Contract #12-05f

2017

French River Watershed-Based Plan

Prepared by the Eastern Connecticut Conservation District, Inc.

www.ConserveCT.org/eastern

This project is funded in part by the Connecticut Department of Energy and Environmental Protection through a US EPA Clean Water Act §319 Nonpoint Source Program grant.

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ACKNOWLEDGMENTS

The preparation of a watershed-based plan requires the efforts of multiple individuals who provide their time, knowledge and expertise. The Eastern Connecticut Conservation District is indebted to the following individuals whose assistance was invaluable to the preparation and development of this plan:

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Ken Beausoleil, First Selectman, Town of Thompson

Alison Boutaugh, Director, Thompson Public Library

Joe Iamartino, Thompson Historical Society

Joe Bachand, Quinnatissett Country Club

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ACRONYMS

AMSL – Above mean sea level
CACIWC – Connecticut Association of Conservation and Inland Wetland Commissions
CAS – Connecticut Audubon Society
CEDC – Connecticut Economic Development Commission
CFPA – Connecticut Forest and Parks Association
CLEAR – Center for Land Use Education and Research
CNMP – Comprehensive Nutrient Management Plan
CLCC – Connecticut Land Conservation Council
CT DoAg – Connecticut Department of Agriculture
CT DOT – Connecticut Department of Transportation
CT RC&D – Connecticut Resource Conservation and Development Area
CWA – Clean Water Act
DCIA – Directly connected impervious area
DPH – Connecticut Department of Public Health
DPW _ Department of Public Works
ECCD – Eastern Connecticut Conservation District
EIS – Environmental Impact Statement
ERT – Environmental Review Team
FSA – Farm Service Agency
FRC – French River Connection
GHP – Good Housekeeping Practices
GIS – Geographic Information System
GMP – Growth management principle
HUC – Hydrologic unit code
IC – Impervious cover
IDDE – Illicit Discharge Detection and Elimination
IPM – Integrated Pest Management
LUST – Leaking underground storage tank
MADEP – Massachusetts Department of Environmental Protection
MEP – Maximum extent practicable
MS4 – Small Municipal Separate Storm Sewer System
NECCOG – Northeastern Connecticut Council of Governments
NEMO – Non-point Education for Land Use Officials
NDDH – Northeast District Department of Health
NOFA – Northeast Organic Farming Association
NPS – Nonpoint source pollution
NRCS – Natural Resources Conservation Service
NOAA – National Oceanic and Atmospheric Administration
NOFA – Northeast Organic Farming Association
OPM – Connecticut Office of Policy and Management
POCD – Plan of Conservation and Development
PRL – Priority Restoration List

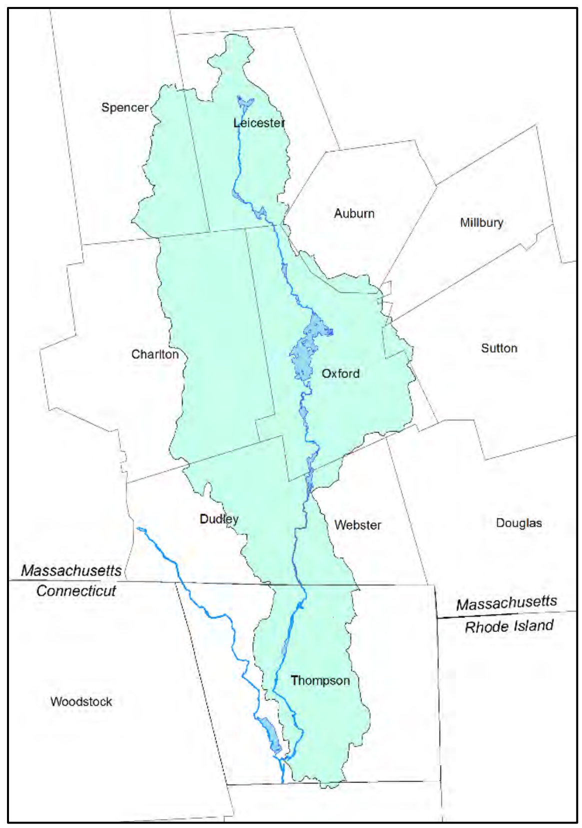
STEAP – Small Town Economic Assistance Program
SWMP – Stormwater Management Plan
SWPPP – Stormwater Pollution Prevention Plan
TLGV – The Last Green Valley, Inc.
TRBP – Thames River Basin Partnership
UA – Urbanized area
UCONN – University of Connecticut
USDA – United States Department of Agriculture
USEPA – United States Environmental Protection Agency
USGS – United States Geological Survey
UST – Underground storage tank
WLA – Webster Lake Association
WPCA – Water Pollution Control Authority

1. EXECUTIVE SUMMARY

This Executive Summary provides an overview of the French River Watershed-based Plan (the Plan). It can be used as a stand-alone guide to the fuller watershed plan, and may be used as a reference document by watershed managers. The purpose of the Plan is to identify sources of fecal coliform bacteria and other common contaminants that have degraded water quality in several waterbodies in the French River watershed, including the French River, Backwater Brook and Quinatissett Brook, and to provide management recommendations to improve water quality so that all waterbodies in the French River watershed can meet established water quality standards for all their designated uses.

1.1. INTRODUCTION

The 101-square mile French River watershed is a regional watershed located in south central Massachusetts and northeastern Connecticut. Approximately 84 square miles (53,780 acres) of the French River watershed are located in Massachusetts. The remaining 17 square miles (10,883 acres) are in Connecticut. The French River watershed is part of the Quinebaug regional and the Thames major watersheds, which, along with the French River, ultimately discharge their water via the Thames River to Long Island Sound.



The French River watershed in Massachusetts and Connecticut.

A 4.61-mile segment of the French River, from the outlet of North Grosvenordale Pond to the confluence with the Quinebaug River (segment CT3300_01-01), has been intermittently listed in recent years, most recently in the CT 2010 Integrated Water Quality Report, as impaired for recreation use. The cause of the French River impairment is periodic high levels of the fecal coliform bacterium *Escherichia coli* (*E. coli*). Long Branch Brook (CT3300-02-01), a tributary to the French River, was listed in the 2012 and 2014 Integrated Water Quality Reports as impaired for recreation due to the presence of fecal bacteria. *E. coli* is a bacterium that is found in the gut of warm blooded animals. While most species of *E. coli* are not harmful, their presence may indicate the presence of other pathogens, such as Salmonella, Hepatitis A, cryptosporidium and Giardia, that may present a health risk to humans.

In 2015, the Eastern Connecticut Conservation District (ECCD), in partnership with CT DEEP, the Town of Thompson, and The Last Green Valley, Inc. (TLGV) Volunteer Water Quality Monitoring Program, conducted a water quality investigation to quantify fecal bacteria levels in the Connecticut portion of the French River and multiple perennial tributary streams, and to identify potential sources of the bacteria documented in the river and streams. The investigation included the collection and analysis of water samples from the French River and its perennial tributaries for fecal bacteria content, a field assessment of the watershed, and a desktop pollutant load analysis. The collected information was evaluated and used to prepare this watershed-based plan. This Plan recommends management practices for watershed managers that address the documented areas of concern, with the goal of reducing bacteria and NPS pollution loading to French River and its tributaries in order to protect the quality of streams that meet Connecticut Water Quality Standards and improve the quality of streams that do not.

Funding to conduct this study and prepare this plan was provided in part by DEEP through a US Environmental Protection Agency (USEPA) Nonpoint Source Program grant under Section 319 of the Clean Water Act.

1.2. Document Overview

The purpose of this watershed plan is to provide guidance to local managers and a spectrum of stakeholders in order to protect good water quality and support the restoration of the impaired waters in the French River watershed so that all waters meet the Connecticut water quality standards for their designated uses.

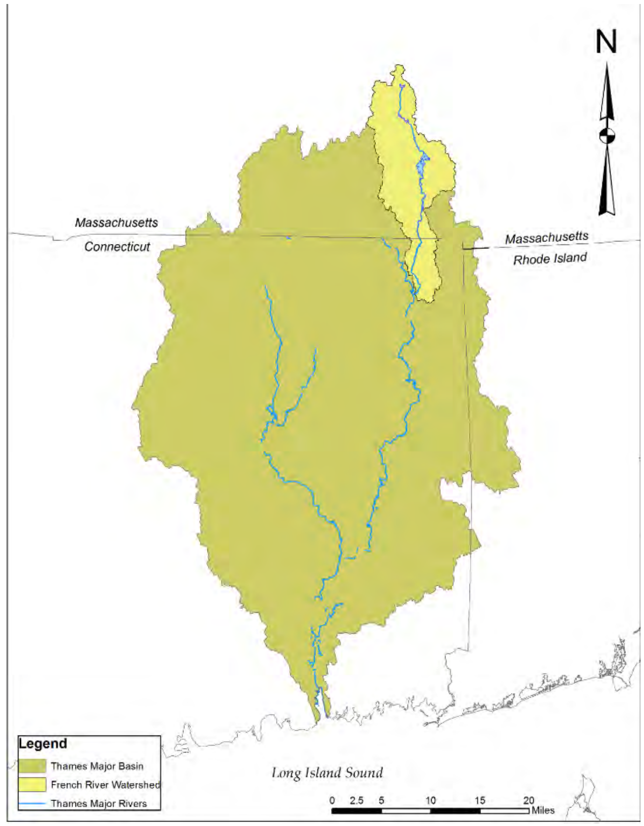
Because watershed planning is both a collaborative and participatory process, the Eastern Connecticut Conservation District engaged a variety of stakeholders to be involved in the development and implementation of this plan, including municipal staff and land use commissions, land owners, agricultural producers and business owners. Upon approval of this Plan, it will become incumbent upon these stakeholders to adopt and implement the plan recommendations.

Like other rural Connecticut watersheds, the French River watershed faces challenges associated with stormwater management, climate change and the potential for future development. Although more than three-quarters of the French River watershed is considered undeveloped, water quality issues associated with stormwater run-off is a primary concern. A USEPA review of climate change indicators, criteria that track environmental conditions over time, indicate that weather patterns have changed in Connecticut. This has resulted in hotter, drier summers, more intense rain storms, and warmer winter temperatures that result in more winter rain and less snow and snow pack. Finally, the potential for suburban development threatens the rural character of Thompson. Due to its location, Thompson is easily accessible to major urban centers, including Worcester and Boston, MA, Providence, RI, Hartford, CT, and New York City, NY. A build-out analysis conducted by the Town in 2009 indicated that, based on current zoning regulations, an additional 9,500 housing units could be constructed, which could add as many as 15,000 new residents (Town of Thompson, 2009).

1.3. Watershed Description

The French River has its headwaters in the central Massachusetts town of Leicester, and ends in Thompson, Connecticut at the confluence with the Quinebaug River, just south of the federal flood control facility at West Thompson Lake. The French River was, in the past, a working river and was key to the development of industrial-era mills in the Massachusetts towns of Leicester, Oxford, and Webster, and Thompson, Connecticut.

The French River watershed encompasses 101 square miles, of which about 83% (84 square miles) is located in Massachusetts. The watershed is relatively long and narrow and is characterized by northwest-to-southeast trending rolling hills. The French River flows southerly through the watershed through a mix of mostly forested rural land and village centers to the Quinebaug River.



The French River regional watershed, part of the Thames major basin, in Connecticut and Massachusetts.

The physical characteristics of the watershed are defined by highly folded and fractured metamorphic bedrock of the Worcester County Plateau (primarily schists and gneiss with igneous intrusions), dating from the Precambrian to Carboniferous periods, approximately 570 - 320 million years ago (University of Massachusetts, 1999). The surficial geology is shaped by the Wisconsinan glaciation, which ended approximately 12,000 years ago, and by fluvial processes that have occurred since that time (University of Massachusetts, 1999). Glacial deposits include unsorted basal and lodgment till deposits in upland areas, and well-sorted sand and gravel outwash deposits in lower elevations and river valleys. Predominant soil types include Charlton-Chatfield Complex soils (25%), Woodbridge fine sandy loams (13%), Canton and Charlton soils (12%), and Ridgebury, Leicester and Whitman soils (10%).

There are approximately 28.7 miles of perennial streams in the French River watershed in Connecticut, and approximately 212 acres of ponds and lakes in the watershed. Notable waterbodies include Langer's Pond (11.9 acres), North Grosvenordale Pond (58.6 acres), and Mechanicsville Pond (33.5 acres), all of which are impoundments of the French River, and Ream's Pond (29.7 acres), an impoundment of Quinatissett Brook. The French River has a surface water classification of B, due to upstream (Massachusetts) waste water treatment plant discharges. The remaining surface waters in the French River watershed have surface water quality classifications of A. Designated uses in Class A surface waters include habitat for fish and other aquatic life and wildlife; potential drinking water supplies; recreation; navigation; and water supply for industry and agriculture. Designated uses for Class B surface waters include habitat for fish and other aquatic life and wildlife; recreation; navigation; and water supply for industry and agriculture. Groundwater throughout most of the French River watershed in Connecticut is classified as GA. Several areas, including Connecticut Water Company's public drinking water supply well field on Sunset Hill Brook, are designated GAA. Portions of the watershed along the French River are designated GB. Designated uses for Class GA groundwater include existing private and potential public or private supplies of water suitable for drinking without treatment, and base flow for hydraulically-connected surface water bodies. Designated uses for Class GAA groundwater includes existing or potential public supply of water suitable for drinking without treatment and baseflow for hydraulically-connected surface water bodies. Designated uses for Class GB groundwater include industrial process and cooling waters, and baseflow for hydraulically-connected surface water bodies.

The French River watershed in Connecticut is predominantly rural. Land cover in the watershed is dominated by undeveloped deciduous and coniferous forests (61%). Developed land (defined as residential, commercial and/or industrial development, and paved surfaces) and turf grass areas associated with developed land, comprise approximately 21% of the watershed. About 7% of the watershed is used for pasture, hay and cropland. Approximately 10% of the watershed is comprised of wetlands and waterbodies.

1.4. Land Management Policies

Land management policies in Connecticut occur on multiple administrative levels, from federal to state to regional to local levels. State planning is administered through the Office of Policy and Management, while regional planning is conducted by regional planning organizations such as councils of government. Local planning occurs via the preparation of municipal planning documents and is administered through land use boards or commissions. In order for land use planning to be at its most effective, it is important for policies and goals to be aligned on local, regional, state and federal levels.
Federal, state and regional planning documents include:

- Final Environmental Impact Statement for the French River Cleanup Program in Massachusetts and Connecticut (January 1987)
- 2013-2018 Conservation & Development Policies: The Plan for Connecticut
- General Permit for the Discharge of Stormwater from the Department of Transportation Separate Storm Sewer Systems (January 2016)
- The Last Green Valley, Inc. *Vision 2020 – The Next Ten Years*

Municipal planning documents include:

- Town of Thompson Plan of Conservation and Development 2010-2020 (2009)
- Conservation and Open Space Plan (2005)
- Natural Resources Inventory (2005)
- Regulations for the Protection of Inland Wetlands and Watercourses in the Town of Thompson (revised March 10, 2009)
- Town of Thompson Inland Wetland Inventory (1980)
- Town of Thompson Zoning Regulations (amended through September 24, 2012)
- Town of Thompson Subdivision Regulations (amended through December 22, 2008)

1.5. Water Quality Conditions/Water Quality Data

The 1972 Federal Clean Water Act requires all states to designate uses for all waterbodies within their jurisdictional boundaries, assign water classifications based on designated uses, and assess waters to determine if they are meeting their designated uses. Designated uses for the French River (Class B) in Connecticut include habitat for fish and other aquatic life and wildlife; recreation; navigation; and industrial and agricultural water supply. Designated uses for all other surface waters in the watershed (designated Class A) include habitat for fish and other aquatic life and wildlife; potential drinking water supplies; recreation; navigation; and water supply for industry and agriculture. Within the French River watershed, the French River Long and Branch Brook have not been meeting their designated use for recreation due to periodic high levels of Escherichia coli from unknown sources.

The State of Connecticut Department of Energy and Environmental Protection Water Quality Standards (effective October 10, 2013) established water quality criteria for indicator bacteria (E. coli) for freshwater. For the purposes of the French River water quality investigation, ECCD utilized the single sample criteria for Freshwater – All other recreational uses of 576 cfu/100ml and the maximum sample set geometric mean of less than 126 cfu/100 ml to evaluate water quality data collected from French River and tributaries.

In 2015, ECCD and volunteers from the Last Green Valley (TLGV) Volunteer Water Quality Monitoring program collected water samples from twenty-three sites in the French River watershed over an eight-week period for *E. coli* content analysis. ECCD staff and TLGV volunteers utilized protocols from a USEPA and CT DEEP-approved Quality Assurance

Project Plan (QAPP) in accordance with an approved water quality monitoring plan. The water samples were processed by the Connecticut Department of Public Health (DPH) Laboratory in Rocky Hill, CT. The results are presented in the table below.

2015 French River Watershed Bacteria Sampling Results

Stream Name	Site #	Location	Geomean (cfu/100 ml)
French River	FR01	500 ft US of Quinebaug River confluence	74
French River	FR02	RT 12 at pull-over north of Riverside Pizza	101
French River	FR03	N end of Riverside Park 100 ft DS of foot bridge	47
French River	FR04	North Grosvenordale Pond outlet	14
French River	FR05	Langers Pond – US Wilsonville Road	57
French River	FR06	MA/CT state line - off Perryville Rd	87
Long Branch Brook	LBB01	US Wagher Road	36
Long Branch Brook	LBB02	US Labby Road	56
Long Branch Brook	LBB03	MA/CT state line - off Labby Rd	61
Knowlton Brook	KB01	DS Wilsonville Road	83
Backwater Brook	BWB0.5	end of box culvert at French River canal	124
Backwater Brook	BWB01	US Main Street at School St	22
Backwater Brook	BWB02	off end of Floral Ave	33
Sunset Hill Brook	SHB01	DS of Klondike Ave	---
Sunset Hill Brook	SHB02	DS Thompson Hill Road (RT 200)	**135**
Stoud Brook	SB01	US Thompson Hill Road (RT 200)	32
unnamed brook from Marianapolis Prep School	UN01	US RT 12 just south of RT 395 S on-ramp	37
Little Mountain Brook	LMB01	DS Robbins Road	96
Quinatissett Brook	QB01	US Ballard Road	**338**
Quinatissett Brook	QB02	US RT 21 at Quinatissett Golf Course	**361**
Elliott Brook	EB01	DS Chase Road	74
Elliott Brook	EB02	DS Quaddick Road	125
Ross Brook	RB01	DS Quaddick Road	**148**
Bold denotes that the sample exceeded established indicator bacteria geometric mean criteria for that site.			

In the summer of 2017, ECCD conducted a windshield field survey to assess the watershed and identify conditions that could contribute to non-point source pollution. The windshield field survey was an informal, visual assessment of existing watershed conditions. Collected data collected was used to identify potential pollutant sources and locations in the French River watershed where restorations and pollution mitigation can be conducted.

Common conditions identified during the windshield field survey included:

- Areas with high amounts of impervious cover (IC)
- Stream buffer encroachments
- Uncontrolled stormwater runoff from commercial and private properties
- Trash and debris at stormwater outfalls
- Invasive plant species along riparian corridors
- Poor or no “good housekeeping” practices

Data collected by other agencies or organizations in the French River watershed in Connecticut includes:

- TLGV and Thompson Conservation Commission (2006 to 2011): Physio-chemical data, including temperature, pH, dissolved oxygen, specific conductivity and turbidity, was collected.
- CT DEEP (2010): *E. coli* data was collected from Long Branch Brook at Labby Road, and was used to prepare the 2012 Long Branch Brook bacteria TMDL.
- CT Audubon (2013): Water samples were collected for fecal bacteria (*E. coli*) analysis from six sites in the French River watershed.
- TLGV (2016): Volunteers collected water samples from Backwater Brook for fecal bacteria (*E. coli*) analysis.

1.6. Pollutant Source Assessment

ECCD evaluated potential pollutant sources using the water quality data collected in 2015, as well as data collected by others. ECCD conducted a windshield assessment of the French River watershed to identify conditions that could contribute to pollutant. ECCD also conducted a desktop pollutant load analysis to determine the annual loading of common nonpoint source (NPS) pollutants such as sediment, nutrients, and fecal bacteria.

Point sources (pollution that is discharged from a single, identifiable point) that were evaluated included regulated discharges and hazardous waste. Potential nonpoint sources of pollution (pollution that is not derived from a single discernible source or point) that were evaluated included impervious cover/stormwater runoff, sewers and septic systems, pet and wildlife waste, riparian area encroachments, agricultural activity and livestock.

1.7. Pollutant Load Assessment

The estimation of pollutant loads is necessary in order to determine the pollutant load reductions that are required to restore the quality of an impaired waterbody. Where water quality measurements have been collected, it is possible to determine pollutant loading directly. Stream bacteria levels documented by ECCD in 2015 were previously presented in Section 1.5. Bacteria reductions are presented in the table below.

Fecal bacteria levels and required reductions.

Site	**Site Description**	**Geomean**	**% Load Reduction Required**
FR01	French River 500 ft upstream of Quinebaug River confluence	74	0
FR02	French River at Rt 12 near Riverside Pizza	101	0
FR03	French River at Riverside Park 100 ft downstream of the footbridge	47	0
FR04	French River upstream of outlet at North Grosvenordale Pond	14	0
FR05	French River upstream of Wilsonville Road bridge	57	0
FR06	French River at the CT/MA state line	87	0
LBB01	Long Branch Brook upstream of Wagher Road	36	0
LBB02	Long Branch Brook upstream of Labby Road	56	0
LBB03	Long Branch Brook at the CT/MA state line	61	0
KB01	Knowlton Brook downstream of Wilsonville Road	83	0
SHB01	Sunset Hill Brook downstream of Klondike Avenue	124	0
SHB02	Sunset Hill Brook downstream of Thompson Hill Road (RT 200)	22	0
SB01	Stoud Brook upstream of Thompson Hill Road (RT 200)	33	0
BWB0.5*	Backwater Brook culvert outfall at the French River canal	**820***	30%
BWB01	Backwater Brook downstream of Phelps Pond outlet	**135**	7%
BWB02	Backwater Brook upstream of Phelps Pond off Floral Avenue	32	0
UN01	Unnamed stream upstream of Route 12 by I-395 SB on-ramp	37	0
LMB01	Little Mountain Brook downstream of Robbins Road	96	0
QB01	Quinatissett Brook downstream of Ballard Road	**338**	63%
QB02**	Quinatissett Brook downstream of Reams Pond outlet	**361**	65%
RB01**	Ross Brook downstream of Quaddick Road	74	0
EB01**	Elliott Brook downstream of Quaddick Road	125	0
EB02**	Elliott Brook downstream of Chase Road	**148**	15%
* Reduction based on single sample limit (576 cfu/100ml) **Only three samples were taken at these sites and do not constitute a reliable sample set.			

When no water quality data is available, the use of models can be used to estimate pollutant loading. ECCD used the Watershed Treatment Model (2013 "Off the Shelf" edition), developed by the Center for Watershed Protection, to estimate watershed pollutant loads based on existing land use conditions. ECCD utilized the local watersheds within the Lower French River regional watershed (HUC 011000010204) to facilitate the modeling process. In order to provide a baseline against which current pollutant loading could be compared, pre-developed watershed loads were calculated for each of the sub-watersheds, using a forested condition as a typical pre-development land cover for Connecticut. Estimated pollutant loads and load reductions by land type and sub-watershed are provided in the tables below.

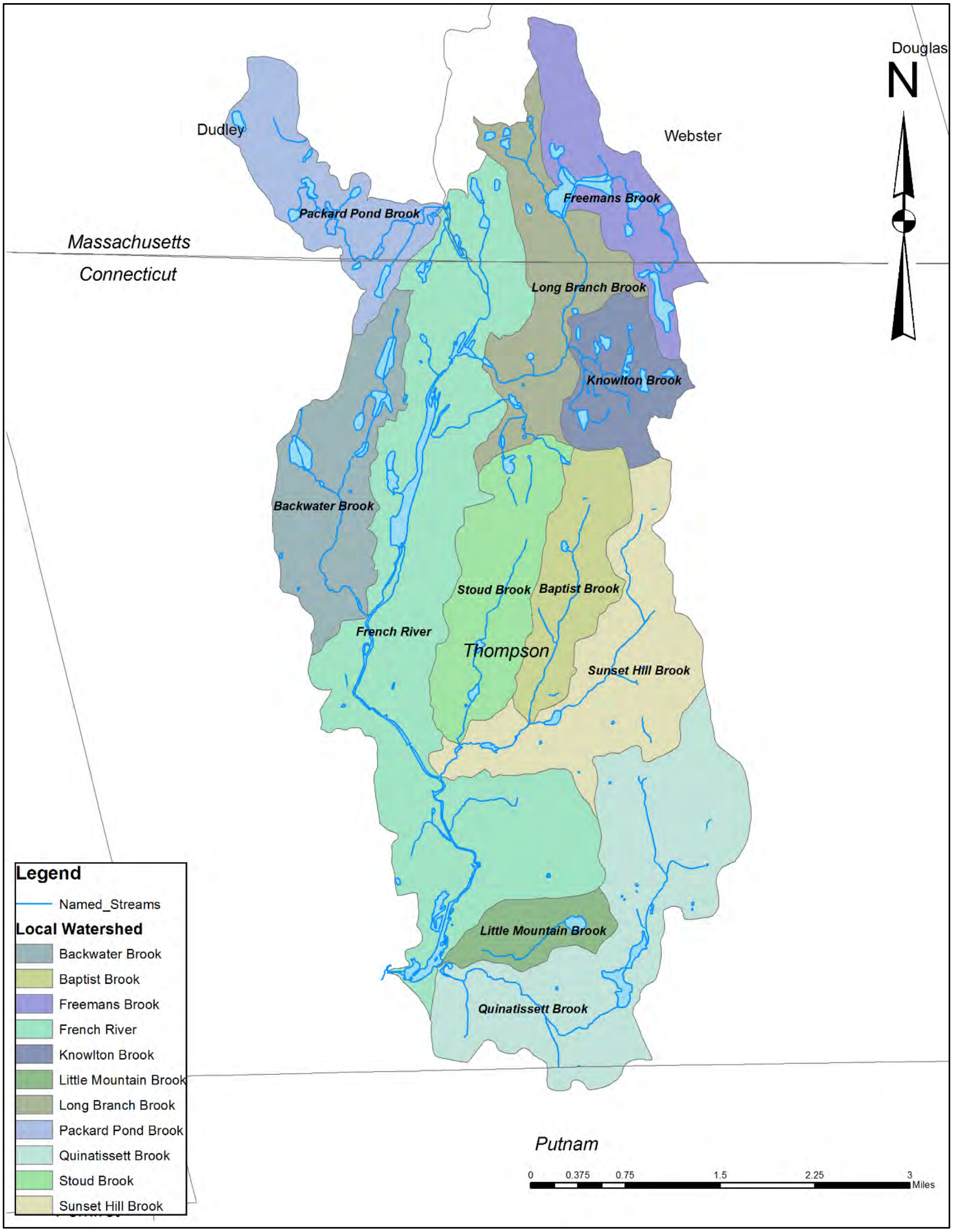
Estimated annual pollutant loads by land use type for the Lower French River watershed.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% of load)	TP (% of load)	TSS (% of load)	Fecal Coliform (% of load)
LDR (<1du/acre)	3,713	548	86,633	161,157	652	7	10	4	14
MDR (1-4 du/acre)	2,384	352	55,628	103,479	419	4	6	3	9
HDR (>4 du/acre)	494	73	11,517	21,425	87	1	1	1	2
Multi-family	178	26	4,160	7,739	31	0	0	0	1
Commercial	668	70	13,685	29,010	117	1	1	1	3
Roadway	15,821	1,720	921,760	627,006	2,536	28	31	42	56
Industrial	439	50	16,155	18,179	74	1	1	1	2
Forest	23,762	1,901	950,490	114,059	1,164	42	34	43	10
Rural	1,201	183	26,100	10,179	33	2	3	1	1
Pasture/Hay	2,625	399	57,060	22,253	72	5	7	3	2
Cropland	165	25	3,590	1,400	4	0	0	0	0
Open Water	5,492	215	66,511	0	0	10	4	3	0
Land Use Total	**56,942**	**5,562**	**2,213,289**	**1,115,886**	**5,189**	**100**	**100**	**100**	**100**
Secondary NPS Sources									
Septic Systems	1,773	295	11,818	5,218	0	53	49	2	37
Stream Channel Erosion	0	0	703,188	0	0	0	0	98	0
Hobby Farms/ Livestock	1,550	306	0	8,740	0	47	51	0	63
Secondary Source Total	**3,323**	**602**	**715,007**	**13,958**	**0**	100	100	100	100
Load Reductions from Existing Practices	-1,084	-1,107	63,231	52,016	-42	-	-	-	-
Total All Sources	**61,349**	**7,271**	**2,865,065**	**1,077,827**	**5,036**	-	-	-	-

Pollutant Load Estimates for sub-watersheds in the Lower French River watershed.

Local Watershed	Existing Pollutant Loads (lbs/year)				Existing Pollutant Yields (lbs/ac/year)				Runoff Volume (ac-ft/year)	Runoff Depth (in)
	TN	TP	TSS	Fecal Coliform (billion/yr)	TN	TP	TSS	Fecal Coliform (% of load)		
French River (3300-00) (3,519 acres)	18,772	2,289	879,990	377,231	5	1	250	107	1,772	6
Packard Pond Brook* (3300-01) (835 acres)	4,586	607	208,601	96,311	5	1	250	115	453	7
Long Branch Brook (3300-02) (979 acres)	5,366	670	248,998	105,189	5	1	254	107	485	6
Freeman's Brook* (3300-03) (799 acres)*	4,819	661	222,157	123,527	6	1	278	155	562	8
Knowlton Brook (3300-04) (575 acres)	2,464	271	129,126	42,103	4	0	225	73	204	4
Backwater Brook (3300-05) (1,053 acres)	3,836	395	203,918	57,541	4	0	194	55	298	3
Sunset Hill Brook (3300-06) (1,283 acres)	5,353	593	263,755	83,624	4	0	206	65	426	4
Baptist Brook (3300-07) (688 acres)	2,465	210	107,846	19,191	4	0	157	28	123	2
Stoud Brook (3300-08) (934 acres)	3,070	310	141,018	27,909	3	0	151	30	173	2
Little Mountain Brook (3300-09) (340 acres)	1,948	251	92,578	38,673	6	1	272	114	175	6
Quinatissett Brook (3300-10) (1,953 acres)	8,668	1,014	367,078	106,530	4	1	188	55	569	3
Total (12,958 acres)	**61,349**	**7,271**	**2,865,065**	**1,077,827**	**5**	**1**	**221**	**83**	**5,240**	**5**

* Watersheds discharge to the French River in Massachusetts



Lower French River (HU C011000010204) local watersheds.

Recommended load reductions based on estimated NPS loads for existing and pre-development land use and land cover in the Lower French River watershed (HUC 00110000204).

Sub-watershed	Existing TN (lb/year)	Pre-developed TN (lb/year)	% Reduction TN (lb/year)	Existing TP (lb/year)	Pre-developed TP (lb/year)	% Reduction TP (lb/year)	Existing TSS (lb/year)	Pre-developed TSS (lb/year)	% Reduction TSS (lb/year)
3300-00 French River Local	18,772	10,295	82	2,289	747	206	879,990	468,560	88
3300-01 Packard Pond Brook*	4,586	2,446	87	607	177	242	208,601	111,187	88
3300-02 Long Branch Brook	5,366	2,512	114	670	198	239	248,998	127,784	95
3300-03 Freeman's Brook*	4,819	2,103	129	661	163	306	222,157	104,608	112
3300-04 Knowlton Brook	2,464	1,524	62	271	118	130	129,126	75,451	71
3300-05 Backwater Brook	3,836	2,703	42	395	213	86	203,918	137,393	48
3300-06 Sunset Hill Brook	5,353	3,323	61	593	260	128	263,755	167,636	57
3300-07 Baptist Brook	2,465	2,020	22	210	146	44	107,846	91,653	18
3300-08 Stoud Brook	3,070	2,464	25	310	191	63	141,018	122,423	15
3300-09 Little Mountain Brook	1,948	935	108	251	70	257	92,578	44,836	106
3300-10 Quinatissett Brook	8,668	5,219	66	1,014	400	153	367,078	256,402	43
* Watersheds discharge to the French River in Massachusetts.									

1.8. Watershed Management Goals and Objectives

The goals of this watershed management plan are three-fold. The Plan goals focus on water quality issues and assessments identified by ECCD and watershed stakeholders during the water quality investigation, as well as recommendations made in planning documents including the Town of Thompson Plan of Conservation and Development 2010-2020 and the 2005 Conservation and Open Space Plan and Natural Resources Inventory.

Goal 1: Protect water quality in the French River watershed where it is good. This goal encompasses the preservation and protection of the high-quality tributary streams in the

French River watershed in order to maintain their excellent water quality, ecological health and biological diversity for the benefit and enjoyment of watershed residents.

Goal 2: Improve water quality in the impaired stream segments identified in Section 4. This goal focuses on improving impaired waters in the watershed in order for those waters to meet Connecticut Water Quality Standards for their intended aquatic habitat and recreational uses, along with improving the downstream water bodies of the Quinebaug River, Thames River and Long Island Sound.

Goal 3: Promote capacity building for adoption and implementation of the French River Watershed Based Plan. This goal strives to build a viable foundation by the Town of Thompson, supporting agencies and organizations, residents, local businesses, and others with a stake in the outcomes of this Plan.

Management objectives are measurable actions that define how to reach stated goals. The following objectives are intended serve as steppingstones to assist watershed managers with achieving the broader watershed plan goals:

- Objective 1 - Create a team or coalition to implement the watershed plan.
- Objective 2 - Raise public awareness of water quality status and threats.
- Objective 3 – Promote land-use regulations and practices that are protective of water quality.
- Objective 4 - Reduce effective impervious cover in the MS4 urban area.
- Objective 5 - Protect and preserve high quality tributaries and undeveloped headwater areas from existing pollutant sources and future threats related to new development.
- Objective 6 - Improve and protect water quality in the French River and impaired tributaries.
- Objective 7 - Promote good housekeeping practices.

1.9. Watershed Management Recommendations

The following watershed management recommendations are strategies designed to implement the stated watershed management objectives in order to achieve the goals of the watershed management plan. Best management practices (BMPs) may be comprised of "non-structural" practices - procedures such as behavioral changes, revisions to municipal regulations and practices, preservation of open space, and modified landscaping practices; or "structural" practices, such as brick and mortar devices installed or constructed on a site to improve water quality. This section outlines management strategies that, once implemented, are intended to restore surface water quality conditions in the French River watershed so that all waterbodies will comply with Connecticut water quality standards for their designated uses.

Recommended Best Management Practices include:

1. Create a team or coalition to implement the watershed plan.
    - Strategy 1-1. Establish the watershed management team.
    - Strategy 1-2. Review watershed management goals and objectives.
    - Strategy 1-3. Identify sources of financial assistance.
    - Strategy 1-4. Identify sources of technical assistance.
    - Strategy 1-5. Identify and establish a mechanism for outreach.
    - Strategy 1-6. Implement the French River Watershed-based Plan.
    - Strategy 1-7. Develop a framework to evaluate implementation effectiveness.
    - Strategy 1-8. Assess implementation effectiveness.

2. Raise public awareness of water quality status and threats.
    - Strategy 2-1. Promote watershed plan among general public.
    - Strategy 2-2. Review watershed plan recommendations with land use commissions.
    - Strategy 2-3. Conduct targeted outreach to address specific water quality threats.
    - Strategy 2-4. Incorporate the French River Watershed-based Plan into K-12 school curriculum.
    - Strategy 2-5. Update the public about water quality improvement projects as they are conducted.
    - Strategy 2-6. Promote watershed stewardship among general public.

3. Promote land-use regulations and practices that are protective of water quality.
    - Strategy 3-1. Adopt land-use planning recommendations proposed in The Town of Thompson Plan of Conservation and Development and Open Space Plan.
    - Strategy 3-2. Adopt and/or update farm-friendly land-use regulations.
    - Strategy 3-3. Review and strengthen existing land-use regulations pertaining to erosion and sediment control and stormwater management.
    - Strategy 3-4. Incorporate language to encourage or require the use of green infrastructure (GI) and low impact development (LID) practices into site plan design and development.
    - Strategy 3-5. Identify and evaluate any existing or perceived institutional barriers to GI and LID.
    - Strategy 3-6. Adopt regulatory language necessary to implement MS4 General Permit.

4. Reduce effective impervious cover in the MS4 urban area.
    - Strategy 4-1. Identify priority stormwater catchments in Urban Areas.
    - Strategy 4-2. Encourage or require LID/GI practices on new and redeveloped parcels in the urban area.
    - Strategy 4-3. Install BMPs on high IC parcels to reduce stormwater runoff and NPS.
    - Strategy 4-4. Conduct IC outreach and education.

5. Protect and preserve high quality tributaries and undeveloped headwater areas from existing pollutant sources and future threats related to new development.
   Strategy 5-1. Support recommendations in the Plan of Conservation and Development and the Conservation and Open Space Plan.
   Strategy 5-2. Promote the use of regulatory and non-regulatory tools to preserve open space.
   Strategy 5-3. Provide regulatory protections for vegetated riparian zones.
   Strategy 5-4. Promote the use of LID to reduce stormwater runoff and improve water quality.
   Strategy 5-5. Encourage the use of forestry BMPs to protect stream crossings and prevent soil erosion.
   Strategy 5-6. Conduct outreach to promote the benefits of open space.

6. Improve and protect water quality in the French River and impaired tributaries.
   Strategy 6-1. Conduct water quality monitoring.
   Strategy 6-2. Conduct water quality improvement projects.
   Strategy 6-3. Implement MS4 Stormwater Management Plan.
   Strategy 6-4. Reduce pet and nuisance waterfowl waste.
   Strategy 6-5. Restore impacted riparian areas to the best extent practicable.
   Strategy 6-6. Conduct NPS education and outreach campaigns.

7. Promote good housekeeping practices.
   Strategy 8-1. Promote municipal Good Housekeeping practices.
   Strategy 8-2. Promote CT DOT Good Housekeeping practices.
   Strategy 8-3. Promote commercial/industrial/institutional Good Housekeeping practices.
   Strategy 8-4. Promote residential Good Housekeeping practices.

8. Site-specific Watershed Management Recommendations.
   Site-specific watershed management recommendations are based on conditions identified during the 2017 windshield survey that could contribute to water quality degradation. A variety of practices are recommended to provide examples of water quality improvement projects that could be conducted not only at these sites but also at similar sites throughout in the watershed. The site-specific locations and recommended BMPs are summarized in the table below.

French River Watershed-Based Plan Site-Specific Recommendations

Location	Recommended BMPs
Heritage Circle	Tree filters in municipal right-of-way, rain gardens and rain barrels at residences.
North Grosvenordale Mill	Tree filters in right-of-way, removal of unneeded paved surfaces, incorporation of LID in parking lots, use of pervious pavers or grids, rain gardens, swales.
Swede Village	Use of rain gardens, rain barrels, grass or vegetated swales, pervious pavers in driveways and roadways.
Superior Bakery	Pave dirt driveway, install bioretention basin.
River Mill Village	Tree filters in municipal rights-of-way, rain gardens and rain barrels at residences, pervious pavers and/or grids in driveways, parking lots and roadways.
Greek Village	Grass or vegetated swale along Market Street, re-establishment of grassed areas, pervious pavers and/or grids in driveways, parking areas and roadways, and conversion of two traffic islands at the south end of the property to infiltration basins or rain gardens.
Cumberland Farms	Bio-retention basin.
Thompson Town Hall	Green roof, parking lot re-grading, vegetated and bio-retention basin.
Thompson Public Schools	Tree filters, rain gardens, bio-retention, grass swales, check dams, filter strips, infiltration trenches, deep sump catch basins, hydrodynamic separator, regrading/reseeding.

1.10. Financial & Technical Assistance

Most, if not all, of the management practices provided will require some financial investment. Watershed municipalities have local funding options, including bonding, capital improvement budgets, and department budget line items that can be utilized to fund water quality improvement implementations and municipal outreach efforts. Funds and support may be available in the form of donations and in-kind services provided by local businesses, community and environmental organizations, and local volunteers. Financial assistance in the form of grants and cost-sharing is available from multiple sources, including federal, state, and local sources.

The planning, design and execution of complex water quality improvement projects may require expertise that small towns, watershed groups and civic organizations do not have access to. As a result, assistance from organizations or agencies that have the technical capacity will be critical to the successful implementation of the management recommendations. Organizations that may provide financial and technical assistance to project managers and watershed stakeholders are listed in the tables below.

Potential Funding Sources for Watershed-Based Plan Implementations.

Funding Source	Award Amount	Contact Information
CT DEEP CWA §319 Grant Program	Varies by project	Eric Thomas (860) 424 -3548
Website: www.ct.gov/dep/cwp/view.asp?a=2719&q=325588&depNav_GID=1654		
CT DEEP Clean Water Fund		Susan Hawkins (860) 424-3325
Website: www.ct.gov/dep/cwp/view.asp?a=2719&q=325578&depNav_GID=1654		
CT DEEP Open Space and Watershed Land Acquisition Grant Program	40-60% of fair market value	Dave Stygar (860) 424-3016
Website: www.ct.gov/deep/cwp/view.asp?A=2687&Q=322338		
Ct Dept of Agriculture Environmental Assistance Prgm	Varies by practice	(860) 713-2511
Website: www.ct.gov/doag/cwp/view.asp?a=3260&q=398986		
Ct Dept of Agriculture Agriculture Viability Grant	Varies by project	(860) 713-2500
Website: www.ct.gov/doag/cwp/view.asp?a=3260&q=398982		
Ct Dept of Agriculture Farmland Restoration Program	Varies by project	Cam Weimer/Lance Shannon (860) 713-2511
Website: www.ct.gov/doag/cwp/view.asp?a=3260&Q=498322&PM=1		
CT DECD Small Cities Program	Varies by town	Jim Watson (860) 270-8182
Website: www.ct.gov/doh/cwp/view.asp?a=4513&q=530474		
CT OPM Regional Performance Incentive Program		Sandy Huber (860) 418-6293
Website: www.ct.gov/opm/cwp/view.asp?q=487924		
CT OPM Small Town Economic Assistance Program	Varies by project	Barbara Rua (860) 418-6303
Website: www.ct.gov/opm/cwp/view.asp?a=2965&q=382970&opmNav_GID=1793		
Community Foundation of Eastern Connecticut	Varies by program	Jennifer O'Brien (860) 442-3572
Website: www.cfect.org/		
US EPA Healthy Communities Grant Program		Jennifer Padula (617) 918-1698
Website: www.epa.gov/region1/eco/uep/hcgp.html		
NOAA Coastal Management Programs		
Website: http://coastalmanagement.noaa.gov/funding/welcome.html		
US EPA Five Star Restoration Grant Program	$20,000 average	Myra Price (202) 566-1225
Website: www.epa.gov/owow/wetlands/restore/5star		
NFWF Long Island Sound Futures Fund	Varies by project	Lynn Dwyer lynn.dwyer@nfwf.org
Website: www.nfwf.org/		
NRCS Agricultural Conservation Easement program		Ray Covino (860) 779-0557 x102
Website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/ct/programs/easements/acep/		
NRCS Environmental Quality Incentives Program	$450,000 over 6 yrs	Ray Covino (860) 779-0557 x102
Website: www.ct.nrcs.usda.gov/programs/eqip/eqip.html		
NRCS Conservation Stewardship Program (CSP)	$200,000 over 5 yrs	Ray Covino (860) 779-0557 x102
Website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/ct/programs/financial/csp/		
NRCS Agricultural Management Assistance Program	$50,000/yr	Ray Covino (860) 779-0557 x102
Website: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ct/programs/financial/?cid=nrcs142p2_011027		
Rivers Alliance of CT Watershed Assistance Small Grants Program	$5000, req. 40% non-federal funding match	Rivers Alliance of CT (860) 361-9349
Website: www.riversalliance.org/watershedassistancegrantrfp.cfm		

Potential Sources of Technical Assistance for Watershed Managers.

Agency/Organization	Type of Assistance Available
CT Department of Agriculture www.ct.gov/doag	Available programs, permitting, agricultural waste management
CT DEEP www.ct.gov/deep	Water quality, forestry, stormwater management, land protection, wildlife, endangered species
CT Department of Transportation www.ct.gov/dot	Design and maintenance of State highways/ stormwater systems and maintenance facilities, design standards
CT Resource Conservation & Development Council www.ctrcd.org	Farm energy program, soil health education, AGvocate program, partnerships/grant management, green ways, planning and development projects, Environmental Review Team (ERT)
Eastern CT Conservation District www.ConserveCT.org/eastern	Water quality, BMP implementations, technical and resource assistance, grant writing
Northeast District Department of Health www.NDDH.org	Review and approval of septic systems, repairs
Local Businesses/Associations http://nectchamber.com/	Potential funding and partnership opportunities
NECCOG www.neccog.org	Regional land use planning support and assistance, GIS assistance
The Nature Conservancy www.nature.org	Outreach/education, planning/ management tools, technical expertise
Town of Thompson – including staff & land use commissions www.thompsonct.org	Enforcement of land use regulations, site plan review/permits, public utilities maintenance, land records, stormwater management plan, planning documents, municipal and DPW staff
USDA/Natural Resources Conservation Service (NRCS) http://www.nrcs.usda.gov/wps/portal/nrcs/site/ct/home/	Programmic/cost-share funding for agricultural BMPs, nutrient management, woodland and wildlife habitat management and improvement
USDA Farm Service Agency (FSA) www.fsa.usda.gov/	Technical/financial assistance for agricultural producers
University of Connecticut – Center for Land Use Education and Research (CLEAR) http://clear.uconn.edu	Outreach and education, GIS support, tools and data, implementation of LID/GI
University of Connecticut - Nonpoint Education for Municipal Officials (NEMO) http://nemo.uconn.edu	NPS education and support for municipal land use organizations
University of Connecticut Extension www.extension.uconn.edu	Technical assistance/education/outreach for land use, forest management and agricultural practices

1.11. Education & Outreach

The objective of the education/outreach component of this plan is to provide watershed stakeholders with guidelines on how to raise awareness of the water quality issues associated with the French River, in order to create an educated populace that understands the issues of nonpoint source pollution, its effects on water quality, and actions that can be

French River Watershed-Based Plan Recommended Education and Outreach Topics

Outreach Topic	Audience	Potential Outreach Partner(s)
Agricultural BMPs, including soil health, tillage practices, and cover cropping	Agricultural producers/home vegetable gardeners	NRCS, UConn Cooperative Extension System, ECCD, Agricultural Commissions, CT RC&D
Livestock Manure Management	Hobby farm owners	ECCD, UConn Cooperative Extension System, NRCS
Homeowner lawn, garden and stormwater BMPS	Residents/property owners	ECCD, UConn Cooperative Extension System
Implementation of MS4 program	Municipality/DPW/residents	CT DEEP Stormwater Management, DPW, CT NEMO, Town of Thompson, CT NEMO, NECCOG, TRBP
Land use commissioner roles and responsibilities	Land use staff and commissions	CT NEMO, CLEAR, CACIWC, municipal advisory and regulatory land use commissions
Low impact development (LID)/ Green Infrastructure (GI)	Land use staff and commissions/DPW	CT NEMO, CLEAR, DEEP, ECCD
Municipal "Good Housekeeping" Public Works practices	Municipality/DPW	CT DOT, DPW
Open space planning, acquisition and management	Land use staff and commissions	CT DEEP, CT NEMO, CLCC, local land trusts, TLGV
Organic lawn/garden care	Residents/property owners	UConn Cooperative Extension System, NOFA
Pet waste management	Residents/property owners	Town of Thompson, Northeast District Department of Health, veterinarians, local pet stores
Rain Gardens and Native Plants	Residents/property owners Land use staff and commissions	CT NEMO, UConn Extension, ECCD, area plant nurseries, garden clubs and beautification committees
Recycling	Residents/property owners	WPCA, municipalities, waste mgmt. companies
Septic System BMPs for Homeowners	Residents/property owners	Northeast District Department of Health, CT DPH, local septic services companies
Trash/litter management	Residents/property owners	Thompson Together, Conservation Commission, DPWs, waste management companies
Understanding Non-Point Source (NPS) Pollution	Residents/property owners Land use staff and commissions	CT NEMO, municipal Conservation Commissions, DEEP, ECCD, USEPA
What not to flush down drains	Residents/property owners	WPCA, Northeast District Department of Health, ECCD

taken to address the problem. Outreach efforts may be watershed-scale, and seek to address issues that are watershed-wide. Outreach efforts may also be more small-scale or focused, and may be tied to specific implementation projects or target a water quality issue in a specific locale. By successfully engaging and educating the public, including students, watershed property and business owners, municipal staff and land use commissioners, this plan should lead to a sense of stewardship that should result in the adoption of land use practices that will be supportive of good water quality in the French River, tributary streams and the watershed as a whole.

1.12. Monitoring and Assessment

The monitoring of water quality conditions is an essential component of any watershed management plan. The collection of water quality data allows watershed managers to assess whether water quality improvement measures are having the intended effect, or whether adjustments need to be made within the adaptive management framework. Water quality monitoring should be coordinated with the implementation of management measures in order to determine if the management measure goals (e.g. a reduction in the amounts of indicator bacteria) are being achieved.

A number of opportunities exist for the future collection of water quality data in the French River watershed. The 2016 Small Municipal Separate Storm Sewer Systems (MS4) general permit requires that the Town of Thompson establish a stormwater monitoring program, and collect water samples from impaired waters within the town. With careful planning, water quality data from this program can be used to evaluate BMP effectiveness.

The following items should be included as part of the monitoring and assessment component of watershed plan implementations as they are undertaken:

- coordination of monitoring activities among the watershed project partners;
- bacteria DNA source tracking at Backwater Brook (BWB01) and Quinatissett Brook (QB02) to identify the bacteria host animal;
- collection of pre- and post-implementation water quality data to determine the effectiveness of the BMP in reducing pollutant loading, if existing data is not available;
- comparison of post-BMP water quality monitoring data to bacteria TMDL targets to determine if bacteria load reductions have been achieved; and
  comparison of post-BMP implementation data collection to NPS pollutant load targets to determine if NPS pollutant load reductions have been achieved.

1.13. Plan Implementation Effectiveness

The implementation of a watershed management plan is necessarily an iterative process. As implementations are undertaken and completed, water quality data should continue to be collected, evaluated and compared to the desired water quality goals to determine if the implementations are achieving the desired results.

If implementations are not as effective as planned, e.g., implementation milestones are not being met, or progress is not being made toward reducing pollutant loads, watershed stakeholders should review the implementation program. If it is determined that the implementation of goals and objectives are not resulting in a positive water quality change, watershed team members may need to make adjustments or revisions to the watershed plan.

1.14. Next Steps

Protecting surface water quality in the French River watershed will be a long-term effort. It will take the actions of many individuals, community leaders and decision makers to address current watershed conditions and take measures to reduce the levels of NPS pollutants, including fecal bacteria, in order to protect the generally good water quality in the French River watershed.

Following the acceptance of the French River Watershed-based Plan by CT DEEP, this Plan should be distributed to all watershed stakeholders for implementation, including, but not limited to, the Town of Thompson, Northeast Connecticut Council of Government, the Northeast District Department of Health, local utilities (including the Thompson Water Pollution Control Authority), CT Department of Transportation, agricultural producers, and business and land owners.

The Plan should be made available to the general public via postings on the CT DEEP, ECCD and Town of Thompson municipal websites. Efforts should be made to publicize the watershed plan using multiple approaches and media platforms to reach different audiences, in order to raise public awareness of water quality and water quality threats in the French River watershed, and steps being taken to protect and/or improve water quality.

The Eastern Connecticut Conservation District intends to remain an active participant and central point of contact as implementations recommended by this Watershed-Based Plan are undertaken.

Any comments or questions regarding this Plan should be directed to:

Eastern Connecticut Conservation District, Inc.
238 West Town Street
Norwich, CT 06360
(860) 319-8806

2. INTRODUCTION

The 101-square mile French River watershed is a regional watershed located in south central Massachusetts and northeastern Connecticut (Fig. 2-1). A watershed is an area of land that drains to a specific waterbody or outlet. Most people are familiar with public drinking water supply watersheds, but not all people understand that all land is part of a watershed.

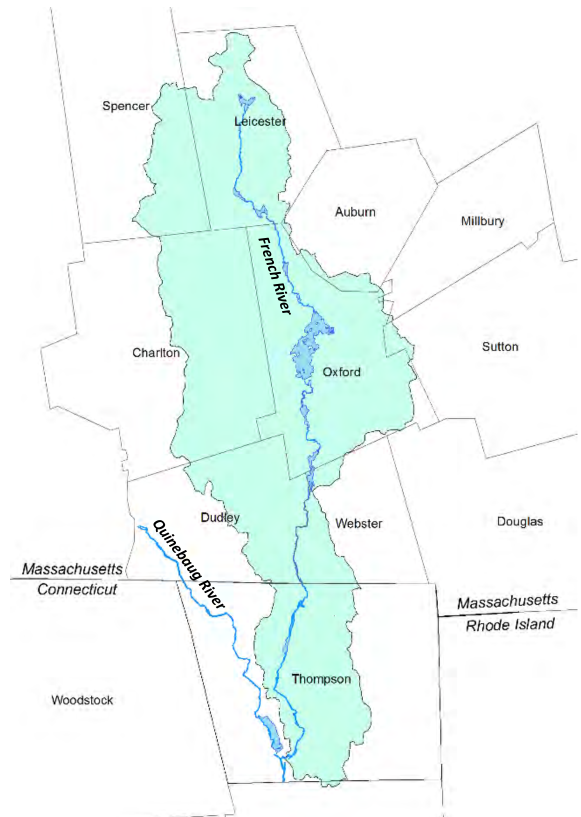


Figure 2-1. The French River watershed in Massachusetts and Connecticut.

Approximately 84 square miles (53,780 acres) of the French River watershed are located in Massachusetts. The remaining 17 square miles (10,883 acres) are in Connecticut, with 16.9 square miles (10,826 acres) in Thompson and 0.1 square mile (57 acres) in Putnam. The 25-mile long French River has its headwaters at Sargent Pond in the central Massachusetts town of Leicester, and flows south to end in Thompson at the confluence with the Quinebaug River, just south of the West Thompson Lake federal flood control facility. It is part of the Quinebaug regional and the Thames major watersheds, which, along with the French River, ultimately discharge their water via the Thames River to Long Island Sound. Long Island Sound is part of the United States National Estuary Program and is designated an estuary of national significance.

The French River and its perennial tributaries in Connecticut are important resources to the residents of Thompson. The waterways and their environs provide a variety of recreation opportunities, including fishing, boating, hiking and hunting. CT DEEP stocks the French River with brown and rainbow trout each year. Undeveloped forest blocks and floodplains adjacent to the river are important wildlife habitats and flood mitigation areas, and provide hiking and hunting opportunities. Many colonial, industrial-era and modern dams along the waterways, especially along the main stem of the French River in both states, create scenic vistas and harken back to Thompson's agricultural and industrial history. These impoundments, while providing flow modification and attenuation for flood control, also divide the river into a series of ponds connected by relatively short, free-flowing river sections. Several of the industrial-era impoundments have potential, or in some cases, are presently used for hydroelectric power generation, including a hydro-electric facility at the outlet of Mechanicsville (Acme) Pond.

A 4.61-mile segment of the French River, from the outlet of North Grosvenordale Pond to the confluence with the Quinebaug River (segment CT3300_01-01), has been intermittently listed in recent years, most recently in the CT 2010 Integrated Water Quality Report, as impaired for recreation use. An impaired waterbody is one that does not meet specified water quality criteria for various designated uses (which may include drinking water, fish and shellfish habitat and consumption, and recreation), as defined in the Connecticut Water Quality Standards (CT DEEP, 2013). The cause of the French River impairment is periodic high levels of the fecal coliform bacterium *Escherichia coli* (*E. coli*). *E. coli* is a bacterium that is found in the gut of warm blooded animals. While most species of *E. coli* are not harmful, their presence may indicate the presence of other pathogens, such as Salmonella, Hepatitis A, cryptosporidium and Giardia, that may present a health risk to humans.

Long Branch Brook (CT3300-02-01), a tributary to the French River, was listed in the 2012 and 2014 Integrated Water Quality Reports as impaired for recreation due to the presence of fecal bacteria. In 2012, the Connecticut Department of Energy and Environmental Protection (CT DEEP) prepared a bacteria total maximum daily load (TMDL) for the French River watershed (CT Department of Energy and Envirnomental Protection, 2012), to address the documented levels of bacteria in Long Branch Brook. A TMDL may be thought of as a water pollution budget that specifies how much of a pollutant can be discharged to a waterbody and still allow it to meet designated water quality standards. The Long Branch Brook TMDL cites potential bacteria sources including point and non-point sources, such as permitted stormwater discharges, stormwater runoff, agriculture, failing septic systems, and nuisance pets and/or wildlife. It quantifies bacteria levels in the stream based on data collected by DEEP in 2010, and provides bacteria reductions necessary to meet state water quality standards. Subsequent to the approval of the TMDL by the US Environmental Protection Agency (USEPA) in 2012 and its adoption by CT DEEP, the brook was delisted in 2014.

In 2015, the Eastern Connecticut Conservation District, in partnership with CT DEEP, the Town of Thompson, and The Last Green Valley, Inc. conducted a water quality investigation to quantify fecal bacteria levels in the Connecticut portion of the French River and multiple perennial tributary streams, and to identify potential sources of the bacteria documented in the river and streams. The investigation included the collection and analysis of water samples from the French River and its perennial tributaries for fecal bacteria content, a field assessment of the watershed, and a desktop pollutant load analysis. The collected information was evaluated and used to prepare this watershed-based plan. This plan identifies potential pollutant sources and recommends management practices for watershed managers that address the documented areas of concern, with the goal of reducing nonpoint source (NPS) pollution to the

French River, in order to protect water quality and continue to meet Connecticut Water Quality Standards.

2.1. Document Overview

2.1.1. Watershed Management Plan Purpose and Process Used

A watershed management plan is “a strategy that provides assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to developing and implementing the plan (US Environmental Protection Agency, 2008).” The purpose of a watershed plan is to provide guidance to local managers and a spectrum of stakeholders for the management of resources within a geographically defined area – the watershed. Watershed management plans are holistic; they evaluate the multiple existing and potential uses of a watershed, from residential, commercial or industrial development to drinking water protection, agriculture, forest planning, wildlife and open space management. The watershed planning process is both iterative and adaptive, requiring periodic review of stated goals and objectives, assessment of whether goals and objectives are being met, and providing a mechanism for mid-course adjustments if it is determined that that goals and objectives are not being achieved (Fig.2-2). This type of adaptive approach allows the plan to evolve as plan recommendations are implemented and evaluated, as land uses and priorities change over time, and as new information or technologies that may further the goals of the plan become available.

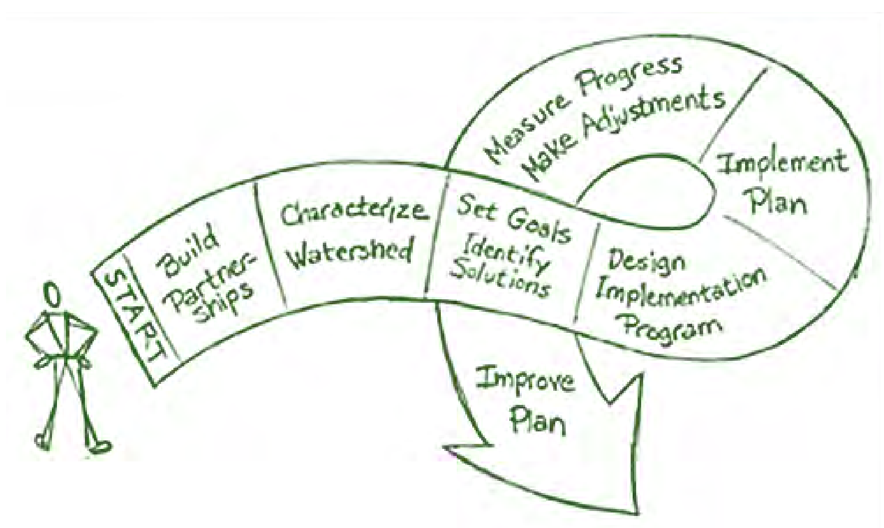


Figure 2-2. This graphic from the USEPA Handbook for Developing Watershed Plans to Restore and Protect Our Waters *depicts the watershed planning process (USEPA 2008).*

The purpose of the *French River Watershed-based Plan* is to provide guidance and strategies for watershed managers that will serve to restore, protect and support the quality of water in the French River watershed so that it meets the Connecticut water quality standards for its designated uses. This document utilizes the nine minimum elements identified by the US Environmental Protection Agency (USEPA) to be used in the preparation of a watershed plan for impaired waters. These elements include:

- Identification of the impairment and pollutant sources
- Description of management measures to achieve load reductions
- Estimate of load reductions expected from proposed management measures
- Technical and financial assistance needed to implement management measures
- Education and outreach required to achieve management goals
- Implementation schedule
- Interim measurable milestones
- Water quality improvement evaluation criteria
- Water quality monitoring component

The French River watershed planning process was conducted in several phases. The first phase involved a review of existing watershed conditions and water quality data for the portion of the French River in Connecticut, including a review of the French River Watershed Summary appendix to the Statewide Bacteria Total Maximum Daily Load Analysis for Bacteria Impaired Waters (CT DEEP, 2012), and water quality and stream data collected by DEEP subsequent to the preparation of the TMDL, and data collected by US Geological Survey (USGS), The Last Green Valley Volunteer Water Quality Monitoring Program, and Connecticut Audubon Society's Citizen Science Program. Based on existing conditions and available water quality data and other information, ECCD, in consultation with CT DEEP, prepared a water quality monitoring plan, and in the summer of 2015, collected additional water quality data from the French River and perennial tributaries in Thompson. The water samples were analyzed by the CT Department of Public Health for fecal bacteria (*Escherichia coli*) content.

The second phase, a field assessment of the Connecticut French River watershed and interviews with land owners, managers and policy makers, was conducted to visually identify possible contaminant sources based on the results of the bacteria collection.

The third phase involved the collection and review of water quality data and land use in the Massachusetts portion of the French River watershed, to assess baseline pollutant loads as the French River enters Connecticut. This included a review of water quality data collected by MA DEP, The French River Connection and the Webster Lake Association, and information contained in the Final Environmental Impact Statement for the French River Cleanup Program in Massachusetts and Connecticut and a GIS-based land use analysis.

The final phase, a desktop pollutant load analysis, was conducted using the Center for Watershed Protection's Watershed Treatment Model (Center for Watershed Protection, 2013). This analysis predicted annual loads (in pounds per acre) for various common NPS pollutants based on land use and land cover within the French River watershed.

The following pages of this document will provide a description of the watershed, including current watershed conditions. Potential pollution sources are identified and assessed, and the impacts to water quality are estimated. Goals and objectives to reduce the pollution load have been developed, and management strategies, including an implementation timeline, potential funding sources and available technical assistance necessary to meet those goals, are outlined.

2.1.2. Issues Facing the Watershed

Like other rural Connecticut watersheds, the French River watershed faces challenges associated with stormwater management, climate change and the potential for future development.

Although more than three-quarters of the French River watershed is considered undeveloped, water quality issues associated with stormwater run-off is a primary concern. Stormwater run-off mobilizes a wide array of pollutants from the land surface and transports them over the ground or through storm drain systems and into waterways. These pollutants are termed nonpoint source (NPS)pollutants. NPS pollutants originate not from a single discernable location such as a pipe or other discrete discharge point but are the aggregate of contaminants that are found in both the built and natural landscape, and include:

- sediment
- lawn, garden and agricultural fertilizers
- herbicides and pesticides
- vehicular chemicals
- heavy metals
- pathogens
- industrial chemicals
- pharmaceuticals
- litter/floatable debris

The development of land increases the volume of stormwater run-off by creating hard surfaces that prevent stormwater from soaking into the ground. These hard surfaces, which include rooftops, parking lots, roads and sidewalks, are called impervious cover (IC). Activities associated with developed land, such as vehicular use and maintenance, lawn and garden activities, and commercial and industrial activities, increase the amount of NPS available for stormwater to mobilize and transport. This increase in stormwater run-off and NPS can degrade natural systems and damage infrastructure, such as roadways and bridges, if not properly managed.

A USEPA review of climate change indicators, criteria that track environmental conditions over time, indicate that weather patterns have changed in Connecticut

(USEPA, 2016). Connecticut has become subject to hotter, drier summers, leading to droughts and an increased risk of wild fire. Annual precipitation in Connecticut has increased, but that same precipitation is more likely to fall in fewer, more intense rain storms, resulting in rainfalls that tend to run off rather than soak into the ground and increasing the likelihood of flash floods. Warmer winter temperatures result in winter precipitation that is more likely to fall as rain than snow, which runs off due to frozen ground surfaces. The lack of snowpack also decreases groundwater recharge from spring snowmelt, contributing to drought, low or no flow in stream beds, exposed lake and pond shorelines, impacted wetlands, and decreased recharge of groundwater-fed wells.

Finally, the potential for suburban development threatens the long-standing rural character of Thompson. Thompson is located on Interstate Route 395, which connects Interstate Routes 90 and 91, Thompson is easily accessible to major urban centers, including Worcester and Boston, MA, Providence, RI, Hartford, CT, and New York City, NY. A build-out analysis conducted by the Town in 2009 indicated that, based on current zoning regulations, an additional 9,500 housing units could be constructed, which could add as many as 15,000 new residents (Town of Thompson, 2009). With changes in zoning regulations and infrastructure improvements such as expanded water and sewer service, the potential for even greater residential, commercial and industrial development, and related impacts to water quality, exists.

2.1.3. Watershed Management Team

Watershed planning is both a collaborative and participatory process. An effective watershed planning process is supported by the active engagement of a local watershed management team. A well-balanced watershed management team should consist of a variety of members of the community, and may include municipal officials and commissioners, business owners, landowners, environmental and civic organizations, as well as any other organizations, agencies or individuals with a stake in the preservation and improvement of water quality in the watershed (Table 2-1).

In order to ensure successful implementation of a watershed-based plan, the Eastern Connecticut Conservation District engaged a variety of stakeholders in the development of this Plan, including watershed residents, land owners, farmers, municipal staff and business owners. These stakeholders were variously involved with the water quality investigation, the development of this watershed plan, and the identification of potential implementation measures. Once the watershed plan has been approved, it will be incumbent upon these and other stakeholders to adopt the Plan and implement the management recommendations contained herein. Watershed management team implementation recommendations are more fully described in Section 8.1 of this document.

Table 2-1. Suggested Watershed Management Team

French River Watershed Management Partners	Role/Responsibility
Eastern Connecticut Conservation District	Project management, water quality monitoring team leader, education and outreach, watershed-based plan development
CT Department of Energy and Environmental Protection – Bureau of Water Protection and Land Reuse	Project funding, oversight and guidance, water quality/resource data and management
University of Connecticut Extension System	Outreach/education, technical support
US Environmental Protection Agency	Project funding assistance through Clean Water Act §319 NPS program, project planning including quality assurance project plan (QAPP) approval
USDA - NRCS	Technical and financial (cost share) assistance to agricultural producers and non-industrial woodland owners
Northeast Connecticut Council of Governments (NECCOG)	Regional planning, technical advisory
Northeast District Department of Health	Water quality protection, septic system inspection/installation, education
The Last Green Valley, Inc.	Water quality data collection through the Volunteer Water Quality Monitoring program, outreach, education, and outdoor recreation programming and forest landowner conservation support through implementation of the region's Vision 2020 Management Plan
Town of Thompson (staff, elected officials and land use commissions)	Project information and support, land use planning, conservation and regulation, data review
Thompson Together	Education and outreach, watershed advocacy
Local agricultural producers	Information related to agricultural land use and practices, adoption of BMPs, stewardship and watershed protection advocacy
Watershed residents, businesses and landowners	Conformance with local regulations, adoption/implementation of BMPs, watershed stewardship and advocacy of clean water restoration and healthy watershed protection

2.1.4. Public Participation

Successful watershed plan implementation requires the engagement of an educated and willing public. The majority of land in the French River watershed is in private ownership, resulting in the need for private citizens to understand the plan and be willing to implement it. Further, members of the community are familiar with the watershed and may have specific resource concerns. When community members are involved from the beginning of the planning process and are satisfied their concerns are being addressed, they are more likely to support the development and implementation of the management plan. During the preparation of this plan, ECCD discussed the water quality resource concerns and solicited information from municipal staff and members of the public, including landowners, business owners and agricultural producers.

As plan implementations are initiated by the proposed Watershed Management Team, it is recommended that public outreach is conducted to make watershed residents, business owners and other stakeholders aware of the watershed plan and its intended purpose, to engender public support and participation in meaningful ways, and to track watershed plan accomplishments and impacts to the restoration of clean water.

3. WATERSHED DESCRIPTION

The French River watershed (CT-3300, USGS HUC 011000010202, 011000010203, and 011000010204) is located in south central Massachusetts and northeastern Connecticut (Fig. 3-1). Most of the 101-square mile watershed is in Massachusetts, an area of approximately 84 square miles. The remaining 17 square miles are in Connecticut.

The French River has its headwaters in the central Massachusetts town of Leicester, and ends in Thompson, Connecticut at the confluence with the Quinebaug River, just south of the federal flood control facility at West Thompson Lake. It is part of the Thames major watershed, which discharges via the Thames River to Long Island Sound. Long Island Sound is part of the United States National Estuary Program and is designated an estuary of national significance.

The French River was, in the past, a working river and was key to the development of industrial-era mills in the Massachusetts towns of Leicester, Oxford, and Webster. The mill development defined the development of these towns as industrial and commercial centers, which has continued into the 21st century.

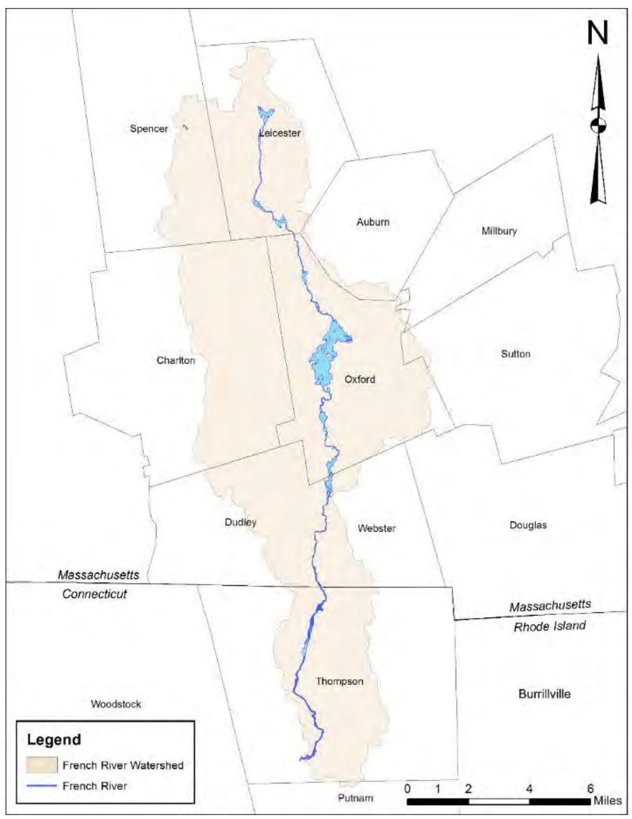


Figure 3-1. The French River watershed, located in south central Massachusetts and northeastern Connecticut.

3.1. The French River Watershed in Massachusetts

3.1.1. Physical and Natural Features

The French River watershed encompasses 101 square miles, of which about 83% (84 square miles) is located in Massachusetts. The watershed is relatively long and narrow and is characterized by northwest-to-southeast trending rolling hills. The French River flows southerly through the eastern side of the watershed through a mix of mostly forested rural land and village centers to Connecticut.

Figure 3-2. The French River near the Massachusetts-Connecticut state line, downstream of the Perryville Dam.

The French River begins in the town of Leicester. It flows for about 14.4 river miles through the towns of Leicester, Oxford and Webster before crossing the state boundary into Connecticut. Major tributaries include Town Meadow Brook, Burncoat Brook and Bartons Brook in Leicester; Little River in Charlton and Oxford; Wellington Brook in Oxford; and Mill Brook in Webster (MA DEP, 2002). Flow is regulated by a US Army Corps of Engineers flood control facility at Hodges Village Dam in Oxford. The Hodges Village facility was completed in 1959 and controls flooding from Oxford to Long Island Sound (US Army Corps of Engineers, New England District, 2016).

The physical characteristics of the watershed are defined by highly folded and fractured metamorphic bedrock of the Worcester County Plateau (primarily schists and gneiss with igneous intrusions), dating from the Precambrian to Carboniferous periods, approximately 570 - 320 million years ago (University of Massachusetts, 1999). The surficial geology is shaped by the Wisconsinan glaciation, which ended approximately

12,000 years ago, and by fluvial processes that have occurred since that time (University of Massachusetts, 1999). Glacial deposits include unsorted basal and lodgment till deposits in upland areas, and well-sorted sand and gravel outwash deposits in lower elevations and river valleys. Predominant Holocene upland soils include the Paxton-Brookfield-Woodbridge series and Canton-Montauk-Scituate series. Soils in river valleys include Chatfield-Hollis and Freetown-Swansea-Saco soils (University of Massachusetts, 1999).

The northern portion of the French River watershed (primarily Leicester and Spencer) is in the Lower Worcester Plateau/Eastern Connecticut Upland Level 4 ecoregion (USDA Forest Service, 1976). This ecoregion has generally higher elevations than the adjacent Southern New England Coastal Plains and Hills. Soils developed "primarily on glacial till in the upland areas, and on stratified deposits of sand, gravel, and silt in the valleys" (Griffith et all, 2009). Major forest types are "transition hardwoods (maple-beech-birch, oak-hickory) with some central hardwoods (oak-hickory" (Griffith et all, 2009).

The southern portion of the watershed is in the Southern New England Coastal Plains and Hills (USDA Forest Service, 1976), which is comprised of "irregular plains with low hills and some open high hills with relief of about 100 to 400 feet. Surface materials are mostly glacial till, with some stratified deposits in valleys. A variety of dry to mesic successional oak and oak-pine forests cover the region today, along with some elm, ash, and red maple that are typical of southern New England's forested wetlands" (Griffith et all, 2009).

3.1.2. Land Use

The French River watershed in Massachusetts is predominantly rural, with the heaviest development in town centers that began as mill villages along the French River, including Oxford, Dudley and Webster. Developed areas comprise approximately 23% of the watershed (Figs. 3-3 and 3-4) and are centered around these industrial-era villages. There is not a strong agricultural presence on the watershed, with only 6% of the watershed under agricultural production. Approximately 60% of the watershed (including forested wetland) is forested, with deciduous forest type dominating. Approximately 6% of the watershed is comprised of open water and non-forested wetlands.

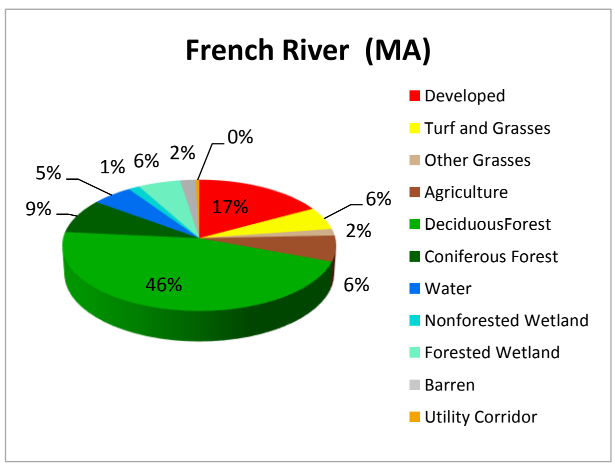


Figure 3-3. Percentages of land use types in the French River watershed in Massachusetts.

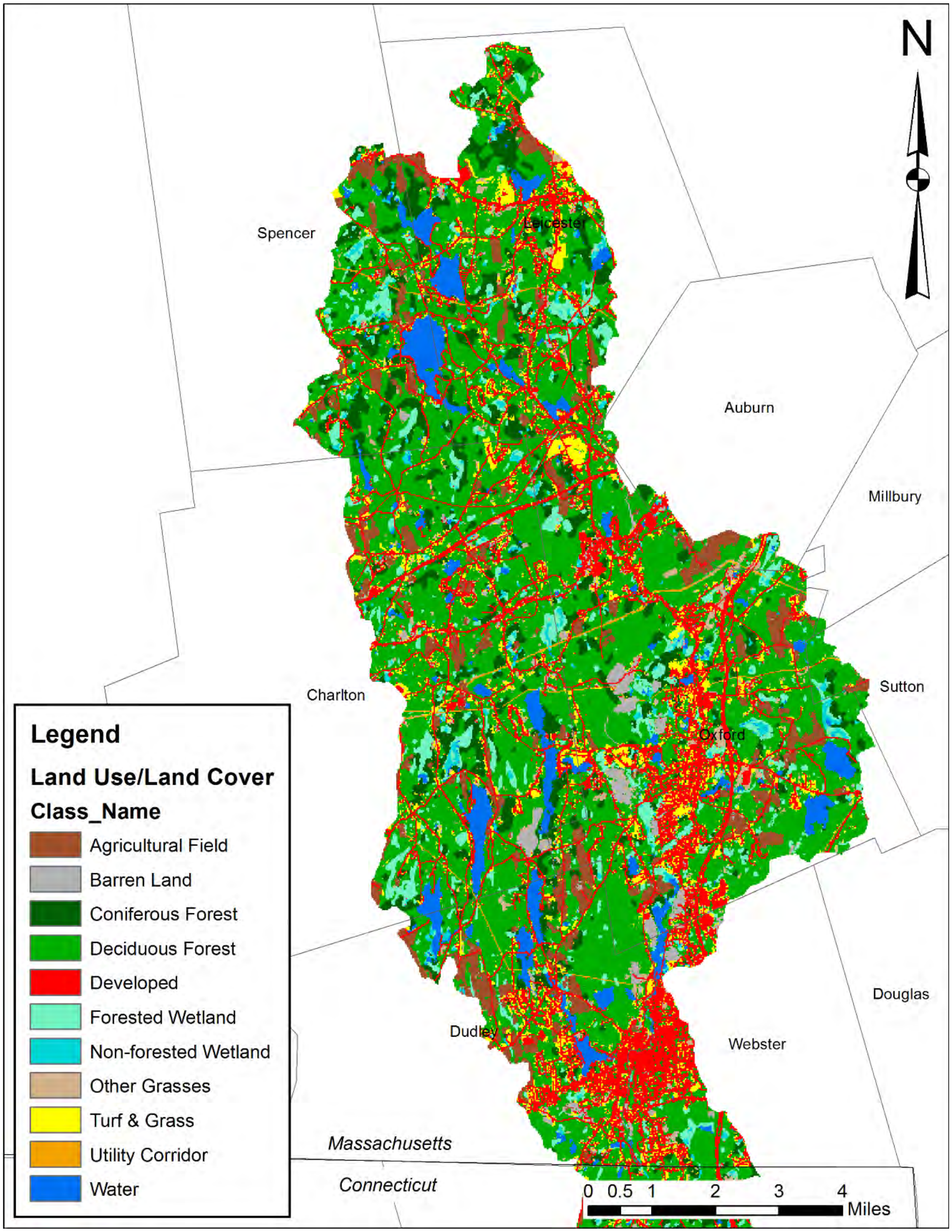


Figure 3-4. Land use and land cover in the French River watershed in Massachusetts (CLEAR, 2010).

3.1.3. Pollution Source Overview

An examination of the water quality of the French River in Connecticut is impossible without understanding potential water quality impacts originating in Massachusetts. The following section identifies potential sources of point and non-point source pollution.

National Pollutant Discharge Elimination System (NPDES) permits are issued to "…all municipal, industrial and commercial facilities that discharge wastewater directly from a point source (a discrete conveyance such as a pipe, ditch or channel) into a receiving waterbody (lake, river, ocean)" (US EPA, 2017). In Massachusetts, NPDES permits are issued by EPA New England (Region 1). Table 3-1 lists final individual NPDES permits issued in the French River watershed. As a result of the findings of the Final Environmental Impact Statement for the French River Cleanup Program in Massachusetts and Connecticut (1987) significant effort has been expended by USEPA and MADEP over the last two decades to improve phosphorus management at a watershed scale for the French River, including infrastructure upgrades and improvements at Massachusetts wastewater treatment facilities.

Table 3-1. NPDES permits issued in the French River watershed in Massachusetts (USEPA, 2017).

Town	Facility Name	Permit Number	Date of Issuance
Webster	Town of Webster Sewer Department	MA0100439	03/24/2006
Oxford-Rochdale	Oxford–Rochdale Wastewater Treatment Facility	MA0100170	07/30/2010
Oxford	IPG Photonics Corporation	MA0040355	02/09/2010
Leicester	Leicester Water Supply District Treatment Facility [MODIFICATION]	MA0101796	07/29/2011
Leicester	Leicester Water Supply District Treatment Facility	MA0101796	09/30/2010

The Phase ll Municipal Small Separate Storm Sewer Systems (MS4) program regulates stormwater that is conveyed through a stormwater conveyance system and is discharged to local waterbodies. Phase ll of the MS4 program regulates small MS4s in urban areas (US EPA, 2017). In Massachusetts, Phase ll MS4 permits are issued by EPA New England (Region 1). The 2016 Massachusetts Small MS4 General Permit will become effective July 1, 2017. Table 3-1 lists final individual NPDES permits issued in the French River watershed. All ten towns in the Massachusetts French River watershed are subject to the MS4 permit.

Other point sources may include hazardous waste sites, such as Superfund (CERCLA) sites, Resource Conservation and Recovery Act (RCRA) sites (sites where a hazardous material leak or spill has occurred) and brownfields (industrial or commercial sites with legacy contamination). A review of MA DEP's Superfund Sites in Massachusetts webpage (http://www.mass.gov/eea/ agencies/massdep/cleanup/sites/npl-superfund-sites-in-massachusetts.html) indicated there are no Superfund sites in the Massachusetts French River watershed. A list of RCRA sites and brownfields in the French River watershed can be accessed at the Massachusetts DEP website (http://www.mass.gov/eea/agencies/massdep/cleanup).

Non-point sources of pollution are much more diverse and difficult to identify without an in-depth examination of the watershed. Sources may include stormwater run-off and discharges from non-regulated stormwater conveyance systems; sanitary sewer leaks; under-functioning or failing septic systems; agricultural activities, including crop fields, pastures and animal containment areas; pets and wildlife; road maintenance practices; land clearing/development; and timber harvesting. Various agencies in Massachusetts are charged with the oversight of activities that may contribute to NPS, including the USDA Natural Resources Conservation Service, MADEP, the Massachusetts Highway Department, state and local public health departments, municipal sewer/waste water treatment departments, and local land use commissions.

3.1.4. Watershed/Water Quality Documents

3.1.4.1. Massachusetts Department of Environmental Protection

MADEP has conducted water quality sampling and prepared water quality assessment reports for the French River as part of the Commonwealth's Summary of Water Quality report (305(b) Report). These reports summarize water quality data which is used to assess the status of designated uses (aquatic life, fish consumption, drinking water, primary and secondary contact recreation and aesthetics) as defined in the Commonwealth's Surface Water Quality Standards. Water quality assessment reports include:

- French and Quinebaug Rivers Watershed Smart Monitoring Program 1999-2004 (MADEP, 2013)
- French and Quinebaug Rivers Watershed Smart Monitoring Program 2005-2010 (MADEP, 2016)
- French and Quinebaug Rivers Watershed Smart Monitoring Program 2011-2013 (MADEP, 2016)
- French & Quinebaug River Watersheds 2001 Water Quality Assessment Report (MADEP, 2002)
- French & Quinebaug River Watersheds 2004-2008 Water Quality Assessment Report (MADEP, 2009)

3.1.4.2. Planning Documents

Numerous planning documents related to the development and/or management of various natural and cultural resources in the French River watershed have been prepared. These range from natural resource and recreation plans to community/municipal planning and urban redevelopment.

A brief list of planning documents is provided below:

- The Final Environmental Impact Statement for the French River Cleanup Program in Massachusetts and Connecticut (January 1987)
- The French–Quinebaug Watershed Plan - A Preliminary Watershed Management Plan (UMass, 1999)
- Southwest Subregion Inter-Community Trail Connection Feasibility Study (Central Massachusetts Regional Planning Commission, 2001)
- The French River Blueway Study (UMass, 2007)
- French River Greenway (French River Greenway Steering Committee, 2011)
- Central Thirteen Prioritization Project (Central Massachusetts Regional Planning Commission, 2012)
- A Landscape Planning Study of Webster, MA (UMass, n.d.)
- Municipal comprehensive master plans and land use regulations

3.1.5. Water Quality Data

An overview of agencies, entities and organizations that collect water quality data in the French River watershed is provided below. Of particular interest to the Connecticut French River Watershed-Based Plan is water quality data collected at the Massachusetts-Connecticut state line, as this represents the water condition inherited by Connecticut water quality managers.

3.1.5.1. MA DEP

MADEP collects water quality data on waterways throughout the French River watershed, including the French River at the Massachusetts-Connecticut state line (Station FR12). This site, located off Perryville Road in Webster, MA., is approximately 0.9 miles downstream of the Webster wastewater treatment plant, and coincides with the northern-most ECCD/TLGV French River sampling site (FR06). A summary of MA DEP data is provided in Table 3-2.

Table 3-2. Summary of MassDEP water quality data (annual averages) at the State line sampling site (Station FR12), Perryville Road, Webster, Mass.

Date	Water Temp (°C)	pH	Spec. Cond. @25C (uS/cm)	Turbidity (NTUs)	DO (mg/l)	E. Coli Geomean (col/100ml)	TN (mg/l)	NH3-N (mg/l)	NO3-NO2-N (mg/l)	TP (mg/l)
2009	14.1	7.1	219	1.5	10.7	59	0.90	0.03	0.59	0.034
2010	14.1	7.1	219	1.8	10.7	275	0.03	0.04	0.03	0.069
2011	15.0	6.8	170	1.2	10.6	65	0.72	0.03	0.46	0.020
2012	13.8	7.0	219	1.5	10.4	135	1.51	0.03	1.15	0.022
2013	6.8	7.1	377	1.0	13.1	33	0.87	0.02	0.60	0.020

3.1.5.2. NPDES Permits

NPDES permit holders are required to collect and report water quality data to ensure they are complying with the terms of their permits. Since all NPDES-permitted facilities were located further up in the watershed, and water quality data was available at the state line, NPDES data was not reviewed as part of the preparation of this document.

3.1.5.3. French River Connection

The French River Connection (FRC) has conducted water quality monitoring on the French River and perennial tributaries since 2005, at sites in Dudley, Webster and Oxford. FRC water quality data collected at the state line at Perryville Road is summarized in Table 3-3. This site coincides with the MA DEP sampling station FR12 and the ECCD/TLGV sampling site (FR06). Additional water quality data can be reviewed at the FRC website at www.frenchriverconnection.org.

Table 3-3. French River Connection water quality annual averages at the state line sampling site, Perryville Road, Webster, Mass.

Date	Water Temp (°C)	pH	Specific Conductivity (uS/cm)	Turbidity (NTUs)	DO (mg/l)	E. Coli (col/100ml)
2012	17.8	7.1	225.9	2.8	9.1	172.4
2013	19.0	7.2	198.2	1.9	8.9	58.5
2014	17.7	6.3	277.3	1.4	9.3	42.3
2015	19.5	7.1	341.1	1.2	8.6	131.8
2016	21.8	7.1	393.9	0.8	8.3	

3.1.5.4. Webster Lake Association

Webster Lake Association (WLA) has conducted lake and lake tributary monitoring since 2004 as a member of The Last Green Valley Volunteer Water Quality Monitoring program. Since water quality data was available from MA DEP and FRC at the MA-CT state line, WLA data was not reviewed as part of the preparation of this document, but can be reviewed at the WLA website at www.websterlakeassociation.org.

3.2. THE FRENCH RIVER WATERSHED IN CONNECTICUT

The Connecticut French River watershed is located in the northeast Connecticut town of Thompson. A very small portion of the watershed (55 acres) is located in the town of Putnam. From the Connecticut/Massachusetts state line to the confluence with the Quinebaug River, the French River flows for approximately 6.7 miles through the central portion of Thompson. The French River gave rise to a number of industrial-era mills along its length, including mills in the villages of Wilsonville, North Grosvenordale, Grosvenordale and Mechanicsville. The village center of North Grosvenordale, which houses the Thompson town offices, school system and public library, was named for the Grosvenor-Dale Company mill, depicted below.

Figure 3-5. The Grosvenor-Dale Mill in the village of North Grosvenordale circa 1872-1896. The French River is visible on the right side of the image.

3.2.1. Physical and Natural Features

3.2.1.1. Watershed Boundaries

The Connecticut portion of the French River watershed encompasses a land area of 17 square miles (10,883 acres). The French River regional watershed (CT3300) is part of the Thames major watershed (CT3000), which is one of seven major watersheds in Connecticut that drain to Long Island Sound (Fig. 3-6). The Connecticut French River watershed is part of the Lower French River watershed (HUC 011000010204), which is, in turn, part of the Quinebaug River watershed (HUC 01100001). HUC, or hydrologic unit codes, are designators within a hierarchical cataloguing system developed by the US Geological Survey to identify hydrologic units (watersheds) throughout the US. The HUC system is based on major river systems, with nested regional, sub-regional and smaller units contained within.

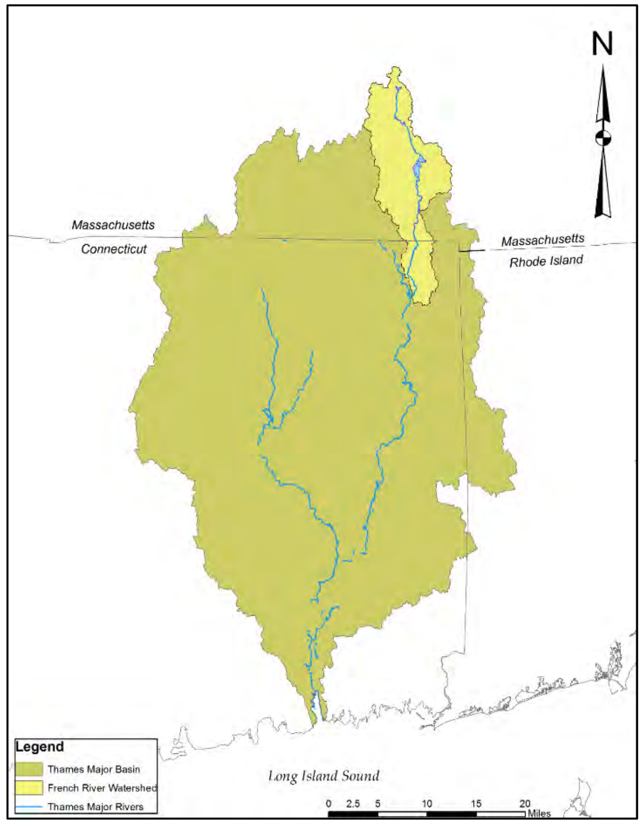


Figure 3-6. The French River regional watershed, part of the Thames major basin, in Connecticut and Massachusetts.

The French River watershed is oriented north-south and is roughly twice as long (±6.5 miles) as it is wide (±3 miles). The watershed is bounded by Depot Hill, Mountain Hill and Cortiss Hill on the west, which divide it from the Quinebaug River watershed, and Fort Hill and Brandy Hill on the east, which divide it from the Five Mile River watershed.

3.2.1.2. French River Sub-watersheds

There are ten (10) local sub-watersheds located within the French River regional watershed in Thompson (Fig. 3-7). Eight of the ten sub-watersheds discharge to the French River in Thompson. The remaining two (Packard Pond Brook and Freeman's Brook) discharge to the French River in Massachusetts and were not included in the water quality investigation. A brief overview of each sub-watershed is provided in the following sub-sections.

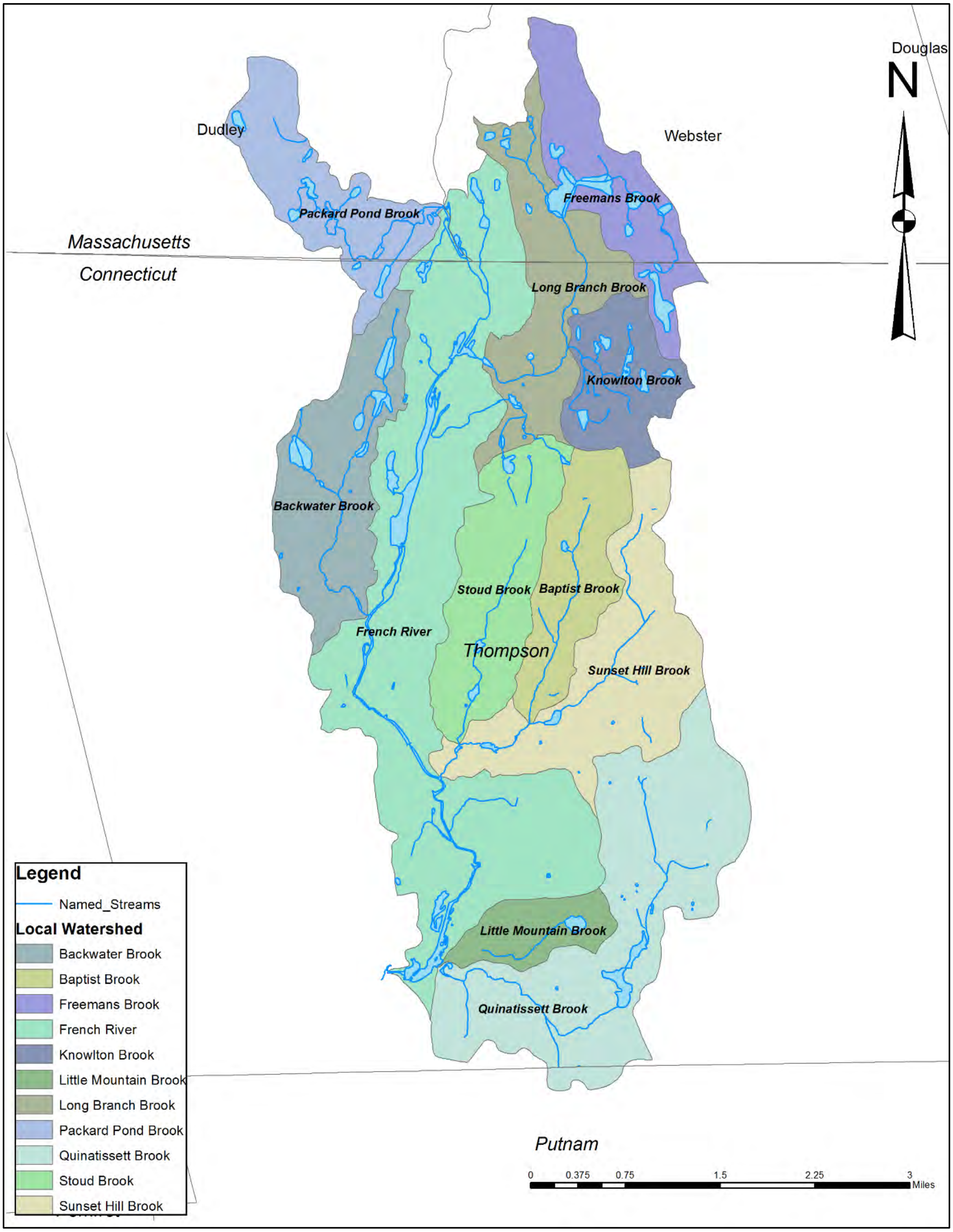


Figure 3-7. French River Sub-watersheds in Connecticut.

3.2.1.2.1. French River Sub-watershed (3300-00)

The French River sub-watershed, located along the mainstem of the French River, is the largest of the sub-watersheds within the Thompson French River watershed. The French River sub-watershed incorporates 5 square miles (3,241 acres) of land from the Massachusetts state line to the confluence with the Quinebaug River.

The French River sub-watershed is the most densely developed of the local watersheds, and includes the village of North Grosvenordale, which was the industrial center of Thompson during the industrial era. As the most populated section of Thompson, portions of North Grosvenordale are subject to the State of Connecticut's Small Separate Storm Sewer System (MS-4) general permit.

There are several industrial-era impoundments along the French River, including dams at Langer's Pond in Wilsonville, North Grosvenordale Pond, and the Mechanicsville (Acme) Pond in Mechanicsville, just above confluence with Quinebaug River. The Mechanicsville Pond dam, constructed in the mid-19th century, was converted to a hydroelectric facility in 1922 by Putnam Light & Power Company. In the 1980s, the dam was converted to a low impact hydropower dam and is currently owned and operated by Saywatt Hydroelectric, LLC. of Canton, Massachusetts.

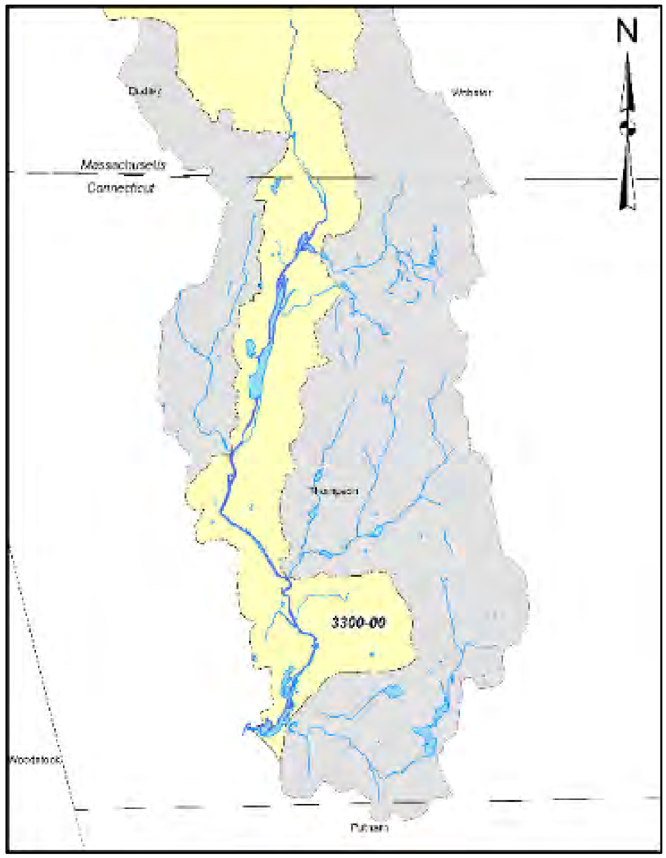


Figure 3-8. The French River sub-watershed.

3.2.1.2.2. Packard Pond Brook Sub-watershed (3300-01)

The Packard Pond Brook sub-watershed is located in the northwest extent of the Connecticut French River regional watershed in Thompson and Dudley, Massachusetts. Most of the 1.3-square mile sub-watershed, including Packard Pond and Packard Pond Brook, is located in Massachusetts. Approximately 0.15 square miles (98 acres) of the sub-watershed are in Thompson.

Packard Pond Brook originates in a marsh wetland and flows through several small ponds, including Packard Pond, before flowing into the French River. While there are several pockets of densely developed land the Packard Pond Brook sub-watershed in Dudley, the Thompson portion of the sub-watershed is comprised primarily of undeveloped forest land, with only one or two residences located along road fronts. Because Packard Pond Brook discharges to the French River in Massachusetts, no bacteria sampling was conducted.

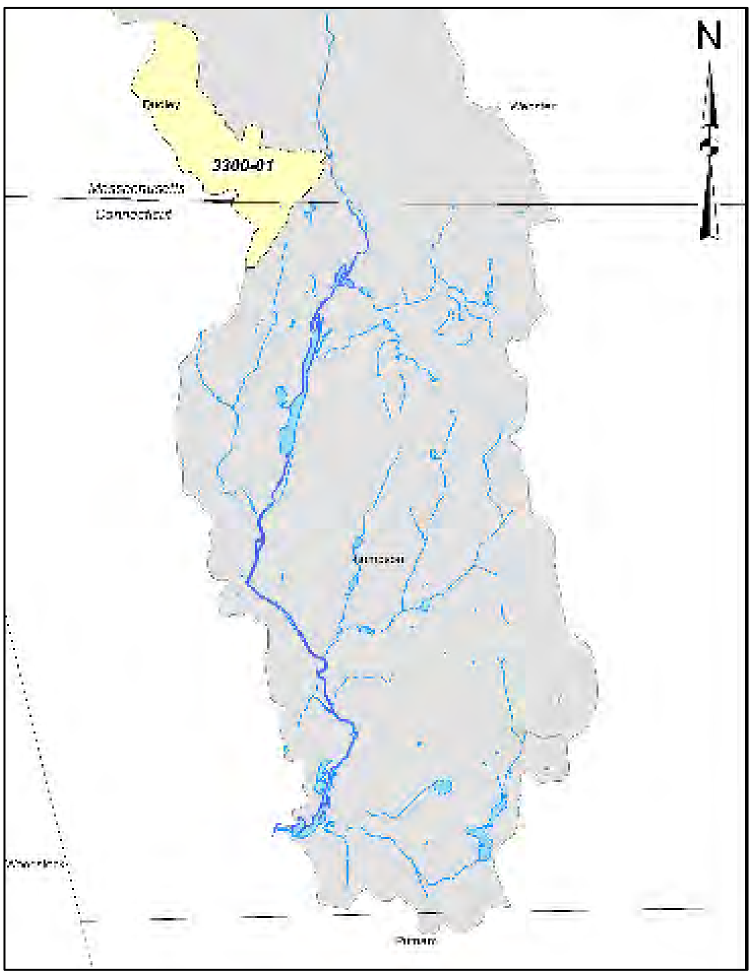


Figure 3-9. Packard Pond Brook sub-watershed.

3.2.1.2.3. Long Branch Brook Sub-watershed (3300-02)

The Long Branch Brook sub-watershed is located in northeast corner of the Connecticut French River regional watershed. Like the Packard Pond Brook sub-watershed, the Long Branch Brook sub-watershed straddles the Massachusetts-Connecticut state line.

Long Branch Brook originates in Webster, Massachusetts in a large wetland system to the west of Webster Lake (also known as Lake Chargoggagogg-manchauggagoggchaubunagungamaugg), adjacent to Interstate Route 395, and south of the heavily developed Webster center. Approximately 60% (0.9 square miles) of the 1.5 square mile sub-watershed is situated in Connecticut.

Long Branch Brook flows southerly from its headwaters in Massachusetts through a largely forested watershed with scattered rural residential development, before merging with the French River at Langer's Pond.

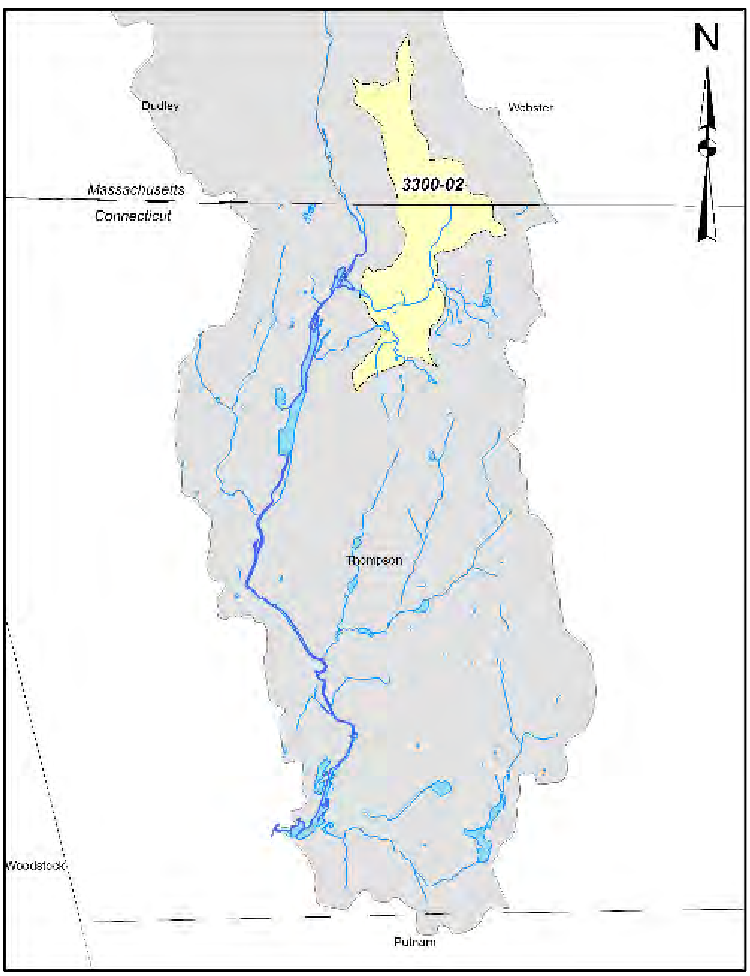


Figure 3-10. Long Branch Brook sub-watershed.

3.2.1.2.4. Freemans Brook Sub-watershed (3300-03)

The Freemans Brook sub-watershed is located in the northeast portion of the French River regional watershed, to the east of the Long Branch Brook sub-watershed. The sub-watershed is 1.2 square miles in size, the majority of the which (84%) is located in Webster, Mass. The stream flows north from a 22-acre wetland in Thompson and joins the French River in Massachusetts.

The Thompson sub-watershed is mostly forested. The southern-most section was cleared for a golf course that was never completed and contains a scattering of rural residential development. Because Freemans Brook discharges to the French River in Massachusetts, no bacteria sampling was conducted.

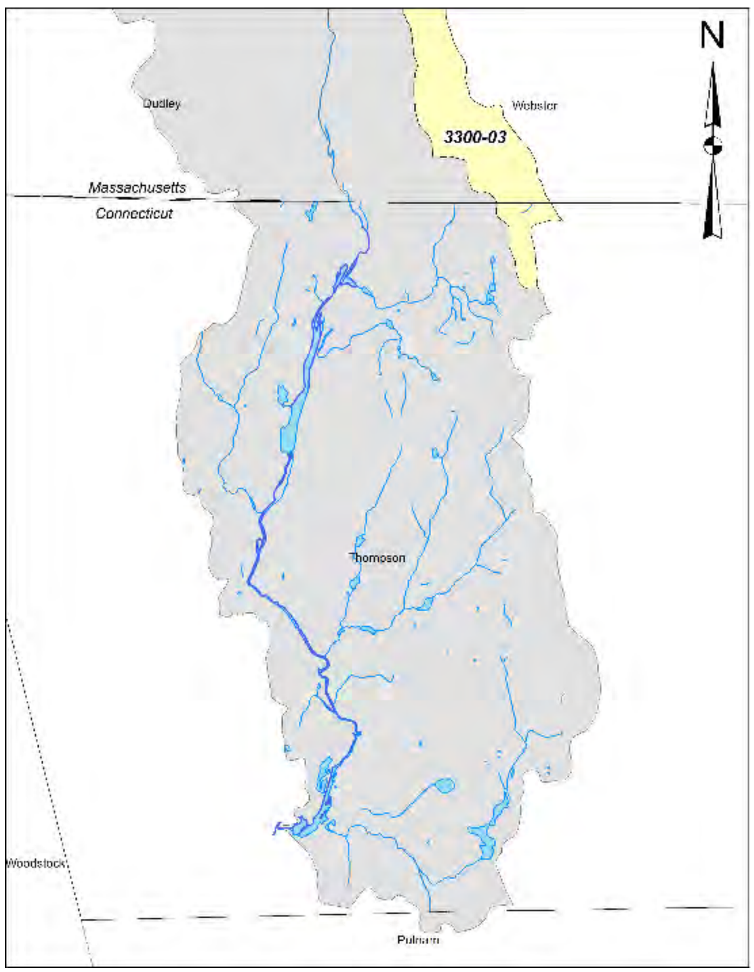


Figure 3-11. Freeman's Brook sub-watershed.

3.2.1.2.5. Knowlton Brook Sub-watershed (3300-04)

The Knowlton Brook watershed is located to the south and west of the Freeman's Brook sub-watershed. Knowlton Brook flows into Long Branch Brook at Wilsonville Road. The 0.9 square mile watershed is primarily forested (approximately 70%), with a scattering of residential development and pasture land.

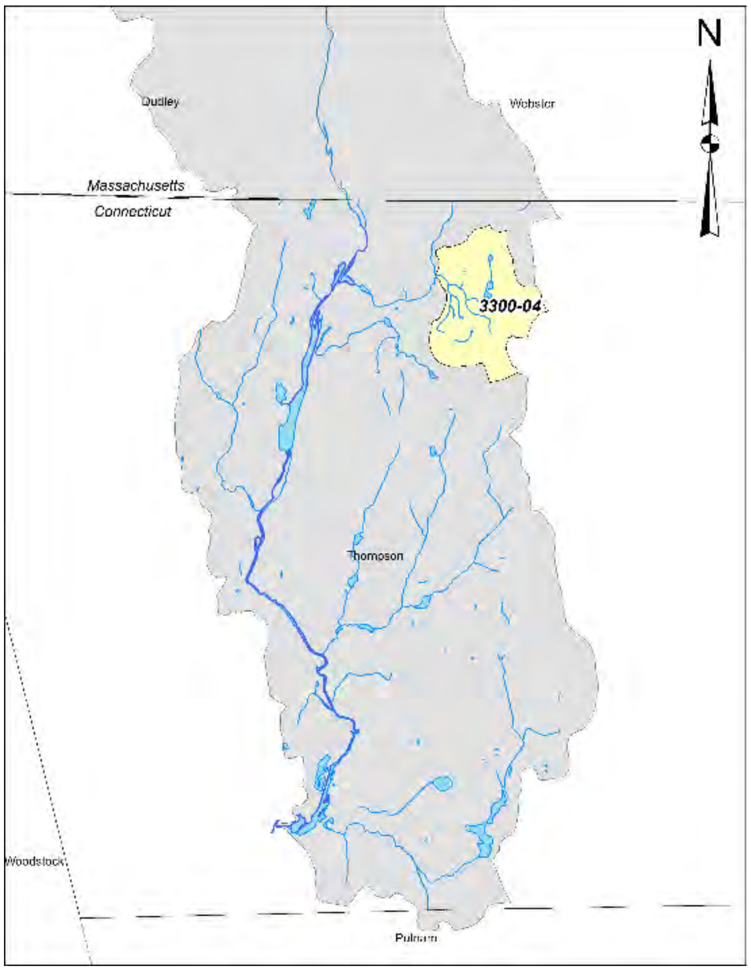


Figure 3-12. Knowlton Brook sub-watershed.

3.2.1.2.6. Backwater Brook Sub-watershed (3300-05)

The 1.6 square mile Backwater Brook sub-watershed is located in northwest part of the French River regional watershed, below the Packard Pond Brook sub-watershed. The upper section of the sub-watershed is characterized by rural development along road frontages and scattered hay land. The lower portion is characterized by the somewhat dense residential development in North Grosvenordale.

The stream flows through forest land in the north part of the watershed, then through an extensive forested wetland before it is impounded at Duhamel Pond in North Grosvenordale. From the outlet of Duhamel Pond, the stream is channelized and then culverted under the Thompson Public Library property to the North Grosvenordale Mill tail.

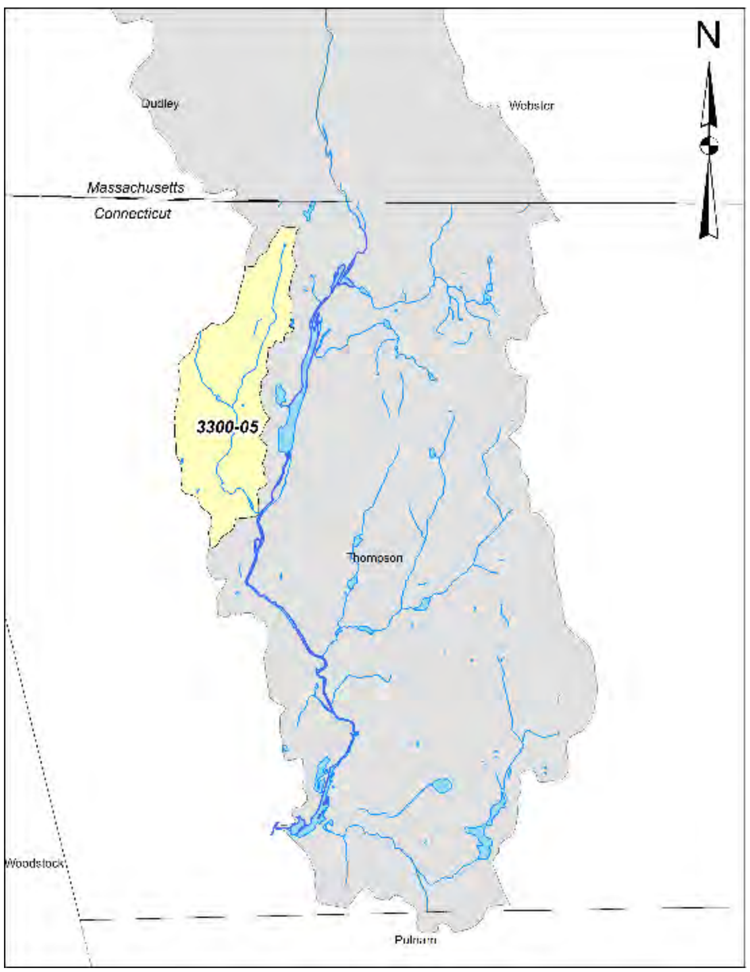


Figure 3-13. Backwater Brook sub-watershed.

3.2.1.2.7. Sunset Hill Brook Sub-watershed (3300-06)

The 2-square mile Sunset Hill Brook sub-watershed is mostly forested with scattered rural residential development in the upper watershed and suburban residential development in lower watershed. The watershed is bisected by and receives stormwater runoff from Interstate Route 395.

There are several small impoundments along the stream, including several dating from the colonial era. The lower section of the sub-watershed, near State Route 12, contains a portion of Thompson's public drinking water supply aquifer.

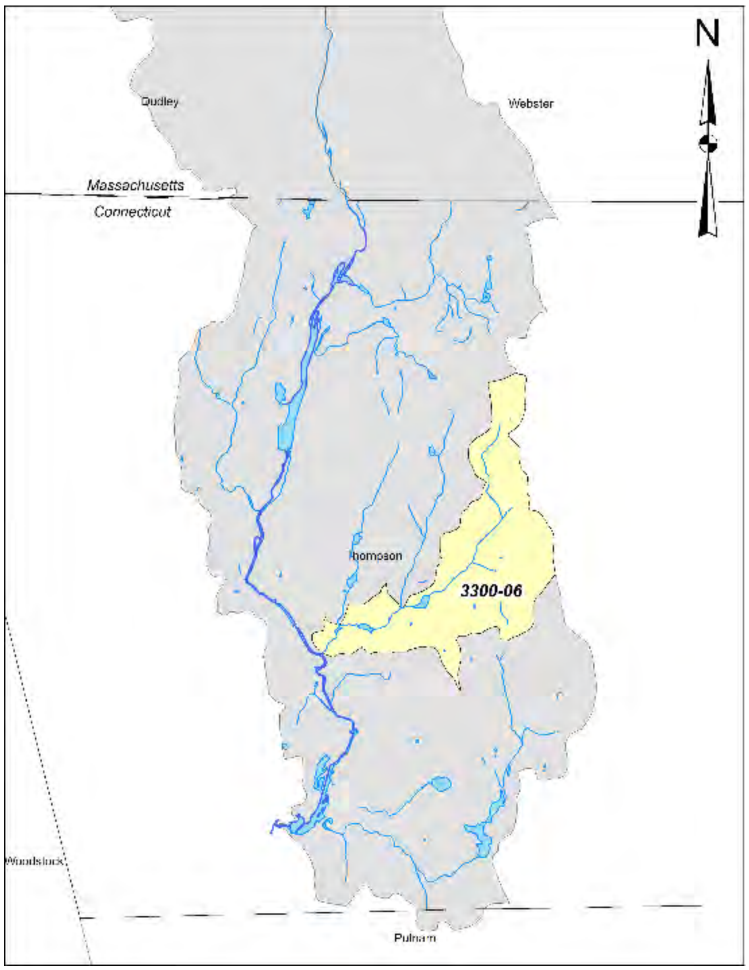


Figure 3-14. Sunset Hill Brook sub-watershed.

3.2.1.2.8. Baptist Brook Sub-watershed (3300-07)

The 1.1-square mile Baptist Brook sub-watershed is the least developed of the French River sub-watersheds, with a scattering of rural residential development and no significant roadway development. Within the watershed, Baptist Brook has one 20th century impoundment.

The Baptist Brook sub-watershed contains the Thompson municipal transfer station and former landfill (Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or Superfund site). Baptist Brook is a tributary to Sunset Hill Brook, which is part of Thompson's public drinking water aquifer.

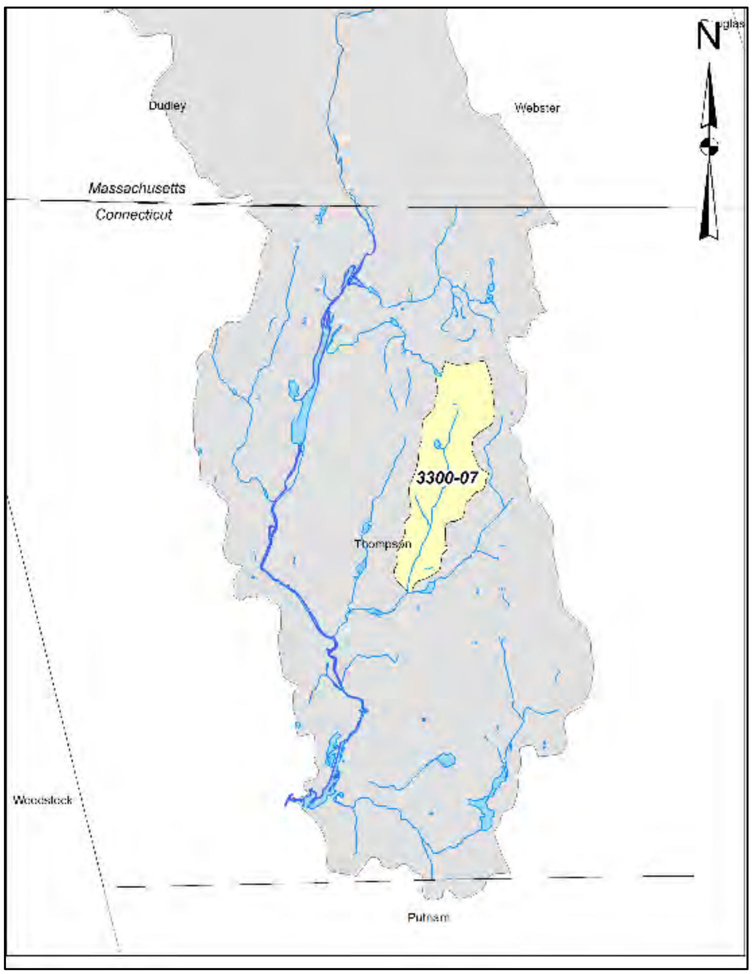


Figure 3-15. Baptist Brook sub-watershed.

3.2.1.2.9. Stoud Brook Sub-watershed (3300-08)

The 1.5-square mile Stoud Brook sub-watershed is located in the central part of the French River regional watershed, immediately to the west of the Baptist Brook sub-watershed.

The sub-watershed is sparsely developed and is mostly forested. There are two impoundments along the brook. The municipal highway garage is located in the Stoud Brook sub-watershed. Stoud Brook is a tributary to Sunset Hill Brook, and contributes to the Thompson drinking water aquifer.

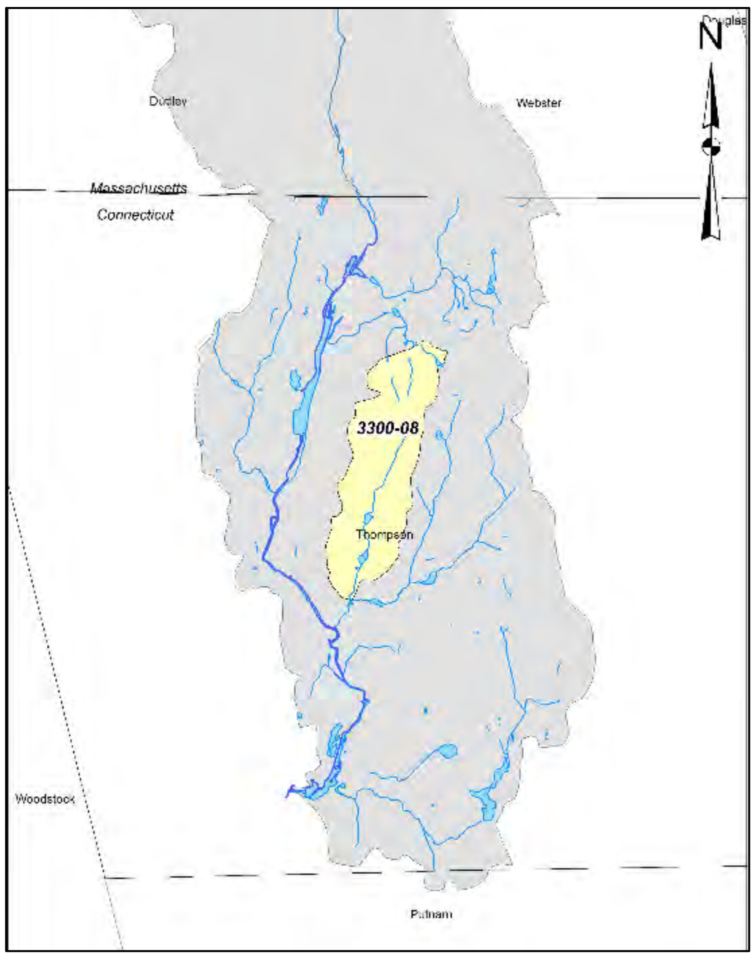


Figure 3-16. Stoud Brook sub-watershed.

3.2.1.2.10. Little Mountain Brook Sub-watershed (3300-09)

The 0.5-square mile Little Mountain Brook sub-watershed is located in the southeast part of the French River regional watershed. Little Mountain Brook begins at a small pond called Duck Pond and flows into the French River at Mechanicsville Pond.

The sub-watershed is characterized by suburban residential development. About 12% of the watershed is comprised of cropland, pasture or hay land. The watershed is bisected by Interstate Route 395.

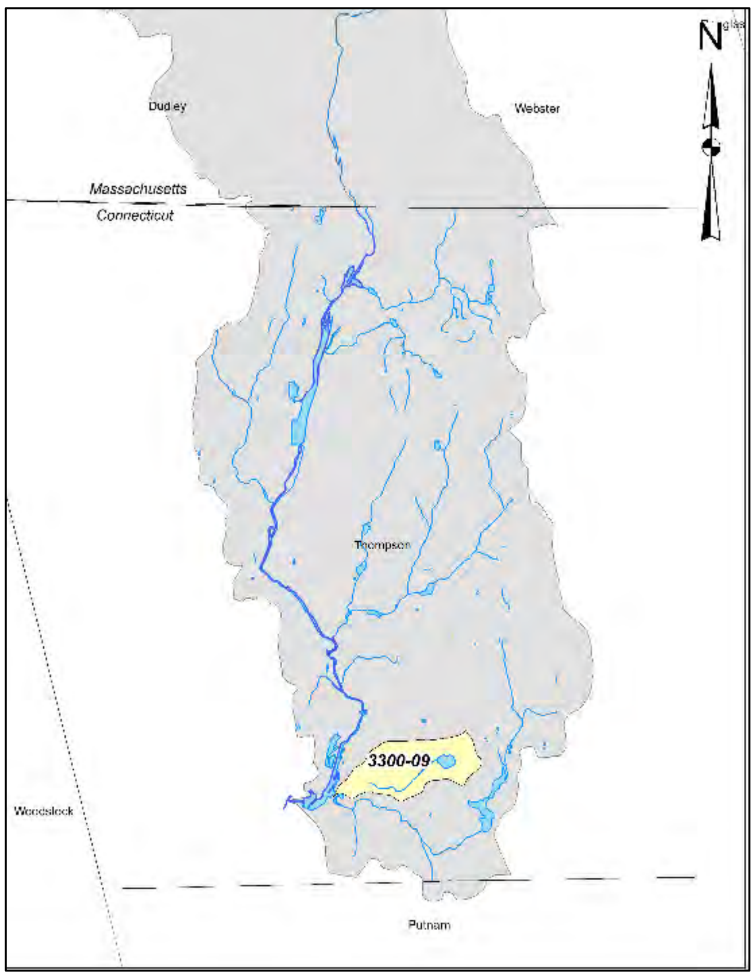


Figure 3-17. Little Mountain Brook sub-watershed.

3.2.1.2.11. Quinatissett Brook Sub-watershed (3300-10)

The 3.1-square mile Quinatissett sub-watershed is located at the southern end of the French River regional watershed. Quinatissett Brook is impounded at the Quinatissett Golf Club to form Reams Pond. Reams Pond supports migratory and resident waterfowl.

The Quinatissett Brook sub-watershed is characterized by rural and suburban residential development, and has the greatest amount of agricultural activity in the French River regional watershed. Agricultural activities include a commercial agricultural operation (farm stand crops), hay and cornfields for a commercial dairy located out of the watershed, and pasture for privately-owned livestock.

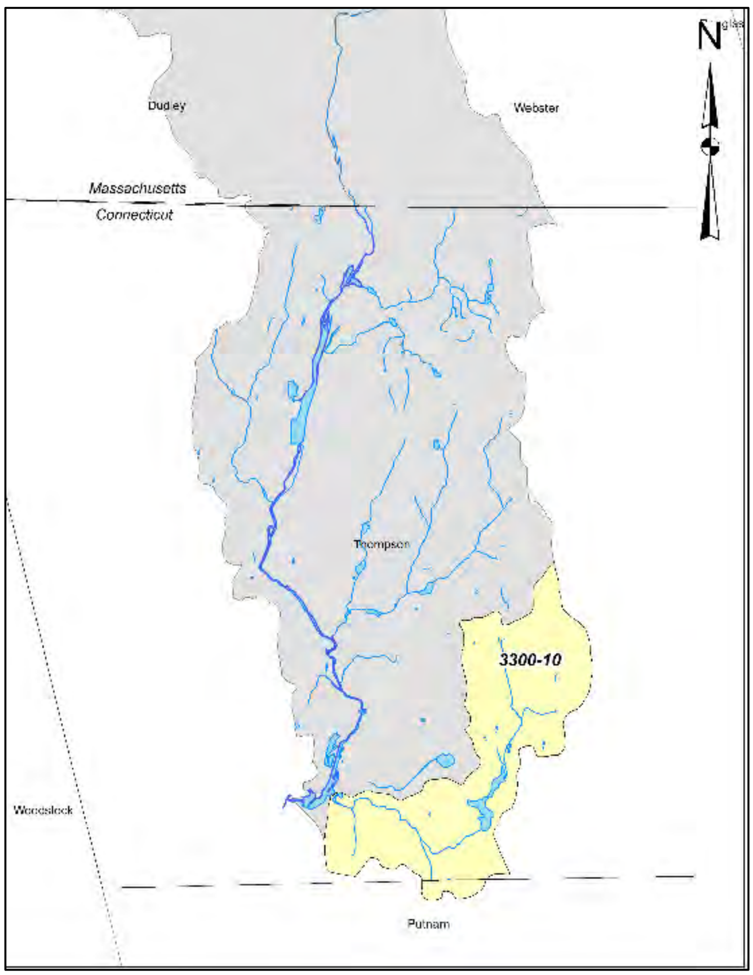


Figure 3-18. Quinatissett Brook sub-watershed.

3.2.1.3. Topography/Elevation

The topography of the French River watershed is defined by north-south-oriented rolling hills formed during the Wisconsinan glaciation, which ended approximately 14,0000 – 12,000 years ago. Glaciers ground and smoothed hilltops, creating the rolling topography typical of southern New England (Fig. 3-19). Glaciers deposited till (unsorted sediment eroded, transported and ultimately deposited by glacial ice) in upland areas and sand and gravel outwash deposits in low lying areas and river valleys. These landforms and deposits have been further modified by Holocene (post-glacial) fluvial processes. Fort Hill, at 651 ft above mean sea level (AMSL), is the highest elevation in the watershed. Other notable topographic features include Brandy Hill (635 ft AMSL), Mountain Hill (626 ft AMSL), Cortiss Hill (610 ft AMSL) and Depot Hill (488 ft). Elevation relief along the French River is approximately 100 feet along the 7 miles of river in Connecticut, from approximately 390 feet AMSL at the Massachusetts state line to 290 feet ASML at the confluence with the Quinebaug River.

3.2.1.4. Climate/Precipitation

Southern New England, including northeastern Connecticut, has a humid continental climate (Dfa in the Köppen climate classification) characterized by cold winters and hot summers. Temperature ranges from 20º F to 90º F are typical, and short duration temperature extremes ranging from 0º F to 100º F are not uncommon. Eastern Connecticut receives approximately 42-46 inches of precipitation each year. Precipitation is distributed relatively evenly throughout the year and falls as either rain or snow (Wikipedia, 2017). Changes in weather patterns due to global climate change have been noted in Connecticut. These changes include warmer winter temperatures which have led to an increase in rainfall versus snowfall, resulting in more surface runoff due to frozen ground conditions and less spring snowmelt; decreased precipitation during the hotter summer months, resulting in lower groundwater levels and decreased stream and river baseflow; and an increase in rainstorm intensity, resulting in greater potential for storm runoff and flash flooding (USEPA, 2016).

3.2.1.5. Geology and Soils

The French River watershed is part of the Worcester County Plateau. Bedrock in the French River watershed is comprised of fractured crystalline metamorphic rock, including gneisses and schists of the Iapetos (Oceanic) Terrane, which dates from the Ordovician Period, 435-500 million years ago. The Iapetos Terrane is composed of oceanic deposits, which were folded and deformed in a collision with the Avalonian Terrane, a volcanic island arc which attached to the proto-Euramerican plate during the Devonian period, approximately 420 million years ago. This collision event resulted in the formation of the New England Appalachian Mountains (Long Island Sound Resource Center, 2011). Bedrock geology of the Iapetos Terrane in the French River watershed is dominated by the Tatnic Hill Formation, a gray to dark gray, medium-grained gneiss or schist (Fig. 3-20). Additional bedrock includes the Quinebaug Formation, a gray to dark gray, medium-grained, well-layered gneiss; the Fly Pond member of the Tatnic Hill Formation, a light gray, medium-grained calc-silicate gneiss; and the Yantic member of the Tatnic Hill Formation, a gray to dark gray, fine to medium-grained schist (CT DEP, 1985).

Soils in the French River watershed are comprised of glacial lodgment and melt-out tills in upper elevations, with glaciofluvial and alluvial floodplain soils and muck soils in the lower elevations. These soils were deposited during and after the last glacial period in Connecticut, which ended approximately 12,000 years ago. Predominant soil types include Charlton-Chatfield Complex soils (25%), Woodbridge fine sandy loams (13%), Canton and Charlton soils (12%), and Ridgebury, Leicester and Whitman soils (10%) (Table 3-4 and Fig. 3-21). Charlton-Chatfield Complex soils are "gently sloping to very steep, well drained and somewhat excessively drained, loamy soils located on glacial till uplands" (USDA, 2003). Woodbridge fine sandy loams are "very deep, moderately well drained, gently sloping soil on tops of hills, on side slopes, and on toe slopes within uplands" (USDA, 2003). Canton and Charlton soils are "gently sloping, very deep, well-drained coarse, loamy melt-out till derived from granite and/or schist and/or gneiss located on hills on uplands" (USDA, 2003). Ridgebury, Leicester and Whitman soils are "poorly drained and very poorly drained soils in depressions and drainage-ways on uplands and in valleys" (USDA, 2003).

The Connecticut Inland Wetlands and Watercourses Act (sections 22a-36 through 22a-45 of the General Statutes of Connecticut) defines wetland soils as soils that are poorly drained, very poorly drained, alluvial and floodplain. Wetland soils comprise approximately 19% of soils in the French River watershed (Table 3-5 and Fig. 3-22).

The US Department of Agriculture Natural Resources Conservation Service (USDA NRCS) and Farm Service Agency (FSA) have identified prime, statewide and locally important farmland soils for Thompson (Fig. 3-23). These are soils that have physical and chemical characteristics that render them suitable for the production of crops (Table 3-6). There are approximately 5,964 acres of farmland soils in the French River watershed, which comprise 55% of the soils in the watershed. Of those, 1240 acres (12%) are Statewide Important Farmland Soils, 1215 acres (11%) are Prime Farmland Soils, and 3510 acres (32%) are locally important farmland soils (Table 3-7).

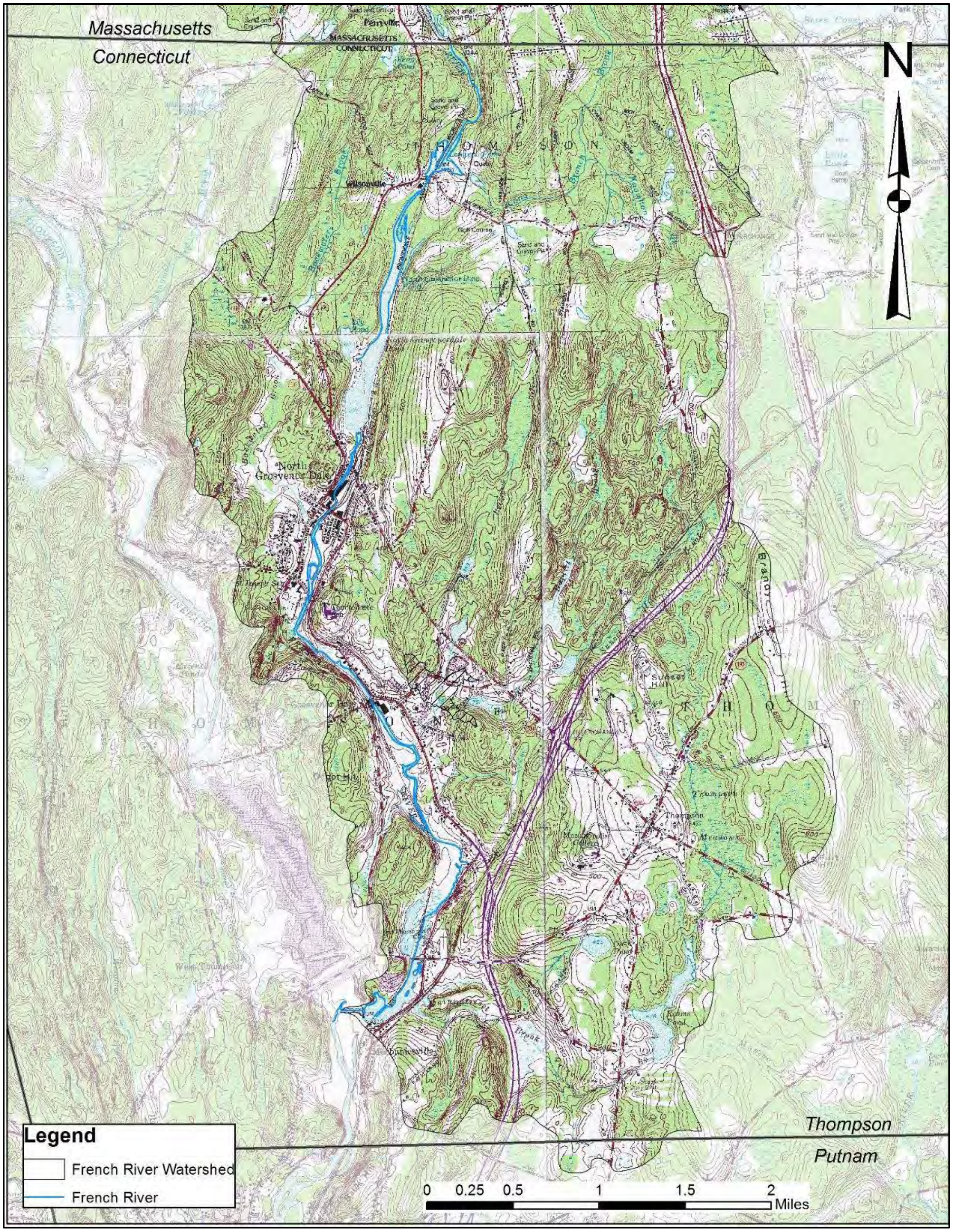


Figure 3-19. Topography of the French River watershed in Connecticut (USGS,1999).

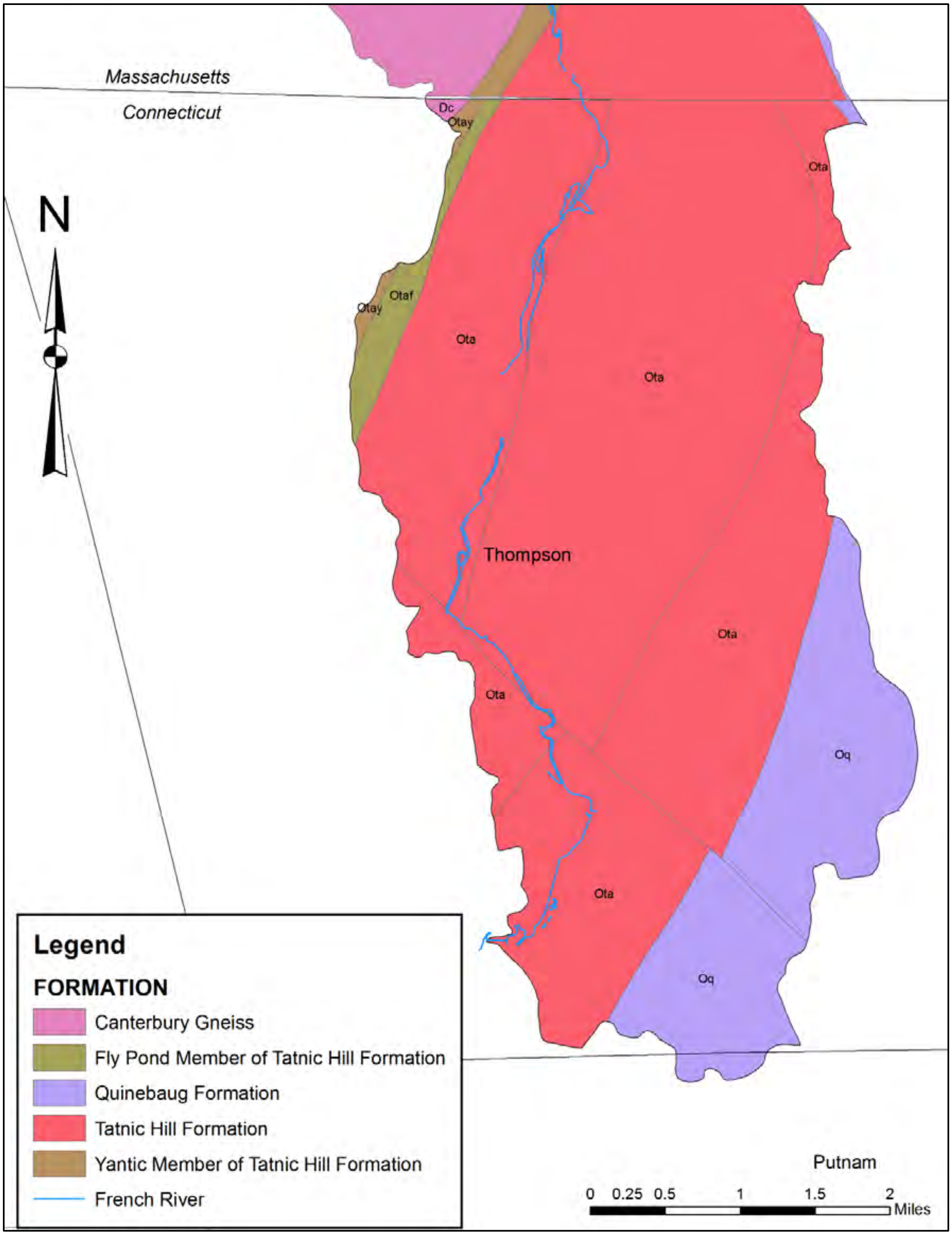


Figure 3-20. Bedrock geology of the French River watershed (CT DEP, 1985).

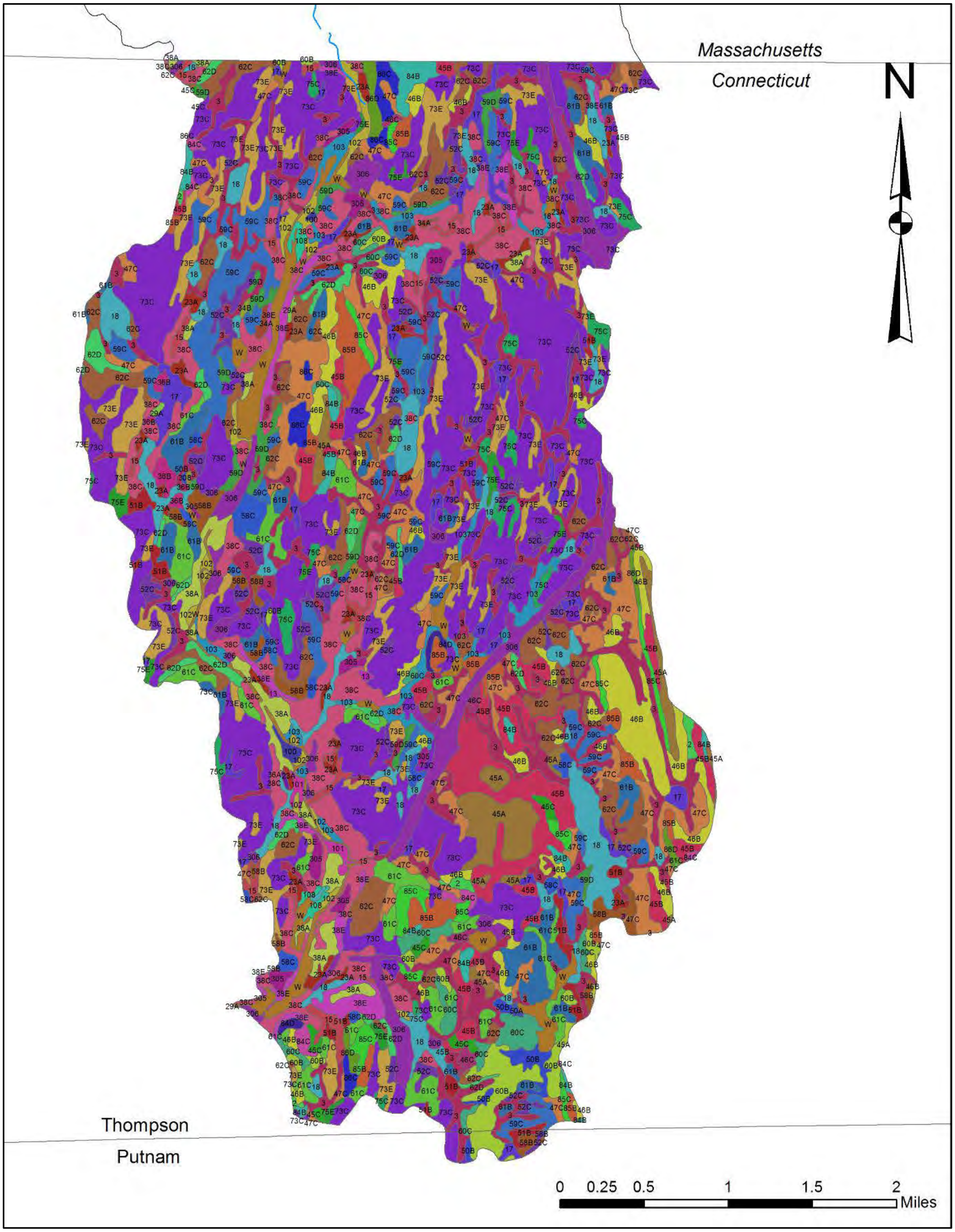


Figure 3-21. Soils in the French River watershed in Thompson, CT (SSURGO, 2009).

Table 3-4. Description of French River watershed soils (SSURGO, 2009).

Symbol	Soil Description	Acres	% Watershed
2	Ridgebury fine sandy loam	16.9	0.2
3	Ridgebury, Leicester, and Whitman soils, extremely stony	1,098.1	10.1
13	Walpole sandy loam	4.1	0.0
15	Scarboro muck	99.5	0.9
17	Timakwa and Natchaug soils	175.9	1.6
18	Catden and Freetown soils	410.8	3.8
23A	Sudbury sandy loam, 0 to 5 percent slopes	97.5	0.9
29A	Agawam fine sandy loam, 0 to 3 percent slopes	4.6	0.0
34A	Merrimac sandy loam, 0 to 3 percent slopes	8.0	0.1
34B	Merrimac sandy loam, 3 to 8 percent slopes	2.5	0.0
36A	Windsor loamy sand, 0 to 3 percent slopes	1.7	0.0
36B	Windsor loamy sand, 3 to 8 percent slopes	24.4	0.2
38A	Hinckley gravelly sandy loam, 0 to 3 percent slopes	136.7	1.3
38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	664.2	6.1
38E	Hinckley gravelly sandy loam, 15 to 45 percent slopes	128.8	1.2
45A	Woodbridge fine sandy loam, 0 to 3 percent slopes	170.1	1.6
45B	Woodbridge fine sandy loam, 3 to 8 percent slopes	360.7	3.3
45C	Woodbridge fine sandy loam, 8 to 15 percent slopes	27.1	0.2
46B	Woodbridge fine sandy loam, 2 to 8 percent slopes, very stony	345.0	3.2
46C	Woodbridge fine sandy loam, 8 to 15 percent slopes, very stony	20.4	0.2
47C	Woodbridge fine sandy loam, 2 to 15 percent slopes, extremely stony	532.5	4.9
50A	Sutton fine sandy loam, 0 to 3 percent slopes	2.3	0.0
50B	Sutton fine sandy loam, 3 to 8 percent slopes	33.8	0.3
51B	Sutton fine sandy loam, 2 to 8 percent slopes, very stony	69.3	0.6
52C	Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony	191.4	1.8
58B	Gloucester gravelly sandy loam, 3 to 8 percent slopes, very stony	82.5	0.8
58C	Gloucester gravelly sandy loam, 8 to 15 percent slopes, very stony	71.6	0.7
59C	Gloucester gravelly sandy loam, 3 to 15 percent slopes, extremely stony	439.8	4.0
59D	Gloucester gravelly sandy loam, 15 to 35 percent slopes, extremely stony	91.2	0.8
60B	Canton and Charlton soils, 3 to 8 percent slopes	130.8	1.2
60C	Canton and Charlton soils, 8 to 15 percent slopes	105.8	1.0
61B	Canton and Charlton soils, 3 to 8 percent slopes, very stony	235.1	2.2
61C	Canton and Charlton soils, 8 to 15 percent slopes, very stony	233.2	2.1
62C	Canton and Charlton soils, 3 to 15 percent slopes, extremely stony	500.5	4.6
62D	Canton and Charlton soils, 15 to 35 percent slopes, extremely stony	120.2	1.1
73C	Charlton-Chatfield complex, 3 to 15 percent slopes, very rocky	2,226.4	20.5
73E	Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky	521.3	4.8
75C	Hollis-Chatfield-Rock outcrop complex, 3 to 15 percent slopes	94.6	0.9

Table 3-4. Description of French River watershed soils (SSURGO, 2009) (cont.).

Symbol	***Soil Description***	***Acres***	***% Watershed***
75E	Hollis-Chatfield-Rock outcrop complex, 15 to 45 percent slopes	55.1	0.5
84B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes	78.3	0.7
84C	Paxton and Montauk fine sandy loams, 8 to 15 percent slopes	25.2	0.2
84D	Paxton and Montauk fine sandy loams, 15 to 25 percent slopes	13.0	0.1
85B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes, very stony	151.1	1.4
85C	Paxton and Montauk fine sandy loams, 8 to 15 percent slopes, very stony	95.8	0.9
86C	Paxton and Montauk fine sandy loams, 3 to 15 percent slopes, extremely stony	54.2	0.5
86D	Paxton and Montauk fine sandy loams, 15 to 35 percent slopes, extremely stony	35.8	0.3
100	Suncook loamy fine sand	9.8	0.1
101	Occum fine sandy loam	16.9	0.2
102	Pootatuck fine sandy loam	65.4	0.6
103	Rippowam fine sandy loam	125.5	1.2
108	Saco silt loam	17.9	0.2
305	Udorthents-Pits complex, gravelly	61.3	0.6
306	Udorthents-Urban land complex	353.2	3.2
308	Udorthents, smoothed	1.5	0.0
W	Water	243.4	2.2
	Totals	10,882.8	100.0

Table 3-5 Connecticut Wetland Soils (SSURGO, 2009).

Symbol	**Soil Type**	**Soil Class**	**Acres**	**% Watershed**
2	Ridgebury fine sandy loam	Poorly Drained and Very Poorly Drained Soils	16.9	0.2
3	Ridgebury, Leicester, and Whitman soils, extremely stony	Poorly Drained and Very Poorly Drained Soils	1,098.1	10.1
13	Walpole sandy loam	Poorly Drained and Very Poorly Drained Soils	4.1	0.0
15	Scarboro muck	Poorly Drained and Very Poorly Drained Soils	99.5	0.9
17	Timakwa and Natchaug soils	Poorly Drained and Very Poorly Drained Soils	175.9	1.6
18	Catden and Freetown soils	Poorly Drained and Very Poorly Drained Soils	410.8	3.8
100	Suncook loamy fine sand	Alluvial and Floodplain Soils	9.8	0.1
101	Occum fine sandy loam	Alluvial and Floodplain Soils	16.9	0.2
102	Pootatuck fine sandy loam	Alluvial and Floodplain Soils	65.4	0.6
103	Rippowam fine sandy loam	Alluvial and Floodplain Soils	125.5	1.2
108	Saco silt loam	Alluvial and Floodplain Soils	17.9	0.2
		Total	2,040.7	18.8%

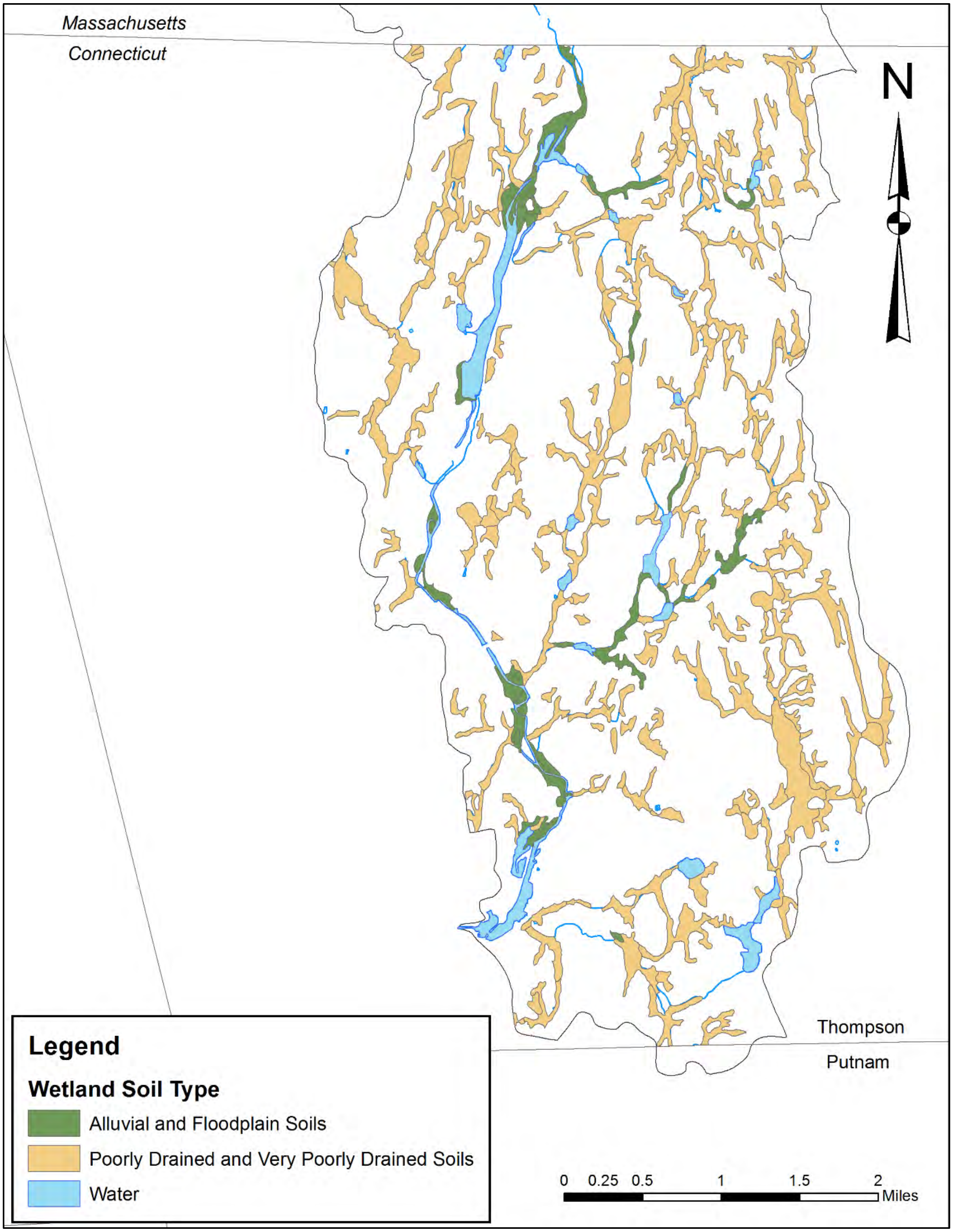


Figure 3-22. Wetland and floodplain soils in the French River watershed in Thompson, CT (SSURGO, 2009).

Table 3-6. USDA description of farmland soil classes

Prime Farmland Soils:
Soils that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oil seed crops, and are also available for these uses (the land could be cropland, pastureland, range-land, forestland, or other land, but not urban built-up land or water). It has the soil quality, growing season and moisture supply needed to economically produce sustained high yields or crops when treated and managed, including water management, according to acceptable farming practices.
Statewide Important Farmland Soils:
Soils that fail to meet one or more of the requirements of prime farmland, but are important for the production of food, feed, fiber, or forage crops. They include those soils that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods.
Locally Important Farmland Soils:
Soils that are not prime or statewide importance but are used for the production of high value food, fiber or horticultural crops. This land may be important to the local economy due to its productivity or value.
- CT ECO, 2015

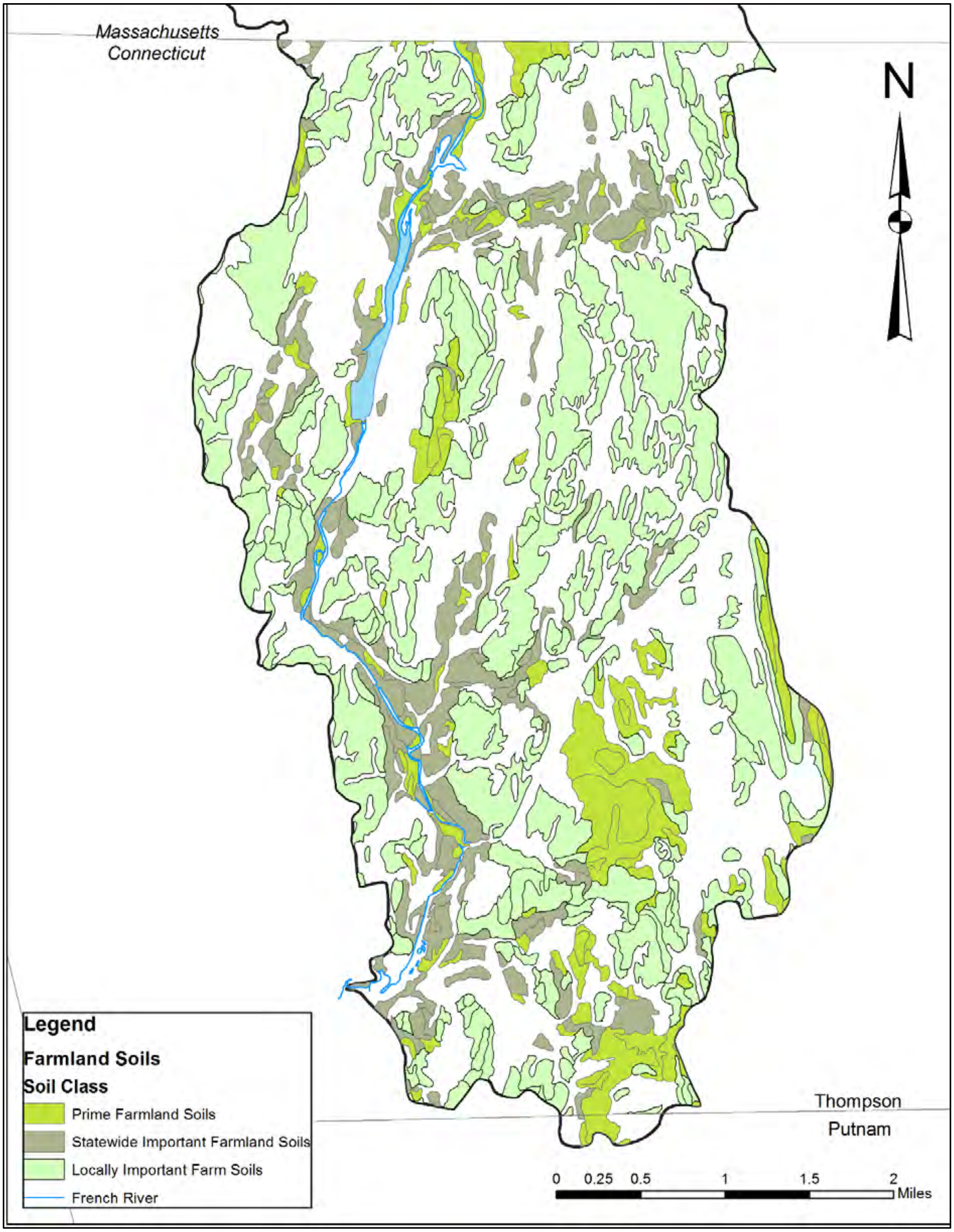


Figure 3-23. Farmland soils in the French River watershed.

Table 3-7. Farmland Soils in the French River Watershed (SSURGO, 2009).

Soil Symbol	Soil Name	Soil Class	Acres in WS	% WS
2	Ridgebury fine sandy loam	Statewide Important Farmland Soils	24.5	0.2
13	Walpole sandy loam	Statewide Important Farmland Soils	4.1	0.0
100	Suncook loamy fine sand	Statewide Important Farmland Soils	9.8	0.1
101	Occum fine sandy loam	Prime Farmland Soils	16.9	0.2
102	Pootatuck fine sandy loam	Prime Farmland Soils	65.4	0.6
103	Rippowam fine sandy loam	Statewide Important Farmland Soils	125.5	1.2
23A	Sudbury sandy loam, 0 to 5 percent slopes	Prime Farmland Soils	97.5	0.9
29A	Agawam fine sandy loam, 0 to 3 percent slopes	Prime Farmland Soils	14.9	0.1
34A	Merrimac sandy loam, 0 to 3 percent slopes	Prime Farmland Soils	8.0	0.1
34B	Merrimac sandy loam, 3 to 8 percent slopes	Prime Farmland Soils	2.5	0.0
36A	Windsor loamy sand, 0 to 3 percent slopes	Statewide Important Farmland Soils	1.7	0.0
36B	Windsor loamy sand, 3 to 8 percent slopes	Statewide Important Farmland Soils	24.4	0.2
38A	Hinckley gravelly sandy loam, 0 to 3 percent slopes	Statewide Important Farmland Soils	136.7	1.3
38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	Statewide Important Farmland Soils	722.0	6.6
45A	Woodbridge fine sandy loam, 0 to 3 percent slopes	Prime Farmland Soils	243.7	2.2
45B	Woodbridge fine sandy loam, 3 to 8 percent slopes	Prime Farmland Soils	402.5	3.7
45C	Woodbridge fine sandy loam, 8 to 15 percent slopes	Statewide Important Farmland Soils	30.7	0.3
46B	Woodbridge fine sandy loam, 3 to 8 percent slopes	Locally Important Farmland Soils	345.0	3.2
46C	Woodbridge fine sandy loam, 8 to 15 percent slopes	Locally Important Farmland Soils	20.4	0.2
50A	Sutton fine sandy loam, 0 to 3 percent slopes	Prime Farmland Soils	2.3	0.0
50B	Sutton fine sandy loam, 3 to 8 percent slopes	Prime Farmland Soils	43.4	0.4
51B	Sutton fine sandy loam, 2 to 8 percent slopes, very stony	Locally Important Farmland Soils	63.7	0.6
58B	Gloucester gravelly sandy loam, 3 to 8 percent slopes, very stony	Locally Important Farmland Soils	76.0	0.7
58C	Gloucester gravelly sandy loam, 8 to 15 percent slopes, very stony	Locally Important Farmland Soils	71.6	0.7
60B	Canton and Charlton soils, 3 to 8 percent slopes	Prime Farmland Soils	206.9	1.9
60C	Canton and Charlton soils, 8 to 15 percent slopes	Statewide Important Farmland Soils	109.2	1.0
61B	Canton and Charlton soils, 3 to 8 percent slopes, very stony	Locally Important Farmland Soils	235.1	2.2
61C	Canton and Charlton soils, 8 to15 percent slopes, very stony	Locally Important Farmland Soils	233.2	2.1
73C	Charlton-Chatfield complex, 3 to 15 percent slopes, very rocky	Locally Important Farmland Soils	2,217.5	20.4
84B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes	Prime Farmland Soils	111.0	1.0
84C	Paxton and Montauk fine sandy loams, 8 to 15 percent slopes	Statewide Important Farmland Soils	51.1	0.5
85B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes, very stony	Locally Important Farmland Soils	151.1	1.4
85C	Paxton and Montauk fine sandy loams, 8 to 15 percent slopes, very stony	Locally Important Farmland Soils	95.8	0.9
Totals			5,964.0	54.8

3.2.1.6. Vegetation

The French River watershed is located in the Eastern Broadleaf Forest Province (US Forest Service, 1976). Vegetation in the watershed is comprised primarily of tall, cold-deciduous broadleaf forests, including oak-hickory, maple-beech-birch, and aspen-birch forest groups in upper elevations and elm-ash-red maple forest groups in lower elevations (USDA, 2004). Coniferous species include scattered white pine stands in upland areas, and hemlocks along stream corridors and in forested wetlands.

3.2.1.7. Non-native/Invasive Species

Non-native plant and animal species can be detrimental to native plants and wildlife. Invasive species are non-native species that exhibit qualities that allow them to out-compete native species, resulting in the reduction of available habitat and food resources, displacement of native species, and alteration of the food web. Costs associated with the environmental and economic impacts and management of invasive species can be in the billions of dollars annually (US Fish & Wildlife Service, 2012).

Common non-native or invasive plant species, including oriental bittersweet (*Celastrus orbiculatus*), multiflora rose (*Rosa multiflora*), glossy buckthorn (*Frangula alnus*), purple loosestrife (*Lythrum salicaria*), and common reed (*Phragmites australis*) were noted in disturbed areas, roadsides and along stream corridors. Asian carp (most likely grass carp - *Ctenopharyngodon idella*) were noted in the French River in the vicinity of the West Thompson Road bridge. Asian clams (*Corbicula fluminea*) were noted in the French River upstream of North Grosvenordale Pond.

No other non-native or invasive plant or animal species were noted during the water quality investigation; however, that does not preclude their presence or absence.

3.2.2. Water Resources

3.2.2.1. Hydrology

There are approximately 28.7 miles of perennial streams in the French River watershed (Fig. 3-25), including the French River itself, which is 6.5 miles in length from the Massachusetts-Connecticut state line to the confluence with the Quinebaug River. Named perennial streams and their corresponding stream lengths are identified in Table 3-8.

There are approximately 212 acres of ponds and lakes in the French River watershed (Fig. 3-25). Notable waterbodies include Langer's Pond (11.9 acres), North Grosvenordale Pond (58.6 acres), and Mechanicsville Pond (33.5 acres), all of which are impoundments of the French River, and Ream's Pond (29.7 acres), an impoundment of Quinatissett Brook.

Table 3-8. Notable Named French River Watershed Streams and Stream Length

Stream Name	Stream Length
French River	6.5 miles
Backwater Brook	3.1 miles
Sunset Hill Brook	2.7 miles
Stoud Brook	2.6 miles
Quinatissett Brook	2.2 miles
Long Branch Brook	1.9 miles
Baptist Brook	1.5 miles
Elliott's Brook	1.1 miles
Knowlton Brook	0.9 miles
Little Mountain Brook	0.8 miles
Coman Brook	0.8 miles
Ross Brook	0.8 miles

3.2.2.2. Wetlands and Floodplains

Wetlands are low-lying areas in the landscape where water is at or near the ground surface. Wetlands are characterized by the presence of hydric soils (Table 3-9), which are soils that have been saturated for extended periods of time and which have developed physio-chemical characteristics in the upper soil layers related to anaerobic conditions (NRCS, 2015). Wetlands support specific plant and animal communities, including hydrophytes, plants that are adapted to the prolonged presence of water.

Wetlands provide important ecosystem services including water quality benefits and flood management. Wetlands provide water quality renovation by filtering sediment, nutrients and other water-borne pollutants. As water is transported through the wetland system, physio-chemical and biological processes entrain, transform and neutralize pollutants. Wetlands have great capacity to capture and store rainwater, holding it and slowly infiltrating it into the ground, mitigating flooding, and replenishing groundwater supplies. The replenishment of groundwater is especially important in rural areas where many residents rely on wells for their drinking water. In Thompson, approximately 70% of households rely on private wells for drinking water.

Typical wetlands in Connecticut include red maple swamps, scrub/shrub and open marshes, bogs and weak fens. Approximately 19 percent (2,041 acres) of the French River watershed is designated as wetlands. Of that, about 1,805 acres (16.6%) are designated as poorly drained and very poorly drained soils, and 236 acres (2%) are designated as alluvial and floodplain soils.

Table 3-9. Connecticut Wetland Soils

Wetland soils are defined in the Connecticut Inland Wetlands and Watercourses Act (sections 22a-36 through 22a-45) by soil drainage class and landscape position:
Poorly drained soils occur where the water table is at or just below the ground surface, usually from late fall to early spring. The land where poorly drained soils occur is nearly level or gently sloping. **Very poorly drained** soils generally occur on level land or in depressions. In these areas, the water table lies at or above the surface during most of the growing season. **Alluvial and Floodplain** soils occur along watercourses occupying nearly all level areas subject to periodic flooding. These soils are formed when material is deposited by flowing water. Such material can be composed of clay, silt, sand or gravel. Alluvial and floodplain soils range from excessively drained to very poorly drained. - CT DEEP, 2015

Floodplains are low-lying areas adjacent to watercourses or ponds that are subject to flooding. Like wetlands, flood plains capture and hold flood waters, infiltrating them into the ground or releasing them slowly as flood waters recede. Floodplains are important to the management of flood waters and especially to the mitigation of potential down-stream flood damage. When flood plains are developed, they lose their capacity to attenuate flood flows, and increase the potential for flood damage to surface structures and infrastructure.

The Federal Emergency Management Agency (FEMA) has designated French River and the adjacent riparian corridor area from the state line to the confluence with the Quinebaug River as flood zone A (Fig. 3-26). FEMA has also designated several perennial streams, including Long Branch Brook, Backwater Brook, Sunset Hill Brook and Quinatissett Brook as flood zone A. Flood zone A is designated as having a 1% annual chance of flooding. The 1% annual chance flood is also referred to as a100-year flood (FEMA, 2015).

Watershed managers are advised to review FEMA flood hazard data as it is updated and becomes available to determine flood risk within the French River watershed. Managers should also review the *2015 Northeastern Connecticut Council of*

Governments Regional Hazard Mitigation Plan relative to potential flood risks. Although flows in the French River are modulated by the Army Corps of Engineers flood control facility at Hodges Village in Oxford, MA, local flooding can occur in response to extremely heavy rain falls.

3.2.2.3. Surface and Groundwater Resources

The State of Connecticut is required through Section 303 of the Federal Water Pollution Control Act (better known as the Clean Water Act) to assess surface and groundwater within the state and assign water classifications based on designated uses. Water quality classifications serve to establish designated uses for surface and groundwaters and identify criteria necessary to support those uses. Designated uses may include public water supplies, support of fish and other aquatic wildlife, agricultural and industrial purposes, recreation and navigation.

The Connecticut Water Quality Standards (CT DEEP, 2013) establish standards for surface and groundwater in Connecticut. The general goal of the Water Quality Standards is to "…restore or maintain the chemical, physical and biological integrity of surface waters. Where attainable, the level of water quality that provides for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water shall be achieved" and to maintain or restore areas with groundwater classifications of GAA, GAAs and GA to their natural quality, such that the ground water is "…suitable for drinking and other domestic uses without treatment (CT DEEP, 2013)."

The French River has a surface water classification of B, due to upstream (Massachusetts) waste water treatment plant discharges. The remaining surface waters in the French River watershed have surface water quality classifications of A (Fig. 3-27). Designated uses in Class A surface waters include habitat for fish and other aquatic life and wildlife; potential drinking water supplies; recreation; navigation; and water supply for industry and agriculture. Allowable discharges to Class A waters may include discharges from public or private drinking water treatment systems, dredging activity and dredge material dewatering operations, including the discharge of dredged or fill material and clean water discharges. Designated uses for Class B surface waters include habitat for fish and other aquatic life and wildlife; recreation; navigation; and water supply for industry and agriculture. Allowable discharges to a Class B waters may include discharges from public or private drinking water treatment systems, dredging activity and dredge material dewatering operations, including the discharge of dredged or fill material and clean water discharges (CT DEEP, 2013).

Groundwater throughout most of the French River watershed in Connecticut is classified as GA (Fig. 3-28). Designated uses for Class GA groundwater include existing private and potential public or private supplies of water suitable for drinking without treatment, and base flow for hydraulically-connected surface water bodies. Allowable discharges for Class GA waters include "…discharge from a septage treatment system or of other wastes that are predominantly human, plant, or animal in origin so long as any such wastes are of natural origin, easily biodegradable and, if properly managed, pose no threat of pollution to the ground water. The ground water plume generated by a discharge from a septage treatment system shall terminate in a stream with classification of B or SB unless the permittee treats the discharge in a manner which the Commissioner determines is adequate to maintain class A water in the receiving stream (CT DEEP, 2013)."

Several areas, including Connecticut Water Company's public drinking water supply well field on Sunset Hill Brook, are designated GAA. Designated uses for Class GAA groundwater includes existing or potential public supply of water suitable for drinking without treatment and baseflow for hydraulically-connected surface water bodies. Allowable discharges to Class GAA groundwater include "…treated domestic sewage as defined in section 22a-430-1 of the Regulations of Connecticut State Agencies, waste generated by certain agricultural practices, certain water treatment waste waters from public water supply treatment systems, or certain minor cooling waters or clean waters (CT DEEP, 2013)."

Portions of the watershed along the French River are designated GB. Designated uses for Class GB groundwater include industrial process and cooling waters, and baseflow for hydraulically-connected surface water bodies. Class B ground waters are not suitable for human consumption without treatment. Allowable discharges to Class GB groundwaters include discharges "…allowable in a GA area under subsection (e) of this section or if such discharge meets all of the following criteria:

> (A) waste [that] is generated by a source which is unlikely to produce persistent pollutants or pollutants that do not biodegrade in soil;
> (B) the waste will be treated as necessary to render it amenable to attenuation by the receiving soil so that the ground water will not be impaired; and
> (C) such discharge otherwise conforms with all applicable legal requirements and standards (CT DEEP, 2013)."

In 2011, Connecticut adopted stream flow standards and regulations (Sections 26-141b-1 to 26-141b-8 of the Regulations of Connecticut State Agencies). The purpose of these regulations is to protect Connecticut's rivers and stream systems by establishing standards for stream flows that are protective of stream aquatic life. The standards apply to all river and stream systems in the state through a classification process and require minimum releases from dams.
The stream flow standards balance human and ecological needs for water by establishing different flow standards for each of four classes of waters, as described

in Table 3-10. The flow standards for each class are based on maintaining the natural variation in flow expected in Connecticut given seasonal climate and rainfall patterns and human use (CT DEEP, 2011).

Table 3-10. Connecticut Stream Flow Definitions (CT Stream Flow Standards and Regulations, rev. 2015)

Stream Class	Description
Class 1	free flowing, priority given to protecting ecological health
Class 2	minimally altered free flowing stream system
Class 3	moderately altered, have intermediate balance points between ecological and human uses
Class 4	substantially altered, priority is given to human uses

Rivers and streams in the greater Thames major watershed in Connecticut, including the French River watershed, were classified in 2014. As might be expected from Thompson's agricultural and industrial heritage, streams in the watershed run the gamut from free flowing to moderately altered flow (Fig. 3-29). Tributaries to the French River are primarily free-flowing, although several, including Stoud Brook, Sunset Hill Brook, Little Mountain Brook, and Quinatissett Brook, are designated moderately altered due to dams that impact flow. The French River is designated free-flowing or minimally altered from the state line to a point on a meander south of the Main Street (North Grosvenordale) bridge. From that point to Mechanicsville Pond the river is designated moderately flow impaired.

3.2.2.4. Dams

Dams are impoundments of free-flowing waters. In colonial New England, many small streams were dammed to provide hydro-power for small gristmills and sawmills to grind grain for flour and provide lumber for construction. In the mid-1800s, at the advent of the industrial era, larger dams were erected to provide hydro-power for thread and cloth mills. Dams were also erected to create ponds for watering livestock and for fire suppression.

There are multiple impoundments in the watershed along the French River and its tributary streams (CT DEEP, 2016). During the industrial era, numerous dams were erected along the French River to power mills. These dams formed mill ponds that exist into the present, including Langer Pond, North Grosvenordale Pond, and Mechanicsville Pond. Numerous impoundments of the various tributary streams form small unnamed ponds throughout the watershed. Some of these ponds are formed by colonial-era sawmills and gristmills. The remainder are more modern and may have been constructed to create as farm or fire ponds, or created by road crossings that caused impoundments (Fig. 3-30).

According to the *Regulations of Connecticut State Agencies Sec. 22a-409-2, Dam safety inspection and classification (revised 3-11-16)*, dams in Connecticut are assigned to one of five classes according to the potential downstream impacts related to dam failure. Factors evaluate dams and assign a hazard potential include dam height, capacity (maximum volume) of the impoundment, the potential area impacted by a dam failure, and the potential damage to property, infrastructure and human life. The dam classes and hazards associated with each are described in Table 3-11. In 2016, the State of Connecticut adopted regulations (Public Act 13-197) that require dam owners to periodically inspect their dams and prepare and submit an Emergency Action Plan every two years if they own a high or significant hazard dam.

Connecticut DEEP identifies fifteen dams in the French River watershed in Connecticut. Of those fifteen (15) dams, eight (8) are included in CT DEEP's *Listing of High, Significant, and Moderate Hazard Dam Owners and Dams in Connecticut* (Table 3-12) (updated on January 21, 2016).

Figure 3-24. Dam on Quinatissett Brook at the outlet of Reams Pond.

Table 3-11. Dam hazard potential.

Dam Class	Hazard Potential	Damage potential if dam were to fail
AA	Negligible hazard	(i) no measurable damage to roadways; (ii) no measurable damage to land and structures; and (iii) negligible economic loss.
A	Low hazard	(i) damage to agricultural land; (ii) damage to unpaved local roadways; or (iii) minimal economic loss.
BB	Moderate hazard	(i) damage to normally unoccupied storage structures; (ii) damage to paved local roadways: or (iii) moderate economic loss.
B	Significant hazard	(i) possible loss of life; (ii) minor damage to habitable structures, residences, including, but not limited to, industrial or commercial buildings, hospitals, convalescent homes, or schools; (iii) damage to local utility facilities including water supply, sewage treatment plants, fuel storage facilities, power plants, cable or telephone infrastructure, causing localized interruption of these services; (iv) damage to collector roadways and railroads; or (v) significant economic loss.
C	High hazard	(i) probable loss of life; (ii) major damage to habitable structures, residences, including, but not limited to, industrial or commercial buildings, hospitals, convalescent homes, or schools; (iii) damage to major utility facilities, including public water supply, sewage treatment plants, fuel storage facilities, power plants, or electrical substations causing widespread interruption of these services; (iv) damage to arterial roadways; or (v) Great economic loss.

Table 3-12. Listed Dams in the French River watershed.

CT Dam #	Dam Name	Pond Name	Stream Name	Hazard Class
14115	Baptist Brook Pond Dam	(not named)	Baptist Brook	BB
14108	Belden Dam	Belden Dam	French River	BB
14113	Coderre Pond Dam	(not named)	Sunset Hill Brook	BB
14124	Duck Pond Dam	Duck Pond	Little Mountain Brook	A
14132	Krawiec Pond Dam	(not named)	Unnamed tributary to French River	not rated
14106	Langers Pond Dam	Langers Pond	French River	BB
14102	Mechanicsville Pond Dam	Mechanicsville Pond (aka Acme Pond)	French River	B
14103	North Grosvenordale Dam	North Grosvenordale Pond	French River	C
14109	Phelps Pond Dam	Phelps Pond (aka Duhamel Pond)	Backwater Brook	B
14123	Reams Pond Dam	Reams Pond	Quinatissett Brook	BB
14121	Sportsmans Pond Dam	(not named)	Stoud Brook	A
14107	Thompson Water Company Dam	(not named)	Sunset Hill Brook	not rated
14112	Thompson Water Company Dam #2	(not named)	Stoud Brook	A
14120	Ware Pond Dam	(not named)	Sunset Hill Brook	A
14122	Welch Pond Dam	(not named)	Unnamed tributary to French River (North Grosvenordale Pond)	BB

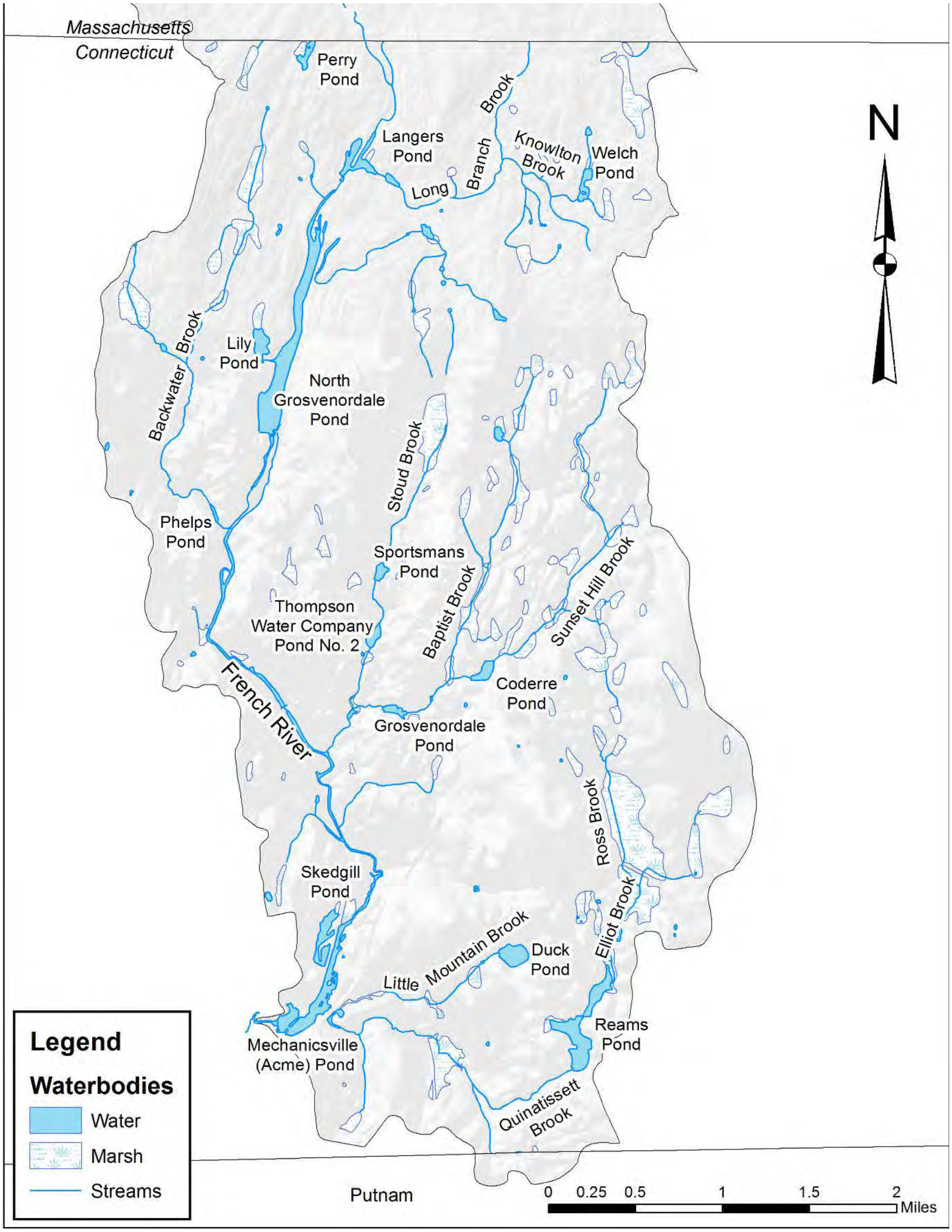


Figure 3-25. Named streams and ponds in the French River watershed in Thompson, CT.

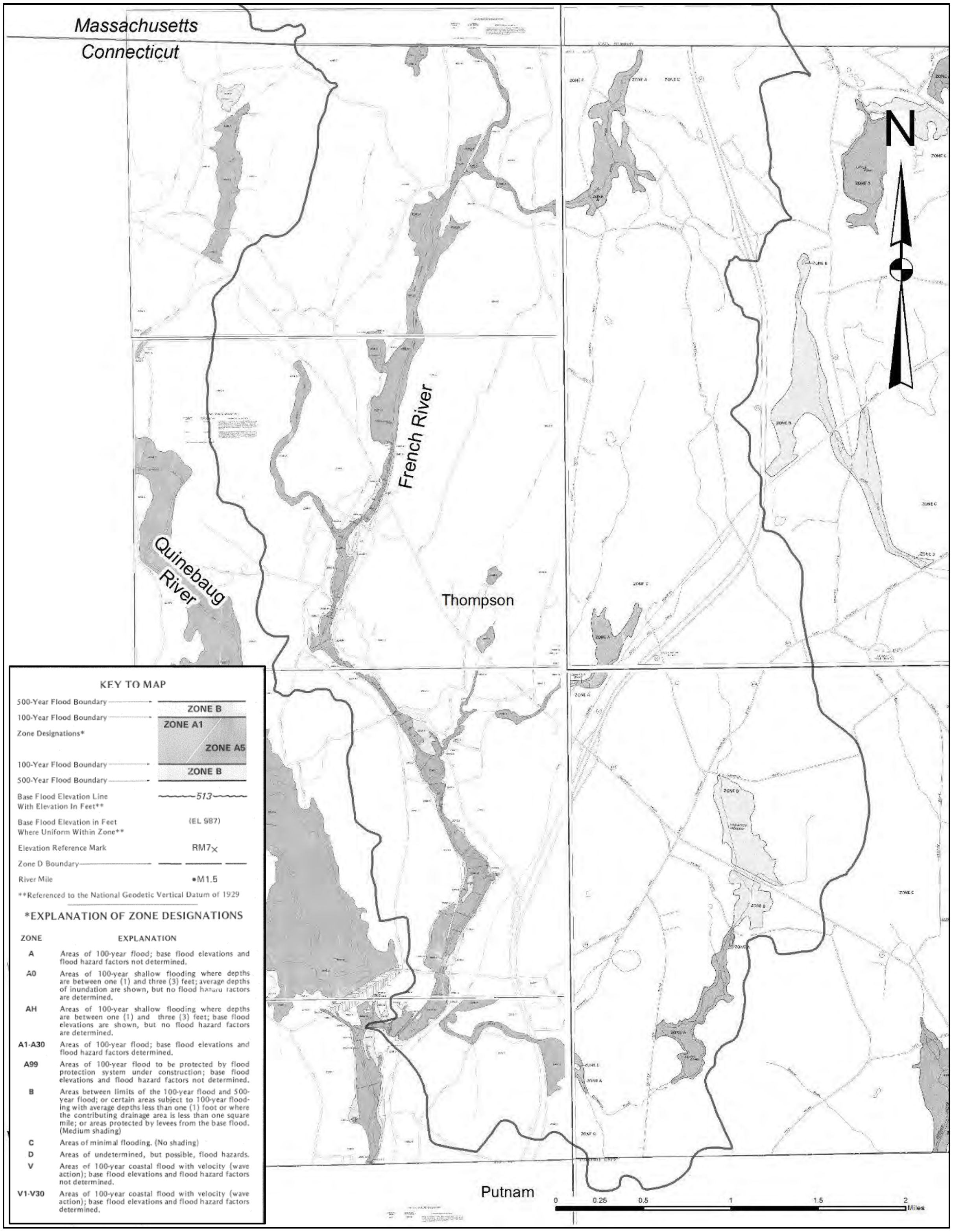


Figure 3-26. FEMA flood zones in the French River watershed in Thompson, CT.

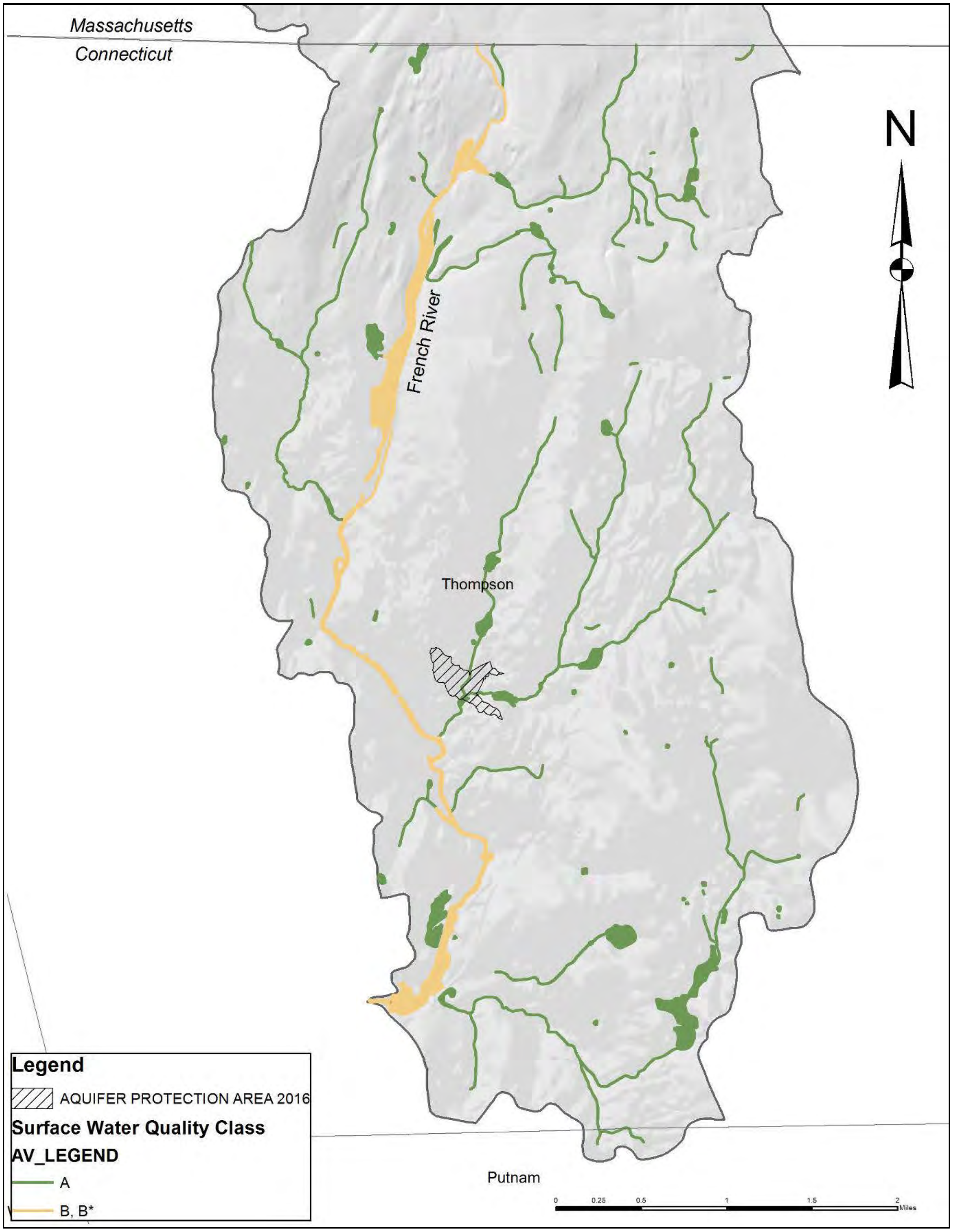


Figure 3-27. Surface water classification

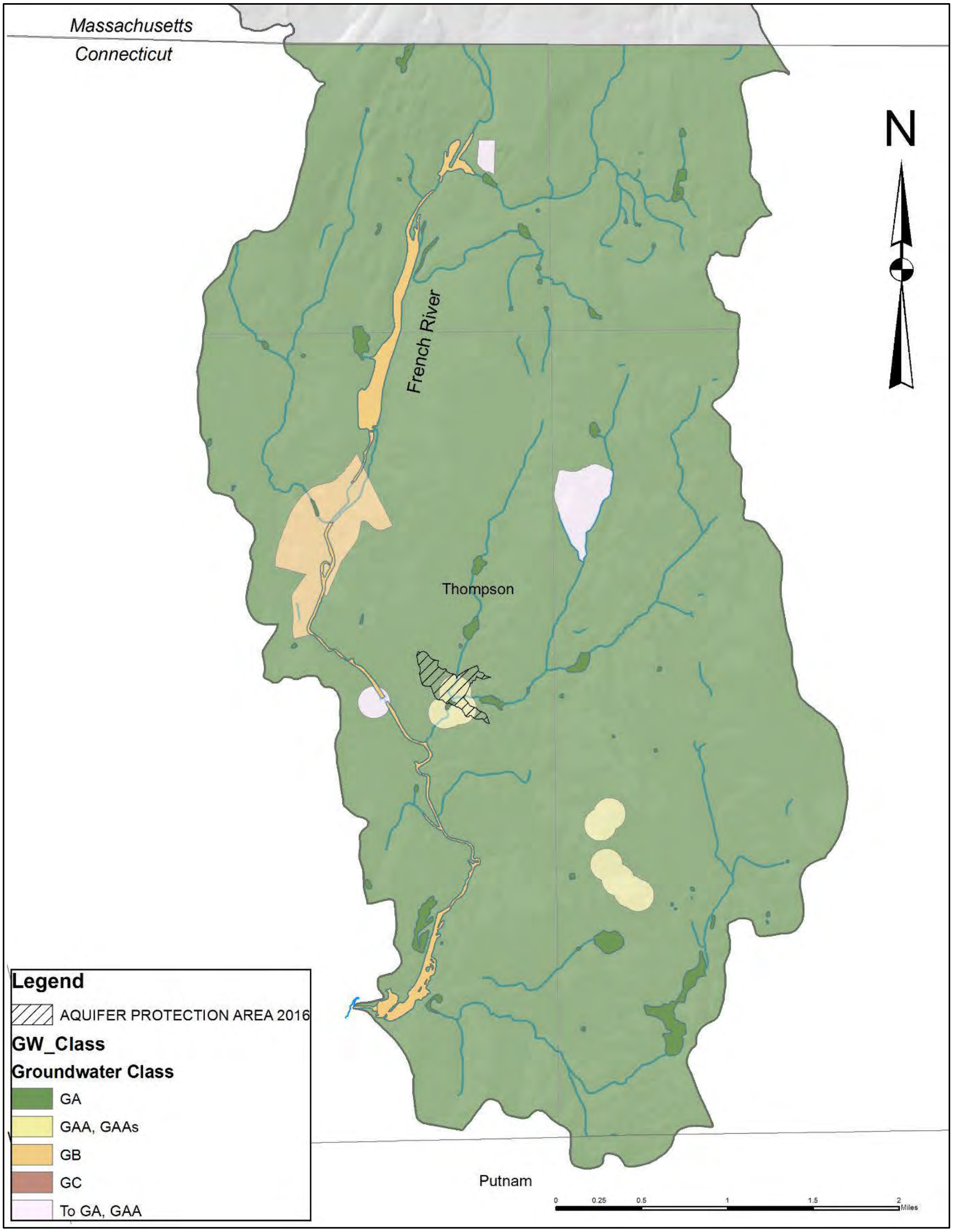


Figure 3-28. Groundwater classification and aquifer protection area.

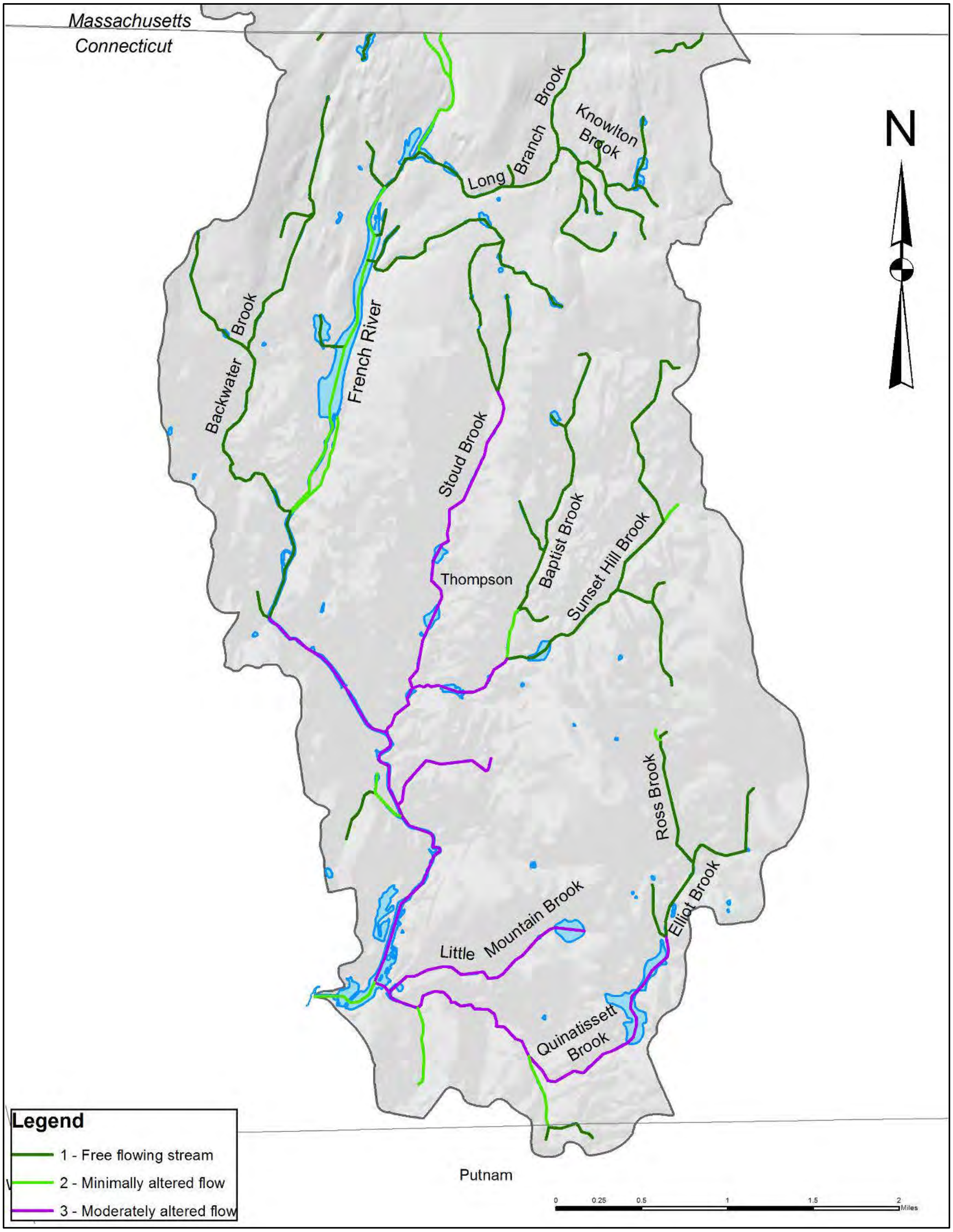


Figure 3-29. Stream flow classifications for streams in the French River watershed in Connecticut (CT DEEP, 2016).

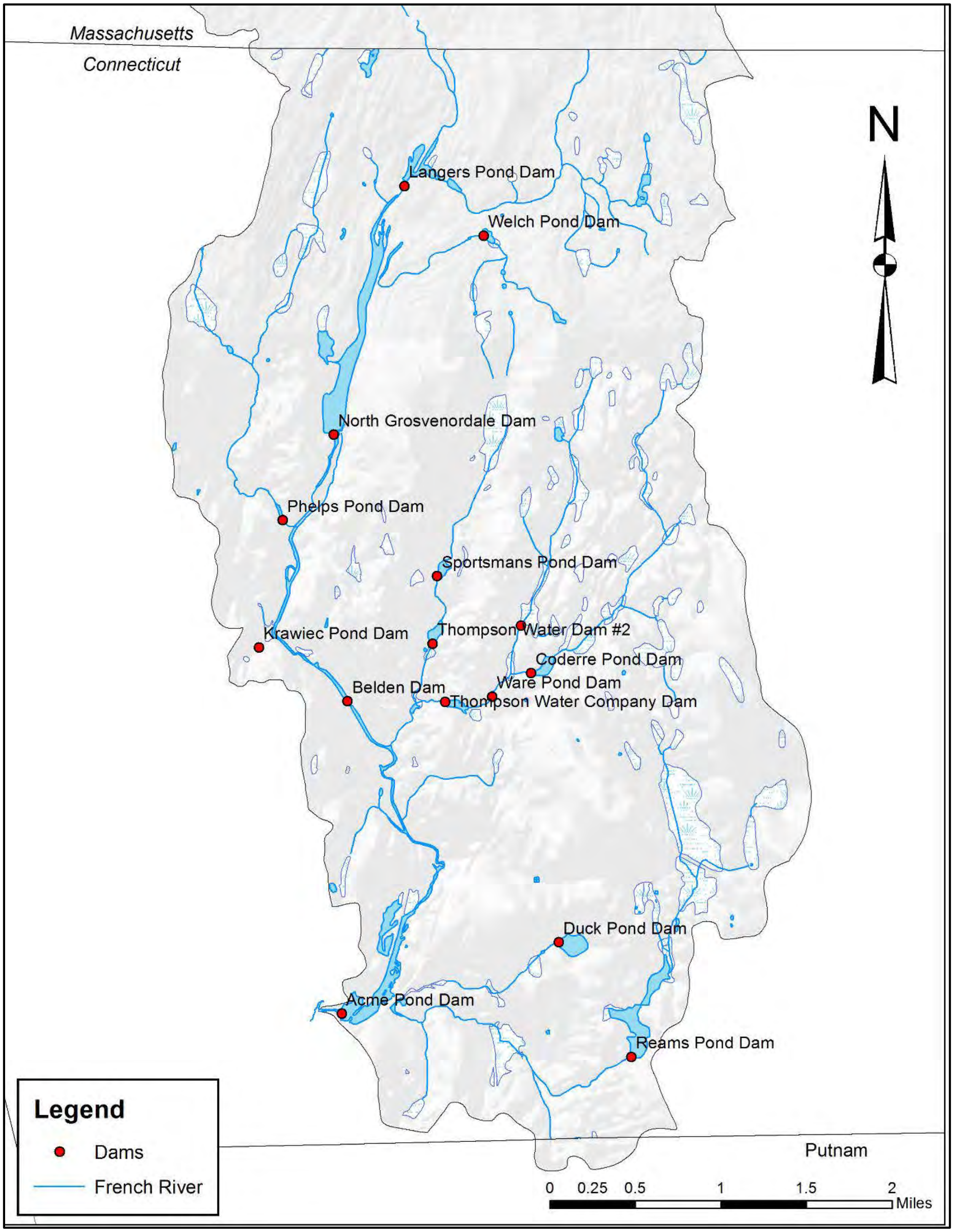


Figure 3-30. Dams in the French River watershed in Thompson, CT (CT DEEP 19xx).

3.2.3. Wildlife and Fisheries

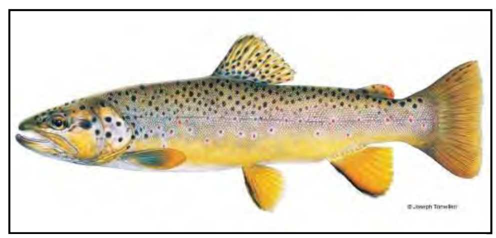
3.2.3.1. Wildlife

Connecticut is located at the intersection of two ecological regions of the Eastern Broadleaf forest province, the lower New England - Northern Appalachian Piedmont section and the North Atlantic Coast ecoregion. As a result, Connecticut contains a highly diverse landscape shaped by terrestrial and marine influences, that in turn supports a highly diverse variety of animal species, including some that are at the northern or southern limit of their natural ranges (CT DEEP, 2015). According to CT DEEP's 2015 Connecticut Wildlife Action Plan, the state's "physiographic gradient and associated regional climatic differences provided a complex ecological framework that supports 84 species of mammals, 335 species of birds, 50 species of reptiles and amphibians, 169 species of fish and an estimated 20,000 species of invertebrates."

Due to its primarily rural character, coupled with large undeveloped forest tracts, the French River watershed provides habitat for a wide variety of animal species common to southern New England, from amphibians and reptiles, to birds and mammals. The 2015 Connecticut Wildlife Action Plan cites habitat fragmentation from road and waterway barriers (such as dams and culverts) and land conversion as two of the greatest threats to wildlife (CT DEEP, 2015). In addition, the Plan identifies inadequate wetland buffer zones as a primary cause for the loss of biodiversity and water quality impacts.

3.2.3.2. Fisheries

The French River is a popular recreational trout stream and is stocked annually by CT DEEP. DEEP typically stocks about 700 adult brown trout and 400 rainbow trout in the French River annually (DEEP 2016 Fish Stocking Report).



http://www.vtfishandwildlife.com

Inland fishery surveys conducted by CT DEEP, most recently in 2014, indicate a thriving warm water (75°F - 85°F) fishery throughout the French River, due in no small part to the multiple impoundments along the length of the river (Neal Hagstrom, CT DEEP, personal communication, 2017). Common fish species include American eel (*Anguilla rostrata*); many minnow species including fallfish (*Semotilus corporalis*), blacknose dace (*Rhinichthys atratulus*), and common shiner (*Luxilus cornutus*); yellow and brown bullhead (*Ameiurus natalis* and *Pomoxis nigromaculatus*, respectively); small and large mouth bass (*Micropterus dolomieu* and *Micropterus salmoides*, respectively); white sucker (*Catostomus commersoni*); and sunfish species, including bluegill (*Lepomis macrochirus*), pumpkinseed (*Lepomis gibbosus*), and black crappie (*Pomoxis nigromaculatus*).

With the exception of Long Branch Brook, the tributaries to the French River also support warm water fisheries. Typical fish species include bluegill and other sunfish species, yellow and brown bullhead, white sucker and large-mouth bass. The upper reaches of Quinatissett Brook, which is impounded at Reams Pond, supports warm water fish; however, a brook trout was documented in the lower reaches of the stream near Ballard Road in 2004. Also in 2004, wild brook trout (*Salvelinus fontinalis*) were documented in Long Branch Brook, the only substantially free-flowing stream in the watershed.

3.2.3.3. Protected Species

In 1989, Connecticut passed the Endangered Species Act (Sec. 26-303 to 26-316 of the Connecticut General Statutes). The Endangered Species Act recognizes that certain plant and animal species and their habitats have become extinct or are threatened with extinction due to human activity (Table 3-13). The Act charges the State to "…conserve, protect, restore and enhance any endangered or threatened species and essential habitat."

Table 3-13. Listed Species Risk Level Definitions.

Endangered Species:
Any native species documented by biological research and inventory to be in danger of extirpation throughout all or a significant portion of its range within the state and to have no more than five occurrences in the state, and any species determined to be an "endangered species" pursuant to the federal Endangered Species Act.
Threatened Species:
Any native species documented by biological research and inventory to be likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range within the state and to have no more than nine occurrences in the state, and any species determined to be a "threatened species" pursuant to the federal Endangered Species Act, except for such species determined to be endangered by the Commissioner in accordance with section 4 of this act.
Species of Special Concern:
Any native plant species or any native non-harvested wildlife species documented by scientific research and inventory to have a naturally restricted range or habitat in the state, to be at a low population level, to be in such high demand by man that its unregulated taking would be detrimental to the conservation of its population or has been extirpated from the state.
-State of Connecticut Endangered Species Act, 1989

Each listed species is assigned a risk level and is listed in the Connecticut Natural Diversity Data Base (NDDB). The NDDB compiles data on listed species and natural communities and maintains maps that represent their approximate locations. According to CT DEEP, these sites may include both terrestrial and aquatic plant and animal species. The Connecticut Department of Energy and Environmental Protection's Natural Diversity Database (NDDB) identifies numerous natural community types in the French River watershed, including alluvial marshes and flood plain forests along the French River and a medium fen on the Massachusetts/ Connecticut border near Perryville (Fig. 3-31). Natural communities are "…groupings of plants that occur together in recurring patterns based on soils, water, nutrients, and climate." (Snyder, 2001).

CT DEEP updates the Natural Diversity Database twice a year. Watershed managers are encouraged to review the most currently updated database to determine if new sites have been added and are encouraged to submit documentation to report sightings of state-listed species or critical habitats. For more specific information on listed species and natural communities, inquiries should be directed to CT DEEP's Natural Diversity Database program. Watershed managers should take the presence of these species in mind when planning watershed management or implementation activities. Local regulatory and advisory authorities should be aware of the presence of these species as well when reviewing land use permit applications to ensure that necessary actions are taken to protect these species, natural communities and habitats. The Natural Diversity Database website can be accessed at:

http://www.ct.gov/deep/cwp/view.asp?a=2702&q=323464&deepNav_GID=1628.

3.2.4. Sensitive Areas

Sensitive areas are those locations that contain plants, animals, and physical or geographic features that could be threatened by poor land management or unrestricted development. These may include areas with listed species and natural communities, wetlands, floodways and floodplains, riparian corridors, and areas with steep slopes, erodible soils, or other physical or cultural constraints.

Sensitive areas within the French River watershed in Connecticut include:

- **Large tracts of undeveloped land along the French River and tributary stream headwater areas**. These large tracts of undeveloped, primarily forested headwater areas contribute to high water quality in the tributary streams and protect the overall quality of water in the French River. Meriting special protection are extensive undeveloped forest tracts surrounding North Grosvenordale Pond, which is a popular location for boating, fishing, walking and picnicking. Adjacent to the pond is a large parcel that has previously been approved for a residential subdivision. The development of that parcel would diminish wildlife habitat and, without proper site design and runoff control measures put in place during and following construction, impact the water quality of the pond, which is generally good due the lack of development along its shores.

- **Alluvial marshes and floodplain forests along the French River.** Alluvial marshes and floodplain forests are influenced by seasonal inundation, and are characterized by flood-deposited sandy or nutrient-rich silty soils (CT ECO, 2011). The alluvial marshes and floodplain forests located along the French River (Fig. 3-31) provide flood water storage and attenuation, protected corridors and habitat for wildlife, and scenic vistas that enhance the rural character of the watershed.
- **Medium fen in the north part of the watershed**. Medium fens are surface or groundwater-fed peatlands that often occur as transitional zones between swamps and upland habitats. They are typically dominated by sedges and may support a dwarf shrubland or grassland habitat that is characterized by a specific plant community adapted to the acidic, nutrient-poor conditions (Edinger et al, 2014). This medium fen (Fig. 3-31) is the only one of its kind documented by DEEP in in the French River watershed in Thompson, which merits special protection.
- **Farmland soils**. Approximately 55% of soils in the French River watershed in Connecticut are designated as farmland soils (Fig. 3-23). According to the American Farmland Trust (www.Farmland.org) farmland soils provide multiple benefits. Farmlands produce the food we eat, and local farms produce locally- sourced products that support local businesses, including farm stands and farmers markets, restaurants, grocery and specialty stores, and tourism destinations. Farmlands provide habitat for a multitude of animal species, including many that require the specific habitat provided by open land to thrive. Farmlands can also provide clean air and water benefits. Once farmland soils are converted to other uses, those benefits are lost forever.
- **Highly erodible soils**. Highly erodible soils in the French River watershed in Connecticut are found primarily along the French River and several tributaries, including Backwater Brook, Long Branch Brook and Stoud Brook (Fig. 3-32). These soils are susceptible to erosion when disturbed by activity such as land clearing, excavation/construction, forestry activities and tillage, which may result in the transportation and deposition of eroded sediments into wetlands and waterways.
- **High impervious cover (IC) areas in Thompson's MS4 area**. Developed landscapes with high percentages of impervious cover contribute significant amounts of NPS-contaminated runoff to waterways. Impervious cover consists of hard surfaces likes roofs, roads, parking lots, and driveways that prevent rain water from soaking into the ground. There are a number of businesses, neighborhoods and institutions in the village of North Grosvenordale that have high levels of impervious cover. Stormwater runoff from those areas flows into the French River, which can diminish water quality in the river.

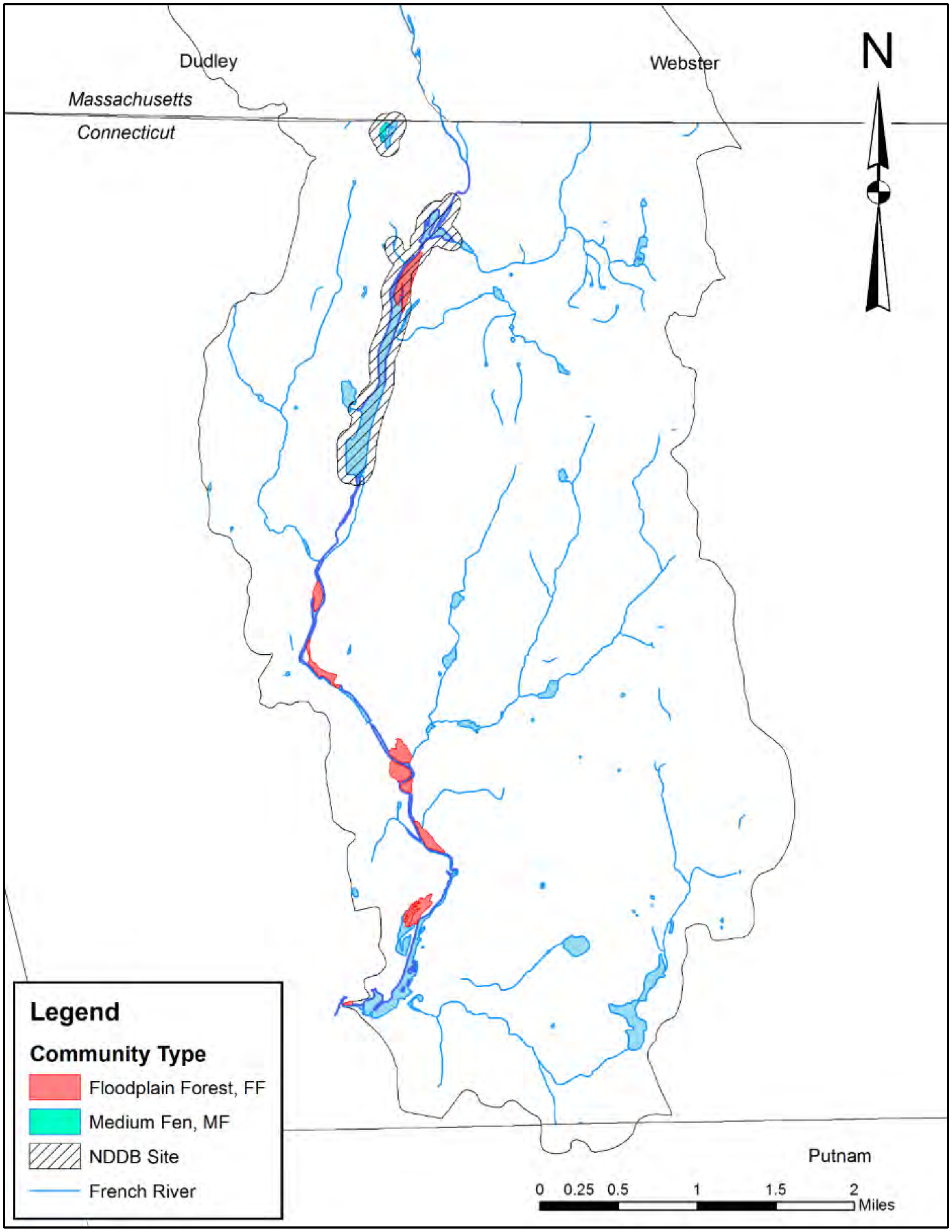


Figure 3-31. National Diversity Database (NDDB) and critical habitat sites in the French River watershed (CT DEEP, 2016).

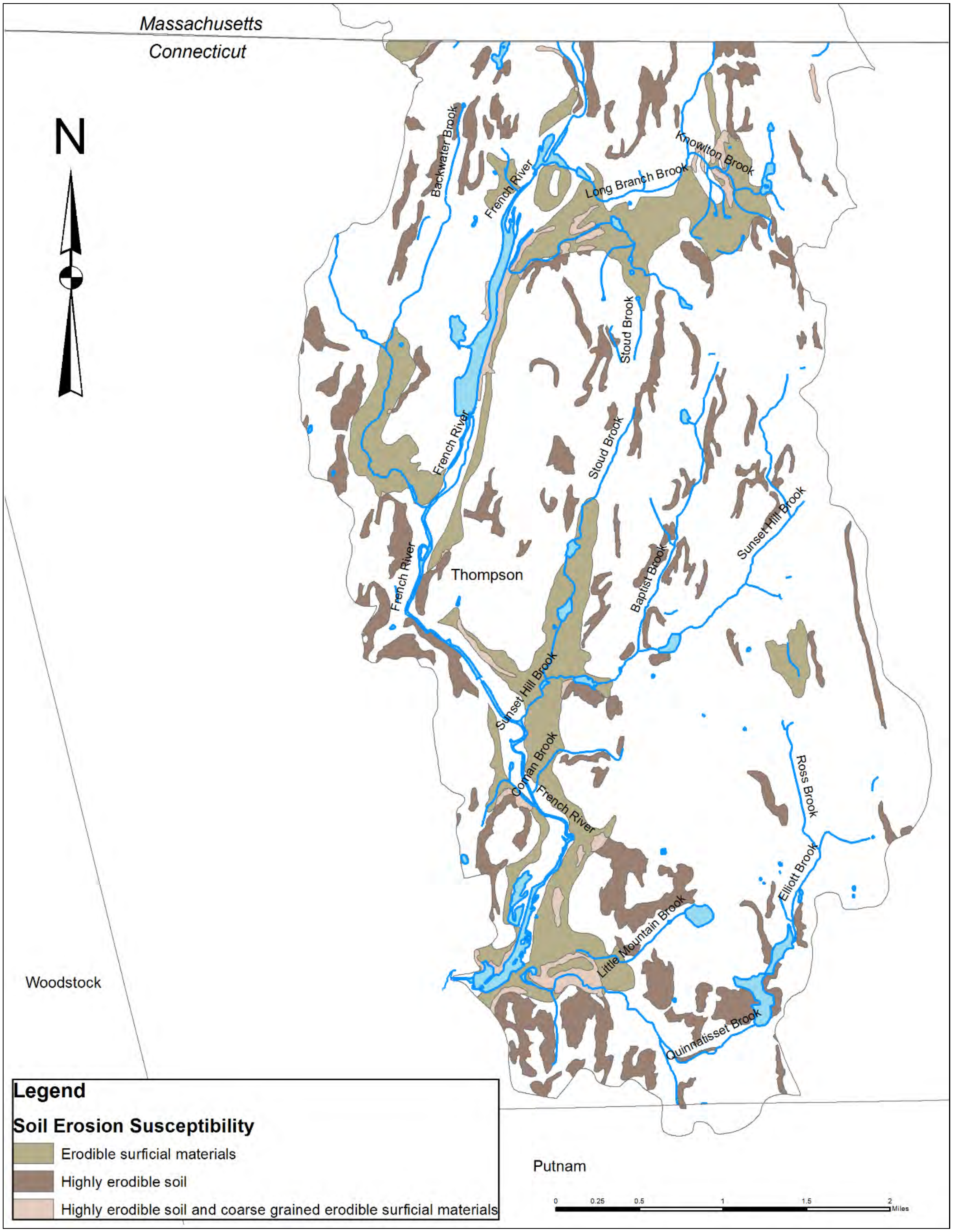


Figure 3-32. Erodible soils in the French River watershed in Connecticut.

3.2.5. Land Use and Land Cover

The character of a community is defined by the nature of its land cover and how the land is used. Whether a landscape is developed and how that development is distributed across the landscape can affect not only the aesthetic qualities of place, but also the quality of the land, air and water, all of which contribute to quality of life. The following section characterizes land cover types in the French River watershed in Connecticut and how the land is used.

The French River watershed in Connecticut is predominantly rural (Figs. 3-33 and 3-34). Land cover in the watershed is dominated by undeveloped deciduous and coniferous forests (61%). Developed land (defined as residential, commercial and/or industrial development, and paved surfaces) and turf grass areas associated with developed land, comprise approximately 21% of the watershed (Table 3-14). About 7% of the watershed is used for pasture, hay and cropland. Approximately 10% of the watershed is comprised of wetlands and waterbodies.

Table 3-14. Land Use and Land Cover in the French River Watershed (CLEAR, 2014).

Land Cover Class	Area (acres)	% Watershed
Developed	1,589	15%
Turf & Grass	643	6%
Other Grasses	191	2%
Agricultural	580	5%
Deciduous Forest	5,713	52%
Coniferous Forest	982	9%
Water	255	2%
Non-forested Wetland	167	2%
Forested Wetland	668	6%
Barren Land	60	0.6%
Utility Corridor	35	0.3%
Total	10,883	100%

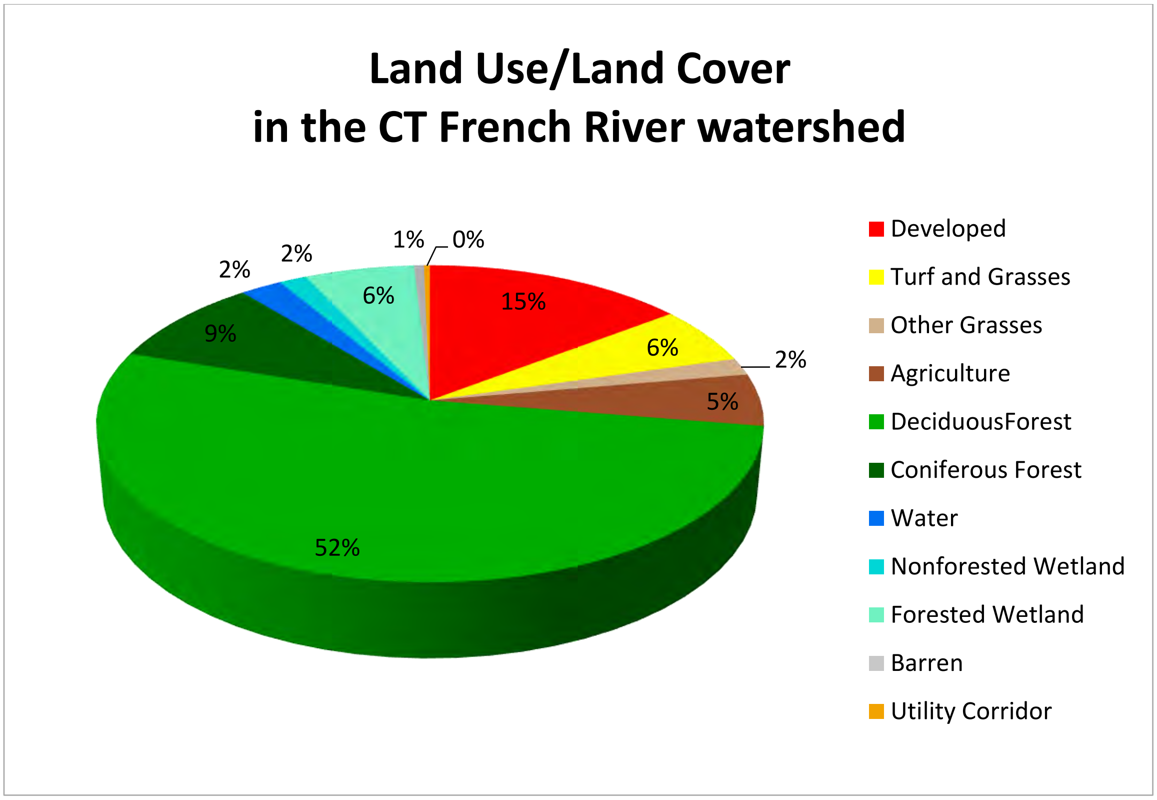


Figure 3-33. Percentages of land use and land cover in the French River watershed in Connecticut (CLEAR, 2014).

3.2.5.1. Developed Areas

Developed areas are defined as areas with impervious surfaces (buildings, roof tops, roads, parking lots and sidewalks) which prevent rainwater from infiltrating into the ground. Rainwater that lands on impervious surfaces typically flows along the ground from these areas, is directed into storm drain systems and is then discharged to areas where it can soak into the ground or flow into nearby waterbodies. Developed land, including residential, commercial and/or industrial properties, paved surfaces, and associated lawns areas, comprises approximately 21% of the French River watershed. The majority of the watershed is lightly developed, and is characterized by undeveloped backland with rural residential development along road frontages. Development increases in density along the Route 12 corridor in North Grosvenordale, which is the most densely developed village center in Thompson, and is characterized by mixed single and multi-family residences, interspersed with commercial and industrial development, focused in and around the industrial-era mills.

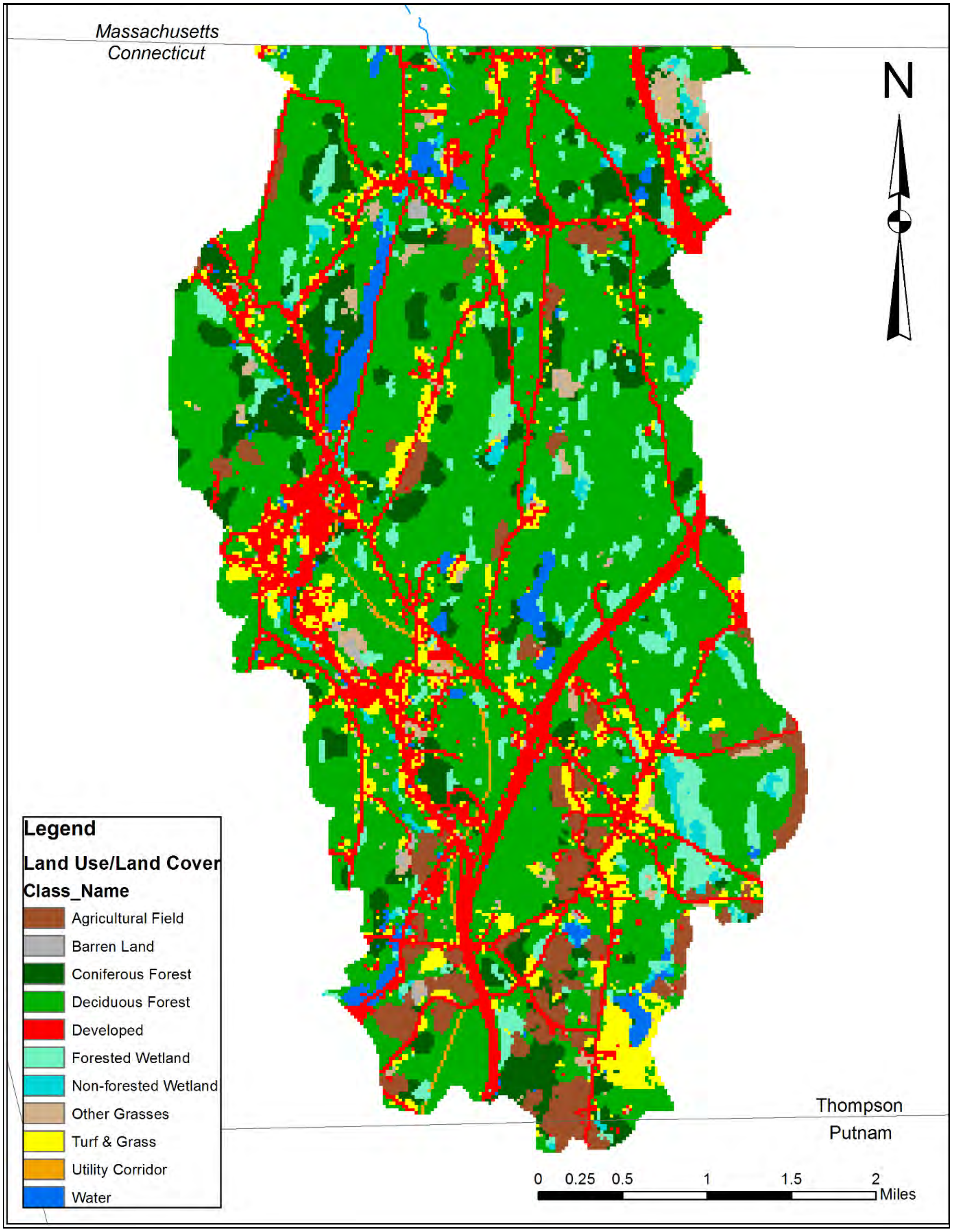


Figure 3-34. Land use/land cover in the French River watershed in Connecticut (CLEAR, 2014).

3.2.5.2. Transportation

There are approximately 78.1 miles of roadway in the French River watershed in Connecticut. There are 43.6 miles of local surface roads owned and maintained by the Town of Thompson. There are 27.2 miles of state highway, including State Routes 12, 21, 131,193 and 200, and 7.3 miles of interstate highway (Interstate Route 395), which are maintained by the Connecticut Department of Transportation. There are approximately 8 miles of rail line, owned and maintained by Providence & Worcester Railroad (now the Genesee and Wyoming Railroad).

3.2.5.3. Open Space

Protecting and preserving open space is an important component of watershed planning. Open spaces provide ecosystem services including oxygen production, carbon sequestration and rain water purification and infiltration. Large tracts of undeveloped land can and often do provide habitat and migration corridors for wildlife. Human benefits provided by open space include recreational opportunities for residents as well as aesthetic values. Undeveloped areas are often included in the open space category, although undeveloped does not equal protected. Approximately 77% of the French River watershed is undeveloped; however, this includes land that could be developed, including agricultural and forest land. There are approximately 399 acres of protected open space in the French River watershed (Fig. 3-35). This land is owned or managed variously by the Town of Thompson, as either municipal properties or private land held under conservation easements, the federal government (West Thompson Lake flood control facility), the State of Connecticut (Airline State Park Trail) and private landowners. An additional 195 acres of unprotected open space is held by the Town (school and recreational areas) and private entities (cemeteries).

3.2.5.4. Recreation

There are many publicly accessible outdoor or nature-based recreational opportunities in the French River watershed. A portion of the State of Connecticut's Airline Trail passes through the French River watershed (Fig 3-35) and connects to other recreational trails in the region. The 1.6 mile-long North Grosvenordale River Walk, located along the French River in North Grosvenordale, is handicap-accessible. Boating and kayaking opportunities are available on the French River, North Grosvenordale Pond and Mechanicsville Pond. The French River is stocked annually by CT DEEP for anglers. Other fishing opportunities are available on privately owned ponds by permission and at Valley Springs Sportsman's Club (via membership). The Thompson Trail Committee maintains trails throughout the town and offers recreational activities throughout the year, as does the Thompson Recreation Commiission. Digital trail maps are available on the town website at http://www.thompsonct.org/index.php/departments-157/planning-development/parcel-map.html and paper maps are available at the Town Hall.

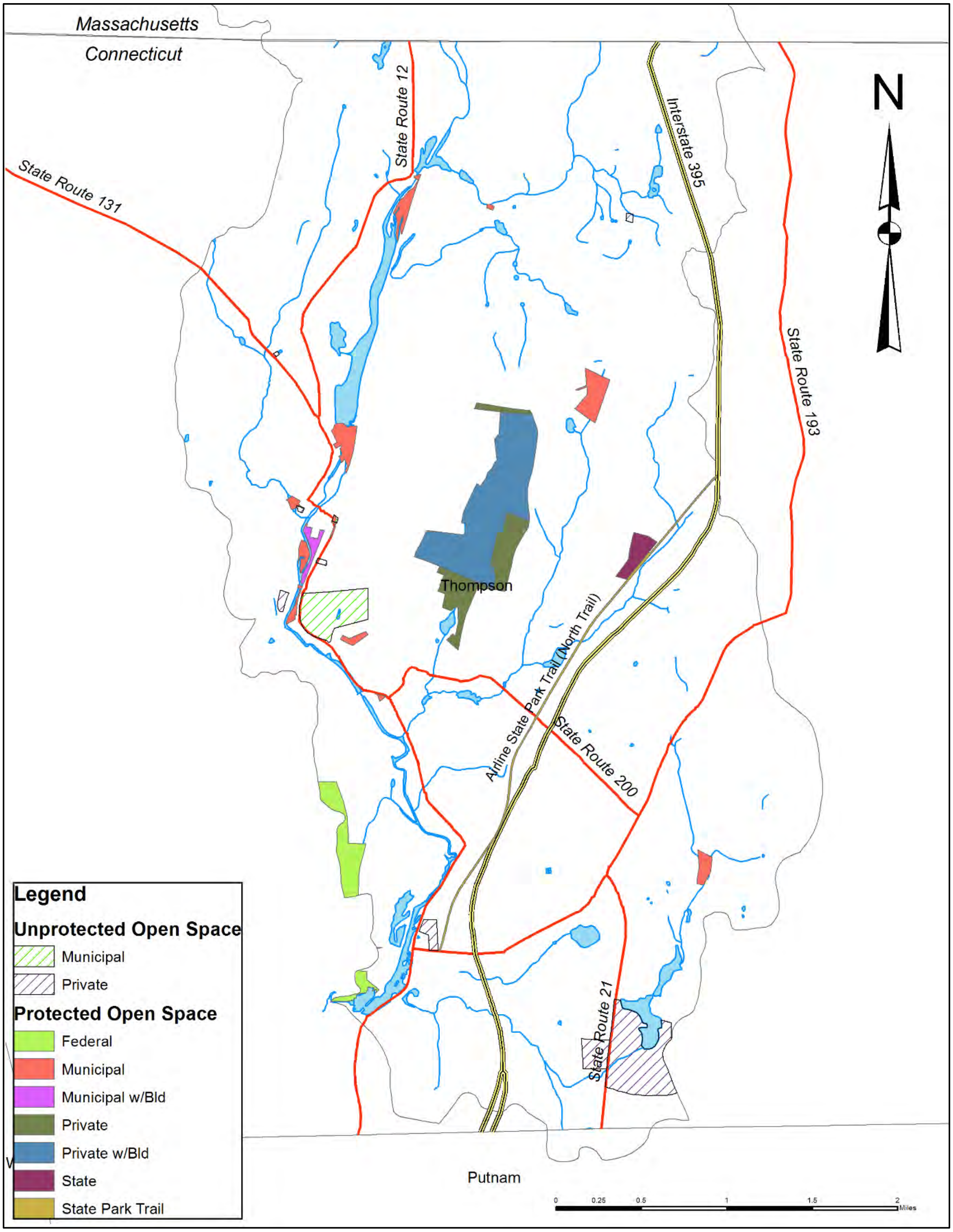


Figure 3-35. Open Space in the French River watershed in Connecticut (CT DEEP 2011).

3.2.5.5. Forests

CLEAR land cover data (CLEAR, 2010) indicates that approximately 61% of the French River watershed in Connecticut is forested. Forest cover is composed primarily of deciduous broadleaf trees (5,713 acres) with scattered stands of conifers (982 acres).

A 2009 study conducted by the CLEAR evaluated forest fragmentation, the fracturing of large forest blocks into smaller and smaller pieces as a result of development, throughout Connecticut (Wilson and Arnold, 2009). The CLEAR study evaluated various categories of forest cover, including core forest, perforated forest, edge forest and patch forest to determine levels of fragmentation. Although nearly two-thirds of the French River watershed is forested, quantity of forest does not necessarily guarantee quality of forest. The fragmentation of forest land can be detrimental to many species of wildlife, especially those that require large tracts of undisturbed forestland to thrive. Fragmentation can also affect ecosystem services associated with forests, including clean air, water and carbon sequestration; the viability of forest products; habitat quality for wildlife, especially species that require core forest to thrive; and recreation opportunities.

Table 3-15. Forest Fragmentation Category Descriptions.

Core Forest:
Intact forest blocks 100 meters or more from the forest/non-forest boundary.
Perforated Forest:
Small clearings within a forested landscape.
Edge Forest:
The forested area located within the 100-meter boundary between core forest and non-forested land.
Patch Forest:
Small forested areas surrounded by non-forested areas that are isolated from core forests. - CLEAR, 2009

According to the CLEAR study, between 1985 and 2006, core forest has decreased state-wide by 3.6%, and by 15.5% in Thompson as a whole. An analysis of forest fragmentation from 1985 to 2010 in the French River watershed by ECCD, utilizing CLEAR methodology, indicates that total core forest in the watershed has decreased by 17% (Table 3-16), and that core forest blocks greater than 500 acres no longer exist in the French River watershed.

For more information about forest fragmentation, visit the CLEAR webpage at:
http://clear.uconn.edu/projects/landscape/forestfrag/index.htm.

Table 3-16. Change in Forest Fragmentation in the French River watershed in Connecticut from 1985 to 2010.

Forest Class	1985 Forest Class Area (Ac)	2010 Forest Class Area (Ac)	Change in Forest Class (Ac)	% Change
Patch Forest	405.4	601.5	196.1	48
Edge Forest	3596.4	3348.3	-248.2	-7
Perforated Forest	859.5	904.0	44.5	5
Core Forest (<250 acres)	2170.6	1758.7	-411.8	-19
Core Forest (250-500 acres)	282.4	750.2	467.9	166
Core Forest (>500 acres)	575.5	0.0	-575.5	-100
Total Core Forest	3,028.5	2,509.0	-519.5	-17

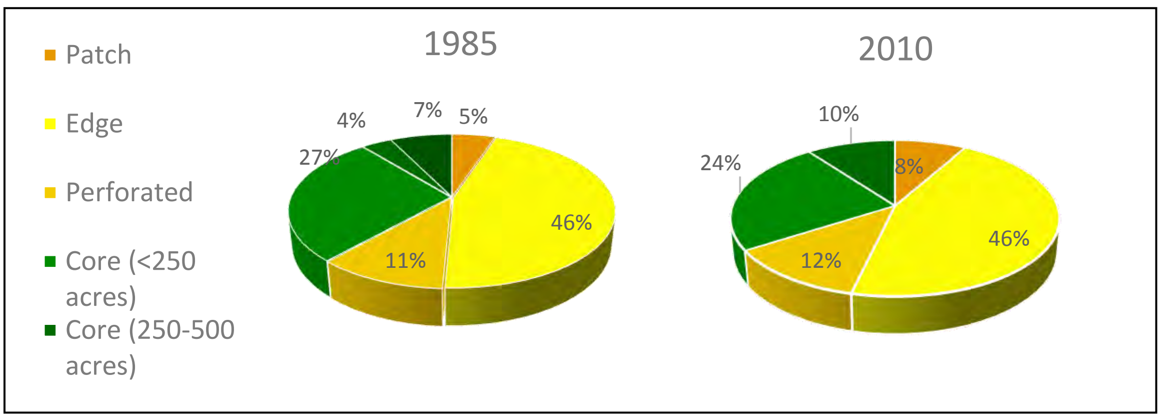


Figure 3-36. Forest fragmentation in the French River watershed in Connecticut from 1985 to 2010 (based on methodology and data from CLEAR, 2009).

3.2.5.6. Wetlands

Approximately 10% (1090 acres) of land cover in the French River watershed in Connecticut is classified by CLEAR as wetlands. Of that, 255 acres are identified as open water; 668 acres are identified as forested wetlands; and 167 acres are identified as non-forested wetlands. Land use change between 1985 and 2010, as depicted in Table 3-17 indicates an 18% loss of wetlands in the French River watershed.

3.2.5.7. Agriculture

Approximately 5% (580 acres) of the French River watershed is under agricultural use. Agriculture in the watershed is located primarily in the southeastern portion of the watershed along Chase Road, Chase Road Extension, and County Home Road (State Route 21), although there are scattered hay and corn fields throughout the watershed, some of which support agricultural operations located outside the watershed. Agricultural products include vegetables, microgreens, bedding plants, cut flowers, gourds, hay, sweet corn and silage corn.

3.2.6. Changes in Land Use

A study conducted by CLEAR evaluated changes in land cover from 1985 to 2006 (CLEAR, 2008). ECCD utilized the CLEAR protocol to evaluate changes in land use in the French River watershed in Connecticut from 1985 to 2010. The evaluation indicates that the amount of developed land in the French River watershed in Connecticut (including turf and grass areas) has increased by 46%, land under cultivation has remained stable, and the amount of forest and wetlands have decreased 15% and 18%, respectively (Table 3-17). The increase in "other grasses," which includes grassy areas along transportation corridors, forested clear-cut areas and agricultural fields converting to scrub/shrub, may be related to land clearing for development. The significant increase in barren land is likely related to an increase in gravel and bedrock mining in the French River watershed since the mid-2000s.

Table 3-17. Change in land cover between 1985 and 2010 in the French River watershed in Connecticut (CLEAR, 2012).

Land Cover Class	1985 Land Cover (acres)	2010 Land Cover (acres)	Land Cover Change (acres)	% Change
Developed	1,327	1,589	262	20%
Turf & Grass	508	643	135	26%
Other Grasses	67	191	123	183%
Agricultural Field	580	580	0	0%
Deciduous Forest	6,125	5,713	-412	-7%
Coniferous Forest	1,062	982	-81	-8%
Water	290	255	-35	-12%
Non-forested Wetland	169	167	-2	-1%
Forested Wetland	704	668	-36	-5%
Barren Land	10	60	50	482%
Utility Corridor	39	36	-3	-9%

3.3. Demographic Characteristics

3.3.1. Cultural Resources

The Town of Thompson has a rich cultural heritage that spans the pre-colonial and colonial eras. Among cultural treasures "…that have endured since colonial and pre-colonial times are [sic] bermed chambers, cairns and burial mounds, early industrial mill buildings and artifacts of same, early mill housing, old churches, old barns and farm structures, old houses and school houses, rural roads bounded by fieldstone walls and/or mature trees, and scenic vistas and viewsheds," (Thompson Open Space and Conservation Plan, 2005).

The town is named after Sir Robert Thompson, an Englishman who purchased a two-thousand-acre tract of land east of present-day Thompson Hill in 1683. The first farms were laid out in 1684, and the first documented settler purchased a farm near the confluence of the French and Quinebaug Rivers in 1707 (Partridge, 2011). Miles of stonewalls that run along roadsides and through watershed woodlands are remnants of those early farm fields and pastures.

Prior to settlement by English colonists, the area was part of the territories of the Quinatissett Nipmuck and Narragansett Indians. Early records identify a Nipmuck fortification on a hill east of Thompson Hill, now known as Fort Hill. The Thompson Plan of Open Space and Conservation also identifies numerous archaeological sites throughout the French River watershed, including cairns and standing stones scattered throughout the woodlands that may be pre-colonial in origin. The Nipmuck tribe, now known as the Chaubungamaug Nipmuck Indians, have a small unofficial reservation in the French River watershed near the Massachusetts state line, and are recognized in Massachusetts.

Within the French River watershed are a number of villages, each with its own distinct character. Notable among them are the Thompson Hill and the village of North Grosvenordale. Thompson Hill formed at a cross road during the colonial era and for many years was the cultural and governmental center of Thompson. A portion of Thompson Hill is part of the Thompson Common Preservation District (Fig. 3-37), and was listed on the National Register of Historic Places and Connecticut State Registry of Historic Places in 1987. The Preservation District is represented by numerous historical structures, including houses, out-buildings, a historic tavern, the former town hall, and congregational church, representing a variety of architectural styles, from Colonial, Federal and Greek Revival to Victorian styles, including Italianate, Queen Anne and Gothic Revival (www.livingplaces.com).

The character of the mill village of North Grosvenordale is defined by thread mills that grew up along the French River in the mid- to late 1800s, including the River Mill (formerly the Grosvenor-Dale Company mill), which is the heart of the North

Grosvenordale Mill Historic District. The North Grosvenordale Mill Historic District (Fig. 3-37), which was listed in 1993, includes the mill, the mill pond dam, dam works, French River and canal, former mill housing along State Route 12, Buckley Hill Road, Floral Avenue, Market Lane, and Marshall, Central, River, and Holmes Streets (colloquially known as Swede Village, Greek Village, and Three Rows), the North Grosvenordale Methodist Church, and the North Grosvenordale Mill Store (Stutts, 2014).

3.3.2. Population/Economics

Thompson, Connecticut was incorporated in 1785. Thompson, CT is located in Windham County and is part of the Northeast Connecticut Planning Area and the Northeast Economic Development Region. Local government is by town meeting, and is administered by a board of selectmen.

The town encompasses a land area of 47 square miles. The population in 2014 was 9,390, yielding a population density of 200 people per square mile. According to 2014 census data, ninety-six percent (96%) of the population identifies as white, <1% as black, <1% as Asian/Pacific, 1.6% as Hispanic and 2.2% as multi-race or other ethnicity. The median age is 43 years old. Of residents 25 years or older, 37% have a high school degree, 11% have an Associate’s degree, and 21% have a Bachelor’s degree or higher. Labor statistics indicate that the unemployment rate in 2014 was 6.1%, which was lower than county and state averages.

Local industries include construction, manufacturing, retail trade, accommodation/food services, health care & social assistance, and government, including municipal government and the public school system. Major employers include the Town of Thompson (including the public school system), Superior Bakery, and NUMA Tool. Median household incomes are greater than the county average and approximately 3.5% less than the state average (Connecticut Economic Resource Center, 2016).

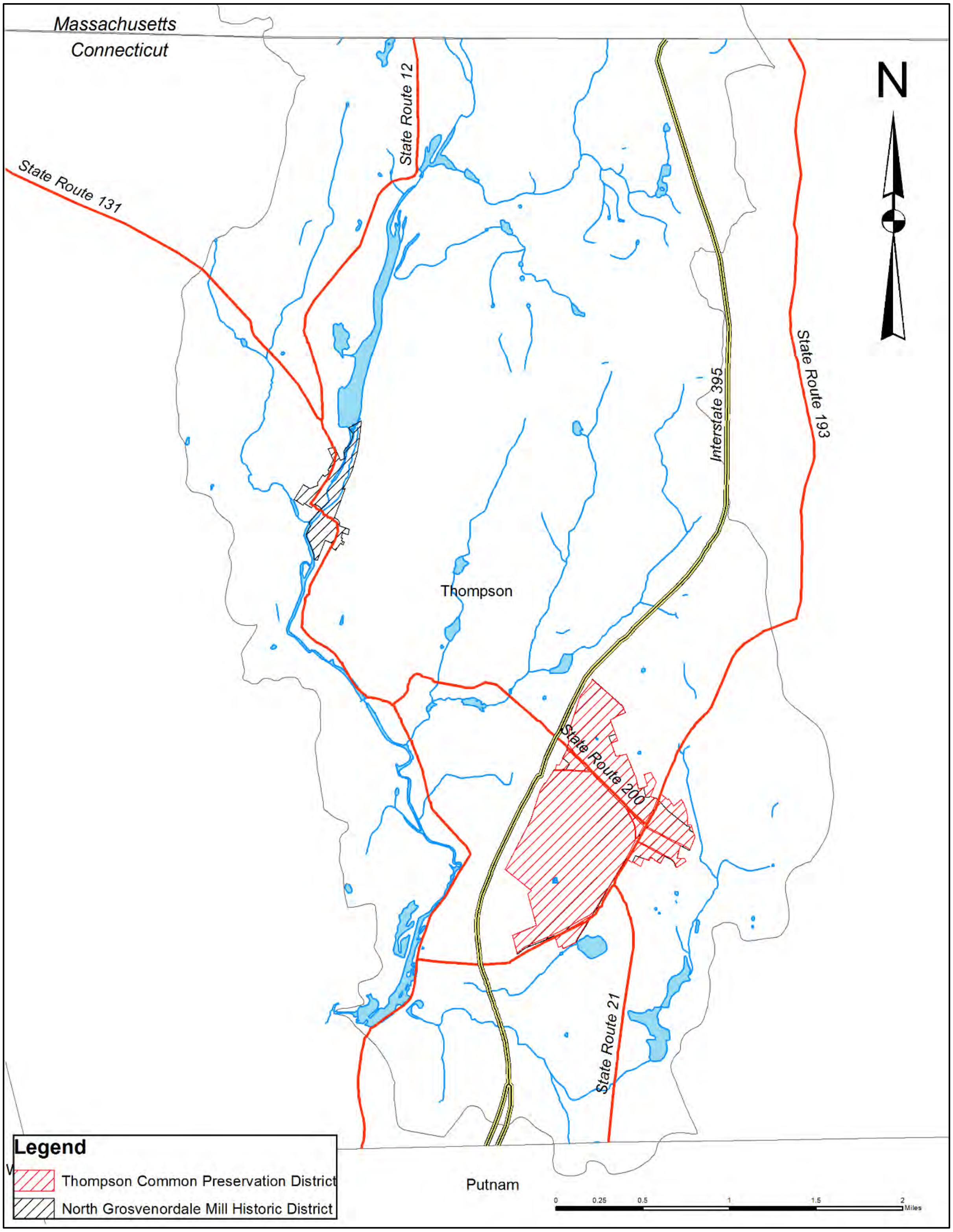


Figure 3-37. National Register of Historic District Sites in the French River watershed in Connecticut.

3.4. Land Management Policies

Land management policies determine how land is used, developed and protected. Documents such as land use plans, policies and regulations provide a framework for land use managers to guide development while protecting important natural and cultural resources. Land use planning determines the "character of place" by identifying what aspects of a landscape are important or significant and providing guidance to protect, preserve and enhance those qualities.

Land management in Connecticut occurs on multiple administrative levels, from state to regional to local levels. Land management policies, especially in the form of municipal land use regulations, can play a significant role in the protection of water quality and other natural resources. When land use planning policies and goals are designed to be consistent on local, regional and state levels, land use planning is at its most effective. As a consequence, local land use planners should review regional and state-level guidance documents and work with regional and state agencies to ensure that planning goals align.

This section reviews and summarizes existing planning documents that affect and influence land use and development and water quality protection in the French River watershed.

3.4.1. Federal-level Planning Policies

3.4.1.1. USEPA Final Environmental Impact Statement for the French River Cleanup Program in Massachusetts and Connecticut

The Final Environmental Impact Statement for the French River Cleanup Program in Massachusetts and Connecticut (January 1987) was prepared to improve water quality in the French River. The objective of the Environmental Impact Statement (EIS) was to evaluate feasible alternatives for achieving water quality goals in the French River, and to identify a plan for implementing the recommendations. Water quality problems identified in the document include extreme low flows and trapped polluted sediments (including nutrients and heavy metals) behind multiple industrial-era impoundments that contribute to low dissolved oxygen levels. EIS recommendations include "augmenting low flow from Buffumville Lake (a US Army Corps of Engineers flood control facility), channel excavation in and wetland isolation at Perryville and Langers Ponds, sediment excavation at the North Grosvenordale Pond impoundment, and instream aeration at the North Grosvenordale impoundment."

In addition to providing recommendations to improve water quality in the French River in Massachusetts and Connecticut, the EIS also provides a comprehensive review of watershed conditions and pollutant sources that may provide substantial guidance to watershed managers.

3.4.2. State-Level Land Planning Policies

3.4.2.1. State of Connecticut

The State of Connecticut conducts state-wide land use planning through the Office of Policy and Management (OPM). The State Plan of Conservation and Development serves as the official state policy in matters pertaining to land and water resources conservation and development, and directs and informs decision making by the executive branch of state government. The *2013-2018 Conservation & Development Policies: The Plan for Connecticut*, prepared by the Office of Policy and Management in accordance with Connecticut General Statutes Section 16a-29, identifies six growth management principles (GMPs) to direct growth and development throughout the State of Connecticut. GMPs that apply to land use planning in the French River watershed in Thompson include:

- Growth Management Principle #2 - Expand Housing Opportunities and Design Choices to Accommodate a Variety of Household Types and Needs. State agency policies under this principle include support for the "adaptive reuse of historic and other existing structures for use as residential housing"; identification of **"**innovative mechanisms, utilizing decentralized or small-scale water and sewage systems, to support increased housing density in village centers and conservation subdivisions that lack supporting infrastructure"; and the encouragement and promotion of "access to parks and recreational opportunities, including trails, greenways, community gardens and waterways, for affordable and mixed-income housing."

- Growth Management Principle #4 - Conserve and Restore the Natural Environment, Cultural and Historical Resources, and Traditional Rural Lands, which promotes the protection of natural and cultural resources, identifies the presence of protected lands, large tracts of wetland soils (> 25 acres), core forest areas (>250 acres) and critical habitat (forested flood plains) in the French River watershed.

- Growth Management Principle #5 - Protect and Ensure the Integrity of Environmental Assets Critical to Public Health and Safety provides for the identification and protection of drinking water sources, including the utilization of **"**an integrated watershed management approach to ensure that high quality existing and potential sources of public drinking water are maintained for human consumption

3.4.2.2. Connecticut Department of Transportation

The Connecticut Department of Transportation (CTDOT) manages approximately 34.5 miles of highway in the French River watershed, including 27.2 miles of state highway (State Routes 12, 21, 131,193 and 200), and 7.3 miles of interstate highway (Interstate Route 395).

CT DEEP, under the authority of the National Pollutant Discharge Elimination System (NPDES) and Connecticut General Statutes Section 22a-430 and 22a-430b, has issued a *General Permit for the Discharge of Stormwater from the Department of Transportation Separate Storm Sewer Systems*. This general permit, which was issued on January 22, 2016 and became effective on July 1, 2017, provides coverage for DOT separate storm sewer systems in order to protect waters of the state from pollution associated with stormwater discharged through DOT storm sewer systems to impaired waters (CT DEEP, 2016).

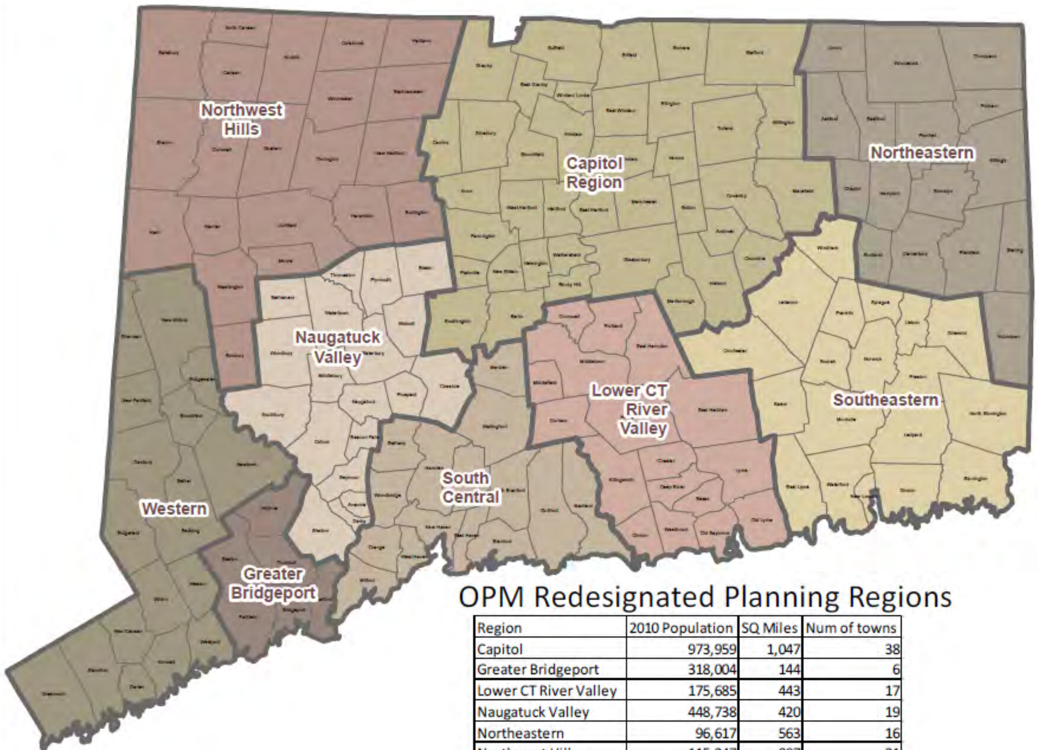
The DOT general permit requires the development and implementation of a Stormwater Management Plan (SWMP), the establishment of a stormwater monitoring program, and preparation and submission of annual reports to DEEP.

Key elements of the SWMP include:

- Public education and outreach
- Public participation
- Illicit discharge detection and elimination
- Construction stormwater management
- Post-construction stormwater management
- Pollution prevention and good housekeeping

3.4.3. Regional Land Planning Policies

Regional planning occurs through Connecticut's nine regional planning areas, each overseen by a regional planning agency (Fig. 3-38), as well as other regional organizations, such as The Last Green Valley, Inc. Thompson is a member of the Northeast Connecticut Council of Governments, located in Killingly. Connecticut's planning regions, through the Councils of Government "… provide a geographic framework within which municipalities can jointly address common interests, and coordinate such interests with state plans and programs (CT OPM, 2015)." Several key planning documents for northeast Connecticut were not available at the time of the preparation of this plan due to a recent realignment of planning regions in eastern Connecticut, including the *Northeast Connecticut Comprehensive Plan* and the *Comprehensive Economic Development Strategy*. Land managers are urged to review regional planning documents when they become available.



Region	2010 Population	SQ Miles	Num of towns
Capitol	973,959	1,047	38
Greater Bridgeport	318,004	144	6
Lower CT River Valley	175,685	443	17
Naugatuck Valley	448,738	420	19
Northeastern	96,617	563	16
Northwest Hills	115,247	807	21
South Central	570,001	374	15
Southeastern	286,711	619	19
Western	589,135	550	18

Figure 3-38. Connecticut's Planning Regions

The Last Green Valley, Inc. (TLGV) is a non-profit organization that manages the Quinebaug and Shetucket Rivers Valley National Heritage Corridor (designated by Congress in 1994). The National Heritage Corridor is comprised of 35 towns in the Quinebaug and Shetucket River watersheds, including nine towns in Massachusetts. The TLGV's planning document *Vision 2020 – The Next Ten Years* provides goals and planning strategies including:

- stewardship
- economic development and community revitalization
- cultural resources
- land use
- agriculture
- air quality
- water quality
- wildlife
- recreation

3.4.4. Municipal Land Use Policies

Planning on the local level typically has the most direct impact on how development and resource protection are managed at the community level. Local planning occurs via the preparation of municipal planning documents and is administered through land use boards or commissions. Several organizations in Connecticut offer support, technical tools, assistance and training to municipal land use commissioners and staff. These include the Center for Land Use Education and Research (CLEAR) and Connecticut Nonpoint Education for Municipal Officials (NEMO) at the University of Connecticut, the Connecticut Conservation Districts, the DEEP Inland Wetlands Management Section, the Connecticut Association of Zoning Enforcement Officials and the Connecticut Chapter of the American Planning Association.

Municipalities address land management policies through variety of documents, including Plans of Conservation and Development, which towns are required by Section 8-23 of the Connecticut General Statutes to update every ten years. Other planning documents include local ordinances and municipal land use regulations, such as planning, zoning, subdivision and inland wetlands and watercourses regulations, stormwater management plans, and watershed management plans. These regulations may be updated or amended from time to time as necessary to ensure they provide the framework necessary for the protection of water and other natural and cultural resources.

Following is a summary of land management policies in effect at the time of the preparation of this document that address water quality concerns. Readers are advised that they should contact Thompson municipal staff to obtain the most current land management regulations and policies.

3.4.4.1. Plan of Conservation and Development

A Plan of Conservation and Development is a blueprint for how a municipality wants to develop over the following 10 – 20 years and is a guide to local decision making in areas such as natural resources preservation, economic development, housing, land use and public services. The Plan documents a town's cultural and natural resources, provides guidance regarding the continued development and progress of a town, and addresses current conditions and the future needs of the citizens and the community. Section 8-23 of the Connecticut General Statutes states that "…at least once every ten years, a town shall prepare or amend and shall adopt a plan of conservation and development for the municipality. Following adoption, a town shall regularly review and maintain such plan. A town may adopt such geographical, functional or other amendments to the plan or parts of the plan, in accordance with the provisions of this section, as it deems necessary."

The *Town of Thompson Plan of Conservation and Development 2010-2020* was adopted November 23, 2009. Key recommendations in the Plan regarding the protection of water resources and open spaces include:

- Open Space Goal (Section 9.4): To wisely manage land development and carefully protect the environment so that Thompson remains a rural community with a balanced approach to sustaining its natural and cultural heritage.

- Open Space Policies & Strategies (Section 9.5):
  - Acquire land and/or conservation easements in identified resource areas
  - Develop special protections for the Quinebaug, French and Five Mile Rivers including the establishment of greenways
  - Encourage private donation of land to land trusts and other conservation organizations
  - Encourage the use of low impact development techniques including porous materials instead of impervious materials

- Open Space Action Steps (Section 9.6):
  - Review and follow the Natural Resources Inventory and guidance provided by the Town's Conservation and Open Space Plan
  - Implement the recommendations to protect the natural resources contained on sites under review for development to include establishment of greenways
  - Review existing land use regulations to identify any additional opportunities to protect Thompson's existing natural resources

- Parks & Recreation Policies & Strategies (Section 15.4): Develop a plan to protect the environment through all Recreation programs.

- Trails Policies & Strategies (Section 16.4): Support organizations that develop wildlife corridors and promote the preservation of wildlife habitat

3.4.4.2. Conservation and Open Space Plan and Natural Resource Inventory

The Thompson Conservation Commission's *Conservation and Open Space Plan* was prepared by the Thompson Open Space Study Committee in December, 2005. The *Conservation and Open Space Plan* and the *Natural Resources Inventory* are intended to compliment and further the goals of the *Thompson Plan of Conservation and Development.*

Among the goals of the Plan are to preserve, protect, and improve water resources; promote best forest management practices; and protect, improve, and preserve habitat that is suitable for indigenous wildlife especially those species that are rare and endangered.

The following is a summary of recommendations meant to further the purpose of the Plan:

- Water Resources:
  - Develop and implement Aquifer Protection regulations
  - Protect critical areas of public supply watersheds
  - Identify water quality improvement projects
  - Increase protection of headwater wetlands and watercourses
  - Amend regulations to increase stream buffers and promote undeveloped buffers
  - Pursue acquisition and/or conservation easements on undeveloped shorefront and on identified priority areas

- Forestry and Wildlife Resources:
  - Encourage forest management and habitat protection through voluntary participation
  - Emphasize prevention of forest fragmentation in land use development decisions
  - Protect habitat corridors
  - Support the natural processes of forests and wetlands

3.4.4.3. Inland Wetlands and Watercourses Regulations

In 1972, the Connecticut legislature passed the *Connecticut Inland Wetlands and Watercourses Act* to protect the environmental quality of the state's wetlands and watercourses. Section 22a-42 of the Act authorizes the municipal regulation of activities affecting the wetlands and watercourses within the territorial limits of the various municipalities or districts.

The Inland Wetlands and Watercourses Commission of the Town of Thompson is charged with enforcing the provisions of the Inland Wetlands and Watercourses Act, Sections 22a-36 through 22a-45, inclusive, of the Connecticut General Statutes, as amended. *The Regulations for the Protection of Inland Wetlands and Watercourses in the Town of Thompson* were first adopted on May 20, 1974. The current edition was revised March 10, 2009.

The Inland Wetlands Commission is authorized to regulate any activity within one hundred (100) feet from a wetland or watercourse and two hundred (200) feet from the ten (10) especially noteworthy wetlands and watercourses identified in the *Town of Thompson Inland Wetland Inventory (1980),* prepared by Northeastern Connecticut Regional Planning Agency.

3.4.4.4. Zoning Regulations

Zoning Regulations define how a community will be developed. These regulations provide specific criteria and standards that determine the type of land use, form, design and compatibility of proposed development within designated building zones. Regulations for Zoning in the Town of Thompson were first adopted on March 31, 1975. The *Town of Thompson Zoning Regulations* were revised in 2007, and have been amended through September 24, 2012.

Following is a summary of zoning regulations that relate specifically to the protection of water resources:

- Article VI - General Use & Dimension Provisions
  - Section 6 – Green Space: Provides guidelines for proposed uses that require minimum impervious surfaces and planting with grass, moss, ground cover or trees in such a way as to allow natural percolation of rainwater and not to interfere with adequate drainage of rainwater from surfaced or built-up portions.
  - Section 8 - Soil Erosion & Sediment Control: Provides guidelines for erosion and sediment control, including the preparation of Erosion and Sediment Control Plans, standards, and inspection
- Article IX - Special Issues:
  - Section 1 – Flood Control Measures: Provides review regarding development in designated flood-prone areas to minimize damage and provide adequate drainage. Proposed activity needs to meet the requirements in the "Ordinance Amending the Flood Damage Prevention Ordinance."
  - Section 2 - Aquifer Protection Program: Protects aquifer protection zones within the Town of Thompson through regulation of land use activities and delineated aquifer protection zones for the existing public water supply and groundwater stratified drift deposits.
  - Section 3 - Storm Drainage and Storm Water Management: Provides guidelines for temporary or permanent disturbance of areas in excess of five (5) acres, including standards for drainage design and calculations, drainage to off-site properties, and detention basins.

3.4.4.5. Subdivision Regulations

Subdivision regulations provide guidance and standards for the design of subdivisions and the construction of streets and other improvements in order to provide for the orderly growth in accordance with other planning documents such as Planning and Zoning Regulations and Plans of Conservation and Development.

The *Town of Thompson Subdivision Regulations* were adopted on February 3, 1969 and were amended through December 22, 2008 (Fifth Edition) in accordance with Section 8-25 of the Connecticut General statutes.

Following is a summary of Subdivision Regulations from the Town of Thompson that relate specifically to the protection of water resources:

- Section 3 – Purposes:
    - J. To prevent the pollution of air, streams, and ponds; to assure the adequacy of drainage facilities; to safeguard the water table, and to encourage the wise use and management of natural resources throughout the municipality in order to preserve the integrity, stability, and beauty of the community and the value of the land.

- Section 5 - Stormwater Runoff Control: The 2002 Connecticut Stormwater Quality Manual by the Department of Environmental Protection, as amended, should be used as a guiding document when addressing stormwater runoff control for these types of developments. Guidance includes standards for drainage design and calculations, storm drainage design/construction, drainage to off-site properties, detention structures, and easements/rights-to-drain.

- Section 6 – Soil Erosion & Sediment Control: Requires plan of measures to be taken to minimize soil erosion and sedimentation of watercourses and drainage systems on all subdivisions and a soil erosion and sediment control plan when the disturbed area of such development is cumulatively more than one-half (1/2) acre. Provides guidance for erosion & sediment control plan, minimum acceptable standards, issuance or denial of certification, and conditions relating to soil erosion and sedimentation control.

- Section 7 – Conservation Subdivisions: Purpose is to maintain and enhance the conservation of natural or scenic resources, protect natural streams and water supplies, promote conservation of soils, wetlands, and other significant natural features and landmarks, and enhance public recreation opportunities; provide for increased flexibility, balanced by increased control, in the development of land so as to facilitate the preservation of open space, natural resources, recreational uses, and community character; and provide guidance regarding the design and development of conservation subdivisions.

- Section 8 – Open Space: Provides guidance on the types, location, size, standards, dedication methods, delineation, and other options regarding open space.

- Section 12 – Special Flood Hazard Areas & Floodways: States that when the subdivision includes land in a special flood hazard area or regulated floodway, the lots, streets, drainage, and other improvements shall be safe from flood damage and shall conform to the Thompson Flood Control Ordinance, as well as, lists practices to minimize flood damage.

- Section 13 – Water Supply & Sanitary Requirements: Requires that water supplies and sub-surface sewage disposal system facilities must be installed to function properly and not cause a pollution problem and be in conformance with the Connecticut Public Health Code or its successor Regulations.

3.4.5. Future Land Use Considerations

Thompson, like similar rural communities, has great potential for future development. A build-out analysis conducted by the Town in 2009 indicated that, based on current zoning regulations (Fig. 3-39), an additional 9,500 housing units could be added increasing the total town population from just under 10,000 to over 25,000 people (Town of Thompson, 2009). As the town develops, a change in land use regulations and re-assignation of land-use zones could result in even denser development.

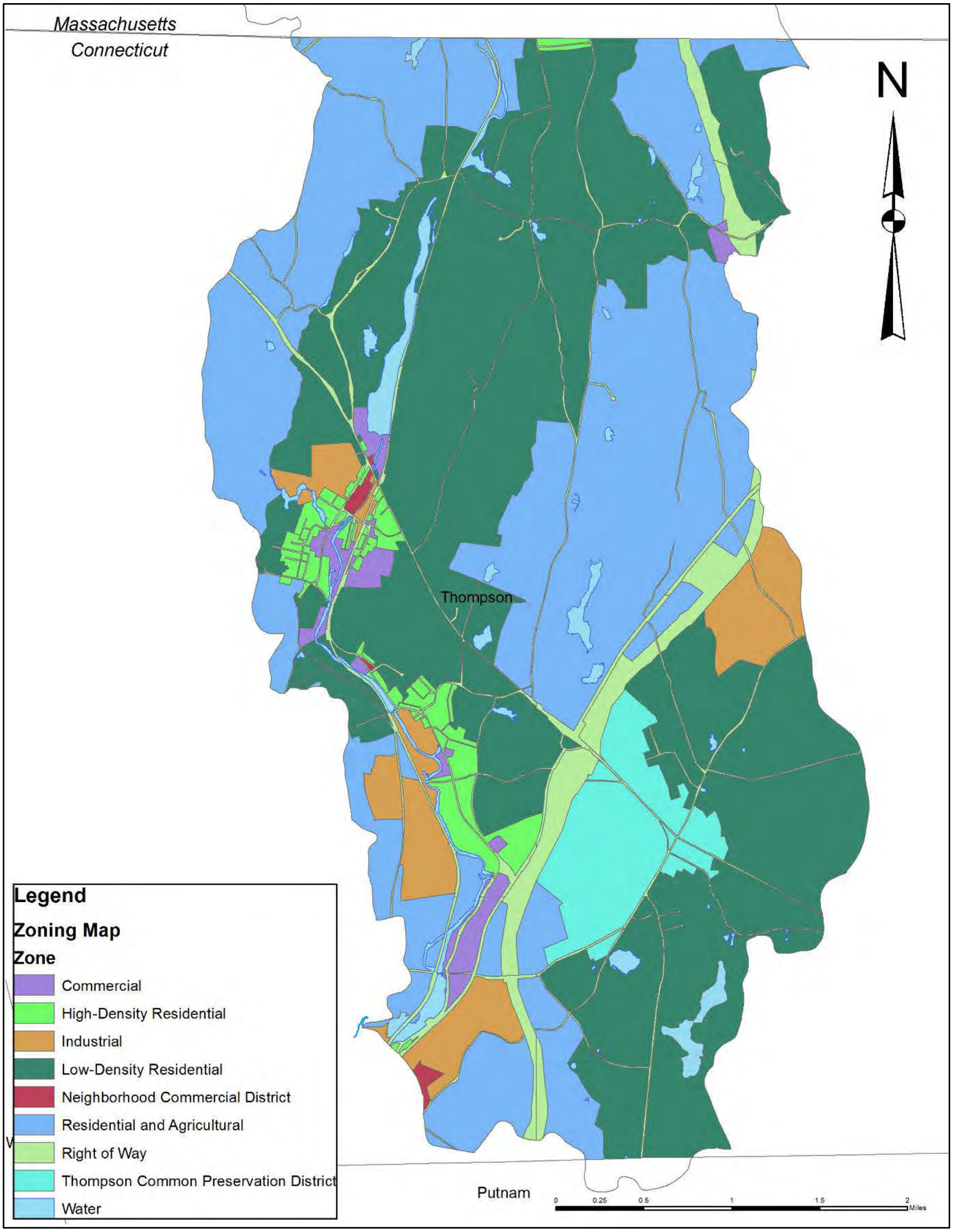


Figure 3-39. Zoning Map of the French River watershed in Thompson, CT.

4. WATER QUALITY CONDITIONS

4.1. WATER QUALITY STANDARDS

The 1972 Federal Clean Water Act requires all states to designate uses for all waterbodies within their jurisdictional boundaries, assign water classifications based on designated uses, and assess waters to determine if they are meeting their designated uses. Designated uses for the French River (Class B) in Connecticut include habitat for fish and other aquatic life and wildlife; recreation; navigation; and industrial and agricultural water supply. Designated uses for all other surface waters in the watershed (designated Class A) include habitat for fish and other aquatic life and wildlife; potential drinking water supplies; recreation; navigation; and water supply for industry and agriculture.

Water quality classifications serve to establish designated uses for surface and ground waters and identify criteria necessary to support those uses. Within the French River watershed, the French River Long and Branch Brook have not been meeting their designated use for recreation due to periodic high levels of *Escherichia coli* from unknown sources. The State of Connecticut Department of Energy and Environmental Protection Water Quality Standards (effective October 10, 2013) established water quality criteria for indicator bacteria (*E. coli*) for freshwater as defined in Table 4-1. For the purposes of this investigation, ECCD utilized the single sample criteria for *Freshwater – All other recreational uses* of 576 cfu/100ml and the maximum sample set geometric mean of less than 126 cfu/100 ml to evaluate water quality data collected from French River and tributaries.

Table 4-1. State of Connecticut water quality criteria for indicator bacteria in fresh water.

Designated Use	Class	Indicator	Criteria
Freshwater			
Drinking Water Supply (1) Existing / Proposed	AA	Total coliform	Monthly Moving Average less than 100/100ml Single Sample Maximum 500/100ml
Potential	A	----	--------
Recreation (2)(3) Designated Swimming (4)	AA, A, B	*Escherichia coli*	Geometric Mean less than 126/100ml Single Sample Maximum 235/100ml
Non-designated Swimming (5)	AA, A, B	*Escherichia coli*	Geometric Mean less than 126/100ml Single Sample Maximum 410/100ml
All Other Recreational Uses	AA, A, B	*Escherichia coli*	Geometric Mean less than 126/100ml Single Sample Maximum 576/100ml

Table Notes:
(1) Criteria applies only at the drinking water supply intake structure.
(2) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23.
(3) See Standard # 25.
(4) Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protection and the Department of Public Health, May 1989, revised April 2003 and updated December 2008.
(5) Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

4.1.1. Anti-degradation Policies:

The Clean Water Act requires that states and tribes establish a three-tiered anti-degradation policy to protect water quality. An anti-degradation policy is a "framework and methodology for deciding if, when, and how water quality that exceeds the CWA 101(a) goal can be degraded by regulated activities and when that water quality must be maintained" by identifying steps and questions that need to be addressed when specific activities affect water quality. Tier 1 of the anti-degradation procedures is applicable to all surface waters. It maintains and protects current uses and water quality conditions to support existing uses. Current uses are identified by showing that fishing, swimming, and other water uses have occurred and are suitable since November 28, 1975. Tier 2 maintains and protects water bodies with existing conditions that are better able to support CWA 101(a)(2) "fishable/swimmable" uses. Tier 3 maintains and protects water quality in outstanding national resource waters, which are the highest quality waters in the US (USEPA, 2015).

The Clean Water Act further specifies that states must identify implementation methods that:

- protect existing uses,
- authorize the lowering of water quality in high quality waters, where necessary for social or economic importance, and
- provide mechanism to provide additional protection for water of exceptional ecological or recreational significance.

Connecticut's Anti-Degradation Standards and Anti-Degradation Implementation Policies (Section 22a-426-8 of the Connecticut General Statutes) are fully defined in the 2013 *Connecticut Water Quality Standards*.

4.2. Available Monitoring/Resource Data

4.2.1. Stream Bacteria Data

In 2015, ECCD and volunteers from the Last Green Valley (TLGV) Volunteer Water Quality Monitoring program collected water samples from twenty-three sites (Table 4-2 and Fig. 4-2) over an eight-week period for fecal bacteria (*E. coli*) content analysis. ECCD staff and TLGV volunteers utilized protocols from a USEPA and CT DEEP-approved Quality Assurance Project Plan (QAPP) in accordance with an approved water quality monitoring plan. The water samples were processed by the Connecticut Department of Public Health (DPH) Laboratory in Rocky Hill, CT. Bacteria results were tabulated and evaluated by ECCD (Table 4-3). A statistical distribution of bacteria levels by site is presented in Fig. 4-3. Stream bacteria levels were compared to rainfall amounts to determine if there was a correlation between wet weather and bacteria levels using rainfall data collected at West Thompson Lake by the US Army Corps of Engineers. The evaluation of rainfall versus stream bacteria levels indicated that for most sampling sites, there was a rise in stream *E. coli* levels after a rainfall, which is consistent with stormwater-conveyed NPS pollutants (Fig. 4-4). *E. coli* levels in Backwater Brook (BWB-01), which did not meet state standards for the geometric mean, generally followed that pattern (Fig. 4-5). However, *E. coli* levels in Quinatissett Brook (QB-01), which did not meet state standards for the single samples and geometric mean, increased over the month of July 2015 during a relatively dry period, indicating that baseflow loading could be responsible for the documented fecal bacteria levels (Fig. 4-6). A complete summary of the water quality investigation (ECCD, 2015) is provided in Appendix A.

Figure 4-1. A TLGV water quality monitoring volunteer collets a water sample from the French River for bacterial analysis.

Table 4-2. French River and tributary stream sampling sites

Stream Name	Site #	Latitude	Longitude	Location
French River	FR01	41.943292	-71.897819	500 ft US of Quinebaug River confluence
French River	FR02	41.952033	-71.886097	RT 12 at pull-over north of Riverside Pizza
French River	FR03	41.983142	-71.900250	N end of Riverside Park 100 ft DS of foot bridge
French River	FR04	41.991856	-71.894589	North Grosvenordale Pond outlet - begin impaired segment
French River	FR05	42.013231	-71.886617	Langers Pond – US Wilsonville Road
French River	FR06	42.024269	-71.883911	MA/CT state line - off Perryville Rd
Long Branch Brook	LBB01	42.010817	-71.877747	US Wagher Road
Long Branch Brook	LBB02	42.011836	-71.871667	US Labby Road
Long Branch Brook	LBB03	42.024311	-71.866200	MA/CT state line - off Labby Rd
Knowlton Brook	KB01	42.009269	-71.861267	DS Wilsonville Road
Backwater Brook	BWB0.5	41.983897	-71.899989	end of box culvert at French River canal
Backwater Brook	BWB01	41.984258	-71.900814	US Main Street at School St
Backwater Brook	BWB02	41.986861	-71.902283	off end of Floral Ave
Sunset Hill Brook	SHB01	41.966858	-71.888022	DS of Klondike Ave
Sunset Hill Brook	SHB02	41.969183	-71.877956	DS Thompson Hill Road (RT 200)
Stoud Brook	SB01	41.970656	-71.885594	US Thompson Hill Road (RT 200)
unnamed brook from Marianapolis Prep School	UN01	41.955744	-71.882292	US RT 12 just south of RT 395 S on-ramp
Little Mountain Brook	LMB01	41.945006	-71.876000	DS Robbins Road
Quinatissett Brook	QB01	41.942406	-71.879853	US Ballard Road
Quinatissett Brook	QB02	41.937647	-71.865400	US RT 21 at Quinatissett Golf Course
Elliott Brook	EB01	41.950992	-71.856833	DS Chase Road
Elliott Brook	EB02	41.955036	-71.854150	DS Quaddick Road
Ross Brook	RB01	41.955903	-71.856375	DS Quaddick Road

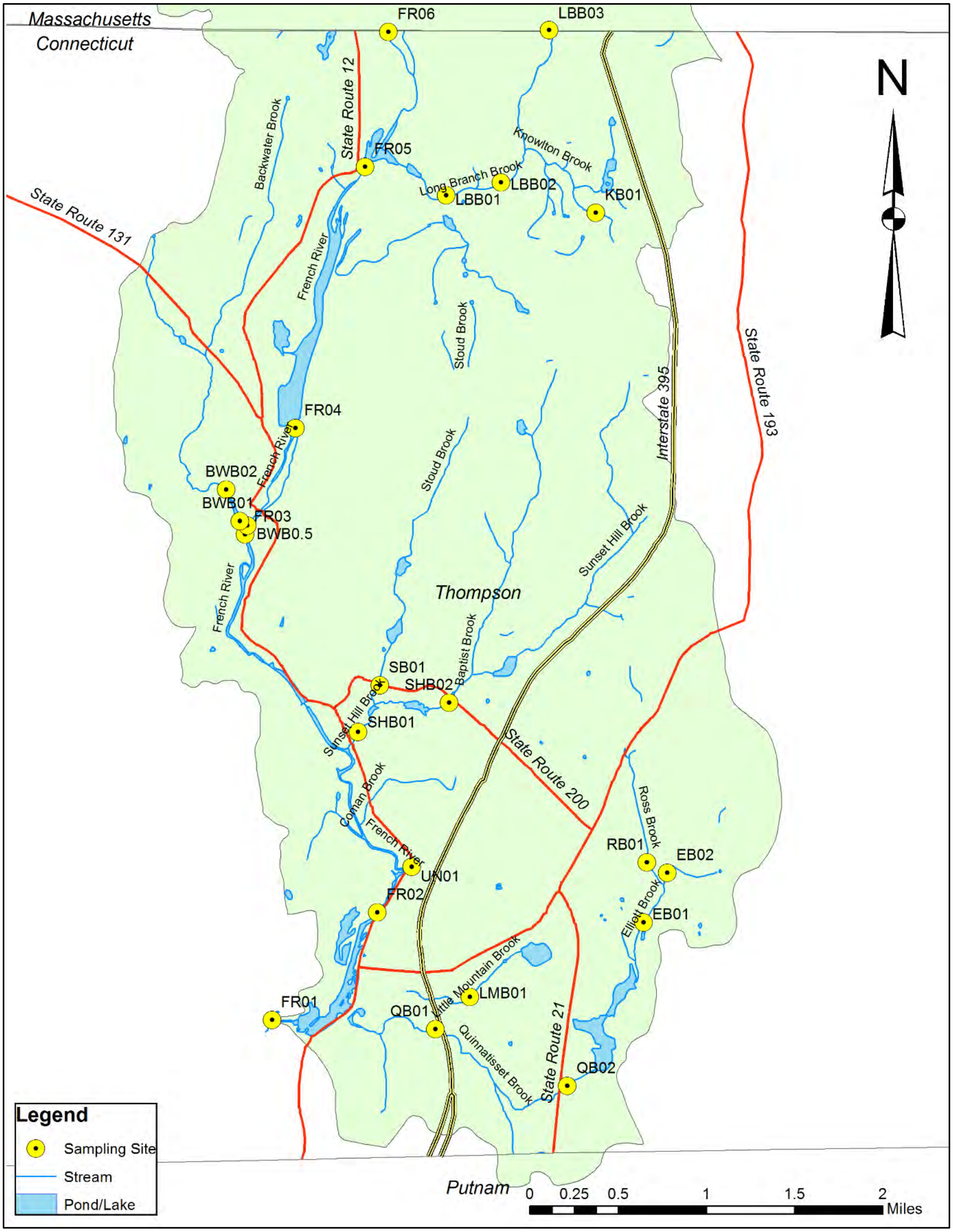


Figure 4-2. Fecal bacteria sampling sites on the French River and tributary streams.

Table 4-3. 2015 French River and tributary streams fecal bacteria sampling results.

Site	6/9/15	6/16/15	6/23/15	6/30/15	7/7/15	7/14/15	7/21/15	7/28/15	Geomean
FR01	20	420	140	85	41	31	86	86	74
FR02	75	63	110	110	110	52	170 (D=160)	120	101
FR03	130	51	200	31	20 (D=10)	31	74	75 (D=41)	47
FR04	<10	10	73	<10	<10	<10	20	<10	14
FR05	41	230	63	20	31	63	63	75	57
FR06	75	300	74	52	52	150	52	96	87
LBB01	20	560	110 (D=52)	10	<10	84	20	10	36
LBB02	20	360	160	85	74	31	<10	41	56
LBB03	<10	280	170	63	20	98	52	63	61
KB01	84	**880**	98	85	31	63 (D=73)	20	110	83
SHB01	96	320	53	31 (D=20)	98	160	**1400**	320	124
SHB02	10	63	41	41	<10	20	31	<10	22
SB01	41	98	63	31	31	10 (D=10)	75	41 (D=20)	33
BWB0.5*								**820**	---
BWB01	86	200 (D=230)	130	110	340	110	84	85	**135**
BWB02	20	73	41	110	<10	<10	41	41	32
UN01	10	150	120	41	10	73	20	31	37
LMB01	41 (D=30)	230	84	63	41	270	52	**830**	96
QB01	160	410	330	220	110	370	**790**	**1100**	**338**
QB02**						**2100**	280 (D=170)	170	**361**
RB01**						110	120	31	74
EB01**						160	97	---	125
EB02**						110	300	98	**148**
Wet/ Dry	dry	wet	dry	dry	dry	dry	dry/ wet***	dry	dry

Bold text indicates exceedance of existing water quality standard.

* Single sample collected at Backwater Brook culvert outfall

** Sites added to bracket water quality observations at QB01

***Rain began midway through sampling

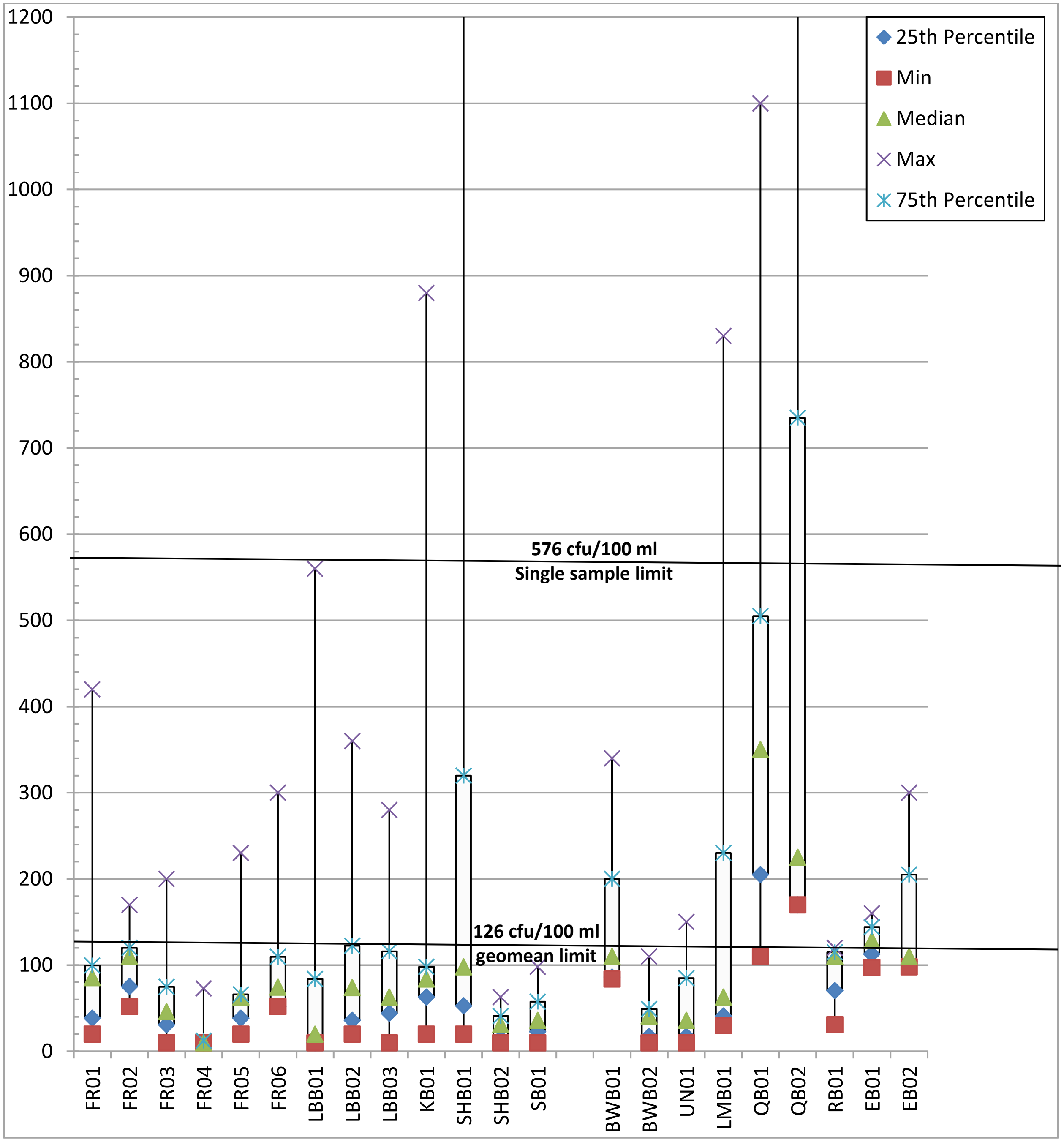


Figure 4-3. Statistical distribution of fecal bacteria at sampling sites in the French River and tributary streams.

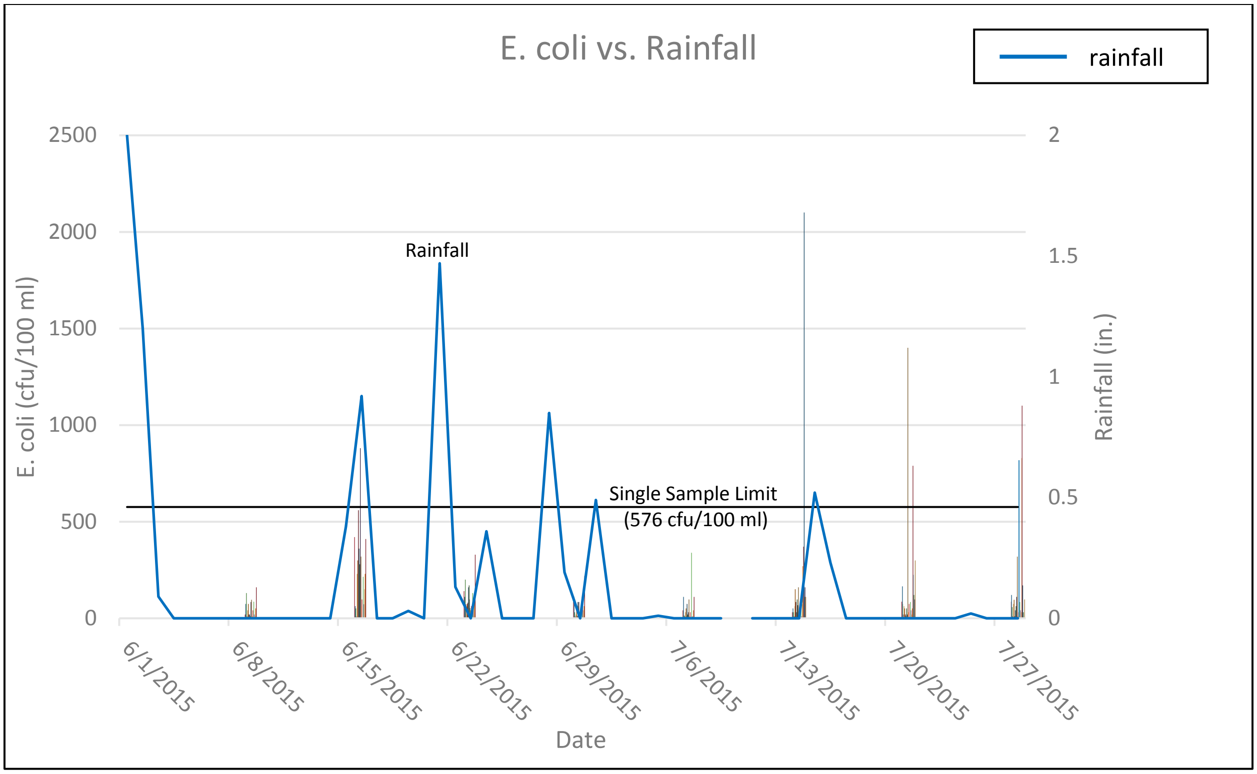


Figure 4-4. Comparison of stream fecal bacteria (E. coli) levels to rainfall.

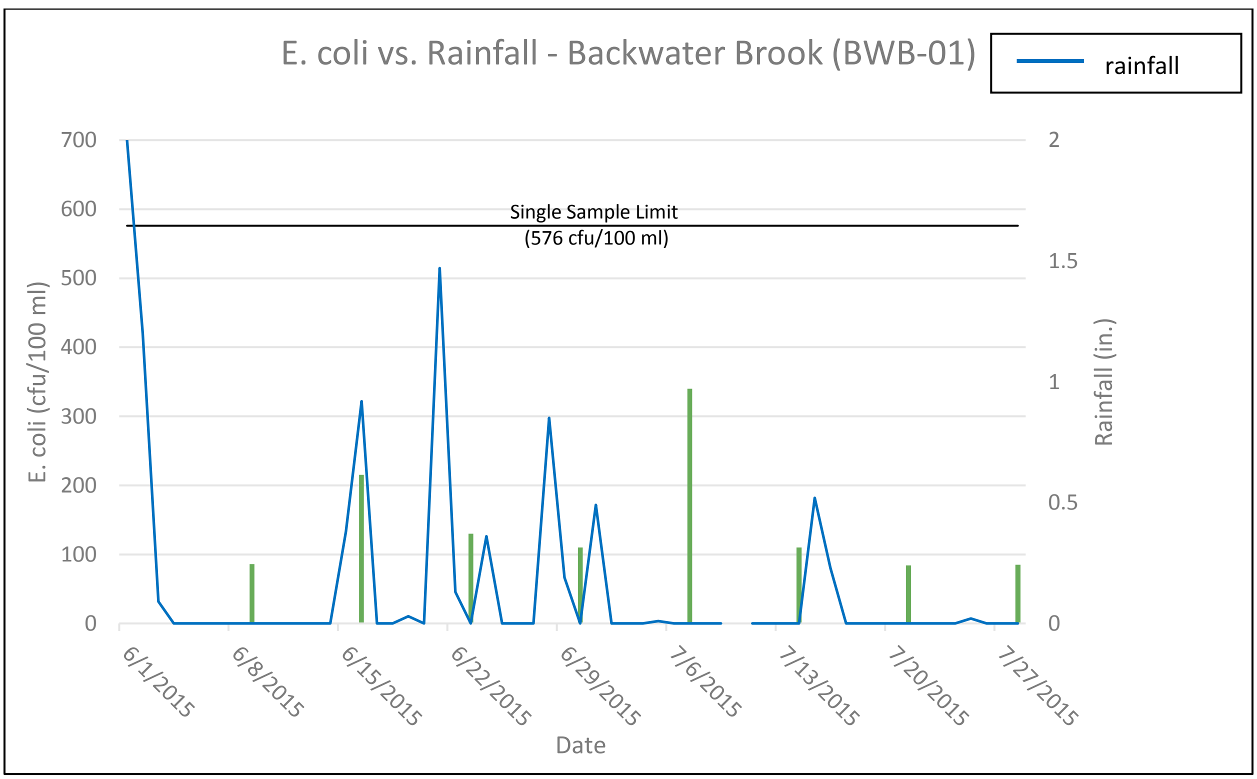


Figure 4-5. Comparison of fecal bacteria (E. coli) levels in Backwater Brook to rainfall.

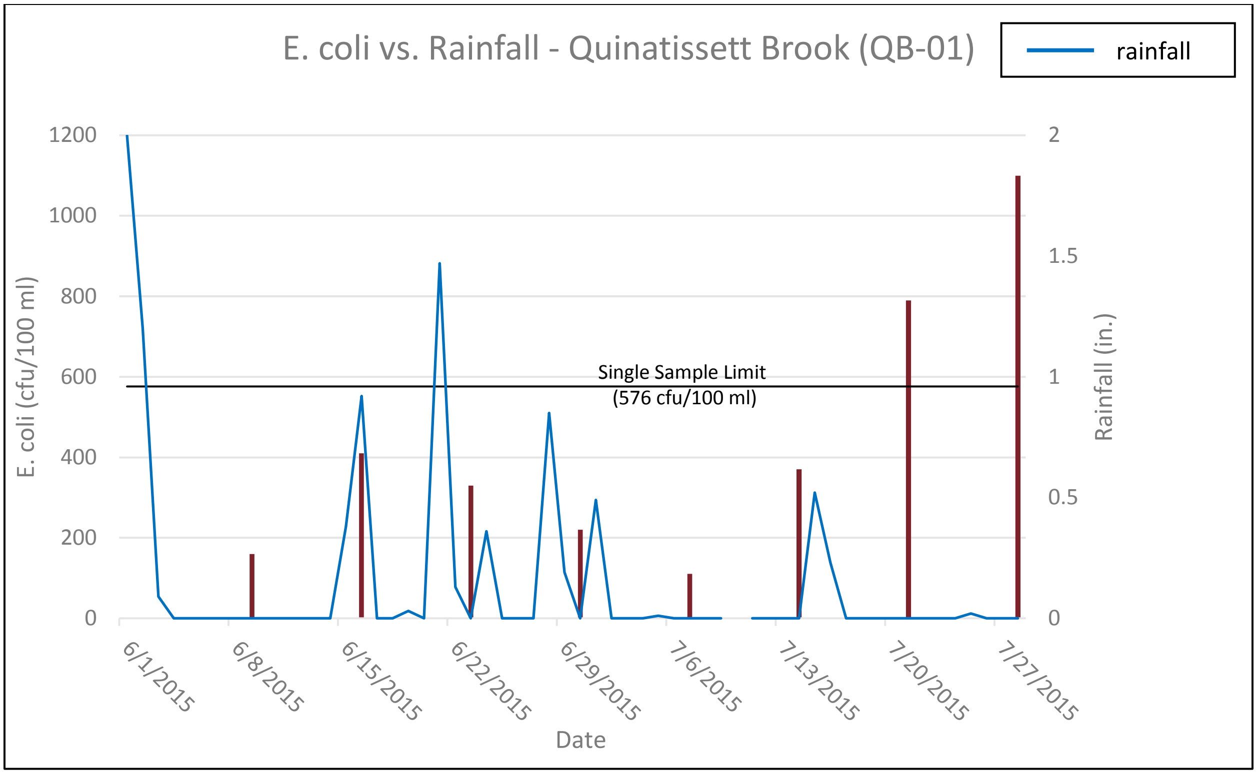


Figure 4-6. Comparison of fecal bacteria (E. coli) levels in Quinatissett Brook to rainfall.

4.2.1.1. Priority Restoration List

ECCD reviewed the 2015 TLGV water quality data to identify bacteria hotspots, locations with consistently high stream water fecal bacteria levels. The 2015 water quality data indicated that while fecal bacteria levels at sampling sites throughout the French River watershed generally met Connecticut water quality standards for indicator bacteria in freshwater for "all other recreational uses," two sites, Backwater Brook (BWB-01) and Quinatissett Brook (QB-01), did not. BWB-01, located on Backwater Brook between Duhamel Pond and the French River, met the state standard for the single sample limit of 576 cfu/100 ml, but exceeded the geometric mean limit of 126 cfu/100 ml for the sample set (n=9) with a geomean of 135 cfu/100 ml. QB-01, located on Quinatissett Brook at Ballard Road, had two individual samples that exceeded the single sample limit (790 cfu/100 ml and 1100 cfu/100 ml), and the geometric mean for the sample set (n= 8) exceeded the established limit with a geomean of 338 cfu/100 ml. In mid-July of 2015, additional sampling sites were added upstream of QB-01 to bracket bacteria levels documented at that site, including a second site on Quinatissett Brook (QB-02) located between the Reams Pond outlet and State Route 21 (County Home Road). Over the remaining sampling period, QB-02 had one single sample that exceeded state limits and did not meet the geometric mean (n=4).

ECCD evaluated the bacteria hotspots to identify potential fecal bacteria sources in the surrounding area, and that information was used to develop a Priority Restoration List (Table 4-4). In addition to identifying bacteria hotspots and potential fecal bacteria sources, the Priority Restoration List (PRL) suggests management actions to reduce fecal bacteria levels, and identifies responsible stakeholders to undertake the management actions. The Priority Restoration List report (ECCD, 2016) is included in Appendix B.

Table 4-4. French River watershed bacteria hotspot Priority Restoration List

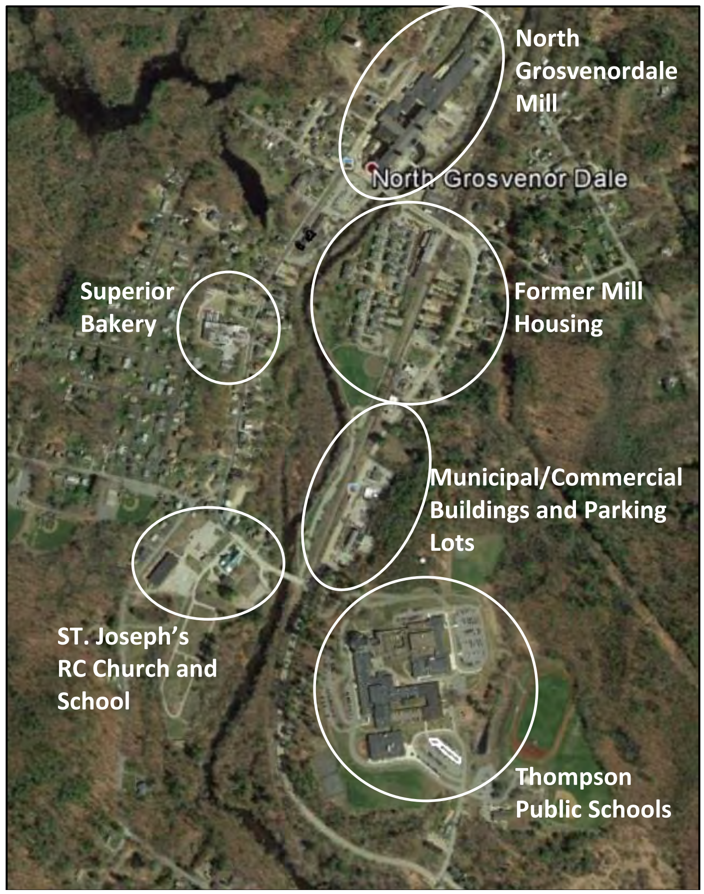
Priority Site	Site/ Waterbody	Site Location	Possible Bacteria Source	Bacteria Geomean (cfu/100ml)*	Reduction Needed	Suggested Management Action(s)	Suggested Responsible Stakeholder
1a	Backwater Brook (BWB01)	downstream of the Duhamel Pond outlet near Main Street, North Grosvenordale	Waterfowl; unauthorized/ un-sewered properties; grey water discharges; illicit discharges	135	7%	Investigate if any properties abutting pond are not sewered; grey water and illicit discharges; manage waterfowl; install streamside buffers	Residents/ property owners; Town DPW/ WPCA; NDDH; CLEAR
1b	Backwater Brook at French River (BWB0.5)	end of culvert at French River, Thompson Public Library property, ~30 ft north (upstream) of foot bridge to Riverside Park	Main St and library storm drain systems; illicit discharges; sewer leaks; dog feces; stormwater runoff	820 (single sample)	42% (single sample)	Investigate storm drain connections to culverted brook; illicit discharges; sewer lines; dog waste management; stormwater management; promote/ demonstrate LID practices and principles	Residents/ property owners; Town DPW/ sewer authority; NDDH; CLEAR
2a	Quinatissett Brook (QB02)	downstream of Reams Pond at Quinatissett Golf Course, County Home Road (State RT 21)	Septic system at golf course of unknown location, age and design; waterfowl; livestock on Chase Road	361	186.5%	Septic system dye test; locate/upgrade septic system; bacteria DNA test; manage waterfowl; promote manure BMPs	Property/ livestock owners; golf course mgrs; Agriculture Comm.; NDDH
2b	Quinatissett Brook (QB01)	at Ballard Road crossing, near Interstate RT 395 overpass	horses on Robbins Road; goats on Ballard Road; sheep on RT 21 at Putnam town line; older or underperforming septic systems; remnant bacteria signal from upstream sources (Reams Pond)	338	168%	Promote pasture/manure BMPs; identify/evaluate failing/ underperforming septic systems; develop septic system monitoring program; conduct bacteria DNA test to ID source	Property/ livestock owners; NDDH; Agriculture Committee; UConn Extension

* The 2013 Connecticut Water Quality Standards establish water quality criteria for indicator bacteria, including *E. coli*, which is the preferred indicator bacterium for fresh waterbodies. For recreational contact, excluding designated and non-designated swimming areas, the single sample maximum is 576 colony-forming units (cfu) per 100 milliliters of water and the maximum sample set geometric mean is less than 126 cfu/100 ml.

4.2.2. Windshield Field Survey

In the summer of 2017, ECCD staff conducted a windshield field survey to assess the watershed and identify conditions that could contribute to non-point source pollution. The windshield field survey was an informal, visual assessment of existing watershed conditions. Data collected will be used to identify potential pollutant sources and locations in the French River watershed where restorations and pollution mitigation can be conducted. The results of the windshield survey are presented in Appendix C. Common conditions identified during the windshield field survey include:

- **Areas with high amounts of impervious cover (IC)**
  Along the Route 12 corridor, particularly in North Grosvenordale, there are a number of locations with high impervious cover. IC is surfaces like buildings, roofs and paved areas such as parking lots, roads and sidewalks, that prevent rainwater from soaking into the ground. These areas contribute large volumes of stormwater to storm drain systems and surface waters. Although opportunities for stormwater management exist at all these locations, little to no such practices were observed.



Areas of high impervious cover (IC) along the Route 12 corridor in North Grosvenordale.

- **Stream buffer encroachments**
  Stream buffer encroachments were observed throughout the French River watershed. In some instances, encroachments occurred in residential areas, where residential lawns extended right to stream's edge. Numerous stream bank encroachments along the French River in North Grosvenordale were observed, particularly along the

Route 12 corridor. In some instances, the stream bank was cleared to allow access for recreational activities or to provide a view of the river. In several areas, Route 12 is located within feet the river, limiting the growth of riparian vegetation.

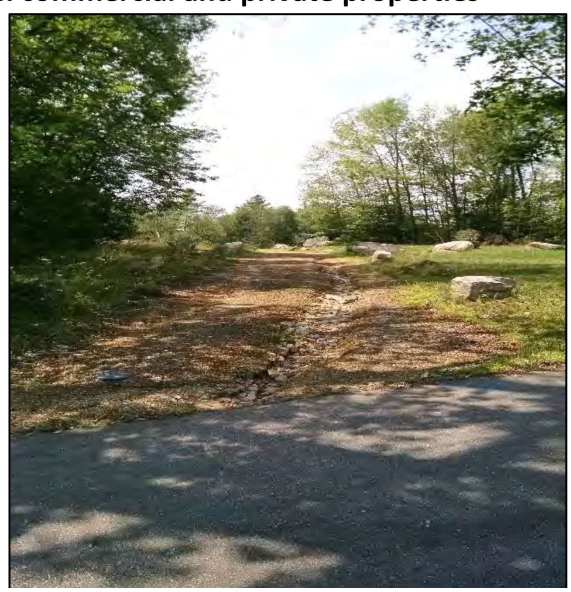
A minimally vegetated buffer at a small pond in the Long Branch Brook sub-watershed has resulted in the growth of excessive aquatic vegetation.

Numerous mills were built on the banks of the river to access the river for power, and in several areas the river bank has been channelized. Mill housing, and later, other businesses were also built right on the river bank, minimalizing or altogether eradicating the existing vegetative buffer. Land use practices along the river since that time have perpetuated the minimization or removal of riparian vegetation.

- **Uncontrolled stormwater runoff from commercial and private properties**

  Several instances of uncontrolled stormwater runoff from private and commercial properties were noted throughout the watershed. This uncontrolled runoff has created erosion and sedimentation issues, particularly on dirt and gravel driveways.

  Proper management of stormwater on commercial and private properties can reduce the volume of stormwater runoff and protect property from potentially costly damage.



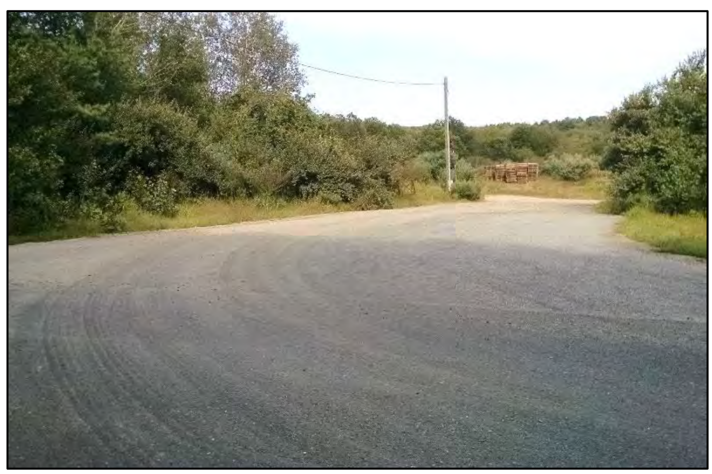
Uncontrolled stormwater runoff from a commercial property in North Grosvenordale has resulted in the development of a deep gulley and deposition of the eroded sediment in the street down-gradient of this dirt driveway.

- **Trash and debris at stormwater outfalls**
  Several instances of trash, especially floatable trash such as coffee and cold drink cups, candy and snack wrappers and plastic bags were noted at storm drain outlets, especially along Route 12 and in North Grosvenordale.

- **Invasive plant species along riparian corridors**
  A variety of common invasive plants including common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), oriental bittersweet (*Celastrus orbiculatus*), glossy buckthorn (*Frangula alnus*) and multiflora rose (*Rosa multiflora*) were noted in disturbed areas throughout the watershed and along river and stream banks. Yellow flag iris (*Iris pseudacorus*) was noted along the banks of North Grosvenordale Pond. Purple loosestrife was noted in multiple locations along the French River corridor, including the vegetated corridor between the Thompson Public Library and Riverside Park. Glossy buckthorn and oriental bittersweet were also noted in the same area.

Phragmites growing at a stormwater outfall along Route 12 near the French River.

- **Poor or no "good housekeeping" practices**
  A few instances of poor housekeeping practices were noted in the French River watershed. These included the lack of parking lot sweeping and catch basin cleaning, especially in privately-owned parking lots; the upkeep of stormwater management practices such as rip-rapped stormwater conveyance swales and level spreaders; and maintenance of features such as sediment anti-tracking strips.



Sediment being tracked onto a public roadway due to the lack of maintenance of an anti-tracking strip.

4.2.3. Review of Data by Others

4.2.3.1. The Last Green Valley Volunteer Water Quality Monitoring Program

Volunteers from The Last Green Valley Volunteer Water Quality Monitoring Program, in partnership with the Thompson Conservation Commission, collected water quality data from 8 sites on the French River and selected tributaries from 2006 to 2011. Physio-chemical data was collected, including temperature, pH, dissolved oxygen, specific conductivity and turbidity, using an In-Situ Troll 9500 multi-parameter sampler. No fecal bacteria data was collected.

In 2016, TLGV water quality monitoring volunteers collected water samples for fecal bacteria analysis from Backwater Brook in order to further evaluate high bacteria levels documented in 2015. Over an eight-week period, volunteers collected water samples from the Backwater Brook culvert outfall at the Thompson Public Library (BWB-0.5) and from Duhamel Pond just upstream of the pond outlet.

Table 4-5. 2016 TLGV bacteria sampling data

Sampling Site	Site Description	6/7/16	6/14/16	6/21/16	6/28/16	7/5/16	7/12/16	7/26/16	8/2/16
BWB-0.5	Backwater Brook - DS Library parking lot	97	210	110 D = 120	510	**4,200**	410	220	**24,196**
BWB-01*	Backwater Brook - US Duhamel Pond outlet	310	140	**1,100**	**5,500**	**10,000**	**750** D = 310	540	**24,196**

*****Site located upstream of ECCD's 2015 BWB-01

Bold text indicates exceedance of existing water quality standard.

D **–** Duplicate sample collected for quality control

4.2.3.2. 2013 Connecticut Audubon Society Citizen's Science Program

In 2013, staff and volunteers from the Connecticut Audubon Society Grassland Center in Pomfret, CT, with support from TLGV's volunteer water quality monitoring program and ECCD, collected water samples for bacteria analysis from six sites in the French River watershed. The 2013 Audubon sampling plan was designed to provide baseline data for ECCD's upcoming 2015 water quality investigation.

Table 4-6. CT Audubon Citizen Science Program sampling data.

Sampling Site	Site Description	6/20/13	6/27/13	7/11/13	7/18/13	7/25/13	8/01/13	8/08/13	8/15/13
BWB01	Backwater Brook DS Rt. 131	<10	90	74	20	410	110	110	63
BWB0102	Backwater Brook US Main St	20	**880**	**11,000**	470	170	260	200	270
LBB02	Long Branch Brook DS Wagher Rd	110	240	160	75	300	75	97	52
FR03	French River US BWB	40	63	**10,000**	540	70	86	41	31
FR04	French River DS BWB	<10	31	**8100**	335	180	52	20	10
QB05	Quinatissett Brook DS Reams Pond	20	20	**24,000**	52	110	10	<10	<10
Wet/Dry		dry	wet	wet	dry	dry	dry	dry	dry

Bold text indicates exceedance of existing water quality standard.

4.2.3.3. CT DEEP Monitoring Programs

Connecticut DEEP has conducted sampling for a variety of programs in the in the French River, including fall macro-invertebrate surveys, ambient fish community sampling, quarterly monitoring, stream dissolved oxygen monitoring, periphyton surveys and probabilistic bacteria monitoring. Collected data has included biological, nutrient, physio-chemical and select metals data. Summaries of fecal bacteria data collected in the French River and Long Branch Brook are tabulated below. The Long Branch Brook data was utilized to develop the French River watershed bacteria TMDL.

Table 4-7. Summary of CT DEEP E. coli sampling data in the French River watershed.

Date	Waterbody	Sampling Site	Program	E. coli (cfu/100 ml)
10/2/1999	French River	Route 12 (Sta. 81)	Quarterly Monitoring	10
2/23/2000	French River	Route 12 (Sta. 81)	Quarterly Monitoring	10
5/9/2000	French River	Route 12 (Sta. 81)	Quarterly Monitoring	31
8/23/2000	French River	Route 12 (Sta. 81)	Quarterly Monitoring	41
6/14/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	130
6/23/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	120
6/28/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	74
6/28/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	150
7/8/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	74
7/13/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	98
7/13/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	110
7/22/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	270
7/22/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	160
7/29/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	510
8/5/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	**1,000**
8/11/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	97
8/11/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	52
8/19/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	73
8/19/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	110
9/15/2010	Long Branch Brook	Labby Road (Sta. 6134)	Probabilistic Bacteria	52
Bold text indicates exceedance of existing water quality standard.				

4.2.3.4. CT DEEP Bacteria TMDL

The *French River Watershed (Long Branch Brook) Summary* appendix to the Statewide Total Maximum Daily Load Analysis for Bacteria Impaired Waters (CT DEEP, 2012), identifies impaired waterbody segments in the French River watershed and provides fecal bacteria reductions in Long Branch Brook to meet State water quality standards. The TMDL identifies potential bacteria sources, including:

- Permitted sources (industrial stormwater general permit issued to Tilcon Connecticut, Inc.)
- Failing septic systems
- Agricultural activity

- Stormwater runoff
- Nuisance wildlife and pets

The TMDL lists mitigative activities to protect waters in the French River watershed, including:

- Identification of areas in developed parts of the watershed to implement Low Impact Development (LID) and stormwater Best Management Practices (BMPs)
- Restoration of riparian buffers and stream bank erosion
- Evaluation of municipal education and outreach regarding animal waste
- Development of a system to monitor septic systems
- Continued monitoring of permitted sources
- Establishment of sufficient buffers on agricultural lands along Long Branch Brook
- Municipal compliance with MS4 program

4.2.3.5. US Geological Survey

The US Geological Survey (USGS) has operated a stream gauging station (USGS 01125100 French River at North Grosvenordale, CT) on the French River at Main Street since 2000. USGS first conducted surface water sampling at the site in 1962, and has conducted regular sampling since 1991. Sampled water quality parameters include physio-chemical constituents, nutrients and metals. USGS sampled for fecal coliform between 1992 and 2006, and enterococci between 1992 and 2000, but with the exception of a single sample collected in November 2002 (25 cfu/100 ml) has not sampled for *E. coli*. Water quality data for the French River North Grosvenordale station can be accessed at:

https://nwis.waterdata.usgs.gov/ct/nwis/uv?site_no=01125100.

5. Pollutant Source Assessment

Pollution in a watershed can come from a variety of sources and may derive from point or non-point sources. Point sources may include identifiable points such as factory or sewage treatment plant pipes which discharge pollution (called effluent) into a receiving waterbody. Non-point source pollution (or NPS) is comprised of a diffuse array of pollutants distributed on the ground across the landscape that are mobilized by rainwater or snowmelt and transported into receiving waterbodies by direct overland flow or via storm drainage systems.

In order to identify potential sources of pollution in the French River watershed in Connecticut, ECCD evaluated a variety of information, including available water quality data (as summarized in Section 4.2.1), documentation such as the *French River Watershed Summary* for the *Statewide Total Maximum Daily Load Analysis for Bacteria Impaired Waters* (CT DEEP, 2012), and state and federal documentation identifying existing stormwater discharge permits and known contaminated sites. Additionally, in the summer of 2017, ECCD conducted a windshield field survey to assess the watershed and identify conditions that could contribute to non-point source pollution.

5.1. Point Sources

Point source pollution is pollution that is discharged from a single, identifiable point, such as a sewage outfall or combined sewer overflow pipe, factory, or confined animal feedlot (National Water Quality Monitoring Council, 2007). Point sources are regulated by state or federal authorities via the National Pollutant Discharge Elimination System (NPDES) permit program (https://www.epa.gov/npdes/about-npdes).

5.1.1. National Pollutant Discharge Elimination System (NPDES)

The National Pollutant Discharge Elimination System (NPDES) is authorized by Section 402 of the Clean Water Act through the 1987 Water Quality Act. The NPDES program regulates direct discharges into navigable waters of the US, including point source discharges and non-point sources. NPDES permits may be issued directly by the US EPA or by states authorized by EPA, including Connecticut. Permits establish pollutant monitoring and reporting requirements, and may include pollutant discharge limits based on specific water quality criteria or standards (US EPA, 2017).

Stormwater permits issued by the State of Connecticut under the NPDES program include:

- **General Permit for the Discharge of Stormwater Associated with Industrial Activity** (“Industrial General Permit”), which regulates industrial facilities with point source stormwater discharges that are engaged in specific activities according to their Standard Industrial Classification (SIC) code.
- **General Permit for the Discharge of Stormwater and Dewatering Wastewaters**

from Construction Activities ("Construction General Permit"), which requires developers and builders to implement a Stormwater Pollution Control Plan to prevent the movement of sediments off construction sites into nearby water bodies and to address the impacts of stormwater discharges from a project after construction is complete.

- **General Permit for the Discharge of Stormwater Associated with Commercial Activity** ("Commercial General Permit"), found only in Connecticut, which requires operators of large paved commercial sites such as malls, movie theaters, and supermarkets to undertake actions such as parking lot sweeping and catch basin cleaning to keep stormwater clean before it reaches water bodies.
- **General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems** ("MS4 General Permit"), which requires each municipality to take steps to keep the stormwater entering its storm sewer systems clean before entering water bodies (CT DEEP, 2014).

5.1.1.1. Phase 1 and 2 Stormwater General Permits

Stormwater permits issued under Phase 1 of the NPDES program include the following stormwater discharges:

- discharges permitted prior to February 4, 1987
- discharges associated with industrial activity
- discharges from large Municipal Separate Storm Sewer Systems (MS4s) (systems serving a population of 250,000 or more)
- discharges from medium MS4s (systems serving a population of 100,000 or more, but less than 250,000)
- discharges judged by the permitting authority to be significant sources of pollutants or which contribute to a violation of a water quality standard (*US EPA, 2014*).

Also included in Phase 1 are municipal separate storm sewer systems (MS4) program permits for medium and large MS4s; construction sites which disturb five or more acres; and for numerous types of industrial facilities.

Stormwater permits issued under Phase 2 of the stormwater program include discharges not covered by Phase I, including small MS4s; construction sites of one to five acres; and industrial facilities owned or operated by small MS4s which were previously exempted under the Intermodal Surface Transportation Efficiency Act (US EPA, 2014).

5.1.1.2. Small Municipal Separate Storm Sewer Systems (MS4)

The purpose of the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 permit) is to protect surface waters from stormwater runoff from storm drain systems originating in urbanized areas (CT DEEP, 2016). Urbanized areas (UAs) are densely populated areas that surround urban centers, and are defined by the federal Census Bureau. The current Connecticut MS4 General Permit was issued by CT DEEP on January 20, 2016. It became effective on July 1, 2017 and expires on June 30, 2022.

The MS4 permit has specific requirements, including the development of a Stormwater Management Plan (SWMP) and the monitoring of specified stormwater outfalls. The SWMP contains information and recommendations to reduce or eliminate the discharge of pollutants through the stormwater system to the maximum extent practicable (MEP). The SWMP also identifies six *Minimum Control Measures* that the permittee must implement, including:

- Public education and outreach
- Public participation
- Illicit discharge detection and elimination (IDDE)
- Construction site stormwater runoff control
- Post-construction stormwater management
- Pollution prevention and good housekeeping

CT DEEP has provided resources for municipalities, including town-based impervious cover (IC) and impaired waters mapping, at the DEEP MS4 Stormwater webpage. To view the information, access the DEEP Stormwater webpage at www.ct.gov/deep/stormwater, and navigate to *General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems ("MS4 General Permit").*

The Center for Land Use Education and Research (CLEAR) at the University of Connecticut has partnered with CT DEEP to assist municipalities with understanding and complying with the requirements of the current MS4 general permit. To further that goal, CLEAR has established a *CT MS4 Guide* on its website at http://nemo.uconn.edu/ms4/index.htm.

Thompson is located within an Urbanized Area (Fig. 5-1) located in North Grosvenordale and connecting to UAs in Dudley and Webster, Massachusetts, and is therefore subject to MS-4 permitting. Thompson has prepared and submitted a Stormwater Management Plan (dated April 12, 2017) to CT DEEP. The Stormwater Management Plan can be found at the Town of Thompson website at:

http://www.thompsonct.org/images/thompson/selectmen/16181-Stormwater-Management-Plan-2017-4-11.pdf.

New in 2016 is a *General Permit for the Discharge of Stormwater from the Department of Transportation Separate Storm Sewers Systems* (DOT MS4). Like the municipal MS4 general permit, the DOT MS4 general permit is intended to protect waters of the state from pollution contained in DOT storm drain systems within Urbanized Areas. State Routes 12, 131 and 200 are located within the UA in Thompson. I-395 is immediately adjacent to the UA and likely discharges to a stream in the UA.

5.1.1.3. General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities

The construction stormwater general permit authorizes the discharge of "…stormwater and dewatering wastewaters to surface waters from construction activities on a site with a total disturbance of one or more acres of land area on a site, *regardless of project phasing"* (CT DEEP, 2013).

Construction stormwater general permits regulate construction activities that fall into one of two categories: *locally approvable* and *locally exempt*. Locally approvable activity is one that has a total area of disturbance between one and five acres. Locally approvable permitted activities require that the permittee obtain local land-use commission approval and adhere to all local regulations (CT DEEP, 2013). Permittees are also required to comply with recommendations of the Connecticut Guidelines for Soil Erosion & Sediment Control (CT DEP, 2002) and Connecticut Stormwater Quality Manual (CT DEP, 2004). Locally approved permits do not need to register with the State and are exempt from plan review and certification "…provided a land-use commission of the municipality (i.e. planning/zoning, wetland, conservation, etc.) reviews and issues a written approval of the proposed erosion and sediment control measures, pursuant to the requirements of section 22a-329 of the Connecticut General Statutes" (CT DEEP, 2013).

A locally exempt activity is a "…construction activity for which the registration is for a project authorized under municipal, state or federal authority and may not be required to obtain municipal approval for the project" (CT DEEP, 2013). Permittees must register the activity with the State and must have the construction plans, including construction phasing, a Stormwater Pollution Control Plan, and an erosion and sediment control plan, reviewed and certified by a qualified professional as defined in the general permit.

A review of CT DEEP's Registrations for the Construction Stormwater General Permit (https://filings.deep.ct.gov/DEEPPortal/PublicSearch/SWC) did not indicate any registrations in Thompson.

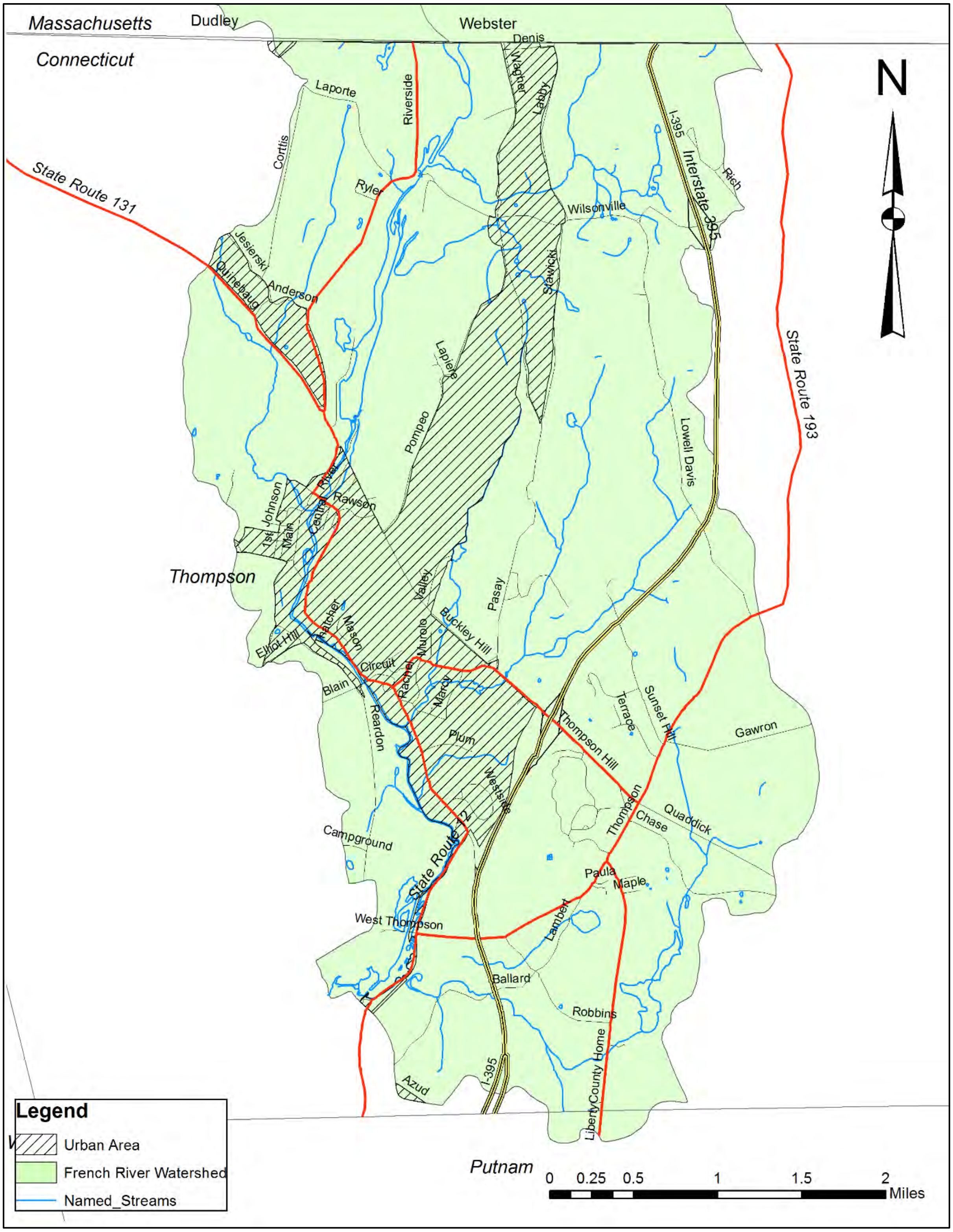


Figure 5-1. Urbanized Areas with the French River watershed (US Census Bureau, 2016).

5.1.1.4. General Permit for the Discharge of Stormwater Associated with Industrial Activity

This stormwater permit authorizes the discharge of stormwater associated with industrial activity to a surface water or storm sewer system. Permittees are required to register with CT DEEP and prepare and submit a Stormwater Pollution Prevention Plan.

Industrial activities located in the French River watershed in Connecticut that are regulated under the industrial stormwater general permit include:

- Mines/quarries and stone cutting
- auto salvage yards
- (non-municipal) transportation facilities
- federal, state or municipal maintenance/repair/salt storage facilities
- DOT maintenance and repair facilities

A review of individual permits at the US EPA Region 1 (New England) NPDES permit webpage (https://www3.epa.gov/region1/npdes/permits_listing_ct.html) indicated that there are no individual industrial stormwater general permits in the French River watershed in Connecticut. CT DEEP lists one industrial stormwater registration by the Connecticut Department of Transportation (CT DOT) salt storage facility at the I-395 Southbound Exit 50 at its website at:

http://www.ct.gov/deep/cwp/view.asp?a=2721&q=558454&DEEPNav_GID=1654

ECCD did not find a registration for the Town of Thompson municipal facilities; however, staff have indicated that the Town has submitted registrations for the highway garage and transfer station, and a Stormwater Pollution Prevention Plan for the municipal transfer station has been posted to the Town website:

http://www.thompsonct.org/images/thompson/selectmen/17117-Transfer-Station-SWPPP-2017-3-21.pdf.

5.1.1.5. General Permit for the Discharge of Stormwater Associated with Commercial Activity

The commercial stormwater general permit regulates the discharge of stormwater associated with commercial activity that is discharged to surface waters or a municipal separate storm sewer system. The permit further applies to "…any activity or facility under Standard Industrial Classifications (SIC) (as defined in "Standard Industrial Classification Manual, Executive Office of the President, Office of Management and Budget 1987") 50-59 and 70-79, with five (5) acres or more of contiguous impervious surface. Impervious surface means roof area, paved walk, paved parking area, paved driveway, paved roadway and any other paved surface" (CT DEEP, 2017).

Commercial facilities subject to the commercial stormwater general permit are required to register with CT DEEP and prepare and submit a stormwater management plan (SWMP). The SWMP must identify stormwater management measures, including:

- Pollution Prevention Team
- Sweeping
- Outside Storage
- Washing
- Spill Control
- Maintenance and Inspection
- Employee Training
- Comprehensive Annual Stormwater Evaluation and Inspection
- Record Keeping
- Future Construction

There are no commercial properties in the French River watershed that exceed five acres of impervious surfaces.

5.1.2. AFO/CAFO Permits

Concentrated Animal Feeding Operations (CAFOs) are agricultural operations where:

> Animals are kept and raised in confined areas for a total of 45 days or more in any 12-month period, and crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility. CAFOs generally congregate animals, feed, manure, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures. Animal waste and wastewater can enter water bodies from spills or breaks of waste storage structures (due to accidents or excessive rain), and non-agricultural application of manure to crop land. CAFOs are point sources, as defined by the CWA Section 502(14) and are regulated through the NPDES program (US EPA, 2014).

Currently, in Connecticut, permits are not being issued for CAFOs, although DEEP does review Comprehensive Nutrient Management Plans (CNMPs) that are voluntarily submitted by producers enrolled in USDA-NRCS programs. DEEP is in the process of preparing a general permit under which CAFOs will be permitted in the future. There are no AFOs or CAFOs located in the French River watershed.

5.2. Hazardous Waste

EPA defines hazardous waste as "waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can be liquids, solids, gases, or sludges. They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes" (US EPA, 2014). Authority for the State of Connecticut to regulate hazardous waste is prescribed through Connecticut General Statutes Section 22a-449.

5.2.1. CERCLA Sites

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as the Superfund, was enacted by Congress on December 11, 1980. A CERCLA or Superfund site is an uncontrolled or abandoned place where hazardous waste or other contamination is located (US EPA, 2014). The CT DOT garage on the southbound side of Interstate Route 395 at exit 50 (State Route 200) is listed on the CERCLA inventory (Fig. 5-2).

5.2.2. RCRA Sites

The Resource Conservation and Recovery Act (RCRA) was enacted by Congress in 1976. RCRA's primary goals are "to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner. RCRA regulates the management of "solid waste (e.g., garbage), hazardous waste, and underground storage tanks holding petroleum products or certain chemicals" (US EPA, 2014). Facilities regulated under the Resource Conservation and Recovery Act (RCRA) may have releases into the environment, thereby requiring cleanup. RCRA sites in the French River watershed, which include the former North Grosvenordale Company Mill at 929 Riverside Drive, the (now closed) municipal sanitary landfill on Pasay Road, and the CT DOT garage at Routes 200 and I-395, are depicted in Fig. 5-2.

5.2.3. Brownfields

A brownfield is defined by Connecticut General Statutes Section 32-9kk(a)(1) as "any abandoned or underutilized site where redevelopment, reuse or expansion has not occurred due to the presence or potential presence of pollution in the buildings, soil or groundwater that requires investigation or remediation before or in conjunction with the restoration, redevelopment, reuse and expansion of the property." The Connecticut Brownfields Redevelopment Authority (CBRA) maintains a town-by-town brownfields inventory that can be found on the CT DEEP brownfields portal (www.ct.gov/deep/cwp/view.asp?A=2715&Q=324930), along with additional information regarding brownfields redevelopment. The former Belding-Corticelli Industries mill at 630 Riverside Drive is included on the Connecticut brownfields inventory (Fig. 5-2). Other mill sites that are not listed on the inventory but that could be considered brownfields at some future time include a vacant mill at 649 Riverside Drive, a former mill site at 700

Riverside Drive, and the former North Grosvenordale Company Mill at 929 Riverside Drive, for which a Phase 1 investigation was completed in 2016. At the time of the preparation of this plan, the report was available in draft form only.

5.2.4. Underground Storage Tanks (USTs)

The US EPA defines an underground storage tank (UST) as “a tank and any underground piping connected to the tank that has at least 10 percent of its combined volume underground” and that stores petroleum or certain hazardous substances (US EPA, 2014). This typically refers to underground tanks at gas and service stations and residential heating oil tanks. The State of Connecticut regulates leaking USTs (LUST) through the Department of Energy and Environmental Protection Storage Tank Enforcement Unit. There are five registered LUST sites in the French River watershed (Fig. 5-2), including two privately-owned properties on Thompson Road and Red Bridge Road, and three municipally-owned tanks at the highway garage, the public school and Riverside Park.

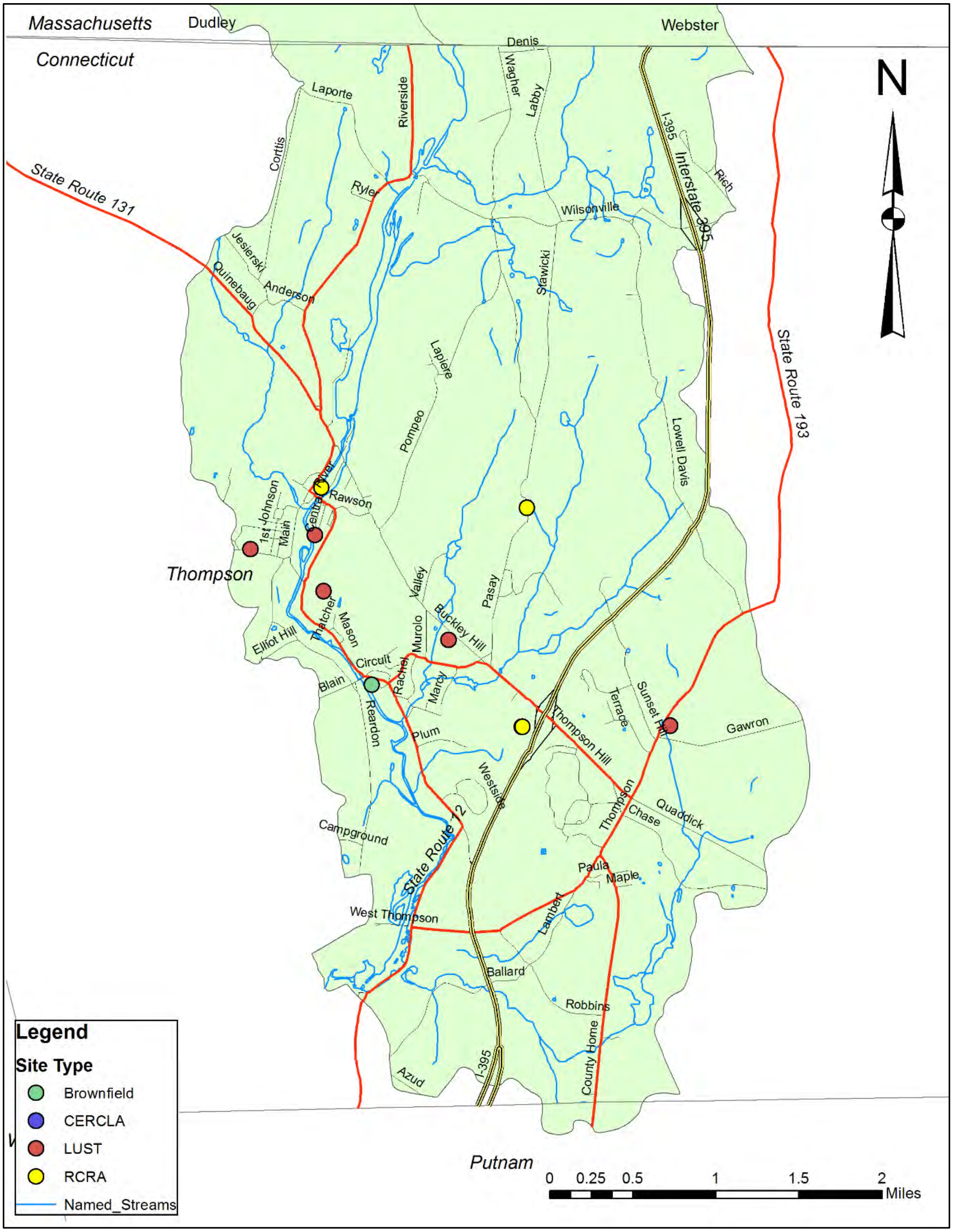


Figure 5-2. Contaminated or potentially contaminated sites and brownfields in the French River watershed.

5.3. Non-point Sources

Non-point source pollution (NPS) is pollution that is not derived from a single discernible source or point, such as a pipe or outfall. NPS results from a diffuse and diverse array of pollutants derived from our everyday activities that are found on the ground surface. These pollutants are mobilized and transported via rain or snowmelt into streams, rivers, lakes, ponds, estuaries and ultimately the ocean, and include:

- Excess or poorly managed fertilizers, herbicides and insecticides from agricultural lands and residential areas
- Oil, grease and toxic chemicals from urban runoff and energy production
- Sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks
- Salt from roadway de-icing materials, irrigation practices and acid drainage from abandoned mines
- Bacteria and nutrients from livestock, pet wastes, faulty septic systems and leaky sewer pipes
- Atmospheric deposition and hydro-modification (US EPA, 2014).

Sources of NPS identified during the 2015 water quality investigation and 2017 windshield field survey are identified in the following sections.

5.3.1. Impervious Cover/Stormwater Runoff

Impervious cover (IC) is any surface in the landscape that cannot absorb or infiltrate rainfall. Impervious surfaces include rooftops and paved areas like roads, sidewalks, driveways and parking. Because IC prevents rainwater from soaking into the ground, it contributes to the volume of stormwater runoff that is shed from developed areas into nearby waterbodies and can be a significant vector for the conveyance of NPS (Fig. 5-3).

The amount of impervious cover in a watershed has been directly linked to impacts to stream quality and stream biodiversity. Numerous studies, including those conducted by Schueler (1994), have demonstrated that the amount of impervious cover in a watershed directly impacts stream quality (Fig. 5-4). In 2007, Roy Schiff and Gaboury Benoit published data from a study of the West River in New Haven, CT. Their study showed that water quality declined when the total impervious area within a stream's contributory watershed exceeded 5%.

A 2008 study conducted by CT DEEP indicated that water quality declined when impervious cover in a watershed exceeded 6% (Bellucci, Beauchene and Becker, 2008). The Connecticut Watershed Response Plan for Impervious Cover (DEEP, 2015), which was developed to provide guidance for "managing stormwater and impervious cover to support water quality improvements," suggests a target impervious cover limit of 12%. Twelve percent impervious cover represents "the level of impervious cover in the contributing watershed, below which a stream is likely to support a macroinvertebrate community that meets aquatic life use goals in Connecticut Water Quality Standards" (DEEP, 2015).

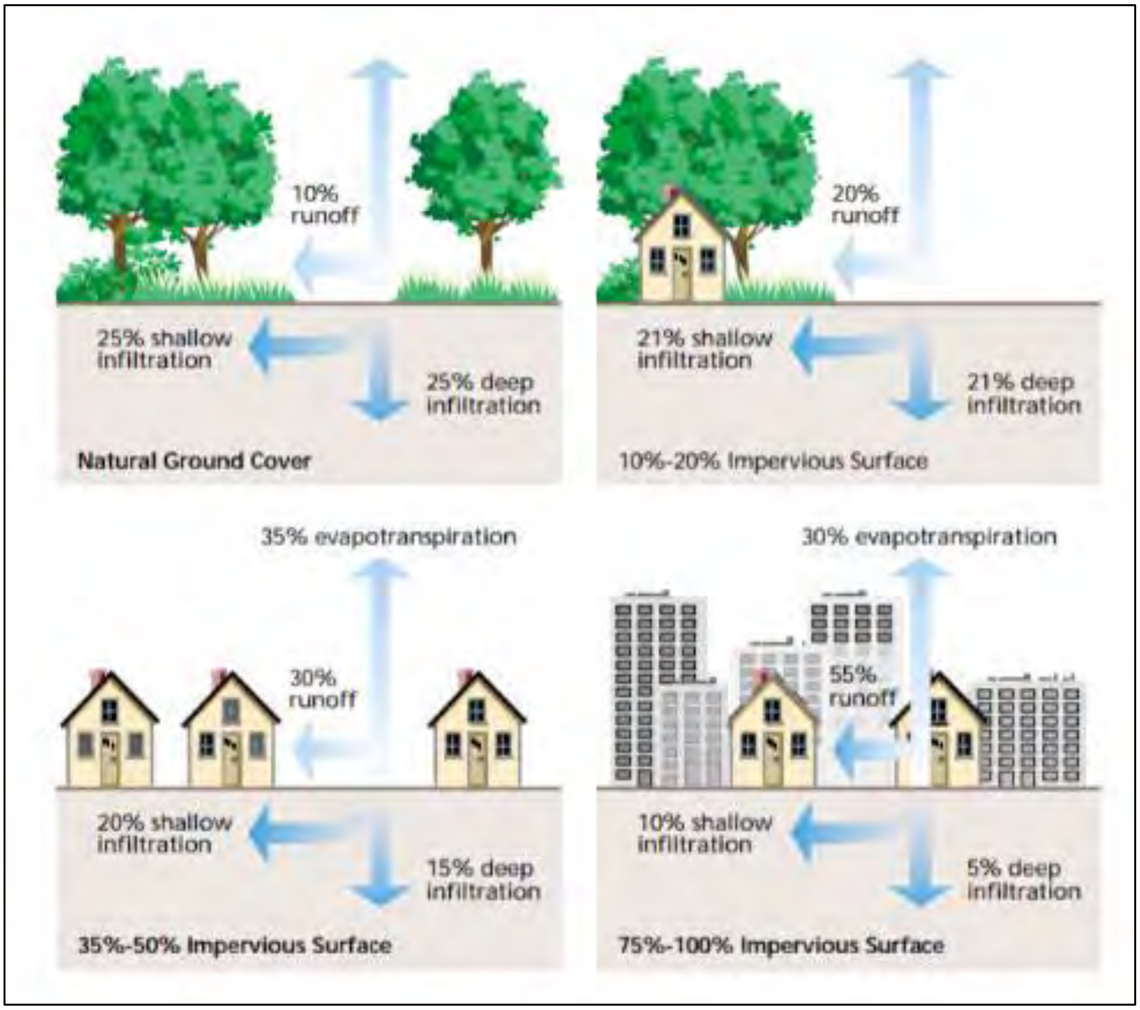


Figure 5-3. Effects of impervious cover on surface stormwater runoff (from Stream Corridor Restoration: Principles, Processes and Practices, FISRWG, 1998).

Approximately 22% of the French River watershed (CT 3300) in Connecticut is developed, and approximately 15% of that developed area is comprised of impervious cover (CLEAR, 2014). Most of the development in the French River watershed is located in the French River local watershed (CT3300-00), which includes North Grosvenordale (the primary urban area in the French River watershed) and mixed-use areas along the Route 12 corridor (Fig. 5-5). About 27% of the French local watershed is developed, and approximately 19% of that is comprised of impervious cover (CLEAR, 2014). Institutions and businesses in the French River watershed that have large areas of impervious surfaces, including extensive roof areas and parking lots, are identified in Table 5-1.

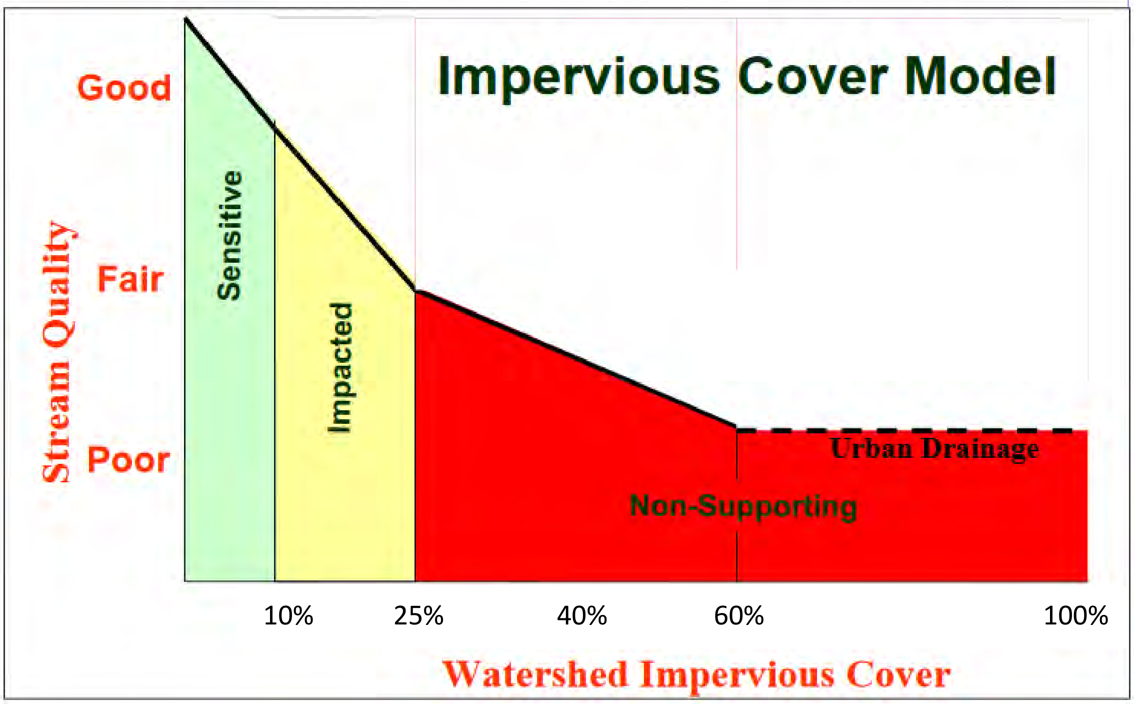


Figure 5-4. The relationship between stream quality and impervious cover in a watershed (Schueler, 1994).

Stormwater runoff from impervious surfaces throughout the watershed and particularly in the more densely developed North Grosvenordale section the watershed can contribute a significant amount of NPS to watershed streams and ponds, including sediment, vehicular chemicals and animal waste. Several instances of stormwater runoff from bare areas and dirt driveways were noted during the windshield field survey. Uncontrolled runoff has created erosion gullies and in several instances, large deposits of eroded sediments were present at the foot of the driveways, where they are transported into nearby storm drain systems during rains. Numerous areas of erosion were also noted at the Thompson public school complex, associated with areas of bare soil.

In order to minimize or prevent water quality impacts from stormwater discharge from impervious areas, especially in the segment of the French River that flows through the center of North Grosvenordale, property owners and watershed managers should take steps to reduce the amount of stormwater runoff from these impervious areas via the adoption of appropriate stormwater management practices. Numerous opportunities to manage stormwater runoff through the use of LID practices such as rain barrels and rain gardens, especially at former mill housing throughout North Grosvenordale, were noted.

Table 5-1. Institutions and businesses in the French River watershed with large impervious areas.

Institution/Business	Location	Sub-Watershed	IC (Acres)
American Rent-All, LLC.	Route 131	Backwater Brook	3.9
Former Extra-Mart offices	Route 131	Backwater Brook	1.5
Tilcon CT	Wilsonville Road	French Local	4.5
Connecticut Transport Company*	Wilsonville Road	French Local	1.8
Church	Route 12	French Local	1.0
Knights of Columbus*	Route 12	French Local	1.25
North Grosvenordale Mill*	Route 12	French Local	10.5
Former hardware store*	Route 12	French Local	2.5
Thompson Public Library*	Route 12	French Local	3.0
River Mill Village*	Central Street	French Local	6.0
Greek Village*	Market Street	French Local	2.0
Superior Bakery*	Main Street	French Local	2.6
St. Joseph's RC Church and School*	Main Street	French Local	4.25
Town Hall/Post Office/Bank*	Route 12	French Local	2.7
Public School Complex*	Route 12	French Local	27.5
American Legion CT Post #67*	Thompson Hill Road (RT 200)	French Local	1.0
State of Connecticut*	Interstate Route 395	French Local	22.0
Thompson Highway Garage*	Buckley Hill Road	Stoud Brook	5.1
Thompson Transfer Station	Pasay Road	Baptist Brook	2.0
J&D Construction*	Route 12	Sunset Hill Brook	1.6
Ivanhoe Tool & Die Co.	Thompson Road (RT 193)	Sunset Hill Brook	1.5
NUMA Tool	Thompson Road (RT 193)	Sunset Hill Brook	7.0
State of Connecticut	Interstate Route 395	Sunset Hill Brook	32.0
State of Connecticut	Interstate Route 395	Little Mountain Brook	8.6
State of Connecticut	Interstate Route 395	Quinatissett Brook	13.7
State of Connecticut	Interstate Route 395	Knowlton Brook	19.8
State of Connecticut	Interstate Route 395	Long Branch Brook	6.0

* Property is located in 2010 US census urban area (UA).

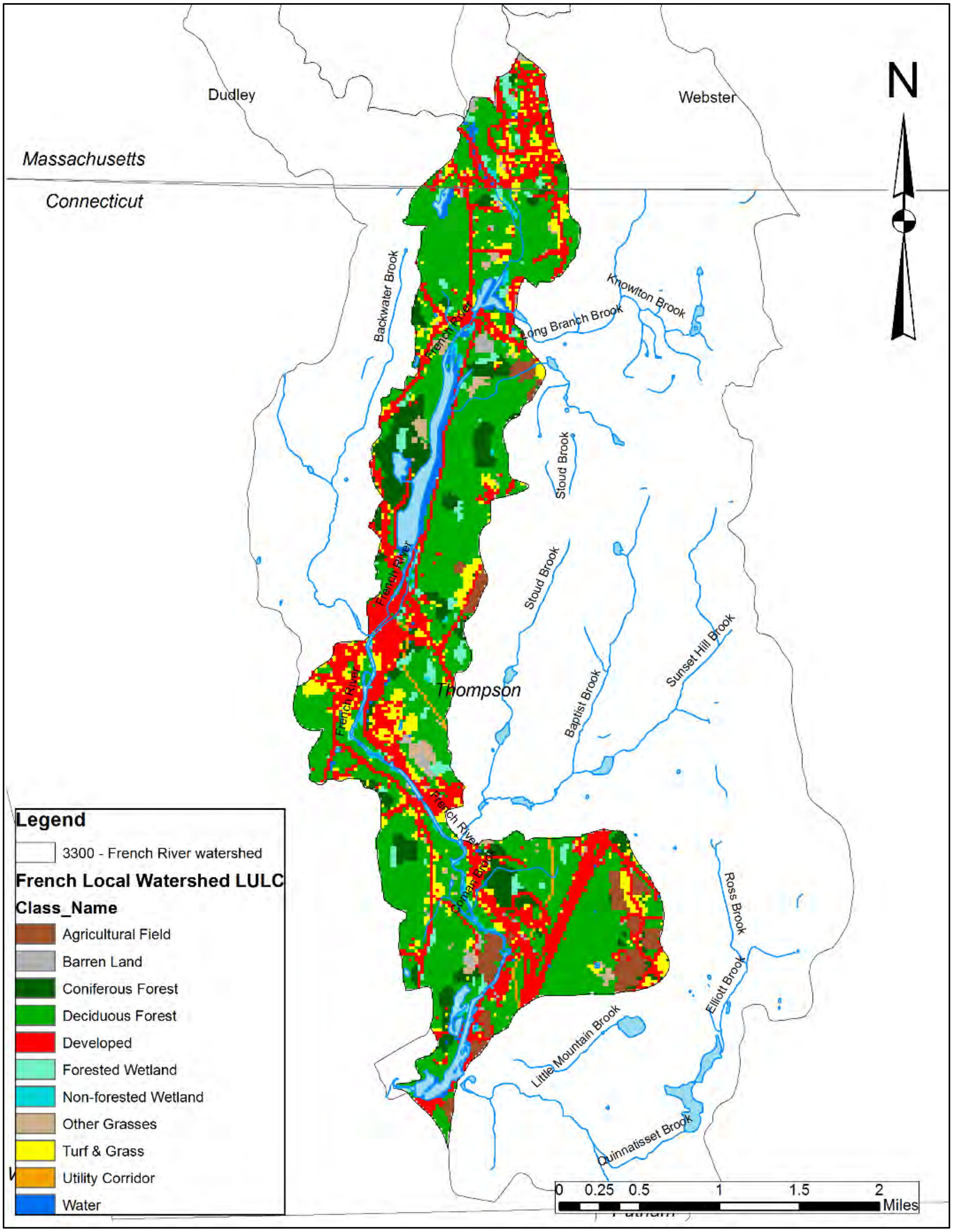


Figure 5-5. Land cover in the French local watershed (CT3300-00). Impervious areas (buildings and paved surfaces) are depicted in red. Yellow areas represent turf grasses such as lawns associated with developed land.

5.3.2. Stormwater Outfalls

Rainwater that falls onto impervious cover is typically directed into storm drain systems which funnel rainwater away from hard surfaces, especially roadways, in order to maintain safe conditions for vehicular traffic. Storm drain systems typically discharge stormwater into low-lying receiving areas, such as ditches, streams, wetlands and ponds (Fig. 5-6). Traditionally, storm drain systems have not been designed to treat the many pollutants that rainwater mobilizes and transports as it is conveyed into the receiving waterbodies. As a result, stormwater can contain a variety of pollutants including bacteria, sediment, nutrients from pets, livestock and lawn care products, trash and debris, and oils, greases and other chemicals from vehicles that can be detrimental to water quality and exceed established water quality standards. Traditional storm drain systems may also be a significant source of fecal bacterial loading, either via the transmission of contaminated surface stormwater runoff to the receiving waterbody, or by loading of bacteria originating in the storm drain. Studies have indicated that E. Coli and other fecal coliform bacteria, once introduced into the environment, can survive and proliferate in the biofilm (scum) layer that forms in storm drain pipes (Skinner et al, 2010).

Much of the storm drain infrastructure installed in the French River watershed in Thompson was designed to quickly remove water from paved surfaces, and does not provide any pollutant remediation prior to discharge to the receiving waterbodies. Traditional storm drain systems on state-maintained roads, including State Route 12 and Interstate Route 395, deliver untreated stormwater to the receiving waterbodies.

Figure 5-6. Stormwater from Wilsonville Road discharges directly to this small pond without any water quality treatment.

5.3.3. Septic Systems

Fecal bacteria loading can occur as a result of malfunctioning or under-functioning septic systems. Approximately 96% of the French River watershed is served by individual on-site subsurface sewage (septic) systems. Individual septic systems are regulated by the Northeast District Department of Health (NDDH) located in Brooklyn, CT. The Health District is responsible for the review of septic system siting and design, including soil evaluations to ensure septic effluent will infiltrate the soil at a specified range of rates and provide adequate bacteria renovation.

Septic system failures can result in sewage breakouts, in which untreated effluent containing both nutrients and fecal bacteria is discharged to the ground surface, where it can contaminate not only nearby waterbodies, but nearby drinking water wells. Septic system failures can also result in the leaching of untreated effluent into groundwater, which can then be conveyed to nearby wells and waterbodies. Septic system functionality can be affected by improper installation and limitations including soil suitability, depth to groundwater, and depth to bedrock. Figure 5-7 depicts the septic suitability of soils in the French River watershed. In general, the watershed appears to be dominated by soils that have low septic potential, necessitating the need for engineered septic systems to ensure effluent is treated properly. Property owners are encouraged to maintain their systems through best management practices, including regular tank pumping, system inspections and proper disposal of chemicals and other materials that might otherwise impact or impair the proper function of the septic system. At the present time, there is no regulatory mechanism in place to require or enforce septic system maintenance and inspections.

High fecal bacteria levels documented in Quinatissett Brook in 2015 may be due to under-performance or failure of the existing sub-surface waste treatment system at Quinatissett Golf Club. Club managers were not certain of the system's age and suggested it could be a cesspool rather than a septic system. They also indicated that planning is underway to replace the system with a new septic system. Soils at the golf course include Canton and Charlton soils (60B), which have high septic potential. Follow-up water sampling is recommended once the new septic system is installed to determine if stream bacteria levels have returned to levels that are supportive of Connecticut water quality standards.

The Northeast District Department of Health has documented several sub-surface waste treatment system failures on Thompson Hill, including older cesspools at private residences and the waste treatment system (septic lagoon) at Marianapolis Preparatory School. Predominant soils on Thompson Hill include Woodbridge fine sandy loams (45A and 45B) which have very limited septic potential due to shallow depths to groundwater and poor soil infiltration rates. Soils in the vicinity of the Marianapolis septic lagoon include Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony (46B) which has a somewhat limited potential due to shallow depths to groundwater and slopes.

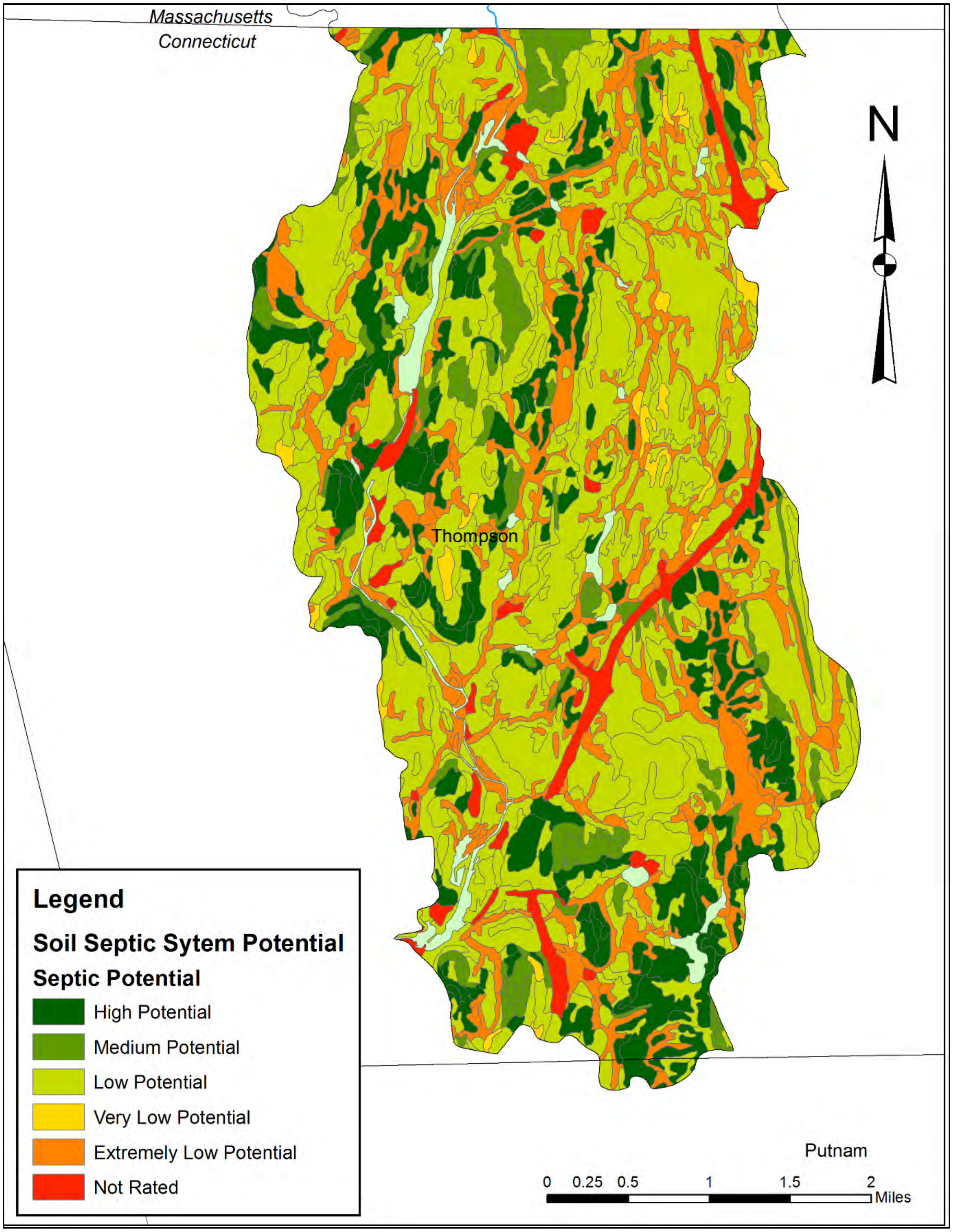


Figure 5-7. Septic potential of soils in the French River watershed (SURRGO, 2009).

5.3.4. Sanitary Sewers

Fecal bacteria loading can occur as a result of undetected leaks in municipal sewer systems or malfunctioning or under-functioning septic systems. The municipal sewer system in Thompson is owned, operated and maintained by the Thompson Water Pollution Control Authority (WPCA).

The municipal sewer in the French River watershed extends from the junction of State Routes 12 and 131 in North Grosvenordale to the sewage treatment plant, located on Route 12 near the Thompson/Putnam town line (Fig. 5-8). Thompson municipal sewer provides service to approximately 1100 residences and businesses along the Route 12 corridor, including the densely developed village center in North Grosvenordale. Untreated sewage from these areas is conveyed via the sewer main to the Thompson sewage treatment plant, where it is treated and discharged to the Quinebaug River.

The municipal sewer system was installed in the late 1960s to early 1970s. Sewer mains are primarily reinforced concrete pipe (RCP), with some plastic pipe. Sewer laterals are clay pipe. The WPCA does not conduct regular maintenance or inspections. Maintenance typically occurs when a problem has been reported by a customer; this usually occurs in sewer laterals and is often related to clogs or tree roots that have ruptured or displaced pipes.

The WPCA conducted an inflow and infiltration (I&I) study in 2017 to evaluate the volume of surface runoff and groundwater that enters the sewer system through inflow and infiltration. As part of the study, the sewer mains were video-inspected, and verified to be in good condition. Stormwater inflow and groundwater infiltration rates were determined to be within acceptable limits. The WPCA also conducted upgrades to the treatment plant in 2017 to comply with State-mandated April to October phosphorus removal rates.

The Town has been mandated since the early 1990s to connect the Thompson Hill area to the municipal sewer. Several properties on Thompson Hill, which is located in the Quinatissett (CT3300-10) and French River local (CT3300-00) watersheds, have had issues with poorly performing septic systems due to shallow depth to bedrock and high groundwater. Since 2015, efforts have been underway to connect Marianapolis Preparatory School, located on Thompson Hill in the French River local watershed (3300-00), to the municipal sewer. The septic lagoon on the property (identified in Section 5.3.3) does not adequately treat sewage. Poorly treated effluent is suspected of being transported by shallow subsurface and/or groundwater flow to an unnamed stream that discharges to the French River near the I-395 southbound on-ramp (Exit 49), near sampling site UN01 (Fig. 5-9). Complications encountered while boring under I-395 to connect to the Marianapolis property have resulted in the temporary suspension of the project while a solution is sought.

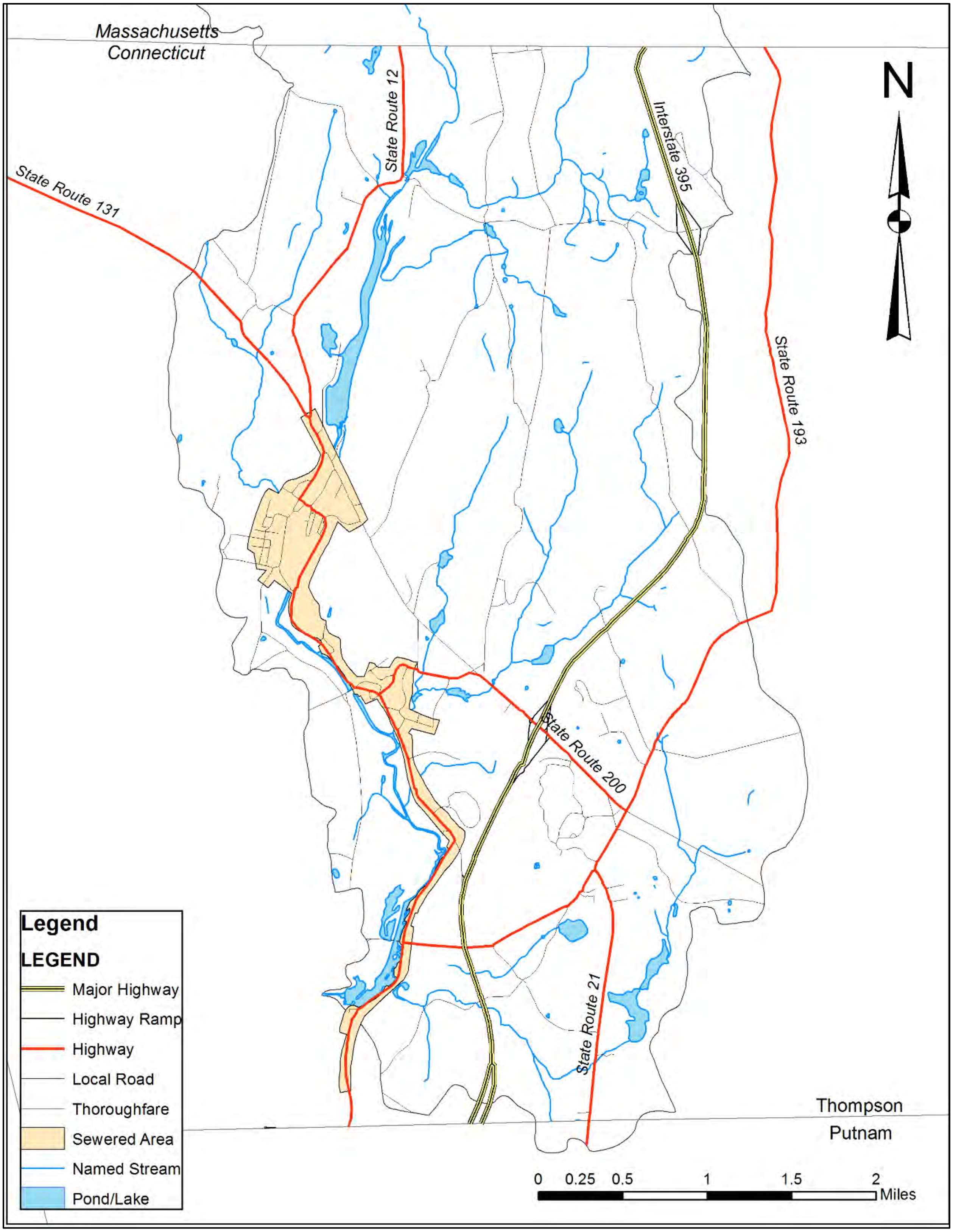


Figure 5-8. Municipal sewer area in the French River watershed

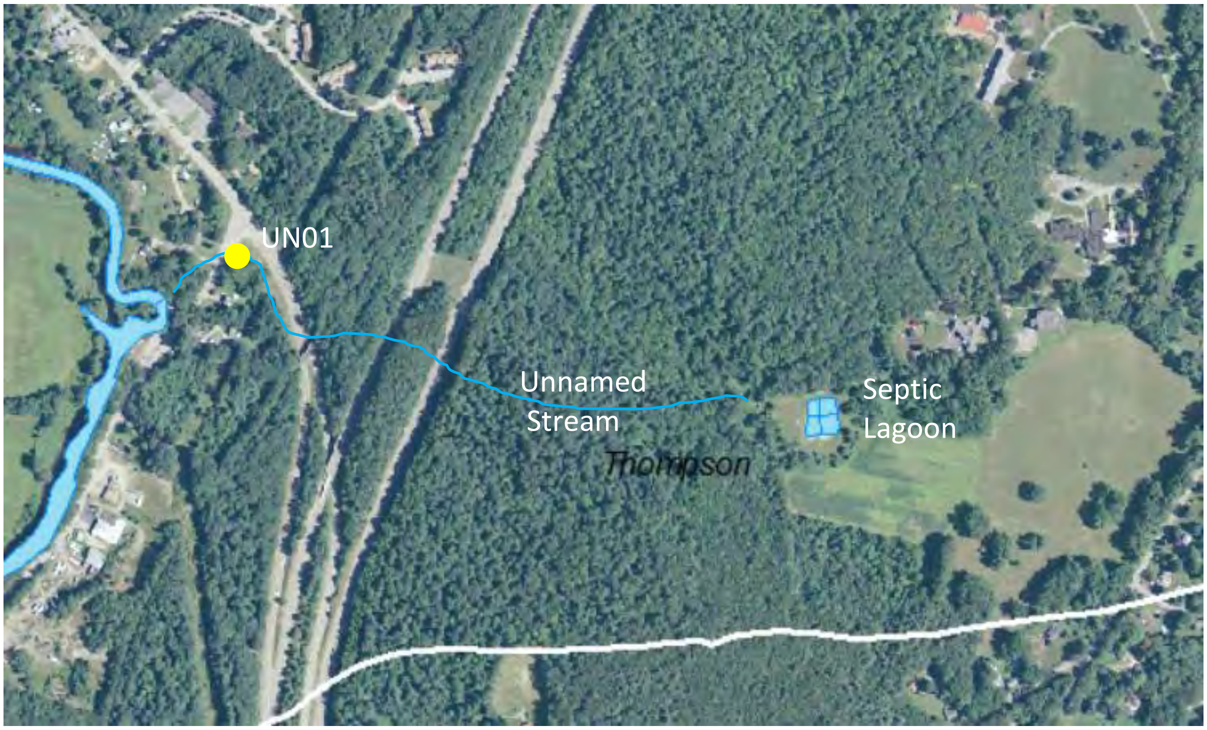


Figure 5-9. Location of Marianapolis Preparatory School septic lagoon relative to the unnamed stream and the French River.

5.3.5. Pets

In developed areas, pet feces, particularly dog feces, can be a significant source of bacteria. A study conducted by the University of Nevada Cooperative Extension (Walker and Garfield, 2008) determined that one gram of fresh dog feces contained an average of 50 million colony forming units (CFU) of E. coli bacteria. The improper or lack of disposal of pet waste can contribute to the total amounts of bacteria in stormwater runoff. In 2016, approximately 1400 dogs were licensed in Thompson (equivalent to about 30 dogs per square mile). In North Grosvenordale, the Main Street area, Riverside Park, and the Riverwalk, which runs along the French River and connects North Grosvenordale Pond to Riverside Park, are popular locations for dogwalkers. However, it has been observed that some dog owners do not clean up after their pets. Thompson does not have an ordinance requiring pet owners to clean up after their animals if they defecate on public property.

5.3.6. Wildlife/Waterfowl

The French River Watershed Long Branch Brook Total Maximum Daily Load Summary (DEEP, 2012) cites waste from wildlife as a potential nonpoint source of bacteria in the watershed; however, it is difficult to determine the exact contribution of the many wildlife species found in eastern Connecticut to the total bacteria load. Unless specific overpopulation problems have been identified, the wildlife contribution is considered representative of "background" or natural levels of bacteria found in a watershed.

Migratory waterfowl are often cited as significant contributors to fecal bacteria levels; however, migratory waterfowl were not noted to be prevalent in the French River watershed, nor were common non-migratory waterfowl such as Canada Geese. There is not a significant amount of agriculture in the French River watershed to attract non-migratory waterfowl, and more suitable habitats are located in areas outside of the watershed.

A small flock of Mallard ducks (about six to eight animals) was observed nesting at Duhamel Pond in North Grosvenordale (Fig. 5-10). Several domestic ducks and geese owned by a near-by resident were also periodically observed at the pond. Bird droppings were frequently observed on the grassy area adjacent to the pond. According to a study conducted by Alderisio and DeLuca (1999), waterfowl can contribute an average of 4,500 to 24,200,000 colony-forming units of fecal coliform bacteria (probably mostly Escherichia coli) per gram of feces "depending on the season and year of observation." Water samples collected from Backwater Brook (BWB01) downstream of the pond outlet did not meet water quality standards for the sample set geometric mean. However, water samples collected at BWB02, just upstream of the Duhamel Pond inlet, met water quality standards, indicating the pond was the location of the source.

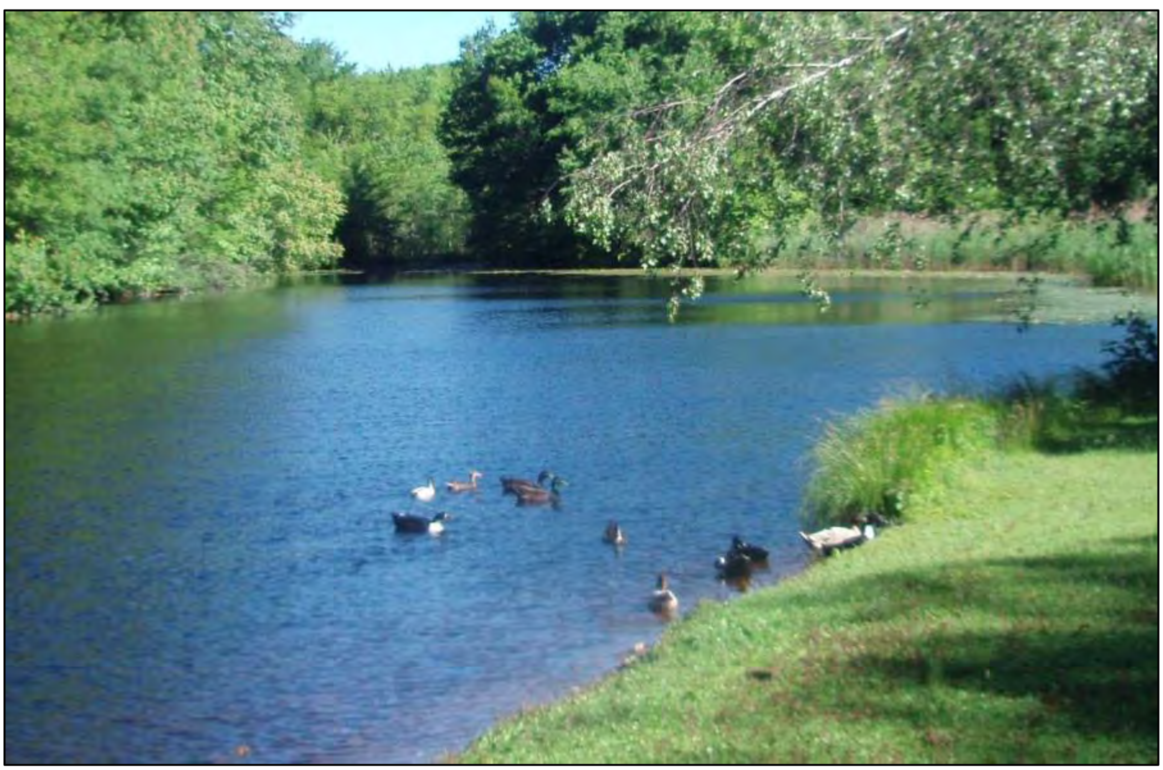


Figure 5-10. Domestic and migratory waterfowl at Duhamel Pond.

5.3.7. Riparian Area Encroachment

Encroachment into the vegetated areas growing along streams and other waterbodies can create conditions that diminish water quality and wildlife habitat. Streamside vegetation performs multiple functions that protect water quality (Osborne and Kovacic, 1993). Riparian plants and trees provide shade to waterbodies, cooling the water and creating thermal refugia for fish and other aquatic species, especially during the warmer months of the years. Riparian plants slow the flow of surface water, allowing it to soak into the ground, and the plant roots hold the soil of the streambanks together, especially during high flows and floods, preventing erosion. A lack of riparian vegetation can allow pollutant-laden stormwater runoff to flow into waterbodies, and that same lack of vegetation can result in streambank erosion and even streambank failure.

Riparian area encroachment was noted throughout the watershed, but was prevalent along the French River in North Grosvenordale. Multiple industrial-era mills were built on the banks of the river, as were appurtenant structures and mill housing. Development of North Grosvenordale as a village center took place along both banks of the French River, and land, including Riverside Park, was often (and continues to be) cleared to the river bank to allow recreational access.

5.3.8. Agriculture/Cropland

Agricultural land use can contribute to both point and nonpoint source pollution. Common agriculture-related pollutants include sediment, nutrients from fertilizer and manure (particularly phosphorus and nitrogen), herbicides and pesticides, and pathogens from animal waste. Pollutant loading varies depending on the type of farming activity, and can be minimized through the selection of appropriate farm management practices and application methods.

There is little agricultural activity in the French River watershed. Approximately 580 acres of land in the watershed (5%) are under agricultural use (CLEAR, 2014). Agricultural land use is primarily divided between hay and silage corn production and is distributed throughout the watershed, with a concentration of agricultural activity in the Little Mountain Brook and Quinatissett watersheds. There is one commercial farm, Chase Road Growers, in the Quinatissett Brook watershed that produces vegetables and cut flowers on approximately 31 acres adjacent to Reams Pond. Chase Road Growers uses commercial fertilizers and cover crops on crop fields.

5.3.9. Livestock/Poultry

Livestock can contribute to on-point source pollution in several ways. Nutrient and pathogen loading can occur from poor or improper manure management practices. Sediment loading can occur via overgrazing and runoff from bare soils in confined paddock areas. Nutrient, pathogen and sediment loading can also occur in areas where livestock are kept near, or allowed access to, waterways.

There are no commercial livestock operations in the French River watershed. Small numbers of livestock (primarily horses and beef cattle) and poultry are scattered throughout the French River watershed, mostly in the more rural upper watershed areas, away from the North Grosvenordale urban area. A small herd of beef cattle (8-10 animals) was noted on Chase Road upstream of sampling site QB02. The cattle were kept in a field adjacent to a wooded wetland adjacent to Elliott Brook, a tributary to Quinatissett Brook, downstream of the Elliott Brook sampling site EB01.

5.4. Other Potential Pollutant Sources

5.4.1. Winter Paved Surface De-icing

The Connecticut Department of Transportation maintains 34.5 miles of state and interstate highway in the French River watershed, including Routes 12, 131, 193,200 and I-395. In 2006, CT DOT switched to a winter de-icing program utilizing salt and liquid chemicals, and discontinued the use of road sand. Chloride is a prime constituent of de-icing compounds. Chloride can negatively impact flora, fauna and water quality, as well as road infrastructure and vehicles.

The Thompson Highway Department manages all municipal roads within its jurisdiction. The department utilizes a molasses-salt brine mix for winter road management. De-icers that utilize agricultural by-products such as molasses as an alternative to rock salt are fairly new and the environmental effects have not been widely researched. However, because they are organic, they can have environmental impacts, especially if they enter waterways, including biological oxygen demand and nutrient enrichment (NHDES, 2016). Improper storage of de-icing materials can have an environmental impact. As a result of the detection of high sodium levels during routine water testing by the Connecticut Water Company, the Town of Thompson has been cited by the State of Connecticut for failing to properly store its road salt. The highway garage is located just north of Thompson's sole public drinking water supply aquifer (managed by Connecticut Water). Runoff from the uncovered road salt stockpile discharges to Stoud Brook, which contributes to the aquifer. Due to the high sodium levels, Connecticut Water has issued a sodium notification to its public water supply customers. The Town has worked with the University of Connecticut to design a salt storage facility and is seeking funding to construct the building.

Private plowing companies and provide plow other management services for private properties, including commercial establishments, condominium and apartment complexes, and so forth. Industry standard is to apply salt brine or sand-salt mixes, which can result in the transport and deposition of substantial amounts of sand in catch basins and receiving waterbodies by snowmelt and stormwater. There is no known coordinated training or certificate process in the region that addresses de-icing best management practices to minimize surface and ground water quality impacts from salt application.

Figure 5-11. Material storage at the Thompson Highway Department at 255 Buckley Hill Road.

5.4.2. Land Clearing/Development

Land clearing and development can be a significant source of pollution. The clearing of large tracts of land preparatory to development can result in the disturbance of many acres of soil, creating the potential for soil erosion.

Land development and land clearing activities occur under the oversight of the municipal land use commissions, including Planning and Zoning and Inland Wetlands and Watercourses Commissions. Commissions are responsible for reviewing land development permit applications, ensuring the proposed activities comply with land-use regulations, including the Construction Stormwater General Permit for parcels from 1 to 5 acres in size, and issuing permit conditions as necessary. Land use staff are responsible for ensuring permitted activities are being conducted in compliance with the municipal regulations and the terms of the permits.

5.4.3. Timber Harvesting

Certain activities associated with timber harvesting, including clear-cutting, establishment of skid trails, and wetland and stream crossings can be a source of pollution. Timber harvesting is considered a form of agriculture (Connecticut General Statutes Section 1-1(q)) and is exempt from land use regulation pursuant to Section 22a-40(a) of the Connecticut General Statutes. However, certain activities are not exempt from regulations. Prior to the commencement of any timber harvesting activity, the Thompson Inland Wetlands and Watercourses Commission requires applicants to submit a *Request for Approval of Timber Harvest as Use Permitted as of Right*.

Due to the abundance of forest land in the French River watershed, there is regular on-going timber harvesting activity. In addition, there are a number of land owners who have forest management plans, resulting in periodic timber harvests in conformance with the management plans. In order to minimize the potential for soil erosion as a result of timber harvesting activities, forestry practitioners should follow industry-established guidelines such as those outlined in the *BMPs for Water Quality While Harvesting Forest Products* guidebook (CT DEP, 2007) and recommendations by the University of Connecticut Extension and CT DEEP foresters.

5.3.4. Earth Removal/Gravel Mining

Earth removal, including sand and gravel removal and processing of bedrock material can be a significant source of pollutants. Pollutants associated with quarries include sediment, dust, suspended and dissolved solids in stormwater runoff, gasoline, diesel, oil and other hydrocarbons associated with mining equipment. Stormwater runoff from mineral mining and processing facilities are regulated under the NPDES *General Permit for the Discharge of Stormwater Associated with Industrial Activity* and are subject to all provisions and requirements contained therein.

There is one earth removal facility in the French River watershed, located off Reardon Road, near the French River (Fig. 5-12).

Figure 5-12. Earth removal operation off Reardon Road.

6. POLLUTANT LOAD ASSESSMENT

6.1. ESTIMATION OF POLLUTANT LOADS

The estimation of pollutant loads is a critical element in the overall watershed planning process. An estimation of pollutant loads is necessary in order to determine the pollutant load reduction that is needed to restore the quality of an impaired waterbody. A pollutant load is defined as the mass of a pollutant being delivered per unit of time to a waterbody, usually expressed as pounds or kilograms per year. In order to identify where pollutant load reductions may be applied to improve water quality, it is necessary to quantify the pollutant load contributions from the watershed. Where water quality measurements are made, it is possible to determine pollutant loading directly. When no water quality data is available, the use of models can be used to estimate pollutant loading. It should be noted that due to the complexity of watershed processes, models are inherently imprecise, and should be used to guide watershed management decision-making and not as a predictor of future water quality.

ECCD used the Watershed Treatment Model (2013 "Off the Shelf" edition), developed by the Center for Watershed Protection, to estimate watershed pollutant loads based on existing land use conditions. The Watershed Treatment Model (WTM) is based on the Simple Method (Schueler, 1987) which uses parameters including watershed area, annual rainfall, runoff coefficients and selected pollutant concentrations (in mg/l) to estimate annual pollutant loads. The WTM incorporates additional elements into the Simple Method model, such as existing structural and behavioral management practices that may reduce existing pollutant loading, the effects of the adoption or implementation of future management practices on pollutant loading, and the effects of future development in the subject watershed on existing loading levels.

6.1.1. Bacteria Loads

Fecal bacteria is the primary pollutant of concern in the French River watershed because recreation is the listed impaired use. Fecal bacteria levels in the French River and perennial streams throughout the French River watershed were documented by ECCD and TLGV in the summer of 2015. The 2015 water quality data is summarized in Table 6-1.

Table 6-1. Geometric means of fecal bacteria (E. coli) samples collected from the French River and perennial tributaries in 2015.

Site	**Site Description**	**Geomean (cfu/100 ml)**
FR01	French River 500 ft upstream of Quinebaug River confluence	74
FR02	French River at Rt 12 near Riverside Pizza	101
FR03	French River at Riverside Park 100 ft downstream of the footbridge	47
FR04	French River upstream of outlet at North Grosvenordale Pond	14
FR05	French River upstream of Wilsonville Road bridge	57
FR06	French River at the CT/MA state line	87
LBB01	Long Branch Brook upstream of Wagher Road	36
LBB02	Long Branch Brook upstream of Labby Road	56
LBB03	Long Branch Brook at the CT/MA state line	61
KB01	Knowlton Brook downstream of Wilsonville Road	83
SHB01	Sunset Hill Brook downstream of Klondike Avenue	124
SHB02	Sunset Hill Brook downstream of Thompson Hill Road (RT 200)	22
SB01	Stoud Brook upstream of Thompson Hill Road (RT 200)	33
BWB0.5*	Backwater Brook culvert outfall at the French River canal	**820***
BWB01	Backwater Brook downstream of Phelps Pond outlet	**135**
BWB02	Backwater Brook upstream of Phelps Pond off Floral Avenue	32
UN01	Unnamed stream upstream of Route 12 by I-395 SB on-ramp	37
LMB01	Little Mountain Brook downstream of Robbins Road	96
QB01	Quinatissett Brook downstream of Ballard Road	**338**
QB02**	Quinatissett Brook downstream of Reams Pond outlet	**361**
* Reduction based on single sample limit (576 cfu/100ml)		
**Only three samples were taken at these sites and do not constitute a reliable sample set.		

6.1.2. Watershed Pollutant Load Estimates

Watershed pollutant loads were modeled by ECCD, using the Watershed Treatment Model (WTM) (2013 “Off the Shelf” edition), developed by the Center for Watershed Protection. WTM is a spreadsheet-based model that estimates watershed pollutant loads based on existing land use conditions and area, annual rainfall amounts, hydrologic soil groups and loading coefficients for common non-point source pollutants such as those identified in Section 5.3.

The following land uses were included in the model:

- LDR - Low density residential (less than one dwelling unit per acre)
- MDR - Medium density residential (1-4 dwelling units per acre)
- HDR - High density residential (greater than four dwelling units per acre)
- Commercial Development
- Industrial Development
- Roadways
- Forest
- Pasture/Hay
- Cropland
- Open Water

In addition to pollutant loading from the land uses listed above, pollutant loading from other potential sources in the watershed were evaluated, including:

- On-site subsurface sewage disposal systems
- Stream channel erosion
- Livestock

Finally, existing structural and non-structural management practices were incorporated into the model, including:

- Riparian (stream corridor) buffers
- Erosion and sediment controls
- Lawn management practices
- Pet waste management practices

Common NPS pollutants that were modeled using the Watershed Treatment Model include total phosphorus (TP), total nitrogen (TN), total suspended sediments (TSS) and fecal coliform (FC).

Modeling pollutant loading in a watershed that straddles a state line presents a challenge. Because water (and pollutants) don't recognize political boundaries, ECCD opted to utilize the US Geological Survey hydrologic unit (watershed) for the lower French River watershed (HUC 011000010204). As a result, for the local watersheds that straddle the Massachusetts-Connecticut state line, including the French River (CT3300-00), Packard Pond Brook (CT3300-01), Long Branch Brook (CT3300-02), and Freeman's Brook (CT3300-03) watersheds, a portion of the estimated loading is based on land use and land cover in Massachusetts. The acreage of each watershed by state is presented in Table 6-2.

Table 6-2. Sub-watersheds that are located in Connecticut and Massachusetts, with their area and percent area in each state.

Sub-watershed	Total Area (acres)	Area in MA (acres)	% in MA	Area in CT (acres)	% in CT
French River	3,519	279	8%	3,240	92%
Packard Pond Brook*	835	736	88%	99	12%
Long Branch Brook	979	392	40%	587	60%
Freeman's Brook*	799	668	84%	131	16%

*Watersheds discharge to the French River in Massachusetts.

The HUC12-based sub-watersheds are depicted in Figure 6-1. Modeled pollutant loads for the French River watershed land use types are presented in Table 6-3. Modeled pollutant loads and annual pollutant yields by sub-watershed are presented in Table 6-4. Modeled pollutant loads in pounds per year are presented by sub-watershed in Figures 6-2 to 6-5. Modeled pollutant yields, pounds of pollutant per acre per year per sub-watershed, are presented in Figures 6-6 to 6-9. Modeled pollutant loads for each sub-watershed by land use type are presented in Appendix D.

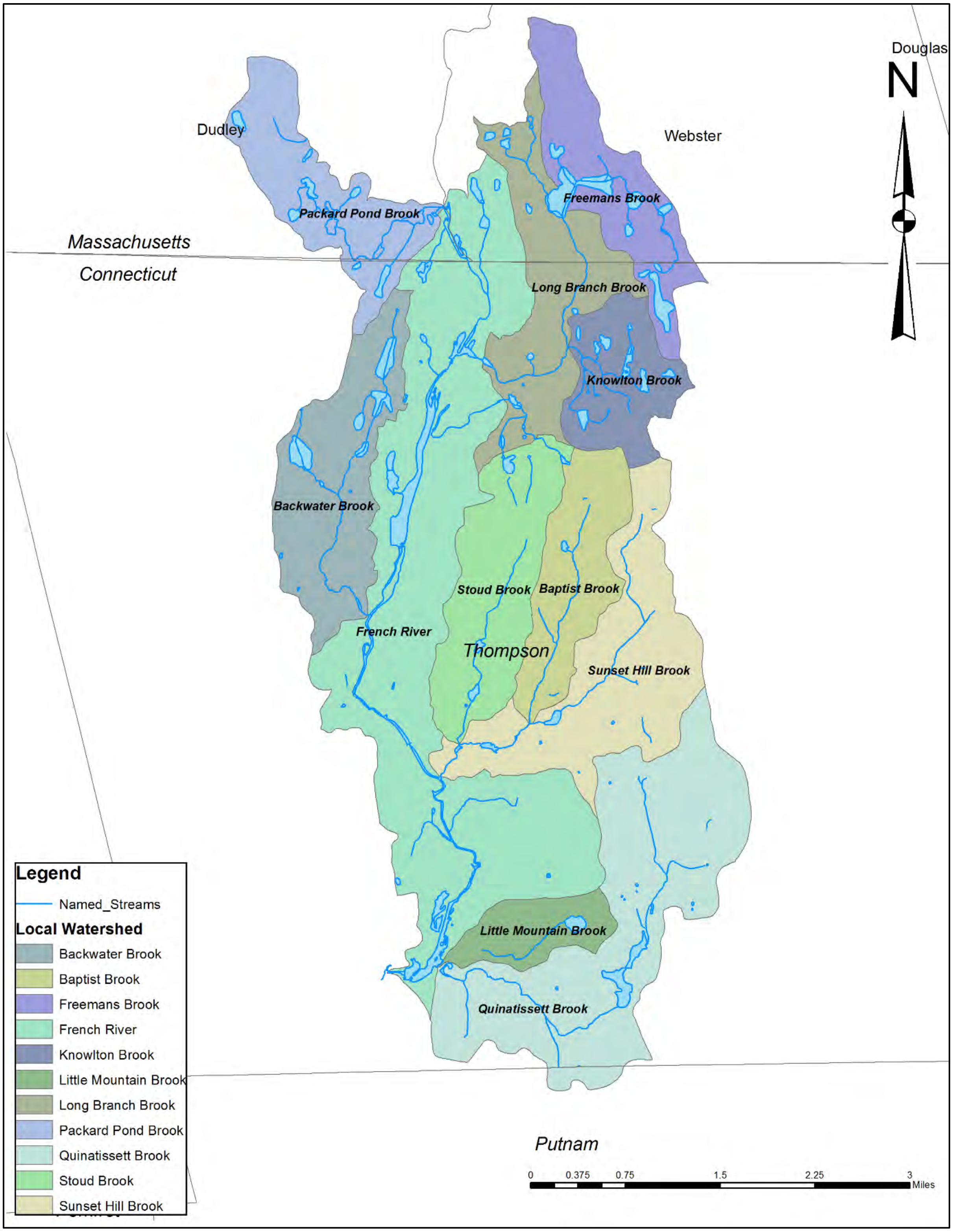


Figure 6-1. Local watersheds in the Lower French River watershed (HUC 011000010204).

Table 6-3. Estimated annual pollutant loads by land use type for the Lower French River watershed (HUC 011000010204).

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% of load)	TP (% of load)	TSS (% of load)	Fecal Coliform (% of load)
LDR (<1du/acre)	3,713	548	86,633	161,157	652	7	10	4	14
MDR (1-4 du/acre)	2,384	352	55,628	103,479	419	4	6	3	9
HDR (>4 du/acre)	494	73	11,517	21,425	87	1	1	1	2
Multi-family	178	26	4,160	7,739	31	0	0	0	1
Commercial	668	70	13,685	29,010	117	1	1	1	3
Roadway	15,821	1,720	921,760	627,006	2,536	28	31	42	56
Industrial	439	50	16,155	18,179	74	1	1	1	2
Forest	23,762	1,901	950,490	114,059	1,164	42	34	43	10
Rural	1,201	183	26,100	10,179	33	2	3	1	1
Pasture/Hay	2,625	399	57,060	22,253	72	5	7	3	2
Cropland	165	25	3,590	1,400	4	0	0	0	0
Open Water	5,492	215	66,511	0	0	10	4	3	0
Land Use Total	**56,942**	**5,562**	**2,213,289**	**1,115,886**	**5,189**	**100**	**100**	**100**	**100**
Secondary NPS Sources									
Septic Systems	1,773	295	11,818	5,218	0	53	49	2	37
Stream Channel Erosion	0	0	703,188	0	0	0	0	98	0
Hobby Farms/ Livestock	1,550	306	0	8,740	0	47	51	0	63
Secondary Source Total	**3,323**	**602**	**715,007**	**13,958**	**0**	100	100	100	100
Load Reductions from Existing Practices	-1,084	-1,107	63,231	52,016	-42	-	-	-	-
Total All Sources	**61,349**	**7,271**	**2,865,065**	**1,077,827**	**5,036**	-	-	-	-

Table 6-4. Pollutant Load Estimates for sub-watersheds in the Lower French River watershed (HUC 011000010204).

Local Watershed	Existing Pollutant Loads (lbs/year)				Existing Pollutant Yields (lbs/ac/year)				Runoff Volume (ac-ft/year)	Runoff Depth (in)
	TN	TP	TSS	Fecal Coliform (billion/yr)	TN	TP	TSS	Fecal Coliform (% of load)		
French River (3300-00) (3,519 acres)	18,772	2,289	879,990	377,231	5	1	250	107	1,772	6
Packard Pond Brook* (3300-01) (835 acres)	4,586	607	208,601	96,311	5	1	250	115	453	7
Long Branch Brook (3300-02) (979 acres)	5,366	670	248,998	105,189	5	1	254	107	485	6
Freeman's Brook* (3300-03) (799 acres)*	4,819	661	222,157	123,527	6	1	278	155	562	8
Knowlton Brook (3300-04) (575 acres)	2,464	271	129,126	42,103	4	0	225	73	204	4
Backwater Brook (3300-05) (1,053 acres)	3,836	395	203,918	57,541	4	0	194	55	298	3
Sunset Hill Brook (3300-06) (1,283 acres)	5,353	593	263,755	83,624	4	0	206	65	426	4
Baptist Brook (3300-07) (688 acres)	2,465	210	107,846	19,191	4	0	157	28	123	2
Stoud Brook (3300-08) (934 acres)	3,070	310	141,018	27,909	3	0	151	30	173	2
Little Mountain Brook (3300-09) (340 acres)	1,948	251	92,578	38,673	6	1	272	114	175	6
Quinatissett Brook (3300-10) (1,953 acres)	8,668	1,014	367,078	106,530	4	1	188	55	569	3
Total (12,958 acres)	**61,349**	**7,271**	**2,865,065**	**1,077,827**	**5**	**1**	**221**	**83**	**5,240**	**5**

* Watersheds discharge to the French River in Massachusetts

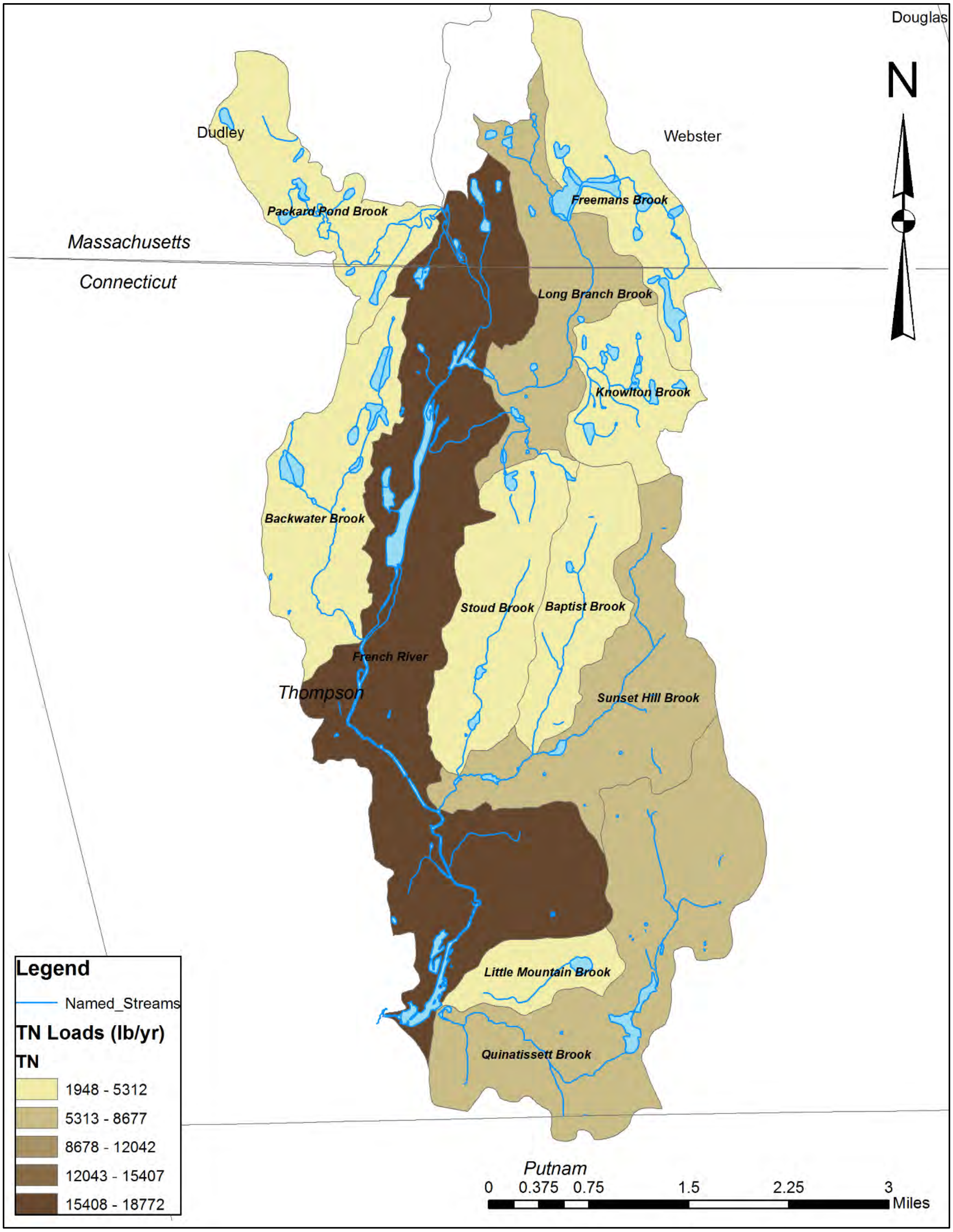


Figure 6-2. Estimated total nitrogen (TN) loads in the French River watershed, in pounds per year (lb/yr).

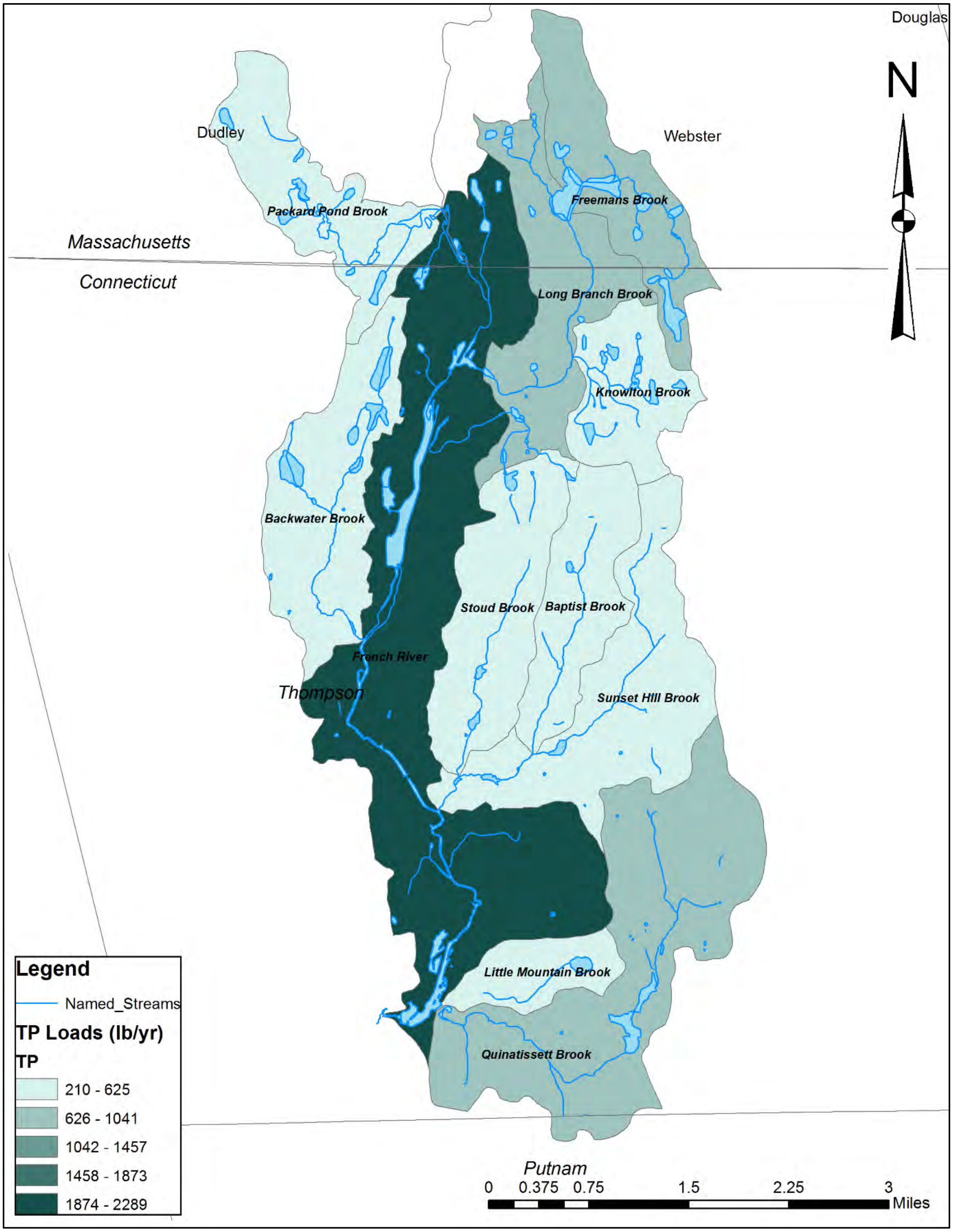


Figure 6-3. Estimated total phosphorus (TP) loads in the French River watershed, in pounds per year (lb/yr).

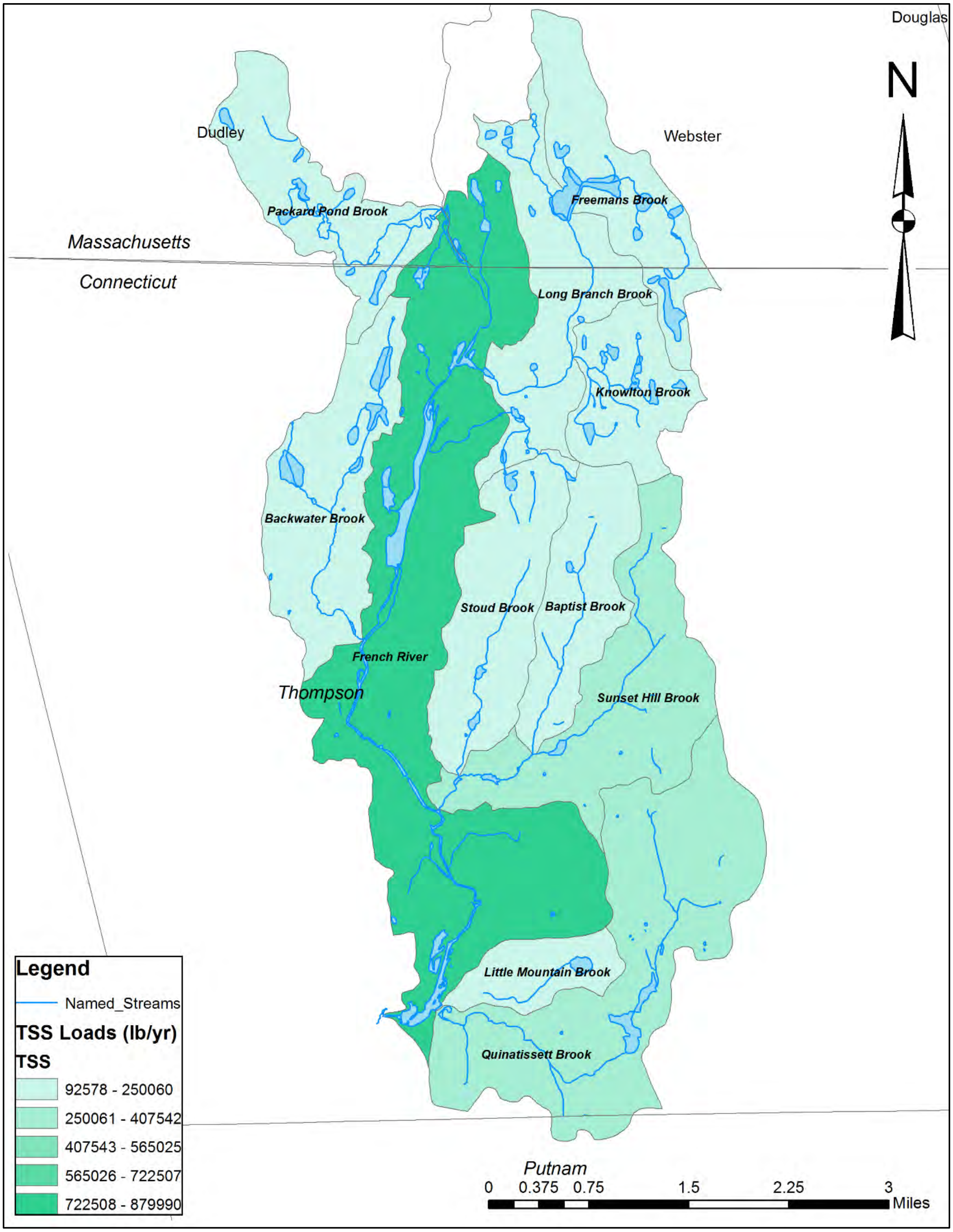


Figure 6-4. Estimated total suspended sediment (TSS) loads in the French River watershed, in pounds per year (lb/yr).

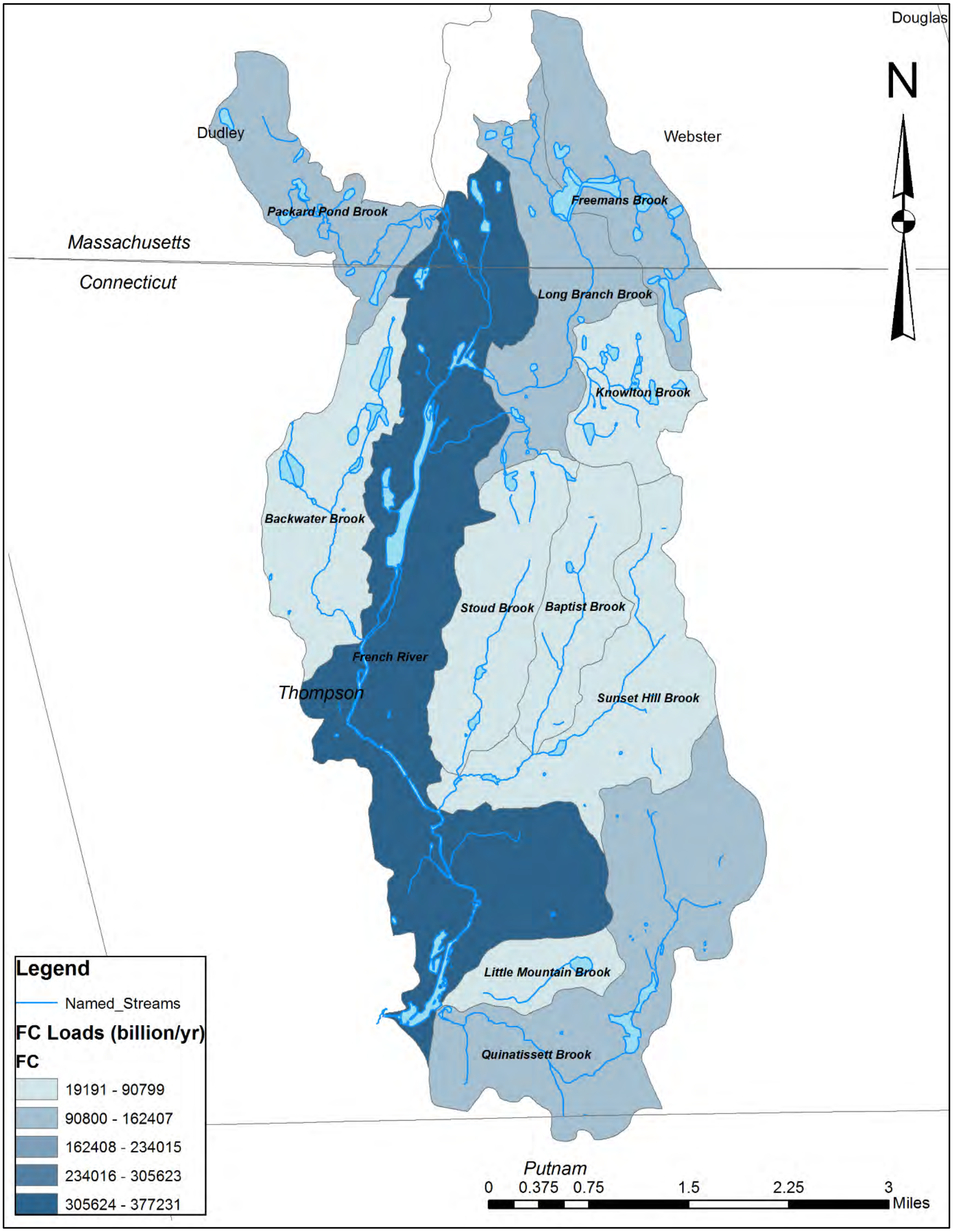


Figure 6-5. Estimated fecal coliform (FC) loads in the French River watershed, in billions per year.

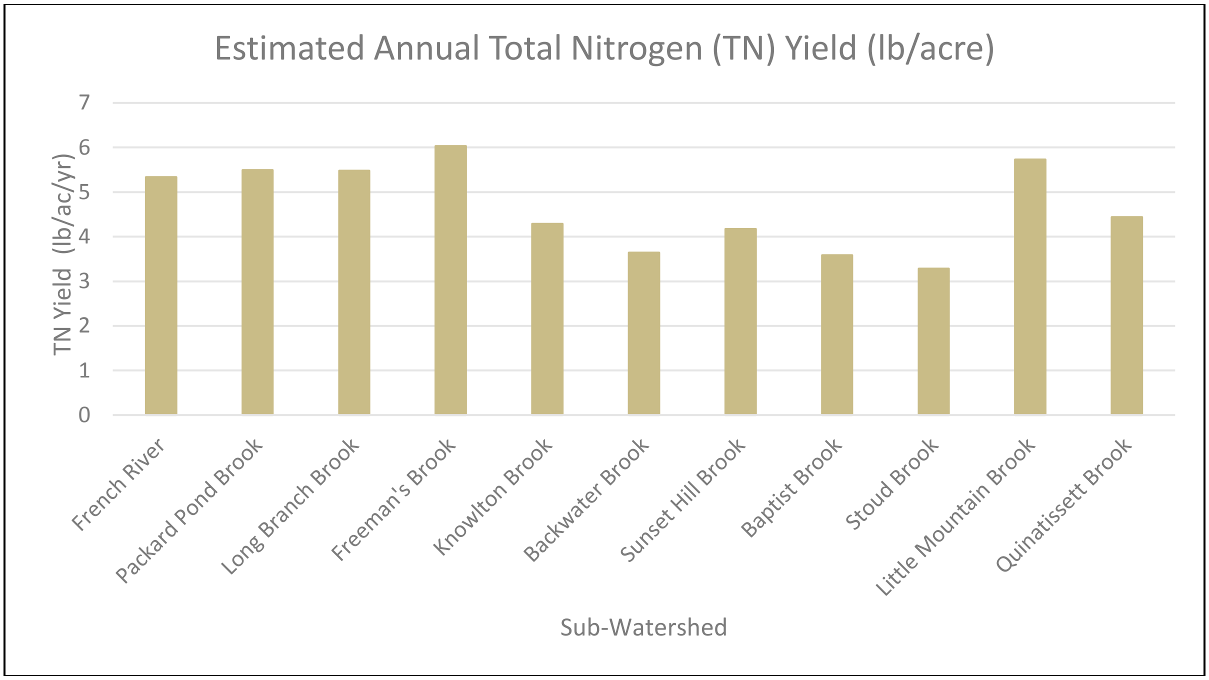


Figure 6-6. Estimated total nitrogen yields (pounds per acre per year) by sub-watershed.

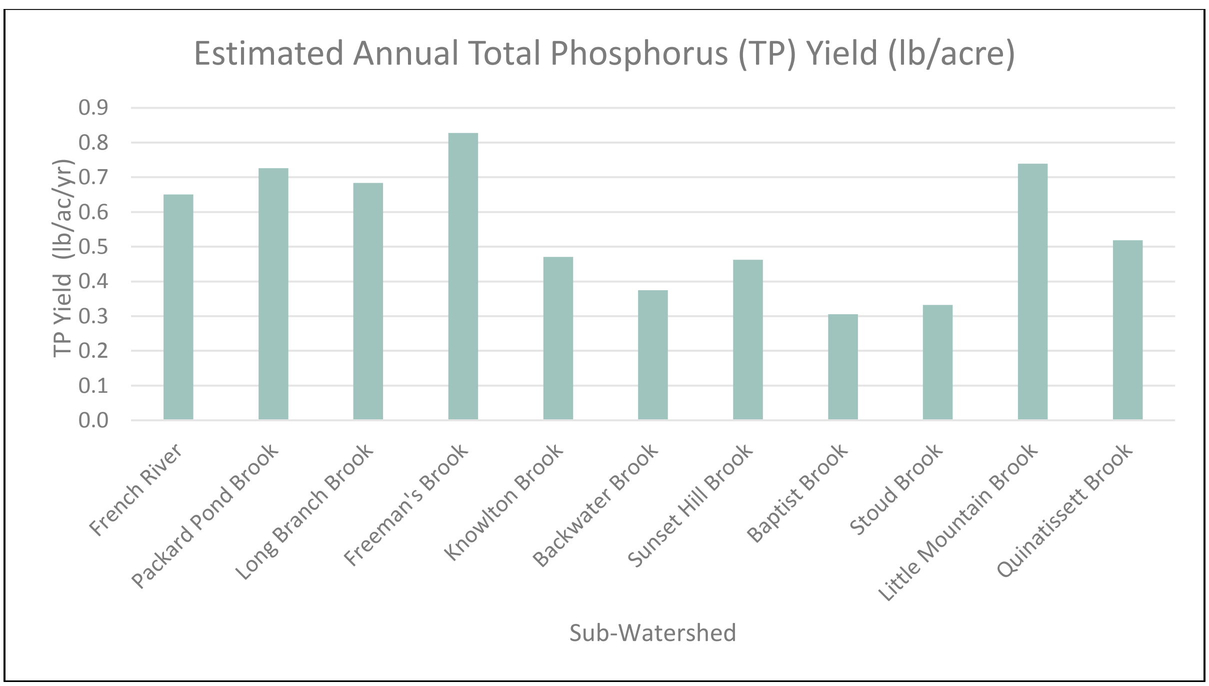


Figure 6-7. Estimated total phosphorus yields (pounds per acre per year) by sub-watershed.

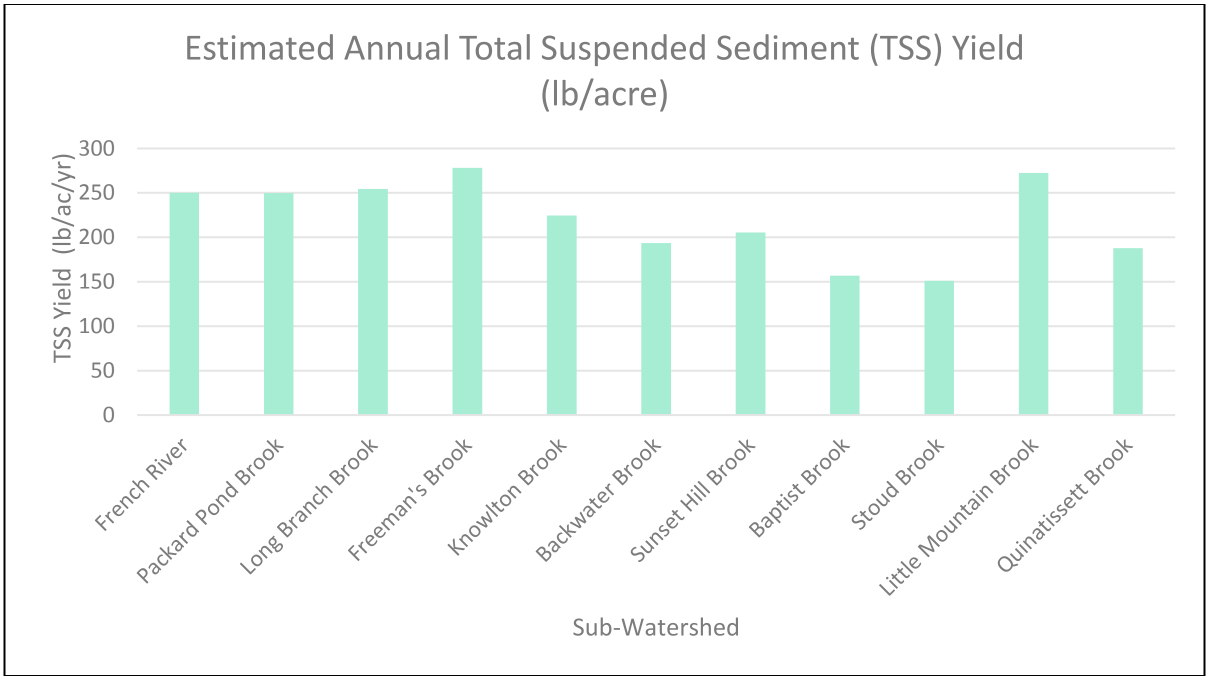


Figure 6-8. Estimated total suspended sediment yields (pounds per acre per year) by sub-watershed.

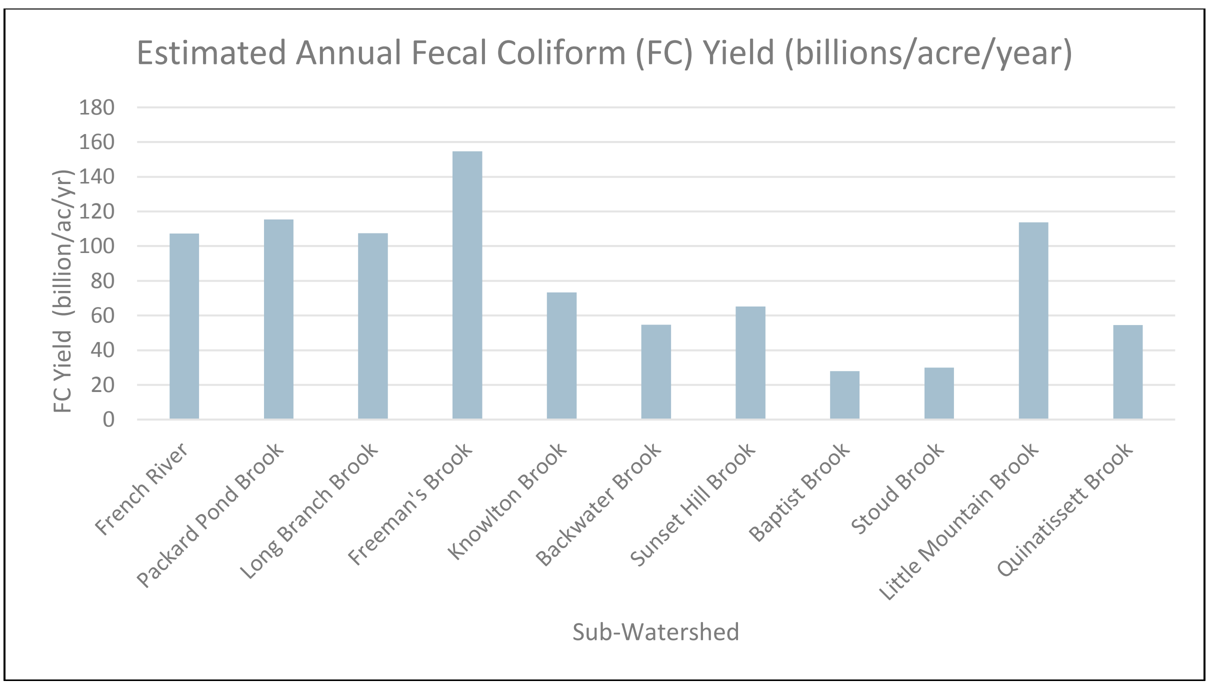


Figure 6-9. Estimated fecal coliform yields (billions per acre per year) by sub-watershed.

6.2. Pollutant Load Reductions

A summary of recommended pollutant load reduction targets is provided in the following sections. Bacteria reductions are based on water quality data collected in 2015. Watershed NPS pollutant load reductions are based on the natural, undeveloped land cover for Connecticut.

6.2.1. Bacteria Load Reductions

One of the primary goals of this watershed plan is to estimate bacterial load reductions of the indicator fecal bacteria *E. coli* that has been documented in several tributary streams to the French River. For the purposes of this investigation, ECCD utilized the Connecticut Water Quality Standards single sample criteria for “Freshwater – All other recreational uses” of 576 cfu/100ml and the maximum sample set geometric mean of less than 126 cfu/100 ml to evaluate the water quality data and determine the load reductions necessary to comply with established water quality standards.

E. coli load reductions are presented in Table 6-5, and are based on the results of bacteria sampling conducted by ECCD and TLGV volunteers in 2015. The *Total Maximum Daily Load Analysis for Recreational Uses of the French River Sub-Regional Basin* cites a geometric mean of 151 cfu/100 ml and recommends a geomean reduction of 17% in Long Branch Brook at Labby Road. Based on data collected by ECCD in 2015, Long Branch Brook met water quality standards; therefore, no reduction is required to meet water quality standards at that site.

Table 6-5. Fecal bacteria levels and required reductions.

Site	Site Description	Geomean	% Load Reduction Required
FR01	French River 500 ft upstream of Quinebaug River confluence	74	0
FR02	French River at Rt 12 near Riverside Pizza	101	0
FR03	French River at Riverside Park 100 ft downstream of the footbridge	47	0
FR04	French River upstream of outlet at North Grosvenordale Pond	14	0
FR05	French River upstream of Wilsonville Road bridge	57	0
FR06	French River at the CT/MA state line	87	0
LBB01	Long Branch Brook upstream of Wagher Road	36	0
LBB02	Long Branch Brook upstream of Labby Road	56	0
LBB03	Long Branch Brook at the CT/MA state line	61	0
KB01	Knowlton Brook downstream of Wilsonville Road	83	0
SHB01	Sunset Hill Brook downstream of Klondike Avenue	124	0

Table 6-5. Fecal bacteria levels and required reductions (cont.).

Site	Site Description	Geomean	% Load Reduction Required
SHB02	Sunset Hill Brook downstream of Thompson Hill Road (RT 200)	22	0
SB01	Stoud Brook upstream of Thompson Hill Road (RT 200)	33	0
BWB0.5*	Backwater Brook culvert outfall at the French River canal	**820***	30%
BWB01	Backwater Brook downstream of Phelps Pond outlet	**135**	7%
BWB02	Backwater Brook upstream of Phelps Pond off Floral Avenue	32	0
UN01	Unnamed stream upstream of Route 12 by I-395 SB on-ramp	37	0
LMB01	Little Mountain Brook downstream of Robbins Road	96	0
QB01	Quinatissett Brook downstream of Ballard Road	**338**	63%
QB02**	Quinatissett Brook downstream of Reams Pond outlet	**361**	65%
RB01**	Ross Brook downstream of Quaddick Road	74	0
EB01**	Elliott Brook downstream of Quaddick Road	125	0
EB02**	Elliott Brook downstream of Chase Road	**148**	15%

* Reduction based on single sample limit (576 cfu/100ml)
**Only three samples were taken at these sites and do not constitute a reliable sample set.

6.2.2. Watershed NPS Pollutant Load Reductions

Pollutant load reduction recommendations have been presented in Table 6-6 to provide guidance to watershed managers regarding the potential reduction of common NPS pollutants in the French River watershed, including total nitrogen (TN), total phosphorus (TP) and total suspended sediment (TSS). Unlike fecal bacteria, which has a specific numerical water quality standard, Connecticut does not currently have numeric standards for nutrients or suspended sediments. Therefore, these load reduction recommendations are provided to allow watershed managers to evaluate loading from the various NPS pollutants, and determine where beneficial loading reductions may be made. Watershed managers should keep in mind that these recommended pollutant load reductions utilize watershed load values calculated by the Watershed Treatment Model based on existing land use practices in the French River watershed and do not represent physical water quality measurements.

In order to provide a baseline against which current pollutant loading could be compared, pre-developed watershed loads were calculated for each of the sub-watersheds, using a forested condition as a typical pre-development land cover for Connecticut. No net gain of wetlands was assumed. Current condition land cover and land uses were derived from the CLEAR 2010 Connecticut land cover dataset (CLEAR, 2014) and the Multi-Resolution Land Characteristics Consortium (MRLC) 2006 National Land Cover Dataset (NLCD).

Based on nutrient loads associated with various land covers and land uses that were modeled by the Watershed Treatment Model, total nitrogen load reductions ranging from 22 to 108% are recommended throughout the French River sub-watersheds to bring nutrient loads within the load range of the pre-developed French River watershed. Total phosphorus load reductions ranging from 44 to 306% are recommended to bring nutrient loads within the load range of the pre-developed French River watershed. Total suspended sediment load reductions ranging from 15 to 112% are recommended to bring sediment loads within the load range of the pre-developed French River watershed.

Table 6-6. Recommended load reductions based on estimated NPS loads for existing and pre-development land use and land cover in the Lower French River watershed (HUC 00110000204).

Sub-watershed	Existing TN (lb/year)	Pre-developed TN (lb/year)	% Reduction TN (lb/year)	Existing TP (lb/year)	Pre-developed TP (lb/year)	% Reduction TP (lb/year)	Existing TSS (lb/year)	Pre-developed TSS (lb/year)	% Reduction TSS (lb/year)
3300-00 French River Local	18,772	10,295	82	2,289	747	206	879,990	468,560	88
3300-01 Packard Pond Brook*	4,586	2,446	87	607	177	242	208,601	111,187	88
3300-02 Long Branch Brook	5,366	2,512	114	670	198	239	248,998	127,784	95
3300-03 Freeman's Brook*	4,819	2,103	129	661	163	306	222,157	104,608	112
3300-04 Knowlton Brook	2,464	1,524	62	271	118	130	129,126	75,451	71
3300-05 Backwater Brook	3,836	2,703	42	395	213	86	203,918	137,393	48
3300-06 Sunset Hill Brook	5,353	3,323	61	593	260	128	263,755	167,636	57
3300-07 Baptist Brook	2,465	2,020	22	210	146	44	107,846	91,653	18
3300-08 Stoud Brook	3,070	2,464	25	310	191	63	141,018	122,423	15
3300-09 Little Mountain Brook	1,948	935	108	251	70	257	92,578	44,836	106
3300-10 Quinatissett Brook	8,668	5,219	66	1,014	400	153	367,078	256,402	43
* Watersheds discharge to the French River in Massachusetts.									

7. Watershed Management Goals and Objectives

7.1. Watershed Management Goals

The goals of this watershed management plan are three-fold. The Plan goals focus on water quality issues and assessments identified by ECCD and watershed stakeholders during the water quality investigation, as well as recommendations made in planning documents including the Town of Thompson Plan of Conservation and Development 2010-2020 and the 2005 Conservation and Open Space Plan and Natural Resources Inventory.

Goal 1: Protect water quality in the French River watershed where it is good. This goal encompasses the preservation and protection of the high-quality tributary streams in the French River watershed in order to maintain their excellent water quality, ecological health and biological diversity for the benefit and enjoyment of watershed residents.

Goal 2: Improve water quality in the impaired stream segments identified in Section 4. This goal focuses on improving impaired waters in the watershed in order for those waters to meet Connecticut Water Quality Standards for their intended aquatic habitat and recreational uses, along with improving the downstream water bodies of the Quinebaug River, Thames River and Long Island Sound.

Goal 3: Promote capacity building for adoption and implementation of the French River Watershed Based Plan. This goal strives to build a viable foundation by the Town of Thompson, supporting agencies and organizations, residents, local businesses, and others with a stake in the outcomes of this Plan.

7.2. Watershed Management Objectives

Management objectives are measurable actions that define how to reach stated goals. The following objectives are intended serve as steppingstones to assist watershed managers with achieving the broader watershed plan goals set forth in Section 7.1.

- Objective 1 - Create a team or coalition to implement the watershed plan.
  The establishment of a committed watershed team to adopt, prioritize, conduct and evaluate plan recommendations will maximize the successful implementation of the French River watershed-based plan.

- Objective 2 - Raise public awareness of water quality status and threats. Achieving the agreed-upon goals of a watershed plan is enhanced when watershed residents understand water quality issues and voluntarily adopt practices and behaviors that are protective of water quality.

- Objective 3 – Enhance land-use regulations and practices that are protective of water quality. Regulatory and advisory land use commissions can exert significant influence on water quality protection by adopting regulations and promoting policies and practices that are protective of water quality.

- Objective 4 - Reduce effective impervious cover in the MS4 urban area. Prioritize the utilization of green infrastructure/low impact development (GI/LID) practices to reduce stormwater runoff in high impervious cover areas to reduce stormwater volume and protect water quality.

- Objective 5 - Protect and preserve high quality tributaries and undeveloped headwater areas from existing pollutant sources and future threats related to new development. Use of community practices such as open space preservation, conservation easements, and GI/LID should be prioritized to protect and preserve areas with high water quality and habitat diversity.

- Objective 6 - Improve and protect water quality in the French River and impaired tributaries. Behavioral and structural practices should be adopted and/or implemented to reduce NPS loading to impaired waters and bacteria hot spot sites in the French River watershed, and to reduce the threats to water quality from land uses with higher pollution potential.

- Objective 7 - Promote good housekeeping practices. Watershed residents, businesses and municipal staff should be educated about and encouraged to adopt good housekeeping practices to prevent the discharge of NPS pollutants to waterways.

Watershed management recommendations, which are strategies designed to assist watershed managers with the implementation of the objectives identified above, are provided in Section 8. These recommendations include brick-and-mortar structural practices to improve water quality, and non-structural practices such as regulation and policy review and revision, preservation of open space and behavioral changes.

8. Watershed Management Recommendations

The following watershed management recommendations are strategies designed to implement the stated watershed management objectives in order to achieve the goals of the watershed management plan. Watershed management strategies, or "Best Management Practices" (BMPs), are control measures that are used to "manage the quantity and improve the quality of stormwater runoff" (US EPA, 2012), typically caused by changes in land use. Generally, BMPs focus on water quality problems caused by increased impervious surfaces from land development. BMPs are designed to reduce stormwater volume, peak flows, and/or nonpoint source pollution through evapotranspiration, infiltration, detention, and filtration or biological and chemical actions (Debo and Reese, 2003).

Best management practices (BMPs) may be comprised of "non-structural" practices - procedures such as individual or community behavioral changes, revisions to municipal regulations and practices, preservation of open space, and modified landscaping practices, or "structural" practices, such as brick-and-mortar devices installed or constructed on a site to improve water quality. There are a variety of BMPs available; selection typically depends on site characteristics and pollutant removal objectives. The US Environmental Protection Agency (EPA) has published a list of stormwater BMPs for use by local governments, builders and property owners (US EPA, 2012) to assist water quality managers with understanding and selecting stormwater BMPs, DEEP promotes Low Impact Development (LID) practices through newer appendices of the CT Erosion & Sediment Control Guidelines (DEEP, 2002) and through the CT Stormwater Quality Manual (DEEP 2004).

This section outlines management strategies that, once implemented, are intended to restore surface water quality conditions in the French River watershed so that all waterbodies will comply with Connecticut water quality standards for activities such as fishing and swimming. A variety of management strategies are provided to target the pollutant sources identified in Section 5. These strategies include short and long-term controls and actions that vary in relative effort and cost, and that can be adopted and implemented by a wide variety of stakeholders.

The best management practices described in the following sections are primarily non-structural practices that can be adopted by land managers and decision-makers in the French River watershed. Site-specific structural management practice recommendations are provided in Section 8.8.

8.1. Create a team or coalition to implement the watershed plan.

As the first step to the implementation of this Plan, it is strongly recommended that stakeholders form a watershed management team to formally adopt the watershed plan. An effective team will be comprised of watershed stakeholders – individuals, groups or organizations that may be affected by or have an interest in the project's outcome. By forming, monitoring and maintaining constructive relationships, the team plays a vital role in ensuring that the watershed plan's goals and objectives will be achieved in an organized and expeditious manner. It is impossible to understate the importance of the management team to the successful implementation of this watershed plan. Without a strong, organized management team, watershed plan goals and objectives will not be achieved.

The watershed management team will be responsible for:

- coordinating the implementation of the Plan recommendations;
- developing a work plan that identifies water quality goals and objectives for French River watershed;
- identifying funding sources and in-kind services, prospective partners and technical assistance;
- reviewing, prioritizing and implementing Plan recommendations; and
- evaluating the results to determine if revisions to the implementation approach are required.

The watershed management team should take an adaptive 3-step approach to:

1) implementing the recommendations contained in this Plan,
2) evaluating implementation measures as they are conducted, and
3) making necessary adjustments based on the results to improve outcomes.

The team should devise a method to track the progress of Plan implementation, and should seek important feedback from land owners, municipal staff/leaders and other stakeholders. The watershed management team will also be responsible for reporting initial steps and results to stakeholders and the broader community, and for celebrating successes throughout the community.

Potential watershed team members are listed in Table 8-1. Watershed management team capacity building strategies are summarized in Table 8-2. These tables can be used as a preliminary plan or guideline for the establishment of a watershed team.

8.1.1. Strategy 1-1. Establish the watershed management team.

A well-balanced watershed management team should consist of a variety of members of the community, and may include municipal officials and commissioners, business owners, landowners, environmental and civic organizations, as well as any other organizations, agencies or individuals with an interest in the preservation and improvement of water quality and water uses in the watershed. It is recommended that at a minimum, the French River watershed management team include a land-use planner or similarly trained professional, members of the Thompson land use commissions, watershed residents and local watershed businesses. It should be noted that the involvement of various watershed stakeholders may change throughout the

planning and implementation phases, depending on their interests, expertise and availability.
Once the members of the watershed team have been established, an initial meeting should be conducted, partner roles and responsibilities should be discussed and a regular meeting schedule established.

Table 8-1. Recommended Watershed Management Team Members and their roles and/or responsibilities.

Team Member	Roles/Responsibilities
Town of Thompson (land use staff, regulatory and non-regulatory commissions, public works department)	Review, update and enforcement of land use regulations and/or ordinances; coordination with Plan of Conservation & Development; site plan review/permitting; public utilities maintenance; development of incentive programs to encourage adoption of BMPs; staff training
Local Businesses & Community Organizations (Thompson Together, others)	Conformance with local regulations; adoption of BMPs; assistance with outreach and education; support and sponsorship of community events/activities
Watershed Residents	Conformance with local regulations; adoption of BMPs; diversity of local knowledge and perspectives, priorities and opportunities
Agricultural Producers & Non-commercial Farmers	Adoption of agricultural BMPs to manage nutrient/manure applications; peer to peer outreach; interface with local agriculture commissions
Northeast District Department of Health	Review and approval of septic systems; identification and repair of failing on-site wastewater systems
Northeastern Connecticut Council of Governments	Regional land use planning; grant writing; sharing of regional plan and implementation resources
Eastern Connecticut Conservation District	Technical assistance; plan implementation; site plan reviews
Thames River Basin Partnership or other watershed organizations	Plan implementation; guidance; outreach and education; regional conservation network connection
CT Department of Energy and Environmental Protection	Bacteria TMDL; Ambient WQM program; SWGP and MS4 programs; technical support in water, natural resources and land management
CT Department of Transportation	Operation and maintenance of state & interstate highways/stormwater systems; administration of DOT MS4 permit; adoption of stormwater BMPS and other division programs (e.g. Office of Environmental Planning, Office of Design)
US Geological Survey	Water quality and flow data collection and analyses at French River (USGS 01125100 French River at North Grosvenordale, CT); technical assistance

8.1.2. Strategy 1-2. Review watershed management goals and objectives.

The French River Watershed-based Plan is a blueprint for watershed managers to achieve the stated watershed goals and objectives. Once the watershed management team has been established, the team should review the watershed plan carefully and identify the goals and objectives, along with a set of measurable outcomes. The goals and objectives will set the framework for how the management team will proceed with the implementation of the Plan recommendations.

There are a number of resources available to assist the watershed team with implementing the watershed plan, including:

- US EPA Watershed Planning - https://www.epa.gov/nps/watershed-planning
- CT DEEP Watershed Planning - http://www.ct.gov/deep/watershed
- Center for Watershed Protection - http://www.cwp.org/
- Eastern Connecticut Conservation District – www.ConserveCT.org/eastern

8.1.3. Strategy 1-3. Identify sources of financial assistance.

Most, if not all, of the management recommendation in the following sections will require some financial investment. Some costs, especially those associated with programmic changes or improvements, may be able to be absorbed into existing municipal budgets or programs. However, as the watershed team and other stakeholders undertake the implementation of Plan recommendations, particularly structural water quality improvement projects, outside sources of funding and community partnerships will likely be required. A list of sources of financial assistance is provided in Section 9.

8.1.4. Strategy 1-4. Identify sources of technical assistance.

As watershed plan implementations are identified and prioritized, the watershed team may need to identify sources of technical assistance to aid with the development and implementation of the proposed stormwater management practices. There are a number of agencies and organizations available to assist with the implementation of the French River Watershed-based plan.

Organizations such as the US Department of Agriculture Farm Services Agency (FSA) and Natural Resources Conservation Service (NRCS), CT DEEP, the CT Department of Agriculture, the Northeastern Connecticut Council of Governments (NECCOG), the Connecticut Conservation Districts, the University of Connecticut Cooperative Extension Service, US Fish & Wildlife Service, local land conservation trusts and others may provide technical assistance to project managers and watershed stakeholders that can ensure project success.

A list of organizations and agencies that can provide technical assistance is provided in Section 9. Most of these organizations and agencies have broad experience working with other watershed-based plans across Connecticut and the region.

8.1.5. Strategy 1-5. Identify and establish a mechanism for outreach.

Over the course of the watershed plan implementation, the watershed team will want to convey information to the general public regarding its activities and successes. In order to be prepared to effectively communicate its message to watershed residents, the watershed team should establish a mechanism for public outreach, including partnerships with like-minded community organizations such as Thompson Together and others. Outreach mechanisms can include a website or webpage on the Town of Thompson website, updates in the town newsletter or periodic articles in the local newspaper, or the development of a series of handouts or brochures to highlight specific resource concerns. The watershed team should identify within its ranks a point person or committee to organize and implement outreach activities.

8.1.6. Strategy 1-6. Implement the French River Watershed-based Plan.

The primary goal of the watershed management team will be to coordinate and oversee the implementation of the recommendations of this Plan. In order to determine how to implement the Plan, the watershed team should review the goals, objectives and implementation strategies. The objectives and implementation strategies should be prioritized, and a priority list developed and distributed among team members and watershed stakeholders. This prioritization process will help the watershed team focus their efforts and provide for a positive outcome. The watershed management team should identify potential partners with whom to collaborate on larger or more complex plan recommendations. Project partners may contribute expertise that will contribute to the success of implementation projects, including project design, planning, installation and long-term maintenance.

8.1.7. Strategy 1-7. Develop a framework to evaluate implementation effectiveness.

Before or concurrent with conducting watershed plan recommendations, the watershed team should develop a framework to assess whether the implementation is having the desired outcome and to help to report out the results to the broader community. The purpose of the evaluation framework is to demonstrate, through data collection or other methodology, that by implementing the management measures, the intended goals are being achieved. The evaluation framework will also provide watershed managers the opportunity to assess and refine the implementation process, which will improve and strengthen the watershed management program.

8.1.8. Strategy 1-8. Assess implementation effectiveness.

Utilizing the assessment methodology created in Strategy 1-7, watershed managers should assess the effectiveness of each implementation measure as it is conducted. The watershed team should create a database or other document to track implementations, including pertinent information such as implementation type, location, start and completion dates, project manager, project goals, and notes specific to the implementation. The implementation should be evaluated utilizing the appropriate methodology specified by the evaluation framework to determine if the project goals have been met, and alternative actions should be identified if goals are not met.

Information about how to develop an evaluation framework and evaluate your implementation effectiveness is provided in the Handbook for Developing Watershed Plans to Restore and Protect Our Waters (USEPA, 2008). Additional sources of technical assistance are provided in Section 9.2.

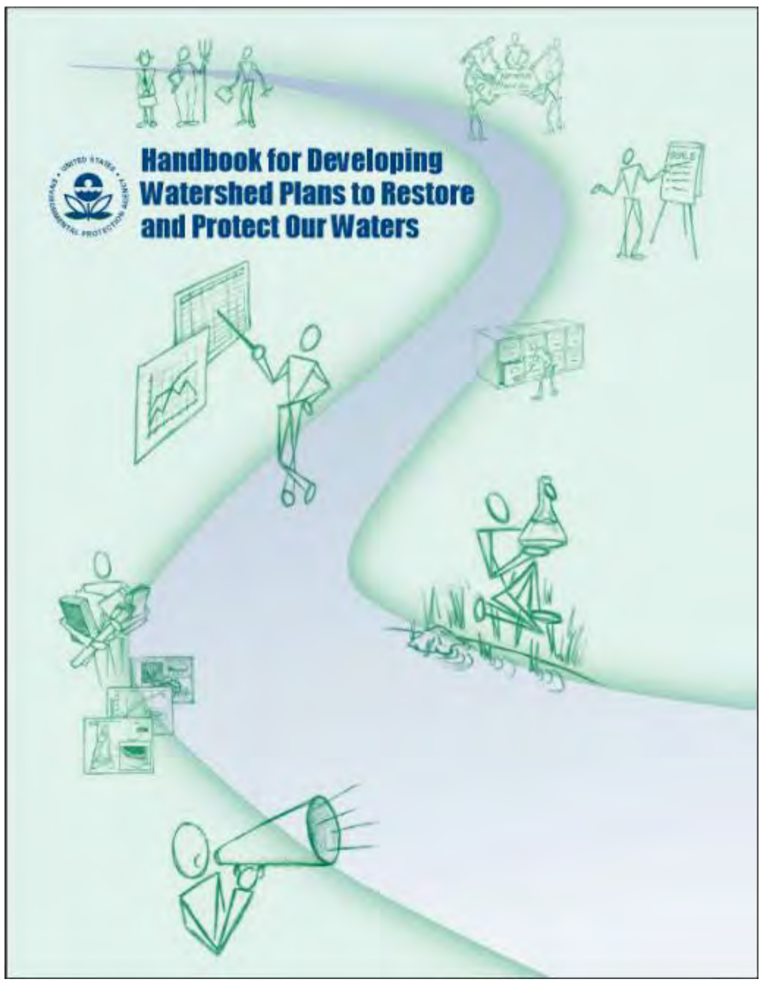


Table 8-2. *Objective 1 - Create a team or coalition to implement the watershed plan.*

Best Management Practice Implementation Strategies/Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
1. Establish the watershed management team: • Identify team members • Obtain team member buy-in • Organize/conduct initial meeting • Identify team member roles • Establish regular meeting schedule	Town of Thompson. DEEP, ECCD, land use commissions, watershed stake-holders	2018	Identification of team members; establishment of mgmt. team; establishment of regular meetings	$5,000 (10 partners/ 10 hr ea. @$ 50/hr)	Town of Thompson, community foundation and private philanthropic grants, corporate grants, CT DEEP 604b watershed planning grants	Municipal staff, ECCD, NECCOG, DEEP, UConn Extension
2. Review watershed management goals: • Review watershed plan • Identify goals and objectives • Prioritize goals • Identify watershed management resources	Watershed management team	2018	Identification & prioritization of clear goals and objectives; watershed management resources	$5,000 (10 partners/ 10 hr ea. @$ 50/hr)	Town of Thompson, community foundation and private philanthropic grants, corporate grants, CT DEEP 604b watershed planning grants	Municipal staff, ECCD, NECCOG, DEEP
3. Identify sources of funding: • Review goals to determine type/level of funding needed • Review funding for applicability to goal • Prepare and submit application for funding	Watershed management team	2018 - 2019	List of potential funding sources (see Table 9-1)	$5,000 (10 partners/ 10 hr ea. @$ 50/hr)	Town of Thompson, community foundation and private philanthropic grants, corporate grants, CT DEEP 604b watershed planning grants	Municipal staff, ECCD, NECCOG, DEEP
4. Identify sources of technical assistance: • Review goals to determine type of technical assistance needed • Identify organizations/agencies offering needed technical assistance • Contact and/or partner with appropriate organization/agency to obtain needed technical assistance	Watershed management team	2018 - 2019	List of agencies/ organizations to provide technical assistance (see Table 9-2)	$5,000 (10 partners/ 10 hr ea. @$ 50/hr)	Town of Thompson, community foundation and private philanthropic grants, corporate grants, CT DEEP 604b watershed planning grants	Municipal staff, ECCD, NECCOG, DEEP

Table 8-2. Objective 1 - Create a team or coalition to implement the watershed plan (cont.).

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
5. Identify and establish a mechanism for outreach: • Identify key outreach elements to disseminate to public • Establish an outreach mechanism (website, • report card, brochure, etc.) • Identify a point person to lead outreach efforts • Organize/implement an outreach campaign	Watershed management team	2018 - 2019	Identification of outreach needs; identification/ establishment of mechanism for outreach; type/amount of outreach conducted	$7,500 (printing & mailing costs; webpage develop-ment; etc.)	Town of Thompson, community foundation and private philanthropic grants, corporate grants, CT DEEP 604b watershed planning grants	Municipal staff, ECCD, DEEP, NECCOG, consulting services
6. Implement the watershed management plan: • Identify and prioritize implementation projects • Identify /assign managing entity • Identify and obtain funding • Identify and obtain technical assistance • Development implementation design/plans • Obtain required materials • Promote municipal and other local champions project for high visibility or technical transfer elements.	Watershed management team, other watershed stakeholders	2019-2028	Number of successfully completed implementation projects	$1000 - $50,000 or more. Cost will vary by BMP project.	Town of Thompson, community foundation and private philanthropic grants, corporate grants, CWA 319 & 604b grants, NRCS programs	Municipal staff, ECCD, DEEP, NRCS, NECCOG, consulting services
7. Develop an assessment framework: • Identify plan elements to be evaluated • Develop an evaluation methodology Identify/establish assessment metrics • Identify a timeline for evaluation/assessment	Watershed management team	2019-2020	Establishment of viable assessment procedure	$5,000 (10 partners/ 10 hr ea. @ $50/hr)	Town of Thompson, community foundation grants, corporate grants, CT DEEP 604b watershed planning	Municipal staff, ECCD, DEEP, NECCOG, consulting services
8. Assess implementation effectiveness: • Create an implementation completion tracking database • Review completed implementations • Evaluate implementation effectiveness utilizing previously established methodology • Determine if intended goals and objectives have been achieved • Identify alternative actions if goals/objectives have not been achieved	Watershed management team	2019-2028	Periodic review/ evaluation of implementation; evaluation of implementation effectiveness; refinement of goals and objectives	$5,000 (10 partners/ 10 hr ea. @ $50/hr)	Town of Thompson, community foundation and private philanthropic grants, corporate grants, CT DEEP 319 and 604b watershed grants	Municipal staff, ECCD, DEEP, NECCOG, consulting servicces

8.2. Raise public awareness of water quality status and threats.

Raising public awareness is an important component to the successful adoption of a watershed-based plan. Educating the community about the water quality status of waterbodies in their neighborhoods, and actions they can take to protect and improve that water quality engenders a sense of stewardship and fosters support for watershed management efforts. Members of the general public have a great capacity to influence water quality through their everyday actions when they are informed and educated about the water quality benefits of those actions.

8.2.1. Strategy 2-1. Promote watershed plan among general public.

Upon adoption of the French River Watershed-based Plan, the general public should be made aware of the Plan via news articles or feature stories in local or regional newspapers or other media outlets, or displays at local festivals or community events. The Plan should be made available for public viewing via posting on the websites such as DEEP's Watershed Management webpage (http://www.ct.gov/deep/watershedplans), the Town's webpage (www.thompsonct.org) or ECCD's webpage (www.ConserveCT.org/eastern) and at easily accessible locations such as the Thompson Town Hall and the Thompson Public Library.

8.2.2. Strategy 2-2. Review watershed plan recommendations with land use commissions.

ECCD will review the French River Watershed-based Plan with Thompson decision-makers, including land use staff and commissions to discuss how plan recommendations may be integrated into land use decision-making. Land use commission are encouraged to take into consideration plan recommendations when reviewing permit applications in the French River watershed.

8.2.3. Strategy 2-3. Conduct targeted outreach to address specific water quality threats.

Watershed managers should conduct outreach to promote the Plan recommendations. Outreach actions may be paired with MS4 outreach requirements to reach a broader audience or may be targeted to specific outreach issues and audiences. Table 8-3 presents potential outreach topics that address water quality issues identified in Section 5 and suggests potential partners to assist with outreach.

8.2.4. Strategy 2-4. Incorporate the French River Watershed-based Plan into K-12 school curriculum.

The Connecticut Core Science Curriculum introduces water quality concepts to students at all grade levels (http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&Q=320890). Incorporation of the French River Watershed-based Plan into Thompson's science curriculum will provide an example of a real-world water quality issue and allow students to learn about and connect to water quality issues that exist in their own community.

As part of the French River water quality investigation, ECCD and the Town of Thompson installed a stormwater tree filter practice in the main parking lot at the Mary R. Fisher Elementary School. This tree filter will treat and infiltrate into the ground stormwater runoff from a portion of the parking lot before it is discharged through the storm drain system to the French River. The placement of this stormwater BMP at the public school was a deliberate decision on the part of the project partners to lay the groundwork for future stormwater BMPs at the public school. These site-specific practices can be used as teaching tools for science teachers at all grade levels, and as an example for public school systems in the region. ECCD also purchased an Enviroscape, a table-top model used to demonstrate the movement of NPS across the landscape, for the school system to be used as a teaching tool in conjunction with the watershed-based plan and the stormwater tree filter.

8.2.5. Strategy 2-5. Update the public about water quality improvement projects as they are conducted.

The watershed team should develop a strategy to inform the community when water quality improvement projects are being conducted. By creating public awareness of on-going water quality improvement projects in the community, the watershed management team promotes Thompson's waterways as valuable resources and builds community support for watershed management efforts. This creates a sense of ownership among residents that can lead to the development of a longer-term stewardship ethos and strengthened appreciation for natural resources in the French River watershed.

8.2.6. Strategy 2-6. Promote watershed stewardship among general public.

The watershed team should sponsor or support activities that engage the general public and engender environmental stewardship. These activities can include participation in citizen science programs sponsored by CT Audubon Society and The Last Green Valley, partnering with Valley Springs Sportsman's Club, Trout Unlimited or CT DEEP to promote water-based recreational activities such as fishing and boating, or participating in or conducting community-based stream clean-ups, such as the Thompson Together French River clean-up, invasive plant removal or riparian (streamside) buffer restorations.

Table 8-3. Public education topics and potential partners.

Outreach Topic	Audience	Potential Outreach Partner(s)

Agricultural BMPs, including soil health, tillage practices, and cover cropping	Agricultural producers/home vegetable gardeners	NRCS, UConn Cooperative Extension System, ECCD, Agricultural Commissions, CT RC&D
Livestock Manure Management	Hobby farm owners	ECCD, UConn Cooperative Extension System, NRCS
Homeowner lawn, garden and stormwater BMPS	Residents/property owners	ECCD, UConn Cooperative Extension System
Implementation of MS4 program	Municipality/DPW/residents	CT DEEP Stormwater Management, DPW, CT NEMO, Town of Thompson, CT NEMO, NECCOG, TRBP
Land use commissioner roles and responsibilities	Land use staff and commissions	CT NEMO, CLEAR, CACIWC, municipal advisory and regulatory land use commissions
Low impact development (LID)/ Green Infrastructure (GI)	Land use staff and commissions/DPW	CT NEMO, CLEAR, DEEP, ECCD
Municipal "Good Housekeeping" Public Works practices	Municipality/DPW	CT DOT, DPW
Open space planning, acquisition and management	Land use staff and commissions	CT DEEP, CT NEMO, CLCC, local land trusts, TLGV
Organic lawn/garden care	Residents/property owners	UConn Cooperative Extension System, NOFA
Pet waste management	Residents/property owners	Town of Thompson, Northeast District Department of Health, veterinarians, local pet stores
Rain Gardens and Native Plants	Residents/property owners Land use staff and commissions	CT NEMO, UConn Extension, ECCD, area plant nurseries, garden clubs and beautification committees
Recycling	Residents/property owners	WPCA, municipalities, waste mgmt. companies
Septic System BMPs for Homeowners	Residents/property owners	Northeast District Department of Health, CT DPH, local septic services companies
Trash/litter management	Residents/property owners	Thompson Together, Conservation Commission, DPWs, waste management companies
Understanding Non-Point Source (NPS) Pollution	Residents/property owners Land use staff and commissions	CT NEMO, municipal Conservation Commissions, DEEP, ECCD, USEPA
What not to flush down drains	Residents/property owners	WPCA, Northeast District Department of Health, ECCD

Strategies and interim milestones associated with raising public awareness of water quality status and threats are summarized in Table 8-4.

Table 8-4. Objective 2 - Raise public awareness of water quality status & threats.

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
1. **Promote water quality watershed plan among general public:** • Publicize watershed investigation via widely distributed news media • Post watershed plan on accessible platforms such as municipal website , ECCD website, CT DEEP website	Watershed management team, Town of Thompson, ECCD, DEEP, other stake-holders	2017-2029	Publication of WBP through local media outlet; access to Plan via Town, ECCD, DEEP websites	$1000 (staff salary)	Town of Thompson, community foundation and private philanthropic grants, corporate grants	Municipal staff, ECCD, NECCOG, DEEP
2. **Review watershed plan recommendations with land use commissions:** • Review water quality investigation and watershed plan with land use commissions • Provide Plan for commission use • Encourage incorporation of Plan recommendations in permit application reviews	ECCD, Town of Thompson staff	2017	Provide paper and/or digital copies of Plan to land use commissions; meet with commissions to review Plan	$2000 (WBP printing costs; ECCD staff time)	Town of Thompson, community foundation and private philanthropic grants, corporate grants, CWA §319 grants	Municipal staff, ECCD, NECCOG, DEEP, CLEAR, CT NEMO
3**. Conduct targeted outreach to address specific WQ threats:** • Identify outreach partners • Identify outreach topics • Prepare outreach materials • Identify best method for dissemination • Conduct public outreach utilizing selected outreach vector	Watershed management team	2018 - 2029	Outreach partners selected; outreach topics identified; outreach material compiled or created; outreach campaigns conducted	$1000 - $5000 (printing costs; varies by outreach topic)	Town of Thompson, community foundation and private philanthropic grants, corporate grants, CT DEEP 604b watershed planning grants	Municipal staff, ECCD, NECCOG, DEEP, CLEAR, CT NEMO, CLCC, UConn Extension, NRCS, others

Table 8-4. Objective 2 - Raise public awareness of water quality status & threats (cont.).

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
4. Incorporate Plan into K-12 school curriculum: • Meet with teachers to review Plan • Identify relevant curriculum topics at all grade levels • Provide available watershed information to assist teachers with curriculum topics • Identify and install relevant BMPs at school facility	Watershed management team, school board, teachers, ECCD	2018-2019	# teachers consulted; # curriculum topics identified; # WBP topics/BMPs incorporated into lesson plans	$4000 (teacher and staff salary)	Town of Thompson, school department, community foundation and private philanthropic grants, corporate grants,	Municipal staff, ECCD, DEEP, CT Dept of Education
5. Update public about water quality improvement projects as they are conducted: • Prepare project summaries for news media outlets • Post project update on outreach platforms such as websites, Facebook, etc. • Prepare and distribute relevant outreach material	Watershed management team, ECCD, DEEP, other project participants	2018-2029	WBP updates disseminated to general public; # website/Facebook posts; outreach material distributed	$1000/ project	Town of Thompson, community foundation and private philanthropic grants, corporate grants, CWA §319 grants	Municipal staff, ECCD, NECCOG, DEEP, NRCS
6. Promote watershed stewardship among general public: • Support existing activities such as the Thompson Together annual French River and roadside clean-up • Promote participation in TLGV Volunteer Water Quality Monitoring Program • Promote participation in CT Audubon Citizen Science programs • Publicize stewardship activities through local media outlets and platforms such as websites and Facebook	Watershed management team, Town of Thompson, partners and stakeholders	2018-2029	# stewardship activities conducted; # participants; activities promoted through local media outlets and platforms	$1000/ activity	Town of Thompson, community foundation and private philanthropic grants, corporate grants	Municipal staff, ECCD, NECCOG, DEEP, TLGV, CFPA, Trails Committee

8.3. Enhance land-use regulations, standards, and practices that are protective of water quality.

Municipalities determine how a town will be developed, and consequently how it will look and function, in large part through the codification of land-use regulations. Land-use regulations are enacted through the passage of municipal ordinances, and through review and revision by the land-use commissions, often in response to legislative changes at the state level. It is incumbent upon municipal decision-makers, including the board of selectmen and land-use boards and commissions, to ensure that regulations and policies both reflect and support the municipality's plans for future growth as defined by the municipal Plan of Conservation and Development; are up-to-date with current state land-use legislation; and are representative of current land use planning practices, including agriculture. Strategies to review and adopt land use policies that rare protective of water quality are listed below.

8.3.1. Strategy 3-1. Adopt land-use planning recommendations proposed in The Town of Thompson Plan of Conservation and Development and Open Space Plan.

The 2010 Plan of Conservation and Development (POCD) and 2005 Conservation and Open Space Plan (COSP) make a number of recommendations pertaining to land-use management and regulation that are protective of water quality. These recommendations should be considered for inclusion in land use regulations, if not already incorporated. There are also many effective, non-regulatory action that can be taken.

Recommendations in the POCD include:

- Acquisition of land and/or conservation easements in identified resource areas.
- Develop special protections for the French River, including the establishment of natural resources-based and passive recreation-based greenways.
- Encourage the use of low impact development (LID) techniques.
- Review existing land use regulations to identify any additional opportunities to protect Thompson's existing natural resources.

Recommendations in the COSP include:

- Increase protection of headwater wetlands and watercourses.
- Amend regulations to increase stream buffers and promote undeveloped buffers.
- Emphasize prevention of forest fragmentation in land use development decisions.

8.3.2. Strategy 3-2. Adopt and/or update farm-friendly land-use regulations.

Land use regulators should evaluate the consistency of planning and zoning regulations and municipal ordinances with existing and future farming activities, including farm-friendly policies and regulations and identification of potential barriers to farms and farming practices.

Planning for Agriculture, A Guide for Connecticut Municipalities (2016 Edition) and *Guidance and Recommendations for Connecticut Municipal Zoning Regulations and Ordinances for Livestock* (2012 are two excellent resources for municipal leaders, land use regulators and agriculture commissions. Both publications can be found at the Planning for Agriculture website (a collaboration between Connecticut Conference of Municipalities and American Farmland Trust) at www.ctplanningforagriculture.com.

8.3.3. Strategy 3-3. Review and strengthen existing land-use regulations pertaining to erosion and sediment control and stormwater management.

Land use regulators should review and strengthen existing land-use regulations pertaining to erosion and sediment control and stormwater management to comply with the *2002 CT Erosion & Sediment Guidelines* and the *2004 Stormwater Quality Manual and Appendices.*

8.3.4. Strategy 3-4. Incorporate language to encourage or require the use of green infrastructure (GI) and low impact development (LID) practices into site plan design and development.

Land use regulators should incorporate language to encourage or require the use of green infrastructure (GI) and low impact development (LID) practices into site plan design and development. These practices seek to mimic the pre-development hydrology of a site and encourage site design that utilizes the natural features of the landscape in a way that minimizes runoff and promotes resource protection. The use of LID/GI is protective of water quality in headwater areas and can be used to reduce the effects of impervious cover in highly developed areas of the French River watershed.

8.3.5. Strategy 3-5. Identify and evaluate any existing or perceived institutional barriers to GI and LID.

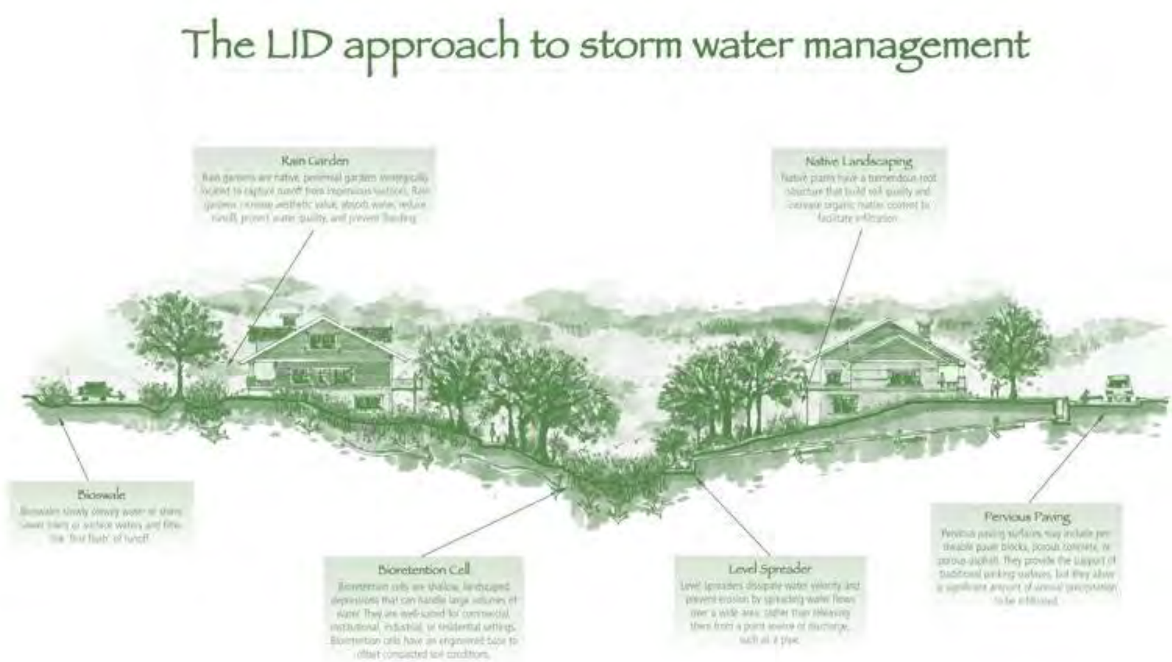
As part of the municipal regulation, land use regulators should identify and evaluate existing or perceived institutional barriers to GI and LID, and investigate opportunities where incentives can be developed to encourage the inclusion of GI and LID into site planning and development. Land-use commissions may benefit from reviewing municipal land-use evaluation projects in the Farmington and Salmon River watersheds, which assessed institutional barriers and evaluated how they may be removed. Additional information on municipal outreach for GI and LID is available at CT DEEP's website at:
http://www.ct.gov/deep/cwp/view.asp?a=2719&q=464958&deepNav_GID=1654.

Watershed managers should also review *The State of LID in Connecticut: Policies, Drivers, and Barriers* at the UConn Center for Land Use Education and Research website (http://clear.uconn.edu).

8.3.6. Strategy 3-6. Adopt regulatory language necessary to implement MS4 General Permit.

Land use regulators will need to adopt regulatory framework as necessary to comply with the 2016 MS4 Stormwater General Permit. Although the general permit is typically administered through public works departments, elements will come under the regulatory authority of land-use commissions, including construction site stormwater runoff control and post-construction stormwater management. The legal authority to administer the MS4 permit will reside in the regulations and land-use policies of the land-use commissions.

Municipal land-use recommendations are summarized in Table 8-5.



Credit: USDA NRCS

Table 8-5. Objective 3 - Promote land-use regulations & practices that are protective of water quality.

MP Implementation Actions/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
1. Adopt land-use planning recommendations proposed in Plan of Conservation and Development and Open Space Plan: • Review Plans of Conservation and Development and Open Space Plan • Develop proposed regulatory language • Review and revise existing regulations	Watershed management team, land-use commissions, staff	2018-2019	List of proposed recommendations; development of proposed regulatory language; adoption of recommendations from POCD/Open Space Plan	$2,000 (staff salary)	Municipal general budget	Municipal staff, NECCOG, DEEP, CT NEMO. CLEAR
2. Adopt/update farm-friendly land-use regulations: • Create a regulation review team • Review existing land-use regulations and policies related to farming • Review recommended guidance documents • Prepare and revise existing regulations	Watershed management team, land-use staff and commissions, agriculture commission, farmers	2019-2020	Identification of relevant regulations; preparation of proposed farm-friendly revisions; adoption of proposed regulation revisions	$2,000 (staff salary)	Municipal general budget	Municipal staff, UConn Extension, CT Farmland Trust, DoAg, DEEP, CT RC&D
3. Review and strengthen existing land-use regulations pertaining to erosion and sediment control and stormwater management: • Form a regulation review team • Review existing land-use regulations/ ordinances • Review sample/model regulations pertaining to E&S controls, stormwater management • Work with land-use staff and boards to develop revised regulations • Adopt new regulations	Watershed management team, land-use commissions, staff	2017-2018	Formation of review team; review of regulations; proposed regulations revisions; adoption of revised regulatory language	$2,000 (staff salary)	Municipal general budget	Municipal staff, CT NEMO, DEEP, NECCOG, CLEAR

Table 8-5. Objective 3 - Promote land-use regulations & practices that are protective of water quality.

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
4. Incorporate language to encourage or require the use of green infrastructure (GI) and low impact development (LID) practices into site plan design and development: • Review existing land-use regulations/ ordinances • Review sample/model regulations pertaining to GI/LID • Work with land-use staff and boards to develop revised regulations • Adopt new regulations	Watershed management team, land-use commissions, staff	2018-2019	Review of existing regulations/ ordinances; review of model regulations; development of proposed revisions; adoption of revised regulations	$2,000 (staff salary)	Municipal general budget	Municipal staff, CT NEMO, DEEP, NECCOG, CLEAR
5. Identify and evaluate any existing or perceived institutional barriers to GI and LID: • Form a review team • Review existing studies on barriers to GI/LID • Review existing land-use regulations for barriers to GI/LID • Interview land-use managers/decision makers about knowledge/attitudes regarding GI/LID • Evaluate results of interviews • Develop outreach to remove barriers • Disseminate outreach material	Watershed management team, land-use commissions, staff	2019-2020	Formation of review team; regulation review; completion of interviews; analysis of results; development and dissemination of outreach material	$2,000 (staff salary)	Municipal general budget	Municipal staff, CT NEMO, DEEP, NECCOG, CLEAR
6. Adopt regulatory language necessary to implement MS4 General Permit: • Review permit requirements • Develop stormwater management plan • Develop land-use regulatory language to authorize required activities • Adopt proposed regulatory language	Land-use commissions, staff, Board of Selectmen	2017-2018	Comprehension of MS4 permit reqts; development / adoption of SWMP; development of regulatory language/ordinances ; adoption of regulations	$2,000 (staff salary)	Municipal general budget	Municipal staff, DEEP, CT NEMO, NECCOG, CLEAR

8.4. Reduce effective impervious cover in the MS4 urban area.

Stormwater runoff from impervious surfaces throughout the French River watershed and particularly in the more densely developed urban area in North Grosvenordale can contribute a significant amount of NPS to watershed streams and ponds, including sediment, vehicular chemicals and animal waste. Efforts by the Town of Thompson and watershed managers to reduce the effects of impervious cover in this area may have the greatest positive impact on water quality improvements.

Watershed managers are urged to review the Eagleville Brook Impervious Cover TMDL website (http://clear.uconn.edu/projects/tmdl/) for information and resources related to impervious cover reduction. The Eagleville Brook Impervious Cover TMDL, adopted in 2007, was the first of its kind in the United States.

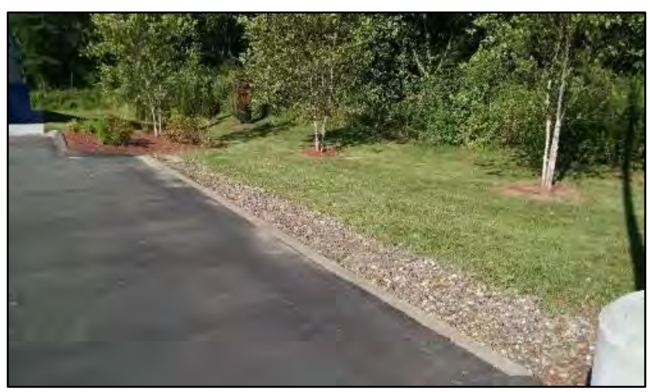
8.4.1. Strategy 4-1. Identify priority stormwater catchments in Urban Areas.

The Town of Thompson inventoried, mapped and photo-documented storm drain outfalls from the municipal storm drain system under the previous MS4 general permit. As part of the 2016 MS4 stormwater general permit, the Town must also map the catchment areas of stormwater outfalls with directly connected impervious areas (DCIA) of greater than 11% or that discharge to impaired waters. Once this mapping is completed, watershed managers can use this information to determine DCIA reduction goals, prioritize stormwater catchment areas for IC reductions and identify sites within priority stormwater catchments to conduct SWM practices.

8.4.2. Strategy 4-2. Encourage or require LID/GI practices on new and redeveloped parcels in the urban area.

Land use regulators should require the inclusion of stormwater management practices that reduce effective impervious cover on permit applications for parcels in Thompson's urban areas, and particularly on properties that are being redeveloped.

The Dollar General store, located on the banks of the French River at 706 Riverside Drive in North Grosvenordale, is an excellent example of the use of LID on a redeveloped property. Site designers incorporated LID practices into the site layout to manage storm water runoff from the 2-acre parcel.



A gravel strip at the edge of the parking area at Dollar General filters stormwater before it enters a grassed swale that leads to an infiltration basin at the rear of the property.

8.4.3. Strategy 4-3. Install BMPs on high IC parcels to reduce stormwater runoff and NPS.

Once watershed managers have completed DCIA mapping, and prioritized DCIA catchment areas, they should work with land owners and developers to install stormwater BMPs on parcels with high percentages of IC to reduce stormwater runoff. A list of properties with high percentages of IC in the French River watershed (Table 5-1) is included in Section 5.3.1. BMPs should include practices that capture and store runoff, such as rain barrels or cisterns, and where soils allow, practices that infiltrate rainwater into the ground, including pervious pavers and/or pavements, rain gardens, vegetated swales and other bio-retention practices. Care should be taken not to infiltrate rainwater on sites that may contain contaminated soils until the sites have been investigated and cleared by licensed environmental professionals.

8.4.4. Strategy 4-4. Conduct IC outreach and education.

Watershed managers should conduct outreach programs to educate homeowners about the effects of NPS on water quality, particularly in the designated urban areas. Outreach efforts should encourage the installation of residential BMPs such as rain barrels, rain gardens, grass swales or other practices that will capture stormwater and allow it to soak into the ground.

In the summer of 2017, ECCD conducted a Build-a-Rain-Barrel workshop at the Thompson Public library and distributed 11 rain barrels to watershed residents. The District also installed stormwater management practices at the library to treat stormwater runoff from impervious areas at the facility, including rooftops and the parking lot. These practices included a rain garden, a grass infiltration swale, downspout planters and storm drain filters. ECCD prepared outreach material to accompany the BMP installations. This site is intended to demonstrate stormwater practices that are suitable for residential, commercial and some institutional properties, and should be an integral part of French River watershed outreach and education.

Recommendations to reduce impervious cover are summarized in Table 8-6.

Credit: Susan Schadt, Univ. CT

Table 8-6. Objective 4 - Reduce effective impervious cover in the MS4 urban area.

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
1. Identify priority stormwater catchments in UAs: • Delineate stormwater outfall catchment areas • Determine DCIA reduction goals • Prioritize catchment areas for IC reductions • Identify prospective sites for BMP installations	Town of Thompson, engineer/consultant	2018-2019	Delineation of DCIAs; completion of DCIA priority list; # potential BMP sites identified	$10,000 (consultant)	Town of Thompson	Municipal staff, CLEAR NECCOG, DEEP, town engineer, USEPA
2. Encourage or require LID/GI practices on new and redeveloped parcels in the urban area: • Develop a list of potential LID/GI BMPs • Make LID/GI BMP list available to developers/contractors • Promote or require LID/GI during permit application review	Watershed management team, project/partners	2019-2029	LID/GI BMP list; # LID/GI practices installed in UA	$2000 (staff salary)	Town of Thompson, community foundation grants, corporate grants, CT DEEP 604b watershed planning grants	Municipal staff, ECCD, NECCOG, DEEP, CLEAR, USEPA
3. Install BMPs on high IC parcels to reduce stormwater runoff and NPS: • Review priority stormwater outfall catchment areas • Identify appropriate SWM practice(s) • Identify funding sources/technical assistance • Install SWM practice • Evaluate implementation effectiveness	Watershed management team, Town of Thompson, project partners, property owners	2019-2029	# BMPs in stalled on high IC parcels	$1000 - $100,000 (Varies depending on BMP)	Town of Thompson, community foundation grants, corporate grants, CWA §319 grants	Municipal staff, ECCD, DEEP , CLEAR, NECCOG, USEPA
4. Conduct public outreach and education: • Identify outreach partners • Identify outreach topics • Prepare outreach materials • Identify best method for dissemination • Conduct public outreach utilizing selected outreach mechanisms	Watershed management team, Town of Thompson, project partners	2019-2029	# outreach events conducted,; amount of outreach material distributed; # people reached	$1000/ outreach event	Town of Thompson, community foundation grants, private corporate grants, CWA §319 & 604b grants	Municipal staff, ECCD, NECCOG, DEEP, CT NEMO, CLEAR

8.5. Protect and preserve high quality tributaries and undeveloped headwater areas from existing pollutant sources and future threats related to new development.

All of the tributary streams to the French River in Connecticut are classified as high quality (Class A) waters, including Sunset Hill, Stoud and Baptist Brooks, which contribute to Thompson's public drinking water supply. It is critical to protect these high-quality streams and the headwater areas from which they originate in order to provide safe and clean water for downstream uses, support a healthy and diverse wildlife habitat, and protect the rural aesthetic that defines Thompson's character.

8.5.1. Strategy 5-1. Support recommendations in the Plan of Conservation and Development and the Conservation and Open Space Plan.

Documents like the 2010-2020 Thompson Plan of Conservation and Development (POCD) and the 2005 Conservation and Open Space Plan (COSP) identify high quality areas meriting protection. Land use regulators should consider these recommendations when evaluating land use development proposals and permit applications.

The 2010 POCD provides the following recommendations to protect high quality tributaries and headwater areas:

- Acquire land and/or conservation easements in identified resource areas
- Develop special protections for the French River including the establishment of a greenway
- Encourage private donation of land to land trusts and other conservation organizations
- Review and follow the Natural Resources Inventory and guidance provided by the Town's Conservation and Open Space Plan
- Implement the recommendations to protect the natural resources contained on sites under review for development to include establishment of greenways
- Support organizations that develop and protect wildlife corridors and promote the preservation of wildlife habitat.

The 2005 COSP provides the following recommendations to protect high water quality tributaries and headwater areas:

- Develop and implement Aquifer Protection regulations in conjunction with the State Aquifer Protection Area program
- Protect critical areas of public supply watersheds
- Identify water quality improvement projects
- Increase protection of headwater wetlands and watercourses
- Amend municipal regulations to increase stream buffers and promote undeveloped buffers

- Pursue acquisition and/or conservation easements on undeveloped shorefront and on identified priority areas
- Encourage forest management and habitat protection through voluntary participation
- Emphasize prevention of forest fragmentation in land use development decisions
- Protect habitat corridors
- Support the natural processes of forests and wetlands

8.5.2. Strategy 5-2. Promote the use of regulatory and non-regulatory tools to preserve open space.

Land use regulators and watershed managers have a number of tools in their land management toolbox to preserve open space, including conservation subdivisions, open space set-asides, conservation easements, the sale of development rights, and private agriculture and forest land conservation programs. Watershed managers should review open space areas identified in the COSP and prioritize those areas for protection. Managers should also work with private land owners, land trusts and other conservation organizations to identify conservation programs and funding sources to protect open spaces.

Sources of open space preservation information and tools available to land use regulators and watershed managers include:

- The recently updated Connecticut Green Plan (www.ct.gov/deep/openspace) which provides guidance and information that "…presents a coordinated approach for land conservation by the State of Connecticut, through DEEP and its conservation partners (municipalities, land conservation organizations, and water companies)" (CTDEEP, 2016).
- The Connecticut Land Conservation Council (CLCC) (www.ctconservation.org/) provides resources for land use commissions, municipalities, land trusts and other conservation organizations to support land conservation in Connecticut.
- The CT Non-point Education for Municipal Officials (NEMO) (http://nemo.uconn.edu/) provides a variety of educational topics and tools for land use officials, including open space planning.
- The University of Connecticut Center for Land Use Education and Research (CLEAR - http://clear.uconn.edu/) provides a variety of outreach and education topics and land management tools for land use officials.
- The University of Connecticut Extension Forestry program (www.ctforestry.uconn.edu/) provides outreach and assistance to Connecticut forest land managers and owners.

State and federal programs to assist land managers and land owners with protecting open space include:

- CT DEEP Open Space and Watershed Land Acquisition Grant Program: (http://www.ct.gov/deep/cwp/view.asp?q=323834
- USDA Forest Service Open Space Conservation programs: https://www.fs.fed.us/openspace/resources_and_tools.html
- USDA NRCS Agricultural Conservation Easements and Healthy Forest Reserves programs: https://www.nrcs.usda.gov/wps/portal/nrcs/main/ct/programs/
- The Last Green Valley Forest Conservation Programs: http://thelastgreenvalley.org/learn-protect/agriculture-forestry/

8.5.3. Strategy 5-3. Provide regulatory protections for vegetated riparian zones.

The establishment of protected riparian corridors along rivers and streams has been demonstrated to protect water quality, create wildlife habitat, promote biodiversity and provide safe travel corridors (Osborne and Kovacic, 1993). Thompson land use regulators may consider the adoption of land use regulations limiting encroachment into streamside vegetative areas. Guidance on developing riparian corridor regulations can be found at the University of Connecticut CLEAR website and the Long Island Sound Study website:

- http://clear.uconn.edu/tools/habitats/riparian.htm
- http://longislandsoundstudy.net/research-monitoring/river-and-stream-bank-restoration-toolbox/

Undisturbed riparan corridor along Long Branch Brook near the Massachusetts state line.

8.5.4. Strategy 5-4. Promote the use of LID to reduce stormwater runoff and improve water quality.

The use of BMPs should be encouraged to protect water quality in headwater areas. All new development and redevelopment should incorporate LID practices to mimic the natural pre-developed hydrological site conditions when site conditions are favorable. This is especially important to protect groundwater quality and provide groundwater recharge in upland areas served by private drinking water wells and septic systems. Land use regulators, watershed managers and developers are encouraged to utilize recommendations in the 2004 Connecticut Stormwater Quality Manual (CTDEEP, 2004) and the Low Impact Development Appendix to the Connecticut Stormwater Quality Manual (CTDEEP, 2011).

8.5.5. Strategy 5-5. Encourage the use of forestry BMPs to protect stream crossings and prevent soil erosion.

Forestry activities frequently require the crossing of streams and small wetlands, activities that can impact water quality and contribute to soil erosion. Forestry practitioners should utilize BMPs such as those outlined in the *BMPs for Water Quality While Harvesting Forest Products* guidebook (CT DEP, 2007) to ensure that any soil or wetland disturbance is kept to a minimum and sites are properly restored when the timber harvest or other forest management activities are complete.

The Thompson Inland Wetland and Watercourses Commission (IWWC) requires forest practitioners to submit a *Request for Approval of Timber Harvest as Use Permitted as of Right*. This allows the IWWC to determine that all proposed activities are a use permitted as of right pursuant to Section 22a-40(a) of the Connecticut General Statutes and Section 4.1 of the Inland Wetlands and Watercourses Regulations for the Town of Thompson. It also provides the opportunity for the Commission and/or staff to initiate discussion to ensure that activities that are allowed as of right will be conducted using BMPs to minimize disturbance.

8.5.6. Strategy 5-6. Conduct outreach to promote the benefits of open space.

An educated general public is more likely to support open space conservation when it understands the benefits. Watershed managers should conduct outreach to promote the multiple benefits of open spaces on clean water and air, wildlife habitat and diversity, and recreational and aesthetic values to engender a greater understanding and support among watershed residents.

In order to connect the public with open spaces in the French River watershed, watershed managers should support, promote and participate in outreach activities such as the CT Forest and Parks Association's Connecticut Trail Days, The Last Green Valley's Walktober events; promote Thompson's recreational trails and encourage residents to participate in trail maintenance and clean-ups; and support hiking activities such as geocaching and letter boxing to encourage families to "get into the woods."

Table 8-7. Objective 5 - Protect and preserve high quality tributaries and undeveloped headwater areas.

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
1. Support recommendations in POCD and Conservation and Open Space Plan. • Review POCD and Open Space Plan • Identify recommendations related to open space preservation • Incorporate recommendations into site plan review and land use decision-making process as is appropriate	Watershed management team, land use staff and commissions	2019-2020	Identification of POCD and Open Space Plan recommendations; incorporation of recommendations into land use planning and review	$2000 (staff salary)	Town of Thompson	Municipal staff, ECCD, NECCOG, DEEP, CT NEMO, CLEAR
2. Promote the use of regulatory and non-regulatory tools to preserve open space. • Review Open Space Plan to identify parcels recommended for preservation • Prioritize parcels for open space preservation • Identify tools/mechanisms for open space preservation • Identify sources of technical assistance • Identify sources of financial assistance • Identify partners for open space preservation • Encourage adoption of open space protections among property owners	Watershed management team, land use staff and commissions, land trusts, property owners	2020-2029	Identification of open space preservation tools/mechanisms; open space preservation priority list; identification of technical/financial resources; # property owners engaged in open space preservation	Varies depending on land value/ assessment	Town of Thompson open space set-aside funds; community foundation grants, corporate grants, fund raising drives, CT DEEP Open Space Acquisition funds; US Forest Service programs; NRCS programs; property donations	Municipal staff, ECCD, NECCOG, DEEP, CT NEMO, NRCS, CLCC, land trusts
3. Provide regulatory protections for vegetated riparian zones. • Identify and review model regulatory language • Determine are to be regulated • Developed proposed regulation • Adopt regulation	land use staff and commissions	2020-2021	Adoption of regulatory language.	$2000 (staff salary)	Town of Thompson	Municipal staff, ECCD, NECCOG, DEEP, other municipalities

Table 8-7. Objective 5 - Protect and preserve high quality tributaries and undeveloped headwater areas (cont.).

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
4. Promote the use of LID to reduce stormwater runoff and improve water quality. • Identify and compile catalog of LID practices • Distribute or make available LID catalog to contractors, developers, & general public • Encourage or require use of LID in site plan design • Promote use of resources such as 2004 CT Stormwater Quality Manual	Watershed management team, land use staff and commissions	2018-2029	Catalog of LID practices; # LID practices implemented	$2000 (staff salary)	Town of Thompson, community foundation grants, corporate grants, CT DEEP 604b watershed planning grants	Municipal staff, CLEAR, ECCD, CT NEMO, NECCOG, DEEP, USEPA
5. Encourage the use of forestry BMPs to protect stream crossings and prevent soil erosion. • Identify and compile catalog of forestry BMPs • Distribute or otherwise make available catalog of forestry BMPs to forestry practitioners and general public • Continue to review forestry plans through established IWWC review process	Watershed management team, land use staff and commissions, forestry professionals	2018-2029	Catalog of forestry BMPs; use of BMPs by forestry practitioners	$2000 (staff salary)	Town of Thompson, community foundation grants, corporate grants, CT DEEP 604b watershed planning grants	Municipal staff, ECCD, NECCOG, DEEP, UConn Extension, forestry organizations
6. Conduct outreach to promote the benefits of open space. • Identify outreach topics. • Identify target audience • Prepare and distribute outreach materials via multiple media platforms • Support and promote existing outreach programs such as CT Trails Day and Walktober and other public opportunities • Conduct outreach/recreation programs to connect the general public with the outdoors	Watershed management team, Conservation Commission, Trails Committee, Recreation Commission	2019-2029	# outreach topics identified; amount of outreach material distributed; # people reached; # programs supported or conducted	$1000/ outreach event	Town of Thompson, community foundation grants, corporate grants, CT DEEP 604b watershed planning grants	Municipal staff, ECCD, NECCOG, DEEP

8.6. Improve and protect water quality in the French River and impaired tributaries.

A primary goal of this watershed plan is to improve and restore impaired waters in the French River watershed. Prior to water quality sampling in 2015 by ECCD and TLGV, the French River, from the Quinebaug River to North Grosvenordale Pond (CT3300-00_01), was assessed as Fully Supporting (meeting State water quality standards) for designated Recreational use, but was not assessed from North Grosvenordale Pond to the Massachusetts line (CT3300-00_02). Long Branch Brook, from Langers Pond to Knowlton Brook (CT3300-02_01), was assessed as Not Supporting for designated Recreational use based on water samples collected by CT DEEP in 2010 (2014 State of Connecticut Integrated Water Quality Report, CT DEEP, 2014).

Subsequent to the 2015 ECCD/TLGV water quality sampling, the French River and Long Branch Brook were assessed as Fully Supporting for designated Recreational use. With the exception of Quinatissett Brook (CT3300-10_01), all of the other tributaries sampled in 2015 also were assessed as Fully Supporting for designated Recreational use (2016 State of Connecticut Integrated Water Quality Report, CT DEEP, 2017). It should be noted that Backwater Brook (CT3300-05_01), which was sampled in 2016 by TLGV and failed to meet state water quality standards, may be placed on the impaired waters list as Not Supporting for designated Recreational use in 2018. None of the French River tributary streams have been assessed for designated Aquatic Habitat use.

Based on the assessments by CT DEEP, efforts to protect and restore impaired waters in the French River watershed should focus on Quinatissett Brook and Backwater Brook. Additionally, although the French River main stem was not designated as impaired, efforts to protect and improve water quality should also focus on it, particularly on the section of the river from North Grosvenordale Pond to the Quinebaug River, because it is the receiving waterbody for Thompson’s urban area.

8.6.1. Strategy 6-1. Conduct water quality monitoring.

In order to understand current water quality conditions and evaluate the effects of any water quality improvement projects, watershed managers should institute a water quality monitoring program or partner with other organizations to collect water quality data.

There are several opportunities for watershed managers to utilize existing water quality sampling programs to monitor the quality of water in the French River and impaired tributary streams. The Town will be required, as part of the MS4 permit, to collect water samples from impaired waterbodies. This will allow the Town to evaluate whether actions being taken as part of the MS4 stormwater management program, and any additional water quality improvement projects, are having the intended effect.

The USGS collects a comprehensive suite of data from the French River at a sampling station at Riverside Park in North Grosvenordale. That data is available on-line from the USGS at the National Water Information System Web Interface at:

https://nwis.waterdata.usgs.gov/ct/nwis/inventory/?site_no=01125100&agency_cd=USGS.

This sampling site is maintained by the USGS Connecticut Office of the New England Water Science Center in East Hartford, CT.

Watershed managers can partner with volunteer water quality monitoring programs such as the CT Audubon Society's Citizen Science programs and The Last Green Valley Volunteer Water Quality Monitoring program to conduct targeted water quality sampling. The recruitment of watershed residents for such programs creates the opportunity to connect the public to local waters and water quality issues, and build a sense of stewardship of and responsibility for local waterways.

Additional fecal bacteria sampling is suggested in Backwater Brook and Quinatissett Brook to track bacteria levels and determine if water quality improvement projects, once implemented, are having the desired effects. Stream corridor assessments, especially of the impaired waterbodies, are valuable to identify condition such as stormwater outfalls, illicit discharges and impacted riparian areas that can contribute to water quality degradation. None of the French River tributaries have been assessed for aquatic habitat. CT DEEP's Riffle Bioassessment for Volunteers (RBV) was developed to assess stream aquatic habitat based on the presence or absence of specific aquatic insects (www.ct.gov/deep/rbv). The collection of this type of stream data by local volunteers can be invaluable to DEEP's water quality assessment program.

8.6.2. Strategy 6-2. Conduct water quality improvement projects.

Site-specific water quality improvement projects are provided in Section 8-8. However, recommendations for those site-specific BMPs should not preclude the implementation of other water quality improvement practices as opportunities and need are identified. Water quality improvement projects should target specific pollutant sources or problem areas, be designed to provide the maximum water quality improvement benefit and be monitored and maintained post-installation to ensure they continue to provide the desired benefit over time.

The watershed management team and watershed stakeholders should review the recommendations of this Plan and identify and prioritize water quality improvement projects for implementation. Since most implementations will likely be on privately owned properties, watershed managers will need to obtain property owner buy-in and a commitment to maintain BMPs going forward. Depending on the type of BMP selected, the team will need to identify sources of funding and partner agencies to provide technical assistance with the design and installation of the BMP. An operation and maintenance plan should be provided to the practice's ultimate owner. It should be reviewed so that it is clear the owner understands and is willing and able to accept any on-going maintenance requirements of the BMP. The watershed team should have a plan in place to evaluate the BMP, such as follow-up water quality monitoring and site visits, to ascertain that desired outcomes are being achieved. Finally, the watershed team should conduct an outreach campaign associated with each BMP installation to inform and educate watershed residents about the resource concern(s) that prompted the BMP installation, pollutants that were targeted, expected water quality outcomes, and suggested actions by watershed residents at home that can help improve the anticipated water quality outcome.

8.6.3. Strategy 6-3. Implement MS4 Stormwater Management Plan.

The Thompson Stormwater Management Plan (SWMP) is designed to address polluted runoff that enters French River waterways via the existing municipal storm drain system in Thompson's MS4 urban areas. The plan provides six minimum control measures to reduce the discharge of pollutants from the municipal storm drain system and specific best management practices, BMP goals, and timelines for completion for each minimum control measure.

Watershed managers should review the SWMP and identify areas where the goals of the SWMP and this Plan overlap. The watershed team should support actions by the Town to implement the SWMP and share resources to strengthen the outcomes of both programs.

8.6.4. Strategy 6-4. Reduce pet and nuisance waterfowl waste.

Water quality sampling by CAS, ECCD and TLGV has revealed periodically high fecal bacteria levels in the French River and Backwater Brook. An assessment of the areas adjacent to the sampling sites has indicated that dog and waterfowl feces may be a contributing factor. In order to reduce dog feces in public areas including sidewalks on Main Street, River Street and in Riverside Park and the River Walk, the Town should consider adopting a dog waste ordinance. In order to encourage dog walkers to pick up after their pets, the Town or watershed managers should post signs in high use areas directing pet owners to clean up after their animals. The Town or watershed managers may consider providing pet waste bag dispensers along the River Walk; however, similar dispensers installed in years past have not fared well. The Town or watershed managers should conduct targeted outreach informing pet owners of

the water quality impacts of pet waste left on the ground, including potential public health risks associated fecal bacteria contamination.

Waterfowl at the Town-owned Duhamel Pond Park may be contributing to the high fecal bacteria loads documented in Backwater Brook during water quality sampling in 2015 and 2016. Waterfowl observed at the pond appeared to be a mix of domestic ducks and geese and non-domestic Mallard ducks. The flock size of about 6-8 Mallard ducks seemed appropriate for the size of the small pond. In order to avoid attracting additional animals to the pond, the Town or watershed managers should conduct targeted outreach to discourage the feeding of the waterfowl. If feeding is a problem, they may consider posting a sign instructing visitors to not feed the ducks. Waterfowl frequently graze on the lawns adjacent to the pond, and leave behind feces. At Duhamel Pond Park, a portion of the grass is mowed to the edge of the pond, allowing bacteria-laden stormwater to flow from the lawn area directly into the pond. Property managers should allow a tall grass strip to grow along the edge of the pond to intercept and slow stormwater, allowing it to soak into the ground rather than flowing directly into the water. The grass strip can be mowed after the waterfowl migrate to prevent woody vegetation and invasive plants from gaining a foothold.

Watershed managers should encourage the utilization of BMPs to manage waste from the domestic waterfowl, including covering the waste pile, properly composting the waste or removing it from the site altogether.

8.6.5. Strategy 6-5. Restore impacted riparian areas to the best extent practicable.

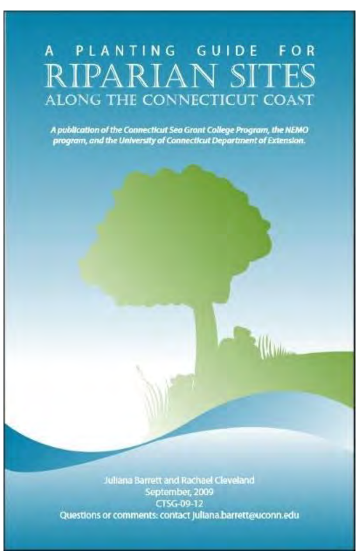
Healthy riparian vegetation provides a variety of benefits to rivers and streams. Plant roots stabilize stream banks, reducing erosion, especially during floods. Streamside vegetation intercepts the flow of surface runoff, allowing runoff to soak into the ground, and some pollutants, such as fertilizers to be taken up by the plants. Riparian vegetation provides food and habitat for wildlife and shades and cools stream water. In locations like the North Grosvenordale UA, intact riparian corridors can provide significant water quality benefits.

Impacted riparian buffers were noted throughout the French River watershed. In many cases, they involved land owners who cleared stream-side vegetation in order to gain a view or access to the water. In other areas, especially along the French River in North Grosvenordale, businesses, residences and infrastructure were built or installed right to the banks of the river during the industrial revolution to access the river for power.

A riparian buffer restoration project was conducted in 2008 along the French River at Riverside Park in North Grosvenordale. The project was funded through a Clean Water Act §319 NPS program grant awarded to CT NRCS and was administered by CT DEEP. The purpose of the project was to restore areas with minimal or no riparian vegetation, reduce or eliminate streambank erosion and provide shade to cool the water of the French River. A variety of native shrubs and trees were planted along the riverbank. Plant mortality and the influx of invasive plants, including oriental bittersweet, multiflora rose and glossy buckthorn, that have competed with the native plantings, have resulted in a less than satisfactory outcome. Town officials are encouraged to adopt an invasive plants management plan for the riverbank at the park and adjoining public library property and evaluate where the original riparian buffer plantings can be bolstered or replaced. This is a highly visible location for interested community residents, business and institution site managers to visit and learn how such a project can be adapted to their own site-specific conditions and objectives.

Watershed managers should conduct steam corridor assessments to identify and inventory impacted riparian buffers. There are several stream corridor assessment protocols that engage the public through volunteerism. These include the Unified Stream Assessment (USA) method developed for small urban watersheds by the Center for Watershed Protection (http://www.cwp.org/) and the NRCS Streamwalk Assessment, developed by the Connecticut USDA-Natural Resources Conservation Service (www.nrcs.usda.gov/wps/portal/nrcs/detail/ct/people/?cid=nrcs142p2_011198). A 2008 stream corridor assessment conducted by NRCS as part of the French River Riparian Corridor Restoration is on file at the Thompson Planning Department and can be used as an example of how the assessment is done.

Once impacted riparian buffer areas have been identified, watershed managers should obtain land-owner buy-in and approval to restore degraded riparian buffer areas, identify sources of funding and technical assistance and conduct the restoration project.



The Connecticut NRCS document *Where the Land and Water Meet: A Guide for Protection and Restoration of Riparian Areas*, is an excellent resource for riparian buffer restoration guidance.

CT NEMO and CT Sea Grant have compiled a selection of riparian resources that can be found on the CLEAR website at http://clear.uconn.edu/tools/habitats/riparian.htm. Including are tools for conducting riparian buffer analyses, and guidance documentation for understanding and restoring riparian buffers.

8.6.6. Strategy 6-6. Conduct NPS education and outreach campaigns.

Engaging the Thompson community in NPS management can have a significant effect on the reduction of NPS pollutants in impaired waterways. The goals of a successful public outreach and education campaign are to create an informed populace that understands the environmental impacts of NPS, and to engender a sense of responsibility for the health of local waterways that prompts the voluntary adoption of behaviors that are supportive of good water quality.

Watershed managers should select NPS outreach topics based on specific resource concerns, such as fecal bacteria or impervious cover, and identify their target audience. In order to effectively convey the outreach message, watershed managers should identify the most appropriate vehicle for outreach. In addition to the traditional outreach methods (such as posters, pamphlets and brochures), outreach messages can be couched in conversation associated with community activities such as road-side/stream-side clean-ups, neighborhood runoff reduction challenges (see USEPA's Campus RainWorks Challenge at the Green Infrastructure webpage listed below), and community day events.

Watershed managers should compile existing or prepare new outreach material and make it available to the public in a variety of formats, including videos like USEPA's *After the Storm – A Citizen's Guide to Understanding Stormwater* (available on YouTube) or hands-on activities like the EnviroScape® stormwater/NPS demonstration model (www.enviroscapes.com).

The USEPA provides a variety of outreach tools and resources on its Healthy Watersheds Protection webpage (https://www.epa.gov/hwp/tools-and-resources-protect-watersheds) including *Getting In Step - A Guide for Conducting Watershed Outreach Campaigns,* 3rd edition (USEPA 2010) and the NPS Outreach Toolbox (https://cfpub.epa.gov/npstbx/index.html).

The USEPA Green Infrastructure webpage (https://www.epa.gov/green-infrastructure) provides additional information and resources, including the *Soak Up the Rain* stormwater public outreach campaign (https://www.epa.gov/soakuptherain) and the 2016 publication *Community Solutions for Stormwater Management: A Guide for Voluntary Long-Term Planning* (https://www.epa.gov/npdes/stormwater-planning).

The Last Green Valley Water Quality Education program provides interactive programs for students about pollution prevention and best management practices to protect local waterbodies (http://thelastgreenvalley.org/learn-protect/programs-for-school/).

Stormwater/NPS EnviroScape® model

Table 8-8. Objective 6 - Improve and protect water quality in the French River and impaired tributaries.

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
1. Conduct water quality improvement projects. • Review Plan recommendations • Identify areas for water quality improvement projects • Obtain property owner buy-in • Identify sources of funding • Design/install implementation • Maintain and evaluate to determine if is having desired effect • Conduct outreach to promote projects	Watershed management team, Town of Thompson, partners, other stake-holders	2019-2029	# water quality improvement projects identified; # water quality improvement implemented	$10,000 - $1000,000 (varies by project)	Town of Thompson, community foundation grants, corporate grants, CWA §319 grants, DECD grants	Municipal staff, ECCD, NECCOG, DEEP, USEPA
2. Conduct water quality monitoring. • Identify impaired tributaries and pollutant source • Review existing water quality data • Identify potential water quality monitoring partners • Identify sources of funding and technical assistance • Develop water quality monitoring plan • Conduct additional bacteria sampling in Backwater and Quinatissett Brooks • Conduct riparian corridor assessments • Conduct RBV in French River tributaries • Conduct water quality sampling to evaluate performance of BMPs • Evaluate water quality data	Watershed management team, project partners, volunteers	2018-2029	Identification of impaired tributaries/ pollutant source; secured funding; development of monitoring plan; summary of data collected; evaluation of results	$500 - $8000 (price varies depending on type of monitoring being conducted	Town of Thompson, community foundation grants, corporate grants, CWA §319 grants	Municipal staff, ECCD, DEEP, TLGV,
3. Implement MS4 SWMP. • Review SWMP. • Identify areas of overlap between SWMP and French River Watershed-based Plan • Support municipal actions • Share resources	Watershed management team, Town of Thompson	2017-ongoing thereafter	Identification of areas of overlap; resources shared;	$5,000 (staff salary, outreach material)	Town of Thompson, community foundation grants, corporate grants	Municipal staff, ECCD, NECCOG, DEEP, CLEAR, USEPA

Table 8-8. Objective 6 - Improve and protect water quality in the French River and impaired tributaries (cont.).

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
4. Reduce pet and nuisance waterfowl waste. • Adopt a dog waste ordinance • Post signs n high use areas • Install pet waste bag dispensers in high use areas • Conduct outreach to encourage responsible pet owner behavior • Discourage the feeding of waterfowl at public parks • Allow a tall grassy strip to grow along the edge of Duhamel Pond • Encourage the use of pet waste BMPs by waterfowl owners	Town of Thompson, watershed management team, pet owners	2019-2020	Adoption of dog waste ordinance, observable reduction of dog waste in public areas, sustainable waterfowl flock size at Duhamel Pond, observable reduction in waterfowl feces on lawn at Duhamel Pond	$4800 (staff salary, signs, pet waste bag dispensers)	Town of Thompson, community foundation grants, corporate grants, CWA §319 grants	Municipal staff, NECCOG, DEEP
5. Restore impacted riparian areas to the best extent practicable. • Identify impacted areas • Obtain landowner buy-in and approval • Identify and obtain funding • Design restoration • Restore impacted riparian buffers • Evaluate and maintain restoration	Town of Thompson, watershed management team, property owners, project partners	2020-2029	Inventory of impacted riparian buffer areas, # property owners engaged, acres of riparian buffers restored	Will vary by restoration/estimated $500 per acre of riparian buffer restored	Town of Thompson, community foundation grants, corporate grants, CWA §319 grants, NRCS cost-sharing programs, forestry grants	Municipal staff, ECCD, NECCOG, DEEP, CT Sea Grant, CLEAR, NRCS, UConn Extension
6. Conduct NPS education and outreach campaigns. • Identify outreach topics • Identify target audience • Identify appropriate vehicle for outreach • Prepare/compile outreach material • Conduct outreach	Watershed management team, Town of Thompson, project partners	2018 – ongoing thereafter	List of NPS outreach topics, amount of outreach material disseminated, # of people reached	$1000/ outreach event	Town of Thompson, community foundation grants, corporate grants, CWA §319 grants	Municipal staff, DEEP, CT NEMO, CLEAR, USEPA

8.7. Promote good housekeeping practices.

Good housekeeping practices are best management practices that are intended to control pollutant discharges and keep pollutants out of waterways. Watershed managers should promote good housekeeping practices to all stakeholders in the French River watershed to prevent the discharge of pollutant to the French River and its tributaries.

8.7.1. Strategy 8-1. Promote Municipal Good Housekeeping Practices.

Municipalities are responsible for maintaining much of the impervious surfaces within their jurisdictional boundaries, including roads, sidewalks, municipal buildings and parking lots. Municipal facilities can create NPS pollutants from normal activities such as structure, vehicle and equipment maintenance and grounds management. Vehicle fueling, material loading, unloading and storage can also be sources of NPS. Town-owned properties in the French River watershed include the transfer station (Baptist Brook sub-watershed); the highway garage (Stoud Brook sub-watershed); and the town hall, public school complex, and public library (French River sub-watershed). All of these properties contain significant impervious cover, storm drainage systems, and in some cases, material stockpiles.

A municipality should adopt good housekeeping practices (GHPs) to minimize the impacts of NPS from these activities and should train staff to follow these practices (US EPA, 2014). Employment of municipal "Good Housekeeping" or Best Management Practices, such as at least annual street sweeping and catch basin and stormwater outfall inspections and cleaning may reduce the amount of NPS discharging to local waterways. These activities remove accumulated sediment, trash and leaves that may otherwise end up in waterways.

Municipalities can also protect water quality (particularly groundwater quality, which is important since many residents in the French River watershed rely on private wells for their drinking water) by utilizing best management practices while servicing vehicles and equipment, properly managing stockpiled materials, and preparing and utilizing emergency spill protocols. Municipalities can also protect waterways from the dumping of dangerous chemicals by sponsoring hazardous materials collections days and partnering with the local health district (NDDH), pharmacies and local or state police to establish drop-off programs for unused medicines. These programs promote the safe and proper handling and disposal of unwanted chemicals, hazardous materials and pharmaceuticals that might otherwise be disposed of improperly.

Municipal Good Housekeeping recommendations are summarized in Table 8-9.

8.7.2. Strategy 8-2. Promote CT DOT Good Housekeeping Practices.

CTDOT is responsible for maintaining 34.5 miles of roadway in the French River watershed including 7.3 miles of Interstate 395 and the state highway facility on the southbound side of I-395 at exit 50. Stormwater runoff from state and interstate highways can be a significant source of NPS. Pollutants such as sediment from road-side erosion and land disturbances, vehicular chemicals from drips and spills, trash, dust and particles from transported loads, and de-icing agents can be conveyed into highway storm drain systems by stormwater runoff. Highway facilities can create NPS pollutants from activities such as building, vehicle and equipment maintenance, and grounds management. Vehicle fueling, material loading, unloading and storage can also be sources of NPS.

Good housekeeping practices by CT DOT should include:

- Development and adoption of operation and maintenance programs to prevent or reduce pollutant runoff from DOT operations,
- employee training to prevent and reduce stormwater pollution from activities such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and stormwater system maintenance,
- development and implementation of an (at least) annual street sweeping program,
- development and implementation of a program to evaluate and (at a minimum) annually clean catch basins and other stormwater structures that accumulate sediment, and
- the development and implementation of a program to evaluate and prioritize the repair and/or upgrade of stormwater conveyances, structures and outfalls (CT DOT, 2015).

CT DOT Good Housekeeping recommendations are summarized in Table 8-9.

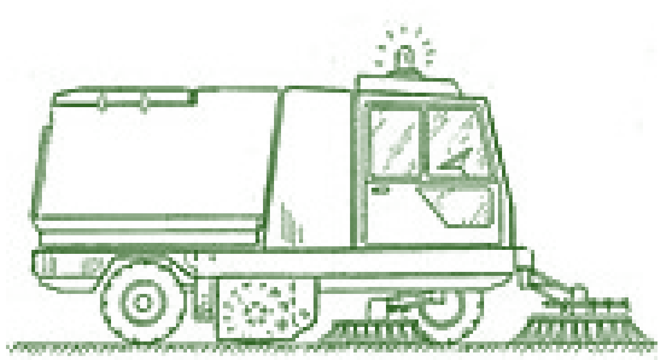


Table 8-9. Objective 7 - Promote Municipal and CT DOT Good Housekeeping Practices.

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
1. Promote municipal good housekeeping practices (GHP). • Conduct at least annual street sweeping • Conduct at least annual catch basin and stormwater outfall inspection and cleaning • Utilize GHPs while servicing vehicles and equipment • Adopt safe material handling and storage protocols • Develop emergency spills protocols • Sponsor hazardous materials and unwanted pharmaceuticals collection days.	Town of Thompson	2018-ongoing thereafter	Adoption of good housekeeping practices; # staff trained	$75,000 (primarily related to annual street sweeping/batch basin clean outs)	Town of Thompson Highway Department budget	CT DOT, DEEP, US DOT, US Federal Highway Administration
2. Promote CT DOT good housekeeping practices. • Develop/adopt O&M programs to prevent or reduce pollutant runoff from DOT operations • Conduct employee training to prevent and reduce stormwater pollution from DOT activities • Develop and implement an (at least) annual street sweeping program • Develop and implement program to evaluate and (at least) annually clean catch basins and other stormwater structures • develop and implement program to evaluate and prioritize the repair and/or upgrade of stormwater conveyances, structures and outfalls	CT DOT	2017-ongoing thereafter	Adoption of good housekeeping practices; # staff trained	Street sweeping - $40/mile Catch Basin cleaning - $300/unit	DOT general budget	CT DOT, DEEP, US DOT, US Federal Highway Administration

8.7.3. Strategy 8-3. Promote Commercial/Industrial/Institutional Good Housekeeping Practices.

Commercial, industrial and institutional properties are faced with different challenges than residential properties and municipalities when managing NPS. Commercial industrial and institutional properties have the potential for the contribution of higher nonpoint source pollutant loads than single family residential development due to greater development density and amount of impervious cover. NPS from commercial, industrial and institutional development is associated with the use and maintenance of lawns and landscaped areas, parking lots, driveways and sidewalks and waste management (dumpster) areas. Commercial and industrial properties also may have stored or stockpiled materials; staff should be properly trained to manage these materials to prevent spills and runoff. Common pollutants include sediment, especially from winter sanding and de-icing, pollutants associated with motor vehicles, and fertilizers and pesticides applied to lawns and landscaping. These pollutants are conveyed via on-site stormwater infrastructure located in the parking lots and driveways to nearby waterways.

Good housekeeping management activities can be adopted by commercial, industrial and institutional property managers to reduce NPS pollution from driveways, parking lots, material storage and dumpsters areas, including:

- spring and fall parking lot and driveway sweeping/vacuuming,
- spring and fall catch basin cleaning,
- safe materials handling, containment and spills protocols, and
- dumpster/dumpster area management, including the periodic cleaning, and replacement of corroded/leaking dumpsters in coordination with waste management contractor.

Best management practices that can reduce the volume of stormwater runoff from impervious surfaces, including rooftops, driveways, parking lots and compacted lawn/turf areas, include:

- installation of rain gardens and vegetated swales to catch and infiltrate runoff,
- use of rain barrels, rain planter boxes or drywells to capture and store roof runoff for non-potable uses, and
- reduction of impervious surfaces through the installation of pervious paving materials, green roofs, or the elimination of unneeded paved surfaces.

Property managers can improve water quality by reducing the amounts of chemicals, including herbicides, pesticides and fertilizers, they put on lawns and landscaping by:

- properly composting and utilizing compost as an alternative to chemical fertilizers,
- placement of lawn and landscape waste away from nearby waterbodies,
- testing soils to determine soil nutrient levels and needs,
- utilizing proper fertilizer application rates and timing, and
- utilizing integrated pest management (IPM) as an alternative to the application of herbicides and pesticides.

Table 8-10. Objective 7 – Promote Commercial, Industrial and Institutional Properties Good Housekeeping Practices.

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
1. Good housekeeping practices to reduce NPS pollution from driveways, parking lots, material storage and dumpsters areas. • spring and fall parking lot and driveway sweeping • spring and fall catch basin cleaning • safe materials handling, containment and spills protocols • dumpster/dumpster area management and maintenance	Watershed management team, property owners	2018 – ongoing thereafter	Adoption of Good Housekeeping practices	Parking lot sweeping - $40 - $80/hr Catch basin cleaning - $200 - $250/unit	General operating budget	Municipal DPW, ECCD, DEEP. NECCOG
2. Good housekeeping practices to reduce the stormwater runoff from impervious surfaces. • installation of rain gardens and vegetated swales to catch and infiltrate runoff • use of rain barrels, rain planter boxes or drywells to capture and store roof runoff • reduction of impervious surfaces through the installation of pervious paving materials, green roofs, or the elimination of unneeded paved surfaces	Watershed management team, property owners	2018 – ongoing thereafter	Adoption of Good Housekeeping practices	Rain barrels - $125-$200 ea. Rain Planters: $85 - !50 ea. Rain Gardens: $15-$20/sf	General operating budget, Community foundation grants, corporate grants CWA §319 grants	CT NEMO, CLEAR, ECCD, DEEP, USEPA
3. Good Housekeeping practices to reduce amounts of herbicides, pesticides and fertilizers. • Compost plant material and use compost as an alternative to chemical fertilizers • place lawn and landscape waste away from waterbodies • test soils to determine soil nutrient levels and needs, • utilize proper fertilizer application rates and timing • utilize integrated pest management (IPM) as an alternative to pesticides.	Watershed management team, property owners	2018 – ongoing thereafter	Adoption of Good Housekeeping practices	Soil tests $12 - $20 ea.	General operating budget	NOFA, UConn Extension, ECCD, DEEP

8.7.4. Strategy 8-4. Promote Residential Good Housekeeping practices.

Landowners can exert considerable influence on NPS loading through their choices of land management practices and behaviors. The adoption of practices that reduce the amount of stormwater runoff from their properties can reduce NPS significantly. Although sustainable lawn and land care practices will not significantly reduce bacteria loadings, they will reduce nutrient loadings, the use of toxic chemicals, and promote water conservation. These practices include:

- installation of rain gardens and vegetated swales to catch and infiltrate runoff,
- use of rain barrels, rain planter boxes or drywells to capture and store roof runoff for non-potable uses, and
- reduction and/or disconnection of impervious surfaces from draining to waterbodies through the installation of pervious paving materials, disconnecting roof downspouts from piped drainage systems to allow discharge onto permeable ground areas away from building foundations, or elimination of unneeded paved surfaces.

Property owners can improve water quality by reducing the amounts of chemicals, including herbicides, pesticides and fertilizers, they put on lawns and gardens by:

- composting and careful utilization of compost as an alternative to chemical fertilizers,
- testing soils to determine soil nutrient levels and needs,
- utilizing proper fertilizer application rates and timing,
- utilizing alternative landscaping methods that reduces maintenance needs, and
- utilizing integrated pest management (IPM) as an alternative to the application of herbicides and pesticides.

Property owners can also reduce the amount of NPS generated by general household activities by adopting water-friendly practices such as:

- use of non-phosphate dish and laundry detergents,
- use of septic system-friendly cleaning chemicals,
- awareness of what is safe to put down the drain
- washing of cars on the lawn or using a commercial car wash, and
- regular maintenance and inspections of septic systems.

Table 8-11. Objective 7 – Promote Residential Good Housekeeping practices.

BMP Implementation Strategies/ Interim Milestones	Responsible Entities	Schedule	Deliverable/ Evaluation Criteria	Cost Estimate	Potential Funding Source	Technical Assistance
1 Good housekeeping practices to reduce the stormwater runoff from impervious surfaces. • installation of rain gardens and vegetated swales to catch and infiltrate runoff • use of rain barrels, rain planter boxes or drywells to capture and store roof runoff • reduction of impervious surfaces through the installation of pervious paving materials, green roofs, or the elimination of unneeded paved surfaces	Watershed management team, property owners	2018 - ongoing thereafter	Adoption of Good Housekeeping practices	Rain barrels - $125-$200 ea. Rain Planters: $85 - !50 ea. Rain Gardens: $15-$20/sf	Household budgets, Community foundation grants, corporate grants CWA §319 grants	CT NEMO, CLEAR, ECCD, DEEP, USEPA
2. Good Housekeeping practices to reduce amounts of herbicides, pesticides and fertilizers. • Compost plant material and use compost as an alternative to chemical fertilizers • place lawn and landscape waste away from waterbodies • test soils to determine soil nutrient levels and needs, • utilize proper fertilizer application rates and timing • utilize integrated pest management (IPM) as an alternative to pesticides	Watershed management team, property owners	2018 - ongoing thereafter	Adoption of Good Housekeeping practices	Soil tests $12 - $20 ea.	Household budget	NOFA, UConn Extension, ECCD, DEEP, home and garden centers
3. General household Good Housekeeping practices. • use of non-phosphate dish and laundry detergents • use of septic system-friendly cleaning chemicals • awareness of what is safe to put down the drain • washing of cars on the lawn or using a commercial car wash • regular maintenance and inspections of septic systems	Watershed management team, property owners	2018 - ongoing thereafter	Adoption of Good Housekeeping practices	Septic tank pumping - $300 - $500	Household budget	UConn Extension, ECCD, DEEP, USEPA

8.8. Site-Specific Watershed Management Recommendations

The following section provides site-specific watershed management recommendations based on conditions identified by ECCD and watershed stakeholders. These conditions, which could contribute to water quality degradation, were identified via a variety of sources, including recommendations in the 2012 French River-Long Branch Brook Bacteria TMDL, analysis of the 2015 water quality data, stakeholder feedback, and conditions documented during the 2017 windshield survey. The sites were selected based on their proximities to nearby waterways, property ownership and potential for positive water quality impacts.

This section does not include every site in the French River watershed where water quality improvement practices could be implemented. Rather, a variety of sites and practices were selected to provide examples of water quality improvement projects that could be conducted not only at these sites, but also at other sites throughout the watershed. As such, this list should not be considered to preclude the identification of other sites in the French River watershed where water quality improvement practices could be implemented. Recommended BMPs range from simple practices that could be adopted by homeowners, such as rain gardens, vegetated swales and rain barrels, to more complex practices requiring engineered site design, and professional installation and maintenance. Watershed managers are advised that additional site investigation should be conducted to identify site conditions that might preclude installation of the recommended BMPs.

The location, description, cost estimate and estimated pollutant load reduction are provided for each recommended BMP. Pollutant load reductions were calculated using the Future Practices tool in the WTM, based on the existing land cover/land use conditions in the sub-watersheds in which the BMPs are proposed.   Site-specific BMP locations are depicted in Fig. 8-1.

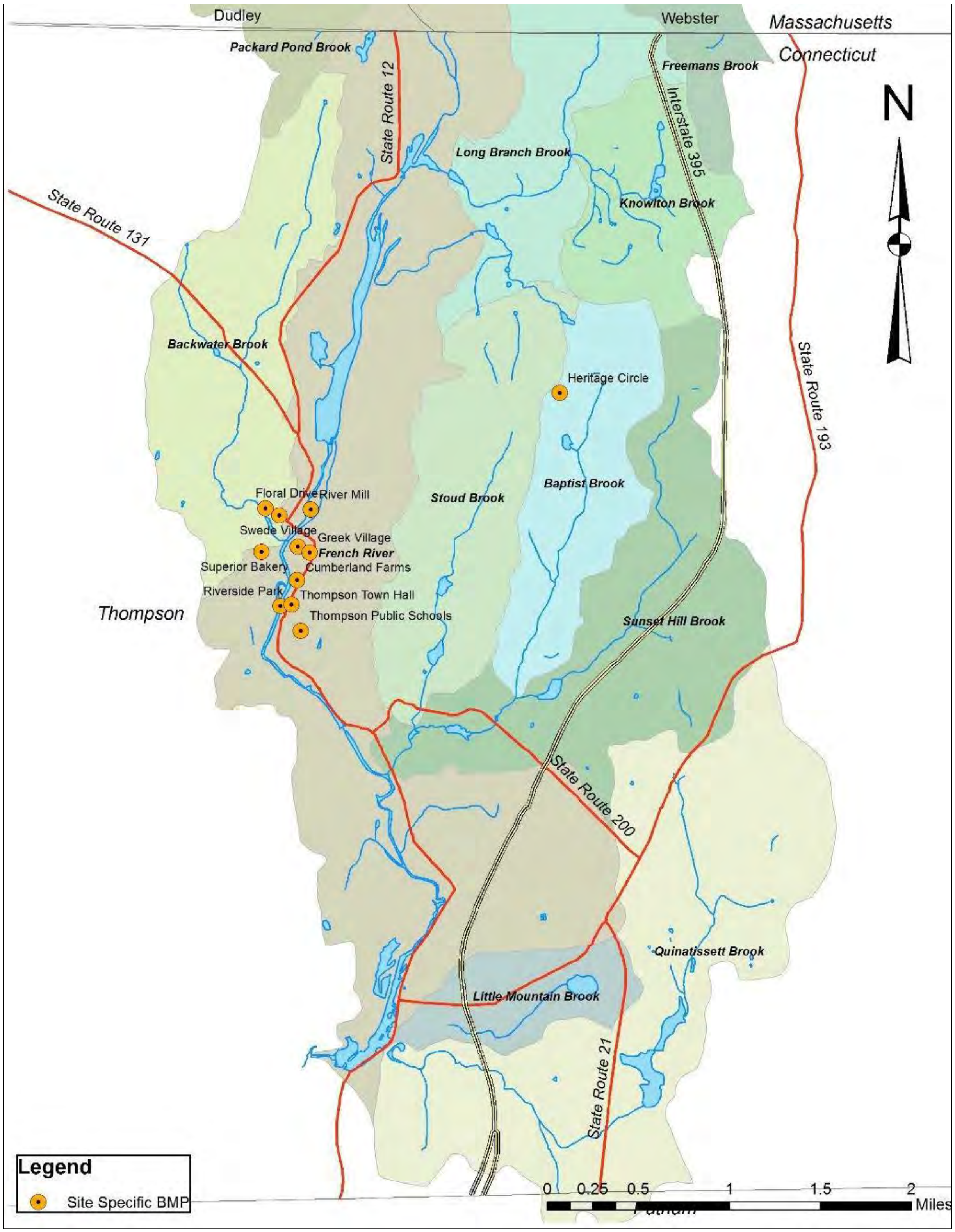


Figure 8-1. Location of proposed site-specific best management practices.

8.8.1. Heritage Circle

Heritage Circle is a 1000-ft long residential cul de sac off Stawicki Road in the Baptist Brook sub-watershed (Fig. 8.2). Baptist Brook is a Class A headwater stream which supplies water to the Connecticut Water public drinking water supply aquifer. Stormwater management recommendations at this site focus on water quality protection of this high-quality headwater stream.

Figure 8-2. Stormwater runoff from the Heritage Circle residential neighborhood is discharged near Baptist Brook, a Class A headwater stream that is part of the Thompson public drinking water supply watershed (Image USDA, 2012).

This subdivision consists of nine residential house lots, and one open space lot owned by the Town of Thompson. Currently four of the lots have been developed. Pollutants originating from residential development include sediment, vehicle chemicals, lawn and garden chemicals including fertilizer, pesticides and herbicides, and fecal bacteria from pet waste. Stormwater management recommendations at Heritage Circle include the installation of LID practices such as rain barrels and rain gardens at the residential properties to "disconnect" those properties from the storm drain system (Fig. 8.3 and 8.4). and the installation of stormwater tree filters upgrade of existing catch basins along the municipal road to intercept and treat stormwater runoff from the road, driveways and lawn areas (Fig. 8.5).

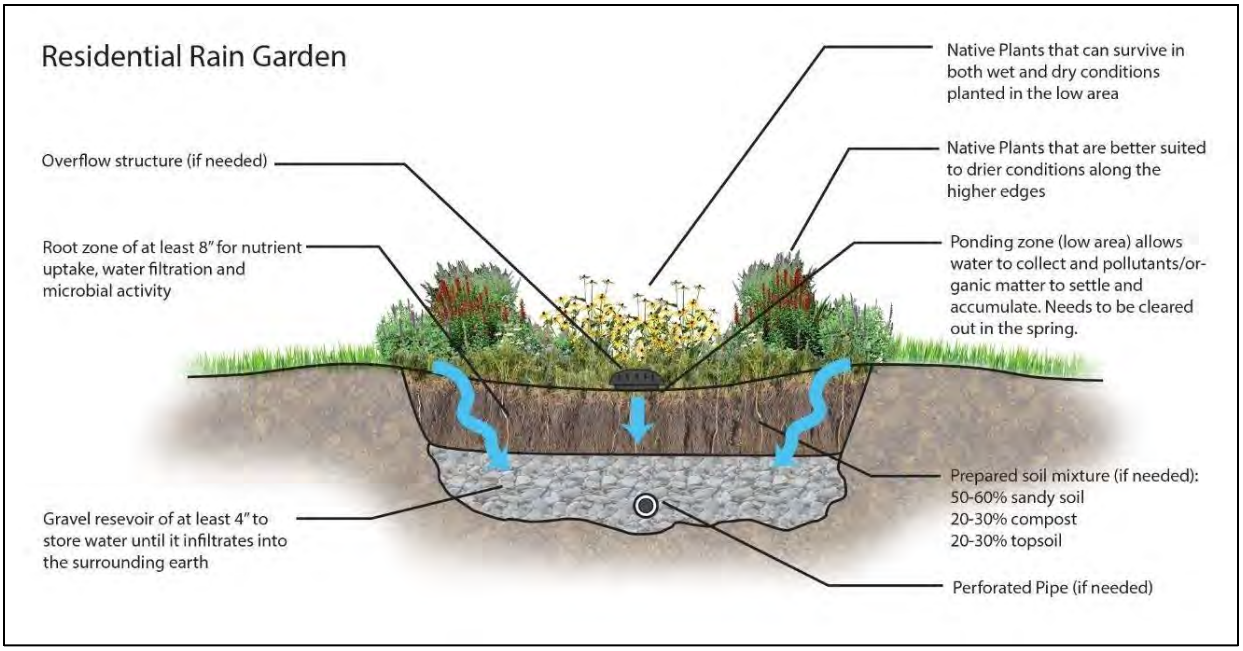


Figure 8-5. Diagram of a residential rain garden diagram (Source: www.holemanlandscape.com).

Figure 8-4. Example of a residential rain barrel.

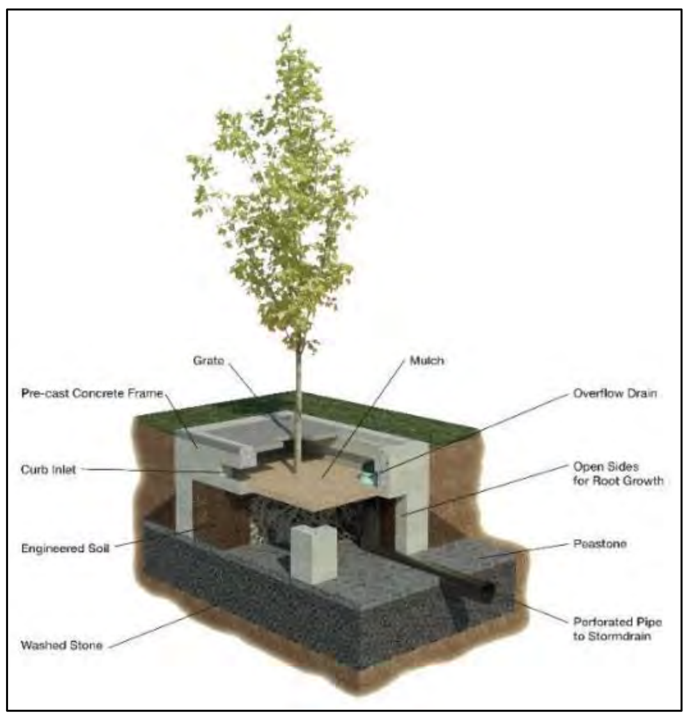


Figure 8-3. Schematic of a stormwater tree filter.

Figure 8-6. The red rectangles depict potential locations of tree filters on Heritage Circle.

Table 8-12. Recommended BMPs for Heritage Circle

Best Management Practice	Location	Sensitive Area	Estimated BMP Cost	Estimated Load Reduction
Stormwater Tree Filters (up to 8)	Heritage Circle ROW	Yes	$12,000/ unit [1]	TN = 15 lb/yr TP = 2 lb/yr TSS = 281 lb/yr FC = 228 billion/yr
Residential Rain Gardens (up to 9)	Heritage Circle private residences	Yes	Up to $500/unit [2] ($5/sq ft)	TN = 11 lb/yr TP = 1 lb/yr TSS = 27 lb/yr FC = 23 billion/yr
Rain Barrels (up to 9)	Heritage Circle private residences	Yes	$100/unit[3]	TN = 11 lb/yr TP = 1 lb/yr TSS = 31 lb/yr FC = 25 billion/yr

Sources:
[1] ECCD project costs
[2] ECCD project costs
[3] ECCD project costs

8.8.2. North Grosvenordale Mill

North Grosvenordale Mill is located on Riverside Drive (State Route 12), adjacent to the French River in North Grosvenordale (Fig. 8.7), in Thompson's MS4 area. Approximately six of the parcel's 9.4 acres consist of impervious cover (roughly 65%), such as River Street (a private thoroughfare owned by the mill), and driveways, parking lots, sidewalks and roof areas associated with the mill structure and grounds. Stormwater runoff from the site discharges directly to the French River. This site is regulated under Resource Conservation and Recovery Act (RCRA); a Phase 1 environmental site assessment was completed in 2016. The potential presence of contaminants should be taken into consideration by any agency or organization considering installing infiltration practices on the site.

Figure 8-7. The North Grosvenordale Mill complex on Route 12 in North Grosvenordale (Google Earth imagery date 5/6/15).

Pollutants associated with this industrial site include sediment, vehicle chemicals, industrial chemicals and stockpiled materials, dog waste (from dog walkers), and trash. Proposed stormwater management practices include:

- the installation of tree filters upgrade of catch basins on River Street;
- the removal and replacement of unnecessary paved surfaces with grass or naturalized plantings;
- the reconfiguration of parking lots to maximize parking space and incorporate LID practices (Fig. 8-8);
- the installation of pervious pavers, grids or similar systems in parking lots and at the road shoulders alongside River Street (Fig. 8-9); and
- the installation of grass swales and rain gardens where soil conditions allow to infiltrate stormwater into the ground.

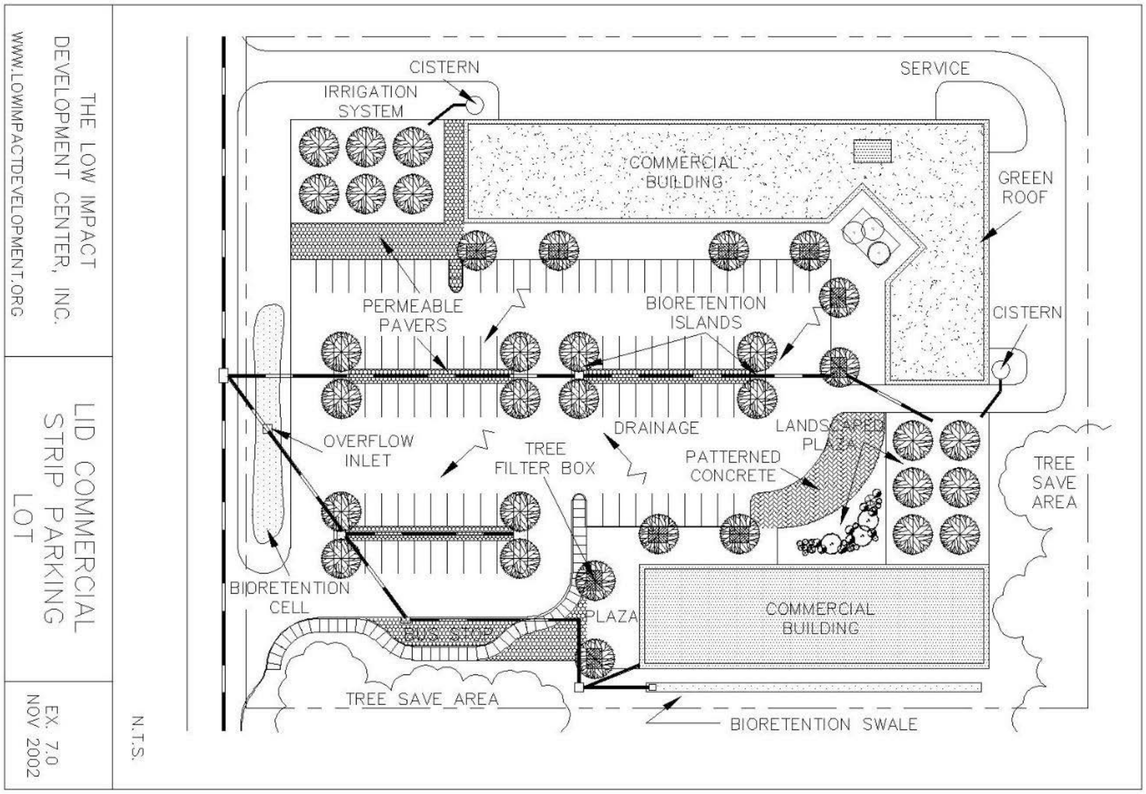


Figure 8-8. This design example from the Low Impact Development (LID) Urban Design Tools Website depicts how LID practices can be incorporated into a commercial parking lot.

Figure 8-9. Example of a roadway with pervious paver shoulders (from LID Appendix to CT Stormwater Quality Manual, 2011).

Table 8-13. Recommended BMPs for North Grosvenordale Mill.

Best Management Practice	Location	Sensitive Area	Estimated BMP Cost	Estimated Load Reduction
Stormwater Tree Filters (up to 6)	River Street	Yes	$12,000/ unit [1]	TN = 7 lb/yr TP = 1 lb/yr TSS = 328 lb/yr FC = 294 billion/yr
Grass swales/rain gardens (2 each)	Parking lots on River Street side of mill	Yes	Up to $500/unit [2]	TN = <1 lb/yr TP = <1 lb/yr TSS = 5 lb/yr FC = 5 billion/yr
Pervious pavers/Grid pavers (±1 acre)	Dirt parking lots, River Street	Yes	Pervious Asphalt/ concrete: 50¢ - $5.75/sf Grid pavers: $1.50 – $6.50/sf Range: $21,780 - $283,000[3]	TN = 5 lb/yr TP = 1 lb/yr TSS = 230 lb/yr FC = 190 billion/yr
Remove unneeded paved areas; replace with vegetation (±1 acre)	Throughout complex	Yes	Asphalt removal: $1/sf - $43,500[4] Soil/grass seed/ vegetation: $9000	TN = <1 lb/yr TP = <1 lb/yr TSS = 5 lb/yr FC = 4 billion/yr

Sources:
[1] ECCD project costs
[2] ECCD project costs
[3] Low Impact Development (LID) Urban Design Tools Website (www.lid-stormwater.net/permpaver_costs.htm)
[4] Average of costs obtained through internet search.

8.8.3. Swede Village

Swede Village is a residential neighborhood on Floral Avenue and Holmes Street in North Grosvenordale, in Thompson's MS4 area, and is comprised primarily of multi-family former mill housing dating to the 1880s (Fig. 8-10). The site is located in the Backwater Brook sub-watershed. Stormwater discharges to Backwater Brook via overland flow from the northern half of Floral Avenue and from the southern half of Floral Avenue and Holmes Street through the existing storm drain system. Backwater Brook was one of two streams identified by ECCD as having periodic high levels of fecal coliform bacteria. Swede Village is typical of former mill housing clusters located throughout North Grosvenordale. Stormwater management recommendations here can be implemented in similar neighborhoods throughout the community.

Figure 8-10. Swede Village, located on Holmes Street and Floral Avenue, is typical of late 18th century former mill housing found throughout the mill village of North Grosvenordale (Google Earth imagery dated 4/7/13).

Pollutants associated with this residential neighborhood include sediment, contaminants associated with vehicle use and maintenance, lawn and yard care chemicals such as fertilizers, herbicides and pesticides, pet waste and trash. Stormwater management recommendations at Swede Village focus on the use of LID practices to disconnect impervious areas.
Suggested LID practices include:

- the installation of rain gardens and rain barrels at the residential properties to “disconnect” those properties from the storm drain system;
- the use of grass or vegetated swales to intercept and infiltrate surface flow to Duhamel Pond; and
- the installation of pervious pavers in driveways (Fig. 8-11). The Town of Sprague, CT has installed pervious pavers on roadways in the mill village of Baltic with good success. The Town of Thompson may consider replacing the paved surfaces of Floral Avenue and Holmes Street with pervious pavers in order to reduce impervious cover in this neighborhood.

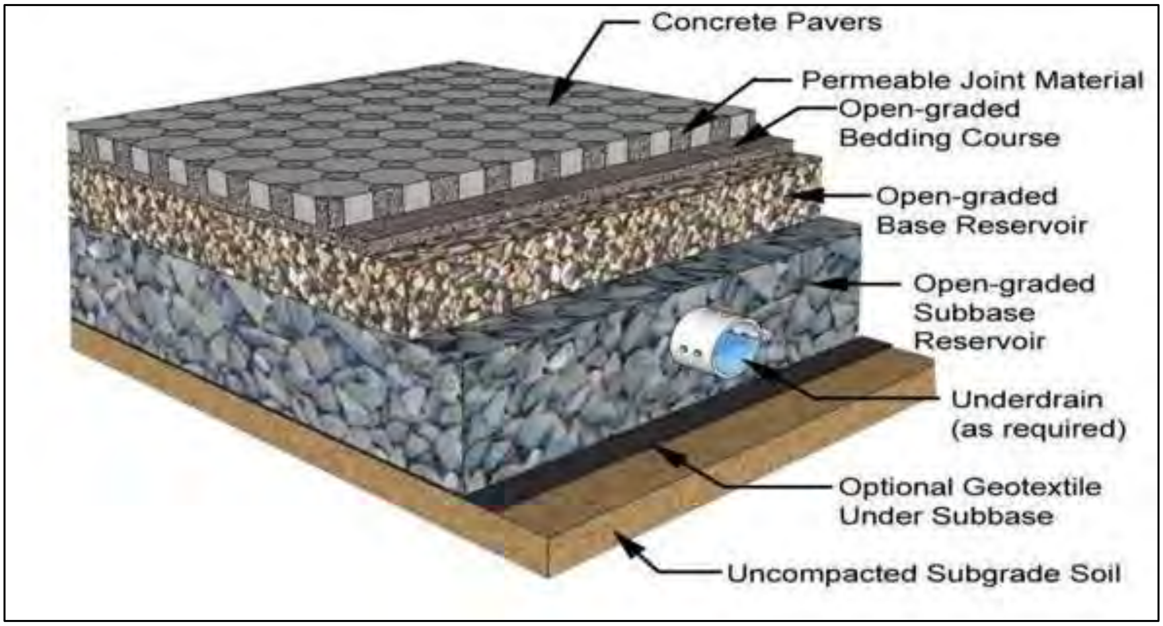


Figure 8-11. Permeable pavers (from Virginia DEQ Stormwater Design Specification No. 7).

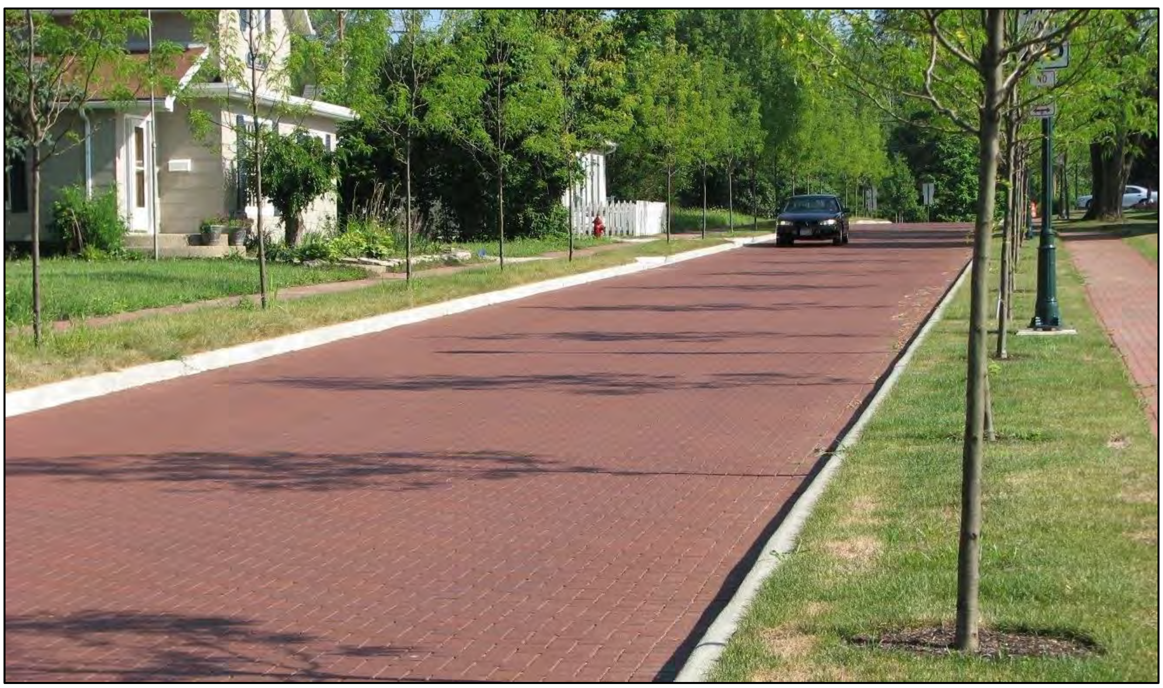


Figure 8-12. A residential pervious paver road (Image from Pine Hall Brick Company, Inc. www.pinehallbrick.com).

Table 8-14. Recommended BMPs for Swede Village neighborhood.

Best Management Practice	Location	Sensitive Area	Estimated BMP Cost	Estimated Load Reduction
Rain gardens (20)	Floral Avenue and Holmes Street	Yes	Up to $500/ unit [1]	TN = 2 lb/yr TP = <1 lb/yr TSS = 106 lb/yr FC = 100 billion/yr
Grass swales (300 ft)	Between houses on Floral Avenue and Duhamel Pond	Yes	$4.50 - $8.50/LF [2] Range: $1,350 - $2,550	TN = 3 lb/yr TP = 1 lb/yr TSS = 197 lb/yr FC = 175 billion/yr
Pervious pavement or Pervious pavers/Grid pavers (22 @ 400 sf each)	Residential driveways	Yes	Pervious concrete pavers: 50¢ - $5.75/sf Grid pavers: $1.50 – $6.50/sf Range: $200 - $2,600 per driveway[3]	TN = 4 lb/yr TP = 1 lb/yr TSS = 150 lb/yr FC = 136 billion/yr
Pervious pavers	Floral Avenue (8700 sf) and Holmes Street (20,150 sf)	Yes	$5 - $10/sf Range: $43,500 - $201,500[4]	TN = 5 lb/yr TP = 1 lb/yr TSS = 210 lb/yr FC = 186 billion/yr

Sources:
[1] ECCD project costs
[2] http://www.bfenvironmental.com/pdfs/veggieSwale.pdf
[3] Low Impact Development (LID) Urban Design Tools Website (www.lid-stormwater.net/permpaver_costs.htm)
[4] The Chicago Green Alley Handbook, CDOT (https://www.cityofchicago.org/city/en/depts/cdot/provdrs/street/svcs/green_alleys.html)

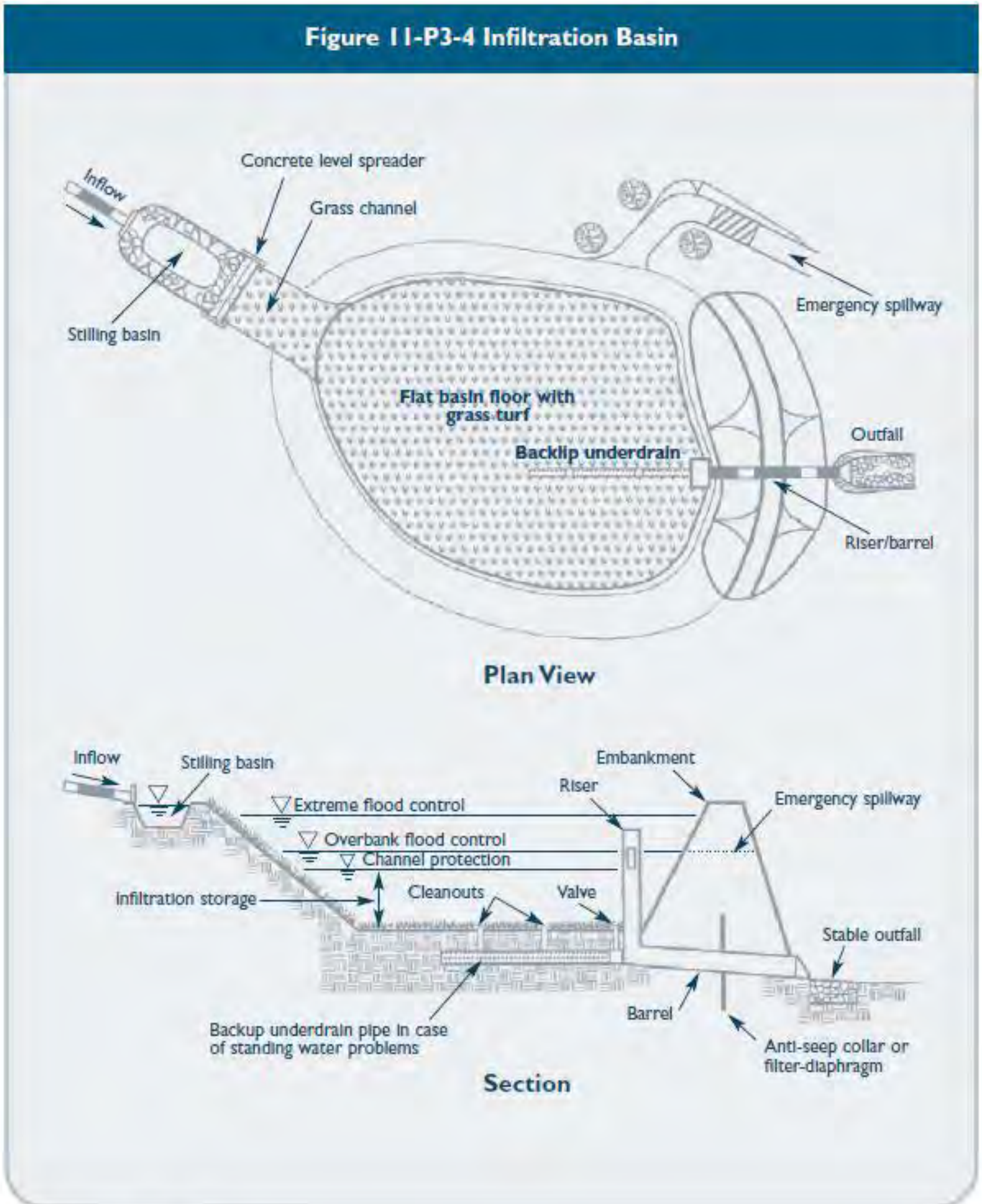
8.8.4. Superior Bakery

Superior Bakery is located on Main Street in North Grosvenordale in the French River local sub-watershed, in Thompson's MS4 area. The site is dominated by a dirt driveway and parking area, and is subject to a fairly substantial delivery truck traffic on a daily basis. Stormwater runoff from the site has caused erosion of the dirt parking lot and driveway (Fig. 8-13). Eroded sediment is transported into the storm drain system on Main Street where it discharges to Backwater Brook and is also tracked along the roadway by vehicle tires.

Pollutants associated with this site include sediment and vehicle chemicals. The proposed stormwater management practice at this site includes paving the driveway and parking lot and directing stormwater runoff from the parking lot to an infiltration basin in the lawn area behind the house (Figs. 8-14 and 8-15).

Figure 8-13. Erosion gullies formed by stormwater runoff in the Superior Bakery driveway.

Figure 8-14. Aerial view of the Superior Bakery property on Main Street in North Grosvenordale, CT. Stormwater flow paths can be seen in the dirt parking lot and driveway (Google Earth imagery date 5/6/15).



Source: Wisconsin DNR, 2000.

Figure 8-15. Infiltration basin detail from the Connecticut Stormwater Quality Manual.

Table 8-15. Recommended BMPs for Superior Bakery.

Best Management Practice	Location	Sensitive Area	Estimated BMP Cost	Estimated Load Reduction
Pave parking lot and driveway (±1 acre)	Superior Bakery parking lot	Yes	\$3 - \$5/sf [1] Range: \$130,700 - \$217,800	N/A
Infiltration basin (±3100 cu ft)	Superior Bakery parking lot	Yes	\$2 - \$5/cu ft treated [2] Range: \$6,000 - \$15,500	TN = 7 lb/yr TP = 1 lb/yr TSS = 321 lb/yr FC = 303 billion/yr

Sources:
[1] Average of costs obtained through internet search.
[2] Connecticut Stormwater Quality Manual (DEEP, 2004)

8.8.5. River Mill Village

The River Mill Village (locally known as Three Rows) is located in North Grosvenordale adjacent to the French River, in the French River local sub-watershed. The neighborhood consists of twenty-five multi-family houses situated on two parallel roads, Marshall Street and Central Street, occupying approximately 7 acres of land in Thompson's MS4 area (Fig. 8-16). Stormwater runoff from the River Mill Village discharges via the municipal storm drainage system to the French River.

Pollutants associated with this residential neighborhood include sediment; contaminants associated with vehicle use and maintenance; lawn and yard care chemicals such as fertilizers, herbicides and pesticides; pet waste; and trash.

Like Swede Village, the River Mill Village offers the opportunity to utilize a variety of LID practices to manage and treat stormwater runoff and disconnect impervious areas from the storm drain system. Suggested LID practices include stormwater tree filters along Marshall and Central Streets (Fig. 8-17), rain gardens and rain barrels at the residential properties, and pervious pavers and/or grids in driveways, parking lots and roadways (Fig. 8-18).

Figure 8-16. Aerial image of the River Mill Village (Google Earth imagery dated 10/10/16).

Figure 8-17. The 2017 removal of street trees has created the opportunity for the installation of tree filters along Central Street in the River Mill Village.

Table 8-16. Recommended BMPs for the River Mill Village.

Best Management Practice	Location	Sensitive Area	Estimated BMP Cost	Estimated Load Reduction
Rain gardens (up to 44)	22 residences on Marshall and Central Streets	Yes	Up to $500/unit [1]	TN = 3 lb/yr TP = <1 lb/yr TSS = 115 lb/yr FC = 106 billion/yr
Rain barrels (up to 44)	22 residences on Marshall and Central Streets	Yes	Up to $100/unit [2]	TN = <1 lb/yr TP = <1 lb/yr TSS = 12 lb/yr FC = 11 billion/yr
Pervious pavers/Grid pavers (±500 sf each)	Residential driveways	Yes	Pervious Asphalt/ concrete pavers: 50¢ - $5.75/sf Grid pavers: $1.50 – $6.50/sf Range: $250 - $3,250 per driveway	TN = 2 lb/yr TP = <1 lb/yr TSS = 85 lb/yr FC = 70 billion/yr
Pervious pavers (±60,000 sf)	Municipal right-of-way - Marshall and Central Streets	Yes	$5 - $10/sf Range: $300,000 - $600,000[4]	TN = 7 lb/yr TP = 1 lb/yr TSS = 323 lb/yr FC = 266 billion/yr
Stormwater Tree Filters (up to 14)	Municipal right-of-way - Marshall and Central Streets	Yes	$12,000 per unit [5]	TN = 8 lb/yr TP = 1 lb/yr TSS = 383 lb/yr FC = 344 billion/yr

Sources:
[1] ECCD project costs
[2] http://www.bfenvironmental.com/pdfs/veggieSwale.pdf
[3] Low Impact Development (LID) Urban Design Tools Website (www.lid-stormwater.net/permpaver_costs.htm)
[4] The Chicago Green Alley Handbook, CDOT (https://www.cityofchicago.org/city/en/depts/cdot/provdrs/street/svcs/green_alleys.html)
[5] ECCD project costs

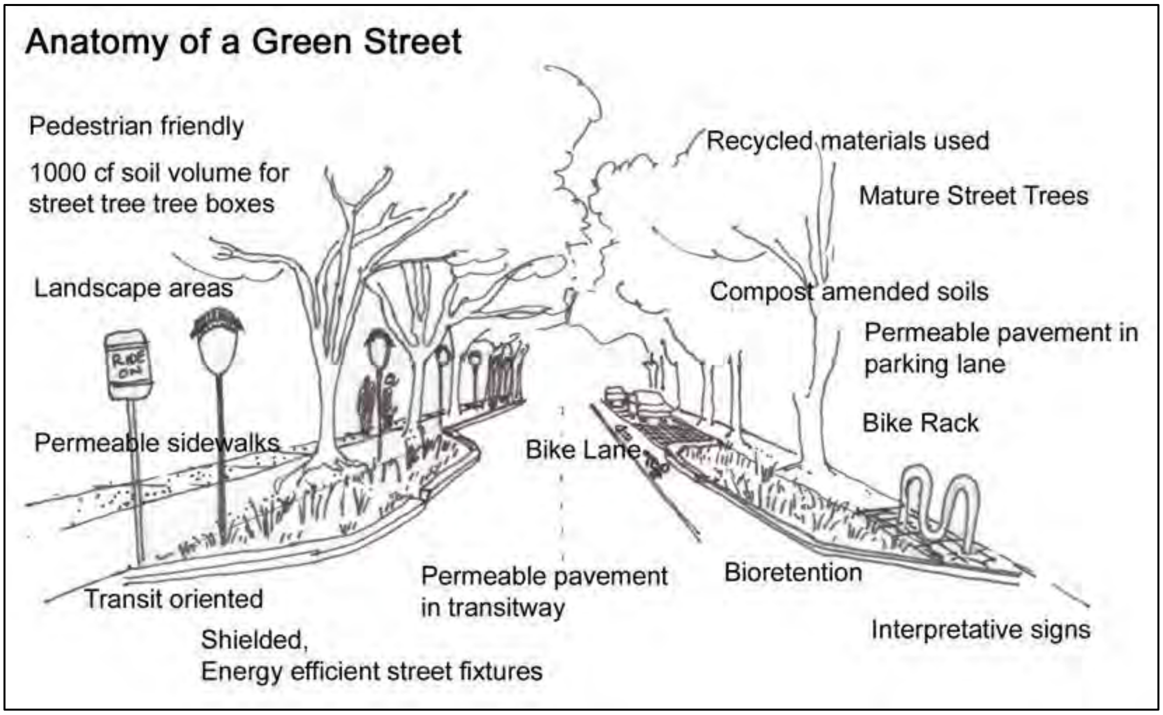


Figure 8-18. Green street design concepts that could be applied to the River Mill Village (from www.lowimpactdevelopment.org).

8.8.6. Greek Village

Greek Village, like the River Mill Village and Swede Village, was built in the late 1800s to house North Grosvenordale Mill workers. The former mill housing cluster consists of four multi-family structures on approximately 2 acres located on Market Street and Market Lane, off Riverside Drive in the MS4 area of North Grosvenordale (Figs. 8-19 and 8-20).

Stormwater from Greek Village, which is located in the French River local sub-watershed, discharges via overland flow to three leak-offs that discharge onto the Providence-Worcester Railroad (P&WRR) right-of-way (Fig. 8-19). Run-off is conveyed through culverts under the railroad bed to catchbasins that connect to the River Mill Village storm drain system (Fig. 8-21).

The use of the open spaces between the buildings for tenant parking has killed much of the grass, compacted the soil and created large areas of bare soil. Roof runoff from many of the buildings discharges from the building gutter/downspout systems onto bare soil or pavement, contributing to stormwater runoff volumes and pollutant transport. Pollutants associated with this residential neighborhood include sediment, contaminants associated with vehicle use and maintenance, pet waste and trash.

Recommended management practices at Greek Village include the installation of LID practices to capture and infiltrate stormwater runoff and disconnect impervious areas from the storm drain system. Suggested practices include the installation of a grass or vegetated swale between Market Street and the railroad ROW in infiltrate storm water (Fig. 8-22), the reconfiguration of parking to allow for the re-establishment of grassed areas, the installation of pervious pavers and/or grids in driveways, parking areas and roadways, and conversion of two traffic islands at the south end of the property (the left side in Fig. 8-18 below) to infiltration basins or rain gardens.

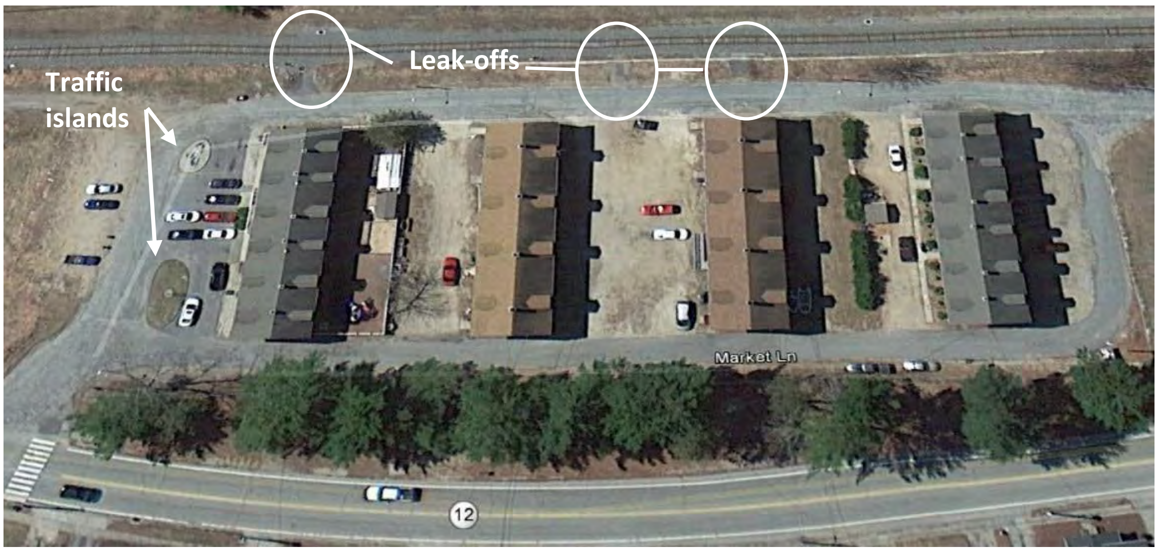


Figure 8-19. Aerial image of Greek Village, located off RT 12 in North Grosvenordale (Google Earth imagery dated 4/7/13). The leak-offs from Market Street onto the P&WRR ROW are delineated by the white circles.

Figure 8-20. Market Street in Greek Village. The Providence-Worcester Railroad is located immediately to the left of the roadway. The River Mill Village (the white structure in the upper left corner of the image) is located on the far side of the rail road tracks and the spires of the North Grosvenordale Mill can be seen in the distance.

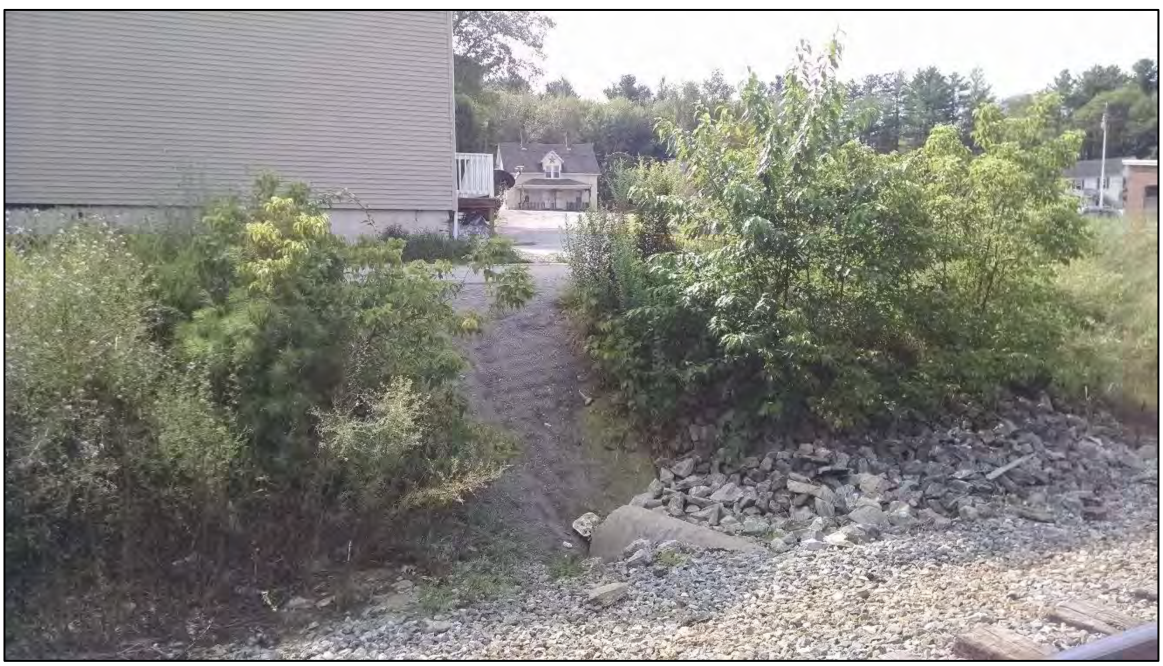


Figure 8-21. One of three leak-offs from Market Street onto the P&WRR ROW.

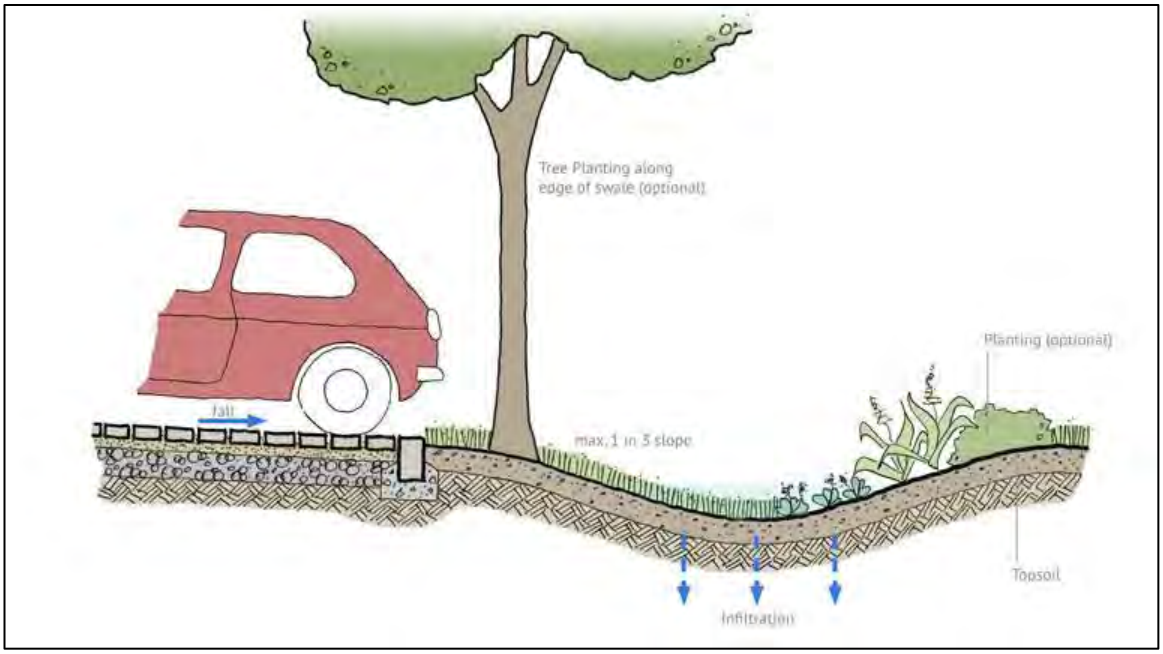


Figure 8-22. Diagram of a vegetated infiltration swale (graphic www.susdrain.org).

Table 8-17. Recommended BMPs for Greek Village.

Best Management Practice	**Location**	**Sensitive Area**	**Estimated BMP Cost**	**Estimated Load Reduction**
Rain gardens (2)	7 Market Lane	Yes	Up to $500/unit [1]	TN = 1 lb/yr TP = <1 lb/yr TSS = 36 lb/yr FC = 34 billion/yr
Vegetated Swale (475 ft)	Market Street	Yes	$4.50 - $8.50/LF [2] Range: $2,150 - $4,050	TN = 1 lb/yr TP = <1 lb/yr TSS = 39 lb/yr FC = 28 billion/yr
Pervious pavers/Grid pavers (±2700 sf each)	Residential driveways	Yes	Pervious Asphalt/ concrete pavers: 50¢ - $5.75/sf Grid pavers: $1.50 – $6.50/sf Range: $1,350 - $17,550 per driveway[3]	TN = 1 lb/yr TP = <1 lb/yr TSS = 60 lb/yr FC = 49 billion/yr
Pervious pavers (±26,000 sf)	Municipal right-of-way – Market Street and Market Lane	Yes	$5 - $10/sf Range: $130,000 - $260,000[4]	TN = 3 lb/yr TP = 1 lb/yr TSS = 133 lb/yr FC = 109 billion/yr

Sources:
[1] ECCD project costs
[2] http://www.bfenvironmental.com/pdfs/veggieSwale.pdf
[3] Low Impact Development (LID) Urban Design Tools Website (www.lid-stormwater.net/permpaver_costs.htm)
[4] The Chicago Green Alley Handbook, CDOT (https://www.cityofchicago.org/city/en/depts/cdot/provdrs/street/svcs/green_alleys.html)

8.8.7. Cumberland Farms

Stormwater from Route 12 and Cumberland Farms (located on Route 12, aka Riverside Drive) in the MS4 area of North Grosvenordale discharges to the French River via a swale that flows under the Providence & Worcester Railroad right-of-way and through Riverside Park (Fig. 8-23). Stormwater from the gas station and Route 12 contains a variety of NPS contaminants including sediment, trash, vehicle chemicals, heavy metals, pet waste, and chemicals associated yard care, including fertilizer, herbicides and pesticides. Because this site receives stormwater from both a commercial facility and the state highway, it may have additional stormwater management requirements specific to the General Permit for the Discharge of Stormwater Associated with Commercial Activity and the General Permit for the Discharge of Stormwater from the Department of Transportation Separate Storm Sewers Systems.

Stormwater management recommendation at this site include the installation of a bio-retention basin to treat stormwater prior to its discharge to the French River.

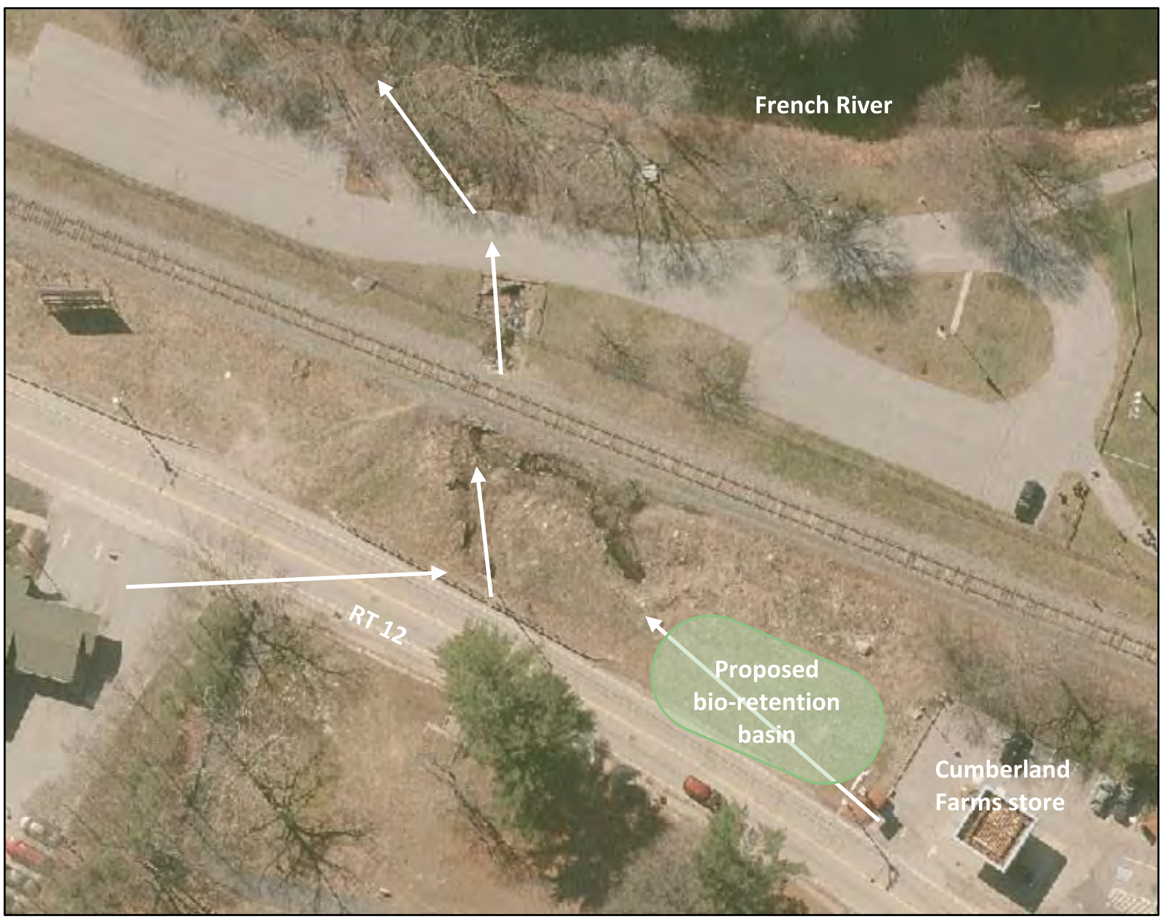


Figure 8-23. Stormwater discharge from the vicinity of Cumberland Farms store on Route 12 in North Grosvenordale discharges to the French River at Riverside Park (imagery CT Eco, 2016).

Table 8-18. Recommended BMP for Cumberland Farms property.

Best Management Practice	Location	Sensitive Area	Estimated BMP Cost	Estimated Load Reduction
Infiltration basin (±1,000 cu ft)	Cumberland Farms Store, RT 12	Yes	\$2 - \$5/cu ft treated [1] Range: \$2,000 - \$5,000	TN = 1 lb/yr TP = <1 lb/yr TSS = 41 lb/yr FC = 36 billion/yr

Sources:
[1] Connecticut Stormwater Quality Manual (DEEP, 2004)

8.8.8. Thompson Town Hall

The Thompson Town Hall is located on Riverside Drive (RT 12) in North Grosvenordale, in the MS4 area. Stormwater from three parking areas and the building roof (a 1-acre area) discharge to the French River via the municipal storm drain system. Pollutants associated with stormwater runoff from the town hall include sediment, automotive chemicals and heavy metals.

Stormwater management recommendations at the town hall include the installation of a green roof on two sections of flat roof area at the rear of the Town Hall and the re-grading of both the upper parking lot (the lot to the rear of the town hall) and the north parking lot (to the left of the town hall on Figs. 8-24 and 8-25) to drain toward the rear of the parcel. A vegetated swale is proposed at the rear of the upper lot to collect and convey stormwater to a bio-retention basin at the rear of the north parking lot.

Figure 8-24. Green roof at Chicago City Hall (photo by Roofscapes, Inc.).

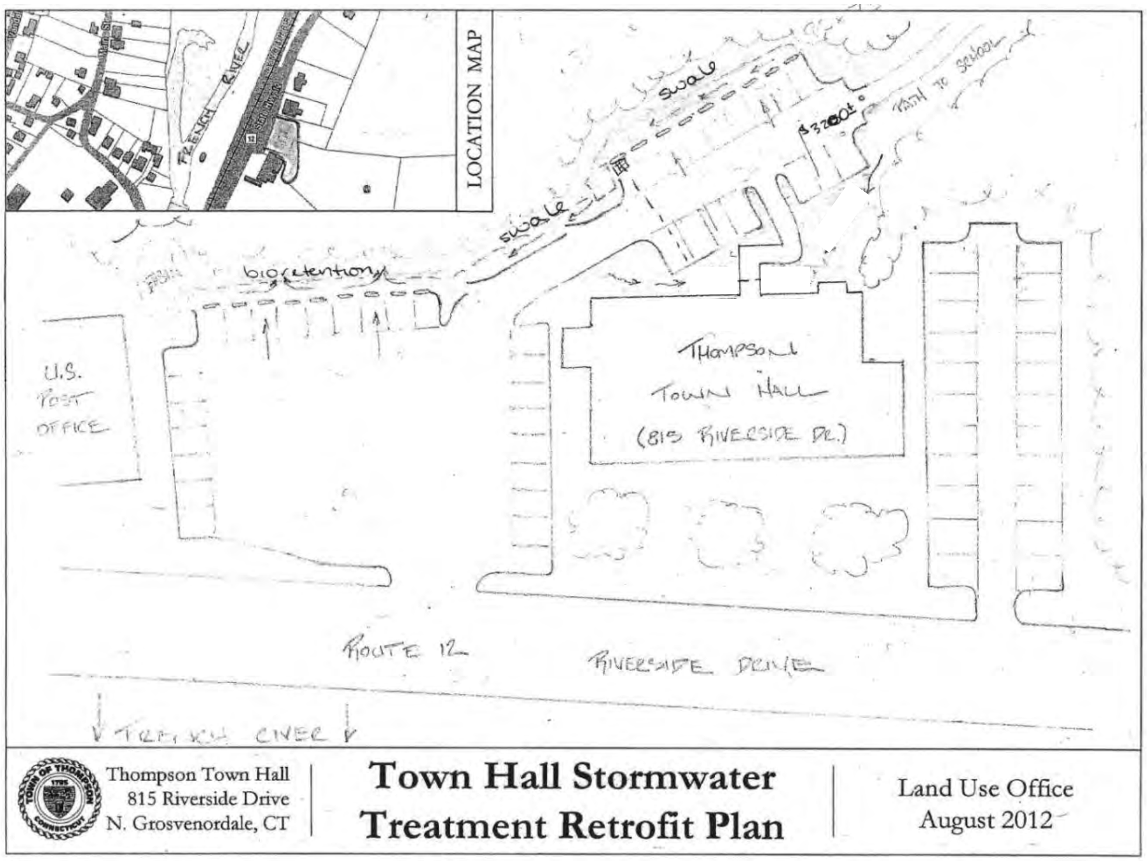


Figure 8-25. Stormwater retrofit for the Thompson Town Hall parking areas.

Figure 8-26. Locations of proposed BMPs at the Thompson Town Hall (Google Earth imagery dated 4/7/13).

Table 8-19. Recommended BMPs at the Thompson Town Hall

Best Management Practice	Location	Sensitive Area	Estimated BMP Cost	Estimated Load Reduction
Green Roofs (±3,850 sf)	Town Hall - first floor roofs at the rear of the building	Yes	$15 - $20/sf Range: $57,750 - $77,000	TN = <1 lb/yr TP = <1 lb/yr TSS = 4 lb/yr FC = 4 billion/yr
Vegetated Swale (±225 ft)	Town Hall – upper parking lot	Yes	$4.50 - $8.50/LF [2] Range: $1,000 - $2,000	TN = <1 lb/yr TP = <1 lb/yr TSS = 9 lb/yr FC = 6 billion/yr
Infiltration basin (±4,700 cu ft)	Town Hall – north parking lot	Yes	$2 - $5/cu ft treated [3] Range: $9,400 - $23,500	TN = 1 lb/yr TP = <1 lb/yr TSS = 35 lb/yr FC = 31 billion/yr

Sources:
[1] Low Impact Development (LID) Urban Design Tools Website **(**www.lid-stormwater.net/greenroofs_cost.htm)
[2] http://www.bfenvironmental.com/pdfs/veggieSwale.pdf
[3] Connecticut Stormwater Quality Manual (DEEP, 2004)

8.8.9. Riverside Park

Riverside Park is located along the French River in North Grosvenordale in the French River local sub-watershed (Fig. 8-23). The park extends from the Main Street bridge north to the River Mill Village and the foot bridge to the Thompson Public Library, in the North Grosvenordale MS4 area. Stormwater runoff from pavement, lawn areas and a baseball field at the 19-acre municipal park flows over the ground surface to the French River. Stormwater contain a number of NPS contaminants including sediment, automotive chemicals and heavy metals, trash, and dog and water fowl waste.

A 2008 riparian buffer restoration project, funded by CT DEEP through the CWA §319 NPS grant program, and conducted by CT NRCS and the Town of Thompson, restored approximately 850 feet of riparian buffer along the French River in Riverside Park (Fig. 8-27). However, in the intervening years, the effectiveness of the restoration has been diminished by buffer plant mortality and the proliferation of invasive plant species along the river bank. Managing the invasive plants while protecting naturally-occurring and planted native plant species has been a challenge for the town highway department, which maintains the park. Additionally, conflicts have occasionally arisen between balancing public uses of the park, such as walking, fishing and aesthetic enjoyment of the river, with water quality protection and wildlife and aquatic habitat needs.

Recommendations at Riverside Park include:

- Plant additional riparian vegetation, including trees, along the remaining riparian area that was not included in the 2008 project (Fig. 8-28 - gazebo to Main Street bridge).
- Review the 2008 planting plan to determine what plants did not survive, identify causes of mortality, and replace plants that were lost.
- Train highway department staff to be able to identify and differentiate between native and invasive plants, and provide instruction regarding invasive plant management.
- Create a management plan for the riparian buffer, to include maintenance practices such as native plant locations and identification, mowing limits, annual streambank mowing schedule (to prevent unwanted woody/invasive plants), and a review of the plan with maintenance staff.

Figure 8-27. The French River riparian buffer in the summer of 2008 after completion of the buffer restoration project.

Figure 8-28. Lower portion of the French River riparian area in Riverside Park (Google Earth imagery dated 5/6/15). Additional riparian buffer restoration is proposed in the area depicted by the oval.

Table 8-20. Recommended BMPs at Riverside Park.

Best Management Practice	Location	Sensitive Area	Estimated BMP Cost	Estimated Load Reduction
Riparian buffer restoration (225 ft)	Riverside Park - Main St bridge to Lion's gazebo	Yes	\$5 - \$10/LF [1] Range: \$1,125 - \$2,250	TN = 587 lb/yr TP = 95 lb/yr TSS = 25,155 lb/yr FC = 22,456 billion/yr
Identify/replace previously planted vegetation	Riverside Park – Lion's gazebo to baseball field	Yes	\$15 - \$30/plant[2]	TN = 1,174 lb/yr TP = 190 lb/yr TSS = 50,311 lb/yr FC = 44, 912 billion/yr
Invasive plant removal	Riverside Park and Thompson Public Library	Yes	\$166 - \$234/acre[3]	N/A
Riparian buffer management plan	Riverside Park	Yes	\$2250 (consultant fee)	N/A
Staff training	N/A	N/A	\$2100 (consultant fee and staff time)	N/A

Sources:
[1] Based on 2008 project costs.
[2] Average wholesale costs for perennial plants and trees.
[3] Average of costs obtained through internet search.

8.8.10. Thompson Public Schools

The Thompson Public School complex is located on Riverside Drive in North Grosvenordale, in the French River local sub-watershed (Fig. 8-29). The school occupies approximately 76 acres in the North Grosvenordale MS4 area. Of that 76-acre area, approximately 42 acres are developed (buildings, sidewalks, driveways, parking lots, lawns and athletic fields) and about 16 acres of the developed area (roughly 38% of the site) are impervious surfaces (buildings and paved surfaces). Stormwater from the site discharges to the French River via the municipal storm drain system and contains sediment, automotive chemicals and heavy metals, lawn care chemicals and trash. Stormwater management practices installed in the early 2000s as part of an addition to the school were designed to manage stormwater volume from the expanded parking areas but do not offer significant water quality treatment.

During the windshield survey, a number of erosion issues related to stormwater runoff from the many impervious surfaces at the school complex were identified. Proposed management measures include practices to divert, capture and infiltrate runoff where practicable, and to utilize structural stormwater management practices where site limitations prevent the use of green infrastructure. Additionally, not only do all of these practices have the potential to be used by Thompson public school teachers as water quality teaching tools, but teachers are strongly encouraged to incorporate these practices, if installed, into their lesson planning.

Recommended practices at the Thompson Public School complex include the installation of:

- stormwater tree filters to capture stormwater runoff from parking areas at the Mary R. Fisher Elementary School and the Tourtellotte Memorial High School (Figs. 8-30 and 8-31),
- a rain garden at the entrance of the Early Childhood Education Center (Mary R. Fisher Elementary School) to infiltrate stormwater (Fig. 8-30),
- a bio-retention basin to capture and infiltrate stormwater runoff from the small parking lot at the Mary R. Fisher Elementary School (opposite the TEEG building) (Fig. 8-30),
- a grass swale with check dams and erosion control mat at the front driveway to Tourtellotte Memorial High School to address soil erosion in those areas (Figs. 8-32 to 8-35),
- bio-retention/rain gardens at the front driveway to Tourtellotte Memorial High School by the Administrative Building (Fig. 8-34),
- infiltration trenches to catch and infiltrate runoff from the driveway and parking areas at the Thompson Middle School and Administrative Building (Figs. 8-36 and 8-37), and,

- site re-grading and seeding, parking exclusions, installation of a deep sump catch basin with hood, and installation of a hydrodynamic separator at the delivery area to address erosion and sedimentation issues (Figs. 8-38 to 8-42).

Figure 8-29. The Thompson public school complex on Riverside Drive (RT 12) and Thatcher Road in North Grosvenordale (Google Earth imagery dated 5/6/15).

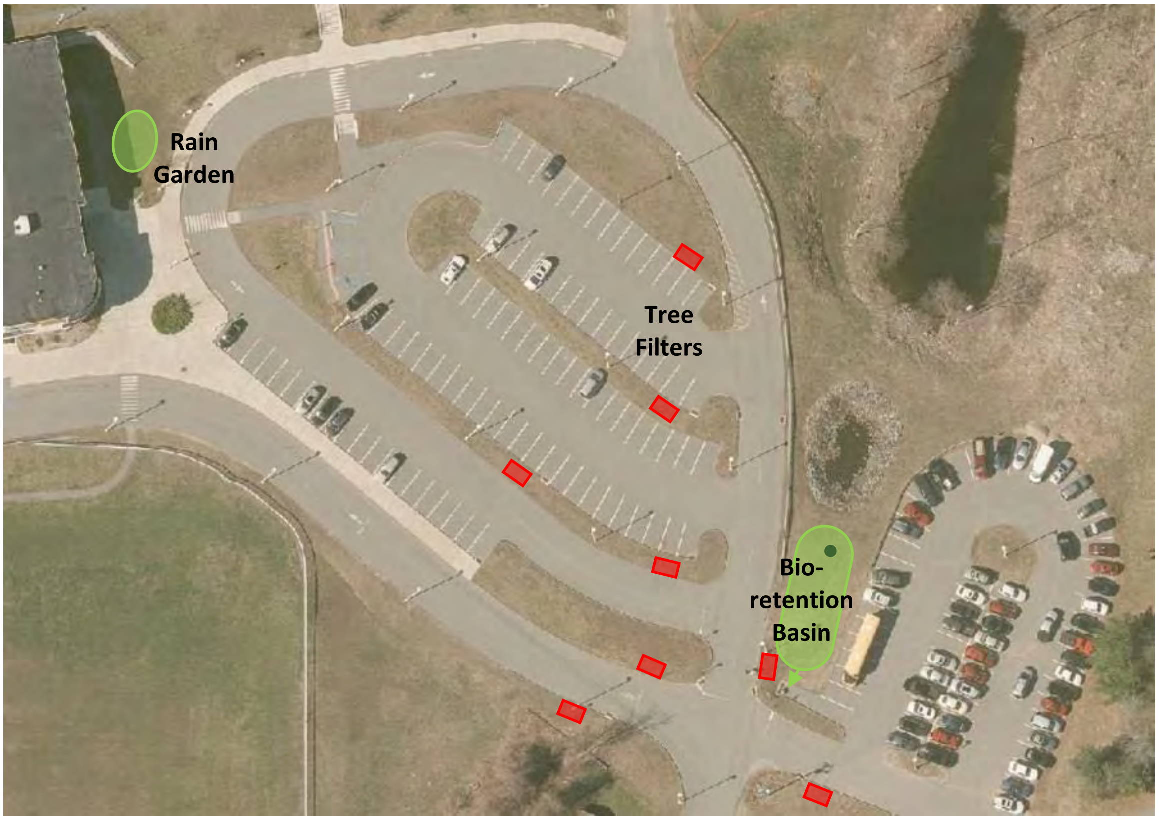


Figure 8-30. Proposed BMPs at the Mary R. Fisher Elementary School (image CTECO, 2017).

Figure 8-31. Proposed BMPs in the Tourtellotte Memorial High School parking lot (Google Earth imagery dated 5/6/16).

Figure 8-32. Erosion at the toe of the slope along the driveway to the high school.

Figure 8-33. Erosion on the hillside along the driveway to the high school caused by stormwater runoff from the parking lot at the top of the slope.

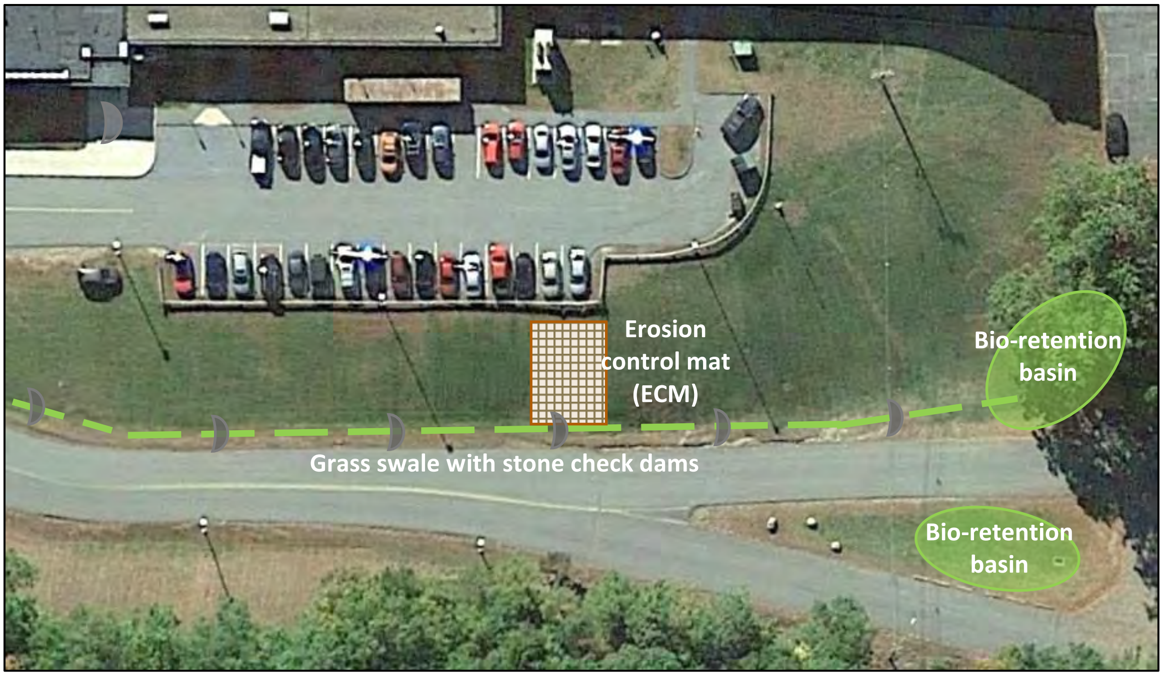


Figure 8-34. Proposed BMPs along the driveway to Tourtellotte Memorial High School.

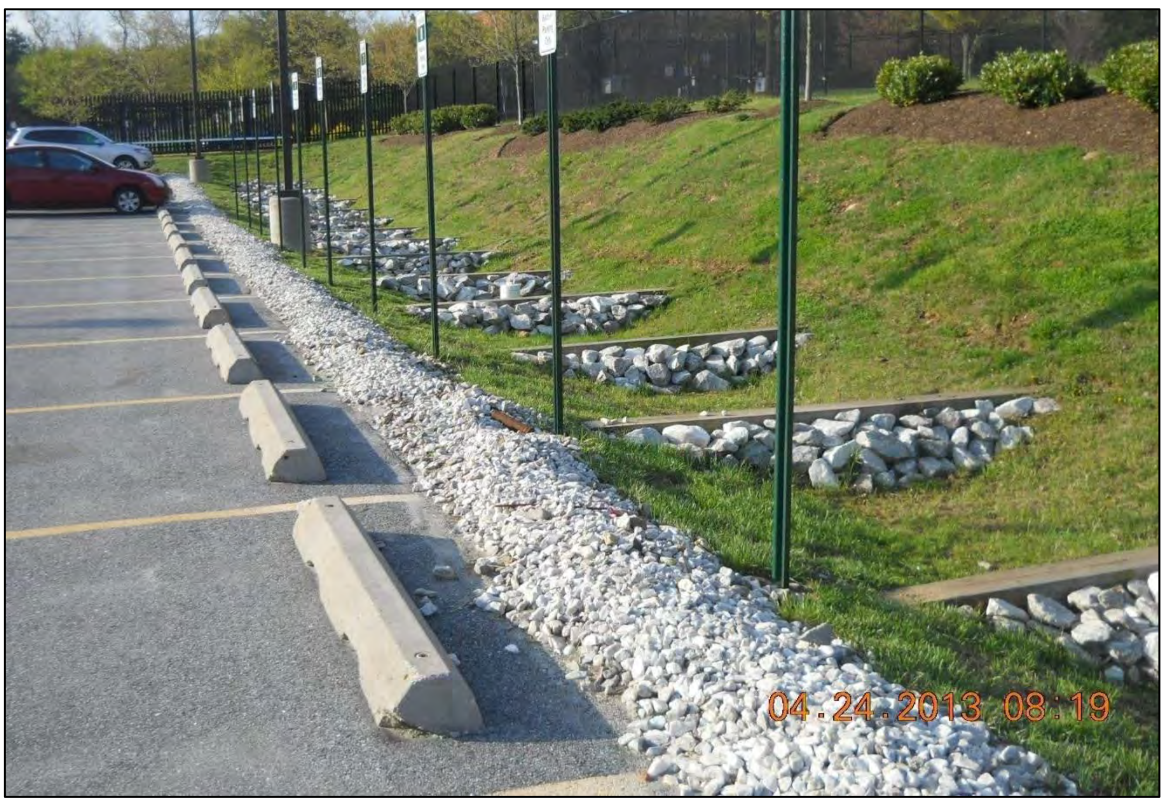


Figure 8-35. Example of check dams placed in a grass swale to slow water flow and prevent soil erosion (image - www.chesapeakestormwater.net).

Figure 8-36. Proposed infiltration trenches along parking areas by the Administrative Building (Google Earth imagery dated 5/6/15).

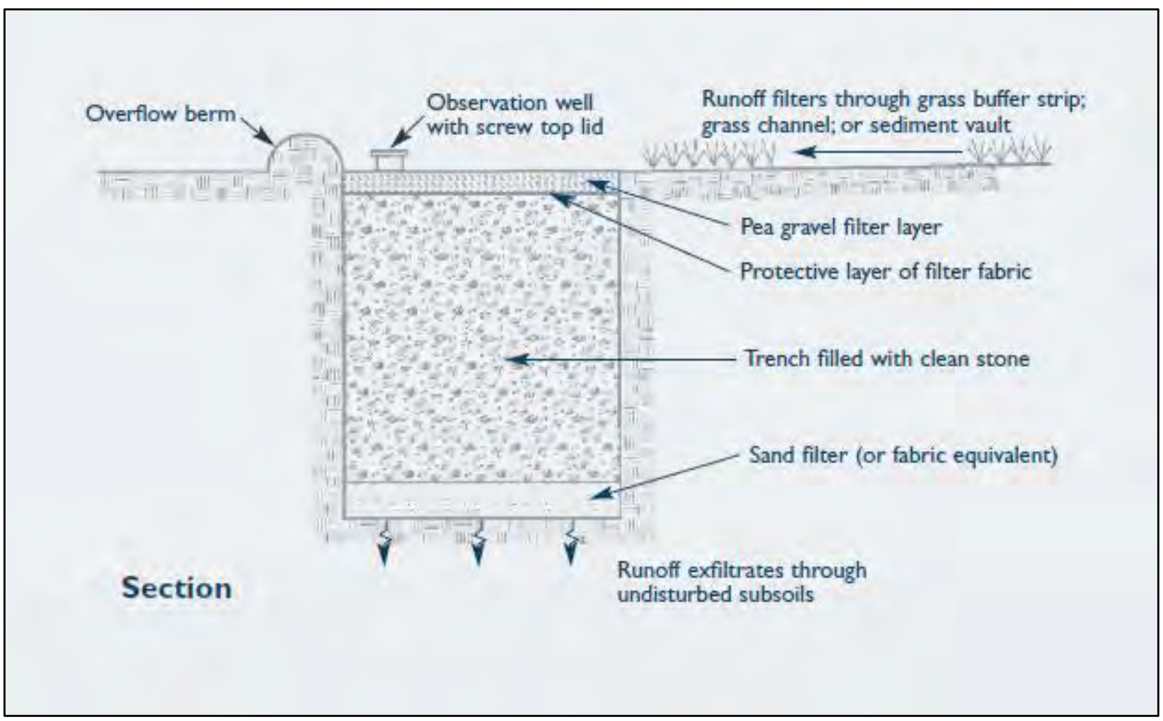


Figure 8-37. Detail of an infiltration trench (from Connecticut Stormwater Quality Manual, 2004).

Figure 8-38. Erosion and sediment deposition along a walkway and the edge of the driveway at the Thompson Middle School delivery area (Google Earth imagery dated 10/10/16).

Figure 8-39. Erosion along a walkway and sediment deposition near the school delivery area.

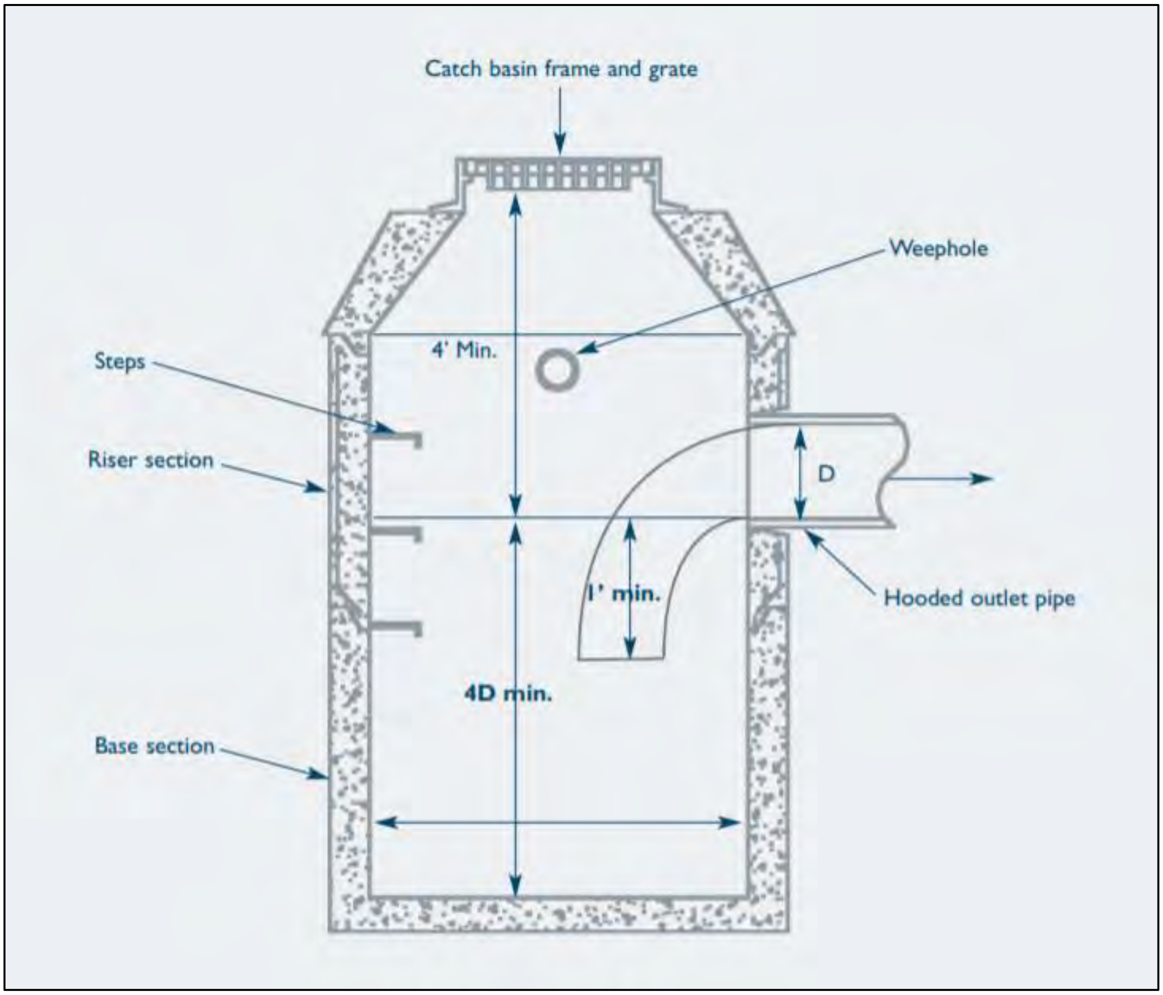


Figure 8-40. Schematic of a deep-sump catch basin (Connecticut Stormwater Quality Manual, 2004).

Figure 8-41. Deposition of eroded sediment near a catch basin at the school delivery area.

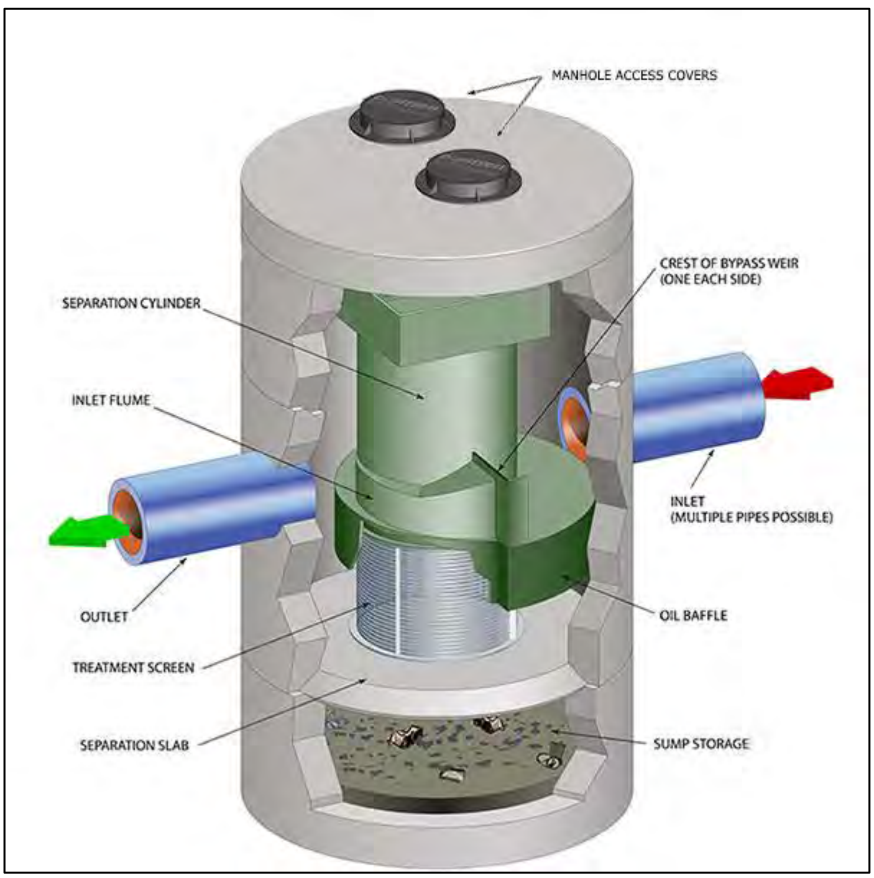


Figure 8-42. Diagram of a hydrodynamic separator (www.conteches.com).

Table 8-21. Recommended BMPs at the Thompson Public School Complex.

Best Management Practice	Location	Sensitive Area	Estimated BMP Cost	Estimated Load Reduction
Infiltration basin (±1,750 cu ft)	MRFES – small parking lot	Yes	$2 - $5/cu ft treated [1] Range: $3,500 - $8,750	TN = 1 lb/yr TP = <1 lb/yr TSS = 31 lb/yr FC = 29 billion/yr
Rain Garden	MRFES – entrance to Early Childhood Center	Yes	Up to $500 [2]	TN = <1 lb/yr TP = <1 lb/yr TSS = 8 lb/yr FC = 7 billion/yr
Tree Filters (up to 7)	MRFES – main parking lot	Yes	$12,000/unit [2]	TN = 6 lb/yr TP = 1 lb/yr TSS = 305 lb/yr FC = 275 billion/yr
Tree filters (up to 4)	Tourtellotte Memorial High School – parking lot	Yes	$12,000/unit [2]	TN = 7 lb/yr TP = 1 lb/yr TSS = 315 lb/yr FC = 284 billion/yr
Grass swale (400 ft) with check dams	Tourtellotte Memorial High School – driveway	Yes	$4.50 - $8.50/LF [3] Range: $1,800 - $3,400	TN = 1 lb/yr TP = <1 lb/yr TSS = 56 lb/yr FC = 50 billion/yr
Erosion Control Mat	Tourtellotte Memorial High School – driveway	Yes	$1.50 - $3.00 sq. yd. [4]	N/A
Bio-retention basins (2)	Tourtellotte Memorial High School – driveway	Yes	Up to $1,000 ea. [2]	TN = 1 lb/yr TP = <1 lb/yr TSS = 54 lb/yr FC = 51 billion/yr
Filter strip and infiltration trenches (1,775 cu ft)	Administration Building	Yes	$11/ cu. ft. treated - $19,525 [5]	TN = 2 lb/yr TP = <1 lb/yr TSS = 113 lb/yr FC = 105 billion/yr
Deep sump catch basin/hood	Thompson Middle School – delivery area	Yes	$3,300[4]	TN = <1 lb/yr TP = <1 lb/yr TSS = 4 lb/yr FC = 0 billion/yr
Hydrodynamic separator	Thompson Middle School – delivery area	Yes	$7,600 - $35,000/unit [4] Installation: $9,000/ac treated	TN = <1 lb/yr TP = <1 lb/yr TSS = 4 lb/yr FC = 0 billion/yr
Fill/re-grade/re-seed eroded area along sidewalk	Thompson Middle School – delivery area	Yes	$100 [2]	N/A

Sources:
[1] Connecticut Stormwater Quality Manual (DEEP, 2004)
[2] ECCD project costs
[3] http://www.bfenvironmental.com/pdfs/veggieSwale.pdf
[4] Average of costs obtained through internet search
[5] Best Management Practices Construction Costs, Maintenance Costs, and Land Requirements. Minnesota Pollution Control Agency, June 2011.

9. Financial and Technical Assistance

9.1. Financial Assistance

Most, if not all, of the management practices provided in Section 8 will require some financial investment. Reasonable financial estimates for each management practice, and particularly those in Section 8.8, have been provided in Tables 8-2 to 8-21. However, costs associated with the development and implementation of each proposed measure will need to be estimated individually as management strategies are undertaken. Factors that may affect the cost of implementing management measures as part of a watershed plan include the type of management practice proposed, installation costs, operation and maintenance costs and methods of cost calculations. Watershed managers should be advised that cost estimates may change over time.

Watershed municipalities have local funding options, including bonding, capital improvement budgets, and department budget line items that can be utilized to fund water quality improvement implementations and municipal outreach efforts. Town planning and land use departments can establish open space set-aside funds for the acquisition of open space, if they do not already have them. Highway/public works departments include annual budget line items for infrastructure repair, maintenance and improvements, and should also include funding for outreach related to MS4 SWMP requirements. Municipal land use commission budgets can include line items for environmental education and outreach programs/ campaigns and materials. The establishment and growth of this local capacity is important. When municipalities apply for outside grants, loans and/or foundation support, they can leverage these local funds. Additionally, numerous grant applications are strengthened by the availability of in-kind services provided by municipal staff, local volunteers and technical assistance providers, among others, as well as donated materials and use of equipment.

Financial assistance in the form of grants and cost-sharing is available from multiple sources, including federal, state, and local sources. These include, but are not limited to, US Environmental Protection Agency (Clean Water Act §319 Non-Point Source program), Connecticut Department of Housing (Small Cities grant program), the Connecticut Office of Policy and Management (STEAP grants), CT Department of Energy and Environmental Protection (Open Space grants, CWA grants), Long Island Sound program grants, and National Fish and Wildlife Fund grants. The US Department of Agriculture Natural Resources Conservation Service (NRCS) offers cost-share programs for qualified agricultural producers, including comprehensive nutrient management planning (CNMP) and environmental quality incentive programs (EQIP). The Connecticut Department of Agriculture offers several grant programs to assist agricultural producers, including farm restoration and agriculture viability grant programs. Local and regional sources may include banks, chambers of commerce, civic/social organizations (such as Lions or Rotary), private, commercial and institutional foundations, and environmental/professional organizations.

Funds and support may also be available in the form of donations and in-kind services provided by local businesses, community and environmental organizations, and local volunteers. These funding sources are subject to the availability of funding and changes in funding cycles and should be reviewed by the applicant for applicability and availability. Stakeholders and watershed managers should be aware of the importance of thoroughly reviewing potential financial assistance programs; some of the provided examples require specific timelines that may take considerable preparation time (and in some cases the assistance of technical expertise) to meet.

A sampling of potential funding opportunities is provided in Table 9-1.

9.2. Technical Assistance

The planning, design and execution of complex water quality improvement projects may require expertise that small towns, watershed groups and civic organizations do not have access to. As a result, assistance from organizations or agencies that have the technical capacity will be critical to the successful implementation of the management recommendations. Organizations such as the US Department of Agriculture Farm Services Agency (FSA) and Natural Resources Conservation Service (NRCS), CT DEEP, the CT Department of Agriculture, the Northeastern Connecticut Council of Governments (NECCOG), the Connecticut Conservation Districts, the University of Connecticut Cooperative Extension Service, US Fish & Wildlife Service and others may provide technical assistance to project managers and watershed stakeholders that will ensure project success.

Table 9-1. Potential funding sources for watershed plan implementations.

Funding Source	Award Amount	Contact Information
CT DEEP CWA §319 Grant Program	Varies by project	Eric Thomas (860) 424 -3548
Website: www.ct.gov/dep/cwp/view.asp?a=2719&q=325588&depNav_GID=1654		
CT DEEP Clean Water Fund		Susan Hawkins (860) 424-3325
Website: www.ct.gov/dep/cwp/view.asp?a=2719&q=325578&depNav_GID=1654		
CT DEEP Open Space and Watershed Land Acquisition Grant Program	40-60% of fair market value	Dave Stygar (860) 424-3016
Website: www.ct.gov/deep/cwp/view.asp?A=2687&Q=322338		
Ct Dept of Agriculture Environmental Assistance Prgm	Varies by practice	(860) 713-2511
Website: www.ct.gov/doag/cwp/view.asp?a=3260&q=398986		
Ct Dept of Agriculture Agriculture Viability Grant	Varies by project	(860) 713-2500
Website: www.ct.gov/doag/cwp/view.asp?a=3260&q=398982		
Ct Dept of Agriculture Farmland Restoration Program	Varies by project	Cam Weimer/Lance Shannon (860) 713-2511
Website: www.ct.gov/doag/cwp/view.asp?a=3260&Q=498322&PM=1		
CT DOH Small Cities Program	Varies by town	Jim Watson (860) 270-8182
Website: www.ct.gov/doh/cwp/view.asp?a=4513&q=530474		
CT OPM Regional Performance Incentive Program		Sandy Huber (860) 418-6293
Website: www.ct.gov/opm/cwp/view.asp?q=487924		
CT OPM Small Town Economic Assistance Program	Varies by project	Barbara Rua (860) 418-6303
Website: www.ct.gov/opm/cwp/view.asp?a=2965&q=382970&opmNav_GID=1793		
Community Foundation of Eastern Connecticut	Varies by program	Jennifer O'Brien (860) 442-3572
Website: www.cfect.org/		
US EPA Healthy Communities Grant Program		Jennifer Padula (617) 918-1698
Website: www.epa.gov/region1/eco/uep/hcgp.html		
NOAA Coastal Management Programs		
Website: http://coastalmanagement.noaa.gov/funding/welcome.html		
US EPA Five Star Restoration Grant Program	$20,000 average	Myra Price (202) 566-1225
Website: www.epa.gov/owow/wetlands/restore/5star		
NFWF Long Island Sound Futures Fund	Varies by project	Lynn Dwyer lynn.dwyer@nfwf.org
Website: www.nfwf.org/		
NRCS Agricultural Conservation Easement program		Ray Covino (860) 779-0557 x102
Website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/ct/programs/easements/acep/		
NRCS Environmental Quality Incentives Program	$450,000 over 6 yrs	Ray Covino (860) 779-0557 x102
Website: www.ct.nrcs.usda.gov/programs/eqip/eqip.html		
NRCS Conservation Stewardship Program (CSP)	$200,000 over 5 yrs	Ray Covino (860) 779-0557 x102
Website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/ct/programs/financial/csp/		
NRCS Agricultural Management Assistance Program	$50,000/yr	Ray Covino (860) 779-0557 x102
Website: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ct/programs/financial/?cid=nrcs142p2_011027		
Rivers Alliance of CT Watershed Assistance Small Grants Program	$5000, req. 40% non-federal funding match	Rivers Alliance of CT (860) 361-9349
Website: www.riversalliance.org/watershedassistancegrantrfp.cfm		

Table 9-2. Potential sources of technical assistance.

Agency/Organization	Type of Assistance Available
CT Department of Agriculture www.ct.gov/doag	Available programs, permitting, agricultural waste management
CT DEEP www.ct.gov/deep	Water quality, forestry, stormwater management, land protection, wildlife, endangered species
CT Department of Transportation www.ct.gov/dot	Design and maintenance of State highways/ stormwater systems and maintenance facilities, design standards
CT Resource Conservation & Development Council www.ctrcd.org	Farm energy program, soil health education, AGvocate program, partnerships/grant management, green ways, planning and development projects, Environmental Review Team (ERT)
Eastern CT Conservation District www.ConserveCT.org/eastern	Water quality, BMP implementations, technical and resource assistance, grant writing
Northeast District Department of Health www.NDDH.org	Review and approval of septic systems, repairs
Local Businesses/Associations http://nectchamber.com/	Potential funding and partnership opportunities
NECCOG www.neccog.org	Regional land use planning support and assistance, GIS assistance
The Nature Conservancy www.nature.org	Outreach/education, planning/ management tools, technical expertise
Town of Thompson – including staff & land use commissions www.thompsonct.org	Enforcement of land use regulations, site plan review/permits, public utilities maintenance, land records, stormwater management plan, planning documents, municipal and DPW staff
USDA/Natural Resources Conservation Service (NRCS) http://www.nrcs.usda.gov/wps/portal/nrcs/site/ct/home/	Programmic/cost-share funding for agricultural BMPs, nutrient management, woodland and wildlife habitat management and improvement
USDA Farm Service Agency (FSA) www.fsa.usda.gov/	Technical/financial assistance for agricultural producers
University of Connecticut – Center for Land Use Education and Research (CLEAR) http://clear.uconn.edu	Outreach and education, GIS support, tools and data, implementation of LID/GI
University of Connecticut - Nonpoint Education for Municipal Officials (NEMO) http://nemo.uconn.edu	NPS education and support for municipal land use organizations
University of Connecticut Extension www.extension.uconn.edu	Technical assistance/education/outreach for land use, forest management and agricultural practices

10. EDUCATION/OUTREACH

The objectives of the education/outreach component of this plan are to provide watershed stakeholders with guidelines on how to raise awareness of the water quality issues associated with the French River in order to create an educated populace that understands the issues of nonpoint source pollution, its effects on water quality; and actions that can be taken to address the problem. By successfully engaging and educating the public, including students of all ages, watershed property and business owners, municipal staff and land use commissioners, this plan should lead to a sense of stewardship that should result in the adoption of land use practices that will be supportive of good water quality in the French River, tributary streams and the watershed as a whole.

Community outreach efforts may be watershed-scale, and seek to address issues that are watershed-wide. Such efforts may include the creative integration of watershed and water quality lessons into local school science curriculums, possibly including an examination of local water quality conditions; or the promotion of homeowner best management practices such as encouraging recycling, washing cars on lawns or using a carwash, properly disposing of pet waste, encouraging composting, reducing the use of lawn chemicals, and discouraging the dumping or depositing of chemicals or other waste in storm drains. These efforts may target a broad spectrum of watershed residents through activities such as presentations at meetings or conferences (land-use commissions, civic organizations, schools), news articles or feature stories in local or regional newspapers or other media outlets, displays at local festivals or field days, and work days such as community clean-up days.

Outreach efforts may also be more small-scale or focused, and may be tied to specific implementation projects or target a water quality issue in a specific locale. Examples may include a rain garden workshop conducted in tandem with the installation of a rain garden at a targeted location with a known water quality issue, a workshop directed to a specific target audience, such as a manure management workshop for horse owners, or the installation of educational signage at a location with a specific resource concern such as cleaning up animal (dog) waste in a public park, not feeding geese or other waterfowl, or carrying out trash from town parks and other recreation areas.

Outreach strategies were presented in Section 8.2.

11. Monitoring and Assessment

The monitoring and evaluation of water quality conditions is an essential component of any watershed management plan. The collection of water quality data allows watershed managers to assess whether water quality improvement measures are having the intended effect, and whether adjustments need to be made within the adaptive management framework. Water quality monitoring should be coordinated with the implementation of management measures in order to determine if the management measure goals (e.g. a reduction in the amounts of indicator bacteria) are being achieved. Baseline fecal indicator bacteria levels have been collected by CT DEEP, TLGV, CAS and ECCD, and have been used to quantify fecal bacteria reductions required to meet state water quality standards, including the establishment of a fecal bacteria TMDL for Long Branch Brook. Physio-chemical water quality data has been collected by the USGS at Riverside Park. These baseline data can be used to evaluate the effectiveness of management measures over time after they are implemented.

A number of opportunities exist for the future collection of water quality data in the French River watershed. The 2016 Small Municipal Separate Storm Sewer Systems (MS4) general permit requires that the Town of Thompson establish a stormwater monitoring program, and collect water samples from impaired waters within the town. With careful planning, water quality data from this program can also be used to evaluate BMP effectiveness. The CT DEEP Ambient Water Quality Monitoring program conducts sampling by major river basin throughout Connecticut on a five-year rotation in support of a biennial assessment of water quality conditions across Connecticut per requirement of the federal Clean Water Act. The USGS collects a suite of water quality data (such as water temperature, pH, dissolved oxygen levels, heavy metals concentrations and nutrient levels) from its sampling station on the French River in North Grosvenordale (USGS 01125100), which can be accessed at the USGS Current Water Data for Connecticut webpage at https://waterdata.usgs.gov/ct/nwis/uv?site_no=01125100. Finally, water quality monitoring volunteers can be recruited and trained through programs such as The Last Green Valley Water Quality Monitoring program to collect water quality data on a project basis. If desired, future bacteria monitoring can incorporate microbial source tracking to determine the likely bacteria host animal. This type of data can assist in targeting clean up and restoration efforts.

The following items should be included as part of the monitoring and assessment component of watershed plan implementations as they are undertaken:

- Coordination of monitoring activities among the watershed project partners.
- Bacteria DNA source tracking at Backwater Brook (BWB01) and Quinatissett Brook (QB02) to identify the bacteria host animal.
- Collection of pre- and post-implementation water quality data to determine the effectiveness of the BMP in reducing pollutant loading if existing data is not available.

- Comparison of post-BMP water quality monitoring data to bacteria TMDL targets to determine if bacteria load reductions have been achieved.
- Comparison of post-BMP implementation data collection to NPS pollutant load targets (nitrogen, phosphorus, total suspended solids) to determine if NPS pollutant load reductions have been achieved.

12. Plan Implementation Effectiveness

The implementation of a watershed management plan is necessarily an iterative process. As implementations are undertaken and completed, water quality data should continue to be collected, evaluated and compared to the desired water quality goals to determine if the implementations are achieving the desired results. Implementation should be considered complete when the targets are reached or exceeded. Once water quality targets have been achieved, periodic water quality sampling should be continued in the French River and the tributary streams to ensure water quality improvements are sustained.

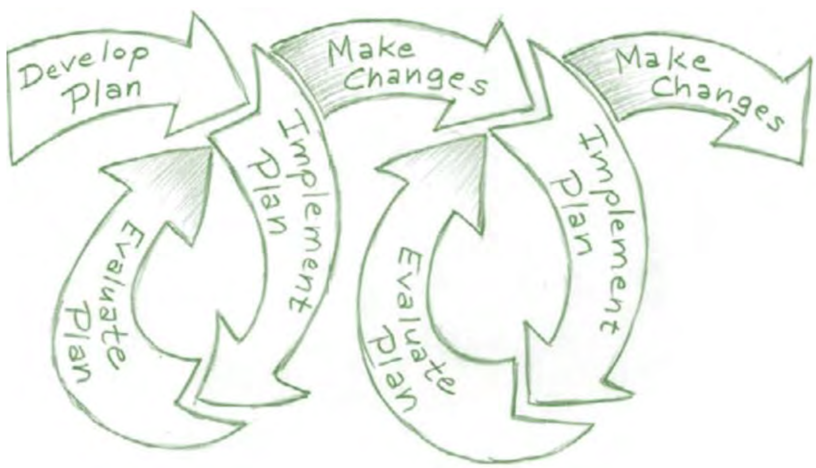


Figure 12-1. This graphic from the USEPA Handbook for Developing Watershed Plans to Restore and Protect Our Waters depicts the iterative nature of the watershed planning process (USEPA 2008).

If implementations are not as effective as planned, e.g., implementation milestones are not being met, or progress is not being made toward reducing pollutant loads, watershed stakeholders will need to review the implementation program. The review should include an examination of the effectiveness of selected BMP practices, a review of goals and objectives to determine if they are realistic and achievable, and an evaluation of the selected implementations to ensure they are adequate to achieve those goals. If it is determined that the implementation of goals and objectives are not resulting in a positive water quality change, watershed team members may need to make adjustments or revisions to the watershed plan. Additionally, watershed stakeholders should review this Plan periodically vis-à-vis changes and/or improvements to the watershed, as BMP implementation strategies and/or interim milestones are successfully completed, and revise or update the Plan accordingly.

13. NEXT STEPS

Protecting surface water quality in the French River watershed will be a long-term effort. It will take the actions of many individuals, community leaders and decision makers to address current watershed conditions and take measures to reduce the levels of NPS pollutants, including fecal bacteria, in order to protect the generally good water quality in the French River watershed. Periodic public events should be scheduled by the watershed management team to reach out to residents of the French River watershed and the broader Thompson community to promote the watershed plan, and inform the community about efforts being undertaken to protect the water quality of the French River and its tributaries. Watershed managers should capitalize on municipal outreach activities required by the MS4 program to target outreach messaging to a broader audience.

Following the acceptance of the French River Watershed-based Plan by CT DEEP, this Plan should be distributed to all watershed stakeholders for implementation, including, but not limited to, the Town of Thompson, Northeast Connecticut Council of Government, the Northeast District Department of Health, local utilities (including the Thompson Water Pollution Control Authority), CT Department of Transportation, agricultural producers, and business and land owners. The Plan should be made available to the general public via postings on the CT DEEP, ECCD and Town of Thompson municipal websites. Efforts should be made to publicize the watershed plan using multiple approaches and media platforms to reach different audiences, in order to raise public awareness of water quality and water quality threats in the French River watershed, and steps being taken to protect and/or improve water quality. It will be incumbent upon all watershed stakeholders to review, understand and adopt the plan recommendations.

The Eastern Connecticut Conservation District intends to remain an active participant and central point of contact as implementations recommended by this Plan are undertaken.

Any comments or questions regarding this Plan should be directed to:
Eastern Connecticut Conservation District
238 West Town Street
Norwich, CT 06360
(860) 319-8806

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Appendix A

Water Quality Investigation Summary

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Contract 12-05f
French River Watershed-Based Plan and Implementation Action

Eastern Connecticut Conservation District
August 25, 2015

Task 1d – Conduct Water Sampling

This project is funded in part by CT DEEP through a US EPA Clean Water Act §319 Nonpoint Source Program grant.

Introduction

The Eastern Connecticut Conservation District (ECCD) has received funding from CT DEEP through the Clean Water Act Section 319 Nonpoint Source program to conduct water quality sampling in the French River (CT3300-00_01) and Long Branch Brook (CT3300-02_01) in Thompson, Connecticut (Fig. 1). The purpose is to identify potential sources of bacteria that have resulted in the periodic inclusion of both waterbodies in the State of Connecticut's Impaired Waters (303d) list. ECCD will use the bacteria data to develop a subwatershed-based plan for the French River watershed.

Segment 01 of the French River (CT3300-00_01), located from the confluence of the French River with the Quinebaug River upstream to the outlet dam of North Grosvenordale Pond, has been listed in multiple cycles of the Connecticut Department of Energy and Environmental Protection's Integrated Water Quality Report to Congress, most recently in 2010, as impaired for recreation due to periodic high levels of the pathogen indicator bacteria *Escherichia coli* (*E. coli*). No specific pathogen sources have been identified. The French River, which has its headwaters in the central Massachusetts town of Leicester, also has several impaired segments in Massachusetts. These segments, including two just across the Connecticut-Massachusetts state line in Dudley and Webster, are impaired for recreation due to the presence of *E. coli.*

Long Branch Brook (CT3300-02_01), is a Class A stream that is a tributary to the French River. Long Branch Brook, like the French River, has its headwaters in Massachusetts, in nearby Webster, MA. Long Branch Brook is listed as impaired for recreation due the presence of *Escherichia coli* (*E. coli*). Potential pathogen sources include permitted and non-permitted stormwater, insufficient septic systems, agricultural activity, and nuisance wildlife and/or pets. In order to quantify bacteria levels and identify potential sources of bacteria to the French River and Long Branch Brook, ECCD conducted bacteria sampling during June and July of 2015.

Procedure

In March 2015, ECCD prepared and submitted a Water Quality Monitoring Plan to CT DEEP outlining the methods ECCD would employ to conduct water quality sampling of the French River and its tributary streams. Upon approval of the Water Quality Monitoring Plan by CT DEEP, ECCD, in partnership with The Last Green Valley (TLGV) Volunteer Water Quality Monitoring program, recruited local volunteers to participate in water quality sampling. A bacteria sampling workshop was held at the Thompson Public Library in Thompson, CT. in May 2015. The volunteers were trained to utilize sampling protocols specified in The Last Green Valley Volunteer Water Quality Monitoring Program Bacteria Sampling Quality Assurance Project Plan (QAPP). This QAPP (US EPA Tracking Number RFA #13504) was approved by CT DEEP and US Environmental Protection Agency (US EPA) in June 2012.

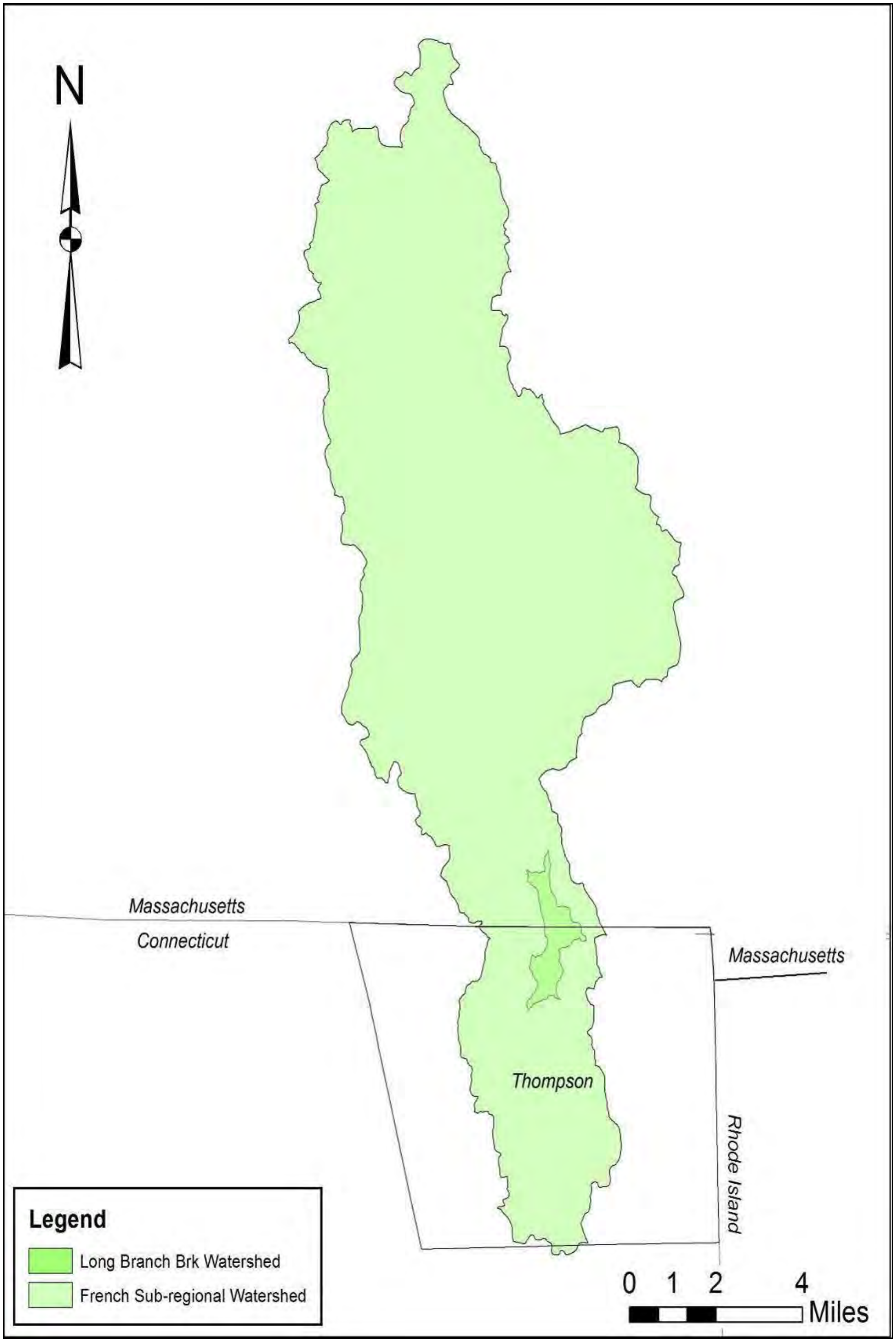


Figure 1. The French River sub-regional watershed in Massachusetts and Connecticut. The Long Branch Brook local watershed is depicted in dark green.

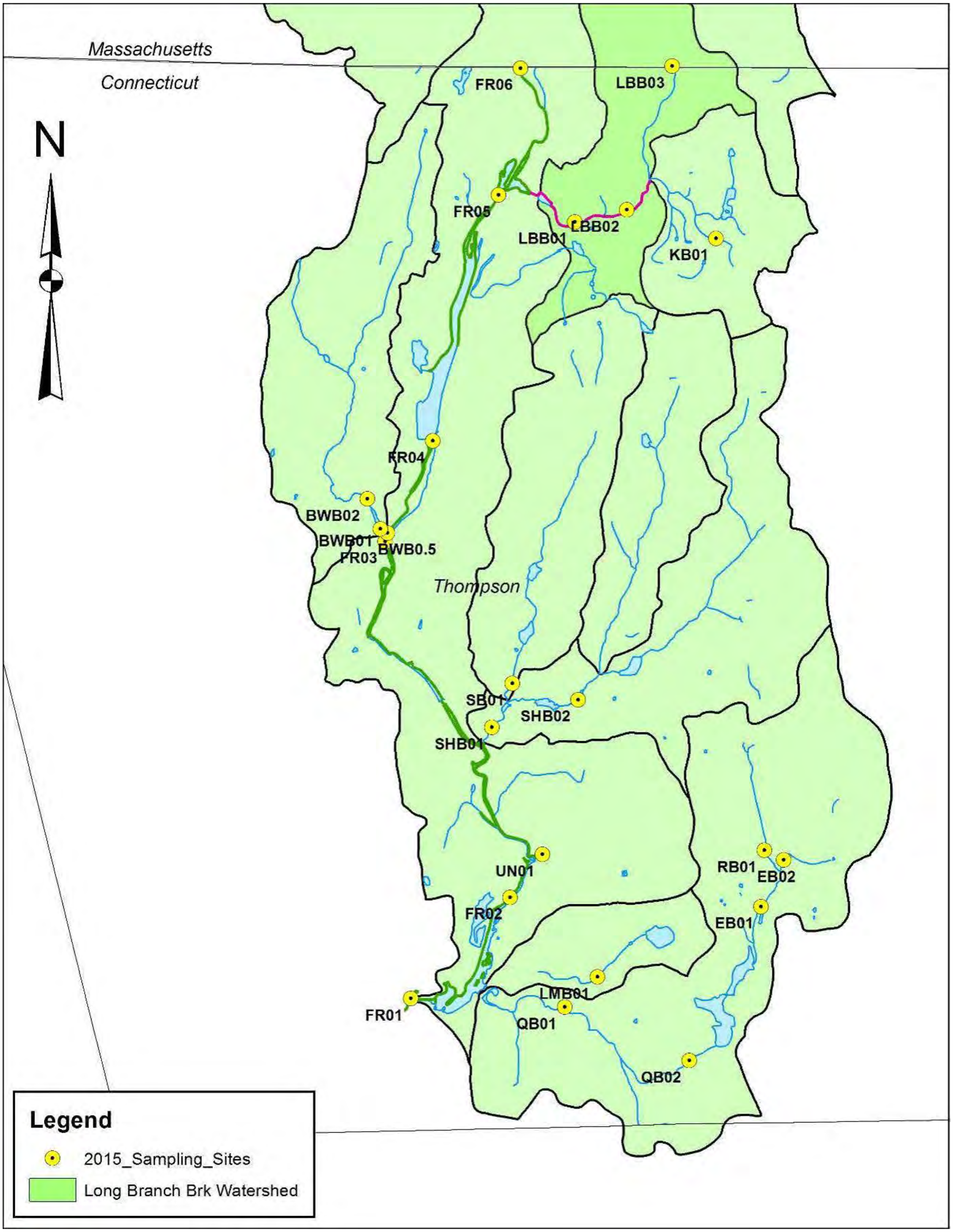


Figure 2. French River watershed bacteria sampling sites. Local watersheds are delineated.

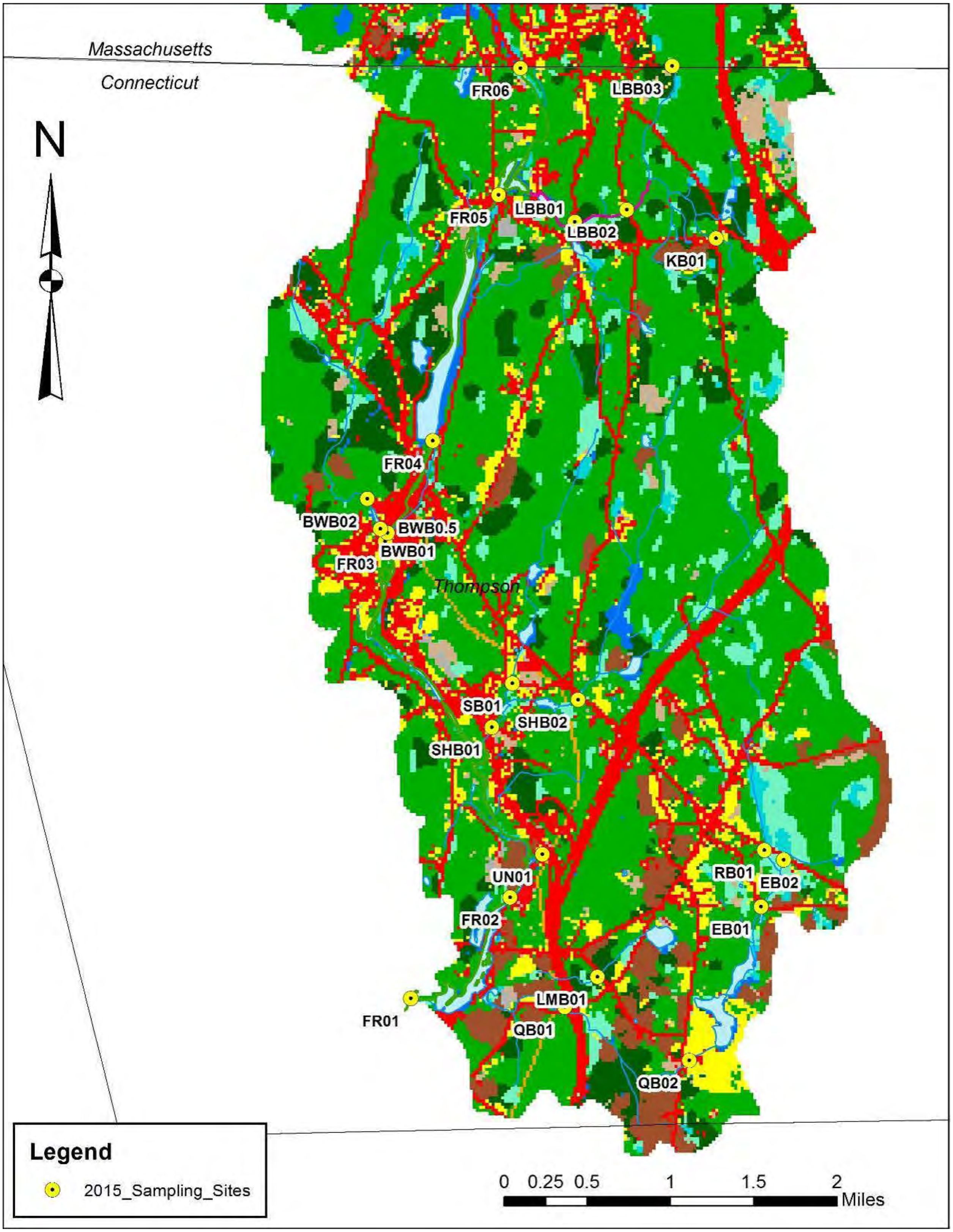


Figure 3. French River watershed bacteria sampling sites relative to land use/land cover (CLEAR 2010).

Prior to the commencement of water sample collection, ECCD identified eighteen sites along the French River and its tributaries to be sampled (Fig. 2). The sampling sites were selected to identify and quantify potential sources of bacterial contamination to the French River based on a review of local land use (Fig. 3) and recommendations made in the *French River Watershed Summary* appendix of CT DEEP's *A Statewide Total Maximum Daily Load Analysis for Bacteria Impaired Waters* (September 19, 2012). The sampling sites were numbered beginning with the downstream-most site on the French River (FR01, located 500 feet upstream of the confluence with the Quinebaug River) and proceeding upstream to the Massachusetts state line (FR06). Named tributaries were designated by their initials (eg. Long Branch Brook was called LBB), and followed the same downstream-to-upstream numbering convention if multiple sites existed. The one unnamed tributary was designated as "UN." In week 6, four additional sites (QB02, RB01, EB01 and EB02) were added upstream of the Quinatissett Brook site (QB01), in the southeast part of the watershed to bracket high bacteria levels documented at QB01. In the final week of sampling, an additional site at the confluence of Backwater Brook with the French River (BWB0.5) was added to document water conditions in response to a "sewage" odor in a nearby catch basin that discharges to Backwater Brook, bringing the total number of sampling sites to twenty-three.

The water samples were collected once a week for eight weeks, beginning June 9th and ending July 28th, utilizing the QAPP protocols in accordance with the approved monitoring plan. Water samples were collected by hand or via an extension pole, using sterilized 125 ml Nalgene collection bottles provided by the CT Department of Public Health. In order to ensure quality control, on each sampling day, one duplicate and one blank sample was collected for every ten samples collected. The locations of the duplicate and blank sample sites were determined using a random number generator. Butterfield's buffer solution was used for the blank sample. Water samples were placed on ice in a cooler during the sampling process. Water samples were delivered to Northeast District Department of Health (NDDH), in Brooklyn, CT., where they were picked up by a Connecticut Department of Public Health (DPH) courier and delivered to the DPH Laboratory in Rocky Hill, CT., for processing. Bacteria analysis results were reported to Northeast District Department of Health and relayed to ECCD by NDDH staff. Bacteria results were tabulated and evaluated by ECCD.

Results

The 2013 Connecticut Water Quality Standards establish water quality criteria for indicator bacteria, including *E. coli*, which is the preferred indicator bacterium for fresh waterbodies. For recreational contact, excluding designated and non-designated swimming areas, the single sample maximum is 576 colony-forming units (cfu) per 100 milliliters of water and the maximum sample set geometric mean is less than 126 cfu/100 ml.

Bacteria sampling results for the French River and its tributary streams are summarized in Table 1 and depicted in Fig. 4. A geometric mean was calculated for each sample set, with the exception of site BWB0.5, for which only one sample was obtained. Bacteria levels listed in **bold** font in the table below exceed the established water quality limits. Bacteria samples with (D = n) indicate a duplicate sample was collected at that site on that sampling day. Table 1 also notes whether the sample was collected during wet (a rainfall in excess of 0.1 inches within 24 hours) or dry conditions. A simple statistical distribution of the sampling results was prepared, using a box and whicker plot of the data set (Fig. 5). Summaries of each individual sampling site are provided below, following Fig. 5.

Table 1. French River watershed bacteria sampling results.

Site	6/9/15	6/16/15	6/23/15	6/30/15	7/7/15	7/14/15	7/21/15	7/28/15	geomean
FR01	20	420	140	85	41	31	86	86	74
FR02	75	63	110	110	110	52	170 (D=160)	120	101
FR03	130	51	200	31	20 (D=10)	31	74	75 (D=41)	47
FR04	<10	10	73	<10	<10	<10	20	<10	14
FR05	41	230	63	20	31	63	63	75	57
FR06	75	300	74	52	52	150	52	96	87
LBB01	20	560	110 (D=52)	10	<10	84	20	10	36
LBB02	20	360	160	85	74	31	<10	41	56
LBB03	<10	280	170	63	20	98	52	63	61
KB01	84	**880**	98	85	31	63 (D=73)	20	110	83
SHB01	96	320	53	31 (D=20)	98	160	**1400**	320	124
SHB02	10	63	41	41	<10	20	31	<10	22
SB01	41	98	63	31	31	10 (D=10)	75	41 (D=20)	33
BWB0.5								**820**	---
BWB01	86	200 (D=230)	130	110	340	110	84	85	**135**
BWB02	20	73	41	110	<10	<10	41	41	32
UN01	10	150	120	41	10	73	20	31	37
LMB01	41 (D=30)	230	84	63	41	270	52	**830**	96
QB01	160	410	330	220	110	370	**790**	**1100**	**338**
QB02						**2100**	280 (D=170)	170	**361**
RB01						110	120	31	74
EB01						160	97	---	125
EB02						110	300	98	**148**
Wet/Dry	dry	wet	dry	dry	dry	dry	dry/wet*	dry	dry

* Began to rain midway through sampling

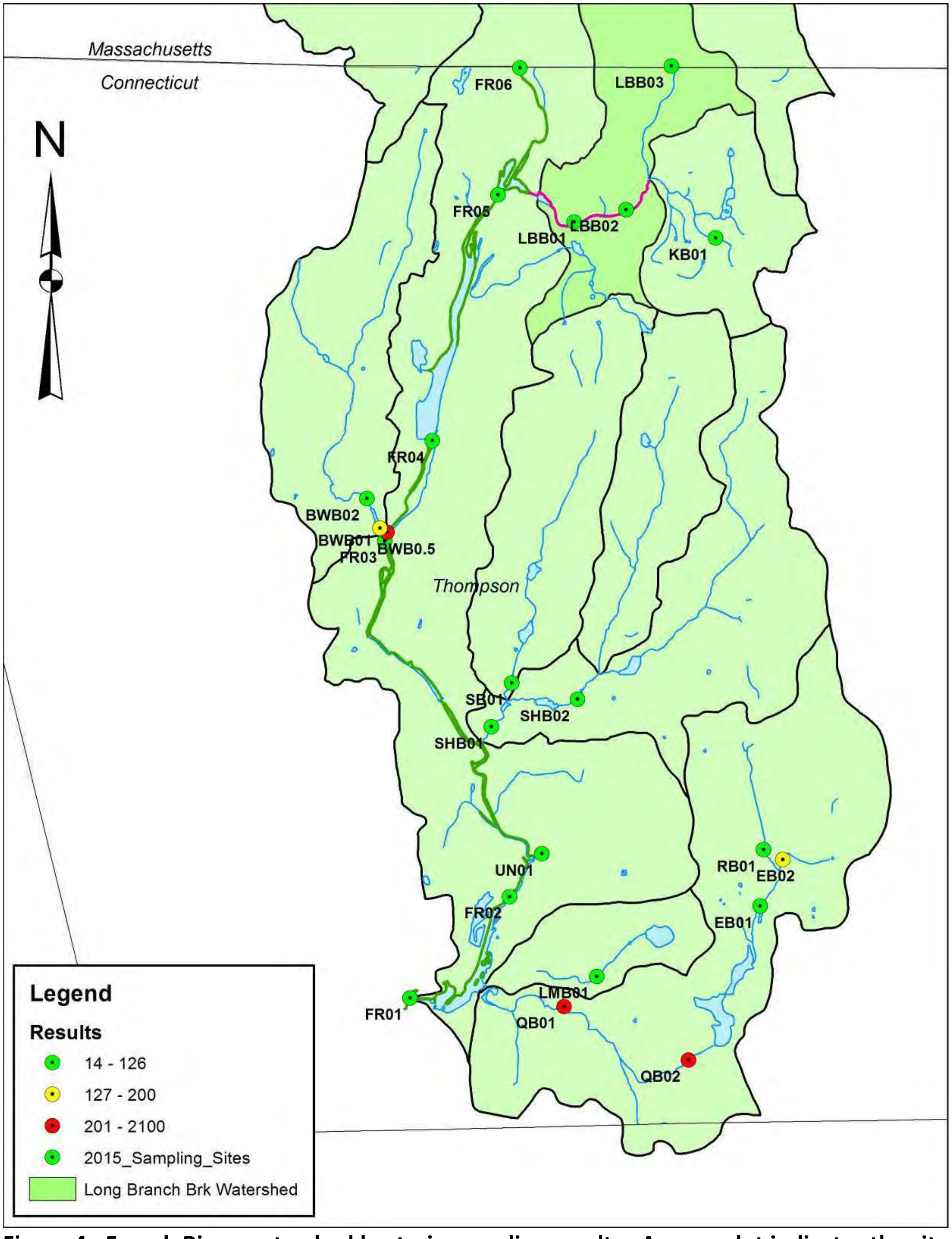


Figure 4. French River watershed bacteria sampling results. A green dot indicates the site may have had a single sample exceedance, but met established water quality criteria for the geometric mean; a yellow dot indicates that the site had no single sample exceedances but failed to meet the geometric mean criteria; and a red dot indicates the site exceeded both single sample and geometric mean criteria.

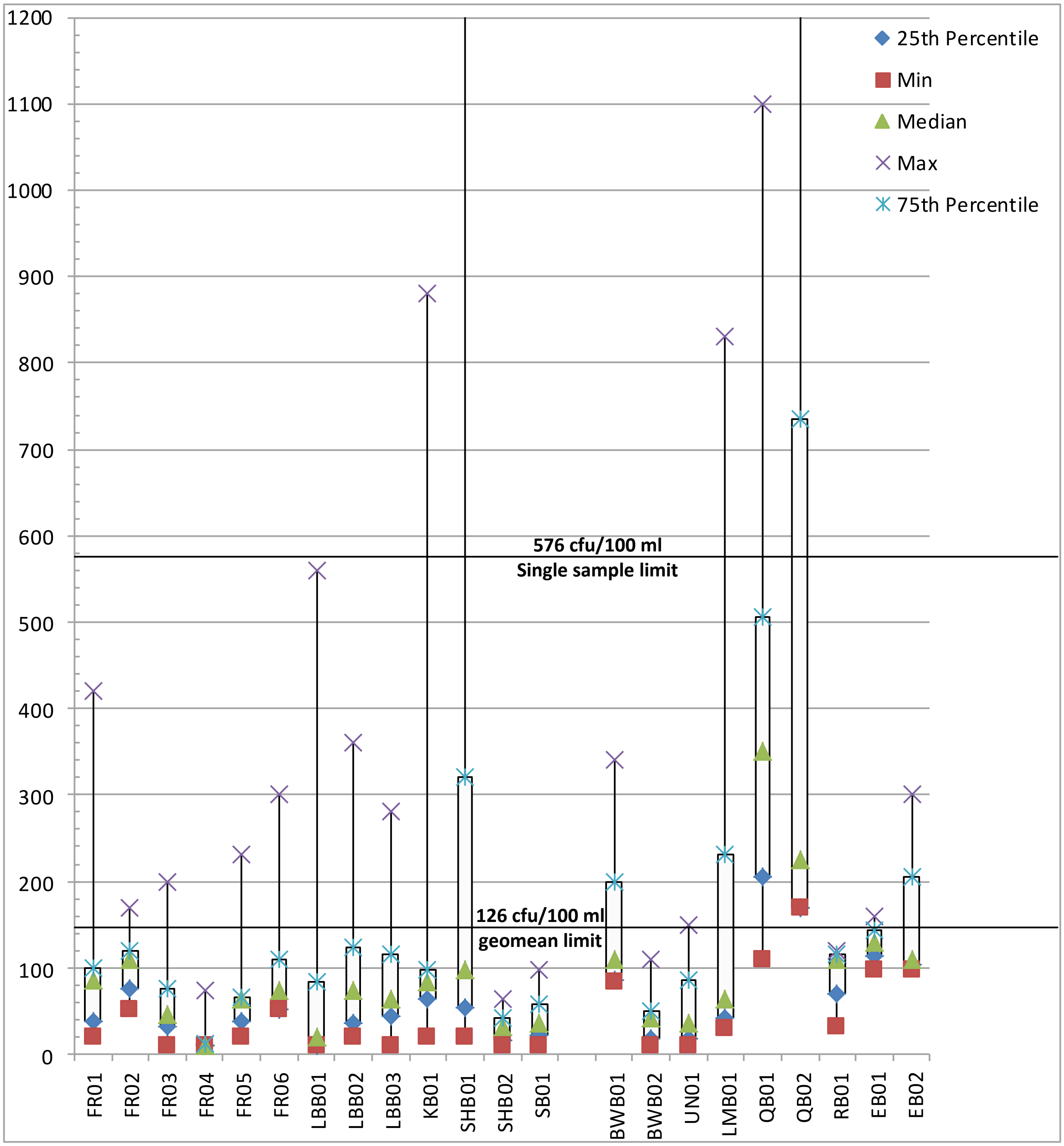


Figure 5. Statistical distribution of bacteria results by sampling site.

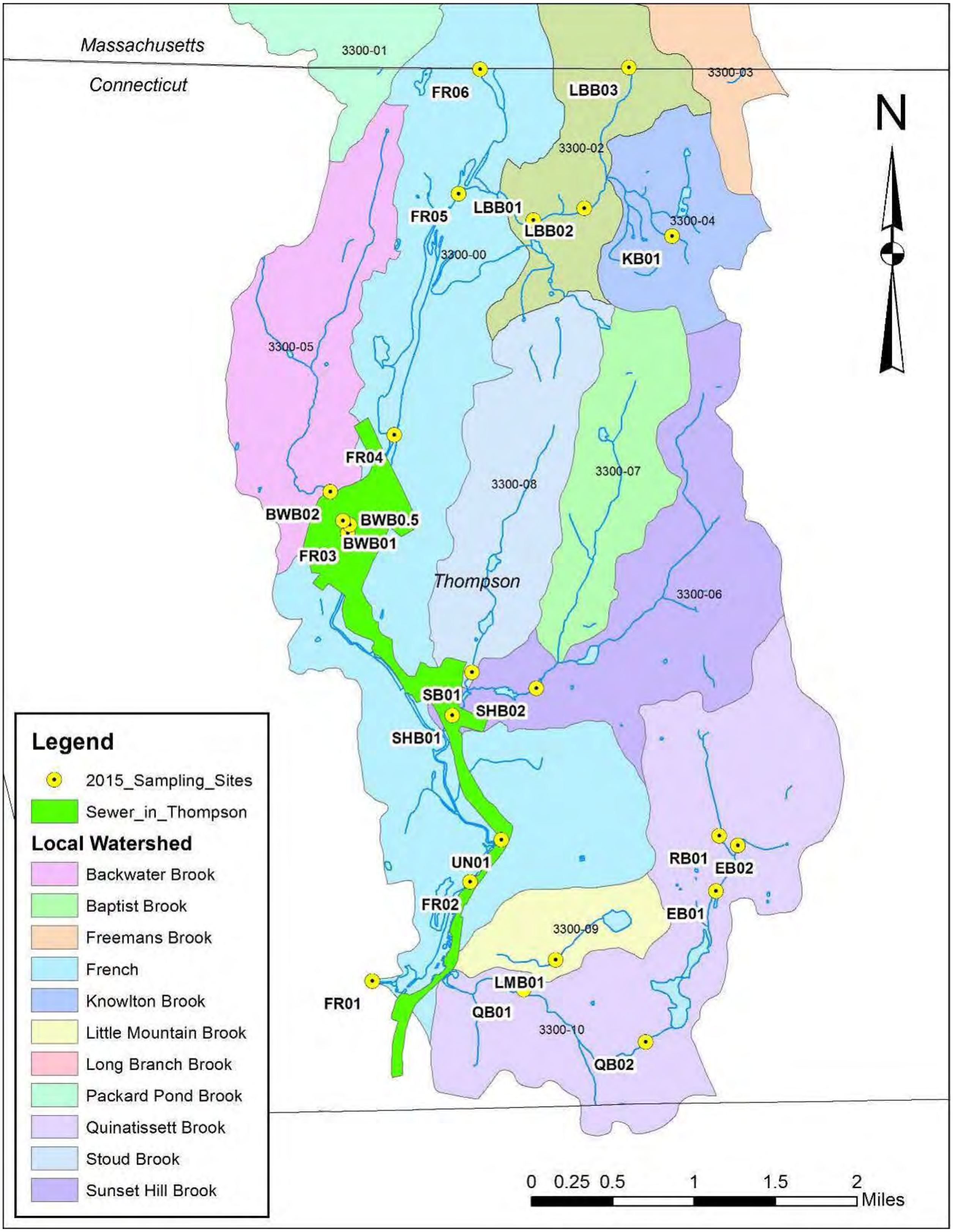


Figure 6. French River local watersheds with sewer service area (in green).

Bacteria Sampling Results by Sampling Site

The results of bacteria sampling by sampling site are provided below.

FR01 – French River upstream of the confluence with the Quinebaug River:

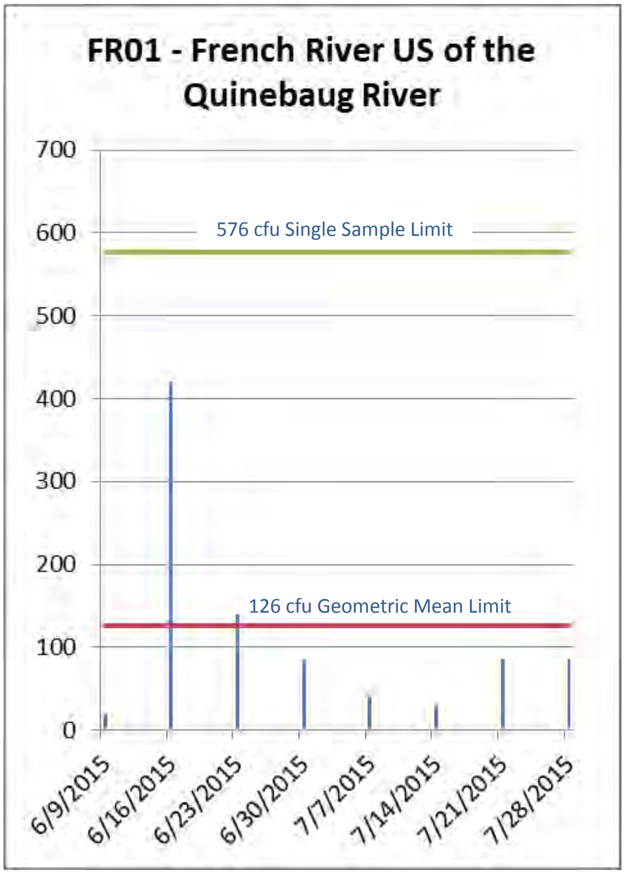


Figure 7. Graph of bacteria sampling results at FR01; downstream view of the French River at the sampling location; and an aerial (Google Earth) image of the sampling site location and vicinity.

FR01 is located on the French River, south of the US Army Corps of Engineers flood control dam at the West Thompson Lake (Quinebaug River) flood control facility. This is the southern-most sampling site on the French River, and is located approximately 500 feet upstream of the confluence with the Quinebaug River. This site was selected to document bacteria levels in the French River prior to its discharge into the Quinebaug River.

Eight water samples were collected at this site. All of the samples met the single sample Connecticut water quality standard of 576 cfu/100ml. The geometric mean for this site is 74, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

FR02 – French River at Route 12:

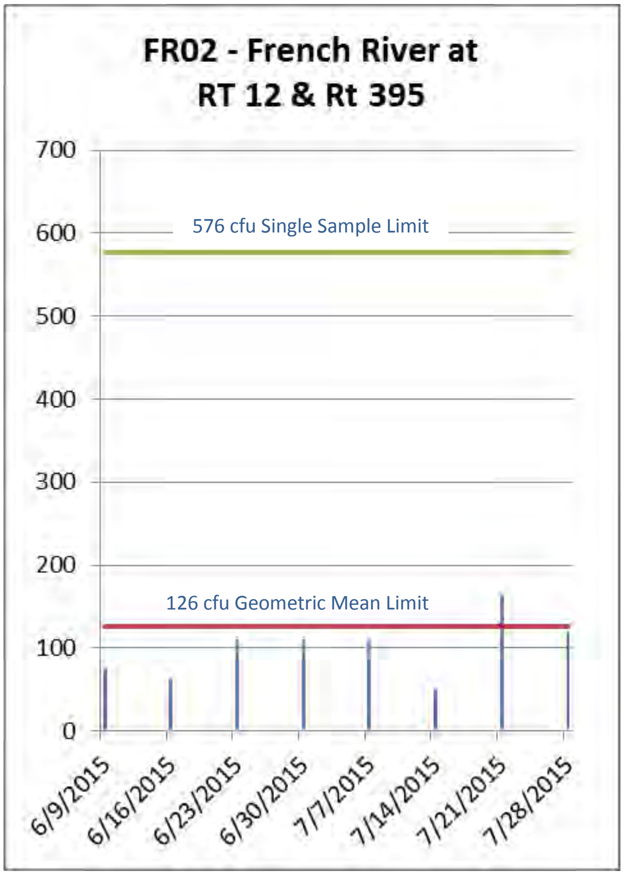
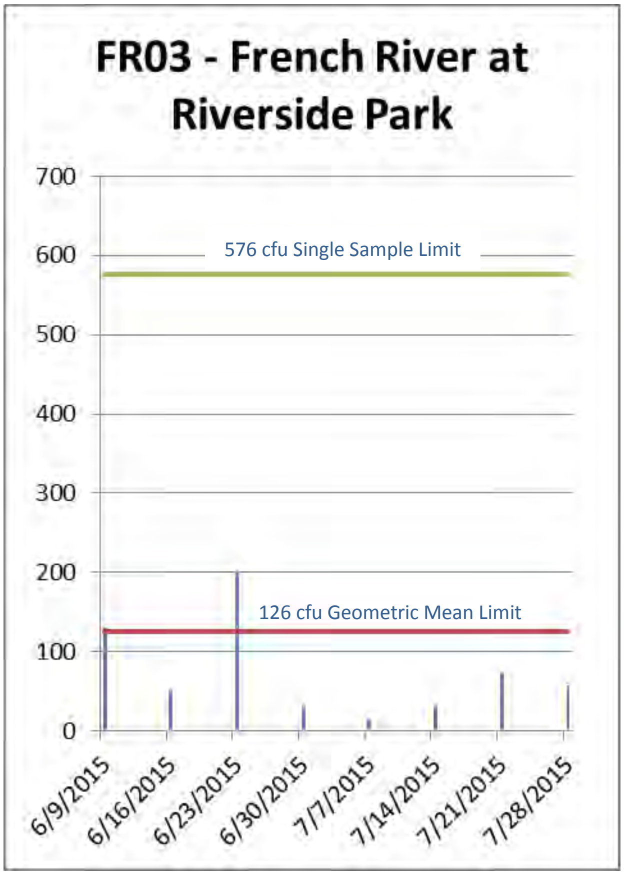


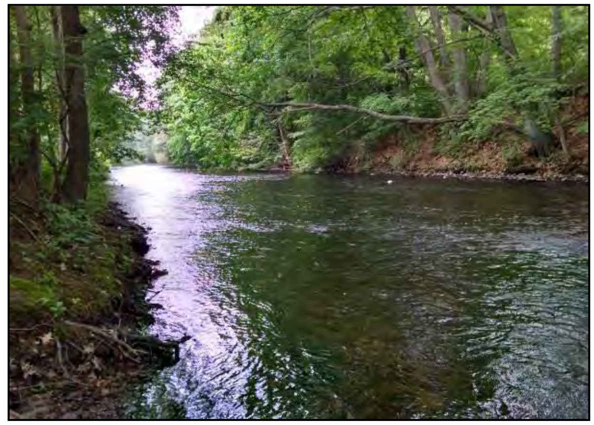
Figure 8. Graph of bacteria sampling results at FR02; downstream view of the French River at the sampling location; and an aerial image of the sampling site location and vicinity.

FR02 is located on the French River along State Route 12, approximately 1 mile upstream of FR01. This site is downstream of a stormwater outfall from Interstate Route 395 and the confluence of an unnamed stream that originates at or near a septic lagoon on the Marianapolis Preparatory School property, and was selected to document potential bacteria contributions from both locations. Land use in the vicinity of this site is mixed, with agricultural fields and a gravel quarry located on the west side of the river, and commercial/industrial uses along Route 12 on the east side of the river. Properties located along the Route 12 corridor are served by municipal sewers (Fig. 6).

Nine water samples were collected at this site, including one duplicate sample. All of the samples (100%) met the single sample Connecticut water quality standard of 576 cfu/100ml. The geometric mean for this site is 101, which did not exceed the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

FR03 – French River at Riverside Park in North Grosvenordale:





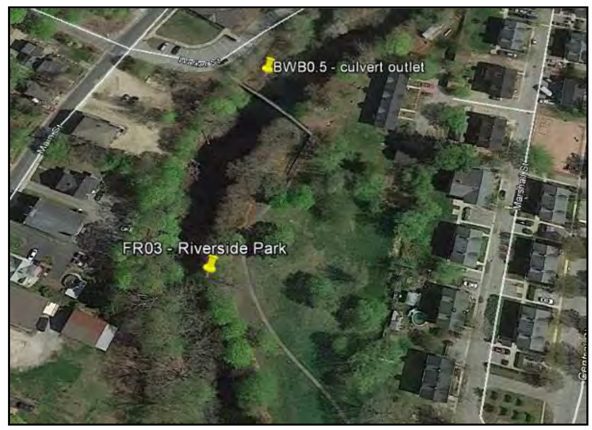


Figure 9. Graph of bacteria sampling results at FR03; downstream view of the French River at the sampling location; and an aerial image of the sampling site location and vicinity.

FR03 is located on the French River at Riverside Park in the North Grosvenordale section of Thompson. This river segment (CT3300-00_01), beginning at the outlet of North Grosvenordale Pond (approximately 3500 feet upstream) and continuing to the confluence with the Quinebaug River, has been periodically listed as impaired due to high bacteria levels. The sampling site is approximately 260 feet downstream of the confluence with Backwater Brook. North Grosvenordale in the immediate vicinity of this site is the most densely developed area in Thompson, and is one of Thompson's two designated MS-4 areas. This site was selected to document water quality impacts related to urban development.

Ten water samples were collected at this site, including two duplicate samples. All of the samples (100%) met the single sample Connecticut water quality standard of 576 cfu/100ml. The geometric mean for this site is 47, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

FR04 – French River at North Grosvenordale Pond:

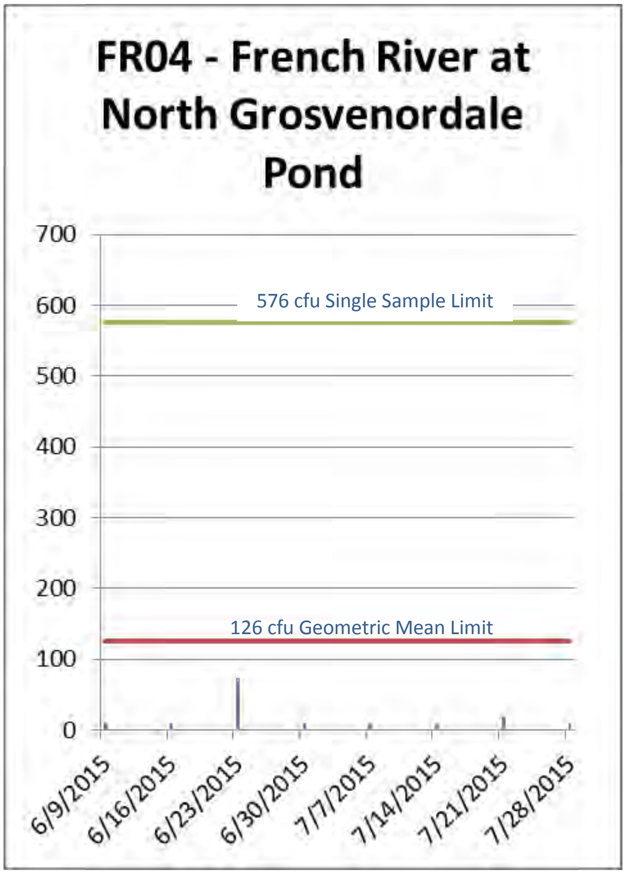


Figure 10. Graph of bacteria sampling results at FR04; view of the sampling site at the North Grosvenordale Pond spillway; and an aerial imagery of the sampling site location and vicinity.

FR04 is located just upstream of the outlet dam of North Grosvenordale Pond, an impoundment of the French River. Land cover in the vicinity and upstream of this site is comprised primarily of undeveloped tracts of forest land. The river segment (CT3300-00_01) from the outlet of this pond to the confluence with the Quinebaug River has periodically been listed as impaired for recreation due to high levels of bacteria. This site was selected to document water quality conditions upstream of the impaired segment.

Eight water samples were collected at this site. All of the samples (100%) met the single sample Connecticut water quality standard of 576 cfu/100ml. The geometric mean for this site is 14, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

FR05 – French River at Langers Pond/Wilsonville Road:

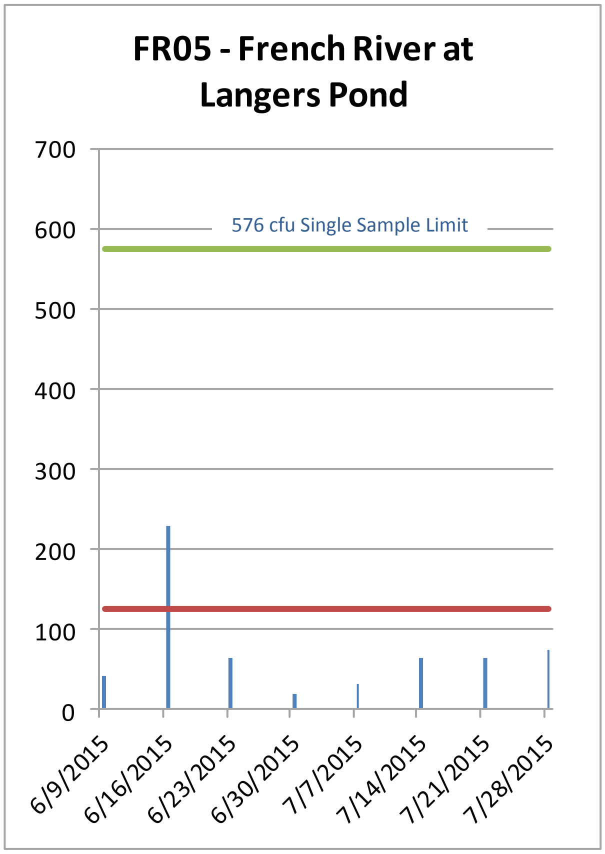


Figure 11. Graph of bacteria sampling results at FR05; upstream view of the French River at the sampling location; and an aerial image of the sampling site location and vicinity.

FR05 is located at the crossing of the French River at Wilsonville Road, at an impoundment known as Langers Pond. The sample was collected from the upstream side of the road crossing. Land cover in the vicinity of the French River from this site to the Massachusetts state line is primarily undeveloped and comprised of large forest tracts. However, two industrial sites of note are located adjacent to the river, including an inactive asphalt plant owned and operated by Tilcon Connecticut, and an automotive junk yard owned and operated by RPM Enterprises. The Tilcon plant has been inactive for a number of years. However, water quality data collected as part of the plant's NPDES industrial permit will be reviewed as part of the water quality investigation. The auto junk yard is located approximately 1800 feet upstream of sampling site, on the west side of the river.

Eight water samples were collected at this site. All of the samples (100%) met the single sample Connecticut water quality standard of 576 cfu/100ml. The geometric mean for this site is 57, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

FR06 – French River near the Massachusetts State Line:

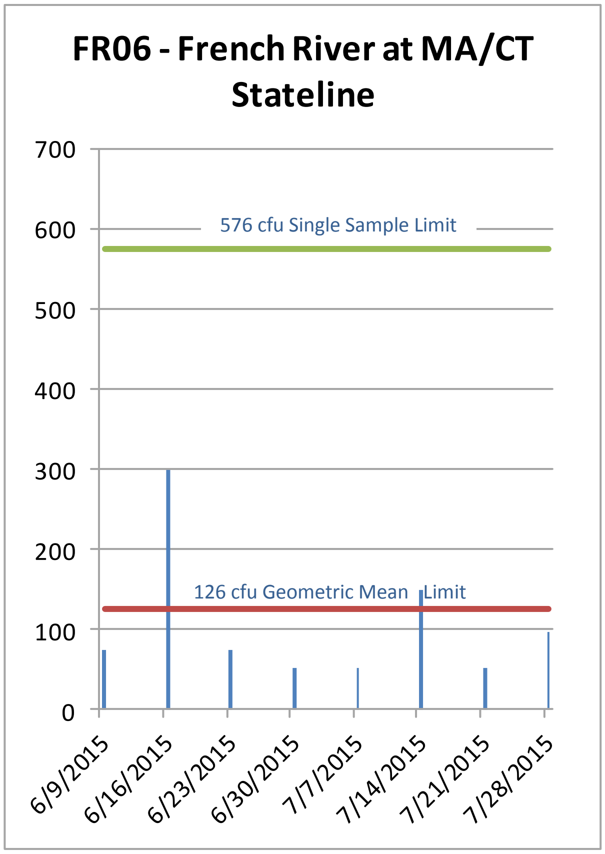


Figure 12. Graph of bacteria sampling results at FR06; downstream view of the French River at the sampling location; and an aerial image of the sampling site location and vicinity.

FR06 is located south of Perryville Road in Dudley, MA, approximately 100 feet south of the state line. This site was selected to establish baseline water quality as water entered Connecticut from Massachusetts.

Eight water samples were collected at this site. All of the samples (100%) met the single sample Connecticut water quality standard of 576 cfu/100ml. The geometric mean for this site is 87, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

LBB01 – Long Branch Brook at Wagher Road:

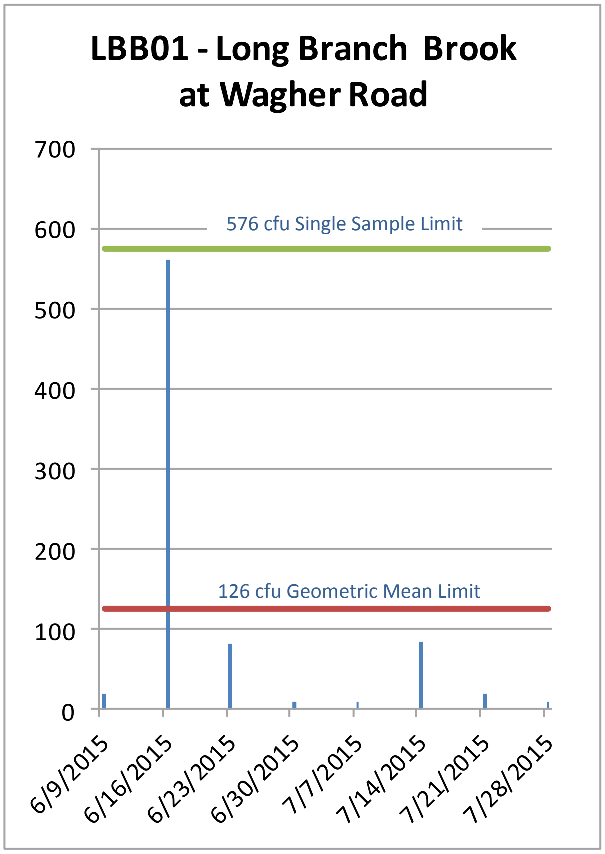


Figure 13. Graph of bacteria sampling results at LBB01; upstream view of Long Branch Brook at the sampling location; and an aerial image of the sampling site location and vicinity.

LBB01 is located at the Wagher Road crossing of Long Branch Brook. This site is located downstream of the CT DEEP probabilistic water quality monitoring site (6134), at which data that was used to determine the water quality impairment was collected. The surrounding area is rural residential and there is very little development between this site and LBB02, located approximately 1725 feet upstream. This site was selected to bracket water quality data at LBB02.

Nine water samples were collected at this site, including one duplicate sample. All of the samples (100%) met the Connecticut water quality standard of 576 cfu/100ml for single samples. The geometric mean for this site is 36, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

LBB02– Long Branch Brook at Labby Road:

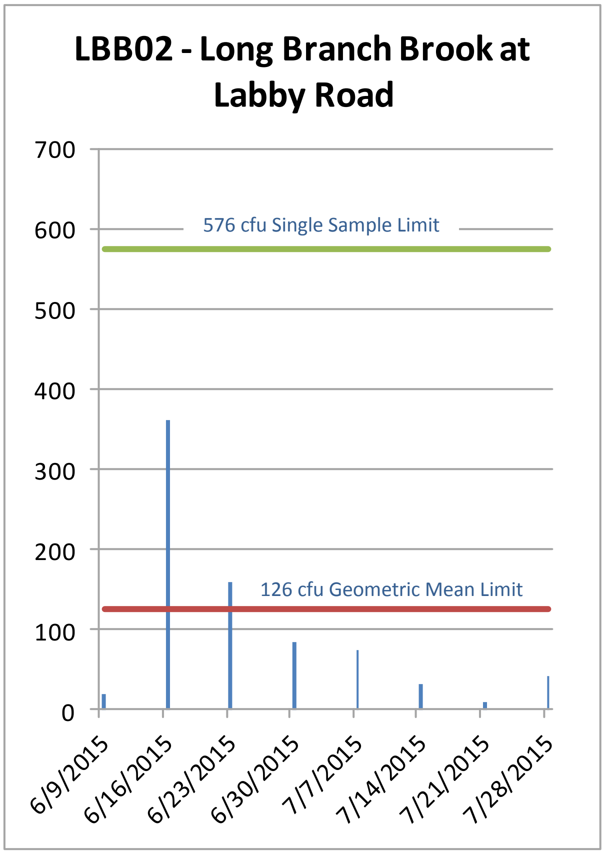


Figure 14. Graph of bacteria sampling results at LBB02; upstream view of Long Branch Brook at the sampling location; and an aerial image of the sampling site location and vicinity.

LBB02 is located at the crossing of Long Branch Brook at Labby Road. This site is just downstream of the CT DEEP probabilistic water quality monitoring site (6134), at which the data that was used to determine the water quality impairment was collected. The surrounding area is very sparsely developed. Long Branch Brook flows through undeveloped forest land between this site and LBB01, approximately 5000 feet upstream.

Eight water samples were collected at this site. All the samples (100%) met the single sample Connecticut water quality standard of 576 cfu/100ml. The geometric mean for this site is 56, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

LBB03 – Long Branch Brook at the Massachusetts State Line:

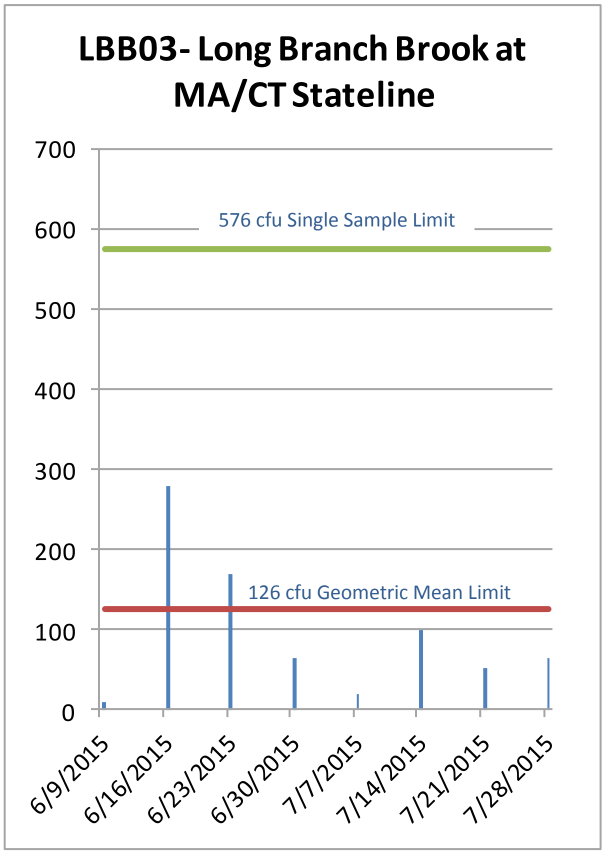


Figure 15. Graph of bacteria sampling results at LBB03; downstream view of Long Branch Brook at the sampling location; and an aerial image of the sampling site location and vicinity.

LBB03 is located on Long Branch Brook near the Connecticut-Massachusetts state line. This site is located between a sewered residential neighborhood to the west and Interstate Route 395 to the east. The area in the immediate vicinity of the sampling site is forested. The headwaters of Long Branch Brook are located approximately 1700 feet upstream. This site was selected to obtain baseline water quality conditions as the stream entered Connecticut.

Eight water samples were collected at this site. All the samples (100%) met the Connecticut water quality standard of 576 cfu/100ml for single samples. The geometric mean for this site is 61, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

KB01 – Knowlton Brook at Wilsonville Road:

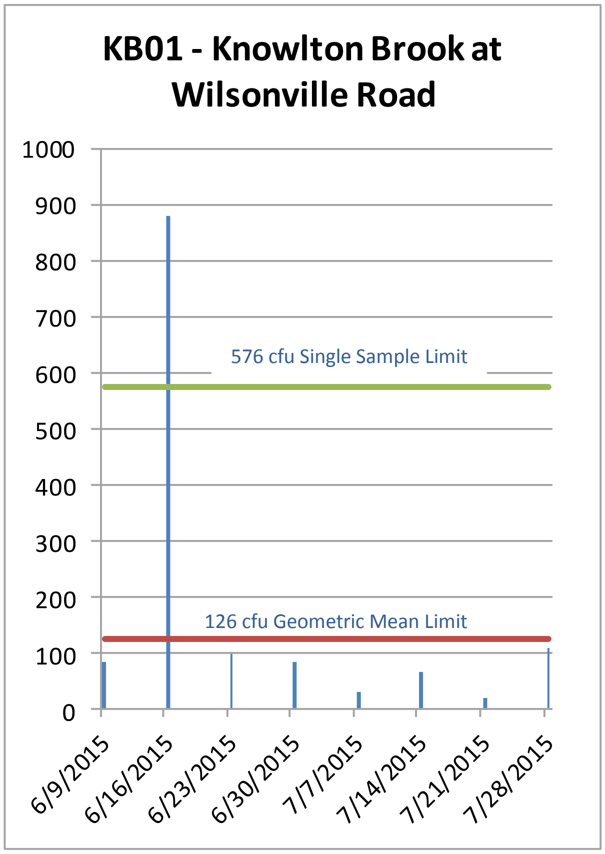


Figure 16. Graph of bacteria sampling results at KB01; downstream view of Knowlton Brook at the sampling location; and an aerial image of the sampling site location and vicinity.

KB01 is located at the Wilsonville Road crossing of Knowlton Brook. The surrounding area is rural residential and is primarily forested. Elevation relief in the vicinity of this site is very low. As a result, Knowlton Brook alternates between a defined channel and a scrub-shrub wetland and is very slow-moving. Knowlton Brook flows into Long Branch Brook approximately 3000 feet downstream of this site. This site was selected to document water quality being discharged to Long Branch Brook from the Knowlton Brook watershed.

Nine water samples were collected at this site, including one duplicate sample. Eight samples (89%) met the Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 83, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

SHB01– Sunset Hill Brook at Klondike Avenue:

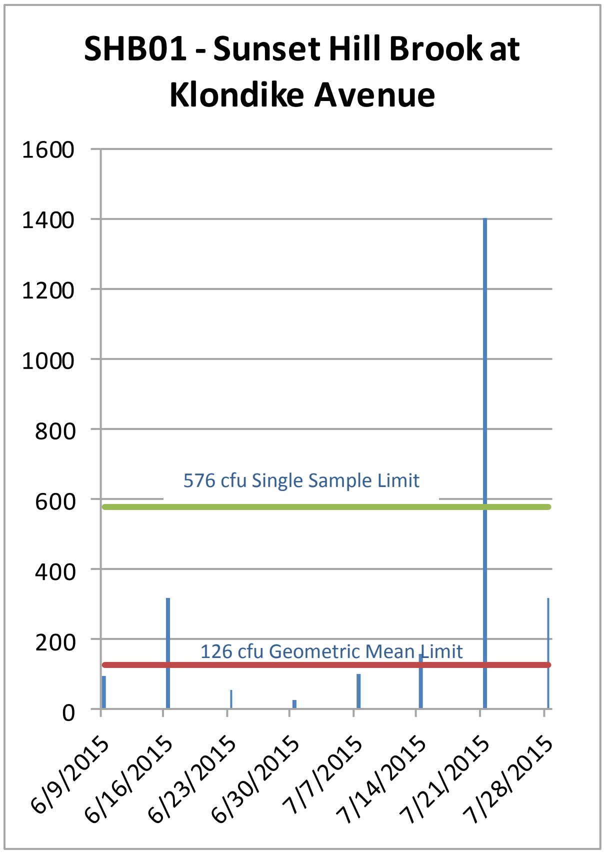


Figure 17. Graph of bacteria sampling results at SHB01; view of Sunset Hill Brook upstream of the sampling site; and an aerial image of the sampling site location and vicinity.

SHB01 is located at the crossing of Klondike Road with Sunset Hill Brook, approximately 700 feet upstream of the confluence with the French River. This site is also located approximately 525 feet downstream of a Connecticut Water Company public drinking water supply wellhead. This site is located in a suburban residential neighborhood which is served by municipal sewer (Fig. 6). This site was selected to document water quality contributions from the Sunset Hill Brook watershed to the French River.

Nine water samples were collected at this site, including one duplicate sample. Eight of the samples (89%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 124, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

SHB02 – Sunset Hill Brook at Thompson Hill Road (State Route 200):

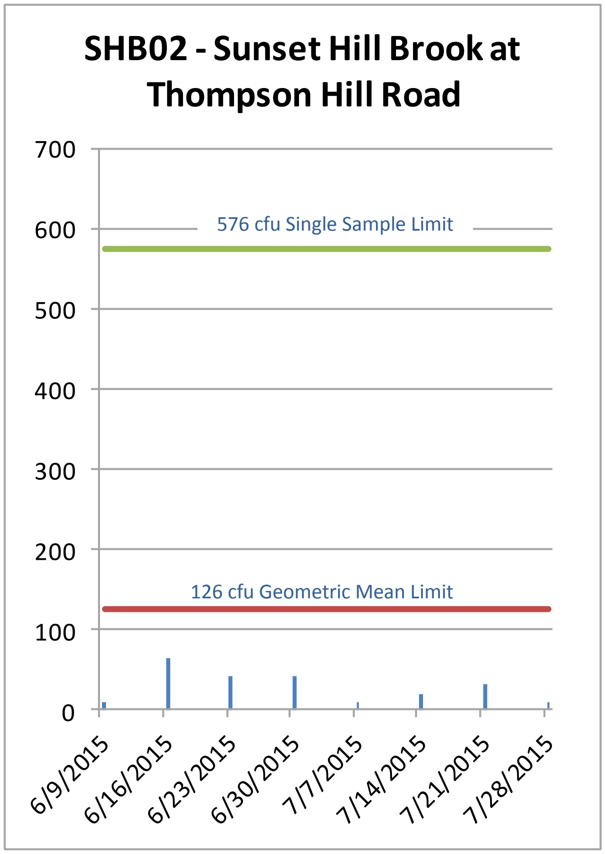


Figure 18. Graph of bacteria sampling results at SHB02; view of the culvert at the sampling location that conveys Sunset Hill Brook under Thompson Hill Road; and an aerial image of the sampling site location and vicinity.

SHB02 is located at the crossing of Sunset Hill Brook with Thompson Hill Road, and is located approximately 3500 feet upstream of SHB01. Sunset Hill Brook is culverted under Thompson Hill Road via a 48 inch corrugated metal pipe a distance of approximately 160 feet. The area surrounding and upstream of the sampling site and is rural residential and is primarily forested. This site was selected to potentially isolate water quality contributions from the Baptist Brook watershed and the upper portions of the Sunset Hill Brook watershed (Fig. 6).

Eight water samples were collected at this site. All the samples (100%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 124, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

SB01 – Stoud Brook at Thompson Hill Road (State Route 200):

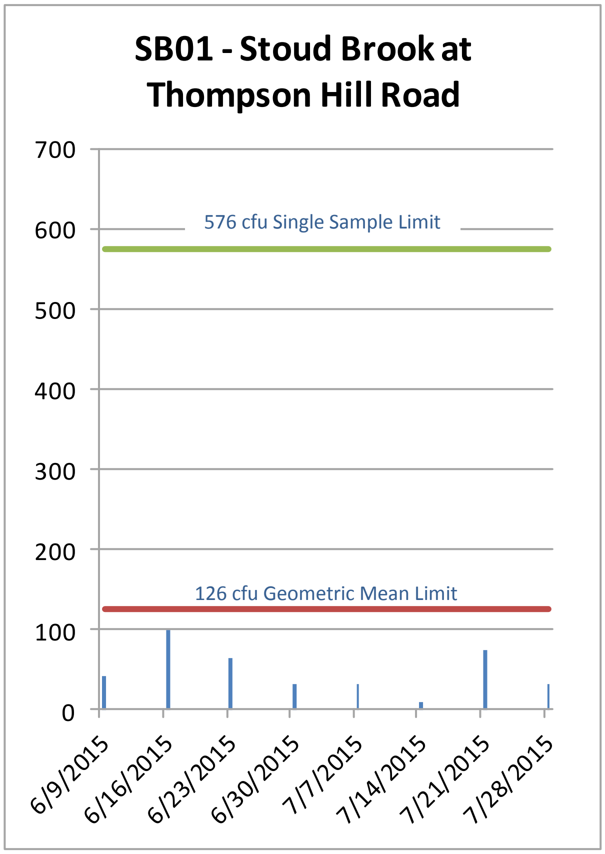


Figure 19. Graph of bacteria sampling results at SB01; view of Stoud Brook upstream of the sampling location; and an aerial image of the sampling site location and vicinity.

SB01 is located at the crossing of Stoud Brook at Thompson Hill Road (State Route 200), in a rural residential neighborhood. It is approximately 500 feet downstream of the Thompson Highway garage. There is a small impoundment approximately 100 feet upstream of the sampling site and a larger impoundment approximately 1250 feet upstream of the sampling site. This site was selected to isolate bacteria levels in Stoud Brook from composite water bacteria levels at SHB01, 1500 feet downstream.

Ten water samples were collected at this site. All the samples (100%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 33, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

BWB0.5 – Backwater Brook at the confluence with the French River:

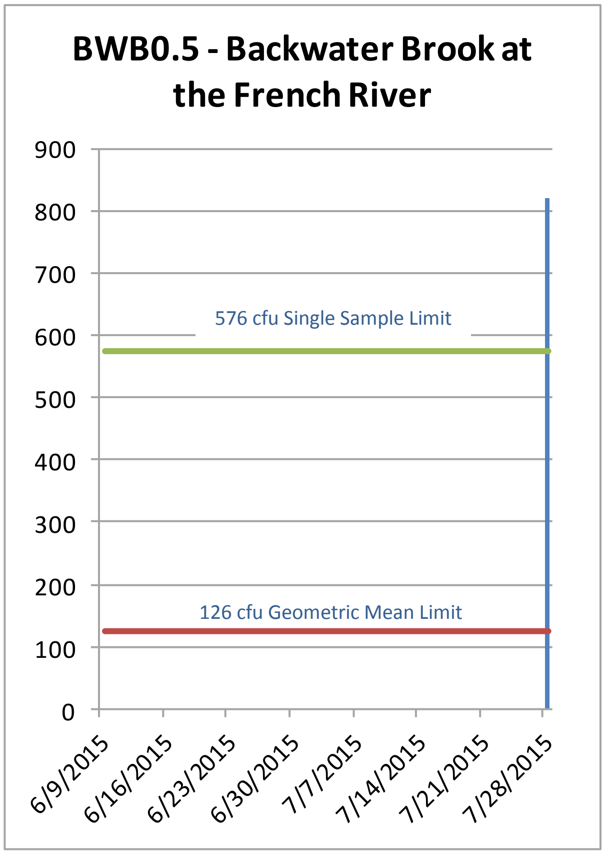
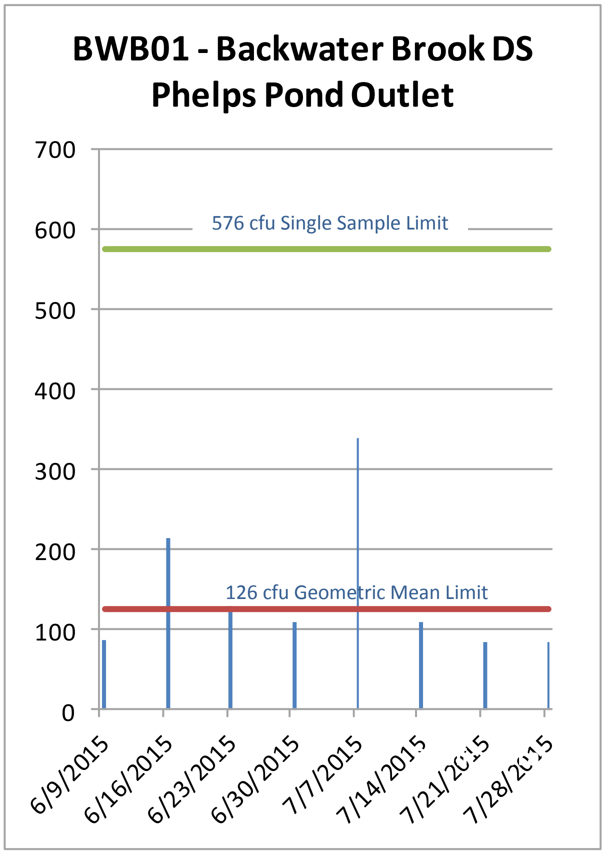


Figure 20. Graph of bacteria sampling results at BWB0.5; view of the culvert conveying Backwater Brook under the public library property and Main Street, just upstream of the sampling location; and an aerial image of the sampling site location and vicinity.

BWB0.5 is located at the outlet of a culverted segment of Backwater Brook, approximately ten feet upstream of the confluence with the French River. This sample was collected in an attempt to quantify water quality in response to a "sewage" odor from a nearby storm drain that is believed to discharge to this culverted segment of stream.

One water sample was collected at this site. At 820 cfu/100 ml, this sample exceeded the Connecticut water quality standard of 576 cfu/100 ml for single samples. Although only one sample was collected, an 85% bacteria reduction (based on a geometric mean of 820 cfu) is required at this site.

BWB01 – Backwater Brook near Main Street:



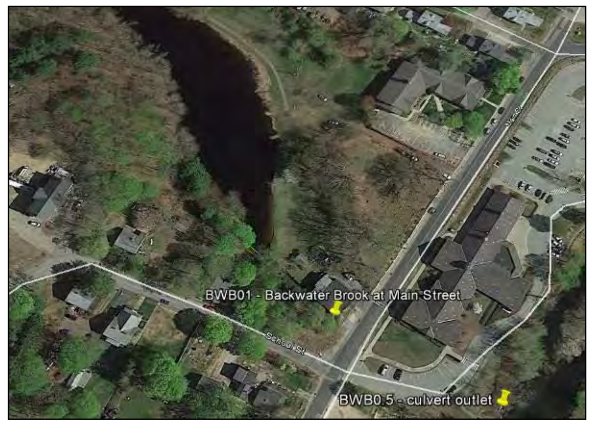


Figure 21. Graph of bacteria sampling results at BWB01; view of Backwater Brook upstream of the sampling location; and an aerial image of the sampling site location and vicinity.

BWB01 is located on Backwater Brook approximately 70 feet downstream of the outlet of Phelps Pond, and approximately 270 feet upstream of the confluence with the French River, near Main Street in North Grosvenordale. Phelps Pond is a Town-owned 3-acre impoundment of Backwater Brook. It is frequently utilized as a nesting and foraging habitat by a variety of waterfowl. North Grosvenordale in the vicinity of this site is the most densely developed area in Thompson, and is one of Thompson's two designated MS-4 areas. This area is served by municipal sewer (Fig. 6). BWB01 was selected to quantify bacteria levels in Backwater Brook upstream prior to its discharge to the French River.

Nine water samples were collected at this site. Eight of the samples (89%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 135, which exceeds the allowable geometric mean of 126 cfu/100 ml. A 7% bacteria reduction is required at this site.

BWB02 – Backwater Brook upstream of Phelps Pond:

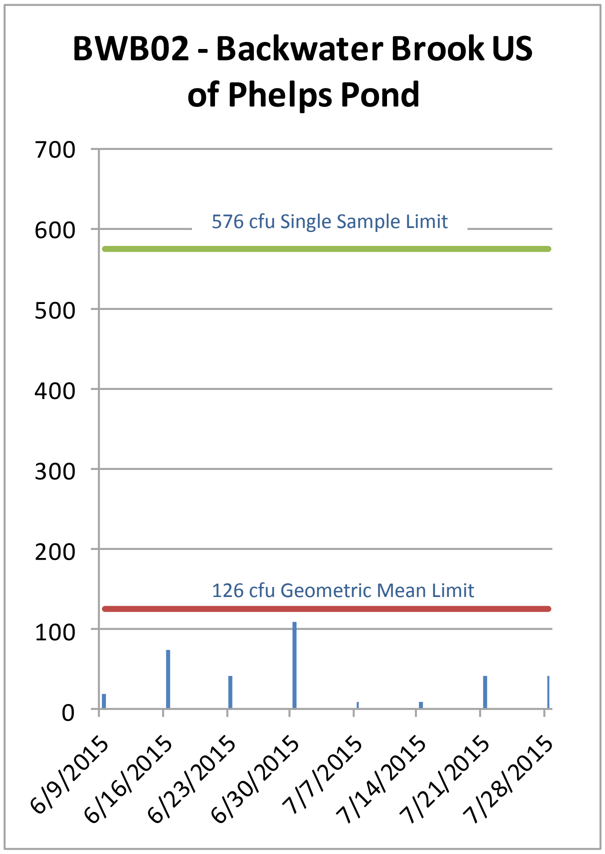


Figure 22. Graph of bacteria sampling results at BWB02; view of a beaver dam on Backwater Brook upstream of the sampling location; and an aerial image of the sampling site location and vicinity.

BWB02 is located on Backwater Brook approximately 300 feet upstream of Phelps Pond, off the end of Floral Avenue. This site is located upstream of dense residential development and was selected to bracket water quality observations at BWB01. The watershed upstream of BWB01 is primarily forested with scattered rural residential development.

Eight water samples were collected at this site. All the samples (100%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 32, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

UN01 – Unnamed stream at State Route 12 and Interstate Route 395:

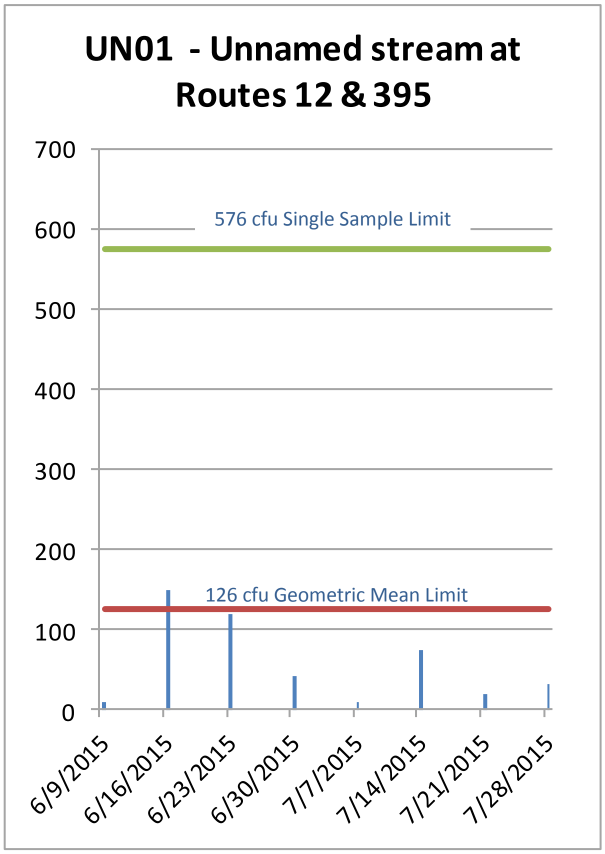


Figure 23. Graph of bacteria sampling results at UN01; view of the unnamed stream upstream of the sampling location; and an aerial image of the sampling site location and vicinity.

UN01 is located on an unnamed stream that originates at the Marianapolis Preparatory School (MPS) property on Thompson Hill, approximately 2700 feet upstream. This stream is suspected of periodically receiving effluent from a septic lagoon. Connection of MPS to the municipal sewer system was underway at the time of this water quality investigation. This stream also receives stormwater runoff from an off-ramp of Interstate Route 395.

Eight water samples were collected at this site. All the samples (100%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 37, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

LMB01 – Little Mountain Brook at Robbins Road:

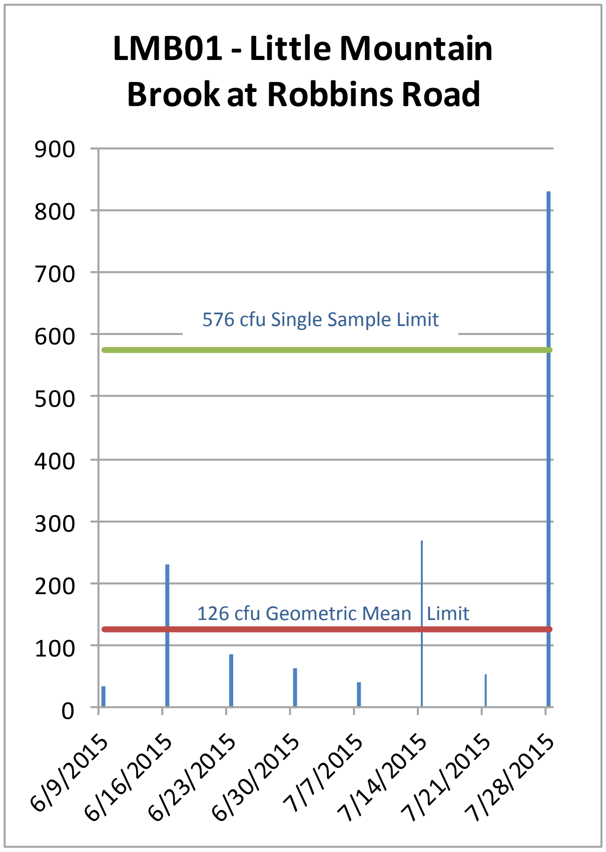
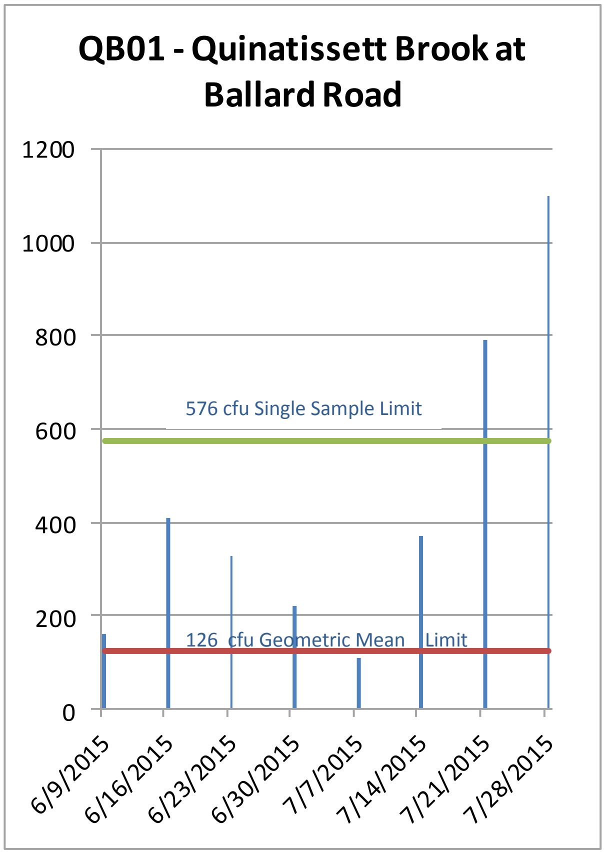


Figure 24. Graph of bacteria sampling results at LMB01; view of Little Mountain Brook at the sampling location; and an aerial image of the sampling site location and vicinity.

LMB01 is located on Little Mountain Brook downstream of the Robbins Road crossing. Little Mountain Brook originates in a small pond known locally as Duck Pond. Land use is in the vicinity of Duck Pond and Little Mountain Brook is a mix of hayfields and rural residential development. This site was selected to quantify bacteria levels in Little Mountain Brook prior to its discharge to the French River.

Nine water samples were collected at this site. Eight of the samples (89%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 96, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site.

QB01 – Quinatissett Brook at Ballard Road:



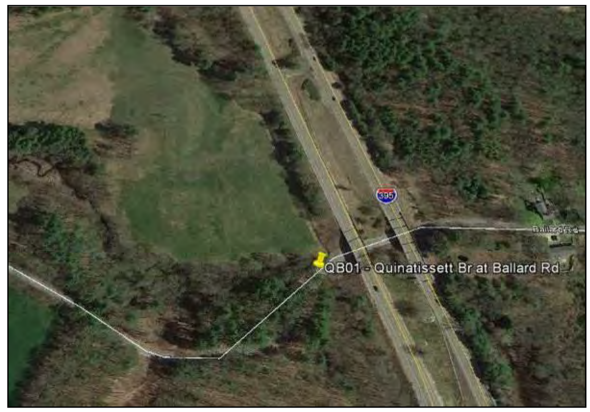


Figure 25. Graph of bacteria sampling results at QB01; view of Quinatissett Brook downstream of the sampling location; and an aerial image of the sampling site location and vicinity.

QB01 is located on Quinatissett Brook at the crossing of Ballard Road. This site is located downstream of agricultural and rural residential land uses. It was selected to characterize bacteria levels in Quinatissett Brook prior to its discharge to the French River.

Eight water samples were collected at this site. Six of the samples (75%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 338, which exceeds the allowable geometric mean of 126 cfu/100 ml. A 63% bacteria reduction is required at this site.

QB02 – Quinatissett Brook at Quinatissett Golf Course, County Home Road (State Route 21):

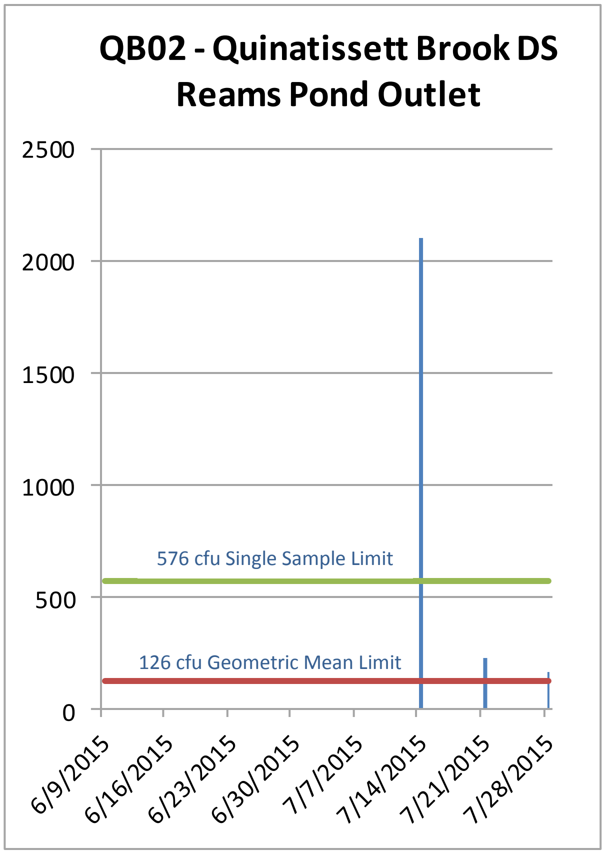


Figure 26. Graph of bacteria sampling results at QB02; view of Quinatissett Brook upstream of the sampling location; and an aerial image of the sampling site location and vicinity.

QB02 is located on Quinatissett Brook approximately 950 feet downstream of the outlet of Reams Pond at the Quinatissett Golf Course on County Home Road (RT 21). This site was added in week six of sampling to bracket upstream bacteria levels that were documented at QB01.

Four water samples were collected at this site. Three samples (75%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 361, which exceeds the allowable geometric mean of 126 cfu/100 ml. A 65% bacteria reduction is required at this site. It should be noted that only four samples were collected from this site during the sampling period, which does not constitute a reliable sample set.

RB01 – Ross Brook at Quaddick Road:

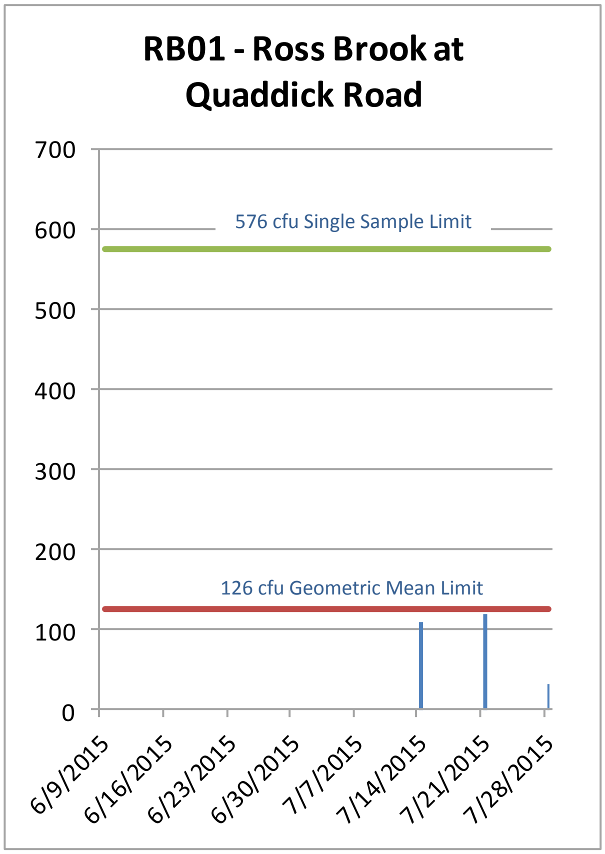


Figure 27. Graph of bacteria sampling results at RB01; downstream view of Ross Brook at the sampling location; and an aerial image of the sampling site location and vicinity.

RB01 is located on Ross Brook at the crossing of Quaddick Road, at the southern end of an extensive red maple wetland known locally as Thompson Meadows. This site was added in week six of sampling to bracket bacteria levels that were documented at QB01, and to isolate potential bacteria sources from nearby Elliott Brook (Ross Brook and Elliott Brook merge a short distance downstream of this site and flow into Reams Pond). There is scattered rural development upstream of this site.

Three water samples were collected at this site. All the samples (100%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 74, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site. It should be noted that only three samples were collected from this site during the sampling period, which does not constitute a reliable sample set.

EB01 – Elliott Brook at Chase Road:

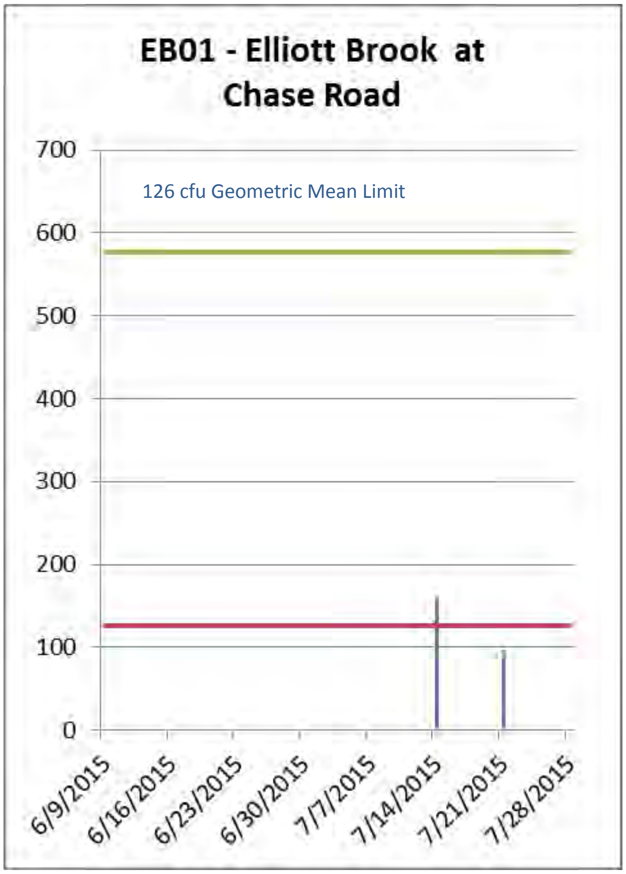


Figure 28. Graph of bacteria sampling results at EB01; view of Elliott Brook at the sampling location; and an aerial image of the sampling site location and vicinity.

EB01 is located at the crossing of Chase Road. This site was added in week six of sampling to bracket bacteria levels that were documented at QB01. This site is located downstream of the confluence of Elliott Brook and Ross Brook.

Two samples were collected at this site. Both samples (100%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 125, which is within the allowable geometric mean of 126 cfu/100 ml. No bacteria reduction is required at this site. It should be noted that only two samples were collected from this site during the sampling period, and do not constitute a reliable sample set.

EB02 – Elliott Brook at Quaddick Road:

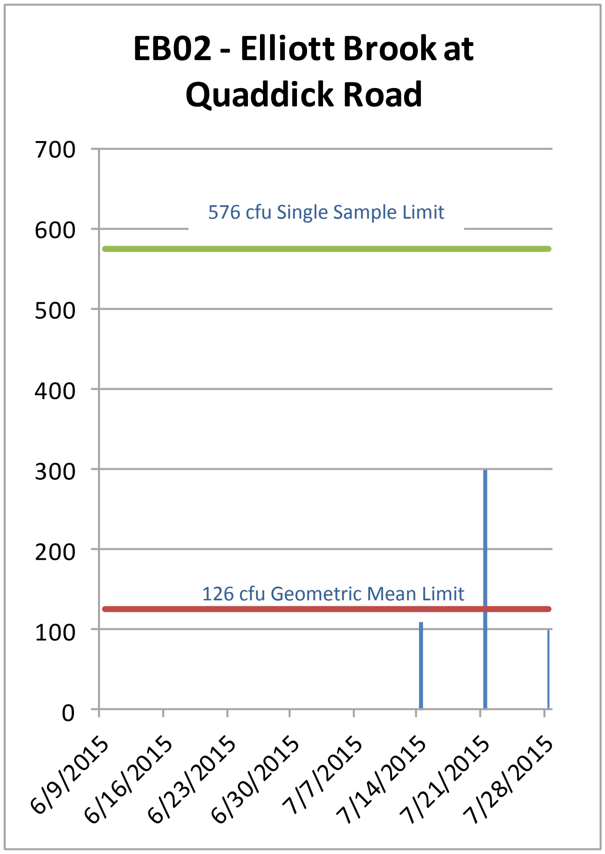


Figure 29. Graph of bacteria sampling results at EB02; view of Elliott Brook at the sampling location; and an aerial image of the sampling site location and vicinity.

EB02 is located on Elliott Brook at the Quaddick Road stream crossing. This site was added in week six of sampling to bracket bacteria levels that were documented at QB01. EB02 is approximately 1650 feet upstream of EB01, and is upstream of the confluence of Ross Brook with Elliott Brook. This site was selected to isolate potential bacteria contributions originating in Elliott Brook from those originating in Ross Brook (Fig. 6). There is scattered rural development upstream of this site.

Three samples were collected at this site. All the samples (100%) met Connecticut water quality standard of 576 cfu/100 ml for single samples. The geometric mean for this site is 148, which exceeds the allowable geometric mean of 126 cfu/100 ml. A 15% bacteria reduction is required at this site. It should be noted that only three samples were collected from this site during the sampling period, and do not constitute a reliable sample set.

Discussion

Bacteria levels at two of the eighteen primary sampling sites failed to meet Connecticut water quality standards for the geometric mean for each sample set. These sites included Backwater Brook downstream of Phelps Pond (BWB01, geomean = 135), near Main Street in North Grosvenordale, and Quinatissett Brook at Ballard Road (QB01, geomean = 338).

Bacteria levels at BWB01 were generally low (84 – 230 cfu/100 ml, with one higher measurement of 340 cfu/100 ml on 7/7/15). None of the samples exceeded the single sample limit of 576 cfu/100 ml. A comparison of bacteria levels at BWB01 to precipitation data collected by the Army Corps of Engineers at nearby West Thompson Lake (Fig. 30) indicates that bacteria levels spike immediately after precipitation. For example, a bacteria level of 215 (the average of 200 and 230 cfu/100 ml, the second value being a sample duplicate) was documented on 6/16/15, one day after a rainfall of 1.4 inches. In the absence of rainfall within 24 or so hours of sampling, bacteria levels in the stream water were generally low, indicating that stormwater runoff may be the primary vector for bacteria transport to Backwater Brook. The exception to this observation is a somewhat aberrant bacteria level of 340 cfu/100 ml collected on 7/7/15, during a period of dry weather. This value may be reflective of a bacteria plug from Phelps Pond due to waterfowl activity or other disturbance, or may be the result of sampling error. It should be noted that several domestic ducks were observed being kept at a property immediately upstream of the sampling site.

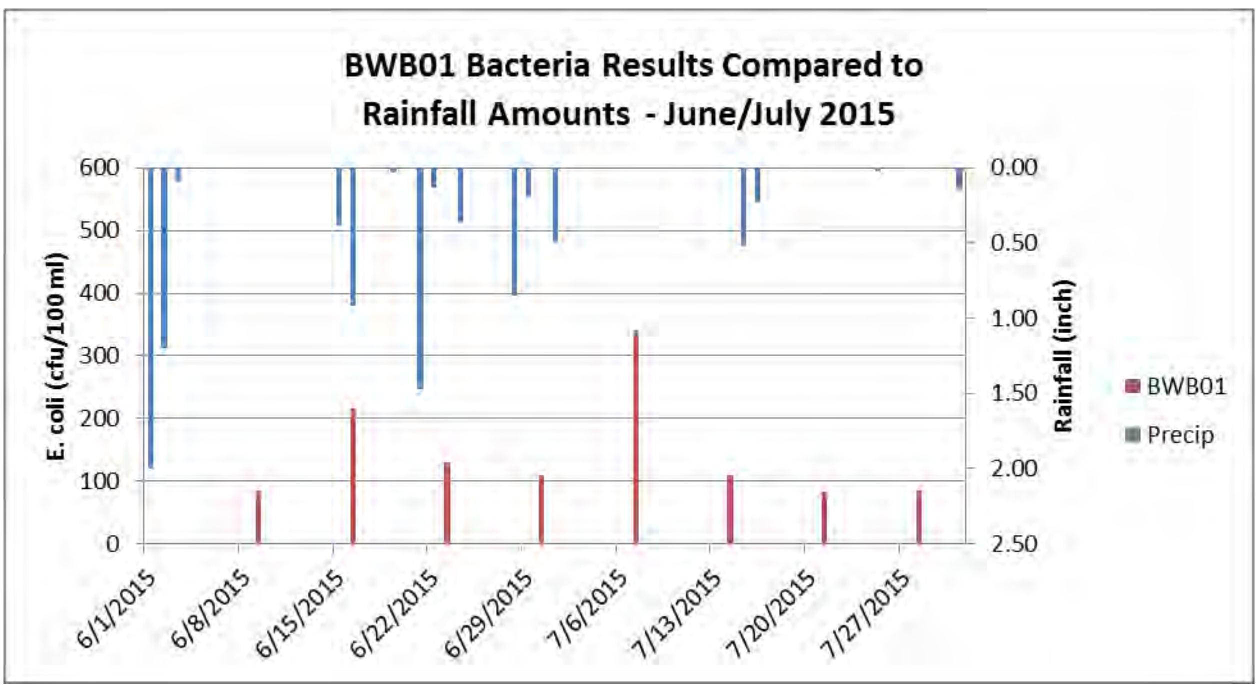


Figure 30. Comparison of bacteria levels at BWB01 (Backwater Brook downstream of Phelps Pond) to occurrence of rainfall.

A second sampling location on Backwater Brook, BWB02, upstream of Phelps Pond, was selected to bracket potential impacts of waterfowl known to utilize the pond for foraging and nesting, and to establish water quality upstream of the municipal sewer service area. Bacteria levels at this site were very low (geomean = 32), indicating that upstream bacteria contributions were insignificant.

A single water sample was collected at a third site on Backwater Brook (BWB0.5) on the final day of sample collection (7/28/15). ECCD staff and water quality volunteers noted a foul odor emanating from a storm drain behind the library (Fig. 31). Backwater Brook is culverted a distance of approximately 250 feet under Main Street and the Thompson Public Library property, before it discharges to the French River (Fig. 31). It is believed that a portion of the storm drain system serving the library parking lot may be tied into the culverted section of stream. A water sample was collected at the outlet of the culvert to determine if discharge from the storm drain system was contributing to bacteria load in Backwater Brook. This single dry weather sample yielded a bacteria level of 820 cfu/100 ml, indicating that further investigation into the layout of the storm drain system at the library should be conducted.

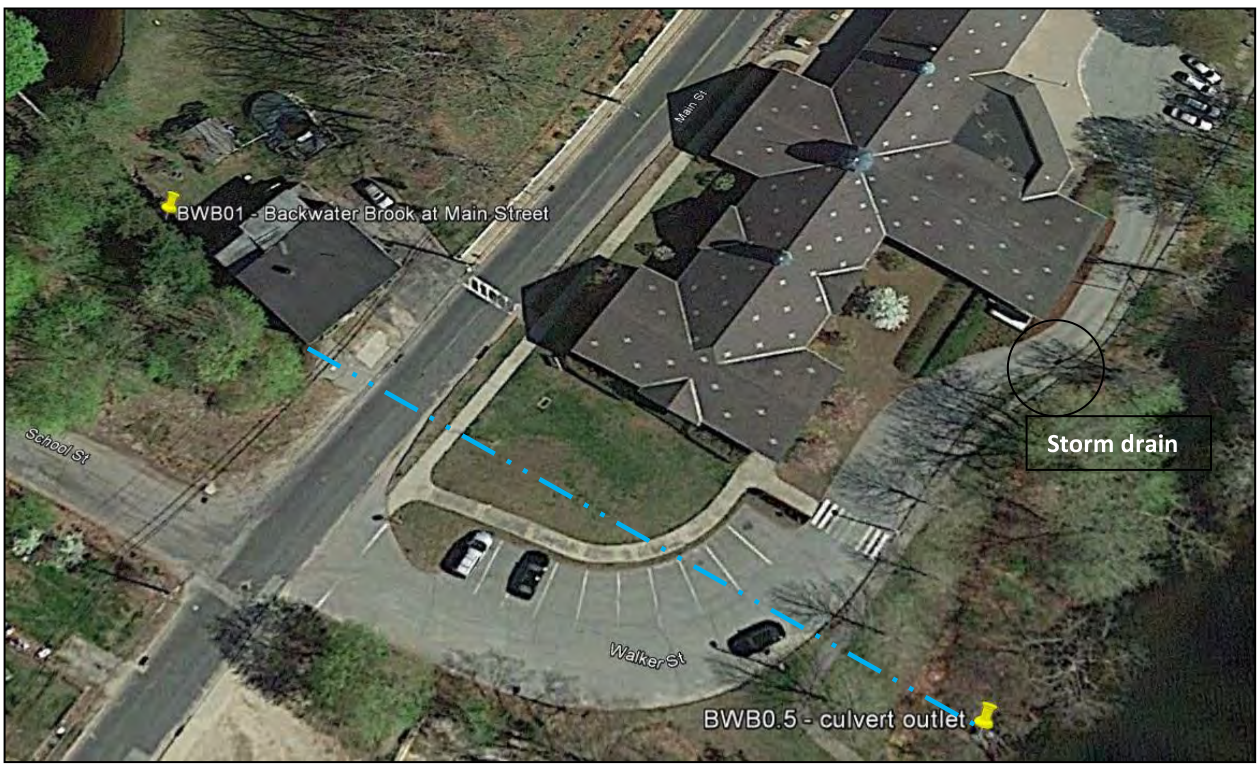


Figure 31. Culverted segment of Backwater Brook (dashed line). Approximately 250 feet of the stream is culverted under Main Street and the Thompson Public Library property.

Bacteria levels in Quinatissett Brook at Ballard Road (QB01) were generally higher than those observed at other sites in the French River watershed (Table 1), and dry weather samples collected on July 21st and 28th exceeded the single sample limit (Fig. 32). Typically, dry weather bacteria spikes indicate point sources, illicit discharges or base flow-related conditions such as septic system failures. However, there is little nearby development, so potential sources of, or contributing to, the observed bacteria levels are not immediately apparent.

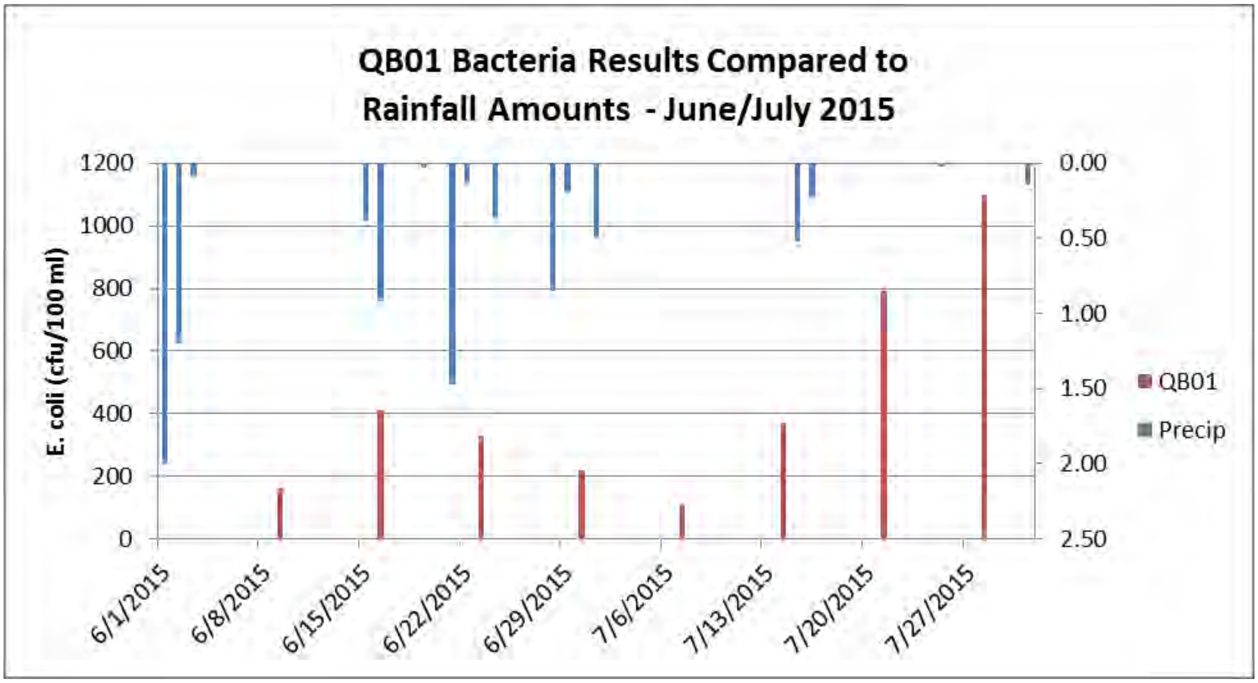


Figure 32. Comparison of bacteria levels at QB01 (Quinatissett Brook at Ballard Road) to occurrence of rainfall.

In order to bracket the bacteria levels observed at QB01, four additional upstream sampling sites were added in week six of sampling. These sites, QB02, RB01, EB01 and EB02 were selected to isolate potential bacteria sources below Reams Pond at the Quinatissett Golf Course (Quinatissett Brook - QB02), upstream of Reams Pond at Chase Road (Elliott Brook - EB01), and at two tributaries (Ross Brook – RB01, and Elliott Brook – EB02) upstream of the Chase Road site (Fig. 2).

The geometric mean of water samples collected at QB02, approximately 950 feet downstream of the outlet of Reams Pond, was 361 cfu/100 ml, which exceeded the established limit of 126 cfu/100 ml for the geometric mean of a sample set. A water sample collected on July 14th during a heavy shower yielded a bacteria level of 2100 cfu/100 ml, exceeding the single sample limit and indicating that pollutants conveyed in stormwater flow may be a significant source of bacteria loading to Reams Pond and Quinatissett Brook.

Potential bacteria sources to Reams Pond and Quinatissett Brook upstream of QB02 include agricultural land along the northeast shoreline, and Quinatissett Golf Course along the southeast, south and southwest shorelines. The shoreline of Reams Pond in the vicinity of the golf course is cleared with the greens extending to the water's edge, potentially creating attractive foraging conditions for waterfowl (Fig. 33). ECCD will follow up with golf course managers to determine if nuisance waterfowl is an issue at the facility.

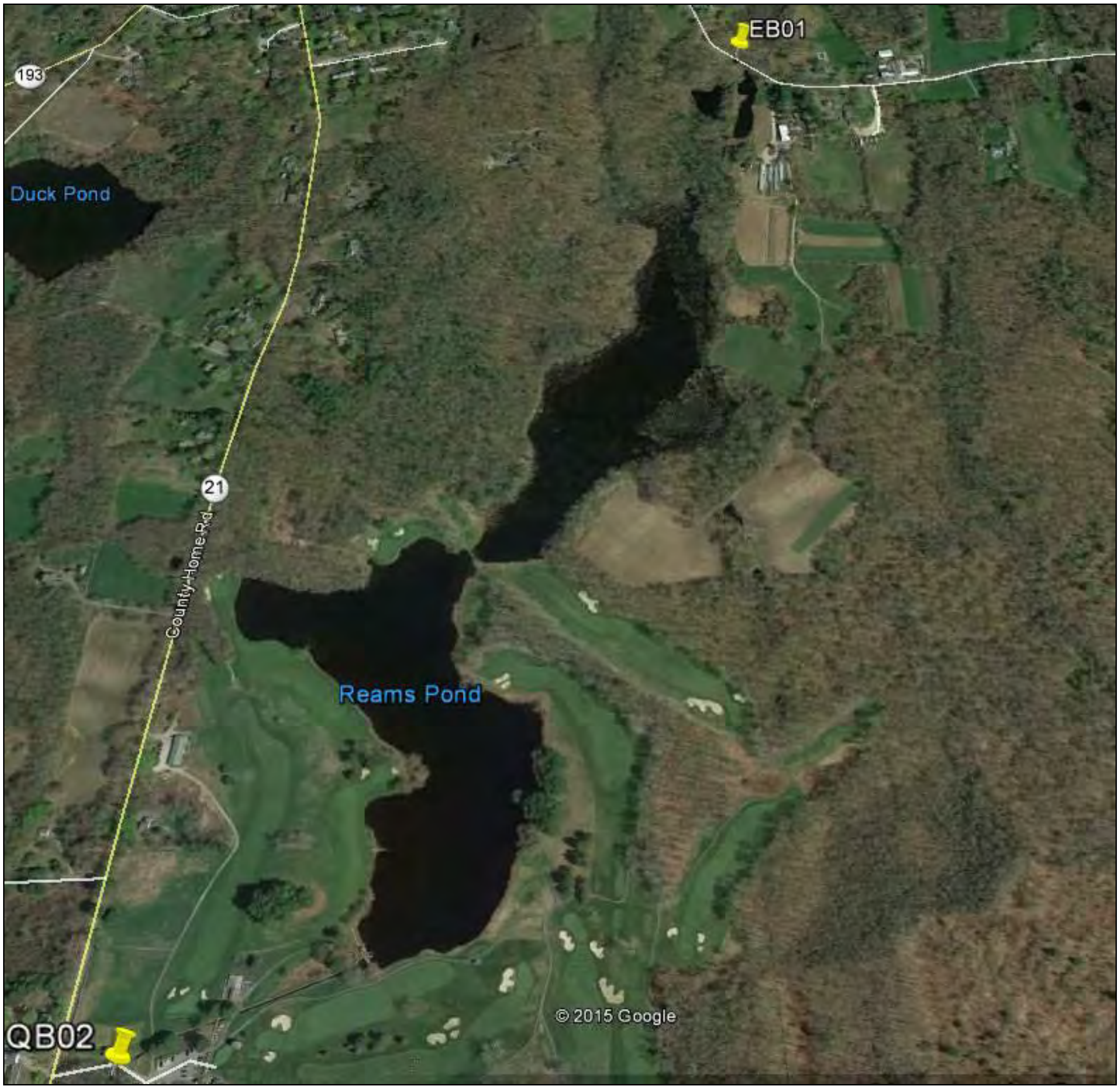


Figure 33. View of land use along Reams Pond, between QB02 and EB01.

Sampling site EB01, located on Elliott Brook at Chase Road, is upstream of the golf course and the agricultural land, and was selected to bracket potential bacteria contributions from those two land uses. The area upstream of EB01 is a forested wetland, with rural residential development along the road frontage. The geometric mean at EB01 was 125 cfu/100 ml, which was within the allowable geometric mean of 126 cfu/100 ml. It should be noted that only two samples were collected at this site, and that the stream was dry on the final day of sampling.

Finally, water samples were collected during the last three weeks of sampling at Ross Brook (RB01) and Elliott Brook (EB02) at Quaddick Road, to isolate bacteria contributions to the lower sampling sites from each of these tributaries. The area upstream of both sites is comprised of a large tract of undeveloped forested wetland known locally as Thompson Meadows. The geomean at RB01 was 74 cfu/100 ml, which was within the allowable geometric mean of 126 cfu/100 ml. The geomean at EB02 was 148 cfu/100 ml, which exceeded the allowable geometric mean. There were no obvious nearby conditions such as residential development or agricultural land that might have contributed to the documented bacteria levels in the stream. However, water levels in the stream were extremely low, and it is possible that low flow and ponding conditions may have concentrated background bacteria levels.

Bacteria levels at all six sampling sites along the French River, from the Massachusetts state line to the confluence with the Quinebaug River, including segment 01 of the French River (CT3300-00_01), were within allowable limits for both geomean and single samples. Segment 01 has been listed in multiple cycles of the DEEP's Integrated Water Quality Report to Congress, most recently in 2010, as impaired for recreation due to periodic high levels of *E. coli*. Likewise, bacteria levels in Long Branch Brook (CT3300-02_01), which was listed in the 2014 Integrated Water Quality Report as impaired for recreation due the presence of *E. coli*, were within allowable limits for both geomean and single samples.

Conclusion

In June and July of 2015, ECCD and TLGV water quality monitoring volunteers collected water samples from a total of twenty-three sites along the French River and its tributaries in Thompson, Connecticut. The water samples were analyzed by the CT Department of Public Health's Microbiology Laboratory for fecal bacteria (*E. coli*) content. A review of the bacteria analysis data indicates that Quinatissett Brook (CT3300-10) and Backwater Brook (CT3300-05) do not currently meet State of Connecticut water quality standards for recreational use. However, the French River, including segment 01 (CT3300-00_01), which has been listed in multiple cycles of the Connecticut Department of Energy and Environmental Protection's Integrated Water Quality Report to Congress, most recently in 2010, and Long Branch Brook (CT3300-02_01), which was listed in the 2014 *Integrated Water Quality Report to Congress* as impaired for recreation due the presence of bacteria, both met established water quality standards.

References

Connecticut, Department of Environmental Protection, *2010 Integrated Water Quality Report*, Final - May 31, 2011, Hartford, CT.

Connecticut, Department of Energy and Environmental Protection, *2014 State Of Connecticut Integrated Water Quality Report*, Draft – July 2014, Hartford, CT.

Connecticut, Department of Energy and Environmental Protection, *Water Quality Standards,* October 2013, Hartford, CT.

Appendix B

Priority Restoration List Report

EASTERN CONNECTICUT CONSERVATION DISTRICT, INC.

238 West Town Street
Norwich, CT 06360-2111
(860) 887-4163, Ext. 400

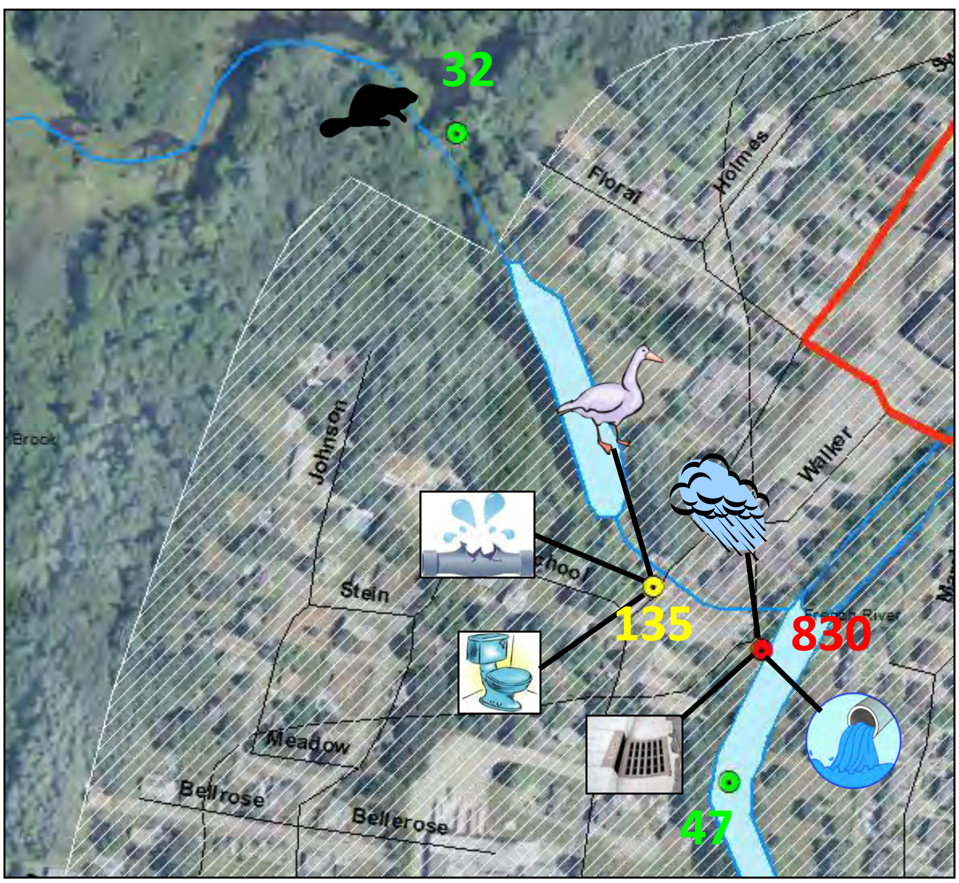
139 Wolf Den Road
Brooklyn, CT 06234
(860) 774-9600

www.ConserveCT.org/eastern

Contract 12-05f
French River Watershed-Based Plan and Implementation Action

Eastern Connecticut Conservation District
March 25, 2016
Revised April 7, 2016

Task 1f – Develop a Priority Restoration List



This project is funded in part by CT DEEP through a
US EPA Clean Water Act §319 Nonpoint Source Program grant.

Introduction

The Eastern Connecticut Conservation District (ECCD) received funding from the Connecticut Department of Energy and Environmental Protection (CT DEEP) through the Clean Water Act Section 319 Nonpoint Source program to conduct a water quality investigation of the French River (CT3300-00_01) and Long Branch Brook (CT3300-02_01, a local watershed located within the French River regional watershed) in Thompson, Connecticut (Fig. 1). The purpose of the investigation is to identify potential sources of fecal bacteria that have impacted water quality and resulted in the periodic inclusion of both waterbodies in the State of Connecticut's Impaired Waters (303d) list. Information collected during the course of this investigation will be used to develop a watershed management plan for the portion of the French River watershed located in Connecticut.

In addition to the impaired stream segments in Connecticut, the French River, which has its headwaters in the central Massachusetts town of Leicester, also has several impaired segments in Massachusetts. These segments, including two just across the Connecticut-Massachusetts state line in Dudley and Webster, are impaired for recreation due to the presence of *E. coli.* Additional information about these impaired waters can be obtained at: http://iaspub.epa.gov/tmdl_waters10/attains_impaired_waters.control?p_state=MA.

In order to address potential fecal bacteria sources from across the state line that may contribute to fecal bacteria levels noted in both the French River and Long Branch Brook in Connecticut, ECCD has consulted with Massachusetts Department of Environmental Protection (MADEP) staff to conduct a complementary water quality investigation in Massachusetts. To conduct this investigation, ECCD proposes to partner with The Last Green Valley, Inc. through Volunteer Water Quality Monitoring Program participants based in Dudley (The French River Connection) and Webster (Webster Lake Association), Massachusetts, the Towns of Dudley and Webster and the Central Massachusetts Regional Planning Commission.

For the purposes of Task 1f – *Develop a priority restoration list*, upon completion of water quality sampling in 2015, ECCD reviewed the water quality data in order to identify bacteria "hot spots," or localized stream segments with high fecal bacteria levels. ECCD identified two fecal bacteria hot spots in the French River watershed within Thompson, Connecticut. ECCD evaluated the land uses surrounding these areas to identify potential fecal bacteria sources for further investigation, and developed a priority restoration list for use within the watershed plan.

Procedure

In June and July 2015, ECCD and volunteers from The Last Green Valley Volunteer Water Quality Monitoring Program collected water samples from twenty-three locations on the French River and perennial tributary streams within the Connecticut portion of the regional watershed for fecal bacteria analysis (Fig. 2). The selection of the water sampling sites was based in part on information and recommendations made in the *Statewide Total Maximum Daily Load (TMDL) Analysis for Bacteria Impaired Waters* (CT DEEP, 2012), and the accompanying *French River Watershed Summary Report* (CT DEEP, 2012). Data collection was conducted in accordance with a water quality monitoring plan submitted to DEEP in March 2015, utilizing sampling protocols specified in The Last Green Valley Volunteer Water Quality Monitoring Program Bacteria Sampling Quality Assurance Project Plan (QAPP). This QAPP (US EPA Tracking Number RFA #13504) was approved by CT DEEP and US Environmental Protection Agency (US EPA) in June 2012.

Water samples were processed by the Connecticut Department of Public Health (DPH) Microbiology Laboratory in Rocky Hill, CT and forwarded to ECCD for review. Bacteria results were tabulated and evaluated by ECCD (Table 1). The 2013 Connecticut Water Quality Standards establish water quality criteria for indicator bacteria, including *E. coli*, which is the preferred indicator bacterium for fresh waterbodies. For recreational contact, excluding designated and non-designated swimming areas, the single sample maximum is 576 colony-forming units (cfu) per 100 milliliters of water and the maximum sample set geometric mean is less than 126 cfu/100 ml.

ECCD reviewed the bacteria data to identify "hot spots," areas where stream fecal bacteria levels consistently exceeded established water quality standards. ECCD considered sampling sites to be hot spots if the geometric mean exceeded established limits, and if one or more single sample results also exceeded established limits. Upon identification of fecal bacteria hot spots, ECCD reviewed the surrounding land uses (Fig. 3) in order to identify possible bacteria sources, including the presence of agriculture, livestock, pets, wildlife, stormwater runoff, underperforming septic systems, sewer line leaks and illicit discharges.

Based on the review of potential bacteria sources, ECCD prepared a prioritized restoration list identifying possible stormwater management practices that could be implemented to improve water quality at each site. The priority restoration list was presented to French River stakeholders at a project status meeting at the Thompson Town Hall on February 29th. Stakeholders present included the Thompson first selectman, municipal land use staff and an

Inland Wetlands Commissioner. Additional stakeholders including several key watershed land managers/owners and town staff were not able to attend. The project partners/stakeholders reviewed the draft priority restoration list and discussed potential bacteria sources and management actions at each of the bacteria hot spots. Based on that discussion, ECCD prepared the French River priority restoration list presented as Table 2.

Results

ECCD identified two stream segments where in-stream fecal bacteria levels consistently exceeded established water quality standards for both single samples and the geometric mean; Quinatissett Brook (sampling sites QB02 and QB01), from the confluence with the French River to the outlet of Reams Pond, and Backwater Brook (sampling sites BWB01 and BWB0.5), from the confluence with the French River to the outlet of Duhamel Pond (Fig. 4). ECCD reviewed the surrounding land uses in order to identify possible fecal bacteria sources (Fig. 5), and prepared a prioritized restoration list identifying possible stormwater management practices that could be implemented to improve water quality at each site (Table 2).

Eighteen of the remaining nineteen sampling sites, including sampling sites at the two stream segments that were listed as impaired, the French River (CT3300-00_01, from the confluence with the Quinebaug River to the outlet of North Grosvenordale Pond) and Long Branch Brook (CT3300-02_01), met established water quality standards. The remaining sampling site, EB02, located on Elliott Brook at Quaddick Road, did not meet the established water quality standard for the sample set geometric mean, although the individual water samples did meet the single sample criteria. However, since only three samples were collected at this site, additional sampling should be conducted to provide a more comprehensive data set for evaluation.

Discussion

ECCD identified two stream segments that did not meet Connecticut water quality standards for recreational use due to high levels of indicator fecal bacteria. These two stream segments, Backwater Brook downstream of Duhamel Pond (BWB01, geomean = 135 cfu/100ml), near Main Street in North Grosvenordale, and Quinatissett Brook downstream of Reams Pond at Quinatissett Golf Course (QB02, geomean = 361 cfu/100ml), were designated priority restoration sites. Each site was evaluated to identify potential fecal bacteria sources, and potential mitigative activities have been proposed.

Quinatissett Brook at Ballard Road (QB01, geomean = 338 cfu/100ml) also failed to meet Connecticut water quality standards for the geometric mean, and had several single sample exceedances, but it is unclear if documented bacteria levels at that site are the result of bacterial loading from nearby sources or reflective of bacteria levels documented at QB02, located approximately 5500 feet upstream. It should be noted that ECCD added sampling site QB02 (as well as several sampling sites upstream of QB02) six weeks into the sampling cycle to bracket and/or isolate the bacteria levels documented at QB01. As a result, the geomean of 361 cfu/100ml is comprised of 3 sampling events and may not constitute a reliable sampling set.

Priority Restoration Site #1 - Backwater Brook: Backwater Brook is located in the North Grosvenordale section of Thompson, a densely developed industrial-era mill village. Surrounding land use is predominantly suburban/urban residential, with intermixed small and medium-sized commercial businesses. North Grosvenordale is served by municipal sewer and a storm drain system that discharges to the French River. BWB01 is located on a channelized segment of Backwater Brook approximately 75 feet downstream of the outlet of Duhamel Pond, a small (±2 acre) town-owned impoundment of Backwater Brook. The pond is used by a small number of waterfowl, including several domestic ducks. A short distance downstream of the sampling site, Backwater Brook is culverted ±250 feet under Main Street and the Thompson Public Library property before it daylights near the French River (Fig. 6). The library site was redeveloped in 1994, following the destruction (in the 1970s) of many of the previous structures on-site by a fire. Much of the existing infrastructure, including a public right-of-way (Walker Road) and sewer and water lines, was discontinued as part of the site redevelopment (Fig. 7). A walking path along the French River (the DEEP-funded French River Walk) passes through the library parcel. This path is well-used by residents and is popular with dog walkers. It has been observed that dog owners are not diligent about cleaning up after their animals and dog feces are commonly found along the walking path, the lawn at the library and also on sidewalks along Main Street, which is served by storm drains that discharge to both Backwater Brook and the French River.

Based on an evaluation of land use in the vicinity of Backwater Brook, suspected sources of fecal bacteria (Fig. 8) that were documented in Backwater Brook include:

- waterfowl observed at Duhamel Pond;
- unauthorized/un-sewered properties;

- sewer line leaks, including the abandoned sewer main and laterals on the library parcel;
- grey water (which is waste water from domestic sources such as kitchen, bathroom, or laundry, but **not** the toilet) discharges to old septic systems or dry wells;
- fecal bacteria contained in stormwater runoff, including canine fecal bacteria; and
- illicit discharges to the existing storm drain system. An illicit discharge is a discharge to the storm drain system that is not composed of stormwater. This could include the discharge of household waste (grey and black water), automotive chemicals such as gasoline, oil or antifreeze, and carwash waste water.

Suggested management activities include:

- manage animal waste and waterfowl at Duhamel Pond;
- verify that all properties abutting Duhamel Pond are properly connected to the sanitary sewer system;
- conduct sewer main inspections/regular maintenance; verify the abandoned sewer main at the former Walker Road is not conveying waste;
- identify/verify presence of greywater discharges;
- reduce, infiltrate and/or treat stormwater runoff from surrounding developed area (roads, sidewalks, driveways, buildings, parking lots) prior to discharge to Backwater Brook and the French River;
- encourage dog owners/walkers to clean up after their pets; and
- identify and eliminate illicit discharges to the existing storm drain network.

Priority Restoration Site #2 - Quinatissett Brook: Quinatissett Brook is located in the southeast corner of Thompson. The Quinatissett Brook watershed is predominantly rural, with intermixed rural residential development, agricultural land and large tracts of forest. There are a variety of livestock (including horses, cattle, goats and sheep) scattered throughout the watershed; one small commercial agriculture operation (farm stand) that grows vegetables and flowers; and numerous fields that produce silage and hay. A golf course (Quinatissett Golf Course) is located along the southern end of Reams Pond on State Route 21 (County Home Road). Residences are served by on-site septic systems and private drinking water wells. Storm drainage is sporadic; most roads are crowned to shed storm water to the shoulders.

Quinatissett Brook begins at the outlet of Reams Pond, a ±30 acre impoundment of Elliott Brook, and flows west approximately 1¾ miles to the French River. Land along the northeast shore of Reams Pond is under cultivation by the farm stand. The farm stand owner has reported that he does not spread manure on the fields, but instead uses commercial fertilizers. Beef cattle are pastured in a field adjacent to an unnamed stream that flows into Elliott Brook south of sampling site EB01 on Chase Road. This stream was not sampled. Several horses are enclosed in a paddock located on the north side of Chase Road, upstream of EB01 and to the west of Elliott Brook. The paddock slopes to a wetland area adjacent to and contiguous with Elliott Brook. Both of these sites may be sources of fecal bacteria.

Quinatissett Golf Course wraps around the southern shore of Reams Pond. The shoreline along the greens is managed to the water's edge, potentially creating attractive foraging conditions for waterfowl. Golf course managers report periodic use of the greens by Canada geese, although not in large numbers. Golf course managers have also reported that the age and location of the club house septic system is unknown. As the French River watershed-based plan is developed, additional research into this subsurface waste system should be conducted by ECCD or other project partners. Soils at the golf course include Canton and Charlton soils and Sutton fine sandy loams. These moderately well-drained soils are shallow, have seasonally high groundwater, and overlay basal till, potentially creating conditions wherein incomplete renovation of septic leachate may occur.

Once Quinatissett Brook flows under State Route 21, it winds through a rural residential neighborhood (Robbins Road and Ballard Road), intermixed with agricultural fields and pastures, prior to discharging to the French River. Cultivated fields on the west side of RT 21, across from Quinatissett Golf Course, are used to grow silage and hay. A wetland system adjacent to these fields drains under Robbins Road to Quinatissett Brook. The farmer who manages these fields reports he uses commercial fertilizers including Milorganite. Milorganite is the trade name of a commercial fertilizer that is derived from wastewater treatment bio-solids and is produced by the Milwaukee Metropolitan Sewerage District. Milorganite is superheated during the manufacturing process to kill pathogens, and as a result, is not considered a bacteria source.

Livestock kept or pastured in the vicinity of Quinatissett Brook on Robbins and Ballard Roads includes horses and goats. Sheep are pastured at a property on State Route 21 at the Putnam town line, in the vicinity of an unnamed stream that flows to Quinatissett Brook. This stream was not sampled for bacteria content. It should be noted that bacteria levels at QB01, located at the Ballard Road crossing of Quinatissett Brook, may not be caused by bacteria loading from nearby land use activities, but may be reflective of higher bacteria levels derived from sources at or upstream of Reams Pond.

Based on an evaluation of land use in the vicinity of Quinatissett Brook (Fig. 9), suspected sources of fecal bacteria include:

- underperforming/failing septic system at Quinatissett Golf Course;
- underperforming/failing septic systems on Robbins Road and Ballard Road;
- waterfowl at Reams Pond;
- livestock upstream of Reams Pond; and
- livestock on RT 21, Robbins Road and Ballard Road.

Suggested management activities include:

- dye test of the septic system at Quinatissett Golf Course;
- bacteria DNA test and other investigations, as needed, to determine possible bacteria host(s);
- waterfowl management at the golf course; and
- promotion of pasture and animal manure best management practices among livestock owners.

In addition to the site-specific fecal bacteria sources provided above, the *French River Watershed TMDL Summary* (CT DEEP, 2012) identifies several potential non-point sources of bacteria in the watershed as a whole, including:

- stormwater run-off from developed areas;
- insufficient septic systems and illicit discharges;
- agricultural activities; and
- wildlife and domestic animal waste.

To address the potential non-point sources of bacteria throughout the Connecticut portion of the French River watershed, the Summary recommends:

- the use of Low Impact Development (LID) and Best Management Practices (BMPs), including of the use of riparian buffer zones, to control stormwater runoff in developed and agricultural areas;

- the evaluation of municipal education and outreach programs regarding animal waste;
- the development of a system to monitor septic systems;
- continued monitoring of permitted sources, including the Tilcon Connecticut Inc. operation (currently inactive), and the Town of Thompson Muncipal Stormwater MS4 permit; and
- municipal compliance with the MS4 program.

Conclusion

In summer of 2015, ECCD and TLGV water quality monitoring volunteers collected water samples from twenty-three sites along the French River and its tributaries in Thompson, Connecticut following an approved water monitoring plan and Quality Assurance Project Plan. The water samples were analyzed by the CT Department of Public Health's Microbiology Laboratory for fecal bacteria (*E. coli*) content. Segment 01 (CT3300-00_01) of the French River, which extends from the confluence with the Quinebaug River to the outlet of North Grosvenordale Pond, and which has been listed in multiple cycles of the CT DEEP's Integrated Water Quality Report to Congress (most recently in 2010) met water quality standards for recreational activities. Long Branch Brook (CT3300-02_01), which was listed in the 2014 *Integrated Water Quality Report to Congress* as impaired for recreation due to the presence of fecal bacteria, also met established water quality standards for recreational activities, which is supportive of the DEEP recommendation for delisting.

However, a review of the bacteria data indicates that Quinatissett Brook (CT3300-10) downstream of Reams Pond, and Backwater Brook (CT3300-05) downstream of Duhamel Pond do not currently meet State of Connecticut water quality standards for recreational use. ECCD evaluated land uses in the vicinity of each stream to identify possible bacteria sources. Based on the land use evaluation, ECCD and watershed stakeholders prepared a priority restoration list identifying possible management actions to address the bacteria sources. This priority restoration list will be used to develop management recommendations in the French River watershed management plan, and to provide guidance on measuring progress and making adjustments to the overall watershed management efforts.

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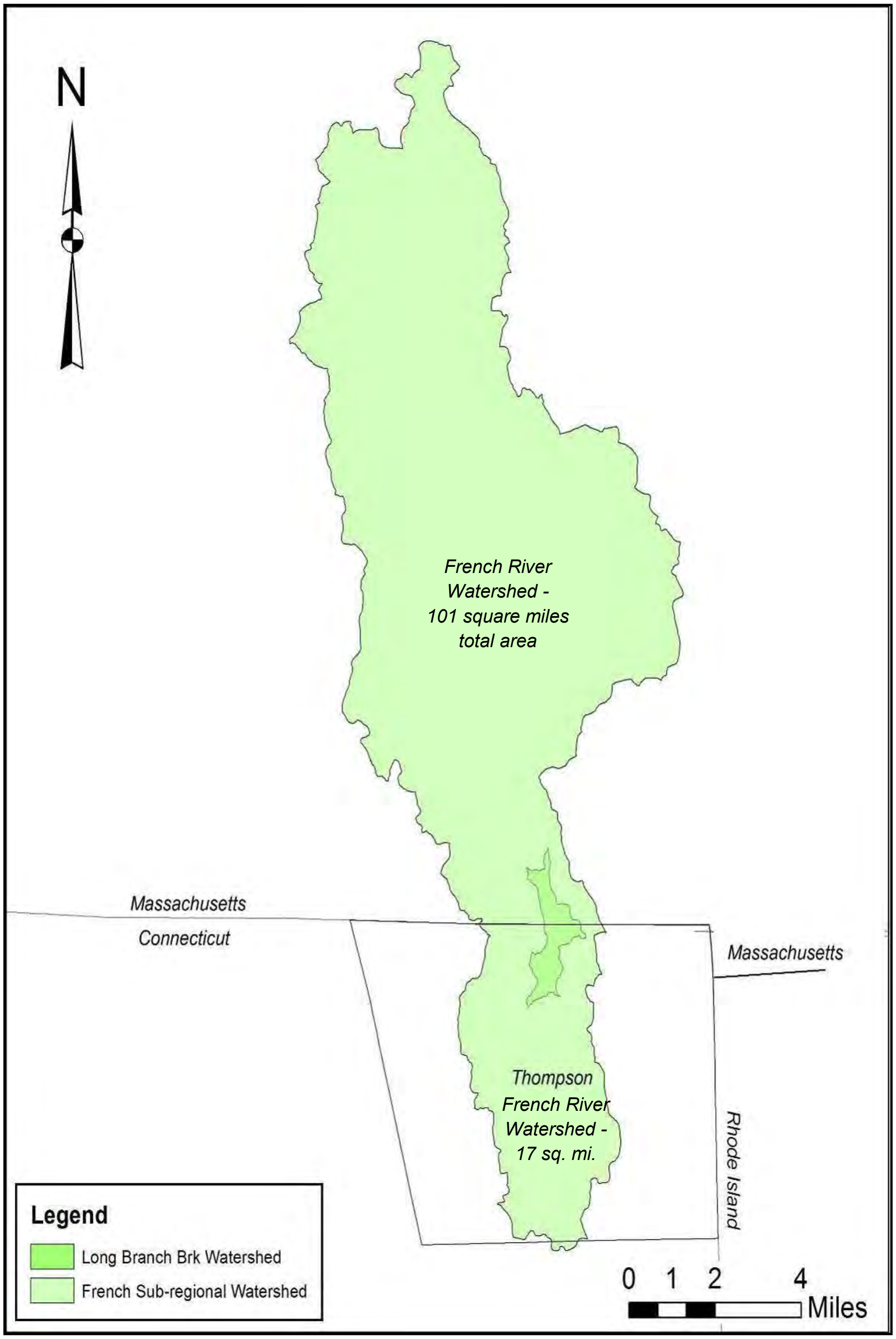

Figure 1. The French River sub-regional watershed in Massachusetts and Connecticut. The Long Branch Brook local watershed is depicted in dark green.

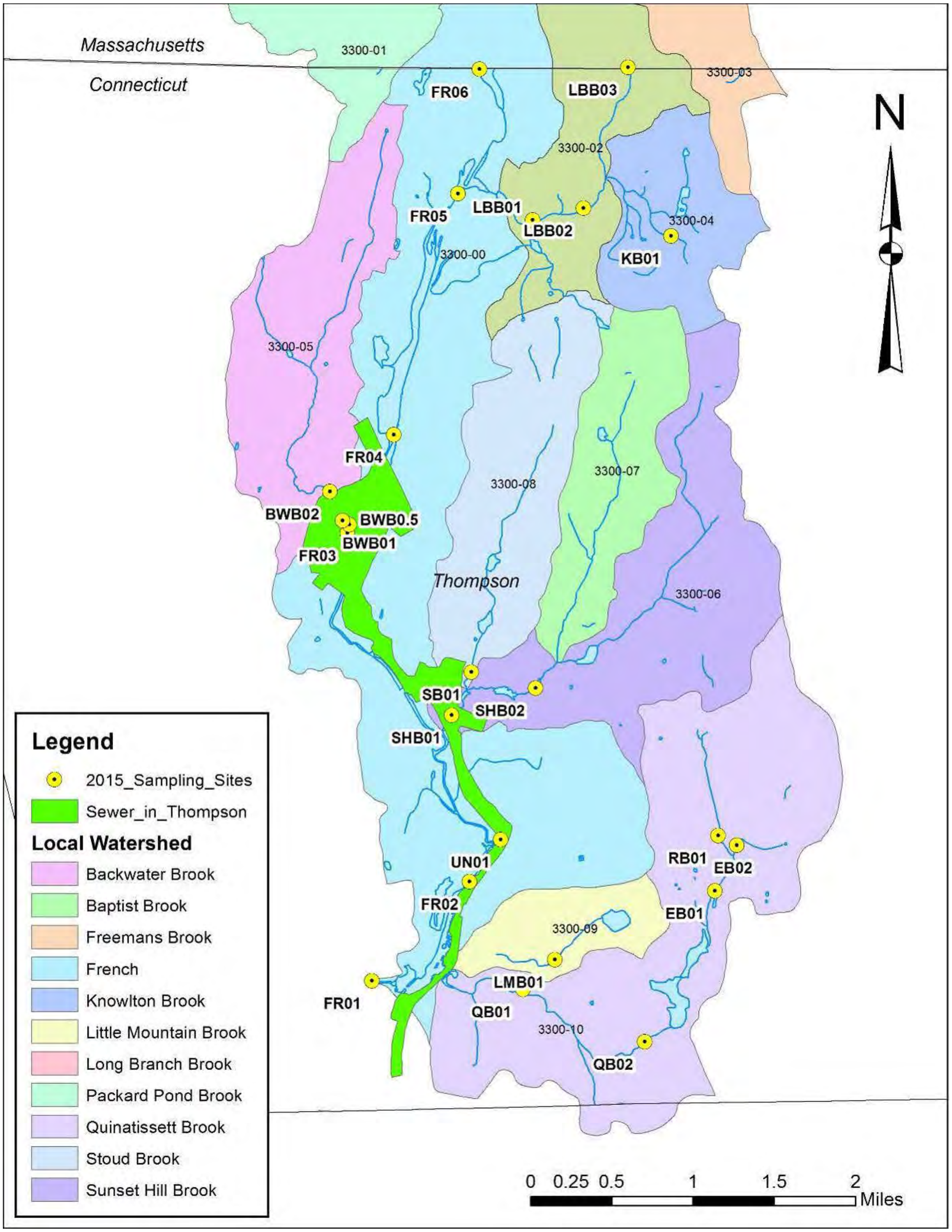

Figure 2. French River watershed fecal bacteria sampling sites. Local watersheds are delineated. The municipal sewer district is depicted in green.

Table 1. French River watershed fecal bacteria sampling results.

Site	6/9/15	6/16/15	6/23/15	6/30/15	7/7/15	7/14/15	7/21/15	7/28/15	geomean
FR01	20	420	140	85	41	31	86	86	74
FR02	75	63	110	110	110	52	170 (D=160)	120	101
FR03	130	51	200	31	20 (D=10)	31	74	75 (D=41)	47
FR04	<10	10	73	<10	<10	<10	20	<10	14
FR05	41	230	63	20	31	63	63	75	57
FR06	75	300	74	52	52	150	52	96	87
LBB01	20	560	110 (D=52)	10	<10	84	20	10	36
LBB02	20	360	160	85	74	31	<10	41	56
LBB03	<10	280	170	63	20	98	52	63	61
KB01	84	**880**	98	85	31	63 (D=73)	20	110	83
SHB01	96	320	53	31 (D=20)	98	160	**1400**	320	124
SHB02	10	63	41	41	<10	20	31	<10	22
SB01	41	98	63	31	31	10 (D=10)	75	41 (D=20)	33
BWB0.5								**820**	---
BWB01	86	200 (D=230)	130	110	340	110	84	85	**135**
BWB02	20	73	41	110	<10	<10	41	41	32
UN01	10	150	120	41	10	73	20	31	37
LMB01	41 (D=30)	230	84	63	41	270	52	**830**	96
QB01	160	410	330	220	110	370	**790**	**1100**	**338**
QB02						**2100**	280 (D=170)	170	**361**
RB01						110	120	31	74
EB01						160	97	---	125
EB02						110	300	98	**148**
Wet/Dry	dry	wet	dry	dry	dry	dry	dry/wet*	dry	dry

* Began to rain midway through sampling

The 2013 Connecticut Water Quality Standards establish water quality criteria for indicator bacteria, including *E. coli*, which is the preferred indicator bacterium for fresh waterbodies. For recreational contact, excluding designated and non-designated swimming areas, the single sample maximum is 576 colony-forming units (cfu) per 100 milliliters of water and the maximum sample set geometric mean is less than 126 cfu/100 ml.

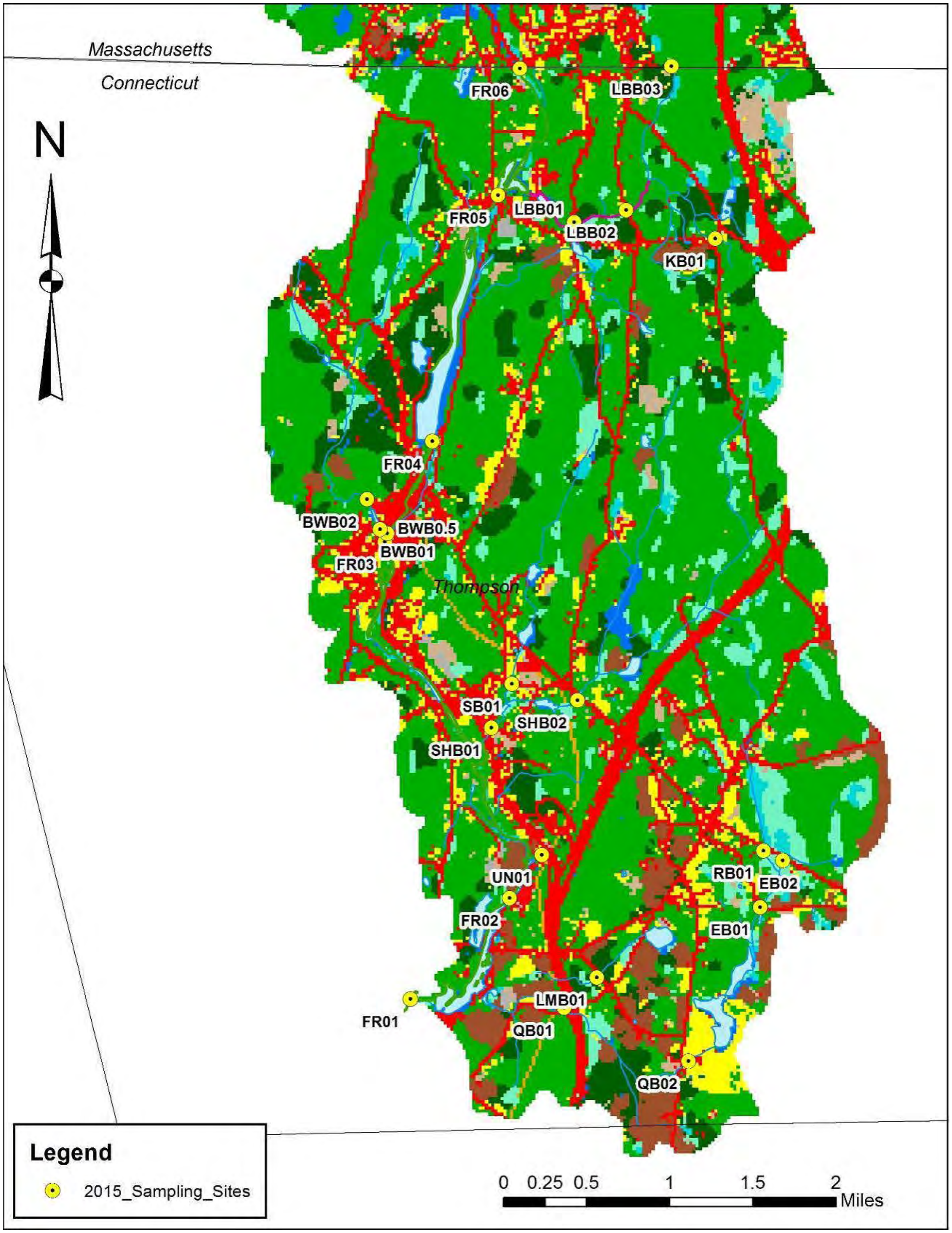

Figure 3. French River watershed bacteria sampling sites relative to land use/land cover (CLEAR 2010).

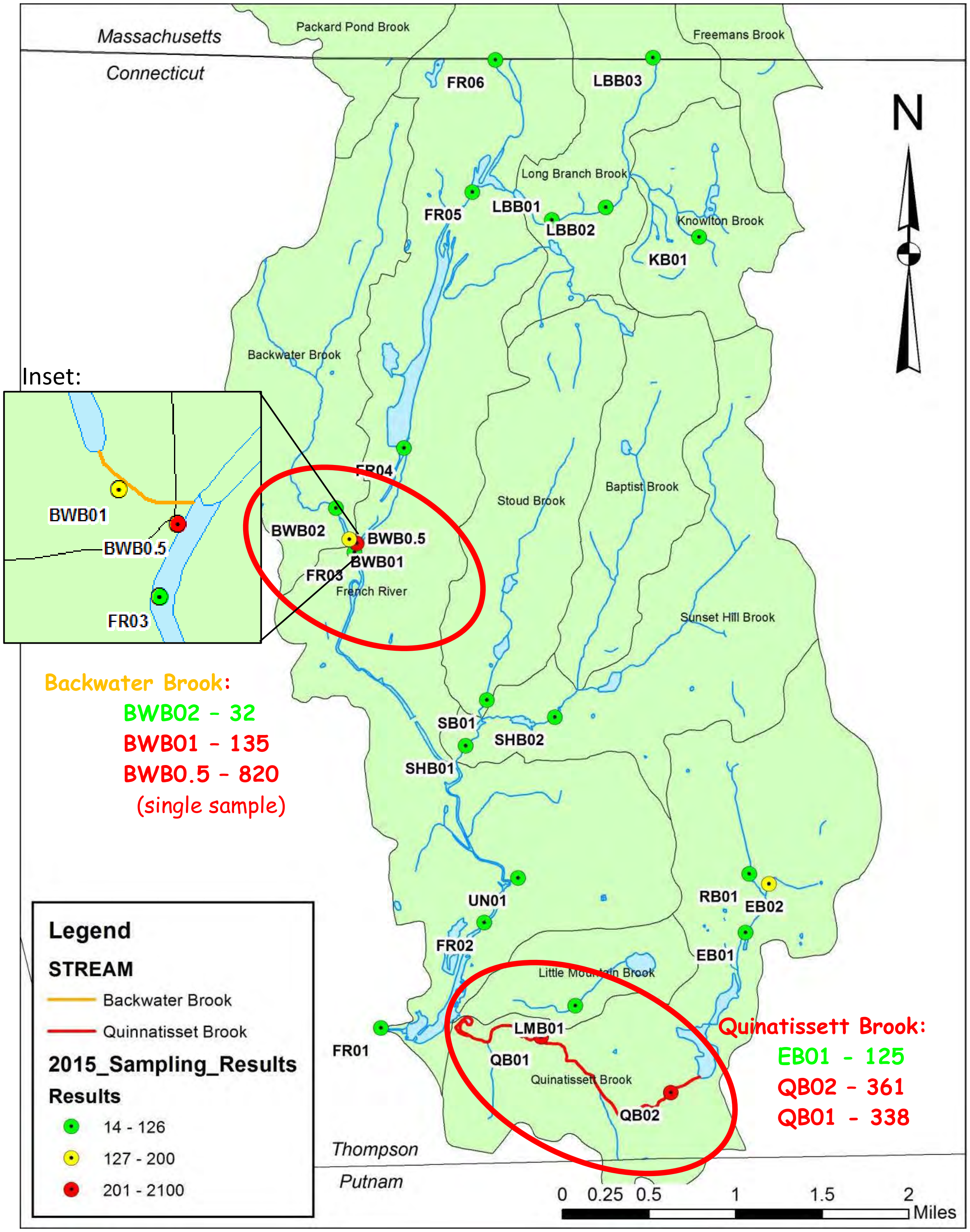

Figure 4. Fecal bacteria hot spots identified in the French River watershed in Thompson, CT. The inset depicts the segment of Backwater Brook (shown in orange) between Duhamel Pond and the French River that did not meet water quality standards.

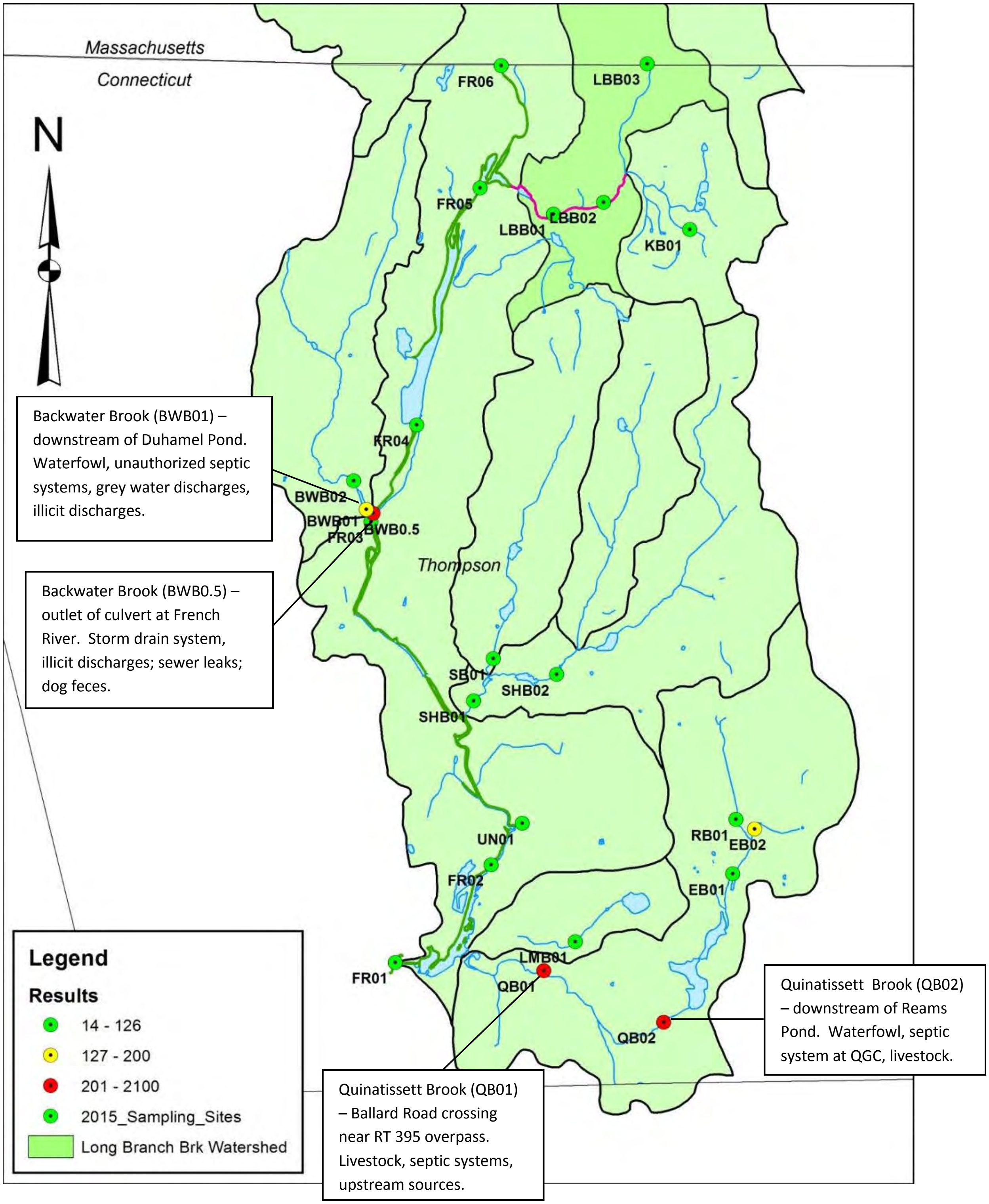

Figure 5. Potential fecal bacterial sources associated with the fecal bacteria hot spots identified at Backwater Brook and Quinatissett Brook in Thompson, CT.

Table 2. French River Priority Restoration List

Priority Site	Site/ Waterbody	Site Location	Possible Bacteria Source	Bacteria Geomean (cfu/100ml)*	Reduction Needed	Suggested Management Action(s)	Suggested Responsible Stakeholder
1a	Backwater Brook (BWB01)	downstream of the Duhamel Pond outlet near Main Street, North Grosvenordale	Waterfowl; unauthorized/ un-sewered properties; grey water discharges; illicit discharges	135	7%	Investigate if any properties abutting pond are not sewered; grey water and illicit discharges; manage waterfowl; install streamside buffers	Residents/ property owners; Town DPW/ sewer authority; NDDH; CLEAR
1b	Backwater Brook at French River (BWB0.5)	end of culvert at French River, Thompson Public Library property, ~30 ft north (upstream) of foot bridge to Riverside Park	Main St and library storm drain systems; illicit discharges; sewer leaks; dog feces; stormwater runoff	820 (single sample)	42% (single sample)	Investigate storm drain connections to culverted brook; illicit discharges; sewer lines; dog waste management; stormwater management; promote/ demonstrate LID practices and principals	Residents/ property owners; Town DPW/ sewer authority; NDDH; CLEAR
2a	Quinatissett Brook (QB02)	downstream of Reams Pond at Quinatissett Golf Course, County Home Road (State RT 21)	Septic system at golf course of unknown location, age and design; waterfowl; livestock on Chase Road	361	186.5%	Septic system dye test; locate/upgrade septic system; bacteria DNA test; manage waterfowl; promote manure BMPs	Property/ livestock owners; golf course mgrs; Agriculture Comm.; NDDH
2b	Quinatissett Brook (QB01)	at Ballard Road crossing, near Interstate RT 395 overpass	horses on Robbins Road; goats on Ballard Road; sheep on RT 21 at Putnam town line; older or underperforming septic systems; remnant bacteria signal from upstream sources (Reams Pond)	338	168%	Promote pasture/manure BMPs; identify/evaluate failing/ underperforming septic systems; develop septic system monitoring program; conduct bacteria DNA test to ID source	Property/ livestock owners; NDDH; Agriculture Committee; UConn Extension

* The 2013 Connecticut Water Quality Standards establish water quality criteria for indicator bacteria, including *E. coli*, which is the preferred indicator bacterium for fresh waterbodies. For recreational contact, excluding designated and non-designated swimming areas, the single sample maximum is 576 colony-forming units (cfu) per 100 milliliters of water and the maximum sample set geometric mean is less than 126 cfu/100 ml.

Figure 6. Culverted segment of Backwater Brook (dashed line). Approximately 250 feet of the stream is culverted under Main Street and the Thompson Public Library property.

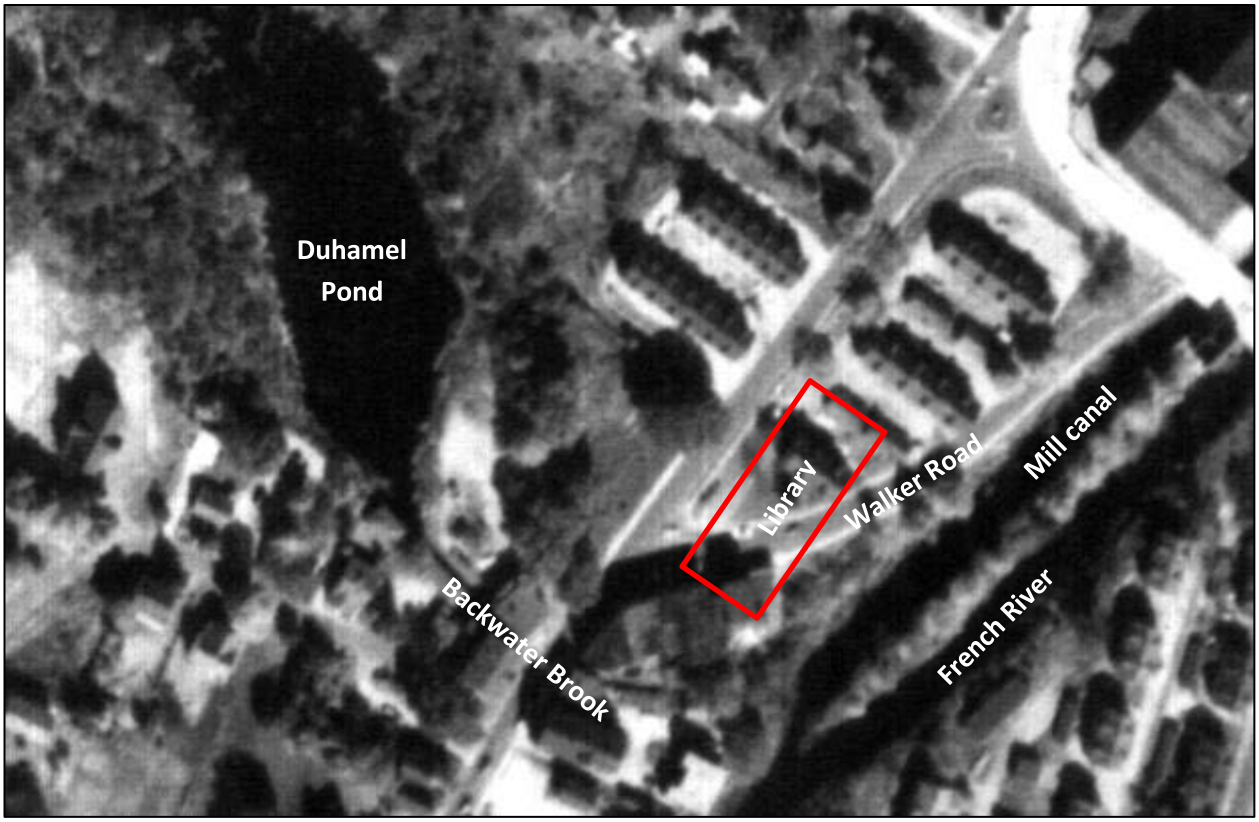

Figure 7. Aerial image of the Thompson Public Library site circa 1963, depicting previous site development (Univ. CT MAGIC Library). The location of the public library is outlined in red.

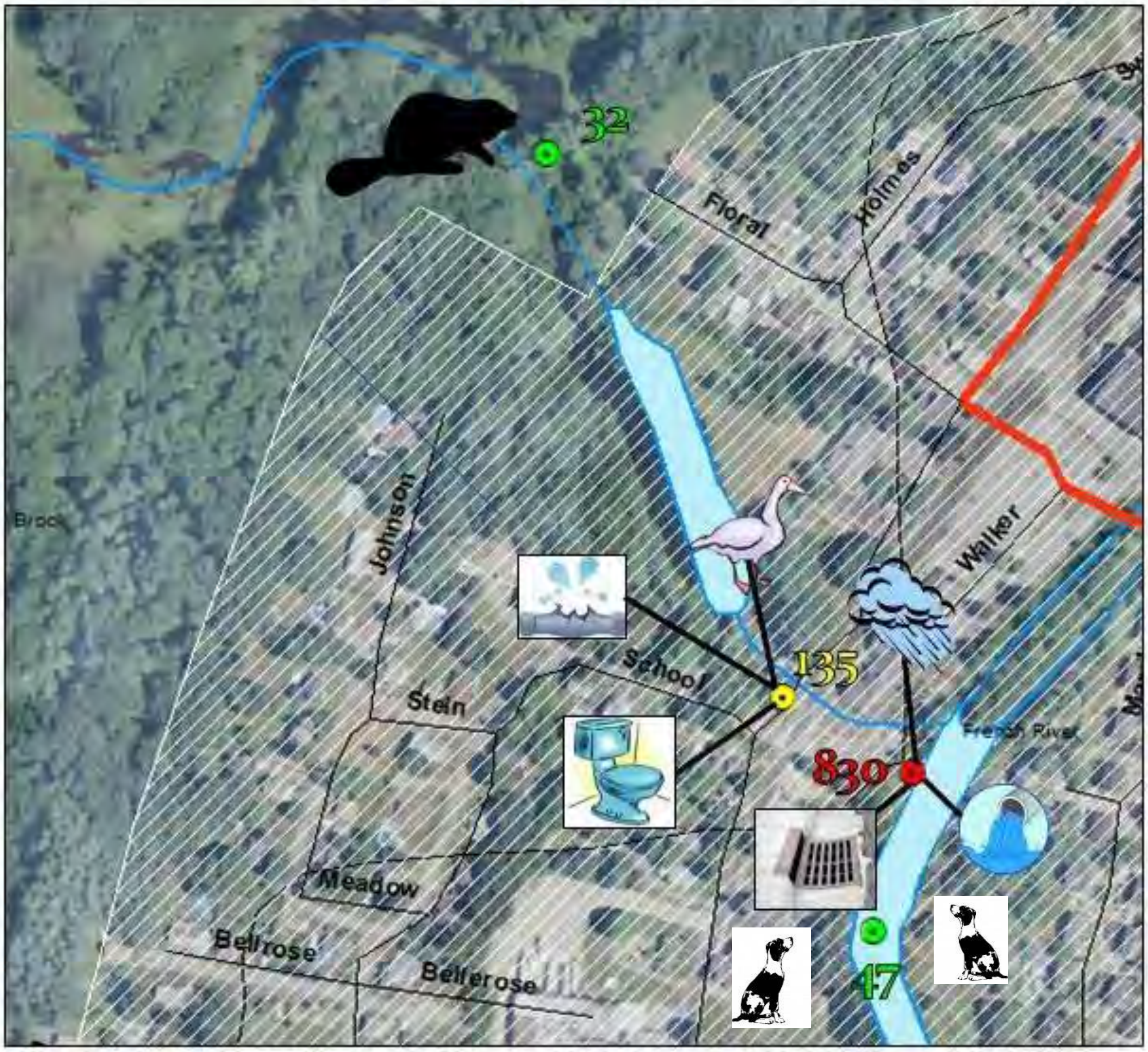

Figure 8. Possible fecal bacteria sources in the vicinity of Backwater Brook in North Grosvenordale. The hatched area depicts the extent of the municipal sewer service area.

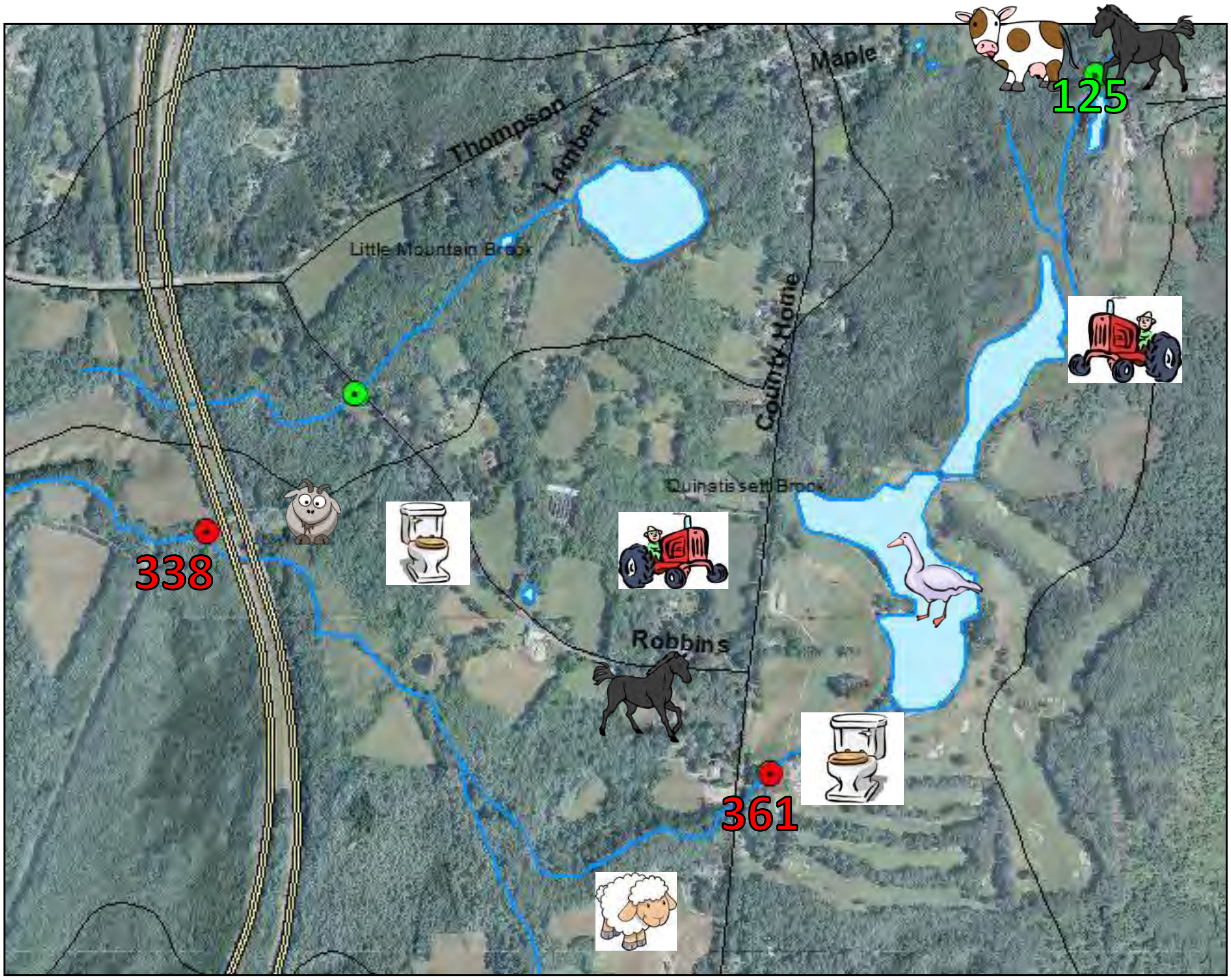

Figure 9. Possible fecal bacteria sources in the vicinity of Quinatissett Brook.

Appendix C

Windshield Survey Results

Location	Owner (if known)	Sub-watershed	Latitude	Longitude	Pollutant or Condition	Description	Recommendation
Central Street River Mill Village	Town of Thompson/ privately owned	CT3300-00 French Main Stem	41°59'0.59"N	71°53'54.54"W	IC/stormwater/NPS	runoff from roofs, roads, parking areas goes directly to French River	green streets/LID practices including tree filters, rain barrels, rain gardens, pervious pavers/grids, other LID
Chase Road	privately owned residence	CT3300-10 Quinatissett Brook	41°57'4.46"N	71°51'24.65"W	nutrients/bacteria	horses in paddock adjacent to, and that slopes to, Elliott Brook	practice manure BMPs, pasture management
Chase Road	privately owned residence	CT3300-10 Quinatissett Brook	41°57'9.76"N	71°51'29.91"W	nutrients/bacteria	beef cattle on Chase Road in pasture adjacent to tributary to Elliott Brook	practice manure BMPs, pasture management
Fairway Drive	privately owned residence	CT3300-02 Long Branch Brook	42° 0'29.98"N	71°52'45.83"W	riparian buffer/nutrients	very green pond - duckweed	reduce fertilizer use/ re-establish riparian vegetation
Floral Drive (ROW)	Town of Thompson	CT3300-00 French Main Stem	41°59'12.24"N	71°54'6.37"W	NPS/stormwater/ trash/debris	stormwater runs to end of street; forms gully to Backwater Brook	water diversion/install infiltration practice
Greek Village - Market Street (ROW)	Town of Thompson/ privately owned	CT3300-00 French Main Stem	41°58'59.19"N	71°53'49.88"W	IC/stormwater/NPS	no stormwater mgmt/leak-offs to storm drains by RR tracks discharge to French River	install infiltration practices; rain barrels; rain gardens; pervious pavers
Heritage Circle (ROW)	Town of Thompson	CT3300-07 Baptist Brook	41°59'44.44"N	71°52'12.15"W	NPS/stormwater	runoff from road	install tree filters/swm practice at cul de sac
Johnson Street (ROW)	Town of Thompson	CT3300-00 French Main Stem	41°59'8.38"N	71°54'10.41"W	stormwater/NPS/ trash/debris	stormwater runs to end of street; overland flow to Backwater Brook	water diversion/install infiltration practice
12-26 Main Street	St Joseph Catholic Society	CT3300-00 French Main Stem	41°58'43.76"N	71°54'7.19"W	IC/stormwater/NPS	runoff from roofs, parking lots, lawns	identify opportunities to install bio-retention practices

Location	Owner (if known)	Sub-watershed	Latitude	Longitude	Pollutant or Condition	Description	Recommendation
2 Main Street	Superior Bakery Inc.	CT3300-00 French Main Stem	41°58'57.36"N	71°54'7.53"W	stormwater/erosion /NPS	runoff from dirt parking lot/driveway	install water diversion; infiltration practice
Main Street - dirt lot next to library	Privately owned	CT3300-00 French Main Stem	41°59'1.90"N	71°54'2.51"W	stormwater/erosion /NPS	runoff from dirt parking lot/driveway	install water diversion; infiltration practice
Riverside Park 35 Marshall Street	Town of Thompson	CT3300-00 French Main Stem	41°58'45.39"N	71°53'59.96"W	stormwater runoff/NPS/ riparian buffer	maintenance and re-establishment of riparian buffer; invasive plant management	remove invasive species, set up management plan, replant with native species
Riverside Park 35 Marshall Street	Town of Thompson	CT3300-00 French Main Stem	41°58'45.39"N	71°53'59.96"W	stormwater/NPS/trash & debris	trash/floatables from outfalls	clean-up (conducted annually by TT); education; trash separators in cbs
Reardon Road	privately owned	CT3300-00 French Main Stem	41°57'56.06"N	71°53'35.31"W	stormwater/manure / nutrients/bacteria	road runoff/ephemeral stream through horse paddock; manure stockpile	water diversion; exclusionary fencing; rotational grazing; manure BMPs; composting
307 Reardon Road	Thompson Rail Business Park LLC.	CT3300-00 French Main Stem	41°57'39.51"N	71°53'33.86"W	stormwater/erosion / sedimentation	sediment at entrance tracked onto roadway	Industrial SWGP; maintain anti-tracking pad; maintain on-site swm practices
15 Red Bridge Road	Thompson Little League Complex - Town of Thompson	CT3300-00 French Main Stem	41°58'47.33"N	71°54'23.81"W	stormwater/NPS/ nutrients	stormwater runoff from parking lots; maintenance of baseball fields	water diversions; install infiltration practice; athletic field BMPs
Riverside Drive (RT 12) State-owned ROW	CT Department of Transportation	CT3300-00 French Main Stem	NA	NA	IC/stormwater/NPS	storm drainage from RT 12 discharges to French River	stormwater retrofits as practicable to provide water quality and volume treatment prior to discharge to French River

Location	Owner (if known)	Sub-watershed	Latitude	Longitude	Pollutant or Condition	Description	Recommendation
North Grosvenordale and Grosvenordale - former mill housing along RT 12 corridor	privately owned	CT3300-00 French Main Stem	NA	NA	IC/stormwater/NPS	stormwater runoff from impervious surfaces; small lots; densely developed	pursue opportunities for outreach/education/installation of rain gardens, rain barrels, bio-swales, etc.
274 Riverside Drive (RT 12)	privately owned (former restaurant)	CT3300-00 French Main Stem	41°56'54.46"N	71°53'17.00"W	IC/stormwater/NPS	large parking lot; former structure right on river bank; minimal riparian buffer	incorporate LID into site redevelopment; re-establish riparian buffer
327 Riverside Drive (RT 12)	privately owned (construction business)	CT3300-00 French Main Stem	41°57'9.06"N	71°53'5.49"W	stormwater/NPS	extensive dirt construction yard; much stockpiled material and construction equipment	Industrial SWGP; manage stockpiled material; re-establish vegetation on bare areas; install stormwater detention practice
630 Riverside Drive (RT 12)	former Belding Corticelli Mill	CT3300-00 French Main Stem	41°58'8.02"N	71°53'34.41"W	IC/stormwater/NPS	redevelopment	incorporate LID into redevelopment design
693 Riverside Drive (RT 12)	Dunkin Donuts	CT3300-00 French Main Stem	41°58'22.45"N	71°53'47.88"W	IC/stormwater/NPS	runoff from roof and parking lot	water diversion/infiltration practices/LID
693 Riverside Drive (RT 12)	Quite Corner Package Store	CT3300-00 French Main Stem	41°58'21.39"N	71°53'46.79"W	IC/stormwater/NPS	runoff from roof and parking lot	water diversion; infiltration practices; other LID practices
694 Riverside Drive (RT 12)	privately owned (former mill)	CT3300-00 French Main Stem	41°58'20.90"N	71°53'48.34"W	IC/stormwater/NPS	redevelopment	incorporate LID into redevelopment design
700 Riverside Drive (RT 12)	privately owned (former mill site)	CT3300-00 French Main Stem	41°58'21.75"N	71°53'49.89"W	stormwater/NPS	redevelopment of burnt-down/ demolished mill property	incorporate LID into new design

Location	Owner (if known)	Sub-watershed	Latitude	Longitude	Pollutant or Condition	Description	Recommendation
706 Riverside Drive (RT 12)	privately owned	CT3300-00 French Main Stem	41°58'24.66"N	71°53'52.72"W	stormwater volume	stream from school overflows during heavy rains causing road flooding	install bio-retention/storm-water wetland on west side of RT 12
near 715/785 Riverside Drive (RT 12)	Town of Thompson or privately owned	CT3300-00 French Main Stem	41°58'26.09"N	71°53'52.41"W	stormwater volume	stream from school overflows during heavy rains causing road flooding	install retention practices on east side RT 12 to slow/detain stormwater
785 Riverside Drive (RT 12	Town Hall Town of Thompson	CT3300-00 French Main Stem	41°58'44.82"N	71°53'57.44"W	IC/stormwater/NPS	runoff from roof and parking lot	install water diversion and infiltration practices; green roofs
Mary R. Fisher Elementary School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	IC/stormwater/NPS	runoff from small parking lot travels overland across grass to double storm drain.	install infiltration basin. Install tree filter in leak-off upgrade of catch basin.
Mary R. Fisher Elementary School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	NPS/stormwater	failed level spreader south of playground	re-install/repair to restore intended function
Mary R. Fisher Elementary School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	IC/stormwater/NPS	extensive parking lots/heat island	install trees in parking lot islands
Mary R. Fisher Elementary School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	IC/NPS/stormwater	extensive parking lots	install tree filters
Mary R. Fisher Elementary School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	stormwater/erosion /NPS	bare/compacted/ eroded soil	seed bare spots/parking guidance/install riprap filter strips/install pervious plastic grids

Location	Owner (if known)	Sub-watershed	Latitude	Longitude	Pollutant or Condition	Description	Recommendation
Mary R. Fisher Elementary School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	NPS/stormwater	yard drain by entrance to Early Childhood Center	install rain garden
Mary R. Fisher Elementary School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	stormwater/erosion /NPS	erosion along driveway to high school	water diversion; install riprap; reseed; parking exclusion
Mary R. Fisher Elementary School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	stormwater/erosion /NPS	erosion on hillside in play yard on driveway to high school	water diversion; erosion mat; re-establish grass
Thompson Middle School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	IC/stormwater/NPS	runoff from roofs, parking lots, lawns	identify opportunities to install bio-retention practices
Thompson Middle School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	stormwater/erosion /NPS	bare ground/erosion along edge of driveways	seed bare spots/parking guidance or exclusions/ install pervious plastic grids
Thompson Middle School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	IC/stormwater/NPS	grassy area by top of driveway to middle school entrance	install grassed swale with check dams to control runoff; parking exclusion
Tourtellotte Memorial High School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	stormwater/erosion /NPS	erosion along-side of driveway to high school	install check dams to slow flow
Tourtellotte Memorial High School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	IC/NPS/stormwater	extensive parking lots/heat island	install trees in parking lot islands

Location	Owner (if known)	Sub-watershed	Latitude	Longitude	Pollutant or Condition	Description	Recommendation
Tourtellotte Memorial High School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	IC/NPS/stormwater	extensive parking lots	install tree filters
Tourtellotte Memorial High School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	stormwater/erosion /NPS	erosion on steep hill	repair with erosion mat/allow grass to grow higher
Tourtellotte Memorial High School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	stormwater/erosion /NPS	bare/compacted/erode d soil along driveways and walking paths	seed bare spots/parking guidance/install riprap filter strips/install pervious plastic grids
Tourtellotte Memorial High School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	IC/NPS/stormwater	erosion along sidewalk to rear of high school from maintenance yard driveway; water runs down edge of sidewalk	water diversion; erosion mat; re-establish grass; deep sump catch basins; hydro-dynamic separator (HDS)
Tourtellotte Memorial High School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	stormwater/NPS	catch basin in lawn before steep hill at Admin. Bldg/high school	grassed rain garden - use existing catch basin as overflow or install standpipe
Tourtellotte Memorial High School 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	stormwater/NPS	grassed traffic island at entrance to HS/exit to RT 12	grassed rain garden - use existing catch basin as overflow or install standpipe
Administrative Building 785 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°58'36.34"N	71°53'53.19"W	stormwater/NPS	parking spaces in front of Administration Building	divert runoff - install rip rap strip and swale to allow infiltration
831 Riverside Drive (RT 12)	N. Grosv'dale Post Office - US Postal Service	CT3300-00 French Main Stem	41°58'47.47"N	71°53'55.68"W	IC/stormwater/NPS	runoff from roof and parking lot	water diversion; infiltration practices; other LID practices

Location	Owner (if known)	Sub-watershed	Latitude	Longitude	Pollutant or Condition	Description	Recommendation
835 Riverside Drive (RT 12)	Hometown Bank	CT3300-00 French Main Stem	41°58'48.70"N	71°53'55.26"W	stormwater/NPS	roofs/parking lots	infiltration practices; rain gardens
854 Riverside Drive (RT 12)	Cumberland Farms (VHS Realty, Inc)	CT3300-00 French Main Stem	41°58'51.88"N	71°53'54.74"W	stormwater, trash/debris	stormwater outfalls from Cumberland Farms store and RT 12 discharge to French River through Riverside Park	install settling basin/infiltration practice on adjacent lot
862 Riverside Drive (RT 12)	Community Fire Department	CT3300-00 French Main Stem	41°58'54.94"N	71°53'51.46"W	IC/stormwater/NPS	wash vehicles; runoff goes directly to storm drain	establish wash station, connect to sanitary sewer
915 Riverside Drive (RT 12)	privately owned (former hardware store)	CT3300-00 French Main Stem	41°59'5.88"N	71°53'49.85"W	IC/stormwater/NPS	redevelopment; large dirt parking lot adjacent to French River	incorporate LID into redevelopment design
929 Riverside Drive (RT 12)	The River Mill	CT3300-00 French Main Stem	41°59'11.47"N	71°53'51.37"W	stormwater/NPS	extensive roofs, dirt and paved parking lots	incorporate LID /infiltration practice into redevelopment; tree filters; curb bump-outs on River Road; impervious pavers; reduction of unneeded paved surfaces
Thompson Public Library 934 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°59'5.64"N	71°53'58.69"W	IC/stormwater/NPS	impervious cover throughout developed area of parcel	replace existing brick pavers with pervious pavers
Thompson Public Library 934 Riverside Drive (RT 12)	Town of Thompson	CT3300-00 French Main Stem	41°59'5.64"N	71°53'58.69"W	invasive plants	invasive plant species on canal bank	remove invasive species, establish management plan, replant with native species
948 Riverside Drive (RT 12) - driveway to water tower	Connecticut Water Company (lessee)	CT3300-00 French Main Stem	41°59'13.43"N	71°53'54.48"W	erosion/stormwater	runoff from water tower area has created a large erosion gully and deposited large sediment pile on edge on RT 12	install water diversion at top of driveway

Location	Owner (if known)	Sub-watershed	Latitude	Longitude	Pollutant or Condition	Description	Recommendation
Riverside Drive (RT 12) - driveway to the Riverwalk by Knights of Columbus	Town of Thompson	CT3300-00 French Main Stem	41°59'29.12"N	71°53'47.57"W	stormwater/NPS	maintenance of existing stormwater infrastructure filled with weeds and sediment	maintain existing riprap swales
1020 Riverside Drive (RT 12)	Thomas Commons	CT3300-00 French Main Stem	41°59'26.76"N	71°53'50.80"W	stormwater/erosion /NPS	runoff from dirt parking lot/driveway to storm drain	water diversion/install infiltration practice
1056 Riverside Drive (RT 12)	Thompson Auto Care	CT3300-00 French Main Stem	41°59'35.51"N	71°53'53.93"W	stormwater/NPS	auto-associated pollutants	Industrial SWGP; BMPs
1366 Riverside Drive (RT 12)	Acts ll Ministries	CT3300-00 French Main Stem	42° 0'44.16"N	71°53'28.54"W	IC/stormwater/NPS	runoff from parking lot	bio-retention/infiltration practices
1495 Riverside Drive (RT 12)	RPM, Inc.	CT3300-00 French Main Stem	42° 1'10.93"N	71°53'5.41"W	stormwater/NPS	auto-associated pollutants	Industrial SWGP; BMPs
Robbins Road	privately owned	CT3300-10 Quinatissett Brook	41°56'42.55"N	71°52'36.13"W	stormwater/manure /nutrients/bacteria	horses in pasture adjacent to Little Mountain Brook	manure BMPs; pasture mgmt
School Street	privately owned	CT3300-05 Backwater Brook	41°59'5.27"N	71°54'4.40"W	nutrients/bacteria	domestic ducks/geese	manure/waste BMPs; composter
Thompson Road (near RT 12)	Airline Trail - State of CT	CT3300-09 Little Mountain Brook	41°56'50.74"N	71°53'6.73"W	stormwater/erosion	runoff from airline trail causing slope erosion and sedimentation	water diversion, slope reinforcement
347 Thompson Road	Thompson Congregational Church	CT3300-10 Quinatissett Brook	41°57'29.61"N	71°51'45.09"W	IC/stormwater/NPS	runoff from large roof area, parking lot	runoff diversion; bio-retention/infiltration practices

Location	Owner (if known)	Sub-watershed	Latitude	Longitude	Pollutant or Condition	Description	Recommendation
445 Thompson Road	business on east side Thompson Rd	CT3300-10 Quinatissett Brook	41°57'51.47"N	71°51'31.82"W	IC/stormwater/NPS	runoff from large roof area, parking lot	runoff diversion; bio-retention/infiltration practices
459 Thompson Road	business on east side Thompson Rd	CT3300-10 Quinatissett Brook	41°57'54.66"N	71°51'29.23"W	IC/stormwater/NPS	runoff from large parking lot	runoff diversion; bio-retention/infiltration practices
646 Thompson Road	NUMA Tool Co.	CT3300-06 Sunset Hill Brook	41°58'30.16"N	71°50'55.59"W	IC/stormwater/NPS	runoff from large parking/storage areas and buildings	runoff diversion; bio-retention/infiltration practices
293 Thompson Hill Road	Marianapolis Preparatory School	CT3300-00 French Main Stem	41°57'29.16"N	71°52'1.94"W	IC/stormwater/NPS/ bacteria	large lawns; parking lots; roof areas; septic lagoon	lawn BMPs; adoption/incorporation of LID practices; connection to municipal sewer
1405 Wilsonville Road	Matty's Transportation	CT3300-00 French Main Stem	42° 0'44.50"N	71°53'16.23"W	IC/stormwater/NPS	all parking lot runoff goes to French River	water diversions/ infiltration/ structural controls
Wilsonville Road	Playground - Town of Thompson	CT3300-02 Long Branch Brook	42° 0'32.99"N	71°52'42.71"W	stormwater/NPS/erosion	dirt parking lot/compacted/large puddle at entrance	water diversion/install infiltration practice

Appendix D

Watershed Model Loading Data

French River Sub-watershed (CT 3300-00) Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	1,285	190	29,995	55,797	226	7	8	3	15
MDR (1-4du/acre)	**775**	114	18,073	33,620	136	4	5	2	9
HDR (>4du/acre)	218	32	5,089	9,466	38	1	1	1	3
Multi-family	151	22	3,526	6,560	27	1	1	<1	2
Commercial	287	30	5,885	12,475	50	2	1	1	3
Industrial	324	37	11,931	13,426	54	2	2	1	4
Roadways	5,236	569	305,060	207,510	839	28	25	35	55
Forest	6,002	480	240,080	28,810	279	32	21	27	8
Rural	0	0	0	0	0	0	0	0	0
Pasture/Hay	836	127	18,170	7,086	21	4	6	2	2
Cropland	67	10	1,450	566	2	<1	<1	<1	<1
Open Water	2,047	80	24,785	0	0	11	3	3	<1
Total Primary Sources	***17,228***	***1,692***	***664,043***	***375,315***	***1,673***	**-**	**-**	**-**	-
Secondary Sources Loads									
Septic Systems	488	81	3,255	739	0	3	4	<1	<1
Stream Channel Erosion	0	0	212,691	0	0	<1	<1	24	<1
Hobby Farms/Livestock	158	46	0	1,200	0	1	2	<1	<1
Total Secondary Sources	***646***	***127***	***215,946***	***1,939***	***0***	-	-	-	-
Load Reductions Existing Practices	***-899***	***-470***	***0***	***23***	***-99***	***5***	***21***	***0***	***0***
Total Load	**18,772**	**2,289**	**879,990**	**377,231**	**1,772**	100%	100%	100%	100%

Packard Pond Brook Sub-watershed (CT 3300-01)* Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	372	55	8,671	16,129	65	8	9	4	17
MDR (1-4du/acre)	370	55	8,642	16,076	65	8	9	4	17
HDR (>4du/acre)	131	19	3,056	5,684	23	3	3	1	6
Multi-family	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0
Roadways	1,252	136	72,965	49,633	201	27	22	35	52
Forest	1,315	105	52,590	6,311	62	30	18	25	7
Rural	0	0	0	0	0	0	0	0	0
Pasture/Hay	230	35	5,000	1,950	60	5	6	2	2
Cropland	0	0	0	0	0	0	0	0	0
Open Water	447	17	5,410	0	0	10	3	3	<1
Total Primary Sources	***4,148***	***427***	***157,003***	***96,044***	***423***	-	-	-	-
Secondary Sources Loads									
Septic Systems	181	30	1,207	274	0	4	5	1	<1
Stream Channel Erosion	0	0	50,392	0	0	<1	<1	24	<1
Hobby Farms/Livestock	0	0	0	0	0	0	0	0	0
Total Secondary Sources	***181***	***30***	***51,599***	***274***	***0***	-	-	-	-
Load Reductions Existing Practices	***-258***	***-149***	***0***	***7***	***0***	***6***	***25***	***0***	***0***
Total Load	**4,586**	**607**	**208,601**	**96,311**	**453**	100%	100%	100%	100%

*Packard Pond Brook Sub-watershed (CT 3300-01) discharges to the French River in Massachusetts and most development is located in Massachusetts.

Long Branch Brook Sub-watershed (CT 3300-02) Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	311	46	7,254	13,493	55	6	7	3	13
MDR (1-4du/acre)	249	37	5,801	10,791	44	5	6	2	10
HDR (>4du/acre)	15	2	356	662	3	<1	<1	<1	1
Multi-family	0	0	0	0	0	0	0	0	0
Commercial	88	9	1,799	3,814	15	2	1	1	4
Industrial	0	0	0	0	0	0	0	0	0
Roadways	1,602	174	93,311	63,473	257	30	26	37	60
Forest	1,835	147	73,410	8,809	91	34	22	29	8
Rural	90	14	1,960	764	2	2	2	1	1
Pasture/Hay	35	5	760	296	1	1	1	<1	<1
Cropland	0	0	0	0	0	0	0	0	0
Open Water	259	10	3,131	0	0	5	1	1	<1
Total Primary Sources	***4,483***	***444***	***187,782***	***102,103***	***467***	-	-	-	-
Secondary Sources Loads									
Septic Systems	174	29	1,161	597	0	3	4	<1	1
Stream Channel Erosion	0	0	60,056	0	0	<1	<1	24	<1
Hobby Farms/Livestock	525	83	0	2,513	0	10	12	<1	2
Total Secondary Sources	***699***	***112***	***61,217***	***3,110***	***0***	-	-	-	-
Load Reductions Existing Practices	***-183***	***-113***	***0***	***25***	***-17***	***3***	***17***	***0***	***<1***
Total Load	**5,366**	**670**	**248,998**	**105,189**	**485**	**100%**	**100%**	**100%**	**100%**

Freemans Brook Sub-watershed (CT 3300-03)* Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	403	59	9,394	17,475	71	8	9	4	14
MDR (1-4du/acre)	588	87	13,730	25,541	103	12	13	6	21
HDR (>4du/acre)	106	16	2,482	4,616	19	2	2	1	4
Multi-family	0	0	0	0	0	0	0	0	0
Commercial	287	30	5,883	12,470	50	6	5	3	10
Industrial	52	6	1,898	2,136	9	1	1	1	2
Roadways	1,397	152	81,394	55,366	224	29	23	37	45
Forest	1,174	94	46,960	5,635	55	24	14	21	5
Rural	23	4	500	195	1	<1	<1	<1	<1
Pasture/Hay	14	2	310	121	0	<1	<1	<1	<1
Cropland	0	0	0	0	0	0	0	0	0
Open Water	433	17	5,239	0	0	9	9	2	<1
Total Primary Sources	***4,477***	***466***	***167,790***	***123,556***	***532***	-	-	-	-
Secondary Sources Loads									
Septic Systems	5	1	30	7	0	<1	<1	<1	<1
Stream Channel Erosion	0	0	54,338	0	0	<1	<1	24	<1
Hobby Farms/Livestock	0	0	0	0	0	0	0	0	0
Total Secondary Sources	***5***	***1***	***54,368***	***7***	***0***	-	-	-	-
Load Reductions Existing Practices	***-338***	***-194***	***0***	***36***	***-30***	***7***	***29***	***0***	***<1***
Total Load	**4,819**	**661**	**222,157**	**123,527**	**562**	**100%**	**100%**	**100%**	**100%**

*Freemans Brook Sub-watershed (CT 3300-03) discharges to the French River in Massachusetts.

Knowlton Brook Sub-watershed (CT 3300-04) Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	92	14	2,150	4,000	16	4	5	2	10
MDR (1-4du/acre)	1	0	31	57	0	<1	<1	<1	<1
HDR (>4du/acre)	0	0	0	0	0	0	0	0	0
Multi-family	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0
Roadways	752	82	43,800	29,794	121	31	30	34	71
Forest	1,104	88	44,150	5,298	51	45	32	34	13
Rural	177	27	3,850	1,502	4	7	10	3	4
Pasture/Hay	116	18	2,520	983	3	5	7	2	2
Cropland	0	0	0	0	0	0	0	0	0
Open Water	106	4	1,287	0	0	4	1	1	<1
Total Primary Sources	***2,348***	***233***	***97,788***	***41,633***	***195***	-	-	-	-
Secondary Sources Loads									
Septic Systems	64	11	426	457	0	3	4	<1	1
Stream Channel Erosion	0	0	30,912	0	0	<1	<1	24	<1
Hobby Farms/Livestock	0	0	0	13	0	<1	<1	<1	<1
Total Secondary Sources	***64***	***11***	***31,338***	***470***	***0***	-	-	-	-
Load Reductions Existing Practices	***-51***	***-27***	***0***	***1***	***-9***	***2***	***10***	***0***	***<1***
Total Load	**2,464**	**271**	**129,126**	**42,103**	**204**	**100%**	**100%**	**100%**	**100%**

Backwater Brook Sub-watershed (CT 3300-05) Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	106	16	2,485	4,622	19	3	4	1	8
MDR (1-4du/acre)	70	10	1,630	3,032	12	2	3	1	5
HDR (>4du/acre)	9	1	215	400	2	<1	<1	<1	1
Multi-family	27	4	634	1,179	5	1	1	<1	2
Commercial	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0
Roadways	912	99	53,132	36,142	146	24	25	26	63
Forest	2,353	188	94,130	11,296	107	61	48	46	20
Rural	74	11	1,600	624	2	2	3	1	1
Pasture/Hay	0	0	0	0	0	0	0	0	0
Cropland	0	0	0	0	0	0	0	0	0
Open Water	88	3	1,070	0	0	2	1	1	<1
Total Primary Sources	***3,640***	***333***	***154,895***	***57,294***	***292***	-	-	-	-
Secondary Sources Loads									
Septic Systems	87	15	582	237	0	2	4	<1	<1
Stream Channel Erosion	0	0	48,441	0	0	<1	<1	24	<1
Hobby Farms/Livestock	0	0	0	13	0	<1	<1	<1	<1
Total Secondary Sources	***88***	***15***	***49,023***	***251***	***0***	-	-	-	-
Load Reductions Existing Practices	***-109***	***-47***	***0***	***3***	***-6***	***3***	***12***	***0***	***0***
Total Load	**3,836**	**395**	**203,918**	**57,541**	**298**	**100%**	**100%**	**100%**	**100%**

Sunset Hill Brook Sub-watershed (CT 3300-06) Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	279	41	6,505	12,101	49	5	7	2	14
MDR (1-4du/acre)	214	32	4,998	9,297	38	4	5	2	11
HDR (>4du/acre)	14	2	320	596	2	<1	<1	<1	1
Multi-family	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0
Industrial	63	7	2,325	2,617	11	1	1	1	3
Roadways	1,629	177	94,908	64,559	261	30	30	36	77
Forest	2,590	207	103,610	12,433	139	48	35	39	15
Rural	116	18	2,530	987	3	2	3	1	1
Pasture/Hay	60	9	1,310	511	2	1	2	<1	1
Cropland	0	0	0	0	0	0	0	0	0
Open Water	302	12	3,658	0	0	6	2	1	<1
Total Primary Sources	***5,268***	***505***	***220,165***	***103,101***	***505***	-	-	-	-
Secondary Sources Loads									
Septic Systems	188	31	1,255	1,687	0	4	5	<1	2
Stream Channel Erosion	0	0	69,807	0	0	<1	<1	26	<1
Hobby Farms/Livestock	276	43	0	1,300	0	5	7	<1	2
Total Secondary Sources	***464***	***74***	***71,061***	***2,987***	***0***	-	-	-	-
Load Reductions Existing Practices	***379***	***-14***	***27,471***	***22,464***	***78***	***-7***	***2***	***-10***	***-27***
Total Load	**5,353**	**593**	**263,755**	**83,624**	**426**	**100%**	**100%**	**100%**	**100%**

Baptist Brook Sub-watershed (CT 3300-07) Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	63	9	1,463	2,721	11	3	4	1	14
MDR (1-4du/acre)	0	0	0	0	0	0	0	0	0
HDR (>4du/acre)	0	0	0	0	0	0	0	0	0
Multi-family	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0
Roadways	209	23	12,168	8,277	33	9	11	11	43
Forest	1,500	120	60,000	7,200	74	61	57	56	38
Rural	54	8	1,180	460	1	2	4	1	2
Pasture/Hay	55	8	1,200	468	1	2	4	1	2
Cropland	0	0	0	0	0	0	0	0	0
Open Water	512	20	6,200	0	0	21	10	6	<1
Total Primary Sources	***2,393***	***189***	***82,211***	***19,127***	***121***	-	-	-	-
Secondary Sources Loads									
Septic Systems	47	8	310	70	0	2	4	<1	<1
Stream Channel Erosion	0	0	25,324	0	0	<1	<1	23	<1
Hobby Farms/Livestock	0	0	0	0	0	0	0	0	0
Total Secondary Sources	***47***	***8***	***25,635***	***70***	***0***	-	-	-	-
Load Reductions Existing Practices	***-25***	***-14***	***0***	***6***	***-3***	***1***	***7***	***0***	***0***
Total Load	**2,465**	**210**	**107,846**	**19,191**	**123**	**100%**	**100%**	**100%**	**100%**

Stoud Brook Sub-watershed (CT 3300-08) Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	190	28	4,432	8,244	33	6	9	3	30
MDR (1-4du/acre)	31	5	722	1,342	5	1	2	1	5
HDR (>4du/acre)	0	0	0	0	0	0	0	0	0
Multi-family	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0
Roadways	313	34	18,224	12,396	50	10	11	13	44
Forest	2,005	160	80,200	9,624	95	65	52	57	34
Rural	161	25	3,500	1,365	4	5	8	2	5
Pasture/Hay	76	12	1,650	644	2	2	4	1	2
Cropland	0	0	0	0	0	0	0	0	0
Open Water	274	11	3,317	0	0	9	4	2	<1
Total Primary Sources	***3,049***	***274***	***112,044***	***33,615***	***190***	-	-	-	-
Secondary Sources Loads									
Septic Systems	106	18	708	161	0	3	6	1	1
Stream Channel Erosion	0	0	34,503	0	0	<1	<1	24	<1
Hobby Farms/Livestock	0	0	0	0	0	0	0	0	0
Total Secondary Sources	***106***	***18***	***35,211***	***161***	***0***	-	-	-	-
Load Reductions Existing Practices	***85***	***-19***	***6,237***	***5,867***	***17***	***-3***	***6***	***4***	***-21***
Total Load	**3,070**	**310**	**141,018**	**27,909**	**173**	**100%**	**100%**	**100%**	**100%**

Little Mountain Brook Sub-watershed (CT 3300-09) Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	138	20	3,220	5,990	24	7	8	3	15
MDR (1-4du/acre)	78	12	1,828	3,400	14	4	5	2	9
HDR (>4du/acre)	0	0	0	0	0	0	0	0	0
Multi-family	0	0	0	0	0	0	0	0	0
Commercial	6	1	118	250	1	<1	<1	<1	1
Industrial	0	0	0	0	0	0	0	0	0
Roadways	753	82	43,858	29,833	121	39	33	47	77
Forest	397	32	15,860	1,903	19	20	13	17	5
Rural	202	31	4,400	1,716	5	10	12	5	4
Pasture/Hay	154	23	3,340	1,303	4	8	9	4	3
Cropland	41	6	890	347	1	2	2	1	1
Open Water	163	6	1,969	0	0	8	2	2	<1
Total Primary Sources	***1,931***	***213***	***75,482***	***44,742***	***190***	-	-	-	-
Secondary Sources Loads									
Septic Systems	86	14	575	130	0	4	6	1	<1
Stream Channel Erosion	0	0	24,344	0	0	<1	<1	26	<1
Hobby Farms/Livestock	13	4	0	100	0	1	2	<1	<1
Total Secondary Sources	***99***	***18***	***24,919***	***230***	***0***	-	-	-	-
Load Reductions Existing Practices	***82***	***-20***	***7,823***	***6,300***	***14***	***-4***	***8***	***-8***	***-16***
Total Load	**1,948**	**251**	**92,578**	**38,673**	**175**	**100%**	**100%**	**100%**	**100%**

Quinatissett Brook Sub-watershed (CT 3300-10) Modeled Annual Pollutant Loads by Source.

NPS Pollutant Source	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	Runoff Volume (ac-ft/yr)	TN (% load)	TP (% load)	TSS (% load)	Fecal coliform (% load)
Primary Sources Loads									
LDR (<du/acre)	474	70	11,065	20,584	83	5	7	3	19
MDR (1-4du/acre)	7	1	175	325	1	<1	<1	<1	<1
HDR (>4du/acre)	0	0	0	0	0	0	0	0	0
Multi-family	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0
Roadways	1,767	192	102,941	70,023	283	20	19	28	66
Forest	3,488	279	139,500	16,740	192	40	28	38	16
Rural	303	46	6,580	2,566	9	3	5	2	2
Pasture/Hay	1,049	160	22,800	8,892	31	12	16	6	8
Cropland	27	4	580	226	1	<1	<1	<1	<1
Open Water	863	34	10,447	0	0	10	3	3	<1
Total Primary Sources	***7,977***	***786***	***294,087***	***119,356***	***601***	-	-	-	-
Secondary Sources Loads									
Septic Systems	346	58	2,310	858	0	4	6	1	1
Stream Channel Erosion	0	0	92,380	0	0	<1	<1	25	<1
Hobby Farms/Livestock	578	130	0	3,600	0	7	13	<1	3
Total Secondary Sources	***924***	***188***	***94,690***	***4,458***	***0***	-	-	-	-
Load Reductions Existing Practices	***233***	***-40***	***21,700***	***17,284***	***32***	***-3***	***4***	***-6***	***-16***
Total Load	**8,668**	**1,014**	**367,078**	**106,530**	**569**	**100%**	**100%**	**100%**	**100%**