Pootatuck River
Watershed Management Plan
DRAFT - January 2024

Prepared by
Housatonic Valley Association
On behalf of the Pootatuck River Partnership

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List of Acronyms

BMP	Best Management Practices
CWA	Clean Water Act
CWS	Community Water System
CT DEEP	Connecticut Department of Energy and Environmental Protection
CT DPH	Connecticut Department of Public Health
CT DOT	Connecticut Department of Transportation
EPA	United States Environmental Protection Agency
ECR	Existing Conditions Report
GHG	Green House Gases
GIS	Geographic Information System
HVA	Housatonic Valley Association
IC	Impervious Cover
IWQR	Integrated Water Quality Report
MS4	Municipal Separate Storm Sewer System
NAACC	North American Aquatic Connectivity Collaborative
NGO	Non-Governmental Organizations
NPS	Non-point Source Pollution
NRCS	USDA Natural Resources Conservation Service
PRP	Pootatuck River Partners
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USGS	United States Geologic Survey
WQS	Water Quality Standards

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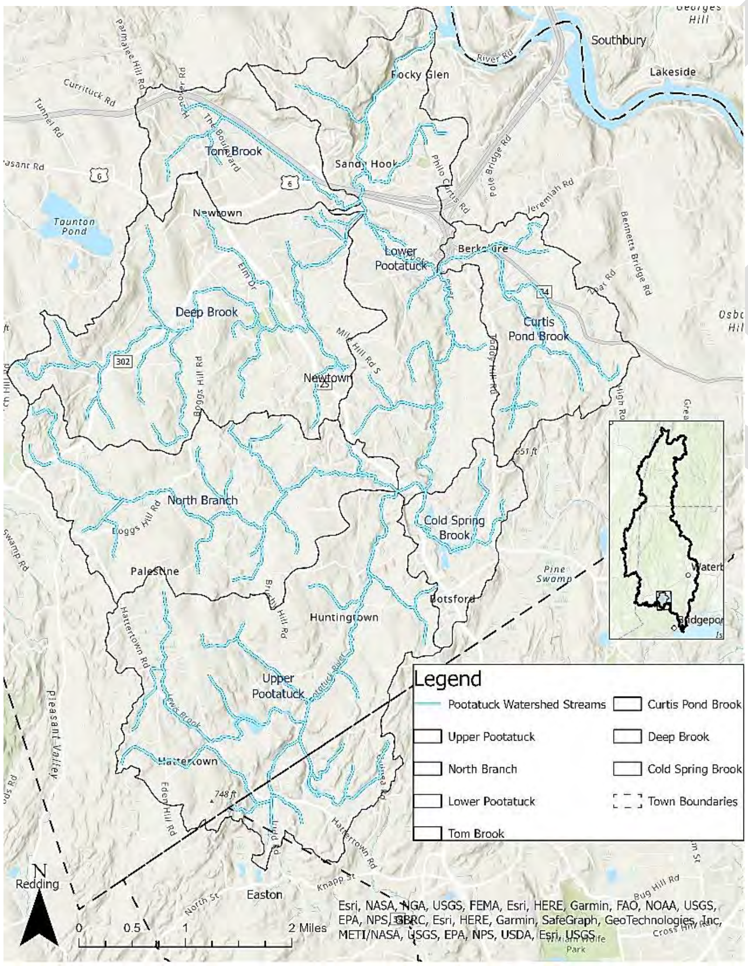
I. INTRODUCTION

1.1 Background

The Pootatuck River Watershed (PRW) is located in Fairfield County, Connecticut. Most of the basin drains the Town of Newtown while leaner parts of the PRW drain the Towns of Monroe and to a smaller extent Easton.[1] The mainstem of the Pootatuck River is confluent with its major tributaries—Deep Brook, Tom Brook, Curtis Pond Brook, North Branch Pootatuck, and Cold Spring Brook.The waters of the Pootatuck flow northward and join the Housatonic River in Sandy Hook, ultimately reaching Long Island Sound[2] (See Map 1).



Map 1. The Pootatuck Watershed

While there have been improvements in Pootatuck River water quality since the 1972 Clean Water Act[3], the PRW still faces ongoing challenges, primarily from non-point source pollution and the effects of climate change. All non-point sources of pollution are caused by runoff of precipitation (rain, snow or hail) flowing over or through the ground that picks up and carries pollutants directly into nearby waterbodies. This includes but is not limited to stormwater associated with development and industrial activity, construction-related runoff, and discharges from municipal separate storm sewer systems (MS4s). Polluted stormwater runoff from commercial and residential development, agriculture and roads introduce harmful substances such as pathogens, excess nutrients, heavy metals, temperature changes, trash and sediment into the Pootatuck and its tributaries. Other non-point sources (NPS) of pollution in the PRW include failing septic systems, illicit discharges to the storm sewer system and winter road maintenance. Additionally, climate change has brought extreme weather events, including more and stronger storms, more frequent drought and overall elevated ambient air temperatures, which exacerbate NPS pollution and increase the risk to public health, property, infrastructure and the environment.

To tackle these complicated problems, the Pootatuck River Partners (PRP) came together in 2020. This group includes local government, state and regional agencies, and non-profit conservation groups. The PRP evolved out of the work of several local partners to restore and protect the Pootatuck River watershed, including the Pootatuck Watershed Association, Candlewood Valley Chapter of Trout Unlimited, Newtown Forest Association, and the Town of Newtown.

The PRP works together to identify shared watershed management concerns and address them through collaboration, resource-sharing and communication with stakeholders and the public. The PRP recognized that Watershed-Based Management Planning is a framework that supports detailed characterization of the watershed, consensus on management priorities, public and stakeholder engagement, and prioritization of specific management actions.

The PRP secured funding through both the Clean Water Act's Section 319 nonpoint source pollution grants program to complete a Watershed-Based Plan for the Deep Brook tributary (led by the Housatonic Valley Association) as well as the Long Island Sound Futures Fund[4] to expand Watershed-Based Planning to the entire Pootatuck River watershed (led by the Town of Newtown).

A primary goal of this Pootatuck River Management Plan is to create a roadmap for removing Impairments that the CT Department of Energy and Environmental Protection (CT-DEEP) identified to recreational uses of Deep Brook and the mainstem Pootatuck River such as swimming, wading or any activities that may lead users to come into contact with surface water. These Impairments are based on elevated levels of *Escherichia coli* (*E.coli*), a bacteria which indicates the presence of untreated human waste and/or waste from domestic or wild animals. In the case of Deep Brook, CT-DEEP has developed a Total Maximum Daily Load (TMDL) analysis that quantifies the amount by which *E. coli* concentrations must be reduced to remove the Impairment and make the waters of Deep Brook safe for contact recreation. More details about the Deep Brook TMDL are in Section 7.2.5. This Management Plan uses the US Environmental Protection Agency's Nine Elements of Watershed-Based Planning to create an approach for meeting the *E. coli* load reductions identified in the Deep Brook TMDL.

In addition to these critical water-quality concerns, this Management Plan addresses other important watershed management issues identified by the PRP, including climate resiliency or flood damage prevention; conservation of species, habitats and other elements of the Pootatuck watershed's natural heritage; and enhancement and management of outdoor recreation. It also addresses future coordination, capacity building, and public engagement or education—each of which is integral to all of the issues of concern for watershed management that are included above and considered below as focus areas.

1.2 EPA Nine Elements of Watershed-Based Plan Development Process

A watershed plan is a guide to mobilize communities toward improved water quality and other watershed management goals.[5]

An endeavor of watershed planning and implementation that earns the approval of the United States Environmental Protection Agency (EPA) follows a process of seven major steps that results in nine elements. The EPA has outlined this structured framework for watershed-based planning, known as the "Nine Elements of Watershed-Based Plan Development Process." These elements and steps serve as comprehensive guidelines for developing effective plans that address water quality and resource management at the watershed level[6]. The nine minimum elements and seven minimum steps are intended to ensure that the contributing causes and sources of NPS pollution are identified, key stakeholders are involved in the planning process, and restoration and protection strategies are identified that will address the water quality concerns[7].

Taking the first such step in 2020 into that seven-stepped process, a group of conservation nonprofits, watershed municipalities and federal, state, and regional agencies came together to form the PRP (**Step 1**). The PRP brings together information and resources that help inform the Pootatuck Watershed Existing Conditions Report (ECR), a document that outlines the state of the Pootatuck Watershed today (**Step 2**). Based on the findings in the ECR, the PRP collaboratively construct a vision for the watershed as well as goals and solutions that will lead to that vision (**Step 3**). Those goals and solutions lay the framework for the Pootatuck Watershed Action Plan, which outlines an implementation strategy toward achieving the watershed planning goals (**Step 4**). The next steps are to put the outlined recommendations into action through implementation (**Step 5**); measure the progress of those actions on pollution loading and water quality and make adjustments (**Step 6**); and ultimately turn these restoration measurements and adjustments back into improvements to this action plan (**Step 7**).

The process described above results in a Nine-Element Watershed-Based Plan such as this one, where the nine elements are listed below.

1. **Impairment:** This element identifies the causes and sources of pollution, necessary for addressing load reductions required to rectify impairments and achieve watershed goals.
2. **Load Reduction:** This element estimates the expected load reductions resulting from the management measures proposed.
3. **Management Measures:** Descriptions of non-point source (NPS) management measures required to achieve the estimated load reductions.
4. **Technical and Financial Assistance:** An estimate of the technical and financial resources needed as well as potential sources and authorities that will support plan implementation.

5. **Public Information and Education:** An information and education component aimed at enhancing public understanding and engagement in the selection, design, and implementation of NPS management measures.
6. **Schedule:** An expedited schedule outlining the implementation of NPS management measures.
7. **Milestones:** Descriptions of interim, measurable milestones for gauging the extent to which NPS management measures or other controls get implemented.
8. **Performance:** Criteria to evaluate the achievement of loading reductions over time, progress towards attaining water quality standards (WQS), and in cases of no such achievement and progress then criteria to evaluate any needs to revise the plan or a related Total Maximum Daily Load (TMDL).
9. **Monitoring:** A monitoring component to assess the effectiveness of implementation efforts over time.

The following table serves as a guide to help readers navigate the EPA Nine Elements of Watershed Planning within the various sections of this report.

Table 1. Nine Elements of EPA Watershed-Based Plan in the sections of the report

1	**Impairment**	Pootatuck Watershed impairments are described in the Watershed Characteristics (*Section II*) and Land Use (*Section III*) of this plan with information on water quality and TMDLs.
2	**Load Reduction**	Load reductions are estimated in the Implementation Strategy/Action Plan (*Section X*) and TMDL requirements for indicator bacteria (E. coli) were introduced in the Water Quality Regulations (*Section 2.4*) and Water Quality Parameters, Pollution Issues, and Sources (*Section 2.5*). Goals And Vision (*Section IX*) also proposes water quality related management measures.
3	**Management Measures**	The bulk of the watershed based plan outlines the Management Recommendations found in Section X - Implementation Strategy/Action Plan. Management Recommendations (*Section 10.1*) and Section 10.3 recommend interventions for Water Quality, Collaboration and Capacity Building, Education and Outreach, Recreation Enhancement, Floodplain Management and Climate Change Resiliency, and Species and Habitat Conservation. Section 10.2 provides construction project descriptions recommended as management measures. Key recommended actions are included in tables found throughout the plan.

4	**Technical and Financial Assistance**	Key recommended actions are included in tables found in the Management Recommendations (*Section 10.1*). These tables include a schedule for implementation, milestones, estimated costs, and possible funding sources. Section 10.2 also provides potential funding sources and technical assistance for construction project descriptions. Section 10.3 includes non-construction program descriptions that recommend technical and financial assistance.
5	**Public Information and Education**	Public participation and outreach has been a key element to the watershed planning process. Each step of the way the watershed planning process involves input from local experts (PRP), Connecticut Department of Energy and Environmental Protection (CT DEEP), and the public. The Management Recommendations (*Section 10.1*) and the non-construction program descriptions (Section 10.3) parts and include specific recommendations for public education and outreach. Finally, the Goals and Vision of the report (*Section IX*) incorporates public information and education components
6	**Schedule**	Projects schedules and performance criteria are defined in the Management Recommendations section (*Section 10.1*) and in all tables in Section 10.2. Furthermore, the construction project descriptions (Section 10.2) and Vision and Goals headings (Section IX) contain schedule and performance related information.
7	**Milestones**	
8	**Performance**	
9	**Monitoring**	The Water Quality parts of Section 10.2 and Section 10.3 have Monitoring and Assessment plan and recommendations for the PWP. Moreover, all the management recommendation tables include monitoring and assessment parts.

1.3 Pootatuck Watershed Management Plan Development Process

Stakeholder organization and engagement has been essential to the planning process. Even before the official planning process began, local partners and stakeholders had convened to form the Pootatuck River Partners (PRP). In March of 2020, an official kickoff meeting was held to develop a basic understanding of NPS pollution issues and the watershed planning process for PRP members. Since the initial kickoff meeting, the PRP has met regularly to guide the development of the Pootatuck River Watershed Based Plan, including the identification of management concerns and areas of opportunity to address said concerns.

The PRP with support from HVA gathered and synthesized existing research and planning related to management of the Deep Brook watershed and its larger Pootatuck River watershed, with a focus on NPS pollution. This effort helped to identify and prioritize NPS pollution reduction strategies. Additionally, partners such as the Pootatuck Watershed Association (PWA), Town of Newtown, and the Candlewood

Valley Chapter of Trout Unlimited (CVTU) have collected and synthesized data throughout the watershed over the past 10 years, providing valuable insight into pollution hotspots and sources. All of the existing research and planning was used to inform strategies and locations for field assessments. Field assessments were conducted by HVA with the support of other members of the PRP and local volunteers (See Section 1.4 for field assessment protocols). The culmination of the existing research and field assessments was an Existing Conditions Report (ECR) that has since been incorporated into this Plan as chapters II and III below. In January of 2023, the first draft of the ECR was distributed to the PRP for comment. HVA then worked to incorporate all comments and concerns made by the PRP so the ECR would be ready for the next planning phase, the setting of vision and goals. The Existing Conditions Report (ECR) for the Pootatuck River Watershed represents a pivotal component of the PRP's ongoing initiatives. It amalgamates extensive research and planning efforts concerning the Pootatuck River with the data collected during on-site visits to the surrounding streams. This comprehensive report serves as a critical tool in devising strategies to enhance water quality, protect natural heritage, enrich recreational opportunities, and bolster the region's resiliency to effects of climate change such as flood risks.

The ECR furnishes a comprehensive snapshot of the current state of affairs, offering invaluable insights that play a fundamental role in shaping a shared vision for the Pootatuck River. This collective vision is one that can mobilize support not only from PRP members but also from the wider community. Moreover, it delineates the precise objectives that must be achieved to implement this vision and puts forth a series of collaborative actions to be collectively pursued in order to attain these objectives. Based on the findings in the ECR, the PRP worked collaboratively to articulate a Vision for the future of the watershed and a set of Goals that must be achieved to realize that Vision. The PRP met on multiple occasions to craft the Vision and Goals, including a meeting to brainstorm initial ideas, a workshop to wordsmith the first vision and goal statements, and finally a meeting to give final edits and approval. The Vision and Goals then informed identification, development and prioritization of construction projects and non-construction programs ranked as the Watershed Plan Implementation Strategy (AKA Action Plan) in chapter X below.

Finishing the Watershed Plan is just the beginning of our work to achieve the Vision articulated by the PRP. The PRP will now shift their focus to the implementation of the Actions identified in the Implementation Strategy of this plan and to tracking the success of those Actions in achieving our goals for water quality, natural heritage, recreation enhancement, and climate resiliency.

1.4 Field Assessments

To assess the negative impacts and potential restoration opportunities within the Pootatuck River and its associated tributaries, HVA conducted comprehensive field assessments in 2021 and 2022. HVA employed the Unified Stream Assessment (USA) continuous stream walk methodology to survey specific reaches within the watershed. These reaches were categorized as impaired or areas of concern, as identified by input from local stakeholders. The USA protocol, originally developed by the Center for Watershed Protection (CWP), was specifically designed for use in urban watersheds.

During these field assessments, HVA's dedicated staff and volunteers ventured into the prioritized impaired reaches of the Pootatuck River and its tributaries. They meticulously documented data related to the conditions of these reaches, potential sources of impacts, and locations with potential for restoration projects (refer to the photo on page 17 for details). It is important to note that certain impaired reaches were inaccessible for field assessments due to various reasons such as the presence of wetlands, buried streams, or extensive channelization.

The stream impacts were categorized into specific types, including Stormwater Outfall, Utility, Trash and Debris, Stream Crossing, Severe Erosion, Impacted Buffer, Channel Modification, Dams, and Miscellaneous. For each identified impact, multiple photographs were taken, and precise location data were collected using handheld GPS units. Additionally, an overall assessment of the reach conditions was documented on a dedicated reach data form. This form included fields to evaluate factors such as average bank stability, in-stream habitat, riparian vegetation, floodplain connectivity, access, flow characteristics, and substrate composition throughout the entire reach. These assessments provide valuable insights into the health of the watershed and inform potential restoration efforts.

HVA Staff and Volunteers conducting Streamwalks along the North Branch Pootatuck River.

The field assessments conducted by HVA included a thorough evaluation of various potential sources of impact within the Pootatuck River Watershed (PRW). Here is an overview of the assessment categories and methods used:

1. **Outfalls:** Outfalls encompassed all stormwater and other discharge pipes. If an outfall was actively flowing (these assessments took place at least 48 hours after the most recent rainfall) or displayed suspicious characteristics such as an unusual odor or color, HVA collected grab samples of the effluent. These samples were then tested for ammonia nitrogen concentration (see photo on page 17). This approach allowed HVA to flag specific outfalls for further investigation and potential pollution trackdown surveys.

2. **Utilities:** Utility assessments in the stream corridor focused on exposed pipes and sewers. Any issues or concerns related to these utilities were documented.
3. **Trash and Debris:** The presence of trash and debris was recorded if its accumulation exceeded the average levels found throughout the reach. HVA estimated the quantity in terms of the number of truckloads.
4. **Stream Crossings:** Assessments of stream crossings, such as bridges and culverts, followed the methods outlined by the North American Aquatic Connectivity Collaborative (NAACC). NAACC data forms were employed to provide details about the overall crossing and its structural characteristics.
5. **Channel Modifications:** This category covered channelized and concrete-lined sections of streams within the watershed. Any modifications or alterations to the natural channel morphology were documented.
6. **Severe Bank Erosion:** Bank erosion was noted as severe if the observed conditions were significantly worse than the average level of erosion observed throughout the entire reach.
7. **Impacted Buffers:** Areas lacking a naturally vegetated buffer zone of at least 25 feet wide were designated as impacted buffers. This category included areas overgrown with invasive species as well as sections where turf lawns bordered the stream.
8. **Miscellaneous:** This category encompassed all other impacts that did not fit within the defined categories, such as the presence of livestock or fish kills.

Collectively, this comprehensive data collection allowed HVA to identify and prioritize future restoration projects aimed at reducing pollution and enhancing overall water quality within the PRW. These efforts are crucial for the protection, conservation and preservation of this valuable natural resource.

(Left) HVA Staff record data during stream walk. | (Right) Culvert recording during stream walks by HVA staff and volunteers.

The Pootatuck River watershed has been thoughtfully divided into seven sub-watersheds, strategically centered on the Mainstem of the river (comprising the Upper Pootatuck and Lower Pootatuck) as well as its tributaries (including Deep Brook, Curtis Pond Brook, North Branch Pootatuck, Tom Brook, and Cold Spring Brook). This subdivision enables efficient planning and management efforts within the watershed, allowing for a more focused approach to address unique challenges and opportunities in each sub-watershed.

All the data collected during streamwalk assessments has been meticulously compiled and made accessible through an online mapping tool. This tool provides an interactive platform displaying the precise locations of marked points, accompanied by associated photographs and the specific data recorded at each point. Interested parties and stakeholders can conveniently access this information online via the provided link to the Pootatuck Streamwalks application.

Utilizing this GIS analysis in conjunction with the Unified Stream Assessment (USA) data, HVA has been able to pinpoint specific sites within the watershed that may pose a higher risk of negatively impacting water quality. These identified sites will be subjected to further reconnaissance efforts, enabling HVA and its collaborators to conduct in-depth assessments of their environmental impact. This detailed evaluation will contribute to the prioritization of restoration projects as part of the Pootatuck River Watershed Plan's comprehensive implementation strategy. By taking these steps, the watershed can look forward to more effective protection and enhancement of its natural resources.

II. WATERSHED CHARACTERISTICS

2.1 Geography

The Pootatuck River Watershed, covering an area of 26.1 square miles, is situated in the northern region of Fairfield County, Connecticut. The Pootatuck River Mainstem originates near the Monroe-Newtown border and flows in a northerly direction through the town of Newtown[8]. The major tributaries of Deep Brook, Tom Brook, Curtis Pond Brook, North Branch Pootatuck, and Cold Spring Brook are confluent with the Pootatuck River along its run to the confluence with the Housatonic River at Sandy Hook. While the majority of its drainage area falls within the town boundaries of Newtown, there are also small portions of Easton and Monroe that contribute to this watershed.

Despite its relatively modest size, the Pootatuck River Watershed holds significant importance for both the Town of Newtown and the broader Housatonic Valley community. The geographic name of the river acknowledges the Pootatuck people, whose lands and waters European settlers colonized into the towns reviewed elsewhere in this Plan[9] and whose present-day Tribal descendants are now the State-recognized Schaghticoke.[10] The American Indian name 'Pootatuck' means the 'River of the Falls Place.' The designation survives as the most important geographic name that has been anglicized into English from an American Indian language relative to all akin such names across the entire lower or southern Housatonic valley.[11] This resilient importance of the geographic marker reflects both the Housatonic's numerous waterfalls near where the Pootatuck River joins the Housatonic and how until the 18th century 'Pootatuck' was also the most commonly used American Indian name for the thirteen river miles of the present-day Housatonic River downstream from the falls bordering the towns of Derby and Shelton—all the way to Long Island Sound, albeit eventually flowing into these quieter tidal waters.[12] Indeed, it was only during the 1700s that the geographic name 'Housatonic' started to extend downstream to encompass the whole River, replacing names such as 'Pootatuck' or eventually 'the Great River'—both of which had been more commonly used until then to refer to the whole lower or southern valley of this larger River.[13]

Within the present-day Pootatuck watershed, there are abundant recreational opportunities for residents and visitors alike, including fishing and hiking. Additionally, it serves as a critical habitat for several species of concern, notably the Eastern Brook Trout (*Salvelinus fontinalis*)[14]. Furthermore, the aquifers nestled within the watershed play a crucial role in providing a sustainable water source for the residents of Newtown.

As the Pootatuck River winds its way through Newtown, it traverses approximately 10.6 miles, coursing through picturesque forested hills before meandering through the town itself. Ultimately, the river finds its confluence with the Housatonic River in the scenic and nationally historic locale of Sandy Hook, a place and community named after the shape of the river. This watershed—with its ecological and human significance as well as its particularly monumental recreational opportunities—plays an integral role in the natural and cultural landscape of the region and indeed the nation.[15]

2.2 Geology and Soils

The geological characteristics of the Pootatuck River Watershed (PRW) resemble those of other watersheds in Connecticut and, on a broader scale, New England. The watershed features narrow valleys formed in bedrock, a common trait in glaciated valleys. The valley walls are composed of glacial till, a mixture of unsorted clay, silt, sand, gravel, and boulders, which overlays the underlying bedrock[16]. Within the Pootatuck River basin, three primary rock units are identified: bedrock, glacial till, and glacial deposits.

The foundational bedrock serves as the structural base of the basin and is predominantly composed of gneiss and schist. In Newtown specifically, the prominent bedrock formation is the Brookfield Gneiss, characterized by its dark and light rock with significant foliation. These metamorphic bedrock formations are prevalent throughout the region, resulting from the accumulation of landmasses along the Northeast coast, which contributed to the formation of the local mountains and hills.

Around 10-15,000 years ago, during a period of glaciation, the area was covered by an ice sheet[17]. As the ice sheets gradually retreated, they sculpted valleys into the bedrock and deposited layers of soil and rock, known as glacial till, on top of the bedrock layer. This till comprises a mix of various-sized particles, creating a diverse substrate. Additionally, the melting ice sheets transported sediment and gave rise to glacial deposits primarily consisting of sands and gravels in the valley bottoms, shaping the geological makeup of the PRW[18].

2.3 The Hydrological Cycle and Watersheds

The quantity of water present on Earth remains constant over time, which means that while it changes form regularly, there is no creation or destruction of water[19]. We can directly observe water's movement in its various forms in our daily lives. For instance, we witness land flooding and watch previously water-rich areas become dry. These fluctuations in visible surface water in our immediate surroundings indicate changes in water storage. Water is stored in different "reservoirs," including the atmosphere, oceans, lakes, rivers, soils, snow and glaciers, and underground reserves[20]. The capacity of these reservoirs to store water varies over both space and time.

The hydrological cycle featured in Figure 1 below is a conceptual model that illustrates how water moves among these storage places through processes like evaporation, precipitation, and flow. The oceans serve as Earth's largest reservoir, containing about 97% of all water. The remaining 3% constitutes the planet's freshwater, with approximately 78% of it stored as ice and 21% as groundwater. This leaves less than 1% of freshwater to flow freely in rivers, lakes, and soils. In essence, the freshwater that we are familiar with accounts for just a minuscule 0.02% of all the water on our planet.[21]

Water undergoes a phase change when it enters the atmosphere, transitioning from a liquid state (through processes like evaporation and transpiration) or a solid state (through sublimation) into a gaseous form known as water vapor[22]. Once in the atmosphere, this water vapor rises and cools. During the cooling process, water vapor molecules adhere to tiny particles in the air and condense, forming water droplets that collectively create clouds. When these droplets become sufficiently heavy, they return to the Earth's surface as precipitation, which can take the form of rain, snow, dew, fog or hail. Whether or not this precipitation might be intercepted by either vegetation or impervious surfaces, it then gets absorbed by the soil, rolled downhill over the land as runoff or dropped directly onto one of the water storage reservoirs.

The topography of the area where precipitation lands determines or directs the droplets to which specific water body the precipitation falling from a particular cloud will eventually go. The amount of water that reaches these storage reservoirs and the time it takes for that runoff to get there is influenced mainly by soils, land use and vegetative cover.

All bodies of water have a finite area of land that drains into them, determined by the surrounding topography. These topographic and hydrological systems are referred to as watersheds, which are also known as drainage basins or catchments[23]. Watersheds serve as the fundamental spatial units of landscapes and each watershed contains sub-watersheds within it. The delineation of watershed boundaries is critical; as it defines where surface water flows separate and accumulate, shaping the movement and distribution of water in a given region.

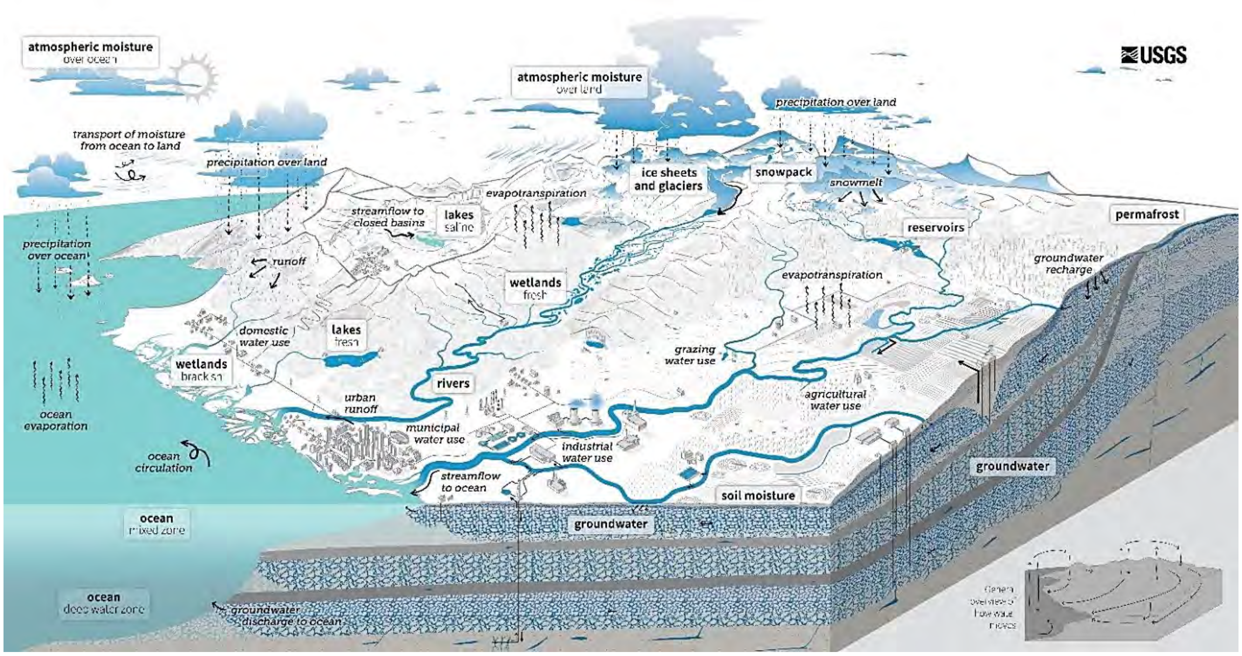


Figure 1. The water cycle (USGS, 2022)

2.4 Water Quality Regulations

In 1967, Connecticut instituted into its laws An Act Concerning the Elimination of Pollution of the Waters of the State. This State legislation soon imprinted a nationwide 'water mark' half a decade later as it became one of the legal bases upon which the U.S. government modeled how a major new federal law went on to govern water.[24]

The Clean Water Act (CWA) is a federal law, established in 1972, that regulates the discharge of pollutants into surface waters and the water quality of surface waters in the United States[25]. The CWA made point source (or end-of-pipe) pollution discharges into navigable waters without a permit illegal through the National Pollutant Discharge Elimination System (NPDES). It also required states and tribes to adopt and revise water quality standards (WQS), regularly assess waters in their jurisdiction to understand where WQS are not being met, and take action to ensure waters not meeting WQS are restored. Connecticut's WQS represent the foundation of waterbody management across the state, including the development of Total Maximum Daily Loads (TMDL).

State WQS required by federal law, under section 303(c) of the Clean Water Act, indicate designated uses (e.g., drinking, swimming, fishing) and water quality classifications (goals) for surface water, groundwater, and coastal/marine surface waters. The system through which CT institutes its water quality classification for inland (fresh) surface waters classifies inland surface waters based on distinct letters (Class AA, Class A, Class B, etc.). Each letter class indicates the water's designated use or best use and therefore its WQS. CT limits discharges from industrial and municipal wastewater treatment facilities to waters with a specific classification. Please see Table 2 below for surface freshwater classifications.

A review of the State WQS is conducted every three years by governing state agencies[26]. Under CWA Section 305 (b) the State of Connecticut Department of Energy and Environmental Protection (CT DEEP) is required to monitor, assess and report on water quality with regard to meeting designated uses for each waterbody, as per Connecticut's WQS and Classifications to the U.S. Environmental Protection Agency (U.S. EPA). This report is called the Integrated Water Quality Report (IWQR) and it provides information on assessed and impaired waterbodies within Connecticut such as the Pootatuck River Watershed (PRW)[27]. Those waters that do not meet the State's WQS are listed as "impaired" for designated uses (drinking water supply, aquatic life and/or recreation) depending on pollutant type and amount.

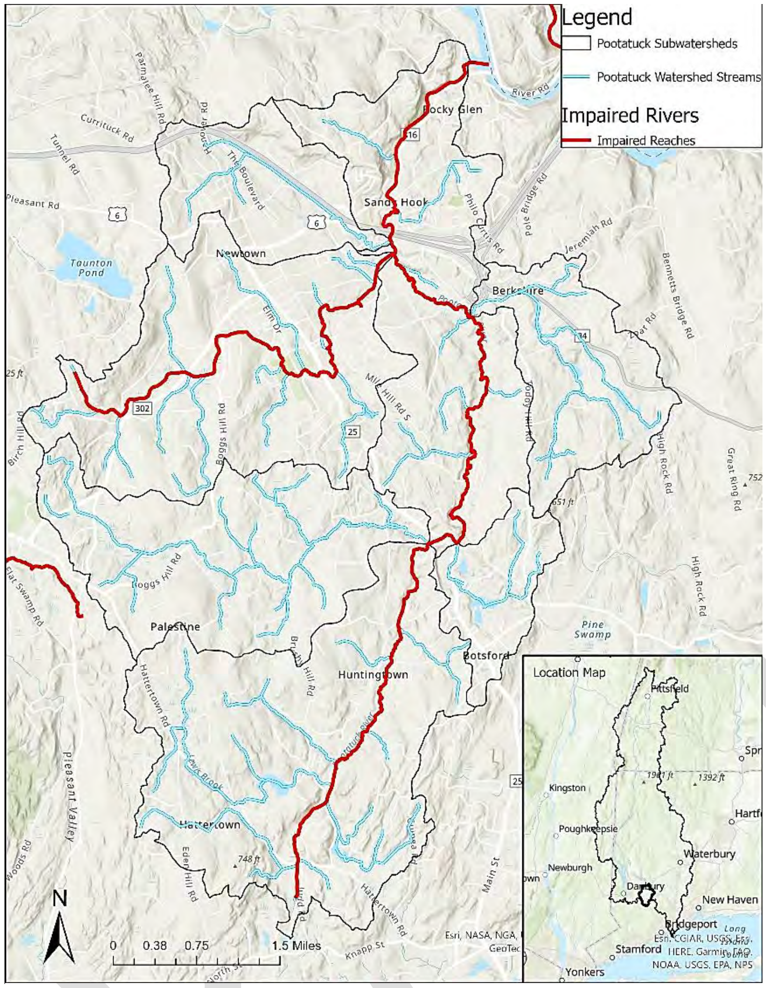
Table 2. CT DEEP Inland Freshwater Classifications

Class	Designated Use	Discharges allowed
AA	Existing or proposed drinking water supply; fish and wildlife habitat; recreational use (may be restricted); agricultural and industry supply	Discharges from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges
A	Potential drinking water supply; fish and wildlife habitat; recreational use; agricultural and industrial supply and other legitimate uses including navigation	Discharges from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges
B	Recreational use; fish and wildlife habitat; agricultural and industrial supply and other legitimate uses including navigation	Same as A as well as discharges from industrial and municipal wastewater treatment facilities that practice best available treatment methods and best management practices. Other discharges allowed with a National Pollutant Discharge Elimination System (NPDES) permit (Connecticut General Statute Section 22a-430).

According to the State of Connecticut IWQR 2022, a few of the major watercourses in the Pootatuck River Watershed are classified as Impaired[28]. This document is dedicated to information related to WQS for inland surface waters within the PRW. Since the enactment of the Clean Water Act (CWA), there has been improvement in the water quality of the Pootatuck. Nevertheless, the most significant remaining threat to water quality is non-point source pollution (NPS).

In compliance with CWA regulations, Connecticut is obligated to report on water quality every two years, specifically concerning the designated uses of each assessed waterbody. Below, you will find a compilation of waterbodies within the PRW extracted from the most recent Integrated Water Quality Report to Congress (2022) (please refer to section 2.7 below). Notably, several stream and river segments within the watershed are deemed Impaired for Aquatic Life and/or Recreation, as indicated in Map 2 below and Table 5 on page 36. Some of these impacted segments include Deep Brook, Meeker Brook, and the Pootatuck Mainsteam.

When a waterway is identified as impaired, states are tasked with identifying the pollutant(s) that prevent that body of water from meeting state WQS[29]. Subsequently, states develop a Total Maximum Daily Load (TMDL), often referred to as a "pollution diet," for the impaired waterbody. A TMDL serves to identify potential sources of pollution and quantify the necessary reductions in pollutant loads to enable the waterbody in question to meet state WQS. The creation and implementation of Watershed-Based Plans have proven to be an effective strategy for achieving the pollutant load reductions prescribed by TMDL(s) within specific waterbodies.



Map 2. Current Impaired River/Stream Reaches within the Pootatuck River Watershed. Deep Brook and Mainsteam Pootatuck are Impaired.

2.5 Water Quality Parameters, Pollution Issues, and Sources

2.5.1 Nutrients

The two nutrients most commonly measured in water quality monitoring are nitrogen and phosphorus[30]. At normal levels, these nutrients are essential for biological growth, but they can be detrimental to water quality when present in excess.

The most common forms of nitrogen in streams are ammonia (NH_3) and nitrate (NO_3). Ammonia concentration that exceeds 1.0 mg/L and nitrate levels above 0.10 mg/L indicate human impact such as from sewage, fertilizers from residential and agricultural stormwater runoff or atmospheric deposition of nitrogen from gas emissions. Consequently, even in small quantities, nitrogen can lead to harm such as toxins for humans and/or animals through algal blooms, eutrophication, and a reduction in dissolved oxygen levels within aquatic ecosystems.

Phosphorus is commonly found as phosphate (PO_4). Plants take up phosphate from water and convert to organic phosphorous. Phosphate will have an impact on aquatic life at concentrations above 0.05 mg/L and as low as 0.01 mg/L. Phosphate is often the limiting factor for aquatic plant growth. Therefore, even in small amounts it can cause harm such as toxins for humans and/or animals through algal blooms, eutrophication, and a depletion of dissolved oxygen levels. For this reason, the EPA recommends keeping phosphate levels below 0.1 mg/L in flowing streams and less than 0.05 mg/L in stagnate water such as lakes, ponds, and reservoirs. Phosphate can originate from various sources, including sewage, animal waste, fertilizers, detergents, disturbed land, anticaking agents (such as those found in road salt), and stormwater runoff from urbanized landscapes. These sources play a pivotal role in the phosphorus cycle and can contribute to water quality issues when not properly managed[31].

2.5.2 Dissolved Oxygen

Dissolved oxygen (DO) is the amount of oxygen dissolved in water and available to aquatic organisms. When dissolved oxygen is too low (below 3 mg/L) aquatic organisms cannot survive. Thus, it is an important measurement of water quality. DO comes primarily from atmospheric exchange or as a byproduct from aquatic plant photosynthesis[32]. The depletion of oxygen in surface waters can be caused by several factors. Below here is how each of several factors contribute to oxygen depletion.

1. Increases in Organic Matter: When organic matter such as leaves, plant debris, or other organic substances enters a water body, it can serve as a food source for bacteria. As these bacteria break down the organic matter through decomposition, they consume dissolved oxygen in the process. This increased microbial activity can lead to a decrease in oxygen levels, especially in areas with a high input of organic material.

2. Decay from Sewage: Sewage or wastewater contains organic materials, including human and organic waste. When sewage is discharged into surface waters without proper treatment, the organic matter in sewage undergoes decomposition by bacteria. This decomposition consumes oxygen, leading to a reduction in oxygen levels in the water. This is particularly harmful to aquatic life and can result in oxygen-deprived "dead zones."

3. Excess Algal Growth: Excess algal growth, often referred to as an algal bloom, can occur due to an abundance of nutrients like nitrogen and phosphorus in the water[33]. Algae are photosynthetic organisms that produce oxygen during the day. However, at night or when the algal bloom dies and decomposes, it consumes oxygen. If the rate of oxygen consumption exceeds the rate of oxygen production through photosynthesis, it can lead to oxygen depletion in the water.

4. Lack of Flow: Stagnant or slow-moving water bodies are more susceptible to oxygen depletion because they have limited contact with the atmosphere. Flowing water, on the other hand, can naturally replenish oxygen through aeration.

5. Warming Waters: Elevated water temperatures, often caused by factors like climate change or the absence of sufficient buffer zones upstream (which can help regulate water temperature), can reduce the capacity of water to hold dissolved oxygen. As water temperatures rise, the ability of water to hold oxygen decreases, potentially leading to decreased DO levels.

Decreased DO levels in surface waters can contribute to fish kills and the death of other aquatic organisms[34]. When oxygen levels drop below a critical threshold, it can have severe consequences for the health of aquatic ecosystems. Therefore, watershed scale management is often required for mitigation[35].

2.5.3 pH

The pH of water is the measure of acidity and is measured on a scale ranging from 0 (highly acidic) to 14 (highly alkaline). It quantifies the concentration of hydrogen ions in the water, indicating whether a solution is acidic (low pH), neutral (pH 7), or alkaline (high pH). Aquatic life thrives in healthy freshwater systems with a pH between 6.5 and 8.0. Environments outside this range can stress or kill aquatic life and can be a sign of industrial waste[36]. The average pH of normal rainfall is between 5.0 – 5.6 (acidic), and the average pH of acid rain is between 4.0 – 4.6 (acidic).

Acid rain is closely related to changes in water pH and is a result of atmospheric deposition. Acid rain occurs when pollutants from various sources, primarily emissions from burning fossil fuels and industrial activities, are released into the atmosphere. These pollutants include sulfur dioxide (SO2) and nitrogen oxides (NOx). Once in the atmosphere, these compounds can undergo chemical transformations, forming acidic compounds such as sulfuric acid (H2SO4) and nitric acid (HNO3).

Environmental regulations have made significant strides in reducing the impacts of acid rain, yet it remains an ongoing concern with repercussions for waterways and aquatic ecosystems. Additionally, the legacy effects of past acid deposition continue to affect water bodies, even as emissions have been reduced.

2.5.4 Turbidity

Turbidity measures the clarity of a water sample or how much material (sediment, algae, pollution, microbes etc.) is suspended in the sample. It is measured by the amount of sunlight that passes through a sample of water, in Nephelometric Turbidity Units (NTUs). The higher the NTUs, the less light passes through the water. Turbidity can be caused by soil erosion from eroding banks, agriculture or construction, stormwater runoff, and sometimes failing septic systems. Each of these turbidity sources involves solids (e.g., pet droppings, leaves and grass clippings, litter, sediments) being transported through the liquid water. High turbidity blocks or absorbs sunlight, reducing the ability of plants to photosynthesize and grow, thus harming the food source for fish and other aquatic life. Moreover, suspended solids can clog fish fills, smother fish eggs, and suffocate the organisms that fish eat.

2.5.5 Chloride

Chloride is found in salts such as sodium chloride (NaCl), calcium chloride, or magnesium chloride. Some common sources of chloride in the environment include:

1. *Winter Road Salting:* During the winter months, road maintenance crews commonly use salt (sodium chloride or calcium chloride) to de-ice roads and highways. When the snow and ice melt, the salt can be washed into nearby water bodies, elevating chloride levels in these waters.

2. *Geologic Formations:* Chloride ions can naturally occur in geological formations and can be leached into groundwater and surface water over time.

3. *Agricultural Runoff:* The use of fertilizers and manure in agriculture can contribute chloride to nearby water bodies through runoff, especially when excessive amounts of chloride-containing fertilizers are applied.

4. *Industrial Wastewater:* Industrial processes may generate wastewater that contains chloride ions as a byproduct. When not properly treated or managed, this industrial wastewater can discharge chloride into waterways.

5. *Effluent from Wastewater Treatment Plants:* Wastewater treatment plants often receive sewage containing chloride from various sources, including household products and industrial discharges. While treatment plants are designed to remove many contaminants, some chloride may still be present in the treated effluent.

Road salt was first used in New Hampshire in 1938 and quickly became a popular solution to deicing winter roads[37]. Rock salt—sodium chloride (NaCl)—is the most common salt used in Connecticut for the removal of snow and ice. It easily dissolves with snowmelt and ends up in nearby road ditches, culverts, and streams[38] as well as groundwater through infiltration[39].

The impact of salt on surface water is detrimental to stream ecosystems as it can lead to acidification and increased mobilization of metals in streams. The U.S. Environmental Protection Agency (EPA) states that stream ecology is impacted when the four-day average concentration of chloride exceeds 230 mg/L or a one-hour average concentration exceeds 860 mg/L more than once every three years.

Chloride can alter the composition of riparian and wetland plant communities, giving a competitive advantage to more salt tolerant invasive species. It can interfere with the natural mixing of lakes and alter or inhibit the microbial communities, which remove nitrate and impact water quality[40]. Chloride in groundwater can interrupt healthy reproduction of plants and increase mortality by interrupting the ion exchange in plant root systems[41]. These impacts reach far beyond the winter salinity spike that occurs at the time of application. Scientists have found concentrations of chloride in surface waters that are sometimes higher in the summer possibly due to a release from highly concentrated groundwater releasing salt throughout the year and into the summer[42]. Moreover, it is estimated that it can take decades for salt levels to stabilize or move through a freshwater river system[43].

Additionally, salt has also impacted private wells and drinking water sources. Since 2013, CT DEEP has seen an increase in salt related complaints concerning private water supplies[44]. The increase in salt and chloride in drinking water supplies is a growing health risk and also a risk to infrastructure as it leads to increased corrosivity.

2.5.6 Temperature

Stream temperature has a significant impact on aquatic ecology. High temperature generally increases solubility of solids and decreases solubility of gases. Among other dynamics, change in temperature affects movement of molecules, fluid dynamics and the metabolic rate of aquatic organisms. Chemical water quality worsens with rising temperature, namely dissolved oxygen levels drop and algal blooms occur more frequently. Algal blooms reduce dissolved oxygen further, can clog fish gills, and produce toxins harmful to animals and humans[45]. Finally, warmer waters also make fish more vulnerable to parasites and diseases[46].

A number of factors influence stream temperatures: watershed land use, groundwater recharge, stream profile (i.e. depth and complexity), riparian buffer canopy density, flow velocity that can be impacted by dams, culverts or other impoundments, and air temperature[47]. Stream temperature data throughout the northeast has been compiled into the Spatial Hydro-Ecological Decision System (SHEDS) Stream Temperature Database. This dataset presents the data collected by 81 organizations at 7,612 monitoring stations through the Interactive Catchment Explorer (ICE) online application[48]. Although the Pootatuck River Watershed (PRW) is not its own basin in the database, the basin that the database uses for the PRW has a current average steam temperature in the summer of 19ºC (66.2ºF). With ambient air temperature rising due to climate change, the temperature of surface waters will rise also. By 2100, climate change models predict air temperatures to rise between 2.0ºC (with low emissions scenario) and 4.8ºC (with high emissions scenario)[49]. An ICE model predicts that with an increased air temperature rise of 2ºC the average stream temperature will rise by 1.4ºC to an average of 20.4ºC during the summers on the PRW (68.7ºF).

Cold water species such as native Eastern Brook Trout (*Salvelinus fontinalis*) require thermal refuges with colder water to survive during warm summer months. Brook Trout cannot survive in stream temperatures above 25ºC and prefer temperatures less than 20ºC[50]. If stream temperature rises to 20.4ºC many Brook Trout and other cold-water obligate populations of fish will likely decrease as fish experience stress and are forced to adapt. These fish species adapt when they find colder water, move north, change the timing of migration and spawning, and/or alter predator-prey ranges and interaction[51].

2.5.7 Indicator Bacteria

Escherichia coli (*E. coli*) is a type of bacteria that is commonly present in the gastrointestinal tracts of all warm-blooded animals, including humans, livestock, and wildlife. While *E. coli* itself is not necessarily harmful, it serves a crucial role as an indicator bacteria in water quality assessment[52]. In essence, the presence of E. coli in water may indicate the potential presence of other harmful pathogens that can pose health risks to humans and wildlife.

The levels of *E. coli* in water bodies can become elevated due to various sources, including human-generated wastewater, agricultural runoff, and the activities of wildlife such as waterfowl. This elevation in E. coli levels can be particularly concerning as it suggests an increased risk of waterborne illnesses and contamination.

One notable factor contributing to the variation in *E. coli* levels within a watershed is land use, especially the density of agricultural land in proximity to streams and water bodies. For instance, in areas with a higher density of agricultural activities, there is an increased potential for the runoff of manure, fertilizers, and other contaminants into nearby waterways. This can lead to elevated levels of E. coli in these aquatic environments.

As an example, consider Deep Brook, which had approximately 20% of its watershed covered by agricultural land at the time of Total Maximum Daily Load (TMDL) assessment[53]. In such areas, the risk of encountering elevated *E. coli* levels is notably higher due to the potential for agricultural runoff carrying fecal matter and other contaminants into the stream.

To mitigate these concerns and safeguard water quality, watershed management strategies often focus on implementing best management practices in agriculture, enhancing wastewater treatment, and conserving natural buffer zones along streams to reduce the transport of contaminants into water bodies. Monitoring and managing *E. coli* levels play vital roles in ensuring safe and healthy aquatic ecosystems that safeguard the health of human beings who interact with these water resources.

2.5.8 Indicator Benthic Macroinvertebrates

Biological monitoring programs with the primary objective to evaluate the health of surface waters through the analysis of benthic macroinvertebrate communities were initiated in Connecticut during the mid-1970s.[54] Benthic macroinvertebrates—animals that have no backbone, can be observed with the naked eye, and spend all or part of their lives living on the bottom—have varying sensitivities to water quality impacts. They also are generally unable to travel long distances in response to habitat changes and lack the ability to detect non-chemical impacts (e.g., siltation and thermal changes), so their ability to avoid pollution is limited.[55] The composition of the benthic macroinvertebrate community at a given site reflects long-term trends in water quality. Sites with episodic or chronic water quality impacts will support fewer organisms that are sensitive to pollution and more organisms that are tolerant of pollution.

Hence, benthic macroinvertebrate assessment provides a valuable indicator of the overall health of a site that may be difficult to capture with water chemistry sampling, especially when researchers may not have the opportunity to visit a site regularly. Individual water chemistry samples deliver a static snapshot of conditions at the instant the sample was taken that might not reflect the range of impacts any site experiences over time, which benthic macroinvertebrates do indicate with these their more dynamic assessments.

In Connecticut, sampling for benthic macroinvertebrates as indicators of water quality is conducted between September 15th and November 30th annually as a precaution to represent worst-case water quality conditions. The samples collected are preserved then brought back to the laboratory for 'subsampling' in a nested process that entails randomly selecting 200 organisms for more detailed analysis as a final sampling procedure.[56]

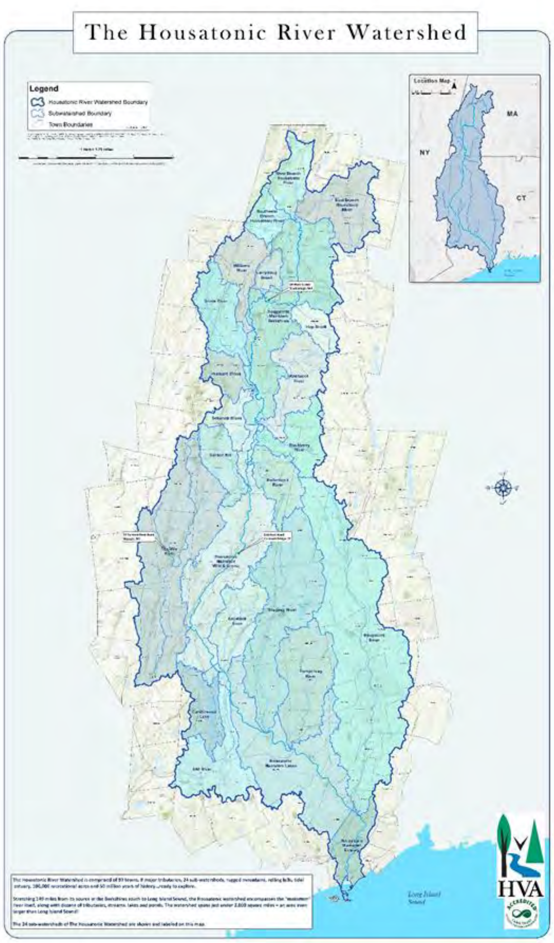
Metrics of a benthic macroinvertebrate community are used in Connecticut to determine whether a section of stream supports or does not support the designated use goal for aquatic life as established by the State's Water Quality Standards (WQS) and are regionally calibrated to account for variations in aquatic systems according to the field conditions of each different state. In Connecticut, such benthic analytical metrics used to assess water quality include calculations of two numbers for the macroinvertebrate structure of each site sampled:

- a macroinvertebrate multimetric index (MMI) as a composite score generated from several macroinvertebrate-based indices of water quality with the score of a site ranging on a scale from 0 to 100, in which generally a MMI value greater than 48 points indicates good water quality and a MMI score of less than 43 is indicative of poor water quality;
- a biological condition gradient (BCG) tier as an illustration of the relationship between the amount of a biological, chemical or physical stress on an environment and its effect on biological communities. Each site is assigned to an integer tier value on a scale from 1 to 6, in which a Tier 1 value indicates good or completely natural water quality and a Tier 6 is indicative of water quality that is poor or completely dysfunctional due to human disturbance. The model attempts to mimic how trained environmental professionals would rank data on any biological (macroinvertebrate) community through a common or universal language for comparison no matter what, how, where or when their evidence is evaluated as in the cases of data on different forms of life (e.g., other biological data such as fish or diatom communities), different methods of data collection, and even evidence from different ecological systems.[57]

2.6 The Housatonic River Watershed and Long Island Sound

The Pootatuck River watershed is a sub-watershed of the Housatonic River basin that is in turn a sub-catchment of the drainage basin for the Long Island Sound.

The Housatonic River watershed is a vast expanse, covering approximately 1,948 square miles. It begins its journey in the Berkshires, north of Pittsfield, Massachusetts, and meanders southward until it reaches the Long Island Sound (LIS). This extensive drainage basin encompasses a significant portion of western Connecticut and extends into New York, where it shares the watershed divide with the Hudson River, spanning across Columbia and Dutchess Counties. Within the boundaries of this watershed, there are 83 towns, each with its deep and unique historical significance. The rich tapestry of these communities adds to the cultural and environmental diversity of the Housatonic River watershed. Eight major tributaries feed the mainstem of the Housatonic River, each contributing to the overall flow of the river. This intricate network of tributaries and streams divides the watershed into 24 distinct sub-watersheds, each with its own ecological characteristics and challenges. Notably, one of these sub-watersheds is the Pootatuck River, which falls within the Housatonic Mainstem Lakes sub-watershed. The Pootatuck River plays a vital role in this larger ecosystem, contributing a significant portion of flow to the sub-watershed. The interconnectedness of these sub-watersheds underscores the importance of holistic watershed management strategies to ensure the health and sustainability of this complex and diverse ecosystem.



Map 3. The Housatonic River Watershed

The LIS watershed extends across a vast geographical area, encompassing nearly the entire state of Connecticut as well as parts of Massachusetts, New Hampshire, Rhode Island, and Vermont. Additionally, it extends into a small portion of Canada. In the state of New York, the LIS watershed also includes parts of New York City and spans across Columbia, Dutchess, Nassau, Suffolk, and Westchester Counties [58]. This extensive drainage basin covers a sprawling 17,814 square miles. The Long Island Sound itself—classified as an estuary—spans approximately 1,320 square miles and boasts an impressive 600 miles of coastline. In its embrace, one can find over 60 bays adorned with beaches and harbors. This vibrant ecosystem exists amidst one of the most densely populated regions in the northern part of the western hemisphere, where more than eight million people call this watershed their home. Effective and thorough environmental policies and regulations play a crucial role in addressing the challenges posed by the dense human populations residing near the LIS and its expansive watershed. Currently, the Long Island Sound is subject to a Total Maximum Daily Load (TMDL) initiative aimed at managing nitrogen levels in the ecosystem[59].

The TMDL program sets a specific target of a 58.5% reduction in nitrogen that originates from sources within the Long Island Sound (LIS) basin[60]. This ambitious reduction goal encompasses a multifaceted approach, addressing in-basin sources of nitrogen. It also involves exploring alternative strategies and establishing greater margins of safety. These comprehensive efforts are paramount in the ongoing endeavor to restore and maintain the ecological health of the LIS ecosystem. The region faces numerous environmental challenges due to its high population density and extensive human activities.

It is important to note that the TMDL program applies to both Connecticut and New York, covering all waterways that lead to the LIS[61]. Save the Sound, an organization dedicated to advocating for the protection of the LIS, periodically issues a report card that provides detailed information about nutrient loading and associated dissolved oxygen levels within the Sound. To effectively assess the condition of the LIS, the report divides the Sound into five distinct regions: Eastern Narrows, Eastern Basin, Central Basin, Western Basin, and Western Narrows.

Of these five regions, the Housatonic River predominantly drains into the Central Basin of the LIS. The Housatonic River watershed is the second-largest source of freshwater to the Sound, second only to the Connecticut River basin. This highlights the need for collaborative efforts and comprehensive strategies to manage and improve water quality throughout the entire Sound ecosystem, given its regional significance and the diverse challenges it faces.

2.7 Pootatuck Basin Water Quality Monitoring

The CT-DEEP administers a number of water quality monitoring programs statewide. The River and Stream Water Quality Monitoring and Lake and Pond Water Quality Monitoring programs conducted by CT-DEEP staff help Connecticut evaluate the impact of pollution and effectiveness of pollution control programs, track water quality trends, explore water quality problems, investigate community complaints, and provide data for the biannual Integrated Water Quality Report (IWQR) to EPA.[62]

The CT DEEP's community-based science programs provide training, equipment and quality control to environmental groups, nonprofits, land trusts and other volunteers monitoring water quality. The Riffle

Bioassessments by Volunteers (RBV) program supports volunteer collection of benthic macroinvertebrate samples, which are used primarily to identify healthy sites along smaller streams. The Volunteer Stream Temperature Monitoring Network (V-STeM) works with local volunteers to deploy in-situ temperature loggers between May and October each year. The data collected by RBV and VSTeM Network volunteers are used to inform CT DEEP water quality assessments, help develop state water temperature standards, identify cold-water habitat, and determine the impact of non-point source (NPS) pollution mitigation projects.[63]

V-STeM data is also uploaded to the Spatial Hydro-Ecological Decision System (SHEDS) Stream Temperature Database administered by the US Geological Survey, which uses the data to refine cold-water habitat distribution predictive models.[64]

Harbor Watch, a PRP stakeholder that is a non-profit dedicated to improving water quality and ecosystem health in Connecticut, conducted comprehensive water quality-data collection efforts within the Pootatuck Watershed during the years 2017, 2018, and 2019 as part of its water-quality monitoring. This initiative was carried out in accordance with EPA-approved Quality Assurance Project Plans (QAPPs) and water samples were meticulously analyzed for indicator bacteria at Harbor Watch's laboratory, which is certified by the CT Department of Public Health (CT DPH).

A notable data gap that Harbor Watch identified in the CT DEEP’s 2016 Connecticut IWQR—which indicated that the Pootatuck River had been categorized as "not assessed" for recreational purposes—catalyzed this monitoring endeavor. This lack of data prompted Harbor Watch to take proactive measures and commence monitoring activities within the watershed. Over the course of those three years, Harbor Watch conducted sampling approximately twice per month from May through September. The primary objectives of Harbor Watch's monitoring efforts were to establish baseline water quality data, encompassing parameters such as dissolved oxygen and indicator bacteria. These data sets served multiple purposes, including sharing them with state authorities like the CT DEEP—which is another PRP stakeholder. Additionally, the data informed decisions regarding the initiation of pollution tracking projects and facilitated collaborative efforts with more local stakeholders to pinpoint and mitigate pollution sources within the watershed.

The data collected by Harbor Watch, detailed in Tables 2 – 4, have played a crucial role in supporting the CT DEEP's recent Connecticut IWQRs to Congress, as outlined in Table 5. These assessments have underscored the imperative need for further endeavors to enhance water quality within the watershed, particularly to ensure its suitability for recreational activities.

Table 3. Harbor Watch water quality monitoring sampling locations

Site Name	Latitude	Longitude	Site location notes	Town
Pootatuck 6	41.33469	-73.29826	Mountainside Drive	Monroe
Pootatuck 4	41.36009	-73.28211	Meadow Brook Road	Newtown
Pootatuck 3	41.38355	-73.26919	Turkey Hill Road	Newtown
Pootatuck 2	41.42292	-73.28190	Rocky Glen State Park	Newtown
Pootatuck 1	41.43745	-73.27017	Walnut Tree Hill	Newtown
Deep 4	41.39217	-73.32881	Head of Meadow Road	Newtown
Deep 3	41.40242	-73.31227	Boggs Hill Road	Newtown
Deep 2	41.39755	-73.29807	Elm Drive	Newtown
Deep 1	41.40980	-73.28536	Old Farm Road	Newtown

As noted above in section 2.5.7 on indicator bacteria, *Escherichia coli*, commonly referred to as E. coli, serves as a vital indicator bacteria employed to assess the presence of fecal contamination in freshwater systems. Again, elevated concentrations of E. coli serve as a red flag, indicating the potential existence of more harmful pathogens that can pose health risks to humans.

The sources of fecal contamination can be categorized into two primary groups: human and animal. Human sources of fecal contamination typically stem from various issues such as leaking or damaged sanitary sewers, septic systems that are malfunctioning or failing, or illicit connections that channel sanitary waste into stormwater systems. On the other hand, animal sources can encompass both natural occurrences, including wildlife, and domestic sources such as farms or pet waste.

To gauge the water quality within the Pootatuck River and Deep Brook, water samples were analyzed for E. coli as well as dissolved oxygen. The results have been summarized in Tables 2 and 3, respectively. These results were then compared against the CT DEEP's water quality standards (WQS), which specify that (1) the geometric mean for E. coli bacteria should be less than 126/100mL and (2) the single sample maximum for E. coli in waters designated as "Recreation – All other uses" is limited to 576/100mL.

An analysis of the data reveals that E. coli concentrations in both the Pootatuck River and Deep Brook consistently exceeded the CT DEEP's allowed geometric mean for indicator bacteria at nearly every monitored sampling site as detailed in Table 3. Importantly, these exceedances were most frequently observed during sampling events that coincided with wet weather conditions. This suggests that the sources of contamination are likely diffuse and non-point in nature, given how the watershed predominantly consists of residential properties with private septic systems, extensive areas inhabited by diverse wildlife, and a number of small farms housing animals such as chickens, horses and cows. The presence of these various sources underscores the importance of continued monitoring and mitigation efforts to safeguard water quality in the watershed and protect the health of those who utilize these waterways for recreational purposes.

Table 4. *E. coli* (MPN/100mL) 2017-2019 geometric means (Source: Harbor Watch).

Site	2017 Geomean	2018 Geomean	2019 Geomean
Pootatuck 6	197	290	193
Pootatuck 4	191	320	190
Pootatuck 3	129	219	95
Pootatuck 2	126	179	186
Pootatuck 1	62	195*	119
Deep 4	369	353	443
Deep 3	182	283	166
Deep 2	232	297	353
Deep 1	94	125	159

*(*During 2018, there was construction at Pootatuck 1, which only allowed for 5 days of data collection at this location while the other sampling sites had 10 days of data collection)*

Dissolved oxygen (DO) serves as a crucial parameter to assess water quality given how it represents the amount of oxygen available for aquatic life, making it essential for the survival of many aquatic species. Just as land animals require oxygen, aquatic species rely on dissolved oxygen to thrive. When concentrations of dissolved oxygen are low, mobile aquatic organisms including fish and macroinvertebrates may either seek areas with better oxygen levels or in severe cases face the risk of mortality.

In evaluating the water quality of the Pootatuck River and Deep Brook, the results obtained by Harbor Watch were compared against the WQS established by the CT DEEP. According to these standards, dissolved oxygen should never fall below 5 mg/L at any time to support healthy aquatic ecosystems.

Overall, the dissolved oxygen levels observed in both the Pootatuck River and Deep Brook generally met the minimum criteria set by CT DEEP as summarized in Table 5 below. Only a small portion of the readings, specifically 23 out of 264 measurements, recorded dissolved oxygen concentrations falling below the 5 mg/L threshold. Among the sampling sites, Pootatuck 6 and Deep 3 exhibited the highest percentage of sampling events where dissolved oxygen levels fell below 5 mg/L. These particular sites are situated in areas where the river's flow tends to slow down, which is likely a contributing factor to the lower dissolved oxygen concentrations observed.

Table 5. Dissolved oxygen summary data from 2017-2019 monitoring seasons (Source: Harbor Watch).

	Minimum recorded value	**# of sampling events**	**% of sampling events less than 5 mg/L**
Pootatuck 6	1.97	30	20%
Pootatuck 4	3.36	30	7%
Pootatuck 3	2.46	30	3%
Pootatuck 2	8.05	30	0%
Pootatuck 1	7.94	24	0%
Deep 4	3.1	30	3%
Deep 3	1.93	30	43%
Deep 2	6.12	30	0%
Deep 1	8.2	30	0%

The CT DEEP's most recent Integrated Water Quality Report to Congress for the year 2022 highlighted several stream reaches within the Pootatuck River Watershed (PRW) that were categorized as impaired. In total, there were five stream reaches assessed for both recreational use and aquatic life. Their conditions were as follows:

1. Three out of the five stream reaches did not support Recreational Use, primarily due to excessive levels of bacteria such as E. coli. These stream segments were identified as having water quality issues that could impact recreational activities. Two of these impaired stretches were located along the Pootatuck Mainstem whereas the third one was situated along Deep Brook.
2. On the positive side, four out of the five stream reaches within the watershed are fully supporting aquatic life. These stream segments were deemed to provide suitable conditions for the various species inhabiting the waterways.
3. However, there was one stream reach that did not support aquatic life within the watershed. This particular reach was a tributary to Deep Brook, known as Meeker Brook or colloquially as 'Oil Creek.' As with such a label or nickname, the impairment in this case was attributed to a series of heating oil spills that occurred at the stream reach in the Fairfield Hills area during 2003, 2004, and 2013.[65]

The identification of impaired stream reaches underscores the need for ongoing water quality monitoring and remediation efforts to address the specific issues affecting these areas. It also highlights the importance of safeguarding water quality to support both recreational activities and the diverse aquatic life that depends on these freshwater ecosystems.

Table 6. Subset of the Connecticut 305b Assessment Results for Rivers and Streams as presented in Appendix A-1 of the 2022 CT Integrated Water Quality Report to Congress.

Waterbody Segment ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation
CT6019-00_01	Deep Brook (Newtown)-01	Mouth at confluence Pootatuck River (south side of I84, near exit 10), US to HW at Deep Brook Pond outlet dam (parallel to Head of Meadow Road), Newtown.	5.25	Fully Supporting	Not Supporting
CT6019-00-trib_01	Unnamed tributary Deep Brook (Newtown)-01	Mouth Deep brook US to HW near Old Farm Rd, Newtown. Locally called Meeker Brook, between Town salt storage lot and old mill.	0.07	Not Supporting	Not Assessed
CT6019-02_01	Unnamed tributary Deep Brook 6019-02 (Newtown)-01	Mouth at confluence Deep Brook DS (north) Head Of Meadow Road crossing, US (south) to HW past Head Of Meadow School, parallel to east along Shepard Hill Road (north of Sugar Hill Road intersection), Newtown.	1.6	Fully Supporting	Not Assessed
CT6020-00_01	Pootatuck River-01	From mouth at confluence with Housatonic River (west bank, DS of Walnut Tree Hill Road crossing), US to confluence with Newtown WPCF outflow (just DS of confluence with Deep Brook, US of I84 crossing), Newtown.	2.44	Fully Supporting	Not Supporting
CT6020-00_02	Pootatuck River-02	From confluence with Newtown WPCF outflow (just DS of confluence with Deep Brook, US of I84 cossing), Newtown, US to headwaters at unnamed pond (parallel to Judd Road), Easton.	8.39	Fully Supporting	Not Supporting

The findings of the report revealed that water temperatures in the watershed exceeded 70 degrees Fahrenheit on multiple occasions, some even recording temperatures in excess of 75 degrees Fahrenheit. These elevated temperatures are not conducive to supporting trout populations and they may indicate a potential issue related to surface runoff originating from impervious surfaces and various land uses upstream.

When rainfall interacts with impervious surfaces such as pavement, it tends to heat up rapidly due to the warm surface and as a result it flows into nearby waterways causing a rapid increase in water temperatures within the stream. Similarly, in areas that have undergone development or are used for agricultural purposes, there tend to be fewer trees and less shade to shield the water from direct sunlight. This lack of shade contributes to higher water temperatures in streams including Deep Brook and ultimately along the Pootatuck River.

In response to these concerns, recent initiatives have been implemented to address the issue of elevated water temperatures. One such initiative focuses on planting riparian vegetation along the banks of the Pootatuck River. This approach serves a dual purpose. First, it increases shade over the water, helping to mitigate temperature increases. Second, it provides valuable habitat for species of concern within the watershed. These efforts reflect a proactive approach to restoring water quality and the health of the aquatic ecosystem in the Pootatuck River and its tributaries.

III. LAND USE IN DRAINAGE BASIN

"Land use" is the term used to describe the human use of land. It represents the economic and cultural activities (e.g., agricultural, residential, industrial, mining, and open space) that are practiced at a given place. When siting and design is not carefully considered, land use can have a significant impact on water quality. In watersheds with less human disturbance, the waterbodies that the land uses supply are generally healthy. In areas that are more developed, the health of the waterbodies they supply tends to decline in proportion to the extent and degree of development.

While both point and non-point sources of pollution contribute to ongoing and potential Impairments in the Pootatuck River Watershed (PRW), this plan is focused specifically on non-point sources of pollution (NPS pollution). Watershed planning of this nature is crucial to addressing NPS pollution. By its nature, NPS pollution is a diffuse issue with many contributing sources and responsible parties across the landscape. Consequently, collaboration and strategic approaches are essential. The CWA does not provide a detailed definition of NPS pollution. Rather, NPS pollution is defined by exclusion—any pollution source not considered a point source (or end-of-pipe) according to the CWA and EPA regulations is NPS pollution.

Runoff from precipitation flowing over the landscape and washing pollutants directly into nearby waterbodies is a key source of NPS pollution. NPS pollution can also come from sanitary sewage disposal issues (e.g., failing septic systems or connections between sanitary sewers and storm sewers); stream instability (excessive erosion or deposition) caused by land use changes, channel modifications or large floods; and atmospheric deposition. Please note that this list is not exhaustive. Examples of NPS pollution include but are not limited to:

- Fertilizers, herbicides and insecticides from agricultural lands and residential areas such as lawns;
- Hydrocarbons (oil and gas), grease, and heavy metals from urban runoff;
- Sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks;
- Salt from road, parking-lot and sidewalk de-icing agents;
- Bacteria and nutrients from livestock, pet wastes, and faulty septic systems;
- Mercury from upwind power generation.

3.1 The Pootatuck River Watershed

As indicated on Figure 2 below and Map 12 on page 50 below, a 15% share of the land in the watershed is developed. While a little over 6% of the land cover across the entire PRW consists of such developments that have been built through impervious surfaces, certain sub-basins of the watershed have impervious surface coverage exceeding 10%. (For specific information on individual sub-basins, please refer to their respective sections 3.5 - 3.8 below.) Agriculture covers 5% of the land in the PRW. The 80% of the watershed that remains alongside these two overall shares of 15% and 5% is predominantly forested, accounting for 56% of the total area. This diverse landscape also includes developed grass and open spaces, wetlands, barren/scrub areas, and water bodies. Historically, agriculture played a significant role in the watershed's land use. While agriculture remains important in the area, its level of production has decreased over time. More recently, there has been a notable increase in development and population growth, marking a transition from a primarily rural community to a suburban one. Agriculture still ranks as the second-highest land use category, underscoring its continued significance to the town.

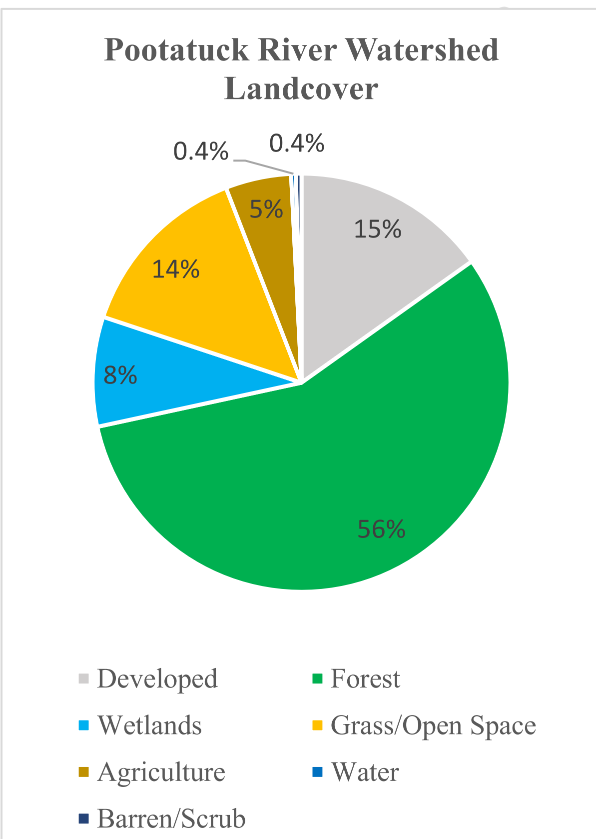


Figure 2. Pootatuck River Watershed Landcover

Impervious cover (IC) refers to surfaces such as pavement or buildings, which are impermeable and do not absorb rainwater. Instead, they collect pollutants and as rainwater runs over them ultimately deliver these contaminants to streams and water bodies. The quantity of IC in a watershed has a direct impact on both water quality and quantity, disrupting the natural hydrological cycle. An increase in the percentage of IC in a watershed is closely linked to decreased stream health. Stormwater runoff from impervious surfaces carries a range of pollutants, including oils, heavy metals, nutrients, bacteria, and sediment[66]. Furthermore, it can lead to temperature variations in receiving water bodies, which can have adverse effects on aquatic ecosystems.

Understanding the dynamics of impervious cover and its associated environmental implications is vital for effectively managing and conserving water resources within the PRW, particularly in light of the evolving land use patterns and development trends in the region. The quantity of stormwater pollutants transported during a rainstorm is positively correlated with the extent of impervious cover (IC) in the watershed.

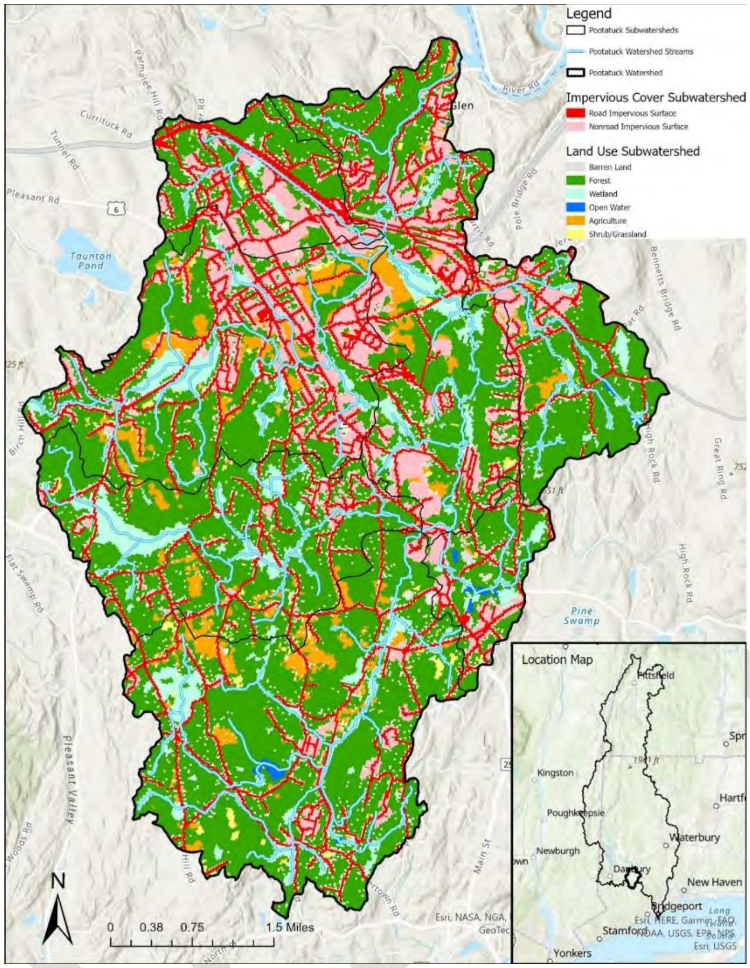
Furthermore, the presence of directly connected impervious areas (DCIA) exacerbates the impact of IC on streams by concentrating runoff into fewer outfalls that ultimately lead to streams. DCIAs are areas of the impervious cover that are hydraulically connected to municipal separate storm sewer systems (MS4) which discharge straight to a surface water. DCIAs usually include streets, sidewalks, driveways, parking lots, and roof tops. An isolated impervious area that is not hydraulically connected to an MS4 or one that otherwise drains to a pervious area would not typically be a DCIA.[67] It is important to note that while IC has been assessed in the Pootatuck River Watershed, the extent of DCIA remains largely unknown and its specific impacts on the Pootatuck River have not been comprehensively studied.

The CT DEEP has conducted studies that highlight the relationship between impervious cover and water quality. The findings from these studies have been instrumental in establishing a TMDL requirement for impervious cover[68]. Given the well-documented connection between IC and water quality impacts, IC serves as a useful proxy for identifying areas where mitigation efforts are needed[69].

The CT DEEP has determined that to maintain healthy habitats for fish, other aquatic life, and wildlife use in these water bodies, an IC area of less than 12% is necessary to limit the effects of stormwater pollution. Stormwater pollution can be categorized into two types: point and non-point sources. Point sources are regulated as a waste load allocation (WLA) under the National Pollutant Discharge Elimination System (NPDES), while non-point sources—or load allocation (LA)—are not subject to specific regulations. However, towns in the watershed can address pollution from non-point sources through their MS4 permits as part of their efforts to meet TMDL requirements.

Distinguishing between stormwater pollution originating from point and non-point sources can be challenging due to data limitations and the variable nature of stormwater pollution in terms of frequency and duration. To account for uncertainties regarding the sources of water quality impacts (point and non-point), a margin of safety of 1% has been subtracted from the target percent IC.

As of the present time, the watershed contains approximately 6-8% IC (depending on the data source) and there is an ongoing goal to reduce impervious surfaces within the area. All three towns within the watershed have established current management activities, which include addressing permitted stormwater sources (e.g., commercial, industrial, construction, and MS4) as outlined in their Stormwater Management Plans (SMPs)—each publicly available online.[70] While each town's stormwater management plans may vary, they tend to incorporate best management practices such as mitigating the impact of impervious surfaces within riparian buffer zones and along the riparian corridor, constructing catchment ponds, and evaluating DCIAs. While impervious cover may not be the sole cause of use impairment to aquatic life, reducing the overall effect of IC within the basin is expected to yield improvements in water quality and support the attainment of use goals for aquatic life.

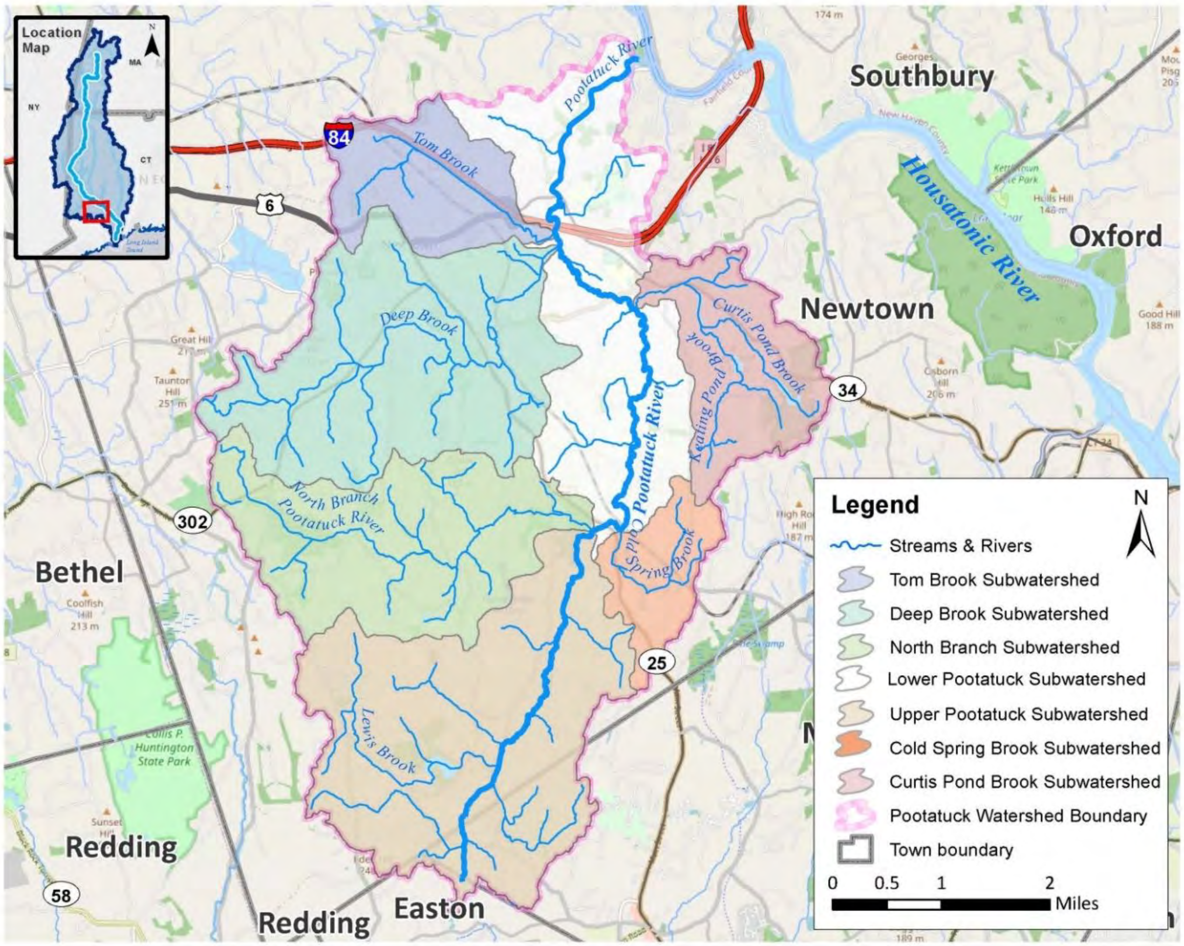


Map 4. Land Use Cover map of Pootatuck River Watershed. Inset map of Pootatuck River Watershed location within Housatonic River Watershed

3.2 Pootatuck River Major Sub-watersheds

The Pootatuck River Watershed (PRW) covers an area of 26.1 square miles with the vast majority of this watershed falling within the boundaries of Newtown. Along all watercourses in the boundaries of Newtown as of 2019, tree canopy has covered 80% of 50-foot riparian buffer zones.[71] The PRW also includes very small portions of two other municipalities, Monroe and to a smaller extent Easton. The PRW can be subdivided into seven distinct sub-watersheds with Deep Brook and Upper Pootatuck being the two largest in terms of area (please refer to Map 5 below for details).

Annually, the PRW receives an average of 50.88 inches of precipitation, which contributes to its overall water resources. As mentioned above, the land cover within the watershed comprises approximately 6% impervious surfaces. However, it is worth highlighting how certain sub-basins within the PRW have impervious surface coverage that exceeds 10%. (For information calibrated for individual sub-basins, please refer to their respective sections 3.5 - 3.8 below.) These specific features provide valuable insights into the characteristics of the PRW, which is essential for understanding its hydrology, land use patterns, and potential environmental challenges.



Map 5. Sub watershed map of Pootatuck River Watershed.

3.3 Deep Brook

The Deep Brook watershed encompasses the area from the confluence with the Pootatuck River to its origin at the outlet dam of Deep Brook Pond. Deep Brook is vital as a designated area for a range of recreational activities, including wading, fishing, boating, and more. Unfortunately, Deep Brook is currently considered unfit for recreational use due to the presence of *E. coli* bacteria as reported in the State of Connecticut's 2010 List of Connecticut Water Bodies that fail to meet state Water Quality Standards (WQS).

Acknowledging the water quality challenges faced by the Deep Brook Watershed, the CT DEEP has taken significant measures to address these issues. Specifically, a TMDL was established for the Deep Brook watershed, following its identification as a priority for TMDL development in 2010. In 2012, the U.S. EPA approved CT DEEP's proposal for a TMDL focused on indicator bacteria in Deep Brook.

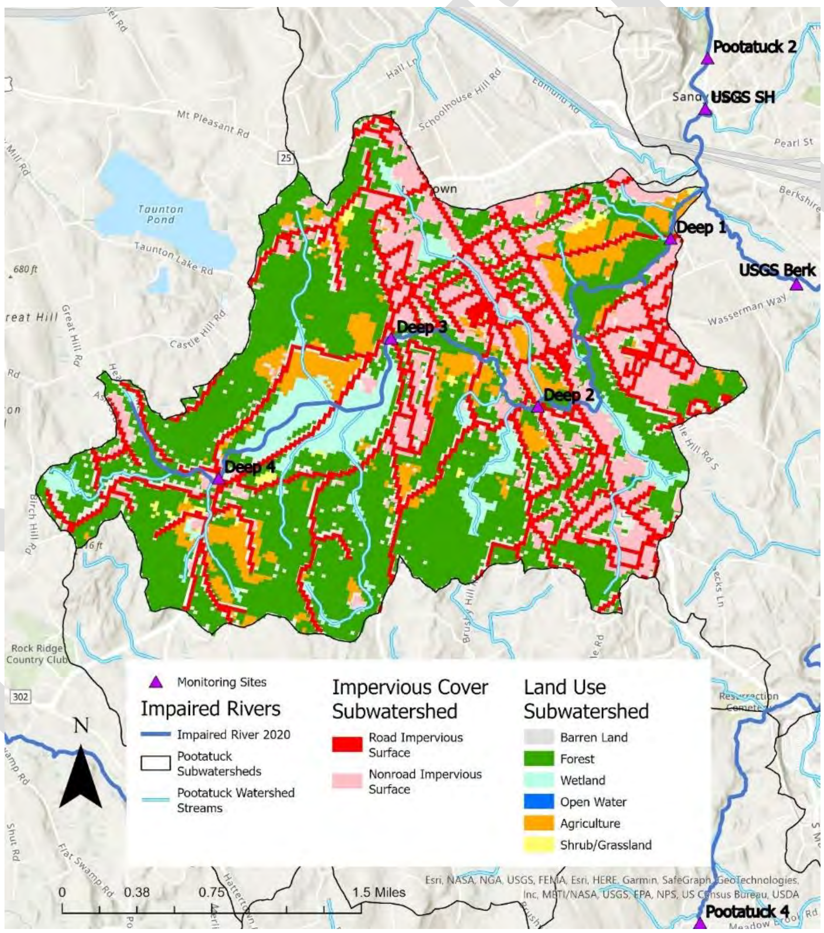
These sources of indicator bacteria are categorized as either unknown or a combination of point and non-point sources (NPS). NPS comprise unspecified urban stormwater, septic systems that have failed, and sources that remain unidentified. For their part among the origins of the indicator bacteria, point sources encompass regulated stormwater runoff, illicit connections or hook-ups to storm sewers, animal waste, and additional sources that are currently unidentified.

Connecticut's WQS stipulate that the geometric mean for indicator bacteria should not exceed 126 colonies per 100 milliliters and the single maximum value should stay below 576 colonies per 100 milliliters. This applies to all recreational uses of freshwater—including "active or passive water-related leisure activities such as fishing, swimming, boating, and aesthetic appreciation."[72] However, during 2017-2019 water samples collected by Harbor Watch—an environmental organization that is a PRP member actively involved in data collection and monitoring in the Deep Brook Watershed—revealed that Deep Brook consistently exceeded these WQS for the geometric mean. This persistent presence of indicator bacteria designates Deep Brook to be unsuitable for recreational use as indicated in Table 4 on page 33 above (under section 2.7). The sources of these indicator bacteria in Deep Brook are diverse and may include unspecified urban stormwater runoff, septic system failures, and other unidentified contributors. Stormwater runoff, illicit stormwater connections, animal waste, and other unknown sources are also potential factors contributing to elevated bacteria levels in the watershed.

The Deep Brook TMDL plan outlines a targeted reduction of 34% in indicator bacteria levels at the monitoring site operated by the CT DEEP, situated at the mouth of Deep Brook. This reduction plan has been in effect through the Housatonic Valley Association (HVA) since 2019 and operates under the framework of the Clean Water Act Section 319 with the primary goal of developing a comprehensive Watershed-Based plan for the Deep Brook basin. This plan aims to address and reduce pollutant loads within the Deep Brook watershed. At the time of the award for the plan, only the Deep Brook watershed was impaired. The larger PRW was determined impaired in subsequent years, when HVA and the Town of Newtown pursued then were awarded additional funds from the Long Island Sound Futures Fund to expand planning to the entire Pootatuck drainage basin.

Deep Brook, a significant tributary located in the eastern region of the PRW, covers an area of approximately 5.35 square miles. This sub-watershed exhibits a diverse range of land uses, reflecting the varied landscape within its boundaries. The headwaters of Deep Brook originate in wooded wetlands on the eastern side of Newtown, whereas another branch begins in the densely developed areas in the center of Newtown (refer to Map 6 below for details). Additionally, the Deep Brook Watershed contains several agricultural areas, which have the potential to influence water quality throughout the region.

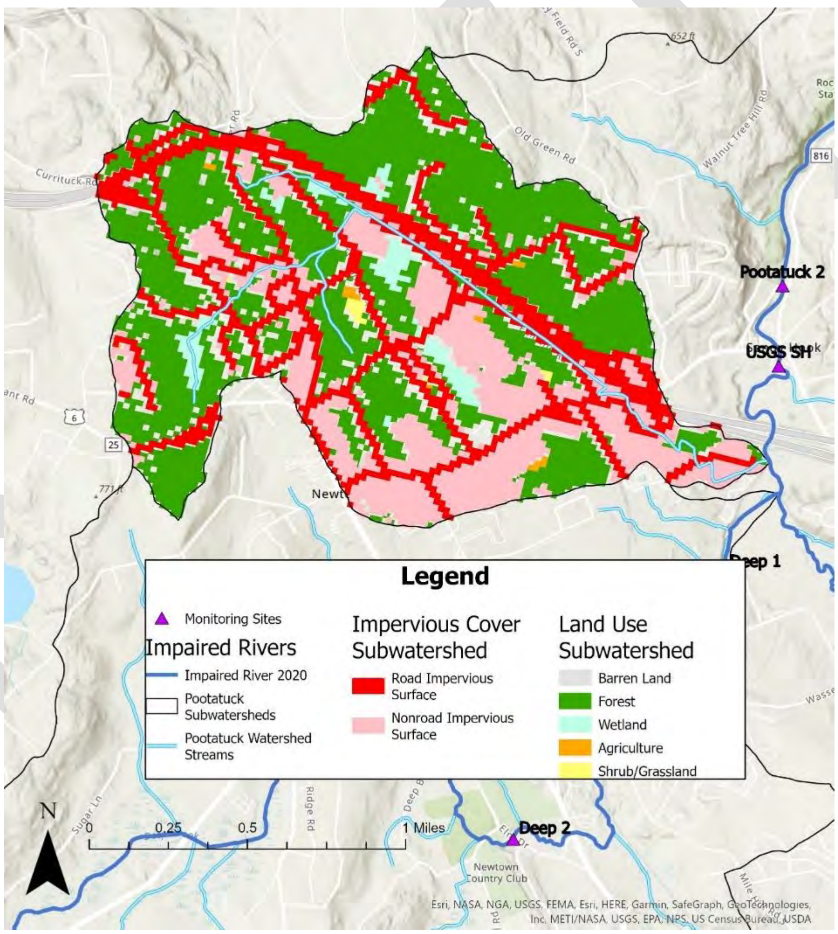
Efforts to monitor water quality in Deep Brook have been undertaken through collaborative initiatives involving multiple non-governmental organizations (NGOs) and the CT DEEP. The CT DEEP contributes to these efforts by periodically releasing an Integrated Water Quality Report to Congress every two years. This comprehensive report assesses the condition of streams, rivers, lakes, and estuaries throughout the state, providing valuable insights into the environmental health and water quality status of these water bodies. In the most recent report, an assessment was conducted on three reaches within the Deep Brook sub-watershed. Among these reaches, two were found to be fully supportive of aquatic life, whereas one reach was identified as not supporting aquatic life. Additionally, one of the reaches was deemed unsuitable for recreational use, while the assessment for the other two reaches in this regard was not conducted or reported (for additional information, please refer to the Mainstem Pootatuck River Section below).



Map 6. Deep Brook Watershed. Land Use Cover, Impervious Cover, and Impaired Waterways.

Furthermore, both the Candlewood Valley Chapter of Trout Unlimited (CVTU) and the Pootatuck Watershed Association (PWA) have actively collected data within the Deep Brook Watershed, encompassing parameters such as water temperature and dissolved oxygen levels. This data collection lacked a Quality Assurance Project Plan (QAPP), indicating that it did not adhere to EPA-approved quality assurance measures during the data collection process. While this data may not be deemed entirely suitable for making conclusive determinations about water quality, it still holds value in guiding future research efforts and informing stakeholders about potential areas of concern within the watershed. Specifically, data has been collected in areas of concern within the watershed, such as the Class 1 Wild Trout Management Area within Deep Brook and the tributary known as Meeker Brook. The data collected in these areas shows that Meeker Brook could be a possible thermal refuge for trout and other aquatic species as water temperatures rise throughout the summer and climate change. Such is just one example as to why all data that has been collected outside of the QAPP is valuable and should be included in some capacity.

3.4 Tom Brook



Map 7. Tom Brook Watershed. Land Cover Use and Impervious Cover.

Tom Brook is a tributary situated in the northern sector of the Pootatuck River Watershed, encompassing an area of 1.87 square miles. When compared to the overall Pootatuck watershed, the Tom Brook watershed exhibits a notably higher percentage of developed land use with a striking 46.5% of its territory categorized as developed, as highlighted in Map 7 below. Additionally, it has a high percentage of impervious surfaces, accounting for 15.5% of its total area. Impervious cover, even as low as ten percent within a watershed, can exert discernible impacts on stream quality. Given this, it is likely that Tom Brook is grappling with some of the consequences associated with impervious cover. A contributing factor to this heightened imperviousness is the presence of Interstate 84, which traverses through the watershed and significantly contributes to the elevated levels of impermeable surfaces.

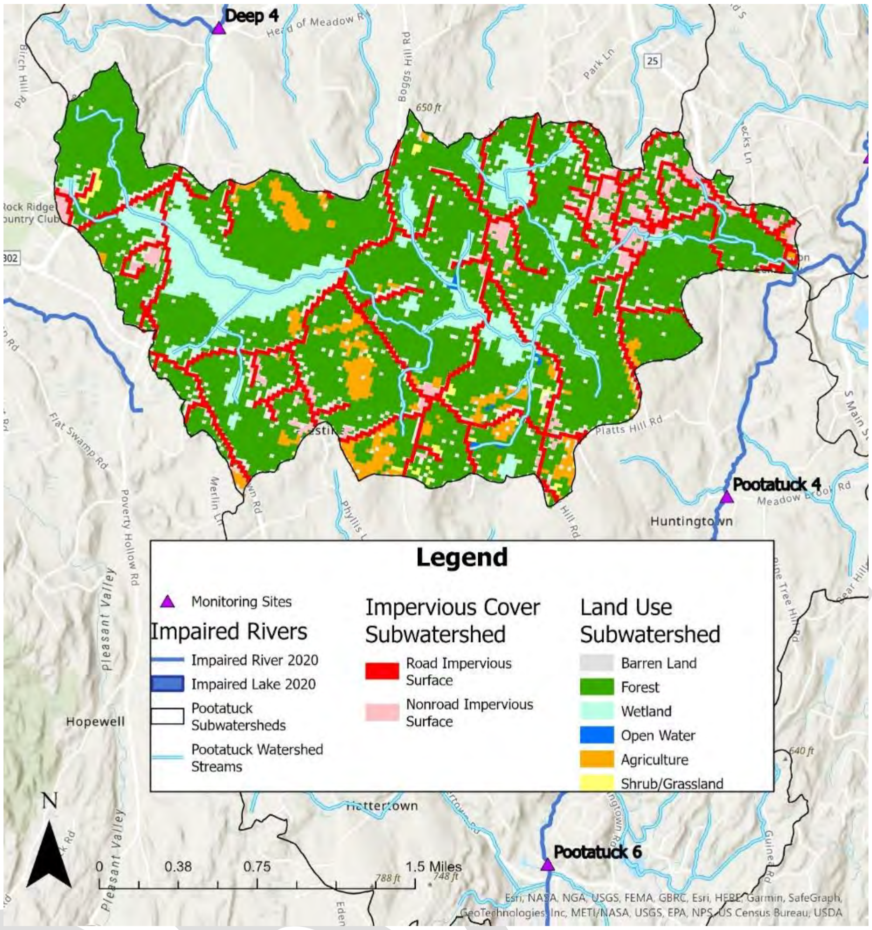
While data specific to Tom Brook remains limited, the elevated proportion of impervious surfaces suggests the potential existence of stormwater runoff issues, which can culminate in adverse effects on water quality within the drainage system. These water quality concerns may subsequently extend to the Pootatuck River. To shed further light on these matters, the Housatonic Valley Association (HVA) has conducted several streamwalks along Tom Brook. Their findings have revealed a multitude of outfalls, providing additional evidence of stormwater-related challenges and the possible occurrence of illicit discharges (For more details, see the online map application: Pootatuck Streamwalks).

3.5 North Branch Pootatuck

The North Branch Pootatuck River watershed is situated in the western sector of the Pootatuck River Watershed, covering an area of 4.13 square miles. In this sub-watershed, approximately 14% of the land has been developed and only 2.2% is classified to be impervious cover, as depicted in Map 8 below.

The notably low percentage of impervious cover within this sub-watershed indicates a relatively low likelihood of issues related to stormwater runoff. Typically, impervious cover levels below 5% tend to have minimal impacts on the environment. It is important to note that a very small portion of the North Branch Pootatuck watershed falls within the South Main Street aquifer protection area, where the North Branch converges with the Mainstem Pootatuck.

While the Housatonic Valley Association (HVA) has not conducted streamwalks in the North Branch Pootatuck sub-watershed as of yet, it is essential to consider future assessments. These assessments could serve as valuable tools for evaluating potential restoration projects and identifying opportunities for environmental protection. The combination of low development and a significant expanse of forested land along the river makes this sub-watershed particularly promising for conservation and restoration efforts.



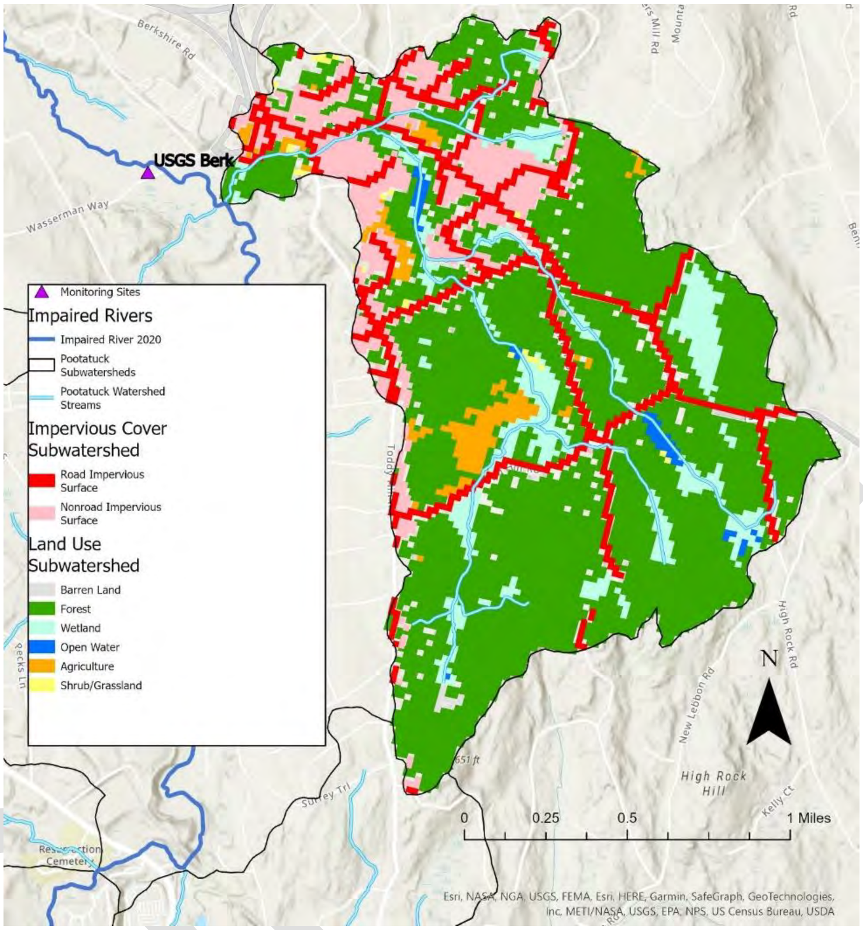
Map 8. North Branch Pootatuck River Watershed. Land Cover Use and Impervious Cover.

3.6 Curtis Pond Brook

The Curtis Pond Brook watershed is located in the northeastern segment of the Pootatuck watershed and spans an area of approximately 2.17 square miles, as illustrated in Map 9. Additionally, Keating Pond Brook contributes to Curtis Pond Brook's flow in the northern region of the watershed.

Within the Curtis Pond Brook watershed, approximately 20% of the land has undergone development and a mere 4% is classified as impervious area. Interestingly, this modest extent of impervious cover is predominantly concentrated near the confluence of Curtis Pond Brook with the Pootatuck River. As a result, the impacts associated with impervious cover are likely restricted to this particular area, whereas the remainder of the watershed—characterized by limited impervious surfaces—is expected to experience minimal environmental effects. Relatedly, the mouth of Curtis Pond Brook exhibits the highest degree of development, whereas the headwaters primarily consist of forested terrain.

To gain a more comprehensive understanding of Curtis Pond Brook and its environmental condition, the Housatonic Valley Association (HVA) conducted a single streamwalk along Curtis Pond Brook, starting from the confluence with the Mainstem Pootatuck River and extending upstream through the developed area.



Map 9. Curtis Pond Brook Watershed. Land Cover Use and Impervious Cover.

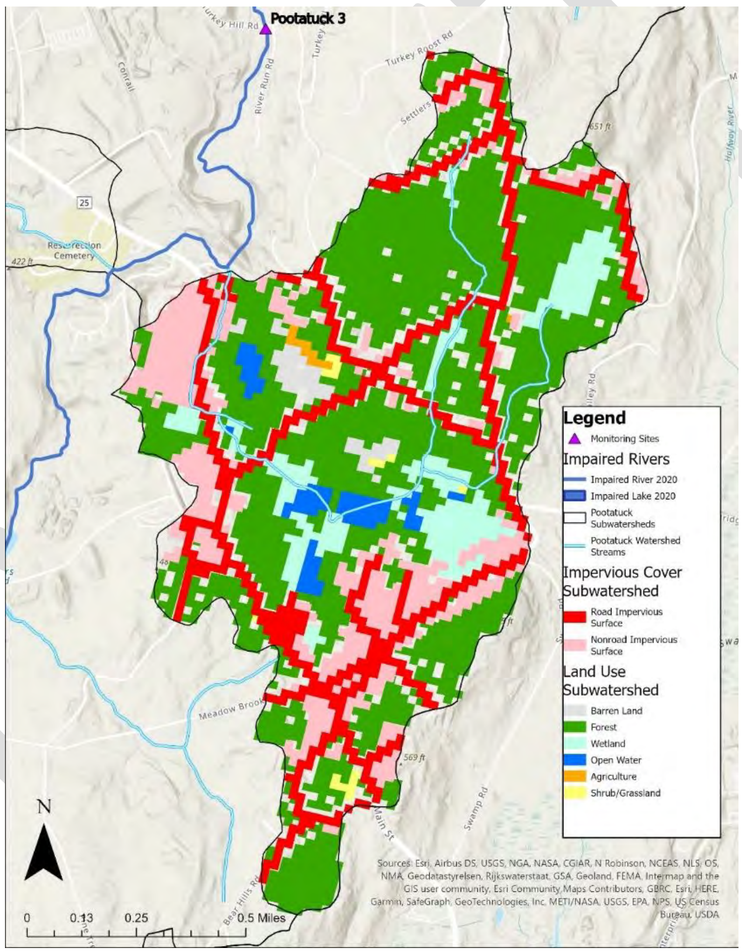
3.7 Cold Spring Brook

The Cold Spring Brook watershed, situated in the southeastern part of the Pootatuck watershed, encompasses an area of approximately 1.12 square miles, as depicted in Map 10 below. This specific watershed has undergone a notable level of development, with approximately 29.9% of its land classified as developed, including 9% designated as impervious surface across its entire expanse.

Notably, the western and southern regions of the watershed are characterized by high levels of development, featuring numerous shopping centers and expansive parking lots. The percentage of impervious surface within the watershed is approaching a critical threshold where more pronounced effects on water quality may become evident. Generally, impervious surfaces exceeding ten percent tend to exert notable impacts on stream quality.

It is important to highlight that a portion of the watershed falls within the South Main Street aquifer protection area[73]. In this area, the landscape has been significantly developed, leading to the creation of impervious surfaces that impede groundwater infiltration and the recharge of the aquifer. Moreover, the watershed boasts several sizable ponds and is surrounded by marginal wetland habitats.

Although the Housatonic Valley Association (HVA) did not conduct streamwalks within this specific watershed, use of desktop analysis could serve as a valuable tool for identifying stormwater outlets and assessing potential impacts stemming from the surrounding development.



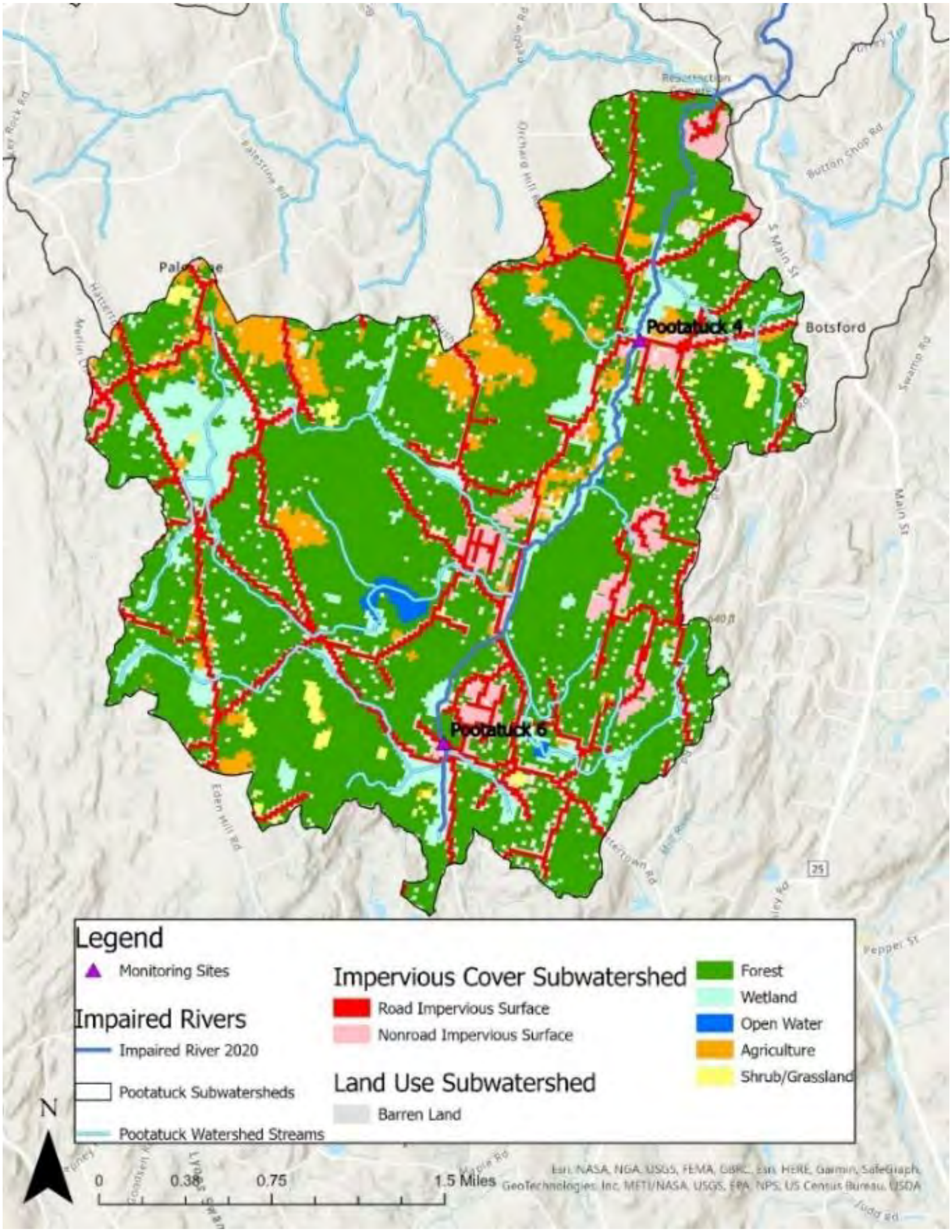
Map 10. Cold Spring Brook Watershed. Land Cover Use and Impervious Cover.

3.8 Mainstem Pootatuck

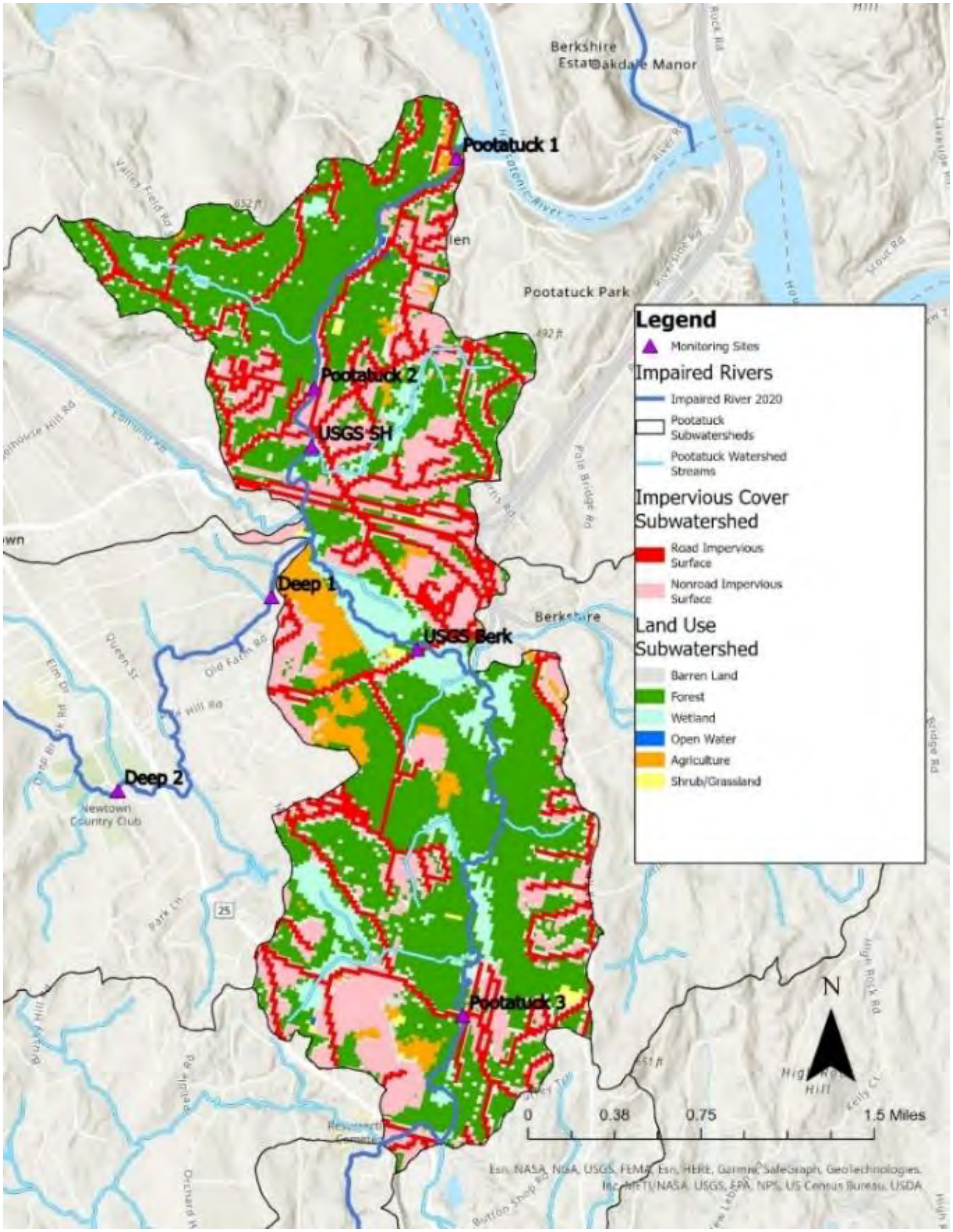
The Mainstem Pootatuck River is the central and largest segment of the Pootatuck River Watershed (PRW). It meanders through a diverse landscape, covering a substantial portion of the watershed's territory. With a drainage area encompassing 10.6 miles, this vital waterway begins near the Monroe-Newtown border and winds its way northward through Newtown, ultimately converging with the Housatonic River in Sandy Hook.

The Mainstem Pootatuck River serves as a critical resource for the Town of Newtown and the broader Housatonic Valley. It offers numerous recreational opportunities, including fishing and hiking, making it a cherished asset for the community. Furthermore, this river provides invaluable habitat for species of concern such as the Eastern Brook Trout (*Salvelinus fontinalis*) and the Wood Turtle (*Glyptemys insculpta*).

Despite its importance, the Mainstem Pootatuck River faces its share of challenges, including non-point source pollution, which results from rainwater and snowmelt moving over and through the ground. As of the most recent Integrated Water Quality Report to Congress in 2022, certain segments of the Mainstem Pootatuck River have been identified as impaired for Aquatic Life and/or Recreation due to specific pollutants. When a water body is labeled as impaired, states identify the pollutant(s) responsible for this impairment and develop TMDLs to address the issue. Watershed-Based Plans are recognized as effective tools to achieve the pollutant load reductions prescribed by TMDLs.



Map 11. Upper Pootatuck. Land Cover Use and Impervious Cover.



Map 12. *Lower Pootatuck Watershed. Land Cover Use and Impervious Cover.*

IV. WATERSHED MANAGEMENT

4.1 Watershed management

In addition to the physical, chemical, and natural characteristics of the watershed, the human impact, organizations, and laws governing the area have a significant influence on its overall health. The enactment of the Clean Water Act in 1972 marked a pivotal moment in improving water quality not only in Connecticut but also across the United States. Since then, there has been a remarkable improvement in water quality throughout the watershed, state, and nation. Congress chose not to address non-point source (NPS) pollution through a regulatory approach, unlike its actions with "point" sources. However, CT issues a Municipal Separate Storm Sewer System (MS4) General Permit that essentially regulates urban stormwater systems as point sources. Communities containing designated "Urbanized Areas" (as determined by the United States Census) discharging stormwater via a separate storm sewer system to surface waters of the state are required to follow the guidelines of the MS4 General Permit. There are two such MS4-permitting towns in the Pootatuck River Watershed (PRW), Newtown and Monroe.

It is worth noting that the PRW is primarily situated within the town of Newtown, which means that the management of the watershed is largely the responsibility of its local authorities. While State and Federal agencies play vital roles in overseeing and regulating water quality, the Town of Newtown plays a crucial role in managing and protecting the watershed within its boundaries.

This collaborative effort between local, state, and federal entities underscores the importance of comprehensive watershed management to ensure the continued health and sustainability of this vital natural resource. The success of such efforts relies on a coordinated approach that considers both the natural environment and the human factors that affect the watershed.

Newtown, itself primarily located within the PRW, has undertaken several environmental management initiatives. These measures aim to address both stormwater management and flood risk mitigation.

Newtown falls under the Municipal Separate Storm Sewer Systems (MS4s) designation, determined by population density. This designation is in line with the U.S. Environmental Protection Agency's (USEPA) Stormwater Phase II rules introduced in 1999, with Newtown's participation commencing in 2004. The MS4 General Permit mandates municipalities to take proactive steps in ensuring that stormwater entering the storm sewer systems is free from contaminants before it reaches water bodies.

The permit's requirements include municipal registration for permit coverage, development and implementation of a comprehensive Stormwater Management Plan, and the annual monitoring of six stormwater outfalls during rainstorms. The Stormwater Management Plan, a crucial component, encompasses information on stormwater systems and municipal infrastructure. It also outlines Best Management Practices (BMPs) aimed at reducing pollutant discharge through storm sewer systems, striving to achieve the Maximum Extent Practicable (MEP) standard set by the EPA. The MEP standard involves an iterative process that requires municipalities to continually develop, implement, evaluate, revise, and enhance their programs to meet water quality requirements. To date, the most recent round of this MS4 process that the Town of Newtown currently reports to the public is from 2021.[74]

The BMPs in the Stormwater Management Plan are categorized into six areas: public education and outreach, public participation, illicit discharge detection and elimination (IDDE), construction stormwater management, post-construction stormwater management, and pollution prevention and good housekeeping. While certain BMPs are mandatory, the permit allows for the implementation of additional BMPs at the discretion of the MS4, particularly when addressing pollution issues. To date, the most recent round of this stormwater-management planning that the Town of Newtown currently reports to the public is from 2021.[75]

Currently, the PRW benefits from various funding sources to support environmental initiatives. Notably, funding from the Long Island Sound Futures Fund is currently allocated for the development of a watershed-based plan for the entire Pootatuck Watershed. Deep Brook also receives funding through a CWA Section 319 grant. In the past, the EMBRACE-A-Stream grant program that the Candlewood Valley Chapter of Trout Unlimited (CVTU) administers focused on water quality and salmonid conservation projects within the Deep Brook and Pootatuck Watershed. These funds have been instrumental in habitat restoration and water temperature studies, contributing to the overall health of the watershed.

V. CLIMATE RESILIENCY TO FLOODING

5.1 Flooding

The Town of Newtown has experienced flooding throughout every season in its recorded history. Spring rain, snowmelt, tropical storms, winter rain on frozen ground, and torrential rainstorms have resulted in flooding events in Newtown. As noted by the hazard mitigation plan, flooding problems are most concentrated around the Pootatuck River. High risk areas include areas around Turkey Hill Road, Nearbrook Drive, and Meadow Brook Drive, with minor flooding often occurring throughout the remaining watershed.

According to the NOAA National Center for Environmental Information (NCEI), there have been 27 flooding and 128 flash flooding events since 1990 in Fairfield County. Tropical storm Irene is one of the more well known events that resulted in historic flooding in recent history, but throughout the years various severe thunderstorms and tropical storms have resulted in significant flooding throughout the PRW.

2. Hazard Mitigation Plan: Newtown has developed a Hazard Mitigation Plan with the primary goal of safeguarding lives and minimizing damage to property, infrastructure, and local resources during natural disasters. In this plan, particular attention is given to flood risk reduction within the PRW. Past events like Hurricanes Irene and Sandy, which led to significant flooding, prompted the town to take proactive measures.

Despite significant flood-control projects, flood risk remains a concern within the watershed. FEMA-designated flood areas, including 100-year and 500-year flood zones, cover substantial portions of the PRW. Participation in the National Flood Insurance Program (NFIP), administered by FEMA, helps assess flood risk, establish development regulations in floodplains, and provide federally subsidized flood insurance to property owners.

The Town of Newtown has experienced flooding throughout every season in its recorded history. Spring rain, snowmelt, tropical storms, winter rain on frozen ground, and torrential rainstorms have resulted in flooding events in Newtown. As noted by the hazard mitigation plan, flooding problems are most concentrated around the Pootatuck River. High risk areas include areas around Turkey Hill Road, Nearbrook Drive, and Meadow Brook Drive, with minor flooding often occurring in the remaining watershed.

VI. WATER QUALITY

6.1 Drinking Water and Groundwater

Clean water is essential to life expectancy and quality of life for humans, other animals, and plants. For humans, the health of surface and groundwaters directly impacts our drinking water supplies, food and fiber production, and recreation opportunities.

Aquifers provide a finite supply of water. Recharging of these supplies is dependent on annual precipitation as well as the water's ability to infiltrate the Earth's surface.

Drinking Water Sources

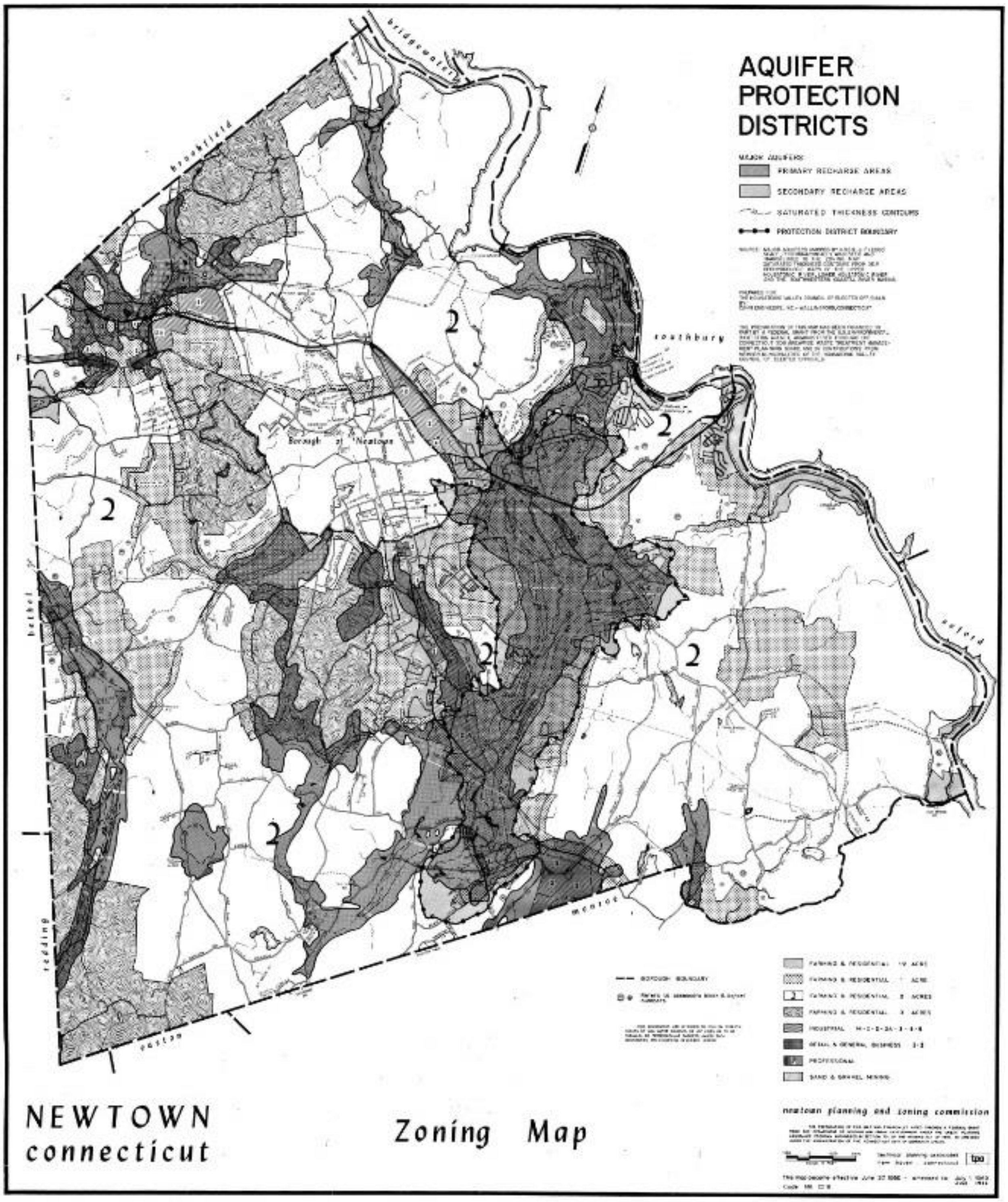
Community members who live within the PRW source their drinking water solely from a groundwater supply out of two wellfields that the Town of Newtown designated as parts of Aquifer Protection Districts (APDs) then the State of Connecticut and the U.S. EPA designated as parts of two Aquifer Protection Areas (APAs) of a combined Pootatuck Aquifer. These water sources are pumped from stratified drift deposits—which are also known as sand-and-gravel deposits—then the water is stored and disinfected before being delivered to homes and other sites where the water is also consumed. As shown in map 13 below, the Town of Newtown designated its APDs that overlap with the drainage basin of the Pootatuck River from 1959 to 1976. The state and federal governments designated the two Pootatuck APAs and their combined Pootatuck Aquifer at the turn from the late 1980s to the early 1990s in response to a petition from State Representative Mae Schmidle of the 106th District of Connecticut.

The CT DEEP Groundwater Classification data classifies the PRW as supporting both GA and GAA groundwater classifications, which are defined in table 4.3.1 below.[76]

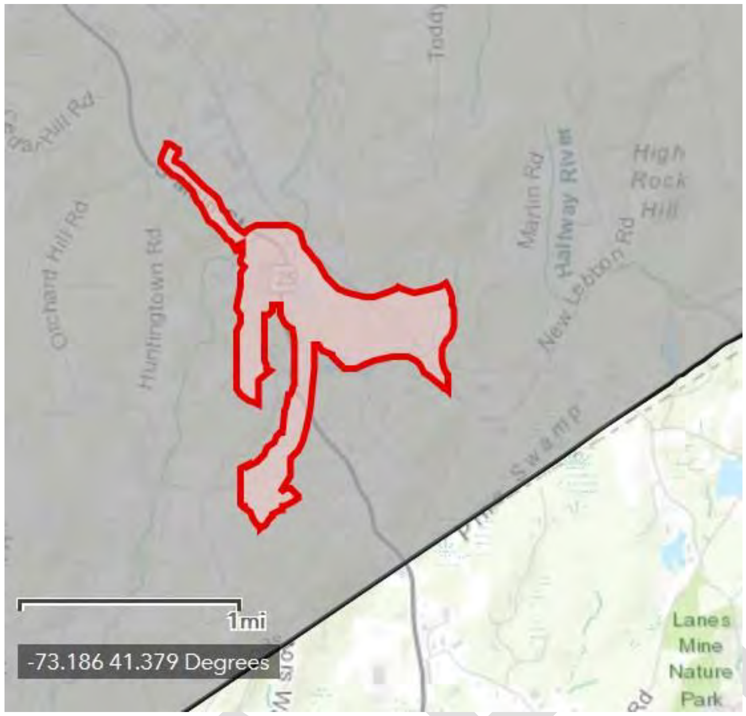
Table 7. CT DEEP Groundwater Classifications in Pootatuck River Watershed

Value	Definition of designated uses
GA	Existing private and potential public or private supplies of water suitable for drinking without treatment; baseflow for hydraulically connected surface water bodies.
GAA	Existing or potential public supply of water suitable for drinking without treatment; baseflow for hydraulically connected surface water bodies.

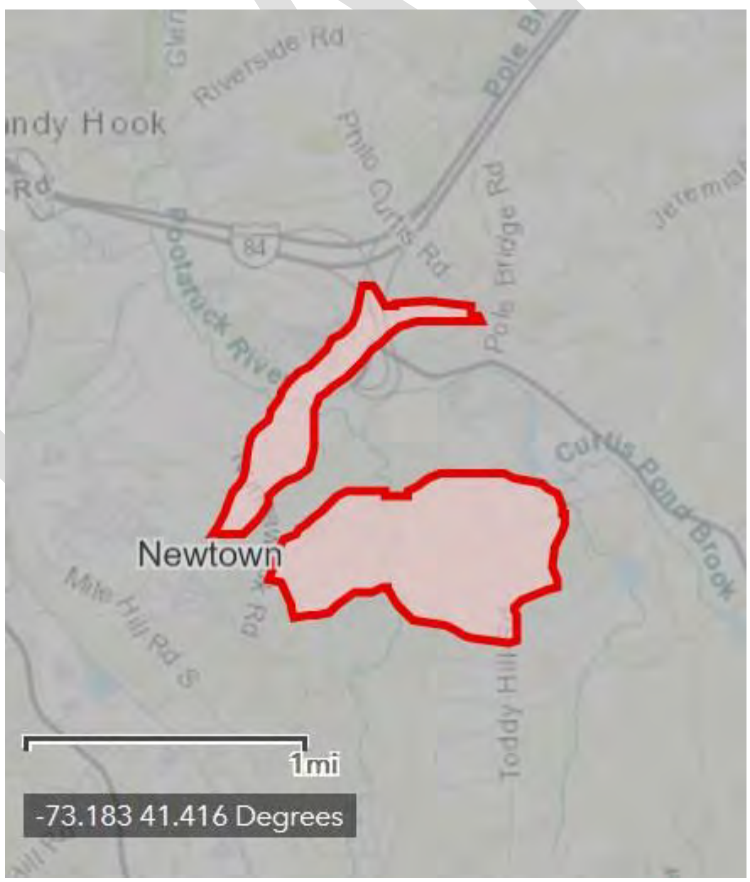
Under the Connecticut Aquifer Protection Program, the wellfields were mapped to Level B standards at the turn from the late 1980s to the early 1990s then to Level A standards during the 2010s. Aquifer maps charted at Level B depict preliminary aquifer recharge and areas that contribute to public water supplies. Aquifer maps charted at Level A such as those shown for each of the Pootatuck APAs in maps 14 and 15 below are based on detailed hydrogeologic analysis of aquifer recharge and of areas that contribute to public water supplies. In most mapping projects submitted to the CT DEEP, areas mapped at Level A have turned out to be smaller than those preliminarily mapped at Level B.[77]



Map 13. *Newtown Aquifer Protection Districts (APDs)*[78]



Map 14. *South Main Street Aquifer Protection Area (APA)*[79]



Map 15. *Fairfield Hills Aquifer Protection Area (APA)*[80]

Whereas the state aquifer protection program designates lands and surface waters relatively close to the wellheads of public water supplies into its areas, the Newtown aquifer protection program designates lands and surface waters that extend farther outwardly from the wellheads into its districts, which cover a town geographic area approximately five times wider than those of the APAs.[81]

According to a Natural Resource Inventory that the Town of Newtown completed in 2011, "there are no viable alternative sources of sufficient supply; the boundaries of the designated area and project review area have been reviewed and approved by EPA; and, if contamination were to occur, it would pose a significant public health hazard and a serious financial burden to the area's residents."[82] Specifically, the Inventory reviews how the "wellfields are located within stratified drift deposits consisting of alluvial floodplains with both hydric and nonhydric soil designations."[83]The Pootatuck Aquifer is the source for the system of the business Aquarion Water Company—a member of the PRP—that supplies water to central Newtown, Mount Pleasant Road, Sandy Hook Center, and South Main Street. The aquifer is also the source for the Town-owned water system that supplies the Fairfield Hills area and the state Garner Correctional Institution in Newtown.[84] Whereas the private Aquarion maintains a wellfield that supplies public water from an area off South Main Street, it also supplies public water from a wellfield that is currently owned by the Town of Newtown at an area located near the former campus of Fairfield Hills Hospital.

6.1.1 **Drinking Water Threats and Protection**

Counted as of the most recent publicly available reports from 2003-2009, more than 1,150 Newtown households have relied on the Pootatuck Aquifer as their sole source of drinking water.[85] Another reason why groundwater contamination is more of a threat than usual for community members in the drainage basin is due to the Pootatuck Aquifer's "relatively high permeability and its shallow water table, which is recharged mainly from precipitation that percolates from… land surfaces lying within the aquifer's watershed."[86]

While the municipal aquifer regulations that Newtown has instituted apply only to proposed activities, those that the State of Connecticut has established also regulate some existing activities. The town's aquifer rules prohibit land uses that can contaminate groundwater and "also regulate certain other land uses that may have the potential to contaminate groundwater."[87] The state regulations restrict development of certain new land use activities that use, store, handle or dispose of hazardous materials as well as "require existing regulated land uses to register and follow best management practices."[88]

To achieve the greatest public health protection, groundwater throughout the PRW must be protected. The APA off South Main Street has a protection area of approximately 336 acres and the APA at Fairfield Hills has a protection area that spans approximately 370 acres.[89] Based on the EPA designation of these

APAs, any projects proposed for construction or modification within the PRW that seek federal financial assistance are subject to EPA review for the purpose of reducing the risk from the projects contaminating ground water.[90] Albeit with all the due outdating caution of a dozen years that have passed since the Town of Newtown—another PRP member—published it in 2011, a major Natural Resource Inventory is still worth referencing at length where it also reviews how Connecticut regulations at the State level have been applied to the APAs in the Pootatuck Aquifer:

> “As required by the Safe Drinking Water Act Amendments of 1996, DPH [(the CT Department of Public Health)] and DEEP have completed source water assessments for all public water supplies in the State of Connecticut. Assessments were completed for the [South Main Street] and Fairfield Hills wellfields in the past few years, and Source Water Assessment Reports were published in 2004. As stated in the reports, the assessments can be used to target and implement enhanced source water protection measures such as inspections, land use regulations, land acquisitions, septic system maintenance, and education.
>
> The [South Main Street] wellfield has a ‘low’ rating for environmental sensitivity (indicating that the source water area is not sensitive) based on proper well construction and the absence of contaminants; a "moderate" rating for potential risk factors (indicating that the source water area has low risk) based on the amount of developable land in the source area and the presence of potential contaminant sources; and a ‘high’ rating for source protection needs based on the fact that the 200-foot sanitary radius around each well is not fully controlled, although local aquifer protection regulations are in place. The overall susceptibility is ‘moderate.’
>
> The main listed strength is that local aquifer protection regulations are in place. Recommendations of the source water assessment report include completing the Level A mapping [that has since been completed as mentioned above], monitoring commercial and industrial activities, working with local officials to ensure that only low-risk development occurs in the source water area, and acquisition of open space in the source water area.
>
> The Fairfield Hills wellfield has a ‘low’ rating for environmental sensitivity (indicating that the source water area is not sensitive) based on proper well construction and the absence of contaminants; a "low" rating for potential risk factors (indicating that the source water area has low risk) based on the amount of developable land in the source area and the presence of potential contaminant sources; and a "moderate" rating for source protection needs based on the fact that less than 10% of the land in the source area is preserved open space, although local

aquifer protection regulations are in place. The overall susceptibility is 'low.'

The main listed strengths are that local aquifer protection regulations are in place and that commercial and industrial land uses comprise less than 10% of the source area. Recommendations of the source water assessment report include completing the Level A Mapping [that has since been completed as mentioned above], monitoring commercial and industrial activities, working with local officials to ensure that only low-risk development occurs in the source water area, and acquisition of open space in the source water area."[91]

Among the attributes of the PRW that the Town of Newtown inventoried as important are how its GA/GAA groundwater serves as the source for public supply wells and how several of its impaired surface waterbodies contribute to public water supply areas.[92] The Newtown Inventory highlights the APAs as important features of the PRW; recommends that both of them be protected through such best management practices as sound engineering and low-impact development; and also recommends that public water supply watershed lands be protected through acquisition, regulation and/or restriction.[93] Indeed, the Inventory deems it as important for the Town of Newtown to "regulate development within these APAs for long-term protection of ground water quality and production" as well as recommends that "any proposed development within these zones should be designed using Low Impact Development (LID) practices." [94]

According to a 2021 Water Quality Report that the Aquarion Water Company publicizes, the Newtown "water has been tested for more than 100 compounds that are important to public health. Only 16 of these were detected, all of which were below the amounts allowed by state and federal law. Most of these compounds are either naturally occurring or introduced as treatment to improve water quality. Monitoring frequency varies from daily to once every nine years per EPA regulation, depending on the parameter. [Aquarion's] testing encompasses the full range of regulated inorganic, organic and radiological compounds and microbiological and physical parameters." [95]

In 2019, the private utility Aquarion voluntarily began a program testing water for six among a wider set of chemicals called per- and polyfluoroalkyl substances (PFAS) in its 72 public water systems across Connecticut. As detailed in table 8 below, test results for the Newtown system that provides most of the public water supply in the PRW have shown PFAS concentrations ranging as follows at points of entry where samples were collected after treatment—as water enters the distribution system before the first customer.

- For each among six chemicals tested: from not detected to 5 parts per trillion (ppt) on any one of the three sample locations tested—Newtown Wells, Sandy Hook Wells #1/#3/#10 or Sandy Hook Wells #7/#12A/#13/#14;
- For the cumulative or combined sum across the six chemicals tested: from 3ppt out of Sandy Hook Wells #1/#3/#10 through 8 ppt out of Sandy Hook Wells #7/#12A/#13/#14 to 18 ppt out of Newtown Wells.

These results have all been well below the advisory maximum limits of 70 ppt that the guidelines of the Connecticut Department of Public Health (DPH) and the U.S. EPA have advised to date, but that is subject to change as there have been current policymaking processes concerned with PFAS at both the state and federal levels.[96]

Table 8. Newtown PFAS Sampling Results in Parts per Trillion (ppt) at Points of Entry[97]

Sample Location	PFOA	PFOS	PFHpA	PFHxS	PFNA	PFBS	Combined sum of 6 PFAS tested
Newtown Well	5	5	3	2	Not detected	3	18
Sandy Hook Wells #1/#3/#10	Not detected	Not detected	Not detected	Not detected	Not detected	3	3
Sandy Hook Wells #7/#12A/#13/#14	4	Not detected	2	Not detected	Not detected	2	8

As tables 8 above and 9 below show, a third (6) of these (18) test results would exceed Maximum Contaminant Levels (MCLs) and/or Maximum Contaminant Level Goals (MCLGs) of a PFAS National Primary Drinking Water Regulation that the U.S. EPA has proposed since March of 2023. As of early January of 2024, this proposed PFAS regulation does not require any actions while it appears to not yet have been finalized—although at the time of proposal the EPA had anticipated finalizing it by the end of 2023.[98]

Table 9. U.S. EPA-Proposed PFAS National Primary Drinking Water Regulation[99]

Compound	**Proposed MCLG**	**Proposed MCL (enforceable levels)**
PFOA	Zero	4.0 parts per trillion (also expressed as ng/L)
PFOS	Zero	4.0 ppt
PFNA	1.0 (unitless) Hazard Index	1.0 (unitless) Hazard Index
PFHxS		
PFBS		
HFPO-DA (commonly referred to as GenX Chemicals)		

The environmental nonprofit organization Environmental Working Group (EWG) also reports on compliance with legally-mandated, health-based federal standards for drinking water in at least the case of the Fairfield Hills APA. While the EWG verifies this wellfield to have been consistently complying with these standards in the most recent assessments (from April 2019 to March 2021), it also reports that seven (7) of eleven (11) contaminants in this drinking water exceed the EWG's health guidelines. The EWG reports six of them to be carcinogenic and the other one to be harmful to the brain and nervous system. The three contaminants that the EWG reports to most exceed its health guidelines are: haloacetic acids (HAA5, by 24 times), total trihalomethanes (TTHMs, by 9.2 times), and bromodichloromethane (by 8.8 times). Haloacetic acids (HAA5) are a contaminant group that includes monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid and dibromoacetic acid. Total trihalomethanes (TTHMs) as another contaminant group include bromodichloromethane, bromoform, chloroform and dibromochloromethane.[100]

To date this planning process has only been able to find one set of existing studies that contribute conclusive knowledge as to a single cause from a likely multi-causal array of reasons why harmful chemicals have been detected in these sources of drinking water; causes which could also serve as guides toward how Pootatuck groundwater sources can be protected most effectively.

A relatively well-known and -studied cause of Pootatuck groundwater contamination has been a U.S.-EPA superfund site that has been undergoing a Connecticut-state-led environmental cleanup over a period of several years.[101] In this groundwater contamination, a former factory of a Canadian-based mining business named Noranda Metal Industries that is also known as Noranda Forge Fin polluted a part of the Newtown aquifer protection districts (APDs)—a site located between rather than within the two Pootatuck state aquifer protection areas (APAs).[102] The hazardous Newtown site has been going through two rounds of remediation since 1989 to clean up a chronic release of the toxic solvent trichloroethylene (TCE) during "the 1950s and 1960s through a hole positioned in the floor of the Noranda factory, which led to an underlying dry well" at a riparian location that drains down to the "Mile Hill Road South wetland, which in turn is drained by a stream" that is an unnamed tributary to Deep Brook.[103] Being a volatile organic compound similar to a dry-cleaning fluid, the TCE was used as a toxic degreasing solvent during the metal-cleaning phases of the property's manufacturing processes then released along with the dirt it dissolved. The chronic releases in substantial volumes are estimated to have reached hundreds of gallons, creating a contaminated industrial site that has extended into a contaminated adjacent wetland.[104] The property is also off of a mixed-use commercial and residential corner, in which the main source area for the pollution is less than an acre whereas the area of the groundwater contaminant plume is estimated to stretch for 15 acres that also outsize the 12-acre property of the former facility itself.[105]

That said, there is a need for further research into additional causes why harmful chemicals have been detected in these Newtown sources of drinking water and there are a few leads that a potential pollution track-down program with any opportunity to also assess contamination of groundwater along the way might already share and/or consider.

One of these prospects would be for the PRP to encourage concerned scientists or public intellectuals to conduct applied research into any long-term toxic impacts from the historical sites of Newtown’s feldspar and mica mines,[106] where contaminants might have percolated the groundwater given how studies show that “hazardous chemicals, such as mercury, crystalline silica, carbon monoxide, diesel or hydrocarbon fumes, cyanide, and mica, associated with mining are harmful to health.”[107]

A more recent and better known potential source of groundwater contamination has been located across the road—namely, Glen Road—from the lower mainstem Pootatuck River at a segment where it borders Rocky Glen State Park.[108] Its pollution is from metal machining operations on cast iron and steel that a local business named R.S Watkins & Sons manufactured at this site from the early 1930s until 1974 then from the welding as well as brass wire drawing and annealing operations that the business added that year and continued to operate until 1990. To date the levels of groundwater contamination at this hazardous site have been lower than the limits that would otherwise require their remediation. However, the remediation process that the Town of Newtown has been leading at the property recommends post-remediation groundwater monitoring of potentially undetected impacts on a site assessed to drain toward the Pootatuck River and zoned within the Newtown APDs, albeit north of the two Pootatuck state APAs.[109]

Another possible groundwater pollution trackdown would assess how at a minimum most or more specifically three sites of the five Newtown locations where the CT DEEP has listed “significant environmental hazards reported” to the agency over the recent quarter century between 1998 and 2023 turn out to be within the Newtown APDs as well as the two Pootatuck APAs for the pair of public wellfields. The CT DEEP has listed these three sites as:

- a gas station placed on 151 South Main Street where “pollution was detected in a drinking water well above standards;”
- an office park located on 153 South Main Street where “pollution in the top two feet of soil may pose a risk to human health as a result of direct contact;”
- and a former hospital situated on 20A Mile Hill Road where “pollution in the top two feet of soil may pose a risk to human health as a result of direct contact” as well.[110]

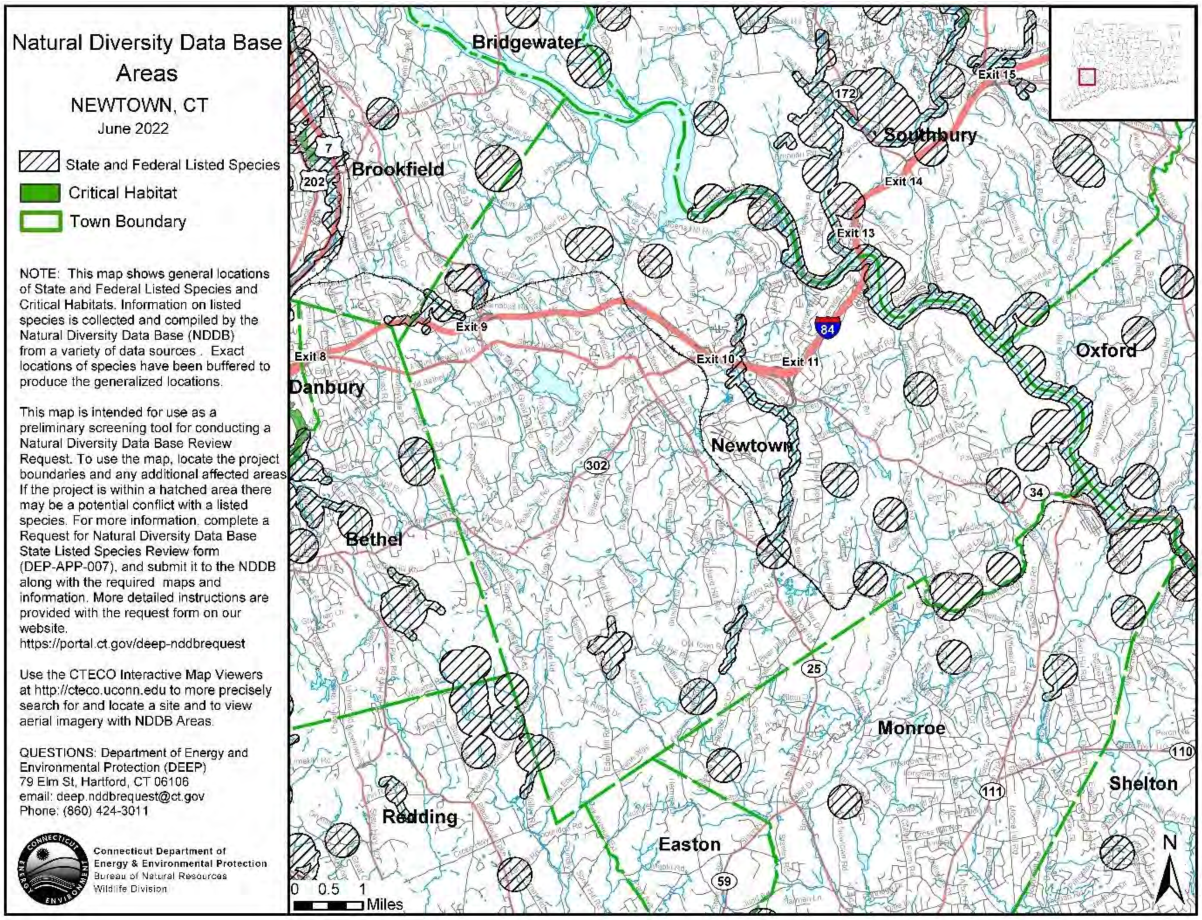
In an outreach collaboration with the Candlewood Valley Chapter of Trout Unlimited (CVTU) and the Town of Newtown that has also briefly reviewed the Noranda superfund site, the Pootatuck Watershed Association (PWA) has presented a documentary that has also promoted public awareness of two potential component parts of groundwater contamination that may accumulate into this third, hospital hazard. These two features are the more recent heating oil spills onto the Deep Brook sub-watershed next to the Fairfield Hills area as reviewed in section 2.7 above and earlier use of an organophosphate insecticide named Dieldrin at the site of the former Fairfield Hills Hospital prior to the U.S. EPA's 1987 ban on its applications.[111]

VII. NATURAL HERITAGE

7.1 Natural Heritage

Despite the impacts of agriculture and urban development in the PRW, the region survives as one where there is a considerable number of notable species and habitats of conservation concern. The CT DEEP's Natural Diversity Data Base (NDDB) identifies areas in the state that are home to ecologically important natural communities and species federally and/or State listed for protection from risks of extinction. As map 13 below shows, these areas of the PRW include:

- the Mainstem of the Pootatuck River from the confluence of the North Branch Pootatuck to Rocky Glen State Park.
- the Mainstem Pootatuck above Cogers Pond.
- the confluence of Morgan Brook and the Pootatuck River.
- the headwaters of Lewis Brook in Monroe.
- the headwaters of Lewis Brook in Newtown.
- the headwaters of Keating Pond Brook.[112]



Map 13. Natural Diversity Data Base Area of Newtown and Surrounding Area. Map depicts areas where State and Federally Listed Species are found.

7.2 Terrestrial Natural Heritage

The PRW is similar to other watersheds in Connecticut in the sense that it is highly influenced by glaciation events that occurred 10-15,000 years ago. These geological legacies shaped many unique habitats that in turn generated the evolution of substantial biodiversity within the watershed.

The State of Connecticut lists several notable species found in the watershed as rare, endangered, threatened, or a species of special concern. These species include the wood turtle (*Glyptemys insculpta*), Eastern ribbon snake (*Thamniphis sauritus*), little brown bat (*Myotis lucifugus*), Northern long-eared bat (*Myotis septentrionalis*) as well as numerous other avian, mammalian, reptilian, amphibian, and botanical species.[113] Many of these species are rare throughout the state and can only be found in a few places, meaning that their current habitat in the watershed is vital for their persistence.

A species of particular concern is the Northern long-eared bat, which the state lists as endangered. Under the recent declines in bat populations attributed to a white-nose syndrome, this bat species is at a heightened risk of extinction. Only nine municipalities in Connecticut have known hibernacula for this state endangered species, including nearby Bridgewater. This limited distribution makes the protection and restoration of suitable habitat for northern long-eared bats even more important within the PRW.[114]

A major threat to both flora and fauna native to the area is the widespread proliferation of invasive species throughout riparian and forested habitats. Floodplains are highly susceptible to invasive species due to their availability of water, nutrient-rich soil, and water flows that tend to disperse seeds. The Town of Newtown compiled a list of the most common invasive plant species found within Newtown and the PRW. The PRP has often referred to these invasive plant species as the 'Dirty Dozen,' albeit the Partners would heartily welcome any new Indigenous and/or Indigenist collaborators who might join the PRP and remind these planners and implementers of how these environmental efforts follow a much longer-term—as in multi-millennial—ecological tenure from the human heritage of the Pootatuck, Schaghticoke and who would more likely refer to these invasive plants as themselves 'displaced relatives' instead.[115] These species include but are not limited to Norway maple (*Acer platanoides*), tree-of-heaven (*Ailanthus altissima*), Japanese barberry (*Berberis thunbergia*), Multiflora rose (*Rosa multiflora*), purple loosestrife (*Lythrum salicaria*), Japanese knotweed (*Fallopia japonica*), Asian bittersweet (*Celastrus orbiculatus*), and water chestnut (*Trapa natans*).[116]

While there is no comprehensive database detailing the extent of invasive species in the PRW, smaller-scale mapping and field assessments suggest that they constitute a significant portion of the local biomass. The warming climate and more recent increases in globalization are conducive to further establishment and spread of invasive species that were previously uncolonized.[117]

7.3 Aquatic Natural Heritage

The relatively high number of wetlands and forested areas within the PRW lends itself to generating a rich history with aquatic species. Newtown and the Pootatuck River Watershed as a whole have an extensive history with fishing and boast excellent sport fisheries for species such as trout and bass. Deep Brook is designated as a Class 1 Wild Trout Management Area, a distinction held by only ten areas in Connecticut.[118] Historically, it has supported populations of Eastern Brook Trout (*Salvelinus fontinalis*) and Brown Trout (*Salmo trutta*).

The watershed has faced significant challenges such as fish kills following 2003, 2004, and 2013 chemical spills in a tributary to Deep Brook that is named Meeker Brook and has since also become known colloquially as 'Oil Creek.'[119] Surveys since then did not find any Brook Trout in the downstream Deep Brook, only Brown Trout. The Pootatuck Watershed Association (PWA) conducted a geomorphic assessment of Deep Brook in 2016, rating sections of stream based on criteria such as anthropogenic impact. The assessment showed very little impact from the spills on Meeker Brook and an upstream portion of Deep

Brook, highlighting potentially excellent habitat for target species even as past chemical spills resulted in large fish kills.

A 2016 collaboration between the Fisheries Division of the CT DEEP and the PWA made an effort to reintroduce Brook Trout from northern Connecticut into Deep Brook with the hope of a restoration that would result in self-sustaining populations. Recent surveys have shown a scarce but reproducing population of Brook Trout in a small tributary that feeds into Deep Brook and that may be one of the last strongholds of Brook Trout within the PRW. The CT DEEP has continued to conduct its work on supplemental fisheries stocking to increase populations of trout within the Pootatuck River and its tributaries, although it did no stocking at the site itself in 2022.

Aquatic life within streams is heavily impacted by land use cover, especially by impervious surfaces and agriculture. Approximately 6% of the PRW is covered by impervious surfaces,[120] where stormwater runoff flows into waterways while bringing along various pollutants that are detrimental to the health of aquatic life[121]. Pollutants such as road salt, trash, and chemicals that have spilled onto pavement get washed into the water and thereby degrade water quality for aquatic species, especially those that have a low tolerance for pollution. Agricultural impacts include excess nutrient runoff from fertilizers and sedimentation. Elevated nutrient levels lead to eutrophication, causing hypoxia and its fish kills through suffocation due to a lack of dissolved oxygen. Sedimentation fills in spaces between rocks, limiting habitat availability for refuge and reproductive spawning.

VIII. OUTDOOR RECREATION

Due to efforts of municipalities and local stakeholders in the PRW, recreational opportunities outdoors are abundant. Efforts to improve and conserve habitat and develop accessible trails have allowed for various such opportunities, which tend to experientially mobilize sufficient additional support for ecological protection among and beyond recreationists over the longer term to indirectly outweigh any negative traces that they may leave on the environment within the direct short term even in these worst-case impact scenarios.

Outdoor recreation is currently more humanly vital than usual in a Town of Newtown and surrounding communities who over the near dozen years since December 14th of 2012 have survived a human tragedy of nationwide proportions then:

- decided to memorialize the victims of the incident through a restorative and outdoor living memorial,[122] a communal decision that can also serve as inspiration for and draw supportive reinforcement from sites of river preservation and restoration;[123]

- decided to set out on a path to heal from the loss of lives through the acceptance of land conveyed by the state of CT, construction, and restoration of a domesticated and wild Animal Sanctuary that honors the memory of an animal-caring six-year-old girl named Catherine Violet Hubbard—whose concerns inspire a site of meadows and woodlands along which a proportionately smaller brook tributary whispers while so does the very bordering Deep Brook of the most particular restoration interest for the ecological purposes of this PRW Plan.[124]

8.1 Fishing

The PRW offers abundant fishing opportunities. Trout are a primary target for anglers within the watershed. Along these lines, Deep Brook is one of only nine Class 1 Wild Trout Management Areas (WTMA) in Connecticut and provides excellent opportunities for anglers. The ecological impacts of this outdoor recreation on fish population structures are minimized through the regulations that the state of CT has instituted for these WTMAs, where fishing is strictly permitted only on a no-harvest basis as in a catch-and-release experience requiring use of a single barbless hook and limiting gear to be artificial only—in other words, ruling out bait.[125] The WTMA provides and maintains multiple parking areas and trails. These amenities offer easier access to the stream and feature kiosks and signage with information on fishing regulations and fisheries management efforts in or around Deep Brook.

In addition, the Fisheries Division of the CT DEEP has usually stocked over 1,100 trout annually in the lower Pootatuck River to supplement fishing opportunities. However, the agency did not stock trout in 2022.

Other opportunities include fishing at the Potatuck Club, a private fishing club where anglers can target Brook Trout, Brown Trout, and Rainbow Trout (*Oncorhynchus mykiss*) along the Pootatuck River.

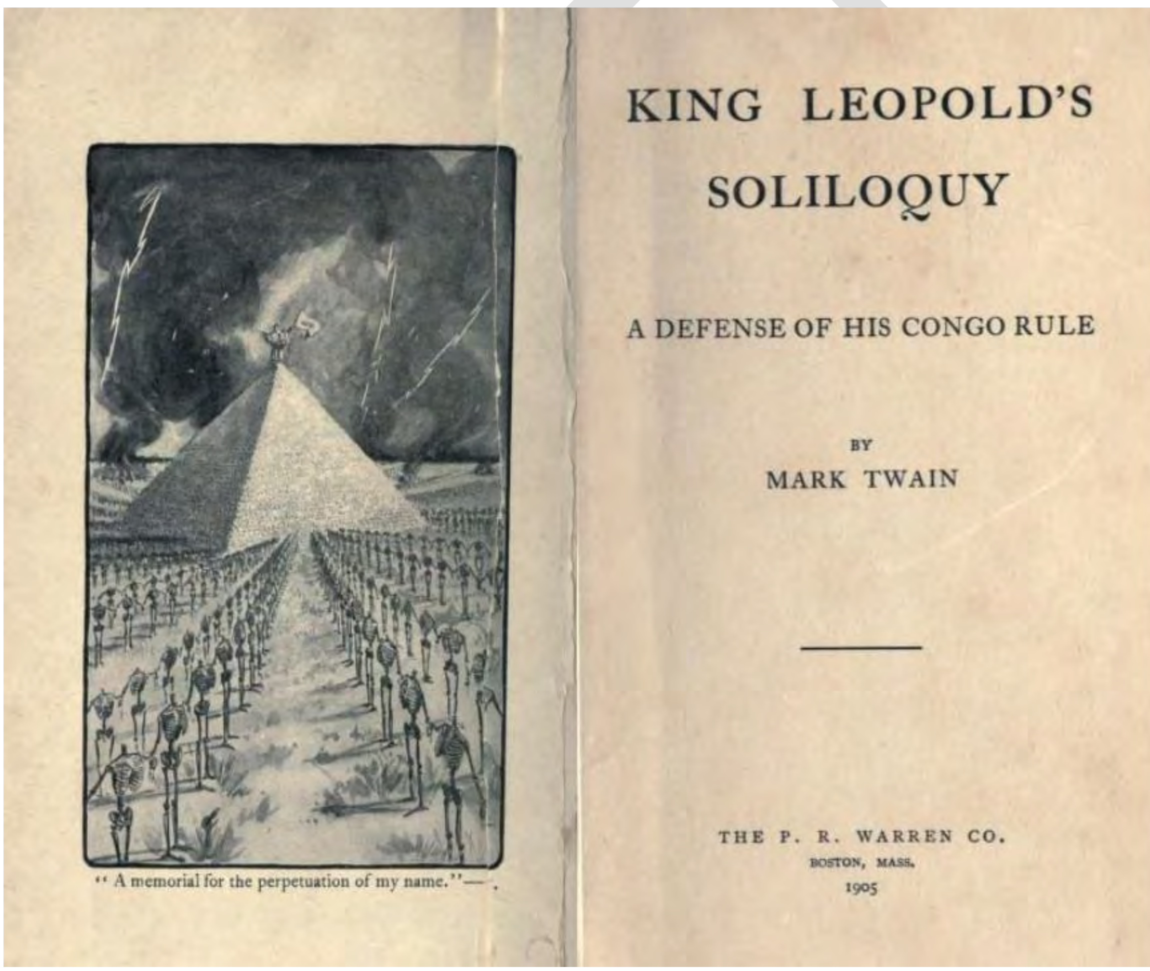
The Pootatuck River also harbors other gamefish such as Largemouth bass, smallmouth bass, and panfish.

8.2 Hiking

The PRW provides hiking opportunities as well. The most prominent pathway is the civically-made and -maintained Al's Trail, a hiking route that spans 10.7 miles from the Pond Brook Boat Launch to the Railroad Bridge on Deep Brook by the Reed Intermediate School. Where its northwestern edge ends on a loop around the Boat Launch and into the Upper Paugussett State Forest, it even forays beyond the PRW and into only the wider watershed of the Housatonic River that it scenically overlooks. Its official name has been the Newtown Trailway while its nickname memorializes the late Al Goodrich's literal trail blazing contributions to many of its paths in town as a member of the Newtown Forest Association, an organization that is in turn part of the Pootatuck River Partners (PRP).[126] The trail winds through Rocky Glen State Park, town forest, greenway, and several land easements providing a nice opportunity for residents to utilize green spaces through parts of the PRW. Al's Trail does abut to the Pootatuck River and Deep Brook in places with several stream crossings, potentially creating drainage issues such as erosion along the trail. Maintenance is required regularly to upkeep riverside trails that limit sedimentation issues from dirt pathways and floodplain encroachment.

Rocky Glen State Park itself is about 46 acres in size and provides additional hiking opportunities that are of worldwide historical proportions while also rooted right at the watershed and the present-day. Indeed, a historic mill building located alongside a dam impounding the lower mainstem of the Pootatuck River at one of its public access points bordering the Park is on the National Register of Historic Places while its hydroelectric plant still generates renewable energy that is still timely both globally under current climate change and locally due to its river fragmentation of aquatic habitat.[127]

Its industrial history of rubber-innovation and -processing on the border of the forested Park site over nearly a century and a half through the decades from 1839 until 1977 offers immense public-programming potential to preserve and learn from environmental history, including past environmental injustice.[128] A major turning point of its history appears to feature how—alongside locations in the Naugatuck municipality two towns over—the site is reported to have been part of where Charles Goodyear experimented his way into making his main invention for the industrialization of rubber from a raw natural resource into durable, stable and usable products, namely through a vulcanization method.[129] The second largest annual event in Newtown, its largest river event, and its largest outdoor-recreation event all since 2000 serves as an indicator of this untapped river programming potential—rubber-tapping pun intended. The event has been a fundraising Pootatuck Duck Race that nods to this Town history as the Newtown Lions Club floats a few thousand yellow rubber ducks down the lower mainstem of the Pootatuck River then responsibly removes them under the watch of several thousand event attendees. The activities of the site at Rocky Glen State Park downstream from the racing rubber duckies were closely tied to those of humanity through episodes such as two decisive examples. In one, this two-factory complex was an important part of war efforts to supply the industrial rubber inputs in which it specialized during the U.S. Civil War then the two World Wars: rubberized fabric fire hose, rubber belts that drove machinery, and during the earliest of the three wars rubberized clothing.[130] In another, its experiences were pivotal when the invention from the unique place shaped the fates of tropical rainforests and their human dwellers as far away as the Amazon much to the south of this Western Hemisphere or even around the world in Central Sub-Saharan Africa and Southeast Asia.[131] As noted above in section 4.6, more recent waves of globalization remain conducive to further establishment and spread of invasive species. Studies also show and a Garner Correctional Institution that the state of Connecticut operates in Newtown on a highly impervious site riparian with a small brook tributary to the lower mainstem of the Pootatuck River too illustrates the negative parts of the variable social impacts from these same recent global waves. These negative social impacts include how global trends have become one of the factors causing a racially disproportionate mass incarceration through a relocation of industrial, factory or manufacturing jobs disproportionately filled by people of color over to emerging markets such as those of the same labor- and rubber-supplying Brazil, Indonesia, Malaysia and eventually or increasingly the same Democratic Republic of Congo (DRC) as well.[132] Hence, these past episodes offer opportunities for recreation-friendly river programs aligned with the Labor-Day river race: For example, programming could restore the PRW while facilitating community conversations on how to learn and overcome rather than repeat this environmental and labor human(-rights) history in the management of displaced plant species or negative social impacts through deliberation on how Connecticut-led innovation on-site inadvertently incentivized smuggling of rubber plants displaced from their native Amazon over to similarly low-labor-standard plantations in Central Sub-Saharan Africa and Southeast Asia.[133]


"A memorial for the perpetuation of my name."—.

KING LEOPOLD'S SOLILOQUY

A DEFENSE OF HIS CONGO RULE

BY

MARK TWAIN

THE P. R. WARREN CO.

BOSTON, MASS.

1905

A year before Mark Twain purchased land for his new home at a town (Redding) bordering Newtown, he published this opposition to colonialism and low labor standards in production of industrial rubber such as that invented and processed with Newtown power from Rocky Glen dams on the Pootatuck River[134]

Indeed, over a third (6) of all (16) programs prioritized in section 10.4 below could tap into the ample potential of these past-present opportunities from in or around Rocky Glen State Park and spill them over the whole PRW—rubber-tapping and water-damming puns intended:

- Engaging streamside landowners with impacted buffers and supporting them in riparian restorations (RiverSmart) as a PRW program could feature outreach to stream-side landowners including the businesses that manage and/or operate out of the historic rubber-factory building on the edge of the Park as well as the Garner Correctional Institution upstream from it;
- Development of a wetlands education center and/or program at Dickinson Park as programmatic work for the PRW through either scenario could be broadened into watershed training and timed on Labor Day before, during and/or after Newtown's signature event on the Pootatuck River—be it:
    - (a) in the proposed new education center itself as initially proposed at the Park,
    - (b) in the temporary riverside sites of the near quarter-century-old annual Rubber Duck Race or
    - (c) in a new education center that could also be implemented closer to this historic site and to the Tribally historic 'River of the Falls Place' that inspired this suitable meaning of the 'Pootatuck' as named after the confluence where the Pootatuck River joins the Housatonic River at Lake Zoar, where a third present-day dam has replaced a third waterfall of a nearby trio spanning both rivers;
- Invasive species management programming for the PRW could leverage more numerous and less-otherwise-likely volunteers for its labor-intense work through a uniquely mobilizing sense of how place as well as time have converged upon both biological and human diversities over recent centuries in or around the Rocky Glen State Park where the lower Pootatuck marks the Park's spatial border with the historic Rocky Glen building;
- Education on waste management and best practices for backyard farmers in the watershed as a PRW program could maximize the attention that backyard farmers are most likely to give it through outreach or promotion of farming or planting native and river-restorative maple trees that:
    - Synchronize with maple-syrup tapping cycles—from the end of January to the end of March in Connecticut—when such farmers are otherwise least busy with their farming and most disposed by winter 'cabin fever' to give their time to this educational outreach, and
    - 'Hook' backyard farmers who are maple-syrup *tappers* into a clever Newtown-Amazon and/or Pootatuck - Amazon Rivers parallel with an environmentally engaging 'Amazon' given how the word suddenly, initially became a trendy U.S. household name since the 1980s and 1990s due to the high-profile mobilization of an environmentally sustainable

Amazonian labor movement of rubber *tappers* led by the late Chico Mendes and the present-day Brazilian Secretary (Minister) of the Environment Marina Silva;

- A Homegrown National Park program for individual property owners as part of programmatic work to restore the PRW could seize an opportunity to encourage innovative property owners such as those who tend to manage and/or own the historic building of a major invention (industrial rubber) right on the edge of the State Park to extend and scale up the Park in proportion to how much they would:
    - Make their home grounds habitats for native animals and plants like the chimney swifts that make their annual two-way migrations from a northern range in the Canadian and U.S. national territories including Newtown to a southern range in the Amazon River Basin where the national territories of Bolivia, Brazil, Colombia, Ecuador, Peru and Venezuela border each other and where their habitat range meaningfully includes one of the most socio-environmentally sustainable parts of the Amazon;[135]
- Development of a master inventory and plan for trails and stream habitat improvements along the Pootatuck River from Lower Agricultural Field of Fairfield Hills to Sandy Hook Center as part of programming to restore the PRW could seize how:
    - The lower part of this river reach or segment overlaps with Newtown's signature Pootatuck River event that has dropped a Rubber Duck Race to float downstream from a start line at the bridge off of the intersection between Glen Road, Church Hill Road and Riverside Road.

If persuasively relevant or useful in framing conversations with collaborators who might approve and/or fund the more place-specific projects recommended in section 10.3 below, nearly a fifth (2) of all (11) projects prioritized in section 10.3 below could also tap into the ample potential of these past-present opportunities in or around Rocky Glen State Park: the Lower Rocky Glen Dam and the Rocky Glen Dam.

The Town-made and -maintained Newtown Greenway system also provides access to green spaces in and around the center of Newtown. Its continued focus on linking open and green spaces holds potential to provide better connectivity for both people and fauna as well as to provide educational opportunities.

As introduced above and noted in the next section, the non-profit Catherine Violet Hubbard Foundation named after a six-year-old student who lost her life at Sandy Hook Elementary has restored and maintained extensive hiking and equestrian trails through its Sanctuary of more than 34 acres. The trails weave through its meadow, woodland and proportionately smaller brook tributary within the drainage basin and hearing or sight range of the very bordering Deep Brook that this PRW Plan is most particularly committed to restoring.

8.3 Various Recreational Opportunities on Neighborhood Parks and Open Spaces

The PRW is graced with additional parks and open spaces that offer various recreational opportunities. Among these settings, Ram Pasture holds particular potential to mobilize river restoration for the foreseeable future even as it is considered by professional historians to be among the three town greens of the most historically notable human heritage across the state of Connecticut, a historical recognition that it shares with its counterparts in the City of New Haven and the Town of Lebanon.[136] The site holds both a special place in the heart of the Town of Newtown and a small tributary to Deep Brook that meanders along its green meadow, eventually flowing through a pond commonly used for winter ice-skating then ultimately joining Deep Brook. Colonially established in 1732, Ram Pasture in effect preserved the human heritage of much longer—multi-millennial—forms of Tribal land tenure that protected its natural heritage for several thousand years. Its colonial turn re-instituted management through a collective pasture or communal property that during colonial and post-colonial times was redirected toward flocks of sheep owned by individual settler farmers and grazed under the common-pool tenure of another commons' provision of similarly decentralized natural protection such as from eventual overgrazing of its meadow and degradation of the central brook into which it drains.[137] Considering that revolutionary troops mobilized for U.S. Independence under French General Rochambeau camped on Connecticut town greens including Ram Pasture on their way to meet General Washington in Yorktown, the heritage of this site also shaped this very turn from colonial to post-colonial history. From the late 1700s until the 1920s, landowners then in effect privatized its property through more individually encroaching land grabs. The maternal family of a long-time Newtown resident named Mary Hawley—whose sources of inherited wealth included investments in water works and presidency over a major water business—purchased and reassembled its pieces during the 1920s.[138] Next, upon her passing her philanthropy returned the land back to civic forms of common-pool management that went through a brief ownership by Yale University and has survived since 1931 until today as a green meadow and open space under the soon-to-be centennial tenure of the non-profit Newtown Village Cemetery Association.[139] This past experience could be leveraged into interpretive recreational signage and volunteer events for hands-on river restoration that also facilitate learning how to manage environmental and/or resource commons from those of the sheep (over)grazing and their (detrimental) river uses in recent centuries to these of a renewed communal tenure for the local river under global commons such as the changing climate etc. in the present time and the foreseeable future.[140]

Adjacent to Ram Pasture, Dickinson Memorial Park is another excellent area for outdoor recreation. This park provides recreationists an array of amenities such as a basketball court, kids playground and creative-play areas, pavilion and picnic facilities with charcoal grills, skate park, softball field, and tennis courts.

The Catherine Violet Hubbard Animal Sanctuary is nestled in the heart of Newtown and located only minutes from the highway, easily accessible for numerous guests such as those from New York City or Boston. Thus far as it steadily institutes itself into the full design of its Foundation's vision, this site of conscience or healing welcomes concerned and/or restorative recreationists to explore the extensive hiking and equestrian trails, butterfly gardens or quiet picnic pavilion in its meadows and woodlands along which a smaller brook tributary whispers while so does a Deep Brook that borders the Sanctuary.

Also in the heart of Newtown and where Deep Brook gracefully flows through the landscape, the private Newtown Country Club offers open space for golf and additional forms of outdoor recreation such as bonfires, outside dining and performing arts.

As with fishing and hiking sites considered in the prior two sections, these parks and open spaces not only directly enhance the quality of life for the human community but also indirectly contribute to the environmental protection of the watershed.

IX. VISION AND GOALS

9.1 Pootatuck River Vision and Goals

Using the draft PRW Existing Conditions Report as a guide, the Pootauck River Partners worked together to craft the following Vision Statement for the Pootatuck River Watershed:

"The Pootatuck River watershed is home to healthy lands and waters that support native species and their habitats, clean drinking water, and outdoor recreation opportunities for people of all backgrounds and abilities. The Pootatuck and its tributaries provide essential ecological services, including pollination, aesthetics, and nutrient cycling for watershed communities and ensuring functioning floodplains that reduce the risk of damage to property and infrastructure during floods and recharge aquifers. Community officials, government agencies, and other stakeholders work collaboratively to:

- *Ensure that surface waters are safe for swimming and fishing, and sub-surface waters are safe for drinking.*
- *Conserve healthy terrestrial and aquatic ecosystems that are resilient and adaptable to our changing climate.*
- *Create and maintain equitable access to open spaces and waterways that provide opportunities for active recreation (including swimming, fishing, hiking and wildlife watching), and for immersion in the natural world, reflection, and learning.*
- *Integrate current and predicted climate change impacts into watershed management decision-making, including local land use and development policies.*
- *Cultivate love and respect for the Pootatuck River and its watershed in residents and visitors through outreach, engagement, and education.*
- *Secure funding, technical support and other resources required to achieve and maintain our shared Vision for the Pootatuck River watershed."*

The next step in the Watershed Planning Process was to develop a set of Goals that must be achieved to realize the PRP's vision for the future of Pootatuck River. The PRP worked collaboratively to develop Goals in each of the four key focus areas:

Water Quality Goals:

1. All streams in the Pootatuck River watershed consistently meet Connecticut water quality standards (WQS) based on classification and use goals:
   a. Pollution loading to streams with existing impairments to recreational and aquatic life uses is reduced to remove those impairments.

   b. A robust water quality monitoring program that characterizes trends in stream health and informs timely interventions to ensure WQS are met as land use and climate conditions change.

2. Drinking water supply continues to be safe and meets all drinking water quality standards.

3. Existing impervious cover connections to storm sewers are characterized to identify opportunities for installing Green Infrastructure/LID practices; retrofit projects that will result in significant pollution reduction are implemented.

4. Community decision-makers have the resources they need to effectively integrate Green Infrastructure/LID practices into new development and redevelopment.

5. Town staff have the resources they need to effectively implement the requirements of the MS4 General Permit, including detecting and eliminating illicit discharges to storm sewers and ensuring that construction projects have adequate erosion and sediment control measures.

6. Riparian buffers of at least 35’ along the Pootatuck River and its tributaries are protected and restored wherever possible. Appropriate ecosystem and practical implementation.

7. Watershed landowners understand how their property management practices can impact water quality and have access to the resources they need to reduce their pollution contributions.

8. Functioning floodplains are protected and restored wherever possible to allow for sediment deposition and removal of pollutants.

9. Dams and barrier culverts are mitigated wherever possible to restore natural flows and reduce pollution arising from impoundments.

10. Wastewater is treated adequately throughout the watershed.

Natural Heritage Goals

1. Decision-makers, landowners, developers, and the public recognize that the unique natural heritage of the Pootatuck River watershed (geologic history, landscapes, biodiversity) is essential to the character of the community and should be conserved.

2. Assessments of species and habitats and their conservation needs are characterized to understand their distribution and habitats of conservation concern.

3. Potential impacts to species and habitats of conservation concern are carefully considered in watershed management and land-use decision making, using the best available information.

4. Landowners have access to resources for conserving habitat on their property, including managing invasive species, establishing native plants, and restoring natural hydrology.

5. Cold-water obligate species such as Eastern Brook Trout are present in the watershed.

6. Dams and barrier culverts are mitigated wherever possible to restore the ability of fish and wildlife to move along stream corridors.

Recreation Goals

1. Existing and potential recreational opportunities/access sites are mapped to understand where access enhancements projects are most important; access enhancement projects are implemented.
2. Opportunities to recreate in the watershed are promoted and provided to all watershed residents and visitors, regardless of background or ability.
3. Visitors to recreation access sites become stewards of the Pootatuck River through passive engagement strategies (such as interpretive signage) and active engagement strategies (such as outreach events planned for busy days).
4. Recreation enhancement is integrated into watershed restoration projects wherever possible.

Climate Resiliency

1. Monitoring of stream temperatures (and other parameters) to understand where areas that are vulnerable/resilient to climate change are located.
2. Green Infrastructure and Low Impact Development strategies are considered and implemented to reduce the impacts of climate change.
3. Local flood analysis is conducted to best identify the most effective flood infrastructure improvements, including reconnecting the Pootatuck and its tributaries to natural floodplains.
4. Watershed residents are educated about the importance of a resilient watershed in the face of climate change.
5. Watershed conservation measures are adaptable to changes in climate and climate related events (storms, drought, reduced snowpack).

X. IMPLEMENTATION STRATEGY/ACTION PLAN

10.1 Management Recommendations

The vision and goals developed for the Pootatuck Watershed Plan provides the foundation for general management recommendations under the key focus areas outlined below.

- Water Quality
- Collaboration & Capacity Building
- Education & Outreach
- Recreation Enhancement
- Floodplain Management & Climate Change Resiliency
- Species & Habitat Conservation

Included in these are recommended actions – concrete steps to take along with who will take them, a timeline, milestones and potential funding sources outlined in a series of tables throughout the section.

10.1.1 Water Quality

Ensuring and enhancing water quality within the Pootatuck Watershed is a fundamental goal of this comprehensive watershed plan. Effective water quality management requires a multifaceted approach, encompassing monitoring, mitigation, education, and community engagement. The following recommendations outline strategic actions and initiatives aimed at safeguarding and improving water quality throughout the watershed:

Continuous Water Quality Monitoring: Increase the density and coverage of water quality monitoring stations across the watershed to capture data from various locations, including tributaries, reservoirs, and key water bodies.

Utilize Advanced Technology: Leverage advanced sensor technologies and data analytics to enhance real-time monitoring capabilities, providing timely insights into water quality variations.

Pollution Source Identification and Mitigation: Identify pollution hotspots, including areas near gas stations and other potential contamination sources. Implement targeted measures to mitigate pollutant discharges in these areas.

Promote Best Management Practices (BMPs): Collaborate with municipalities, businesses, and residents to encourage the adoption of BMPs for stormwater management, reducing the influx of pollutants into water bodies.

Within the context of the Pootatuck River Plan, ongoing monitoring and assessment activities are crucial for supporting the successful implementation of watershed restoration efforts. While the CT DEEP and

HVA have conducted monitoring during the watershed planning process, this plan recommends additional efforts to further this cause. This includes continuing existing assessments such as the Unified Stream Assessment (USA) and Unified Stream and Subwatershed Assessments (USSR), outlined below, as well as the introduction of new programs like Ambient Water Quality Monitoring and Pollution Trackdown Surveys. These assessments will serve to inform an updated TMDL assessment and establish a fresh baseline for water quality within the Pootatuck River. Furthermore, ongoing assessments will aid the PRP in identifying areas requiring restoration, pinpointing pollution sources, and refining a more detailed action plan.

The PRP, including HVA and other stakeholders, have committed to regularly revisiting this Watershed Plan. On an annual basis, they will assess progress towards the recommended actions and goals outlined in the Action Plan. Every five years, a comprehensive update of the plan will take place based on achievements, outcomes, and newly identified priorities. This update will involve an assessment of the progress made, incorporation of new data, and inclusion of new projects. Revisions to the Watershed Plan will be considered to enhance the effectiveness of implementation efforts if monitoring reveals no improvements following Best Management Practices (BMP) initiatives.

Unified Stream Assessment (USA):

In 2021 and 2022, HVA conducted stream corridor field assessments within the Pootatuck River watershed to identify adverse impacts and potential opportunities for restoration. The USA employed continuous stream walk methods to survey all reaches classified as impaired, encompassing approximately 30 stream miles. This protocol was developed specifically for urban watersheds by the Center for Watershed Protection. During the USA field assessments, HVA staff and volunteers conducted surveys of prioritized impaired reaches of the Pootatuck River and its tributaries, documenting data on reach conditions, potential impacts, and areas suitable for restoration.

In cases where certain impaired reaches were inaccessible for field assessments due to reasons such as wetlands, buried streams, or extreme channelization, ten reaches were assessed through desktop analysis using aerial imagery to identify stream impacts. Various types of impacts were recorded, including Stormwater Outfall, Utility, Trash and Debris, Stream Crossing, Severe Erosion, Impacted Buffer, Channel Modification, and Miscellaneous. Each impact was documented with multiple photographs, and location data were collected using handheld GPS units. The overall conditions of each reach were comprehensively documented on reach data forms, encompassing factors such as average bank stability, in-stream habitat, riparian vegetation, floodplain connectivity, access, flow, and substrate throughout the entire reach.

Outfalls, including stormwater and other discharge pipes, were subject to assessment, and grab samples of effluent were taken and tested for ammonia nitrogen concentration if an outfall was flowing and displayed suspicious characteristics. This allowed for the identification of outfalls warranting additional investigation and potential pollution track down surveys.

Utility-related elements within the stream corridor, such as exposed pipes and sewers, were assessed, as were accumulations of trash and debris exceeding average levels within a reach, quantified by estimated numbers of truckloads. Stream crossings, including bridges and culverts, were assessed in accordance with the methods outlined by the North American Aquatic Connectivity Collaborative (NAACC). NAACC data forms captured details pertaining to the overall crossing and its structural aspects.

Channel modifications, encompassing channelized and concrete-lined sections of the stream, were documented, as were instances of severe bank erosion, noted if conditions were significantly worse than erosion levels throughout the entire reach. Impacted buffers were identified in cases where a portion of the reach lacked a naturally vegetated buffer of at least 25 feet in width, which included areas overgrown with invasive vegetation or bordered by turf lawns. The Miscellaneous category covered all other impacts not fitting into the aforementioned categories, such as the presence of livestock or fish kills.

Pollution Trackdown Surveys

Pollution trackdown surveys identify the source and character of pollutants entering the storm sewer system through illicit discharge. This method has been used very effectively by PRP member Harbor Watch to achieve rapid and cost-effective pollutant load reductions. Pollution Trackdown entails detailed testing of stormwater outfalls to determine if an illicit discharge is likely present. If yes, the next step is to test the storm sewer system (accessed through storm drains and manholes) at various junctures upstream of the outfall to bracket the origin of pollution on the landscape. That area is then investigated to understand the likely source of pollution and responsible parties. Once identified, municipalities can take regulatory measures to rectify pollution at its source.

USA streamwalks conducted as part of the Watershed Planning process included a rapid screen of each outfall encountered based on dry-weather flow, ammonia nitrogen concentration, surfactant concentration, and a visual assessment. This data formed the basis for compiling a list of suspicious outfalls that warrant further investigation using the pollution trackdown method.

HVA's approach involves integrating this USA outfall data with GIS-based analysis of remaining outfalls not flagged as flowing. The analysis takes into consideration the characteristics of each outfall's catchment area, utilizing available spatial data such as aerial photography/LIDAR, land use, hydrology, topography, parcels, and results from ambient monitoring. Collaborating with its partners, HVA prioritizes catchments that exhibit suspicious characteristics, including proximity to pollution hotspots like gas stations, poor condition, high outfall density, and more. Depending on the quality and type of data available in each town, HVA selects a set of key screening factors that indicate a heightened risk of polluted discharge and assigns scores to each factor. These scores are aggregated to generate a normalized cumulative score, which guides the prioritization of outfalls for further investigation.

High-priority outfalls, those scoring significantly on the cumulative scale, undergo screening for excessive levels of nutrients, bacteria, surfactants (detergents), and other relevant parameters. Outfalls demonstrating elevated pollutant levels prompt pollution trackdown investigations—a modified procedure involving tracing the stormwater flow within the pipe to isolate the source of contamination. Once the source is identified, HVA collaborates with municipalities and other stakeholders to address and ultimately mitigate pollutants.

While this passage used the examples of how Harbor Watch and/or HVA have carried out pollution trackdown surveys, the following recommendations extend well beyond them and are proposed for all current and prospective PRP stakeholders.

Recommended Actions:

- Regularly revisit the Watershed Plan every year and comprehensively update it every five years. Conduct assessments annually and every five years to evaluate progress towards the recommended actions and goals outlined in the Plan, incorporate new data, and introduce and/or reprioritize new projects or programs. Make adjustments to the Watershed Plan to enhance the effectiveness of implementation efforts were monitoring to indicate no improvement post-initiatives of Best Management Practices (BMP).
- Establish and execute a bacteria-monitoring program to conduct routine assessments for *E. coli*, nutrients, and other applicable pollutants at fixed locations throughout the Pootatuck River watershed. Sampling should occur during April to October and encompass both wet and dry weather conditions.
- Establish a baseline for water quality and subsequently measure water quality after project installation. These measurements should encompass locations both upstream and downstream of project sites.
- Conduct USA streamwalks to record impacts in areas presenting high potential for restoration that were not assessed during initial WBP development.
- Investigate suspicious outfalls flagged during USA and conduct Pollution Trackdown Assessments.
- Ongoing assessment of sites for stormwater retrofit potential using the Unified Stream and Subwatershed Assessments (USSR) protocol as areas of concern arise.

Table 10.1.1 Water Quality Recommendations

Recommended Actions & Milestones	Who	Timeframe	Deliverables & Evaluation Criteria	Estimated Costs	Potential Funding Sources
• Revisit Watershed Plan on a regular basis (minimum every year Action Plan; every 5 years full plan)	PRP	Annually (Action Plan) Every 5th year (Watershed Plan fully)	• Update appendix • Revisions to plan document as necessary	$$	
• Establish and implement bacteria and nutrients monitoring program	PRP	Establish 0-1 year Seasonal sampling (Apr – Oct)	• Approved QAPP • Staff, interns & volunteers trained • Monitoring results/reports	$$	CT DEEP 319 Funds; NFWF Long Island Sound Futures Fund
• Establish and conduct pollution trackdown surveys	Harbor Watch/ HVA/Town of Newtown	0-2 years)	• Approved QAPP • Track down survey results and recommendations	$$$	CT DEEP 319 Funds NFWF Long Island Sound Futures Fund
$ = $0 to $5,000	s**$$** = $5,000 to $10,000		**$$$** = $10,000 to $50,000		**$$$$** = Greater than $50,000

10.1.2 Collaboration and Capacity Building

One of the main objectives of the Pootatuck Watershed Plan is to bring together municipal staff and officials, agencies, environmental organizations, and engaged groups of residents to share information and resources and implement specific actions that accomplish shared goals for water quality and other watershed management considerations. While the interests of each of these entities may vary, the vision and set of goals is the same; to see a restored healthy watershed for all to enjoy. To make the vision a reality requires active participation and "buy-in" of the Pootatuck Watershed Plan and its recommendations as well as resources put toward implementation projects identified herein. This work has started through the formation of the Pootatuck River Partners (PRP), a core group of municipal staff, recreation enthusiasts, environmental groups, and engaged residents brought together to create the Pootatuck Watershed Plan. Already we have seen the effectiveness of this collaboration through the implementation of watershed projects. The next step to building capacity will come through greater engagement with watershed residents interested in volunteering, implementation of projects and programs identified during the watershed planning process, and the addition of project funding through grants and corporate sponsorship. Below are some recommendations aimed at accomplishing these goals:

Recommended Actions

- Continue the active engagement of PRP through quarterly meetings.
- Seek and secure funding as well as coordinate watershed implementation projects.

- Seek adoption of the watershed plan by watershed municipalities who will support the projects and recommendations of the watershed plan through funding, staff hours, and other resources.
- Seek and secure funding through a variety of sources including federal grants, state grants, private foundations, and corporate sponsorship.

Various potential funding sources can be explored to support the implementation of the Pootatuck Watershed Plan, including:

State and Federal Public Sources:

- CT DEEP Section 319 Nonpoint Source Grants
- Connecticut Clean Water Fund
- FEMA Grants for Flood Mitigation

Private/Civic Foundations:

- Fairfield County Community Foundation
- Northwest Hills Community Foundation
- Horizon Foundation
- Werth Foundation
- The Conservation Fund

Public-Private/Hybrid Sources:

- Long Island Sound Futures Fund[141]

Corporate/Business Sponsorship:

- Lowe's
- Patagonia
- Union Savings Bank
- Locally-owned businesses

These funding avenues encompass a diverse range of public and/or private entities that have shown an interest in supporting environmental and watershed restoration initiatives. Exploring these sources and establishing strategic partnerships with them can significantly contribute to the successful implementation of the Pootatuck Watershed Plan.

Table 10.1.2 Capacity Building Recommendations

Recommended Actions & Milestones	Who	Timeframe	Deliverables & Evaluation Criteria	Estimated Costs	Potential Funding Sources
• Continue coordination of the Pootatuck Watershed Plan • Continue to hold bi-annual PRP meetings • Hire a Pootatuck Watershed Coordinator	PRP	1 year Ongoing	• Published meeting minutes • Hired Coordinator	$$$	Various sources
• Municipal support of the Pootatuck Watershed Plan • Adoption of Pootatuck Watershed Plan during municipal meetings (Board of Selectman, Town Hall, and City Hall meetings)	PRP	2 years	• Municipal meeting minutes that indicate adoption • Integration of the Pootatuck Watershed Plan in municipal POCDs	$$$	Various sources
• Identify and secure funding • Review and prioritize funding sources • Prepare and submit grant applications • Secure grants	HVA	0-5 years Ongoing	Funding sources secured for watershed based projects	$$	Various sources
$ = $0 to $5,000 **$$** = $5,000 to $10,000 **$$$** = $10,000 to $50,000 **$$$$** = Greater than $50,000					

10.1.3 Education and Outreach

As a suburbanized watershed, the public plays a crucial role in the restoration of the Pootatuck Watershed. Therefore, outreach and education are necessary to accomplish watershed planning success as it empowers people with the knowledge and skills to abate practices that deteriorate the watershed and contribute to restoration actions. Under the current MS4 stormwater management permit, municipalities are required to provide information to their residents on what they can do to minimize the impacts of stormwater pollution. Regional and statewide entities such as Western Connecticut Council of Governments and University of Connecticut's CLEAR NEMO program have published information on the impacts of stormwater pollution and best management practices for municipalities, residents, and businesses. One particularly helpful resource is the CT CLEAR NEMO 2004 CT Stormwater Quality Manual, which includes an appendix of a number of different GI/LID concepts. It can be found at link: https://ctstormwatermanual.nemo.uconn.edu/.

In addition, public education is part of the mission of local nonprofits such as HVA. A number of programmatic efforts exist that work to educate the public on local environmental issues, including River Environmental Education Days, River Academies, River Watershed Connections programs, and CT RiverSmart. Outlined below are programs and goals organized by the specific target audiences. Each one is important in accomplishing lasting stewardship throughout the watershed.

Youth and Students

The Pootatuck Watershed includes three school districts. While hiking trails, town parks, and open space are more accessible to many children outside of the suburban center, there are relatively few opportunities for environmental education when compared to more rural areas throughout the state. This makes educational opportunities all the more important as organizations such as HVA, PWA, additional PRP members, municipal parks and recreation departments, and local school districts work together to deliver watershed education that addresses water quality, water conservation, and issues specific to the Pootatuck.

Recommended Actions

- Pootatuck River Watershed Connections. A Pootatuck River Watershed Connections program has potential to connect high school students from the Pootatuck area with environmental restoration projects to provide hands-on environmental education, teach about environmental careers, provide job skills training, and raise awareness of the Pootatuck River in watershed communities. The program would also provide a reliable source of volunteer labor for restoration project installation and maintenance. Such a Connections program tends to be built on strong partnerships between area schools, youth service non-profits, watershed municipalities, and conservation groups working to implement the Pootatuck River watershed plan.
- Implement Projects that include riparian buffer plantings, removing invasives, improving recreation access, mapping rare plant species, and so much more.

Table 10.1.3 Education and Outreach

Recommended Actions & Milestones	Who	Time-frame	Deliverables & Evaluation Criteria	Estimated Costs	Potential Funding Sources
• Expand Watershed Connections program to integrate suburban with urban participants and/or their home Housatonic tributaries—Still River and Pootatuck River	HVA and Site Partners such as the Town of Newtown and others also involved in the proposed new education center or program		• Number of students reached throughout the watershed • Number of BMP projects implemented and maintained • Project metrics tracked (ex. Square feet of invasives removed, length of riparian buffers established, lbs. of trash removed, etc.)	$$$	CT DEEP 319 NPS Grants, EPA EE Grants, Municipalities
• Provide homeowner outreach on LID, sustainable landscaping, pet waste	HVA and Municipalities	5-10 years On-going	• Education programming throughout the watershed	$$$	CT DEEP 319 NPS Grants, EPA EE Grants, Municipalities

disposal, and septic system maintenance • Develop outreach messages and materials • Distribute outreach materials • Facilitate public education programs			• Number of people reached through social media, website traffic, email open rates, print media distribution) • Number of program participants		
• Provide education and training for municipal employees, planning and zoning boards, and other volunteer commissions dealing with land use and development on LID retrofit, septic systems, sustainable landscaping, and stormwater management (MS4 permit) • Develop outreach messaging • Facilitate education and training programs on the above topics with appropriate experts • Provide ongoing support to municipalities to comply with the MS4 permit	HVA and Municipal ities, UCONN, Western CT Council of Govern-ments (WestCoG , including but not limited to that of Newtown where it is based in Sandy Hook)	2-5 years	□Municipal outreach and education program implemented □ Number of municipal staff and volunteer commissioners that program reached □ Accomplished goals of the MS4 permit	$$	Municipalities, additional grants as researched
• Participate in community events • Research list of relevant events in the watershed □ Promote, publicize, support, and participate in existing events □ Grow a list of local volunteers through event signups	HVA	On-going	• Created event list □ Amount of event participation (tabling, presentation, etc.) □ Number of volunteer signups garnered through event participation	$	HVA General Funds
$ = $0 to $5,000	**$$** = $5,000 to $10,000		**$$$** = $10,000 to $50,000	**$$$$** = Greater than $50,000	

10.1.4 Recreation Enhancement

Promoting outdoor recreation along the Pootatuck River is a central goal of this watershed-based plan. Various recreation groups are actively working to enhance river access and recreational opportunities within their respective municipalities. With additional funding and support from local communities and enthusiasts, the Pootatuck River can transform from an area of recent indifference into a sought-after destination. The growing interest among paddlers and hikers to explore the Pootatuck River is a positive sign. The watershed offers opportunities for people of all abilities to enjoy the river.

Recommended Actions

- Establish a Pootatuck River Recreation Subcommittee of the PRP, comprising representatives from various groups dedicated to enhancing recreation and to collaborate across municipalities. This subcommittee's primary function will be to plan, design, and implement a Pootatuck River Greenway and Water Trail, pooling resources, seeking funding, and coordinating efforts to develop and maintain a network of recreational opportunities throughout the watershed.
- Develop consistent messaging and branding for a Pootatuck River Greenway and Water Trail to be used across all sections, access points, trailheads, and boat launches.
- Incorporate educational signage, workshops, activities, and materials into recreation projects to inform users about the Pootatuck River watershed, its history, and ongoing restoration efforts.
- Conduct a comprehensive assessment of existing and potential recreation opportunities throughout the watershed, creating linkages between open space, parks, trails, public transportation, sidewalks, pathways, river access points, and other transportation infrastructure where possible.
- Enhance accessibility to individuals of all ages, abilities, and backgrounds, promoting the accessibility of recreation activities such as hiking, boating, fishing, etc., to low-income individuals, people of color, those with disabilities, children, and the elderly. Evaluate the impact of public transit and city/town infrastructure on recreation accessibility within the watershed. Develop engaging programming and messaging to attract and involve these diverse audiences in watershed recreation, fostering a sense of belonging.

Table 10.1.4 Recreation Enhancement

Recommended Actions & Milestones	Who	Time-frame	Deliverables & Evaluation Criteria	Estimated Costs	Potential Funding Sources
Establish a Pootatuck River Recreation Subcommittee: • Recruit PRP currently involved in recreation activities to the Recreation Subcommittee • Formulate vision, missions goals, and programs/projects that will enhance recreation in the watershed • Schedule regular meetings to update on the progress of those goals	HVA, Municipalities, Park and Rec. Departments, WestCoG		Complete vision, mission, and goals statement Meeting minutes Number of engaged parties in the subcommittee Number of completed projects/programs	$$	CT DEEP Rec Trails, National Recreation and Park Association
Integrate signage about watershed stewardship in recreation areas Identify areas for signage Develop outreach messages and appropriate signage specific to each area (kiosk, road sign, interpretative sign, nature trail, etc.)	HVA, CT DOT, CT DEEP, Municipal Commissions, Recreation Groups, Parks and Rec.	0-2 years Ongoing as new recreation areas are	Number of signage projects installed throughout the watershed	$$$	National Recreation and Park Association, Municipalities, CT DEEP Recreation Trails Grant

☐ Work with appropriate parties to finalize signage and secure landowner permission	Departments	develo ped			
Create linkages between recreation opportunities throughout the watershed ☐ Create an inventory of existing and potential recreation opportunities ☐ Study linkages between recreation opportunities including trails, public transportation, sidewalks, pathways, river access points and other forms of transportation infrastructure. ☐ Identify gaps in access and work with stakeholders to strengthen access	CT DOT, Municipaliti es, Land Trusts, H2H, WestCOG	2-5 years	☐Completed inventory of recreation opportunities ☐ Linkages/Access report including recommendations for improved access to open space and recreation ☐ Improved access	$$	EPA Environmental Justice Grant, Meserve Foundation
Increase accessibility to people of all ages, abilities, and backgrounds. ☐ Research accessibility gap in current recreation areas including but not limited to the connectivity of public transit and city/town infrastructure as well as handicap accessibility ☐ Propose site specific solutions to improve access ☐ Design and implement programming that cater to and excite these audiences in creative and engaging ways to encourage use of recreation infrastructure ☐ Create messaging, branding and design of watershed recreation that pulls these audiences in, engages them in creative ways, and generates a sense of belonging. ☐ Secure funding to implement accessibility projects	HVA, WestCOG, Municipal Parks and Recreation Depts., Still River Alliance Commission	2-5 years	Report on accessibility gap including recommended solutions ☐ Programs and projects implemented that increase accessibility ☐ Increased usership among targeted populations (low income communities, people of color, those with disabilities, children and	$$$$	EPA Environmental Justice Grant
$ = $0 to $5,000 **$$** = $5,000 to $10,000 **$$$** = $10,000 to $50,000 **$$$$** = Greater than $50,000					

10.1.5 Floodplain Management and Climate Change Resiliency

Flooding is a natural process inherent to the Pootatuck Watershed. Furthermore, the impacts of climate change, including increased precipitation in terms of both quantity and frequency, are expected to amplify the occurrence of flood events. According to the EPA (https://www.epa.gov/green-infrastructure/manage-flood-risk), the average 100-year floodplain is projected to expand by 45%. These factors underscore the critical importance of effective floodplain management within the Pootatuck Watershed.

The extent of current development and infrastructure within the floodplain varies significantly among different municipalities within the watershed. Consequently, floodplains in these areas function naturally, allowing the river's waters to overflow into undeveloped regions, naturally receding as water levels fluctuate. In such towns, the primary objectives of floodplain management are geared towards safeguarding these floodplains from future development and establishing guidelines for development setbacks in anticipation of the expanding floodplain areas caused by climate change. Achieving these goals necessitates the implementation of several solutions.

One approach involves the adoption of setback policies in alignment with updated FEMA floodplain maps, effectively prohibiting development within the 100-year floodplain zone. This can be supplemented by training inland wetlands agents and personnel from planning and zoning boards to gain a comprehensive understanding of flood dynamics, which will enable them to assess construction permits more effectively. Additionally, maintaining up-to-date floodplain maps and consistent flood regulations across towns and the State ensures that information remains uniform among all stakeholders.

Conversely, certain areas were historically constructed around waterways, leveraging the river for industrial and other purposes. In these instances, striking a balance between the existing built environment and flood realities poses a greater challenge. Encroachments such as fill, impervious cover, and development in floodplain areas exacerbate flood-related issues by intensifying the frequency and severity of floods, thereby threatening infrastructure located in close proximity to the river and its tributaries.

The key to effective floodplain restoration lies In the incorporation of green infrastructure practices. When integrated with existing grey infrastructure, green infrastructure can effectively reduce stormwater loads, thereby buffering the intensity of floods and mitigating their impact. This watershed-based plan advocates for a comprehensive assessment of impervious cover within the floodplain and the initiation of a prioritization process. This process would involve partnering with property owners to evaluate the feasibility of green infrastructure projects. To implement this, property owners are encouraged to collaborate with HVA and other conservation groups to secure funding for green infrastructure projects aimed at mitigating stormwater loading.

Recommended Actions

- Increase floodplain storage capacity in accordance with the latest FEMA floodplain mapping of the 100-year floodplain.
- Standardize floodplain regulations and floodplain management practices across all towns within the watershed.

- Implement climate-resilient strategies in watershed communities by prioritizing the development of green infrastructure, especially within floodplain areas, mapping rare plant species, and more.

Table 6.1.5 Floodplain Management & Climate Change Resiliency

Recommended Actions & Milestones	Who	Time-frame	Deliverables & Evaluation Criteria	Estimated Costs	Potential Funding Sources
Increase floodplain storage to adjust to increased flood potential. Standardize floodplain regulation and floodplain management across the three Pootatuck watershed towns. • Review current zoning code/ ordinances in Newtown and potentially also Easton and Monroe • Propose changes to zoning to increase floodplain storage in new development	HVA	2-5 years	Proposed changes to zoning code presented to municipal planning and zoning commissions and land use departments	$$	FEMA Hazard Mitigation Assistance
Implement climate resilient strategies in watershed communities • Examine areas of high flood risk due to increase in precipitation • Design LID and GI solutions that can mitigate flooding in those areas • Install LID and GI solutions	HVA and Municipalities	2-5 years	• Number of LID/GI projects installed in flood risk areas • Decreased impact of flooding on infrastructure	$$$$	FEMA Hazard Mitigation Assistance
$ = $0 to $5,000 **$$** = $5,000 to $10,000 **$$$** = $10,000 to $50,000 **$$$$** = Greater than $50,000					

10.1.6 Species and Habitat Conservation

Land use within the Pootatuck Watershed can be broadly categorized into two primary categories. The first category can be characterized by higher levels of development, fragmented habitats, and open spaces primarily managed for human use. In contrast, areas situated outside this suburban center feature more open space, lower-density housing, and larger expanses of natural habitats. The approach to managing these diverse landscapes differs, broadly characterized as restoration versus protection.

It is essential to recognize that suburban areas can coexist harmoniously with native species and habitats when guided by intelligent urban planning. Cities can serve as havens for nature to flourish and wildlife to thrive by promoting the presence of native habitats wherever possible. This can be achieved through the establishment of native habitats in settings like parks, backyards, residential gardens, and business landscapes. Furthermore, creating wildlife corridors within urban areas, facilitating the movement of wildlife into less managed regions, is instrumental in preserving biodiversity. Concepts such as biophilic design, urban ecology, and sustainable development provide valuable tools for fostering habitat-friendly urban design. Rethinking fundamental city infrastructure to incorporate habitat-friendly design elements represents a promising starting point. For instance, replacing culverts with stream-simulated design bridges can eliminate barriers to fish and aquatic life while allowing terrestrial animals to move freely, reducing road crossings. A proactive approach involving the mapping of current infrastructure, identification of opportunities for habitat-friendly design, and the presentation of example redesigns sets the stage for the eventual replacement of failing infrastructure with more eco-friendly alternatives.

Invasive Species

Invasive species pose a pervasive and extensive challenge within the watershed. These invasive species exhibit aggressive growth patterns and often outcompete native flora, resulting in diminished biodiversity and the displacement of native habitats. Notable invasive species in the watershed include Japanese Knotweed, Barberry, Mugwort, Phragmites, and Japanese Hops. The management of these invasive species presents a considerable challenge due to the scale of the problem. However, invasive species removal coupled with habitat restoration using native plants can significantly increase the available habitat for native New England species. Key areas where such efforts are particularly beneficial include:

Recommended Actions

- Continued Invasive Species Management: Continue to manage invasive species in previously identified areas while exploring new opportunities where invasive management is both cost-efficient and impactful.
- Stay Informed: Remain current with research on effective invasive management approaches and prevention strategies.
- Habitat Restoration: Restore areas previously cleared of invasive species with native plantings and habitat restoration to prevent further colonization by additional invasive species.

Table 6.1.6 Species and Habitat Conservation

Recommended Actions & Milestones	Who	Timeframe	Deliverables & Evaluation Criteria	Estimated Costs	Potential Funding Sources
Continue to manage invasive species and restore native habitat. • Identify areas where invasive management is both cost efficient and highly impactful • Research effective removal and management practices	HVA, Local Land Trusts, Parks and Rec. Departments	0-2 Years Ongoing	Volunteer program implemented	$$	FCCF, Horizon Foundation
Identify and protect areas of highest conservation value throughout the watershed through	HVA	0-2 Years Ongoing	Mapped areas of high conservation value □ Number of acres of	$$$	Highland Act, Forest

conservation easements, and other conservation mechanisms. • Develop criteria to define "conservation value" • Apply criteria to watershed and identify areas of high conservation value • Among those, identify parcels available for protection along with potential partners • Engage land owners in educational programming around land protection • Set in place easements where possible with willing landowners			protected land throughout the • watershed		Legacy Fund
Increase open space, public access, and recreation opportunities throughout the watershed • Identify and evaluate areas of potential open space • Analyze feasibility of procurement • Secure funds for protection • Develop open space access and features (trails, recreation opportunities, signage, etc.)	H2H, Local Land Trusts	2-5 years Ongoing	Acres of open space protected	$$$$	Highland Act, Forest Legacy Fund

$ = $0 to $5,000 **$$** = $5,000 to $10,000 **$$$** = $10,000 to $50,000 **$$$$** = Greater than $50,000

10.2 Prioritization process for construction projects and non-construction programs

Field assessments were the first step in identifying programs and projects for development then prioritization. Please see section 5.6 for information regarding field assessments. The construction projects that the PRP strategize into this Plan call for low-impact development, green infrastructure or habitat regeneration through river-restorative actions such as planting trees along a stream or capturing polluted runoff from a parking lot to filter out pollution. The non-construction programs that the Partners strategize into this Watershed report recommend actions such as water-quality monitoring, raising public awareness, capacity-building, habitat and species management or making policy changes. The programmatic or project-based interventions were identified and developed through HVA's field assessments, conversations with the PRP and watershed residents, and common practices used in similar watersheds.

Once the Pootatuck River Partners (PRP) identified and developed a suite of construction projects and non-construction programs, their next task was to prioritize them for further action based on their potential to accomplish their shared Goals for the Pootatuck River under each focus area of the Watershed Plan (Water Quality, Natural Heritage, Outdoor Recreation and Climate Resiliency). The PRP deemed the best projects and programs to be those that most help to advance their goals in each focus area of the Pootatuck Watershed Vision and Goals that they established as described above during this management planning exercise. They did so while noting that their existing funds (CWA Section 319 Grants Program and Long Island Sound Futures Fund) required them to focus on developing projects with measurable water quality benefits.

Using a Pootatuck project and program ranking form, each Partner ranked each construction project and non-construction program on a 1-10 scale with 1 being the highest priority and 10 being the lowest priority. Each Partner who operates solely within the Pootatuck watershed or Town of Newtown was eligible to submit up to two ranking forms:

- Newtown Forest Association
- Pootatuck Watershed Association
- Potatuck Club
- Town of Newtown

Each Partner whose service area extends beyond the Pootatuck watershed was eligible to submit one ranking form:

- Aquarion Water Company
- Candlewood Valley Trout Unlimited
- Connecticut Department of Energy and Environmental Protection
- Harbor Watch
- Housatonic Valley Association

- Northwest Conservation District
- Western Connecticut Council of Governments

The Partner stakeholders sent completed ranking forms via email to two HVA staff persons, who then aggregated and shared with Partners each ranking received along with a Partners-wide ranking that consolidates management priorities for the watershed from the viewpoints of all stakeholders.

This Plan features the suite of construction projects and non-construction programs that Pootatuck Partners identified in the order that the stakeholders prioritized them for further action based on their potential to accomplish their shared Goals for the Pootatuck River under each focus area of the Watershed Plan. In other words, the implementation strategies that follow in the lists below and in the next two headings as conceptual construction projects and non-construction programs are each organized according to the Partners' prioritization in the order from their highest to their lowest priorities.

10.3 Priority construction project descriptions

10.3.1 Ram Pasture

Address: 4 S Main St, Newtown, CT 06470

Coordinates: 41.407636, -73.304638

Subwatershed: Deep Brook

Proposed Project: Riparian Corridor

Site Description: Ram Pasture is located in the heart of Newtown and is an important historical space to its residents. The large lawn creates a great space for picnics and other recreational activities during the summer and acts as an ice-skating pond in the winter, but it has its issues with Canada Goose and nutrient runoff. Ram Pasture is currently mowed to the banks of the stream and pond that runs through the middle of it, but it provides an excellent opportunity to improve riparian habitat. Increasing the riparian buffer limiting the times it is mowed would help reduce the amount of excess nutrients running into the stream and ultimately Deep Brook. Additionally, there are erosion concerns throughout the stream corridor, resulting in sediment deposition in the pond. Riparian plantings would be targeted to address areas susceptible to erosion. There is also an opportunity to provide educational signage about riparian restoration in a popular public location.

Rams Pasture Location Map

Rams Pasture: Existing Conditions

Rams Pasture: Proposed Conditions

The proposed Best Management Practice for Rams Pasture targets riparian buffers along the stream corridor and pond edge. Broken into two phases (Pond and Stream), the plantings work to reduce nutrient loading, remove sight lines for Canada Goose, and stabilize streambanks.

Pond

1. Riparian plantings at waters edge.
   a. Planting beds will remove sight lines for geese.
   b. Will uptake nutrients before they enter the water.
2. Upland Planting beds set back from edge of pond with upland plant species.
   a. Beds will overlap with riparian plantings to block sight lines to and from the water for geese, but be set back so that there is 10’ gap between upland beds and riparian beds for recreational access.

Stream

1. Riparian plantings within the stream corridor. Will be targeted in areas that are currently lacking any buffer and mowed down to the banks, and expanding riparian areas that are susceptible to erosion (outside bend of stream).

Challenges:

- Historical Space and pushback from altering amount of space available.
- Maintenance cost of riparian buffer.

Opportunities:

- Potential for interpretive signage and volunteer events to facilitate learning how to manage environmental and/or resource commons from the sheep (over)grazing and their (detrimental) river uses of recent centuries to a renewed communal tenure for the local river under global commons such as the changing climate etc. of the present.
- Potential for interpretive signage and volunteer events to mobilize younger interest in history through the historical preservation and restoration of buffering plants as living varieties of historical collections.
- Replant with Native species.
- Reduced streambank erosion and sediment loading.
- Remove sight lines from Canada Geese.
- Reduce nutrient loads into Deep Brook.
- Excellent location for Public Education/volunteer planting.
- Reduced mowing costs and opportunity for additional revenue to maintain the pasture through trees in honor or memory of individuals as the recent experience of Newtown’s own Catherine Violet Hubbard Foundation shows with its restoration and fundraising through “legacy trees.”

These plans are only recommendations that are meant to show a possible treatment for the property. More investigation, accurate surveys and detailed plans will be required prior to the installation of the BMPs.

Pollution Reduction Estimates:

Pollution reduction estimates were calculated with the EPA Pollution Load Estimation Tool (PLET). Parameters input into PLET were conservative with practice effectiveness set at 0.5 (0-1 scale with 1 being the most effective).

Pollution Reduction	Stream Channel	Pond
Nitrogen (lbs/year)	21.07	6.19
Phosphorous (lbs/year)	8.11	0.70
Biological Oxygen Demand (lbs/year)	42.14	21.05
Sediment (lbs/year)	15.49	0.26

Estimates for the reduction in E. coli were calculated by following the formula outlined in Meerburg et al. 2011, showing that population x average weight of fecal production per 24 hours x number of colony forming units per gram ($CFUg^{-1}$) of fecal bacteria equals the potential fecal contamination of bird species.

	Goose Population (Geese per day)			
% Reduction in Goose Population	0.10	0.5	1	2
0	140,800,000	704,000,000	1,408,000,000	2,816,000,000
25	105,600,000	528,000,000	1,056,000,000	2,112,000,000
50	70,400,000	352,000,000	704,000,000	1,408,000,000
75	35,200,000	176,000,000	352,000,000	704,000,000
100	0	0	0	0

Cost Estimate:

BMP	**Size**	**Plants ($8/plant)**	**Labor**	**Materials**	**Total**
Riparian Buffer (Pond)	8,850 ft^2	$7,800 (975 plants)	$5,520	$1,000	$14,320
Riparian Buffer (Stream)	7600 ft^2	$6,688 (836 plants)	$5,520	$0	$12,208

10.3.2 CT DOT Highway Garage

Address: 21 Old Farm Rd, Newtown, CT 06470

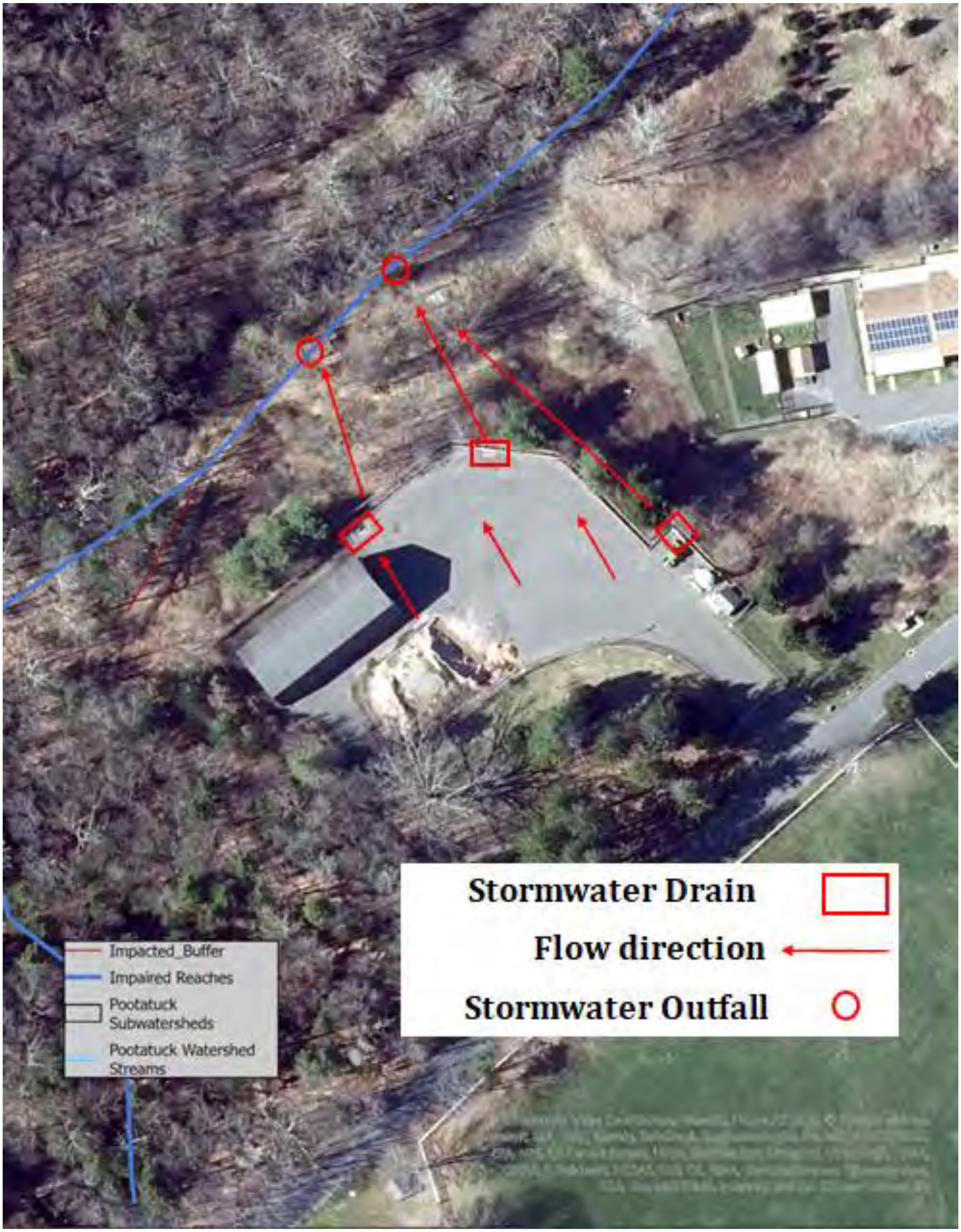
Coordinates: 41.407326, -73.286929

Subwatershed: Deep Brook

Proposed Project: Stormwater Retrofits/Bioretention System

Site Description: The salt and sand storage facility on Old Farm Road is adjacent to Deep Brook and the Wild Trout Management Area (WTMA) on Deep Brook. It is also next to the Dog Warden and Dog Park. Deep Brook is listed as impaired by CT DEEP and the salt and sand storage facility provides an opportunity to place a retrofit to improve water quality. The stormwater drains on the property appear to drain directly into Deep Brook, meaning all the stormwater runoff and the pollutants it picks up flow into the Brook. During Unified Stream Assessments two outfalls were recorded downslope of the facility, draining directly into Deep Brook. The total surface area of the facility drains about 39,000 square feet. The facility is also state owned which adds an additional challenge to implementing the project.

CT DOT Highway Garage Aerial.

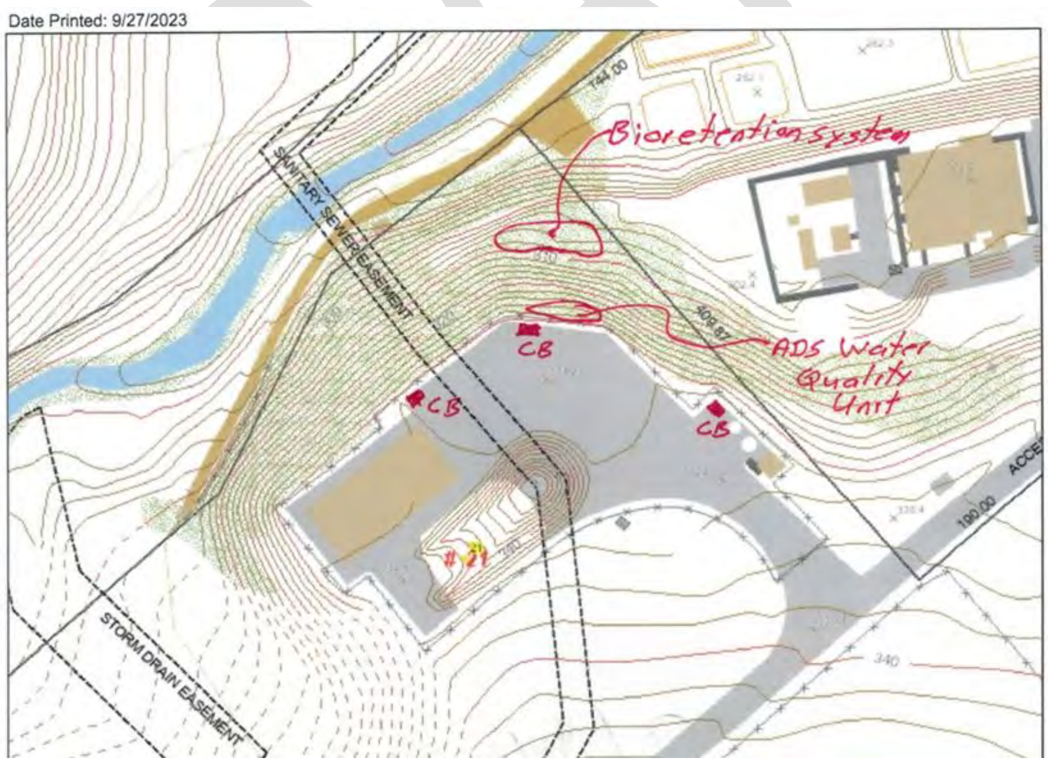


CT DOT Highway Garage Existing Conditions.

Stormwater outfalls into Deep Brook. Suspected connections to CT DOT Highway Garage.

This site is a CT DOT site with a salt storage shed. Based upon available Town of Newtown GIS mapping and Google Earth Pro, there are several catch basins in the parking lot which likely are directly discharged to Deep Brook which is located to the north and at the bottom of a large slope. Chlorides from deicing salts are impossible to remove from stormwater at this time as the chloride ions stay in solution in water. The ions will also bind to soil and remain there. The following are conceptual ideas to address runoff from the roof and paved areas of the site.

1. As this site is considered a high pollutant load site, infiltration cannot be done without a high degree of pre-treatment.
2. According to the NRCS Websoil Survey, the slope between the facility and Deep Brook consists of Hinckley soils which are well drained sands and gravels.
3. Installation of an offline ADS Water Quality Unit after the catch basins and before the existing discharge pipe sized for the required Water Quality Flow. This unit would remove large percentages of sediments, hydrocarbons and metals which are the dominant non-point source pollutants on this site. This unit would provide a high degree of pre-treatment of the runoff which would then allow infiltration to considered.
4. A long linear Bioretention system can be installed along the top of the slope above Deep Brook to handle any overland flow from the site which does not directly drain to one of the several catch basins on the site.
5. The discharge from the ADS Water Quality Unit can also be directed to the linear Bioretention system for infiltration.
6. A paved lip or other solid barrier should be installed at the opening of the salt shed to minimize any salt or runoff from leaving the inside of the building. The only thing which can be done to address chloride issues is to reduce the use of the product and also prevent its exposure to rainfall.
7. Possible locations of these systems are shown in the Figure below.



21 Old Farm Rd, Newtown, CT 06470

Services	Estimated Costs
Land survey with topographic information:	$5,500
Civil Engineering (Design only):	$7,000
ADS Water Quality Unit/Piping	$30,000
Bioretention System	$6,500

Pollution Reduction Estimates:

Pollution reduction estimates were calculated with the EPA Pollution Load Estimation Tool (PLET). Parameters input into PLET were conservative with practice effectiveness set at 0.5 (0-1 scale with 1 being the most effective).

Pollutant	Reduction Estimates (lbs/year)
Nitrogen	6.26
Phosphorous	0.68
Biological Oxygen Demand (BOD)	0.00
Sediment	0.15

10.3.3 Head O'Meadow Elementary School

Address: 94 Boggs Hill Rd, Newtown, CT 06470

Coordinates: 41.382812, -73.314366

Subwatershed: Deep Brook

Proposed Project: Infiltration Basins/Stream Daylighting

Site Description: Head O'Meadow Elementary School is located in the headwaters of the Deep Brook Watershed. It is located on a tributary of Deep Brook that contains a wild population of Brook Trout. The school drains an area of approximately 175,000 square feet into the tributary. The school provides an excellent opportunity to install a retrofit to mitigate the amount of stormwater entering the stream. It also provides an excellent chance to engage the elementary students about water quality.

Head "Meadow Elementary School.

Existing Conditions:

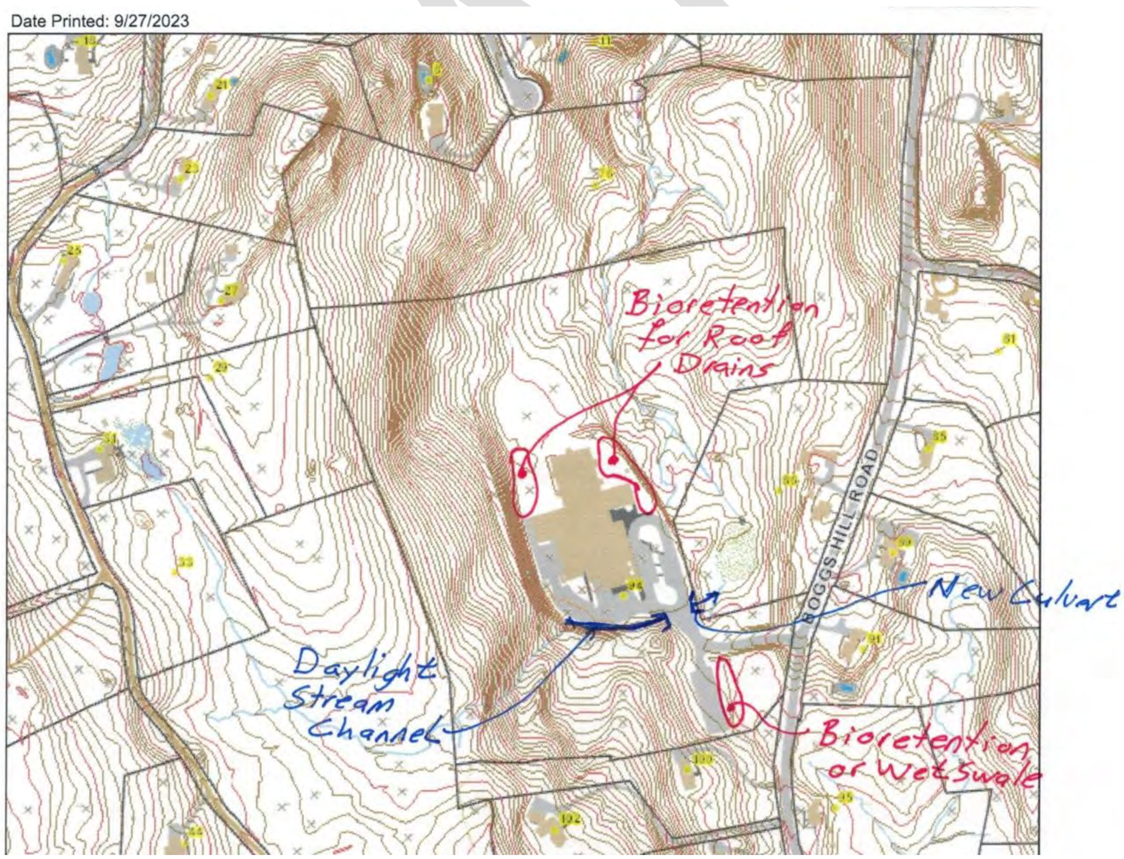
This site presents a challenge to treat runoff from the impervious areas.   A perennial stream which enters the site from the southwest has been placed in some type of underground culvert system from the southwest corner of the parking lot through the parking lot and then exits off the northeast corner of the front parking lot. It appears that roof drains from the school may be connected to this underground culvert system, the dimensions of it are unknown at this time.

There is a surface parking area located to the south of the main school area and runoff appears to drain as overland flow into a wetland corridor which runs north and south through the site more of less parallel with Boggs Hill Road.   There are several drainage structures within the driveway and parking areas of the school but it is not known at this time where the pipes discharge. It is possible that these catch basins may be connected to the underground culvert which the perennial stream is in.

Proposed BMPs 1:

According to the NRCS Websoil Survey, Hinckley and Canton Chatfield soils could be located on the site which would be suitable for infiltration. The following are conceptual ideas to address runoff from the roof and paved areas of the site.

1. If the soils are suitable for infiltration, a Bioretention system could be used to treat the runoff from the southernmost parking area prior to be directed to the wetland corridor.
2. If the soils are not suitable for infiltration, then a Wet Swale could be used to treat the same area.
3. If the roof drains could be disconnected from the existing underground culvert system, then these drains could be directed to one or more Bioretention systems around the school building to infiltrate the runoff if the soils are suitable for infiltration.
4. Divert the perennial stream which is currently in a culvert through the site along the southern perimeter of the parking area and then under the existing driveway in a much shorter culvert to the existing stream. DEEP encourages the removal of streams from culverts when possible. A restored stream channel would also provide a living habitat to be used for educational purposes.
5. ADS Water Quality Unit(s) could be used to treat the runoff currently directed to catch basins to reduce sediment, hydrocarbons, and metals loads. Unit location not shown as catch basins are not visible on any mapping.
6. Possible location of these systems are shown in the Figure below.



94 Boggs Hill Road

Estimated Costs:

Service	Cost
Land survey with topographic information:	$ 16,500.00
Civil Engineering (Design only):	$ 27,000.00
Stream Daylighting/New Culvert	$ 100,000.00
ADS Water Quality Unit/piping	$ 30,000.00
Bioretention Systems/Wet Swale	$ 11,500.00

Proposed BMPs 2:

A smaller BMP has also been conceptualized to address stormwater water coming from the parking lot near the entrance of the school where the turnaround is located. An infiltration basin will be used to capture and infiltrate stormwater before entering the stream, limiting the amount of pollutants that run off directly from the impervious surface into the stream. Preliminary estimates of stormwater water runoff using the National Stormwater Calculator show that runoff would be reduced from 33.51 inches/year to 13.73 inches/year using an infiltration basin that is 5% of the total area being treated (total average rainfall of 45.65 inches per year). An increase to 10% total area lowers total runoff to 7.18 inches/year, further reducing the amount of pollutants entering the Deep Brook Watershed.

Proposed infiltration basin to capture stormwater from parking lot.

Challenges:

- Working around School Schedule.
- Installation and maintenance of infiltration basin and their associated costs.
- Adequate area to install stormwater retrofits.
- Size of the area and subsequent size of retrofit projects.

Opportunities:

- Reduce a source or stormwater runoff from entering Tributary of Deep Brook with native Brook Trout.
- Infiltration basin doubles as pollinator/wildlife habitat.
- Involve School students with the project.
- Youth exposure to green infrastructure and low impact development.

Cost Estimate:

BMP	**Basin Size** (Basin size/total area)	**Cost**
Infiltration Basin	5%	$5,343 – $12,117
Infiltration Basin	10%	$6,145 – $14,295

Pollution Reduction Estimates:

Pollution reduction estimates were calculated with the EPA Pollution Load Estimation Tool (PLET). Parameters input into PLET were conservative with practice effectiveness set at 0.5 (0-1 scale with 1 being the most effective).

Pollutant	**Reduction Estimates (lbs/year)**
Nitrogen	8.53
Phosphorous	0.85
Biological Oxygen Demand (BOD)	0.00
Sediment	0.48

10.3.4 Country Club Riparian Buffer

Address: 2 S Main St, Newtown, CT 06470

Coordinates: 41.4001681, -73.2990147

Subwatershed: Deep Brook

Proposed Project: Riparian Corridor

Site Description: The Newtown Country Club falls within the Deep Brook watershed. The same tributary to Deep Brook that runs through Ram Pasture also runs through the Country Club. There is currently very little riparian buffer along the stream and it is mowed down to the banks. Increasing the buffer to 30 feet on either side would reduce the amount of nutrients entering Deep Brook and help reduce the temperature of the tributary. It would also increase the stability of the stream banks and reduce the amount erosion occurring along the stream channel. Being along the golf course there would be an excellent opportunity for educational signage about the importance of riparian buffers.

Challenges:

- Buy in from golf course management.
- Pushback from golfers.
- Maintenance cost of riparian buffer.
- Cost of planting large area.

Opportunities:

- Replant with Native species/pollinator resource.
- Reduce stream temperatures with increased buffer and shading.
- Increased bank stability/reduced streambank erosion.
- Reduce nutrient loads into Deep Brook.
- Excellent location for Public Education.
- Opportunity for volunteer planting event.

Pollution Reduction Estimates:

Pollution reduction estimates were calculated with the EPA Pollution Load Estimation Tool (PLET). Parameters input into PLET were conservative with practice effectiveness set at 0.5 (0-1 scale with 1 being the most effective).

Pollutant	Reduction Estimates (lbs/year)
Nitrogen	19.44
Phosphorous	7.48
Biological Oxygen Demand (BOD)	38.88
Sediment	14.29

10.3.5 Deep Brook Dam

Address: 63 S Main St, Newtown, CT 06470

Coordinates: 41.399412, -73.292911

Subwatershed: Deep Brook

Proposed Project: Dam Removal/Mitigation

Site Description: Deep Brook Dam is located behind the Taunton Press along Deep Brook. The dam acts as a barrier for fish passage and prevents any fish from moving upstream into Deep Brook from the Pootatuck River. There is also a record of another dam immediately downstream but was not found while conducting streamwalks. Upstream of the impoundment, there is a wetland that could be a cause for concern if the dam were to be removed. Removing Deep Brook dam would allow for a natural flow regime and fish passage up to the headwaters of the Deep Brook Watershed.

Challenges:

- Private ownership.
- Another dam immediately downstream (according to CT DEEP Files).
- Financial Cost to Remove.
- Environmental concerns: Sediment, Water Flow, Temperature.
- Wetlands immediately upstream.

Opportunities:

- Major barrier on Deep Brook.
- Fish passage from Pootatuck River to Deep Brook Headwaters possible.
- Restore natural flow and channel dynamics.

HVA Staff measuring Deep Brook Dam and facing the downstream wall of dam

Aerial photo of Deep Brook Dam.

10.3.6 Sand Hill Plaza

Address: 228 S Main St, Newtown, CT 06470

Coordinates: 41.3732238, -73.2725871

Subwatershed: Cold Spring Brook

Proposed Project: Stormwater Retrofits

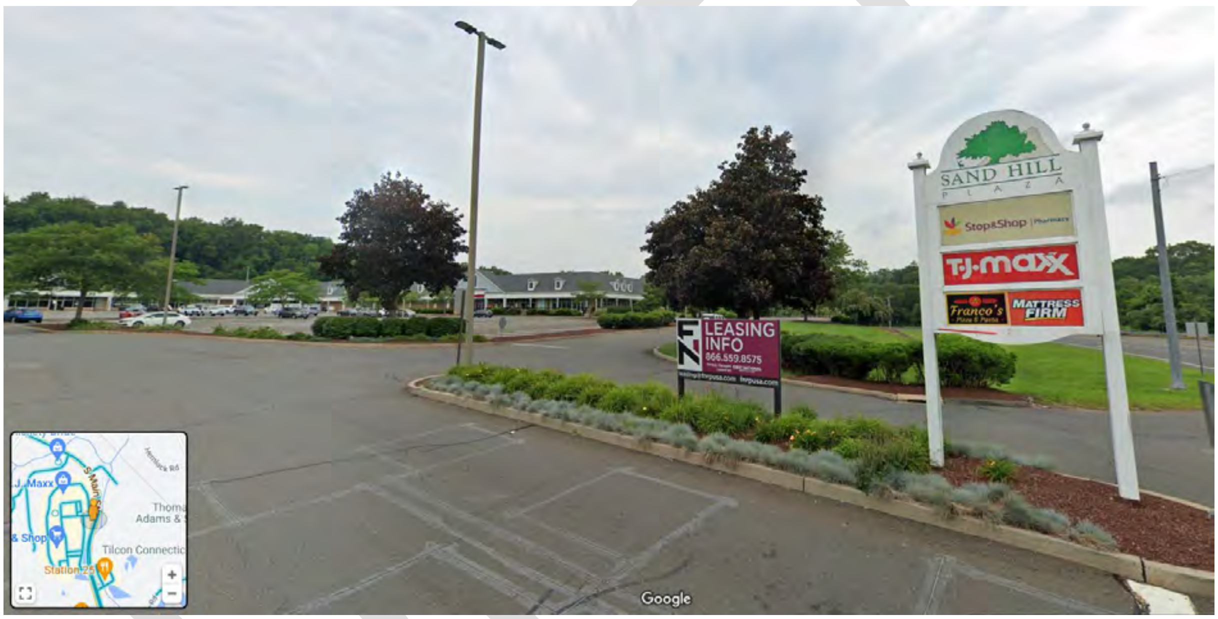
Site Description: The Sand Hill Plaza is a large commercial shopping center that resides within the Cold Spring Brook subwatershed. It is unclear where each stormwater drain flows to but it is either into Cold Spring Brook or the Mainstem Pootatuck River. There are numerous drains throughout the parking lot offering many opportunities for retrofits to be installed. Conversely the volume of drains throughout the property will make installing retrofits more expensive. The most efficient solution would be to intercept the stormwater just before it enters Cold Spring Brook/Pootatuck River. Sand Hill plaza has an approximate area of 700,000 square feet, making it a substantial source of stormwater runoff.

Challenges:

- Commercial property.
- Installation and maintenance of retrofits and their associated costs.
- Adequate area to install stormwater retrofits.
- Size of the area and subsequent size of retrofit projects.

Opportunities:

- Reduce a significant source or stormwater runoff from entering waterways.
- Educational opportunities given the commercial use.



Sand Hill Plaza Location

Pollution Reduction Estimates:

Pollution reduction estimates were calculated with the EPA Pollution Load Estimation Tool (PLET). Parameters input into PLET were conservative with practice effectiveness set at 0.5 (0-1 scale with 1 being the most effective).

Pollutant	Reduction Estimates (lbs/year)
Nitrogen	8.53
Phosphorous	0.85
Biological Oxygen Demand (BOD)	0.00
Sediment	0.48

10.3.7 Newtown Transfer Station

Address: 4 Ethan Allen Rd, Newtown, CT 06470

Coordinates: 41.3793690, -73.2728139

Subwatershed: Lower Pootatuck

Proposed Project: Trash Cleanup and Prevention

Site Description: The Newtown Transfer Station is located along the Pootatuck River in the Lower Pootatuck subwatershed. Trash from the transfer station has migrated into the river corridor, resulting in a large amount of trash being in and around the river. There is an opportunity to create a river cleanup event to pick up trash from the transfer station, but also in other areas throughout the watershed. There is also a need to create a long-term solution for trash migrating into the river given its close proximity to the river corridor.

Challenges:

- Preventing future trash from falling into the river.
- Proximity to River creates a constant threat of trash in the river.

Opportunities:

- Remove large amounts of trash from the Pootatuck River.
- Chance to create a community cleanup event.
- Creation of a long-term solution to trash migration from transfer station.

Aerial of Newtown Transfer Station and cleanup area.

10.3.8 Aquarion Well Field

Address: 219 S Main St, Newtown, CT 06470

Coordinates: 41.3762335, -73.2727985

Subwatershed: Lower Pootatuck

Proposed Project: Riparian Corridor/ Instream Habitat Restoration

Site Description: The Pootatuck River runs through the Aquarion Water Company well field along Main Street in Newtown. The area has a large amount of invasive species such as Japanese Barberry, Mile-a-minute, and Japanese Knotweed. There is also a lack of trees and large cover that provides shade and habitat for wildlife. The well field creates an opportunity to remove a large number of invasive species and also augment instream habitat for fish, especially trout. This project would depend on how removing invasive plant species would impact the well field.

Challenges:

- Possible impacts to well field.
- Permission from Aquarion to work within well field.
- Initial cost to remove invasive species
- Maintenance cost and effort of invasive removal.

Opportunities:

- Replant with Native species.
- Aquarion has recently planted 53 trees and shrubs to mitigate some of these riparian buffer and cover issues.
- Improved in-stream habitat for fish and wildlife.
- Prevent warming of Pootatuck River through trees and shrubs.

Aerial image of Aquarion Well Field and Proposed area of restoration.

10.3.9 Potatuck Club Dams

Address: 100 Mile Hill Rd, Sandy Hook, CT 06482

Coordinates: 41.4059324, -73.2714611

Subwatershed: Lower Pootatuck

Proposed Project: Dam Removal/Mitigation

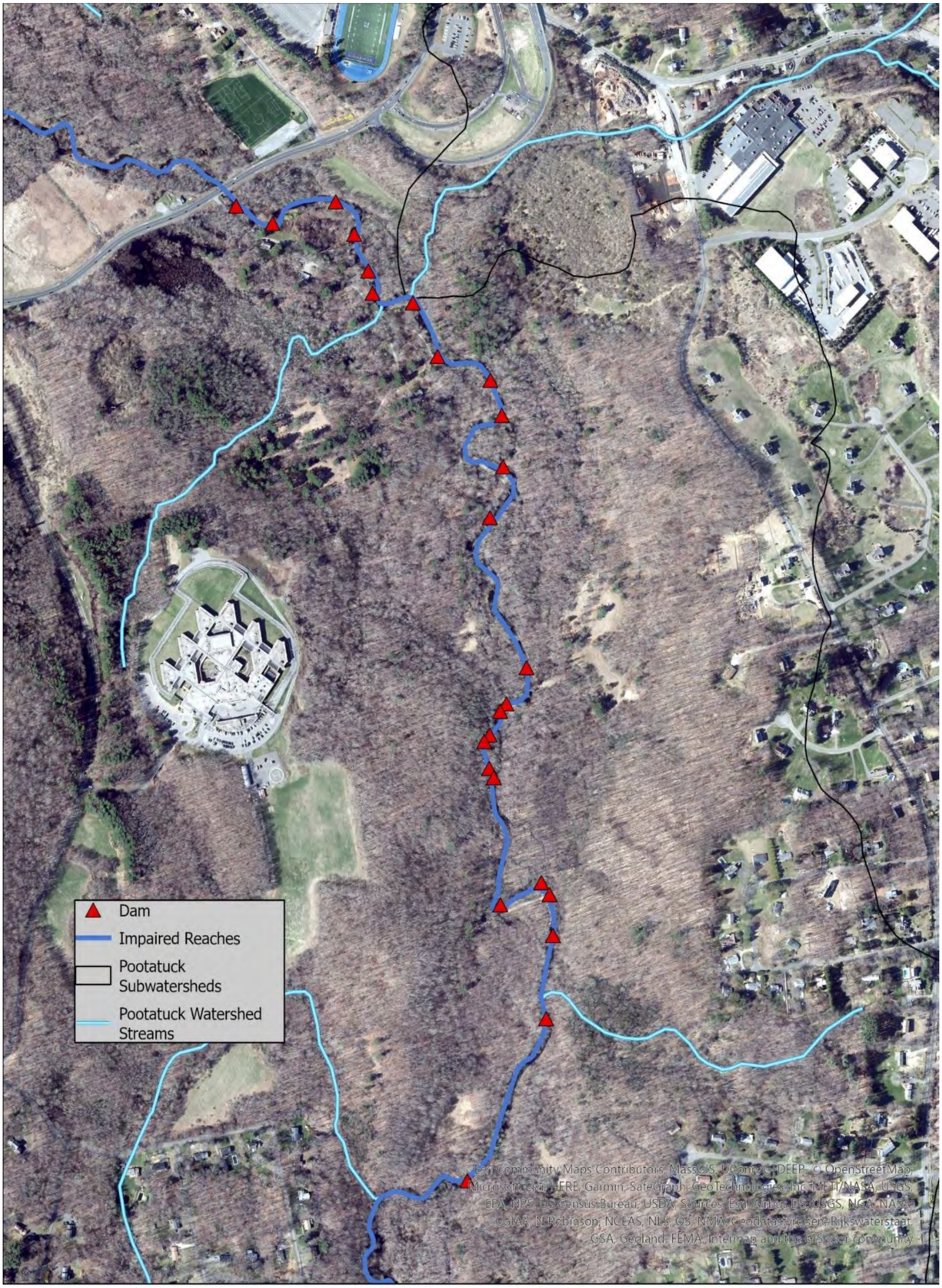
Site Description: The Potatuck Club owns a large section of property on the mainstem Pootatuck River with a series of over 20 rock dams over the course of about one and a half stream miles. The dams create pools that provide angling opportunities to members of the club. The series of dams that occur of the course of the property limit fish passage through the rest of the Pootatuck River and the tributaries upstream of the properties. There is the possibility of mitigating the dams by partially removing them rather than completely removing each dam. This project would be dependent on if the Club would be open to any remediation of the dams.

Challenges:

- Private ownership.
- Series of dams (>20).
- Time, effort, and cost to remove all dams.
- Environmental concerns: Sediment, Water Flow, Temperature.

Opportunities:

- Would allow for fish passage to the upper Pootatuck and its tributaries.
- Restore natural flow and channel dynamics.



Aerial image of Mainstem Pootatuck River along Potatuck Club Property. Dams are marked with red triangles.

One rock dam in the series of many dams.

10.3.10 Lower Rocky Glen Dam

Address: 27 Glen Rd, Sandy Hook, CT 06482

Coordinates: 41.425888, -73.281598

Subwatershed: Lower Pootatuck

Proposed Project: Dam Removal/Mitigation

Site Description: The Lower Rocky Glen Dam is located just upstream of the Rocky Glen Dam, counterintuitively or unconventionally named as their locations make this use of a 'Lower' qualifier. The Steering Committee identified this site as a possible candidate for removal or mitigation. This dam is the second major barrier in the Pootatuck River Watershed and acts as a barrier for fish passage for anything trying to move upstream from the Housatonic River. Removing the Lower Rocky Glen Dam would open up fish passage for a significant portion of the Lower Pootatuck Subwatershed and Tom Brook Watershed but would still be limited by the Rocky Glen Dam downstream.

Challenges:

- Hydroelectric power generation.
- Another dam immediately downstream.
- Expensive to remove dams.
- Environmental concerns: Sediment, Water Flow, Temperature.

Opportunities:

- As a removal opportunity for this second major barrier on the Pootatuck River, bundle it with downstream dam removal to open up Mainstem Pootatuck and tributaries such as Tom Brook for fish passage.
- In a mitigation opportunity, the Lower Rocky Glen dam has operation issues that could cause problems for the watershed such as on occasions during the year when the facility shuts off the river flow in order to do maintenance. Low-cost or no-cost changes to its operating procedures could result in significant improvements for the lower Pootatuck.
  .

Aerial image of Lower Rocky Glen Dam.

10.3.11 Rocky Glen Dam

Address: 75 Glen Rd, Sandy Hook, CT 06482

Coordinates: 41.432919, -73.276274

Subwatershed: Lower Pootatuck

Proposed Project: Dam Removal/Mitigation

Site Description: The Rocky Glen Dam is located just upstream of the confluence of the Pootatuck River and Housatonic River. The Steering Committee identified this site as a possible candidate for removal or mitigation. This dam is the first major barrier in the Pootatuck River Watershed and acts as a barrier for fish passage for anything trying to move upstream from the Housatonic River. The dam also acts as a hydroelectric power station, presenting an additional challenge for removal. There is also another dam upstream, meaning any removal would only open a very short segment of the Pootatuck River.

Challenges:

- Hydroelectric power generation.
- Another dam immediately upstream.
- Expensive to remove dams
- Environmental concerns: Sediment, Water Flow, Temperature.

Opportunities:

- First major barrier on the Pootatuck River.
- Bundle with upstream dam to open up Mainstem Pootatuck and its tributaries for fish passage.

Aerial image of Rocky Glen Dam.

10.4 Priority non-construction program descriptions

10.4.1 Engaging streamside landowners with impacted buffers and supporting them in riparian restorations (RiverSmart)

Streamside landowners often maintain turf lawns that are mowed down to the banks of the waterway, leaving very little vegetation to act as a buffer for pollution resultant from fertilizers, pesticides, pet waste and other sources. Turf lawns also have shallow roots, leading to increased erosion along the impacted buffer. Hence, there is a need to engage such streamside owners to encourage "RiverSmart" practices, but also support the implementation of restoration projects with technical and financial assistance.

On the one hand, these practices may confront challenges such as:

- Large number of streamside landowners
- Previous lack of technical and financial support for interested landowners.
- Facilitating relationships with landowners with whom Partners do not have a current relationship or contact.
- Funding for implementation of buffers and other RiverSmart practices.

On the other hand, these same practices may seize opportunities such as:

- Mobilization of existing resources from the RiverSmart program.[142]
- Utilizing connections from other programs such as those of the CT DEEP unit for the stream-side Rocky Glen State Park or the CT Department of Corrections (DOC) staff and collaborators for the stream-side Garner Correctional Institution.
- Current expertise to support homeowners with technical assistance.
- Reduced impacts from residential sources.

10.4.2 Pollution track down program

A program could be instituted to track down pollution within the Pootatuck Watershed. Track down programs have been successful in other watersheds (Still River) where they have not only made a productive contribution to locate, but also freed up resources to address pollution concerns. Track downs involve systematically working up from an outfall to identify the exact source of pollution within the system. Once identified, action can be taken to remediate the source of pollution.

On the one hand, these practices may confront challenges such as:

- Requirement of initial sampling to find outfalls that are high in pollutants.
- Funding can be difficult to obtain.
- Working with landowners to find and/or fix existing pollution sources can be challenging.

On the other hand, these same practices may seize opportunities such as:

- Identification of "low-hanging fruit" that can quickly improve stream health in some situations.

- Identification of specific pollutant sources and informative input into intervention.
- Optimization or moderation of sufficient assessment efforts to maximize remediation of pollution sources.

If warranted, PRP stakeholders such as Harbor Watch or the Town of Newtown could conduct additional monitoring to track pollution sources using repetitive sampling for indicator bacteria, ammonia, chlorine, and/or surfactants instream as well as outfall screening and sampling within stormwater structures to identify sewage sources such as illicit connections or broken sewer pipes. Pricing for track-down is variable depending on the project and parameters tested and would need to be evaluated at the time of the project.

10.4.3 Water quality monitoring program

A program could be established to monitor water quality across the entire watershed. Parameters monitored could include but not necessarily be limited to pH, temperature, conductivity, dissolved oxygen, indicator bacteria, and nutrients. Water quality monitoring would be designed to support performance tracking of watershed management activities and track trends in water quality over time to inform management.

On the one hand, these practices may confront challenges such as:

- Comprehensive monitoring is time intensive and requires some level of training before taking samples and measurements.
- Funding for water quality monitoring not tied to a specific project can be difficult to obtain.
- Agencies like the CT DEEP do not actively encourage monitoring programs.

On the other hand, these same practices may seize opportunities such as:

- Understanding the water quality of the Pootatuck River watershed in its entirety.
- Being able to identify areas of concern and pollution sources.
- Robust data set for future comparison as the climate changes.
- Identification of habitat for species of concern (cold water refugia).
- Installation of gauges and sondes in areas of interest could lower the time intensiveness of these practices.

The Pootatuck River mainstem and 5 of its subwatersheds (Cold Spring Brook, Curtis Pond Brook, Deep Brook, North Branch Pootatuck River, and Tom Brook) have 17 years of water quality data (physical, chemical, and biological) collected by various organizations, namely the Pootatuck Watershed Association, USGS, and Harbor Watch at Earthplace. Continual and frequent monitoring within the watershed is important to understand current water quality conditions of the watershed in its entirety, identify hot spots to prioritize for pollution source identification and remediation, determine if water quality standards are being met, maintain a robust dataset to track trends over time to inform management solutions, and support performance tracking of implemented watershed management activities.

Plan recommendations:

- Seek funding to conduct water quality monitoring throughout the watershed to establish an annual monitoring program, support data collection on a wide variety of parameters, and encourage track-down projects to identify pollution sources and determine steps remove them from the watershed.
- Establish an annual pathogen monitoring program at a set list of stations with a goal of 10 sampling events (twice per month) from May through September (minimum of 8 sampling events conducted to collect enough data for potential use by CT DEEP in their assessments).
    - Monitoring should be conducted on a randomized schedule every two weeks (in order to not bias sampling on a particular day of the week).
    - Monitoring should be conducted regardless of weather conditions so as to not bias wet vs. dry weather sampling.
- Conduct pollution track-down when elevated bacteria concentrations are observed to identify sources and prioritize remediation. This monitoring should include a combination of repetitive indicator bacteria samples over short period of time, field kits for ammonia, chlorine, and surfactants, and any other methods available to isolate pollution sources.
- Evaluate watershed concerns annually to determine if additional parameters should be monitored; either added to the annual program or on a modified schedule determined by funding and need. Potential parameters include nutrients, pH, PFAS, and other emerging contaminants of concern.
- Install data loggers to monitor physical and chemical parameters that are important for assessing habit including but not limited to dissolved oxygen, water temperature, conductivity, and water level.

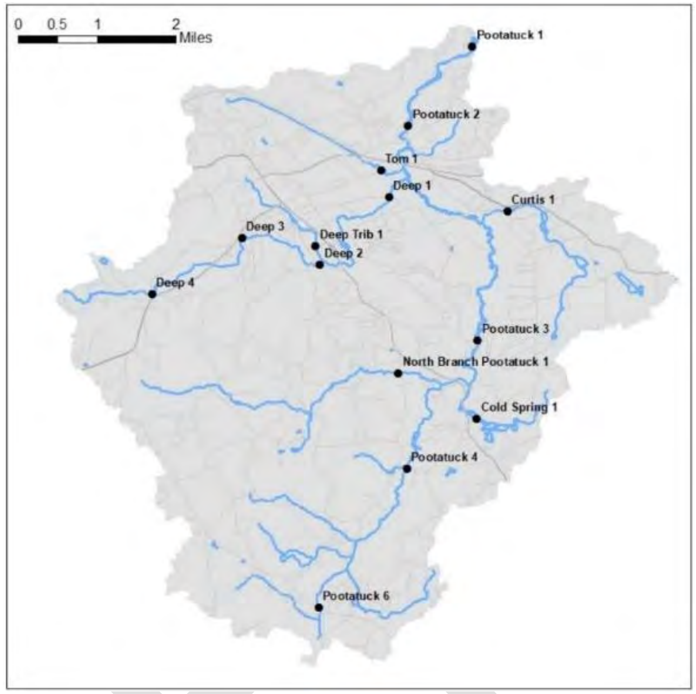


Figure 3. Proposed monitoring locations selected based on past sites of sample collection by Harbor Watch and Pootatuck Watershed Association as well as new sites that appear to have easy access at public road crossings.

Table 6.2.3.

Proposed budget:

Item	Cost
Personnel (field and laboratory)	$4,450
Supplies (sample bottles, reagents, standards, etc)	$2,985
Travel	$500
TOTAL	$7,935

A program could monitor the Pootatuck River watershed from May to September for indicator bacteria (E. coli), dissolved oxygen, water temperature, and conductivity. Sampling would be conducted throughout the watershed, with priority given to the main stem of the Pootatuck River and Deep Brook, both which are currently assessed waterways by CT DEEP and have segments that are listed as impaired. Additional sites would be located on the tributaries to assist in determining if the sub-watersheds are contributing to poor water quality (Figure 3). Data would be collected approximately twice per month (about every two weeks on randomized schedule) during the May through September monitoring season. For an added monitoring effort, Harbor Watch has the ability to collect samples for nutrient analysis as well, should the stakeholders be interested in that data. There are two contract laboratories that could process the samples. Harbor Watch could collect the samples during the regular monitoring at no additional personnel cost. Funding would be required to pay for the sample analysis by the contract laboratory at approximately $57 per sample for TN, TP, Ammonia, Nitrate, Nitrite, and TKN (price varies by lab, as does minimum detection limits).

10.4.4 Education on proper septic maintenance and practices

A program could be generated to educate individuals about septic systems in a manner that facilitates their understanding of how these systems work, what an important difference regular septic maintenance makes, and how to properly dispose of wastewater. Properly functioning septic systems are essential for preventing contamination of groundwater, surface water, and nearby ecosystems. This knowledge empowers homeowners to take responsible actions that safeguard the environment and protect water quality.

On the one hand, these practices may confront challenges such as:

- Difficulty in identifying exactly where septic tanks are in use versus where sewer lines are in use across the watershed.
- Approaching septic owners without implication of fault or presumption of knowledge gap.

On the other hand, these same practices may seize opportunities such as:

- Some resources are already on the RiverSmart website.
- Possibility to work with septic companies to spread proper maintenance practices.
- Assurance of public and environmental health through accessible education materials.

10.4.5 Develop a wetlands education center and/or program at Dickinson Park

A wetlands education center and/or program at a Newtown public outdoor site such as Dickinson Park or behind a ball field on the confluence of the Pootatuck River with the Housatonic River at Lake Zoar off of Walnut Tree Road would provide an easily accessible space for community members to learn and engage in wetland conservation and restoration. A center and/or program would also be an opportunity for local schools to take advantage of a place to conduct wetland research and give students a hands-on experience in conservation. Development of a program and staffing an environmental educator would be the biggest strains to such a program and/or center.

On the one hand, these practices may confront challenges such as:

- Funding an education center and/or program including staffing and resources will be difficult.
- Infrastructure would also be needed to facilitate a weather-proof education center.

On the other hand, these same practices may seize opportunities such as:

- Generating a sense of stewardship for the environment among the community.
- A place to provide resources and support for those interested in improving their environment.
- Possible community-based science location.
- Promotion of wetland conservation and restoration.
- A broader watershed training program could be included either in the education center itself or in the like-minded while nearby Catherine Violet Hubbard Animal Sanctuary and/or the temporary riverside sites of Newtown's 23-year-old annual Rubber Duck Race.

10.4.6 Land protection program

Land protection refers to the conservation and preservation of land and natural resources to safeguard their ecological, cultural, recreational, and economic values for present and future generations. It involves various strategies and mechanisms aimed at preventing the degradation, fragmentation, or loss of important land areas. Land protection also protects water quality, valuable habitat for fish and wildlife, and provides recreational opportunities. Areas that contain important habitat, water resources, and species of concern should be considered for land protection.

On the one hand, these practices may confront challenges such as:

- Funding requirements to purchase parcels of land.
- Approaching landowners about possible easements.

On the other hand, these same practices may seize opportunities such as:

- Protection of natural areas.
- Water quality benefits of protecting forested areas.
- Fish and wildlife habitat protection.
- Recreational opportunities.

10.4.7 Invasive species management program

An invasive species management program is a comprehensive strategy designed to address the threats and impacts of invasive species within the Pootatuck River Watershed. It outlines a systematic approach to identify, prevent, control, and manage invasive species populations, aiming to minimize their negative effects on native biodiversity, ecosystems, economies, and human well-being. Prevalent invasive species in the watershed include Japanese Barberry, Japanese Knotweed, Mile-a-minute, Asian Bittersweet, and many more.

On the one hand, these practices may confront challenges such as:

- Invasives are persistent through the entire watershed and a major effort would be needed to make any meaningful impact.
- Proper disposal of plants is needed to prevent spreading.
- Significant investment of finance and time.

On the other hand, these same practices may seize opportunities such as:

- Replacement of invasive species with native species.
- Maximize effectiveness through integration with soil erosion plans and efforts.
- Prevention of invasive species from spreading further.

10.4.8 Education on waste management and best practices for backyard farmers in the watershed

Backyard farming, also known as urban or suburban farming, refers to the practice of growing food and raising animals in residential areas, typically in small-scale settings such as home gardens, balconies, rooftops, or community plots. It involves utilizing available space to cultivate a variety of crops, raise livestock or poultry, and engage in sustainable agricultural practices. By providing backyard farmers with educational resources about best management practices for backyard farming, the possible negative impacts can be minimized while any positive impacts can be maximized.

On the one hand, these practices may confront challenges such as:

- Identifying backyard farmers tends to be more time-consuming than finding conventional farmers such as those on the Pootatuck River Watershed itself.
- Approaching backyard farmers with educational resources.

On the other hand, these same practices may seize opportunities such as:

- Raising awareness of sustainable practices such as composting, rain barrels, and reduced pesticide use.
- Nurturing relationships with more community members.
- Fostering a sense of environmental stewardship among the backyard farming community.

10.4.9 Work with Town of Newtown to place greater emphasis on protection of watercourses

A program could institute work with Town of Newtown officials to include language and policy that places greater emphasis on protecting watercourses. This would include advocacy and lobbying for town officials to incorporate low-impact development (LID) and green infrastructure (GI) into town policies and plans (erosion management plan, hazard mitigation plan, etc.).

On the one hand, these practices may confront challenges such as:

- Compromise between development and protection/restoration.
- Implementation and enforcement of environmental plans.

On the other hand, these same practices may seize opportunities such as:

- Updates to erosion management plan.
- Inclusion of LID/GI practices for new developments.
- Best management practices for Town-managed turf.

10.4.10 Conifer revetment program

A conifer revetment program is a proactive approach to stabilize riverbanks, shorelines or slopes using conifer trees as a natural erosion control measure. The program involves securing conifer species such as spruce or pine to the streambank along vulnerable areas to prevent soil erosion and provide long-term stability. Conifer revetment programs provide opportunities for community engagement and education while also enhancing habitat and reducing erosion.

On the one hand, these practices may confront challenges such as:

- Ongoing maintenance requirements.
- Site preparation and installation.
- Landowner cooperation and buy-in.

On the other hand, these same practices may seize opportunities such as:

- Community engagement and education.
- Cost-minimization through volunteer labor and holiday-tree donations.
- Erosion control and habitat enhancement along stream and river banks.

10.4.11 Homegrown National Park program for individual property owners

The concept of Homegrown National Parks recognizes that urban and suburban areas can play a crucial role in supporting biodiversity and ecological health. Such a program promotes reduction of lawn desert areas and elimination of synthetic lawn chemicals and pesticides. As an alternative, it encourages homeowners, businesses, schools, and other organizations to create and maintain native plant habitats in their yards, gardens, parks, and other available spaces. By doing so, these individual habitats collectively form a network of "mini-parks" or "micro-reserves" that provide food, shelter, and breeding sites for a variety of native species.

On the one hand, these practices may confront challenges such as:

- Community engagement and buy-in.
- Lack of incentive outside of environmental benefits.
- Numerous conflicting resources that may lead to exotic, non-native plants being planted.

On the other hand, these same practices may seize opportunities such as:

- Encouragement for homeowners to plant native and embrace wildlife.
- Landowners can be involved in multiple ways.
- Encouragement for property owners to get on the map and make the watershed a hotspot that serves native animals and plants as a welcoming habitat.

10.4.12 Municipal ban on neonicotinoid pesticides for non-agricultural use[143]

Neonicotinoids have been the subject of considerable concern due to their potential adverse effects on pollinators, particularly bees and other beneficial insects. These effects are attributed to the toxicity of neonicotinoids and their ability to persist in nectar and pollen, which are essential food sources for bees and other pollinators. A municipal ban on these pesticides would benefit pollinators throughout the watershed and limit the amount that enter watercourses from runoff.

On the one hand, these practices may confront challenges such as:

- Uncertainty as to how pervasive neonicotinoid use in the watershed is outside of agriculture.
- A municipal ban would be difficult to enforce at the local level and might make more sense as a State-level policy initiative.

On the other hand, these same practices may seize opportunities such as:

- Ban on neonicotinoid use would be a win for pollinators and environment.
- Impose restrictions on neonicotinoids similar to those in New Jersey, New York and Vermont.
- Serve as an example for other municipalities and advocate at the State level for non-agricultural restrictions that could become policy consistently enforced across Connecticut.
- Advocate for alternative methods of pest control that are more environmentally friendly.

10.4.13 Winter water quality monitoring[144]

Winter water quality monitoring entails the same sampling as normal summertime monitoring, but during the winter months instead. Sampling during the winter would provide a complete picture of water quality throughout the year. Winter sampling is not typically done because most parameters of interest (bacteria, DO, etc.) are not a concern during the winter months like they are during the summer.

On the one hand, these practices may confront challenges such as:

- Some parameters (indicator bacteria) are better measured during the warm season to understand stream health; winter data can dilute year-round results.
- Winter monitoring is not supported by the state.
- Safety is a concern while working in and around water with ice or snow under freezing temperatures.

On the other hand, these same practices may seize opportunities such as:

- Full year worth of data.
- Alternative option could be a more targeted form of monitoring only for tracking road salts during the winter (in-situ conductivity loggers, chloride etc.).

10.4.14 Enhancement of buffer and native plants in utility right-of-ways, particularly those next to streams

Planting native vegetation in utility right-of-ways (ROWs) involves establishing and maintaining native plant species within the areas where utility infrastructure such as power lines, pipelines, or transportation corridors are located. Depending on where the right-of-ways are located, there can be restrictions on the mature size of plants that can be planted, often limiting them to less than 15’ tall.

On the one hand, these practices may confront challenges such as:

- Continuous maintenance needed to remove invasive plant species and trees from right-of-ways.
- Approaching utilities about working in right-of-ways.

On the other hand, these same practices may seize opportunities such as:

- Connecting areas of land that could act as pollinator habitat.
- Chance to remove invasives in and around watercourses.
- Support food chains for native animal species.

10.4.15 Develop master inventory and plan for trails and stream habitat improvements along Pootatuck River from Lower Agricultural Field of Fairfield Hills to Sandy Hook Center

A program could be designed to take inventory and develop a trail system from Fairfield Hills down to Sandy Hook. Such an inventory of trails could then be used to develop new trails in areas that do not have adequate access while also making these trails accessible to everyone. There is also a need to ensure that trail development does not negatively impact habitats or put species of concern at risk.

On the one hand, these practices may confront challenges such as:

- Working with landowners to allow trails to go through their property.
- Making sure trails and access do not negatively impact the environment.

On the other hand, these same practices may seize opportunities such as:

- Connecting a trail system through the Pootatuck River Watershed.
- Greater access to open and green spaces throughout the watershed.
- Viability of including more accessible trails within plan.

10.4.16 Advocacy for municipal and State tax credits for those reducing lawn and planting native plants

Municipal tax credits for reducing lawn and planting native vegetation would incentivize homeowners and property owners to adopt more sustainable landscaping practices. The tax credits would aim to promote environmental conservation, improve biodiversity, conserve water resources, reduce chemical use, and create habitat for native species. Advocacy for such tax credits would have to be done at the local level with Newtown policy makers.

On the one hand, these practices may confront challenges such as:

- Convincing municipality to adopt such credits.
- Buy-in from Newtown homeowners or property owners to reduce lawn and increase native plants.

On the other hand, these same practices may seize opportunities such as:

- Incentivizing homeowners to increase buffers and plant natives will help pollinators and other wildlife.
- There are plenty of resources about native planting (Homegrown National Park, Million Pollinator Garden Challenge etc.)

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[128] Explore Connecticut, "Rocky Glen State Park."

[129] Please see Perrefort, "History Lives on in Sandy Hook Industrial Building." Please see also Soule, "Historic Mill Building in Connecticut Set to Be Auctioned Off."

[130] The United States Rubber Company purchased the rubber factory during a war effort in 1917 and kept it until 1977 by which time the aftermath of World War II settled down. On rubber supplies during and in the aftermath of the two World Wars generally, please see Hecht, *The Scramble for the Amazon and the "Lost Paradise" of Euclides Da Cunha*; Dean, *Brazil and the Struggle for Rubber: A Study in Environmental History*. On the purchase and ownership of the rubber factory specifically over those 60 years, please see Explore Connecticut, "Rocky Glen State Park." During the Civil War, please see: Cruson, "A Brief History of Newtown: Newtown in the Nineteenth Century"; Warshauer, "Connecticut Fights the Civil War: How a Little State Won a Big War."

[131] Please see Hecht, *The Scramble for the Amazon and the "Lost Paradise" of Euclides Da Cunha*, p. 254 and 263. Please see also Dean, *Brazil and the Struggle for Rubber: A Study in Environmental History*.

[132] William, *When Work Disappears: The World of the New Urban Poor*.

[133] For reviews of how smuggling displaced the rubber plants, please see Hecht, *The Scramble for the Amazon and the "Lost Paradise" of Euclides Da Cunha*; Dean, *Brazil and the Struggle for Rubber: A Study in Environmental History*.

[134] McFarland, *Mark Twain and the Colonel: Samuel L. Clemens, Theodore Roosevelt, and the Arrival of a New Century*; p. 212 and 340; see Zwonitzer, *The Statesman and the Storyteller: John Hay, Mark Twain, and the Rise of American Imperialism*; p. 520; see also Kinzer, *The True Flag: Theodore Roosevelt, Mark Twain, and the Birth of American Empire*.

[135] For sightings of chimney swifts in and/or around Newtown, please see Cornell Lab of Ornithology, "Upper Paugussett State Forest"; Cornell Lab of Ornithology, "Bent of the River Sanctuary"; Cornell Lab of Ornithology, "Lanes Mine Nature Park, Monroe." For the northern and southern ranges of the migratory chimney swifts and how they include parts of the Amazon River Basin such as where Bolivia, Brazil and Peru border each other, please see Cornell Lab of Ornithology, "Chimney Swift." For how the Brazilian state of Acre bordering Bolivia and Peru has been home to one of the most socio-environmentally sustainable parts of the Amazon, including its single most sustainable rubber-tapping, please see Hecht, *The Scramble for the Amazon and the "Lost Paradise" of Euclides Da Cunha*; Dean, *Brazil and the Struggle for Rubber: A Study in Environmental History*.

[136] On these historical considerations and recognition, please see Gagnon, "The Connecticut Town Green."

[137] On common-pool tenure of decentralized environmental and/or natural-resource protection, please see Committee on the Human Dimensions of Global Change (Ostrom, Elinor et al.), *The Drama of the Commons*.

[138] Hicks, "The ABCs Of Newtown: H Is For (Mary) Hawley, Part One."

[139] Please see Gagnon, "The Connecticut Town Green."

[140] On how such environmental or natural-resource commons scale up globally as well as how they live on in the present time and foreseeable future, please see Conca and Dabelko, *Green Planet Blues: Critical Perspectives on Global Environmental Politics*.

[141] The civic association National Fish and Wildlife Foundation manages the fund in collaboration with and major funding from the U.S. Environmental Protection Agency (EPA) through the Long Island Sound Study (LISS) as well as with additional funding from the U.S. Fish and Wildlife Service and the private Avingrid Foundation.

[142] Housatonic Valley Association et al., "Be River Smart: Clean Water Starts with You."

[143] There was a precise mathematical tie in the Partners-wide prioritization between this implementation strategy of a municipal ban on neonicotinoid pesticides for non-agricultural use and that of a winter water-quality monitoring program. While the Partners may eventually break this prioritization tie during the implementation of this plan, the order between these two programmatic strategies in this document is merely based on an interim or placeholding coin flip.

[144] There was a mathematically precise tie in the Partners-wide prioritization between this implementation strategy of a winter water-quality monitoring program and that of a municipal ban on neonicotinoid pesticides for non-agricultural use. While the Partners may eventually break this prioritization tie during the implementation of this plan, the order between these two programmatic strategies in this document is merely based on an interim or placeholding coin flip.