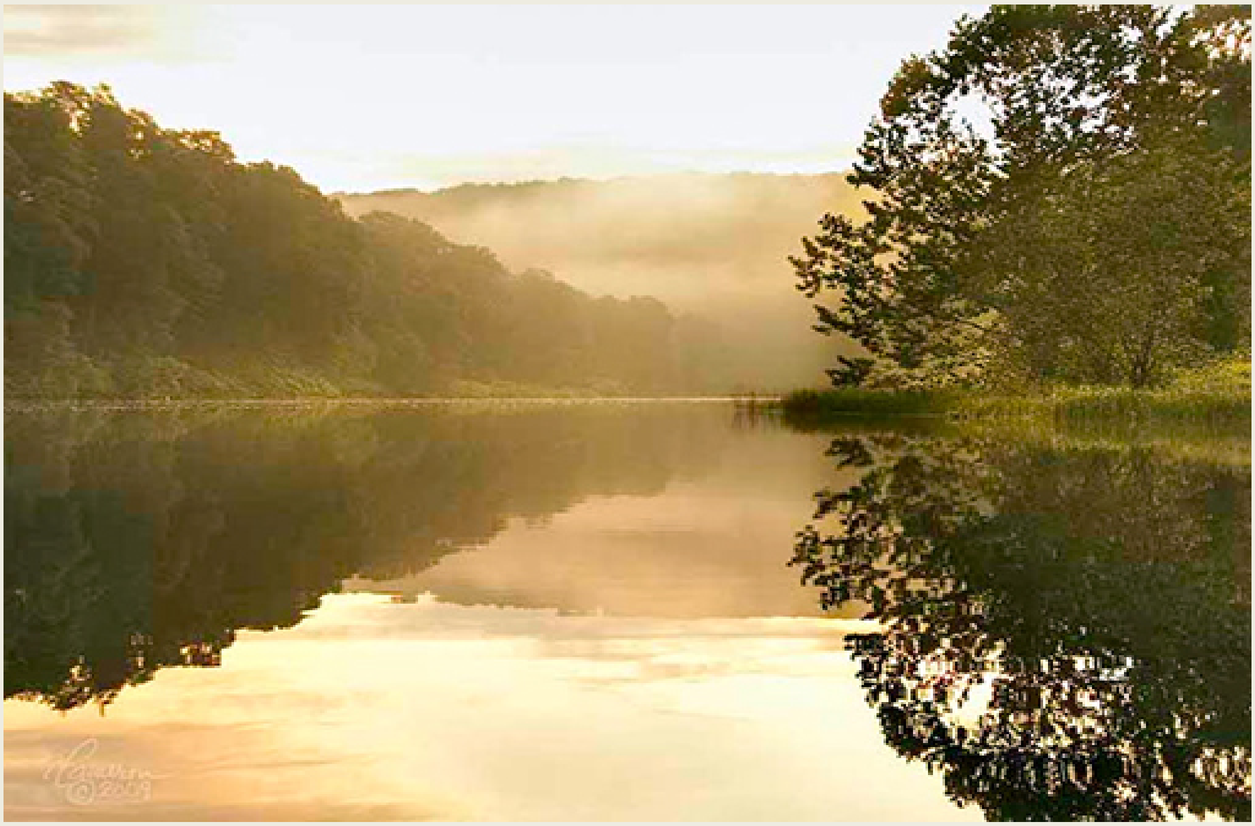
Farmington River Watershed
Water Quality Improvement
Environmental Action Plan
December 13, 2019



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Overview: The purpose of this plan is to investigate and evaluate pollutant levels in the Farmington River Watershed, focusing primarily on the Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) containing aqueous film forming foam spill that occurred in June 2019. The plan also addresses invasive species that affect water quality and the ability of the watershed to filter contaminates. The environmental plan will address existing water quality and provide decision makers with greater insight into the causes and sources of contaminants found in the river. The plan will recommend counter measures to prevent future contamination events**.**

1. Introduction

The Farmington River Watershed covers 67,451 acres in the mid-northern portion of Connecticut. The watershed spans several Connecticut towns, including Windsor Locks, Windsor, East Granby, Granby, Bloomfield, Simsbury, Avon, Farmington, Burlington, Canton, New Hartford, Barkhamsted, Hartland, and Colebrook, and the northern portion of the watershed extends into southern Massachusetts. The Farmington River plays an important role in drinking water supply for people living in Greater Hartford area and the Farmington Valley. The river provides an important Atlantic Salmon restoration habitat and is a popular destination for recreational canoeing and fishing. In 2019, the lower Farmington River and Salmon Brook received Federal Wild & Scenic River status.

Area populations in the watershed range from as little as 500 in rural areas to as high as 60,000 outside the Greater Hartford and New Haven city limits. See Figure 1. The watershed is characterized by a wide variety of terrain including well-established deciduous and evergreen forests, grasslands and agriculturally developed fields. The lower basin and southeast bounds are characterized by more densely populated developed areas and urban landscapes. See Figure 2,

A. Population Map Figure 1.

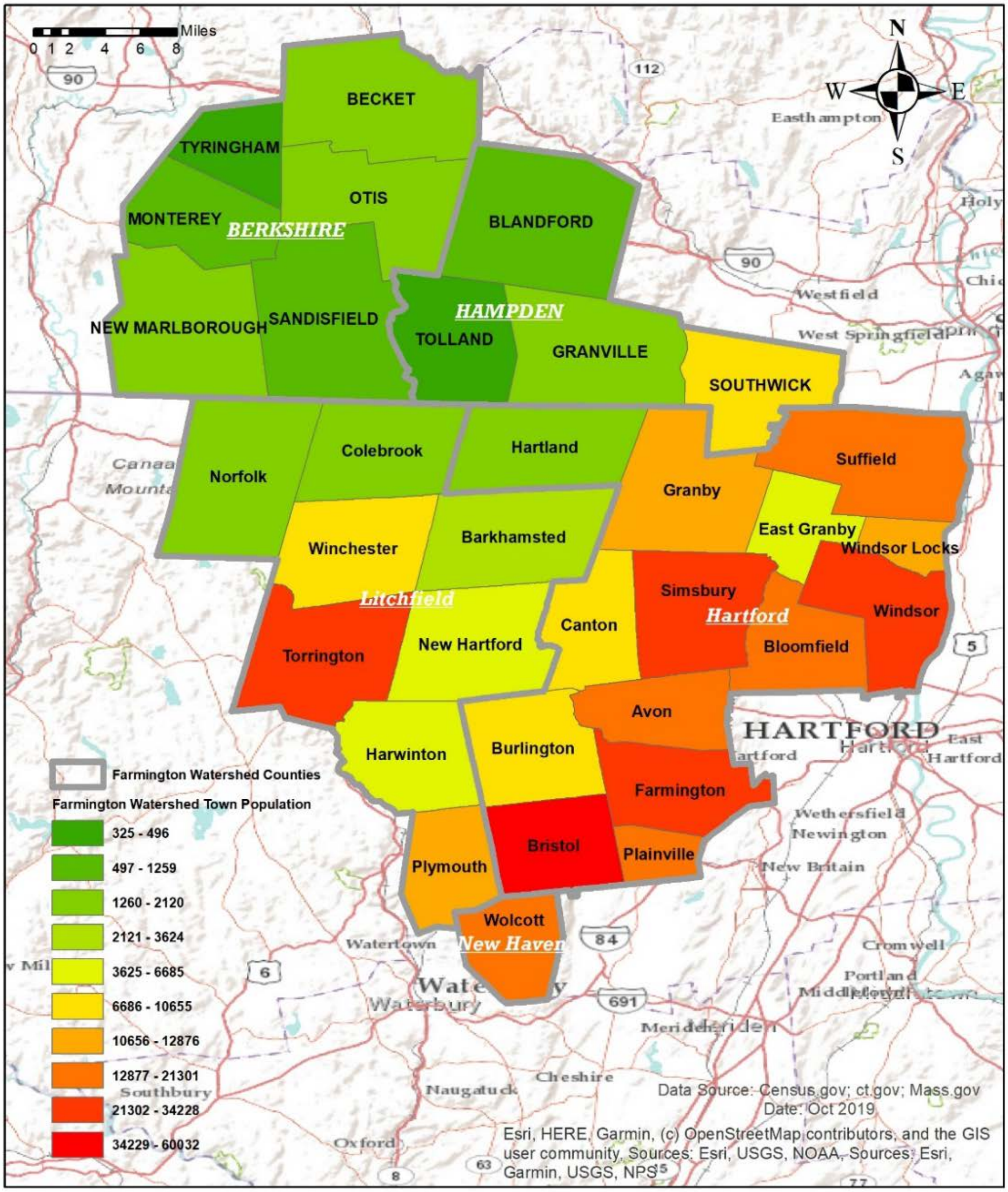


Figure 1.

B. Land Cover Map Figure 2.

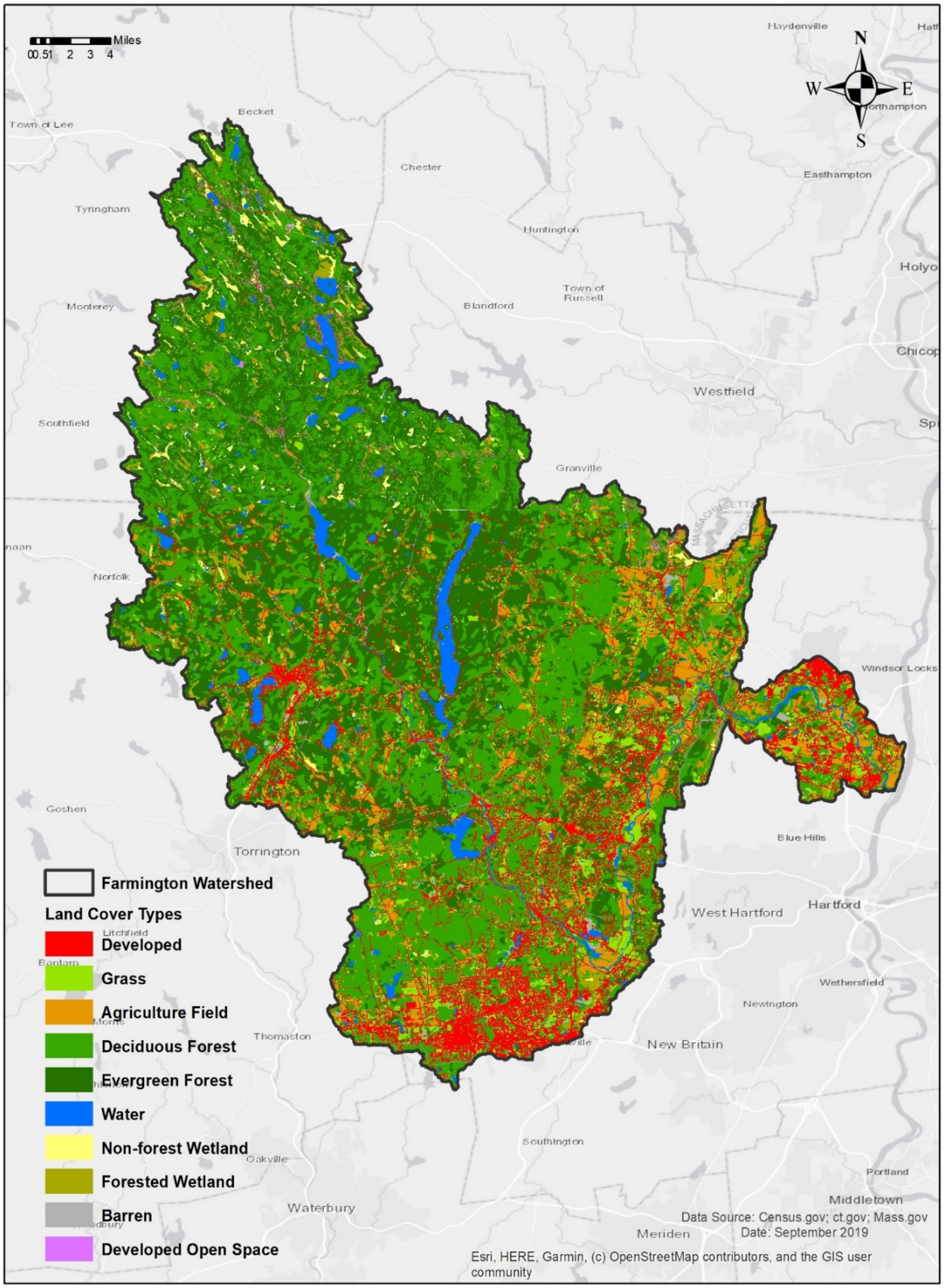


Figure 2.

2. Watershed Characterization:

The purpose of this section is to address the status of flora and fauna, both native and invasive in the Farmington River Watershed, including endangered species. The projection graphically demonstrates the differences between Connecticut and Massachusetts's habitat protection policies and what each state considers critical habitat and how each state protects endangered species. See Figure 3. Invasive species can spread quickly but are under control in many areas; however, there are few data sets that show accurate distributions of their ranges. These data sets are an area for greater follow on research. Addressed are species of special concern, including strategies to reduce their introduction and spread inside the watershed.

A. Habitat Map Figure 3.

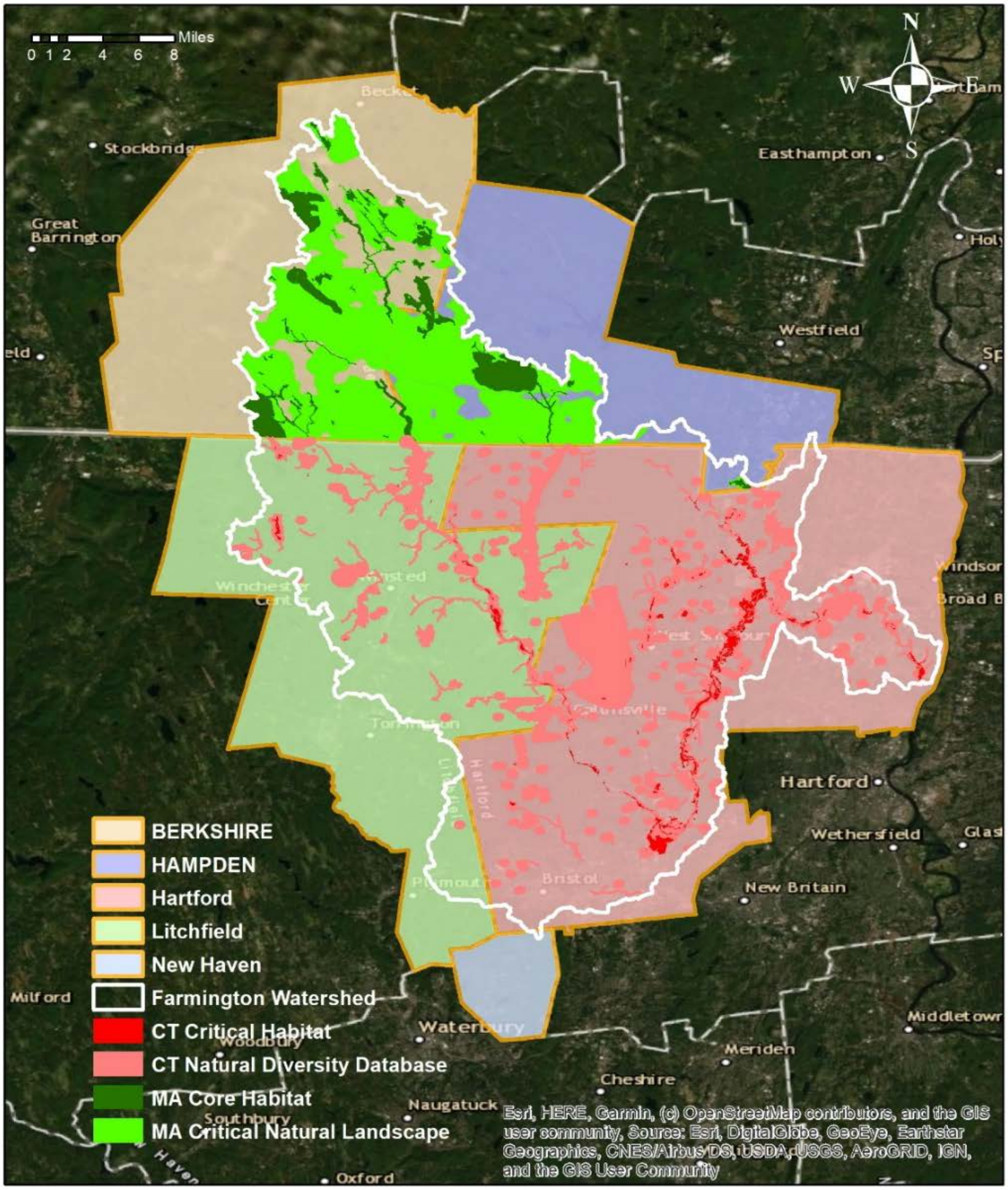


Figure 3.

B. Invasive Species

Invasive plant species can move into habitats through various natural and anthropogenic means and overtake native species. The means by which invasion plant species out-compete native plant include nutrient absorption, quick growth, longer growing species, fragmentation spreading, and the absence of natural predators. Invasive species take hold in disturbed areas and especially near water systems due to low elevations for nutrient sinks and for constant natural disturbances with hydrology. Invasive species are difficult to control because they spread quickly and can form dense monocultures. Controls include burning, removal, dredging, and pesticides. All of these methods are labor intensive and require specialized equipment that can have negative environmental impacts.

The Farmington River Watershed has both terrestrial and aquatic invasion plant species. Terrestrial invasive species include:

Shrub Honey Suckle	Japanese Barberry	Japanese Knotweed
Autumn Olive	Black Locust	Pachysandra
Coltsfoot	Burning Bush	Mugwort
Multiflora Rose	Forget-me-not	Narrow-leaf
Garlic Mustard	Bittercress	Oriental Bittersweet
Japanese stilt-grass		

Of these species, Autumn Olive, Japanese stilt-grass, Japanese Barberry, Japanese Knotweed, Multiflora Rose, and Oriental Bittersweet are of the more aggressive and can take over inedited fields, flood plains, stream banks, roadsides, and wetland habitats. With these invasions, comes biodiversity loss, nutrient loading, loss of access for recreation, and hydrological alterations.

Concerning aquatic invasive plant species, the following exist in the Farmington River Watershed:

Eurasian Water Milfoil	Variable Leaf Milfoil	Hydrilla
Curly Leaf Pond Weed	Fanwort	Water Chestnut

Similar to terrestrial invasive species, aquatic invasive species out-compete native species through nutrient absorption, quick growth patterns, longer growing seasons, spreading by fragmentation and the absence of natural predators. These organisms can impede water quality and can interrupt recreational activities. A special concern with these species is their ability to spread to isolated water bodies by human activity. Seeds and fragments stick to the bottom of boats or boots and are carried to new bodies of water. The public must be educated on rinsing procedures for equipment and personnel, to prevent the spread of these species. The most common control for aquatic invasive species is herbicides, which can increase the risk of algae plums once the nutrients have been released from the decomposed plants. This process can deplete oxygen from the water causing hypoxia and mass die-offs of aquatic life.

Endangered Species

Both Connecticut and Massachusetts abide by the Federal Endangered Species Act, but use different methods to designate habitats for the ones depicted in the watershed. Connecticut, through the natural diversity data bank (NDDB), provides a grey dot map that shows all locations of known endangered flora and fauna. Location of specific species and identification is purposefully left off the map features. This protects the species from the public trying to capture, photograph or otherwise harass and disturb them. Through the core habitat program, Massachusetts designates priority habitats to preserve for rare species. Compared to Connecticut's natural diversity database, Massachusetts has designated a larger portion of the land in the watershed as critical natural landscape. Although these designated areas most likely contain the same endangered species, each state has different regulations on how land is categorize and protected in response to endangered species.

Protected and Critical Habitats

Both Massachusetts and Connecticut have systems for identifying protected and critical habitats that are ecologically sensitive to human activities, have become rare through over development, or are havens for high biodiversity. See Figure 4.These areas are designated to protect natural resources, specialized ecosystems, and for planning professionals to be made aware of their locations and attributes. Connecticut protects these lands and prevents anthropogenic effects from altering the marked areas. Massachusetts' Critical Natural Landscape program covers more areas, but is less stringent on what can occur in the areas. These protected areas may still allow some restricted development.

Both Connecticut and Massachusetts have high concentrations of critical habitats around the main sections of the Farmington River, major tributaries, lakes, ponds, and wetlands. Critical areas indicate where previous development occurred, and where remaining preserved areas exist. These habitats not only allow flora and fauna to thrive, but naturally filter pollutants and nutrients from the water, store water in heavy flow times, and prevent erosion. This natural filtration and storage process also contributes to the regeneration of underlying aquifer stores.

C. Protected Areas Map Figure 4.

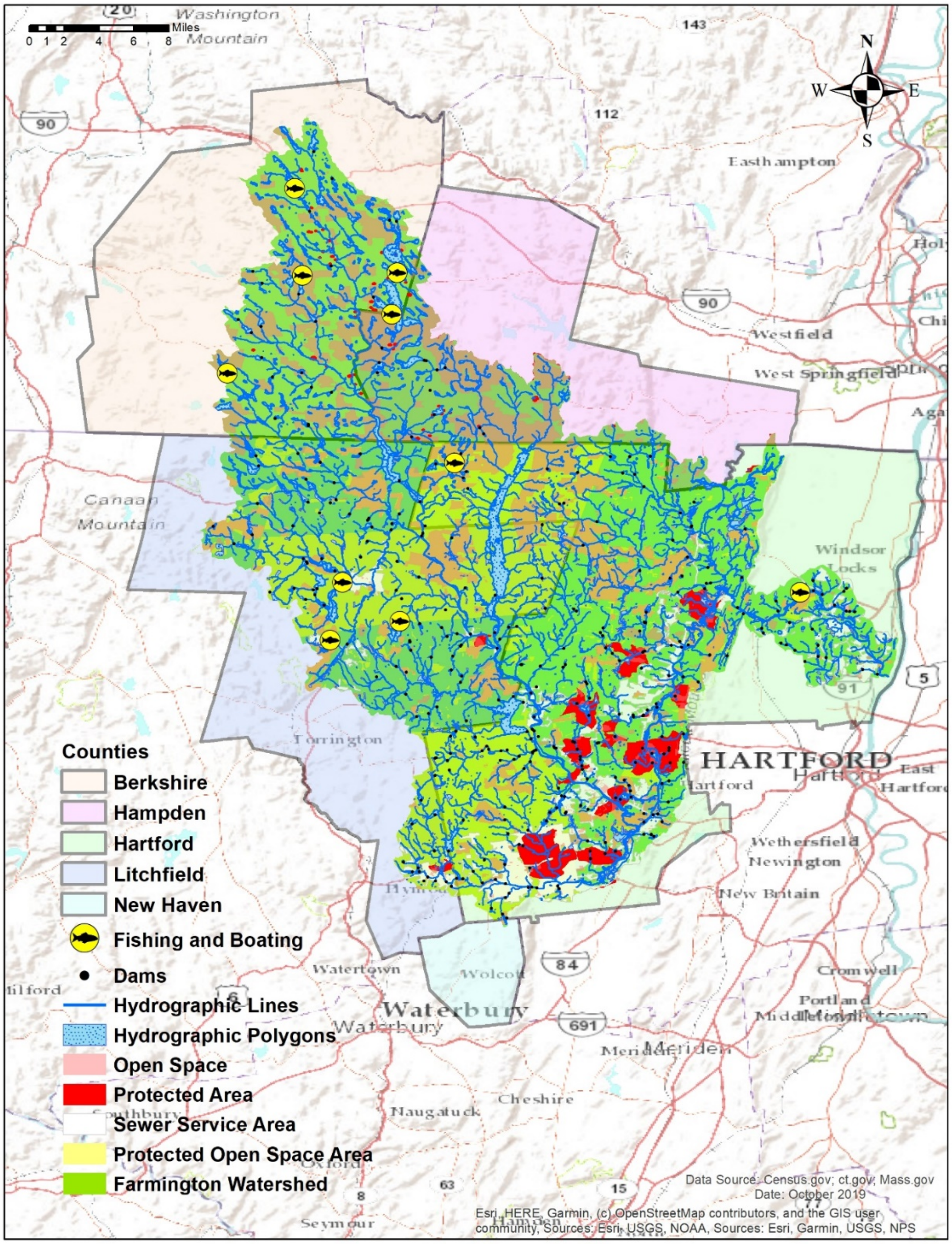


Figure 4.

3. Water Quality Baseline Assessment Figures 5 & 6.

A. **Water Quality Maps**

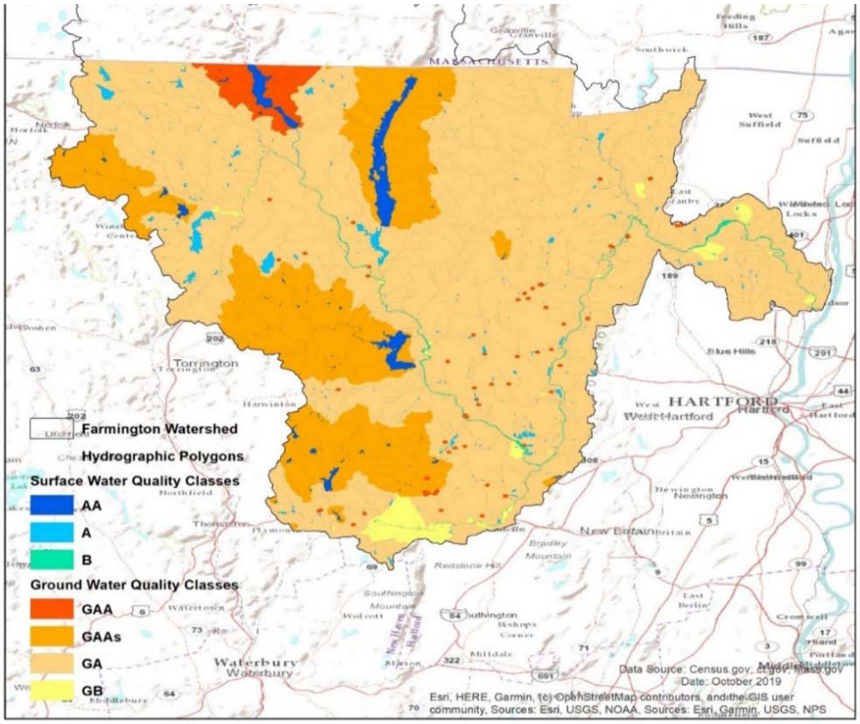


Figure 5.

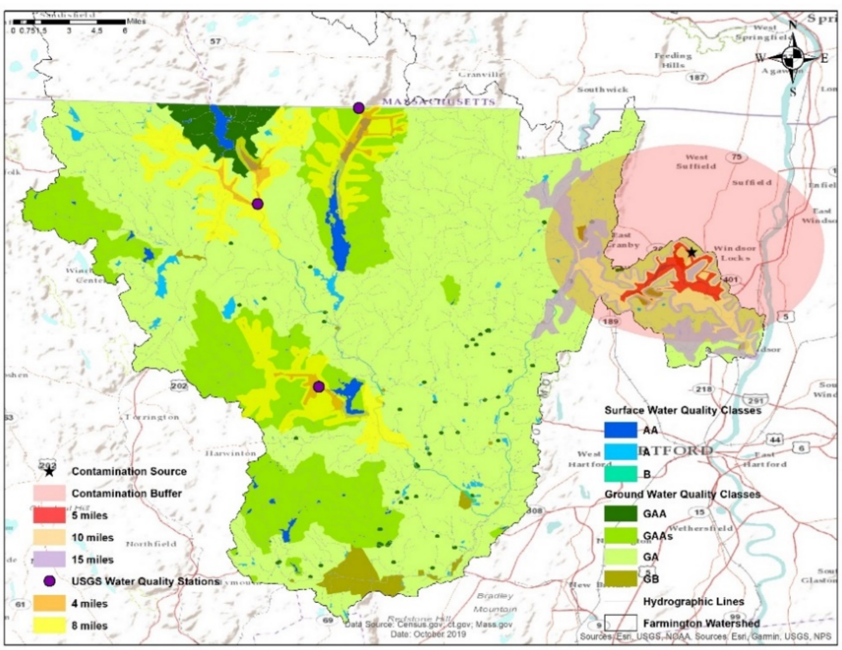


Figure 6. * Contamination source: 2019 PFAS release from Bradley International Airport

B. Water Quality Analysis

Water Quality Baseline Assessment- Inland Surface Water Quality Classifications. See Figure 5:

- Class AA: Existing or proposed drinking water supply, fish, aquatic life and wildlife habitat, recreational use (may be restricted), agricultural and industrial supply.
- Class A: Potential drinking water supply; fish, aquatic life and wildlife habitat; recreational use; agricultural and industrial supply and other legitimate uses including navigation water supply for industry and agriculture.
- Class B: Recreational use; fish, aquatic life and wildlife habitat; agricultural and industrial supply and other legitimate uses including navigation, water supply for industry and agriculture.

All three of the above surface water quality classifications are present in the Farmington River Watershed. Class AA surface waters are reservoirs primarily used for drinking water supplies and the tributaries that connect to them. These are:

- Barkhamsted Reservoir in the East Branch Farmington River Basin
- West Branch Reservoir and the Colebrook River Lake in the West Branch Farmington River Basin,
- Rugg Brook Reservoir and Crystal Lake in the Still River Basin
- Nepaug Reservoir in the Farmington River-Headwaters to Thampson Brook Basin

All tributaries leading to the Farmington River are Class A, which indicates they have potential as drinking water but not currently utilized. The main section of the Farmington River is Class B, which indicates usage for recreational purposes and for habitat conservation. Tributaries generally have cleaner water because they flow through native undisturbed areas, and are not subject to storm water runoff. The larger sections of the river have had surface flow contributions from upstream-development, and therefore are not as satisfactory for drinking water.

Groundwater Quality Classifications See Figure 6.

- Class GAA: Existing or potential public supply of water suitable for drinking without treatment; base flow for hydraulically connected surface water bodies.
- Class GAAs: Subclass for tributary to a public water supply reservoir.
- Class GA: Existing private and potential public or private supplies of water suitable for drinking without treatment; base flows for hydraulically connected surface water bodies.
- Class GB Industrial process water and cooling waters; base flow for hydraulically connected surface water bodies; presumed not suitable for human consumption without treatment.
- Class GC: Assimilation of discharge authorized by the Commissioner pursuant to Section 22a-430 of the General Statutes.

Due to the nature of groundwater, it is hard to locate the extent of available waters for public and departmental use. From the information available, GAA and GAAs aquafers exist under large portions of the following:

- Nepaug River
- Mad River
- West Branch Farmington River
- East Branch Farmington River
- Pequabuck River
- Mine Brook basins of the Farmington River

The Pequabuck River basin also has medium sized areas of Class GA and GB just North of Hartford. The Salmon Brook, West Branch Salmon Brook, Still River, Sandy Brook, Burlington Brook to Thompson Brook, and Hop Brook Basins are characterized by the an assortment of small GA and GB areas, GAA wells, and GAA impaired wells.

Typical Water Quality Metrics

Phosphorous: Total phosphorous (organic and inorganic) is naturally at a low concentration in streams and rivers. Increased total phosphorous concertation indicates fertilizer run-off is present in tributaries and is most often sourced from agricultural activities. Because phosphorous is a common limiting factor for plant growth in stream systems, increasing phosphorus concretion in the water increases plant and algae growth, thus reducing oxygen levels of the water at night when plants and algae respire, but do not photosynthesize. Decreased oxygen levels endangers habitat for species of fish, insects, mollusks, and coruscations living in the water.

Bacterial Loading: The focus of the bacterial loading for this watershed was on Escherichia Coli (E. Coli) because the EPA has identified E. Coli as the best indication of health risk from water contact in recreation waters. High levels of E. coli in water indicates a habitat for disease-causing bacterial, viruses and protozoans to thrive. The Connecticut water quality standard for E. coli bacterial under 'Recreation -All Other Uses' states counts should not exceed 576 CFU per 100 mL, a geometric mean of 126 CFU per 100 mL (State of Connecticut, 2015)

Total Suspended solids (TSS): particles smaller than 2 microns suspended in the water column. Particles may include silt, clay, finely divided organic and inorganic matter, plankton and other particulate matter. Increased total suspended solids act as a vector for phosphorous to bind to and travel in the water. Storm water runoff and erosion of streambeds often increase suspended solids in the water column. For this reason, comprehensive storm water management plans need to control not pollutant loading, but quantity of runoff water into tributary systems.

Assessment Methods:

- **Water Sampling: Phosphorous, bacteria, TSS**
- **Water Monitoring: Temp and pH**
- **Visual Assessmen**t: Visual assessment is an integral part of watershed management and may indicate why specific sections of streams or river express different water quality conditions. Site assessments allow for the location of degraded habits, erosion, rare plants/animals, invasive species tracking, identification of pollutant sources, and overall health of the streams. The information collected from visual assessments includes a collection of field notes, visual assessment forms, photographs and a determination on overall condition quantified by a ranking system based on NRCS (1998 & 2009). This system utilizes 14 factors such as channel condition, hydrologic alteration, bank condition, riparian area quantity, riparian area quality, canopy cover, water appearance, nutrient enrichment, manure or human waste, pools, barriers to movement, fish habitat complexity, aquatic invertebrate habitat, and riffle embeddedness.

Each factor was assessed and assigned a score. The overall rank of each location assessed was calculated by an average of the factor scores. An assigned condition for each tributary was determined be averaging the scores in all sites in each tributary. Designation ranged from ‘severely degraded’ to ‘excellent’. An example of the field notes and ranking system has been included for the Pequabuck River Sub Region. See Figure 7.

Table 1.1 – Field Assessment Notes Sorted by Local Basin			
Local Basin	**Subregional Basin**	**Station**	**Field Notes**
4313-00	Poland River	PQ001	Stream assessment, Upper Poland River
4313-00	Poland River	PQ002	Stream assessment, Poland River on Route 72
4313-00	Poland River	PQ012	Small hobby farm (cattle or horse?); 120 High Street
4313-04	Poland River	PQ023	Pinnacle Road; very suburban development – green lawns, sidewalk, grass strip between sidewalk and road, curb & gutter – increase size of grassed area between sidewalk and road, redirect flow and add raingarden
4313-04	Poland River	PQ024	Ravine where stormwater is discharged on Hopmeadow Road; no treatment taking place; ephemeral stream, large concrete outlet structure, some erosion
4314-00	Coppermine Brook	PQ035	Stream assessment, Coppermine Brook on South Main Street
4314-01	Coppermine Brook	PQ005	Whigville Brook, tributary to Coppermine Brook; stream dry, unable to do assessment
4314-01	Coppermine Brook	PQ006	Whigville Brook, standing water but no flow
4314-01	Coppermine Brook	PQ007	Stream assessment, Whigville Brook
4314-01	Coppermine Brook	PQ029	Sessions Woods Conservation Education Center; lots of trails, some logging activity; run by CT DEEP, not open – good spot for outreach & education
4314-02	Coppermine Brook	PQ021	Small feedlot; angus beef, small number of cattle
4314-04	Coppermine Brook	PQ036	Wildcat Brook headwaters; deep ravine off Wildcat Road
4314-06	Coppermine Brook	PQ022	Stream assessment, Negro Hill Brook on West Chippens Hill Road; water present but not flowing, very close to headwaters
4314-06	Coppermine Brook	PQ025	Stone House Estates: future development, paved with curbed and drained roads; nice multi-tier treatment basin at end of cul de sac; no homes constructed yet
4314-06	Coppermine Brook	PQ026	Stormwater treatment at Nadeau Estates/Nicole Road
4314-06	Coppermine Brook	PQ027	Home under construction – bare soil, no straw, no silt fence; need improved E&S ordinances and/or enforcement
4314-06	Coppermine Brook	PQ028	Negro Hill Brook on East Chippens Hill Road, Burlington. State lands and extensive wetlands upstream; grate over twin culverts, downstream culverts are hanging above stream (no organism passage)

4314-06	Coppermine Brook	PQ030	Stream assessment, Negro Hill Brook on Route 69; sign in woods says “wild trout stream”
4314-08	Coppermine Brook	PQ034	Pokeville Brook on Nelson Farm Road; upstream is braided small stream, downstream is single channel; lots of cover (shrubs and trees) but no cobbles, riffles or pools
4315-00	Pequabuck River	PQ003	Stream assessment, headwaters of Pequabuck River; very small stream with little flow. Any impairment may be due to natural conditions
4315-00	Pequabuck River	PQ008	Stream assessment, small tributary to Pequabuck River at Napco Road. Upstream of road is ditched without tree cover; downstream first 100’ is straight w/angular cobble and not much habitat (root mats, undercut banks); below study reach

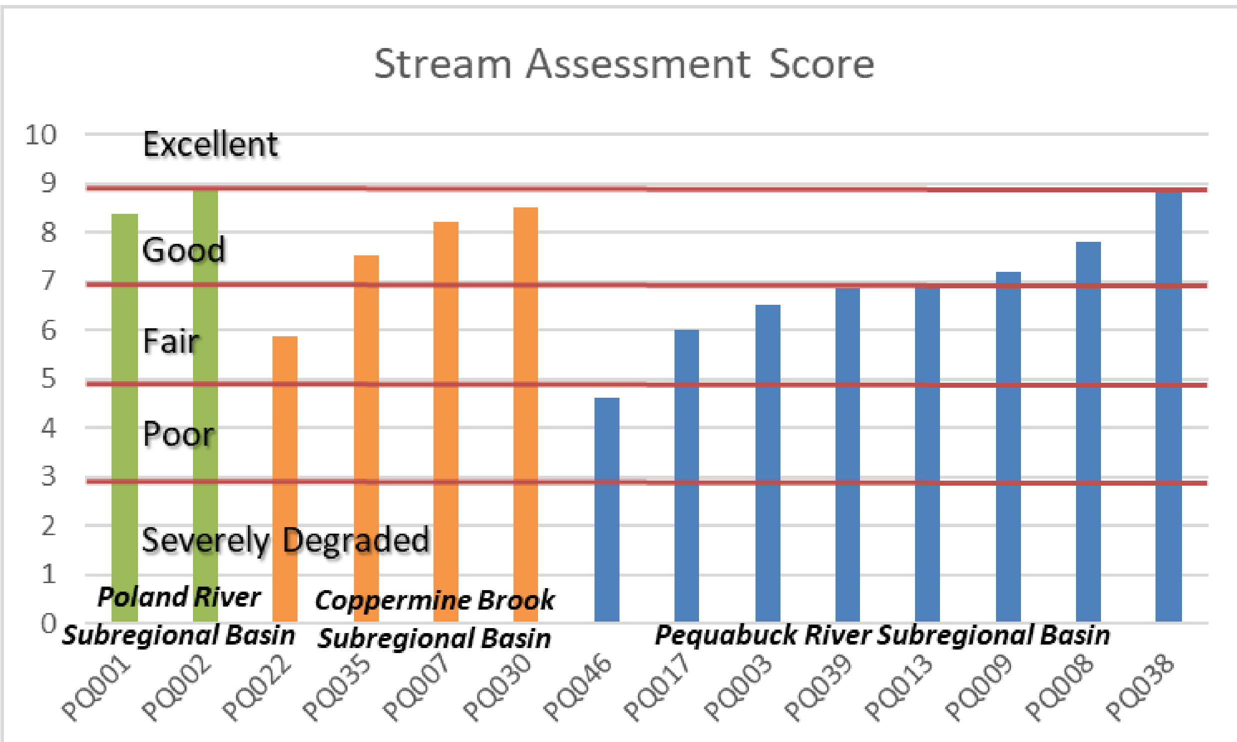
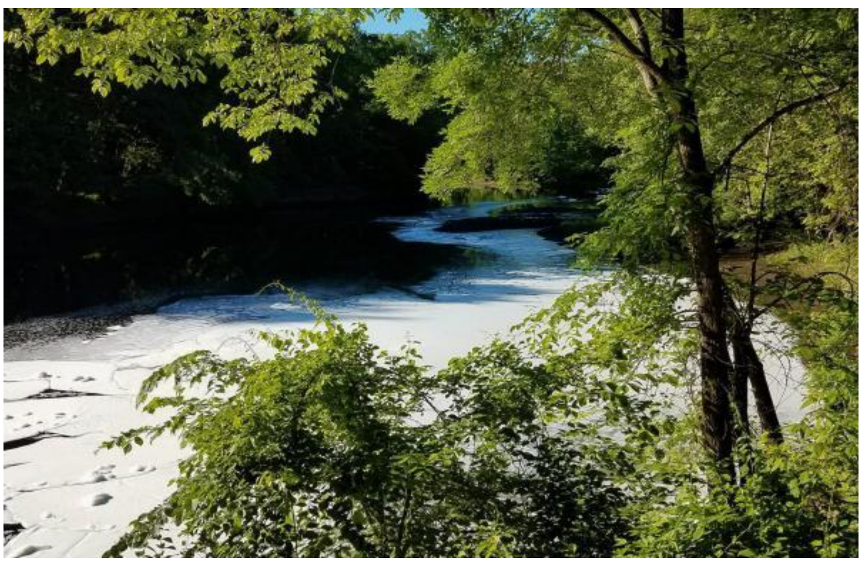


Figure 7: Pequabuck River – Visual Stream Assessment Scores Sorted by Subregional Basin

https://www.mass.gov/files/documents/2018/05/21/31wqar.pdf

C. Source and Effect of the PFAS Spill

Photo Source: The Hartford Courant: Gregory B. Hladky Reporting



Firefighting foam that spilled in the Farmington River in June. Photo Source Connecticut DEEP

The source of the subject matter PFAS leak was a malfunction of a fire suppression system at a private hanger on Bradley International Airport June 8, 2019. Signature Flight, a global aircraft servicing company, operates the hangar. The spill, between 40,000-50,000 gallons of PFAS and water, entered the MDC sewer system where it subsequently discharged into the Farmington River. The leak occurred over an 18-hour period before discovery. The extent of the spill is still under testing. Wells within 500 feet of the sewer line were tested extending out a 500-foot zone where wells tested positive. The spill impacted upward of 20 private wells.

On July 9, 2019, subsequent to this spill, Government Led Lamont convened a Statewide, Interagency PFAS Task Force that will study the long-term consequences of this spill as well as the sources and cleanup of other contaminated sites throughout the state. (DEEP, 2019). The spill is still under testing in both water, fish and sediment. The immediate effect was a public safety announcement to suspend river related recreational activities including swimming and fishing. As of October 10, 2019, DEEP and other public entities continue to warn against recreational activities, especially fishing for consumption, in the area of the release. As of November 14, 2019, the extent of the environmental impact and geographical extent of the spill is still unknown. This was a onetime incident of PFAS spillage of this magnitude although subsequent testing of local landfills indicates that PFAS leakage may pose an additional hazard to the Farmington River Watershed.

D. PFAS Assessment and Monitoring

The purpose of this section is to identify standardized testing for PFAS and to identify monitoring methods and metrics for PFAS contamination. Although the EPA uses Method 537.1 to assess PFAS in drinking water, there are no validated standard EPA methods for analyzing PFAS in surface water, non-potable water, ground water, wastewater or solids. The EPA is still in the process of developing standard operating procedures for testing for total of (25) PFAS chemicals. Sample holding times vary from 28-45 days to observe for sample degradation. These holding times are to establish the effects of vessel materials on analyte recovery (ie glass/ plastic containers). PFAS testing is complicated further by the widespread use of PFAS in standard laboratory equipment (tubing, sample containers and sampling tools). PFAS cross contamination is also a hazard with baseline testing. Standardization across labs and laboratory hygiene standards must be established as part of the new PFAS protocol. The EPA does not have standard/ validated methodology for testing PFAS in surface water, non-potable water, ground water, wastewater or solids. (epa.gov/water-research/).

The PFAS task force is recommending a phased approach to sample and analyze drinking water, which is the primary method of reducing PFAS exposure. This will include developing a GIS database of universal potential sources of pollution and populations that may be most vulnerable (ct.gov/deep/pfastaskforce). For the Farmington River Watershed the team will determine testing sites. These sites will be surveyed for water, soil, shellfish and fish for contaminate levels. The environmental plan will call for one initial survey at identified sites, with follow up 6 months, 12 months and 18 months later. The analysis will include standard EPA method 537.1 using a method 537.1 certified lab.

4. Site Recommendations

After reviewing the identified sites during the assessment process, priorities were set on human health and water quality with acute time scale concerns. These priorities were made with an understanding of possible conflicts with current projects underway with other agencies and organizations and with consideration of the financials. The following locations were selected to mitigate the corresponding challenges. These project plans will be enacted once designs and logistics are finalized. Some plans involve hiring specialized private contractors to complete the work; others involve cooperation with other government agencies and land management organizations. Others involve engaging public parties to take action.

Site 4: E-Coil Bacteria Loading and Nutrient Loading

Where the Farmington River takes its most southern turn in Farmington, a tributary meets the river. This tributary spans a very developed area and has a measures geomean of 780 ppm for E. Coli from the 2016 data. This location on the Farmington River is also significant because of the large cover of agricultural land adjacent to both sides of the banks. This one area could benefit from buffering along the tributary banks and the main riverbanks to reduce bacterial and nutrient loading. Locating sources of bacteria from waste is essential and can be helped by updated degraded septic leach field systems and removing pet feces left on lawns in large densities.

This location is a priority site because of the density of issues occurring there. This site, where a tributary connects to the Farmington River at its most southern bend is plagued by high E. coli bacteria readings. There is potential for large amounts of agricultural and storm water runoff that feed from the highly developed area around the tributary. In order to address these issues, we recommend the following:

- Establish elevated buffers between the river/tributary and agricultural areas to prevent fertilizer runoff directed into the surface waters. Design these buffers to withstand a minimum 10-year storm event. Stabilize the buffer with native plants that will also provide filtering ability through phytoremediation. These elevated buffers must be maintained and monitored for invasive species.
- Constructed wetlands for agricultural water remediation are recommended to be established on agricultural lands to filter runoff before they enter the surface water. Since these are not required by law, we recommend a financial aid backing for private landowners and/or farmers to install and maintain these constructed wetlands. We have

the capacity to fund 75% of construction costs and can aid in adjusting taxes for the area of the constructed wetlands.

- Control pet defecation 200 feet around open surface waters. Towns must enforce the removal of pet defection and decrease this pollutant in the waterways.
- Inspections and replacement of non-functioning septic systems will be required for any property within 1000 feet of the open waterways. Towns must enforce this zoning issue. Mitigating these pollutants at the source and focusing on septic systems closest to open waterways will provide the greatest impact with the least effort.

Site 5: Storm Water Management

Reducing storm water runoff in urban areas is always a priority. Urban areas have more impervious cover that increases the amount of water that enters the surface waters and which convey more pollutants like heavy metals, sediments, road salts, car oils and other chemicals. Site 5 represents one of the most developed areas in the watershed and would show the most improvement from the implementation of green storm water infrastructure (GSI) practices. Strategies include:

- Installation of pervious pavements in lieu of traditional roads and sidewalks. Concrete sidewalks to be replaced using pervious concrete pavers with gravel of pea-stone underlayment. Asphalt roads to be replaced with porous asphalt with gravel underlayment. These methods allow water to penetrate the surface and eliminate the need for de-icing salts as water will not pond and freeze. These methods also last for long periods because freeze thaw does not damage the surfaces or underlayment. An important note to add is the necessary maintenance for these technologies. These pavements are recommended to be cleaned with a sediment vacuum apparatus at least twice per year.

- Green roofs serve many purposes, like adding thermal insulation, creating relaxing usable spaces for building tenants, reducing nutrient loads, sequestering carbon, and most importantly, reducing stormwater runoff by approximately 50% in this region. Green roofs collect water through plant uptake, and through vegetation transportation, release water vapor back into the atmosphere.
- Rain gardens allow for surface runoff and piped runoff from roof tops and paved surfaces, to filter through the soil close to where precipitation hits the surfaces. This reduces the discharge into the rivers and streams, lessening soil erosion, and reduces the amount of pollutants picked up in runoff. These are a very affordable and scalable management practices that can be installed by homeowners or commercial companies.

Site 7: Rainbow Brook, Windsor

Rainbow Brook is a small stream that runs 1 mile south from Bradley International Airport and feeds into the Farmington River. Rainbow Brook begins at Bradley Airport between Runway 6 and the airport terminal and runs under Route 20 before feeding into the river. The proximity of Rainbow Brook to Bradley International Airport has made it a priority site for immediate action. This brook was responsible for carrying PFAS polluted water directly into the Farmington River, drastically increasing the area of distribution of the pollutant. As mentioned, the emergency response team placed booms across the surface of the brook at various locations along the length, but only captured surface concentrations. Sediment testing will be conducted along a controlled and regular spaced route in the most polluted sections to establish dredging priorities. Before dredging begins, sediment filters and pollutant treatment will be established at the outflow of the brook to collect any release. The dredging should start at the airport inlet and continue down to the Farmington River. Emplacement of new elevated buffers is a critical factor between airport runways and the riverbanks to contain any future spills.

Site 8: MDC Water Pollution Control Center, Windsor

Metropolitan District Commission (MDC) Water Pollution Control Center, Windsor. MDC operates a satellite water pollution control facility (WPCF) in Poquonock (Windsor) 3 miles south of Bradley International Airport along the Farmington River. This secondary wastewater treatment facility requires a priority upgrade to filter any further PFAS fire foam releases in the Bradley cantonment area. The EPA has recommendations for specific abilities this facility should possess and we would agree with their recommendations. The following will require an engineering contract to assess the current conditions of the MDC satellite point.

- Granular Activated Carbon (GAC) – Chemicals like PFAS stick to the small pieces of carbon as the water passes through.
- Powdered Activated Carbon (PAC) – The carbon is powdered and is added to the water. The chemicals then stick to the powdered carbon as the water passes through.
- Ion Exchange Resins –Small beads (called resins) are made of hydrocarbons that work like magnets. The chemicals stick to the beads and are removed as the water passes through.
- Nanofiltration and reverse osmosis –A process where water is pushed through a membrane with small pores. The membrane acts like a wall that can stop chemicals and particles from passing into drinking water.

5. Outreach and Education

This section covers the actors involved in PFAS remediation efforts thus far. Two state executive agencies, the Department of Energy and Environmental Protection (DEEP) and the

Department of Public Health (DPH), have taken the lead at the Governor's request. DEEP and DPH spearhead an Inter-Agency Task Force, comprised of many other state institutions and sections within the two leads. The Task Force is responsible for creating a PFAS Action Plan to coordinate and codify Connecticut's PFAS prevention and remediation going forward. The draft plan was published in October and the public comment period has already closed. The final report is pending submission to the Governor. This team will continue to monitor the final report and analyze the final document for qualities of productivity, feasibility and effectiveness.

As a statewide issue, state agencies naturally take the lead. However, there are many stakeholders in the PFAS spill, including municipalities and local non-profits. Municipalities must communicate to their residents about the situation, especially when it is unsafe to engage with the river and its products. Communication channels between DEEP and municipal leaders must remain clear and open in order to maintain public safety. Municipalities are seeking a quick recovery from PFAS, as the spill affected local economic activity such as recreational activities and fishing.

6. Partnership Opportunities

The overarching legal purview resides with the US Federal Department of Environmental Protection Agency (EPA). The requirement for public water system testing falls under the Third Unregulated Contaminant Monitoring Rule (UCMR3) carried out pursuant to the Safe Drinking Water Act (SDWA). Connecticut State jurisdiction primarily includes Department of Public Health (DPH) and Department of Environmental and Energy Protection (DEEP). A threat to the plan is that although PFAS production and subsequent environmental release has been ongoing since the 1950s, health effects have not been sufficiently studied. Opportunities include PFAS as an "emerging contaminant" which is a chemical or material that is characterized by a perceived, potential, or real threat to human health or the environment or by a lack of published health standards." Due to this designation the CDC has been funded to conduct testing at multiple contamination sites across the US. Also, the UCONN CARIC Superfund research inaugural cycle intends to stand up interdisciplinary research and apply for funding to research PFAS.

For the Farmington River Watershed Plan, there are multiple partner organization opportunities available. These businesses could be collaborated with, as several of them are currently working on various projects relating to the Farmington River watershed and it's well-being. Potential organizations include The Farmington River Watershed Association (FRWA), the 501(c)(3) not-for-profit company focused on water quality in the river, and The Farmington River Coordinating Committee (FRCC), which mainly focuses on the wildlife/scenic aspects. These two organizations already do a great deal for the watershed in terms of water quality testing and analysis, as well as conservation efforts.

Other potential partner organizations include Connecticut DEEP and the Metropolitan Water District (MDC). Connecticut DEEP, through action taken by Governor Ned Lamont, has established the Connecticut Interagency PFAS Task Force as of July of 2019. This Task Force run by the Department of Public Health (DPH) and DEEP was created in direct response to the PFAS chemical leak that our plan is addressing. Partnering with DEEP could enhance the comprehensiveness of the plan, as it includes strategies to (1) Minimize human health risk for Connecticut residents, (2) Minimize future releases of PFAS to the environment, and (3) Identify, assess, and clean up historic releases of PFAS to the environment (Protection). Working alongside organizations striving to reach similar goals will increase the efficiency of this plan's work, not to mention DEEP is comprised of representatives from several state agencies, which it would be tangentially involved with.

Additionally, MDC currently owns more than 6,000 acres of watershed forest land on the West Branch of the Farmington River, and the surrounding reservoirs are a crucial future water supply for them. Specifically, the West Branch Reservoir is reserved for future drinking water supply (Farmington). Multiple areas of the river are owned by the MDC and used for fishing, boating/recreation, and even energy production purposes such as hydroelectric facilities at the Colebrook River Dam. As a critical user of the water supply provided by the Watershed, this plan directly impacts and should consider a relationship with the MDC.

Other partners include fishing associations such as the Farmington River Anglers Association and CT Trout Unlimited, as well as the municipalities of 33 river towns in the States of Connecticut and Massachusetts.

7. History of Policy and Recommendations

In general, the short-term policies and goals of PFAS actions have been the prevention of exposure, followed by long-term goals of treatment and clean up. The Toxic Substances Control Act (TSCA) gives the EPA "authority to require reporting, record-keeping, and testing of chemical substances and mixtures, and protect against unreasonable risks to human health and the environment from existing chemicals" (United).

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), otherwise known as a "Superfund", provides the federal government with authority to respond to the threat of release, or actual release of hazardous substances. If substances such as pollutants and contaminants present an "imminent and substantial endangerment", the federal government has the authority to respond. The federal government is additionally authorized authority to investigate the site these substances caused a threat to, per CERCLA section 104(e).

PFOS, PFOA, and PFAS have since been included among these substances, and EPA has fought to extend authorities to involve cost recovery for affected communities (United).

The Safe Drinking Water Act (SDWA), specifically Section 1412 of the SDWA "requires the EPA to publish a list of contaminants known or anticipated to occur in public water systems which may require regulation under the Safe Drinking Water Act." The EPA has included PFOA and PFOS and has worked to include PFAS in a third Unregulated Contaminant Monitoring Rule (UCMR) in 2012 (United).

The EPA designed and implemented The Drinking Water Treatability Database (DWTD) in order to provide information to communities on the treatability of drinking water supplies. This includes cost information for the technologies available to respond to PFAS. The database also provides information on new and emerging PFAS issues. Available technologies include processes like activated carbon, ion exchange, and high-pressure membranes. Communities, stakeholders, engineers, and partners have ready access to this information (United). In 2013, CT DEEP testing confirmed that zero large public drinking water systems (defined as systems serving >10,000 people) had contained elevated levels of PFAS above EPA limits.

In 2016 the Federal Department of Public Health (DPH) established the Drinking Water Action Level of 70 ppt for the aggregate concentrations of five PFAS compounds: perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA), perfluoroheptanoic acid (PFHpA), and perfluorohexanesulfonic acid (PFHxS) (BB&K). The 2017 events which took place in Westchester County, NY influenced The Connecticut DEEP Remediation Division to have a roundtable "requesting that PFAS be addressed as a contaminant of concern at sites where warranted based on past site history and operations".

In 2018, in further response to the Westchester contamination, DEEP and DPH took more samples and began more extensive outreach. One private well detected PFAS levels over the DPH allowable levels. DPH implements the requirement for 80 PWS to perform “land use risk assessments” to determine vulnerabilities to PFAS contaminations. DEEP and DESPP formed a committee to begin research and evaluations for alternatives to firefighting foams (Protection).

Water quality monitoring in the area is a high priority as well as the overall health of aquatic life. Since 2002, CT DEEP has been monitoring a 20 mile section of the Farmington River as an impaired body of water due to bacteria levels, specifically E.coli. The Farmington River Watershed Association (FRWA) provides mapping of Lower River and Upper River sample sites and their E.coli levels. Water sampling for bacteria is conducted through CT DEEP as well as the Farmington Valley Health District. Partnerships between FRWA, FRCC, and MDC also work toward sampling and testing areas for bacteria, chemicals, and metals (Bacteria). Aquatic insect monitoring and habitat study/restoration efforts are also conducted under the FRWA in conjunction with DEEP.

The Natural Resources Defense Council (NRDC) issued a policy assessment in 2019 addressing PFAS in drinking water and all of the issues associated with it. The NRDC policy covers the various health effects caused by PFAS chemicals, such as “cancer, hormone disruption, liver and kidney damage, developmental and reproductive harm, changes in serum lipid levels, and immune system toxicity - some of which occur at extremely low levels of exposure” (PFAS). The guidelines presented by local, state, and federal government bodies do not provide enough protection to the public from exposure to toxic chemicals, which could lead to developing any one of these known complications. As previously discussed, the EPA has allowed “acceptable” levels to exist in drinking water, but the NRDC proposes that a maximum contaminant level (MCL) for these substances be set at zero in order to adequately protect the public. NRDC also proposes taking analytical procedures and measures to identify and quantify a total PFAS number for water supplies, since it has been difficult to accurately measure this historically.

Proposed Policy Improvements:

These policy recommendations follow extensive review of local, state and federal regulations and policies. This includes current policies regarding the treatment of PFAS chemicals in water bodies, as well as response to critical incidents such as the Bradley PFAS release. This review includes the history of PFAS monitoring at the state and federal level. In 2019 the Public Health Committee introduced H.B. No. 5910 to the Connecticut General Assembly to propose a ban on PFAS use in food packaging and firefighting foam. The status of that bill is unpublished. The EPA and State of Connecticut action plans appear to be working in the right direction, but current policies do not seem focused on obtaining those AFFF alternatives on a large scale, which would significantly reduce the risk of contamination of PFAS in water supplies.

The Connecticut Airport Authority has been taking action to replace AFFF with dyed water and fluorine free alternatives. As a response to the Farmington River contamination, CAA has requested tenants plug airport hangar floor drains to prevent further leaking, while solutions are determined and effects mitigated. Department of Emergency Services and Public Protection has been working with DEEP to find alternatives to the PFAS containing foams. Though there has been an active push to cease the use of these chemicals, a clear policy is required in order to ban or restrict PFAS use.

Strict policies actions such as enacting a future ban date, would force industry users to begin research and development (R&D) to find PFAS alternatives and reduce the health risks posed on the community. After reading through the current policies and potential solutions, it seems that the gaps lie within the feasibility of switching from PFAS containing foams to other alternatives and the cost of that transition. An outright ban of these products seems to have worked in other states such as New York. In May of 2019, Senate Bill S439 and Assembly Bill A445 passed the proposed legislation to ban these chemicals from use in firefighting foams, responding to the threats these chemicals pose to public health and safety due to a crisis at Stewart Air National Guard Base, which contaminated the city water supply (Holyman). This crisis mirrors what happened in 2019 in the Farmington River watershed, and this type of policy ban action seems effective. Finding alternatives will open future industry and research initiatives, but a ban on these chemicals eliminate PFAS usage now.

The NRDC assessment has further policy change recommendations. This includes an increase in health advisories and better notification levels. Public drinking water sources which have *any* level of PFAS in them would require notifications to public users and health officials. Additionally, treatment of water sources contaminated with PFAS would require higher-level technologies, such as reverse osmosis, to identify and remove a broad range of chemicals. A challenge with this recommendation is the substantial cost of the process. Our plan, complemented with thorough research of current strategy and solutions, proposes an increase in the attention given to public health and well-being, more public knowledge regarding the chemical contaminants present in their drinking water, as well as stopping the use of PFAS in firefighting foams.

8. Financing

A significant part of this plan was to assess sources of funding available to the team and the proposed scope of work. As the scope of the project involves the entire watershed, the budget is much larger than if we were to tackle a specific section. The Farmington River/Lower Farmington River is recognized by the National Park Service (NPS) as a Partnership Wild and Scenic River, which has a substantial effect on the ability of the project to garner governmental financial support. The possibilities of financial support range from state/local/federal grants and loans, to public investment in the plan's initiatives. The Farmington River Coordinating Committee, a congressionally established organization, offers grants to small projects working toward protection, monitoring, and issue resolution for the watershed. Our project would definitely be eligible to receive funding from this source, as we satisfy the necessary requirements. Through the FRCC we would be able to apply for up to $10,000 in grants.

In terms of available loans, The Conservation Fund offers low-interest loans for various conservation projects, such as habitat restoration and ecosystem services. These loans could be useful for financing of protection of flora and fauna local to the area. The State of Connecticut has a variety of potential sources of grants, such as the CT Clean Water Fund, which is available to municipalities, drinking water projects, and private water systems. These projects are also eligible to receive funding from the Drinking Water division of the Department of Public Health (DPH). Essentially, these CWSRF programs serve as a type of "environmental infrastructure bank", as they provide low interest loans to many eligible water projects.

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