



Eightmile River Watershed Summary

Eightmile River

WATERSHED DESCRIPTION AND MAPS

The Eightmile River watershed covers an area of approximately 20,170 acres in the southern Connecticut River basin in Connecticut (Figure 1). There are several municipalities located at least partially in the watershed, including the Towns of Colchester, East Haddam, Salem, and Lyme, CT.

The Eightmile River watershed includes two segments impaired for recreation due to elevated bacteria levels. These segments were assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of the waterbodies in the watershed.

The entire length of the Eightmile River (CT4800-00_01) is impaired for bacteria. The Eightmile River begins in a forested area in northeastern East Haddam at the outlet of the Pecks Meadow Pond dam. The river flows south through East Haddam and passes into Lyme near the intersection of Route 156 and Route 82. The Eightmile River ends where it flows into the Connecticut River in Hamburg Cove in Lyme. The Eightmile River's impaired segment is 12.22 miles long and located in the towns of East Haddam and Lyme.

The impaired segment of the Eightmile River has a water quality classification of A. Designated uses include potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. The segment is impaired due to elevated bacteria concentrations and the designated use affected by the impairment is recreation. As there are no designated beaches on the segment, the specific impairment is for recreation for non-designated swimming and other contact water-related activities.

Impaired Segment Facts

Impaired Segments Name:

1. Eightmile River (CT4800-00_01)

Municipalities:

Colchester, East Haddam, Lyme

Impaired Segment Length: CT4800-00_01 (12.22 miles),

Water Quality Classification:
CT4800-00_01: Class A

Designated Use Impairment:
Recreation

Sub-regional Basin Name and Code:
Eightmile River, CT4800

Regional Basin: Eight Mile

Major Basin: Connecticut

Watershed Area (acres): 20,170

MS4 Applicable? No

Figure 1: Watershed location in Connecticut

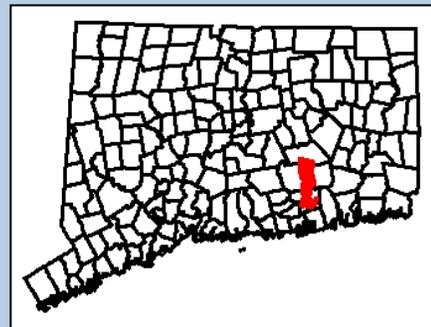
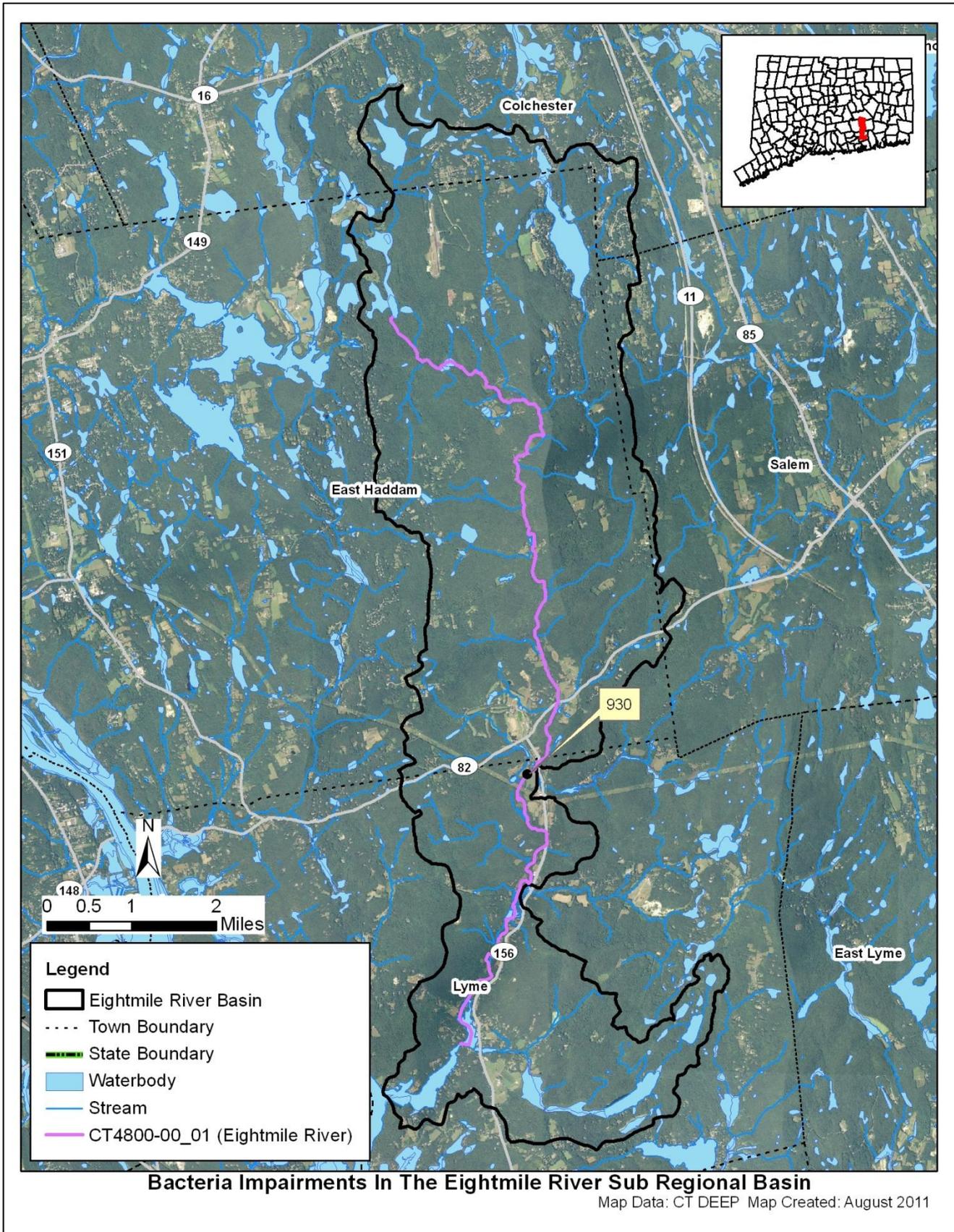


Table 1: Impaired Segment and nearby Waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT4800-00_01	Eightmile River (Lyme)-01	From mouth at Connecticut River, Hamburg Cove (part of Connecticut River tidal area), US to headwaters at Peck Meadow Pond outlet dam.	12.22	FULL	NOT	FULL
<p>Shaded cells indicate impaired segment addressed in this TMDL FULL = Designated Use Fully Supported NOT = Designated Use Not Supported U = Unassessed</p>						

Figure 2: GIS map featuring general information of the Eightmile River watershed at the sub-regional level



Land Use

The existing land use in a watershed can affect the water quality of the waterbodies within that watershed (USEPA, 2011c). In an undeveloped watershed, natural processes such as infiltration of stormwater into the soil and plant uptake of water and nutrients can occur. As watersheds become more developed with commercial, residential, and industrial land uses, the amount of stormwater runoff increases as the natural landscape is altered with impervious surfaces, such as rooftops, roads, and sidewalks. The amount of pollutants, such as nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities, can also increase, can become entrained in this runoff, and negatively affect nearby waterbodies. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Eightmile River watershed consists of 79% forest, 9% urban area, 5% agriculture, and 7% water. The portions of the watershed in Colchester, particularly surrounding the start of Early Brook, are characterized by urban land uses. The areas adjacent to the Eightmile River in southern East Haddam and Lyme are also characterized by urban land uses. There are several large agriculture operations surrounding the Eightmile River in southern East Haddam, northern Lyme, and near the end of the Eightmile River’s impaired segment at Hamburg Cove in Lyme. While much of the watershed is dominated by forest, there are many areas where urban, or agricultural land uses surround the impaired segment of the Eightmile River.

Figure 3: Land uses within the Eightmile River watershed

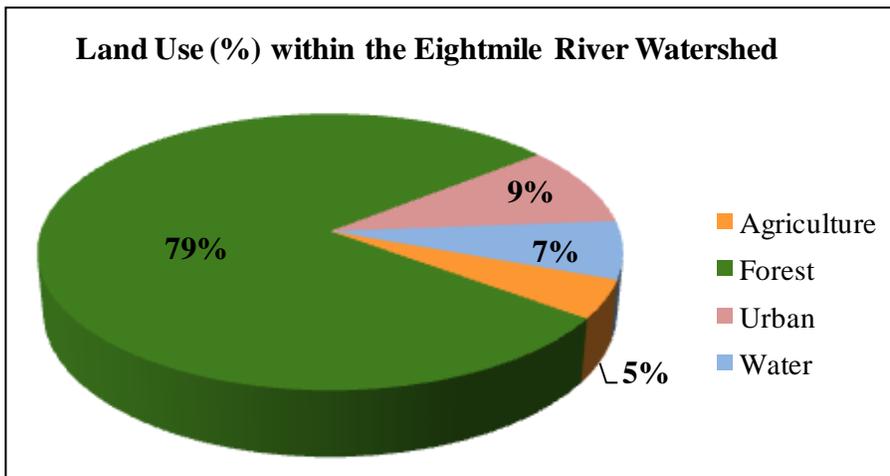
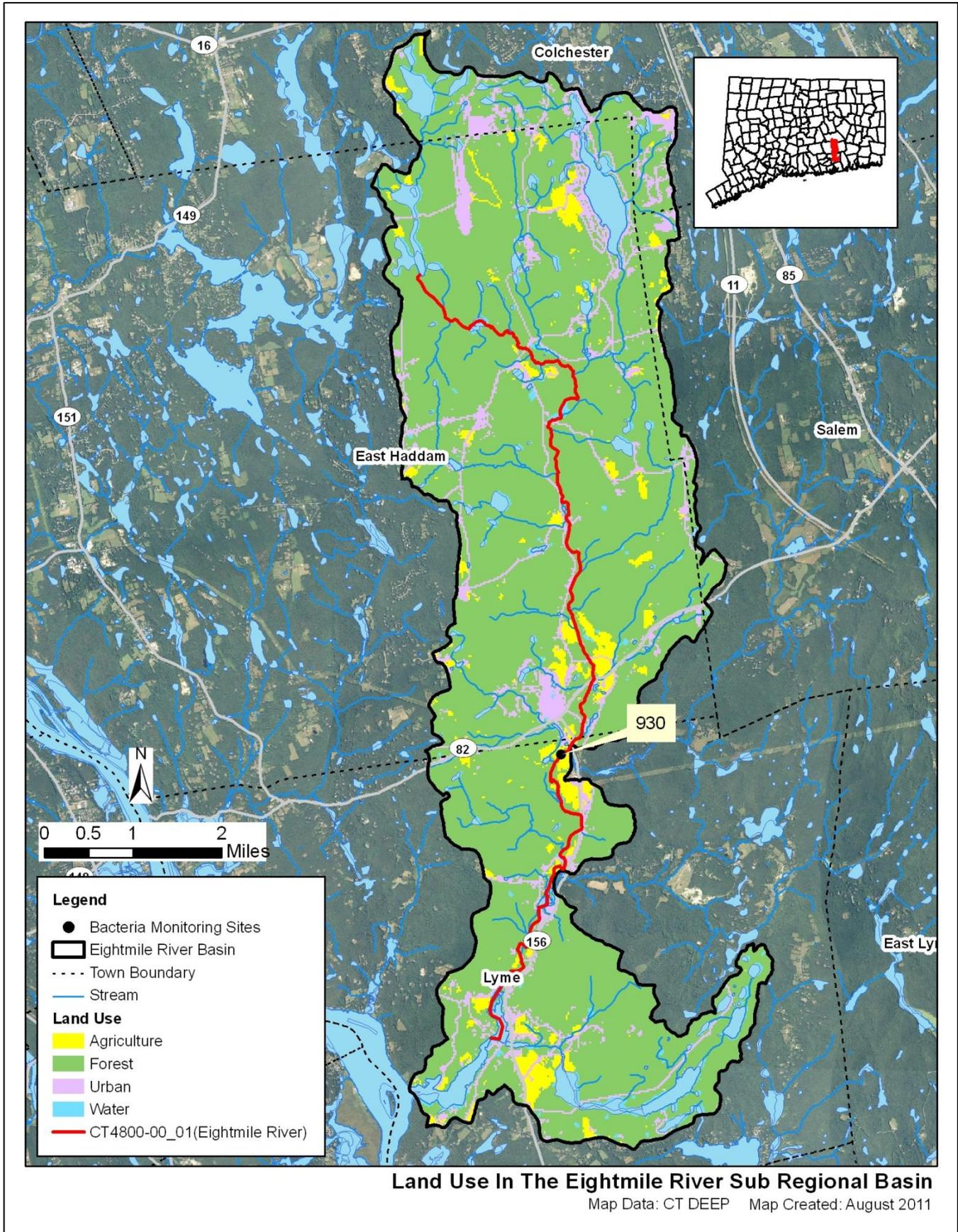


Figure 4: GIS map featuring land use for the Eightmile River watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT state criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture or volunteer monitoring efforts at stations located on the impaired segments.

Table 2: Sampling Station Location Description for the Impaired Segments in the Eightmile River Watershed (stations organized downstream to upstream)

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT4800-00_01	Eightmile River	930	Confluence with East branch Eightmile R. (Rte 156)	Lyme	41.430033	-72.339203

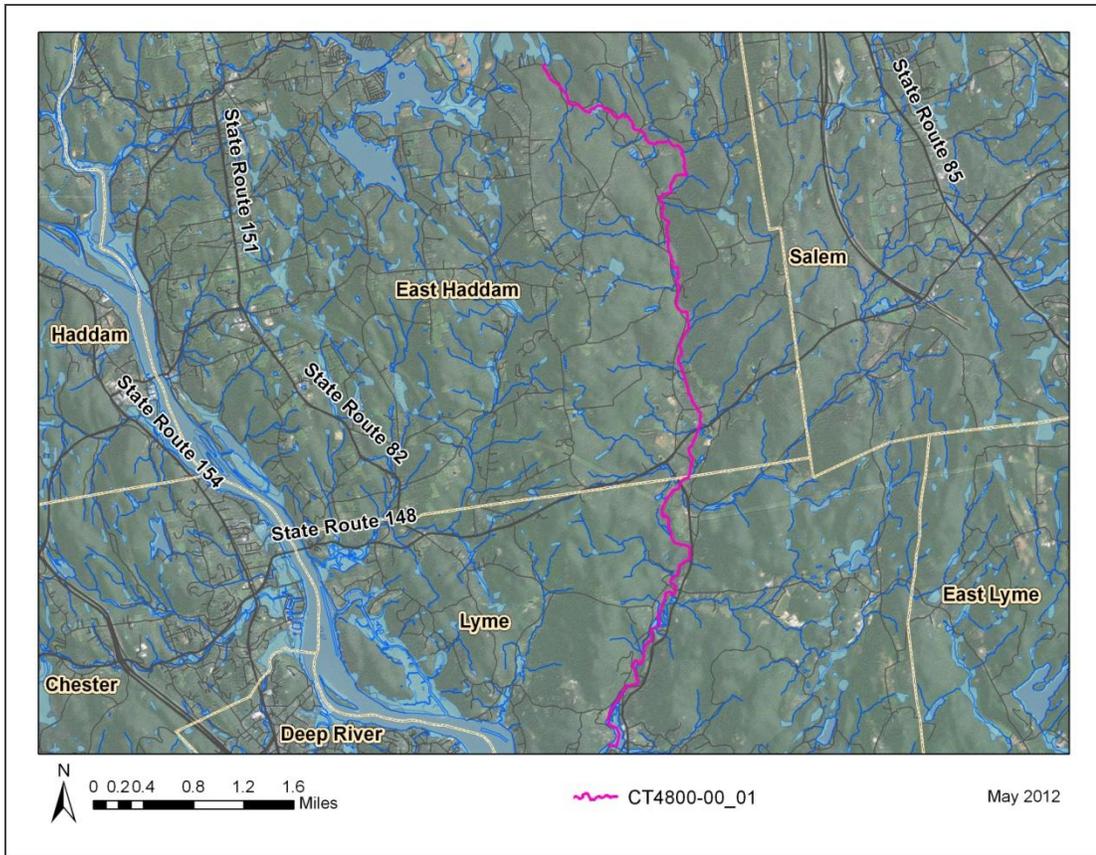
The Eightmile River (CT4800-00_01) is a Class A freshwater river. The applicable designated uses are potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from one sampling location on the Eightmile River (Station 930).

The water quality criteria for *E. coli*, along with bacteria sampling results from 2006-2009 are presented in Table 6 for the Eightmile River. For the Eightmile River, single sample values for Station 930 exceeded the WQS for *E. coli* once in 2007 and once in 2008. The annual geometric mean was calculated for Station 930 and exceeded the WQS for *E. coli* in 2007 and 2008..

To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days, where possible (Tables 6 and 7). For the Eightmile River, the wet-weather geometric mean exceeded the WQS for *E. coli* at Station 930. The dry-weather geometric mean for Station 930 did not exceed. The wet-weather geometric mean was over two times greater than the calculated dry-weather geometric mean at this station.

Due to the elevated bacteria measurements presented in Tables 7 and 8, the Eightmile River did not meet CT's bacteria WQS, was identified as impaired, and was placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all water bodies to comply with state WQS.

Figure 5: Aerial map of the Eightmile River



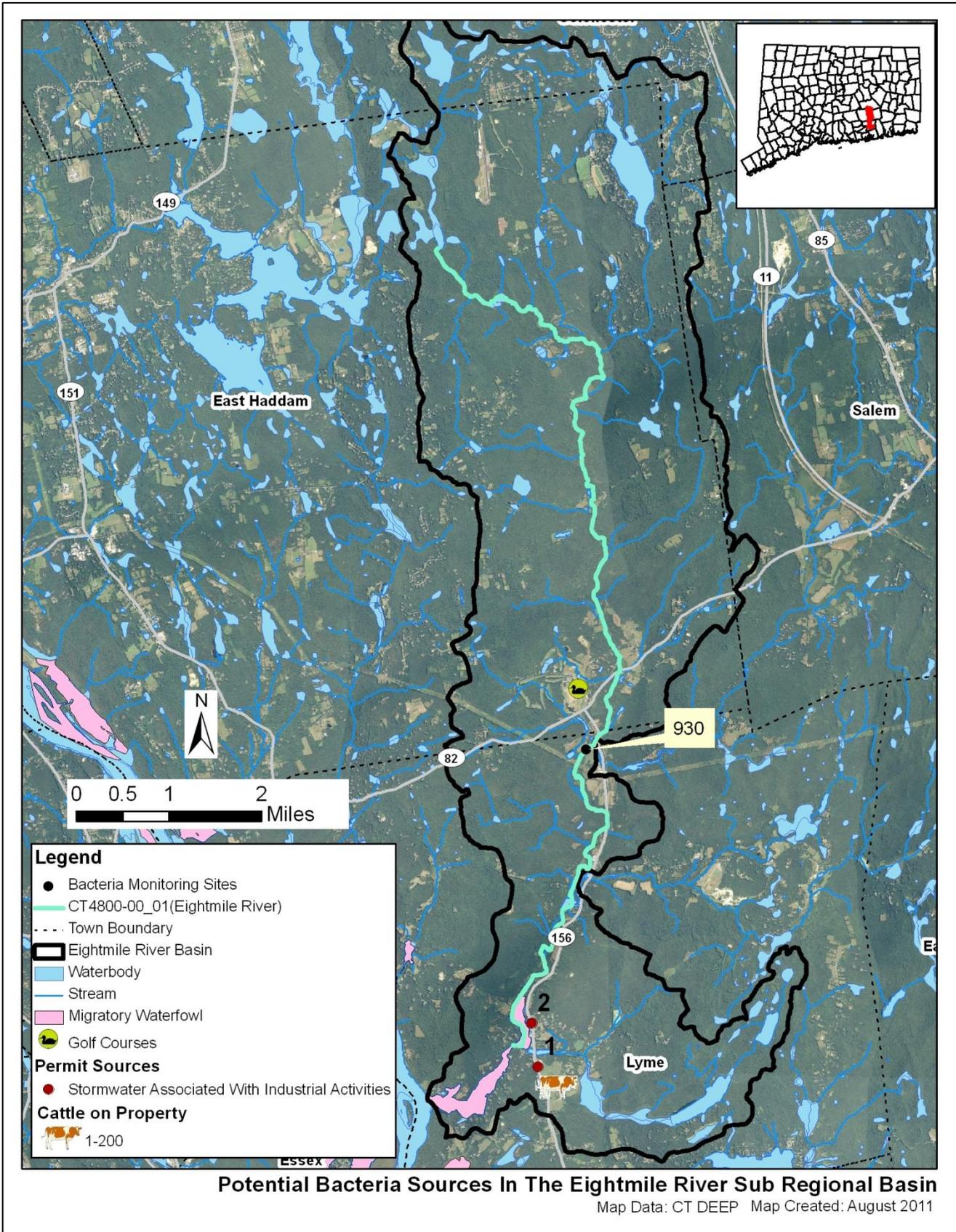
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the Eightmile River watershed based on land use (Figures 2 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 below and shown in Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segment. Further monitoring and investigation will confirm listed sources and discover additional sources. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not mean that there are no data nor that there are no impairments in existence in the segment. In some of these segments there are data from permitted sources and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources in the Eightmile River watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/ Pets	Other
Eightmile River CT4800-00_01	x			x	x	x	x	

Figure 6: Potential sources in the Eightmile River watershed



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map it is because no examples of that specific source were discovered to be present during the analysis of the basin. The following is the list of potential sources that were evaluated during analysis of the impaired basin: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources exist within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring could reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type.

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	0
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	0
GSI	Stormwater Associated with Industrial Activity	2
GSM	Part B Municipal Stormwater MS4	0
GSN	Stormwater Registration – Construction	0
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	0

Permitted Sources

As shown in Table 5, there are several permitted discharges in the Eightmile River watershed. Bacteria data for these permitted facilities are not currently available. The permitted sources within the Eightmile River watershed, some of which are near the Eightmile River’s impaired segment (Figure 6) could still be potential sources of bacterial contamination to the Eightmile River. Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the Eightmile River watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Lyme	Town Of Lyme	GSI000730	Stormwater Associated With Industrial Activities	Lyme Recyclables Transfer Station	1
Lyme	Reynolds Garage & Marine, Inc.	GSI001720	Stormwater Associated With Industrial Activities	Reynolds Garage And Marine, Inc.	2

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

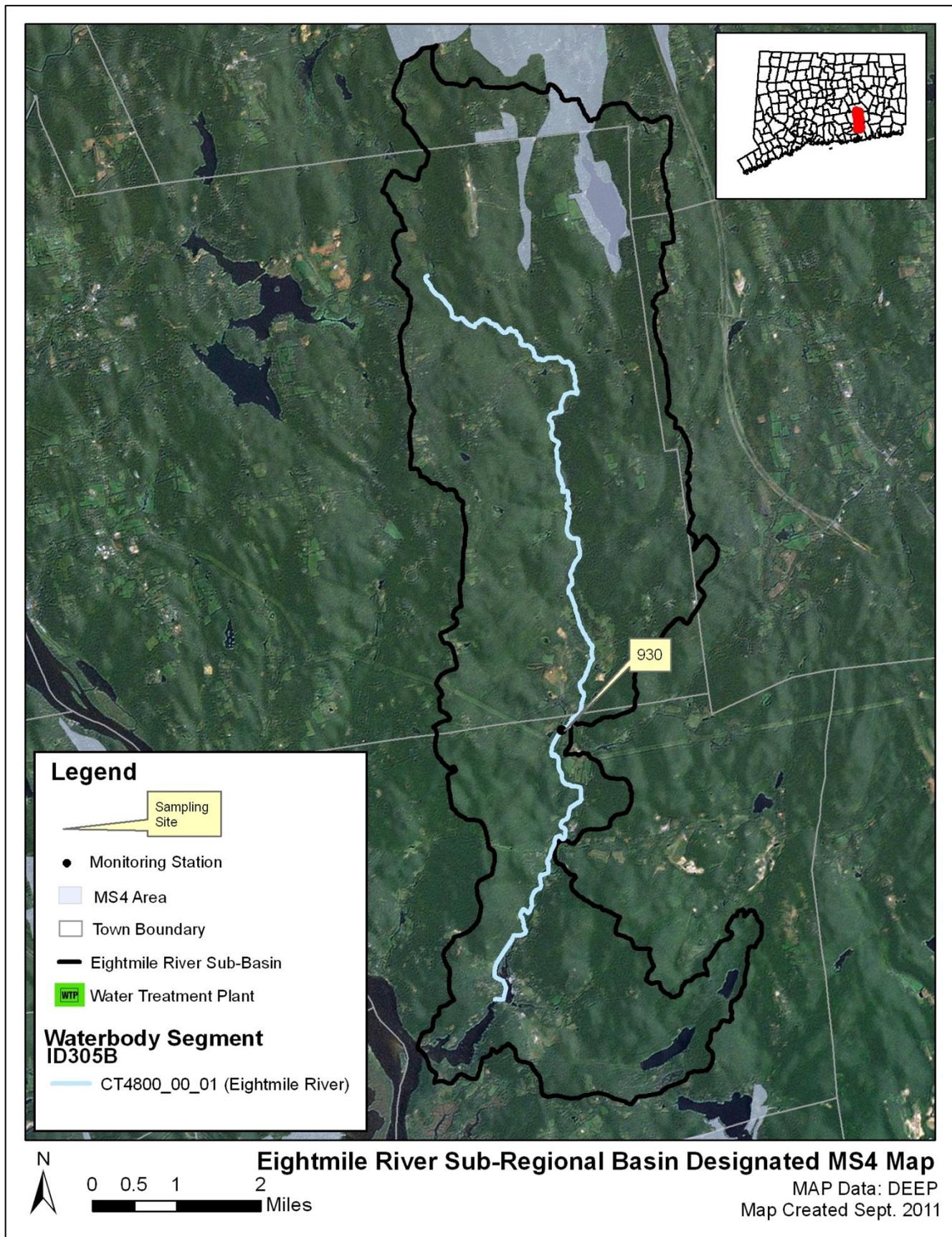
As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

The impaired segment of the Eightmile River is located in the towns of Colchester, East Haddam, and Lyme. As there are no urbanized locations as defined by the U.S. Census Bureau around the impaired segments, the towns are not MS4 areas and are not required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the CT DEEP (Figure 7). Information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website at:

(http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Figure 7: MS4 areas of the Eightmile River watershed



Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contract recreation (swimming or wading). Potential sources of NPS within the Eightmile River watershed are described below.

Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of a vegetated buffer along the shoreline. Agricultural land use makes up 5% of the Eightmile River watershed. There are several agricultural near the Eightmile River in East Haddam and Lyme.

Multiple fields are located near the Eightmile River including the Old Lyme Show Stable, which boards horses, and the Lord Creek Farm. Both of these operations are located along Hamburg Road in Lyme. As seen in Figure 6, a cattle farm with 200 head of cattle is documented as a potential source of bacterial contamination near the end of the Eightmile River's impaired segment at the intersection of Hamburg Road and Sterling City Road in Lyme. These agricultural areas are potentially carrying pollutants, including bacteria, into the Eightmile River.

Insufficient Septic Systems

As shown in Figure 6, all of the residents within the Eightmile River watershed do not have access to a sanitary sewer. These residents surrounding the Eightmile River rely on onsite wastewater treatment systems, such as septic systems to treat their waste. Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters.

In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Towns of East Haddam and Colchester do not have their own health directors. These towns are part of the Chatham Health District (<http://www.chathamhealth.org/>). The Town of Lyme has its own director of health (<http://www.twnlyme.org/>).

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Eightmile River watershed represent a potential source of bacteria. Wildlife, including waterfowl, may be a significant bacteria source to surface waters. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of these natural sources on water quality (USEPA, 2001).

Open spaces located along the impaired segments may provide an area for waterfowl to congregate. Geese and other waterfowl are known to congregate in open areas including recreational fields, golf courses, and agricultural crop fields. There are multiple large grassed fields along the Eightmile River on Three Bridges Road No. 1 and Hopyard Road in East Haddam. The Fox Hopyard Golf Club is located along the Eightmile River at the intersection of Norwich Salem Road and Hopyard Road in East Haddam. The open fields near the River and turf grass within the golf course represent a potential place for geese and other waterfowl to congregate. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and cause water quality problems due to bacterial

contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants. These factors make wildlife waste a potential source of bacteria to the impaired segments of the Eightmile River.

Residential development surrounds much of the Eightmile River (Figure 5). Waste from domestic animals such as dogs, when not disposed of properly, can enter surface waters directly or through stormwater infrastructure. Therefore, domestic animal waste may be contributing to bacteria concentrations in the impaired segments of the Eightmile River.

Stormwater Runoff from Developed Areas

In several areas of the watershed, the land around the impaired segments is developed. Approximately 9% of the land use in the watershed is considered urban, and much of that area is concentrated around the impaired segments in the Towns of East Haddam and Lyme (Figures 4 and 9). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Past studies have shown a link between the amount of impervious area in a watershed and water quality conditions (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin et. al., 2000).

Approximately 99% of the Eightmile River watershed is characterized by land with 0 to 6% impervious cover, with only 1% of the watershed containing 7 to 11% impervious cover. None of the land in the watershed is characterized by 12 to 15%, or >16%, impervious cover (Figure 8). While there is a relatively modest amount of impervious surfaces within the watershed, there are many areas in the more urbanized portions of East Haddam and Lyme where impervious surfaces are in close proximity to the Eightmile River. The proximity of those surfaces to the Eightmile River, indicate that stormwater runoff from developed areas is a potential source of bacterial contamination.

Figure 8: Range of impervious cover (%) in the Eightmile River watershed

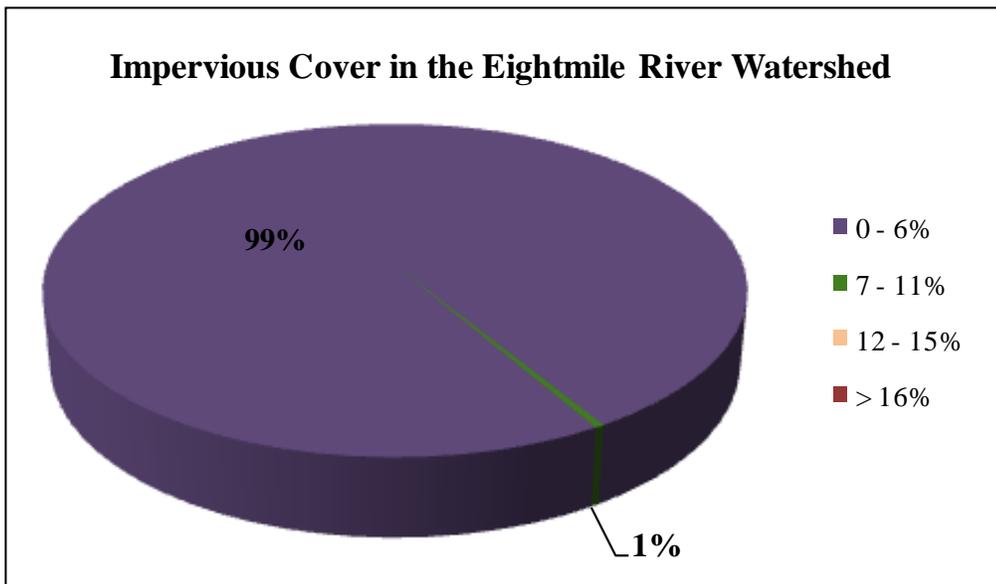
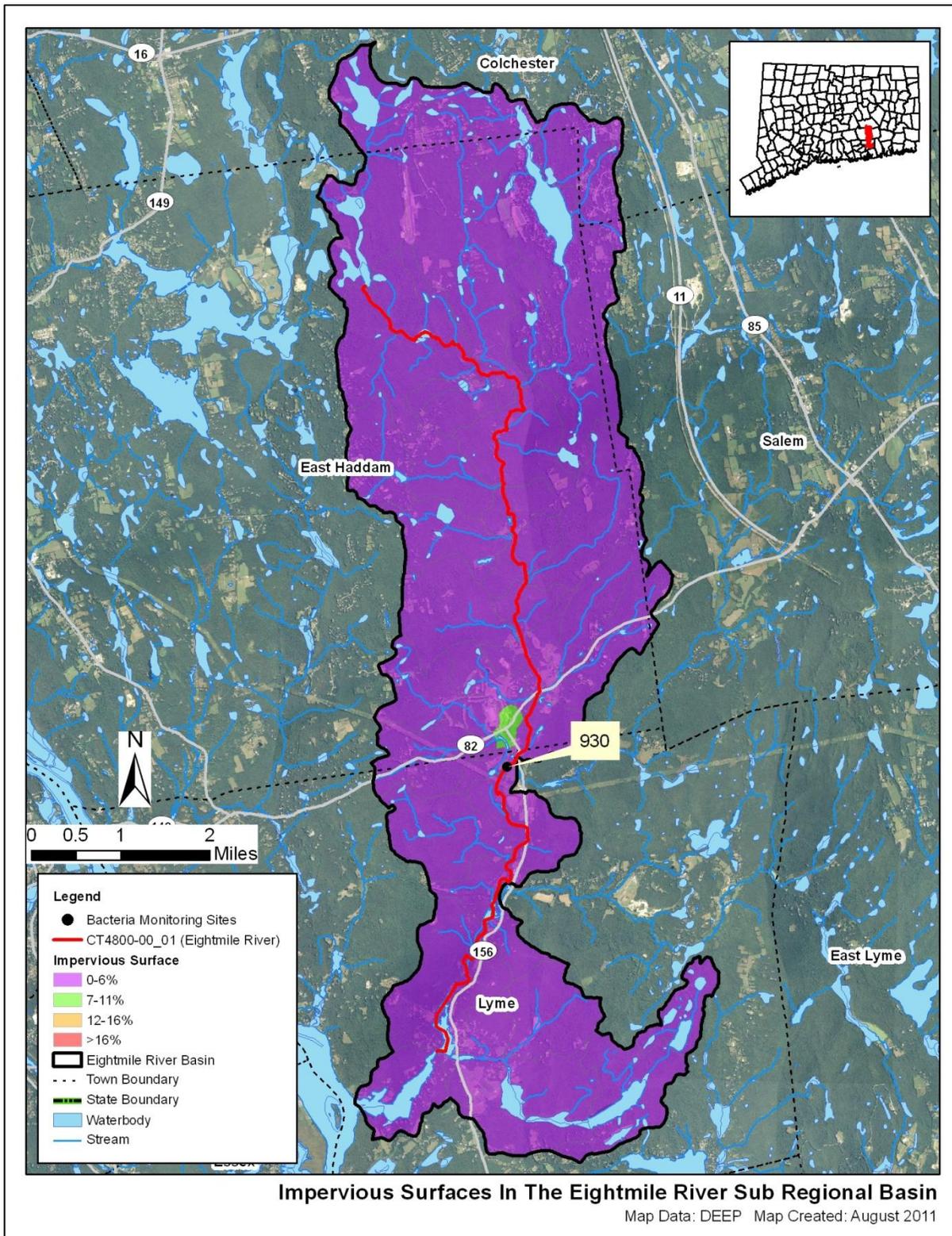


Figure 9: Impervious cover (%) for the Eightmile River sub-regional watershed



Additional Sources

There may be other sources not listed here or identified in Figure 6 which contribute to the observed water quality impairment in the Eightmile River. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their unique soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (<http://clear.uconn.edu/>) which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The riparian zone of the Eightmile River is mostly forested (Figure 10). However, there are multiple areas, such as near Station 930 on the Eightmile River where most of the riparian zone is characterized by agricultural lands. As previously mentioned, developed and agricultural areas, especially when within the riparian zone, can be sources of bacterial contamination.

CURRENT MANAGEMENT ACTIVITIES

The Towns of East Haddam and Lyme have developed and implemented programs to protect water quality from bacterial contamination. In 2006, the Eightmile River Watershed Based Plan was completed and is available for viewing here: (http://eightmileriver.org/publications/management_plan/index.html). This document outlines current actions in the watershed and recommends future actions necessary to maintain or improve water quality. The Towns of East Haddam and Lyme were essential project partners in the development and implementation of the Watershed Based Plan. More information about the Watershed Based Plan and the efforts in the Eightmile River watershed can be found on the Eightmile River Wild & Scenic Watershed website (<http://www.eightmileriver.org>).

RECOMMENDED NEXT STEPS

As shown above, the Towns of East Haddam and Lyme have developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of the Eightmile River and have been prioritized below.

1). Ensure there are sufficient buffers on agricultural lands along the Eightmile River and its tributaries.

If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict access to livestock and horses to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place. Particular attention should be paid to the agricultural operations near the Eightmile River. Below are specific recommendations made in the Eightmile River Watershed Based Plan (2006) to reduce the impacts of agricultural activities on water quality (Eightmile River, 2006).

- A. Support the Eightmile River Wild and Scenic Committee (ERWSC) in implementing landowner education and outreach initiatives on the importance of riparian buffers, especially along agricultural fields.
- B. Promote best management practices for agricultural land uses that prevent non-point source pollution.
- C. Work with the Inland Wetlands Commissions to consider the potential water quality affects of activities allowed under the state agricultural exemption and determine potential strategies to minimize water quality degradation from such impacts.

2). Develop a system to monitor septic systems.

All of the residents within the Eightmile River watershed rely on septic systems to dispose of their waste. If not already in place, Colchester, East Haddam, and Lyme should establish a program to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could also be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems. Below are specific recommendations made in the Eightmile River Watershed Based Plan (2006) to reduce the impacts of failing septic systems on water quality (Eightmile River, 2006).

1. Establish a septic system maintenance regulation in each watershed community
2. Establish a Residential Underground Storage Tank Removal Regulation in each watershed community.
3. Establish and enforce slope and soil imitations for all new construction in each watershed community.

3). Evaluate municipal education and outreach programs regarding animal waste.

Any education and outreach programs within East Haddam, Lyme, and Colchester should highlight the importance of not feeding waterfowl and wildlife, picking up after dogs, and other pets within parks and the other recreational areas located along the Eightmile River. The municipalities and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas of the impaired segments of the Eightmile River that are frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans may contribute to water quality impairments in the Eightmile River watershed and can harm human health and the environment.

Animal wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

4). Identify areas along the more developed portions of the Eightmile River to implement Best Management Practices (BMPs) to control stormwater runoff.

Since urban development is concentrated around the Eightmile River, stormwater runoff may be contributing bacteria to these waterbodies. To identify specific areas that are contributing bacteria, all of the municipalities in the watershed should conduct wet-weather sampling at stormwater outfalls that discharge directly to the Eightmile River. To treat stormwater runoff, the towns should also identify areas along the more developed sections of the Eightmile River, to install BMPs designed to encourage stormwater to infiltrate into the ground before entering these waterbodies. These BMPs would disconnect impervious areas and reduce pollutant loads to the Eightmile River's impaired segments. Below are specific recommendations made in the Eightmile River Watershed Based Plan (2006) to reduce the impacts of stormwater runoff on water quality (Eightmile River, 2006). More detailed information and BMP recommendations can be found in the core TMDL document.

- A. Require the 2004 CT DEEP Stormwater Quality Manual be used as guidance for the design, implementation and maintenance of all new and existing stormwater systems in each community
- B. Complete and implement a Stormwater Management plan for each municipality's stormwater system as described in the State's General Permit for the Discharge of Stormwater from Small municipal Separate Storm Sewer Systems.
- C. Adopt the University of Massachusetts guidance for watercourse crossings, an approach that is used by the Army Corps of Engineers (New England Region).
- D. Each community adopts maximum impervious surface limits of 10% per local watershed and 4% for the Eightmile River Watershed as a whole.

5). Monitoring of permitted sources.

As Figure 6 displays, there are multiple permitted discharges within the Eightmile River watershed, with some close to the Eightmile River. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility is an additional recommendation. Monitoring should continue on all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection. Table 6 details the appropriate waste load allocations for use as water quality targets for permittees as permits are renewed and updated, within the Eightmile River watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 6. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreation Use

Class	Bacteria Source	Instantaneous <i>E. coli</i> (#/100mL)						Geometric Mean <i>E. coli</i> (#/100mL)	
		WLA ⁶			LA ⁶			WLA ⁶	LA ⁶
A	Non-Stormwater NPDES	0	0	0				0	
	CSOs	0	0	0				0	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235 ⁷	410 ⁷	576 ⁷				126 ⁷	
	Stormwater (non-MS4)				235 ⁷	410 ⁷	576 ⁷		126 ⁷
	Wildlife direct discharge				235 ⁷	410 ⁷	576 ⁷		126 ⁷
	Human or domestic animal direct discharge ⁵				235	410	576		126

- (1) **Designated Swimming.** 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 Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.
- (2) **Non-Designated Swimming.** 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.
- (3) **All Other Recreational Uses.**

- (4) 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. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)
- (5) Human direct discharge = swimmers
- (6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations
- (7) These values can be "as naturally occurs" if the only pollutant source is wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 7: Eightmile River Bacteria Data

Waterbody ID: CT4800-00_01

Characteristics: Freshwater, Class A, Potential Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli* bacteria)

Water Quality Criteria for *E. coli*:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: 32%

Single Sample: 85%

Data: 2006-2009 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Eightmile River with annual geometric means calculated by station

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
930	Downstream of Route 156 crossing ¹	6/21/2006	52	dry	66
930	Downstream of Route 156 crossing ¹	6/28/2006	240	dry	
930	Downstream of Route 156 crossing ¹	7/3/2006	86	dry	
930	Downstream of Route 156 crossing ¹	7/11/2006	75	dry	
930	Downstream of Route 156 crossing ¹	7/18/2006	75	dry	
930	Downstream of Route 156 crossing ¹	7/27/2006	120	dry	
930	Downstream of Route 156 crossing ¹	8/2/2006	10	dry	
930	Downstream of Route 156 crossing ¹	8/9/2006	51	dry	
930	Downstream of Route 156 crossing ¹	8/16/2006	130	wet	
930	Downstream of Route 156 crossing ¹	8/23/2006	52	dry	
930	Downstream of Route 156 crossing ¹	9/11/2006	41	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Eightmile River with annual geometric means calculated by station (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
930	Downstream of Route 156 crossing ¹	6/6/2007	270	wet	185* (32%)
930	Downstream of Route 156 crossing ¹	6/13/2007	84	dry	
930	Downstream of Route 156 crossing ¹	6/20/2007	170	dry	
930	Downstream of Route 156 crossing ¹	7/12/2007	150 [†]	dry	
930	Downstream of Route 156 crossing ¹	7/19/2007	210	wet	
930	Downstream of Route 156 crossing ¹	7/26/2007	170	dry	
930	Downstream of Route 156 crossing ¹	8/9/2007	74	wet	
930	Downstream of Route 156 crossing ¹	8/23/2007	290	wet	
930	Downstream of Route 156 crossing ¹	9/4/2007	97	dry	
930	Downstream of Route 156 crossing ¹	9/12/2007	1100	wet	
930	Downstream of Route 156 crossing ¹	6/4/2008	320 [†]	wet**	179
930	Downstream of Route 156 crossing ¹	6/11/2008	120	dry**	
930	Downstream of Route 156 crossing ¹	6/19/2008	180	dry**	
930	Downstream of Route 156 crossing ¹	6/25/2008	85	wet**	
930	Downstream of Route 156 crossing ¹	7/2/2008	400	dry**	
930	Downstream of Route 156 crossing ¹	7/9/2008	97	dry**	
930	Downstream of Route 156 crossing ¹	7/16/2008	150	dry**	
930	Downstream of Route 156 crossing ¹	7/23/2008	130	wet**	
930	Downstream of Route 156 crossing ¹	7/30/2008	150	dry**	
930	Downstream of Route 156 crossing ¹	8/6/2008	2750* [†] (85%)	wet**	
930	Downstream of Route 156 crossing ¹	8/13/2008	140	dry**	
930	Downstream of Route 156 crossing ¹	8/21/2008	41	dry**	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Eightmile River Segment 1 with annual geometric means calculated by station (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
930	Downstream of Route 156 crossing ¹	6/3/2009	41	dry**	86
930	Downstream of Route 156 crossing ¹	6/11/2009	98	wet**	
930	Downstream of Route 156 crossing ¹	6/25/2009	51	dry**	
930	Downstream of Route 156 crossing ¹	7/9/2009	250	wet	
930	Downstream of Route 156 crossing ¹	7/16/2009	74	dry	
930	Downstream of Route 156 crossing ¹	7/23/2009	98	wet	
930	Downstream of Route 156 crossing ¹	7/29/2009	74 [†]	dry	
930	Downstream of Route 156 crossing ¹	8/6/2009	74	dry	
930	Downstream of Route 156 crossing ¹	8/13/2009	120	dry	
930	Downstream of Route 156 crossing ¹	8/20/2009	86	dry	

Shaded cells indicate an exceedance of water quality criteria
[†] Average of two duplicate samples
**** Weather conditions for selected data taken from Hartford because local station had missing data**
***Indicates single sample and geometric mean values used to calculate the percent reduction**
¹ Full Station Location is: 150 meters downstream of confluence with Eightmile River and Route 156 crossing

Wet and dry weather geometric mean values for all monitoring stations on Eightmile River

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
930	150 meters downstream of confluence with Eightmile River and Route 156 crossing	2006-2009	13	30	118	226	89

Shaded cells indicate an exceedance of water quality criteria
Weather condition determined from rain gages at Norwich Public Utility Plant in Norwich, CT and at Hartford Bradley International Airport

REFERENCES

- Costa, Joe (2011). Calculating Geometric Means. Buzzards Bay National Estuary Program. **Online:** <http://www.buzzardsbay.org/geomean.htm>
- CTDEEP (2011). State of Connecticut Water Quality Standards. **Online:** http://www.ct.gov/dep/lib/dep/water/water_quality_standards/wqs_final_adopted_2_25_11.pdf
- CTDEEP (2010). State of Connecticut Integrated Water Quality Report. **Online:** http://www.ct.gov/dep/lib/dep/water/water_quality_management/305b/ctiwqr10final.pdf
- CWP (2003). Impacts of Impervious Cover on Aquatic Systems. Center for Watershed Protection. **Online:** http://clear.uconn.edu/projects/tmdl/library/papers/Schueler_2003.pdf
- Eightmile River (2006). Eightmile River Watershed Management Plan. Eightmile River Watershed Wild & Scenic Study. **Online:** http://eightmileriver.org/publications/management_plan/index.html
- Federal Register 67 (March 15, 2002) 11663-11670. Urban Area Criteria for Census 2000
- Mallin, M.A., K.E. Williams, E.C. Escham, R.P. Lowe (2000). Effect of Human Development on Bacteriological Water Quality in Coastal Wetlands. *Ecological Applications* 10: 1047-1056.
- USEPA (2001). Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water. **Online:** http://www.epa.gov/safewater/sourcewater/pubs/fs_swpp_petwaste.pdf.
- USEPA (2011a). Managing Nonpoint Source Pollution from Agriculture. **Online:** <http://water.epa.gov/polwaste/nps/outreach/point6.cfm>
- USEPA (2011b). Riparian Zone and Stream Restoration. **Online:** <http://epa.gov/ada/eco/riparian.html>