



Bruce Brook

Watershed Summary

WATERSHED DESCRIPTION AND MAPS

The Bruce Brook watershed covers an area of approximately 2,199 acres in the southwestern portion of Connecticut (Figure 1). There are two municipalities located in the watershed, including the Town of Stratford and the City of Bridgeport, CT.

The Bruce Brook watershed includes one segment impaired for recreation due to elevated bacteria levels (CT7102-00_02). This segment was 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 were currently unassessed as of the writing of this document. This does not mean that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment 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).

Bruce Brook begins north of Route 108 in Stratford. The bacteria impaired segment of Bruce Brook (CT7102-00_02) begins at the town line of Bridgeport and Stratford at Barnum Avenue and consists of 0.22 miles of the brook (Figures 2 and 5). This segment flows southerly through a developed area parallel to West Avenue and ends at the inlet to Bruce Pond. Bruce Brook continues southerly through the outlet of Bruce Pond, crosses Route 130 and Interstate 95, and flows to its outlet at Bridgeport Harbor.

The impaired segment of Bruce Brook has a water quality classification of B. Designated uses include habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. This segment of the river is impaired due to elevated bacteria concentrations, affecting the designated use of recreation. As there are no designated beaches in this segment of Bruce Brook, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Impaired Segment Facts

Impaired Segment:

Bruce Brook (CT7102-00_02)

Municipalities: Stratford and Bridgeport

Impaired Segment Length (miles): 0.22

Water Quality Classifications: Class B

Designated Use Impairments: Recreation

Sub-regional Basin Name and Code: Bruce Brook, 7102

Regional Basin: Southwest Eastern

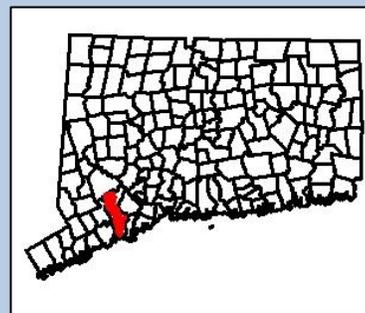
Major Basin: Southwest Coastal

Watershed Area (acres): 2,199

MS4 Applicable? Yes

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

Figure 1: Watershed location in Connecticut

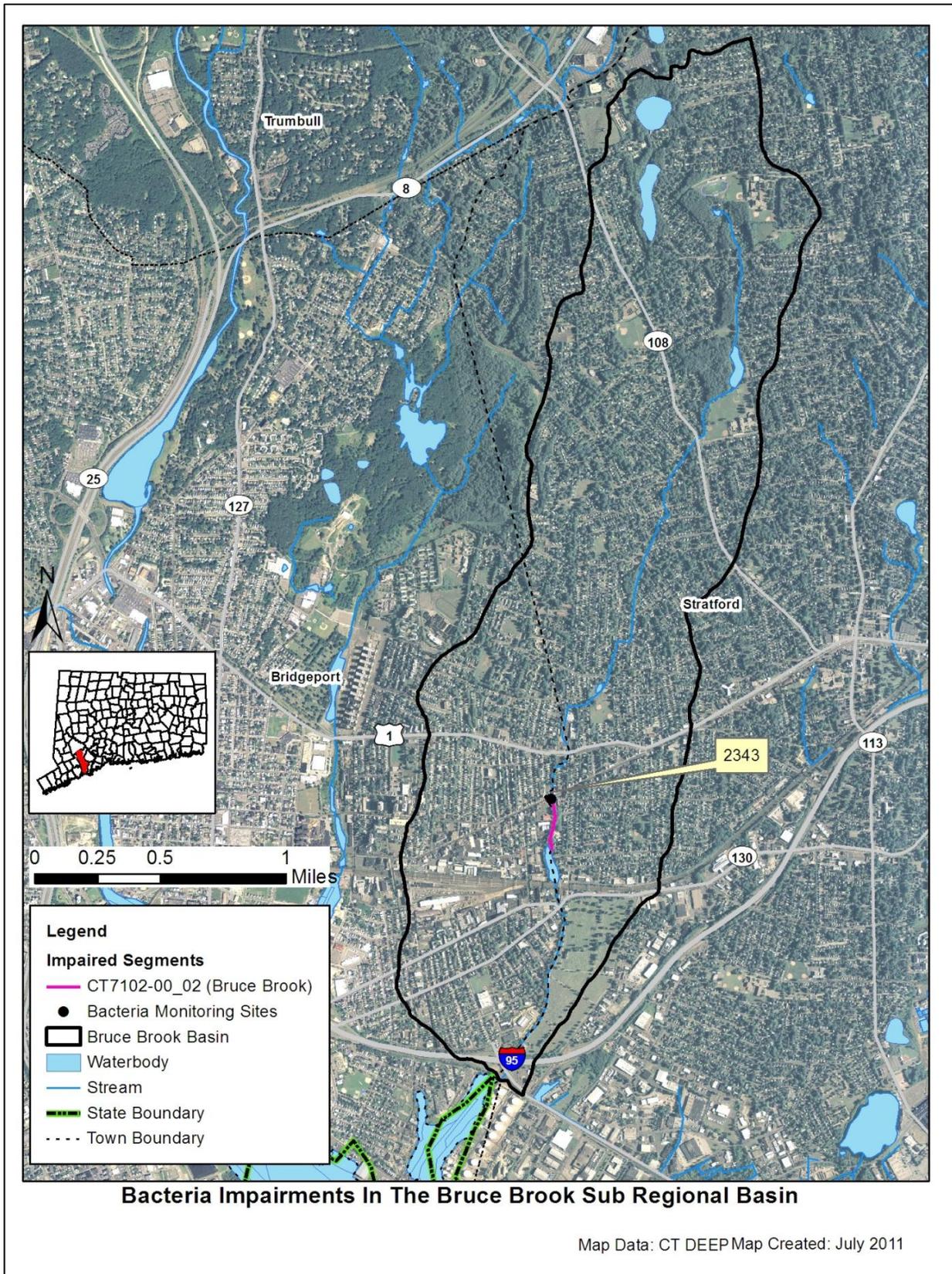


swimming and other water contact related activities.

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
CT7102-00_01	Bruce Brook (Bridgeport/Stratford)- 01	Mouth on Bridgeport Harbor at Route 113 crossing, US to Bruce Pond outlet, just US of Stratford Avenue and RR crossings, Bridgeport/Stratford town line.	0.87	U	U	FULL
CT7102-00_02	Bruce Brook (Bridgeport/Stratford)- 02	Inlet to Bruce Pond, US to Barnum Avenue crossing, Bridgeport/Stratford town line.	0.22	NOT	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 Bruce Brook 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 Bruce Brook watershed consists of 94% urban area, 5% forests, 1% water, and less than 1% agriculture. The majority of the watershed is developed, though small sections to the north are forested. By contrast, the middle and southern portions of the watershed are almost entirely developed (Figure 4).

Figure 3: Land use within the Bruce Brook watershed

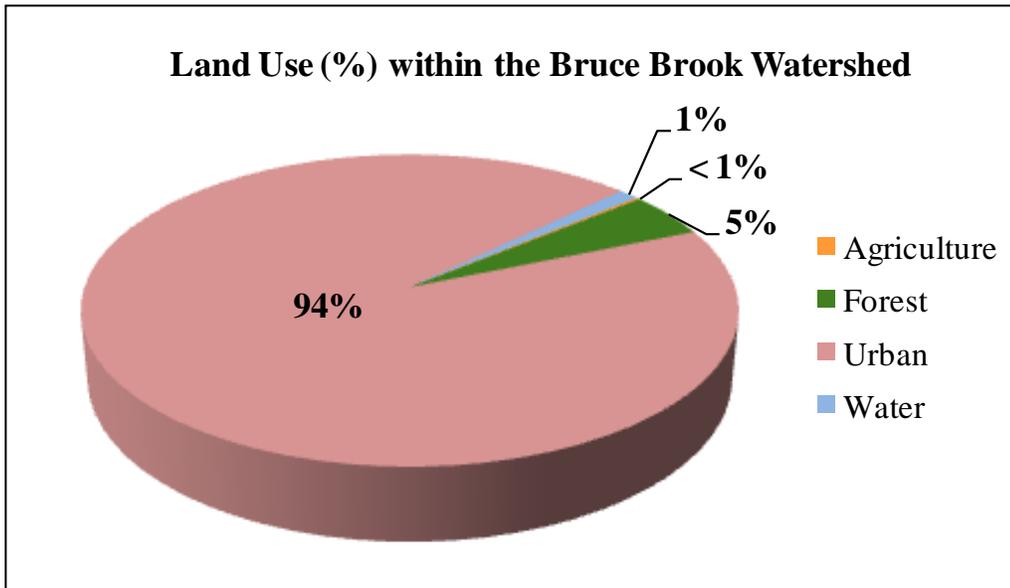
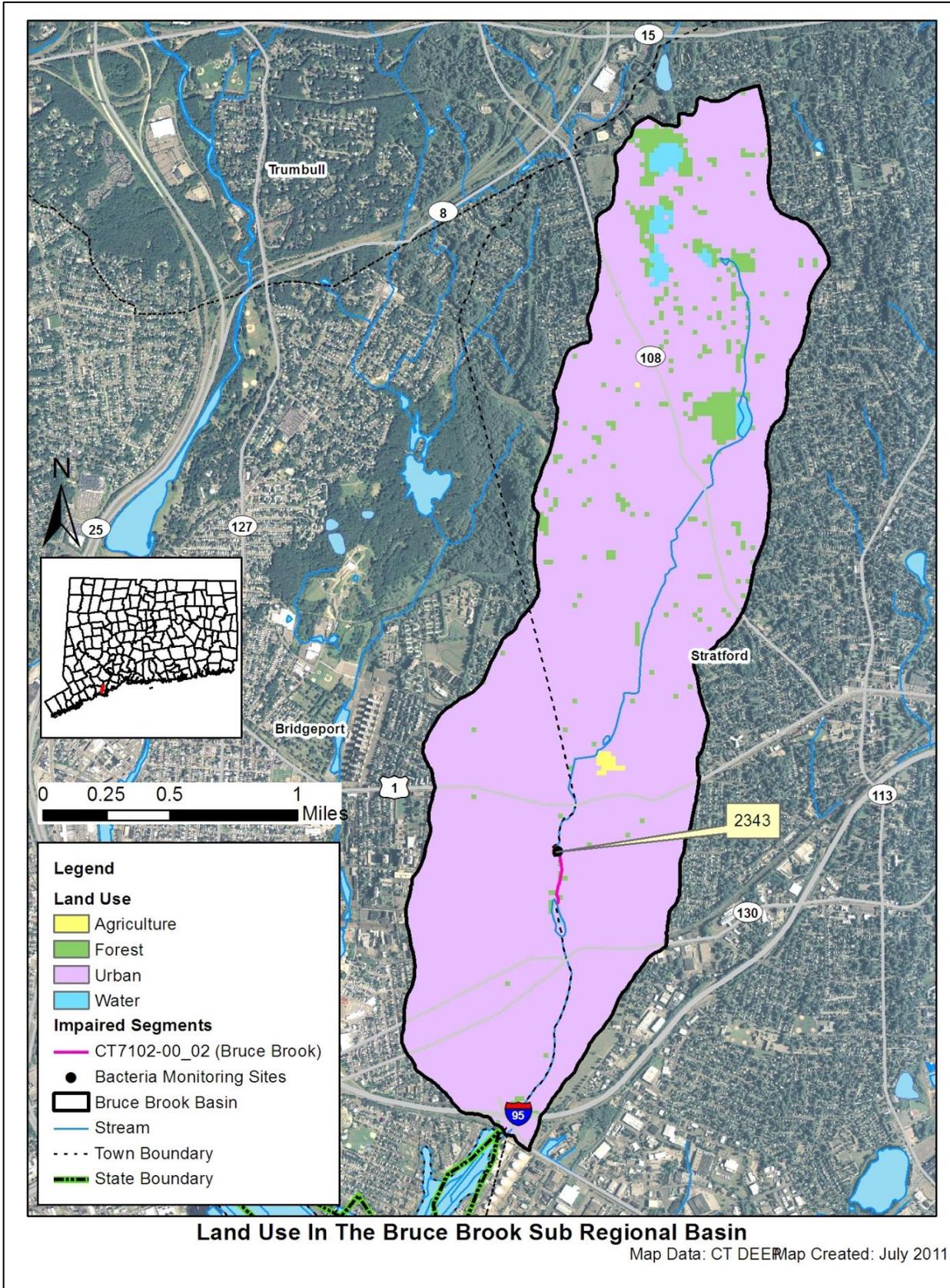


Figure 4: GIS map featuring land use for the Bruce Brook watershed at the sub-regional level



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.

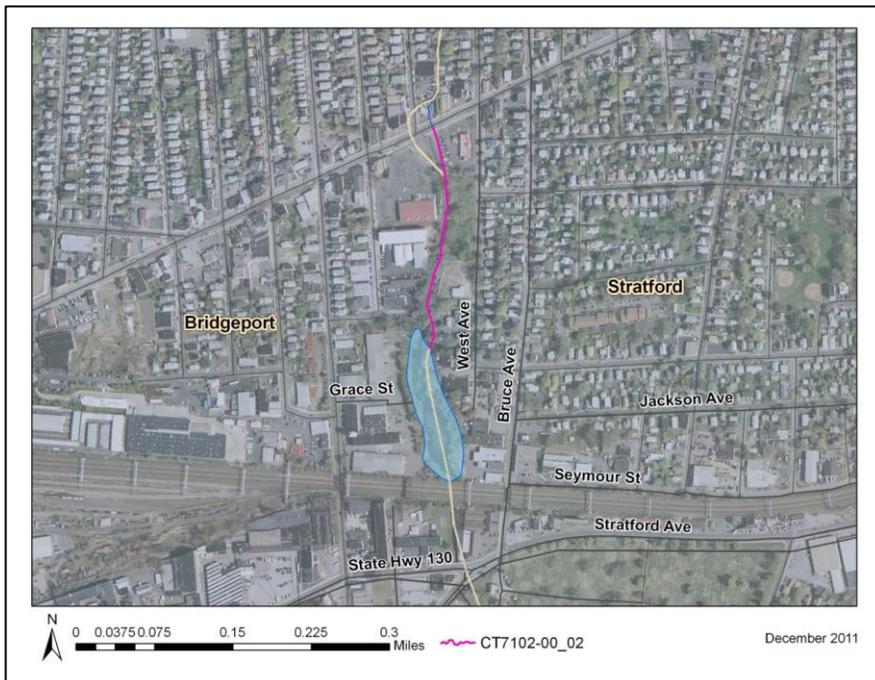
Table 2: Sampling station location description for the impaired segment in the Bruce Brook watershed

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT7102-00_02	Bruce Brook	2343	McDonalds off Barnum Avenue	Bridgeport	41.189900	-73.155100

The impaired segment of Bruce Brook (CT7102-00_02) is a Class B freshwater river (Figure 5). Its applicable designated uses are 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 in 2007 and 2008 (Table 2). Water quality criteria for *E. coli*, along with bacteria sampling results from 2007 and 2008, are presented in Table 9. Single sample values for Station 2343 exceeded the WQS for *E. coli* on both sample dates.

Due to the elevated bacteria measurements presented in Table 9, this impaired segment does 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 waterbodies to comply with State WQS.

Figure 5: Aerial map of Bruce Brook



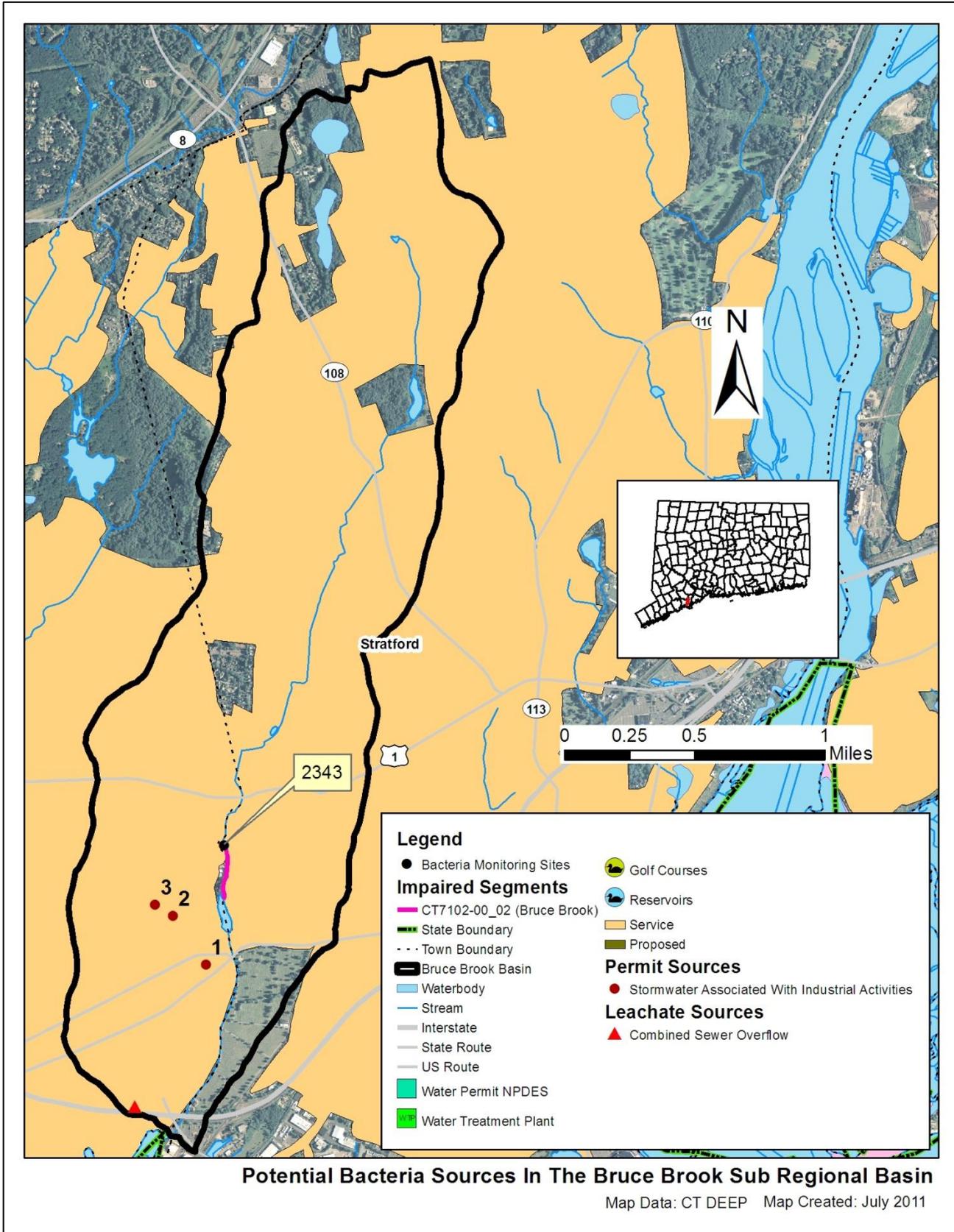
POTENTIAL BACTERIA SOURCES

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 Bruce Brook watershed based on land use (Figures 3 and 4) and a collection of local information for each of the waterbodies 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 segments. 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 nor that there are no impairments in existence in the segment. For some 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 Bruce Brook watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/Pets	Other
Bruce Brook CT7102-00_02	x	x		x		x	x	

Figure 6: Potential sources in the Bruce Brook 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.

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	3
GSM	Part B Municipal Stormwater MS4	2
GSN	Stormwater Registration – Construction	0
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	0

Permitted Sources

As shown in Table 5, there are five permitted discharges in the Bruce Brook watershed, though many of these discharges occur downstream of the impaired segment. 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 Bruce Brook watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Bridgeport	Bridgeport United Recycling, Inc.	GSI000514	Stormwater Associated With Industrial Activities	Bridgeport United Recycling, Inc.	2
Bridgeport	Reliable Plating & Polishing Co., Inc.	GSI000881	Stormwater Associated With Industrial Activities	Reliable Plating & Polishing Co., Inc.	1
Bridgeport	Greater Bridgeport Transit District	GSI001118	Stormwater Associated With Industrial Activities	Greater Bridgeport Transit District	3
Bridgeport	City of Bridgeport	GSM000017	Part B Municipal Stormwater MS4	City of Bridgeport	NA
Stratford	Town of Stratford	GSM000105	Part B Municipal Stormwater MS4	Town of Stratford	NA

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.

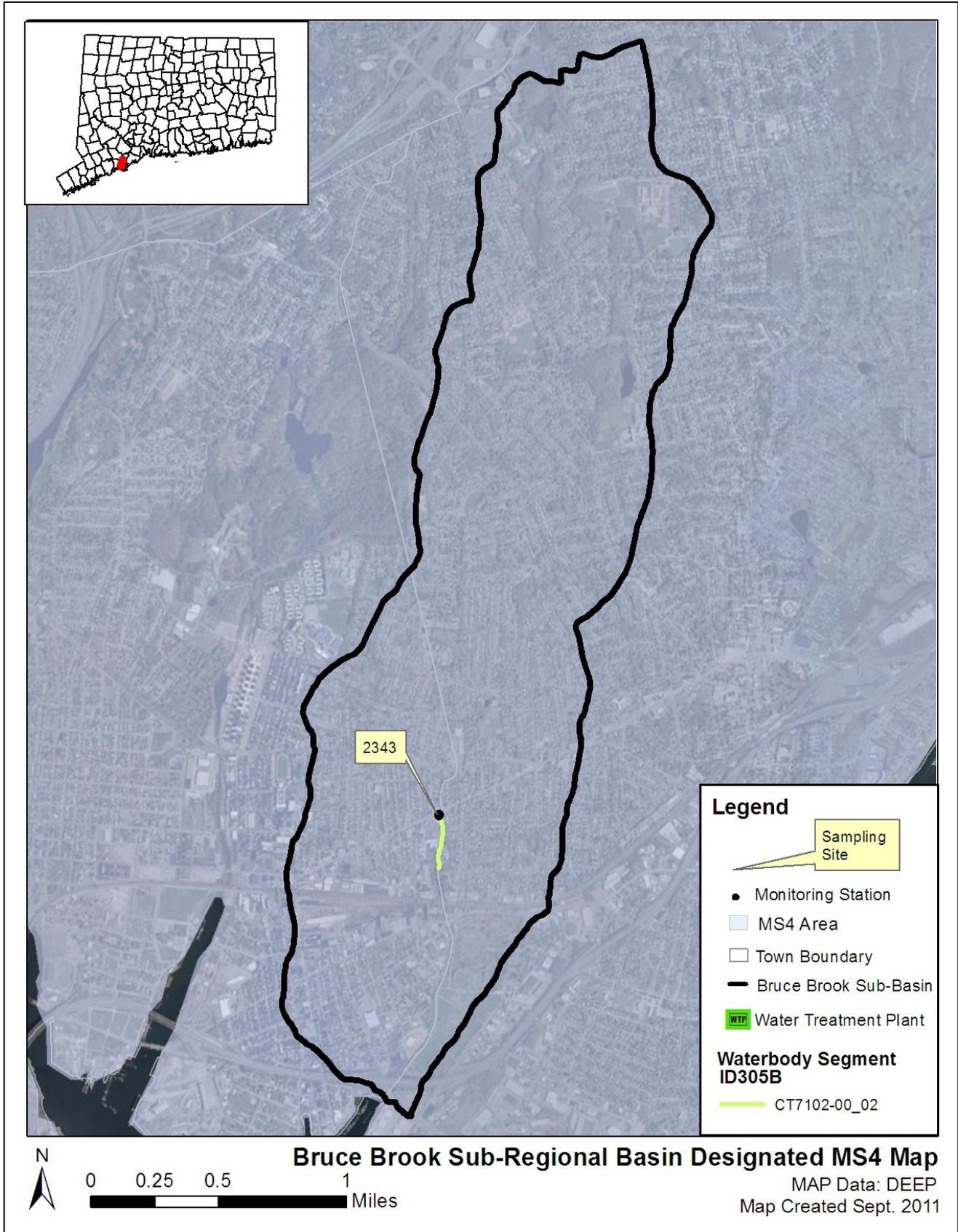
The Bruce Brook watershed is located within the Town of Stratford and the City of Bridgeport. Both municipalities have designated urban areas, as defined by the U.S. Census Bureau and are required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (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 requires municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. It would be beneficial for both municipalities to adjust their monitoring locations to target some spots within the Bruce Brook watershed. CT DEEP staff will provide assistance with monitoring locations if requested by the municipality. 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).

One monitored outfall for the Bridgeport MS4 permit appears to be within the Bruce Brook watershed (Table 6). This outfall had multiple results over 1,000 colonies/100 mL of *E. coli*.

Table 6: List of MS4 sample locations and *E. coli* (colonies/100 mL) results in Bruce Brook

Town	Location	MS4 Type	Receiving Waters	Sample Date	Result
Bridgeport	Connecticut Avenue	Industrial	LIS	12/01/04	43
Bridgeport	Connecticut Avenue	Industrial	LIS	10/17/06	0
Bridgeport	Connecticut Avenue	Industrial	LIS	10/19/07	1,260
Bridgeport	Connecticut Avenue	Industrial	LIS	09/06/08	1,840
Bridgeport	Connecticut Avenue	Commercial	LIS	07/21/09	4,240
Bridgeport	Connecticut Avenue	Commercial	LIS	09/16/10	>4000
Shaded cells indicate an exceedance of single-sample based water quality criteria (410 colonies/100 mL)					

Figure 7: MS4 areas of the Bruce Brook watershed



Non-point Sources

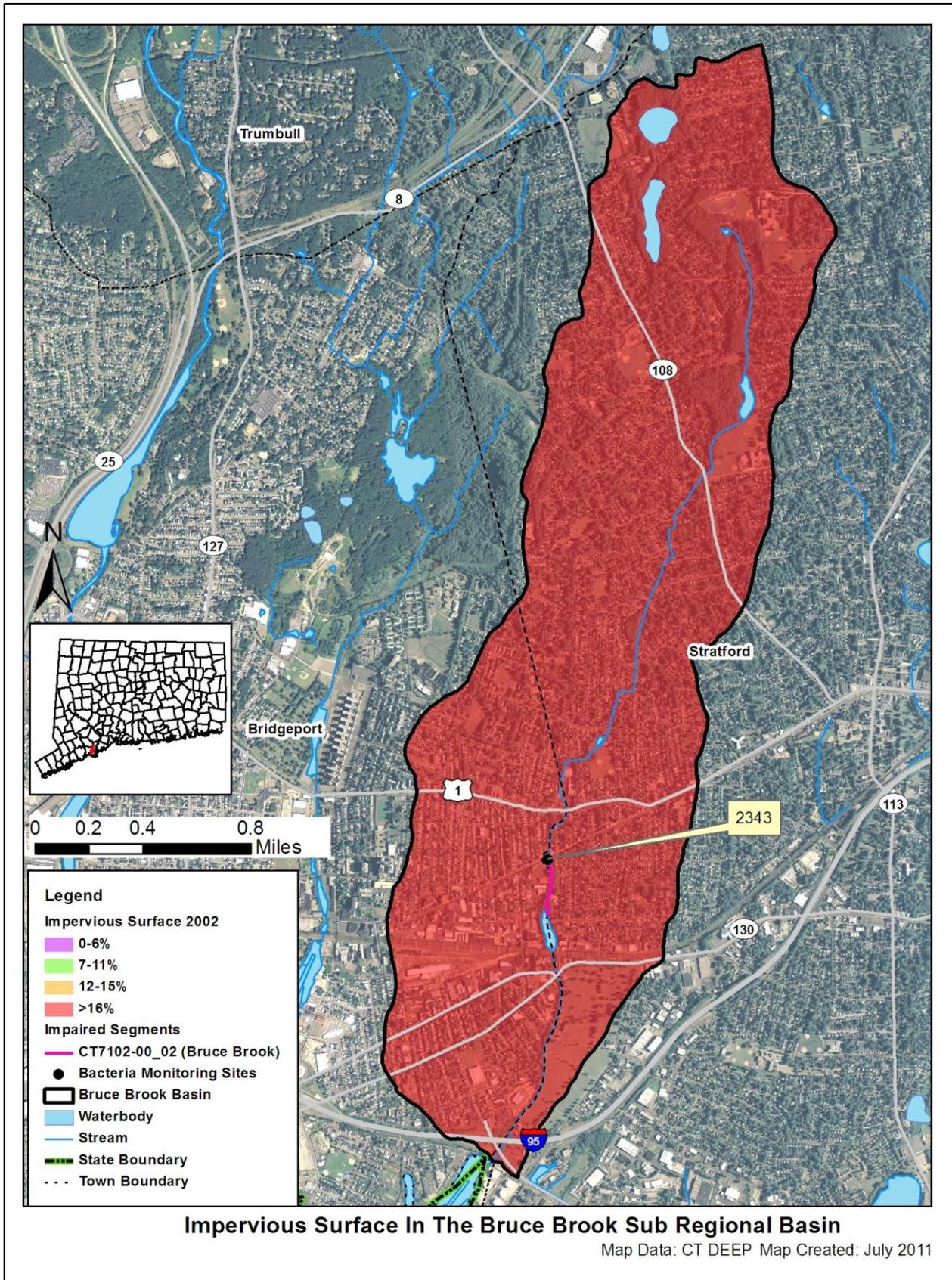
Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture,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

Stormwater Runoff from Developed Areas

Approximately 94% of the watershed is considered urban, and the entire watershed characterized by greater than 16% impervious surfaces (Figure 8). 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).

Water quality data were insufficient to calculate geometric means during dry and wet-weather, but single sample values were high, exceeding 24,000 colonies/ mL of *E. coli*. These high readings, in combination with the MS4 monitoring data, indicate that stormwater runoff is a likely source of bacteria to Bruce Brook.

Figure 8: Impervious cover (%) for the Bruce Brook sub-regional watershed



Illicit Discharges and Insufficient Septic Systems

As shown in Figure 6, the majority of the Bruce Brook watershed, including the area around the impaired segment, relies on the municipal sanitary sewer system. Sewer system leaks and other illicit discharges can contribute bacteria to nearby surface waters.

A small portion of the watershed also relies on onsite wastewater treatment systems, such as septic systems. Properly managed septic systems and leach fields have the ability to effectively remove bacteria from waste. If systems are not maintained, bacteria will not be adequately treated and may result in bacteria reaching nearby surface and ground water. 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 Town of Stratford (<http://www.townofstratford.com/content/1302/402/615/default.aspx>) and the City of Bridgeport (<http://www.bridgeportct.gov>) have full-time health directors.

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Bruce Brook watershed represent another potential source of bacteria to the impaired waterbodies. Any elevated bacteria levels that are due solely to a natural population of wildlife are not subject to the WQS. Any exacerbation of wildlife population sizes or residency times influenced by human activities are subject to the CT WQS and TMDL provisions. 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).

Though only a small portion of the watershed is undeveloped, wildlife waste is a potential source of bacteria in the Bruce Brook watershed. Wildlife and waterfowl may congregate in parks such as Wooster Park and Veterans Park, located in the northern portions of the watershed. Geese and other waterfowl are known to congregate in open areas including recreational fields, agricultural crop fields, and golf courses. 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. Waste from domestic animals such as dogs, may also be contributing to bacteria concentrations in the impaired segment in the Bruce Brook watershed.

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). Though agricultural land use occupies only less than 1% of the land use in the watershed, there is an agricultural operation upstream of the impaired segment of Bruce Brook, just north of US Route 1 (Figure 4). Agricultural runoff from this farm and others in the area is a potential source of bacteria to Bruce Brook.

Additional Sources

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in the Bruce Brook watershed. Further monitoring and investigation will confirm 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

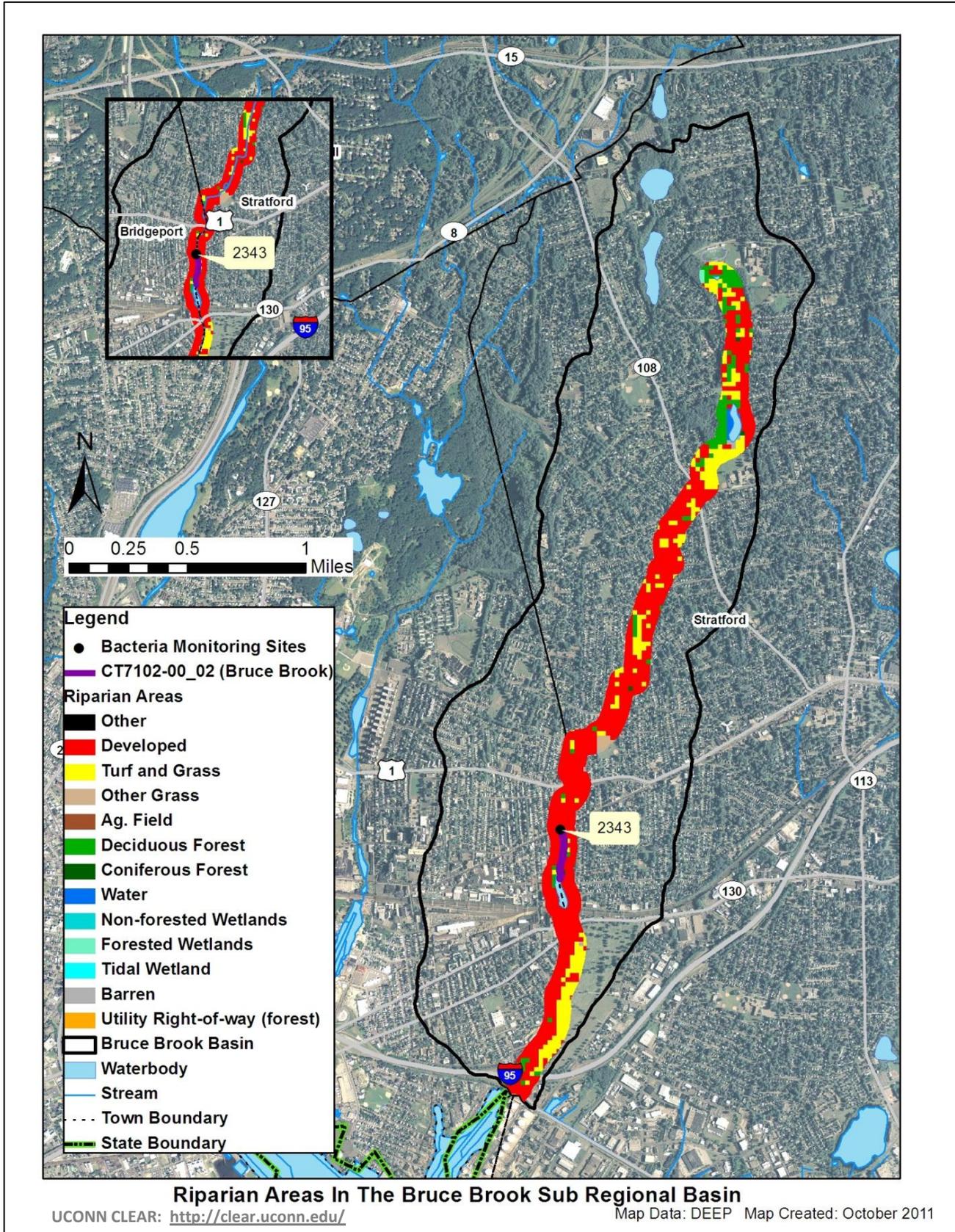
Riparian Buffer Zones

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 zones for the northern portion of the impaired segment of Bruce Brook are characterized by urban areas (Figure 9). Developed areas within the riparian zone likely contribute pollutants such as bacteria to the waterbody since the natural riparian buffer is not available to treat runoff.

Figure 9: Riparian buffer zone information for the Bruce Brook watershed



CURRENT MANAGEMENT ACTIVITIES

The municipalities within the Bruce Brook watershed have developed and implemented programs to protect water quality from bacterial contamination. As indicated previously, portions of the watershed in Stratford and Bridgeport 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 town is also 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.

Table 7: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Bridgeport, CT (Permit # GSM000017)

Minimum Measure	Bridgeport Annual Report Update (2010)
Public Outreach and Education	1) MS4 information distributed in WPCA tax bill.
Public Involvement and Participation	1) Continued catch basin stenciling program.
Illicit Discharge Detection and Elimination	1) Mapped all 12" storm drains.
Construction Site Stormwater Runoff Control	1) Reviewed and updated all land use regulations to meet MS4 requirements.
Post Construction Stormwater management	1) Continued to develop long term maintenance program for BMPs.
Pollution Prevention and Good Housekeeping	1) All roads swept 6 times per year (minimum). 2) All catch basins and outfalls inspected and cleaned. 3) Identified sewer lines in need of repair and obtained funding to line 30,000 linear feet of sewer.

Table 8: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Stratford, CT (Permit # GSM000105)

Minimum Measure	Stratford Annual Report Update (2010)
Public Outreach and Education	1) Stormwater information distributed in public hallway information slots outside of Engineering and Building Departments. 2) A “Notice to Developers and Contractors” is attached to all zoning applications. 3) Received a grant for a stormwater stenciling program from LISFF. 4) Received a grant for training municipal employees. 5) Developed two educational brochures.
Public Involvement and Participation	1) Held a volunteer clean-up day (Project GreenSweep) every other year since 2005.
Illicit Discharge Detection and Elimination	1) Developed a base map of existing storm sewer system. 2) Approximately 30% of stormwater outfalls have been identified. 3) Conducted wet weather sampling at 6 locations during all permit years. 4) Drafted an IDDE/Stormwater ordinance that was not approved by the town council in 2010.
Construction Site Stormwater Runoff Control	1) Reviewed and revised zoning regulations to clarify and strengthen requirements for controlling stormwater runoff and maintaining effective erosion and sedimentation control measures.
Post Construction Stormwater management	1) Reviewed and revised zoning regulations to clarify and strengthen requirements for controlling stormwater runoff and maintaining effective erosion and sedimentation control measures.
Pollution Prevention and Good Housekeeping	1) Completed annual street sweeping. 2) Developed the Project First Impression to identify streets to sweep more regularly.

RECOMMENDED NEXT STEPS

Though the municipalities within the Bruce Brook watershed have developed and implemented programs to protect water quality from bacterial contamination, future mitigative activities are necessary to ensure the long-term protection of Bruce Brook and have been prioritized below.

1) Identify areas in the Bruce Brook watershed to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, 94% of the Bruce Brook watershed is considered urban, and the municipalities within the Bruce Brook watershed are MS4 communities regulated by the MS4 program. The entire watershed has an impervious cover greater than 16%, and the impaired segment of Bruce Brook is located adjacent to a parking lot in a heavily urbanized area. As such, stormwater runoff is likely contributing bacteria to Bruce Brook.

To identify specific areas that are contributing bacteria to the impaired segments, Stratford and Bridgeport should conduct wet-weather sampling at stormwater outfalls that discharge directly to the impaired segment of Bruce Brook watershed. To treat stormwater runoff, all watershed towns should identify areas along the brook to install BMPs designed to encourage stormwater to infiltrate into the ground before entering the waterbodies. 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) Continue monitoring of permitted sources.

Previous sampling has shown high levels of bacteria in Bruce Brook. 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 Bruce Brook 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

Class	Bacteria Source	Instantaneous <i>E. coli</i> (#/100mL)						Geometric Mean <i>E. coli</i> (#/100mL)	
		WLA ⁶			LA ⁶			WLA ⁶	LA ⁶
	Recreational Use	1	2	3	1	2	3	All	All
B ⁴	Non-Stormwater NPDES	235	410	576				126	
	CSOs	235	410	576				126	
	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) 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.

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

Most of the Bruce Brook watershed relies on a municipal sewer system (Figure 6). It is important for Bridgeport and Stratford to develop a program to evaluate its sanitary sewer system and reduce leaks and overflows. This program should include periodic inspections of the sewer line.

4) Develop a system to monitor septic systems.

Some residents of the Bruce Brook watershed rely on septic systems. If not already in place, municipalities 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 be adopted. Municipalities can also develop programs to assist citizens with the replacement and repair of older and failing systems.

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

Any education and outreach program in the watershed should highlight the importance of not feeding waterfowl and wildlife and managing waste from horses, dogs, and other pets. The towns 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 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 Bruce Brook 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.

6) Ensure there are sufficient buffers on agricultural lands on Bruce Brook.

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 Best Management Practices (BMPs) are in place. Particular attention should be paid to any agricultural operations located upstream of the impaired segment of Bruce Brook (Figure 4).

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 10: Bruce Brook Bacteria Data

Waterbody ID: CT7102-00_02

Characteristics: Freshwater, Class B, 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: NA

Single Sample: **98%**

Data: 2007 - 2008 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* data (colonies/100 mL) from Station 2343 on Bruce Brook

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
2343	Behind McDonalds off Barnum Avenue	11/28/2007	24001*[†] (98%)	dry	NA
2343	Behind McDonalds off Barnum Avenue	6/18/2008	9800 [†]	wet	NA

Shaded cells indicate an exceedance of water quality criteria

[†]Average of two duplicate samples

*Indicates single sample value used to calculate the percent reduction

Wet and dry weather *E. coli* (colonies/100mL) geometric means for Station 2343 on Bruce Brook

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
2343	Behind McDonalds off Barnum Avenue	2007-2008	1	1	15337	NA	NA

Shaded cells indicate an exceedance of water quality criteria

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

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