Mill River

Watershed Summary

Watershed Description and Maps

The Mill River watershed covers an area of approximately 16,286 acres in the southern coastal area of Connecticut (Figure 1). There are multiple towns located at least partially in the watershed, including the municipalities of Cheshire, Hamden, North Haven, Wallingford, and New Haven, CT.

The Mill 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. Some segments in the watershed are currently unassessed as of the writing of this document. This does not suggest that there are no problems on those segments, but indicates a lack of current data to evaluate the segments as part of the assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of waterbodies in the watershed (CT DEEP, 2010).

The Mill River begins in a residential area just south of Wallingford Road in Cheshire. The bacteria impaired segment of the Mill River (CT5302-00_02) begins at the Cook Hill Road crossing in Cheshire, flows south into Hamden, passes through Sleeping Giant State Park and Quinnipiac University before entering downtown Hamden and North Haven, and ends at the inlet to Lake Whitney at the Connolly Parkway crossing near Route 15 (Figure 2). The bacteria impaired segment of Shepard Brook (CT5302-06_01), a tributary to the Mill River, begins at the confluence with an unnamed tributary behind the business park between Sherman Avenue and Town Walk Drive, flows through Turners Pond, and ends at the confluence with the Mill River just downstream of the Route 15 crossing in Hamden.

The impaired segments of the Mill River have a water quality classification of AA. Designated uses include existing or proposed drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. As there are no designated beaches in these segments of the Mill River, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Impaired Segment Facts

Impaired Segment:
1. Mill River (CT5302-00_02)
2. Shepard Brook (CT5302-06_01)

Municipalities: Hamden, Cheshire, North Haven

Impaired Segment Length (miles): 5302-00_02 (9.06); 5302-06_01 (1.78)

Water Quality Classification: Class AA

Designated Use Impairment: Recreation

Sub-regional Basin Name and Code: Mill River, 5302

Regional Basin: Quinnipiac

Major Basin: South Central Coast

Watershed Area (acres): 16,286

MS4 Applicable? Yes

Applicable Season: Recreation Season (May 1 to September 30)

Figure 1: Watershed location in Connecticut

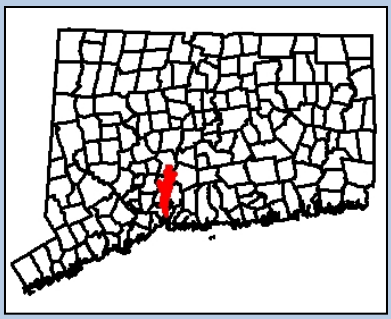


Table 1: Impaired segment and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT5302-00_01	Mill River (Hamden)-01	From Footbridge off of Park Road (US extent of saltwater influence), US to Lake Whitney outlet dam, Hamden. (Segment is tidally affected, but not saltwater).	0.41	NOT	NOT	FULL
CT5302-00_02	Mill River (Hamden/Cheshire)-02	From inlet to Lake Whitney (east side of Route 15, just DS of Connolly Parkway crossing), Hamden, US to Cook Hill Road crossing, Cheshire.	9.06	U	NOT	FULL
CT5302-00_03	Mill River (Cheshire)-03	From Cook Hill Road crossing, Cheshire, US to headwaters (US of Williamsburg Drive crossing).	3.09	NOT	U	FULL
CT5305-06_01	Shepard Brook (Hamden)-01	Mouth at confluence with Mill River just DS of Route 15 crossing, US (includes Turners Pond) to confluence with unnamed tributary behind business park off Sherman Avenue on west and Town Walk Drive on east (above ponded area at Sherman Lane), Hamden.	1.78	U	NOT	U

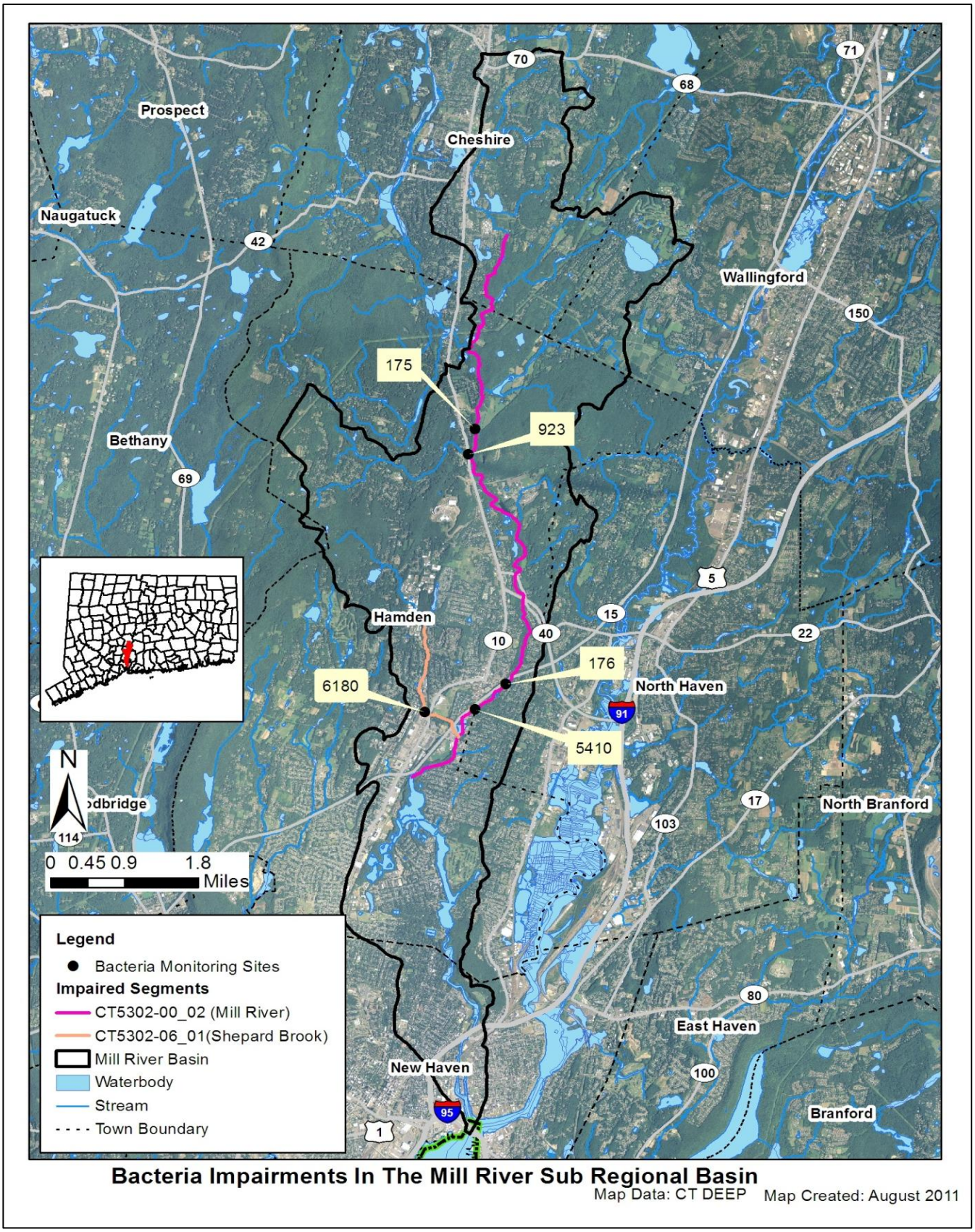
Shaded cells indicate impaired segment addressed in this TMDL

FULL = Designated Use Fully Supported

NOT = Designated Use Not Supported

U = Unassessed

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



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. 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 Mill River watershed consists of 52% urban area, 39% forest, 4% agriculture, and 4% water. The majority of the watershed surrounding the impaired segments is dominated by urban land use. There are several large agricultural areas in the Mill River watershed, including a large agricultural operation adjacent to the Mill River (CT5302-00_02) near Station 175 in Hamden (Figure 4).

Figure 3: Land use within the Mill River watershed

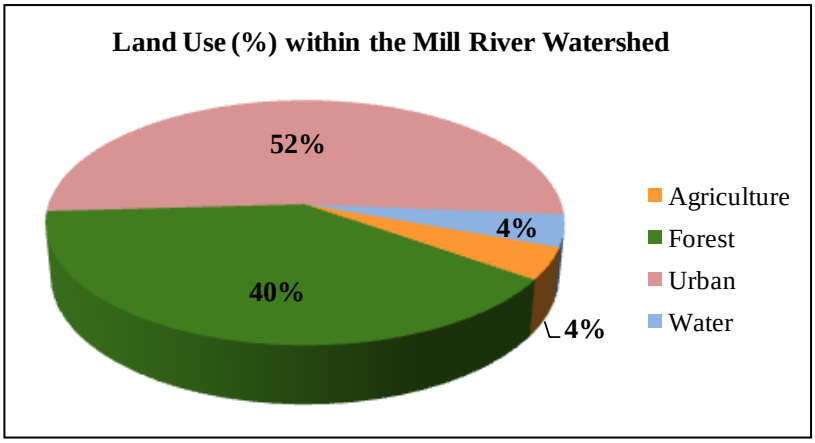
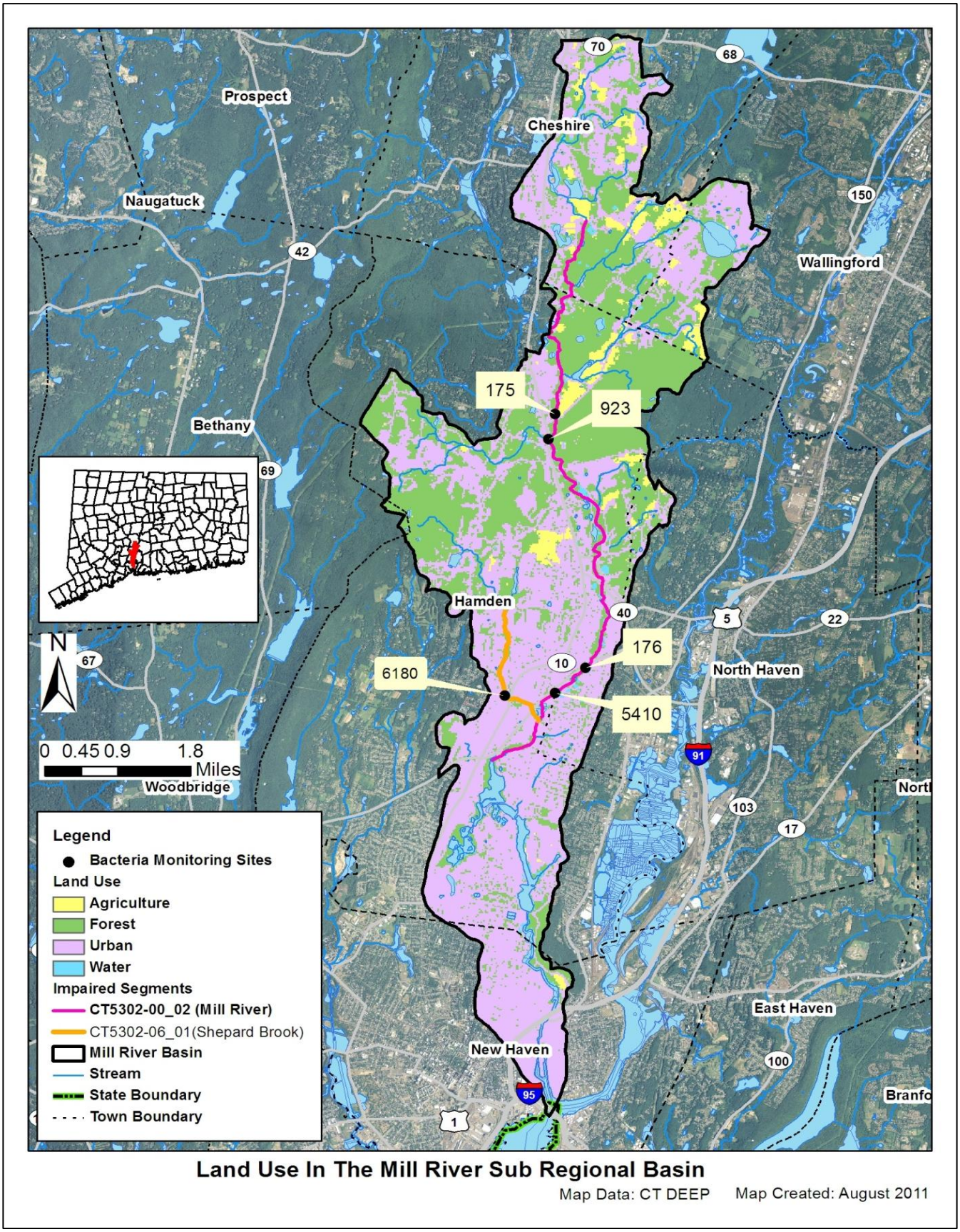


Figure 4: GIS map featuring land use for the Mill River watershed at the sub-regional level



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 Mill River watershed (stations organized downstream to upstream)

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT5302-00_02	Mill River	5410	at Whitney road exit at park and ride	Hamden	41.378060	-72.903890
		176	Dixwell Avenue	Hamden	41.382758	- 72.896677
		923	Tuttle Road	Hamden	41.425900	-72.905583
		175	Tuttle Road	Hamden	41.430650	-72.903989
CT5302-06_01	Shepard Brook	6180	Route 10	Hamden	41.376874	-72.914686

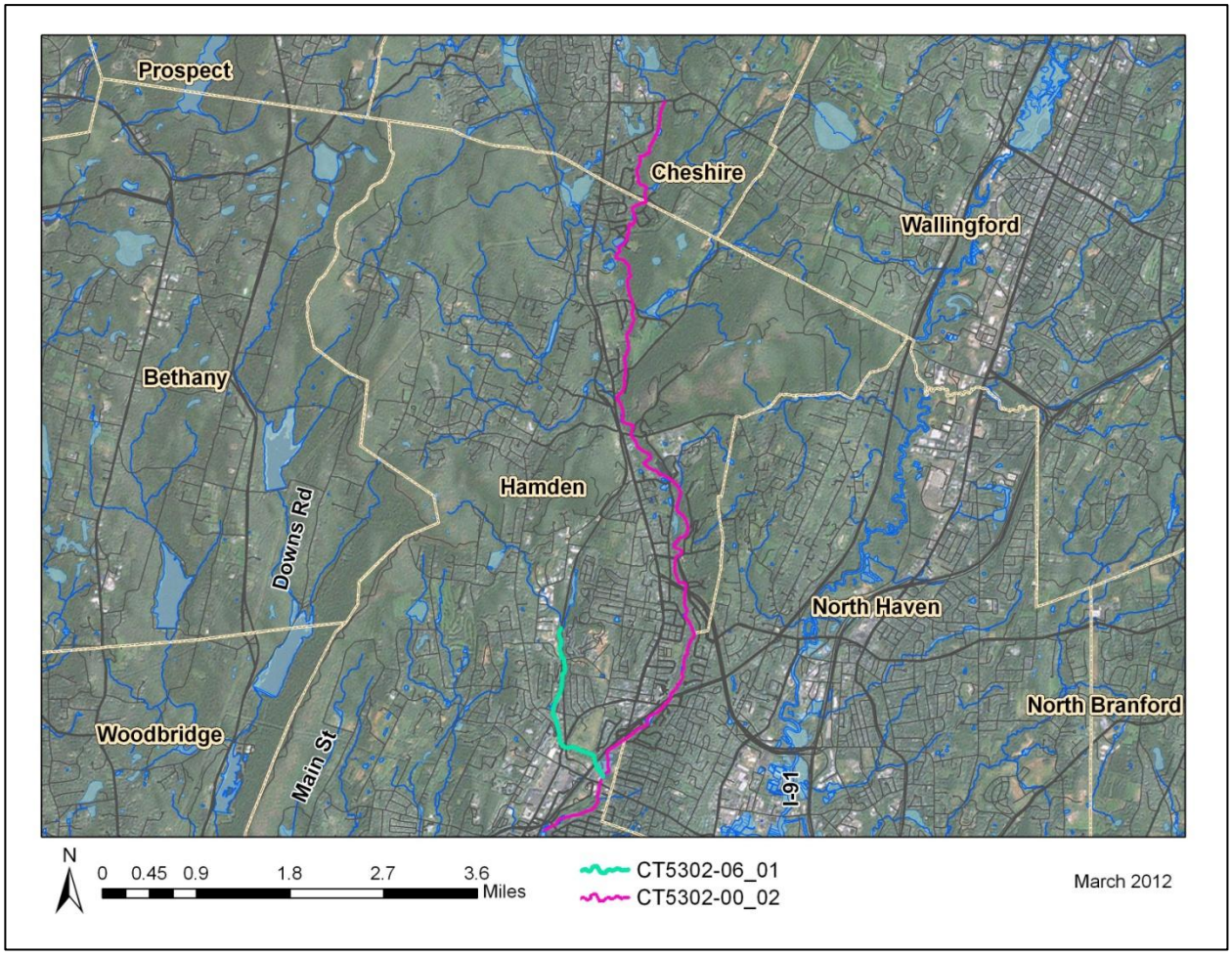
The impaired segments of the Mill River are Class AA freshwater rivers (Figure 5). Their applicable designated uses are existing or proposed drinking water supply, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from four sampling locations (Stations 175, 176, 923, and 5410) from 1998, 2003-2004, and 2006-2010 on the Mill River (CT5302-00_02), and from one sampling location (Station 6180) from 2010-2011 on Shepard Brook (CT5302-06_01) (Table 2). 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 appropriate (Tables 10 and 11).

Mill River (CT5302-00_02): As shown in Table 10, geometric mean values exceeded the WQS for *E. coli* once at Stations 175 and 176 in 1998, multiple times at Stations 923, and once at Station 5410 in 2010. Single sample values also exceeded the WQS for *E. coli* multiple times at Stations 923 and 5410, and once at Stations 175 and 176. Geometric mean values were also calculated for wet and dry-weather conditions, and Stations 5410 and 923 exceeded the WQS for *E. coli* during both wet and dry-weather. Geometric mean values at Stations 175 and 176 also exceeded the WQS for *E. coli* during dry-weather. Geometric mean values during wet-weather were more than twice the value of dry-weather at Stations 923 and 5410.

Shepard Brook (CT5302-06_01): As shown in Table 11, geometric mean and single sample values exceeded the WQS for *E. coli* multiple times at Station 6180. Geometric mean values were also calculated for wet and dry-weather conditions, and Station 6180 exceeded the WQS for *E. coli* during both wet and dry-weather.

Due to the elevated bacteria measurements presented in Tables 10 and 11, these segments of the Mill River do not meet CT's bacteria WQS, were identified as impaired, and were 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 waterbodies to comply with State WQS.

Figure 5: Aerial map of the impaired segments of the Mill River



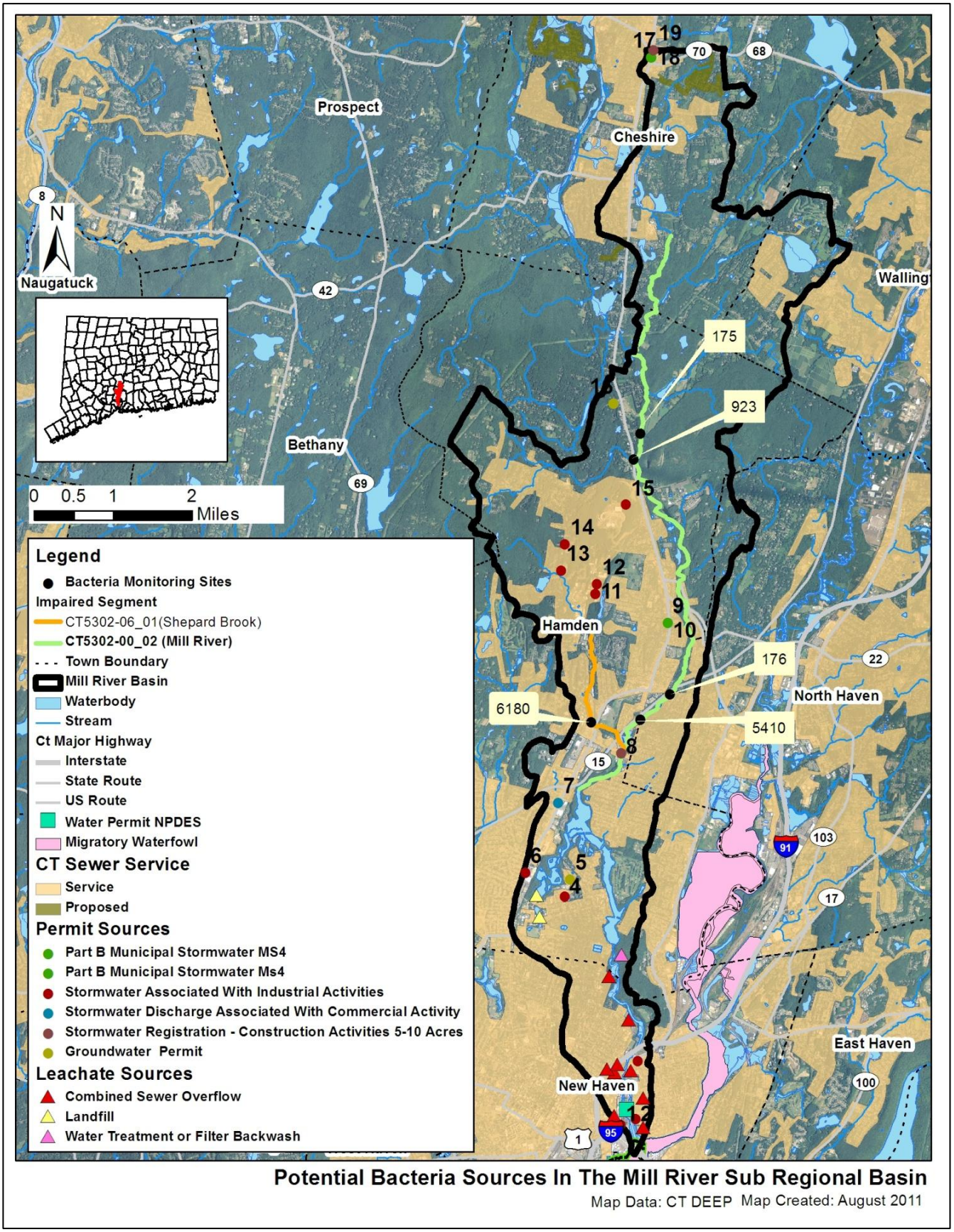
POTENTIAL BACTERIA SOURCES

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 Mill River watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and 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 ones. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not mean that there are no data or no impairments existing in the segment. For some, 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 Mill River watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/ SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/ Pets	Other
Mill River CT5302-00_02	**x**	**x**		**x**	**x**	**x**	**x**	
Shepard Brook CT5302-06_01	**x**	**x**		**x**	**x**	**x**	**x**	

Figure 6: Potential sources in the Mill River watershed at the sub-regional level



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, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: 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 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. When available, bacteria data results from these permitted sources are listed in Table 6.

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	1
GSI	Stormwater Associated with Industrial Activity	10
GSM	Part B Municipal Stormwater MS4	3
GSN	Stormwater Registration – Construction	2
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	2

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Mill River watershed. Bacteria data from 2001-2003 from several of these industrial permitted facilities are included in Table 6. Though Connecticut does not have a recreation WQS for fecal coliform bacteria, multiple samples were high at Saint-Gobain Performance Plastics Corp. (GSI001379), exceeding 1,000 colonies/100 mL and "too numerous to count" or above the detection limits of the analysis on several sample dates. This discharge is located downstream of the impaired segments of the Mill River. These results, while not impacting the impaired segments directly, display how other permitted sources near the impaired segments (Figure 6) could be a potential source of bacterial contamination to the Mill River.

Figure 6 also identified multiple CSOs in the southern portion of the watershed as the Mill River outlets to Lake Whitney. Although the CSOs are downstream of the impaired segments, they may contribute to future bacterial impairments of downstream segments. As discussed in Estuary 6: New Haven (Appendix

80), CSOs represent a likely source of bacterial contamination to the New Haven Estuary since overflowing CSOs will deposit raw sewage with high levels of bacteria into a receiving water. More information on CSOs can be found in the core TMDL document (Section 6.2.5).

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 Mill River watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Cheshire	Town Of Cheshire	GSM000021	Part B Municipal Stormwater MS4	Cheshire, Town Of	NA (18)
Cheshire	Cheshire Academy	GSN002121	Stormwater Registration - Construction Activities 5-10 Acres	Cheshire Academy	19
Hamden	Home Depot U.S.A., Inc.	GSC000334	Stormwater Discharge Associated With Commercial Activity	Home Depot #8473	7
Hamden	Porce-Len, Inc	GSI000210	Stormwater Associated With Industrial Activities	Porce-Len, Inc	4
Hamden	First Student, Inc.	GSI002217	Stormwater Associated With Industrial Activities	First Student, Inc. #20629	6
Hamden	Greater New Haven Transit District	GSI001465	Stormwater Associated With Industrial Activities	Greater New Haven Transit District	11
Hamden	Superior Printing Ink Co., Inc.	GSI002205	Stormwater Associated With Industrial Activities	Superior Printing Ink Co., Inc.	12
Hamden	Town Of Hamden	GSI001682	Stormwater Associated With Industrial Activities	Hamden Public Works Garage	13
Hamden	Town Of Hamden	GSI001721	Stormwater Associated With Industrial Activities	Voed Building	14
Hamden	Town Of Hamden	GSI001681	Stormwater Associated With Industrial Activities	Landfill, Transfer Station & Recycling Center	15
Hamden	Town Of Hamden	GSM000102	Part B Municipal Stormwater MS4	Hamden, Town Of	NA (10)
Hamden	Hamden Hall School, Inc.	GSN001855	Stormwater Registration - Construction Activities 5-10 Acres	Hamden Hall Country Day School	8
Hamden	Whitney Center, Inc.	UI0000344	Groundwater Permit	Whitney Center	5
Hamden	Canal Commons Association, Inc.	UI0000047	Groundwater Permit	Canal Commons Association, Inc.	16

Table 5: Permitted facilities within the Mill River watershed (continued)

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
New Haven	Petroleum Terminals, Inc.	GSI001190	Stormwater Associated With Industrial Activities	Petroleum Terminals, Inc.	1
New Haven	Waterfront Enterprises, Inc.	GSI000657	Stormwater Associated With Industrial Activities	Salt Storage	2
New Haven	H.N.S. Management Co.	GSI000774	Stormwater Associated With Industrial Activities	Connecticut Transit New Haven	3
New Haven	City of New Haven	GSM000030	Part B Municipal Stormwater MS4	New Haven, City Of	NA

Table 6: Industrial permits in the Mill River watershed and available fecal coliform data (colonies/100mL). The results cannot be compared to the water quality standard as there is no recreation standard for fecal coliform.

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
New Haven	H.B. Ives	GSI001038	Mill River	S001	07/26/01	20
New Haven	H.B. Ives	GSI001038	Mill River	S001	07/23/02	0
New Haven	H.B. Ives	GSI001038	Mill River	S002	07/26/01	0
New Haven	H.B. Ives	GSI001038	Mill River	S002	07/23/02	88
New Haven	H.B. Ives	GSI001038	Mill River	S003	07/26/01	0
New Haven	H.B. Ives	GSI001038	Mill River	S003	07/23/02	16
New Haven	Quinnipiac Energy	GSI001370	Mill River	SW-1	09/14/01	96
New Haven	Quinnipiac Energy	GSI001370	Mill River	SW-1	10/16/02	0
New Haven	Quinnipiac Energy	GSI001370	Mill River	SW-2	09/14/01	116
New Haven	Quinnipiac Energy	GSI001370	Mill River	SW-2	10/16/02	150
New Haven	Saint-Gobain Performance Plastics	GSI001379	Mill River	SG-1	07/26/01	100
New Haven	Saint-Gobain Performance Plastics	GSI001379	Mill River	SG-1	08/20/02	2,700
New Haven	Saint-Gobain Performance Plastics	GSI001379	Mill River	SG-1	06/18/03	10
New Haven	Saint-Gobain Performance Plastics	GSI001379	Mill River	SG-2	07/26/01	1,100
New Haven	Saint-Gobain Performance Plastics	GSI001379	Mill River	SG-2	08/20/02	1,000
New Haven	Saint-Gobain Performance Plastics	GSI001379	Mill River	SG-2	06/18/03	40
New Haven	Saint-Gobain Performance Plastics	GSI001379	Mill River	SG-3	07/26/01	TNTC
New Haven	Saint-Gobain Performance Plastics	GSI001379	Mill River	SG-3	08/20/02	4,600
New Haven	Saint-Gobain Performance Plastics	GSI001379	Mill River	SG-3	06/18/03	>1000
New Haven	Connecticut Transit	GSI000774	Mill River	CB 003	07/26/01	10
New Haven	Connecticut Transit	GSI000774	Mill River	CB 003	11/11/02	70
New Haven	Connecticut Transit	GSI000774	Mill River	OF 006	07/26/01	430
New Haven	Connecticut Transit	GSI000774	Mill River	OF 006	11/11/02	260
TNTC = too numerous to count						

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)

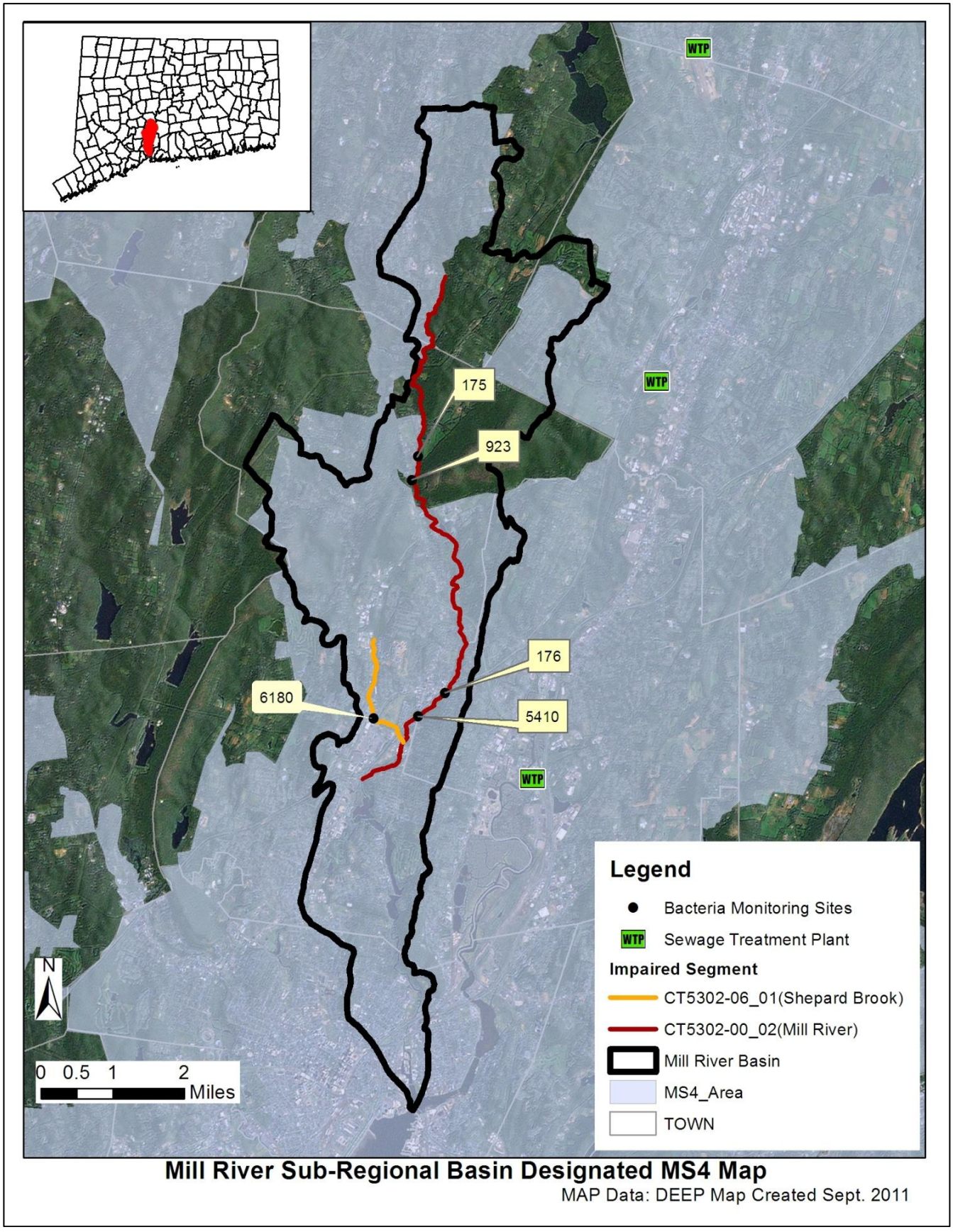
While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some 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 segments of the Mill River watershed are located within the Towns of Cheshire, Hamden, and North Haven. All of these towns have designated urban areas, as defined by the U.S. Census Bureau, and are required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the Connecticut Department of Energy and Environmental Protection (DEEP) (Figure 7). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit required municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. The MS4 permit is discussed further in the "TMDL Implementation Guidance" section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Figure 7: MS4 areas of the Mill 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 contact recreation (swimming or wading). Potential sources of NPS within the Mill River watershed are described below.

Stormwater Runoff from Developed Areas

The majority of the Mill River watershed is developed. Approximately 52% of the land use in the watershed is considered urban, and much of that area is concentrated around the impaired segments in the Town of Hamden (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 the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (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).

A portion of the Mill River watershed in northern Hamden and southern Cheshire is characterized by 0-6% and 7-11% impervious cover. The southern portion of the watershed in Hamden, North Haven, and New Haven, particularly near the lower portion of the Mill River (CT5302-00_02) and Shepard Brook (CT5302-06_01), has 12-15% and greater than 16% impervious cover (Figure 8). Water quality data taken at stations along the impaired segments were consistently high, especially during wet weather, which suggests that stormwater runoff may be a source of bacteria to the Mill River (Tables 10 and 11). Stormwater pollution sources include fertilizer runoff, leaky septic systems, horse farms, golf courses, and impervious surfaces.

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

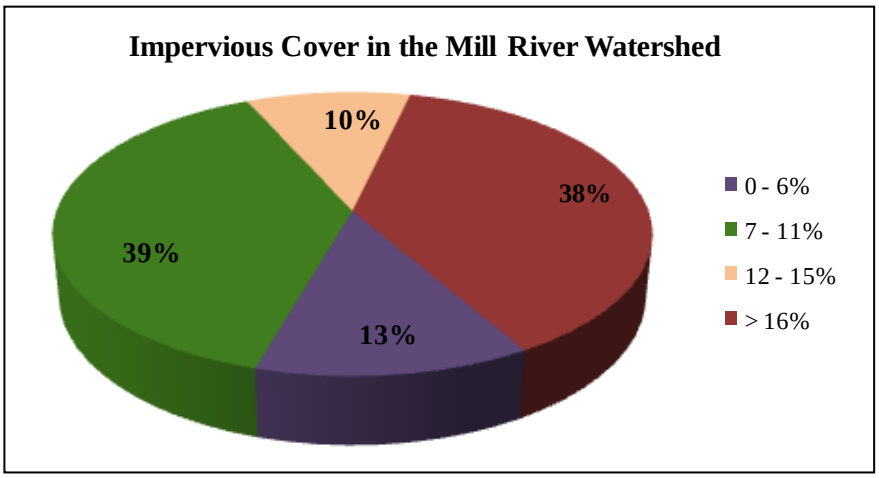
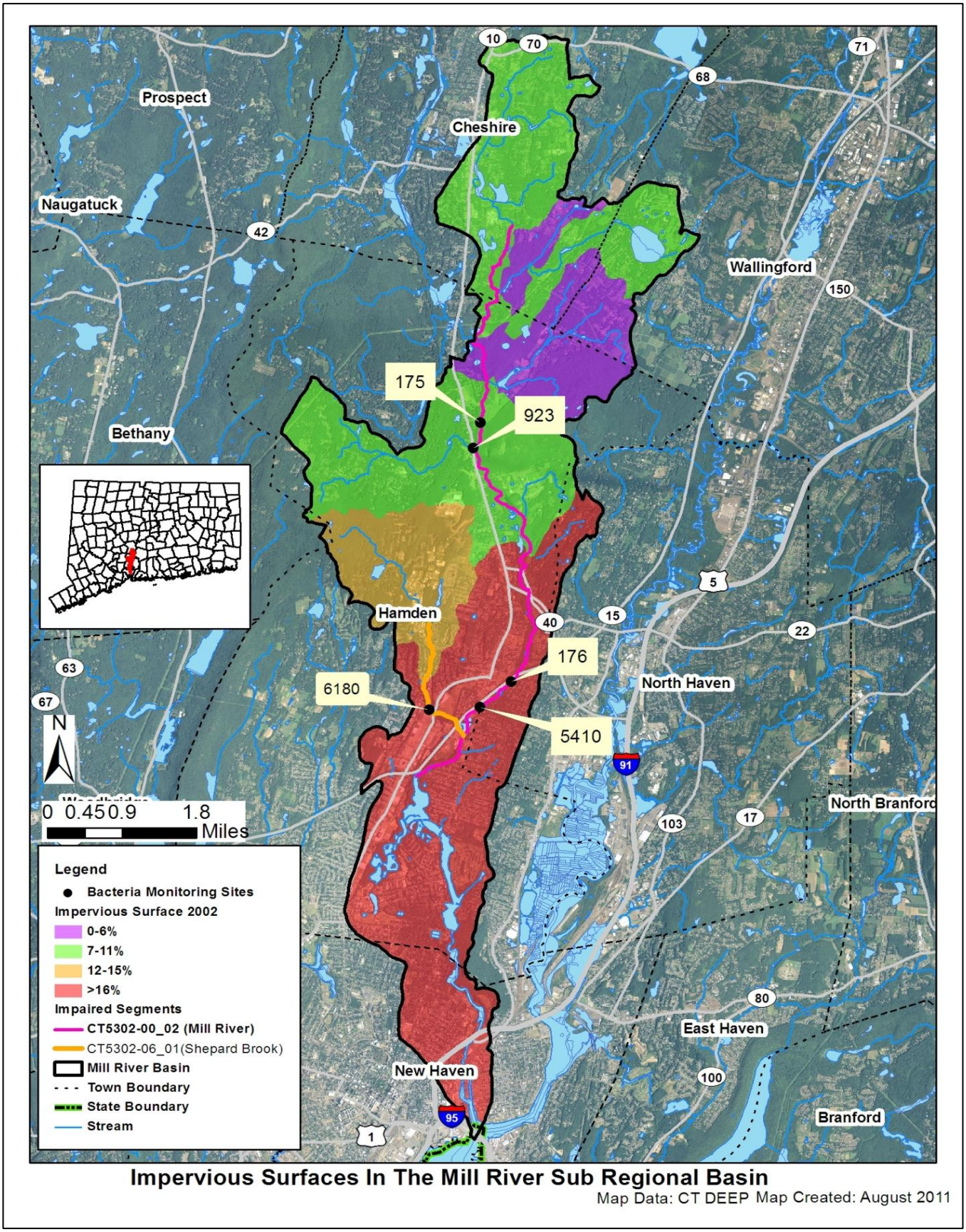


Figure 9: Impervious cover (%) for the Mill River sub-regional watershed



Illicit Discharges and Insufficient Septic Systems

As shown in Figure 6, most of the watershed is serviced by sanitary sewers, particularly around the impaired segments in the southern half of the watershed. As noted previously, there are multiple CSOs located downstream of the impaired segments in New Haven (Figure 6). Although not impacting the impaired segments discussed in this TMDL, the CSOs may be contributing bacteria to the lower reaches of the Mill River. Sewer system leaks and other illicit discharges that are located within the watershed of the impaired segments may be contributing bacteria to the impaired segments of the Mill River.

The northern portion of the watershed, particularly around the upper half of the Mill River (CT5302-00_02) in Cheshire and northern Hamden, relies on onsite wastewater treatment systems, such as septic systems. 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 of failing septic systems in a specific municipality. The Town of Cheshire is part of the Chesprocott Health District, located in Cheshire (http://www.chesprocott.org/). The City of North Haven and Town of Hamden are part of the Quinnipiac Valley Health District, located in North Haven (www.qvhd.org).

As shown in Tables 10 and 11, geometric mean values during dry-weather exceeded the WQS for *E. coli* at all stations along the Mill River and its tributary, Shepard Brook. The area surrounding Stations 5410, 176, and 6180 is serviced by the municipal sanitary sewer system and may be receiving bacteria from leaks in the system or other illicit discharges to the river. The area surrounding Stations 175 and 923 is not serviced by the sanitary sewer system, which may indicate that bacteria from insufficient septic systems is a source of bacterial concentrations in the impaired segments of the Mill River.

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 vegetated buffer along the shoreline. Agricultural land use makes up 4% of the Mill River watershed. There are several areas where agricultural lands are adjacent to the Mill River and its tributaries, such as those along Tuttle Avenue near Station 175 and along Evergreen Avenue in Hamden. Agricultural areas near the impaired segments may be directly depositing bacteria to the Mill River.

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Mill River watershed represent another potential source of bacteria 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 natural sources on water quality (USEPA, 2001).

Geese and other waterfowl are known to congregate in open areas including recreational fields, agricultural crop fields, and golf courses. There are several golf courses within the Mill River watershed, including the Sleeping Giant Golf Course on Whitney Avenue in Hamden adjacent to the impaired segment of the Mill River. 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 lead to habitat destruction as a result of overgrazing on wetland and riparian plants

Also, dense urban development surrounds much of the impaired segments of the Mill River (Figure 4). When not disposed properly, waste from domestic animals such as dogs can enter surface waters either directly or indirectly through stormwater infrastructure. Therefore, pet waste may also be contributing to bacteria concentrations in the Mill River.

Additional Sources

As shown in Figure 6, there are additional potential sources of bacterial contamination that may impact the lower reaches of the watershed downstream of the impaired segments, including two landfills, a water treatment or filter backwash, and one NPDES water permitted facility. There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in the Mill 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

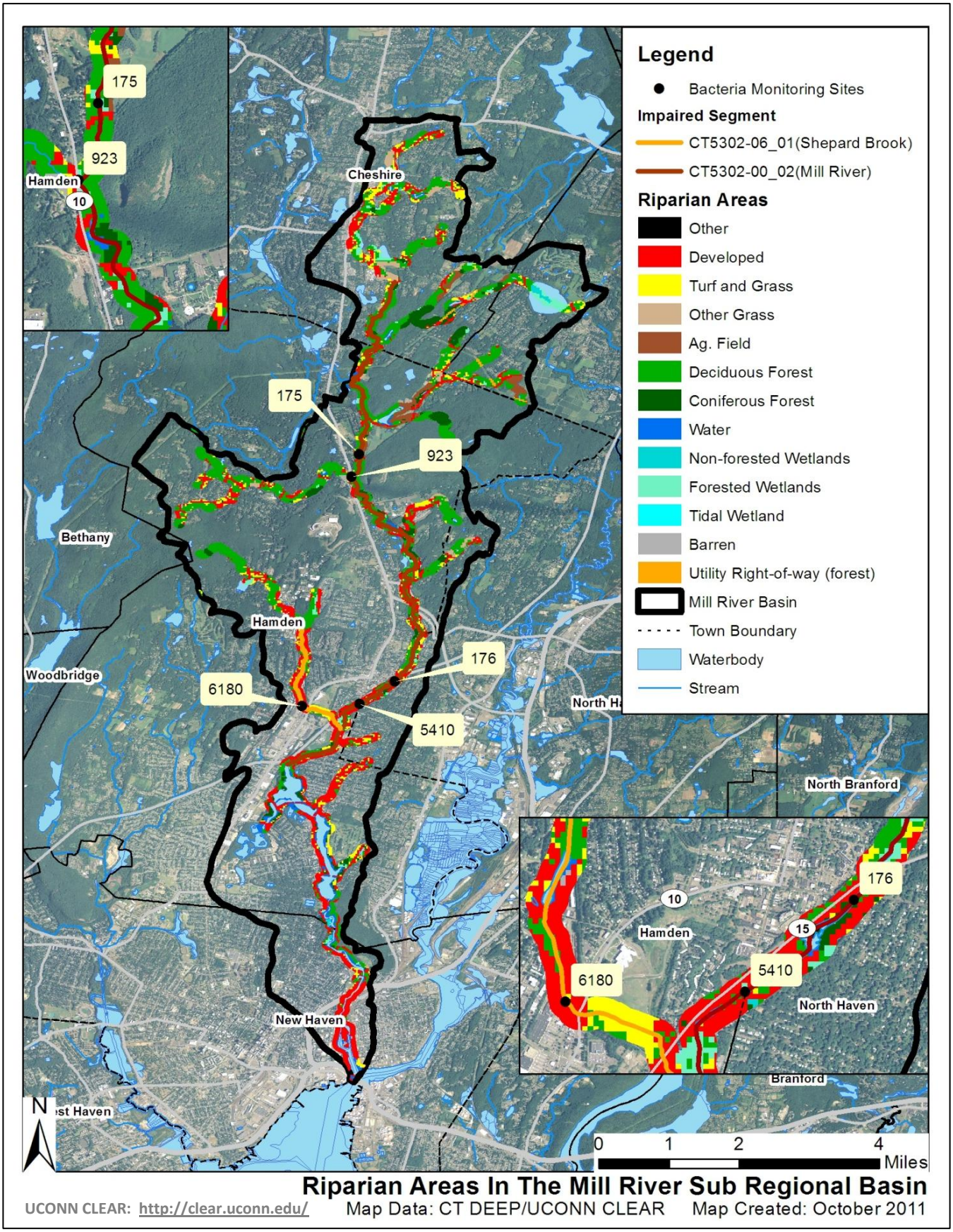
Riparian Buffer Zones

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 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. Land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The majority of the riparian zone for the impaired segments of the Mill River, particularly near the downstream areas in Hamden and North Haven, is characterized by developed land use (Figure 10). The northern portion of the Mill River (CT5302-00_02) in northern Hamden and Cheshire is dominated by coniferous and deciduous forests with multiple agricultural areas. Developed and agricultural areas are potential sources of bacterial contamination.

Figure 10: Riparian buffer zone information for the Mill River watershed



CURRENT MANAGEMENT ACTIVITIES

As indicated previously, the Towns of Cheshire and Hamden, and the City of North Haven are regulated under the MS4 program. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the State. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in the new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Each municipality is required to submit an annual update outlining the steps they are taking to meet the six minimum measures. All updates that address bacterial contamination in the watershed are summarized in Tables 7 and 8. The Town of Hamden had a MS4 report, but no recent updates were noted and a table was not included.

Table 7: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Cheshire, CT (GSM000021)

Minimum Measure	Cheshire Annual Report Update (2009)
Public Outreach and Education	1) Provided stormwater information to the public via utility bills (tax and sewer users). 2) Maintained stormwater outreach materials at the Chesprocott Health District office in Cheshire.
Public Involvement and Participation	1) Participated in a volunteer clean-up of the Mill River with the QRWA.
Illicit Discharge Detection and Elimination	1) Implemented a manhole rehabilitation project that repaired 140 manholes located along interceptor sewers adjacent to waterbodies. 2) Conducted illicit discharge inspections and remediated stormwater discharges to reduce flow at the Water Pollution Control Plant and stormwater sewer overflows. 3) Utilized GPS to locate and map outfalls greater than 15". Conducted dry-weather inspections, noting any deficiencies at drainage outlets, illicit discharges or abnormal conditions. 4) Performed stormwater sampling and testing at six residential and industrial locations.
Construction Site Stormwater Runoff Control	No updates.
Post Construction Stormwater Management	No updates.

Table 7: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Cheshire, CT (GSM000021) (continued)

Minimum Measure	Cheshire Annual Report Update (2009)
Pollution Prevention and Good Housekeeping	1) Expanded annual training program to address park facilities and other municipal buildings. Training to include handling of chemicals such as chlorine, fertilizers and pesticides. 2) Removed sediment, trash, and debris from catch basins, including the area surrounding major rivers and brooks.

Table 8: Summary of MS4 requirement updates related to the reduction of bacterial contamination from North Haven, CT (Permit #GSM000095)

Minimum Measure	North Haven Annual Report Update (2011)
Public Outreach and Education	1) Continued to partner with QRWA to educate the public on watershed dynamics and pollution loading issues. 2) Distributed brochures on North Haven Earth Day, including NRCS "What is a Watershed" and Rivers Alliance of Connecticut "The Importance of Streamside Buffers." 3) Identified a brochure regarding the impact of failing septic systems on the quality of waterbodies to be distributed to homeowners. 4) Posted pet waste reduction signs and planted vegetative buffers around Todd's Pond to discourage geese from flocking there. 5) Maintained education program for 3rd and 4th graders on the "Problem with Pollution," which identifies both point and nonpoint source pollutants that impact area waters.
Public Involvement and Participation	1) Held a public meeting to introduce the North Haven SMP to the public. 2) Stenciled 250 storm drains with the help of volunteers.
Illicit Discharge Detection and Elimination	1) Drafted an IDDE Program Plan. 2) Continued to investigate and correct any citizen complaints or inquiries regard possible illicit discharges. 3) Sampled stormwater outfalls for illicit discharges on three separate dates in 2010 for CT DEEP compliance. 4) Performed stormwater sampling and testing at six residential and industrial locations.
Construction Site Stormwater Runoff Control	No updates.
Post Construction Stormwater Management	No updates.
Pollution Prevention and Good Housekeeping	1) Continues to train public works and treatment plant employees on pollution prevention. 2) Performed annual street sweeping on all town roads.

RECOMMENDED NEXT STEPS

As show above, the Towns of Cheshire and Hamden, and the City of North Haven 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 impaired segments in the Mill River and have been prioritized below.

1) Identify areas along the Mill River to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, the Towns of Cheshire and Hamden, and the City of North Haven within the Mill River watershed are MS4 communities regulated by the MS4 program. Since 52% of the watershed is considered urban and the area surrounding the lower portion of the impaired segments has an impervious cover of 12-15% or greater than 16%, stormwater runoff is likely contributing bacteria to the waterbodies. To identify specific areas that are contributing bacteria to the impaired segments, the towns should conduct wet-weather sampling at stormwater outfalls that discharge directly to the Mill River. To treat stormwater runoff, the towns should also identify areas along the more developed sections of the Mill River, particularly along the impaired segments, to install BMPs that encourage stormwater to infiltrate the ground before entering the Mill River. These BMPs would disconnect impervious areas and reduce pollutant loads to the river. More detailed information and BMP recommendations can be found in the core TMDL document.

2) Implement a program to evaluate the sanitary sewer system.

Most of the Mill River watershed surrounding the impaired segments relies on a municipal sewer system (Figure 6). Cheshire and North Haven have already taken significant steps to reduce the impact of leaks or overflows from the sewer system, such as repairing manholes, checking for illicit discharges, and conducting dry-weather inspections at residential and industrial sites. It is important for Cheshire and North Haven to continue and expand this program. Since the majority of the impaired segments are located in the Town of Hamden, Hamden should also develop a program that evaluates its sanitary sewer and reduces leaks and overflows. This program should include periodic inspections of the sewer line.

3) Develop a system to monitor septic systems.

Many residents near the impaired segment (CT5302-00_02) in northern Hamden and Cheshire rely on septic systems (Figure 6). If not already in place, Cheshire and Hamden 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 sub-standard systems within a reasonable timeframe could also be adopted. Towns can develop programs to assist citizens with the replacement and repair of older and failing systems.

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

North Haven has taken several steps to reduce bacterial contamination from pet and waterfowl waste (Table 8). However, additional measures can be taken in all of the watershed towns. Cheshire, Hamden, and North Haven can encourage residents to allow tall, coarse vegetation to grow in the riparian areas of the impaired segments of the Mill River that are frequented by waterfowl, particularly within parks and golf courses. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shoreline 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 impairment in the Mill 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-use areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

5) Ensure sufficient buffers exist on agricultural lands along the upstream portion of the Mill River.

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 livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate BMPs are in place. Particular attention should be paid to those agricultural operations located near the impaired segment of the Mill River (CT5302-00_02).

6) Continue monitoring of permitted sources.

Previous sampling of discharges from the Saint-Gobain Performance Plastics Corporation and other permitted sources has shown elevated levels of fecal coliform bacteria, an indicator of bacterial pollution (Table 6). Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. 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 are an additional recommendation. Regular monitoring should be established for 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.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 9 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Mill 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 9. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

		Instantaneous *E. coli* (#/100mL)						Geometric Mean *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA[6]**			**LA[6]**			**WLA[6]**	**LA[6]**
	Recreational Use	**1**	**2**	**3**	**1**	**2**	**3**	**All**	**All**
AA	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	546		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) Replace numeric value with “natural levels” if only source is naturally occurring 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 10: Mill River Bacteria Data

Waterbody ID: CT5302-00_02

Characteristics: Freshwater, Class AA, Existing or Proposed 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: **77%**

Single Sample: **94%**

Data: 1998, 2003-2004, 2006-2010 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

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

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
5410	At Whitney Road exit Park and Ride	8/11/2010	260	dry	267
5410	At Whitney Road exit Park and Ride	8/26/2010	690	wet	
5410	At Whitney Road exit Park and Ride	9/9/2010	250	dry	
5410	At Whitney Road exit Park and Ride	9/14/2010	10	dry	
5410	At Whitney Road exit Park and Ride	9/20/2010	280	dry	
5410	At Whitney Road exit Park and Ride	9/22/2010	300†	dry	
5410	At Whitney Road exit Park and Ride	9/27/2010	460	wet	
5410	At Whitney Road exit Park and Ride	9/29/2010	1400	dry	
176	Downstream of Dixwell Avenue crossing	7/7/1998	200	dry	332
176	Downstream of Dixwell Avenue crossing	9/29/1998	550	dry	
923	At first pull-off downstream of Tuttle Road crossing	4/21/2003	10	dry	246
923	At first pull-off downstream of Tuttle Road crossing	8/13/2003	230†	dry	
923	At first pull-off downstream of Tuttle Road crossing	11/5/2003	**6500* (94%)**	wet	
923	At first pull-off downstream of Tuttle Road crossing	2/19/2004	74	dry	NA

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

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
923	At first pull-off downstream of Tuttle Road crossing	6/1/2006	98	wet	
923	At first pull-off downstream of Tuttle Road crossing	6/15/2006	390	wet	
923	At first pull-off downstream of Tuttle Road crossing	6/21/2006	715†	wet	
923	At first pull-off downstream of Tuttle Road crossing	6/29/2006	1100	wet	
923	At first pull-off downstream of Tuttle Road crossing	7/12/2006	190	wet	
923	At first pull-off downstream of Tuttle Road crossing	7/20/2006	680	wet	342
923	At first pull-off downstream of Tuttle Road crossing	7/27/2006	290	dry	
923	At first pull-off downstream of Tuttle Road crossing	8/3/2006	240	wet	
923	At first pull-off downstream of Tuttle Road crossing	8/10/2006	270	dry	
923	At first pull-off downstream of Tuttle Road crossing	8/17/2006	445†	dry	
923	At first pull-off downstream of Tuttle Road crossing	8/24/2006	230	dry	
923	At first pull-off downstream of Tuttle Road crossing	6/17/2007	140†	dry	
923	At first pull-off downstream of Tuttle Road crossing	6/20/2007	310	wet	
923	At first pull-off downstream of Tuttle Road crossing	7/5/2007	4900	wet	
923	At first pull-off downstream of Tuttle Road crossing	7/11/2007	370	dry	
923	At first pull-off downstream of Tuttle Road crossing	7/19/2007	440	wet	
923	At first pull-off downstream of Tuttle Road crossing	7/26/2007	180†	dry	**559* (74%)**
923	At first pull-off downstream of Tuttle Road crossing	8/8/2007	**6500* (94%)**	wet	
923	At first pull-off downstream of Tuttle Road crossing	8/22/2007	2001	wet	
923	At first pull-off downstream of Tuttle Road crossing	9/10/2007	160	dry	
923	At first pull-off downstream of Tuttle Road crossing	9/20/2007	230†	dry	
923	At first pull-off downstream of Tuttle Road crossing	6/2/2008	330	dry	
923	At first pull-off downstream of Tuttle Road crossing	6/11/2008	475†	dry	
923	At first pull-off downstream of Tuttle Road crossing	6/18/2008	410	wet**	
923	At first pull-off downstream of Tuttle Road crossing	6/25/2008	325†	wet**	
923	At first pull-off downstream of Tuttle Road crossing	7/2/2008	1400	dry	
923	At first pull-off downstream of Tuttle Road crossing	7/9/2008	295†	dry	
923	At first pull-off downstream of Tuttle Road crossing	7/17/2008	335†	dry	419
923	At first pull-off downstream of Tuttle Road crossing	7/30/2008	340†	dry	
923	At first pull-off downstream of Tuttle Road crossing	8/5/2008	620†	dry	
923	At first pull-off downstream of Tuttle Road crossing	8/13/2008	325†	dry	
923	At first pull-off downstream of Tuttle Road crossing	8/20/2008	355†	dry	

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

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
923	At first pull-off downstream of Tuttle Road crossing	6/17/2009	120	dry	214
923	At first pull-off downstream of Tuttle Road crossing	6/24/2009	200	wet	
923	At first pull-off downstream of Tuttle Road crossing	7/1/2009	200†	dry	
923	At first pull-off downstream of Tuttle Road crossing	7/22/2009	1750†	wet	
923	At first pull-off downstream of Tuttle Road crossing	8/5/2009	210	dry	
923	At first pull-off downstream of Tuttle Road crossing	8/12/2009	190	dry	
923	At first pull-off downstream of Tuttle Road crossing	8/19/2009	130	dry	
923	At first pull-off downstream of Tuttle Road crossing	9/3/2009	98†	dry	
923	At first pull-off downstream of Tuttle Road crossing	9/9/2009	220	dry	
175	Upstream of Tuttle Road crossing	7/7/1998	220	dry	366
175	Upstream of Tuttle Road crossing	9/29/1998	610	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**

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for all monitoring stations on the Mill River

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
5410	At Whitney Road exit Park and Ride	2010	2	6	265	563	206
176	Downstream of Dixwell Avenue crossing	1998	0	2	332	NA	332
923	At first pull-off downstream of Tuttle Road crossing	2003, 2004, 2006-2009	17	28	345	702	224
175	Upstream of Tuttle Road crossing	1998	0	2	366	NA	366

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gages at Tweed KMMK station in New Haven, CT and at Hartford Bradley International Airport

Table 11: Shepard Brook Bacteria Data

Waterbody ID: CT5302-06_01

Characteristics: Freshwater, Class AA, Existing or Proposed 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: **77%**

Single Sample: **71%**

Data: 2010-2011 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from Station 6180 on Shepard Brook with annual geometric means calculated

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
6180	Upstream of Route 10	9/29/2010	660	dry	293
6180	Upstream of Route 10	9/27/2010	160	wet	
6180	Upstream of Route 10	9/22/2010	180	dry	
6180	Upstream of Route 10	9/20/2010	140	dry	
6180	Upstream of Route 10	9/14/2010	160	dry	
6180	Upstream of Route 10	9/9/2010	150	dry	
6180	Upstream of Route 10	8/26/2010	**1400* (71%)**	wet	
6180	Upstream of Route 10	8/11/2010	600	dry	
6180	Upstream of Route 10	6/14/2011	700	wet	**555* (77%)**
6180	Upstream of Route 10	5/16/2011	440	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**

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for Station 6180 on Shepard Brook

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
6180	Upstream of Route 10	2010-2011	3	7	333	539	270
Shaded cells indicate an exceedance of water quality criteria							
Weather condition determined from rain gages at West Thompson Lake, Grosvenor Dale in Windham, CT.							

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