
Farmington River
Watershed Plan 2019
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This report will investigate and evaluate pollutant levels in the Farmington River Watershed, focusing on the PFAS containing aqueous film forming foam spills which occurred this year and other contaminants found in and along the river, in an effort to improve water quality of the watershed by providing decision makers with greater insight into the causes and sources of contaminants found in river and watershed areas and by suggesting counter measures to prevent other chemical contamination events from occurring.

I. 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 for over 600,000 people living in Greater Hartford area and the Farmington Valley. It also 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 and was added under the federal designation.

On June 8, 2019 a release of aqueous film forming foam (AFFF) occurred at the Signature Flight aircraft hangar at Bradley Airport. The release was caused by a malfunction of a fire suppression system and discharged an estimated 50,000-gallons of AFFF mixed with water inside the hangar. Nearly half the foam and water mixture entered an onsite oil water separator system through floor drains in the hangar and made its way into the municipal sewer system. Foam was observed at the MDC's Water Pollution Control Facility in Windsor before it was ultimately discharged into the Farmington River. The foam contains Perfluoroalkyl and polyfluoroalkyl substances (PFAS), which are a larger group of man-made chemicals, and are known as toxic "Forever" substances with strong chemical bonds. An emergency contractor was able to capture about 15,000 gallons of water and AFFF containing PFAS onsite and 5,000 gallons of foam containing water was vacuumed from the Farmington River. On Oct. 2 the situation was exacerbated as another estimated 25,000 gallons of AFFF containing PFAS was used to suppress the fire caused by a vintage aircraft crash. Early containment and cleanup measures by airport and DEEP emergency spill response staff immediately following the crash reduced the impact of the release of the materials into the environment; however, some dissolved fire fighting materials made it into nearby Rainbow Brook. Surface water and groundwater carry PFAS quickly, allowing a widespread distribution to occur. PFAS chemicals travel up the food chain and accumulate in fish, wildlife, and people. They can harm human health, increasing cancer risk in the liver and kidneys, disrupting hormones, and causing thyroid and immune system disorders.

A. Purpose:

The overall the purpose of the project was to conduct a complete investigation and evaluation of the Farmington River Watershed in an effort to improve water quality of the entire

watershed and provide decision makers with greater insight into the causes and sources of contaminants found in river and watershed areas and to put in place counter measures to prevent other chemical contamination events from occurring.

B. Objectives:

1. One of the major objectives of this project was to closely examine the June of 2019 AFFF contamination spill in specific segments and develop recommendations for addressing the contamination and impairments which occurred with the ultimate goal of removing harmful and toxic chemicals such as PFAS, and improving the well-being of local social ecological systems which depend on the watershed.

2. Lastly, a primary objective of this project was to formalize recommendations for the implementation of best practices that will result in improved water quality, as well as practices that will prevent future pollutants from entering the watershed. Formalizing the recommendations will provide a reference which can guide the prioritization, selection, and design of future projects that will provide the greatest benefit to the water quality in the Farmington River watershed.

II. Research:

A. Watershed Characterization:

The Farmington Watershed is a comprehensive area, crosses two states, five counties, and thirty-three towns. Fig 1 (a) shows varies level of administrative boundaries within our study area; part of the upper Farmington watershed locates in Massachusetts while the majority area of this watershed locates in Connecticut. Differences in zoning methods cause irrelevances in several watershed characteristics, like water quality standards and endangered species habitat definitions. Therefore, datasets are analyzed separately for different regions and examined independently for each state. Table 1 and Fig 1 (b) present estimated population of the watershed towns in 2010, hot spots show up in the southeastern region of Farmington Watershed and Torrington town. As significantly more residents live in the lower Farmington region, it is more affected by development and artificial contaminations and plays a more important role of water supply sources for local dwellers.

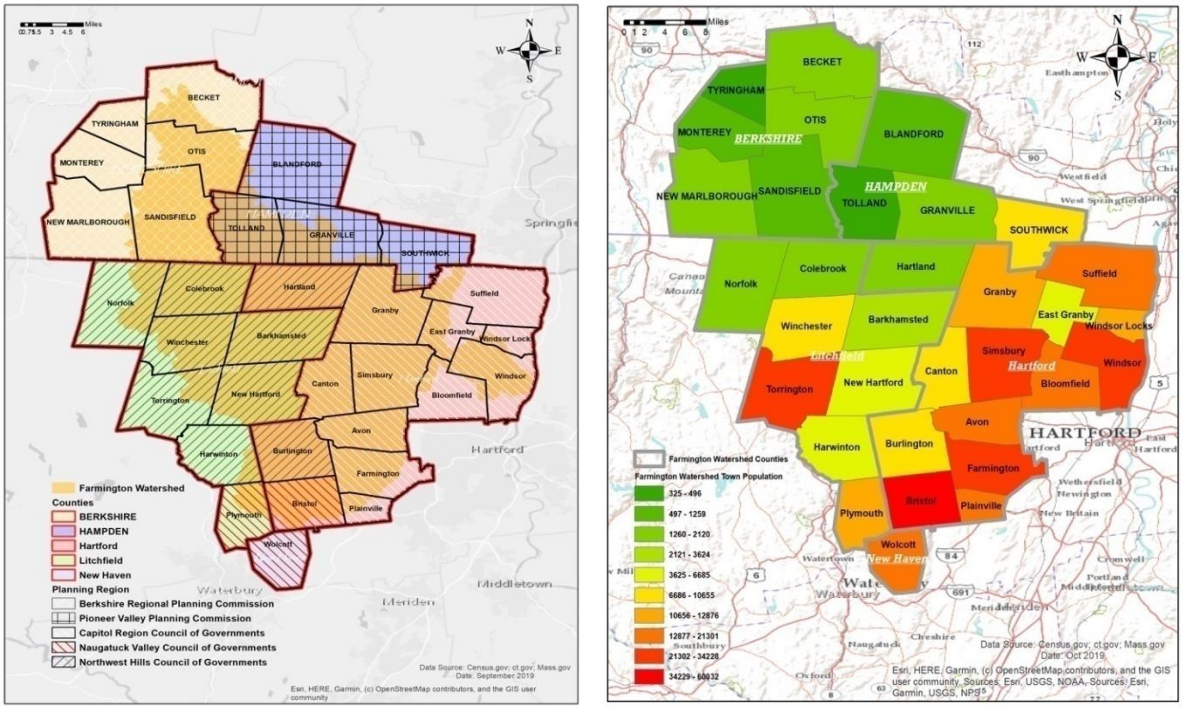

Figure 1. Administrative boundaries of Farmington towns, (a). Population of Farmington towns, (b)

Table 1. 2010 Estimated population of each Farmington towns.

Town	State	County	Population
Avon	CT	Hartford	18,302
Barkhamsted	CT	Litchfield	3,624
Bloomfield	CT	Hartford	21,301
Bristol	CT	Hartford	60,032
Burlington	CT	Hartford	9,665
Canton	CT	Hartford	10,270
Colebrook	CT	Litchfield	1,405
East Granby	CT	Hartford	5,147
Farmington	CT	Hartford	25,506
Granby	CT	Hartford	11,375

Hartland	CT	Hartford	2,120
Harwinton	CT	Litchfield	5,430
New Hartford	CT	Litchfield	6,685
Norfolk	CT	Litchfield	1,640
Plainville	CT	Hartford	17,623
Plymouth	CT	Litchfield	11,645
Simsbury	CT	Hartford	24,979
Suffield	CT	Hartford	15,743
Torrington	CT	Litchfield	34,228
Winchester	CT	Litchfield	10,655
Windsor	CT	Hartford	28,760
Windsor Locks	CT	Hartford	12,876
Wolcott	CT	New Heaven	16,649
Becket	MA	Berkshire	1,762
Blandford	MA	Hampden	1,259
Granville	MA	Hampden	1,622
Monterey	MA	Berkshire	948
New Marlborough	MA	Berkshire	1,478
Otis	MA	Berkshire	1,576
Sandisfield	MA	Berkshire	910
Southwick	MA	Hampden	9,737
Tolland	MA	Hampden	496
Tyringham	MA	Berkshire	325

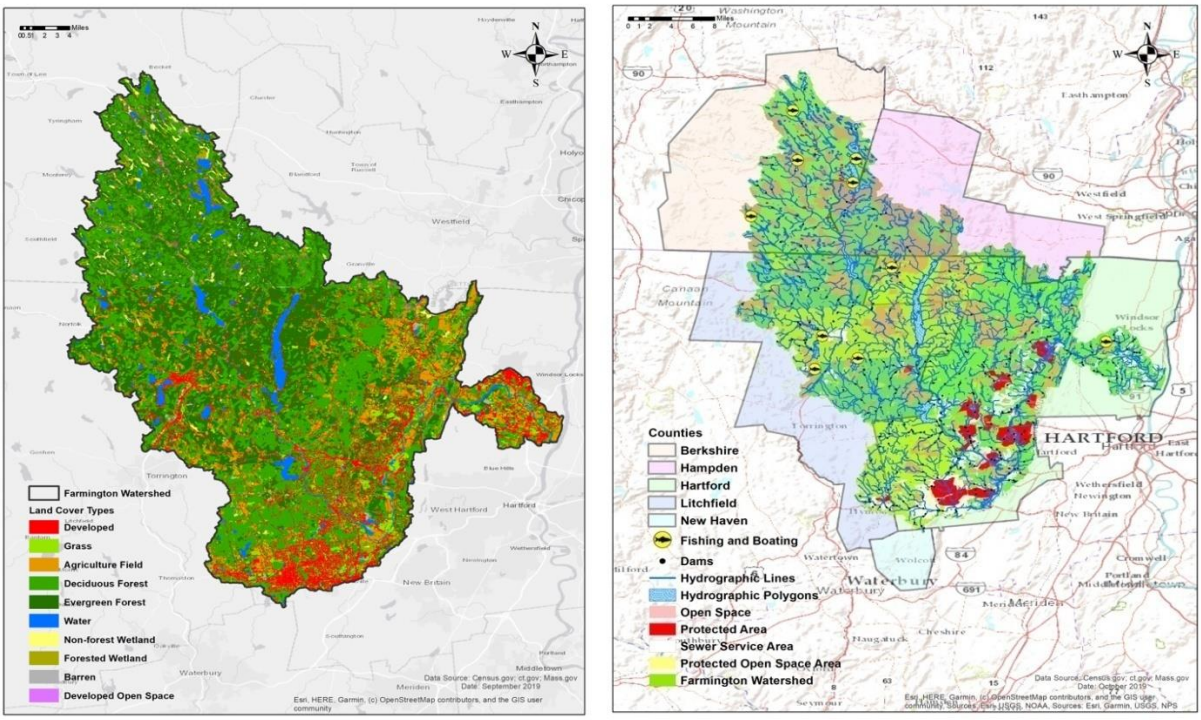

Figure 2. Land cover types of Farmington Watershed, (a). Hydrological features, recreation areas, and protected drinking water areas of Farmington Watershed, (b).

Fig. 2. (a) shows the land cover types in Farmington Watershed, southeastern part of this region has high density of development and agriculture fields, which agree with the population concentration. It includes area where the PFAS releasing accident took place and its downstream areas. Intensive settlement increases the possibility of PFAS leaking in such region and risk of contaminating drinking water. Hydrological features including major water bodies, streams and dams are presented in Fig 2 (b) along with recreation open spaces and fishing and boating areas, and water supply areas. Sewer service systems around the spill aggravate diffusion of the chemical foam and run into the river eventually. As there are fishing and boating area and recreation open spaces right beside the contaminated area, it has created concerns over residents and wildlife health. Water quality changes and monitoring of protected areas and wells along lower Farmington River are another issue that should be took into consideration.

B. Status of Flora and Fauna:

1. 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 on 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, moving and dredging practices and pesticide uses, all of which

are labor intensive, require specialized equipment, and can have negative environmental impacts.

The Farmington River Watershed has both terrestrial and aquatic invasion plant species which have established themselves.

Terrestrial invasion species:

- Shrub Honey Suckle
- Japanese Barberry
- Autumn Olive
- Japanese Knotweed
- Black Locust
- Pachysandra
- Coltsfoot
- Mugwort
- Burning Bush
- Multiflora Rose
- Forget-me-not
- Narrow-leaf Bittercress
- Garlic Mustard
- 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, road sides, 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 have been identified in the Farmington River Watershed:

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

Like terrestrial invasive species, these species can 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 actives. A special concern with these species is their ability to spread to isolated water bodies by human actives. Seeds and fragments will can stuck to the bottom of boats or boots and be carried to new bodies of water. It is imperative the public follow rinsing procedures 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 release from the decomposed plants, which can remove all oxygen from the water and thus killing all aquatic life.

2. Endangered Species:

Both Connecticut and Massachusetts abide by the Federal Endangered Species Act, but use different methods to designate habitats for the ones shown in the watershed. Connecticut, through the natural diversity data bank (NDDB), provide a grey dot map, which shows all locations endangered flora and fauna have been identified. On the map, large, rounded areas are shown and no information on what species was identifies there is provided. This is done to protect the species from the public trying to capture or purposely disturb them. Massachusetts, through the core habitat program, designates priority habitats for rare species to thrive in and makes efforts to preserve these lands. Massachusetts has designated a larger portion of the land in the watershed as critical natural landscape when compared to CT's natural diversity database areas. Although these designated areas most likely contain the same endangered species, states have different regulations on how land is categorize and protected in response to endangered species.

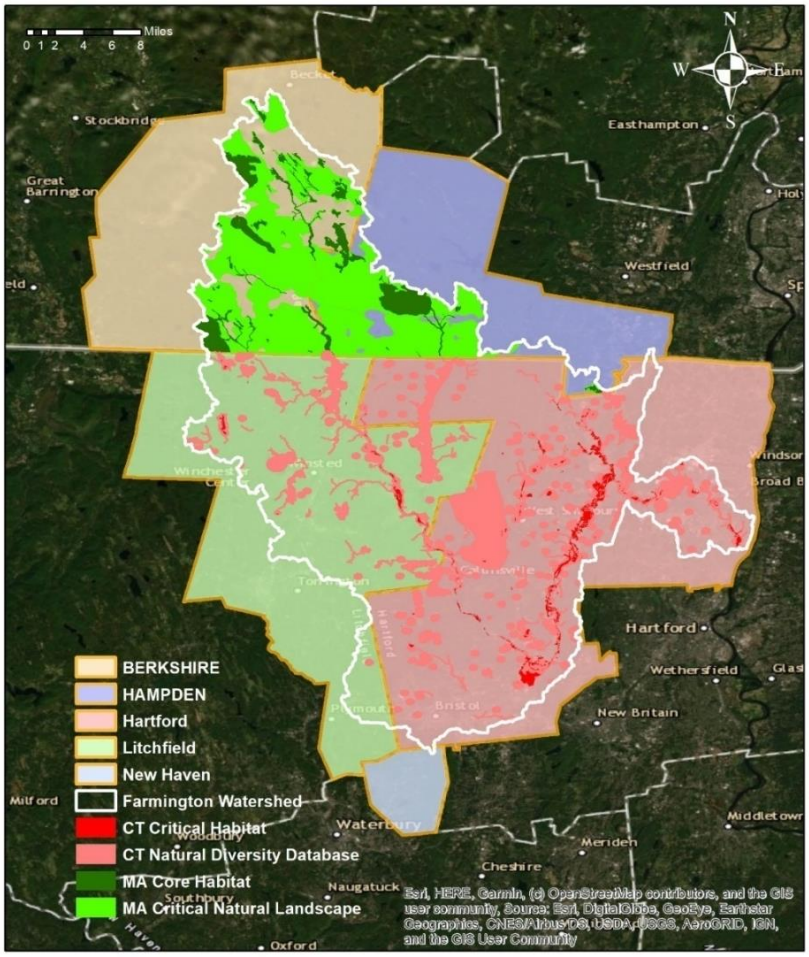

Figure3. Critical habitats located in Connecticut and Massachusetts Farmington River Watershed

3. Critical Habitats:

Both Massachusetts and Connecticut have systems for identifying critical habitats which are ecologically sensitive to human actives, have become rare through over development, or are havens for high biodiversity. These areas are designated such in

efforts 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 can still be developed, but have restrictions on what can occur. Figure 3 shows the extent of the critical habitats in the Farmington River Watershed. Notice how many of the protected areas are surrounding the main river systems. Both Connecticut and Massachusetts have high concentrations of critical habitats around the main sections of the Farmington River, major tributaries, lakes and ponds, and wetlands. This concentration of critical areas around water habitats shows these habitats have been developed in the past and these are the remaining preserves areas. These habitats not only allow ecosystems to thrive, but naturally remove pollutants and nutrients from the water and store water in heavy flow times to prevent erosion.

C. Water Quality Baseline Assessment:

1. Inland Surface Water Quality Classifications:

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.

In the Farmington River Watershed, all three surface water quality classifications are present. For the most part, Class AA surface waters are reservoirs used for drinking water supplies and the tributaries that connect to them. Reservoirs like Barkhamsted Reservoir in the East Branch Farmington River Basin, the 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 and the Nepaug Reservoir in the Farmington River-Headwaters to Thompson Brook Basin make up the larger drinking water supply surface waters. All tributaries leading to the Farmington River are Class A, which dictates they have the potential to be used as drinking water, but currently are not being utilized. The main section of the Farmington River is Class B, which indicates it is only used for recreational purposes and protected for habitat conservation. Generally speaking, tributaries have cleaner water because they are filtered by the ground and have not had any surface flow from developed areas. The larger sections of the river have had surface flow contributions from developed areas upstream and thus are not always a sufficient source of drinking water.

2. Groundwater Quality Classifications:

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 aquifers existing under large portions of the Nepaug River, Mad River, West Branch Farmington River, East Branch Farmington River, Pequabuck River, and the 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.

3. **Typical Water Quality Metrics:**

Phosphorous: Total phosphorous (organic and inorganic) is naturally at a low concentration in streams and rivers. Increased total phosphorous concentration indicated fertilizer run-off is present into tributaries and is most often sourced from agricultural activities. Because phosphorous is a common limiting factor for plants 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 are respiring, but not photosynthesizing. 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 indicate a habitat for disease-causing bacteria, viruses and protozoa's 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)

- State of Connecticut. Connecticut Water Quality Standards Regulations Section 22a-426-9.2015.

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 stream beds 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.

4. Assessment Methods:

1. **Water Sampling:** Phosphorous, bacteria, TSS

2. **Water Monitoring:** Temp and pH

3. **Visual Assessment:** Visual assessment is an integral part of watershed management and gives clues as to why specific sections of streams or river express different water quality conditions. Site assessments allow for degraded habits, erosion, rare plants/animals to be located, invasive species to be tracked, pollutant sources to be identified and overall health of the streams to be determined. The information collected from visual assessments include a collection of field notes, visual assessment forms, photographs and a determination on overall condition quantified by an ranking system based on NRCS (1998 & 2009) and utilizing 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 density. Each factor was assessed and assigned a score. The overall rank of each location assessed was calculating the 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.

Table 2. – Field Assessment Notes Sorted by Local Basin

Local Basin	Sub regional 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 rain garden.
4313-04	Poland River	PQ024	Ravine where storm water 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	Storm water 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

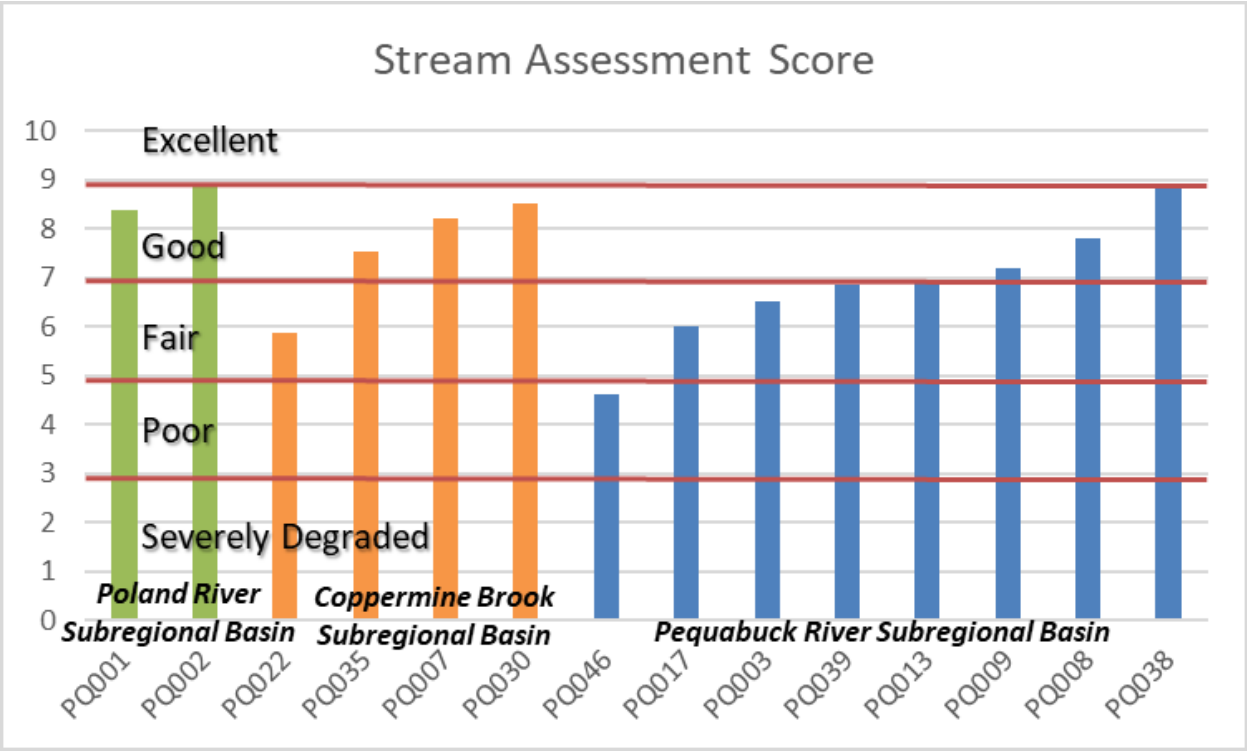

Figure 4: Pequabuck River – Visual Stream Assessment Scores Sorted by Sub-regional Basin

D. Extent of Farmington River Watershed PFAS Leak:

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. (Hladky, 2019) The spill between 40,000-50,000 gallons of PFAS and Water (Zieller, 2019) entered the MDC sewer system where it subsequently discharged into the Farmington River. (Hladky, 2019). The leak occurred over an 18 hour period before discovery (Hernendez, 2019). The extent of the spill is still under testing. Wells within 500 feet of the sewer line are to be tested extending out a 500-foot zone if the wells test positive. Upward of 20 private wells may have been impacted by the spill (Zieller, 2019).

On 8 July 2019, Subsequent to this spill, Government Ned 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). As of August 8, 2019 the extent of the environmental impact and geographical extent of the spill is still unknown.

Figure 5. Location of MDC Waste Water Treatment Plant and outflow pipe which released PFAS contaminated water into Farmington River.

III. Watershed Assessment:

A. Site Assessments

After gathering information about the current condition of the watershed including recent PFAS contamination, water quality, flora and fauna, several sites have been identified in the watershed where changes need to be implemented, either physical or policy-based. These locations all have the potential to benefit the watershed in one of the three significant measures of overall watershed wellness. As these locations are presented, not all are feasible to be altered due to property rights, financial constraints, physical access, or conflicts with other organizational projects.

Site 1. Reservoir Perimeter Buffer: Nepaug Reservoir is the third largest drinking water supply in the Farmington River. It is located just West of Collinsville, CT. Although the reservoir is mostly surrounded by undeveloped land, there are several areas where major roads and small facilities adjacent to the reservoir. These locations show promise for implementing buffering and contaminate filtering systems to reduce runoff pollution. A man-made brim allows for Route 202 to cross the North-west section of the reservoir which could contribute to significant runoff.

Site 2. E-Coil Bacteria Loading: Where Cherry Brook meets the Farmington River (just North of Collinsville, CT, the Geomean for the E . Coli measurement of

the 2016 data set reached 770 ppm, making it the second highest in the monitor station placed on a tributary in the watershed. This brook travels through substantial residential area and clearly collects a bacteria loading from its minor watershed. Reducing the runoff from fertilizers and seasoned septic systems will reduce the concentration in the tributary.

Site 3. Storm Water Management: Due to high urbanization in the area, the level of impervious surfaces has dominated the landscape not allowing for water infiltration. With less water infiltration comes increased storm water runoff. This runoff picks up contaminates from the roads, roofs, sidewalks, and compacted lawns and fields. Implementing pervious surfaces using Green Storm water Infrastructure practices will reduce the runoff from the area and thus prevent tributary and riverbank erosion and pollution transportation. Road salt runoff is a growing concern which is able to mobilize heavy metals in the soil and can alter pH and salinity in surface waters.

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 river banks 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 are not left on lawns in large densities.

Site 5. Storm Water Management: Due to high urbanization in the area, the level of impervious surfaces has dominated the landscape not allowing for water infiltration. With less water infiltration comes increases in stormwater runoff. This runoff picks up contaminates from the roads, roofs, sidewalks, and compacted lawns and fields. Implementing pervious surfaces using Green Stormwater Infrastructure practices will reduce the runoff from the area and thus prevent tributary and riverian bank erosion and pollution transportation. Road salt runoff is a growing concern which is able to mobilize heavy metals in the soil and can alter pH and salinity in surface waters.

Site 6. Nutrient Loading: Due to high agricultural density in close proximity to the river, nutrient loading from excess fertilizer, decomposing organic matter, manure and other sources can enter the riparian habitat through surface water runoff of through groundwater transport. Excessive nutrients breed high bacteria populations, algae blooms, and encourage invasive species to invade pristine areas.

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. Following the accidental fire retardant discharge in June of 2019, Rainbow Brook was responsible for carrying PFAS contaminated water into the Farmington River. The brook is also located adjacent to the airport de-icing facility which in Oct. of this year was destroyed during an aircraft crash. An estimated 25,000 gallons of

aqueous film-forming foam (AFFF) containing PFAS was used to suppress the fire caused by the crash. Booms were laid across the brook to contain the AFFF foam on the surface following the spills. Analyses of surface water samples taken on Oct. 2 and Oct. 3 from numerous locations along the brook indicate the presence of PFAS, with higher concentrations near the outflow from the airport and lower concentrations downstream near the confluence with the Farmington River. Continued use of booms to collect AFFF is recommended, however preventing AFFF from reaching Rainbow Brook is a priority.

Site 8. MDC Water Pollution Control Center, Windsor: The Metropolitan District (MDC) operates a satellite water pollution control facility (WPCF) in Poquonock (Windsor) 3 miles south of Bradley International Airport along the Farmington River. This satellite facility provides full secondary treatment of the wastes it receives from its service area. Secondary treatment is treatment processes for wastewater using physical phase separation to remove settleable solids and a biological process to remove dissolved and suspended organic compounds. This process is not adequate for the removal of PFAS chemicals. It also cannot process sludge wastes which have the potential to harbor PFAS chemicals.

The EPA has recommended these processes be implemented at WPCF's for the removal of PFAS chemicals:

- **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.

Site 9. Bradley International Airport, Windsor Locks: Bradley International Airport is a public-use, commercial service airport, located 12 miles north of Hartford and 1 mile north of the Farmington River. On June 8 a release of 50,000-gallons of aqueous film forming foam (AFFF) occurred at the Signature Flight aircraft hangar at Bradley Airport. Nearly half the foam and water mixture entered an onsite oil-water separator system through floor drains in the hangar and made its way into the municipal sewer system. On Oct. 2 another estimated 25,000 gallons of AFFF containing PFAS was used to suppress the fire caused by a vintage aircraft crash. Early containment and cleanup measures by airport and DEEP emergency spill response staff immediately following the crash reduced the impact of the release of the materials into the environment; however, some dissolved fire fighting materials made it into Rainbow Brook. A contamination buffer area of 5 miles and 10 miles away from the PFAS spill is recommended. The contamination buffer areas are used for identification of

potential affected local basins in the watershed and will allow further investigation into the cleanup and prevention of future spills.

Site 10. E-Coli Bacteria Loading: The last tributary to enter the Farmington River in Windsor, CT approximately 1 mile West of the CT River/Farmington River convergence, has the highest E. Coli bacteria loading in the watershed, with a geomean of 1271 ppm based on the 2016 data. This extremely high measurement is related to the highly developed portion of land the tributary travels through. Clearly some runoff detention efforts coupled with updated septic and litter prevent systems need to be established to prevent this contamination from entering the recreation sections of the Farmington and the Connecticut Rivers.

Site 11. Potential Affected Basins: Identified by the buffer area of contamination source, local basins within the buffer area are selected. Based on the basins within potential polluted area, lower river basins of them are then extracted as potential affected area. Based on DEEP's geospatial datasets, 247 acres of fisheries management area, 26188 acres of open space, 68569 acres of protected open space, and 17733 acres of protected drinking water areas located in selected basins.

Site 12. Service Areas of USGS Water Quality Stations: USGS provides water-quality data collected by more than 2,000 stations throughout the United States and 3 of them located in the Farmington Watershed. The existence of USGS water quality stations enable the monitoring real-time information of stream flow, water temperature, specific conductance, pH, dissolved oxygen, turbidity, and nitrate. Based on the network analysis of Connecticut final-stream lines, 5-10-15 miles service areas along the river are calculated. The result shows that current real-time water-quality stations only cover western areas if Farmington Watershed, while the southwestern part of the watershed is lack of long-term real-time monitoring stations.

IV. Threats and Opportunities:

A. Legal and Regulatory Threats and Opportunities for the Environmental Plan:

The Overarching legal purview resides with the US Federal Department of The Environmental Protection Agency (EPA). "Between 2013 and 2015, large public water systems serving more than 10,000 individuals were required to test their finished drinking water for six specific PFAS chemicals, among other pollutants, under the Third Unregulated Contaminant Monitoring Rule (UCMR3) carried out pursuant to the Safe Drinking Water Act (SDWA)." (Draft CT Interagency PFAS Plan)

CT State jurisdiction primarily includes Department of Public Health (DPH) and Department of Environmental and Energy Protection (DEEP)

Threats: Although PFAS production and subsequent environmental release has been ongoing since the 1950s, health effects are not well known and additional research is required. (CDC Fact Sheet). The primary problem with PFAS is that it is a "forever" toxin that does not break down and accumulates over time. The primary routes of exposure

are drinking water, consumption through meats and fish, and consumer products such as pizza boxes which are a routine exposure.

Opportunity to fund testing and participate in larger research efforts:

PFAS is “An “emerging contaminant” 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 (CDC Fact Sheet).

UCONN CARIC Superfund research inaugural cycle intends to stand up interdisciplinary research and apply for funding. (Draft CT PFAS Task Force)

The Farmington River Watershed Association is another partner organization that already provides extensive water quality testing and GIS surveying of the watershed. This is an excellent partnering opportunity.

B. Financing and Funding Opportunities:

Our plan combines actions such as water quality assessment, intensive geographical mapping of the area, research and outreach efforts, all of which will require substantial funding resources. The Farmington River as well as the Lower Farmington River has been 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 term “partnership river” refers to the partnership of state, local, and federal entities working together to support and protect the area.

The possibilities of financial support range from state/local/federal grants and loans, to public investment in the plan’s initiatives. An initiative similar to ours is the Farmington River Watershed Association, a 501(c)(3) not-for-profit organization, which is funded largely by public/private donations, as well as gift donations of stocks and securities.

The Farmington River Coordinating Committee, a congressionally established organization, offers grant 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. Requirements as listed by the FRCC are to benefit one of the following areas: (1) Conservation/restoration of the river and river-related resources (including critical uplands), (2) Promotion of responsible recreational use, (3) Public education about the river, its resources, and methods of protection, (4) Public involvement in river-related issues, (5) The project must be consistent with the Upper Farmington River Management Plan, (6) Preferred projects will also provide opportunities to broaden partnerships between river stakeholders” (FARMINGTON). Our plan intends to benefit the majority of these areas. 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.

Additionally, 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). In October of 2018, the state was awarded approximately $30.7 million for the Clean Water and Drinking Water State Revolving Loan Fund (SRF). Essentially, these CWSRF programs serve as a type of “environmental infrastructure bank”, as they provide low interest loans to many

eligible water projects. The repayments on these loans “revolve” at the state level and returned back into the fund.

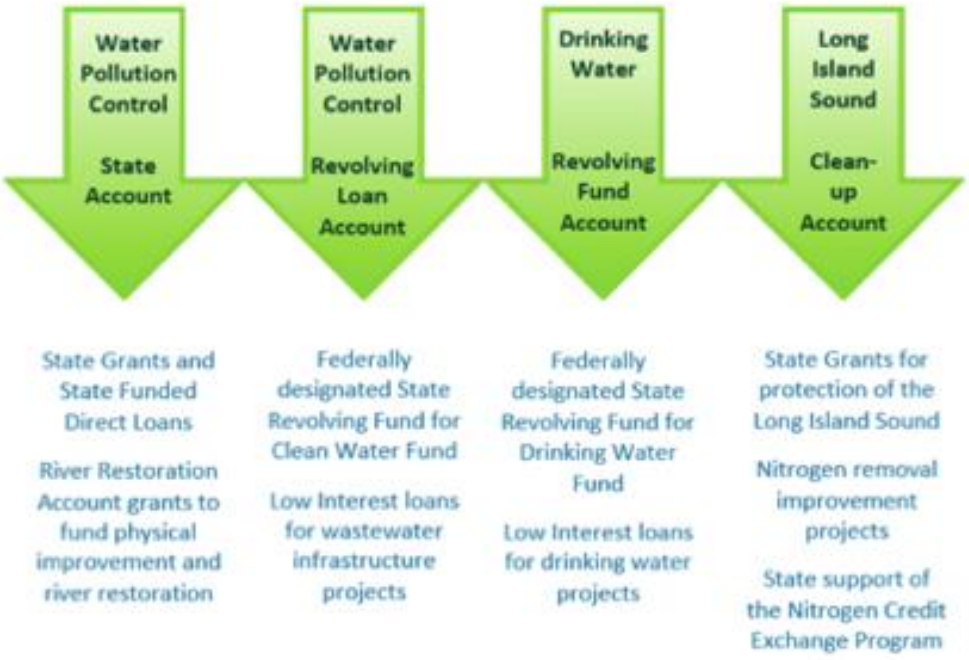

Figure 6. Funding of state water cleanup and monitoring based on application.

Other obstacles include the significant decrease in staff of the CT DEEP due to severe underfunding over the past few years. This could impact the amount of funding/support available from them.

C. Possible Partner Organization Opportunities:

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 CT DEEP and the Metropolitan Water District (MDC). CT 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 State of Connecticut and State of Massachusetts, including municipal support from the 33 river towns in both CT and MA.

These towns include:

Table 4. Watershed Towns, Connecticut

Avon	Farmington	Simsbury
Barkhamsted	Granby	Suffield
Bloomfield	Hartland	Torrington
Bristol	Harwinton	Wolcott
Burlington	New Hartford	Winchester/Winsted
Canton	Norfolk	Windsor
Colebrook	Plainville	Windsor Locks
East Granby	Plymouth	

Table 5. Watershed Towns, Massachusetts

Becket	New Marlborough	Tolland
Blandford	Otis	Tyringham
Granville	Sandisfield	
Monterey	Southwick	

D. Technical Support:

Expertise and assistance from agencies are needed to provide technical guidance and assistance resources of general issues to regional organizations. Agencies like CT DEEP, USGS, Census Bureau, the CT Department of Transportation, CT Resource Conservation and Development Council,US Department of Natural Resources Conservation Service (NRCS), the Connecticut Conservation Districts, the University of Connecticut Cooperative Extension Service, US Fish & Wildlife Service and others (Table 6). These offices may have expertise to assist water management groups, public, and the watershed stakeholders by offering recommendations on techniques and methods related to groundwater and geology, land and water use, environment, surface water, water quality, engineering, design, and modeling.

Table 6. Potential sources of technical assistance.

Agency	Assistance Available
CT DEEP www.ct.gov/deep	Water quality, land use and land cover, wild life habitat, critical areas, endangered species, surface water, ground water
USGSwww.usgs.gov	Long-term water quality sites
Census Bureauwww.census.gov	Demographic information
CT Resource Conservation & Development Council www.ctrcd.org	Soil health education, partnership/grant management, planning and development projects, Environmental Review Team (ERT)
NECCOG www.neccog.org	GIS assistance, regional land use planning support and assistance
USDA/Natural Resources Conservation Service (NRCS)www.nrcs.usda.gov	Nutrient management, woodland and wildlife habitat management and improvement

UCONN – Center for Land Use Education and Research (CLEAR) clear.uconn.edu	GIS support, Outreach and education, tools and data
University of Connecticut Extension extension.uconn.edu	Outreach, education, technical assistance for land use and land cover

The Geospatial Information System (GIS) enables real-time risk assessment for emergency environmental planning of chemical spills in hydrology (Jiang et al. 2012). Integration of GIS and surface water transport modeling is applied by modeling the contamination transport modeling, potential hazard areas estimation, coupling relative environmental models, and risk mapping.

Such decision support system helps monitoring real-time water quality changes caused by the PSFA spill, analyzing impacts on vulnerable receptors, identifying warning areas.

V. Outreach:

A. Action on PFAS in Connecticut by Public and Private Agencies:

1. Government Agencies:

Nationally, the EPA is acutely aware of the threats posed by PFAS. After holding a National Leadership Summit on PFAS, the agency issued a PFAS Action Plan in February 2019 that calls for the escalation of PFAS protections and studies (Task Force, 2019). However, the chemical's use is not regulated by the EPA, as PFAS is not listed under their Toxic Release Inventory, which would require all industries to report their chemical emissions (Hardman, 2019). Including PFAS on that list would escalate its status as a harmful chemical, and would encourage states to take action against its use. After several PFAS spills in Connecticut, Senator Richard Blumenthal called the Federal Aviation Administration to ban the use of PFAS, recommending widespread use of non-chemical firefighting foam (Lopez, 2019).

Even if the federal government does not act on PFAS itself, it can provide funding to public agencies and non-profits in affected areas. After the spill, Attorney General Tong joined other Attorneys General in sending a letter to Congress asking the federal government to provide funding to help states and municipalities deal with the social and ecological aftermath of a PFAS spill.

State legislatures can ban the use of PFAS, and eights states have already proposed, if not passed, such a bill (Pazniokas, 2019). Connecticut attempted this in the 2019 legislative session with two bills, however both were not passed. The 2020 legislative session begins in February, and the subject will likely be the subject of a bill again, especially after the high profile spills of summer 2019. Connecticut already has a suite of strong water quality laws, and although they do not explicitly mention PFAS, regular water monitoring and testing as required by statute would detect such contamination, hopefully avoiding health risks.

Meanwhile, Governor Lamont created an “inter-agency task force...to develop an action plan on how to measure and address pollution” from PFAS, that is akin to the EPA’s plan, but specific to Connecticut (Pazniokas, 2019). The task force includes a variety of public agencies and universities, (see list below) headed by the DPH and DEEP Commissioners. After a public comment period for the draft plan, the Governor published a PFAS Action Plan on November 1, 2019, that is almost verbatim the recommendations for PFAS remediation (Task Force, 2019).

The Plan also includes a breakdown of relevant state agencies and their work on the issue thus far. For example, DPH’s Drinking Water Section maintains thorough scientific knowledge on PFAS, and regularly inspects the state’s drinking water sources. DEEP has the role of identifying which industries use or may use PFAS, and conducting studies on native fish and plant species to check for contamination. They are currently in the process of determining if fish in the Farmington River are safe for human consumption.

DEEP and DPH are the lead agencies in this case, but others also play a role. The Department of Emergency Services and Public Protection is the main liaison to fire departments and seeking a change in firefighting chemicals to reduce the risk of future spills. Research institutions like the state Extension program and UConn have been conducting ongoing research into the effects of PFAS and like chemicals.

2. Review of Governor Lamont’s PFAS Action Plan:

The Plan proposes measures to minimize resident exposure, minimize future PFAS releases, remediate past releases, and advance public education on PFAS. These measures are productive and if fully realized, would achieve the stated goals of reducing exposure and maintaining a healthy environment. For example, the plan proposes identifying workplaces with PFAS exposure and creating strategies for minimizing worker risk, and collaborating with local emergency personnel to make public communications more efficient(Task Force, 2019). The plan also identifies “Potential Legislative Opportunities” related to PFAS, including a chemical take-back program, and to require all water bottle companies to test their products for PFAS (Task Force, 2019).

However, this Plan will only be effective if the state follows through with funding and action. Some of these proposed measures lack details, making them less likely to be enacted. For example, the draft plan recommends consistent water quality testing, but does not specify where, how often, or who will conduct such tests.

3. List of Agencies involved in Inter-Agency Task Force:

- Department of Energy and Environmental Protection (Commissioner Katie Dykes, Task Force co-chair)
- Department of Public Health (Commissioner Renée Coleman-Mitchell, Task Force co-chair)
- Office of the Governor
- Department of Emergency Services and Public Protection
- Connecticut Airport Authority
- Office of the Attorney General
- Office of Planning and Management
- Department of Transportation

- Public Utilities Regulatory Authority
- Department of Consumer Protection
- Connecticut Military
- Department of Correction
- Department of Administrative Services
- Connecticut State Colleges and Universities
- University of Connecticut
- Department of Agriculture
- Department of Developmental Services
- Connecticut Agricultural Experiment Station

4. **Non-Profit Organizations:**

Since the PFAS leak came from a state agency and flows into a river affecting many towns, the PFAS leaks in the upper Connecticut and Farmington rivers is inherently under state jurisdiction. However, non-profit organizations still play a role in cleanup efforts. They serve as watchdog groups for government actions, putting pressure on legislators and regulators to implement comprehensive, effective action. Any proposed environmental plan will incur comments from many local non-profit organizations, which will in turn encourage the public to comment as well.

In Connecticut, the Farmington River Watershed Association is the main non-profit representative for the Farmington River. It has not conducted any actions on its own, but has served as a liaison between government agencies and local stakeholders to communicate progress on both ends.

Clean Water Action's Connecticut branch, however, has their concerns about PFAS front and center on their website, including an email campaign to the Governor's office with the following demands:

- Restrict the use of firefighting foam as fluorine-free foam already exists.
- Establish comprehensive monitoring of water sources.
- Restrict the procurement, sale and distribution of food packaging and food service ware containing PFAS and
- Establish health-protective drinking water standards for PFAS," (Clean Water Action, 2019).

Lobbying groups like Clean Water Action provide a channel for the public to get involved, and keep the government accountable for its promises and duties. As a national group, Clean Water Action can compare Connecticut's policy choices to those of other states, and draw examples to encourage Connecticut to act in the right direction.

A bi-state organization with New York, Connecticut Fund for the Environment/Save the Sound is also keeping a close eye on government action. Their work focuses on Long Island Sound, which will be directly impacted by PFAS spills upstream in the Connecticut River. They have advanced data on the Sound's quality and that of its estuaries and bays, which could be of use to future PFAS action measurement. They also emphasize Connecticut's disappointing failure to pass bills banning PFAS in the 2019 legislative session, while the New York legislature passed a similar ball limiting use of the chemical (Connecticut Fund for the Environment/Save the Sound, 2019).

5. **Municipalities:**

Most watershed town websites do not reference PFAS, such as Avon, Bristol, Hartford, Simsbury, and Windsor Locks. Many of the Farmington River watershed towns are also upstream of the June and October spill sites, so the PFAS contamination will likely not enter their jurisdictions. As a cross-town, cross-sector issue, the state is a more appropriate lead actor on the PFAS spills rather than municipalities. If towns do mention PFAS, the media is largely as a safety warning for residents. Some towns that issued statements on PFAS are detailed below.

Bloomfield - The town's Conservation, Energy, and Environment Committee has been regularly discussing PFAS since their July meeting. They are concerned and paid close attention to the Governor's report, but have issued no municipal action. (Conservation, Energy, and Environment Committee, 2019).

East Granby - The town website issued a health advisory regarding the October PFAS release during the plane crash, advising residents to avoid all contact with the foam and fish from the river. This town also defers to the state for data collection and environmental action (Town of East Granby, 2019).

Windsor - While the town has not released any official action plans, they state they will continue to "remain in contact with state agencies regarding the June chemical release," (Town of Windsor, 2019).

VI. Recommendations:

A. Policy Recommendations for Future PFAS Treatment:

Upon review of state, local, and federal regulations and current policies in place regarding the treatment of PFAS chemicals in water bodies, as well as other instances such as what has occurred in the Farmington River, we have determined possible policy changes to be considered.

Review of these policies, efforts, and current regulations included assessments of the following:

1. History of EPA Actions on PFAS:

Short-term goals: prevent exposure, Long-term goals: treatment and cleanup.

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).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)- 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", they have authority to respond to those as well. The federal government is also granted the 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).

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).

Drinking Water Treatability Database- Database has been designed and implemented by the EPA to provide information to communities regarding the treatability of the drinking water supplies and cost information for the available technologies used in response to PFAS. It also provides information on new/additional PFAS. These 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).

2. **History of CT PFAS testing/issues prior to 2019:**

The EPA mandated testing of water sources, and in 2013 it was confirmed by CT DEEP 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 Dept. 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 CT 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).

3. Non-PFAS Protections:

Water quality monitoring of the area is a high priority, as well as overall health for aquatic life. As of 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 is done through CT DEEP as well as the Farmington Valley Health District for bacteria monitoring. 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.

4. **NRDC Responses to Policy Faults:**

The Natural Resources Defense Council (NRDC) has issued a policy assessment in 2019 addressing PFAS in drinking water, and all of the issues associated with it. The NRDC points out in their assessment 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 being exposed to toxic chemicals which could lead them 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 must be set at zero in order to adequately protect the public. NRDC also proposes analytical procedures and measures are taken to identify and quantify a total PFAS number for water supplies, since it has been difficult to accurately measure this historically.

5. **Proposed Policy Improvements:**

As of 2019, H.B. No. 5910 has been introduced by the Public Health Committee to the Connecticut General Assembly to propose a ban on PFAS use in food packaging and firefighting foam. The EPA and state of CT action plans seem to be working in the right direction, but current policies don’t seem to be focused enough 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 airport hangar floor drains be plugged to prevent further instances while solutions are being determined and the effects are mitigated. Department of Emergency Services and Public Protection has been working with DEEP to also find alternatives to the PFAS-containing foams. Though there has been an active push to cease the use of these chemicals, a clear policy needs to be implemented to ensure they will not continue to be used.

It would of course not eliminate the threat entirely, but more strict action such as bans would force industry users to begin R&D to find a better alternative 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 costs of that scenario, and if those alternatives are just as effective. 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 being used 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, contaminating the city water supply (Holyman). This crisis is a mirror of what has happened at the Farmington River watershed, and this type of action seems most effective. Finding alternatives is a must, but a ban on these chemicals will ensure that their use is stopped completely.
Through reading the NRDC assessment, it appears there are even more policy change recommendations to be made. There should be an increase in health advisories and better notification levels. Public drinking water sources which have any levels of PFAS in them should be regulated and have required notifications to public users/health officials. Additionally, water sources contaminated at any level with PFAS could be treated through better technologies, such as reverse osmosis to identify and remove the broad range of chemicals. The issue with this recommendation is the heavy 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.

B. Site Recommendations:

After reviewing the identified sites during the assessment process, setting priority on human health and water quality with time scale concerns, as well as, understanding possible conflicts with current projects with other agencies/organizations and considering the financial realities, we have selected the following locations to enact physical change to mitigate the corresponding challenges. These project plans will be enacted once final designs and logistical specifics have been finalized. Some plans involve hiring specialized private contractors to complete the work, others involve cooperation with other government agencies and land management organizations, while others involve engaging public parties to act.

Site 4: E-Coil Bacteria Loading and Nutrient Loading

This location was chosen as one of the priority site locations to enact change because of the density of issues that are occurring here. This site, where a tributary connects to the Farmington River at its most southern bend, is plagued by high E. coli bacteria readings, potential for large amounts of agricultural runoff and stormwater runoff which feeds from the highly developed area around the tributary. In order to address these issues, we recommend the following:

- Elevated buffers should be established between the river/tributary and agricultural areas to prevent fertilizer runoff directed into the surface waters. These buffers must be designed to withstand at least a 10 year storm event and be stabilized by native plants which will also provide filtering ability through phytoremediation. It is imperative these elevated buffers are not taken over by invasive species, and thus must be maintained.
- 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/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.
- Pet defecation must be controlled in the areas 200 feet around the open surface waters. Enforcing the removal of pet defiction will be placed on towns to up the enforcement to ensure these pollutants are not allowed to enter our waterways and impact human exposure.
- Inspections and required replacement of non-functioning septic systems will be required for any property within 1000 feet of the open water ways. This will also be placed on towns to enforce. Mitigating these pollutants at the source and focusing the ones closest to open waterways will see the most substantial improvements for the least amount of effort.

Site 5: Storm Water Management

Reducing the storm water runoff for urban areas is always a priority. Urban areas have more impervious cover which increase the amount of water that enters the surface waters and contribute 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 are recommended to be replaced using pervious concrete pavers with gravel of pea-stone underpayments. Asphalt roads are recommended to be replaced with porous asphalt with gravel underlayment. These methods not only allow water to penetrate the surface, but also eliminate the need for de-icing salts as water will not pond and freeze. These methods also last for long periods of time 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 storm water 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 practice which can be installed by home owners or commercial companies.

Site 7: Rainbow Brook, Windsor

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 this only captured the surface concentrate. The brook sediment itself has been polluted and thus must be dredged. Sediment testing must first be completed are regular spacing along the length to identify the most polluted sections. After the sections to dredge have been identified, but before the operations begin, sediment filters and pollutant treatment must be established at the outflow of the brook to collect any releases. The dredging should start at the airport inlet and continue down to the Farmington River. To prevent this type of incident from occurring again, elevated buffers should be established between the airport runways and the banks to contain any runoff.

Site 8: MDC Water Pollution Control Center, Windsor

This secondary wastewater treatment facility must be upgraded to handle a possible PFAS spill. The EPA has recommendations for specific abilities this facility should possess and we would agree with their recommendations.

- **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.

The state of the existing facility will need to be evaluated to formulate a design for implementing these filtration processes. This will involve cooperation with the facility management and maintenance team the municipality responsible for its staffing and funding.

C. Education and Outreach:

It is important to address the impacts of environmental pollutants entering the Farmington River Watershed in a holistic approach. In order to do so, education programs and lines of communication between officials and citizens need to be established. The goal of the environmental education and outreach program are to raise awareness of Farmington River Watershed and promote stewardship and foster an appreciation for our water resources. Below the key goals, strategies and topics of the education and outreach program have been outlined.

1. **Goals & Objectives:**
   To educate the public on their drinking water supply and the value of having access to clean, safe water
   To engage the public in a variety of water-related topics and increase awareness of environmental issues
   To enhance the public's understanding and appreciation of water resources
   To explore real-world environmental issues and solve practical problems

2. **Target Audience:**
   Students in grades K-12th
   Populace living in and around the watershed
   Local government officials and agencies

3. **Strategies:**
   Conduct targeted outreach to area elementary, middle and high schools
   Participate in various community and school-related events
   Reach out to local governments and municipalities
   Collaborate with local partner agencies and organizations
   Increase awareness of environmental education program

4. **Tactics**
   Develop and facilitate environmental lessons/presentations for local students
   Utilize social media to promote and publicize environmental education program
   Create an online request form to capture requests and coordinate outreach and education opportunities
   Post new education and outreach content on website
   Establish a public outreach team consisting of DEEP and DPH personnel along with representatives of other state agencies as needed

Collaborate with local emergency response personnel and establish utilization of existing communication plans to effectively disseminate information and inform the public.

5. Key Topics:

a. Water Quality:
- Drinking water supply
- Water testing
- Water treatment
- Water quality aspects/issues

b. Water Conservation

c. Water Pollution:
- Types of water pollution
- Sources of water pollution
- Impact of water pollution
- Solutions to water pollution
- Methods of removing pollution from river

d. Wastewater treatment:
- Origins of wastewater
- Steps in the treatment process
- Outcomes of wastewater treatment
- Effectiveness of wastewater treatment of pollutants
- Impacts of water pollution of watershed

e. Environmental Lessons:
- School Events Community
- Events
- Local Government Functions

f. Evaluation:
- Online/web-based surveys
- Hard copy surveys
- Policy changes

D. Future Monitoring Methods and Plan:

Although the EPA uses Method 537.1 (solid phase extractions/ targeted analysis) 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. (epa.gov/water-research/). The EPA is still in the process 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). (epa.gov/water-research/). PFAS testing is further complicated by the widespread use of PFAS in standard laboratory equipment (tubing, sample containers and sampling tools). PFAS cross contamination also a hazard with baseline testing and standardization across labs and laboratory hygiene standards must be established as part of the new PFAS protocols. (epa.gov/water-research/). For Specific laboratory analytical sampling methods approved for method 537.1 see (cfpub.epa.gov)

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. Although PFAS is the primary concern for the watershed due to the two recent chemical releases, the 537.1 testing method will be expanded for other suspected contaminates. Chloride from road salt is another area of opportunity for testing.

Public drinking water systems are the priority followed by private wells. Water bottled in CT will be another area requiring testing in proposed targeted legislative opportunities. (ct.gov/deep/pfastaskforce) For the Farmington River Watershed the team still needs to 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.

The plan will incorporate separate water quality testing for E. Coli already covered through The Farmington River Watershed Association.

Conclusion:

The Farmington River is one of the largest and most important watersheds in the State of Connecticut. It provides drinking water for over 600,000 people and is a habitat for thousands of species of wildlife and fauna. It also provides an important salmon restoration habitat and is a popular destination for recreational activities. It is important that the state and municipalities, as well as local citizens, learn about the threats their watershed faces and the actions they can take to prevent irreversible damage from happen to the river in the future. Because of this it is recommended that action be taken to preserve the Farmington River Watershed from threats such as PFAS chemicals through outreach programs involving education for local communities, as well as, site specific actions including clean up and preventative measures, including policy change.

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