) Field inventories of the most promising green infrastructure retrofit opportunities in the watershed; and
3) Development of concept designs for selected retrofit sites.

The assessment identified approximately 30 site-specific, high-priority retrofit concepts in the watershed and is documented in a separate technical memorandum entitled *Green Infrastructure Assessment, Wood-Pawcatuck Watershed FloodResiliency Management Plan* (Fuss & O'Neill, 2016). The memorandum is available online here:
https://wpwa.org/documents/Flood%20Plan/Appendix%20M%20-%20Green%20Infrastructure%20Assessment.pdf

Stormwater Utility Districts-

BMP Maintenance challenges could be addressed at the municipal level through the formation of a Stormwater Utility District. RIDEM has been able to utilize certain state bond funds and limited federal funds to provide matching grants to municipalities and other entities, but the funding sources are variable. In order to address local funding shortfalls, RIDEM has partnered with municipalities interested in exploring the feasibility of establishing sustainable local (or regional) funding sources, such as a stormwater enterprise or utility fund. In 2011 RIDEM and the Town of Westerly produced a report, the *Stormwater Utility District Feasibility Study Final Report* (RI DEM Office of Water Resources, December 2011) to study the potential within the Wood-Pawcatuck watershed. The report outlines a pathway by which the town could implement such a utility district by to date the town has not committed to proceed beyond the study phase. A stormwater utility fee is based on the demand placed on the municipal stormwater system by each user, not on property's assessed value. It is therefore considered more equitable than other funding methods since users with a large burden on the stormwater system will pay their fair share. As with a water or sewer utility, a stormwater utility fee generates revenue based upon the amount of stormwater generated on a property and conveyed to a public stormwater system. These fees are assessed by measuring the amount of impervious cover within a parcel and are determined by the stormwater management financing needs of the municipality. They can be adjusted over time to continually meet those needs. A stormwater utility provides a means for:

- Consolidating or coordinating responsibilities that were previously dispersed among several departments and divisions;

- Generating funding that is adequate, stable, equitable and dedicated solely to managing stormwater; and
- Developing stormwater management programs that are comprehensive, cohesive and consistent year-to-year.

Climate change is predicted to produce wetter and more variable precipitation conditions in the decades ahead with more frequent intense storms that have large amounts of precipitation falling over shorter time periods. Stormwater management systems are designed based on the average precipitation rates in the recent past. The capacity and performance of these systems will be an issue to closely evaluate as precipitation patterns in RI change in response to climate change. Stormwater utility districts are a potentially effective tool to support these efforts to build resiliency.

R.I. Infrastructure Bank Stormwater Project Accelerator

The Stormwater Project Accelerator (SPA) provides upfront capital for green stormwater infrastructure projects that will eventually be funded through state and local reimbursement grants.

- Eligible SPA projects include green infrastructure, nature-based solutions, and stormwater best management practices which address water quality issues;
- Municipalities, non-profit organizations, and utilities are eligible to participate in the program;
- Individual agreements and financing timelines for loans made through the SPA are made on a case-by-case basis;
- SPA loans are interest-free but a 1.5% fee will be charged on the total loan amount to cover loan administration;
- Eligible projects must secure state or local funding and provide a signed grant agreement.

B. Onsite Wastewater Management

All OWTS are regulated and permitted by RIDEM through implementation of the RIDEM "Rules Establishing Minimum Standards Relating to Location, Design, Construction and Maintenance of Onsite Wastewater Treatment Systems." These rules set prescriptive standards for the OWTS components, size of systems based on intended use and soil conditions on each site, and the location of systems based on maintaining minimum separation distances from drinking water wells, wetlands and waterbodies, property lines, and other structures. Design flow from OWTS range from 345 gallons per day for a three-bedroom residence to greater than 20,000 gallons per day for some schools and other institutions. Private sector professionals are licensed by RIDEM to conduct an evaluation of the proposed site soil conditions, design, and install the systems.

In addition to conventional system designs specified in the Rules, RIDEM has established a procedure for approval of alternative or experimental OWTS technologies and leachfields. These are more complex systems that require a greater level of oversight to ensure they operate as designed in order to achieve the desired level of treatment. Alternative systems cost more to install and operate but are used on difficult sites to overcome site limitations (e.g., high water table, small lots, nearby private wells) where a conventional system cannot be installed. The alternative system can be installed with a smaller footprint or provide a higher level of treatment, resulting in an equivalent or better environmental condition than a conventional system on an acceptable lot with no site constraints.

Cesspools are an older, substandard method for wastewater disposal into the ground. A cesspool is any buried chamber (could be a metal tank, a perforated concrete vault, or a covered hollow or excavation) that receives sewage from a building for disposal into the ground. All cesspools in Rhode Island pre-date 1968, the first year regulations for septic systems took effect. Cesspools are considered substandard systems. They don't treat wastewater, they merely dispose of it. Cesspools concentrate the wastewater in one location, often deep within the ground and in direct contact with groundwater, causing groundwater contamination. This groundwater flows into drinking water wells and surface waters contributing to adverse public health and environmental impacts. RIDEM estimates there are approximately 20,000 cesspools still in use in RI. The Rhode Island Cesspool Act of 2007 (RIGL § 23-19.15), as amended in 2015, mandates that all cesspools within the state must, over time, be removed from service. The structure served by the cesspool must either be upgraded to a new OWTS or connected to a sewer line if one is available. The timeline for cesspool removal is as follows:

- If a property is subject to sale or transfer, the cesspool must be removed from service within one year of the closing date;
- If a cesspool is failed, the cesspool must be replaced within 1 year of the failure, or less if an imminent threat to public health is identified;
- If a cesspool serves a non-residential facility serving more than 20 people per day, or any multifamily dwelling, the cesspool must be replaced as required under current RIDEM and EPA regulations;
- If a cesspool is located within one of the three areas described below, the cesspool must be replaced immediately:
    - Within 200 feet of the inland edge of all shoreline features bordering tidal water areas (i.e., Coastal Resources Management Council's jurisdiction);
    - Within 200 feet of any public wells; or
    - Within 200 feet of a water body with an intake for a drinking water supply.

  The deadline for replacing cesspools located within these 200-foot zones was January 1, 2014 and all remaining cesspools in these areas are in violation of the Cesspool Act.

Within the Wood-Pawcatuck watershed, relatively few cesspools were located within the 200-foot zones specified in the Act. 44 sites were identified by DEM's analysis as having a cesspool subject to the Act and enforcement efforts are ongoing. The Cesspool Act does not have a reporting requirement for property transfers so the number of cesspools replaced under this provision can only be estimated. Based on publicly available sales data and reviews of DEM OWTS permit records, approximately 30 cesspools are replaced each year as part of property transfers.

Operation and maintenance of existing systems is the responsibility of the property owner. State regulatory oversight is limited except in cases where OWTS fail and an enforcement action is needed. Local governments can play an important role in encouraging OWTS maintenance. All OWTS, both conventional systems and alternative treatment systems with pumps and other electronic components, require periodic maintenance to achieve expected levels of treatment performance. Lack of maintenance is considered to be the primary cause of system failure causing health and water quality concerns as wastewater backs up onto the land surface and flows directly into surface waters, stormwater collection systems or moves untreated into groundwater. The Table below summarizes local onsite wastewater management activities within the Wood/Pawcatuck Watershed. Within the watershed, eight towns have adopted Onsite Wastewater Management Plans to encourage or require maintenance activities such as system inspections and pumping of septic tanks (as enabled by RI General Law Chapter 45-24.5). These plans make the towns eligible for the Community Septic System Loan Program (CSSLP), in which the towns can access funds from the Clean Water Revolving Loan Fund for low interest loans to homeowners for OWTS repairs. Seven towns within the watershed participate in the CSSLP.

Municipal Onsite Wastewater Management Programs

	OWTS Program Summary	
	Does the town have an approved Onsite Wastewater Management Plan?	Does the town participate in the Community Septic System Loan Program?
Towns		
Charlestown	Yes	Yes
Coventry	Yes	Yes
East Greenwich	No	No
Exeter	Yes	No
Hopkinton	Yes	Yes
North Kingstown	Yes	Yes
Richmond	Yes	Yes
South Kingstown	Yes	Yes

West Greenwich	No	No
Westerly	Yes	Yes

More information on local onsite wastewater management efforts can be found in Appendix 2.

C. Point sources – RIPDES major discharges

Permitted RIPDES Major Discharges in the Wood-Pawcatuck Watershed:

Figure 30

Note: The Westerly Airport discharge is outside of the Wood-Pawcatuck watershed but portions of the facility are within the watershed.

With authority delegated from the EPA, RIDEM administers the Rhode Island Pollutant Elimination Discharge System (RIPDES) permitting program for discharges to surface waters. In the late 1980's, RIDEM started incorporating more stringent effluent limits based on updated federal wastewater treatment standards and increased consideration of the receiving water conditions. All major WWTFs and most minor permittees now operate with water quality-based permits that reflect effluent limits developed using water quality assessments of their receiving waters and corresponding wasteload allocations. Effluent monitoring data is collected monthly, reported to RIDEM and shared with EPA. As part of an adaptive management approach, permits are periodically re-issued allowing advancements in scientific understanding to be incorporated into discharge permits as necessary.

The number of major point source discharges within the Rhode Island portion of the Wood-Pawcatuck watershed has declined in recent years. There are currently 14 individual outfalls from four different facilities permitted under the Rhode Island Pollutant Discharge Elimination System (RIPDES). In 2007, there were 12 major discharges to surface water and 3 multi-sector general permit discharges in the program. Different types of wastewater are regulated under the RIPDES program. Sanitary wastewater is sewage produced in homes and businesses. None of the currently active major discharges in the watershed include sanitary wastewater. Non-sanitary wastewaters can include cooling water or waterborne wastes produced as part of manufacturing or other industrial processes.

D. Facility management (underground storage tanks, hazardous materials, etc.) and contaminated site clean-up

Hazardous Materials Management: Effective hazardous materials management requires a multi-phase approach to ensure that water resources, the environment, and public health and safety are protected:

- Ability to respond to accidents and leaks in a timely and effective manner to limit the environmental impact.
- Proper storage and handling to prevent accidents and leaks.
- Proper disposal of waste generated in the use of the hazardous materials.
- Strategies to clean up the environmental impacts from any accidental or illegal releases and addresses climate change.

Note: Maps of the following facilities are available using RIDEM's Environmental Resource Mapper, http://www.dem.ri.gov/maps/ Maps include both active and inactive sites.

Tanks (Above and Below Ground)

Storage tanks for petroleum or other hazardous materials are under the authority of both State and Federal regulations. Tanks must be registered and managed so as to avoid leaking or spilling hazardous materials into the environment. There are 233 active tanks within the watershed regulated by RIDEM programs, including 14 sites with leaking tanks. These 14 tanks are priority sites for monitoring and remedial action under DEM's Leaking Underground Storage Tank program. While these tanks can have localized impacts to groundwater most of the sites have been under management for over 20 years and there are no widespread impacts to surface waters at this time.

Table of Active tanks by program: Regulatory Program	Number of Active Tanks
Above Ground	143
Underground	76
Leaking Underground	14

Sites with hazardous materials

The industrial and commercial facilities ("Tier 2 facilities") that exceed certain volume thresholds for the storage of hazardous materials are required to prepare emergency response plans that are shared with local and state officials. These plans outline clear areas of responsibilities and actions to be taken in the event of a chemical release caused by accident, fire or natural disaster. Tier 2 facilities are under the oversight of EPA regulations and RIDEM's Office of Emergency Response. There were 43 Tier 2 facilities in the Wood/Pawcatuck Watershed in 2016.

Contaminated site cleanups

Discovery of active and former commercial and industrial sites that have contamination of soil, groundwater and river sediments from hazardous materials and petroleum products are unfortunately a fairly common occurrence throughout RI. Most of the contamination that has been discovered is a result of activities that predated the comprehensive environmental regulations that have been in place since the 1980s.

Many of the contaminated sites lie in areas where problems could, or do threaten surface water, groundwater, and other sensitive environmental resources that the state is trying to protect and/or restore. Restoration of these sites is essential to assure long-term water quality goals in a watershed are met. Water quality issues at these sites are typically:

- Contaminated groundwater that can impact drinking water wells and flow to and impact down gradient surface waters.
- Contaminated sediment from historical discharges of waste into these waters. Although discharges of toxic pollutants to our waters have been reduced and eliminated, persistent high concentrations of contaminants in bottom sediments of rivers, ponds, and bays continue to degrade aquatic habitat in localized areas, particularly in the urban core.

Site remediation is overseen by both RI DEM and the EPA. Sites can be restored to reduce the threat of contamination to surface and groundwater. For example, the United Nuclear site in Wood River Junction was the site of a serious radiological accident in the 1950s. After extensive cleanup work, the site is now managed as a natural area by The Nature Conservancy. There are currently 37 active sites within the Wood-Pawcatuck watershed under investigation by RIDEM's Office of Land Revitalization and Sustainable Materials Management, Site Investigation and Remediation Program.

E. Lawn and grounds management

The care and maintenance of residential lawns and other landscaped areas such as golf courses, cemeteries, athletic fields, and parks, can contribute to water quality degradation. Turf is a major feature of all but the highest density urban landscapes, and how it is managed impacts water quality. Excessive amounts and using inappropriate formulations of fertilizer and pesticides, and poor timing of applications can result in impacts to groundwater and surface water.

Proper turf management depends on the use of the turf. Athletic fields, golf courses and other heavily used grassed areas are managed much differently than residential lawns. There is no single maintenance approach that is applicable to all turf areas whether due to type of use or the site's soil characteristics. Athletic fields, golf courses, etc. are usually professionally managed and represent a small fraction of the overall turf area compared to home lawns. Most homeowners are not aware of the appropriate best management practices to reduce the impacts to water quality in managing their lawns.

RI has no state law to address fertilizer use. Local government actions to address fertilizer use have been limited to resolutions, ordinances requiring the use of sustainable vegetation and conditions placed on permit approvals. Laws regarding turf management are difficult to enforce, therefore, strategies for managing fertilizer and pesticide use on turf are focused on education and training. The URI Cooperative Extension Program and other associations have produced public information materials and provided onsite training and education on proper lawn management. The intent has been for RI residents, landscaping companies, turf managers for golf courses and athletic fields, and garden centers to be aware of and to implement the appropriate strategies to reduce water quality impacts from turf care activities.

Lawn and Grounds Management in Charlestown

The town of Charlestown has established a Voluntary Recommended Landscaper Process. The development of this process is the result of extensive research of peer review academic papers, collaboration with turf grass and lawn care professionals and academics, other municipalities and the URI Cooperative Extension. Landscapers who sign onto the program have agreed to the Town's established landscaping processes. The registration process is intended to promote best management practices in lawn care and landscaping in order to protect sensitive and impacted groundwater and surface water resources. A major practice of the landscaping process is to utilize less than 2 pounds of water non-soluble fertilizer per 1,000 square feet of lawn per year. The process also establishes local retailers and sod companies that have agreed to the practices.

For more information, visit the Town's website at www.charlestownri.org

Lawn watering is the primary use of our water resources in the summer -- the time when water levels in streams and groundwater are at their lowest. This water use stresses some public supplies and may jeopardize public safety (water for fire suppression) and the resulting low stream flows can have devastating effects on stream ecology. The most effective way to minimize water quality impacts associated with lawn care is simply to minimize lawn area. To the extent that some landscaping is desired, minimum maintenance/minimum disturbance and xeriscaping strategies (the use of plant materials that require low moisture and/or nutrient requirements) should be pursued.

F. Agriculture

Rhode Island's farms contribute to the state's economic development and provide Rhode Islanders with local food and farm landscapes, as well as tourism opportunities and wildlife habitat. But the nature of farming in RI has changed significantly over the past 20 years. There are fewer large farms (particularly dairy farms) and more smaller, specialized farms in RI. The smaller farms are producing more locally consumed farm products. Farming will continue in Rhode Island, thus it is important to ensure that these operations are conducted in a manner that avoids water quality impacts. 7% of the land within the Rhode Island portion of the Wood-Pawcatuck watershed is used for agriculture. Over time, land in turf grass production has made up an increasing percentage of the agricultural acreage.

The potential water quality contaminants associated with agricultural operations include nutrients (from fertilizers and animal wastes), pathogens and organic materials (primarily from animal wastes), sediment (from field erosion), pesticides, and petroleum products. Well managed farms can operate with minimal adverse impacts on water resources. However, instances of significant contamination of surface water and groundwater have occurred. For example within the Wood-Pawcatuck watershed, pesticides such as Temik (Aldicarb) have been found in groundwater as a result of past use on potato crops.

In addition, water withdrawals are a management issue of increasing concern in certain subwatersheds. The need for irrigation water can place high demands on local groundwater or surface water supplies which, in turn, can cause a low flow condition in streams potentially resulting in dramatic negative impacts on stream ecology.

There are no state regulations that establish standards for specific farm management practices to control or prevent water pollution. However, there are general agricultural best management practices which aim to prevent or minimize pollution of surface waters and groundwater. The RIDEM Division of Agriculture works closely with the federal United States Department of Agriculture programs including the technical and financial assistance programs administered through the USDA Natural Resources Conservation Service (NRCS).

The Pawcatuck River Main Stem HUC 12 (#010900050205***)*** (particularly Tomaquag Brook) is one of the designated watersheds under the National Water Quality Initiative (NWQI). NWQI is a cooperative effort between NRCS and EPA/RIDEM Non-point Source programs. This effort will result in increased water quality monitoring of the Tomaquag Brook sub-basin with the anticipated implementation of agricultural BMPs supported by NRCS.

An important means to minimize the impact of agricultural operations is for a farm to develop and implement a Conservation Plan that at minimum addresses water quality issues. Plans are usually developed in consultation with RIDEM and NRCS. The plan describes the schedule for implementing conservation practices needed to solve natural resource concerns and may include

multiple components to address resource issues, such as nutrient management, erosion control, irrigation management, integrated pest management, wildlife and habitat management, forest management and others. In addition to conserving natural resources important to the farm, many of the practices included in such plans offer additional benefits to the farmer including cost–savings. Conservation Plans are not currently required in RI, unless the farm is participating in the RI Farm, Forest, Open Space Program, which is a state program to allow eligible properties to be assessed at its current use, rather than its value for development. Another option to increase conservation planning is to require that plans be developed for those farms receiving state funds through the purchase of development rights. Efforts to increase the development of conservation planning must be supported by strategies for plan implementation.

G. Road Salt

White stained pavement and piles of sand at the edge of the road are ample evidence of our efforts to maintain the safety of our roadways in winter. However, there is a water quality cost for the application of salt and sand. Salt and sand wash into surface waters impacting aquatic life. Salt can enter groundwater and contaminate drinking water wells. Not only is the water not suitable for drinking, but the salt corrodes the pipes, and can cause harmful metals, such as lead, to leach out into the water.

The sand that is applied on the roads during winter is either washed into our waters, changing aquatic life and streambed habitat dramatically, or it becomes a major contributor to stormwater BMP failure by clogging the systems. RIDOT estimates that only about five to ten percent of the sand applied to the road is recovered as street sweepings.

Minimizing impacts to water resources from road salt and sand application while at the same time maintaining public safety presents a unique challenge. Improved technology and best management practices can be utilized to reduce the amount of salt and sand applied to roads without compromising winter travel safety. In addition, the sand and salt must be stored in a manner to reduce impacts to water quality, primarily by the covering of the salt pile in a structure and containing runoff from the site. RIDEM rules require that all stockpiles of road salt (state, town, and private) in the watershed be covered with, at minimum, a durable cover. There are six municipal and one RIDOT salt piles in the Wood-Pawcatuck Watershed, all kept in covered structures.

Strategies towns and RI DOT can take include:

- Use of liquid brine (23.3% salt-water solution) applied before or early in a snowfall prevents the formation of frost and bonding between snow and ice and pavement.
- Pre-wetting the salt and sand mixture allows the material dispersed to stick to the road instead of bouncing and blowing off to the shoulder.
- Improved Spreader Technology that allows the operators to accurately administer and monitor the exact amount of salt applied.
- Using real-time information systems capable of monitoring road temperatures.

- Reducing salt use within wellhead protection areas for community water supply wells.

It is not uncommon for Rhode Island to experience mild conditions and rain events between winter storms. These events contribute to sand and road salt washing into waterways prior to the typical time when street sweeping is conducted in the Spring. Increasing the frequency of street sweeping, particularly on mild winter days, can help prevent more of this sand and salt from entering waterbodies.

H. Riverine Debris

Styrofoam cups, plastic drinking water bottles, fishing line, cigarette butts, balloons, plastic bags, and other types of debris floating in our rivers and coastal waters and washed up on our beaches is not just a visual litter or waste issue. It is a water quality issue. Trash in the rivers that is not removed flows to Little Narragansett Bay and beyond. Trash in our waters can:

- injure swimmers and beach goers.
- kill and injure wildlife. Many species accidentally ingest trash and degraded bits of plastic, mistaking it for food. Discarded fishing line and other forms of debris can entangle wildlife.
- threaten tourism and recreation, and the dollars they add to local economies by limiting people's enjoyment of beach and water related activities.
- complicate boating by causing navigational hazards; and
- cause expensive costs for retrieval and removal.

Most waterway debris comes from land-based sources. It is either blown into the water or, most commonly, washed off our streets and into our waters via storm drains. Debris (mostly plastic) is an often-overlooked water quality issue best addressed through increased public awareness.

V. Aquatic Habitat Management

Climate Change and Aquatic Habitat Management

Current and future habitat management efforts will need to take climate change into account. Rhode Island is the fastest-warming state in the lower 48 states, average atmospheric temperatures having increased more than 2 degrees Celsius. Water temperatures in Narragansett Bay have increased 1.6 degrees Celsius over the last century (Narragansett Bay Estuary Program *State of Narragansett Bay and Its Watershed 2017 Technical Report*). The impacts of climate change are already being felt, including sea level rise, increased storm frequency and intensity, changing patterns of precipitation and snowmelt, longer dry periods and droughts, increased evaporation, increased vulnerability to wildfires, and overall average warmer temperatures for air and water. While more rain is expected, it will not be evenly distributed throughout the year—flooding is likely to be worse in winter and spring, while droughts are likely to be worse than currently experienced in summer and fall.

According to the National Climate Assessment, "the Northeast has experienced a greater increase in extreme precipitation over the past few decades than any other region in the United States; between 1958 and 2010, the Northeast saw a 74% percent increase in the amount of precipitation falling in very heavy events" (Melillo, Richmond, T.C., & Yohe, G.W.). Rainfall in New England is expected to continue to increase due to climate change, which is expected to increase the risk of river-related flooding in the future. Bridges, roads and dams will be more susceptible to flood damage because of more severe storms and heavy rainfall. Sea level rise and increased frequency of storms may threaten coastal infrastructure, while increased flooding could affect inland infrastructure. (F&O Flood Resiliency Report)

In the Wood-Pawcatuck Rivers watershed, these large-scale, systemic changes will have impacts on specific types of aquatic habitat. For example, increasing air temperature will lead to a decline in suitability of coldwater streams as habitat for important species such as Brook Trout. This will lead to cascading effects on the dynamic food web within streams and adjoining terrestrial ecosystems. Freshwater wetlands will be affected by changes in hydrology due to shifts in precipitation patterns. Spring seasonal flows may include more flood events and produce drier summers that change groundwater levels and soil moisture. The hydroperiod of vernal pools may shorten affecting the breeding success of species dependent on this habitat such as amphibians. Changing conditions may result in shifts in the plant community as previously wetter areas dry out. For example, marshes and swamps may contract inward toward areas where water is deeper or more reliable. Larger wetlands may become fragmented. Floodplain forests may suffer damage from more frequent intense storms (Adapted from *Water 2035*).

A) Wetlands

As discussed in Section II., freshwater wetlands provide many environmental and ecological benefits. When wetlands are altered, these services are diminished or lost. Direct disturbance to wetlands includes activities such as cutting of vegetation, filling, illegal dumping, excavating, water diversion, or roads and crossings (see Subsection E, below). Wetlands can also be directly altered by an influx of sediment transported in stormwater. The sources of sediment can come from open construction sites, winter road sand, eroding river and stream banks due to excess high velocity runoff (either from poorly managed stormwater runoff or increasing intensities of storms), and from other areas of loose soil, such as dirt roads and driveways or vacant lots.

Wetlands are not isolated systems. The ecosystem of each wetland has adapted to certain water saturation depths, inundation at certain times of the year, and frequency and duration of inundation throughout the year. Such changes to a wetland hydrologic condition may be due to the direct disturbances noted above, or factors outside the wetland including dams, building in floodplains, and increased or decreased water inputs due to increases in impervious surfaces or decreases in groundwater recharge. Hydrologic alterations can also be caused by manmade withdrawals of water (discussed further below in Subsection D) for watering lawns, irrigation, or drinking water, and have been identified as a concern in Rhode Island with respect to freshwater wetlands.

While direct impacts to wetlands are regulated by law, the contributing drainage area to a wetland is not protected by wetland regulations. This stresses the importance of watershed planning in order to protect wetlands, not as isolated systems, but as an interconnected water resource—one that performs important functions with cumulative effects within the watershed. Watershed planning for wetlands can integrate policies and regulations pertaining to land use planning, stormwater management, erosion controls, land conservation, public water supply demand management, and other techniques to avoid indirect impacts to wetlands. More programs for education and outreach on the importance of wetlands in performing functions that benefit us, and how to avoid indirect impacts to wetlands, are also needed.

Threats to Wetlands

Threats and stressors to the viability and functioning of freshwater and coastal wetlands include the following:

- Loss of vegetated buffer adjacent to waterbody or wetland due to development.
- Degradation of freshwater wetlands due to physical and hydrologic alteration (e.g. filling, increased impervious surfaces, water withdrawals).
- Climate change, particularly changes to hydrology.

What Needs to be Done?

Protection and Restoration

As established in the R.I. Wetlands Act (RIGL § 2-1-19) the policy of the state is "to preserve the purity and integrity of the freshwater wetlands, buffers, and floodplains of this state." The state wetlands permitting program implements avoidance and minimization requirements thereby keeping direct wetland losses to a minimum. The R.I. Wetlands Act was revised in 2015 to strengthen wetland protection by expanding the jurisdictional area for state agencies, establishing statewide buffer standards, and redefining and clarifying terminology. Vernal pools, a priority habitat within the Wood-Pawcatuck Rivers watershed, are specifically included in the definition of given buffer protections. Regulations to implement these legislative changes take effect on July 1, 2022. Since freshwater wetlands perform such valuable functions, it is worth looking at potential opportunities to restore degraded wetlands where possible. However, because wetlands are complex systems, restoring them to perform their original function is very difficult. It is, therefore, very important (and more cost effective) to first and foremost preserve and protect wetlands and their buffers from negative impacts. Unfortunately, many wetlands have been historically altered. Where feasible, restoration of altered wetlands and riparian buffers (see next section) can help improve conditions in the watershed and provide multiple resource protection benefits.

Monitoring and Assessment

Under the Clean Water Act, states are required to report on the condition of all waters of the United States, including wetlands. A detailed wetlands assessment was conducted as part of the Pawcatuck Watershed Flood Resiliency and Management Plan Project to identify and prioritize wetland conservation and restoration opportunities. While the focus of the project was on the ability of wetlands to attenuate flooding, the report also identified those wetlands that provide high-quality ecosystem services. The report is available online here: http://wpwa.org/documents/Flood%20Plan/Appendix%20L%20-%20Wetlands%20Assessment.pdf.

Additional earlier work was done in 2006 through 2009. A collaborative project in the Queen's River watershed within the larger Wood-Pawcatuck Rivers watershed identified and studied vernal pools with the eventual goal of providing better protection through non-regulatory means such as land acquisition, conservation easements, etc. In this project, vernal pools identified through aerial photography were visited, evaluated, and ranked based on habitat value for amphibians. Metrics included pool size, hydroperiod, characteristics of surrounding forest, and evidence of breeding activity by amphibians such as spotted salamanders and wood frogs. The result of this project was both a methodology for evaluating vernal pools based on their habitat value as well as a list of specific sites to be prioritized for protection.

B) Aquatic Invasive Species

Aquatic invasive plants are a widespread problem throughout the state of Rhode Island, documented in at least 102 lakes and 27 river segments (see following map). Invasive species

pose many problems. Thriving invasive plant populations outcompete native plant communities and upset the healthy balance of plants and animals. These aggressive plants change fish and wildlife habitats, disrupt local food webs, and may degrade water quality. Further, large patches of plants can interfere with recreational activities, making boating, swimming, and fishing difficult in these areas. Prolonged effects on recreational opportunities may harm tourism and local businesses, reduce waterfront property values, and become costly to manage and control over the long term. The Wood-Pawcatuck Watershed is no exception, and invasive plants have been found throughout the region. The RIDEM Office of Water Resources has visually surveyed 28 lakes and specific locations on 26 river segments to document any floating or submersed aquatic invasive plants present. During these surveys, at least one or more aquatic invasive plant has been documented at 20 lakes and in five river segments. The most common aquatic invasive plant, variable milfoil (*Myriophyllum heterophyllum*) has been identified in 14 lakes and 3 rivers, and fanwort (Cabomba caroliniana) is the second most common invasive in 8 lakes and in one river (these species often co-occur in the same location). Variable milfoil is especially aggressive in the reservoirs of the Wood River, requiring periodic herbicide treatments to control where residents and lake users have sought resources to do so (Boone Lake, Breakheart Pond, Locustville Pond, Wincheck Pond, Wyoming Pond). Ten other aquatic invasive plants have been found in the watershed (American lotus, Brazilian elodea, curly-leaf pondweed, Eurasian milfoil, inflated bladderwort, mudmat, spiny naiad, water chestnut, and yellow floating heart), however their distribution is much more limited and they only have been documented at one to three distinct locations each. Regardless of the limited distribution on the landscape, even one population at a lake can quickly take over large swaths of a water body and significantly alter fish and wildlife habitat. The American lotus found in Chapman Pond, is a good example of this phenomenon. It is estimated upon review of aerial photography that the population of American lotus grew from only half of an acre in 2010 to over 17 acres measured in 2019. Please note that Water hyacinth (*Eichhornia crassipes*) commonly sold in water garden stores for its pretty purple flowers, has been observed at three locations in the Wood-Pawcatuck watershed, but those populations have not overwintered and have not yet been observed again in those areas in subsequent visits the following year.

Many of the aquatic invasive plants can spread via one tiny plant fragment hitch-hiking a ride from one pond to the next on birds, wildlife, or boats, kayaks, canoes, motors, trailers, paddles, jet skis, fishing gear, waders or anchors. The most efficient and cost-effective management strategy to control invasive plant populations is to prevent the plants from moving to a new water body via human transport. Clean boat hygiene practices are the first line of defense and can be effective in stopping invasive plants before they become established in a lake. RIDEM amended Freshwater Fisheries Regulations in 2020 to join all the other New England states in banning the transport of any plant or plant part into any waterbody on any type of boat, motor, trailer, fishing supplies, or gear. The new regulation carries a $100 fine for each violation, with a goal to urge boaters to check and clean their boats and gear before and after launching their watercraft in a lake or river.

The Rhode Island Aquatic Invasive Species Plan outlines a plan for aquatic invasive species management in Rhode Island with the goal of implementing a coordinated approach to minimizing the economic, environmental and social impacts of AIS on the marine and freshwater ecosystems and resources of Rhode Island. The plan is constructed around seven strategies:

1. Coordination and communication;
2. Monitoring;
3. Education, outreach, and training;
4. Research and development;
5. Planning and assessments;
6. Prevention and control; and,
7. Legislation and regulation.

The Plan is available online here:
http://www.anstaskforce.gov/State%20Plans/RI_SMP_Draft.pdf.

Additional information and more specific actions are discussed in the 2011 Rhode Island Freshwater Lakes and Ponds Report (available online here: http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/lakes012.pdf). Preventing the spread of invasive species into waters currently free of invasives is clearly the preferred management option for rivers and lakes. It is both more cost effective and environmentally sound than the strategies available to mitigate an infestation. When aquatic invasive species are not stopped during the early stages of infestation, their rapid spread usually results in a lengthy and expensive effort at controlling the problem.

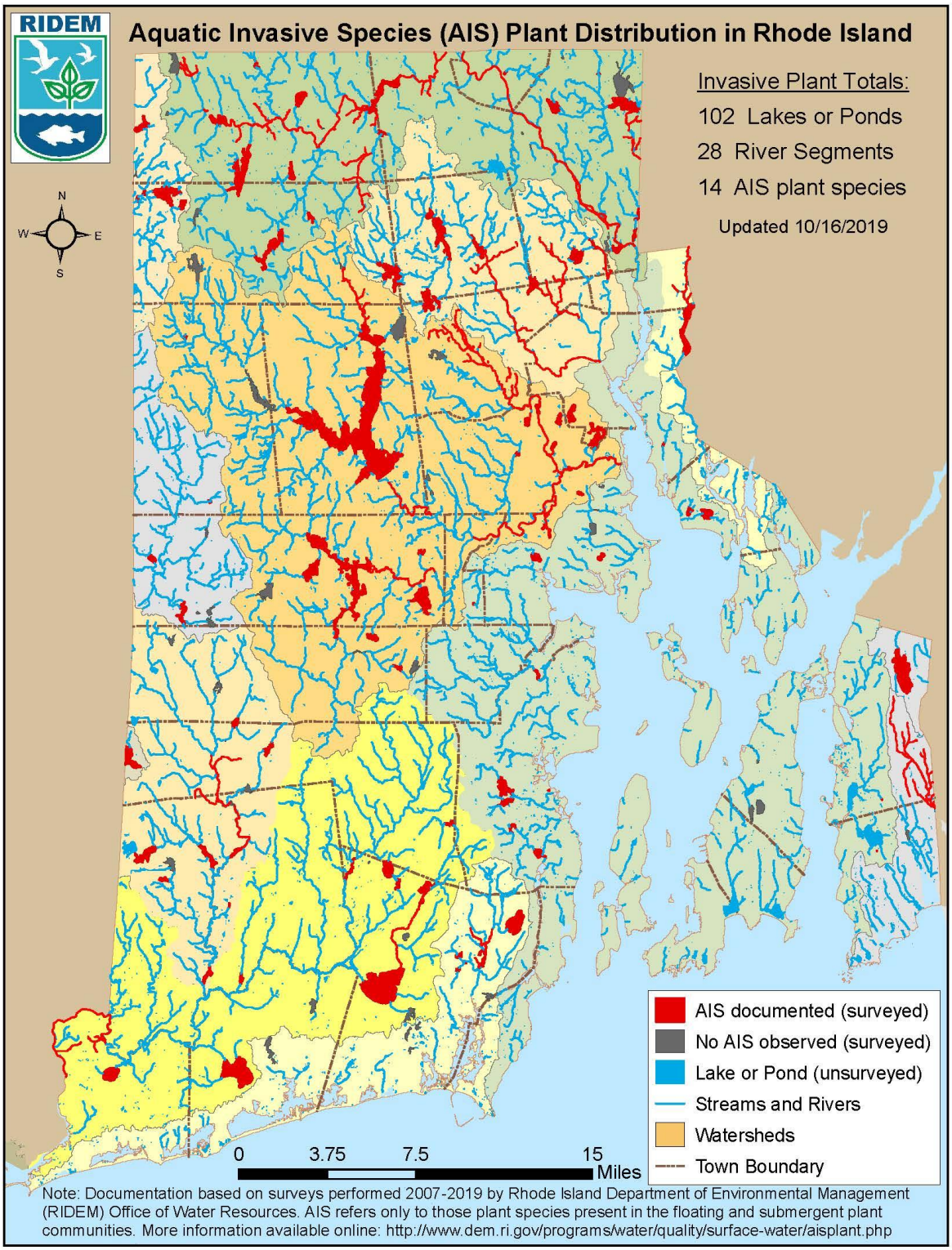
RIDEM
Aquatic Invasive Species (AIS) Plant Distribution in Rhode Island
Invasive Plant Totals:
102 Lakes or Ponds
28 River Segments
14 AIS plant species
Updated 10/16/2019
N
W
E
S
0
3.75
7.5
15
Miles
AIS documented (surveyed)
No AIS observed (surveyed)
Lake or Pond (unsurveyed)
Streams and Rivers
Watersheds
Town Boundary
Note: Documentation based on surveys performed 2007-2019 by Rhode Island Department of Environmental Management (RIDEM) Office of Water Resources. AIS refers only to those plant species present in the floating and submergent plant communities. More information available online: http://www.dem.ri.gov/programs/water/quality/surface-water/aisplant.php

Figure 31

C) Riparian Buffers

One of the primary means to protect aquatic habitat is to ensure the preservation of a vegetated buffer around that habitat. This buffer will act to:

- Filter out sediments, nutrients, pesticides and other pollutants coming off the landscape;
- Provide valuable habitat for plants and animals;
- Absorb stormwater and therefore mitigate potential streambank erosion and flooding; and
- Moderate water temperature by providing shade.

Given the large amount of contiguous forest and the relatively small amount of development in the watershed, riparian buffers in the Wood-Pawcatuck can be characterized as moderately to completely intact throughout much of the watershed. Development along the stream corridors in the Lower Pawcatuck River subwatershed, in the more densely developed villages, and in residential and agricultural areas of the watershed has resulted in substantial loss of riparian vegetation in some locations (Wood-Pawcatuck Flood Resiliency Plan Baseline Assessment, 2016).

Recent state law requires RIDEM and CRMC to revise its freshwater wetland regulations to establish new buffer distances and regulatory procedures for permitting new development. At the same time, the law prohibits local governments from establishing more stringent buffers and setbacks. These revised Rules are expected to be promulgated in late 2020 or early 2021. However, local governments can play a role in protecting aquatic habitat with buffers by promoting buffer restoration where possible and through land acquisition. Implementing LID (discussed in Section IV. (A)) will also protect and restore riparian buffers by avoiding unnecessary clearing and land alteration.

D) Water Use and Streamflow impacts –

The impacts of commercial turf farms and other significant water users on streamflow and aquatic habitat is an ongoing concern in the watershed. Excessive water withdrawal can cause extreme low flow for small tributaries when there are low rain years, impacting the habitat value of the streams. In the Wood-Pawcatuck watershed, this is a particular concern in the Chipuxet River sub-watershed due to surface water withdrawals for turf farms and groundwater withdrawals for municipal drinking water supplies.

Rhode Island does not have a separate permitting system to regulate water withdrawals. Conditions may be placed on new projects involving withdrawals subject to the RIDEM freshwater wetlands regulations or the water quality regulations. Municipal governments can also help safeguard streamflow levels through the implementation of LID. One of the goals of LID is to maintain pre-development hydrology. Local decisions in land use planning, permitting, and public education all have an impact on how water moves through the landscape and into streams.

Chipuxet River Basin Water Withdrawals

The Chipuxet River flows from headwater streams in the town of Exeter, through the villages of Slocum and West Kingston, just to the west of the Kingston campus of the University of Rhode Island, and into Worden Pond in South Kingstown. The drainage basin totals 36.93 square miles and is located primarily in the towns of South Kingstown (66%) and Exeter (18%) followed by North Kingstown (8%), Richmond (5%) and Charlestown (3%). Four major public water supplies withdraw groundwater from the Chipuxet River watershed. These wells are located in South Kingstown and the water is used in South Kingstown and Narragansett. Residents and businesses in North Kingstown, Richmond and Charlestown also use groundwater from the basin. Agricultural withdrawals up to one million gallons per day of surface water in Exeter can occur during dry summers.

Chipuxet basin withdrawals vary by month, by season, and by year depending on the type of use and the amount of precipitation. Generally, water demands are higher in the summer months and in dry summers, timing which corresponds to lower natural flows in the river. As a result, the amount of water currently withdrawn from the Chipuxet is in excess of the "Resource Protection Goal," or what the river needs to maintain its ecological integrity. For this reason, the R.I. Water Resource Board (WRB) 2012 Strategic Plan has identified the Chipuxet River basin and associated aquifer as an area of concern.

Efforts to help bring water withdrawals in line with resource protection goals start with determining how much water is necessary to maintain the ecological integrity of the river itself. RIDEM's Streamflow Depletion Methodology (http://www.dem.ri.gov/programs/benviron/water/withdraw/pdf/stremdpl.pdf) establishes the volume of water that can be extracted from a stream (whether as direct stream withdrawals or indirect groundwater withdrawals) while still leaving sufficient flow to maintain habitat conditions essential to a healthy aquatic ecosystem. For the Chipuxet River basin, this volume has been set at 3.0 million gallons per day (MGD). The current summer (dry season) demand for existing uses in the basin leads to a deficit of over 6 MGD. Using this information as well as projected future water demand data, the WRB is developing an approach to both better manage demand and protect the supply of water in the Chipuxet. Actions include policies and techniques to reduce demand such as municipal regulations on water efficency standards and regulating outdoor water use. On the supply side, recharge to the aquifer can be enhanced through land use best management practices to encourage infiltration of stormwater, careful wastewater planning, and investigating water sources outside of the Chipuxet basin. The WRB is working on strategies to refine and improve policies at the state level to improve the long-term sustainability and reliability of water supplies.

E) Stream connectivity/ dams

Rivers and streams can be and have been physically altered by the construction of dams and sub–standard stream crossings (i.e., bridges and culverts). These barriers to stream connectivity prevent the free movement of aquatic life up and down a river system. In addition to contributing to flood hazards, dams and undersized road crossings of stream in the watershed are also potential obstacles to aquatic organism passage, preventing fish and other wildlife from using certain portions of the river system and isolating some populations. The result is fragmented aquatic habitat, potential impacts on water quality and an increase potential for flooding. Two major dams have recently been removed from the Pawcatuck River, the Bradford dam and the White Rock dam. With the completion of these projects, the entire length of the main stem of the Pawcatuck River is now available for migrating fish species for the first time in many years. However, numerous dams remain in the watershed on the Wood River and other smaller tributaries.

Sub-standard stream crossings at roadways and driveways on public and private land are much less obvious barriers on our waterways. These are typically characterized by constricted or inadequate flow, perched culverts, blocked crossings or crossings in disrepair. Undersized stream crossings also can contribute to flooding by restricting flood flows, causing backwater, sediment deposition, bifurcating flow, and sudden formation of new channels upstream of the crossing as well as scour downstream of the crossing. Undersized crossings increase the risk of floods inundating the associated road or railroad and can potentially cause floods to breach through a section of road fill adjacent to the existing channel. The Wood-Pawcatuck watershed contains nearly 600 structures (roads, rail lines, and developed bike/hiking trails) that cross mapped streams. A detailed assessment of dams, bridges, and culverts was done by Fuss & O'Neill in 2016 to evaluate stream crossings. The assessment considered both aquatic habitat connectivity and flood resiliency and rated each structure according to a prioritization system. The assessment report is available online here: http://wpwa.org/documents/Flood%20Plan/Appendix%20G%20-%20Dams%20Bridges%20Culverts%20Assessment_REVISED.pdf
37% of the assessed structures in the watershed were rated as a high priority for upgrade or repair, 43% were rated as intermediate priority, and 20% were low priority. The high-priority stream crossings were associated with local roads (103), state roads (41), driveways (7) and trails (6), with a slightly higher percentage of local road stream crossings (40%) rated as high priority compared with high-priority stream crossings of state roads (31%). Circular conduits and box culverts comprise the highest percentage of high-priority stream crossings in the watershed. Approximately 80% of the high-priority stream crossings are circular conduits or box culverts. 30 bridges and one arched conduit were also considered high priority. The largest numbers of high-priority structures were found in the Queen-Usquepaug River, Upper Wood River, and Lower Wood River subwatersheds, although the Beaver River, Wyassup Brook, and Ashaway River subwatersheds had the highest percentage of high-priority structures.

F) Cold water fisheries

Cold water fisheries are, as the name implies, fresh water habitats that support species dependent on cold water temperatures. Brook trout are a characteristic species of cold water streams in Rhode Island. These streams also support a unique macroinvertebrate fauna of mayflies, stoneflies, caddisflies, midges, craneflies, blackflies, dragonflies and damselflies, crayfish, and mollusks. In general, those waterbodies identified as cold water fisheries are the least impacted by human activities. Development of the area surrounding cold water streams and the associated increase in impervious surface are the primary threat to this habitat type. Impoundments of the streams themselves also slow the flowing water and allow it to warm up, making it less suitable for species that prefer cold water temperatures. Cold water habitat can be maintained by protecting buffer areas along streams and minimizing impervious surface areas.

As shown in Map #7 and the following table, the Wood-Pawcatuck watershed contains important cold water habitat:

	Stream Miles			
	Cold	Warm	Unassessed	Total
Lower Pawcatuck	45.3	25.4	7.5	78.2
Upper Pawcatuck	100.4	20.8	4.6	125.8
Wood	88.1	5.3	8.1	101.5
Total	233.8	51.5	20.2	

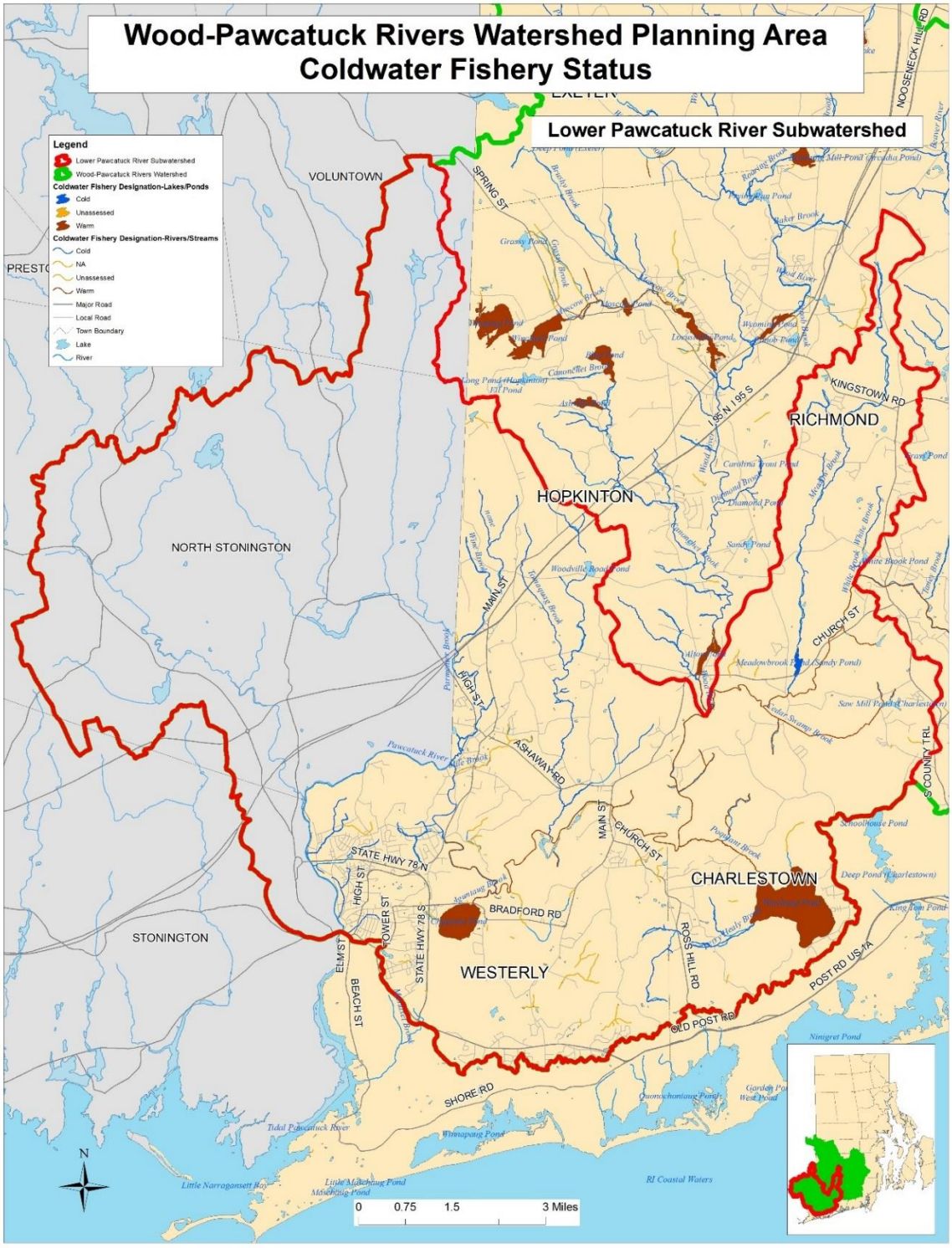
Wood-Pawcatuck Rivers Watershed Planning Area
Coldwater Fishery Status
Lower Pawcatuck River Subwatershed
Legend
Lower Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Coldwater Fishery Designation-Lakes/Ponds
Cold
Unassessed
Warm
Coldwater Fishery Designation-Rivers/Streams
Cold
NA
Unassessed
Warm
Major Road
Local Road
Town Boundary
Lake
River
VOLUNTOWN
NORTH STONINGTON
HOPKINTON
RICHMOND
CHARLESTOWN
WESTERLY
STONINGTON
EXETER
SPRING ST
KINGSTOWN RD
I 95 N 195 S
MAIN ST
CHURCH ST
HIGH ST
ASHAWAY RD
STATE HWY 78 N
STATE HWY 78 S
BRADFORD RD
TOWER ST
ELM ST
BEACH ST
ROSS HILL RD
POST RD US 1A
OLD POST RD
SHORE RD
COUNTY TRL
NOOSENECK HILL RD
Tidal Pawcatuck River
Little Narragansett Bay
RI Coastal Waters
N
0 0.75 1.5 3 Miles

Figure 32

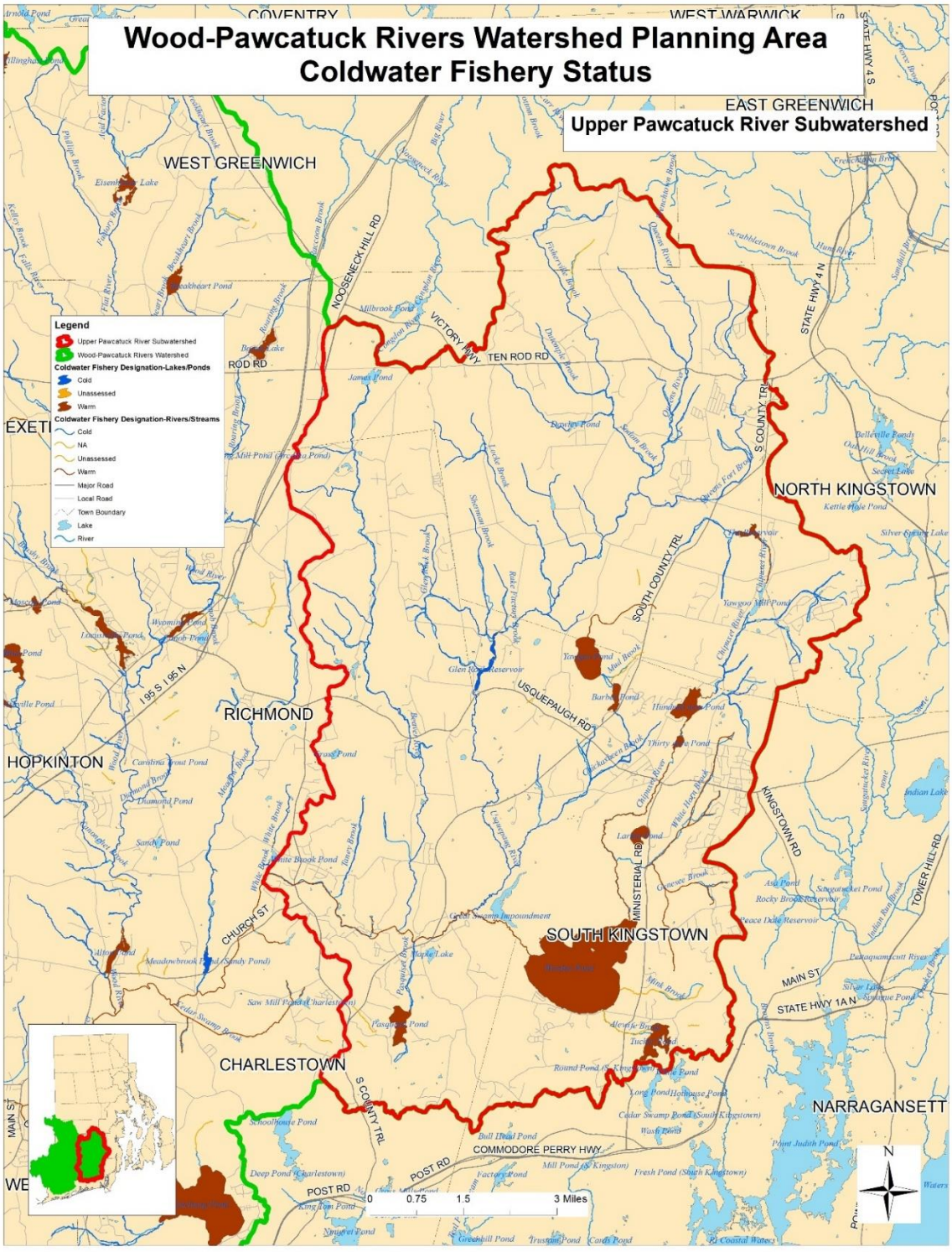
Wood-Pawcatuck Rivers Watershed Planning Area
Coldwater Fishery Status
Upper Pawcatuck River Subwatershed
COVENTRY
WEST WARWICK
EAST GREENWICH
WEST GREENWICH
EXETER
RICHMOND
HOPKINTON
CHARLESTOWN
SOUTH KINGSTOWN
NORTH KINGSTOWN
NARRAGANSETT
NOOSENECK HILL RD
VICTORY HWY
TEN ROD RD
ROD RD
S COUNTY TRL
SOUTH COUNTY TRL
STATE HWY 4 N
USQUEPAUGH RD
KINGSTOWN RD
MINISTERIAL RD
TOWER HILL RD
CHURCH ST
MAIN ST
STATE HWY 1A N
COMMODORE PERRY HWY
POST RD
195 S 195 N
Legend
Upper Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Coldwater Fishery Designation-Lakes/Ponds
Cold
Unassessed
Warm
Coldwater Fishery Designation-Rivers/Streams
Cold
NA
Unassessed
Warm
Major Road
Local Road
Town Boundary
Lake
River
0 0.75 1.5 3 Miles
N

Figure 33

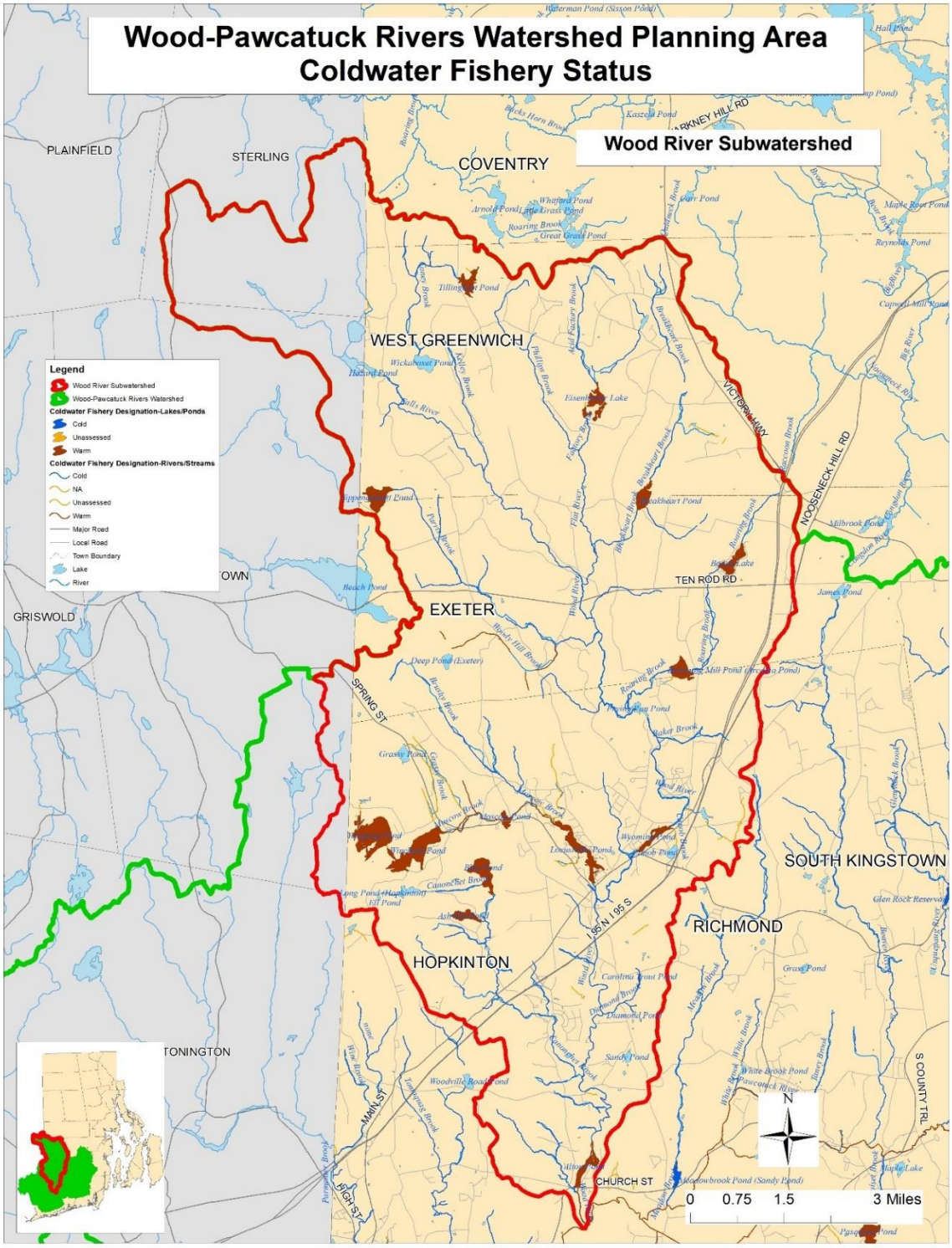
Wood-Pawcatuck Rivers Watershed Planning Area
Coldwater Fishery Status
Wood River Subwatershed
PLAINFIELD
STERLING
COVENTRY
WEST GREENWICH
EXETER
GRISWOLD
HOPKINTON
RICHMOND
SOUTH KINGSTOWN
TONINGTON
TEN ROD RD
NOOSENECK HILL RD
VICTORY HWY
SPRING ST
MAIN ST
HIGH ST
CHURCH ST
S COUNTY TRL
Legend
Wood River Subwatershed
Wood-Pawcatuck Rivers Watershed
Coldwater Fishery Designation-Lakes/Ponds
Cold
Unassessed
Warm
Coldwater Fishery Designation-Rivers/Streams
Cold
NA
Unassessed
Warm
Major Road
Local Road
Town Boundary
Lake
River
N
0 0.75 1.5 3 Miles

Figure 34

VI. Protection and Restoration Actions

Climate change and watershed resiliency

As discussed in Section V, climate change is recognized as a threat to all aquatic habitats. Changes in temperature, precipitation patterns, hydrology and the frequency of intense storms may impact the physical and chemical characteristics and biota of aquatic habitats. All aspects of watershed based planning need to take climate change into account. At the state level the Executive Climate Change Coordinating Council (EC4) is charged with incorporating consideration of climate change into the powers and duties of all state agencies. This includes setting specific greenhouse gas reduction targets, planning for mitigation, and evaluating and making recommendations regarding plans, programs, and strategies relating to climate change mitigation and adaptation. The State Guide Plan Water Quality Element also incorporates consideration of climate change across a broad array of topic areas. At the local and regional level, habitat preservation efforts can be targeted to work with shifting habitats as the climate changes. In many cases, actions taken to adapt to or mitigate climate change will also have a positive effect on water quality and aquatic habitat. The reverse can also be true as healthier ecosystems are also more resilient in the face of climate change.

A) Public Information and Outreach

Be a Part of Protecting and Improving Water Resources

Each of us can make a difference improving water quality and protecting wetlands by being aware of our water resources and taking steps to protect and restore these resources. Individual actions in our own backyards may not seem to have much of an effect by themselves, but the overall cumulative impact (positive or negative) on water quality in the watershed by individuals can be dramatic!

Watershed protection and restoration can only be successful when those that live and work in the watershed realize that they are a crucial part of their watershed.

What You Can Do:

- See the brochure "Simple Ways YOU Can Help Keep Rhode Island's Waters Clean"
- Participate in local activities that benefit the environment.

- Attend public meetings on water related issues.
- Advocate for strong municipal government actions for water resource protection (contact the local Conservation Commission).
- Volunteer and support the efforts of the groups below that are making a difference in the Wood & Pawcatuck Rivers watershed:
    - Wood-Pawcatuck Watershed Association: Since its inception in 1983 as a 501(c)(3) non-profit organization, the Wood-Pawcatuck Watershed Association (WPWA) has fostered a mission to promote and protect the integrity of the lands and waters of the Pawcatuck Watershed. WPWA is recognized as an outspoken voice working for those who use and enjoy the rivers. Many of WPWA's activities are directed toward educating and informing residents, visitors, and public officials about the watershed's pristine lands and water resources. WPWA plays an ongoing role in public policy formulation and debate within the watershed. As the state-designated watershed council for the Pawcatuck, WPWA has legal standing to advocate on behalf of the Wood-Pawcatuck Watershed. When necessary to serve the best interest of the watershed resource and the general public, WPWA will take a position on matters of land use, surface and groundwater use, water quality, threats to habitat, growth issues, and river corridor concerns. WPWA works in partnership with local, state, and federal agencies to encourage the watershed approach to environmental management and works on the local level with regard to specific aspects of watershed protection.
    - URI Watershed Watch (volunteer water quality monitoring)
    - Land Trusts
    - Regional/Statewide Groups:
        - Audubon Society of RI
        - Save the Bay
        - Save the Lakes
        - The Nature Conservancy

B) Local Ordinances-

Each of the ten Rhode Island towns within the Wood and Pawcatuck Rivers watershed have worked to manage water pollution and protect aquatic habitat at the local level through the passage of ordinances. Local ordinances can include groundwater protection (discussed below), OWTS management (discussed in section IV(B)), earth removal regulations, or others. An extensive discussion of municipal ordinances can be found in Appendix A of the Wood-Pawcatuck Wild and Scenic River Stewardship Plan (2018, http://wpwildrivers.org/wp/wp-content/uploads/2018/06/WandSStewardshipPlanAppendixA.pdf). Note that Stormwater and LID ordinances, where they exist, have been discussed above in Section IV(A).

Because of the importance of groundwater in the watershed, in the RI portion of the watershed, Charlestown, Exeter, Hopkinton, North Kingstown, Richmond, South Kingstown, and Westerly

all have Groundwater Protection Overlay Districts in their ordinances. The purpose of a Groundwater Protection Overlay District is to protect, preserve and maintain the quality and supply of the groundwater resources used for a present and future water supply. Groundwater also influences surface water quality and as such protections to the former can help improve quality of the latter. At the state level, groundwater is protected through regulations establishing wellhead protection areas, through high-level prohibitions of certain activities (e.g. landfills, salt storage) in areas of high-quality groundwater, and through discharge permitting. Municipal Groundwater Protection Overlays complement state-level protections by restricting or managing potential sources of pollution to the groundwater. These ordinances can help reduce the risk of accidents or illegal activity by prohibiting uses outright or making the review and approval process for such uses more stringent.

C) Open space preservation

Preserving land in the watershed in its natural state is an important tool in protecting water quality and aquatic habitat. Natural landscapes remove pollutants through natural processes such as the infiltration of stormwater into the soil and the uptake of water and nutrients by plants. Protecting areas along the shoreline of a waterbody is particularly important as these natural riparian buffers reduce the amount of pollutants that enter the waterbody and provide important wildlife habitat for the many wetland dependent species.

In addition to the ways in which open space improves water quality, it also provides improved overall environmental quality, healthy lifestyles, and economic benefits. It provides valuable wildlife habitat and migratory corridors; natural areas for groundwater recharge; recreational opportunities for hiking, biking, swimming, hunting, and fishing; pleasing scenic vistas; and often contains other historic and cultural values such as stone walls.

In Rhode Island, natural landscapes are protected through conservation easements on private lands, purchases in fee simple, and conservation development (or 'cluster') zoning provisions. Conservation easements, which permanently limit the use of the land in order to protect its conservation value, are the most common tool for conserving private lands, and for adding an additional layer of legal protection to open space land. Conservation of land is undertaken by all levels of government (local, state, federal) and non-governmental entities, including land trusts and conservation organizations. Many homeowner's associations own conservation land as part of their conservation or cluster development neighborhood.

Responsibly farmed lands can also protect water quality and aquatic habitat. As discussed in Section IV(F), conservation plans developed for farms under guidelines from RIDEM and the Natural Resources Conservation Service can be an important means to minimize the impact of agricultural operations on water quality and aquatic habitat. Farms can also be a part of a community's open space planning through the purchase of development rights. Efforts to increase

the development of conservation planning must be supported by strategies for plan implementation.

Within the RI portion of the Wood-Pawcatuck Rivers watershed area, over 52,000 acres of land are protected through fee simple ownership, easements, deed restrictions, and other legal instruments. The distribution of protected land by ownership type in each subwatershed is shown in the maps below and summarized in the following table (2019 data):

	Lower Pawcatuck River		Upper Pawcatuck River		Wood River		Total	
Ownership Structure	Acres	% of Sub-watershed	Acres	% of Sub-watershed	Acres	% of Sub-watershed	Acres	% of RI Portion of the Watershed
State Owned	10051	24.0%	9822	16.0%	19698	38.7%	39571	24.9%
Muncipally Owned	674	1.6%	169	0.3%	32	0.1%	875	0.6%
Private/NGO/Other	2499	6.0%	6267	10.2%	3352	6.6%	12118	7.9%
						Watershed Total=	52564	34.1%

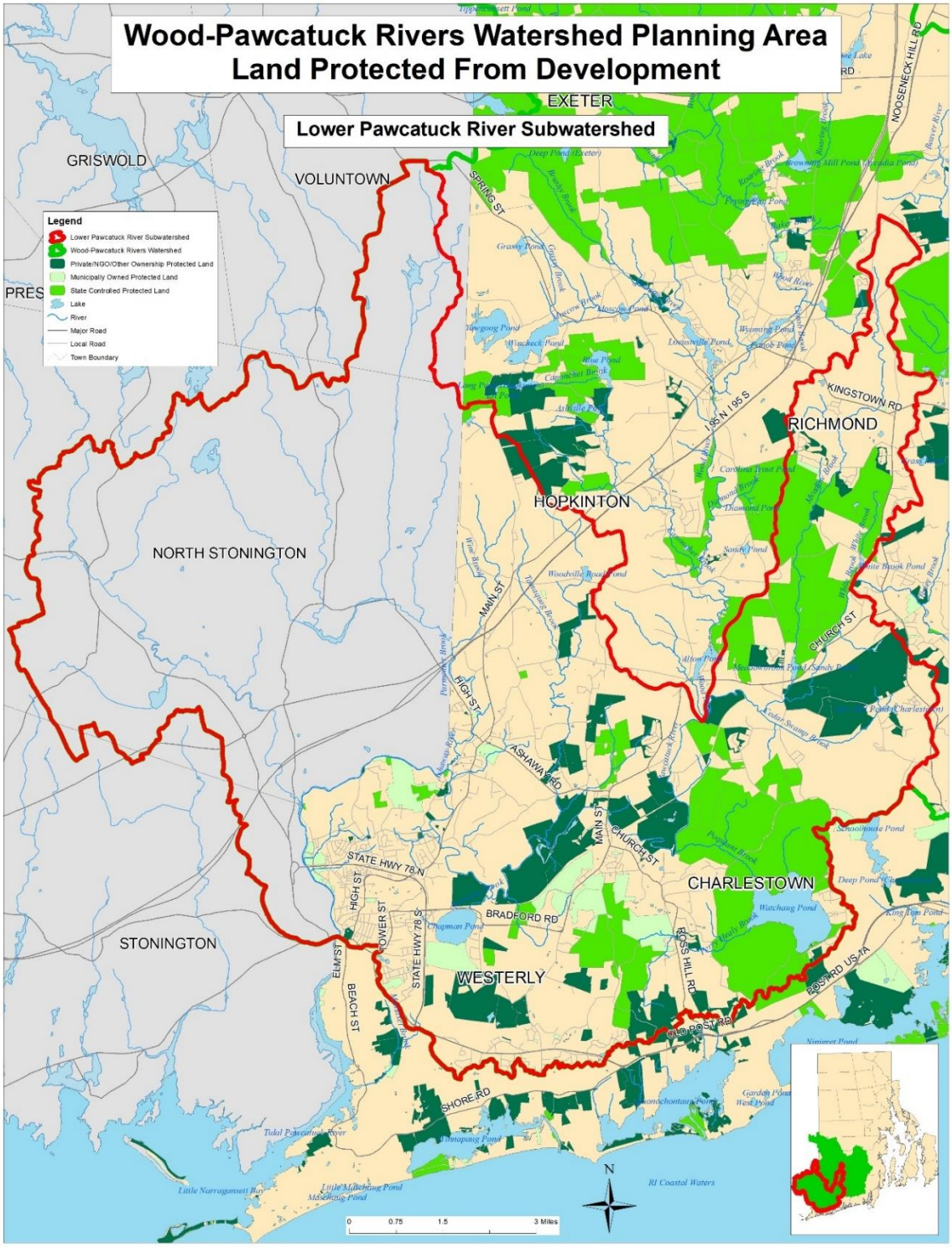
Wood-Pawcatuck Rivers Watershed Planning Area
Land Protected From Development
Lower Pawcatuck River Subwatershed
EXETER
GRISWOLD
VOLUNTOWN
PRES
NORTH STONINGTON
HOPKINTON
RICHMOND
CHARLESTOWN
STONINGTON
WESTERLY
Legend
Lower Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Private/NGO/Other Ownership Protected Land
Municipally Owned Protected Land
State Controlled Protected Land
Lake
River
Major Road
Local Road
Town Boundary
SPRING ST
KINGSTOWN RD
I 95 N I 95 S
MAIN ST
CHURCH ST
HIGH ST
ASHAWAY RD
STATE HWY 78 N
STATE HWY 78 S
BRADFORD RD
ELM ST
BEACH ST
TOWER ST
ROSS HILL RD
POST RD US 1A
OLD POST RD
SHORE RD
NOOSENECK HILL RD
Tidal Pawcatuck River
Little Narragansett Bay
RI Coastal Waters
N
0
0.75
1.5
3 Miles

Figure 35

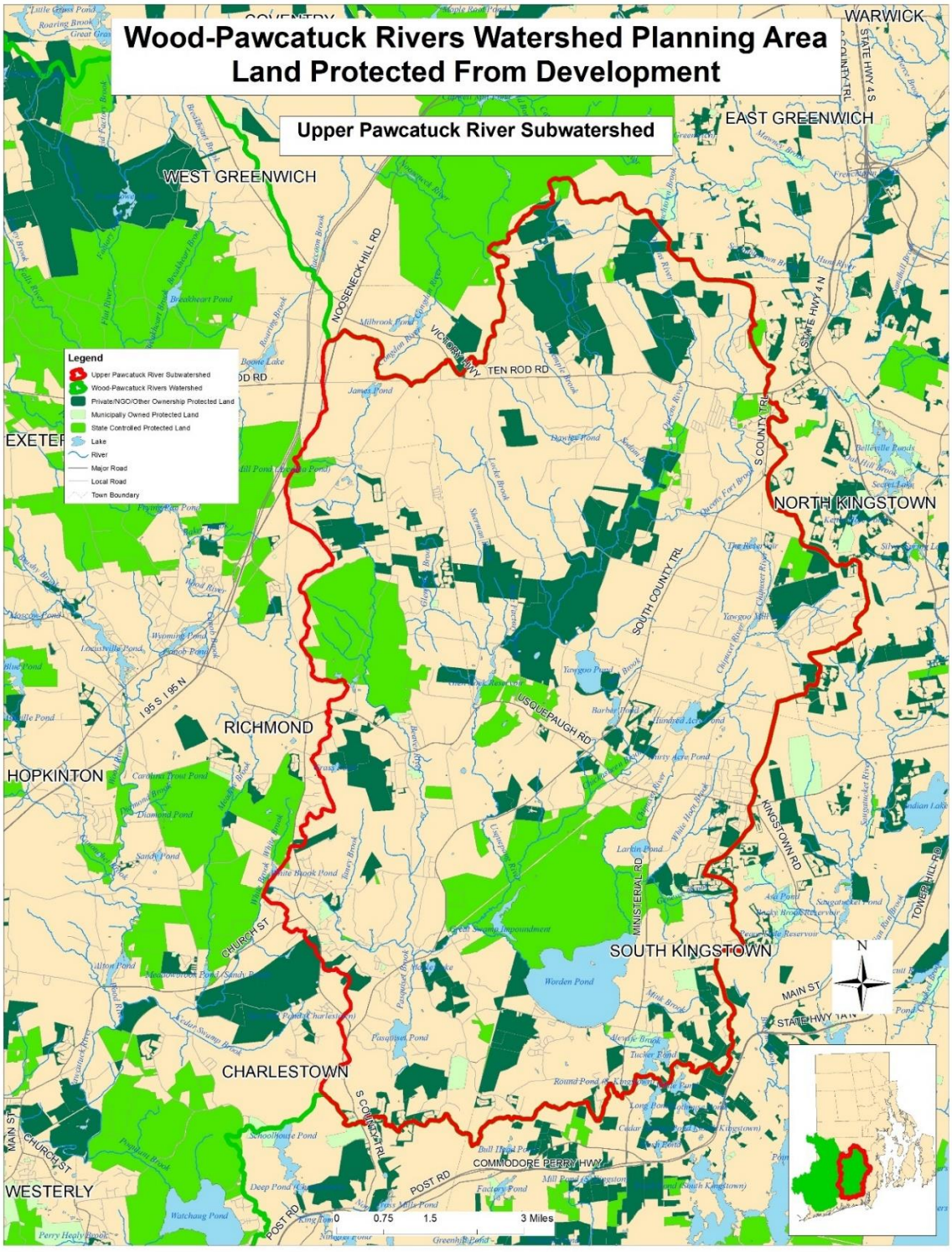
Wood-Pawcatuck Rivers Watershed Planning Area
Land Protected From Development
Upper Pawcatuck River Subwatershed
WARWICK
EAST GREENWICH
WEST GREENWICH
EXETER
NORTH KINGSTOWN
RICHMOND
HOPKINTON
SOUTH KINGSTOWN
CHARLESTOWN
WESTERLY
NOOSENECK HILL RD
TEN ROD RD
SOUTH COUNTY TRL
USQUEPAUGH RD
KINGSTOWN RD
MINISTERIAL RD
CHURCH ST
MAIN ST
POST RD
COMMODORE PERRY HWY
TOWER HILL RD
Legend
Upper Pawcatuck River Subwatershed
Wood-Pawcatuck Rivers Watershed
Private/NGO/Other Ownership Protected Land
Municipally Owned Protected Land
State Controlled Protected Land
Lake
River
Major Road
Local Road
Town Boundary
0 0.75 1.5 3 Miles
N

Figure 36

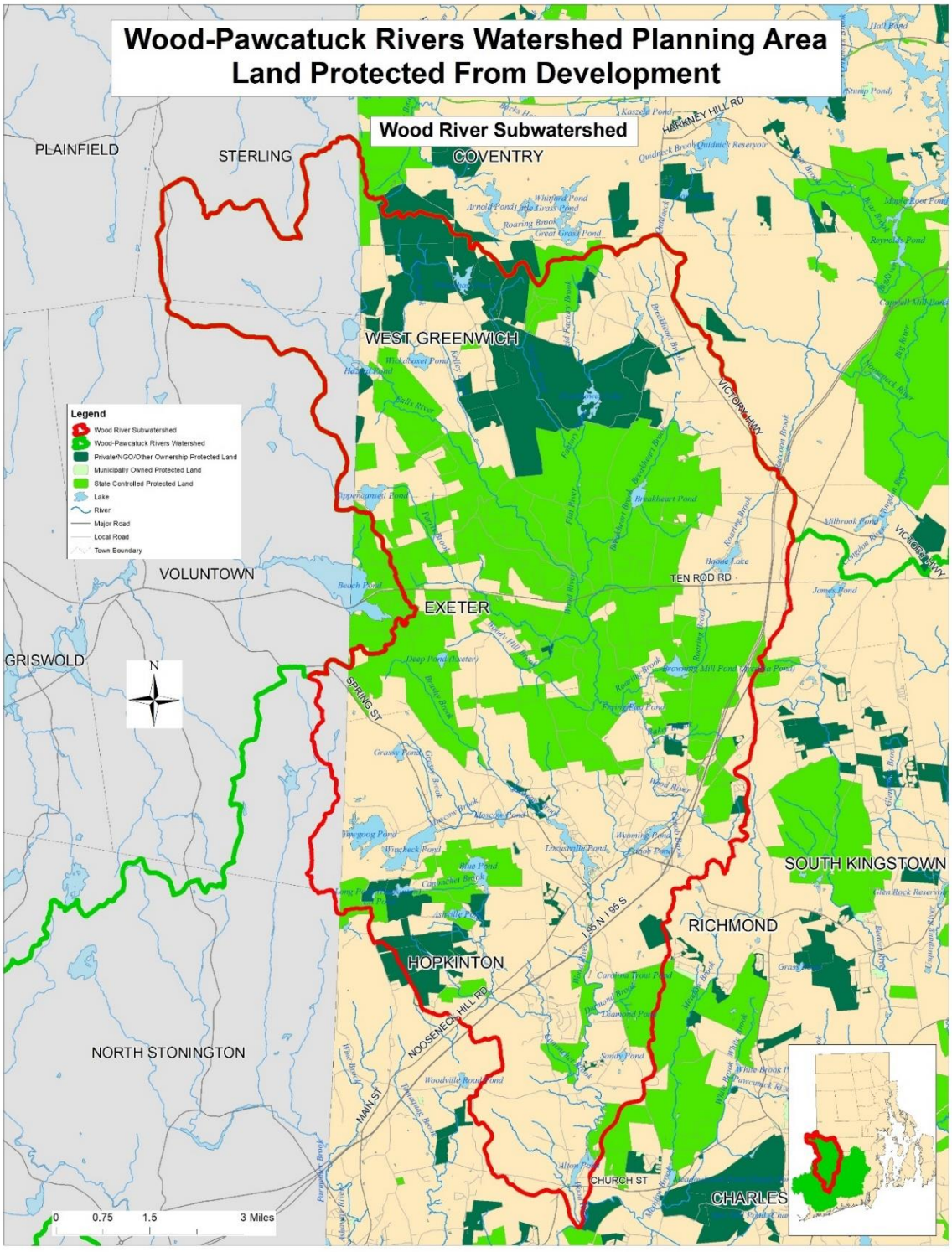
Wood-Pawcatuck Rivers Watershed Planning Area
Land Protected From Development
Wood River Subwatershed
PLAINFIELD
STERLING
COVENTRY
WEST GREENWICH
VOLUNTOWN
EXETER
GRISWOLD
SOUTH KINGSTOWN
RICHMOND
HOPKINTON
NORTH STONINGTON
CHARLES
TEN ROD RD
CHURCH ST
SPRING ST
MAIN ST
NOOSENECK HILL RD
HARKNEY HILL RD
VICTORY HWY
I 95 N I 95 S
Legend
Wood River Subwatershed
Wood-Pawcatuck Rivers Watershed
Private/NGO/Other Ownership Protected Land
Municipally Owned Protected Land
State Controlled Protected Land
Lake
River
Major Road
Local Road
Town Boundary
N
0 0.75 1.5 3 Miles

Figure 37

Moving forward, areas targeted for open space preservation should be evaluated based on the conservation organization's goals, funding sources, and an evaluation of the resource value of a piece of property (water supply, habitat value, etc.). Targeting the preservation of intact wetlands and buffers along shorelines of streams and ponds is particularly important from both a water quality protection and aquatic habitat perspective. Municipalities should consider open space acquisition in light of the opportunities for siting green infrastructure projects that can help meet restoration and management goals required under TMDLs and/or stormwater permits. Open space conservation efforts can also focus on preserving areas identified in the RI State Wildlife Action Plan as 'Conservation Opportunity Areas' (COAs). An online map of Rhode Island COAs is available on RIDEM's website here: http://www.dem.ri.gov/maps/.

The Conservation Opportunity Areas are mapped areas where a multitude of important conservation and ecosystem features overlap, including areas of large unfragmented forest, habitats of high biodiversity and high vulnerability, Ecological Land Units (ELUs) of diverse physical features, marine and estuarine systems, coastal habitats, natural corridors, and areas that are important to the species in Rhode Island with the greatest conservation need. COAs are priority areas that offer the best opportunities for conserving RI's species of greatest conservation need. The ELUs are landscapes that support ecological diversity and build in an element of resiliency, as these areas are likely to support diverse communities of plants and animals as the climate changes. The Rhode Island portion of the Wood-Pawcatuck watershed includes extensive COAs, in particular extensive large (>250 acres) forest blocks.

D) Implementation Table – "What needs to be done".

Significant work has already been done in the Wood-Pawcatuck watershed to identify specific actions to improve water quality and aquatic habitat. Two reports written within the last five years have identified many actions that can be implemented immediately as well as over the longer term. The first report is the "*Wood-Pawcatuck Watershed Flood Resiliency Management Plan*" completed in 2017, available online at: http://wpwa.org/flood_resiliency.html. Dozens of specific project ideas to reduce flooding also have co-benefits of improving water quality, aquatic habitat, and stream connectivity. The second report is the "*Wood-Pawcatuck Wild and Scenic Rivers Stewardship Plan*," June, 2018, available online at: http://wpwildrivers.org/study-committee/. Actions identified in this report will help maintain the water quality and aquatic habitat that have earned the Wood-Pawcatuck Rivers designation as a Wild and Scenic River system.

Rhode Island is fortunate to have a robust planning program that includes considerations for water quality and its relationship with other land use and activities that take place within the watershed. Rhode Island has a State-enabled Community Comprehensive Planning Program which compels each municipality to prepare and adopt a local Comprehensive Plan. These plans address natural resources, including water, and require that goals, policies, and action items be consistent throughout the plan with the other sectors addressed in the Comprehensive Plan, such as economic development, transportation, services and facilities, recreation, housing, and land use. Further, every comprehensive plan must be consistent with and embody the State's goals and policies for natural resources as found in the State Guide Plan (Water Quality 2035 is particularly relevant) and the laws of the State.

The following table includes actions identified in the Plans referred to above as well as other planning documents prepared by municipal and state government agencies. Table headings are as follows:

1) Action Item
2) Responsibility: primary responsible parties listed include municipality, state agency, non-governmental organizations, private companies, landowners, etc. Where applicable, supporting parties are indicated in parentheses.
3) Timeframe: ongoing (esp. maintenance activities), 1-2 years, 3-5 years, 5-10 years.
4) Estimated Cost: Dollar figure or relative indication of cost. For example:
   $ = <$25,000; $$ = $25,000 -- $100,000; and $$$ = >$100,000.
5) Priority, as follows:
   Required

H – High
M – Medium
L – Low

****A Note on Sources: Action items that are not specifically attributed to another document or plan are DEM recommendations based on agency policy and/or watershed planning best practices.****

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
Stormwater Management				
Ensure local land development and re-development ordinances are consistent with the RI Stormwater Design and Installation Manual. (1)	Town of Westerly	As Necessary	$	M
Consider requiring a smaller minimum threshold (than the one-acre MS4 General Permit minimum) for project size to trigger LID stormwater management and soil erosion control requirements for new and redevelopment applications. (1)	Towns	1-2	$	M
Complete LID Site Planning and Design Techniques Municipal Self-Assessment	Towns	1-2	$	H
Incorporate Low Impact Development techniques in local regulations to the maximum extent practicable.	Towns	Ongoing	$	M
Consider requiring LID techniques on projects below the 1-acre threshold in the MS4 General Permit. (1)	Town of Westerly	1-2	$	M
Conduct Structural BMP Study for densely-developed portion of TMDL study area (Downtown Westerly). (1)	Town of Westerly, RIDOT	3-5	$$	H
Determine if 6 minimum measures are sufficient to meet bacteria reduction targets outside of downtown Westerly. (1)	Town of Westerly,	1-2	$	M

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
	RIDOT			
Implement 6 Minimum Measures under RIPDES Phase II Stormwater Regulations for watershed areas of Chickasheen Brook and Barber Pond. (2)	RIDOT, Towns of Exeter, South Kingstown	1-2	$-$$	Required
Implement RIPDES Phase II, including implementation of Stormwater Management Program Plans. (3)	Towns, RIDOT	Ongoing	$-$$	Required
Implement Stormwater Utility, either be town-wide or limited to a district comprised of more densely developed areas.	Towns	3-5	$$	M
Manage stormwater to capture and remove pollutants from atmospheric deposition before discharge to surface waters. (4)	Towns, RIDOT	Ongoing	$-$$$	H
Address impaired waters by supporting and implementing TMDLs – Impaired waters are those that are impacted by pollution from stormwater runoff, development, and other human processes. Priorities should focus on river segments with greatest reduction needs (>75%) including the Ashaway River, Chickasheen Brook, Tomaquag Brook, Spring Brook, and the C and E segments of the Pawcatuck River. (5) Waterbodies with licensed beaches experiencing frequent closures should also be considered high priorities.	Towns	As Necessary	$-$$	H (implementation required)
Increase green canopy - Increase urban/suburban forest canopy cover within developed areas of the Wood-Pawcatuck Watershed to aid in stormwater quantity and quality management, while decreasing runoff temperatures. (5)	Towns, Property owners	Ongoing	$	L
Promote the use of green infrastructure techniques, such as vegetated roofs and walls in the built environment, to better manage runoff in the watersheds. (5)	Towns, Property Owners	Ongoing	$	M
Improve water quality - Use low-impact development techniques to pre-treat runoff prior to discharging to any tributaries. (5)				

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
Practice bioretention – Biorentention is a way of retaining runoff on a site using such practices as rain gardens or retention basins. They are designed to remove contaminants from the water before it runs into the river. (5)	Towns, NGOs, Property Owners	Ongoing	$-$$$	H, May be required
Publicize the benefits of bioretention areas and promote the use of these and other green infrastructure and/or low-impact development techniques for managing runoff from nearby farms and developed areas. (5)	Towns, NGOs, RIDEM	1-2	$	M
Support and promote impervious surface reduction strategies within watersheds (narrower roads, porous pavements and surfaces that absorb runoff) to reduce stormwater runoff and water temperatures. (5)	RIDOT, Towns, NGOs	Ongoing	$	L
Wastewater Management				
Write Onsite Wastewater Management Plan: Identify threats to water quality from septic systems. Evaluate the degree of threat from potential faulty and/or illicitly discharging septic systems, which may result in bacterial and nutrient contamination of nearby streams and groundwater. (5)	East Greenwich, West Greenwich	1-2	$	M
Implement OWMP	Charlestown, Coventry, Exeter, Hopkinton, Richmond, North Kingstown, South Kingstown, Westerly	1-2, Ongoing	$	M

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
Create onsite wastewater management district (1)(3)	Towns	1-2	$	M
Join the Community Septic System Loan Program	Town of Exeter	1-2	$	H
Develop community-wide wastewater plans that integrate facility planning and on-site wastewater management planning. (4)	Coventry, Westerly, South Kingstown	5-10	$$	L
Require connection to sewer systems where access exists. (4)	Towns	Ongoing	$$	L
Pet Waste Management				
Encourage proper pet waste disposal (1)(3)	Towns, NGOs	Ongoing	$-$$	M
Consider municipal ordinances requiring owners to pick up after their pets on all property. (4)	Towns	1-2	$	L
Educate the public about the impact of pet waste on water quality. (4)	Towns, NGOs, RIDEM	Ongoing	$	M
Adopt strategies for controlling pet waste at State and local public facilities. (4)	Towns, RIDEM	3-5	$	L
Wildlife/Waterfowl Waste				
Discourage the feeding of ducks and other waterfowl, particularly in waters identified as impacted by waterfowl in TMDLs. Consider local ordinances to prohibit feeding. (1)(3)(4)	Towns, NGOs	Ongoing	$	M

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
Storage Tanks				
Lawn and Turf				
Consider regulations for reduced areas of disturbance for turf and encouraging xeriscaping and alternative landscaping strategies. (4)	Towns	3-5	$	L
Encourage best practices for property owners - Reduce pollution from landscaping chemicals and reduce water consumption. Provide advice to citizens on proper use of lawn chemicals to prevent over-treatment. Encourage riparian landowners through an education campaign to minimize pesticide and fertilizer use, reduce runoff on their property, minimize impervious surfaces and maintain an appropriate buffer between the treated land and the waterway. (5)	Towns, NGOs	Ongoing	$	M
Agriculture				
Encourage agricultural BMPs to minimize livestock access to wetlands, waterbodies (1)(3)	Towns, Landowners	Ongoing	$	M
Encourage farming best management practices (BMPs) – BMPs help protect water quality and provide economic benefits. Encourage BMPs by providing financial incentives and technical assistance to farmers. (5)	Towns, NGOs, RIDEM, Federal (USDA?)	Ongoing	$-$$	M
Encourage the use of federal programs –a. Environmental Quality Incentive Program: This program provides technical and financial assistance to landowners and operators of crop or live-stock farms for planning and designing best management practices that protect the soil, air and water, increase soil	Towns, NGOs, RIDEM,	Ongoing	$	M

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
productivity, enable care for farm animals, and manage waste produced on the farm. b. Wildlife Habitat Incentive Program: Technical and financial assistance is provided through this program for landowners who want to voluntarily improve wildlife habitat or restore ecosystems on their property. c. Wetland Reserve Program: This program provides assistance for the purchase of temporary or permanent easements on farmed wetlands for water supply protection and wildlife habitat and helps to restore farmed wetlands for wildlife habitat. (5)	Federal (USDA?)			
Road Salt and Sand				
Upgrade municipal equipment and adopt new and innovative techniques for more effective control of snow and ice on roadways.(4)	Towns, RIDOT	3-5	$-$$$	L
Designate reduced salt zones near drinking water sources, and in watersheds of chloride impaired waters. (4)	Towns, RIDOT	1-2	$	H
Maintain all salt and sand storage areas and cover salt piles (public and private). (4)	Towns, RIDOT	Ongoing/Required	$-$$	H
Dispose of snow in accordance with the DEM snow disposal policy. (4)	Towns, RIDOT	Ongoing	$	M
Improve efficiency and frequency of street sweeping to remove sand applied to roads and parking areas. (4)	Towns, RIDOT, Property Owners	Onging	$$	M
Follow best practices for road salt and sand - Work with local municipal Departments of Public Works (DPW), highway departments, and the Rhode Island Departments of Transportation to promote best management practices	NGOs, RIDEM			

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
that minimize road salt and sand runoff to wetlands, streams, and rivers. Research alternatives to road salt and encourage towns to use them. (5)				
Restore streambeds - Restore streambeds impacted by road sand deposition and seek solutions to reduce future road sand and other sedimentation. Involve town DPWs and RIDOT as appropriate. (5)	Towns, NGOs, RIDOT, RIDEM	5-10	$$$	L
Marine and Riverine Debris				
Reduce Marine and Riverine Debris- Educate boaters, anglers, and others recreating on or near rivers to ensure trash and debris is properly contained on land and on boats to minimize release to the environment. (4)	Towns, NGOs, RIDEM	Ongoing	$	L
Wetland Protection and Restoration				
Include maps of all tributary streams, wetlands and other sensitive areas within community comprehensive plans. (4)	Towns	5-10	$	L
Protect water flow - Maintain, protect, and enhance water flow regimes that support the habitat requirements of native river fauna, while accommodating demands for water supply, waste assimilation, commercial, industrial, and agricultural uses. (5)	State, Towns	Ongoing	$-$$	H
Support State efforts to enhance wetland protection, with particular emphasis on vernal pools. (5)	Towns	Ongoing	$	M
Target wetlands and ample buffers for open space protection strategies, including purchases, easements, and through alternative zoning techniques	Towns	Ongoing	$$-$$$	M

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
that require open space. Focus on assemblage of large areas of protected land in order to provide better protection for wetlands. (5)				
Encourage the restoration of wetlands and their buffers on public and private property. (5)	Towns	3-5	$	L
Buffer Protection				
Protect riparian buffers – Riparian buffers protect water quality as well as provide habitat and scenic value. Encourage protection of these buffers and establish replanting programs where feasible. Preserve forest canopies over coldwater fisheries resources to ensure streams remain shaded. (5)	Towns	Ongoing	$	H
Protect riparian zones - Work with the states, local communities and land-owners to protect riparian zones from unnecessary clearing and land alteration. (5)	Towns, NGOs	Ongoing	$	H
Conduct stream assessments to identify and repair manmade bank disturbances and/or erosion impacting natural structure and reducing riparian vegetative cover. (5)	Towns, NGOs, RIDEM	3-5	$$	L
Engage utility companies - Work with private and public utility companies on creating and updating utility corridor management plans that recognize the importance of maintaining healthy wetlands, stream and river riparian buffers, and of reducing the use of chemical pesticides in or near these sensitive areas. (5)	Towns, RIDEM(?)	3-5	$$	L
Protect forested riparian areas along rivers and streams to promote improved water quality, wildlife diversity, enhanced aesthetics, and reduced flooding. (6)	Charlestown	Ongoing	$-$$$	H
Invasive Species (AIS and terrestrial)				

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
Monitor invasive species – Work with state agencies to monitor the presence of species that have the ability to thrive and spread aggressively outside their native range, both aquatic and land-based. Help local communities find out about methods for control and eradication. Communicate with and educate the public for prevention and control. (5)	Towns, RIDEM	Ongoing	$	H
Monitor invasive aquatic weeds - Where feasible as time and funding permit, conduct baseline mapping of aquatic invasive weeds along the rivers using Rhode Island state guidelines. Additionally, those areas previously mapped should be periodically revisited to determine if any invasive plant growth has occurred. (5)	Towns, NGOs, RIDEM	Ongoing	$	M
Encourage native plantings - Encourage landscaping using native plants, at home and at businesses, to support native wildlife, particularly pollinators. Planting native species reduces the potential for new invasive species from other areas to establish themselves in the watershed (5)	Towns, NGOs	Ongoing	$	M
Organize clean-up efforts to reduce invasive plants - Support biodiversity in riparian habitat by organizing river clean-up days with local volunteers to remove common terrestrial non-native invasive species such as Japanese knotweed, Japanese barberry, Asian bittersweet, and glossy buckthorn. (5)	NGOs, RIDEM	As needed	$$	L
Encourage clean boating - Educate boaters to make sure boat hulls are clean before putting in to limit the spread of aquatic invasive "hitchhikers." (5) Strategies can include: -Post signs warning of non-native invasive aquatics at boat launch sites, reminding boaters to check their boats for hitchhiking plants. -Provide educational materials for lake and pond associations on invasive terrestrial and aquatic flora and fauna, including the proper cleaning of boats and motors to prevent transport and spread of aquatic invasives.	RIDEM, Towns, NGOs	Ongoing	$-$$	H

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
-Present programs and prepare articles for local media to educate the broader public about aquatic invasives, how to identify them, and things individuals can do to prevent the establishment and spread of aquatic invasives.				
Water Withdrawals				
Protect water flow - Maintain, protect, and enhance water flow regimes that support the needs of native river plants and animals, while accommodating demands for water supply, waste assimilation, commercial, industrial and agricultural uses. (5)	Towns, RIDEM	Ongoing	$-$$$	H
Work with the R.I. Water Resources Board to finalize and implement an approach for managing and allocating groundwater within the Chipuxet River basin.	State (WRB, DEM), Towns	2-4	$$	M
Encourage rainwater reuse - Actively promote rainwater harvesting and reuse. Encourage communities to consider requirements for capture and storage of rainfall for non-potable water uses on development projects to help better manage stormwater runoff and reduce the use of potable water. Encourage all landowners in methods of returning water to the ground instead of running off the property, including the use of rain barrels and rain garden installation.	Towns, NGOs	Ongoing	$	L
Stream Habitat Connectivity				
Prevent brook impoundments in Chickasheen Brook (2)	RIDEM, Adjacent property owners	Ongoing	$	L

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
Protect drainage - Protect and restore natural drainage patterns where feasible through stream restoration projects. One type of restoration is "daylighting," which redirects or uncovers previously buried streams. (5)	Towns, RIDOT	5-10	$$-$$$	L
Conserve contiguous habitat – Continue to work with communities, state agencies, local land trusts and other non-profit entities to identify conservation strategies that will provide contiguous habitat, corridors, and linkages among habitat types to address the needs of diverse plant and wildlife populations. (5)	Towns, NGOs, RIDEM	Ongoing	$$-$$$	L
Protect land corridors - Focus on creating land protection corridors, dis-persal and migratory wildlife routes through which terrestrial and aquatic flora and fauna will be able to move and adapt, as climate disturbance in-creasingly impacts biological processes and drives species north. (5)	Towns, NGOs, RIDEM	Ongoing	$$-$$$	M
Protect brooks - Protect small, cold, headwater brooks, which are necessary for reproduction and rearing of juvenile fish and thermal refuge during periods of high temperatures. (5)	Towns, NGOs, RIDEM	Ongoing	$$	H
Improve culverts and crossings - Improve stream habitat by replacing and/or upgrading poorly designed culverts and other stream crossings. (See recommendations in the Wood-Pawcatuck Watershed Flood Resiliency Management Plan). (5)	Towns, RIDOT	3-5	$$-$$$	H
Support fish passage projects on the all the designated rivers. These include constructing structures such as fish ladders and nature-like rock ramps. (5)	Towns, NGOs, RIDEM	3-5	$$$	M
Consider removal of unused dams – This process should involve the communities to ensure that important functions of the dams are taken into account. (5)	Towns, RIDEM, Dam Owners	5-10	$$$	L
Climate Change Resiliency (see also Stormwater; Wetland Protection and Restoration)				

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
Take action on findings of the *Wood-Pawcatuck Watershed Flood Resiliency Management Plan*: Appendices G and M of the management plan identify specific ideas and locations for projects such as dam, bridge, and culvert improvements and green infrastructure installations. (7)	Towns, RIDEM, RIDOT	1-3	$$-$$$	H
Implement land-protection and habitat restoration findings of NBEP-funded Beaver River Watershed Assessment upon project completion.	Town of Richmond	3-5	$-$$$	M
Open Space/ Conservation				
Conserve land - Conserve undeveloped and sensitive land within the Wood-Pawcatuck Watershed, particularly within one-quarter mile of the Wild and Scenic River segments, to limit impervious cover and mitigate the effects of urbanization. Corridor protection strategies that prevent or limit placement of infrastructure within the corridor will protect the river system from future erosion and flood losses (3)(5)	Towns, NGOs, RIDEM	Ongoing	$$-$$$	M
Work with local land trusts, non-government agencies, and state agencies to identify and develop a priority list of important habitat parcels. (5)	Towns, NGOs, RIDEM	2-4	$	M
Purchase properties and conservation easements to directly protect land by permanently prohibiting clearing forests and building structures in or near the rivers. (5)	Towns, NGOs, RIDEM	Ongoing	$$$	M
Protect habitats and corridors identified as high priority by the Rhode Island Natural Heritage Programs and the State Wildlife Action Plan. (5)	Towns, NGOs, RIDEM	Ongoing	$$$	H
Encourage land conservation easements and restrictions - Educate and encourage landowners to consider Conservation Easements (CE) and the importance of maintenance and enforcement of these restrictions. Consider	Towns	Ongoing	$$	L

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
providing funding to budget-strapped local land trusts whose lack of capacity makes it difficult to do the required annual monitoring of all CEs. (5)				
Encourage current use programs - Encourage conservation and the preservation of existing forest, farm, and recreational land through programs such as Farm, Forest, and Open Space. These programs can be used by landowners who want to keep their land in open space but are not able or willing to execute a permanent conservation restriction/easement agreement. (5)	Towns, RIDEM	Ongoing	$	L
Consider density of development in Growth Centers (Cross Mills, Carolina, Shan-nock) while preserving rural areas from development (6)	Charlestown	Ongoing	$	L
Implement conservation design in subdivision zoning regulations that set high standards for the quality and configuration of the resulting open space and contribute to creating an interconnected network of open space throughout the community. (6)	Charlestown	2-4	$	M
Promote establishing protective undeveloped zones along water resources and other habitats through the use of setbacks, design standards, exactions, open space dedication. (6)	Charlestown	3-5	$	L
Groundwater/Drinking Water Protection				
Include overlay protection zones within zoning ordinances for sensitive resources (e.g., aquifer recharge areas, wellhead protection areas, drinking water reservoir watersheds, etc.). (4)	Towns	2-4	$-$$	M
Consider ordinances prohibiting heating oil USTs, particularly in areas dependent on private wells and in wellhead protection areas. (4)	Towns	3-5	$	L
Municipalities consider adopting more stringent standards for siting and operation of above ground storage facilities. (4)	Towns	5-10	$	L

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
Plan for pollutant spills - Ensure that the affected towns' public works, fire, or police departments, and both states, have emergency plans for accidental pollutant spills and have equipment for such emergencies on hand. (5)	Towns	1-3	$-$$$	H
Promote aquifer protection - Promote extended aquifer protection through land use regulations, acquisitions, and landowner stewardship. (5)	Towns	Ongoing	$-$$$	M
Preserve hydrology - Work with planning boards, town engineers, conservation commissions and developers, and landowners to consider maintaining or restoring predevelopment hydrology in order to protect groundwater recharge capability. Appropriate techniques include limiting impervious surfaces, rainwater harvesting, the use of swales and other low-impact development measures, and best management practices that assist infiltration. Post-development runoff cannot be greater than pre-development levels, which is why each town needs staff that is capable of interpreting stormwater calculations. (5)	Towns	Ongoing	$$	M
Lakes and Ponds Management				
Develop lake management plans: Identify threats to water quality and develop strategies to identify and implement BMPs to preserve or restore water quality and aquatic habitat.	Towns, NGOs	1-3	$-$$	H
Implement lake management plans.	Towns, NGOs	3-5	$-$$$	M
Monitoring and Evaluation				
Monitor water quality - Ensure that state and local organizations such as URI Watershed Watch, a volunteer, citizen-based water monitoring program, continue monitoring and capturing data from geographically representative	NGOs, RIDEM	Ongoing	$$	H

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
sites. Collect stream flow and water quality data as needed to support the protection of these resources. (5)				
Continue to operate USGS river gages - Ensure continued monitoring of the US Geological Service (USGS) gages on the Beaver, Queen, Usquepaugh, Shunock, Wood and Pawcatuck Rivers. Two of the gages on the Pawcatuck River have been operating and providing water flow records since 1940. (5)	USGS	Ongoing	$$	H
Public Education (see also specific topics for additional education needs)				
Encourage rainwater reuse - Actively promote rainwater harvesting and reuse. Encourage communities to consider requirements for capture and storage of rainfall for non-potable water uses on development projects to help better manage stormwater runoff and reduce the use of potable water. Encourage all landowners in methods of returning water to the ground instead of running off the property, including the use of rain barrels and rain garden installation. (See Rhode Island Drought Management Plan) (5)	Towns, NGOs	Ongoing	$	L
Raise awareness about streams - Collaborate with anglers' organizations, aquatic biologists, naturalists, local school systems, and others to increase public awareness and appreciation of how headwater streams work. Focus on minimum low flows, the recreational value of coldwater fisheries, and the ways that individuals can both enjoy and contribute to sustaining these remarkable resources. Conduct outreach focused on engineers who develop stormwater systems for projects, municipal members of planning and conservation boards, and others whose decisions affect stormwater management and land use change. (5)	Towns, NGOs	Ongoing	$	M
Raise awareness about invasives - Post signs warning of non-native invasive aquatics at boat launch sites, reminding boaters to check their boats for	Towns, NGOs	Ongoing	$	H

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
hitchhiking plants. Provide educational materials for lake and pond associations on invasive terrestrial and aquatic flora and fauna, including the proper cleaning of boats and motors to prevent transport and spread of invasives. Present programs and prepare articles for local media to educate the broader public about aquatic invasives, how to identify them, and things individuals can do to prevent the establishment and spread of invasives. (5)				
Engage the public - Engage with residents and others in the watershed on ecological issues, particularly with regard to recognizing that the streams, streambanks, and riparian areas, including riparian buffers and corridors, are sensitive places that might be conserved, restored, and protected. (5)	Towns, NGOs	Ongoing	$	L
Pursue education opportunities - Pursue opportunities to educate landowners, developers, and local land use boards about the causes of nonpoint-source pollution, its potential impacts on water quality and instream resources, and methods—such as best management practices—for reducing or eliminating it. Pursue opportunities to demonstrate the use of best management practices such as expanding riparian native vegetation buffers to control non-point-source pollution. (5)	Towns, NGOs	Ongoing	$	L
Engage school-aged children – Work with local schools to conduct educational and recreational programs so children will learn about and understand the importance of the rivers to their communities. Champion the river as a classroom with “on-water education” and field trips to the rivers. (5)	Towns, NGOs	Ongoing	$	M
Teach watershed science to teachers - conduct courses for teachers in the use of the AWESome (ACTIVE WATERSHED EDUCATION) Curriculum. (5)	Towns, NGOs	Ongoing	$	L
Teach watershed science to citizens - Educate citizens about the geographic extent and functions of the rivers in the Wood-Pawcatuck Watershed, the specific needs for protection of and improvement to the rivers systems, and the benefits of a healthy watershed to individuals and communities. (5)	Towns, NGOs	Ongoing	$	L

Action Item (Listed by Management Topic)	Responsible Party	Timeframe	Cost Estimate	Priority
Promote stewardship - Encourage the public to speak out on issues and to participate in the stewardship of the proposed designated area. (5)	Towns, NGOs	Ongoing	$	L
Build an educational network - Encourage organizations with existing education and outreach programs to continue and expand their efforts, through cooperation among those organizations. Develop methods to provide information and education about the Wood-Pawcatuck Watershed. (5)	Towns, NGOs	Ongoing	$	L
Further Study Needs/ Gaps in Information				
Address data gaps - Support the Rhode Island State Wildlife Action Plan and RIDEM coldwater fishery programs to address data gaps in brook trout population and status. (5)	RIDEM, NGOs	Ongoing	$	L
Plan Implementation, Coordination, and Follow-up				
Consider water in land use planning - Ensure that land use planning includes adequate water supply resources, stormwater drainage systems, and wastewater treatment systems (both onsite and centralized wastewater treatment systems) as well as permanent and temporary soil stabilization techniques and groundcover for all disturbed areas (5)	Towns	Ongoing	$	M
Coordinate with State of Connecticut as appropriate when updating this watershed plan or when a plan is prepared for the Connecticut portion of the watershed.	Towns, RIDEM, NGOs	Ongoing	$	M

Sources:
(1) Total Maximum Daily Load Analysis for the Pawcatuck River and Little Narragansett Bay Waters: Bacteria Impairments (RIDEM 2010)

(2) Total Phosphorus TMDL for Chickasheen Brook, Barber Pond, and Yawgoo Pond, Rhode Island (RIDEM 2004)
(3) Rhode Island Statewide Total Maximum Daily Load for Bacteria Impaired Waters- Waterbody Summaries (RIDEM 2011)
(4) Water 2035- State Guide Plan Element
(5) Wood-Pawcatuck Wild and Scenic Rivers Stewardship Plan (2018) (Includes Mason and Associates Municipal Ordinance Report)
(6) Wood/Pawcatuck Wild and Scenic Stewardship Plan Appendix A (Mason & Associates Summary of Municipal Plans and Ordinances)
(7) Wood-Pawcatuck Watershed Flood Resiliency Management Plan (2017)

[5]Wood Pawcatuck Watershed Action Plan (2008): https://wpwa.org/wp-content/uploads/2018/04/Watershed-Action-Plan-revised-2008.pdf Accessed October 2019

VII. Financial Support/Implementation Tools

Funding assistance for water quality and aquatic habitat protection and restoration actions is available from various government and private sources. This section provides a brief program overview and contact agency for financial assistance that may be used to implement some of the actions in this plan.

A. Federal Clean Water Act, Section 319 Nonpoint Source Implementation Grants

Section 319 Grants are available for projects to protect and restore water quality through reducing and managing nonpoint source pollution and for projects restoring aquatic habitat. Projects must be consistent with the goals and actions in the USEPA approved RI Nonpoint Source Management Program Plan. These grants are made possible by federal funds provided to RI DEM by the USEPA under Section 319 of the Clean Water Act.
Eligible applicants: Projects must be in watershed with a watershed plan; municipal, state, or regional governments, quasi-state agencies, public schools and universities, and non-profit watershed, environmental, or conservation organizations.
Contact: RI DEM's Office of Water Resources

B. R.I. Infrastructure Bank, Clean Water State Revolving Fund Loans

The Clean Water State Revolving Fund is a federal/state partnership designed to finance the cost of infrastructure needed to achieve compliance with the Clean Water Act. The program is available to fund a wide variety of water quality projects including: 1) Traditional municipal wastewater treatment projects; 2) contaminated runoff from urban and agricultural areas; 3) wetlands restoration; 4) groundwater protection; 5) Brownfields remediation; and 6) estuary management. Through this program, Rhode Island maintains revolving loan funds to provide low-cost financing for a wide range of water quality infrastructure projects. Funds to establish or capitalize these programs are provided through federal government grants and state matching funds. The interest rate charged to the Clean Water State Revolving Fund is one-third off the borrower's market rate.
Eligible applicants: Statewide, including municipal, state, or regional governments, quasi-state agencies. Funds are awarded to projects based on ranking of environmental benefits of the project, readiness to proceed, and availability of funds.
Contact: RI DEM Office of Water Resources; Rhode Island Infrastructure Bank

In addition to the overall Program described above, the Rhode Island Infratstructure Bank manages the following two OWTS related programs:

Community Septic System Loan Program

The Community Septic System Loan Program allows homeowners in participating communities to obtain no-interest loans to repair or replace failed, failing, or substandard onsite wastewater treatment systems. These individual loans are funded from a Clean Water State Revolving Fund loan to a community and are administered locally by Rhode Island Housing. The loans to homeowners are interest-free, with borrowers only subject to a $300 loan origination fee and a 1% annual servicing fee on the outstanding loan balance. Residents may borrow up to $25,000 with a term of up to ten years (maximum loan amount varies by community).

Eligible applicants: Statewide. Municipal partcipation requires RI DEM approval of an onsite wastewater management plan. Funds are awarded to communities based on ranking of environmental benefits of the project, readiness to proceed, and availability of funds.
Contact: RI DEM Office of Water Resources; Rhode Island Infrastructure Bank

Sewer Tie-In Loan Fund

Modeled after the Community Septic System Loan Program, the Sewer Tie-In Loan Fund allows owners of existing homes to access funds to connect to the local sewer system. Individual loans are funded from a Clean Water State Revolving Fund loan to a sewer system owner and are administered locally by Rhode Island Housing. The loans to homeowners are interest-free, with borrowers only subject to a $300 loan origination fee and a 1% annual servicing fee on the outstanding loan balance. Residents may borrow up to $10,000 with a term of up to five years (maximum loan amount varies by community).
Eligible applicants: Statewide. Funds are awarded to communities based on ranking of environmental benefits of the project, readiness to proceed, and availability of funds.
Contact: RI DEM Office of Water Resources; Rhode Island Infrastructure Bank

C. Narragansett Bay and Watershed Restoration Bond Fund

State funds approved by RI voters are periodically available from this Bond Fund to restore and protect the water quality, and enhance the economic viability, environmental sustainability and resiliency of Narragansett Bay and the state's watersheds. The Fund is meant to provide funding assistance for the feasibility analysis, design, and construction of means to control nonpoint sources of pollution, stormwater pollution control projects, riparian buffer and aquatic habitat restoration projects.
Eligible applicants: Statewide; municipal, state, or regional governments; quasi-state agencies, public schools and universities, and non-profit watershed, environmental, or conservation organizations; and non-governmental for profit businesses, private schools.
Contact: RI DEM Office of Water Resources

D. EPA Southeast New England Coastal Watershed Restoration Program (SNEP)

The US EPA Southeast New England Coastal Watershed Restoration Program brings together partnerships to protect and restore coastal watersheds of southeast New England from Westerly to Cape Cod. The Program seeks projects and partnerships that leverage multiple resources to generate collaboration to implement innovations and efficiencies in ecosystem management.
Eligible applicants: Municipalites, non-profit organizations, and research/educational institutions.
Contact: EPA Region 1, Southeast New England Coastal Watershed Restoration Program; Narragansett Bay Estuary Program; RI DEM Office of Water Resources

E. U.S. Department of Agriculture Natural Resources Conservation Service Grants

Environmental Quality Incentives Program (EQIP)

This is a voluntary conservation grant program designed to promote and stimulate innovative approaches to environmental enhancement and protection, while improving agricultural production. Through EQIP, farmers and forestland managers may receive financial and technical help to install or implement structural and management

conservation practices on eligible agricultural and forest land. Examples of eligible EQIP activities include practices for farm waste storage, nutrient management, riparian buffers and stream bank improvements, wetland restrictions, and groundwater and surface water conservation activities. EQIP payment rates may cover up to 75 percent of the costs of installing certain conservation practices.

Eligible applicants: Any person engaged in livestock, agricultural production, aquaculture, shellfishing, or forestry on eligible land.

Contact: USDA NRCS – RI State Office/Service Center

Wildlife Habitat Incentives Program (WHIP)

This program is a voluntary program for landowners who want to develop and improve fish and wildlife habitat on private agricultural land, non-industrial private forest land, and tribal land. Through WHIP, farmers and forestland managers may receive financial and technical help to develop upland, wetland, aquatic, and other types of wildlife habitat on their property. The current focus of WHIP in RI is on coastal habitats, freshwater wetlands, vernal pools, riparian habitats, upland habitats of State significance (early successional habitats), and the restoration of native habitats impacted by invasive species.

Eligible applicants: Any person owning private agricultural land, non-industrial private forest land, or tribal land.

Contact: USDA NRCS – RI State Office/Service Center

Easement Programs

NRCS offers various easement programs to landowners who want to maintain or enhance their land in a way beneficial to agriculture and/or the environment. NRCS provides technical help and financial assistance to protect private lands through a variety of programs. These programs include the Farm and Ranch Land Protection Program, the Grasslands Reserve Program, the Healthy Forests Reserve Program, and the Wetlands Reserve Program.

Eligible applicants: Private landowners.

Contact: USDA NRCS – RI State Office/Service Center

F. Healthy Watersheds Consortium Grant Program

The Healthy Watersheds Consortium (HWC) was launched in summer 2015 and is a partnership between the U.S. Endowment for Forestry and Communities, the U.S. Environmental Protection Agency, and the USDA Natural Resources Conservation Service. The goal of the HWC Grant Program is to accelerate strategic protection of healthy, freshwater ecosystems and their watersheds, with a primary focus on prevention of land deterioration in the watershed by:

- Developing funding mechanisms, plans, or other strategies to implement large-scale watershed protection, source water protection, green infrastructure, or related landscape conservation objectives;
- Building the sustainable organizational infrastructure, social support, and long-term funding commitments necessary to implement large-scale protection of healthy watersheds; and
- Supporting innovative or catalytic projects that may accelerate funding for or implementation of watershed protection efforts, or broadly advance this field of practice.

Eligible Applicants: Not-for-profit 501(c)(3) organizations, for-profit companies, tribes, intertribal consortia, interstates, state, and local government agencies including water utilities and wastewater facilities, and colleges and universities.
Contact: EPA Healthy Watersheds Protection Consortium Grant Program

G. Community Development Block Grants

Title 1 of the Housing and Community Development Act of 1974 authorized the Community Development Block Grant program. The program is sponsored by the US Department of Housing and Urban Development, and the Rhode Island program is administered through the State of Rhode Island Office of Housing and Community Development. These grants include water and sewer system improvements.
Eligible applicants: Municipalities
Contact: R.I. Department of Administration, Division of Planning, Office of Housing and Community Development

H. State Open Space Grants

RI DEM administers a grant program to facilitate land conservation relying on State bond funding and Federal program funds. Local Open Space Grants provide up to 50% matching funds to preserve valuable open space through ownership or easements.
Eligible Applicants: Municipalities, land trusts, watershed councils, and non-profit organizations.
Contact: RI DEM Office of Planning and Development

I. Land Trusts

Land trusts seek to preserve open spaces, natural areas, scenic character, watersheds, drinking water sources, farmland, forests, historic sites, and shorelines that uniquely define communities. Land can be held by a land trust in outright ownership or by means of holding a conservation easement that permanently limits the use of the land in order to protect its conservation value.

VIII. Evaluation -- Monitoring and Measuring Progress

Water Quality Monitoring

Wood-Pawcatuck Watershed Association Volunteer Monitoring Program
The overall goals of WPWA's water quality sampling program are to track the status of waterbodies in the watershed, to monitor trends in water quality (stable, improving, or declining), and to identify water quality problems which need further investigation. The Wood-Pawcatuck Watershed Association (WPWA), working closely with the University of Rhode Island's Watershed Watch program, other local partners, and volunteers, conducts water quality monitoring at various locations throughout the watershed. Over the past 26 years, WPWA has performed water quality sampling at 165 sites in the watershed, contributing over 70,000 data points to Watershed Watch. At present, there are approximately 50 active monitoring locations that are sampled for a suite of parameters from April to October each year. WPWA is in the process of modifying its monitoring program to develop a more targeted program that will help focus on locations with water quality and flooding issues, which will be more effective in helping to identify potential sites for water quality improvement.

State Water Quality Monitoring Programs

Under the Clean Water Act, water quality in the Wood-Pawcatuck watershed is monitored on a regular basis by RI DEM. Using a "Rotating Basin" approach, sampling is conducted in a different region of the state on a five-year schedule, meaning data is collected in the Wood and Pawcatuck basins roughly every five years. The Wood and Pawcatuck Rivers watersheds are large enough that the total watershed area is divided between two assessment units. In addition, data is gathered by the United States Geologic Survey on an ongoing basis at a network of fixed sites on larger rivers like the Pawcatuck. Waterbodies are assessed to determine whether they are able to support designated uses such as aquatic life and wildlife, primary contact recreation, and fish consumption. RI DEM has used 121 sites within the Wood-Pawcatuck watershed for water quality monitoring although not all sites are used in every assessment rotation.

Examples of statewide programs:

-RI DEM Rotating Basin Assessments of Rivers and Streams (http://www.dem.ri.gov/programs/water/quality/surface-water/river-monitoring.php)

-HEALTH beach monitoring: There are 12 licensed freshwater beaches in the Wood & Pawcatuck Rivers watershed monitored by HEALTH. During the summer months, a map is available online from this page: https://health.ri.gov/data/beaches/.

-URI Watershed Watch (https://web.uri.edu/watershedwatch/): Trained volunteer monitors obtain water samples from waterbodies throughout Rhode Island and adjacent Connecticut and Massachusetts. Data supports scientific research by a variety of state and federal agency partners.

Measuring Progress

There are several indicators of progress that can be used to measure and document improvements in water quality and aquatic habitat protection and restoration in the watershed. The most direct and straightforward indicators are water quality measurements such as dissolved oxygen levels or concentrations of bacteria, nitrogen, and phosphorus. Water quality monitoring data for these parameters can be compared with the water quality criteria for the waterbody classification. Monitoring can extend to biological indicators such as aquatic macroinvertebrates and anadromous fish. Biological monitoring can look at species population levels, species composition, and/or contaminant levels in tissues.

Indirect indicators of water quality reflect the ecological implications of the direct indicators discussed above. Examples of indirect indicators of pollutant loads in the Wood and Pawcatuck River watersheds include:

- Change in trophic status.
- Number of algae blooms observed in lakes.

Indicators to measure improvements to the health of aquatic habitat include:

- Number of waterbodies without aquatic invasive species (AIS).
- Total stream miles with improved stream connectivity due to removal of barriers.
- Acres of damaged wetlands and buffers restored.

An additional way to measure progress is to systematically track the implementation of the actions in the Implementation Table. Taking this a step further, the programmatic performance indicators below may be used to measure plan implementation. Although these actions are not a measure of

direct environmental improvements, they are assumed to contribute to water quality and aquatic habitat improvements.

Some potential performance indicators for water quality and aquatic habitat improvements include:

- Number of stormwater BMPs installed.
- Number of substandard or failing septic systems upgraded or connected to sewer system.
- Number of illicit discharges discovered compared with percent that are corrected.
- Acreage of open space/ percent of watershed in conservation.
- Acreage of wetlands protected, and acreage/percent degraded that are restored.
- Number of watershed projects implemented to improve and protect wetlands.
- Acreage of buffers protected, and acreage/percent degraded that are restored.
- Number of watershed projects implemented to improve and protect riparian buffers.
- Number of stream connectivity projects implemented/ percent of substandard crossings improved for connectivity.
- Number/percent of lakes managed for AIS with a Lake Management Plan.
- Municipal progress in implementing strategies for improved OWTS, Stormwater, and LID programs.
- Increase in impervious area that is connected to stormwater treatment , i.e., area that is disconnected.
- Number of contact hours of educational outreach attained.
- Awareness among residents and other targeted audiences as measured by surveys.

The planning process is on-going. Once the plan is adopted, success toward implementing the plan should be regularly evaluated and the plan must then be updated accordingly.

IX. Further Reading

As discussed in the Introduction, this plan is intended as a high-level overview of the issues and potential actions relating to water quality and aquatic habitat within the Wood and Pawcatuck Rivers watershed. When considering specific places, pollutants, habitats, or potential actions, the reader is directed to additional targeted plans, studies, and reports. Examples include:

- Wood and Pawcatuck Rivers Wild and Scenic River Study Documents
- Wood and Pawcatuck Rivers Flood Resiliency Study
- RIDEM Water Quality Restoration Plans (TMDLs)
- Municipal Stormwater Management Plans
- Municipal Onsite Wastewater Management Plans
- Municipal Wastewater Facility Plans
- Municipal Comprehensive Plans
- NRCS Farm Plans
- State Guide Plan Elements
    - Water Quality 2035
    - Land Use 2025: Rhode Island's State Land Use Policies and Plan
- Specific Sub-watershed and Lake Management Plans

- Invasive Species Management Plans
- Riparian Buffer Plans
- Habitat Restoration Plans (wetland restoration, stream connectivity)
- RI Department of Health Source Water Assessments (drinking water suppliers)
- Water Supply System Management Plans (large public drinking water systems)
- Source Water Protection Plans (small public drinking water systems)
- State Wildlife Action Plan
- Municipal Flood Hazard Plans
- Municipal Greenspace Plans

X. References

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Appendix 1: Unacceptable Waters Summary Table As Listed in the 2018-2020 Integrated Report

Wood-Pawcatuck Rivers Watershed Unacceptable Waters Summary	Fish Consumption		Primary & Secondary Recreation		Fish and Wildlife Habitat/Aquatic Life Use		Public Drinking Water Supply		Reasons for Impairment
Waterbody	**Supporting**	**Not Supporting**	**Supporting**	**Not Supporting**	**Supporting**	**Not Supporting**	**Supporting**	**Not Supporting**	
Tidal Pawcatuck River (Westerly)	✓			✓		✓	N/A		Dissolved Oxygen Recreation Cause: Fecal coliform
Chapman Pond (Westerly)	✓		✓			✓	N/A		Non-Native Aquatic Plants, Lead
Hundred Acre Pond (South Kingstown)		✓	✓			✓	N/A		Non-Native Aquatic Plants, Dissolved Oxygen Fish Consumption Cause: Mercury in Fish Tissue
White Brook Pond (Richmond)	Not Assessed		✓			✓	N/A		Phosphorus
Alewife Brook (South Kingstown)	Not Assessed		✓			✓	N/A		Copper, Lead, Iron
Ashaway River & Tribs (Hopkinton)	Not Assessed			✓		✓	N/A		Cadmium Recreation Cause: Enterococcus
Chipuxet River & Tribs (South Exeter)	Not Assessed		✓			✓	N/A		Cadmium, Copper, Iron
Mile Brook (Hopkinton)	Not Assessed			✓		✓	N/A		Iron Recreation Cause: Enterococcus
Pawcatuck River & Tribs (from dam at Kenyon to beginning of Carolina Mill Pond) (Richmond, Charlestown)	Not Assessed			✓		✓	N/A		Whole Effluent Toxicity (WET) Recreation Cause: Enterococcus
Pawcatuck River & Tribs (from Bradford Dyeing Associates WWTF discharge point to Route 3 bridge crossing) (Hopkinton, Westerly)	Not Assessed			✓		✓	N/A		Benthic-Macroinvertebrate Recreation Cause: Enterococcus
Pawcatuck River & Tribs (from Route 3 bridge to the Route 1 highway bridge at junction of Main St.-Broad St) (Westerly)	Not Assessed			✓		✓	N/A		Iron, Lead, Non-Native Aquatic Plants Recreation Cause: Enterococcus
Perry Healy Brook & Tribs	Not Assessed		✓			✓	N/A		Copper, Lead
Queens Fort Brook & Tribs (Exeter)	Not Assessed		✓			✓	N/A		Iron. Lead, Turbidity
Deep Pond (Exeter)	Not Assessed		Not Assessed			✓	N/A		Dissolved Oxygen, Phosphorus
Acid Factory Brook & Tribs (West Greenwich)	Not Assessed			✓	✓		N/A		Entercoccus
Canonchet Brook & Tribs (Canonchet Brook headwaters to Route 3)(Hopkinton)	Not Assessed		✓			✓	N/A		Copper, Iron
Canonchet Brook & Tribs (From Route 3 to the confluence with the Wood River)(Hopkinton)	Not Assessed			✓		✓	N/A		Cadmium, Copper, Lead Recreation Cause: Enterococcus
Coney Brook & Tribs (West Greenwich)	Not Assessed		✓			✓	N/A		Copper
Wood River (Richmond)	Not Assessed		✓			✓	N/A		Ambient Bioassay -- Chronic Aquatic Toxicity, Benthic-Macroinvertebrate, Copper
Baker Brook (Richmond)	Not Assessed			✓	✓		N/A		Entercoccus
Canob Brook (Richmond)	Not Assessed		✓			✓	N/A		Iron
Watchaug Pond (Charlestown)		✓	✓		✓		N/A		Mercury in Fish Tissue
Meadowbrook Pond (Sandy Pond) (Richmond)		✓	✓		✓	✓	N/A		Mercury in Fish Tissue Fish & Wildlife Habitat Cause: Non-Native Aquatic Plants
Tucker Pond (South Kingstown)		✓	✓		✓		N/A		Mercury in Fish Tissue
Larkin Pond (South Kingstown)		✓	✓		✓	✓	N/A		Mercury in Fish Tissue Fish & Wildlife Habitat Cause: Non-Native Aquatic Plants
Barber Pond (South Kingstown)	Not Assessed		✓		✓	✓	N/A		Non-Native Aquatic Plants, Dissolved Oxygen

Yawgoo Pond (Exeter, South Kingstown)		✓	✓			✓	N/A	Excess Algal Growth, Phosphorus, Dissolved Oxygen Fish Consumption Cause: Mercury in Fish Tissue
Chickasheen Brook (Exter)	Not Assessed			✓		✓	N/A	Non-Native Aquatic Plants, Phosphorus Recreation Cause: Entercoccus
Mastuxet Brook & Tribs	Not Assessed			✓	✓		N/A	Fecal coliform, Enterococcus
Meadow Brook & Tribs	Not Assessed			✓	✓		N/A	Entercoccus

Wood-Pawcatuck Rivers Watershed Unacceptable Waters Summary	**Fish Consumption**		**Primary & Secondary Recreation**		**Fish and Wildlife Habitat/Aquatic Life Use**		**Public Drinking Water Supply**		**Reasons for Impairment**
Waterbody	**Supporting**	**Not Supporting**	**Supporting**	**Not Supporting**	**Supporting**	**Not Supporting**	**Supporting**	**Not Supporting**	
Pawcatuck River & Tribs	Not Assessed			✓	✓		N/A		Entercoccus
Taney Brook (Richmond)	Not Assessed			✓	✓		N/A		Entercoccus
Tomaquag Brook & Tribs	Not Assessed			✓	✓		N/A		Entercoccus
White Horn Brook & Tribs	Not Assessed			✓	✓		N/A		Entercoccus
Dutemple Brook (Exeter)	Not Assessed			✓	✓		N/A		Entercoccus
Parmenter Brook & Tribs (Hopkinton)	Not Assessed			✓	✓		N/A		Entercoccus
Alton Pond (Hopkinton)		✓	✓			✓	N/A		Non-Native Aquatic Plants Fish Consumption Cause: Mercury in Fish Tissue
Ashville Pond (Hopkinton)		✓	✓			✓	N/A		Non-Native Aquatic Plants Fish Consumption Cause: Mercury in Fish Tissue
Wincheck Pond (Hopkinton)		✓	✓				N/A		Mercury in Fish Tissue
Yawgoog Pond (Hopkinton)		✓	✓		Not Assessed		✓		Mercury in Fish Tissue
Locustville Pond (Hopkinton)		✓	✓			✓	N/A		Non-Native Aquatic Plants Fish Consumption Cause: Mercury in Fish Tissue
Wyoming Pond (Hopkinton)		✓	✓			✓	N/A		Non-Native Aquatic Plants Fish Consumption Cause: Mercury in Fish Tissue
Browning Mill Pond (Arcadia Pond) (Exeter, Richmond)		✓	✓		✓		N/A		Mercury in Fish Tissue
Boone Lake (Exeter)		✓	✓		✓		N/A		Mercury in Fish Tissue
Eisenhower Lake (West Greenwich)		✓	✓		✓		N/A		Mercury in Fish Tissue
Breakheart Brook & Tribs	Not Assessed			✓	✓		N/A		Entercoccus
Brushy Brook & Tribs	Not Assessed			✓	✓		N/A		Entercoccus
Phillips Brook & Tribs (West Greenwich)	Not Assessed			✓	✓		N/A		Entercoccus
Wood River & Tribs (Exeter, Hopkinton, Richmond)	Not Assessed			✓	✓		N/A		Entercoccus
Breakheart Pond (West Greenwich, Exeter)	✓		✓			✓	N/A		Non-Native Aquatic Plants
Carolina Trout Pond (Richmond)	Not Assessed		Not Assessed			✓	N/A		Non-Native Aquatic Plants
The Reservoir (Exeter)	Not Assessed		Not Assessed			✓	N/A		Non-Native Aquatic Plants
Thirty Acre Pond (South Kingstown)	Not Assessed		Not Assessed			✓	N/A		Non-Native Aquatic Plants
Chipuxet River (South Kingstown)	Not Assessed		✓			✓	N/A		Non-Native Aquatic Plants
Wood River (Richmond, Hopkinton)	Not Assessed		✓			✓	N/A		Non-Native Aquatic Plants
Wood River & Tribs (Hopkinton, Richmond)	Not Assessed		✓			✓	N/A		Non-Native Aquatic Plants
Pasquiset Pond. Charlestown	Not Assessed		✓		✓		N/A		
Worden Pond. South Kingstown	Not Assessed		✓		✓		N/A		
Glen Rock Reservoir. South Kingstown	Not Assessed		✓		✓		N/A		
Ashaway River and tributaries from the Ashaway Road highway bridge to its confluence with the Pawcatuck River. Hopkinton	Not Assessed		✓		✓		N/A		
Beaver River and tributaries. Exeter, Richmond	Not Assessed		✓		✓		N/A		
Cedar Swamp Brook and tributaries. Charlestown	Not Assessed		✓		✓		N/A		

Chickasheen Brook and tributaries from the Yawgoo Pond outlet to the confluence with the Usquepaug river. South Kingstown, Richmond	Not Assessed	✓		✓		N/A	

Wood-Pawcatuck Rivers Watershed Unacceptable Waters Summary	Fish Consumption		Primary & Secondary Recreation		Fish and Wildlife Habitat/Aquatic Life Use		Public Drinking Water Supply		Reasons for Impairment
Waterbody	**Supporting**	**Not Supporting**	**Supporting**	**Not Supporting**	**Supporting**	**Not Supporting**	**Supporting**	**Not Supporting**	
Chipuxet River from the outlet of The Reservoir to the entrance of Yawgoo Mill Pond. North Kingstown, Exeter	Not Assessed		✓		✓		N/A		
Fisherville Brook and tributaries. West Greenwich, Exeter	Not Assessed		✓		✓		N/A		
Glen Rock Brook and tributaries. Richmond, South Kingstown	Not Assessed		✓		✓		N/A		
Locke Brook and tributaries. Exeter	Not Assessed		✓		✓		N/A		
Pasquiset Brook. Charlestown	Not Assessed		✓		✓		N/A		
Pawcatuck River from Warden Pond to the dam at Kenyon. South Kingstown, Charlestown	Not Assessed		✓		✓		N/A		
Poquiant Brook and tributaries. Charlestown	Not Assessed		✓		✓		N/A		
Queens River and tributaries from headwaters south to its entrance into Bear Swamp in Exeter. West Greenwich, Exeter	Not Assessed		✓		✓		N/A		
Queens River from its entrance into Bear Swamp to its confluence with Queens Fort Brook. Exeter	Not Assessed		✓		✓		N/A		
Queens River and tributaries from its confluence with Queens Fort Brook to Glen Rock Reservoir. Exeter	Not Assessed		✓		✓		N/A		
Sodom Brook. Exeter	Not Assessed		✓		✓		N/A		
Usquepaug River from Glen Rock Reservoir to the confluence with the Pawcatuck River. Richmond, Charlestown, South Kingstown	Not Assessed		✓		✓		N/A		
White Brook. Richmond	Not Assessed		✓		✓		N/A		
Sherman Brook. Exeter, South Kingstown	Not Assessed		✓		✓		N/A		
Aguntaug Brook. Westerly	Not Assessed		✓		✓		N/A		
Mud Brook. Exeter, South Kingstown	Not Assessed		✓		✓		N/A		
Wickaboxet Pond. West Greenwich	Not Assessed		✓		✓		N/A		
Long Pond. Hopkinton	Not Assessed		✓		✓		N/A		
Brushy Brook headwaters including tributaries to Sawmill Road. Exeter, Hopkinton	Not Assessed		✓		✓		N/A		
Brushy Brook and tributaries from the outlet of Locustville Pond to the confluence with the Wood River. Hopkinton	Not Assessed		✓		✓		N/A		
Falls River and tributaries. West Greenwich, Exeter	Not Assessed		✓		✓		N/A		
Moscow Brook and tributaries. Hopkinton	Not Assessed		✓		✓		N/A		
Parris Brook and tributaries. West Greenwich, Exeter	Not Assessed		✓		✓		N/A		
Roaring Brook. West Greenwich, Exeter, Richmond.	Not Assessed		✓		✓		N/A		

Woody Hill Brook and tribs. Exeter.	Not Assessed	✓		✓		N/A	

Appendix 2: RI Local Onsite Wastewater Management Programs

Wood & Pawcatuck Rivers Watershed RI Towns:
Onsite Wastewater Management at the Local Level

OWTS Program Element	Charlestown	Coventry	East Greenwich	Exeter	Hopkinton	North Kingstown	Richmond	South Kingstown	West Greenwich	Westerly
Does the town have an approved Onsite Wastewater Management Plan?	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Does the town participate in the Community Septic System Loan Program?	Yes	Yes	No	No	Yes	Yes	No	Yes	No	Yes
Has the town adopted an Onsite Wastewater Management ordinance?	Yes	No	No	No	No	Yes	No	Yes	No	No
Does the Onsite Wastewater Management Plan have mandatory inspections?	Yes	No	NA	No	No	Yes	No	Yes	NA	No
If so, has the town taken enforcement actions in cases of non-compliance?	No	NA	NA	NA	NA	No	NA	No	NA	NA
Does the town have a web-based tracking system?	Yes	No	No	No	No	Yes	No	Yes	No	No
Does the town have a website for information and education on OWTS issues?	Yes	No	No	No	No	Yes	No	Yes	No	No
Does the town have a staff person whose primary responsibility is management of the OWMP?	Yes	No	No	No	No	No	No	No	No	No

Appendix 3: Simple WaysYOU Can Help Keep Rhode Island's Waters Clean

This pamphlet is an example of public outreach materials available for use in the watershed.

REDUCE YOUR LAWN by creating "no-mow zones" of native wildflowers, grasses, shrubs, and trees, especially as buffers near ponds and streams. This reduces water, fertilizer, and pesticide use and provides a welcoming habitat for wildlife.

FERTILIZE SMART Have your soil tested before applying fertilizer to your lawn to see if it even needs it. Don't over-fertilize - more is not better. During rainstorms, nutrients from fertilizers can wash off lawns into local waters where the excess nutrients promote algae blooms, including some algae that are harmful to people and pets. Algae blooms cause a decrease in oxygen in the water which endangers aquatic life and can cause fish kills. Use phosphorus fertilizer for new lawns only, unless the soil test shows a need for phosphorus on an established lawn. Sweep up fertilizer that spills on hard surfaces. Leaving grass clippings on your lawn can reduce your fertilizer needs by up to 25%. For more information on soil testing see www.URIMasterGardeners.org

REDUCE USE OF LAWN AND GARDEN PESTICIDES Investigate use of biological controls and products with natural ingredients. Read the labels— apply the right amount at the right time and be aware of the toxicity warnings.

REDUCE RUNOFF Increase the amount of stormwater absorbed into the ground by directing downspouts onto your lawn, not onto paved surfaces where the runoff could pick up oil, yard waste, and other debris. Install a rain barrel— use the water for plantings. Install a rain garden to increase the amount of stormwater absorbed into the ground. For more information, see www.RIStormwaterSolutions.org

DON'T DRAIN YOUR SWIMMING POOL into storm drains, wetlands, rivers, or ponds. Instead drain it onto the ground away from your drinking water well. Drain your pool only when your test kit does not detect chlorine levels so that it won't harm vegetation.

PUMP IT, DON'T DUMP IT! If you own a boat, have your holding tank emptied at one of the local pumpout stations around Rhode Island. For a list of pumpout locations contact DEM.

VOLUNTEER with clean-up efforts or water quality monitoring. Participate in local activities that benefit the environment. Find out if there is a watershed council for your area. YOUR opinion counts! Attend public meetings. Your participation makes the statement that your community is concerned about local waterways. If you see a problem or want something done, say something! If you don't have time to attend meetings, call or contact a city or town official, a state representative, or DEM.

NOW...GET OUT AND ENJOY THE WATER ! Swim, sail, surf, kayak, fish, boat, shellfish, go birding or walk along the shore. Explore Rhode Island's waters.

If you need more information on any of these topics contact DEM Water Resources

RIDEM

RI Department of Environmental Management
Office of Water Resources
235 Promenade Street
Providence, RI 02908-5767
401-222-4700
www.dem.ri.gov

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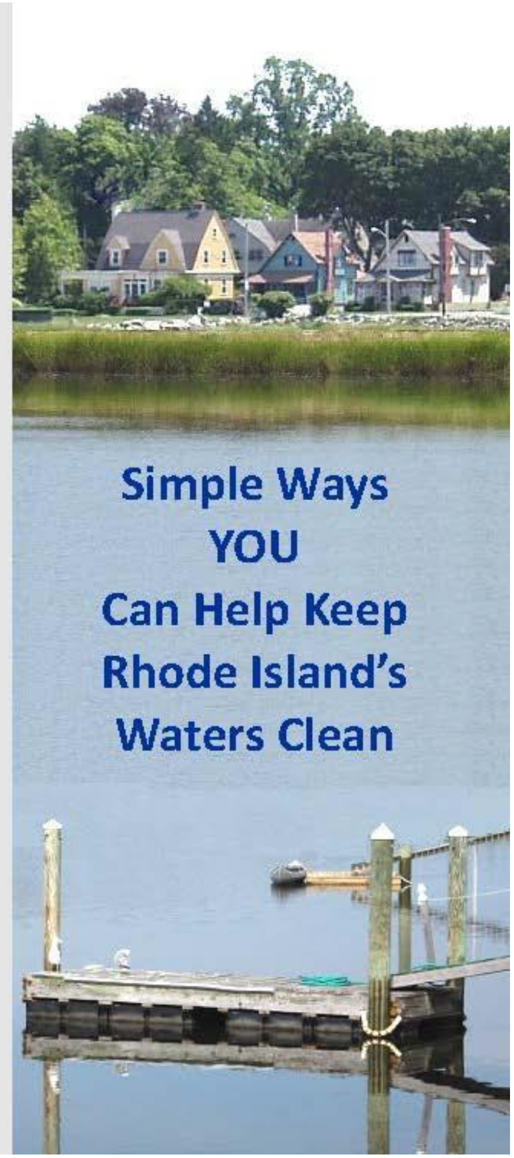

YOU Can Make A Difference!

- **DO YOU EVER STOP AND WONDER** what you can do to make a difference in keeping our waters safe enough to swim in, fish from, or use for drinking? What you can do to protect the groundwater that supplies your drinking water well?
- **WHEN IT RAINS** water travels across our properties collecting pollutants such as animal feces, fertilizers, soil, oil, and chemicals. This runoff then flows untreated into local rivers, lakes, and streams; polluting water for human use as well as plant and animal life.

LEARN ABOUT YOUR LOCAL WATERS Everyone lives in a watershed, which is the area that drains to a nearby river, stream, lake, or pond. Think about washing everything in a sink then letting it go down the drain. The sink is your watershed and the drain is your local river or stream. Find out what waters are closest to you and where they flow.

TAKE CARE OF YOUR SEPTIC SYSTEM Faulty septic systems can pollute local waters. Systems should be inspected every three to five years and tanks pumped as recommended. Don't drive or park anywhere on your septic system. Plant only grass over and near the system. If you have a cesspool, consider replacing it with a septic system.

DON'T FEED THE DUCKS! Feeding geese, ducks, gulls, and other waterfowl can cause large populations of birds to become concentrated in areas that are incapable of supporting them. The waste they produce contributes bacteria to our waterways and results in beach closures and pollution of shellfishing areas.

SCOOP THE POOP Pet waste left on sidewalks, streets or yards can be washed away by rainwater and carried into storm drains and drainage ditches which flow untreated to nearby rivers, ponds and beaches. Pet waste contains bacteria that can cause human illness and contribute to the closing of beaches and shellfish beds. Always carry a baggie - scoop up waste, bag it, and put it in the trash.

DON'T FLUSH MEDICATIONS Old or unwanted prescription drugs and over the counter medications flushed down the toilet or drain can end up in our waters and harm organisms living there. Check to see if you can drop off medications at your police station. If not, properly dispose of them in the trash. Crush pills and tablets. Put the medicine into a sealable plastic bag. Place the sealed bag in the trash.

MINIMIZE THE USE OF HAZARDOUS PRODUCTS as much as possible. Cleaning and other household products contain many hazardous chemicals. Read labels and try to use the least harmful products available. Don't dispose of products down the toilet or drain. Dispose of household hazardous chemicals (e.g., oil based paint, pesticides, drain cleaner, oven cleaner, pool chemicals) using the RI Eco-Depot Program. See www.rirrc.org

DRIVEWAY CARE Driveway sealant can be either an asphalt or a coal tar mixture. Coal tar has much higher levels of chemicals harmful to human health and aquatic life. As sealants wear down, particles wash off in stormwater. If you must seal your driveway, use an asphalt sealant.

WASH VEHICLES ON YOUR LAWN (away from your drinking water well) or use a commercial car wash. Washing on your lawn minimizes the amount of dirty, soapy water flowing into the storm drains that run directly into our waterbodies. If you are unable to wash your car on your lawn, use only biodegradable, phosphate-free cleaners. If washing near a storm drain, temporarily divert the water towards grassy areas. Commercial car washes typically use far less water, recycle their wash water, and treat their water prior to releasing it into the sewer system.

RECYCLE USED MOTOR OIL AND ANTIFREEZE Don't dump automotive fluids down the storm drain or dispose of them in your trash. Contact your local Department of Public Works or see the RI Eco-Depot Program at www.rirrc.org

CONSERVE WATER Don't overwater your lawn. Lawns need only one inch of water per week (from either watering or rain). Excessive water use, especially in summer, can dramatically reduce flow in rivers and streams, harming aquatic life.

If your house is connected to a public sewer, conserving water will help reduce the discharge from your wastewater treatment facility into local waters AND save you money! If you use a septic system, water conservation helps prevent system failures.