Piper Brook

Watershed Summary

Watershed Description and Maps

The Piper Brook watershed covers an area of approximately 7,334 acres in central Connecticut (Figure 1). There are multiple towns located at least partially in the watershed, including the municipalities of West Hartford, New Britain, and Newington, CT.

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

Piper Brook (Segment 2) (CT4402-00_02) is 5.81 miles long and begins at St. Mary's Cemetery just upstream of the railroad crossing and parallel to Route 9 where the pipe emerges from the ground in New Britain, flows downstream into Newington to cross Route 175, Route 173 and Main Street, flows north into West Hartford, and ends at the conduit entrance to Piper Brook (Segment 1) upstream of New Britain Avenue. Piper Brook (Segment 1) (CT4402-00_01) is 0.05 miles long completely within a conduit from the conduit opening upstream of New Britain Avenue to the confluence with Trout Brook above South Branch Park River in West Hartford. These segments have been altered by human activities, including rerouting and channelization prior to 1985, and current maps may not reflect the true routing of these urban streams.

The impaired segments of Piper Brook have 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. These segments of the river are impaired due to elevated bacteria concentrations, affecting the designated use of recreation. As there are no designated beaches in these segments of Piper Brook, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Impaired Segment Facts

Impaired Segments:
1. Piper Brook (Segment 1) (CT4402-00_01)
2. Piper Brook (Segment 2) (CT4402-00_02)

Municipalities: New Britain, West Hartford, Newington

Impaired Segment Length (miles): 4402-00_01 (0.05); 4402-00_02 (5.81)

Water Quality Classification: Class B

Designated Use Impairment: Recreation

Sub-regional Basin Name and Code: Piper Brook, 4402

Regional Basin: Connecticut

Major Basin: Park

Watershed Area (acres): 7,334

MS4 Applicable? Yes

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

Figure 1: Watershed location in Connecticut

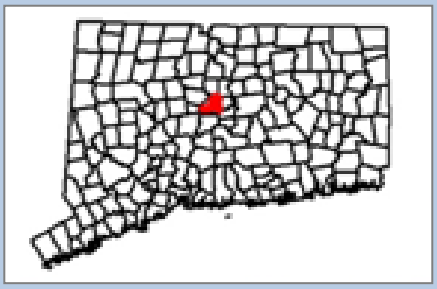


Table 1: Impaired segments and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT4402-00_01	Piper Brook	From mouth at confluence with Trout brook, above S Branch Park River, West Hartford, US (under New Britain Avenue), to conduit opening, US side of New Britain Ave (segment completely in conduit).	0.05	NOT	NOT	FULL
CT4402-00_02	Piper Brook	From conduit entrance (segment-01) US side of New Britain Avenue, West Hartford, US into St. Mary's Cemetery (just US of railroad crossing and parallel with Route 9) where pipe emerges from ground, New Britain.	5.81	NOT	NOT	FULL

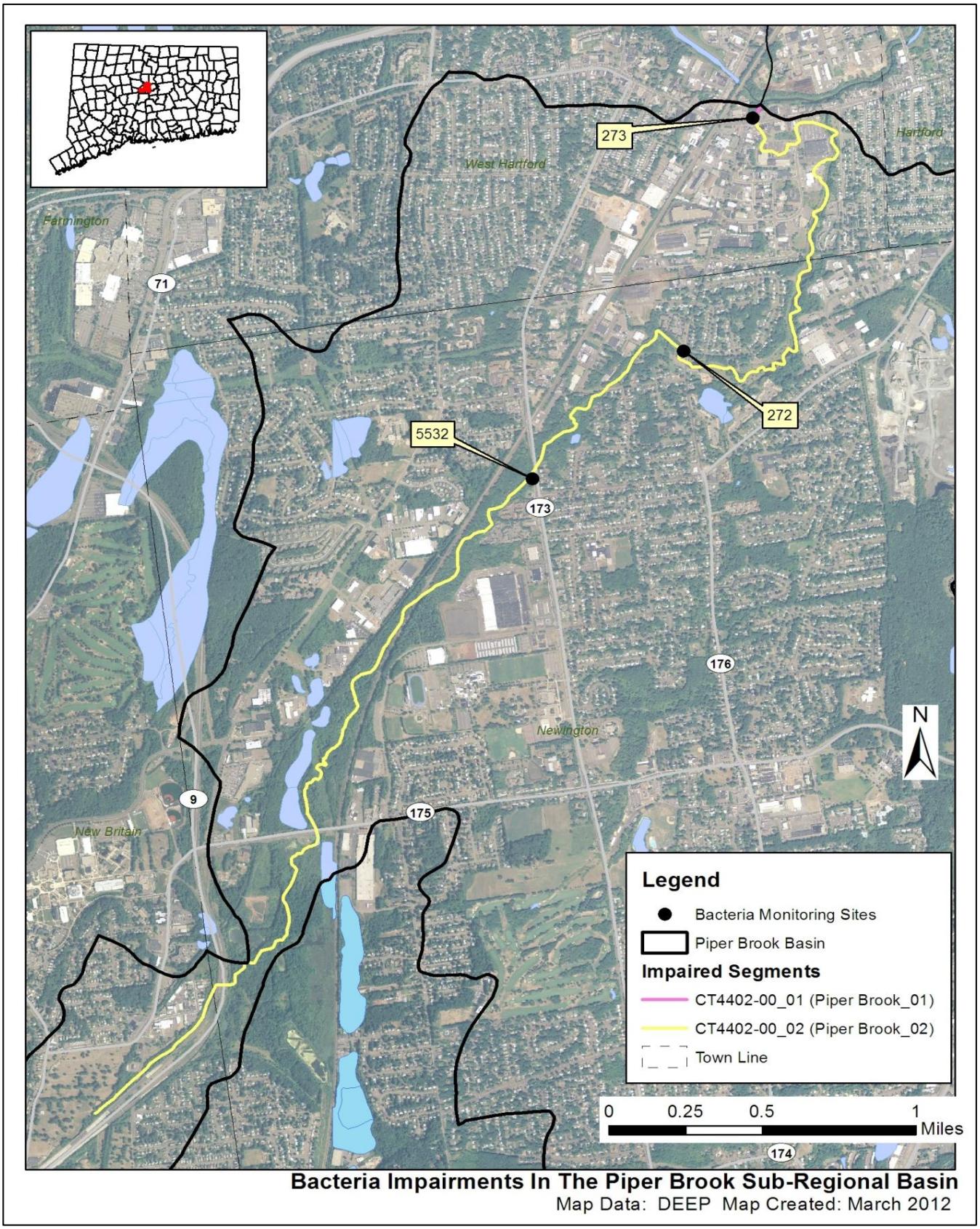
Shaded cells indicate impaired segment addressed in this TMDL

FULL = Designated Use Fully Supported

NOT = Designated Use Not Supported

U = Unassessed

Figure 2: GIS map featuring general information of the Piper 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 Piper Brook watershed consists of 82% urban area, 14% forest, 2% agriculture, and 2% water. Piper Brook (Segment 2) begins between St. Mary's Cemetery and Route 9, continues along Route 9 through a major commercial area, and flows into a wetland complex. The wetland has been cleared for dirt bike/ATV paths. A recreation area was also identified nearby at the Newington Arena. Piper Brook (Segment 2) continues downstream (north), passing near dense residential neighborhoods and an industrial building, New Wave Industries. After crossing Main Street in Newington, significant channelization is evident and exposed mowed stream banks provide little buffer from nearby residential development, particularly from a new house construction site with uncovered dirt piles. The impaired segments flow through a major commercial area along New Britain Avenue to meet Trout Brook. Underground conduits and human alterations make it difficult to determine land use impacts from aerial maps, particularly for the end of Piper Brook (Segment 2) as it connects with Piper Brook (Segment 1).

Figure 3: Land use within the Piper Brook watershed

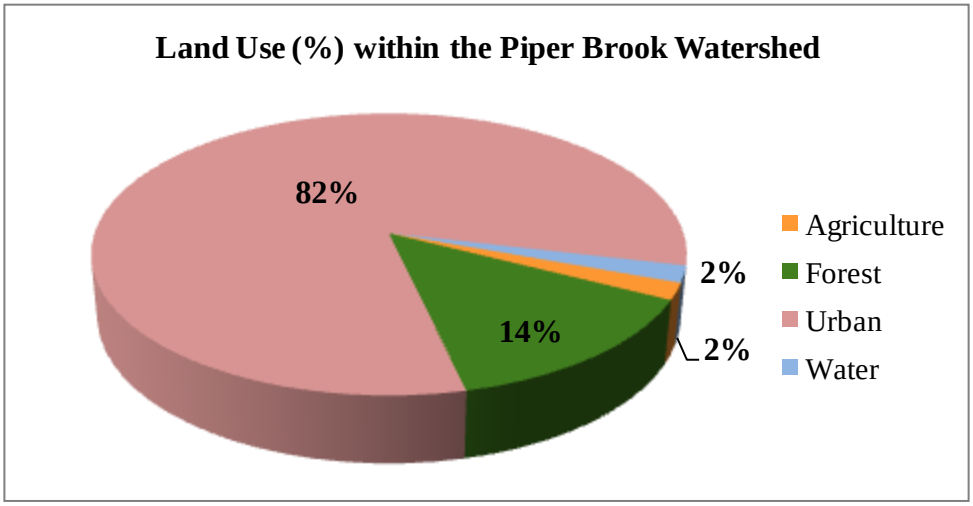
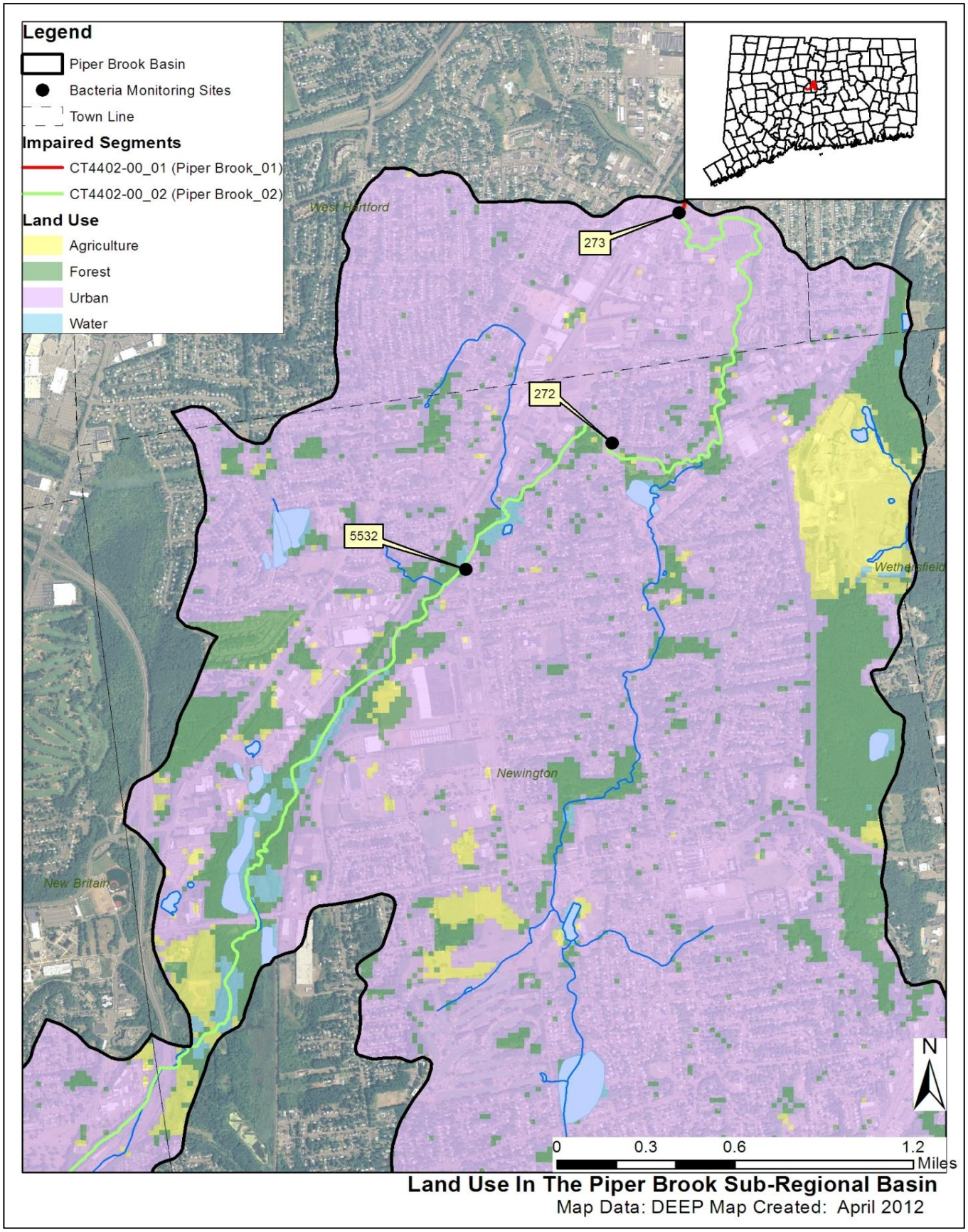


Figure 4: GIS map featuring land use for the Piper Brook watershed at the sub-regional level



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 segments in the Piper Brook watershed (stations organized downstream to upstream)

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT4402-00_01	Piper Brook (Segment 1)	273	Near mouth of old Piper Brook channel	West Hartford	41.7302750000	-72.7230555556
CT4402-00_02	Piper Brook (Segment 2)	272	Upstream of Main Street	Newington	41.7186083333	-72.7274166667
		5532	Upstream of Willard Avenue bridge	Newington	41.7122200019	-72.7369499975

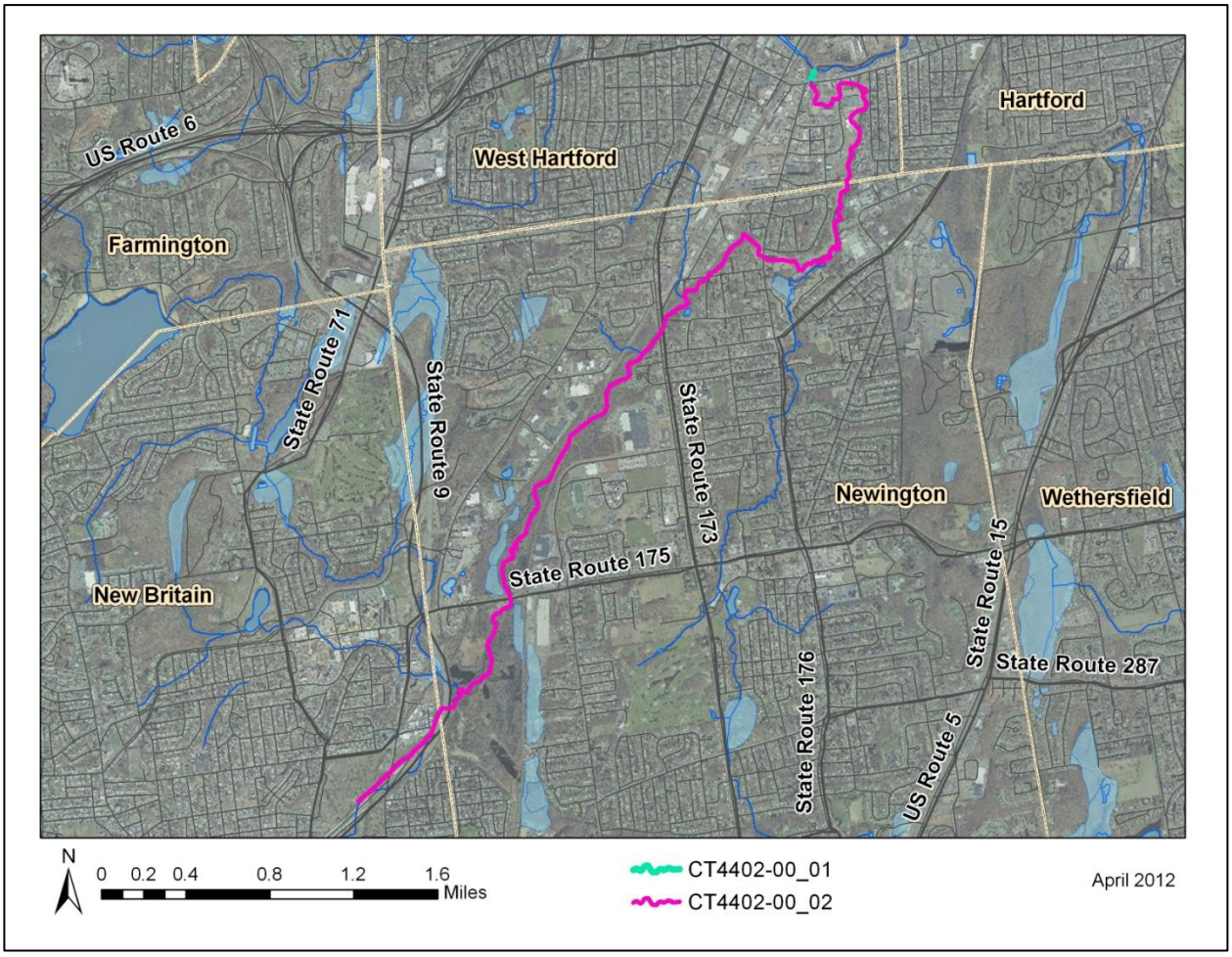
The impaired segments of Piper Brook are Class B freshwater rivers (Figure 5). Their applicable designated uses are habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from one sampling location (Station 273) from 2008-2010 on Piper Brook (Segment 1) (CT4402-00_01), and from two sampling locations (Stations 272 and 5532) from 2008-2010 on Piper Brook (Segment 2) (CT4402-00_02) (Tables 12 and 13). 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 12 and 13).

Piper Brook (Segment 1) (CT4402-00_01): As shown in Table 12, geometric mean values exceeded the WQS for *E. coli* at Station 273 for all sampling years. Single sample values also exceeded the WQS for *E. coli* multiple times at Station 273 for all sampling years. Geometric mean values were calculated for wet and dry-weather conditions, and Station 273 exceeded the WQS for *E. coli* during both wet and dry-weather. Wet-weather values were more than three times dry-weather values.

Piper Brook (Segment 2) (CT4402-00_02): As shown in Table 13, geometric mean and single sample values exceeded the WQS for *E. coli* at Stations 272 and 5532 for all sampling years. Geometric mean values were also calculated for wet and dry-weather conditions, and both stations exceeded the WQS for *E. coli* during both wet and dry-weather. Wet-weather values were more than three times dry-weather values.

Due to the elevated bacteria measurements presented in Tables 12 and 13, these segments of Piper Brook did 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 Piper Brook



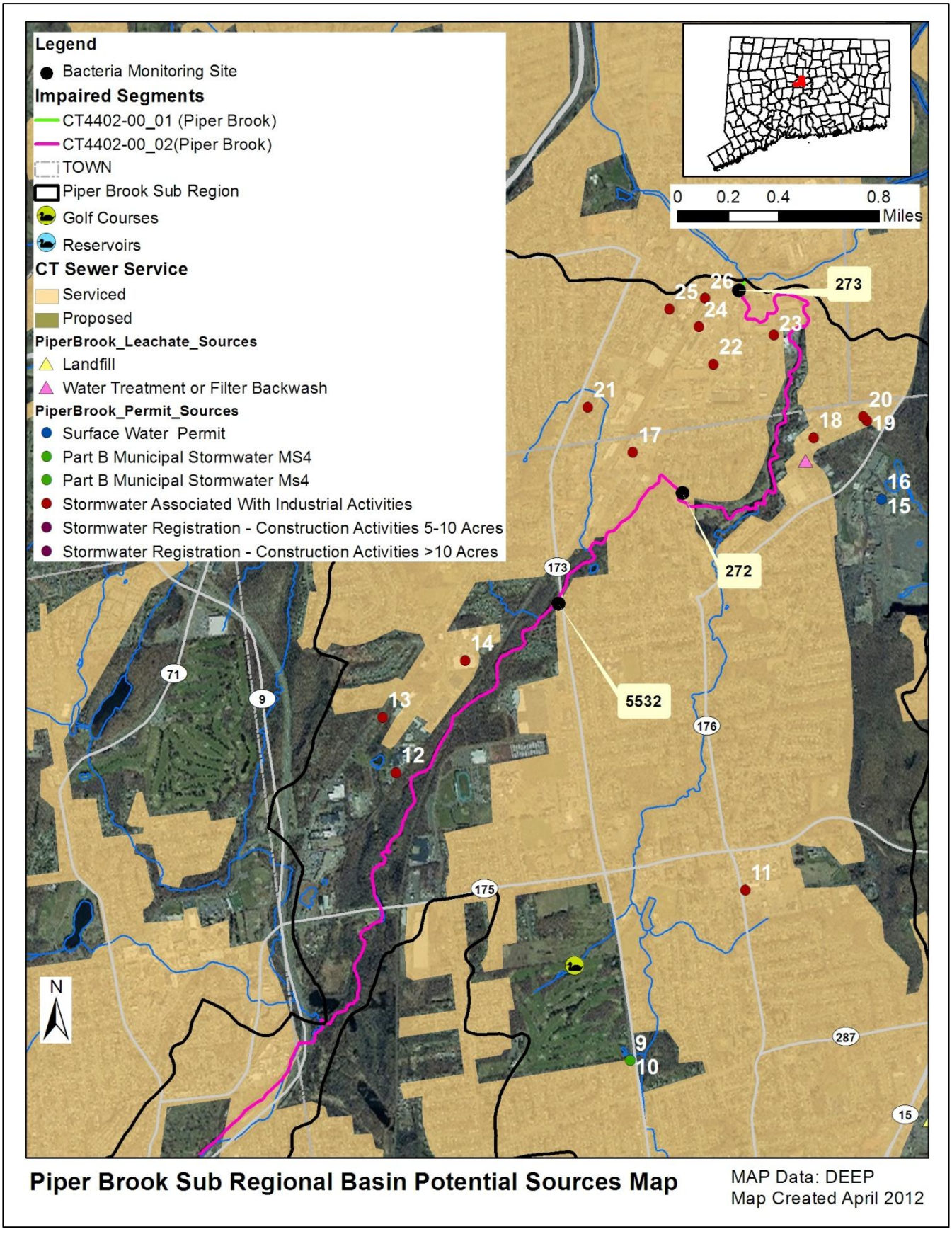
POTENTIAL BACTERIA SOURCES

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 Piper Brook watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody are 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. 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 Piper Brook watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/ SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/ Pets	Other
Piper Brook CT4402-00_01	**x**	**x**				**x**	**x**	
Piper Brook CT4402-00_02	**x**	**x**		**x**		**x**	**x**	

Figure 6: Potential sources in the Piper 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. 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	1
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	0
GSI	Stormwater Associated with Industrial Activity	18
GSM	Part B Municipal Stormwater MS4	3
GSN	Stormwater Registration – Construction	3
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	0

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Piper Brook watershed. Bacteria data from 2001-2003 from several of these industrial permitted facilities are included in Table 6. Although Connecticut does not have a recreation WQS for fecal coliform bacteria, multiple samples were high, exceeding 6,000 colonies/100 mL, including Stanley Works (GSI000640), Acme Packaging Corp. (GSI001323), Keeney Manufacturing Company (GSI000762), Kohler Mix Specialties of CT (GSI001248), and Danaher Holo-Krome Group (GSI000461). Permitted sources discharging directly to the impaired segments or tributaries of the impaired segments are a potential source of bacterial contamination to Piper Brook. 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 Piper Brook watershed

Town	Client	Permit ID	Permit Type	Site Name	Address	Map #
New Britain	Metallurgical Processing, Inc.	GSI000509	Stormwater Associated With Industrial Activities	Metallurgical Processing, Inc.	68 Arthur Street	4
New Britain	Creed Monarch, Inc.	GSI001004	Stormwater Associated With Industrial Activities	Creed Monarch, Inc.	One Pucci Park	7
New Britain	Stanley Black & Decker, Inc.	GSI001559	Stormwater Associated With Industrial Activities	Stanley Works	600 Myrtle Street	9
New Britain	City Of New Britain	GSM000064 / 200901941	Part B Municipal Stormwater MS4	New Britain, City Of	MS4 Permit	5 & 6
New Britain	City Of New Britain	GSN001888	Stormwater Registration - Construction Activities >10 Acres	Pinnacle Heights Housing Area Demolition	Slater Road and Long Swamp Road	8
Newington	Tilcon Connecticut Inc.	CT0030155	Surface Water Permit	Tilcon Connecticut, Inc.	301 Hartford Avenue	17
Newington	Town Of Newington	GSI000133	Stormwater Associated With Industrial Activities	Highway Department	281 Milk Lane	13
Newington	Miniature Nut & Screw	GSI000136	Stormwater Associated With Industrial Activities	Miniature Nut & Screw Corp.	820 N Mountain Road	20
Newington	Component Technologies, Inc.	GSI000370	Stormwater Associated With Industrial Activities	Component Technologies, Inc.	68 Holmes Road	15
Newington	International Bridge & Iron, Co.	GSI000601	Stormwater Associated With Industrial Activities	International Bridge & Iron, Co.	90 Day Street	18
Newington	Keeney Manufacturing , Co.	GSI000762	Stormwater Associated With Industrial Activities	Keeney Manufacturing, Co.	1170 Main Street	12
Newington	Custom Metal Crafters, Inc.	GSI000908	Stormwater Associated With Industrial Activities	Custom Metal Crafters, Inc.	815 N Mountain Road	21
Newington	Tilcon Connecticut Inc.	GSI001437	Stormwater Associated With Industrial Activities	Tilcon Connecticut, Inc.	301 Hartford Avenue	16

Table 5: Permitted facilities within the Piper Brook watershed

Town	Client	Permit ID	Permit Type	Site Name	Address	Map #
Newington	Advanced Adhesives System, Inc.	GSI001828	Stormwater Associated With Industrial Activities	Advanced Adhesives System, Inc.	681 N Mountain Road	19
Newington	Spx Precision Components Llc	GSI002192	Stormwater Associated With Industrial Activities	Spx Precision Components Llc	300 Fenn Road	14
Newington	Town Of Newington	GSM000060 / 200903039	Part B Municipal Stormwater MS4	Newington, Town Of	MS4 Permit	10 & 11
Newington	Double C. Construction, Llc	GSN001852	Stormwater Registration - Construction Activities 5-10 Acres	Morningside	Deming Street	1
Newington	Landworks Development Llc	GSN002177	Stormwater Registration - Construction Activities 5-10 Acres	Morningside	Deming Street	2
West Hartford	Elm-Cap Industries, Inc.	GSI000204	Stormwater Associated With Industrial Activities	Elm-Cap Industries, Inc.	111 South Street	23
West Hartford	Danaher Tool Group	GSI000461	Stormwater Associated With Industrial Activities	Holo-Krome, Co.	31 Brook Street	22
West Hartford	The Abbott Ball, Co.	GSI001079	Stormwater Associated With Industrial Activities	Abbott Ball, Co.	11 Railroad Place	27
West Hartford	The Wiremold, Co.	GSI001403	Stormwater Associated With Industrial Activities	The Wiremold, Co.	60 Woodlawn Street	26
West Hartford	The United Tool And Die, Co.	GSI001686	Stormwater Associated With Industrial Activities	The United Tool And Die, Co.	1 Carney Road	25
West Hartford	American Medical Response Of Connecticut, Inc.	GSI001856	Stormwater Associated With Industrial Activities	AMR	130 Shield Street	24
West Hartford	Town of West Hartford	GSM000001	Part B Municipal Stormwater MS4	West Hartford, Town of	MS4 Permit	NA

Table 6: Industrial permits in the Piper Brook 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 Britain	Metallurgical Processing, Inc.	GSI000509	Sebethe River	CB	07/26/01	4,500
New Britain	Metallurgical Processing, Inc.	GSI000509	Sebethe River	CB	08/29/02	1,300
New Britain	Metallurgical Processing, Inc.	GSI000509	Sebethe River	CB	07/09/03	600
New Britain	Stanley Works	GSI000640	Piper Brook	D-001	07/26/01	1,400
New Britain	Stanley Works	GSI000640	Piper Brook	D-001	09/26/02	50
New Britain	Stanley Works	GSI000640	Piper Brook	D-002	07/26/01	6,900
New Britain	Stanley Works	GSI000640	Piper Brook	D-003	07/26/01	350
New Britain	Stanley Works	GSI000640	Piper Brook	D-004	07/26/01	9,800
New Britain	Stanley Works	GSI000640	Piper Brook	D-004	09/26/02	550
New Britain	Creed Monarch, Inc.	GSI001004	Connecticut River (Mattabasset)	MHI	08/27/01	0
New Britain	Creed Monarch, Inc.	GSI001004	Connecticut River (Mattabasset)	MHI	09/26/02	2
New Britain	Creed Monarch, Inc.	GSI001004	Connecticut River (Mattabasset)	Parking lot drain	08/27/01	5
New Britain	Creed Monarch, Inc.	GSI001004	Connecticut River (Mattabasset)	Parking lot drain	09/26/02	3
New Britain	Acme Packaging Corp.	GSI001323	Piper Brook	#1 - Adjacent to road and brown shed	09/04/01	>6000
New Britain	Acme Packaging Corp.	GSI001323	Piper Brook	#1 - Adjacent to road and brown shed	06/05/02	>600
New Britain	Acme Packaging Corp.	GSI001323	Piper Brook	#1 - Adjacent to road and brown shed	06/18/03	>600
New Britain	Acme Packaging Corp.	GSI001323	Piper Brook	#2 - Adjacent to N train door	09/04/01	>6000
New Britain	Acme Packaging Corp.	GSI001323	Piper Brook	#2 - Adjacent to N train door	06/05/02	>600
New Britain	Acme Packaging Corp.	GSI001323	Piper Brook	#2 - Adjacent to N train door	06/18/03	>600

Table 6: Industrial permits in the Piper Brook 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. (continued)

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
New Britain	Acme Packaging Corp.	GSI001323	Piper Brook	#3 SE corner of building #451	09/04/01	>6000
New Britain	Acme Packaging Corp.	GSI001323	Piper Brook	#3 SE corner of building #451	06/05/02	>600
New Britain	Acme Packaging Corp.	GSI001323	Piper Brook	#3 SE corner of building #451	06/18/03	800
Newington	Town of Newington	GSI000133	Piper Brook	NE corner of property	02/01/02	250
Newington	Feen Manufacturing Co.	GSI000327	Tributary to Piper Brook	SW-1	07/11/01	600
Newington	Feen Manufacturing Co.	GSI000327	Tributary to Piper Brook	SW-1	12/20/02	300
Newington	Feen Manufacturing Co.	GSI000327	Tributary to Piper Brook	SW-1	05/21/03	300
Newington	Component Technologies, Inc.	GSI000370	Piper Brook	DSG 001	07/26/01	800
Newington	Component Technologies, Inc.	GSI000370	Piper Brook	DSG 001	06/05/02	100
Newington	International Bridge & Iron, Co.	GSI000601	Piper Brook	CB @ Road	09/10/01	100
Newington	Keeney Manufacturing, Co.	GSI000762	Piper Brook	DSN 001	09/04/01	1,200
Newington	Keeney Manufacturing, Co.	GSI000762	Piper Brook	DSN 001	08/29/02	3,000
Newington	Keeney Manufacturing, Co.	GSI000762	Piper Brook	DSN 001	06/18/03	100
Newington	Keeney Manufacturing, Co.	GSI000762	Piper Brook	DSN 002	09/04/01	400
Newington	Keeney Manufacturing, Co.	GSI000762	Piper Brook	DSN 002	08/29/02	11,000
Newington	Keeney Manufacturing, Co.	GSI000762	Piper Brook	DSN 002	06/18/03	1,000
Newington	Custom Metal Crafters, Inc.	GSI000908	Connecticut River	CB on N Mountain Road	09/04/01	300
Newington	Custom Metal Crafters, Inc.	GSI000908	Connecticut River	CB on N Mountain Road	08/29/02	30
Newington	Kohler Mix Specialties of CT	GSI001248	Piper Brook	002	09/15/02	TNTC
Newington	Kohler Mix Specialties of CT	GSI001248	Piper Brook	002	05/01/03	10
Newington	Kohler Mix Specialties of CT	GSI001248	Piper Brook	004	09/04/01	>600
Newington	Kohler Mix Specialties of CT	GSI001248	Piper Brook	004	09/15/02	100

Table 6: Industrial permits in the Piper Brook 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. (continued)

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
Newington	Kohler Mix Specialties of CT	GSI001248	Piper Brook	004	05/01/03	70
Newington	Kohler Mix Specialties of CT	GSI001248	Piper Brook	005	09/04/01	1,200
Newington	Kohler Mix Specialties of CT	GSI001248	Piper Brook	005	09/15/02	15,000
Newington	Kohler Mix Specialties of CT	GSI001248	Piper Brook	005	05/01/03	110
North Branford	Tilcon Connecticut, Inc.	GSI001437	Piper Brook	DSN 03	09/26/02	70
Newington	Tilcon Connecticut, Inc.	GSI001437	Piper Brook	DSN 05	09/26/02	950
Newington	Tilcon Connecticut, Inc.	GSI001437	Piper Brook	DSN-05N	07/26/01	>600
Newington	TECT Turbine Engine Components	GSI001481	Piper Brook	Outfall 003	07/23/02	TNTC
West Hartford	Elm-Cap Industries, Inc.	GSI000204	Piper Brook	DSG 001	04/10/02	50
West Hartford	Elm-Cap Industries, Inc.	GSI000204	Piper Brook	DSG 001	08/29/02	>600
West Hartford	Elm-Cap Industries, Inc.	GSI000204	Piper Brook	DSG 001	05/08/03	80
West Hartford	Elm-Cap Industries, Inc.	GSI000204	Piper Brook	DSG 002	04/10/02	10
West Hartford	Elm-Cap Industries, Inc.	GSI000204	Piper Brook	DSG 002	05/08/03	10
West Hartford	Nutmeg Chrome Corp.	GSI000396	S Branch Park River	CB-end of driveway	09/14/01	5,800
West Hartford	Nutmeg Chrome Corp.	GSI000396	S Branch Park River	CB-end of driveway	10/11/02	450
West Hartford	Danaher Holo-Krome Group	GSI000461	Tributary to Piper Brook	001	09/04/01	8,800
West Hartford	Danaher Holo-Krome Group	GSI000461	Tributary to Piper Brook	001	11/04/02	150
West Hartford	Danaher Holo-Krome Group	GSI000461	Tributary to Piper Brook	002	09/04/01	3,300
West Hartford	Danaher Holo-Krome Group	GSI000461	Tributary to Piper Brook	002	11/04/02	250
West Hartford	Abbott Ball, Co.	GSI001079	Piper Brook	CB along RR	07/26/01	1,000
West Hartford	Abbott Ball, Co.	GSI001079	Piper Brook	CB along RR	07/09/02	320
West Hartford	The Wiremold, Co.	GSI001403	Piper Brook	#1	11/20/01	180

Table 6: Industrial permits in the Piper Brook 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. (continued)

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
West Hartford	The Wiremold, Co.	GSI001403	Piper Brook	#1	10/16/02	800
West Hartford	The Wiremold, Co.	GSI001403	Piper Brook	#2	11/20/01	10
West Hartford	The Wiremold, Co.	GSI001403	Piper Brook	#2	10/16/02	>2000
West Hartford	Airborne Express	GSI001547	Piper Brook	CB 5	10/14/02	10

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 Piper Brook watershed are located within the City of New Britain and the Towns of West Hartford and Newington. These 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 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).

Multiple MS4 outfalls have been sampled for *E. coli* bacteria in the watershed (Table 7). In Newington, six MS4 outfalls were sampled from 2004 – 2011. Of these outfalls, all but one exceeded the single sample water quality standard of 410 colonies/100 mL on at least one sample date.

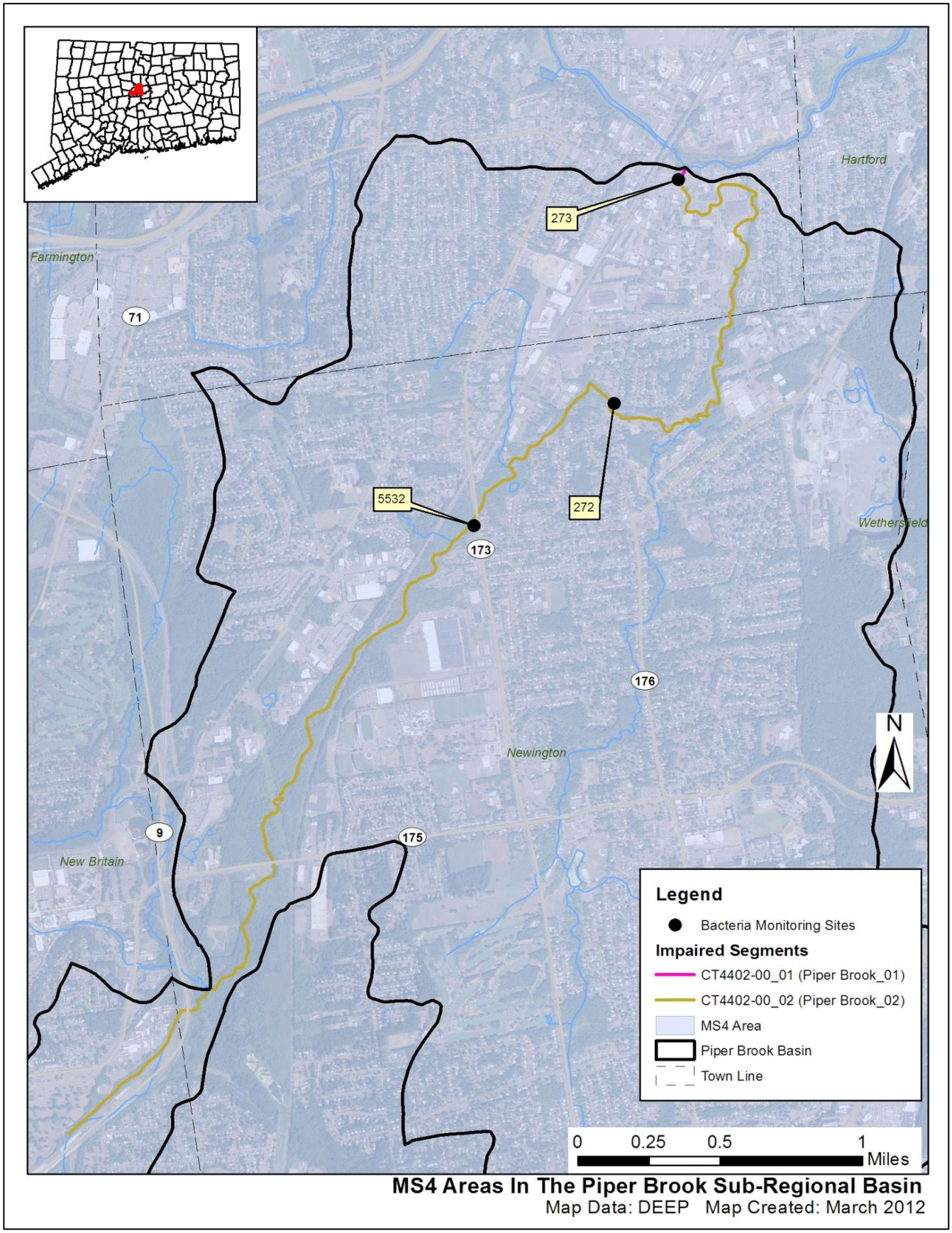
Table 7: List of MS4 sample locations and *E. coli* (colonies/100 mL) results in the Piper Brook watershed

Town	Location	MS4 Type	Receiving Waters	Sample Date	Result
Newington	3-R at Brookside and Sunnyside Street	Residential	Piper Brook	09/14/06	130,000
Newington	3-R at Brookside and Sunnyside Street	Residential	Piper Brook	07/19/07	48,200
Newington	3-R at Brookside and Sunnyside Street	Residential	Piper Brook	09/26/08	1,670
Newington	3-R at Brookside and Sunnyside Street	Residential	Piper Brook	07/31/09	13,000
Newington	3-R at Brookside and Sunnyside Street	Residential	Piper Brook	06/17/11	12,030
Newington	5-I Holmes Road outfall	Industrial	Piper Brook	11/09/05	3,800
Newington	5-I Holmes Road outfall	Industrial	Piper Brook	09/14/06	5,100
Newington	5-I Holmes Road outfall	Industrial	Piper Brook	07/19/07	700
Newington	5-I Holmes Road outfall	Industrial	Piper Brook	09/26/08	2,050
Newington	5-I Holmes Road outfall	Industrial	Piper Brook	07/31/09	24,200
Newington	5-I Holmes Road outfall	Industrial	Piper Brook	06/17/11	8,160

Table 7: List of MS4 sample locations and *E. coli* (colonies/100 mL) results in the Piper Brook watershed (continued)

Town	Location	MS4 Type	Receiving Waters	Sample Date	Result
Newington	6-I Stamm Road CMP	Industrial	Piper Brook	09/14/06	6,100
Newington	6-I Stamm Road CMP	Industrial	Piper Brook	07/19/07	25,200
Newington	6-I Stamm Road CMP	Industrial	Piper Brook	09/26/08	2,010
Newington	6-I Stamm Road CMP	Industrial	Piper Brook	07/31/09	3,780
Newington	N-3 Anna Reynolds School outfall	Residential	Piper Brook	11/12/04	100
Newington	N-5 Constance Leigh Street outfall	Commercial	Piper Brook	11/12/04	2,200
Newington	N-6 Holmes Road outfall	Industrial	Piper Brook	11/12/04	69,000
Shaded cells indicate an exceedance of single-sample based water quality criteria (410 colonies/100 mL)					

Figure 7: MS4 areas of the Piper 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 Piper Brook watershed are described below.

Stormwater Runoff from Developed Areas

The majority of the Piper Brook watershed is developed with approximately 82% considered urban. Much of that area is concentrated around the impaired segments in the Towns of West Hartford and Newington and the City of New Britain (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).

Approximately 90% of the Piper Brook watershed is characterized by greater than 16% impervious cover as the impaired segments flow through dense commercial and residential areas. A portion of Piper Brook (Segment 2) flows along a railroad track buffered by forest and is characterized by 12-15% impervious cover (Figures 8 and 9). Water quality data taken at all stations along the impaired segments were consistently high, especially during wet weather, which suggests that stormwater runoff may be a source of bacteria to Piper Brook (Tables 12 and 13).

Figure 8: Range of impervious cover (%) in the Piper Brook watershed

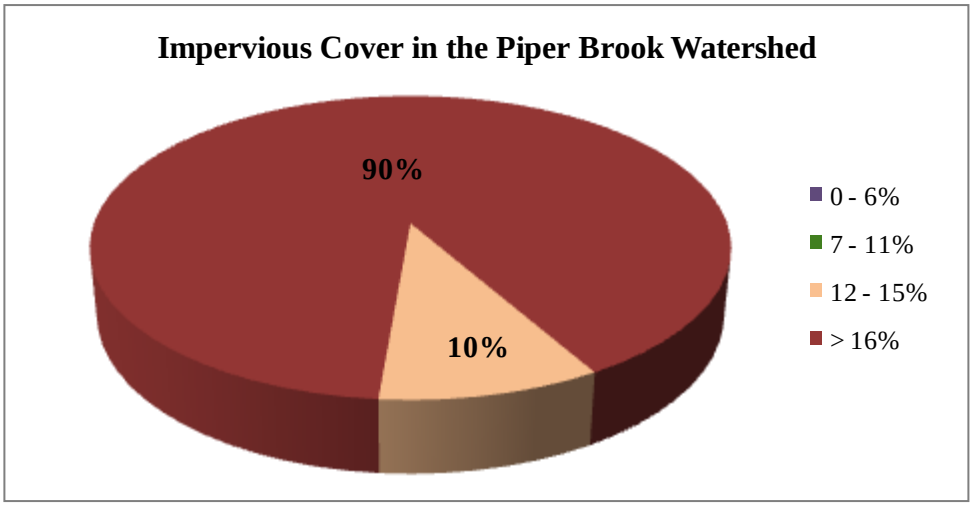
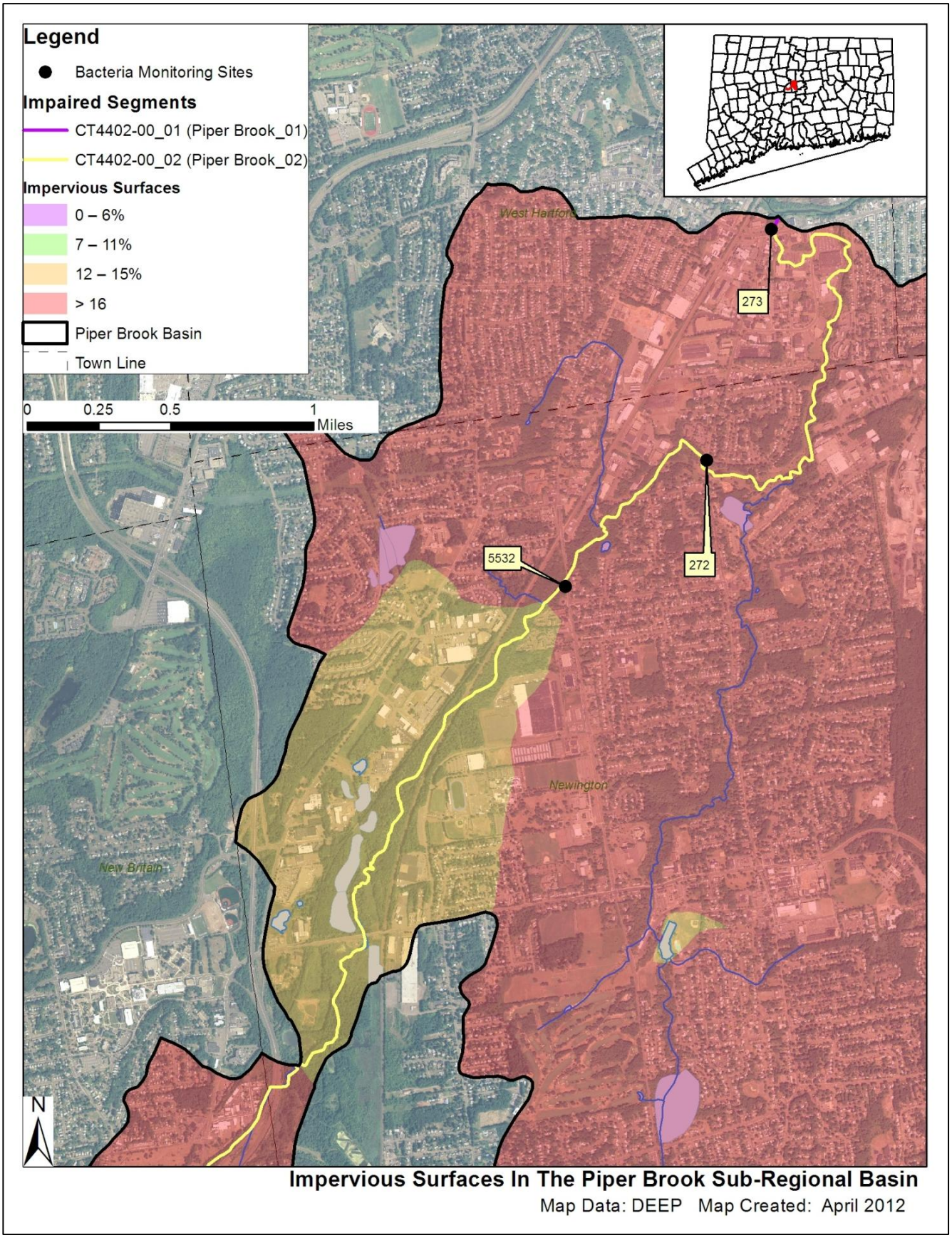


Figure 9: Impervious cover (%) for the Piper Brook sub-regional watershed



Illicit Discharges and Insufficient Septic Systems

As shown in Figure 6, most of the watershed is serviced by sanitary sewers. Sewer system leaks and other illicit discharges may be contributing bacteria to the impaired segments of Piper Brook. A portion of Piper Brook (Segment 2) along the railroad tracks in Newington 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 or failing septic systems in a specific municipality. The City of New Britain has a full-time health director (http://www.new-britain.net/liv_htlhdept.html). The Town of Newington is part of the Central Connecticut Health District (http://www.ccthd.org/), and the Town of West Hartford is part of the West Hartford-Bloomfield Health District (http://www.westhartford.org/whcares/TownDepartments/HealthDistrict/Health1.htm).

As shown in Tables 13 and 14, geometric mean values during dry-weather exceeded the WQS for *E. coli* at all stations along the impaired segments of Piper Brook. The area surrounding these stations is serviced by the sanitary sewer system, which may indicate that bacteria from leaky pipes are a source of bacterial contamination to the impaired segments of Piper Brook.

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Piper Brook 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 open spaces near the impaired segments, including the Indian Hill Golf Club in Newington, the Newington Arena with multiple soccer and baseball fields, and mowed stream bank areas downstream of the Main Street crossing in Newington. 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 residential development surrounds much of the impaired segments of Piper Brook (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 Piper Brook.

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 only 2% of the Piper Brook watershed. No major agricultural areas were identified as potential sources of bacterial contamination to the impaired segments of Piper Brook.

Additional Sources

As shown in Figure 6, a landfill was identified along the far upstream reaches of a tributary to the impaired segments of Piper Brook. There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in Piper Brook. 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

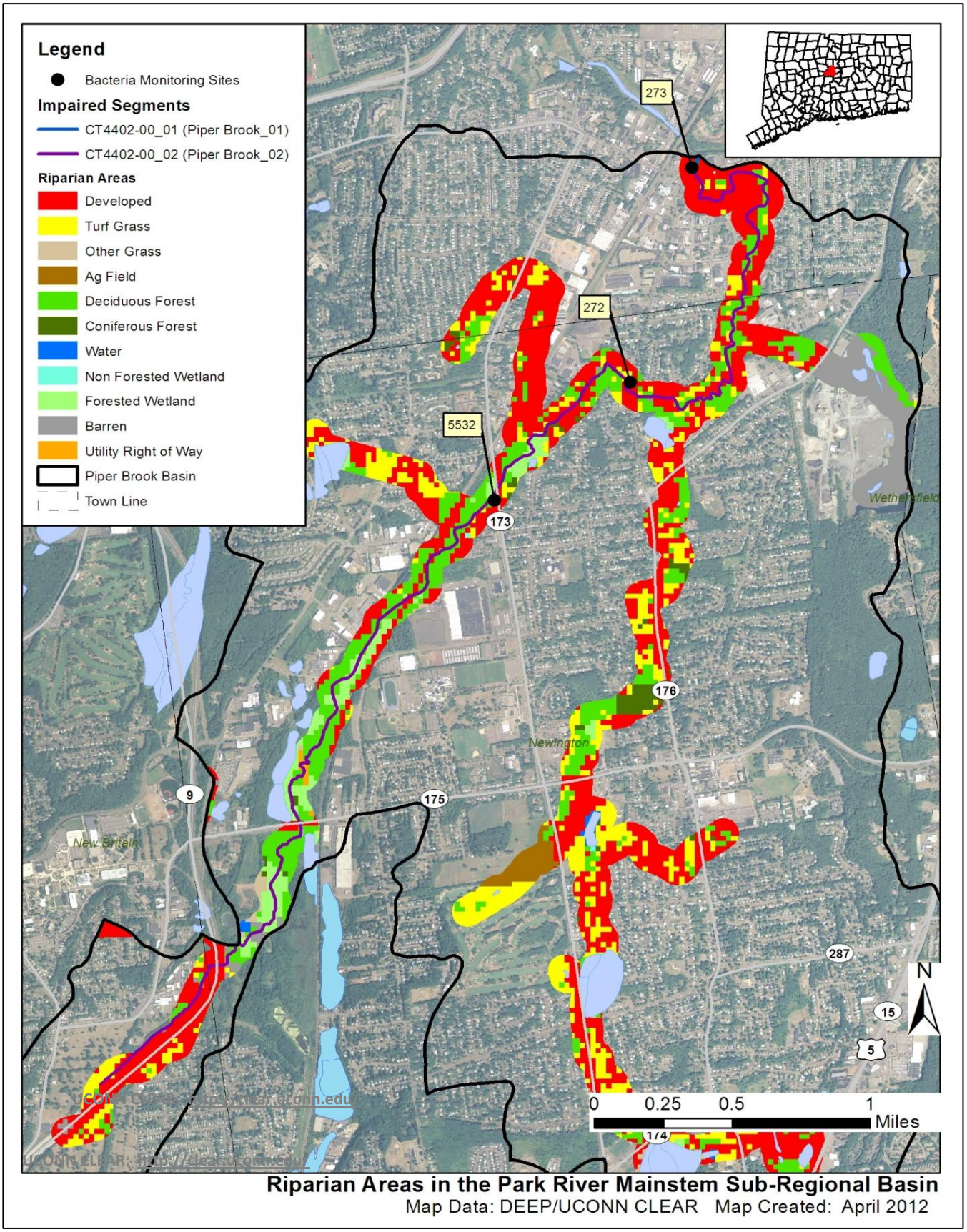
Riparian Buffer Zones

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 Piper Brook is characterized by developed land use with some forested areas, particularly along the railroad track in Newington (Figure 10). Developed areas within the riparian zone likely contribute pollutants such as bacteria to the waterbody since the natural riparian buffer cannot treat stormwater runoff from impervious surfaces.

Figure 10: Riparian buffer zone information for the Piper Brook watershed



CURRENT MANAGEMENT ACTIVITIES

As indicated previously, the City of New Britain and the Towns of West Hartford and Newington 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 8, 9, and 10.

Table 8: Summary of MS4 requirement updates related to the reduction of bacterial contamination from New Britain, CT (GSM000064)

Minimum Measure	New Britain 2008 SWMP
Public Outreach and Education	1) Sponsors public speaking opportunities on topics related to stormwater management. 2) Installed plaques on 1,000 catch basins, noting "Drains to Waterway, No Dumping". 3) Developed 17,000 stormwater management brochure for distribution.
Public Involvement and Participation	1) Sponsored river clean-ups. 2) Developed complaint tracking system through email. 3) Will create a stormwater committee.
Illicit Discharge Detection and Elimination	1) Mapped all drainage systems with GIS. 2) Will develop an illicit discharge program. 3) Collected water samples from six outfalls during wet-weather.
Construction Site Stormwater Runoff Control	1) Developing an inspection checklist for projects that impact waterways.
Post Construction Stormwater Management	1) Will develop program to ensure long-term maintenance of BMPS installed at development sites.
Pollution Prevention and Good Housekeeping	1) Cleaned 20% of catch basins each year. 2) Swept all town roads.

Table 9: Summary of MS4 requirement updates related to the reduction of bacterial contamination from West Hartford, CT (Permit #GSM000001)

Minimum Measure	West Hartford 2007 Annual Report
Public Outreach and Education	1) Provided online links to CT DEEP's MS4 outreach materials.
	2) Public awareness bulletins of new large constructions projects delivered with tax bills.
Public Involvement and Participation	1) Held public meetings for new development projects, which included storm water reviews.
Illicit Discharge Detection and Elimination	1) Conducted stormwater outfall sampling at six locations.
Construction Site Stormwater Runoff Control	1) Conducted strict review of new Blue Back Square (West Hartford Center) and housing condo construction projects.
Post Construction Stormwater Management	1) Conducted annual water samplings at the Public Works Department site.
Pollution Prevention and Good Housekeeping	1) Labeled catch basins that drain to watercourses.
	2) Cleaned 2,833 catch basins.
	3) Swept all town roads.

Table 10: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Newington, CT (Permit #GSM000060)

Minimum Measure	Newington 2010 Annual Report
Public Outreach and Education	1) Established an information line for citizens to ask questions or report illicit discharges. 2) Reconfigured current web site to provide information on stormwater management. 3) Initiated catch basin stenciling. 4) Developed and distributed brochures on stormwater management.
Public Involvement and Participation	1) Solicited public comments on Draft Stormwater Management Plan (SWMP). 2) Created a stormwater committee. 3) Participated in Connecticut River Watch Program and Mattebesset River Watershed Association efforts.
Illicit Discharge Detection and Elimination	1) Developed an illicit discharge detection and elimination program. 2) Field verified the connectivity and size of all storm drain piping. 3) Conducted sampling at six outfalls during wet-weather.
Construction Site Stormwater Runoff Control	1) Revised procedures for site plan reviews to incorporate considerations of potential water quality impacts.

Table 10: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Newington, CT (Permit #GSM000060)

Minimum Measure	Newington 2010 Annual Report
Post Construction Stormwater Management	1) Established standard procedures for inspecting, cleaning, and maintaining structural BMPs.
Pollution Prevention and Good Housekeeping	1) Cleaned all catch basins. 2) Purchased vac truck for catch basin cleaning. 3) Swept all town roads once per year.

RECOMMENDED NEXT STEPS

As show above, the City of New Britain and the Towns of West Hartford and Newington 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 Piper Brook and have been prioritized below.

1) Identify areas along Piper Brook to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, the City of New Britain and the Towns of West Hartford and Newington within the Piper Brook watershed are MS4 communities regulated by the MS4 program. Since 82% of the watershed is considered urban and the area surrounding most of the impaired segments has an impervious cover 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 continue to conduct wet-weather sampling at stormwater outfalls that discharge directly to Piper Brook. To treat stormwater runoff, the towns should also identify areas along the more developed sections of Piper Brook, particularly along the impaired segments, to install BMPs that encourage stormwater to infiltrate the ground before entering Piper Brook. 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 of industrial discharges and MS4 outfalls has shown elevated levels of bacteria, an indicator of bacterial pollution (Tables 6 and 7). 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 11 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 Piper 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 11. 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**
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 Piper Brook watershed surrounding the impaired segments relies on a municipal sewer system (Figure 6). Since the majority of the impaired segments are located in the City of New Britain and the Towns of West Hartford and Newington, the municipalities should develop a program that evaluates the sanitary sewer system and reduces leaks and overflows. This program should include periodic inspections of the sewer line.

4) Develop a system to monitor septic systems.

A portion of Piper Brook (Segment 2) along the railroad track in Newington relies on septic systems (Figure 6). If not already in place, Newington 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.

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

As most of the Piper Brook watershed is developed, any education and outreach program should highlight the importance of not feeding waterfowl and wildlife and managing waste from horses, dogs, and other pets. Municipalities and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas of Piper Brook 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 Piper Brook 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.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 12: Piper Brook (Segment 1) Bacteria Data

Waterbody ID: CT4402-00_01

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: **76%**

Single Sample: **98%**

Data: 2008-2010 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from Station 273 on Piper Brook (Segment 1) with annual geometric means calculated

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
273	Near mouth of old Piper Brook Channel	6/16/2008	130	wet	258
273	Near mouth of old Piper Brook Channel	7/1/2008	230	wet	
273	Near mouth of old Piper Brook Channel	7/10/2008	110	dry	
273	Near mouth of old Piper Brook Channel	7/17/2008	41†	dry	
273	Near mouth of old Piper Brook Channel	7/23/2008	4400	wet	
273	Near mouth of old Piper Brook Channel	8/7/2008	960†	wet	
273	Near mouth of old Piper Brook Channel	8/12/2008	2900	wet	
273	Near mouth of old Piper Brook Channel	8/21/2008	98	dry	
273	Near mouth of old Piper Brook Channel	8/28/2008	110	dry	
273	Near mouth of old Piper Brook Channel	9/2/2008	74	dry	
273	Near mouth of old Piper Brook Channel	9/12/2008	200	wet	
273	Near mouth of old Piper Brook Channel	9/15/2008	330	wet	

Single sample *E. coli* (colonies/100 mL) data from Station 273 on Piper Brook (Segment 1) with annual geometric means calculated (continued)

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
273	Near mouth of old Piper Brook Channel	6/29/2009	310	dry	340
273	Near mouth of old Piper Brook Channel	7/10/2009	220	dry	
273	Near mouth of old Piper Brook Channel	7/15/2009	120	dry	
273	Near mouth of old Piper Brook Channel	7/24/2009	**24001* (98%)**	wet	
273	Near mouth of old Piper Brook Channel	8/5/2009	190	dry	
273	Near mouth of old Piper Brook Channel	8/14/2009	930	dry	
273	Near mouth of old Piper Brook Channel	8/28/2009	190	wet	
273	Near mouth of old Piper Brook Channel	9/4/2009	1000	dry	
273	Near mouth of old Piper Brook Channel	9/8/2009	250	dry	
273	Near mouth of old Piper Brook Channel	9/15/2009	41	dry	
273	Near mouth of old Piper Brook Channel	9/25/2009	104	dry	
273	Near mouth of old Piper Brook Channel	5/7/2010	120	dry	**525* (76%)**
273	Near mouth of old Piper Brook Channel	5/12/2010	405	wet	
273	Near mouth of old Piper Brook Channel	5/20/2010	600	dry	
273	Near mouth of old Piper Brook Channel	5/25/2010	170	dry	
273	Near mouth of old Piper Brook Channel	5/27/2010	14000	wet	
273	Near mouth of old Piper Brook Channel	6/8/2010	300	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 273 on Piper Brook (Segment 1)

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
273	Near mouth of old Piper Brook Channel	2008-2010	11	18	332	958	174

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gage at Hartford Bradley International Airport.

Table 13: Piper Brook (Segment 2) Bacteria Data

Waterbody ID: CT4402-00_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: **81%**

Single Sample: **97%**

Data: 2008-2010 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Piper Brook (Segment 2) with annual geometric means calculated

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
272	Upstream of Main Street	6/16/2008	530	wet	508
272	Upstream of Main Street	7/1/2008	740	wet	
272	Upstream of Main Street	7/10/2008	190	dry	
272	Upstream of Main Street	7/17/2008	250	dry	
272	Upstream of Main Street	7/23/2008	1000	wet	
272	Upstream of Main Street	8/7/2008	1600	wet	
272	Upstream of Main Street	8/12/2008	2300	wet	
272	Upstream of Main Street	8/21/2008	790[†]	dry	
272	Upstream of Main Street	8/28/2008	210	dry	
272	Upstream of Main Street	9/2/2008	200	dry	
272	Upstream of Main Street	9/12/2008	230	wet	
272	Upstream of Main Street	9/15/2008	560	wet	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Piper Brook (Segment 2) with annual geometric means calculated (continued)

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
272	Upstream of Main Street	6/29/2009	230	dry	265
272	Upstream of Main Street	7/10/2009	290	dry	
272	Upstream of Main Street	7/15/2009	52	dry	
272	Upstream of Main Street	7/24/2009	**13000* (97%)**	wet	
272	Upstream of Main Street	8/5/2009	210	dry	
272	Upstream of Main Street	8/14/2009	720	dry	
272	Upstream of Main Street	8/28/2009	98	wet	
272	Upstream of Main Street	9/4/2009	97	dry	
272	Upstream of Main Street	9/8/2009	195	dry	
272	Upstream of Main Street	9/15/2009	200†	dry	
272	Upstream of Main Street	9/25/2009	180	dry	
272	Upstream of Main Street	5/7/2010	190	dry	496
272	Upstream of Main Street	5/12/2010	930	wet	
272	Upstream of Main Street	5/20/2010	400	dry	
272	Upstream of Main Street	5/25/2010	200	dry	
272	Upstream of Main Street	5/27/2010	3900	wet	
272	Upstream of Main Street	6/8/2010	270	dry	
5532	US Willard Ave bridge	5/7/2010	630	dry	**674* (81%)**
5532	US Willard Ave bridge	5/12/2010	380	wet	
5532	US Willard Ave bridge	5/20/2010	490	dry	
5532	US Willard Ave bridge	5/25/2010	270	dry	
5532	US Willard Ave bridge	5/27/2010	4400	wet	

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 Piper Brook (Segment 2)

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
272	Upstream of Main Street	2008-2010	11	18	395	986	226
5532	US Willard Ave bridge	2010	2	3	674	1293	437

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gage at Markham_Municipal_Meriden_KMMK in New Haven, CT.

REFERENCES

Costa, Joe (2011). Calculating Geometric Means. Buzzards Bay National Estuary Program. **Online**: http://www.buzzardsbay.org/geomean.htm

CTDEEP (2010). State of Connecticut Integrated Water Quality Report. **Online:** http://www.ct.gov/dep/lib/dep/water/water_quality_management/305b/ctiwqr10final.pdf

CTDEEP (2011). State of Connecticut Water Quality Standards. **Online:** http://www.ct.gov/dep/lib/dep/water/water_quality_standards/wqs_final_adopted_2_25_11.pdf

CWP (2003). Impacts of Impervious Cover on Aquatic Systems. Center for Watershed Protection. **Online**: http://clear.uconn.edu/projects/tmdl/library/papers/Schueler_2003.pdf

Federal Register 67 (March 15, 2002) 11663-11670. Urban Area Criteria for Census 2000.

Mallin, M.A., K.E. Williams, E.C. Escham, R.P. Lowe (2000). Effect of Human Development on Bacteriological Water Quality in Coastal Wetlands. Ecological Applications 10: 1047-1056.

USEPA (2001). Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water. **Online**: http://www.epa.gov/safewater/sourcewater/pubs/fs_swpp_petwaste.pdf.

USEPA (2011a). Managing Nonpoint Source Pollution from Agriculture. **Online:** http://water.epa.gov/polwaste/nps/outreach/point6.cfm

USEPA (2011b). Riparian Zone and Stream Restoration. **Online:** http://epa.gov/ada/eco/riparian.html

USEPA (2011c). Land Use Impacts on Water. **Online:** http://epa.gov/greenkit/toolwq.htm