



**Wood-Pawcatuck
Wild and Scenic
Rivers
Stewardship Plan
for the
Beaver, Chipuxet,
Green Fall-Ashaway,
Pawcatuck,
Queen-Usquepaugh,
Shunock, and
Wood Rivers**



WOOD - PAWCATUCK
Wild and Scenic Rivers

WOOD-PAWCATUCK
WILD & SCENIC
STUDY COMMITTEE

Wood-Pawcatuck Wild and Scenic Rivers Stewardship Plan

for the

**Beaver, Chipuxet, Green Fall-Ashaway,
Pawcatuck, Queen-Usquepaugh, Shunock,
and Wood Rivers**

June 2018

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The logo for the Wood-Pawcatuck Wild and Scenic Study was designed by Richard Seager.
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“We are never far from the lilt and swirl of living water. Whether to fish or swim or paddle or only to stand and gaze.... All of us are drawn to rivers.... We need their fluent lives interflowing with our own.” Furthermore, “Rivers are places that renew our spirit, connect us with our past and link us directly with the flow and rhythm of the natural world.” “Like a trusted friend, a river shares its attributes unconditionally.”

Respectively, John Daniel, Ted Turner and J.L. Leigh

Questions and Contact Information

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This Plan is also available on our website www.WPWildRivers.org (and once a final draft is produced, hard copies will be made available in the Town Clerks’ offices and town libraries). Additional information and requests for electronic copies of this plan are available from our website www.WPWildRivers.org or by sending a request to WPWildRivers@WPWA.org.



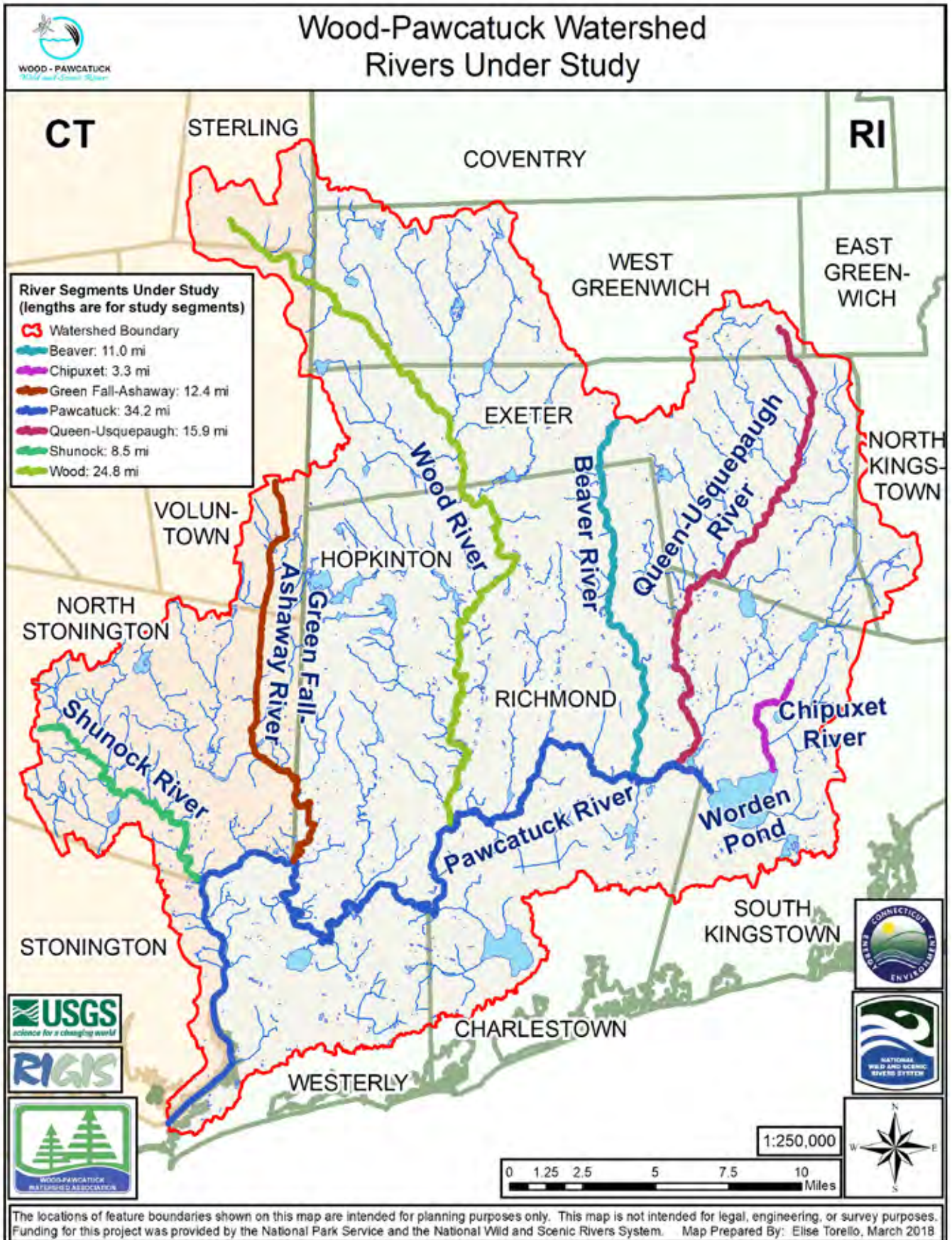


Figure 1. Seven rivers within the Wood-Pawcatuck Watershed under consideration for Wild and Scenic designation.



Message from the Wood-Pawcatuck Wild and Scenic Rivers Study Committee

Greetings:

The Wood-Pawcatuck Wild and Scenic Rivers Study Committee is pleased to present the Wild and Scenic Stewardship plan for the Wood-Pawcatuck Watershed and its rivers - the Beaver, Chipuxet, Green Fall-Ashaway, Queen-Usquepaugh, Pawcatuck, Shunock, and Wood. Over the past three years local residents appointed by the watershed towns, with support from the National Park Service, the Wood-Pawcatuck Watershed Association, state agencies from Connecticut and Rhode Island, and several non-government agencies, have participated in the Wood-Pawcatuck Wild and Scenic Rivers Study Committee. The Committee has carefully studied the rivers, considering their natural, cultural and recreational resource values, and evaluated current strategies for protecting and enhancing these special places. Based on this analysis and by looking at plans for other Wild and Scenic Rivers in neighboring New England states, the Committee has developed a plan for the eight towns in Rhode Island and four towns in Connecticut that provides local protection strategies for their consideration and implementation. We hope it provides a blueprint that is not only consistent with local and state ordinances but looks forward to meet future needs as well.

As we consider the Stewardship Plan that is being presented, let's take a moment to reflect on the Wood-Pawcatuck Watershed. We may remember walking a wooded trail along the river bank with our grandparents, or paddling the river with our families, or enjoying the quiet solitude as we fish from the shoreline. The 300-square-mile Wood-Pawcatuck Watershed is renowned throughout the region for its history and beauty, as well as for providing recreational fishing and paddling opportunities unsurpassed in Southern New England. Much of the land in the watershed is protected either by Rhode Island Department of Environmental Management or Connecticut Department of Energy and Environmental Protection,

non-government agencies, or local Land Trusts. Historic mills and other landmarks highlight the Native American culture and local history. The watershed contains the Pachaug-Great Meadow Swamp, a National Natural Landmark, and its pristine tributaries are the habitat of diverse fish populations. Contiguous forest patches and unique wetlands in the watershed provide critical habitat for many of the endangered species in Rhode Island and southern Connecticut. All of these 'Outstandingly Remarkable Values' are being considered for recognition by the National Park Service's Wild and Scenic Rivers program. The goal of the Wood-Pawcatuck Wild and Scenic Rivers Stewardship Plan is to ensure that watershed residents will continue to enjoy these special places and to ensure that these rivers continue to provide outdoor joy and adventure to all citizens of southern New England for generations to come.



Wood-Pawcatuck Wild and Scenic Rivers Study Committee (Photo credit: Ayla Fox)

Acknowledgments

The Wood-Pawcatuck Wild and Scenic Rivers Study Committee

The Study Committee's membership includes locally appointed representatives from each town in the Study Area, and representatives from the Connecticut Department of Energy and Environmental Protection (CT DEEP), the Rhode Island Department of Environmental Management (RI DEM), the National Park Service (NPS), the Wood-Pawcatuck Watershed Association (WPWA), Save The Bay (STB), Audubon Society of Rhode Island (ASRI), and The Nature Conservancy (TNC). The town appointees are all volunteers, who met more than thirty times over the three years of the study period. They also put in countless hours between meetings researching and reviewing materials for this plan and conducting outreach to their towns. Thanks to their dedication and perseverance the study process has truly been a grass-roots effort.

The Study Committee would like to thank Senators Jack Reed and Sheldon Whitehouse, and Representatives Jim Langevin and David Cicilline from Rhode Island; and Senators Richard Blumenthal and Chris Murphy, and Representative Joe Courtney from Connecticut, for nominating and supporting the Wood-Pawcatuck Watershed for National Wild and Scenic designation. Additionally we would like to recognize the town councils and boards of selectmen, and other town boards and commissions, for their support in endorsing the Stewardship Plan. Thanks to Ayla Fox and Chip Young for bringing the watershed to life through multimedia; Louis Sposato for his guidance in chairing the Study Committee at its outset; all of the experts who shared their time and expertise with the Committee over the course of the study; and to WPWA for hosting most of the Study Committee's activities. Finally, we would like to recognize Denise Poyer for her tremendous efforts in coordinating the Study Committee's activities and shepherding the Stewardship Plan from concept through to completion; it would not have been possible without her hard work and dedication. Thank you.



*Wood-Pawcatuck Wild and Scenic Rivers Study Committee
(Photo credit: Ayla Fox)*

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Rhode Island Natural
History Survey



Great blue heron on the Pawcatuck River in Westerly, RI (Photo credit: Dan Hyland)

CHAPTER 1: EXECUTIVE SUMMARY

Determination: The Study Committee established that all seven rivers meet eligibility under the Wild and Scenic Rivers Act (WSRA), and identified several outstandingly remarkable values for each river and the watershed as a whole. The committee developed a stewardship plan that demonstrates ongoing policies and activities that protect the rivers' values. The Study Committee decided to focus on a watershed approach to protection, since it would better protect the values of all seven rivers. The plan also suggests ways to improve protection to assure the rivers' values will exist for future generations.

Next Steps: After resolutions of support are obtained from all twelve towns in the watershed Congress will be asked to approve a bill to amend the National Wild and Scenic Rivers Act to include the the Beaver, Chipuxet, Green Fall-Ashaway, Queen-Usquepaugh, Pawcatuck, Shunock, and Wood Rivers.

Effects of the Stewardship Plan

Designation as a Wild and Scenic River will result in establishment of a Stewardship Council comprised of representatives appointed by the twelve participating municipalities, CT DEEP, RI DEM, WPWA, STB, TNC, ASRI, and the NPS. The Stewardship Council will guide the administration of the designation and imple-

mentation of the locally-developed Stewardship Plan. Designation will result in an appropriation of federal funds, subject to Congressional approval, to support implementation of the Stewardship Plan.

Existing state and local laws will continue to govern; private lands and activities will not be subject to increased federal control. Land use decisions will continue to be made by local planning and zoning boards, not federal agencies. **The federal government will not acquire lands as a result of the designation.** Existing dams can remain or be retrofitted for fish and aquatic life passage structures. Hunting and fishing laws and regulations will be unaffected, and rules governing agricultural practices will not change. If the rivers are designated as Wild and Scenic, the designation will give the local municipalities a voice, through the Stewardship Council and the National Park Service, in protecting the rivers' Outstandingly Remarkable Values (ORVs) from any harmful effects of new federally funded or permitted construction or development of projects affecting the designated portions of the rivers.

Stewardship Recommendations

This Stewardship Plan presents a series of recommendations that can be **voluntarily implemented** by local landowners, municipalities, and state and federal agencies working together to help protect river-related resources and maintain and enhance the quality and way of life valued by so many people. The voluntary recommendations in this Stewardship Plan can be implemented by the locally-appointed Stewardship Council, working with communities and partners on a voluntary basis, after the seven rivers are designated by Congress as Wild and Scenic Rivers.

Why a watershed approach?

Alan Desbonnet

Tens of thousands of years ago, retreating glacial ice left behind great sand-filled depressions in the landscape of southern New England. The sands filled with water and became rivers, the source of life for the rich diversity of the Wood-Pawcatuck Watershed. Today, waters above and below the ground are an intimately linked system essential to sustaining all life in the watershed.

Four towns in Connecticut and eight in Rhode Island have jurisdiction over the lands and waters comprising the Wood-Pawcatuck Watershed. However, natural systems like watersheds do not follow human boundaries nor do they conform to the tangle of local, state and federal regulations. When governmental entities do not closely coordinate land use planning and regulations across manmade boundaries the potential for conflict is high. Therefore the best way to avoid conflicting and potentially damaging cross-jurisdictional use and planning is to ignore the human boundaries and take a holistic watershed-wide approach to the stewardship of rivers, ponds and underground reservoirs.

Everyone needs water to survive. In the Wood-Pawcatuck Watershed nearly one hundred percent of the population relies on the watershed's underground reservoirs, called aquifers, to supply them with clean drinking water. That is why the Environmental Protection Agency designated the Wood-Pawcatuck Watershed as a "Sole Source Aquifer" in 1988. This Sole Source designation exists to add federal protection to regions where more than fifty percent of people cannot obtain drinking water from anywhere other than wells fed by groundwater. Often unknowingly, private homes, municipal water suppliers, and industry compete with each other for these limited underground drinking water sources. The only sensible way to manage an invaluable resource like drinking water is to employ a watershed-wide approach.

The importance of such an approach is also crucial to preserving the quality of life we all enjoy thanks to the mostly rural character of the watershed. The land and water bodies found in the Wood-Pawcatuck Watershed are highly acclaimed for their outstanding recreational value. Outdoor enthusiasts of all kinds such as canoeists, kayakers, hikers, hunters, birders, and fishermen throughout New England rely on this watershed as a doorway to quiet, relaxing and refreshing time in a largely undeveloped landscape. The Wood River—its headwaters and tributaries in particular—is considered some of the best trout fishing water in the region. Just knowing that abundant wildlife exists within two of the most densely populated states in the nation is balm to many of the residents.

Access to clean water should be afforded to everyone, not just those who live next to it. We are living in a time of rapidly changing climatic conditions. Some regions of New England are expected to become drier, some wetter. We don't yet know exactly how that will change the watershed and affect the rivers and aquifers. We expect more rain in winter and less snow, and more extreme rainfall events and resulting periods of flooding. Will the new "normal" - for how much precipitation falls, in what form, and when - provide continuity of the rivers' Outstandingly Remarkable Values? How will this affect those values for future generations?

Designation as Wild and Scenic provides a unique opportunity for the people and the authorities that use and manage watershed resources to convene and plan for the future. A water-

shed-wide approach that unifies ecological needs and multi-jurisdictional human needs is what must be used if watershed resources and uses are to survive and thrive into the future. The challenges are great, especially in the face of a rapidly changing climate. But the benefits which will come to the unique jewel of a resource, the Wood-Pawcatuck Watershed, from planning in a watershed-wide fashion today, will be incalculable for generations to come.



Reflections on the Wood River (Photo credit: Elise Torello)



Shunock Brook Preserve, North Stonington, CT (Photo credit: Peter Marteka)

CHAPTER 2: INTRODUCTION AND BACKGROUND

Background and History: The story of National Wild and Scenic Rivers designation for the Wood-Pawcatuck Watershed actually began in 1980 when the National Park Service (NPS) conducted a survey of potential rivers along the east coast to include in the national program. While the criteria at the time were not favorable for the small rivers of New England (this was before the partnership rivers model), the survey report did identify sections of the Wood and Pawcatuck Rivers as having several Outstandingly Remarkable Values (ORVs). In particular it was noted that the Wood River had the highest biodiversity of any river in New England. Due in large part to this report, the Wood-Pawcatuck Watershed Association (WPWA) was formed in 1983 to protect the rivers of the watershed.

In 2010 WPWA formed a coalition of stakeholders in the watershed to again pursue Wild and Scenic River designation to recognize and protect five rivers of the Wood-Pawcatuck Watershed. The group developed local, regional and state partnerships, gathered letters of support and gained votes of approval from all of the towns that would be involved in a Wild and Scenic River Study. Specifically, local interest was expressed in pursuing a "Partnership Wild and Scenic River Study," based on river management models such as the Lamprey River in New Hampshire and the Farmington River in Connecticut.

A reconnaissance survey of the Wood-Pawcatuck Watershed was conducted by the Northeast Region of the NPS at the request of Representative Jim Langevin (RI-2) in 2013. The reconnaissance survey provided a preliminary assessment of the eligibility and suitability of the Wood-Pawcatuck River as a candidate for a Wild and Scenic designation according to criteria established under the Wild and Scenic Rivers Act. Preliminary findings stated “the NPS reconnaissance survey team has determined that segments of the Wood-Pawcatuck Rivers exhibit free-flowing character and noteworthy natural, cultural and recreational resource values likely to meet eligibility criteria for inclusion in the National Wild and Scenic Rivers System. In addition, the presence of very strong community and interest group support for a Wild and Scenic River Study, together with a demonstrated track record of natural and cultural resource protection, support key elements of suitability for inclusion in the System, and provide a strong indication that a Wild and Scenic River Study would be appropriate and productive.”

As a result of the support of the watershed towns, Congressmen Jim Langevin and Joe Courtney introduced the Wood-Pawcatuck Watershed Protection Bill (Study Bill) in the House of Representatives during the 112th Congress. A companion bill was introduced into the Senate by Senators Jack Reed and Sheldon Whitehouse. The Study Bill passed the House but failed to make its way through the complete legislative process. The Study Bill was re-filed in February 2013, where it again easily passed the House and received Senate approval in late 2014. The Study Bill amends the Wild and Scenic Rivers Act to designate segments of the Beaver, Chipuxet, Queen-Usquepaugh, Wood, and Pawcatuck Rivers for study for potential inclusion in the National Wild and Scenic Rivers System. In 2016 the Study Committee elected to add two more rivers in the state of Connecticut – the Shunock and Green Fall-Ashaway Rivers.

Current Study: NPS developed a cooperate agreement with WPWA to coordinate the study in 2015. WPWA solicited representatives from each of the fourteen towns in the watershed to serve on the Wood-Pawcatuck Wild and Scenic Rivers Study Committee. Twelve towns appointed representatives to the Study Committee: Charlestown, Exeter, Hopkinton, North Kingstown, Richmond, South Kingstown, Westerly and West Greenwich in Rhode Island; North Stonington, Sterling, Stonington and Voluntown in Connecticut. Also included were the two state environmental agencies, RI DEM and CT DEEP; and three key environmental nonprofit organizations, STB, TNC, and ASRI. NPS provided staff support and overall coordination. Two towns, Coventry and East Greenwich in Rhode Island, have less than one percent their town in the watershed and neither contains any portion of the rivers under study. Both towns elected not to send a representative to the Study Committee.



Figure 2. Major watersheds adjacent to the Wood-Pawcatuck Watershed

The Watershed

The Wood-Pawcatuck Watershed encompasses approximately 300 square miles in southeastern Connecticut and southwestern Rhode Island. The watershed contains seven major 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 its outstanding New England sports fishery, fifty-two miles of flat water paddling, and hundreds of acres for wildlife viewing and birdwatching, the region is a key destination for recreation. The headwaters of the Pawcatuck River are located in the town of South Kingstown, Rhode Island and its terminus is in the town of Westerly, Rhode Island and Stonington, Connecticut, where it drains to the Little Narragansett Bay at the northeastern corner of Long Island Sound. The coastal town of Westerly is a popular tourism destination with its scenic views of the Rhode Island Sound and has long been a destination for those seeking a beach community vacation.

The Wood-Pawcatuck Watershed is unique in the region due to the high level of habitat and species diversity, as well as the number of rare and endangered species (including some globally-rare species). This high biodiversity is due in large part to past efforts to protect lands within the Wood-Pawcatuck Watershed. About twenty-three percent of the watershed is protected within lands owned and managed by RI DEM and CT DEEP, while non-government agencies (e.g. TNC, ASRI, and local land trusts) protect another ten percent of the watershed. TNC, a local partner of the WPWA, has dubbed the Wood River a “Unique and Special Place,” and the associated “Borderlands” along the Connecticut/Rhode Island border valuable due to the thousands of acres of contiguous woodlands. In addition, the North Atlantic and lower New England ecoregions intersect within the watershed, providing for plant and animal communities that reflect a mixture of coastal and inland, and northern and southern, influences.

This Stewardship Plan was developed as part of the Wood-Pawcatuck Wild and Scenic Rivers Study process. The goal of this plan is to establish recommended tools and strategies for future collaborative management of the Wild and Scenic Rivers to ensure that the watershed will be protected for generations to come. The Plan was developed by the Study Committee, with leadership from the WPWA, and with input from local towns and citizens within the Watershed, state managers, invested nonprofits and other stakeholders. Community and state endorsement for the plan substantiate local and state commitment to watershed conservation.

Purpose of the Stewardship Plan

The Wood-Pawcatuck Watershed Stewardship Plan, developed in partnership with the Study Committee, local town planners and conservation commissions, residents, the states of Connecticut and Rhode Island, and major non-government agencies, provides a blueprint for the long-term protection of the watershed's special natural, cultural and recreational resources. **The activities described in the Stewardship Plan will be led and implemented locally with input and guidance from the Stewardship Council (see below). The Stewardship Plan is a non-regulatory document.** The plan describes a management approach that is consistent with the original intent of the study effort, which was to insure that watershed management and protection efforts are maintained by the twelve municipalities and two state governments.

The Stewardship Plan accomplishes the following:

1. Provides stakeholders a clear recommendation of how to protect and enhance the watershed's ORVs and the role a Wild and Scenic designation would have in implementing such recommendations.
2. Substantiates to Congress the suitability of the watershed for designation by showing the willingness of the local communities, the state and other stakeholders to be partners in the plan's implementation.
3. Provides measurable indicators and guidance to future decision-makers about what constitutes sufficient protection if goals for the ORVs are to be met.
4. Establishes management recommendations that rely principally on locally-led and locally implemented strategies.
5. Serves as the Comprehensive Management Plan required for all Wild and Scenic rivers.
6. Establishes eligibility for federal technical and financial assistance when the watershed becomes part of the National Wild and Scenic River System.

Regardless of achieving a designation, the Stewardship Plan will serve as a guiding document for ongoing management of the region. It will need occasional updates and adaptation as resource protection needs evolve and priorities shift.



Beaver River, Richmond, RI (Photo credit: Denise Poyer)

CHAPTER 3: WOOD-PAWCATUCK WILD AND SCENIC RIVERS

The main task of the Study Committee over the past three years was to determine and define what overall values of the rivers and the watershed are the most important to the region and the nation. The Committee identified the following categories of values as the most significant and worthy of national recognition: **Geology/Hydrology, Exceptional Ecosystem, Cultural, and Recreational**

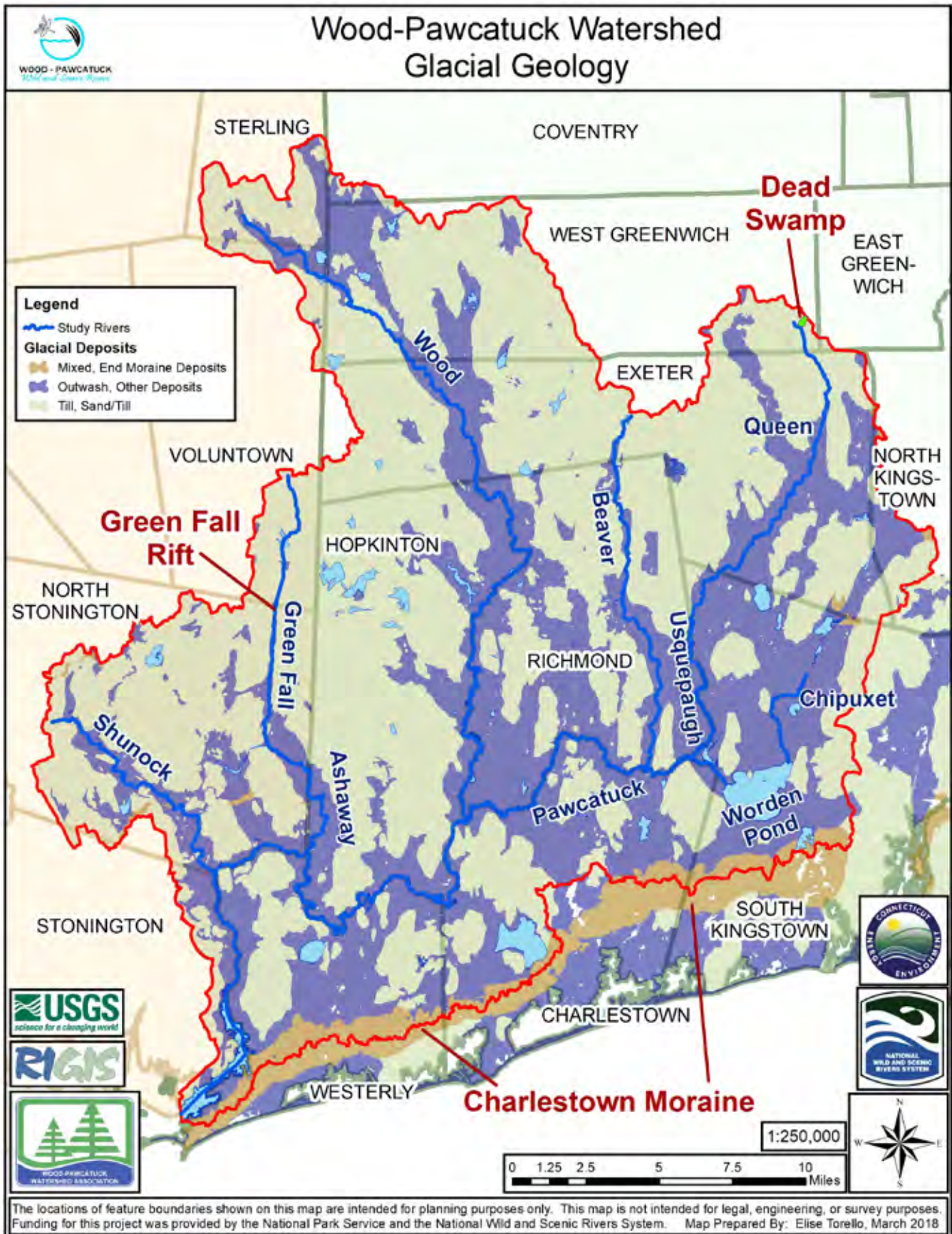


Figure 3. Wood-Pawcatuck Watershed glacial geology

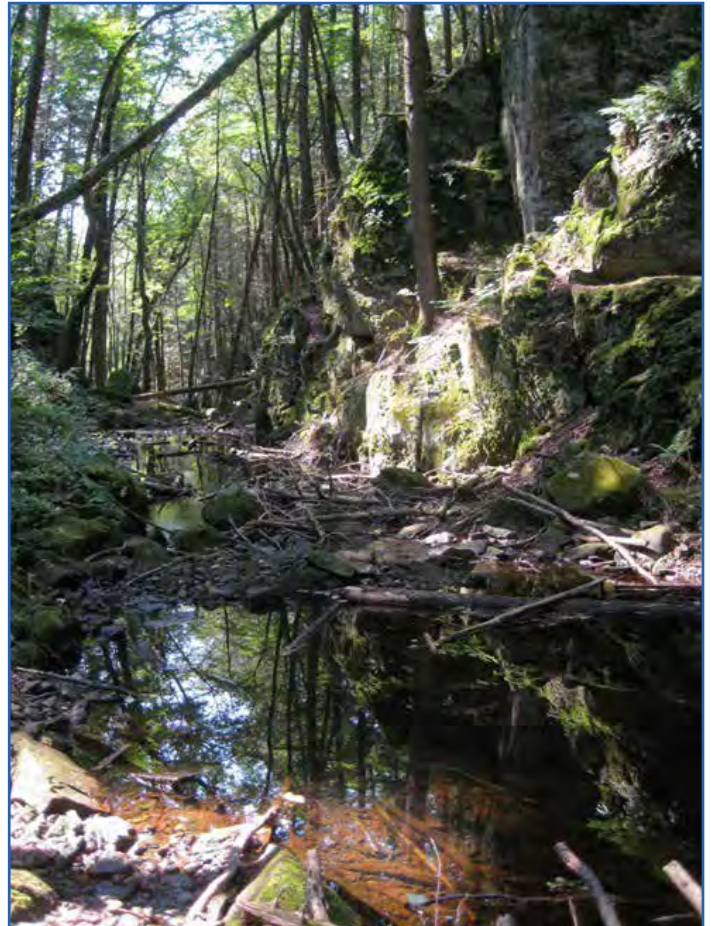
Geology/Hydrology

The key geological feature of the Wood-Pawcatuck Watershed is the formation of the basin. About 20,000 years ago, retreating glaciers left a recessional moraine, now known as the Charlestown Moraine. Running approximately east to west along US Rt. 1 in Rhode Island, this 150-foot high land mass effectively blocked the southerly flow of historic rivers. Instead the rivers collected into the Pawcatuck River which flowed to the west and even north at times before forming an outlet into Little Narragansett Bay between present-day Westerly, RI and Stonington, CT. In addition, the moraine created extensive wetlands to the north, including the Great Swamp, Cedar Swamp, and Chapman Swamp.

The Environmental Protection Agency (EPA) has recognized the Wood-Pawcatuck Watershed as a sole source aquifer. All of the drinking water for residents of the watershed is supplied by private or public wells that tap into one of the seven significant subsurface aquifers, which were also created by the glacial retreat. These are found primarily along the river corridors. The Kingston Water District has wells just east of Worden Pond and supplies water for The University of Rhode Island and parts of South Kingstown. Most all of the watershed contains high quality water.

Some Key Findings on the Exemplary Status of the Geology and Hydrology in the Wood-Pawcatuck Watershed

- Green Fall Rift Valley (in the Green Fall region) is one of the more notable geologic features in the watershed. More of a shear than a rift, it is evidence of weakened bedrock snapping apart and falling in a linear fault pattern called a lineament. During the assemblage and subsequent breakup of the Pangea supercontinent between 175 and 200 million years ago, the southern Rhode Island and Connecticut borderlands region was geologically traumatized. Western North Stonington pres-



*Green Fall Gorge, North Stonington, CT
(Photo credit: Auntie Beak)*

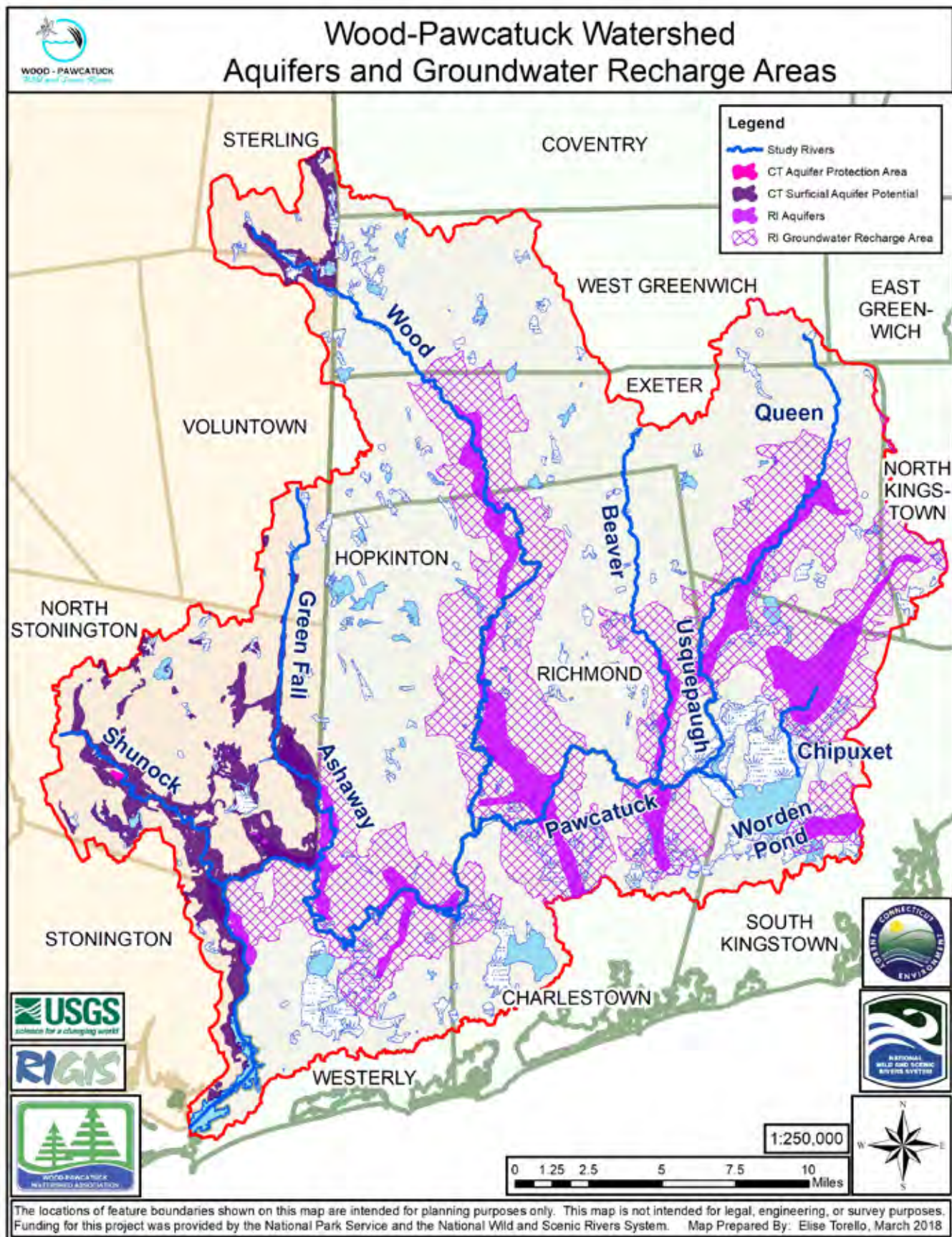


Figure 4. Wood-Pawcatuck Watershed aquifers and groundwater recharge areas

ently hosts the tectonic plate margin left behind from that era. The landscape is profoundly contorted in areas where it is not buried under glacial sediments.

- The deposition of the Charlestown Moraine by the retreating glaciers 20,000 years ago created the current path of the Pawcatuck River and Worden Pond, the largest natural freshwater lake in Rhode Island. It also caused vast acres of swamps to develop along the rivers path. These include the Great Swamp, the largest wetland in the region, Cedar Swamp, Phantom Bog, and Chapman Swamp. Due to the extensive wetlands many areas were never developed.
- An unusual topographic feature is the headwaters of the Queen-Usquepaugh River, Dead Swamp in West Greenwich. This is the only place in the region where a wetland flows into two separate watersheds – the Wood-Pawcatuck Watershed and the Pawtuxet River Watershed. Near the village of Usquepaugh the Queen-Usquepaugh River is part of a large outwash plain, which contains significant agricultural fields. The river is used for irrigation of these fields.
- The lower Wood River has an extensive aquifer that supplies town wells for some Hopkinton and Richmond residents. In addition the RI Water Resources Board has identified several properties along river that have the potential to be future public wells. Several of these properties have been purchased and are now in permanent protection.
- The Chipuxet River is also part of the aquifer that supplies water for the Kingstown Water District and the town of South Kingstown. The rich aquifer and abundant surface water of the Chipuxet River provide irrigation for agricultural fields, both above and at the beginning of the designated area. These agricultural fields are on outwash plains, the result of glacial melt water, and contain high quality soils for farming.



*Beaver lodge in the Great Swamp, South Kingstown, RI
(Photo credit: Elise Torello)*

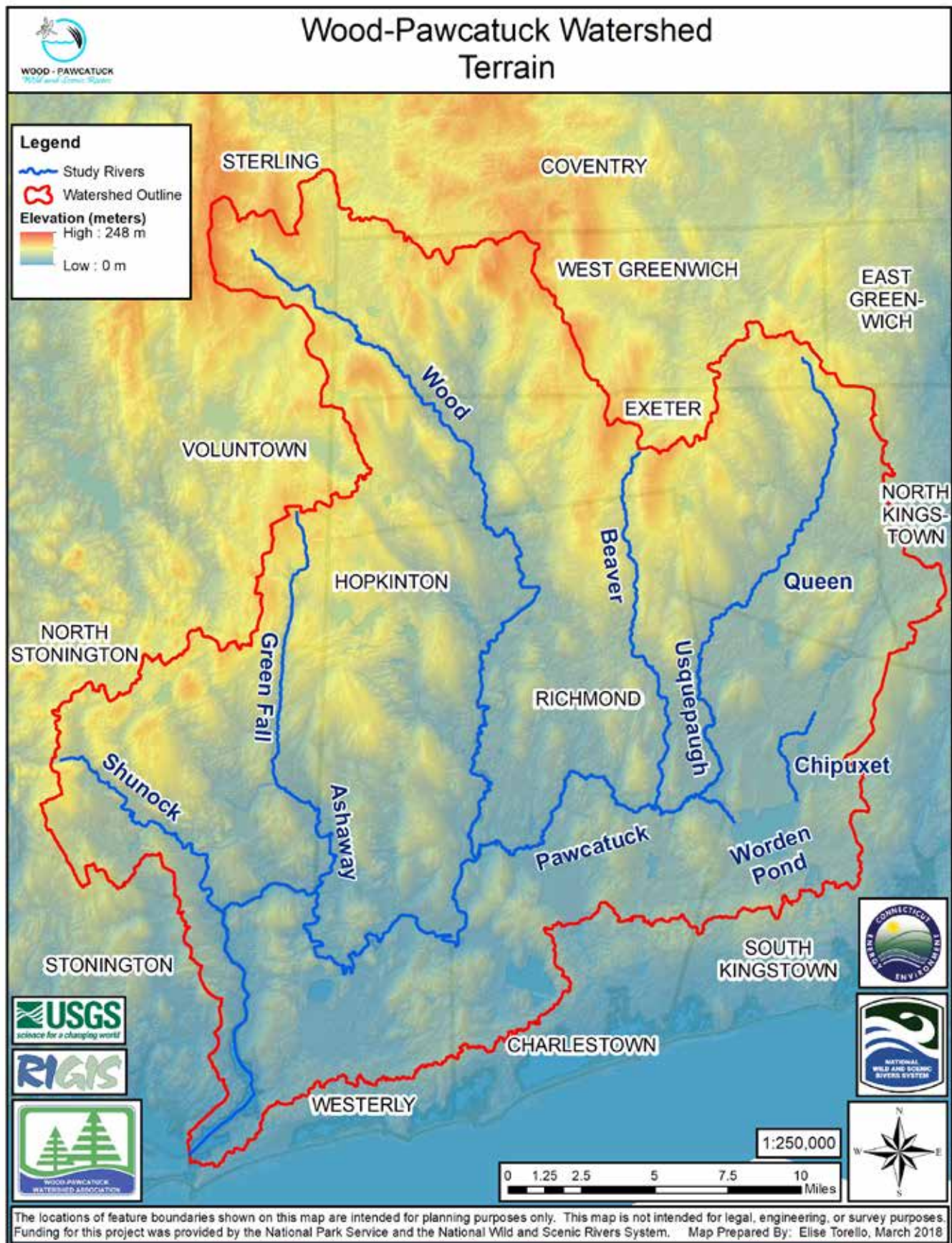


Figure 5. Wood-Pawcatuck Watershed hillshade elevation map

Southern New England Deep Freeze

Charles Hickox

Imagine standing knee-deep in ice water. The time is mid-summer, 17,000 years ago. The place is your favorite beach along the Rhode Island shore. Look north; immediately before you lies the steep front of an ice sheet that extends northward to Canada and beyond. This ice sheet is almost a mile high. You are soaked to the knees because the ice is melting rapidly in the summer heat. The melt water is pouring down the front of the glacier in a braid of streams. Look south; the sea is nowhere in sight. A soggy, sandy plain slopes gently southward from the foot of the glacier. In the middle distance is a freshwater lake, eight miles wide and sixty miles long. The lake is between what are today the southern beaches of Rhode Island and Block Island. Beyond the lake a colossal hill of dirt and rocks towers over the southern horizon. Parts of this hill will become Long Island in New York, Block Island, Martha's Vineyard, and Cape Cod. Out of sight beyond the hill a second sandy plain blankets what is to become the continental shelf. It too slopes gently toward the south, to the sea many miles away. Upon the plains grow tundra-type plants, which feed the musk-ox, woolly mammoth, and great herds of caribou. Waiting to snatch up stray animals are wolves, giant bears, and saber-toothed tigers. All of these animals are soon to be extinct or will be forced to make their homes farther north.

During the past 2.5 million years glaciers have covered most of the northern hemisphere at least four times. Each of these glacial stages lasted about 70,000 years. They were separated from each other by longer periods of time, called interglacial stages, when the earth warmed up. During the interglacial, the ice melted from both Eurasia (Europe and Asia) and North America. Glaciers on the mountains drew back and almost disappeared. No one knows what causes the climate to turn so cold that it produces glaciers.

The most recent glacial period, called the Wisconsin Stage, began about 75,000 years ago. Huge snow storms covered the area. So much snow fell that it became packed down under its own weight and turned into ice. Like earlier ice sheets, this one developed over the Laurentian mountains east of Hudson Bay, in Canada. It took a long time, but finally it became so thick that it started to flow outward in all directions. The ice covering North America reached its maximum extent about 21,000 years ago. The front edge of the ice reached as far south as northern New Jersey, and ice covered a third of the world's land surface. Ice domes that covered Canada, Scandinavia, and Siberia were as much as 2.5 miles thick. These domes were like the ones that still cover Greenland and the Antarctic today. The tremendous amount of water, locked up in glaciers, came from evaporation of seawater. Because so much water was frozen, sea level worldwide was lowered 350 feet. The New England shoreline lay along the outer limit of the continental shelf, as much as 150 miles off the present coast.

Glaciers are messy and dirty. That's because as the ice moves forward it picks up soil, sand, gravel, and boulders, collectively called sediments. The glacier rolls the sediments up into the ice, just like rolling a snowball over dirt. An advancing glacier is also a bulldozer, pushing ahead of it the loose material that lies in its path. Even when the edge of the glacier begins to melt, the ice is still pushing ahead from its source far to the north, continually bringing more sediment to the edge. When the push finally stops and the ice starts to melt back, a gigantic hill, or ridge, of these sediments is left behind. These ridges are called terminal moraines or end moraines. Long Island, Rhode Island and southern Massachusetts

have some of the finest examples of moraines in the world. The terminal moraine south of New England originally extended unbroken from Brooklyn, New York, eastward along the axis of Long Island, Martha's Vineyard, and Nantucket. When the climate started to warm up again the ice front melted back, but not all at once. About 17,000 years ago the climate cooled again for a short time. It actually became cold enough so that the glaciers started to grow again. This time, the glacier moved forward only about twenty miles. But it did have a chance to bulldoze up another moraine. This recessional moraine also begins at Brooklyn, but it stretches eastward along the north shore of Long Island to Orient Point, through Plum and Fisher's Islands, Napatree Point, and Watch Hill, then along the Rhode Island coast near Routes 1 and 1A. At Point Judith it swings seaward to form the Elizabeth Islands and the north shore of Cape Cod. In Rhode Island, this ridge is known as the Charlestown Moraine. If you drive south on Ministerial Road (Rt. 110) to Rt. 1, you will drive up and over the recessional moraine. The Great Swamp and Worden Pond in South Kingstown and Watchaug Pond in Charlestown were created because the water flowing south could not get through the Charlestown Moraine.

16,000 years ago the climate had warmed once again and the glacier started to move back again. By 12,500 years ago the front had receded back into Canada from whence it came and New England has been ice-free ever since. Each of the above dates has been established by one of several radiometric methods.

The glacier left behind special land formations called kames and kettles. Kames are rounded, twisting ridges that form steep rocky hills. Kames are formed when the huge cracks, or crevasses, in the ice become filled with glacial debris. When the ice melts, these crevasse-fillings are left standing as ridges. Kettles form where great blocks of ice broke off from the main glacier, but did not melt right away. These great blocks finally melted, leaving a depression in the ground. The depressions were in effect a cast of the ice blocks. The holes filled with ground water to form the kettle ponds commonly seen in New England. They are roughly circular, but the size and depth depend on the size of the melting block. No Bottom Pond and Dr. Lewis Pond are kettles, as are most of those closed depressions and little ponds of Fisher's Island and Watch Hill. Block Island is said to have a pond (kettle) for every day of the year. The water tower off Winnapaug Road sits on a kame; so does the Ocean House. Chin Hill and the Dumplings at the west end of Fisher's Island Sound are kames. Like a great Swiss cheese, the land along Routes 1 and 1A is typical kame-and-kettle topography.

In addition to the moraines, the glacier left behind two main types of glacial deposit from which our modern soils have evolved in Rhode Island. If you live north of the Charlestown moraine, your house probably rests on till. Till covers about eighty percent of any area that once had a glacier on it. It is the stuff left behind after the ice has melted, an unsorted hodgepodge of all sizes of rocks, from fine clay to boulders as big as a house. New England till is very coarse and full of boulders because the bedrock is made of very hard granite. Midwestern till, on the other hand, tends to be fine-grained because there the bedrock is made of soft shale and limestone. Anywhere you see a stone fence in the woods around New England, you know that you are on till. All the till in the area made it hard to farm. That is why so many farms in Exeter and West Greenwich were abandoned when the mills started up near the rivers. Mill villages grew up around dams and factories. The farms turned back into woods.

The second type of soil produced by the glaciers is called outwash. It is deposited in front of a melting glacier. When the water flows down the steep front of the glacier and reaches the flat plain at its foot it loses speed. The melt water puts down the sediment, sand and gravel, like a great sandy apron. Outwash is layered and well sorted because it has been moved around by running water. Although most of the outwash along the southern New England coast now lies on the continental shelf, remnants extend seaward from the foot of the moraines. The plains along the south shore of Cape Cod, Nantucket, Martha's Vineyard, and Long Island are examples. In Westerly, the gently sloping surface at the foot of the Charlestown Moraine, between Winnapaug and Maschaug Ponds, is outwash. Winnapaug Day Camp lies on outwash, as do most of Pond View Golf Course and holes 10 through 13 of the Winnapaug course. East from Westerly, Quonochontaug Beach, Ninigret Wildlife Preserve, Charlestown Beach, and Matunuck are all located on outwash. Outwash is not only deposited as a broad apron at the foot of an end moraine, but is also deposited in valley bottoms where streams are fed by torrents of glacial meltwater. Advancing ice overrides its own outwash, but a melting glacier will leave behind a valley partly filled with beds of sand and gravel. The outwash plains at White Rock and Shunock Brook are examples. The Little League field at Anquilla Brook, Pawcatuck, is on outwash; so are the turf farms along Rt. 2 and Chariho High School, the playing fields at the University of Rhode Island, and former Ladd Center in Exeter, as well as the Veterans Cemetery, River Bend, and Elm Grove cemeteries. In fact, most Yankee cemeteries are located on outwash, where digging was easy. Many small and large outwash plains became gravel pits. The Center of New England, a large retail and residential complex off Rt. 95 in Coventry, was built on the site of a gravel pit where most of the sediments from the outwash plain have been removed.

When at last the world's climate began to warm and the great ice sheets melted, the sea came back upon our shore like a great tide flooding a beach. During deglaciation, sea level rose so quickly that no lasting shoreline features had time to develop. Today, the Connecticut shore has deep estuaries and snug harbors but few beaches. Long Island and Rhode Island, bordered by the Charlestown moraine and gently shelving sandy outwash, are known for their barrier beaches and salt ponds.

Whatever the cause, we are in an interglacial stage today. The cycles of ice ages and interglacial periods of the past were presumably no different from those that will follow in our future.



*Mountain laurels on the Charlestown Moraine, South Kingstown, RI
(Photo credit: Elise Torello)*

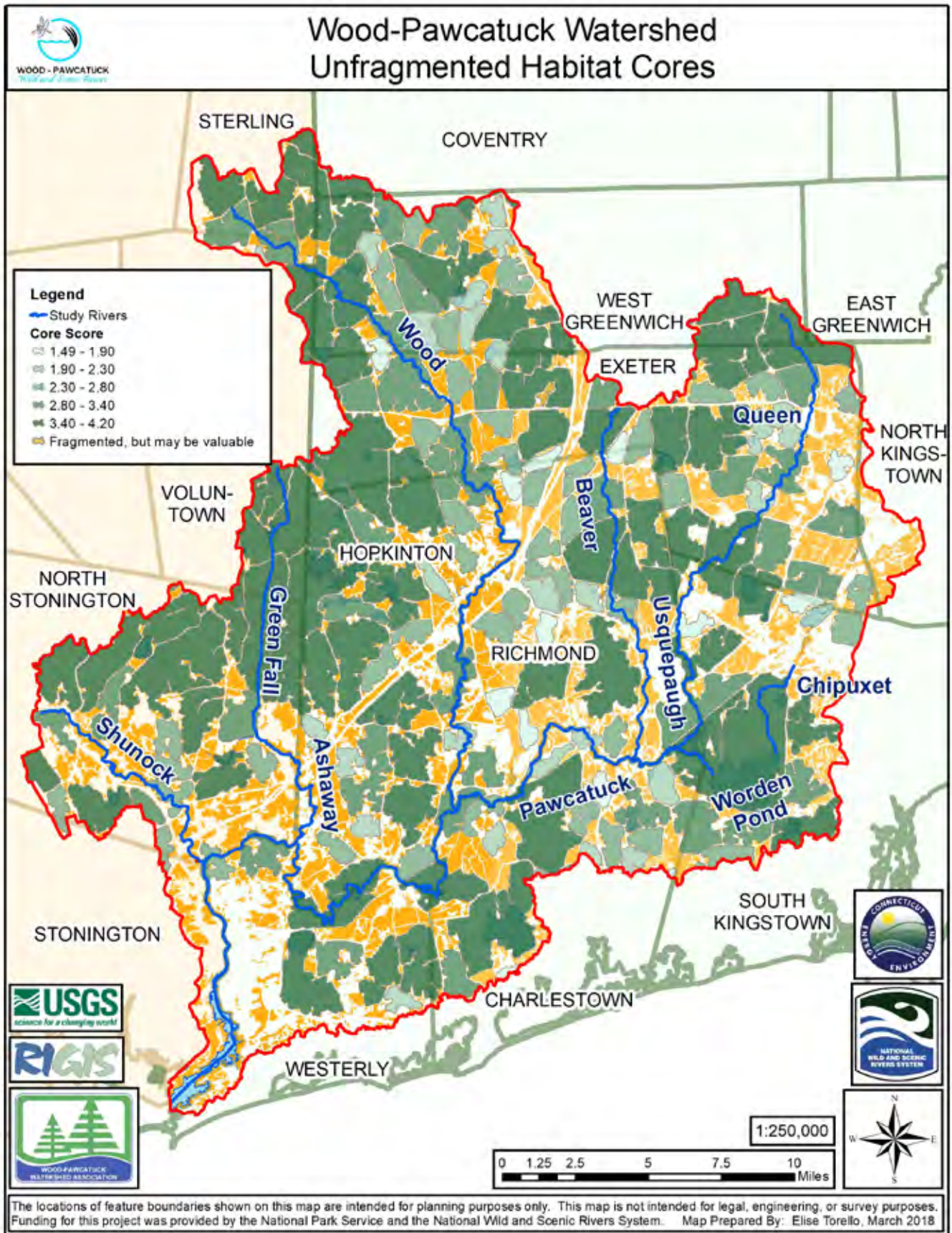


Figure 6. Wood-Pawcatuck Watershed unfragmented habitat cores

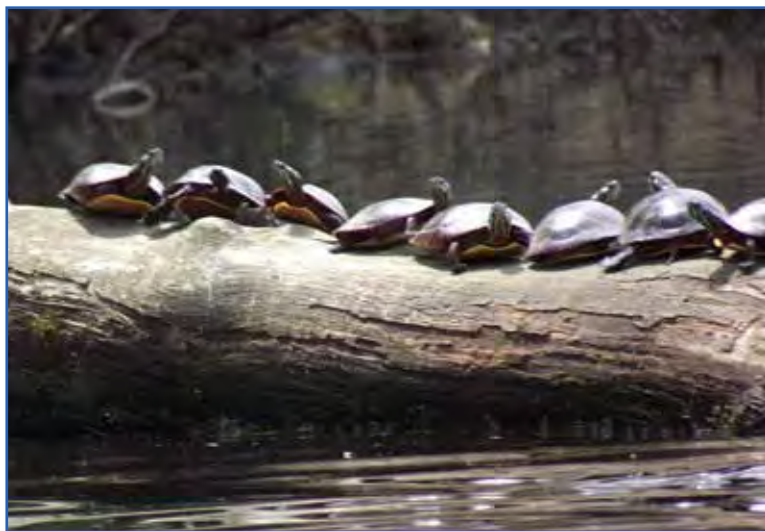
Exceptional Ecosystems

This unique convergence of geology and hydrology have created exceptional ecosystems throughout the watershed, supporting over fifty percent of the region's rare, endangered, or species of concern. The Wood-Pawcatuck Watershed is one of the least developed watershed ecosystems in the New York to Boston corridor. It was found by the EPA Resource Protection Study to contain the highest incidence of large, contiguous, forested areas in southeastern New England. Both the Rhode Island and Connecticut State Wildlife Action Plans describe unfragmented cores of over 500 acres as being of special importance to protecting wildlife. The watershed contains more than half of Rhode Island's largest cores, including 31 of 60 statewide over 1000 acres; 6 out of 9 statewide over 2000 acres, and 3 of 4 statewide over 2500 acres. The data in Figure 6 represent another tool to assess intact habitat cores, using scores developed by Environmental Systems Research Institute (Esri) staff. Habitat cores are minimally disturbed natural areas at least 100 acres in size and greater than 200 meters wide. These data are intended to identify natural assets and support green infrastructure planning at the national, regional, and local scales.

Due to the lack of development and large forested tracts, the watershed remains one of the darkest areas in the region. The watershed also contains considerable aquatic habitat suitable to the maintenance of diadromous fish and other native fishes. It has been the site of several ongoing fish passage restoration programs. Most of the rivers and streams in the watershed are coldwater fisheries, supporting native brook trout and freshwater mussel species.

Some Key Findings on the Exemplary Status of Exceptional Ecosystems in the Wood-Pawcatuck Watershed

- The *Beaver River* is ninety-one percent undeveloped and heavily forested. Nearly half the river runs through protected properties held by RI DEM, The Nature Conservancy and local land trusts. Due to these large areas of unbroken forested blocks, the *Beaver River* provides clean, cold water habitat



Painted turtles on a log in the Wood River (Photo credit: Thomas Tetzner)

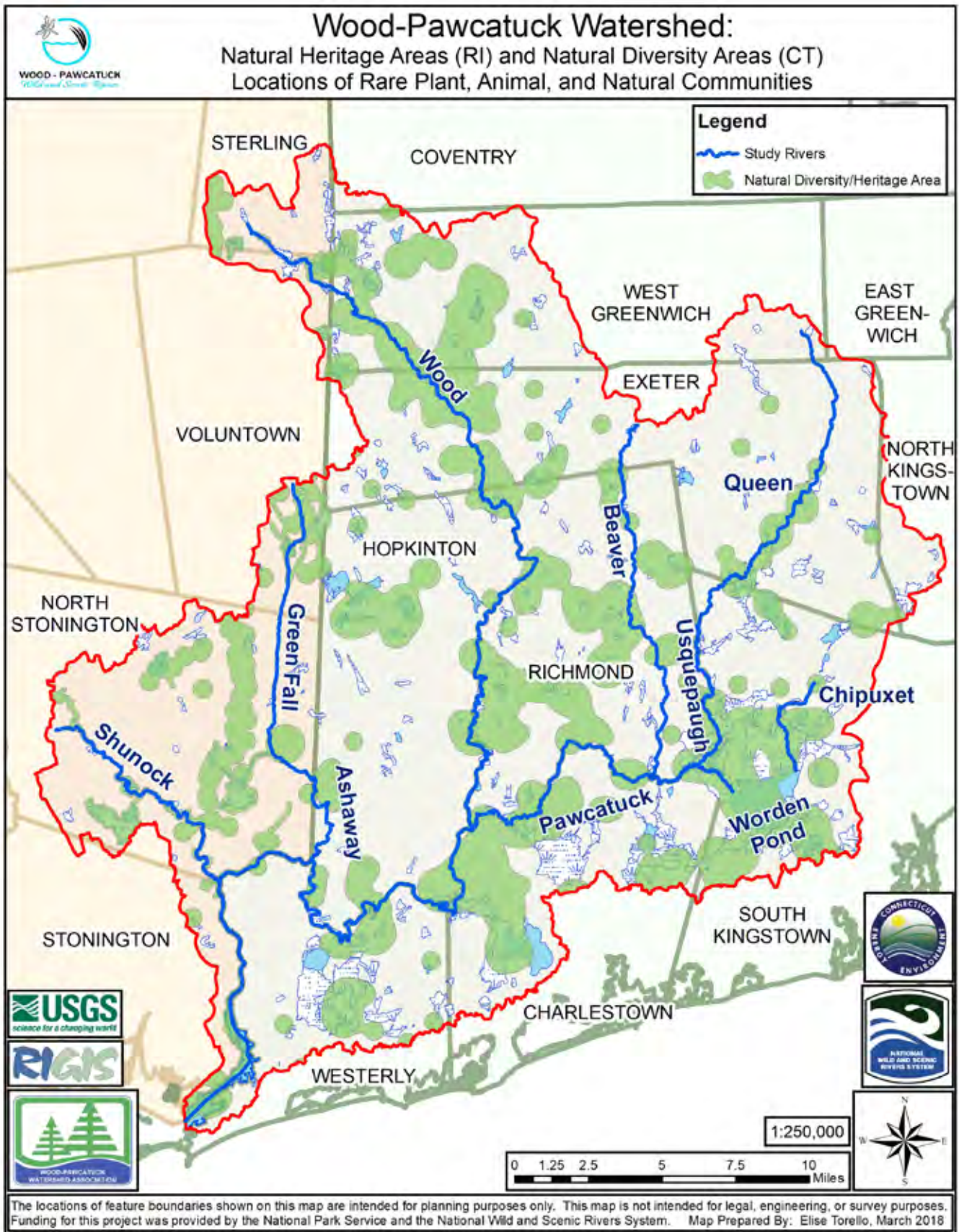


Figure 7. Wood-Pawcatuck Rhode Island Natural Heritage Areas, Connecticut Natural Diversity Areas, and locations of rare plant, animal, and natural communities

that supports a large number of invertebrate species. The river contains healthy populations of wild brook trout and mussels. Many vernal pools are located near the river, supporting amphibian species such as wood frogs and spotted salamanders. A large variety of birds nest in the deep forest areas.

- The Nature Conservancy identified the Pawcatuck River system as one of the best examples of intact riverine habitat in the Lower New England ecoregion, and thus selected it as a target for conservation. The Pawcatuck River's 300 square mile watershed comprises most of southwestern Rhode Island and extends into Connecticut. It falls within the Pawcatuck Borderlands and supports roughly 70% of Rhode Island's globally-imperiled species of dragonflies and damselflies. In fact, the watershed hosts the largest and perhaps most significant cluster of known breeding sites for the globally-vulnerable Ringed Boghaunter dragonfly (*Williamsonia lintneri*) across the specie's range. Beneath the Pawcatuck watershed, clean groundwater serves as the sole source of drinking water for more than 60,000 local residents.
- The entire three miles of the Chipuxet River, from Taylor's Landing to Worden Pond, is undeveloped. This stream is an integral component of the Great Swamp, the largest swamp in the region, which is owned and managed by RI DEM. This Wildlife Management Area encompasses a wide diversity of wetland plants, therefore the habitat supports many aquatic dependent species of invertebrates, birds, mammals, amphibians and reptiles. The area is designated as a National Natural Landmark.
- The Green Fall-Ashaway River occurs within one of the largest contiguous forests in southern New England. From its headwaters, much of the river runs through the Pachaug State Forest, which is Connecticut's largest forest, 27,000 acres. The river extends through 5 towns and includes lands within The Pawcatuck Borderland - New England's coastal forest eco-region, dark skies project. The Green Fall-Ashaway River is also part of the U.S. Fish and Wildlife Service's new Great Thicket National Wildlife Refuge. Three-quarters of Green Fall River flows within the Pachaug-Ledyard block of the 6-state refuge system to help recreate and manage shrubland acreage



Green heron
(Photo credit: Elise Torello)

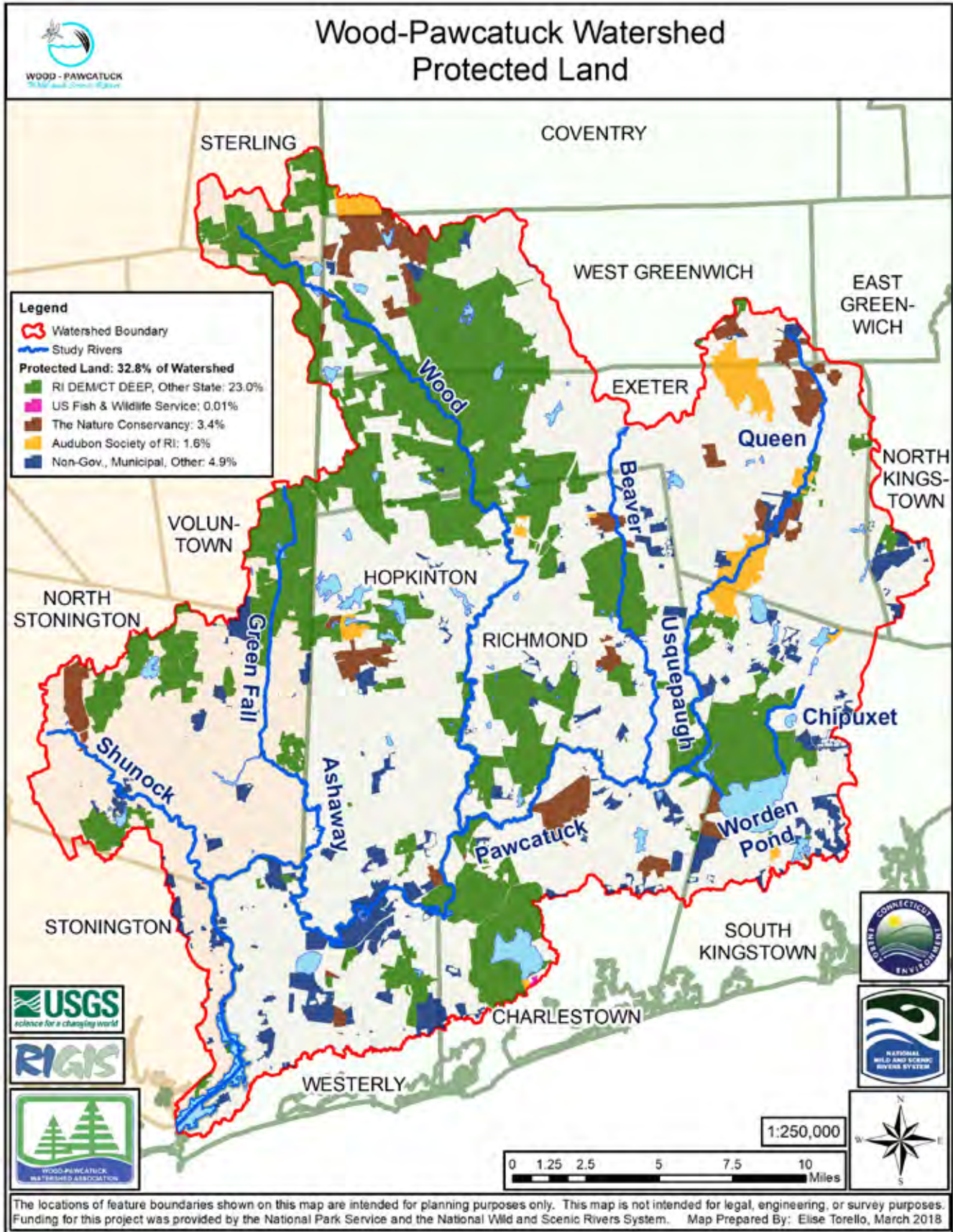


Figure 8. Wood-Pawcatuck Watershed protected land

for over 40 species of wildlife. The goal of this new refuge is to create early successional habitat for a rare native species of rabbit, New England Cottontail, as well as several species of birds that use old fields and scrub-shrub habitats including prairie warbler, blue-winged warbler, field sparrow, American woodcock, and brown thrasher. According to Forest Birds of Connecticut and Rhode Island (Robert Craig, 2017) there are an exceptional number and variety of birds occurring in the newly created North Stonington Wyassup Road Refuge.

- Bell Cedar Swamp is a significant Atlantic White Cedar swamp that drains into the Wyassup Brook and Green Fall River. It consists of decomposed peats and deep muck; stagnant slow-moving water; spectacular critical Atlantic White Cedar stands; and other imperiled natural habitats that support endangered, rare and uncommon plants like green adder's mouth orchid, nettled chain fern, and the Hessel's Hairstreak butterfly.
- The upper Wood River is an exceptional river ecosystem which supports the highest biodiversity of any river in New England. From the headwaters in Sterling, CT to Frying Pan Pond in Richmond and Hopkinton, RI, over 94% of the immediate land use surrounding the river is undeveloped and primarily forested. The river, and its tributaries in the upper section (above Barberville Dam), runs through several thousands of acres of protected properties, including Arcadia and Wickaboxet State Management Areas, TNC's Tillinghast Pond Management Area, URI's Alton Jones Campus in RI; and the Pachaug State Forest in CT. It is part of the TNC Pawcatuck Borderland Project to protect large forested blocks and preserve the "dark sky" nature of the region. Local land trusts from Sterling, CT and Exeter, West Greenwich, Hopkinton, and Richmond own preserves near the Wood River.



Pickerel weed
(Photo Credit: Elise Torello)



Native rhododendron
(Photo Credit: Elise Torello)



Cardinal flower
(Photo credit: Margie Parsons)



Marsh violet
(Photo credit: Denise Poyer)



Bur marigold
(Photo credit: Margie Parsons)

- The Nature Conservancy and Audubon Society of RI have protected several large tracts in the Queen-Usquepaugh River because of its high biodiversity, especially of dragonflies. According to the RI Odonata Atlas this river is second only to the Wood River with the overall number of Odonata species and has the highest number of river species of any river in the region. Several first and second order streams provide clean, cold water throughout the year, making this great habitat for freshwater mussels, brook trout, and amphibians. There is a large pitch pine forest on TNC property with several rare species endemic to that habitat. The lower section of the river is called the Usquepaugh River. The last two miles of the Usquepaugh River are part of the western border of RI DEM's Great Swamp Wildlife Mangement Area. Both sections are 90% undeveloped.

Odonata (Dragonflies and Damselflies) of the Wood-Pawcatuck Watershed

Virginia Brown

Dragonflies and damselflies are aquatic insects that are found in a wide variety of freshwater, and even in some saltwater, habitats. They are large, colorful, and charismatic, and are voracious predators of other insects in both the winged adult stage and the aquatic larval stage. They are good indicators of a healthy habitat, and many species are sensitive to or intolerant of disturbance in both aquatic and terrestrial habitats.

There are 138 species of dragonflies and damselflies in Rhode Island. Inventory of these insects in all areas of the state has revealed that freshwater systems with the most intact forest and the least amount of development support more species than those that have less forest and more development. The Wood-Pawcatuck Watershed has abundant high quality



Dragonhunter (Hagenius brevistylus)
(Photo credit: Denise Poyer)

and streams flowing through large areas of protected forest, and numerous freshwater ponds and wetlands nestled in this matrix of fast moving water habitats. The watershed is host to a rich and abundant odonate (dragonfly) population that includes species found nowhere else in the state, species that are scarce statewide but flourish in the Wood-Pawcatuck system, and species that are intolerant of disturbance.

Compared to other watersheds in the area, the Wood-Pawcatuck supports more species of dragonflies that prefer or are found ex-



Female prince baskettail (*Epiptera princeps*)
(Photo credit: Denise Poyer)

clusively in habitats made up of fast moving freshwater, and more species that are sensitive to pollution, siltation, changes in water temperature, dams, and disturbance of bank and stream vegetation. Of the forty species of dragonflies and damselflies in Rhode Island that can be expected to occur in river habitats, thirty-six, or ninety percent, are found in the Wood-Pawcatuck Watershed. Species that are also found in other watersheds are more abundant in the Wood-Pawcatuck Watershed and occupy more available habitat. Additionally, this is the only watershed in the state that hosts all nine dragonfly species that are intolerant of disturbance factors listed above.

River specialties that occur in the Pawcatuck system but are rare or absent elsewhere include Brook Snaketails (*Ophiogomphus aspersus*), Spine-crowned Clubtails (*Gomphus abbreviatus*), Mustached Clubtails (*Gomphus adelphus*), and Zebra Clubtails (*Stylurus scudderi*). Brook Snaketails are especially sensitive to degradation of river habitat, and are found only in rivers with clean sand deposits.

Dragonflies and damselfies of lakes, ponds, and bogs also find abundant habitat in the Wood-Pawcatuck Watershed. Specialties include three northeast endemic Bluet damselfies (*Enallagma spp.*) that occur in ponds and the Ringed Boghaunter (*Williamsonia lintneri*), a species inhabiting bogs and fens.

The Wood-Pawcatuck Watershed is a critical region for the state's dragonfly and damselfly populations. The long term viability of these insects, as well as other aquatic organisms, depends upon the preservation of clean, undisturbed rivers, ponds, and wetlands. Also critical to the protection of the state's Odonata are the forested uplands that not only maintain water quality, but provide habitat for adult dragonflies and damselfies. In this watershed thousands of acres of land and water are already protected, a significant foundation for the long term conservation of this vibrant group of insects.



Ebony jewelwing damselfly (*Calopteryx maculata*) (Photo credit: Elise Torello)



Male eastern pondhawk (*Erythemis simplicicollis*) (Photo credit: Denise Poyer)

The Status of Freshwater Mussels in Rhode Island

Christopher J. Raithel and Raymond H. Hartenstine

[Below are extracts from the article "The Status of Freshwater Mussels in Rhode Island" by Christopher J. Raithel and Raymond H. Hartenstine, published in Northeastern Naturalist, Vol. 13, No. 1 (2006), pp. 103-116. The full text is available at www.jstor.org/stable/4131010]

We obtained data for 199 discrete Rhode Island localities of varying size and visited several of these repeatedly. We surveyed 129 sites completely and had partial data for 70 other sites. We recorded 8 mussel species. Localities with high species richness were confined to the Pawcatuck River and Pawtuxet River Basins. Only the Pawcatuck River Basin supported all local mussel species. Within the Pawcatuck River Basin, we found sites with high (4-5) species richness within the Queen River, Chipuxet River, and Pawcatuck River Sub-basins. The primary epicenters of Rhode Island mussel diversity are presently located in the headwaters of the Pawcatuck River Basin and in the South Branch River Sub-basin of the Pawtuxet River Basin.



Alasmidonta undulata (common name: Triangular Floater) was fairly widespread, occurring at 20 sites (16%), but was usually uncommon at any given site. (Photo Credit: VT Center for Ecostudies)

Anodonta implicata (Alewife Floater) occurred at 12 sites in coastal rivers and ponds. This species occurred in the Pawcatuck River as far upstream as the village of Carolina (Richmond) and northward to Mechanic Street Dam (Hopkinton/Richmond) in the Wood River. (Photo Credit: CT DEEP)



Elliptio complanata (Eastern Elliptio) was the most widespread species, found in 58% of occupied sites. It was also the only species that could be considered common, vastly outnumbering all other species in mixed assemblages. Sizeable E. complanata populations were located in Worden's Pond (South Kingstown) and two other sites outside the Pawcatuck Basin. (Photo Credit: Wikipedia)

Lampsilis radiata (Eastern Lampmussel) occurred primarily in natural lakes and connecting rivers. It is uncommon and localized, recording this species at only 10 localities within the Pawtuxet River and Pawcatuck River Basins. Within the Pawcatuck River Basin, we found L. radiata only within the natural lakes and connecting rivers that extend from Hundred Acre Pond (South Kingstown) through Thirty Acre Pond (South Kingstown) and, via the Chipuxet River (South Kingstown), to Larkin's Pond (South Kingstown) and Worden's Pond. (Photo Credit: CT DEEP)





Ligumia nasuta (Eastern Pondmussel) was found only within the Pawcatuck River Basin. *L. nasuta* was moderately common only in Worden's Pond and perhaps at Chapman Pond (Westerly). *L. nasuta* is one of the most localized and uncommon of Rhode Island's mussels. (Photo Credit: DiscoverLife.org)

Margaritifera margaritifera (Freshwater Pearl Mussel) occurred primarily in headwater streams of the Pawcatuck River Basin, especially in the Wood River Subbasin.

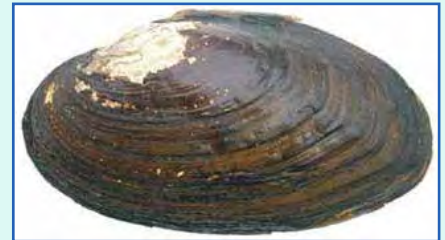
M. margaritifera was usually the only species found where it occurred, but we also detected it sparingly within mixed assemblages in the better riffle areas of the lower Pawcatuck River, as at Potter Hill and White Rock (Westerly). *Margaritifera margaritifera* populations have suffered dramatic declines even within the scope of this survey. Streams within the Arcadia Management Area formerly hosted large populations of *M. margaritifera*. In the 1980s, this species was so common in the Flat and Falls Rivers (Exeter) that one could not wade without stepping on one.

Recently, *M. margaritifera* has declined to the point of near extirpation in one of those rivers. A population in Beaver River (Richmond) has concurrently declined. (Photo Credit: Wikipedia)



Pyganodon cataracta (Eastern Floater) was the next most widespread species, found at 21% of occupied sites, predominantly in ponds and slow rivers, often in modified habitats (e.g., reservoirs). (Photo Credit: DiscoverLife.org)

Strophitus undulatus (Creeper) was not only localized in distribution, but was also uncommon. We found this species primarily in higher quality riffle areas in larger rivers. The best populations occurred in the Queen River (Pawcatuck River Basin), and two other sites outside the watershed. *S. undulatus* is so uncommon and localized that its future in Rhode Island seems tenuous. It is clearly one of the highest priorities for mussel conservation in Rhode Island. (Photo Credit: NH Fish & Game)



Although comparisons to the historical era are difficult, we infer that Rhode Island's present mussel fauna has been vastly reduced from its ancestral condition. Of the three largest river systems in Rhode Island, only the Pawcatuck River Basin contains populations of all local mussel species. The most significant concentrations of mussels in this system are presently found in the Queen River and the natural lakes in the upper Pawcatuck River Subbasin. Unfortunately, these lakes are threatened by agricultural run-off and other sources of contamination, as well as from summer water withdrawals that sometimes render connecting streams nearly dry. Several ponds in the upper Pawcatuck River Basin have become obviously more eutrophic since 1980. Mussels depend on stable, relatively clean aquatic habitats. Therefore, even the mussels in the Pawcatuck River Basin are under siege.

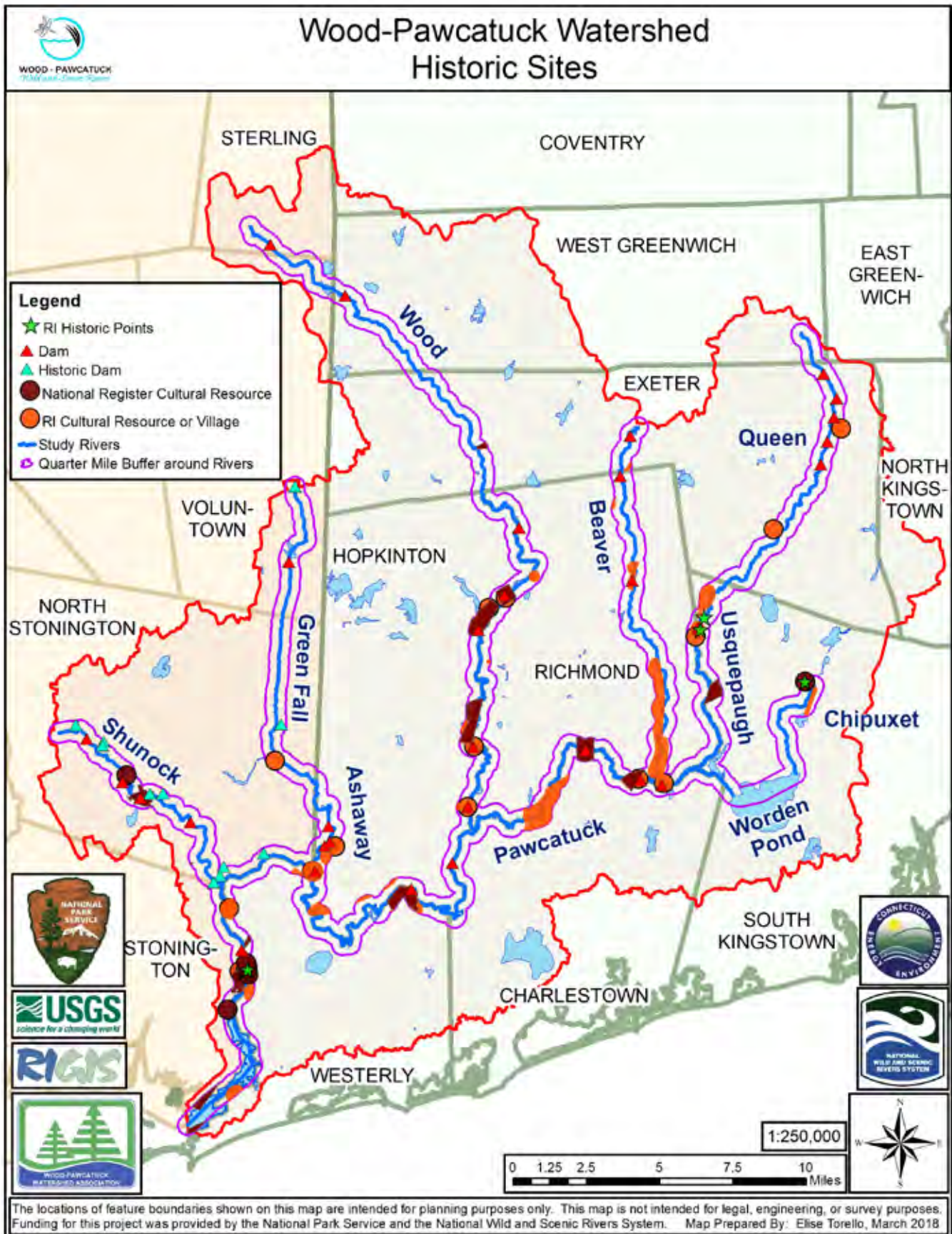


Figure 9. Wood-Pawcatuck Watershed historic sites

Cultural

The abundant wildlife and fish in the region attracted Native American tribes to the Wood-Pawcatuck Watershed, such as the Narragansetts and Pequots. Prior to the arrival of European colonists, there were about 7,000 Native Americans living in southern RI. Many current names in the watershed are Native American in origin.

The colonization of southern Rhode Island began with the arrival of Roger Williams in Wickford in 1637 followed by a multitude of other freethinking settlers and enterprising businessmen. By the mid 18th century these large plantations extended across southern Rhode Island and resulted in an aristocratic plantation culture. Rhode Island was an important part of commerce within the entire Atlantic community. Shipbuilding began in Westerly in 1681 and continued for 200 years. Over 240 vessels were constructed in this area.

At the end of the 18th century political power shifted to the more mercantilist cities such as Newport, Bristol and Providence. The many rivers and streams in the watershed were dammed and used to power over 30 mills. The presence of mills attracted workers from throughout the region. Villages sprang up around the mills. Buildings, dams, and other remnants of these historical sites are present on every river in the watershed. The Wood, Pawcatuck, Beaver, Shunock and Green Fall-Ashaway Rivers contain many fine examples of early to late industrial mill buildings and structures. There are many other dams and historic mill artifacts throughout the watershed on tributaries to all seven rivers. While they are not discussed in this document they are still of historic significance.

Important agricultural resources are found on outwash plains near the Queen-Usquepaugh, Chipuxet, Beaver, Pawcatuck, and Green Fall-Ashaway Rivers.

Some Key Findings on the Exemplary Status of Cultural resources in the Wood-Pawcatuck Watershed

- The Hillsdale Historic and Archeological District was a center for various kinds of milling, using the Beaver River for water power.



*North Stonington sawmill
(Courtesy of North Stonington Historical Society)*



Figure 10. Wood-Pawcatuck Watershed dams and fish passage structures on study river segments

Hillsdale produced textiles, primarily coarse cottons and woolens, in the western part of Richmond during the period 1830 to 1870. Presently the mill village exists as a series of archeological sites: industrial, commercial, and domestic, strung out along Hillsdale Road and set in 68 acres of second growth, hardwood forest. The Historic District is a small portion of a large, 2,000 acre, state-owned wooded tract, the Hillsdale Management Area. The various components of the mill village have been preserved from subsequent reuse or development and feature a high degree of archeological integrity.

- On the Shunock River the Avery mill from the very early 1700s was the basis for the first naming, Avery Mill, of what is now North Stonington Village. In fact, the Village of North Stonington had the largest concentration of river dependent industry in the region.
- In this region of CT the Green Fall River supplied water for mills that were built both earlier and bigger than mills found on the Shunock. Two fairly complete villages, Clarks Falls and Shady Glen, grew up around the river. These villages had churches, schools, retail stores, large fulling mills and woolen mills. Also, throughout the river there were several little country mills located in the woodlands. Extensive Native American ceremonial stonework in the area includes the Manitou hassunash, the stone groupings and hassuneutunk, the walls and serpent effigy constructions for the Narragansetts. Five working farms still utilize prime agricultural soils that are the results of outwash plains from the retreat of the glaciers. A battle was won by the Narragansett Indians against the Pequot Indians at the lower falls of the Pawcatuck River in Shannock for fishing rights. Archeological sites include a shell heap at Pawcatuck Point, burials on the Whit Davis arm, stone tools Rock Site, and a fourth site on Mastuxet Cove.
- There are three state documented tribal camping/fishing/settlements of the Pequot and Eastern Pequot Tribes along the Shunock River. Ceremonial stone sites are also found throughout the area with more discoveries continuing. Historic early mills and villages were a result of the



*Shannock Falls monument, Richmond, RI
(Photo credit: Denise Poyer)*

socioeconomic impact of the river. North Stonington enjoyed a period of prosperity as a mill town thanks to the abundant water supplied by the *Shunock River* and Assekonk Brook. In fact, the Village of North Stonington had the largest concentration of river dependent industry in the region. A variety of mills sprouted up along the river from the late 1600s through early 1900s. The Avery Mill from the very early 1700s was the basis for the first name, Avery Mills, for what is now North Stonington.

- Two Native American tribes claimed areas near the upper *Wood River* for winter camps. The Mohegan used the section above Baily Pond in Sterling, CT and the Narragansett used the region that started in RI. Along the Step Stone Falls are remnants of an old quarry where bedrock was easily accessible. The foundation for a timber mill using these quarried rocks can be found slightly further downstream. There are seven dams along the *Wood River* with additional dams on the river's tributaries. The numerous waterfalls and small ponds were well adapted for mill wheels. Hope Valley and Wyoming dams supported thriving communities which have been well documented and the Hope Valley and Wyoming Village Historic Districts are listed in the National Register of Historic Places.



Old mill equipment and Mechanic St. dam on the Wood River, Hopkinton, RI (Photo credits: Elise Torello)



Potter Hill Mill, Westerly, RI (Photo credit: Denise Poyer)



*Kenyon grist mill (still operating) on the Usquepaugh River, South Kingstown, RI
(Photo credit: Elise Torello)*

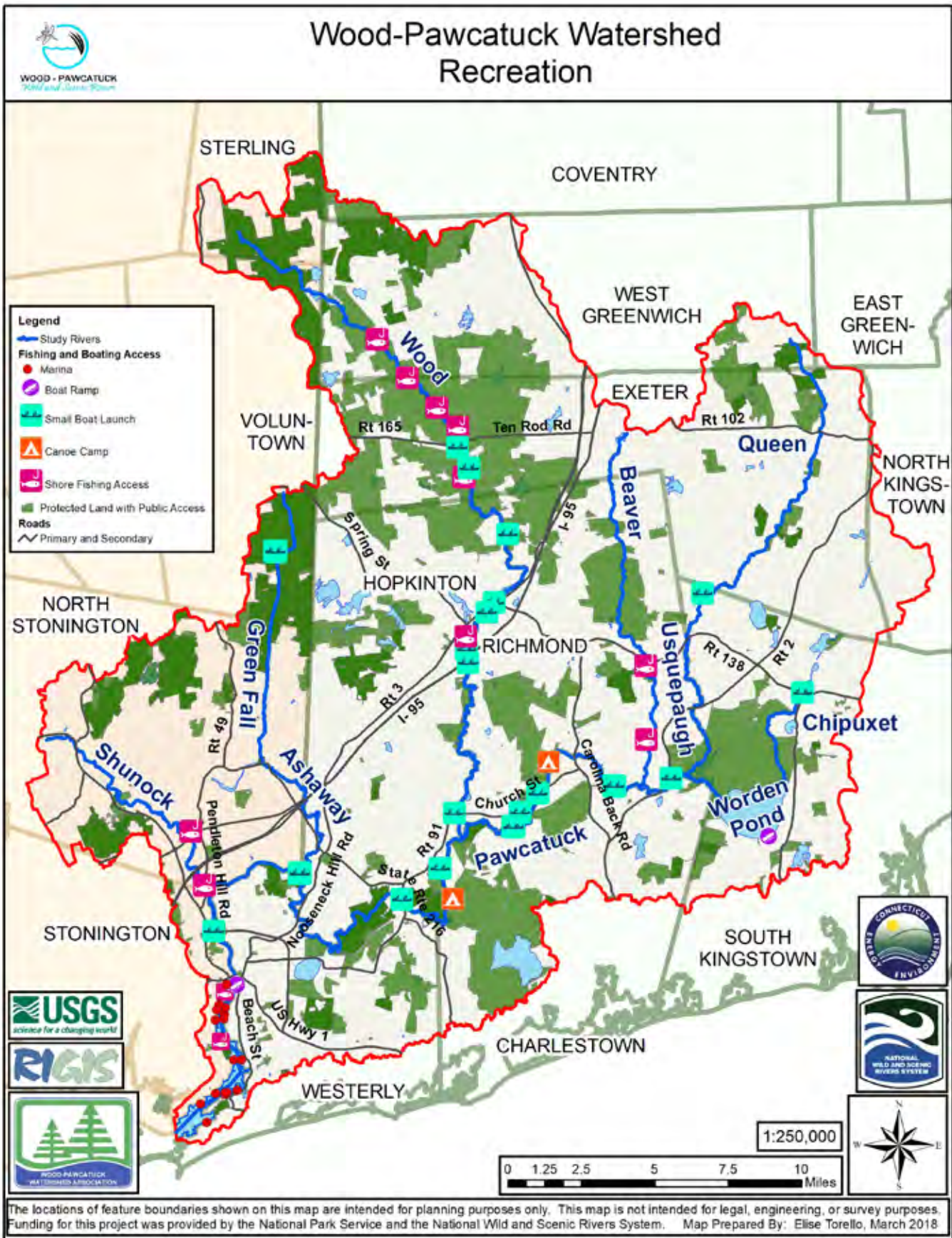


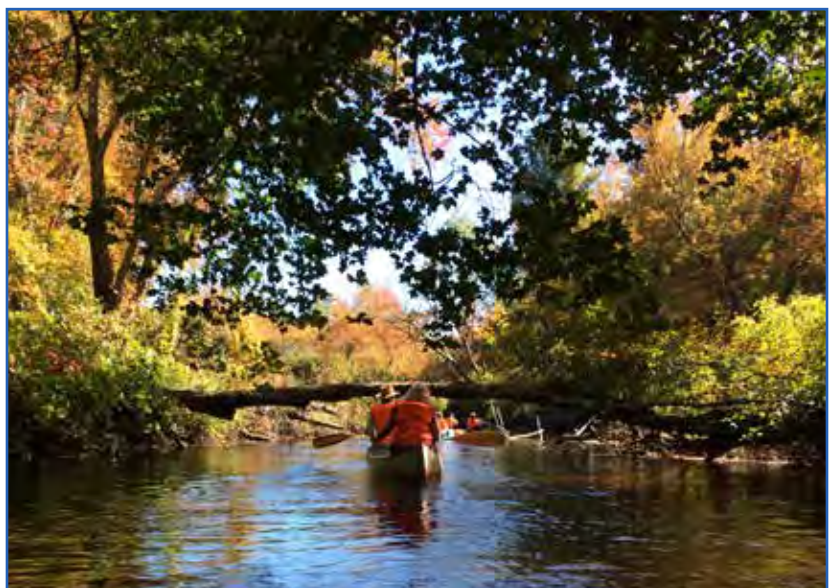
Figure 11. Wood-Pawcatuck Watershed recreational areas, including open space parcels with public access, shore fishing access points, and boat launches

Scenic/Recreation

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. The lower Pawcatuck provides safe harbor for several marinas, with access to Long Island Sound and the Atlantic Ocean. The thousands of acres owned by state and non-government agencies and local land trusts along the rivers offer hundreds of miles of trails for hiking, biking, and birding. State management areas supply ample hunting and fishing for local residents.

Some Key Findings on the Exemplary Status of Scenic and Recreation resources in the Wood-Pawcatuck Watershed

- The Chipuxet River's slow meander through three miles of wetlands provides beautiful scenery for paddlers; opportunities to fish and hunt; and observation of wildlife. The South County Bike Path crosses the Chipuxet, giving bikers and walkers a glimpse into a wild system.
- Green Fall Pond, remote within Pachaug Forest in Voluntown, is deeply a part of local use and pride. It has a long history of use as a campground, with swimming, canoeing, fishing, and hiking of several surrounding renowned trail systems, a public boat launch, places for hunting, horseback riding and mountain biking. Locals call it their childhood "swimming hole near the ravine."
- The Pawcatuck River is a recreation destination. Starting at the mouth of the river, there are fourteen marinas, a public boat launch, parks and nature preserves. Motorized boats are found primarily in the estuary and two short upstream stretches which are deep enough to allow them. Otherwise the Pawcatuck River is primarily



*Paddlers on the upper Wood River
(Photo credit: Elise Torello)*

River Paddling

Jim Leigh

Whether you are new to paddling or you are an experienced paddler, the Wood-Pawcatuck Watershed provides a multi-sensory adventure to your river paddle trip. Paddling within this special watershed takes the canoeist, kayaker, and paddle boarder into a resplendent wild and scenic river environment. The rural atmosphere and the feeling of solitude, embraces the human need for relaxation and freedom. Today, the Native American Narragansett people continue to navigate the Wood and Pawcatuck Rivers by canoe. Their primary focus for paddling centers upon recreation, harvesting and ceremony.

Along the river by-ways, flowing tributary waters and small inlets imprint the riverbanks. The rivers are a mixture of smooth flat water, occasional ripples of quick water and minor rapids which can be portaged. The river system offers the paddler two established river camping sites and selected unofficial river pull-out resting stops. According to the Wood-Pawcatuck River Routes Guide there are seventeen miles of canoeable passage on the Wood River, four miles on the Chipuxet River, and forty-six on the Pawcatuck River.

As you paddle through this watershed region, you will encounter a variety of flora and fauna. Grand stately pines, majestic river oaks and an assortment of maples are growing along the rivers. Mountain laurel and rhododendron groves border various riverbanks. Marshes, bogs and vernal pools complement the watershed's unique environment. Also, the watershed offers a protective habitat for a variety of animal river life. Deer, foxes, coyotes and raccoons may be observed along the river. Likewise, nesting ducks, migrating geese, egrets and blue heron occupy the shadows of the river. As a paddler, you may encounter the passage of native and migratory fish such as blueback herring, alewife, American shad, trout and American eels.

A river paddling outing through the Wood-Pawcatuck river system is an extraordinary multi-sensory adventure from the past, for the present and into the future.



Stand up paddleboarders on the Wood River (Photo credit: Elise Torello)

enjoyed by canoists, kayakers, and stand up paddlers. There are two riverfront campsites on the *Pawcatuck River*. They are in the Burlingame and Carolina Management Areas. Nine fishing and boating access points dot the river from Biscuit City Landing to the Westerly Town Dock.

- The *Pawcatuck River's* scenic beauty is encountered along the entire water byway. The river flows through a rural wooded landscape. This watershed region is one of the few remaining pristine areas between New York and Boston. The water is clean and clear with many transparent views of the riverbed. Alluring marshes and swamps are viewed along the river course. Seasonal changes bring a variety of auditory and visual attractions to the river along with captivating sunrises and sunsets for the river tourist. A mature canopy of trees line the river's forested banks.
- The *Wood River* is a destination river for recreation throughout New England because it is within an hour drive of anywhere in RI and eastern CT. This river has forested banks and clean, cold water, therefore trout can find pools of refuge even in the heat of summer, making this a regional destination for fly fisherman. RI DEM stocks brown, rainbow, and hatchery raised brook trout throughout its length. There are wild brook trout in all the tributaries and upper reaches of the river. A section of the river, from West Greenwich to Exeter, is reserved for catch and release fishing. Canoists and kayakers flock to the *Wood River* to enjoy the experience of a wild, natural river, with its many twists and turns and small class II rapids. Birders can find numerous species of birds along the river banks. The RI North South Trail system runs beside the *Wood River* and many of the tributary streams. People use the river to hunt for small game, deer, and waterfowl.



A group of schoolchildren paddling in Frying Pan Pond (Photo credit: Elise Torello)

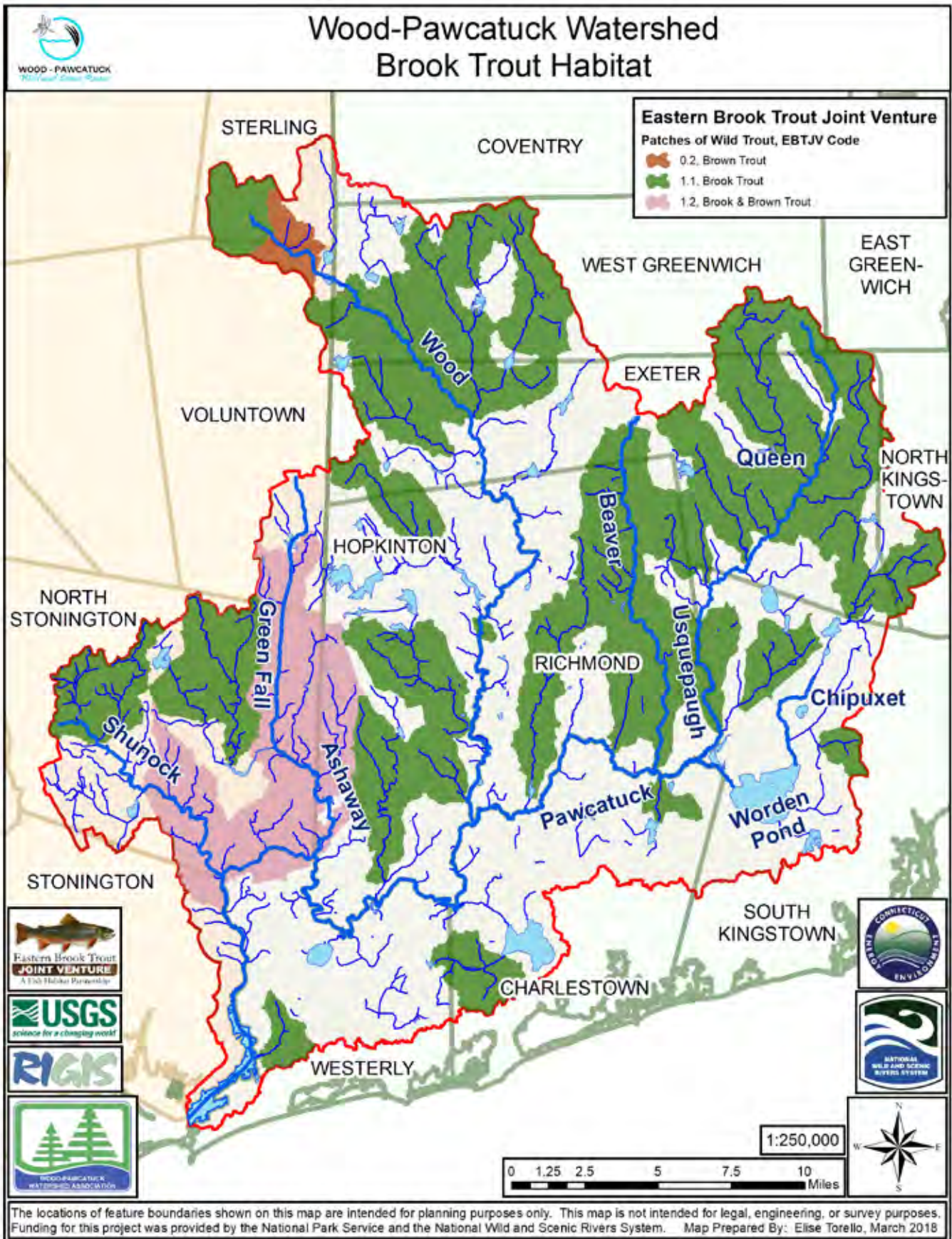


Figure 12. Wood-Pawcatuck Watershed brook trout habitat, from the Eastern Brook Trout Joint Venture

Brook Trout in the Wood-Pawcatuck River Watershed

Corey Pelletier

The Wood-Pawcatuck Watershed provides essential habitat to one of the few native fish species to Rhode Island, the Eastern brook trout. Wild brook trout rely on cold, well oxygenated water for their survival, and Wood-Pawcatuck Watershed provides more of this than any other watershed in the state.

As both an ecologically and recreationally important species, brook trout have been impacted by development and land clearing. They continue to be affected by a variety of natural and anthropogenic factors. Due to the amount of land protected by state and conservation groups, the Wood-Pawcatuck Watershed contains the least impacted forests and waterways in Rhode Island. As a result, this watershed has created a stronghold of wild brook trout populations throughout its network of streams. They can be found from the uppermost reaches of headwaters down to the main stems of the Wood and Pawcatuck Rivers.

Various other watersheds across the state have faced extensive urbanization and degradation of water quality, greatly reducing suitable habitat for wild brook trout. Maintaining the remaining habitat by protecting coldwater streams across Rhode Island is vital. Although the Wood-Pawcatuck Watershed is one of the remaining drainages with abundant coldwater streams and forested riparian networks, still this native fish species is still impacted. Warming waters due to impoundments and climate change pose one of the more challenging impacts to brook trout. Fragmentation of habitat by impassable culverts and dams affect these fish by reduction of movement. Protecting these lands and reducing further degradation is essential for the persistence of this species.

The Wood River Watershed: A Tranquil Hidden Gem for Fly Fishers

Dick Diamond

For most fly fishermen living east of the Mississippi, getting to secluded trout waters means leaving the hustle and bustle of urban living behind by driving for hours into the hinterlands or making the long trek to mountainous national parks and forests. This is not the case for southern New England trout anglers. Lying only a few minutes' drive from the roar and rumble of eighteen-wheelers racing north and south on busy Interstate 95, the Wood River Watershed provides a mostly tranquil and frequently solitary year-round fly fishing experience much closer to home.



A brook trout (Photo credit: Richard Benson)

The Wood River and its smaller tributaries the Falls River, Flat River and Breakheart Brook meander through the heavily forested 14,000 acres of the Arcadia Management Area. While the Management Area provides a rich assortment of recreational opportunities for hiking,

hunting, biking, kayaking and canoeing, the trout fisherman often enjoys having his favorite deep pool or shady run mostly to himself. There are multiple access points and plenty of nearby parking so that the ambitious angler can cover most of the river in a day. Given its location in the center of the smallest state of the union, few Rhode Islanders are more than an hour away.

Except for a brief closure from the last day of February until the second Saturday in April, the Wood River is open for trout fishing year-round. Spring rains can bring occasional high waters, but the river is mostly wadable during the peak season of May through September. The ability to wade safely becomes especially important during the Wood's signature *Hexagenia Limbata* hatch which occurs nightly at dark during the summer months. During the day, a thick canopy of pines keeps the water sheltered from the heating rays of the sun and insulates the wading fisherman from outside noise and other distractions. A rich diversity of insect hatches, plentiful bait fish and late summer terrestrial activity provide ample opportunities for the dry fly purist, streamer fishermen and nymphing specialists.

The Wood River Fly Fishing Club regularly assists in generously stocking the Wood River with quality Rainbow and Brown trout from state hatcheries. While the state no longer stocks Brook Trout, there are plenty of colorful wild Brook Trout scattered throughout the watershed to challenge fly fishers. Narragansett Chapter of Trout Unlimited provides volunteers and other support for improving the habitat and enhancing the fishery.

All things considered, southern New England fly fishermen are fortunate indeed to have easy year-round access to a nearby New England trout stream and all the beauty of nature it provides.

Table 1. Outstandingly Remarkable Values (ORVs)

River Segment	ORV Category	Landscape Feature	Area of Comparison	Unique/Rare/Exemplary
Watershed	Geology/ Hydrology	Recessional moraine forming the Great Swamp, Cedar Swamp, and Chapman Swamp; sole source aquifer. High water quality for most of the surface water	New England	Unique
	Ecology	Critical habitat contains large forested blocks and multiple wetlands; fifty percent of the regions rare and endangered species; part of the New England dark sky region	Southern New England	Rare
	Cultural	Native American archeological sites; assemblage of historic mill villages	New England	Exemplary

River Segment	ORV Category	Landscape Feature	Area of Comparison	Unique/Rare/Exemplary
	Recreation/ Scenic	Over fifty-six miles for boat passage; river corridors provide fishing, hunting, birding, hiking, and camping	Southern New England	Exemplary
Beaver River	Ecology	91% undeveloped, large areas of unbroken forested blocks; cold, clean water habitat supporting invertebrates, wild brook trout	Southern New England	Exemplary
	Cultural	Hillsdale Historic and Archaeological District	New England	Exemplary
Chipuxet River	Ecology	Undeveloped three miles of the river form a key part of the Great Swamp; National Natural Landmark	New England	Exemplary
	Recreation	Slow meander allows for scenic paddling, hunting, fishing, birding	Southern New England	Exemplary
Green Fall River	Geology/ Hydrology	Green Fall Rift Valley	Southern New England	Rare
	Cultural	Clarks Falls and Shady Glen mill villages	Southern New England	Exemplary
	Recreation	Green Fall Recreation Area	Southern New England	Exemplary
Pawcatuck River	Geology	Worden Pond – largest freshwater lake in Rhode Island; Charlestown Moraine creates east-west passage and many large swamps	New England	Unique
	Cultural	Narragansett Indian archaeological sites at Pawcatuck; nine historic mill sites; historic ship building	New England	Exemplary
	Recreation	boating; fishing; hunting; camping	Southern New England	Exemplary
	Scenic	Marshes and swamps along the waterway, rural wooded landscape	Southern New England	Exemplary

River Segment	ORV Category	Landscape Feature	Area of Comparison	Unique/Rare/Exemplary
Queen-Usgeupough River	Ecology	Highest river Odonata count in the region; high number of freshwater mussel species; Western border of the Great Swamp; National Natural Landmark	New England	Rare
	Geology/ Hydrology	Headwaters of the Queen River - Dead Swamp	Southern New England	Unique
Shunock River	Ecology	Cold water fisheries, CT DEEP Class 3 Wild Trout Management Area	Southern New England	Exemplary
	Cultural	Three state-documented tribal settlements of the Pequot and Eastern Pequot Tribes; early mill villages established the town of North Stonington	New England	Exemplary
Wood River	Ecology	Upper Wood River supports the highest biodiversity of any river in New England	New England	Unique
	Ecology	Large tracts of undeveloped forests; contains over fifty percent of the regions rare and endangered species	Southern New England	Unique
	Recreation	Fly fishing; popular for kayaking due to scenic resources	Southern New England	Exemplary
	Cultural	Native American quarry site and winter camps; seven historic mill villages	Southern New England	Exemplary
	Scenic	Forests, wetlands, wildlife viewing	Southern New England	Exemplary

Beaver in the Wood-Pawcatuck Watershed

Charles Brown

The American beaver (*Castor canadensis*) was likely common throughout the Wood-Pawcatuck Watershed and much of North America prior to the arrival and settlement of Europeans on the continent. Beavers were an important resource for native peoples who utilized the meat, fur, and castoreum (an oily substance secreted by beaver that is often used in perfumes). An insatiable demand for their fur in Europe led to exploitation by native peoples to trade for European goods, and later by European settlers, eventually leading to their extirpation over much of their range. While they could be found in northern areas, they completely moved out of southern New England. It is not known when beavers disappeared from what is now Rhode Island, but given our knowledge of the early fur trade and considering the state's proximity to the coast, beavers were probably gone from the area prior to 1700.

The beaver is North America's largest rodent. It is not uncommon for adults to weigh more than sixty pounds. They live in extended family groups of five to eight individuals called colonies, which typically consist of an adult pair and offspring, called kits, from the prior year and from the current year. Young beavers remain in the family group until they are two years old, at which time they leave or are forced out by their parents. They disperse to find suitable habitat elsewhere to establish their own territory and find a mate. Beavers are territorial, and will vigorously defend their territory from other beavers.

In 1976, the DEM's Division of Fish and Wildlife documented the first beaver colony in Rhode Island in modern times, within the Moosup River system in western Coventry. Beavers had colonized the area from the Quinebaug watershed in Connecticut. Over the next 20 years beaver populations expanded throughout the Moosup River system and other watersheds within Rhode Island including the Wood-Pawcatuck. A survey conducted by the Division of Fish and Wildlife in the winter of 2006-07, documented over 90 active colonies throughout the Pawcatuck watershed. Today, beavers continue to expand into new areas of the state.

Beavers can profoundly impact their environment by building dams and cutting trees and woody vegetation. Areas impounded by beavers create important habitat for a variety of wildlife species, and recharge groundwater. Impounded areas provide a refuge for trout and other fish species during times of drought. Sediment that settles behind dams provides nutrients that are exposed when water levels recede, creating meadows rich with a wide variety of plant and animal life.



Beaver activity on the Pawcatuck River (Photo credit: Elise Torello)

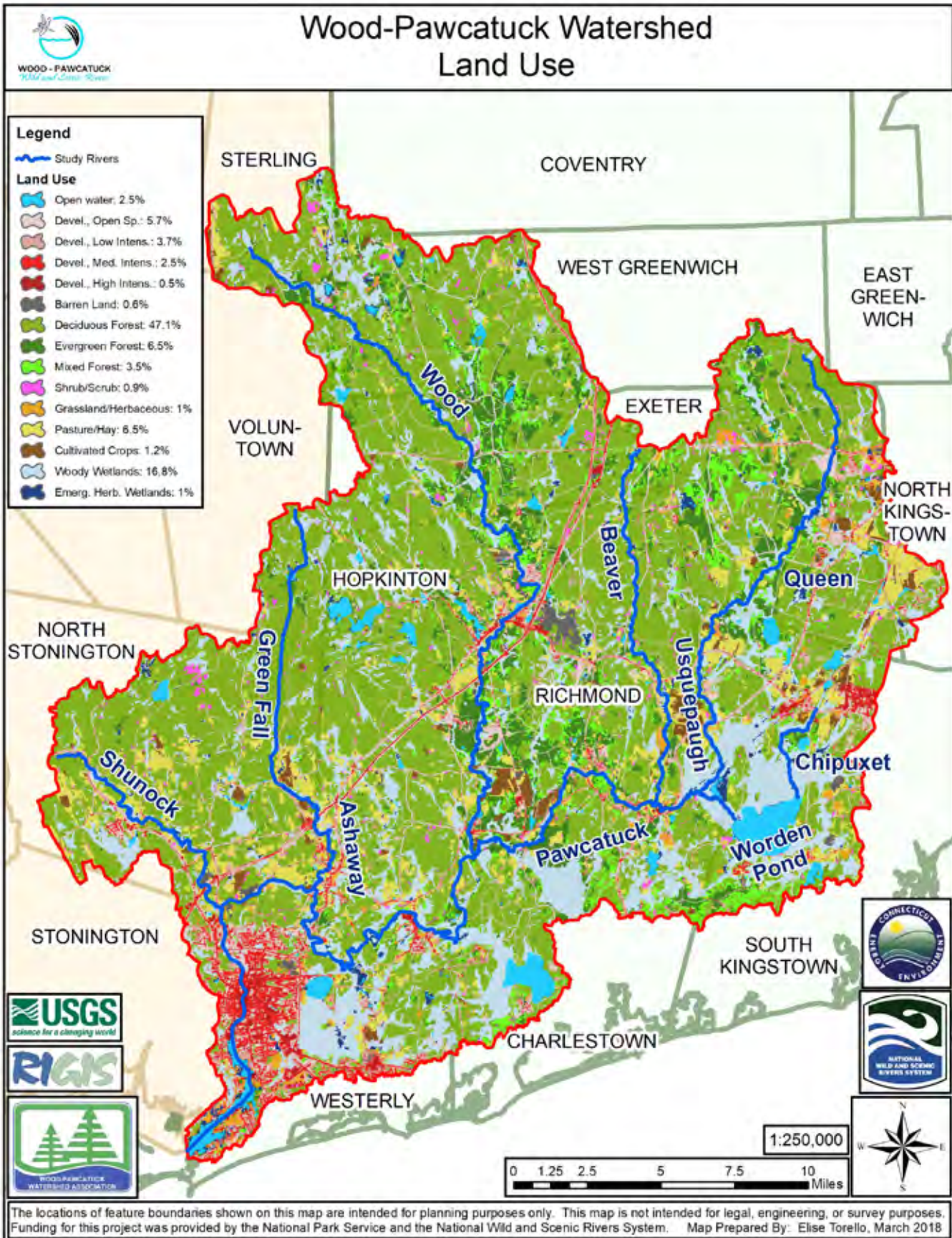


Figure 13. Wood-Pawcatuck Watershed land use, from the USGS National Land Cover Dataset 2011

The Watershed

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. The watershed is the most rural, least developed in Rhode Island with approximately eighty-seven percent of the land undeveloped or in agriculture and approximately seventy-five percent forested. Much of the Connecticut portion of the watershed is also undeveloped due to the protection of the Pachaug State Forest and the Green Falls Recreation Area. (Undeveloped is a Land Use category defined as forest, shrubs, cultivated fields, grasslands, hay, wetlands and open water. Developed is defined as low, medium, and high density, open space associated with developments, golf courses, ball fields, and barren land.) Five segments under study – Beaver River, Chipuxet River, and the first segments of the Queen-Usquepaugh, Wood, and Pawcatuck Rivers – are at least ninety percent undeveloped. The estuary of the Pawcatuck River winds its way through the more highly 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.

Watershed species diversity relates to the water and land's unspoiled character and large variety of high quality habitat types including pitch pine barrens, rhododendron swamps, laurel thickets, flood plain forests, marshes, bogs, fens, hundreds of vernal pools, crystal clear ponds, an estuary and some of the region's largest Atlantic white cedar evergreen swamps.

Occupying a narrow band from southern Maine to Florida, some of the largest stands of Atlantic White Cedar are found in the Pawcatuck River watershed at such places as the Great Swamp (found on the Chipuxet River, a Pawcatuck tributary, this swamp is the largest in New England and is a National Natural Landmark), Indian Cedar Swamp, and Chapman's Swamp in Westerly. Forests of white Cedar provide a specialized habitat for many organisms, including the Hessel's Hairstreak butterfly. Some of these species feed exclusively on cedar foliage.

Also of particular note is the existence of one of the largest deciduous floodplain forests in Rhode Island, of more than 300 acres. Located near the headwaters of the Pawcatuck, it is potentially the highest quality swamp site in Rhode Island and is a prime example of pre-European settlement vegetation due to the complete lack of development. The Great Swamp is a Rhode Island State Management Area and is one of the only New England nesting sites of the prothonotary warbler.

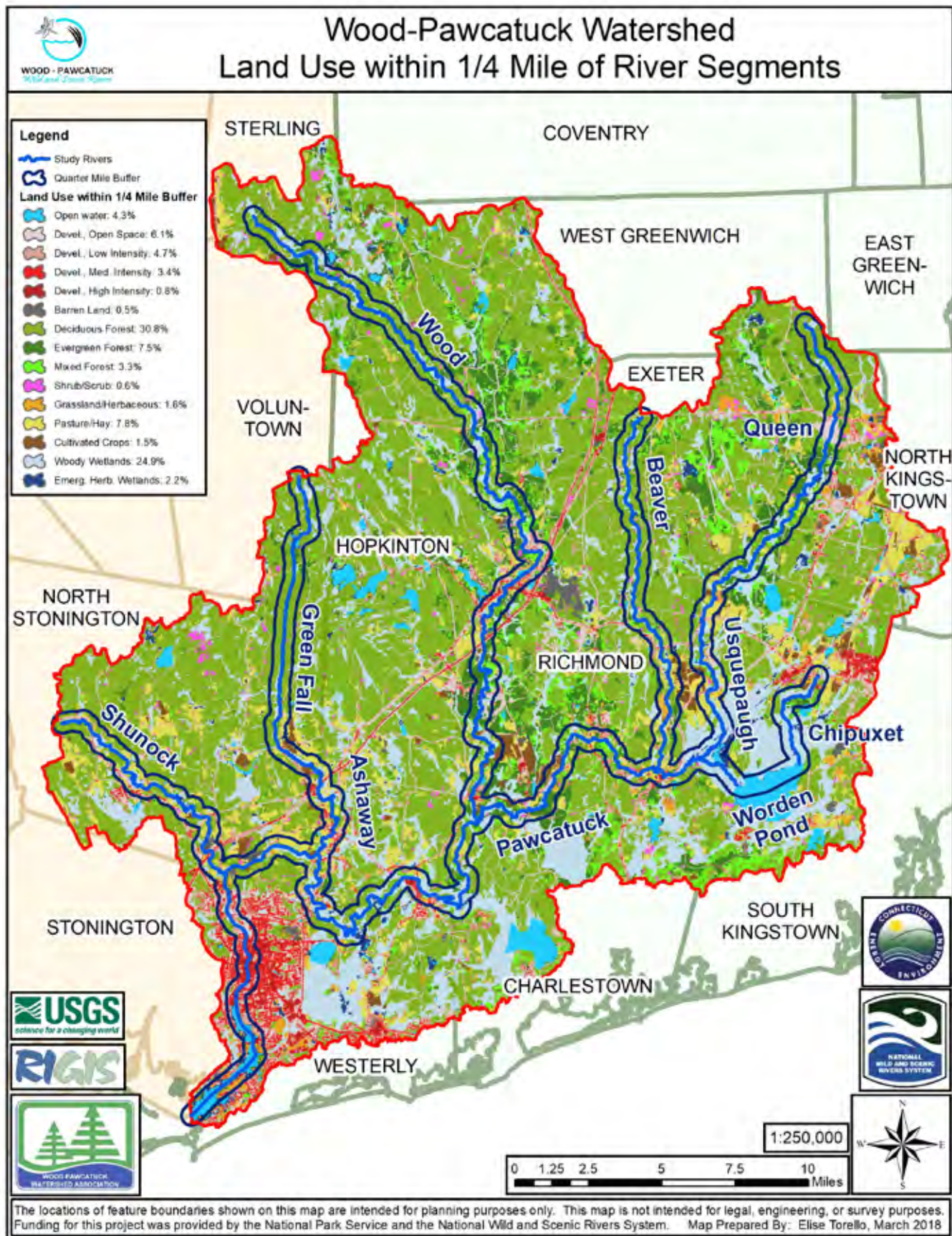


Figure 14. Wood-Pawcatuck land use within 1/4 mile of the study rivers

According to the 1999 Pawcatuck Watershed Report, seventy-five percent of all animal species found in Rhode Island occur within the watershed - this includes 36 mammals, 16 amphibians, 18 reptiles, 123 nesting birds, 33 freshwater fish and thousands of insects. Some of the species found here such as nesting neotropical migrant birds, freshwater mussels, river invertebrates, reptiles and amphibians rely on a landscape of large undisturbed areas for survival.

About "...70 percent of Rhode Island's globally rare (generally found at fewer than 100 sites, worldwide) and 63 percent of its rare species and natural community occurrences are found within the Pawcatuck watershed." Of the 397 plant and animal species listed in the Rhode Island Heritage database, 197 of them are found in the Wood-Pawcatuck Watershed. Some species of note are the sandplain gerardia, northern parula warbler, etuberlated rush, eastern spadefoot toad, spatterdock darter, eastern pearlshell and pale green pinion moth. They are not found elsewhere in the state.

In the eighteenth and nineteenth centuries, European communities developed as mill villages along the watershed's rivers to harness water power for saw, grist and carding mills. This assembly of historical mill villages in both Connecticut and Rhode Island was identified by the National Park Service for a potential Thematic Group designation on the National Register of Historic Places. Kenyon's Grist Mill, located at the site of Glen Rock Reservoir in Usquepaugh Village, is the oldest manufacturing business, and the second oldest in continuous operation, in Rhode Island. Grain is milled on the original granite millstones quarried from Westerly, Rhode Island. Shunock Village was originally referred to as "Mill Village" due to the collection numerous of mills in the heart of the town. There is a long tradition of ship building and boat yards in this area near the coastal locations in the watershed. Dating back to 1680, ship building was the most popular occupation. Although there is no longer



Shunock River near North Stonington Village Green, CT (Photo Credit: Madeline Jeffery)

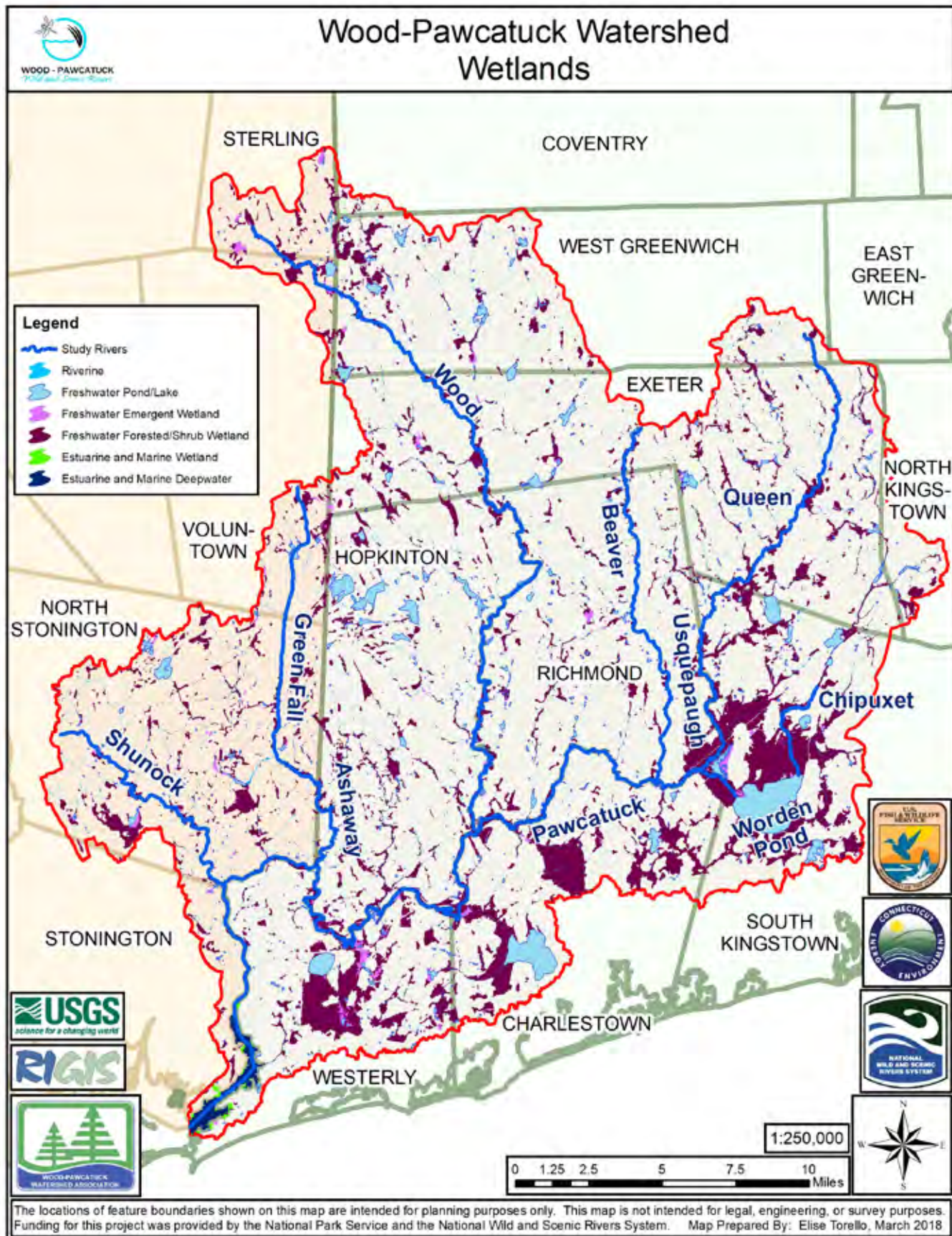


Figure 15. Wood-Pawcatuck wetlands from the US Fish and Wildlife Service National Wetlands Inventory

any ship building, there are still a number of boat yards and marinas in the estuary.

The region is also popular for recreation. The forested scenery is the backdrop that creates an enjoyable environment for recreating on and beside the Wood and Pawcatuck Rivers and their tributaries, and the unspoiled quality of the landscape contributes to the recreational experience. Some of the most popular recreational activities of the Wood-Pawcatuck Watershed include paddling, fishing and hiking. Other popular recreational pursuits include camping, hunting, wildlife viewing, and photography. The rivers' high water quality supports recreational use.

The watershed has about fifty-two miles of primarily flat paddling water with some limited Class II rapids. There are a large number of access points to the river, along with eleven ponds with public access, two state parks, and eight state management areas. The removal of the Lower Shannock Dam has resulted in a new fast-water recreational feature for kayakers.

Wood-Pawcatuck Watershed Association (WPWA) has a fleet of canoes and kayaks stored on their campus on the banks of the Wood River for their educational and recreational programs. WPWA produces the Wood-Pawcatuck River Guide and water trail maps for the Wood River. Paddling provides exceptional wildlife viewing opportunities as well as the ability to view some of the historical mill sites. Fairly narrow watercourses with heavily vegetated banks provide a unique backwoods paddling experience. A sense of solitude can be achieved in the midst of a densely populated region of southern New England.

Paddling opportunities are promoted locally and regionally, and paddling on Rhode Island's many water trails has been identified by National Geographic Society (NGS) as a "Best Adventure Destination" of 2012. NGS refers to the Rhode Island Blueways Alliance, which has mapped the paddling links between the many miles of coastline with the rivers of Rhode Island.

There is an outstanding New England sports fishery here due



Kayaker enjoying running the broken Burdickville Dam on the Pawcatuck River (Photo credit: Denise Poyer)

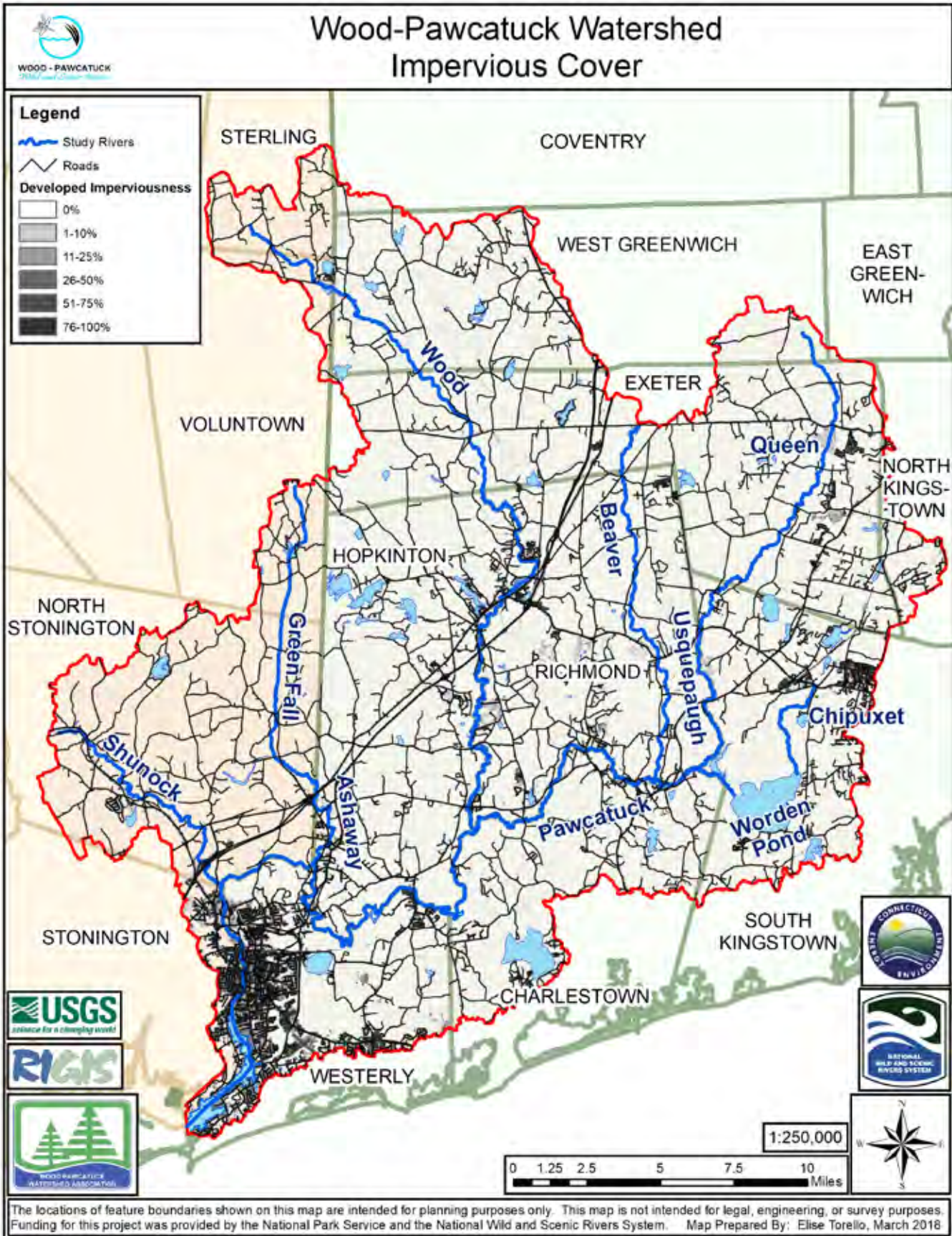


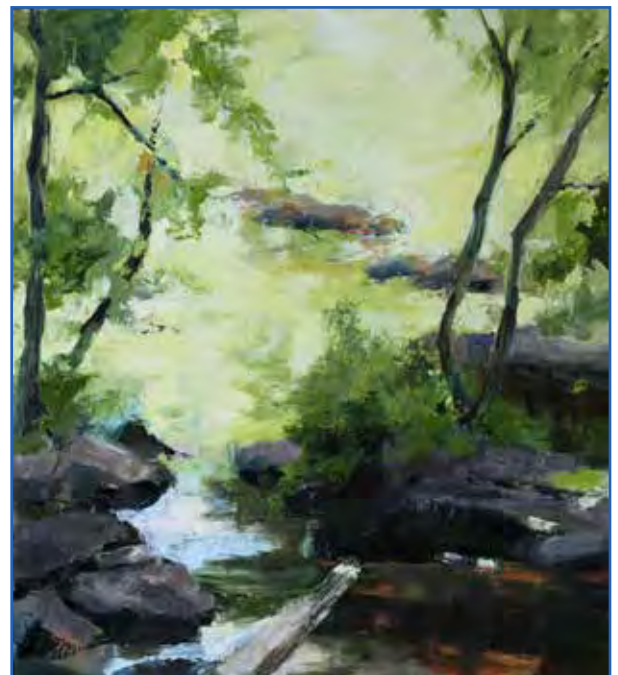
Figure 16. Wood-Pawcatuck Watershed impervious cover, from the National Land Cover Dataset 2011

to the significant cold water trout fishery that includes a wild brook trout population. The Shunock River is a Class 3 Wild Trout Management Area, with both wild and hatchery raised trout. The Wood River and tributaries of both the Wood and Pawcatuck Rivers are the most heavily RI DEM trout-stocked rivers in the state. Multiple efforts to remove dams and provide fish passage have resulted in some fish restoration successes for diadromous fish (see free-flow analysis section for details). There has been great success restoring a self sustaining shad population to the Pawcatuck River with help from a restocking program.

THE RIVERS

River Names: The names of two of the rivers provide a little difficulty. The Green Fall River is also referred to on some maps as the Green Falls River. Likewise the Queen River often had an "s" at the end. The Study Committee decided to use the United States Geological Survey (USGS) topographic maps' naming convention for these rivers, which leaves the "s" off. Also, the Queen River, which runs from Exeter and West Greenwich to South Kingstown, RI is divided into two different names on the USGS topographic maps. From its headwaters to the Glen Rock Dam, it is called the Queen River. From below the Glen Rock Dam to its confluence with the Pawcatuck River it is called the Usquepaugh River. However, it is essentially the same river. Both sections contain Outstandingly Remarkable Values (ORVs) that the Study Committee determined were important to protect. Therefore, for the purpose of this report the entire river will be referred to as the Queen-Usquepaugh River. However, segments may be referred to separately in the tables for ORVs and Classifications.

The Green Fall River flows from Voluntown, CT to its confluence with the Ashaway River. The Ashaway River then flows for three more miles to its confluence with the Pawcatuck River. The Study Committee decided to include this section of the Ashaway River so that the Green Fall River has a connection to the Pawcatuck River and allows better protection of the ORVs. Therefore the river will be referred to as the Green Fall-Ashaway River.



Painting of Stepstone Falls on the Wood River by Susan Shaw

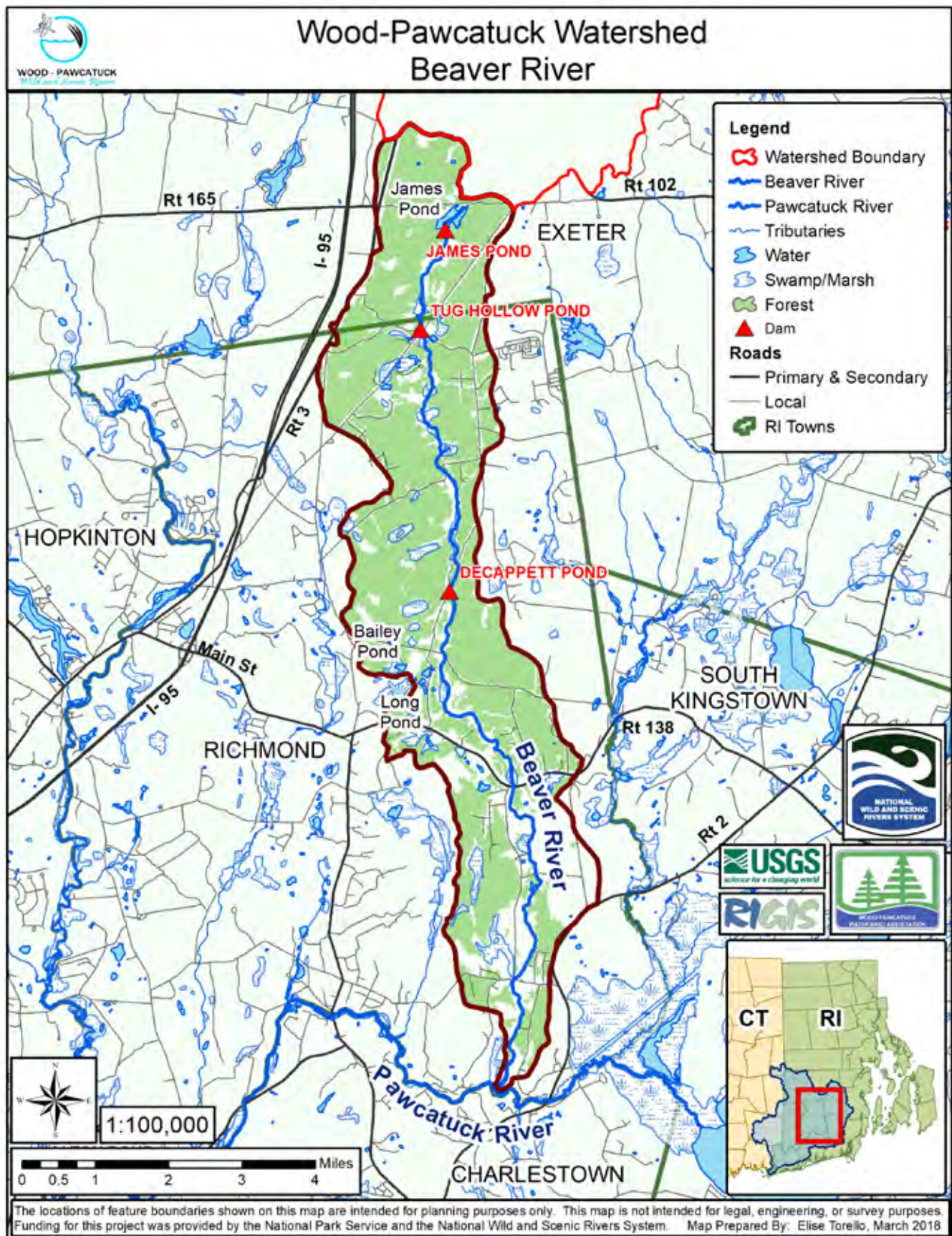


Figure 17. Beaver River and its sub-basin

Beaver River

The Beaver River runs approximately eleven miles from James Pond on the Exeter/West Greenwich line, through the center of Richmond, to its outlet into the Pawcatuck River at the Richmond/Charlestown town line. Much of the Beaver River passes through several protected areas including The Nature Conservancy's (TNC) Beaver River and Grassy Pond Preserves and the RI DEM Hillsdale Management Area (formerly known as the Thaddeus DeCoppet Estate). The Beaver River contains a large population of wild brook trout. The southern reaches of the river are fairly flat, and supply irrigation water for adjacent agricultural fields. Wetlands dominate the surrounding land as the stream nears the Pawcatuck River. It is classified as Scenic because there are several roads and small dams that allow access to the river, and homes abut much of this segment. However, 91% of the river corridor remains undeveloped.

Outstandingly Remarkable Values

Ecology – The Beaver River is ninety-one percent undeveloped and heavily forested. Nearly half the river runs through protected properties managed by RI DEM, TNC and the Richmond Rural Preservation Land Trust. Large patches of contiguous forest along the Beaver River provide clean, cold water habitat that supports a diversity of invertebrates intolerant of disturbance. The river contains sustainable, abundant populations of wild brook trout and mussels. The contiguous forested habitats near the river support large populations of obligate vernal pool amphibians, such as wood frogs and spotted salamanders. The diversity of habitats along the river provides critical habitat for a wide variety of breeding birds that winter in the neotropics, as well as nearctic migrants and resident birds.

Cultural – The Hillsdale Historic and Archeological District in Richmond, Rhode Island was added to the National Register of Historic Places in 1980. Originally a grist mill, the site was converted to a wool-carding mill in 1828, then a textile mill that produced coarse cotton and woolen cloth. Presently the mill village exists as a series of archeological sites that include industrial, commercial, and domestic structures along Hillsdale Road, within sixty-eight acres of second growth, hardwood forest. The Historic District is a small portion of a large, 2,000 acre, state-owned wooded tract, the Hillsdale Management Area. The various components of the mill village have been preserved from subsequent reuse or development and feature a high degree of archeological integrity.



Beaver River at Shannock Hill Rd., Richmond, RI (Photo credit: Elise Torello)



Beaver River at RI Rt. 138, Richmond, RI (Photo credit: Elise Torello)

Historic Mill Villages in Rhode Island

Jeffrey D. Emidy

The watercourses of Rhode Island have been instrumental in the development patterns of the state. From the heavily industrialized Blackstone River in the northern part of the state to the Wood-Pawcatuck River in the south and throughout the watersheds in between, rivers and streams provided a number of resources that were the catalysts for agricultural, industrial, and residential development.

In the seventeenth and eighteenth centuries, Rhode Island's stream and river valleys proved to be successful agricultural areas, and sparse development resulted. The watercourses flowing through these valleys provided power to gristmills and sawmills that supported the agricultural economy.

The nineteenth century saw the birth and maturation of the cotton and woolen textile industries in Rhode Island (and the United States), beginning with the Slater Mill in Pawtucket. Early, small milling successes often proved the viability of their water supplies for expanded uses. Dams were built and controls were put on the water to provide more consistent flow rates that would be reliable through seasonal water level fluctuations. Water from the rivers and streams was used in manufacturing processes, and the wastes of those processes were released back into the same waterways.

The establishment of textile processing or manufacturing on a river or stream necessitated other forms of development: transportation for raw and finished materials and for workers, housing, stores, churches, schools, and recreation. Soon, an industrial site became a village. The mill village form that developed in the Blackstone Valley was replicated throughout Rhode Island and the region. As the size and number of industrial concerns grew, so did the villages. Some of Rhode Island's smaller water courses spawned small, isolated villages, while larger rivers were intensively harnessed for industrial development and became the cities of the late nineteenth and twentieth centuries.

Mill villages large and small were the driving forces in the economy of Rhode Island in the nineteenth and early twentieth centuries and are largely responsible for much of the village-to-town-to-city development pattern that still defines the state today. While the companies in the mills may have moved on, the characteristic mill village collection of buildings remains to remind us of the state's industrial past, and the rivers and streams are gradually returning to their pre-industrial states.



Wyoming Dam in Richmond, RI (Photo credit: Elise Torello)



Figure 18. Chipuxet River and its sub-basin

Chipuxet River

The Chipuxet River headwaters are in North Kingstown, Rhode Island, where the river flows through agricultural fields and two ponds before reaching Route 138 in South Kingstown, Rhode Island. The segment being considered for Wild and Scenic study starts at Taylor's Landing, a popular river access point and site of a United States Geological Survey (USGS) stream gauge station. This three-mile long segment of the Chipuxet River is classified as Wild because there is no access to the river for three miles downstream of Taylor's Landing until the river empties into Worden Pond. A trip from Taylor's Landing to its outlet into Worden Pond gives the paddler a sense of what this area must have looked like before European settlement.

Along this segment, the Chipuxet River slowly meanders through the 3,350 acre RI DEM Great Swamp Management Area, where it becomes part of a larger complex of forested and scrub-shrub wetlands. With virtually no changes in gradient, the river flow is languid and slowed even more by adjacent wetland vegetation. Water quality remains high due to extensive contiguous forest buffers surrounding the river and lack of development and accessibility. However, there are threats to the Chipuxet River from multiple water withdrawal wells throughout the aquifer. Along the headwaters of the Chipuxet, there are expansive agricultural fields, primarily turf, that withdraw water either directly from the river or from retention ponds to irrigate fields. Also, this area includes public water supply wells that provide all the drinking water for the University of Rhode Island and Kingston village. Just south of Taylor's Landing are two more water withdrawal wells used for agricultural irrigation.

Outstandingly Remarkable Values

Ecology – The entire three-mile segment under consideration for Wild and Scenic designation from Taylor's Landing to Worden Pond is undeveloped. This stream is an integral component of the RI DEM Great Swamp Wildlife Management Area, which represents the largest swamp in the region. The river basin is dominated by Red Maple swamps and a few scattered Cedar swamps with a relatively high diversity of wetland plants. Because the area represents one of the region's largest contiguous forest patches, the habitat supports many aquatic dependent species of invertebrates, birds, mammals, amphibians and reptiles. The area has been designated as a National Natural Landmark.

Scenic/Recreation – The Chipuxet River slowly meanders through three miles of contiguous forest and wetlands that provide beautiful scenery for paddlers, with little evidence of human settlement. Opportunities to fish and hunt in the Great Swamp Wildlife Management Area are available, and many people use this area to hike and observe wildlife. The William C. O’Neill Bike Path crosses the Chipuxet approximately a half mile south of Route 138, giving bikers and walkers a glimpse into a wild system.

Cultural – Rich agricultural fields are found on the outwash plains to the west of the northern end of this segment. The Great Swamp Massacre, a battle between an alliance of the New England militia and Pequot tribes against the Narragansett tribe, took place near the Chipuxet in December 1675.



Chipuxet River winding through the Great Swamp, South Kingstown, RI (Photo credit: Elise Torello)

Narragansett Uses of the River

Lorén Spears, Executive Director, Tomaquag Museum

The Narragansett people used the Wood and Pawcatuck Rivers and their tributaries for variety of reasons throughout history and continue to do so today. They were historically utilized as a means of travel not only locally but around the region. Today, the Narragansett still canoe the rivers but more for recreation, harvesting and ceremony.

The rivers are used to harvest food including a wide variety of fish. Prior to industrialization and the damming of the rivers the tribal community harvested fish utilizing weirs, also known as basket traps, capturing herring, salmon and other spawning fish. They set up fishing camps along the rivers to harvest the resources in season. Along with fish, birds such as geese and ducks, amphibians like frogs, salamanders and reptiles such as turtles, eels, and snakes, were harvested. They also hunted aquatic mammals and mammals that traveled by the river's edge. These animals were used for food, clothing, blankets, capes, shoes, tools, sewing implements and much more.

The Narragansett utilized as much of the animal as possible. Today, they still utilize many parts beyond the food of animals harvested. Traditional artists use fish teeth to make their loom thread separators, turtle shells for rattles, skins and furs for clothing, and hides, reeds, and wood for musical instruments such as rattles, drums and flutes.

Along the banks they gather clay, which was used historically to create cooking pots and today for contemporary pottery as art. The Narragansett also harvest plant life around the rivers for food, medicinal herbs, and for creating items they need. Baskets, mats, sashes and other woven items are made from bulrush, cattails, and other reeds. Traditional homes, called wetu or wigwam, were covered with mats made from bulrush and cattails in the summertime; a layer of bark was added for winter homes or longhouses.

The rivers were used to transport people from their winter homes to their summer homes, as well as to other locations for trade or for visiting other villages of the Narragansett Nation or neighboring nations. The rivers provided economic, social and community vibrancy. The rivers were and are an important part of Narragansett lifeways. The rivers are a gift from the Creator. They continue to give blessings of fresh, clear water, transportation, food, medicine, recreation, and ceremony.



*Snapping Turtle Basket by Robin Spears Jr.
Photo courtesy of Tomaquag Museum*

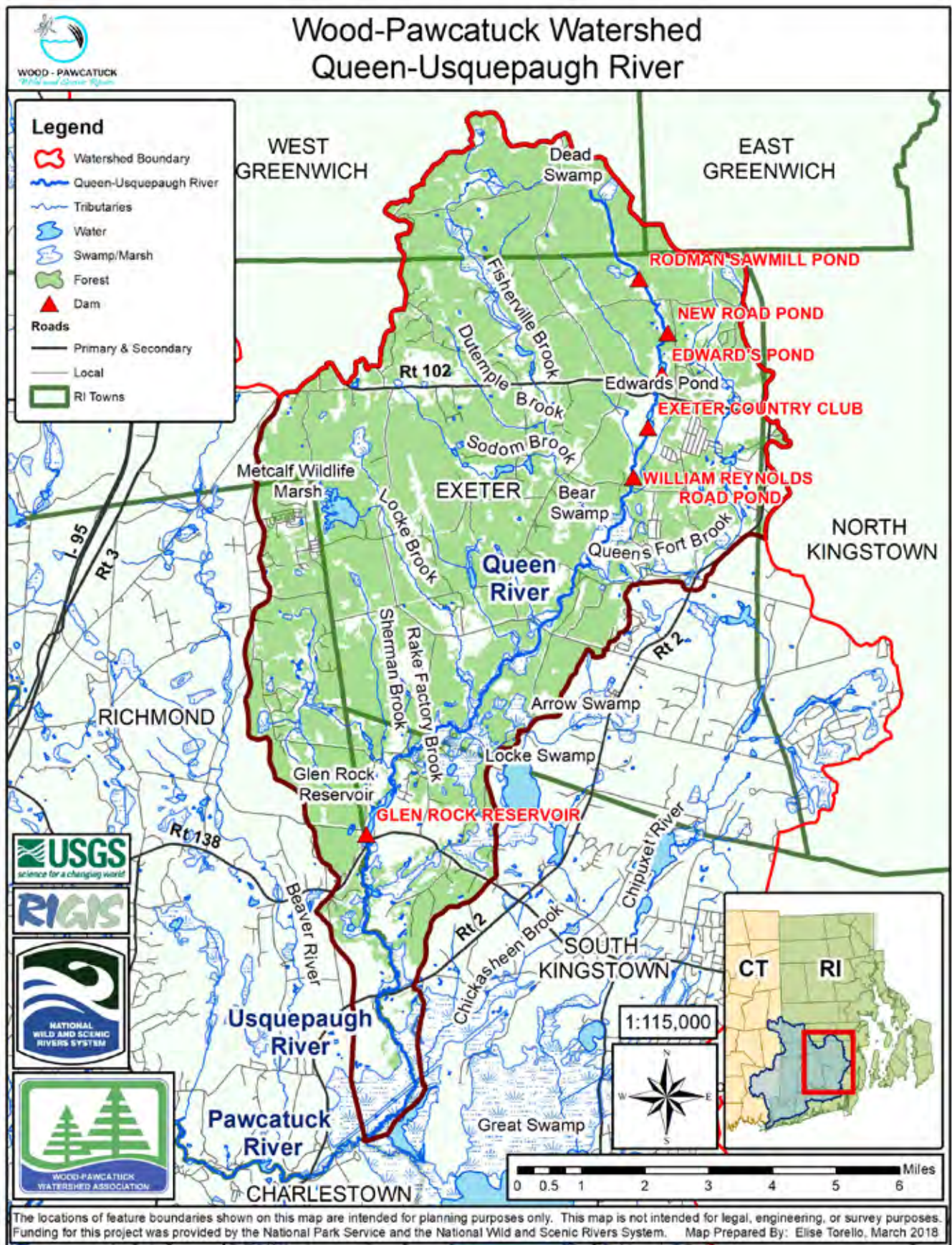


Figure 19. Queen-Usquepaugh River and its sub-basin

Queen-Usquepaugh River

Colloquially this river has been broken into two segments: the Queen River is a six-mile segment from its headwaters in Exeter and West Greenwich until the Glen Rock Dam in South Kingstown. Downstream of Glen Rock Dam is the five-mile long Usquepaugh River in South Kingstown that joins the Pawcatuck River in South Kingstown. USGS maps also use this method of naming the two segments. These rivers have exceptional habitat value due to their many clean, cold water tributaries and low (1.6%) impervious surface. The Queen-Usquepaugh River is a key component of private land protection efforts in Rhode Island, with important areas protected by TNS and ASRI. A statewide study of dragonflies and damselflies (collectively known as the order of Odonata) determined that the Queen-Usquepaugh River has the highest number of species in the state, matched only by the Wood River. The Queen-Usquepaugh River also contains the most significant populations of freshwater mussels in Rhode Island. The Queen River segment is classified as Scenic because some roads, light development, and actively farmed agricultural fields occur within a one-quarter mile buffer of the river. There is almost no development along the Usquepaugh River, with only a few agricultural fields and one road crossing. The banks are entirely wooded, providing excellent habitat for a broad array of wildlife, due in part to the high water quality. The Usquepaugh River segment is classified as Wild, primarily because much of the river is contained within RI DEM's Great Swamp Wildlife Management Area.

Outstandingly Remarkable Values

Ecology – The many first and second order streams of the Queen-Usquepaugh River provide clean, cold water throughout the year, making this superior habitat for freshwater mussels, brook trout, and amphibians. A large pitch pine forest on TNC property has several rare species of plants and animals that are endemic to



*Queen River at Dugway Bridge Rd., South Kingstown, RI
(Photo credit: Elise Torello)*



*Queen River at Kenyon Grist Mill, South Kingstown, RI
(Photo credit: Elise Torello)*

that habitat. The large patches of contiguous forested habitat along the Usquepaugh River provide vital habitat for area-sensitive wildlife, in part because both segments are over ninety percent undeveloped.

Of the three largest river systems in Rhode Island, only the Pawcatuck River Basin contains populations of all local mussel species. The most significant concentrations of mussels in this system are presently found in the Queen-Usquepaugh River,

with seven out of the eight documented species. According to the Rhode Island Odonata Atlas (soon to be published) this river has the highest Odonata species richness (number of species) of any river in the region. It includes more riverine species than even the larger Wood River.

Geology/Hydrology – An unusual topographic feature, the Dead Swamp in West Greenwich, occurs in the headwaters of the Queen-Usquepaugh River. This unique wetland actually contributes water into two separate watersheds – the Wood-Pawcatuck Watershed and the Pawtuxet River Watershed.

Cultural – Near the village of Usquepaugh on the Queen-Usquepaugh River is a large outwash plain that contains large, actively-farmed agricultural fields. Water from the Queen-Usquepaugh River is pumped to provide irrigation of these fields. The Kenyon Grist Mill, one of the oldest operating gristmills in the region, still grinds corn along the banks of the Queen-Usquepaugh River using the original granite grinding stones quarried in Westerly, Rhode Island.



*Dugway Rd. bridge on the Queen River,
South Kingstown, RI (Photo credit: Elise Torello)*

Importance of the Wood-Pawcatuck Watershed to Regional Conservation

Kevin Ruddock

The Wood-Pawcatuck Watershed sits primarily in the large tracts of relatively unfragmented forest found along the western border of Rhode Island. These forest blocks form a resilient and biologically significant landscape-scale ecosystem that is rare, if not unique, in the highly developed coastal region stretching from Washington D.C. to Boston.

This region has been highlighted by multiple government and non-governmental organizations. The National Park Service designated the Connecticut and Massachusetts section of this landscape as "The Last Green Valley," a National Heritage Corridor; The US Fish and Wildlife Service and the North Atlantic Conservation Cooperative's "Nature's Network" show that the area contains many significant, highly important lands, waters, and habitats; and The Nature Conservancy's (TNC) Lower New England/Northern Piedmont Ecoregional plan identifies the Pawcatuck River and its watershed as regionally important conservation targets. TNC refers to the sparsely developed landscape of Eastern Connecticut and Western Rhode Island as "The Borderlands." This area includes "matrix forests" and other critical habitats that help to provide the clean waters that make up the Wood River.

This regional significance of a relatively undeveloped area of this size is apparent when viewed in context of the "Nighttime Lights" map (below). The light associated with human development makes a reliable proxy for mapping the overall impact and disturbance of residential, commercial, and industrial development and its associated transportation networks. The Nighttime Lights map shows the location of the Wood-Pawcatuck Watershed and its relation to the relatively undeveloped forests of The Borderlands.

The states of Rhode Island and Connecticut, as well as numerous local and non-profit or-



ganizations, have long recognized the ecological value of the forests and clean rivers of the Wood-Pawcatuck system. The Rhode Island DEM's Arcadia Management Area comprises nearly 16,000 acres of forest with more than ninety miles of hiking trails and thirty miles of river shoreline. TNC purchased its first preserve in the watershed in 1972 (the Butler tract at Ell Pond in Hopkinton, RI) and has continued to work to protect land and reconnect rivers.



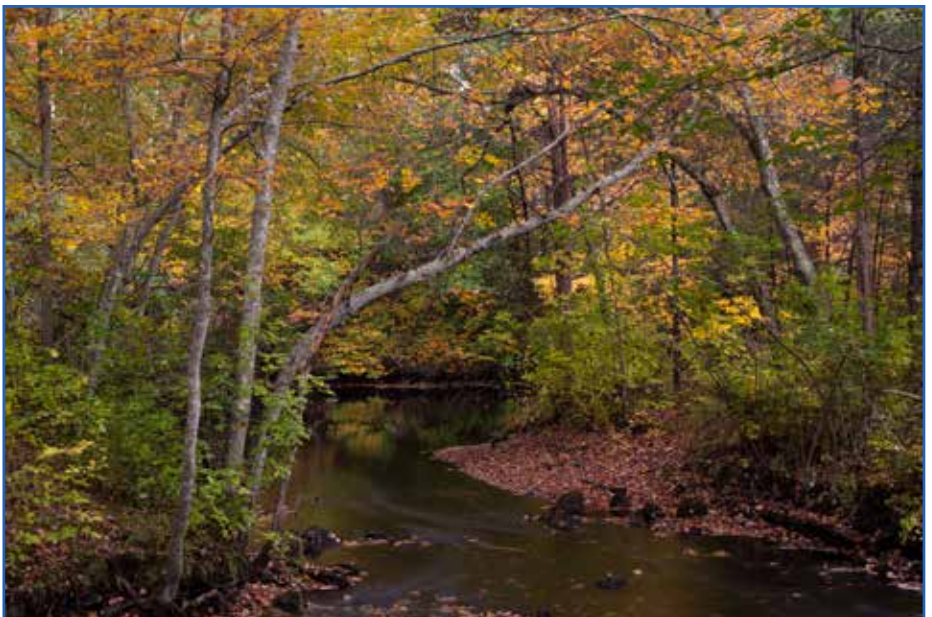
Figure 20. Wood River and its sub-basin

Wood River

The Wood River is the shining jewel of the region. From high quality ecosystems to cold water fisheries and unparalleled scenery, the Wood River is representative of all the attributes of a Wild and Scenic river.

When NPS conducted a study of rivers in eastern North America in the early 1980s, they determined that the Wood River had the highest biodiversity of any river in New England. The main stem of the Wood River has its headwater in Sterling and Voluntown, Connecticut, where the river then crosses east into West Greenwich, Rhode Island. At this point, the Wood River is known as the Falls River until its junction with the Flat River in Exeter, Rhode Island. From there it flows south forming the border between Richmond and Hopkinton, Rhode Island until it empties into the Pawcatuck River at Wood River Junction, near Charlestown. Besides the good water quality and high habitat value for abundant wildlife, the Wood River provides exceptional recreation opportunities. Fourteen miles of the twenty-four-mile long river is navigable by canoe or kayak. The scenery along this winding river is dominated by native plants and animals, including numerous migratory and resident birds, fish, and turtles. Flowers can be typically found along its banks from May until October. Its many tributaries provide cold, clean water, making it excellent habitat for trout fishing. Hunting and trapping are allowed in the three RI DEM Wildlife Management Areas adjacent to the Wood River.

The upper thirteen miles of the Wood River (Sterling, Connecticut to the Barberville Dam on Arcadia Road in Richmond and Hopkinton, Rhode Island) are classified as Wild. There are only three paved roads that cross this segment of the river, and no development is adjacent to the river until just below Frying Pan Pond. The Nature Conservancy has made land protection of this area a priority under their Pawcatuck Borderlands Project. The downstream eleven mile segment of the Wood River, from below Barberville Dam to its confluence with the Pawcatuck River, has



Upper Wood River (Photo credit: Denise Poyer)

been classified as Scenic. The river flows through a number of lightly developed mill villages and includes five run-of-the-river dams.

Outstandingly Remarkable Values

Ecology – The upper Wood River is an exceptional river ecosystem which supports the highest biodiversity of any river in New England. From the headwaters in Sterling, Connecticut to Frying Pan Pond in Richmond and Hopkinton, Rhode Island, over ninety-four percent of the land within a one-quarter-mile buffer of the river is undeveloped and primarily forested. The upper segment of the river (above Barberville Dam) runs through several thousands of acres of protected properties, including RI DEM’s Arcadia and Wickaboxet State Management Areas, TNC’s Till-inghamst Pond Management Area, URI’s Alton Jones Campus, and the Pachaug State Forest in Connecticut. It is part of the TNC Pawcatuck Borderland Project to protect large forested blocks and preserve the “dark sky” nature of the region. Local land trusts from Sterling, Exeter, West Greenwich, Hopkinton, and Richmond also own preserves near the Wood River.

While the diversity of flora and fauna of the lower Wood River is reduced compared to upper segment, the lower Wood River is still more than seventy-five percent undeveloped and contains many protected properties that support local wildlife. These include the Carolina Wildlife Management Area, Black Farm Management Area, TNC properties, and local land trust properties.

The Wood River and its tributaries contain a wide variety of wetland habitats. In addition to swamps and marshes, there are also rare and unusual habitats for this region, including white cedar swamps, black spruce bogs, fens, and vernal pools. Besides supporting healthy populations of local native reptiles and mammals, the Wood River contains several state-listed species of mussels, odonata and amphibians. Neotropical migratory birds (for example, several species of warblers, vireos, thrush, and tanagers), waterfowl, raptors, and other species of birds thrive in the large blocks of contiguous forested habitats near the Wood River. The clean cold water of the rivers provides ideal habitat for wild brook trout and the aquatic invertebrates that support them.

Scenic/Recreation – The Wood River is a destination river for paddlers throughout southern New England. It is within an hour drive from anywhere in Rhode Island and eastern Connecticut. Because of its forested banks and clean, cold water, trout can find pools of refuge even in the heat of summer, making this a vital habitat for fly fisherman. For people of all ages interested in fishing opportunities,

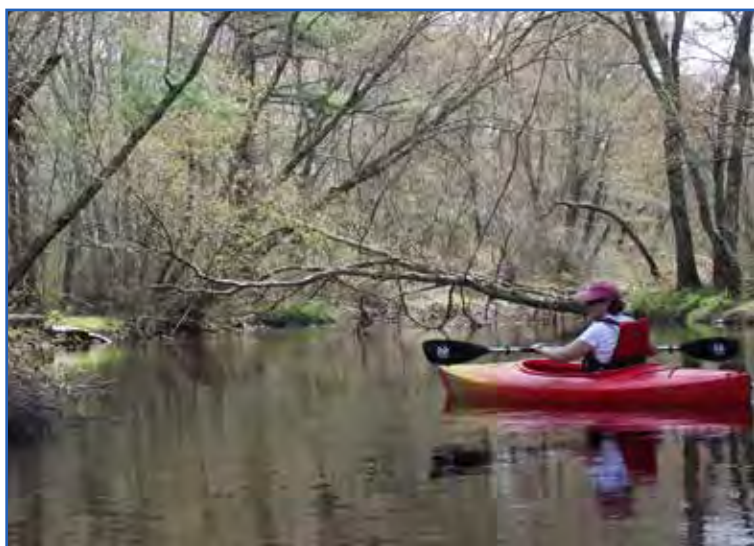
RI DEM stocks brown and rainbow hatchery-raised trout throughout the entire Wood River. There are also wild brook trout in all the tributaries and upper reaches of the river. One section of the river that extends from West Greenwich to Exeter, Rhode Island, is reserved for catch-and-release fishing.



*Wood River Canoe/Kayak access at Switch Rd., Hopkinton, RI
(Photo credit: Denise Poyer)*

The same habitats that support a plethora of wildlife also offer incredible scenery and delight for outdoor enthusiasts. Canoeists and kayakers flock to the Wood River to enjoy the experience of a wild, natural river, with its many twists and turns and small class II rapids. Birders can find numerous species along the river banks. Hundreds of miles of trails can be found in the state management areas and TNC and land trusts properties. The Rhode Island North-South Trail system runs beside the Wood River and many of the tributary streams. People use the river to hunt for small game, deer, and waterfowl.

Cultural – Two Native American tribes claimed areas near the upper Wood River for winter camps. The Mohegan used the section above Bailey Pond in Sterling, Connecticut and the Narragansett used the region that started in Rhode Island. Along the Step Stone Falls are remnants of an old quarry where bedrock was easily accessible. The foundation for a timber mill using these quarried rocks can be found slightly further downstream.



*A paddler in the upper Wood River
(Photo credit: Denise Poyer)*

Historically, as soon as people settled along the Wood River, they



Hope Valley dam on the Wood River (Photo credit: Thomas Tetzner)

constructed mills. There are seven dams along the Wood River with additional dams on the river's tributaries. These dams have a long cultural history. The early colonial settlers of the area used dams for gristmills, sawmills, tanneries, and ironworks. The numerous waterfalls and small ponds were well adapted for mill wheels. During the Industrial Revolution, from 1870 to 1940, textile mills replaced or were located beside pre-existing gristmills or sawmills. The new mills became the focus of mill villages and supported thriving communities such as those the towns of Hope Valley and Wyoming. Both the Hope Valley and Wyoming Village Historic Districts are listed in the National Register of Historic Places. Two other dams on the Wood River, the Alton and Woodville dams, supported smaller mill villages.

Geology/Hydrology – The lower Wood River has an extensive aquifer that supplies town wells for some Hopkinton and Richmond residents. In addition, the Rhode Island Water Resources Board has identified several properties along river that have the potential to be future public wells. Several of these properties have been purchased and are now in permanent protection.



*Site of an early colonial quarry at Stepstone Falls, Richmond/Hopkinton, RI
(Photo credit: Denise Poyer)*



*Opening day of fishing season at Wyoming Dam on the Wood River, Richmond/Hopkinton, RI
(Photo credit: William McCusker)*

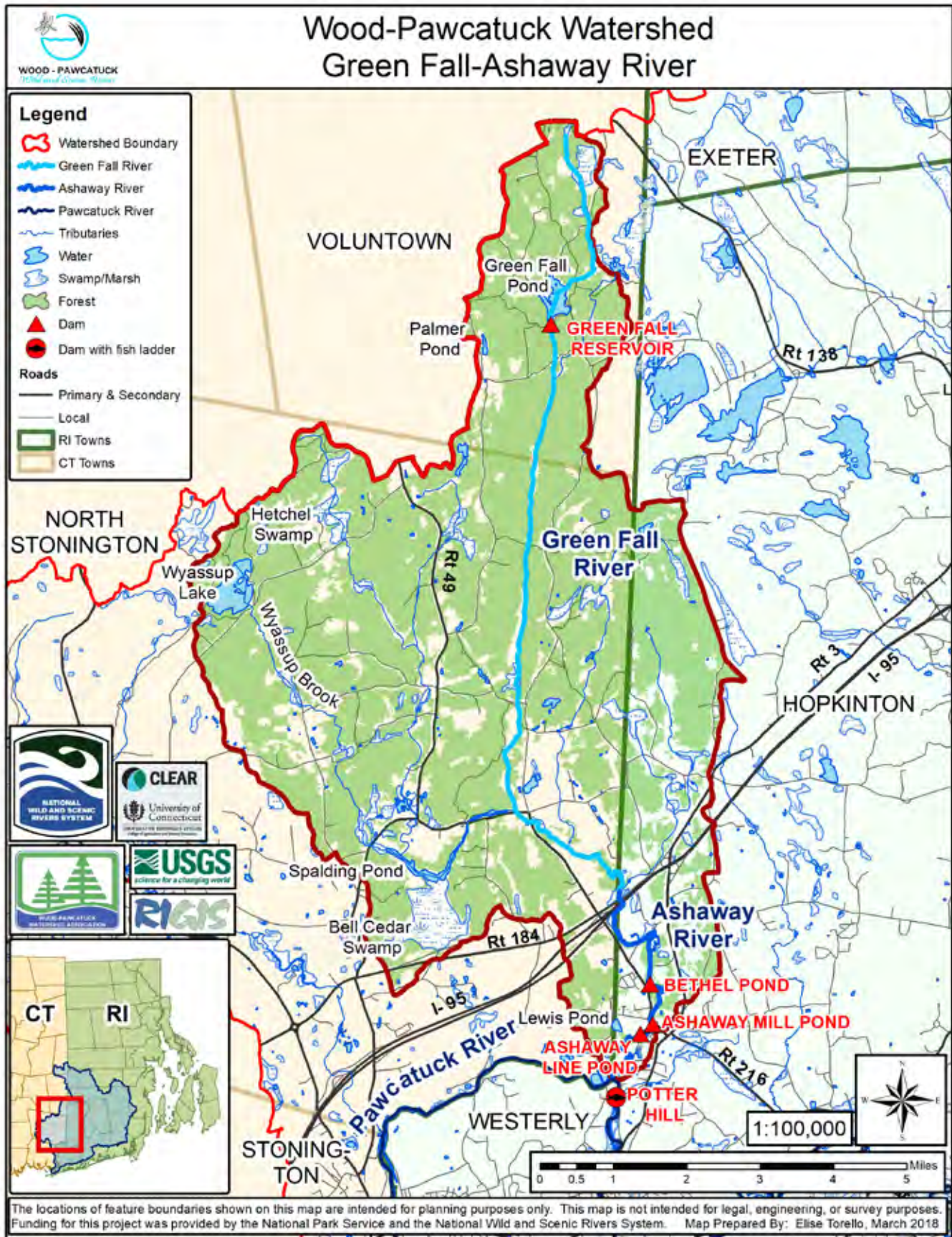


Figure 21. Green Fall-Ashaway River and its sub-basin

Green Fall-Ashaway River

The Green Fall River is a forested river corridor and an environmental treasure. The river runs from Voluntown and North Stonington, Connecticut, through Pachaug State Forest, Connecticut's largest state forest, through ravines of ancient stone ledges, small cliffs and moss-covered stone walls, fields of rich agricultural soils, and hidden quiet back roads and trails that stir the soul. The night skies can be dark here and are within New England's known coastal forest eco-system of dark skies. This entire watershed is a part of The Nature Conservancy's Pawcatuck Borderlands Project of conservation and preservation. Green Fall River joins the Ashaway River, just over the border in Hopkinton, Rhode Island, where it then serpentine four miles more to its confluence with the Pawcatuck River near Westerly, Rhode Island. A unique geological feature of the river is the Green Fall Rift Valley, renowned for its tempestuous falls and ancient rock formations and stone walls by both Native American and early settlers. The hundreds of acres of rich flood plain soils at the river's southern end continue in agriculture to this day, with five dairy farms in high production. The days of a bustling mill village life along Green Fall River are past, but mill artifacts, stone foundations, stone walls and meadows abound as do a gallant number of stone and earthen dams still in use.

For nine miles from its headwaters in Voluntown, CT to the confluence with the Ashaway River, the Green Fall river is classified as Scenic because it is 90% undeveloped. The landscape is primarily forests with some agriculture and a few houses. For the next three miles until the confluence with the Pawcatuck River the Green Fall-Ashaway River runs through a more developed landscape with several small dams and village centers, with a Recreation classification.

Outstandingly Remarkable Values

Ecology – The Green Fall-Ashaway River is part of the newly designated U.S. Fish and Wildlife Service's Great Thicket National Wildlife Refuge. A long stretch of Green Fall River flows within the Pachaug-Ledyard block of this



Spalding Pond near the confluence with Green Fall River, North Stonington, CT (Photo courtesy North Stonington Citizens Land Alliance)

six-state refuge. With the New England cottontail rabbit, New England's only native rabbit, as its poster child, the management plan hopes to return certain older forest acreage to its younger forest life as an important way to enable the return of over forty species of animals and birds to their natural habitats. Among a long list of over 35 species, these successional habitats will become the refuge for the prairie warbler, blue-winged warbler, field sparrow, American woodcock and brown thrasher. Ornithologists are excited about the bird populations that have already been drawn to several clearings completed in North Stonington. In addition to these managed habitats, significant natural communities of animals, birds, and fish are designated in Connecticut's Natural Data Base, not only all along Green Fall River, but also its rich tributaries of Pendleton Hill Brook, Wyassup Brook, and Spalding Pond.

Bell Cedar Swamp was once historically known as a place for the felling and milling of giant cedar trees. Today it is treasured as a highly significant Atlantic white cedar swamp; it is no longer timbered, but preserved in trust, with drainage into Spalding Pond, one of Green Fall River's tributaries. Much of its acreage is composed of peats, large tufts and stalks of grasses in deep muck, stagnant slow-moving water, home to tall ramrod-straight cedars, whose outer bark texture is distinctive and memorable. In addition to its exemplary cedar population, Bell Cedar Swamp supports a plethora of animal, plant, bird species, with many rare and uncommon plants, including green adder's mouth orchid, nettled chain fern, and Hessel's hairstreak butterfly.

Geology/Hydrology – The Green Fall Rift Valley is a memorable, dramatic and



*Green Fall bridge, North Stonington, CT
(Photo credit: David R. Brierley*

majestic six-mile long fault, referred to by some as "one of the most significant known fault rifts." Along and within this fault, the river flows between rocky ridge lines and embankments which slowly rise three hundred to four hundred feet on either side. They are comprised of ancient gnarled stones and boulders which look elegant in the rushing water and within a dark green em-

brace of tall evergreen forest. There is a silence and sense of being away from the world that is present here. Much of Green Fall flows through Pachaug Forest, and the state trails near sections of the river and its Green Fall Pond as well as its narrow dirt entry roads are well taken care of in this special place.

Cultural – The Green Fall Rift Valley is very special to Native Americans because there is extensive ceremonial stonework throughout this river region. It includes Manitou hassunash, and hassuneutunk, the wall and serpent effigies of the Narragansett Indians. In contrast, intermingled with the sharp and enormous boulders, are miles of green velvet moss-covered stone walls, in and out, under and over, the presently forested land.

Further south from the rift valley, nearer to what had once been the two river villages known as Laurel Glen and Clarks Falls, is the rich flood plain of Green Fall River which is presently home to five working dairy farms, with over 375 acres of corn and hay fields.

One of the farm owners, advocating for the protection of these acres for agriculture, brought together the farm owners and collectively earned for Connecticut purchase of development rights for each of the farms, ensuring that this special area will permanently remain in agriculture.



Green Fall Pond, North Stonington, CT (Photo credit: Auntie Beak)

The Green Fall River Mills

Richard Seager (Photos courtesy of the North Stonington Historical Society)

The Green Fall River rises from a swamp south of Rockville Road (Connecticut Rt. 138) in Voluntown. The river then flows due south to Green Fall Pond. It then continues south through North Stonington and into Hopkinton, Rhode Island, where the river converges with the Parmenter Brook to form the Ashaway River. Peg Mill Brook, Palmer Pond Brook and Glade Brook are all tributaries to the Green Fall River.

Just south of Green Fall Pond, starting below the dam, the river flows through a ravine formed by steep granite walls. There were mills in this ravine. The river is crossed just south of the pond by Sand Hill/Green Fall Road. Further into the ravine the river is joined by Peg Mill Brook. This brook was dammed and used to power Peg's Mill, which was located just upriver from where the two waterways meet.



*Green Fall ravine
(Photo credit: David R. Brierley)*



1875 photo by M. Herbert Kenyon of a wooden sluiceway held up on rock cairns across Green Fall River ravine, Voluntown, CT.

The river flows on into North Stonington and Laurel Glen where it is crossed by Putker Road. The river had a major influence on settlement in this area due to its use as a power source. The settlement of Laurel Glen supported mills and businesses all powered by the Green Fall River. Among them were a felt mill, a shoelace factory, a lace factory, The Ashaway Line Company, and The Laurel Glen Manufacturing Company operated by Charles Kenyon and later by Deacon Barber; there is also evidence of hemp spinning for rope making. The village included a retail store, a small church and a one-room school. The foundations of some of these enterprises and the school are still there just off Dennison Hill Road. The land in this area was first owned in the early eighteenth century by Gershon Palmer, the son of Walter Palmer who emigrated to the Stonington area in the seventeenth century.

After Laurel Glen the river continues south to Clarks Falls. It is at this point that it meets with the flow from Clark's Falls Pond, first called Birch's pond or Burch pond. This pond is formed by a dam at its eastern end that powered a grist mill erected by Joshua Birch in 1733. This mill was operated by the Birch family until it was purchased by Thomas Clark of Newport, Rhode Island in 1783. In 1864, in partnership with Peleg Tift, Alfred Clark erected a woolen mill across the road from the grist mill. A long sluiceway, parts of which still exist, ran under the road from the falls on the pond on the north side of the road to the open land beyond on the south side and on to the mill site. This was a very large mill. During the Civil War it became the Clarks Falls Company, operated by S. Briggs, and it manufactured products for the

army. It later became the Federal Felting Company.

It was during the Clark family's long occupancy that the area became known as Clark's Falls, today written as Clarks Falls. Similar to Laurel Glen, Clarks Falls had a retail store, a church and one of the fifteen one-room schools that were arrayed around North Stonington.



Water from Clark's pond flowed into the Green Fall River supplying more power to drive the town's mills. Upstream from Clark's falls pond is Spaulding pond. This somewhat larger pond is formed by a dam at its eastern end, probably the site of a mill. Spaulding pond becomes Bell Cedar Swamp on its southern side; both the swamp and two tributaries contribute water to Spaulding pond. The western tributary is the Wyassup Brook, its source Wyassup Lake located in the depression between Stuart Hill and Chapman Hill. The water level in Wyassup Lake was raised in order to provide a more even flow of water to Spaulding Pond and on to Birch Pond and the Clarks Falls mills. Wyassup Brook may have provided power to Peabody's sawmill, and also have had the Old Dam where the Holmes family operated a mill. The location of the Old Dam is not known, but there is still a stone sluiceway on the southern slope of Chapman Hill that might be what remains of Peabody's sawmill.

The second tributary feeding Spaulding pond is Pendleton Hill Brook. The source of this brook is on the southeastern slope near the top of Pendleton hill. The brook is first crossed by Pendleton Hill road, just north of where the brook powered a shingle and clapboard mill. Midway down the run of the brook it joins Hetchel Brook, which flows out of Hetchel Swamp located in the depression between Chapman Hill and Pendleton Hill. Further south of where these waterways meet, there are more stone structures on Pendleton Hill Brook. It is likely that these are other old mill sites. The earliest known use of water power in the area of Clarks Falls was in 1660. During this year Thomas Bell established an iron works in the Bell Cedar Swamp. The river that was used became known as the Red River due to pollution by the iron working process. This could only have been the Green Fall River, from the mill site on down to where it joins with Glade Brook and Parmenter Brook to become the Ashaway River, and on into the Pawcatuck River at White Rock. Some years later, in the early 1700s, Thomas Bell and Gershon Palmer ran a shingle mill in Bell Cedar swamp, possibly because of the abundance of cedar available there.

Bell Cedar swamp is not in the course of the Green Fall River but contributes to the Green Fall by flowing over a dam at the eastern end of Spaulding Pond and into Burch's Pond. At the eastern end of Burch's Pond is another dam at Clarks Falls mill. From here, after passing either over the dam or through a sluiceway to the mill, the flow passes directly into the Green Fall River. On the Green Fall just north of this junction another dam, some remains of which still exist, channeled water through a sluiceway back westward to flow into Burch's Pond. This was used to augment the water flow to a gristmill.

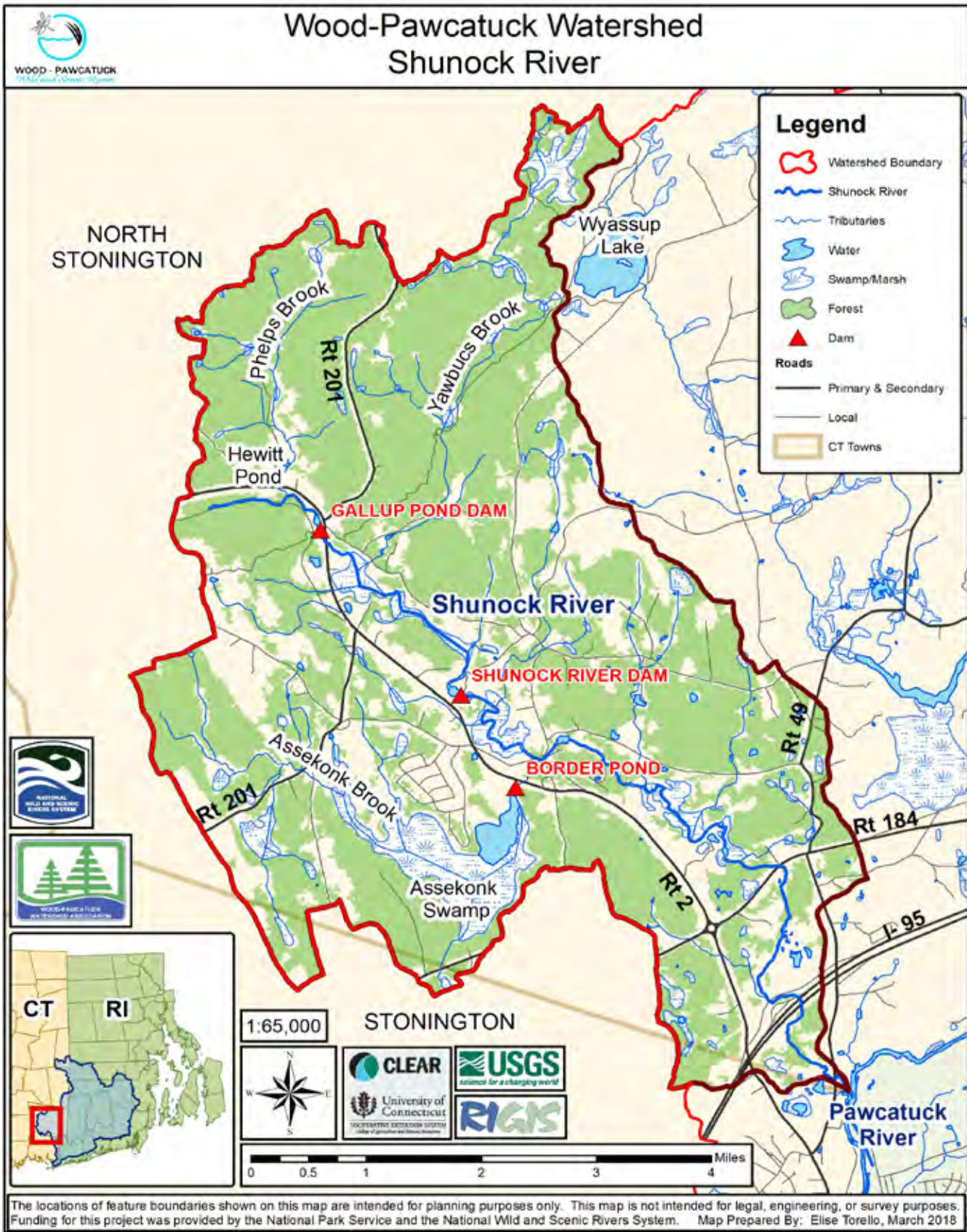


Figure 22. Shunock River and its sub-basin

Shunock River

The Shunock River flows for its entire length of eight miles within the one town of North Stonington, Connecticut. The Shunock River's past reveals some of the earliest documented use of inland water power; it was a critical resource when the town was initially developed. The river's days of being a source of energy, a constant and relied upon work horse for the community, has long been over. Today the Shunock is a narrow and winding river, resting in small fields and yards, hidden away from the hustle and bustle, while its sister, Green Fall River, runs narrow and straight, deep within its dark and stony geologic fault. Both rivers are an integral part of this rural, mostly forested town. The river enjoys recognition within The Nature Conservancy's Pawcatuck Borderlands because of its dark skies and land conservation qualities. This segment is classified as Recreation because of multiple road accesses and development along parts of the river's banks.

Outstandingly Remarkable Values

Geology/Hydrology – The Shunock runs through parts of parts of a large Connecticut aquifer before its confluence with the Pawcatuck River. Its water is cold and clear and is identified as a Level A aquifer. Two commercial wells near Lewis Pond supply water for the town's schools and other buildings, as well as certain North Stonington Village homes, and for the neighborhoods of Kingswood and Meadowood near the village.

Ecology – The Shunock is known locally as one of the town's favorite fishing holes. It is a Class 3 Wild Trout Management area noted for both its hatchery-raised and wild trout. The hatchery-raised trout are stocked in four different places along both the Shunock and Green Fall Rivers each year. There are state and federally noted natural communities of fish, wild plants, birds and animals studied and documented in the CT DEEP National Diversity Data Base; there is a richness of diversity to be found along the southern length of the Shunock from Assekong Swamp through North Stonington Village, continuing through marshes and wetlands and free-running water to its confluence with the Pawcatuck River. Ripley



Small inlet to Shunock River (Photo courtesy of North Stonington Citizens Land Alliance)



*Shunock Brook Preserve, North Stonington, CT
(Photo credit: Peter Marteka)*

Park Pond, right in the village, is known to be a venerated place for alewives, blue-back herring, sea-run trout, and American eel. With perseverance and foresight from many local groups much of the Shunock's embankments and land mass have been permanently preserved. Individual families,

land trusts, private institutions, the state, and the town itself, have protected at least 2000 acres along the Shunock; most of them open for the use of the public. Old Haven Farm has over 500 acres of family farm and forest land protected in a conservation easement along Phelps Brook and the Shunock, with its 18th century house and its barns still in use for agriculture. The 634-acre Assekongk Swamp Fish and Wildlife Area is a glorious place for walking, hiking, fishing, and hunting and is within the village's parameters, abutting the school's playing fields. The Assekongk Brook, a major tributary, feeds directly into the Shunock in the center of the village. Assekongk Swamp is managed by CT DEEP's Wildlife Division and is renowned for its anadromous fish populations. Its aquatic habitats have been successfully managed through stocking, monitoring, and restoration programs. Extraordinary birding, hiking, and landscapes await the walker through the marshes and bogs. The Shunock runs right through North Stonington's 103-acre Hewitt Farm which the town purchased from Mystic Seaport in 2008. It, too, is near the village and has become well known as a place for horseback riding, fishing, and paddling in Lewis Pond; its 1750 farmhouse overlooks a long hay meadow and a set of community gardens. Lewis Pond is one of the



*Shunock River in the village of North Stonington, CT
(Photo credit: Richard Seager)*

water monitoring sites tested yearly by land trust volunteers for the University of Rhode Island's Watershed Watch Program. There are testing results available for the Shunock and its tributaries as well as Green Fall River and its tributaries for well over twenty-five years, a testament to how important North Stonington residents consider the health of the town's rivers. Avalonia Conservancy's Don Henne Preserve on Babcock Road is a delightful countryside of open fields, stone walls, and woods, with the spectacular paradise of open marsh land, wetlands, and vernal pools. Across the road it has now been joined with another preserve of rocky ridges, steep and hilly, and again, North Stonington's signature stone walls.

Cultural – Native American hunting, gathering, and fishing sites are present along the Shunock and all through North Stonington. The Connecticut Office of State Archaeology has identified and documented three sites (designated 102-24, 102-25, and 102-26) within the Shunock River Corridor. The location and protection of ancient ceremonial stone works is a serious endeavor for a loyal and constant group of people within many of the neighboring towns. They have search parties, meetings, walks, and there are two known presently published books by local photographers to document these stone structures.

North Stonington's early stone walls are unique and prized. The town was named correctly; there are miles and miles of stone walls, different sizes and shapes, up and down the hilly landscape, and along its brooks and rivers. One will find stone walls in obscure places by today's land use. What were they built for, how were they used, and who built them? There are known settler walls and there are known Native American walls. Were fences for sheep, cattle, horses, or goats, or was a fence a place to put rubble from cleared land, or both? It makes no difference today, because in North Stonington stone walls are special, the *piece de resistance* in all the town. There are many early North Stonington homes along the Shunock and along its tributaries, unassuming, ageless, and in character with the very river that flows in and out of their yards with ageless energy.



Shunock River in the village of North Stonington, CT (Photo credit: Richard Seager)

The Shunock River Mills

Richard Seager (Photos courtesy of the North Stonington Historical Society)

The Shunock River flows out of Gallup Pond. Gallup Pond is fed by the Phelps Brook which runs into Hewitt Pond from the north and then on to Gallup Pond. Gallup Pond is formed by a large dam, the location of an early mill.

As the Shunock flows south it is joined by Yawbucks Brook. Continuing southeast, the River flows into Lewis Pond, also known locally as Hewitt Pond. This pond is also formed by a dam and was the site of another mill. It is likely that this was a grist mill due to its location within a large farm property. Until recently the mill turbine and headwater sluice were visible; they are now covered in concrete due to a recent bridge and dam repair resulting from the 2010 flood.

From here the river flows south toward the center of North Stonington Village. It is said that Samuel Richardson, an early settler, operated a mill on the Shunock as early as 1702. What the purpose of this mill was or where it was located is no longer known. The village was known in the 1700s as Avery's mill and then as Milltown in the 1800s. It is the site of several old mill remains. Just up river from Main Street was the upper dam, of which there are just some stone remnants today. It was built to create a mill pond, raising the water level to power the mills in the center of town. There was a sluiceway canal from this pond along the north side of Main Street and under Wyassup road, providing some of the power for the Park mill and others.



The left picture shows part of the outtrace; the right picture shows the dam structure.

The Main channel of the river passes under Main Street and joins with the Assekong Brook and then passes under Main Street again and into a deep cut in the land. Towards the eastern end of this cut is the lower dam, which formed a mill pond that powered mills located there.

Both the dam and the pond are still there; a mill race and turbine can still be seen.

North Stonington enjoyed a period of prosperity as a mill town, thanks to abundant water power supplied not only by the Shunock River but also by the Assekong Brook, critical contributor of water power to the village. The Assekong draws its water from the south slope of Wintechog hill and from the Assekong Swamp.

North Stonington Village supported a variety of mill operations and related local businesses from the late 1600s through early 1900s. Within the village there were numerous mills for various purposes. One of the earliest mills in the village was operated by the Avery family starting in the early 1700s. This was probably a grist mill. The village was called Avery's mills during this early period. In the nineteenth century when the village was called Milltown there

was a wide variety of mills operated in the village. The grinding of corn, the operation of saw mills, iron works, trip hammers, and nail manufacturing all took place in the village; there were also more sophisticated cotton and fulling mills.

While mill operations in North Stonington spanned three centuries, the early and mid-1800s saw the most intense industrial activity in the area. Woolen mills that carded wool for household spinning joined early gristmill and sawmill operations. These mills, in turn, helped foster the growth of John Wheeler's blacksmith business, Wheeler Hake's shoemaking enterprise, and Joseph Frink's carpenter shop. The town became a prosperous mercantile center that also included dye houses, grocery stores, and dry goods stores.

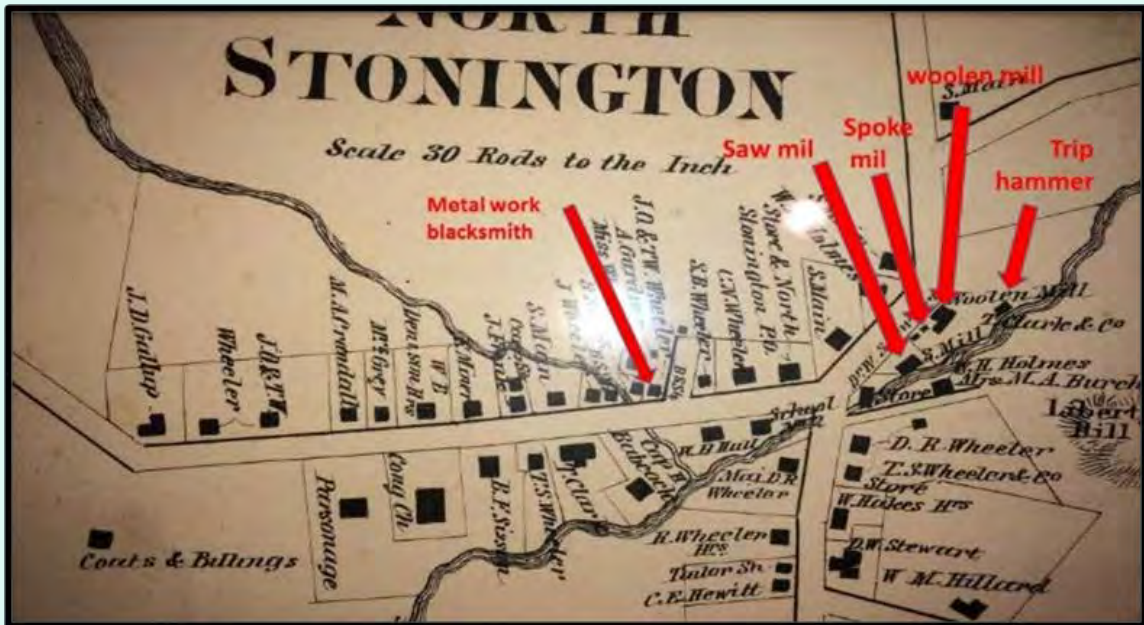
After flowing through the village the river continues generally to the southeast without additional mill sites until it passes under today's route 184, the old King's Highway that runs from Providence to New London. Downstream from where it today passes under the highway, the river provided power for the Vincent Sash and Blind factory from 1842 until the late 1880s. It is clear that the power supplied by the Shunock River along with its tributaries, the Assekonk Brook, the Phelps Brook and Yawbucks Brook, was central to the development of the village of North Stonington.



A sawmill in about 1900 which was located near the lower dam. This mill was operated by the Park family from the late 1800s to the early 1900s.



Park Mill at the end of its existence. After its collapse the Park Hotel was built on its site.



An 1866 map showing the village with some of the mills indicated. The depiction of the river is inaccurate--it does not illustrate the mill ponds formed by the upper and lower dams.

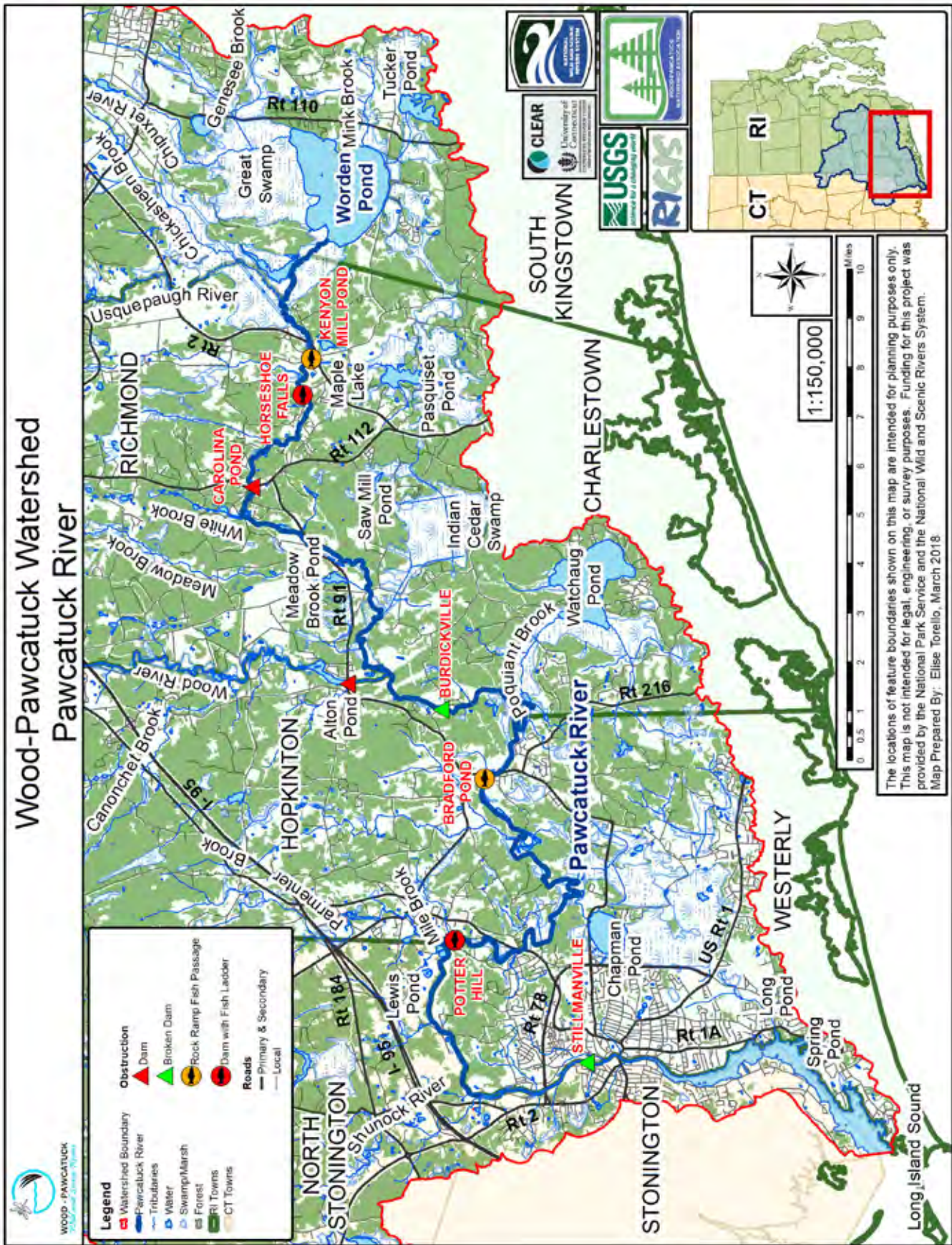


Figure 23. Pawcatuck River and the confluences with the six major tributaries

Pawcatuck River

The Charlestown Moraine altered the flow patterns of the Pawcatuck River more than 16,000 years ago. The river was forced into three compass directions due to glaciation. The river's headwaters initiate at the outlet from Worden Pond, South Kingstown (locally known as the Charles River until the confluence with the Queen-Usquepaugh), where it flows generally from east to west for thirty-six miles to its mouth at Little Narragansett Bay. Along its course the Pawcatuck flows through, or borders, Charlestown, Richmond, Hopkinton, and Westerly in Rhode Island, and North Stonington and Stonington in Connecticut. As it nears Westerly, the river meanders from north to south before reaching the ocean. There were numerous historical dams along the Pawcatuck River; therefore conservationists over the past decade have made concerted efforts to restore fish passage. There have been two complete dam removals, one fish ladder installation, and two nature-like fish passage structures (also known as rock ramps) completed since 2010. As a result, herring have been able to spawn in Worden Pond for the first time in over 200 years.

Because the river is long and flows through several different land uses, it has been broken up into four segments for proposed classification purposes.

Headwaters Pawcatuck River: This three mile segment, from Worden Pond to the Rt. 2 Bridge in South Kingstown, has been classified as Wild. It is primarily part of the Great Swamp wetland complex that includes the Chipuxet River, Worden Pond, and the Queen-Usquepaugh River. There is no road access throughout this segment.

Upper Pawcatuck River: From the Rt. 2 Bridge to the Rt. 112 Bridge in Richmond, the river flows for about four miles through several old mill villages and an operating manufacturing building. This stretch has been classified as Recreation due to the road access and light to medium development along its banks.



Worden Pond, South Kingstown, RI (Photo credit: Denise Poyer)

Middle Pawcatuck River: From the Rt. 112 Bridge and the old Carolina Mill, the river flows for twenty-one miles through heavily forested areas until the confluence with the Shunock River in Westerly, Rhode Island and Stonington, Connecticut. Here it forms part of the border between the two states. This section is classified as Scenic because of minimal road access and some light development.

Lower Pawcatuck River: From the Shunock River confluence the river flows through increasingly urbanized banks for eight miles to the Little Narragansett Bay. In this segment it becomes a vibrant part of two towns, providing recreation and scenic values. At the Rt. 1 Bridge the water becomes brackish as the river becomes the Pawcatuck Estuary. This segment has been classified as Recreation because of the moderate to heavy development along the banks.

Outstandingly Remarkable Values

Geology/Hydrology – This unique river was created by the action of the glaciers receding about 20,000 years ago. As the glacier slowly melted back from its furthest point near Block Island, the climate changed enough that it stalled along what is now the south coast of Rhode Island. For several thousand years the glacier kept moving sand and boulders down, depositing them in a recessional moraine. The Charlestown Moraine can be seen just north of Rt. 1 in South Kingstown, Charlestown, and Westerly, Rhode Island. The moraine forced the normally southerly flowing rivers to find an outlet toward the west, eventually heading south between Westerly and Stonington, Connecticut.

Ecology – The presence of the moraine created extensive wetlands just to its north, including the Great Swamp, Indian Cedar Swamp, Phantom Bog, and Chapman Swamp. The Great Swamp is the largest swamp in New England. It supports large areas of swamp, forest and marsh vegetation. Bordered on the east and west by the Chipuxet and Usquepaugh Rivers, this expansive wetland provides unparalleled



*Mural depicting the Pawcatuck River in downtown Westerly, RI
(Photo credit: Dan Hyland)*

habitat for a vast biodiversity of plants and animals. It is the wildest part of Rhode Island. This area is a National Natural Landmark.

The Pawcatuck River is home to sixty-seven species of fish, more than any other watershed in Rhode Island. The WPWA and TNC have successfully reconnected anadromous fish, such as herring and alewives, to their historic spawning grounds at Worden Pond. American eels, a federal species of concern, are abundant throughout the river corridor. They inhabit the many streams and rivers that feed the Pawcatuck. In 2018, Bradford Dam was replaced by a nature-like fishway, which is a series of boulder weirs spanning the width of the river allowing fish to incrementally make their way up stream. The remaining two dams, Horseshoe Dam in Richmond/Charlestown and Potter Hill Mill Dam in Westerly, now have fish ladders.

Cultural – Several important Native American archeological sites are found near the Pawcatuck River. A monument to the Great Swamp Massacre of Narragansett Indians by colonists in the seventeenth century can be found in the Great Swamp Management Area. An historic battle between the Narragansetts and the Pequots was fought at the Lower Shannock Falls.

Fish Passage in the Wood-Pawcatuck Watershed

Christopher Fox

Our rivers once meandered through the watershed uninhibited by human influence, carving new curves as the centuries passed. In the eighteenth century, European settlers began to harness the power of the Wood and Pawcatuck Rivers to support the growing economy by both straightening and damming the rivers. How much consideration they gave to the impact their actions would have on the resident and migratory fish that depend on the free flowing rivers has been lost to history.

As the centuries passed, the impact became clear and could be most easily seen by the decline in the annual return of salt water fish that require calm freshwater ponds to reproduce. This fish depletion was not unique to the watershed, occurring all around North America. By the mid-twentieth century the concern for the decline became great enough that fish ladders began to be installed on the dams of the lower Pawcatuck River. These concrete structures helped fish find their way around the dams that were too tall for the fish to get over. Many fish were unable to make it up the ladders, but enough did, marking the beginning of fish passage restoration on the Pawcatuck River.

This first burst of restoration provided passage at the Potter Hill and Bradford Dams in Westerly and Hopkinton, Rhode Island, restoring fish access to spawning grounds at Watchaug Pond in Charlestown, Rhode Island. The upper Pawcatuck River remained inaccessible to migratory fish, and the habitat for the resident freshwater fish was segmented. This deficiency was addressed in the report titled Pawcatuck River Estuary and Little Narragansett Bay: An Interstate Management Plan adopted July 14, 1992 by the Rhode Island Coastal Resources Management Council and the Connecticut Department of Energy and Environmental Protection. The report pointed to the restoration of river continuity as a high priority toward restoring fish passage throughout the entire Pawcatuck River.

In the twenty-first century, after careful planning and fundraising, work began to remove the remaining impassable barriers located in Richmond and

Charlestown, Rhode Island. With the removal of Lower Shannock Falls Dam (done in 2011), a fish ladder and eel-way added to Horseshoe Falls Dam (2012) and the redevelopment of the Kenyon Dam into a nature-like fishway (2013), resident and migratory fish were now able to move throughout the Pawcatuck River system. Successfully providing access between the pristine spawning grounds of Worden Pond in South Kingstown, Rhode Island and the Atlantic Ocean in Westerly, Rhode Island and Stonington, Connecticut was truly an historic achievement.



Fish and eel passage at Horseshoe Falls on the Pawcatuck River, Charlestown, RI (Photo credit: Denise Poyer)

These efforts were so successful, from a restoration and community impact perspective, that further work to improve fish passage efficiency on the lower Pawcatuck River was later undertaken. The White Rock Dam in Westerly and Stonington was removed in 2016 and the Bradford Dam has been redeveloped into a nature-like fishway, just completed in 2018. The effort to remove or upgrade the aging fish ladder at Potter Hill is also on the horizon.

The Wood River, a main tributary of the Pawcatuck River, has received no attention with regard to river or fish passage restoration at its five dams. This river has no natural ponds that could serve as prime spawning grounds for migratory fish, making it a low priority for restoration. However, river connectivity is equally important to the freshwater fish and other wildlife that call the Wood River home. Perhaps in the coming decade greater emphasis on the needs of these species will lead to further restoration efforts.

The work outlined above could not have been accomplished without the many partnerships



Nature-like fish passage in the Pawcatuck River at Kenyon Industries, Charlestown/Richmond, RI (Photo credit: Elise Torello)

between entities like the Wood Pawcatuck Watershed Association, The Nature Conservancy, Rhode Island Department of Environmental Management, Connecticut Department of Energy and Environmental Protection, Rhode Island Coastal Resources Management Council, United States Fish and Wildlife Service, National Oceanic and Atmospheric Administration, the United States Natural Resource Conservation Service, Federal Emergency Management Agency, the United States Geological Survey, and many towns, communities, private landowners, engineering and construction firms.



*Pawcatuck River at Kenyon Industries, Charlestown/Richmond, RI
(Photo credit: Denise Poyer)*

While there is only one productive mill along the river, remnants of nine historic mills, dams, and villages can be found throughout the river course starting at Kenyon Industries in the village of Kenyon, which straddles the Richmond-Charlestown border. The Pawcatuck River also passes through the villages of Shannock, Carolina, Burdickville, Alton, Bradford, Ashaway, and

White Rock. The Pawcatuck estuary had an active shipbuilding industry for over 200 years, from 1681 to 1889. The estuary provided transportation to move coal and other goods into and out of Westerly, including the famous Westerly granite used in many well known statues and buildings throughout the east coast.

The NPS has designated the area adjacent to the Pawcatuck River on Mechanic Street as the Mechanic Street Historic District for inclusion in the National Registry of Historic Places. The Rhode Island Royal Charter of 1663 documented English royal recognition to the colony of Rhode Island and Providence Plantations and identified the Pawcatuck Estuary as the westward boundary. The Westerly – Pawcatuck Route 1 Bridge spanning the Pawcatuck River was originally built in 1712.



*Rt. 1 bridge over the Pawcatuck River, Westerly, RI/Pawcatuck, CT
(Photo credit: Dan Hyland)*

Scenic/Recreation – Today the Pawcatuck River is well known for recreation. All of its thirty-six miles are



Kayakers in the Pawcatuck River (Photo credit: Denise Poyer)

navigable by small craft under most water levels. Starting at the mouth of the river, there are several marinas, a public boat launch, parks and nature preserves. Motorized boats are found primarily in the estuary including two short upstream stretches which are deep enough to accommodate them. Otherwise

the Pawcatuck River is primarily enjoyed by canoeists, kayakers, and stand up paddlers. There are five state management areas in Rhode Island and Connecticut, along with numerous conservation lands owned by TNC, ASRI, and local land trusts. These properties are prime spots for hiking, biking, birding, and wildlife viewing. There are two riverfront campsites on the Pawcatuck River, the Burlingame and Carolina Management Areas. Nine fishing and boating access points dot the river from Biscuit City Landing to the Westerly Town Dock.



Rt. 1 bridge over the Pawcatuck River, Westerly, RI/Pawcatuck, CT (Photo credit: Dan Hyland)

Ships Built on the Pawcatuck River

Dwight C. Brown, Jr.

More than 240 ships are known to have been built along the Pawcatuck River. One of them, the whaleship *Charles Phelps*, launched in 1842, made special contributions to the history of Pawcatuck River built vessels. She served in the Stonington whaling fleet until a decline in the industry just prior to the Civil War. During the Civil War, the *Phelps* was sold to the United States government to be used as part of the so-called Stone Fleet. The Navy found her in such good condition that they kept her for use as a store ship. She spent the war years in the southern ports around Norfolk, Virginia.

While on this duty, official Navy records indicate that she was capable of freighting 342 tons of coal in one voyage and that some of her freight included parts for an Ericsson cannon. The only Ericsson cannon in use with the navy at that time were on the USS *Monitor*, famous for its battle with the *Merrimack*.

The New York Herald listing of U. S. Navy ships listed the *Charles Phelps* as being armed with one cannon. Her crew was also noted in Navy records as being comprised of more than seventy percent African-Americans.

After the Civil War, the *Phelps* was sold to New Bedford parties, who outfitted her as a whaler and renamed her *Progress*. As the *Progress*, she was in the New Bedford whaling fleet until the mid-1880s, when she was idled along with many others of the American whaling fleet. In 1893 she was chosen to represent the United States whaling fleet at the Chicago World's Fair. After the Fair closed, the *Progress*, which was by then in a neglected condition, was, according to one report, burned to the water line in the Chicago River, thus ending a long and historical life as a whale ship and Civil War store ship.

Jane, a sloop rigged sailing vessel later converted to a schooner rigged vessel, was built in 1832 in the Main Street Amos Cross Shipyard, Westerly, Rhode Island, located on the Pawcatuck River. The *Jane* sailed between the ports of New Bedford, Hartford, New York and Albany, but mostly between Westerly and Providence, Rhode Island. This vessel called Westerly her home port for many years. Her freight consisted of thousands of tons of coal for the industries along the Pawcatuck River, all kinds of fish for the city markets, and cotton goods shipped to and from Westerly for many of the ports on her voyages. For the first six years of the *Jane's* career, her captain was a correspondent for the Providence Journal, collecting any and all news items in Westerly for publication.

The *Jane* was part of a trade that was capable of transporting all types of freight and passengers along the coastal trade routes in the northeastern ports of call. When the schooner *Jane* was more than sixty years old, she was found abandoned in Boston harbor. Whether she survived much longer is unknown at this time.



Marinas on the lower Pawcatuck River (Photo credit: Dan Hyland)

Water Quality in the Wood-Pawcatuck Watershed

Arthur J. Gold, D. Q. Kellogg, Margaret Kerr

Among the large river systems within the Narragansett Bay basin the Wood-Pawcatuck Watershed encompasses waters of the highest quality (Figure 24).

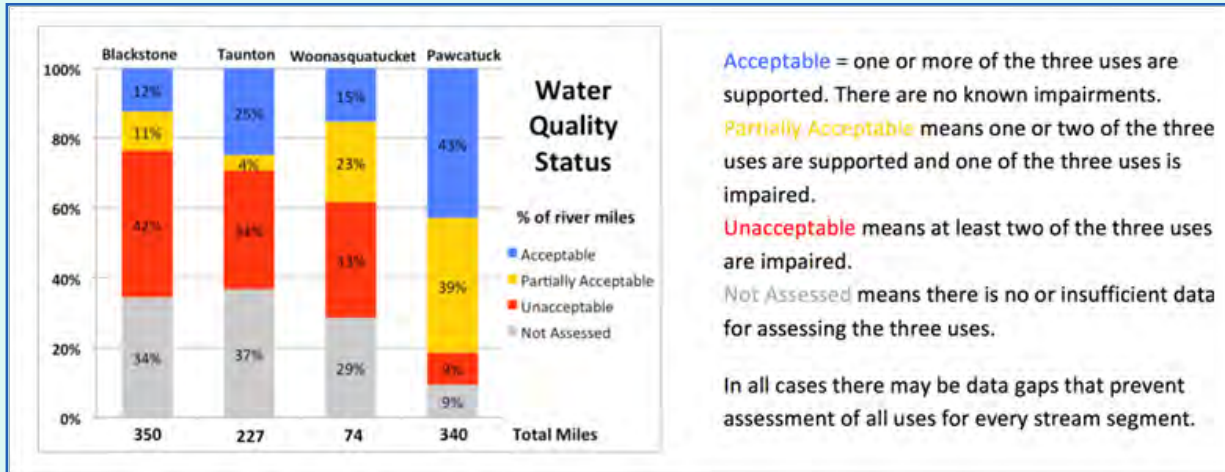


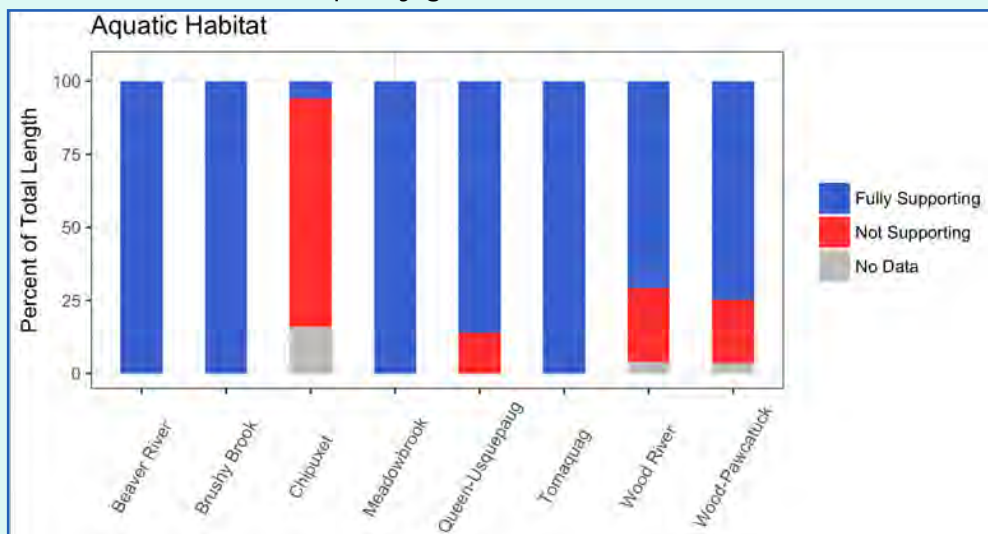
Figure 24. Water quality status of four of the largest river systems within the Narragansett Bay basin, based on the 2010 assessment (RI DEM, 2010). Figure from Watershed Counts (2012).

We examined water quality within the Wood-Pawcatuck Watershed and its major sub-basins (Figure 2) from two perspectives: the degree to which aquatic life is supported, and the extent of impervious cover.

Aquatic Habitat

Based on the 2016 assessment of water quality within the watershed, close to 75% of assessed miles fully support aquatic habitat, defined as “waters suitable for the protection, maintenance, and propagation of a viable community of aquatic life and wildlife” (RI DEM, 2018). Factors considered when assessing river reaches include (RI DEM, 2018):

- Biological (macroinvertebrate) data including physical habitat information
- Conventional parameters, e.g., dissolved oxygen, nutrients and pathogens
- Toxic parameters in water column
- Toxicity data
- Minimum water quality general criteria and aesthetics



Most of the major sub-basins meet criteria to fully support aquatic life along at least 75% of assessed miles, with the Chipuxet being the exception (Figure 25). The reasons for impairment within the Chipuxet include the presence of non-native aquatic plants in one reach and the presence of iron in a second reach (RI DEM, 2016).

Figure 25. Status of Aquatic Habitat Use within the Wood-Pawcatuck Watershed and major sub-basins. Based on data from RI 2016 assessment (RI DEM, 2016).

Impervious Cover: Impervious cover (IC) has long been associated with water quality impairments and has proved to be a useful watershed management metric. IC increases surface runoff during storm events, carrying a wide range of pollutants—sediments, nutrients, pathogens, pesticides, and other chemicals associated with transportation systems—to receiving waters (RI DEM, 2012; CWP, 2003). Commonly accepted thresholds are used to evaluate the expected water quality status within a watershed.

Impervious Cover Range	Water Quality Status
0 to 10%	Protected
10 to 25%	Impacted
> 25%	Degraded

One study found brook trout were most likely to be found in streams where the watershed IC was less than 4% (Stranko et al., 2008).

All of the major sub-basins as well as the Wood-Pawcatuck as a whole fall well below the 10% IC threshold deemed "Protected", while all except one (Chipuxet) fall below the 4% threshold deemed as most favorable for brook trout (Figure 27).

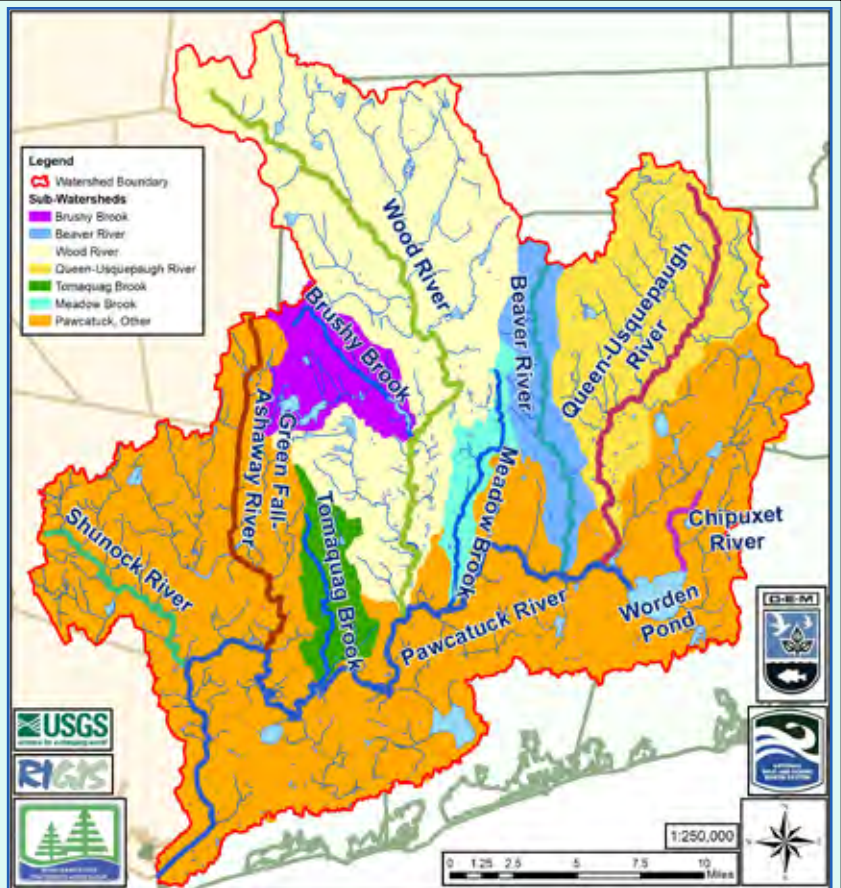


Figure 26. Major sub-basins in the Wood-Pawcatuck Watershed that are discussed in this section. These may vary somewhat from others with similar names because of the chosen outlet point.

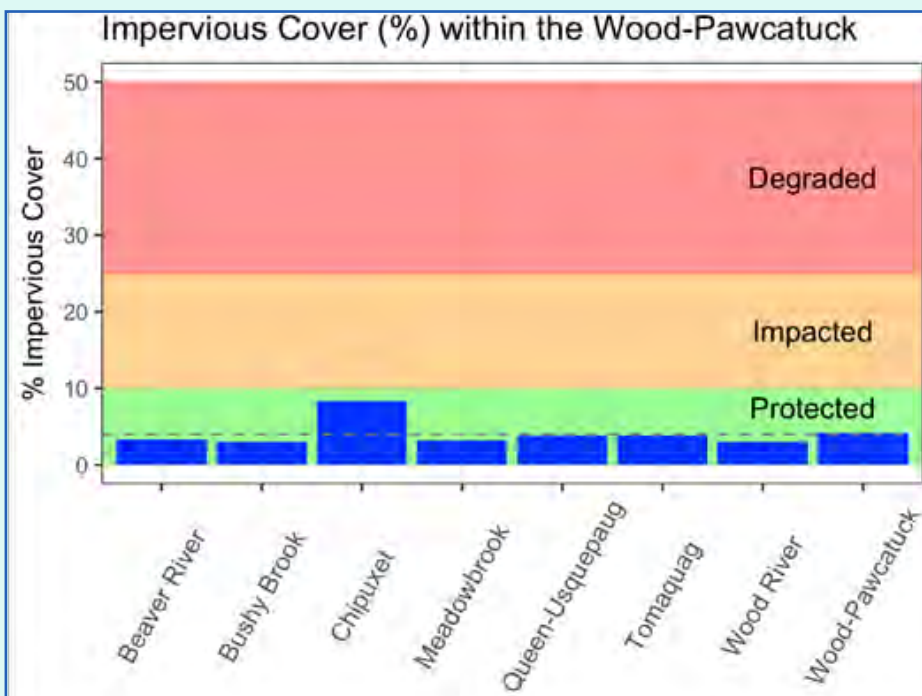


Figure 27. Impervious cover (%) within the Wood-Pawcatuck and its major sub-basins. Note that all fall below the 10% IC threshold to be deemed "Protected" while all except one (Chipuxet) fall below 4% IC (gray dotted line), the threshold below which brook trout are most commonly found.

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Beaver dam in the Pawcatuck River (Photo credit: Elise Torello)



Painting of the Wood River by Susan Shaw

CHAPTER 4: WINNING STRATEGIES FOR THE WOOD-PAWCATUCK WATERSHED

An important aspect of the Partnership Wild and Scenic Rivers Program is to verify that there are already adequate measures in place to protect the Outstandingly Remarkable Values (ORVs) of the rivers. The Study Committee elected to engage a consultant to review the current local, state, and federal protections as they pertain to the Beaver, Chipuxet, Green Fall-Ashaway, Queen-Usquepaugh, Pawcatuck, Shunock, and Wood Rivers in CT and RI. They selected Mason and Associates because they had experience working with several of the towns to update their Town Comprehensive Plan or Plan of Conservation and Development. Based on this report the Study Committee determined that there do exist good measures to adequately protect the rivers' ORVs.

Excerpts from the Mason and Associate's report are below. The full report is included as Appendix A.

Summary of Federal, State, Municipal and Tribal Laws, Regulations, Ordinances and Plans for the Wood-Pawcatuck Wild and Scenic Rivers Study

Introduction

This report summarizes plans and regulations for twelve towns in the Wood-Pawcatuck Wild and Scenic Rivers Study area. As part of that study, the Wood-Pawcatuck Wild and Scenic Rivers Study Committee is preparing "...a locally-based Wood-Pawcatuck Wild and Scenic Rivers Stewardship Plan and a Study Report that describes the eligibility and suitability of a Partnership Wild and Scenic River designation for the Beaver, Chipuxet, Green Falls, Queen-Usquepaugh, Pawcatuck, Shunock, and Wood Rivers." (WPWSRSC, 2018). The Stewardship Plan will help to protect the Outstandingly Remarkable Values (ORVs) documented in the Study. The National Park Service (NPS) 2013 report "Wild and Scenic River Reconnaissance Survey of the Wood-Pawcatuck Watershed" states (p.20):

An in-depth analysis is undertaken during a Wild and Scenic Study and includes an evaluation of:

- *The adequacy of local zoning and other land use controls in protecting the Wild and Scenic River value by preventing incompatible development. ...*
- *The state/local government's ability to manage and protect the Wild and Scenic River values on non-federal lands. In conducting this evaluation a study team will determine if the communities and state have existing zoning and land use controls adequate to protect the waterways and associated ORVs, or whether additional controls are necessary to protect resources. Essential programs or regulations, together with resource objectives and recommendations for future action, are documented in the comprehensive river management plan (CRMP) developed as a part of the Study. Partnership Wild and Scenic River (PWSR) designation under the WSRA is only suitable when there is strong, broad-based support for these critical elements as included in the Plan. (NPS, 2013)*

Federal and state laws provide significant protection to the rivers and provide a foundation for local protections as well; key federal and state laws are therefore described in this report. For each of the twelve member communities, this report provides a summary of community plans and municipal ordinances that relate to the use, protection, and/or management of the study rivers, and identifies potential areas for improvement.

3.0 Federal, State and Tribal Protection

Regulatory protection of rivers and watersheds is based on state, tribal, and in some cases federal plans, policies and laws. This section describes key regulations at the federal, state and tribal level that protect study rivers and associated Wood-Pawcatuck Watershed ORVs. In some cases the regulations described below provide direct protection without significant local responsibility for implementation; in many cases the regulations delegate implementation to the municipal government (the National Flood Insurance Program, for example). In many instances the regulatory protections afforded to a particular resource involve multiple jurisdictions and authorities. This section begins with a brief listing of some of the more important federal laws, followed by descriptions of the protections afforded by the Narragansett Indian Tribe, the State of Rhode Island and the State of Connecticut. (See Appendix A for complete listing)

3.1 Federal

Besides the Wild and Scenic Rivers Act there are several federal protections already in place. These include:

- National Environmental Policy Act (NEPA) requires that all federal agencies consider the environmental impacts of their actions. Each federal agency has implementing regulations that are followed to ensure NEPA compliance.
- Historic Preservation Act – Section 106 of the federal Historic Preservation Act requires that federal agencies consider the impacts of their actions on historical and archaeological resources. Whether officially designated or not, properties that are eligible for listing on the National Register of Historic Places are protected.
- The National Flood Insurance Program provides federally subsidized flood insurance to homeowners and businesses. To be eligible to participate in the program, a local government (municipality) must enact laws that restrict development in flood hazard areas.
- The federal Clean Water Act (CWA) regulates many activities affecting the study rivers. It sets goals that waters of the United States should be fishable and swimmable and generally suitable for public water supply. The most important CWA protections involve regulation of point source discharges of wastewater (municipal sewage, industrial pollutants, stormwater outfalls), non-point sources of pollution such as stormwater runoff from farms and urban areas, and the destruction of wetlands by filling.

- The federal Safe Drinking Water Act (42 U.S.C. 300f, 300h-3(e), Pub. L. 93-523) is intended to ensure safe potable water is available to the public. It sets specific water quality criteria and standards, and empowers EPA to administer implementing regulations. In 1988 the EPA designated the groundwater of the entire Pawcatuck Basin Aquifer System (entire Wood-Pawcatuck Watershed) as a “Sole Source Aquifer” because of its importance as the only source of drinking water available to the public (53 FR 17108).
- CERCLA, RCRA, FIFRA, and TSCA - Environmental pollution from toxic chemicals lead to a number of federal laws in the 1970s and 1980s that regulate the use and disposal of toxic or otherwise hazardous chemicals. While the CWA focused largely on wastewater discharges to waterways, these other regulations focused on a) the use of chemicals in the workplace, home and environment, and b) the ultimate disposal of waste chemicals in the environment.
- The Endangered Species Act authorizes USFWS and NMFS to identify endangered and threatened species, and species of concern, and implement regulations to protect those species.

3.2 Narragansett Indian Tribe

The Narragansett Indian Tribe (NIT) is a sovereign nation with federally recognized tribal lands adjacent to the Pawcatuck River and extending southward to Route 1. These tribal lands include important water resources such as Indian Cedar Swamp and Schoolhouse Pond, and are known to support a number of different rare species and habitats. The NIT tribal land overlies one of the largest groundwater reservoirs (high yield aquifers) in the region. While the designated tribal lands are certainly rich in cultural resources associated with the Narragansett Indian Tribe and their ancestors, such resources are extensive throughout the Wood-Pawcatuck Watershed. Resource protection is provided by the NIT’s Department of Community Planning and Natural Resources, and the Narragansett Indian Tribal Historic Preservation Office (NITHPO).

3.3 State of Rhode Island

Rhode Island has many resource protection laws, policies and programs similar to other states and often developed in conformance with federal laws. These are summarized (see Appendix A) along with those which are somewhat unique to RI. Statutes are referenced with respect to the RI General Laws (RIGL). Unlike CT, regulation of wetlands and onsite wastewater treatment systems (OWTSs, also known as septic systems) is done by RI DEM at the state level rather than at the

local level as in neighboring states. State enabling legislation related to planning and zoning requires implementation at the local level in conformance with state Guide Plans and procedures.

3.4 State of Connecticut

Connecticut's resource protection laws, policies and programs are similar to those in other states and are often developed in conformance with federal laws. These are summarized below along with those which are somewhat unique to CT. Statutory reference is made to the Connecticut General Statutes (CGS) and regulatory reference is made to the Regulations of Connecticut State Agencies (RCSA). Unlike RI, Connecticut has a formal permit program for the diversion of groundwater or surface water at a rate of 50,000 gallons per day (gpd) or more. Connecticut's Natural Diversity Data Base program has a formal process for reviewing potential impacts to rare species and their habitats, unlike Rhode Island's program. The CT coastal zone jurisdictional area extends 1,000-foot landward of tidal waters and wetlands; this is significantly larger than the RI 200-foot CRMC jurisdictional area. State enabling legislation related to planning and zoning requires implementation at the municipal level in conformance with state guidance and procedures. CT has policies that require each town to have a Conservation and Development Plan.

4.0 Summary Overview of All Towns

This section summarizes the major regulatory and plan elements of resource protection in the subject towns. It is organized by major element: community plans, zoning, land development regulations, and special resource protection. For all towns these elements are interrelated, but the exact substance and interrelationships of regulations and plans varies by town and state. If protection for a special resource is contained in the zoning ordinance it will first be described in the zoning section for that town (groundwater protection districts, for example). In many towns, the zoning ordinance, land development/subdivision regulations, and some resource ordinances are provided separate and apart from the main code of ordinances. Not all towns have updated their plans and regulations, and sometimes internal inconsistencies exist.

4.1 Community Plans

All towns in the study area have some sort of master plan to guide growth and development in the future. Both Rhode Island and Connecticut have state laws that govern the preparation and content of such plans. Both states provide financial support to towns for plan preparation. In Rhode Island, these plans are called Comprehensive Community Plans (Comprehensive Plans, or “Comp Plans”). In Rhode Island these local plans must be prepared in conformance with the RI Comprehensive Planning and Land Use Regulation Act (RIGL 45-22.2) and associated regulations and guidance from the RI Department of Administration Division of Statewide Planning (RIDSP, 2018). In Connecticut, this plan is typically called the Plan of Conservation and Development (POCD). Those local plans are guided by the State of Connecticut 2013-2018 Conservation and Development Policies Plan (OPM, 2013), in accordance with state law (CGS 8-23). In both states, towns may have supplemental or associated plans that focus on an important community planning element such as open space or economic development. Such supplemental or related plans are described below to the extent they are relevant to resource use or protection in the study area.

All of the towns include goals promoting the preservation of natural resources, open space, and the rural/historic character of the town. In most cases these preservation goals are tied to water supply protection, protection of development from flood damage, and for some towns the protection and promotion of the tourism industry. Towns also recognize the importance of resource protection for financial sustainability, understanding the loss or diminishment of certain resources may pose adverse financial consequences to the town. All towns protect the study river corridors to a large extent, and provide meaningful development regulations that protect water resources in the river’s watersheds. Many towns promote green-ways and interconnected conservation lands; some towns specifically support the Wood-Pawcatuck Wild and Scenic River Study effort.

4.2 Zoning

All of the towns in the study area also have enacted zoning ordinances that place controls on land uses to protect public health, safety and general welfare. Because they must be consistent with state enabling legislation (which is, in turn, based on federal model legislation) the ordinances all tend to be very similar in form, even though there is a wide variation in the types of zones established and the types of uses allowed. Zoning ordinances typically consist of two parts. The first part is

the text. The text establishes zoning districts and indicates which uses are allowed within each district. Other common parts of the text include:

- Legal Authority, and Purpose
- General Provisions
- Zoning Districts and Regulations
- Use Tables
- Dimensional Requirements
- Nonconforming Uses, Structures, and Lots
- Impact Standards, Performance Standards, Review/Approval Criteria
- Administration, Enforcement and Appeals
- Amendment Procedures

The second part of the Zoning Ordinance is the Zoning Map. The Zoning Map shows the locations of the various zoning districts within the town. This analysis concentrates first and foremost on the types of zones designated in proximity to the study rivers with an eye to evaluating the level of resource protection provided by the Ordinance. Protection of watershed ORVs is also described. In addition, many communities include “overlay” districts that provide a higher level of resource protection than the underlying district. Typical overlay districts within the study area include aquifer and groundwater protection zones, wellhead protection areas, flood hazard zones, historic village districts and occasionally wetland and riverfront protection zones. Some overlay zones are explicitly mapped, others are incorporated by reference to specific maps such as the local Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs).

Finally, some zoning ordinances include special measures that allow proposed developments to be configured in such a way as to protect natural resources while still providing the same development densities as conventional development. These allow uses to be arranged on one part of a property at higher densities while leaving other parts of the property undeveloped to protect open space, agricultural land, historical resources, wetlands, floodplains and other valuable natural resources. Examples include residential compounds, cluster development ordinances, and Planned Unit Developments (PUD). The terms “Conservation Development” and “Low Impact Development” (LID) are also referenced in zoning and land development regulations, but often with different meanings and specificity in different towns.

In each case, the Zoning Ordinance also establishes a Zoning Board of Review or Zoning Board of Appeal. The responsibility of the Zoning Board is to hear cases where the literal application of the Ordinance would result in a “hardship” for an

individual property owner and/or would deprive a property owner of all reasonable use of the land. The Board is empowered to grant variances in those cases assuming the conditions for “relief” have been met. Most Zoning Boards also grant Special Use Permits for uses where special conditions must be met as a pre-requisite to development. They also hear appeals of decisions made by the Planning Board/Planning and Zoning Commission in the development review process described below.

Town zoning provides very good protection of study river corridors for the most part, especially in combination with large areas of protected conservation lands. Many of the zoning challenges with respect to resource protection are a result of the historic village developments along the river. While these villages are an important asset to the cultural and scenic values of the rivers, they often pose challenges to new growth and redevelopment because of lot densities and inadequate infrastructure (wastewater disposal and water supply, for example) in addition to the historic and water resource constraints such as flood hazards.

4.3 Land Development Regulations

All of the study area towns also have adopted a set of land development regulations. These may also be referred to as the “Subdivision Ordinance” and/or the “Land Development Ordinance”. These typically apply to subdivision of land into three or more lots, and large development projects. While the Zoning Ordinance indicates WHAT uses are permitted on a property, the land development ordinances indicate HOW those uses may be developed. They specify the procedures by which the local regulatory authorities will review and approve proposed land subdivision and development projects and set minimum standards for land development projects that may include more detail than that provided in the Zoning Ordinance. Unlike the Zoning Ordinance, the land development regulations often provide specific requirements for evaluation and protection of natural and cultural resources during the subdivision and land development process. Some towns also have separate but related design standards that are important to preserving natural resources and scenic views.

4.4 Special Resource Protection

Each of the Towns in the study area also has its own set of local ordinances. These local laws cover a wide range of topics based on local priorities. Many of them provide specific protections for resources considered important within the communities. They range from nuisance laws about garbage and debris to “dark

skies” ordinances that control outside lighting. This study reviews the local requirements and guidance contained in the ordinances for the protection of wetlands, floodplains, groundwater aquifers, public wells, and any other resources that may related to the protection of the rivers.

4.4.1 Wetlands and Watercourses

Wetlands and Watercourses are protected by state law in both Rhode Island and Connecticut. In Rhode Island, development projects with a potential impact on wetlands are reviewed primarily by the Rhode Island Department of Environmental Management (RI DEM) and wetlands in the vicinity of the coast are regulated by the Coastal Resources Management Council (CRMC). Wetlands are identified by soils, vegetation and hydrology and projects are encouraged to avoid, minimize and mitigate wetlands impacts. Some projects include construction of replacement wetlands but 1:1 replacement by area is not normally required. Rhode Island communities are allowed (at least at present) to administer their own wetlands regulations in existence prior to the new wetland statute (12/2015), but their jurisdiction is limited by the state.

In Connecticut, the cities and towns implement wetlands protection through local Inland Wetlands and Watercourses Commissions (IWWCs or Wetland Commissions) pursuant to the state law. The Wetlands Commissions review development projects at the town level. Jurisdictional areas include the inland wetlands, all watercourses (intermittent and perennial), and a minimum 100-foot “upland review area” surrounding the wetlands and watercourses. Inland wetlands are primarily identified by soil indicators and applicants are required to avoid wetlands, minimize encroachment and mitigate adverse impacts. Mitigation typically requires 1:1 replacement for impacted wetlands by area although exceptions are made where it can be established that replacement of functions and values can be accomplished without 1:1 replacement. The Town of Stonington also includes coastal zone wetlands that are regulated pursuant to state law and the town’s Coastal Area Management regulations.

4.4.2 Floodplains

All of the towns in the study area have adopted flood hazard ordinances. These local ordinances are required by the Federal Emergency Management Agency (FEMA) as a condition of participation in the National Flood Insurance Program (NFIP) and most of them are based on the FEMA minimum requirements. The National Hazard Mitigation Planning Program requires each state have statewide natural hazard mitigation planning. As a result, most of them include the same, or similar, provi-

sions that protect floodways, prohibit/regulate development in flood hazard areas, regulate placement of mobile homes in floodplain, and establish requirements for stormwater management, debris management, and often establish erosion and sedimentation control requirements for flood prone areas. Although zoning and subdivision regulations often include flood-related provisions, the town's flood hazard ordinances are often a separate chapter of the town code, include specific reference to the NFIP, and cite the FEMA Flood Insurance Rate Maps (FIRMs) as depicting the regulated area. Many towns have included flood hazard overlay districts to their zoning regulations with the flood hazard boundaries corresponding to those depicted in the FIRMs.

4.4.3 Stormwater

Regulations regarding stormwater management for new development are generally included in the zoning and subdivision regulations. Additional stormwater ordinances have been adopted by municipalities such as Westerly and Stonington with town-owned stormwater drainage systems as required by the federal Clean Water Act and administered by RI DEM and CT DEEP (the so-called MS4 requirements). Restrictions on new connections, inspection, enforcement and management of stormwater infrastructure are specified.

4.4.4 Groundwater

Most of Rhode Island's groundwater reservoirs and recharge areas lie within the Wood-Pawcatuck Watershed. These represent high yield aquifers suitable for public water supply. They were created by glacio-fluvial deposits during the ice age. Areas outside these groundwater reservoirs are also used for individual water supplies and small community and non-community wells. Most of the RI communities in the Wood-Pawcatuck Watershed have groundwater protection overlay districts with additional resource protections including land use restrictions and performance standards for new development.

In Connecticut, aquifers are an essential natural resource and a major source of public drinking water. Significant aquifers are associated with the Shunock, Green Fall, Ashaway and Pawcatuck Rivers. To protect these groundwater resources from contamination, Connecticut established the Aquifer Protection Area Program. This program, administered by CTDEEP, identifies critical water supply aquifers and protects them from pollution by managing land use. Protection requires coordinated responsibilities shared by the state, the municipality, and the water company to ensure a plentiful supply of public drinking water for present and future genera-

tions. Both Stonington and North Stonington have high quality, high yielding aquifers in the study areas of the Shunock, Green Fall, Ashaway and Pawcatuck Rivers.

4.4.5 Wastewater (Septic Systems and Sewers)

Subsurface sewage disposal systems, also known as septic systems or onsite wastewater treatment systems (OWTSs) are regulated by municipalities in Connecticut and by RI DEM in Rhode Island (with various levels of local participation by RI towns). In Rhode Island, OWTSs are regulated, reviewed under the Rules Establishing Minimum Standards Relating to Location, Design, Construction and Maintenance of Onsite Wastewater Treatment Systems. Rhode Island communities are not (yet) prohibited from enforcing their own standards that are stricter than the state standards. The most common of these local ordinances establish On-site Wastewater Management Plans (OWMP) and associated Wastewater Management Districts. An OWMP describes the elements of the municipal management program for septic systems. Program elements may include requiring system inspections, enhancing homeowner education, or specifying more stringent treatment requirements in environmentally sensitive areas. Once approved by RI DEM, an OWMP makes a town eligible to apply to the Community Septic System Loan Program (CSSLP). Local OWTS setbacks from wetlands in excess of state standards will not be allowed after RI DEM regulations are adopted in accordance with the revised Freshwater Wetlands Act enacted in December 2015. At this time no implementing regulations have been proposed by RI DEM.

In Connecticut, septic systems, defined as subsurface sewage disposal systems, are regulated by Public Health Code (PHC) Section 19-13-B103 and the associated Technical Standards for Subsurface Sewage Disposal Systems (Technical Standards). Septic systems with design flows of 7,500 gallons per day (GPD) or less are regulated and permitted by the Local Director of Health. Large septic systems serving buildings with design flows of 2,000 to 7,500 GPD, and all systems with design flows greater than 7,500 GPD must be approved by the CT Department of Energy and Environmental Protection.

4.4.6 Soil Erosion and Sedimentation

All of the communities in the study area have their own soil erosion and sedimentation control ordinances. These ordinances tend to be oriented toward fulfilling certain requirements of the federal Clean Water Act as implemented through each state's environmental agency; they require minimum controls on soil disturbance during construction to reduce soil erosion and pollutant discharges from storm-water runoff. Relatively small areas of soil disturbance may be regulated, and a

determination of applicability is typically required from the building official for such disturbances. Where applicable, a soil erosion and sedimentation control plan (SESCP) is required to be submitted for local review and approval. Most towns in the study area have such regulations and all require such control plans as part of their land development regulations. In Rhode Island the RI DEM or CRMC reviews SESCPs associated with wetland permit applications, or otherwise regulates land disturbing activities over one acre through its RIPDES General Permit for Storm-water Discharge Associated with Construction Activity. Most towns have a local ordinance that regulates land disturbances much smaller than one acre; in some cases the threshold of disturbance may relate to the proximity to regulated water resources.

4.4.7 Resource Extraction

Some of the study area communities, particularly those with a history of quarrying and/or sand and gravel excavation, have adopted local ordinances that regulate mining and resource extraction. These are typically adopted to work in conjunction with erosion and sedimentation control regulations, to reduce noise, protect air and water quality, and regulate truck traffic associated with extractive industries.

4.4.8 Solid Waste

Most study area communities also have local bylaws that regulate solid waste. These vary widely, but almost all are based on the community "Police Powers" for the protection of public health and safety. They typically prohibit unauthorized disposal, littering, trash and debris and, because recycling is mandatory in both Rhode Island and Connecticut, most of them also establish procedures for recycling as well as for solid waste storage, collection and disposal.

4.4.9 Vegetation

Relatively few of the study area towns have ordinances that relate to the protection of vegetation, except perhaps as it relates to maximum impervious cover allowed on a lot. Some towns have tree ordinances, but these are typically restricted to public street trees and/or to trees on public property. Local tree ordinances provide for minimal fines for removing public trees without permission of local authorities. Some towns also have a "Tree Warden" charged with managing publicly owned trees, trimming limbs that overhang streets or utility wires and, as needed, removing trees that are seriously damaged, diseased or otherwise a threat to public safety. A few towns have adopted ordinances to protect rare, threatened or endangered plant species, typically by prohibiting collection and/or by regulating

disturbance within critical habitat areas. Most towns' land development regulations include provisions for vegetated buffers and/or landscaping associated with large development proposals.

4.4.10 Special Habitats

Although community plans typically identify important habitat areas in each town, and most of the towns include general requirements for protection of special habitats as part of their development regulations, very few study area towns have chosen to protect special habitats for fish, wildlife, or vegetation directly through local ordinances. Hunting, fishing, and logging are regulated at the state level supplemented by local ordinances. These typically have a stronger focus on public safety and resource sustainability rather than habitat protection. It appears the most common means of protecting special habitats in the study area is for the communities to acquire the land containing those important habitat areas and protect them through public ownership. Open space set-asides and in-lieu fee contributions to public open space are often targeted towards habitat protection. Each state's environmental agency provides mapping of rare species and critical habitats that towns use in conservation planning. The CT DEEP Natural Diversity Data Base program maps have regulatory importance with regard to certain CT DEEP permit programs pursuant to the CT Endangered Species Act and other state laws. In contrast, the RI Natural Heritage Program provides no specific protection for state listed rare species or critical habitats, rather, the RI DEM partners with the private non-profit RI Natural History Survey to track rare species occurrences, update mapping and provide information through RIGIS and direct consultation.

4.4.11 Open Space Conservation

All the study area communities have some local ordinances or regulations for protection of open space. Some require dedication of public open space (or equivalent in-lieu fee payment) as a condition of approval for larger developments. Most require that open space at least be identified as part of all major land development projects. All the study area towns have some form of Land Trust, Conservancy or other conservation organization that functions to acquire and protect open space locally. These organizations own land outright, hold conservation easements, and serve as rights holders for acquisition of property development rights. Some Land Trusts are town-specific and are active in only one town; some of these are private and some towns have a municipal land trust. Others are natural resource oriented and are active in more than one community. Jurisdictions frequently overlap such that several communities are served by multiple such organizations. (There are six different Land Trusts currently active in Westerly, RI for example.)

Most of the Land Trusts and Conservancy groups active in the study area have established criteria by which they assess properties under consideration for acquisition and protection. Where those criteria are publicly available, they almost universally include proximity to major rivers, streams, and surface water bodies as important criteria. Most weight access to surface water very highly in choosing properties for protection. Conservation Commissions in some towns are very active in the identification, prioritization and acquisition of open space for conservation. Most study area towns call for interconnections between parcels of dedicated open space, providing greenbelts or wildlife corridors, often organized around the town's river network.

Towns also typically include other types of open space, conservation, and recreation lands in their open space planning and conservation efforts. These include federal and state protected areas, lands preserved as open space temporarily through easement or tax mechanisms (farm, forest and open space programs for example), undeveloped municipal lands, and private recreation lands.

4.4.12 Historic/Cultural Resources

The study rivers in the Wood-Pawcatuck River watershed include historic villages that date back to the early days of European colonization. Native American cultural resources are also present throughout the Wood-Pawcatuck Watershed as well as the riparian corridors. Historic and other cultural resources occur along the rivers due to their importance for fisheries, transportation and water power. A number of municipalities have enacted regulations to protect these resources, including provisions for resource identification and preservation as part of land development regulations, and historic village overlay districts in the zoning ordinance. Where enacted, such village overlay districts typically attempt to preserve the historic village character with design guidelines/standards. Some towns may require historic/archaeologic studies as part of the land development review process. Most of the historic villages along these rivers include old mills that present difficult challenges for preservation and reuse.

4.5 Summary Comparison Matrix

The Summary of Plans and Ordinances lists each town along with an indication of the primary regulatory basis of resource protection, if any, for the natural and cultural resources associated with the study river corridors and watersheds.

Table 2. Comprehensive Plans (RI) and Plans of Conservation and Development (CT), Wood-Pawcatuck Wild and Scenic Rivers Study

Town	Rivers ¹	Plan Date & Status ²		Future Land Use Plan/Map Protection of River Values ³		Comments
		Adopted Plan	Draft Plan	Corridors	Water-sheds	
Charlestown	P	2006 E	expected 2018	Yes	Yes	2 historic villages
Exeter	B, QU, W	2011 E		Yes	Yes	village approach
Hopkinton	A, P, W	2/5/2018		Yes	Yes	WPWSR support
North Kingstown	Only C (QU) watersheds	8/20/2008 E	July 2016	Not Applicable	Yes	
Richmond	B, P, QU, W	9/20/16 E		Yes	Yes	WPWSR support
South Kingstown	C, P, QU	1/11/16 E	expected 2018	Yes	Yes	
West Greenwich	QU, W	2008		Yes	Yes	plan not accepted by state
Westerly	P	11/7/2011 E	expected 2018	Yes	Yes	
North Stonington	GF, P, S	2/12/2013		Yes	Yes	WPWSR support, OS Plan 2013
Sterling	W	June 2009		Yes	Yes	
Stonington	P	5/7/2015		Yes	Yes	OS Plan 2007
Voluntown	GF, W	2010		Yes	Yes	
Notes:	<p>1. A=Ashaway, B=Beaver, C=Chipuxet, GF=Green Fall, P=Pawcatuck QU=Queen-Usquepaugh, W=Wood, watershed=C & QU watershed only</p> <p>2. Date of Town adoption; E = expired</p> <p>3. Wild and Scenic River values are free-flowing condition, water quality and Outstandingly Remarkable Values (ORVs) identified in the study watershed</p>					

Table 3. Zoning Ordinances, Wood-Pawcatuck Wild and Scenic Rivers Study

Town	Source	Date	Zoning Districts ⁴		Cluster	Comments
			Corridors	Water-sheds		
Charlestown	Code Ch. 218	1/8/2018	OS, LDR, VO, GWO	OS, LDR, VO, GWO	Yes	VO w/ MDR, C, I
Exeter	Code Ap. A	10/2/2017	OS, LDR, GWO	OS, LDR, GWO, C, MU	Yes	C, MU along Rt. 2 south
Hopkinton	Code Ap. A	12/21/2007	LDR, C, M, GWO	LDR, C, M, GWO	Yes	Also Code Ch 13.5
North Kingstown	Code Ch. 21	7/17/2017	Not Applicable	LDR, C, I, GWO	Yes	
Richmond	Code Ch. 18	1/2/2018	LDR, C, I, GWO	LDR, C, I, GWO, PD	Yes	
South Kingstown	Code Ap. A	2/12/2018	OS, LDR, GRW	OS, LDR, I, C, GWO	Yes	
West Greenwich	Ord. 16 ⁵	5/10/2017	OS, LDR, I	OS, LDR, MDR, HDR, I, C, MU, GWO, HMO	Yes	Wood - OS & LDR, Queen - OS, LDR, I
Westerly	Code Ch. 260	2/26/2018	OS, LDR, MDR, HDR, I, C, MU, GWO, HMO	OS, LDR, MDR, HDR, I, C, MU	Yes	River Corridor Overlay is reserved
North Stonington	Indep. Doc. ⁵	11/17/2017	LDR, VO, C, I, GWO	LDR, VO, C, I, GWO	Yes	
Notes:	<p>4. Zoning districts generalized to facilitate comparison, see town discussion and Appendix A maps and ordinances for town specific zones. Does not include overlay districts for flood hazards or wetlands.</p> <p>District codes: C=Commercial; GWO=groundwater/aquifer protection overlay; HMO=Historic Mill overlay; I=Industrial; LDR/MDR/HDR=Low, Medium, High Density Residential (2+ acre, 1 ac. +/-, and 0.5 ac. or smaller lots, respectively; M=Manufacturing, MU=Mixed Use; OS=Open Space; PD=Planned Development; VO=Village Overlay</p>					

Table 3, continued.

Town	Source	Date	Zoning Districts ⁴		Cluster	Comments
			Corridors	Water-sheds		
Sterling	Indep. Doc. ⁵	1/29/2018	LDR, MU see comments	LDR, MU see comments	Not Explicitly	one primary zone allows various uses if they meet standards and are not prohibited
Stonington	Indep. Doc. ⁵	2/1/2018	LDR, MDR, HDR, C, I, MU, GWO, CAMO	LDR, MDR, HDR, C, I, MU, GWO, CAMO	Yes	Pawtucket Village, Industrial Heritage Re-Use and Heritage Mill Districts along river. Also sep. Aquifer Protection Regs
Voluntown	Code Sec. 4 ⁵	3/1/2012	OS, LDR	OS, LDR	Not Explicitly	
Notes:	<p>4. Zoning districts generalized to facilitate comparison, see town discussion and Appendix A maps and ordinances for town specific zones. Does not include overlay districts for flood hazards or wetlands.</p> <p>District codes: C=Commercial; GWO=groundwater/aquifer protection overlay; HMO=Historic Mill overlay; I=Industrial; LDR/MDR/HDR=Low, Medium, High Density Residential (2+ acre, 1 ac. +/-, and 0.5 ac. or smaller lots, respectively; M=Manufacturing, MU=Mixed Use; OS=Open Space; PD=Planned Development; VO=Village Overlay</p>					

Table 4. Land Development Regulations, Wood-Pawcatuck Wild and Scenic Rivers Study

Town	Source	Date	Protection of River Values ³		Comments
			Corridors	Water-sheds	
Charlestown	Code Ch. 188	1/8/2018	Yes	Yes	requires cluster residential
Exeter	Code Ap. B	10/2/2017	Yes	Yes	TDRs
Hopkinton	Code Ch. 18 ⁵	9/3/2014	Yes	Yes	Also Stormwater and Hazard Mit. Plans
North Kingstown	Code Ap. A	7/17/2017	Not Applicable	Yes	Little opportunity for new development in watershed
Richmond	Code	10/27/2015	Yes	Yes	
South Kingstown	Indep. Doc.5	12/12/2012	Yes	Yes	
West Greenwich	Ord. 4 ⁵	5/18/2015	Yes	Yes	
Westerly	Code Ch. A261	2/26/2018	Yes	Yes	
North Stonington	Indep. Doc. ⁵	11/2/2015	Yes	Yes	
Sterling	Indep. Doc. ⁵	3/23/2010	Yes	Yes	
Stonington	Indep. Doc. ⁵	8/8/2016	Yes	Yes	Also sep. Design Review Guidelines 8/09, Technical Standards 3/21/11
Voluntown	Code Sec. 3 ⁵	7/1/2011	Yes	Yes	
Notes:	<p>3. Wild and Scenic River values are free-flowing condition, water quality and Outstandingly Remarkable Values (ORVs) identified in the study watershed</p> <p>5. Published as a separate document from town code.</p>				

Table 5. Special Resource Protection, Wood-Pawcatuck Wild and Scenic Rivers Study

Town	Study Rivers	Wetlands & Watercourses	Flood-plains	Storm-water	Ground-water
Charlestown		Ch. 174, 188, 210, 218	FHO, Ch. 117	Ch. 188	GWO
Exeter		App. A Sec. 2.5.2, (Ch. 50)	Ch. 22 Art. IV	App. A Sec. 2.5.2	GWO
Hopkinton		Ap. A Sec. 33	FHO, Ap. A Sec. 33	Ch. 13.5, SWMPP	GWO
North Kingstown		Ch. 8 Art. IX	FHO, Sec. 21-188	Ch.8 Art. IX	GWO, Ch. 8 Art. VII, S. 21-186
Richmond		LDSR	FHO, Ch. 18.44	Ch. 8.06	GWO, Ch. 18.7
South Kingstown		Ch. 20, 21, LDSR	FHO, Ap. A Sec. 601, Ch. 21	Ch. 20	GWO, Ap. A Sec. 602
West Greenwich		Ord. 1a, 4, 16 Art. VII Sec. 10, Art. IX	Ord. 4, 91	Ord. 4, 90	Ord. 4, 16, 84
Westerly	Sec. 260-57, (260-15E & -56 res)	Ch. 86, 223, 260, A261	FHO, Ch. 127, 260, A261	Ch. 223, 224. 260, A261	GWO Sec. 260-52, Ch. 251
North Stonington		IWWC reg.s, LDSR	FHO, Ch. 10, Zoning 307, LDSR	Ch. 10, Zoning 1112, LDSR	GWO APA Reg.s, Zoning 703
Sterling		IWWC reg.s, Zoning Ap. A, C, LDSR	Code p. 47, 78, 97, LDSR Sec. 7	Code p. 124, Zoning Ap. A, C, LDSR S. 10	Code p. 124, LDSR S. 11
Stonington	P.R. Harbor Manag. Com., Zoning 4.9.4.7	IWWC reg.s, Zoning 7.3, LDSR	FHO, Zoning 7.7, LDSR 7.5	Ord. Illicit Disch. ..., Zoning 7.13, LDSR 5.7, 5.9, 7.4	GWO, Zoning 7.2, Aquifer Prot. Regs
Voluntown		IWWC reg.s, Zoning 8.4, LDSR	Code p. 66, Zoning 8.5, LDSR 5.4	Road Ord. p. 47, LDSR 4.3, 5.4.3	Zoning 9.5.1, LDSR 3.1.2 (wells)

Table 5, continued. Special Resource Protection, Wood-Pawcatuck Wild and Scenic Rivers Study

Town	Septic Systems & Sewers	Soil Erosion & Sediment Control	Resource Extraction	Solid Waste	Vegetation
Charlestown	S. 11	Ch. 174, Ch 188	Ch. 174, 218	Ch. 165, 218	Ch. 163, 188
Exeter	App. A Sec. 2.5.2	Ch. 23	Ch. 30 Art. I, II	Ch. 34	App. A Sec. 2.5.2
Hopkinton	WWMD Ch. 21	Ch. 13.5	Ap. A, Ch. 17, Earth Rem. Ord.	Ch. 16	Ch. 13.5
North Kingstown	Ch. 8 Art. III, VIII	Ch. 8 Art. IX Div II	Ch. 16	Ch. 6	Ch. 8 Art. IX, Ch. 17 Art. IV, Ap. A
Richmond	LDSR	Ch. 15.06	Ch 15.16	Ch. 8.18	Ch. 18, LDSR
South Kingstown	WWMD, Ch. 19 Art. 2	Ch. 20 Art. 2	Ap. A	Ch. 15	Ch. 18.5, LDSR
West Greenwich	Ord. 4, 7	Ord. 4, 79	Ord. 16	Ord. 1a, 2, 7, 28, 44, 60, 74	Ord. 4, 16 Art. VII, IX
Westerly	Ch. 206, 260, A261	Ch. 224, 260-89, A261	A261, Temp Measure 4/3/17	Ch. 217	CH. 128, 260, A261
North Stonington	Ch. 9 Art. II	Ch. 10, Zoning 1111, LDSR	Zoning 202, 1006	Ch. 17	Zoning CH. 10 & 11, LDSR
Sterling	Code p. 24, LDSR S. 11	Code p. 97, 124, Zoning, 6.03, Ap. A, LDSR Sec. 6	Code p. 15, 124, Zoning Ap. A	Code p. 30, 75, 106, Zoning 116.14	Code p. 124, Zoning Ap. A, C, LDSR 2.6
Stonington	Zoning 6.6, 7.2, 7.8, 8	Zoning 7.6, LDSR 5.8, 7.6	Zoning 7.5	Ord. Solid Waste	Zoning 2.16
Voluntown	Zoning 3.2.2, 9.5.1, LDSR 4.3	Zoning 10.4.1, LDSR 4.4	Zoning 9.5.7	Recycling Ord. p. 21, 27, Zoning 8.3	LDSR 4.3, 8.1.2

Table 5, continued. Special Resource Protection, Wood-Pawcatuck Wild and Scenic Rivers Study

Town	Special Habitats	Open Space/ Conservation	Historic/ Cultural Resources
Charlestown	Ch. 188, 218	Ch. 11, 163, 184, 218	VO, Ch. 188, 218
Exeter	App. A Sec. 2.5.2	App. B Sect. 5	App. A Sec. 2.5.2
Hopkinton	Ch. 13.5	LT, Ch. 19.7, LDSR	Ch. 7, 13.5
North Kingstown	App. A 16.6.3	Ch. 21 Art. VII, Sec. 21-218	Ch. 21 Art. XIII, Sec. 12-5
Richmond	LDSR 13.2.3.1	Ch. 18.38, 18.41, LDSR Art. 4	Ch. 18, LDSR
South Kingstown	Ap. A Sec. 510	LDSR Art. III, V	Ch. 14 Art. 2, HOD, Ap. A Sec 600
West Greenwich	Ord. 4, 16 Art. IX	Ord. 4, 16 Art. VII, LT, Ord. 67	Ord. 4, 16 Art. VII, IX
Westerly	Sec. 260-84, A261-30	LT, Ch. 30, 260-13, 260 Art. IX	Ch. 137, 260 (-55 res), 260-57, A261
North Stonington	Zoning 1009.4, 13 J, LDSR 6.6	Ch. 16-7, Zoning 505, LDSR	Zoning 702, 1109, LDSR
Sterling	Zoning Ap. C	Zoning Ap. C, LDSR Sec. 8	Zoning Ap. B, C, LDSR S. 5
Stonington	Zoning 2.16, 8.8, LDSR 7.9	Zoning 6.6.22, LDSR Ch. 8, 10	Zoning 6.6.24, 8.8, LDSR 7.8
Voluntown	LDSR 8.1.2	LDSR 7.1, 7.3	Zoning 10.2, LDSR 4.3

Table 6. Code of Ordinances Sources, Wood-Pawcatuck Wild and Scenic Rivers Study

Town	Date	Source, Online or Other	Comments
Charlestown	1/8/2018	ecode360.com/CH1115	
Exeter	10/2/2017	library.municode.com/ri/exeter/codes/code_of_ordinances	
Hopkinton	12/21/2007	library.municode.com/ri/hopkinton/codes/code_of_ordinances	
North Kingstown	7/17/2017	library.municode.com/ri/north_kingstown/codes/code_of_ordinances	
Richmond	3/6/2018	clerkshq.com/default.ashx?clientsite=richmond-ri	
South Kingstown	2/12/2018	library.municode.com/ri/south_kingstown/codes/code_of_ordinances	
West Greenwich	undated 2016-2018	www.wgtownri.org/town-clerk/pages/ordinances	Each Ord. sep. dated doc.
Westerly	2/26/2018	ecode360.com/WE1997	
North Stonington	9/18/2017	library.municode.com/ct/north_stonington/codes/code_of_ordinances	
Sterling	8/13/2014	www.sterlingct.us/wp-content/uploads/2015/05/Ordinance-Rev-December-17-2014.pdf	
Stonington	undated on town website	www.stonington-ct.gov/special-acts-and-local-ordinances	
Voluntown	2014	NA online	

Table 7. Code of Ordinances, References and Contacts, Wood-Pawcatuck Wild and Scenic Rivers Study

Town	website	Town Clerk	Town Planner/ Planning Department
Charlestown	www.charlestownri.org	(401) 364-1200	(401) 364-1225
Exeter	www.town.exeter.ri.us	(401) 294-3891	(401) 294-2592
Hopkinton	www.hopkintonri.org	(401) 377-7777	(401) 377-7770
North Kingstown	www.northkingstown.org	(401) 268-1551	(401) 268-1572
Richmond	www.richmondri.com	(401) 539-9000 x 9	(401) 539-9000 x 6
South Kingstown	www.southkingstownri.com	(401) 789-9331 x 1236	(401) 789-9331 x 1241
West Greenwich	www.wgtownri.org	(401) 392-3800	(401) 392-3800 x 121
Westerly	westerlyri.gov	(401) 348-2508	(401) 348-2562
North Stonington	www.northstoningtonct.gov	(860) 535-2877 x 21	(860) 535-2877 x 26
Sterling	www.sterlingct.us	(860) 564-2657	(860) 564-2275
Stonington	www.stonington-ct.gov	(860) 535-5060	(860) 535-5095
Voluntown	www.voluntown.gov	(860) 376-4089	(860) 376-3867



Lower Pawcatuck River (Photo credit: Dan Hyland)

CHAPTER 5: THE NATIONAL WILD AND SCENIC RIVERS SYSTEM

The National Wild and Scenic Rivers System was established by Congress in 1968 to protect certain outstanding rivers from the harmful effects of new federal projects such as dams and hydroelectric facilities. Since then over 200 rivers or river segments have been protected nationwide, including six in New England. To be considered a “Wild and Scenic” river it must be free flowing and have at least one outstanding natural, cultural, or recreational value.

The Act, Public Law 90-542. States:

It is hereby declared to be the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations.

Benefits of Wild and Scenic Designation

A National Wild and Scenic River designation can bring a river system many benefits. Through National Park Service funding and staff support, resources could be made available to help all the partners achieve the protection of the watershed's Outstandingly Remarkable Values (ORVs) resulting in:

- Preservation of a clean and plentiful water supply, through collaborative implementation of the Stewardship Plan and Federal support for partner goals and strategies.
- Protection of the rural character that defines the local communities, through implementation of tools that protect wildlife habitats, historic sites, open space areas and other resources.
- Robust and diverse plant and animal populations that reflect a healthy ecosystem.
- Possible funding support to help towns achieve their open space conservation goals.
- Information and technical support to help town staff perform their functions, saving time and money.
- Small grants to help local schools, towns, civic groups, private land-owners and others on projects which support the purposes and goals of the plan.
- National recognition and prestige associated with a designation.
- Outreach and education opportunities that enhance an understanding of the watershed and its characteristics, celebrating the special places in local communities.
- Financial resources to help towns with certain activities that they may have had to otherwise fund on their own.
- Protection of public health through promotion of the natural functions of the river and floodplains for flood control.
- Prevention of federally permitted projects determined to be adverse to the watershed's outstanding values, through the Wild and Scenic legislation mandate that no federally permitted project be allowed to have a "direct and adverse" impact upon the ORVs.

In addition, if designation is achieved, the National Park Service is required to review and comment on all projects that are either federally funded or federally permitted to ensure such activities are consistent with the protection and enhancement of the ORVs that made the river eligible for designation.

Partnership Wild and Scenic Rivers Program

Over the past 25 years, river conservation interests at the local, state and federal levels have worked in loose collaboration to adapt the National Wild and Scenic Rivers Act into an effective, partnership-based approach to national designations. This unique approach called “Partnership Wild and Scenic Rivers” has been recognized by the National Park Service and the US Congress as a distinct and consistent application of the Wild and Scenic Rivers Act. Partnership Wild and Scenic Rivers, currently consisting of thirteen rivers in the northeast and mid-Atlantic states, are federally designated components of the National Wild and Scenic Rivers System that share the following common principles and management systems:

1. No federal ownership of lands.
2. Adjacent land use continues to be governed by local communities and state statutes (as prior to designation).
3. The River Stewardship Plan is written and implemented through a broad participatory process involving guidance from a locally-based Advisory Council, and is locally approved prior to federal designation (as a part of the feasibility study). The Plan, locally approved and endorsed by relevant state and federal authorities, forms the basis of the designation and post-designation management.
4. Administration of the designation and implementation of the Stewardship Plan is accomplished through a broadly participatory Stewardship Council convened for the rivers of the watershed specifically for this purpose.
5. The responsibilities associated with stewardship and protection of the river resources are shared among all of the partners - local, state, federal, and non-governmental, and volunteerism is a consistent backbone of success.

The Partnership Wild and Scenic Rivers program has a proven track record of effectively creating river protection strategies that bring communities together in protecting, enhancing and managing local river resources.

Designation also provides communities with special federal protection of the river. Section 7(a) of the Wild and Scenic Rivers Act describes the specific protections provided to designated rivers:

The Federal Power Commission [Federal Energy Regulatory Commission] shall not license the construction of any dam, water conduit, reservoir, powerhouse, transmission line, or other project works under

the Federal Power Act...on or directly affecting any river which is designated ...and no department or agency of the United States shall assist by loan, grant, license, or otherwise in the construction of any water resources project that would have a direct and adverse effect on the values for which such river was established...No department or agency of the United States shall recommend authorization of any water resources project that would have a direct and adverse effect on the values for which such river was established...

Designation creates a specific mandate that no federally permitted or funded “water resource development project” shall be allowed that would have a “direct and adverse” impact upon the Outstandingly Remarkable Resource Values that made the river eligible for designation. The National Park Service is charged with ensuring such federal consistency. However, overall river management continues to rely on local control and self-determination and allow existing river uses to continue.

Designation does not establish a federal park or locally undesired federal land ownership. It is important to note designation itself would only affect federally licensed or assisted water resource projects that would impact the river’s Outstandingly Remarkable Resource Values. Other types of development would continue to be regulated by local and state land use laws. Designation will not rezone private land or change property rights. Land use controls on private land are solely a matter of state and local jurisdiction. Any changes to local or state zoning regulations stimulated by the designation would only occur through existing procedures at the town or state levels. Wild and Scenic designation also does not give the federal government any authority to infringe on an individual’s privacy or property rights.

The Study Process

The story of National Wild and Scenic Rivers designation for the Wood-Pawcatuck Watershed actually began in 1980 when the National Parks Service (NPS) conducted a survey of potential rivers along the east coast to include in the national program. While the criteria at the time was not favorable for the small rivers of New England (this was before the partnership rivers model), the report did identify sections of the Wood and Pawcatuck Rivers as having several Outstandingly Remarkable Values. In particular it was noted that the Wood River had the highest biodiversity of any river in New England. Due in large part to this report, the Wood-Pawcatuck Watershed Association (WPWA) was formed in 1983 to protect the rivers of the watershed.

In 2010 WPWA formed a coalition of stakeholders in the watershed to again pursue Wild and Scenic River designation to recognize and protect five rivers of the Wood-Pawcatuck River. The group developed local, regional and state partnerships, gathered letters of support and gained votes of approval from all of the towns that would be involved in a Wild and Scenic Study. Specifically, local interest was expressed in pursuing a “Partnership Wild and Scenic River Study,” based on river management models such as the Lamprey River in New Hampshire and Farmington River in Connecticut.

A reconnaissance survey of the Wood-Pawcatuck Watershed was conducted by the Northeast Region of the NPS at the request of Representative Jim Langevin (RI-2) in 2013. The reconnaissance survey provided a preliminary assessment of the eligibility and suitability of the Wood-Pawcatuck Watershed as a candidate for a Wild and Scenic designation according to criteria established under the Wild and Scenic Rivers Act (WSRA). Preliminary findings stated “the NPS reconnaissance survey team has determined that segments of the Wood-Pawcatuck Rivers exhibit free-flowing character and noteworthy natural, cultural and recreational resource values likely to meet eligibility criteria for inclusion in the National Wild and Scenic Rivers System. In addition, the presence of very strong community and interest group support for a Wild and Scenic River Study, together with a demonstrated track record of natural and cultural resource protection, support key elements of suitability for inclusion in the System, and provide a strong indication that a Wild and Scenic River Study would be appropriate and productive. ”

The Wood-Pawcatuck Watershed Protection Bill (Study Bill) was introduced in the House of Representatives during the 112th Congress. The Study Bill passed the House but failed to make its way through the complete legislative process. The Study Bill was re-filed in February, 2013 where it again easily passed the House. Senate approval was obtained in late 2014. The Study Bill amends the Wild and Scenic Rivers Act to designate segments of the Beaver, Chipuxet, Queen, Wood, and Pawcatuck Rivers for study for potential inclusion in the National Wild and Scenic Rivers System.

NPS developed a cooperative agreement with WPWA to coordinate the study in 2015. WPWA solicited representatives from each of the twelve towns in the watershed to serve on the Wood-Pawcatuck Wild and Scenic Rivers Study Committee: Charlestown, Exeter, Hopkinton, North Kingstown, Richmond, South Kingstown, Westerly and West Greenwich in RI; North Stonington, Sterling, Stonington and Voluntown in CT. Also included were the two state environmental agencies, Rhode Island Department of Environmental Man-

agement and Connecticut Department of Energy and Environmental Protection; and three key environmental nonprofits organizations, Save the Bay, The Nature Conservancy, and Audubon Society of Rhode Island. NPS provided staff support and overall coordination.

The Study Committee elected to add two more rivers from Connecticut – the Shu-nock and Green Fall Rivers. They established that all seven rivers meet eligibility under the WSRA and identified several outstandingly remarkable values for each river and the watershed as a whole. The committee developed a stewardship plan that demonstrated ongoing policies and activities that protect the rivers' values. The plan also suggests ways to improve protection to assure the rivers' values will be around for future generations.

The Study Committee also coordinated outreach to the local communities. In June 2018 all twelve towns and both states passed a resolution supporting the designation of the Wild and Scenic Rivers and adopting the Stewardship Plan. A new bill was introduced in September 2018.



Upper Wood River (Photo credit: Denise Poyer)



Pawcatuck River at Avondale (Photo credit: Rebecca Woodward)

CHAPTER 6: ACTION STRATEGIES FOR THE FUTURE

At their September 2017 meeting the Study Committee voted that, based on their determination of regionally and nationally significant values of the rivers, and based on the support of watershed towns, that the committee will pursue Wild and Scenic Rivers designation for the seven rivers in the Wood-Pawcatuck Watershed.

Chapter 5 contains information about the many excellent regulations already in place from the twelve municipalities, as well as Rhode Island and Connecticut state regulations, for each of the Outstandingly Remarkable Values (ORVs). This chapter provides suggested actions which are **voluntary measures** that individual towns, states, federal or non-profit agencies may wish to institute on their own or in conjunction with the Wood-Pawcatuck Watershed Association and the Wild and Scenic Rivers Stewardship Council. Many of these suggested actions are already described in current town, state, and federal regulations, as described in the previous chapter.

Not included in the Mason and Associates' report is a discussion of water quality monitoring in both CT and RI. Key points from the Rhode Island Water Quality Management Plan apply to both states:

- Water quality monitoring is essential for effective water resources management.

- The capacity of the State and its partners to sustain important monitoring programs is an on-going concern.
- Stewardship of aquatic habitats requires monitoring to characterize the ecological health and functioning of the targeted habitat.
- Climate change reinforces the need for monitoring hydrology and habitats that are most vulnerable to its impacts.

In the Wood-Pawcatuck Watershed water quality monitoring is conducted by Rhode Island Department of Environmental Management (RI DEM) through their state monitoring programs (see Part 4, Water Quality Monitoring and Assessment, Water Quality 2035 Rhode Island Water Quality Management Plan), Connecticut Department of Energy and Environmental Protection (CT DEEP) (see CT DEEP Ambient Water Quality Monitoring Program Strategy 2015 - 2024), and the University of Rhode Island Cooperative Extension Watershed Watch Program. Several towns, along with WPWA and the North Stonington Citizen Land Alliance, work with the Watershed Watch program to provide funding and monitoring volunteers. There is also limited monitoring conducted by the US Environmental Protection Agency at a very broad scale usually on a rotating basis.

To monitor threats and assess restoration projects it will be essential to support and expand water quality monitoring at all levels in the watershed.

Identifying Threats

On July 26, 2017 a Rhode Island Stewardship Summit was attended by staff from RI DEM, Rhode Island Department of Administrations Division of Planning, Grow Smart RI, University of Rhode Island (URI) Department of Natural Resources Science, South Kingstown Planning Department, Hopkinton Planning Department, The Nature Conservancy, Save the Bay, National Parks Service (NPS), and several Wood-Pawcatuck Wild and Scenic Rivers Study Committee members. On October 12, 2017 a Connecticut Stewardship Summit was held attended by CT DEEP, Eight-mile River Wild and Scenic Coordinating Council, NPS, and several Wood-Pawcatuck Wild and Scenic Rivers Study Committee members. The participants in these summits helped to identify the following threats to the watershed:

- *Climate change*

Among the negative impacts of climate change, there has been an increase of severe storms, particularly in the northeast region of the country. These storms have resulted in more flooding in low-lying areas along the Wood and

Pawcatuck Rivers. Climate change is also causing increasingly hotter and dryer summers, resulting in drought conditions, warmer streams, and low stream flow.

- *Development including:*

- ◇ Unplanned residential growth and suburban sprawl from nearby urban regions.
- ◇ Improper siting of large commercial installations, such as large solar panel installations on low density zoned areas.
- ◇ Excessive runoff during storms due to impervious surfaces.

Residential development results in increased impervious surfaces, primarily by creating more roads. Impervious surfaces contribute to stormwater runoff into streams, rivers and ponds, which decreases water quality and increases stream temperatures. Residential developments can increase sediments in adjacent rivers, which adversely affects aquatic life. It can also contribute to groundwater contamination of the sole source aquifer. In addition, residential development adds the need for wastewater treatment, either as individual septic systems or large scale treatment plants. While development is a necessary part of any community, steps need to be taken to insure that housing developments have minimal impact on the ORVs of the rivers.

- *Point-Source Pollution*

There are several points of direct discharge into the twelve rivers, including two sewage treatment plants and one industrial plant on the Pawcatuck River. Improper agriculture practices can contribute discharges of herbicides and nutrients that can harm the streams and rivers.

- *Habitat fragmentation*

Habitat fragmentation occurs when large blocks of contiguous habitats are subdivided into smaller, isolated parcels. In suburban landscapes such as the Wood-Pawcatuck Watershed, this is caused primarily by building roads and housing developments. These barriers in the landscape make it difficult or impossible for many native species that need to disperse across the landscape to breed, such as turtles and frogs, to travel between habitats that provide for critical parts of their annual cycle. Increased fragmentation can lead to major reductions in the diversity of flora and fauna in a region, particularly native species that require contiguous habitats.

- *Invasive species*
Invasive species can be detrimental to the native flora and fauna of the Wood-Pawcatuck Watershed. Invasive species are non-native plants or animals that negatively impact native species. They originate from other regions of North America or from other continents. Lacking natural predators that control their populations, they can invade habitats and extirpate native plants and animals. Invasive species are often introduced inadvertently by people who live or recreate in the watershed.
- *Limited resources for protected lands*
One way to protect lands is to purchase them for conservation. Many organizations can be involved in this process including local land trusts, town municipal land trusts, state and federal agencies and private non-profit organizations. However, these agencies and groups often have limited funds for both the purchase of lands and management of the lands after purchase.

These threats present key management challenges to protecting the ORVs of the rivers and their corridors. Strategies to protect the ORVs can be found in the following plans:

- Rhode Island State Wildlife Action Plan
- Connecticut State Wildlife Action Plan
- Rhode Island Water Quality 2035
- Wood-Pawcatuck Watershed Flood Resiliency Management Plan
- Connecticut Green Plan
- Pawcatuck River Bacteria TMDL
- Connecticut Bacteria TMDL Shunock River

Geology and Hydrology

Geology - The geologic features of the Wood-Pawcatuck Watershed are not currently under threat.

- The Charlestown Moraine is such a large feature that other than land conservation there are no suggestions for special protection at this time. The Champlin Park in Westerly covers a small section of the moraine and allows hikers to see some of the key geological features, such as kames and kettle ponds. This park includes educational signage and explanations regarding the features of the moraine.

- Green Fall Rift Valley is contained almost entirely within the Pachaug State forest.
- Dead Swamp is protected by a conservation easement held by the town of West Greenwich.

Hydrology - There are a number of threats to the hydrology of the Wood-Pawcatuck Watershed. Hydrology is the science that studies the distribution, movements, and quality of water in the watershed.

1. Development – More housing developments in the twelve rural towns in the Wood-Pawcatuck Watershed will lead to more runoff into the rivers, which will cause water quality degradation, erosion, and loss of habitat.
2. Flooding – All seven rivers within the Wood-Pawcatuck Watershed have experienced flood events over the past decade, especially in areas with residential and commercial developments within the floodplain of each of the rivers. Increased flooding is due to:
 - a. Buildings located on natural flood plains.
 - b. Channelization, or straightening, of the rivers.
 - c. Improperly functioning dams and other structures such as road culverts.
 - d. Increases in impervious surface that lead to increased water velocity and increased runoff into the rivers.
3. Water withdrawals – There are increasing ground water withdrawals for municipal wells and surface water withdrawals for irrigation. These can cause extreme low flow for small tributaries when there are low rain years, impacting the habitat value of the streams.
4. Climate change – The changing climate causes more frequent storms with larger amounts of rainfall, as well as longer dry periods without measureable precipitation. These changes in precipitation can both increase the timing and severity of flooding, and also decrease stream flow. One of the biggest direct threats of climate change is that stream temperatures may be warming over time. Warm water, especially during low flow months in the summer, can reduce or eliminate appropriate habitat for many macroinvertebrates and wild brook trout.

Hydrology Action Plan

A. Preserve and protect water quality and quantity.

1. **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 sites. Collect stream flow and water quality data as needed to support the protection of these resources.
2. **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.
3. **Address impaired waters** – Impaired waters are those that are impacted by pollution from stormwater runoff, development, and other human processes. Most of these impairments entail excess bacteria or nutrients. Support approved plans by both state and federal agencies for impaired sections of rivers in the designated reaches. This usually entails better management of stormwater runoff.
4. **Protect riparian buffers** – Riparian buffers protect water quality as well as provide habitat and scenic value. State regulations in RI require at least one hundred feet of vegetated buffers on either side of rivers. In CT, DEEP Fisheries Division promotes hundred foot set back. Encourage protection of these buffers and establish replanting programs where feasible.
5. **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. CT Stream Flow Standards and Regulations use approved classifications to protect streams in the watershed. RI uses regulations developed for the Freshwater Wetlands Act.
6. **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.
7. **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. Also, promote the use of other green infrastruc-

ture techniques, such as vegetated roofs and walls in the built environment, to better manage runoff in the watersheds.

8. **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.
9. **Improve water quality** - Use low-impact development techniques to pre-treat runoff prior to discharging to any tributaries.
10. **Practice bioretention** – Bioretention 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. 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.
11. **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.
12. **Follow best practices for road salt and sand** - Work with local municipal Departments of Public Works (DPW), highway departments, and the Connecticut and Rhode Island Departments of Transportation to promote best management practices that minimize road salt and sand runoff to wetlands, streams, and rivers. Research alternatives to road salt, and encourage towns to use them.
13. **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 reduce runoff on their property, minimize impervious surfaces and minimize pesticide and fertilizer use. Often this can be accomplished by maintaining an appropriate buffer between the treated land and the waterway.
14. **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.
15. **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.

- 16. Identify threats from septic systems** - Partner with towns to identify 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.

B. Preserve and protect important high- and medium-yield aquifers.

- 1. Promote aquifer protection** - Promote extended aquifer protection through land use regulations, acquisitions, and landowner stewardship.
- 2. Conserve water** - Actively promote water conservation. Encourage communities to consider mandatory conservation measures to augment volunteer efforts during droughts. Develop homeowner incentives to conserve water.
- 3. 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 and Connecticut Drought Management Plan)
- 4. 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.

C. Develop flood resiliency

- 1. Protect floodplains and wetlands** - Maintain the ability of floodplains and wetlands to efficiently absorb water and protect the river from runoff-related pollution. Assess floodplain and wetland mapping for the corridors and determine ways to improve it, coordinating with state and federal agencies. Work with town boards to inform them of the importance of floodplains for flood-

water storage and to encourage protection of floodplains and wetlands when considering development proposals.

- 2. Mitigate Flooding** – In 2017 the Wood-Pawcatuck Watershed Association produced a Flood Resiliency Management Plan (FRMP) for the Wood-Pawcatuck Watershed (wpwa.org/flood_resiliency.html). This comprehensive document examines all the factors contributing to flooding the watershed and makes specific recommendations to alleviate or mitigate those factors. In general the recommendations are:
- a. Remove, replace, or repair in-stream structures such as culverts, bridges and dams that contribute to flooding.
 - b. Conserve and restore flood plains, river corridors, and wetlands in a natural condition.
 - c. Reduce runoff volumes, flooding, and water quality impacts through improved stormwater management and the use of green stormwater infrastructure.
 - d. Improve stream meanders. Fluvial geomorphic assessments done on the Wood and Pawcatuck Rivers indicate that many areas have been straightened or channelized. This upsets the rivers' natural tendency to meander and evolve a channel form that is in equilibrium, or at balance, with the water and sediment inputs of their watersheds.

Information concerning all these potential projects, including a prioritized list of structures and potential funding sources, can be found in the FRMP. An example of a small project that could be done at a town level is to replace road culverts with box culverts that are open at the bottom. This can be done when the town is ready repair or resurface the road. Some funding may be obtained through state emergency management projects to reduce flooding. An example of a large project which the Stewardship Committee may want to implement would be to restore natural stream meanders in the Pawcatuck River, below the Bradford fish structure.

For the purposes of this Stewardship Plan, the recommendation is to have the Stewardship Committee work with the towns, states, and federal agencies to implement as many of the projects recommended in the FRMP as possible. The advantage of many of these projects is that by reducing flooding issues they also tend to improve water quality and increase habitat values. Therefore many of these projects can also be used to protect and improve other ORVs.

Ecosystems

The Wood-Pawcatuck Watershed is currently seventy-five percent undeveloped. While the exact amount differs between the rivers, all of them benefit from low levels of development and consequently low amounts of impervious surface. Studies have shown that streams in watersheds with less than ten percent impervious surface have good to excellent water quality and more stable stream banks. The 2016 CT Integrated Water Resources Management program address stream protection and restoration. The major threats to ecosystems in the watershed are similar to those for hydrology:

1. Development
2. Climate change

Ecosystem Action Plan

A. Preserve and protect habitat.

1. **Purchase properties and conservation easements** to directly protect land by permanently prohibiting clearing forests and building structures in or near the rivers. Work with local land trusts, non-government agencies, and state agencies to identify and develop a priority list of important habitat parcels.
2. **Protect habitats and corridors** identified as high priority by the Rhode Island and Connecticut Natural Heritage Programs and the State Wildlife Action Plans.
3. **Protect riparian zones** - Work with the states, local communities and land-owners to protect riparian zones from unnecessary clearing and land alteration.
4. **Protect vegetative buffers** - Ensure that appropriate buffers are maintained to help lower water temperatures.
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 state Departments of Transportation as appropriate.
6. **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.
7. **Carefully site any new trails and river accesses** to make sure they do not encroach into sensitive core habitats.

8. **Protect land corridors** - Focus on creating land protection corridors, dispersal and migratory wildlife routes through which terrestrial and aquatic flora and fauna will be able to move and adapt, as climate disturbance increasingly impacts biological processes and drives species north.
9. **Carefully site new alternative energy installations** – Limit large installations to already impacted areas in the towns. Encourage updated best management practices when located in a river buffer. Develop new town ordinances to properly site installations so that they protect watersheds and forests areas.
10. **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 providing funding to budget-strapped local land trusts whose lack of capacity makes it difficult to do the required annual monitoring of all CEs.
11. **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.
12. **Reduce light pollution** – Unnecessary ambient lighting can have negative effects on wildlife behavior. This is particularly important along river corridors where wildlife concentrates. The watershed has been identified as part of the last remaining dark sky region in southern New England by The Nature Conservancy. Many towns already have “dark sky” ordinances which other towns could consider adopting. Dark sky ordinances are consistent with the NPS program to protect “night skies as a natural resource,” www.nps.gov/subjects/night skies/natural.htm.

B. Protect and enhance coldwater fisheries resources.

1. **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.

2. **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.
3. **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).
4. **Preserve canopies** - Preserve forest canopies over coldwater fisheries resources to ensure streams remain shaded.
5. **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.
6. **Maintain riverbanks** - Conduct stream assessments to identify and repair man-made bank disturbances and/or erosion impacting natural structure and reducing riparian vegetative cover.
7. **Address data gaps** - Support the Connecticut and Rhode Island State Wildlife Action Plan and the Connecticut DEEP and Rhode Island DEM coldwater fishery programs to address data gaps in brook trout population and status.

C. Protect and Enhance Anadromous Fisheries.

1. **Support fish passage projects** on the all the designated rivers. These include constructing structures such as fish ladders and nature-like rock ramps.
2. **Consider removal of unused dams** – This process should involve the communities to ensure that important functions of the dams are taken into account.

D. Minimize the Effect of Non-Native Invasive Species.

1. **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.
2. **Raise awareness about invasives** - 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 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.

3. **Monitor invasive aquatic weeds** - Where feasible as time and funding permit, conduct baseline mapping of aquatic invasive weeds along the rivers using Rhode Island and Connecticut state guidelines. Additionally, those areas previously mapped should be periodically revisited to determine if any invasive plant growth has occurred.
4. **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. **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.

E. Educate the public about river ecology and ways to keep rivers healthy.

1. **River signage** – have the name of each river posted at every bridge crossing. Include the words “A Wild and Scenic River”.
2. **Engage town and state agencies** - Work with town DPW road crews and Rhode Island and Connecticut Department of Transportation agencies who could help alert the public to the significance of Wild and Scenic Rivers.
3. **Raise awareness through events** - Sponsor local events to raise public understanding about native wildlife and the impacts of development patterns on habitat and ecosystem integrity. For example, provide Wild and Scenic River outreach information at community events, fairs, festivals, canoe races, fishing events, and other public gatherings.
4. **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. **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.
6. **Pursue education opportunities** - Pursue opportunities to educate landowners, developers, and local land use boards about the causes of non-

point-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.

7. **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.
8. **Teach watershed science to teachers** - conduct courses for teachers in the use of the AWESome (ACTIVE WATERSHED EDUCATION) Curriculum.
9. **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.
10. **Promote stewardship** - Encourage the public to speak out on issues and to participate in the stewardship of the proposed designated area.
11. **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.

Cultural

Rivers are the life blood of the communities in the Wood-Pawcatuck Watershed. It is important to note that the Wild and Scenic Rivers designation is as much about celebrating the communities’ ties to the rivers as it is about the rivers themselves. From pre-European times to today, residents and visitors in the watershed have shared an emotional and spiritual as well as practical connection to the rivers.

There are many examples of indigenous archeological sites throughout the watershed, particularly along the Wood, Pawcatuck and Green Fall Rivers. Extensive Native American ceremonial stonework can be seen throughout the river region, including Manitou hassunash, and hassuneutunk, the walls and serpent effigy of the Narragansett Indians. Landmarks in the watershed contain many names from the Narragansetts and Mashantucket Pequots, such as the Usquepaugh River.

Many watershed towns have villages named after the mills that were instrumental in their establishment. Remnants of these early mills are found throughout the

rivers today. Agriculture remains an important aspect of the watershed. The prime agricultural soils in the large floodplains along the banks of all seven rivers were historically significant to the founding of the first colonial towns and are still heavily utilized to this day.

Cultural Action Plan

A. Preserve and protect cultural resources

- 1. Study our historical relationship with the rivers** - Encourage the Stewardship Council to work with representatives of the Narragansett and Pequot tribes to share information on their relationship with the rivers. Also work with historical societies, as well as other entities as appropriate, to undertake further research into the historical relationship between the adjacent communities and the rivers.
- 2. Emphasize our connection with the rivers** - Develop materials and public programming to highlight the connection between the communities and the rivers and to foster increased appreciation.
- 3. Consider economic benefits of historical-cultural focused tourism** - Consider doing an "economic benefits" analysis of historical-cultural focused tourism in the subject region, possibly in cooperation with Freedoms Way Heritage Association and regional planning commissions or others.
- 4. Consider maintenance and restoration of sites** - Consider maintenance and restoration of historical and cultural sites.
- 5. Protect historical and cultural character** - Raise awareness so that new development along the river corridors is compatible with the historical and cultural character of the surroundings and fully reflects the need to protect those amenities, including mill redevelopment.
- 6. Protect traditional landscapes** - Protect traditional New England visual resources and landscape patterns typified by colonial mills along rivers. Support resource-based economic activities or "working landscapes" including sustainable farming, forestry, and ecotourism, in any way possible.
- 7. Nominate historic sites** - Develop documentation leading to the nomination of historic sites as National Historic Landmarks, or for other state or local recognition.
- 8. Protect prehistoric resources** – Work with the Narragansett and Mashantucket Pequot tribes to investigate and protect all major prehistoric resources.
- 9. Consider interpretive signage** - Pursue suggestions in regards to interpretive signage of prehistoric and historic resources.

10. **Develop compatibly** - For any new development along the river corridors that towns have accepted, encourage compatibility with existing historic development.
11. **Address structural needs of dams** – Pursue opportunities for comment and input on structural issues surrounding dams.

B. Preserve and protect agriculture

1. **Preserve agricultural soil** - Protect prime agricultural soils in the large floodplains along the banks of the rivers, which were historically significant to the founding of the first colonial towns and are still utilized to this day.
2. **Preserve working farms** – Provide viable alternatives to farmers to keep their land in agricultural use. Payments for conservation easements on farmland encourage the continued use of agricultural practices while providing some much needed funding for the farmer.
3. **Encourage farming best management practices** – Provide educational opportunities and economic incentives to farmers to learn about and follow best management practices.
4. **Support alternative incomes for farming** such as farm stands, farmers markets, and events.
5. **Encourage a new generation of farmers** – Provide better access to information about grant programs, assistance and business development.
6. **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 livestock farms for planning and designing best management practices that protect the soil, air and water, increase soil 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.

Scenic and Recreation

The Wood-Pawcatuck Watershed lies within an easy drive between the greater Boston metropolis region (population 4.7 million) and New York metropolis region (population 8.5 million). In Rhode Island alone, the watershed is an hour or less drive for over 1 million residents. Because the watershed is seventy percent forested, it creates a green oasis for urban dwellers to unwind and reconnect with nature. This makes the river-related recreational pursuits greatly valued throughout southern New England.

Scenic and Recreation Action Plan

A. Ensure healthy ecosystems to support recreational fisheries.

- 1. Protect riparian land** - Keep riparian forests contiguous, so that their shade helps keep water temperature cool, allowing the water to hold more dissolved oxygen than warm water. 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. Promote education and awareness, and changing of local subdivision and development codes.
- 2. 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.
- 3. Support native fish** - Work with local, state and federal partners to keep healthy populations of native brook trout and other native sport fish for recreational fishing.
- 4. Support fish passage at dams** – Work with town, state, and federal agencies to identify appropriate projects that promote fish passage as well as working for the local communities.
- 5. Balance multiple uses** - Promote dialogue regarding balancing multiple uses and avoidance of over-use resulting from increased public exposure on all the rivers in order to reduce potential conflicts. Continue to work with RI DEM, CT DEEP, and the Trail Advisory Committee and CT Greenways Council.
- 6. Promote responsible angling** - Educate and encourage anglers about proper disposal of lures, weights and other fishing equipment including monofilament line.

B. Provide and maintain public boating access.

1. **Maintain existing access for boaters** - Maintain and, where possible, improve the current appropriate public access sites for boaters. This includes access points just for canoes and kayaks, as well as trailer launches for motor boats where appropriate.
2. **Support new access points** - Support creation of additional appropriate public access sites for canoe and kayak users, as well as trailer launches for motor boats where appropriate.
3. **Support handicapped access** - Support development of appropriate handicapped accessible sites.
4. **Consider boat access as part of road projects** - Consider requiring provision for appropriate public access when bridges or culverts (especially on state roads) are upgraded.
5. **Support water-based recreation planning** - Encourage the planning of water-based recreational opportunities. Encourage “blue trails” (waterway trails) and their canoe access sites, in connection with the Rhode Island Blueways Alliance and the Appalachian Mount Club chapters in Connecticut and Rhode Island.
6. **Improve parking and signage** - Encourage adequate parking and signage at existing and new sites. Work with state agencies and local communities to provide bathroom facilities at select public launches.
7. **Improve boating passage** - Improve rivers for safe boating passage by having regular maintenance to remove obstructions such as large woody material while maintaining habitat quality.
8. **Maintain stream flows** – Maintain or modify stream flows to maintain or enhance recreational and scenic qualities, while accommodating demands for water supply, waste assimilation, commercial, industrial, and agricultural uses.
9. **Encourage clean boating** - Educate boaters to make sure boat hulls are clean before putting in as a way to limit the spread of aquatic invasive “hitchhikers”.
10. **Publicize paddle guides** - Publicize the Wood and Pawcatuck River Routes Guide to encourage boaters to select trips compatible with their skill level. Update as appropriate. Consider developing a smartphone app of this guide, which could eventually include other rivers in the watershed.
11. **Work with paddling groups** - Coordinate with regional paddling groups such as the Narragansett Chapter of the Appalachian Mountain Club (AMC), Rhode Island Canoe and Kayak Association, Southern New England Paddlers,

and local land trust groups, which organize numerous trips on rivers in the Wood-Pawcatuck Watershed.

C. Provide opportunities for hikers and walkers along the rivers.

1. **Practice trail stewardship** - Increase monitoring and maintenance of trails and river access areas. Minimize littering, parking problems, all-terrain vehicle abuses, vandalism, and trespassing on adjacent private lands. Encourage "Adopt-a-Trail"-style projects.
2. **Work with volunteer groups** - Maintain access to existing trails and provide information for trail users via coordination with local trail committees.
3. **Teach multi-use principles** - Help users of the various hiking trails learn how to safely navigate multiple types of concurrent use, for example horses, pedestrians, and cyclists simultaneously using the trails. Help users identify trails appropriate to their form of recreation.
4. **Publish trail guides** – Consider developing riverside trail guide books or maps, both print and online, to encourage use of hiking trails in the watershed and assist in exploration of such trails.
5. **Support regional trail groups** - Encourage the work of regional trail groups such as AMC Narragansett Chapter.
6. **Encourage universal accessibility** - Encourage Americans with Disabilities Act accessible trails and wildlife viewing areas where feasible.

D. Inform the public and be informed.

1. **Publicize the Wild and Scenic River program** - Provide Wild and Scenic River program information at community events, fairs, canoe races, fishing events and other public gatherings.
2. **Host a Wild and Scenic River event** - Consider developing a signature event, which would annually help further inform the public on the value of the rivers, their outstanding resources, the value of their designation as Wild and Scenic Rivers, and opportunities to engage in stewardship activities.
3. **Formalize pet policies** - Clarify appropriate recreational areas for dog owners. Reinforce or create pet waste ordinances (pooper-scooper laws) and restrictions on illegal dumping, or otherwise secure and maintain pet waste disposal containers.
4. **Engage public in nature-focused wildlife viewing and events** - Encourage continued public support and participation in a variety of active and passive learning programs involving the rivers.
5. **Be responsive to an existing and evolving variety of recreational interests** - Track new types of recreational activities and equipment that are

not foreseen today, to make sure they are compatible with managing and protecting our rivers' ORVs. For example, a decade ago the emergence of drone aircraft was not foreseen, but is a consideration today.

6. **Study economic benefits of recreation** - Consider analyzing the economic benefits of recreation in the proposed designated area, possibly in partnership with state and local tourism bureaus.

E. Recognize the importance of views from the rivers and help preserve them.

1. **Protect viewshed** - Encourage protection of traditional New England landscape patterns and scenic visual resources. This may include, for example, concerns regarding steep slopes, building heights, and outdoor lighting. Protect traditional New England landscape patterns and visual resources by supporting resource-based economic activities—"working landscapes"—including sustainable farming, forestry, and ecotourism.
2. **Assess exceptional views** - Consider conducting a formal scenic assessment of exceptional views (such as National Park Service's "Visual Resource Inventory") to identify resources in need of protection that also include views from on the rivers toward undeveloped shoreline banks. The forested corridor or greenway is a much appreciated aesthetic resource.
3. **Consider aesthetics in management plans** - Pay special attention to aesthetics, in addition to forest health, when first drafting Forest Management Plans along the rivers. The natural, "wild" appearance of open space is a key component of the special enjoyment the public derives on these rivers.
4. **Consider adopting scenic river provisions** - Protect the scenic and environmental integrity of the river by requiring structures to be integrated into the existing landscape to minimize its scenic and environmental impact.



Painted turtle in the Wood River (Photo credit: Thomas Tetzner)

CHAPTER 7: WORKING TOGETHER INTO THE FUTURE: Role of the Wood-Pawcatuck Wild and Scenic Rivers Stewardship Council

Wood-Pawcatuck Wild and Scenic Rivers Stewardship Council (WPWSRSC)

PURPOSE OF COUNCIL

- To provide a forum to prioritize, discuss, and resolve river and watershed issues across town and state lines.
- To implement the Wood-Pawcatuck Wild and Scenic Rivers Stewardship Plan and to periodically update the Plan.
- Coordinate with other stakeholders on implementation of Plan goals and actions.

MEMBERSHIP

Municipal members will be comprised of representatives from the twelve towns within the watershed.

Charlestown	Exeter	Hopkinton	North Kingstown
North Stonington	Richmond	South Kingstown	Sterling
Stonington	Voluntown	West Greenwich	Westerly

The Council is structured to allow one representative appointed by each town's legislative body. One alternate may also be appointed at the discretion of the town. Terms of appointment will be for two years, or as determined is necessary.

NOTE: The towns of Coventry and East Greenwich are also a part of the Wood-Pawcatuck Watershed, though were not participants in the Wild and Scenic Study Committee. Both towns should be offered membership on the Stewardship Council upon consideration and adoption of the Stewardship Plan by their town's legislative bodies.

Agency members –The CT DEEP and RI DEM will be asked to appoint a representative to provide support and assistance to the Stewardship Council. Alternates may be appointed at the discretion of the agencies' directors. The National Park Service will continue to provide guidance and support to the Council.

Other members - Non-profit conservation organizations – Wood-Pawcatuck Watershed Association, Save The Bay, The Nature Conservancy, Audubon Society of Rhode Island, Rhode Island Land Trust Council and Connecticut Land Conservation Council will be invited to appoint one representative each to serve on the Council. The Council may also decide to add other members from organizations that may help implement the Stewardship Plan.

Non-voting members such as the local land trust and conservation commissions may be invited to attend meetings or to serve on subcommittees.

STRUCTURE

The Council will develop their own by-laws to articulate the details of how they will function. The following is based on the structure of the Study Committee and can be used to assist the establishment of the Council.

Officers - The Council may elect officers, such as Chairperson, Vice Chairperson, Secretary, and Treasurer, from its town appointed members. Terms of appointment will be for two years, or as determined is necessary.

Meetings - Meetings shall be open to the public. In order to have a quorum, at least half of the towns (six, at this time) must have at least one representative present. The meetings will be conducted under Robert's Rules of Order. The Council shall maintain minutes and agendas in standard formats in a publicly accessible location.

Subcommittees - The Council may form subcommittees as needed. People who are not currently on the Council may be asked to serve on the subcommittees.

Other Council Activities - The Council will set its own budget, hire its own contractors, and approve dispersal of funds as appropriate.

VOTING

Each organizational member of the committee shall have one vote, including municipal and non-municipal members. To the extent that it is possible the Council will be encouraged to come to consensus on all issues.

FREQUENCY OF MEETINGS

The Council will meet at least bimonthly, or as often as it deems appropriate.

PLAN UPDATES

The Council shall formally revise the Stewardship Plan at least once every ten (10) years. A less formal update should occur no more than five (5) years from the date of the latest revision.

FUNDING/STAFF

When the rivers receive Wild and Scenic River designation then the National Park Service (NPS) will provide funding through the Partnership Wild and Scenic Rivers Program, subject to congressional appropriations. In addition to providing staff

support and/or direct financial assistance the NPS may provide technical planning and river conservation assistance to the Council if requested and if sufficient appropriations are available. WPWSRSC is encouraged to leverage any potential federal funding provided to maximize the impact of such funds. WPWSRSC may wish to pursue financial assistance and/or in-kind contributions from individuals, foundations, corporations, and government (federal, state, and/or local).

Cooperative Agreements are formal written agreements between NPS and a local partner to create the ability to distribute federal funding or other federal assistance for supporting the implementation of the Wood-Pawcatuck Wild and Scenic Rivers Stewardship Plan pursuant to Sec. 10(e) and/or Sec. 11(b)(1) of the Wild and Scenic Rivers Act. A local partner will be chosen from among the membership of the Stewardship Council to act as the fiscal agent for WPWSRSC and NPS. This will likely be the Wood-Pawcatuck Watershed Association (WPWA) which is consistent with the conduct of the Study. Decisions on how funds are allocated, if they become available, remain with WPWSRSC in consultation with NPS.

It is anticipated that with the funding from NPS, WPWA will provide a Rivers Coordinator to serve the Stewardship Council, help implement stewardship projects, and conduct education and outreach. The Coordinator may be WPWA staff or an independent contractor. The Coordinator may NOT be the WPWA Executive Director, or one of its Board of Directors. The Coordinator's salary will be paid through the NPS funding. The Coordinator will answer to the Council. Hours and expenses for the Coordinator will be approved by the Council Chairperson.

wpwilddrivers.org



Chipuxet River at Rt. 138 in South Kingstown, RI (Photo credit: Elise Torello)