Bantam River

Watershed Summary

Watershed Description and Maps

The Bantam River watershed covers an area of approximately 25,732 acres in the north western area of Connecticut (Figure 1). There are several towns located at least partially in the watershed, including the municipalities of Washington, Morris, Litchfield, Goshen, and Torrington, CT.

The Bantam River watershed includes one segment addressed in this TMDL impaired for recreation due to elevated bacteria levels (CT6705-00_01). 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 are currently unassessed as of the writing of this document. This does not suggest that there are no issues on these segments, but indicates a lack of current data to evaluate the segments as part of the assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 (CTDEEP, 2010).

The Bantam River begins in a marshy area upstream of the Litchfield Reservoir on the south side of Pie Hill Road in Goshen. The bacteria impaired segment (CT6705-00_01) of the Bantam River begins at the confluence of the Bantam River and Bizell Brook upstream of the West Morris Road crossing in Morris (Figure 4). The impaired segment ends at the confluence with the Shepaug River, parallel to Whittlesey Road in Washington. The segment is 4.53 miles long and located in the Towns of Washington and Morris.

The impaired segment of the Bantam River has a water quality classification of AA. Designated uses include existing or proposed drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. 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 the Bantam River, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Impaired Segment Facts

Impaired Segment:
Bantam River (CT6705-00_01)

Municipalities: Morris, Washington

Impaired Segment Length (miles):
4.53

Water Quality Classification:
Class AA

Designated Use Impairment:
Recreation

Sub-regional Basin Name and Code: Bantam River CT6705

Regional Basin: Shepaug

Major Basin: Housatonic

Watershed Area (acres): 25,732

MS4 Applicable: No

Figure 1: Watershed location in Connecticut

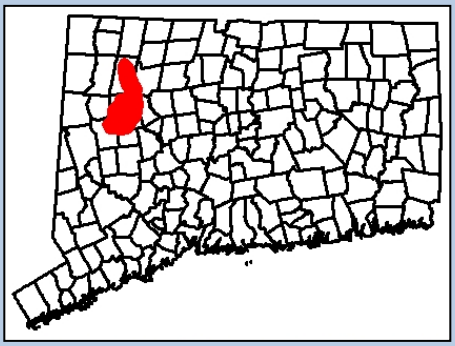


Table 1: Impaired segment and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT6705-00_01	Bantam River-01	From mouth at confluence with Shepaug River (parallel with Whittlesey Road), Washington, US to confluence with Bizell Brook (just US of West Morris Road crossing), Morris.	4.53	FULL	U*	FULL
CT6705-00_02	Bantam River-02	From confluence with Bizell Brook (just US of West Morris Road crossing), Morris, US to hydropower dam outlet at Bantam Lake Road (Route 209) crossing, Litchfield.	2.01	U	U	FULL
CT6705-00_03	Bantam River-03	From hydropower dam outlet at Bantam Lake Road (Route 209) crossing, US to outlet of Bantam Lake (just US of North Shore Road crossing), Litchfield.	1.64	U	U	FULL
CT6705-00_04	Bantam River-04	From inlet to Bantam Lake (northeast portion, in marsh, DS of Whitehall Road crossing), Litchfield, US to headwaters (marsh US of Litchfield Reservoir, south side of Pie Hill Road, east of Route 63 intersection), Goshen.	12.02	FULL	U	FULL

Shaded cells indicate impaired segment addressed in this TMDL

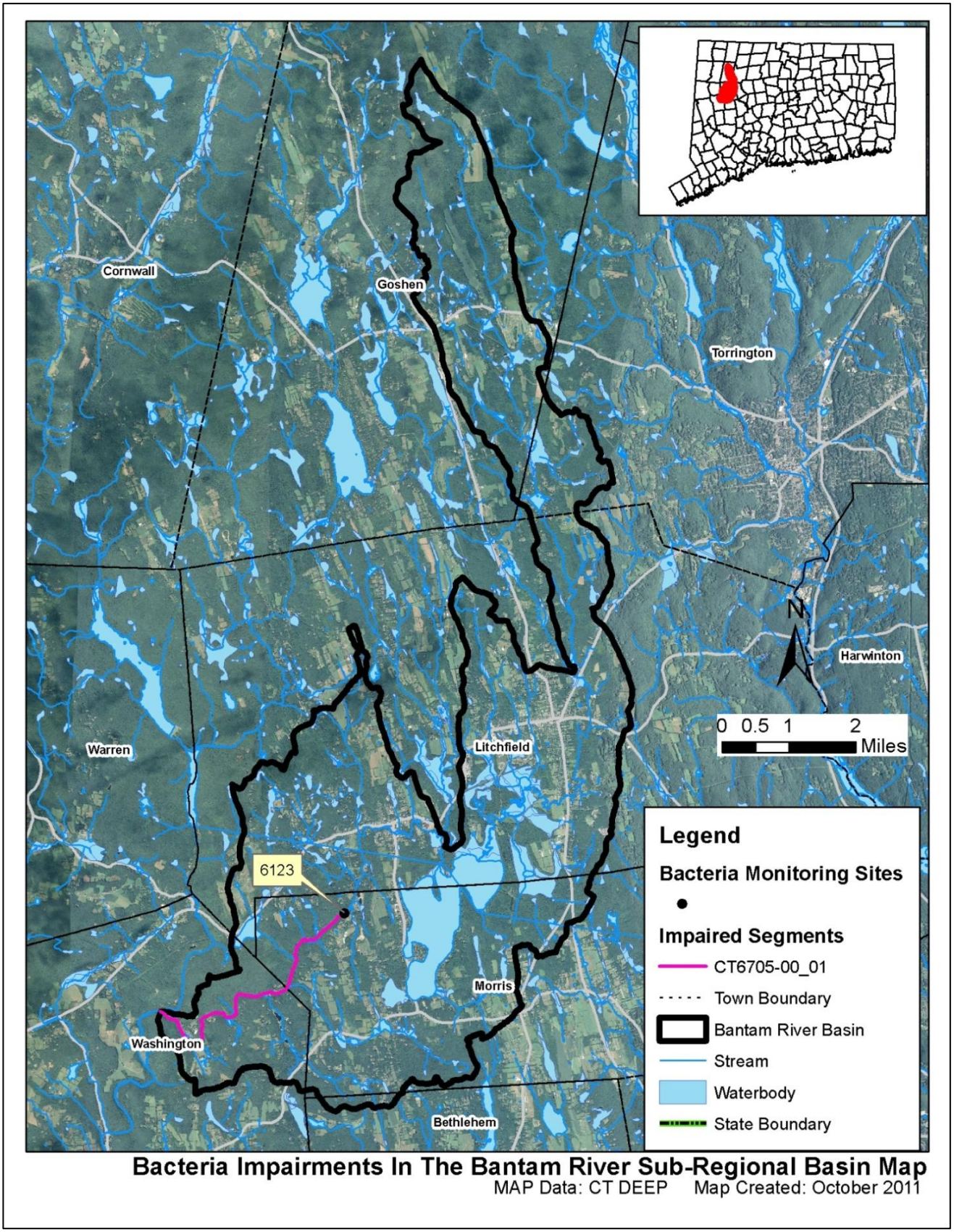
***Impairment determined from 2010 data; will be listed as impaired on the 2012 303(d) List of Impaired Waters**

FULL = Designated Use Fully Supported

NOT = Designated Use Not Supported

U = Unassessed

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



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from nutrients and bacteria 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 Bantam River watershed consists of 15% urban area, 58% forest, 15% agriculture, and 12% water. The majority of the watershed surrounding the impaired segment consists of forested land use with some agricultural and urban land uses as well. Large agricultural operations are located near the upstream portion of the impaired segment at the West Morris Road crossing in Morris (Figure 4).

Figure 3: Land use within the Bantam River watershed

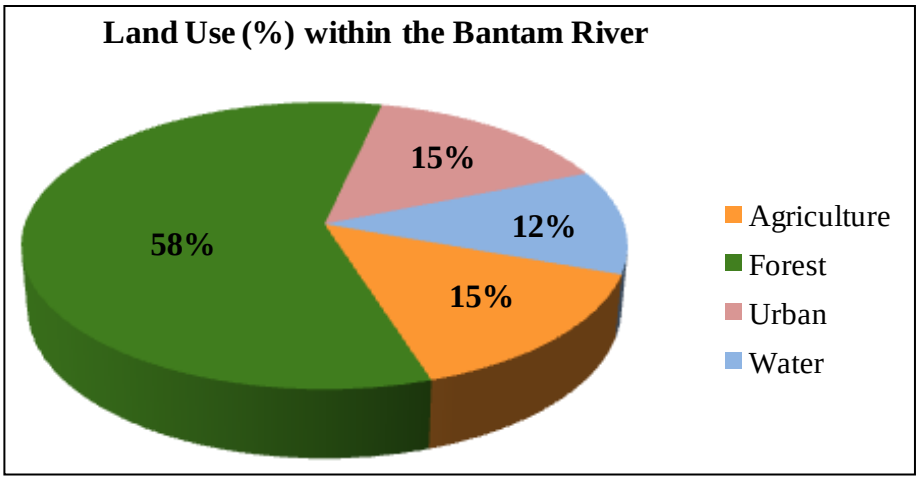
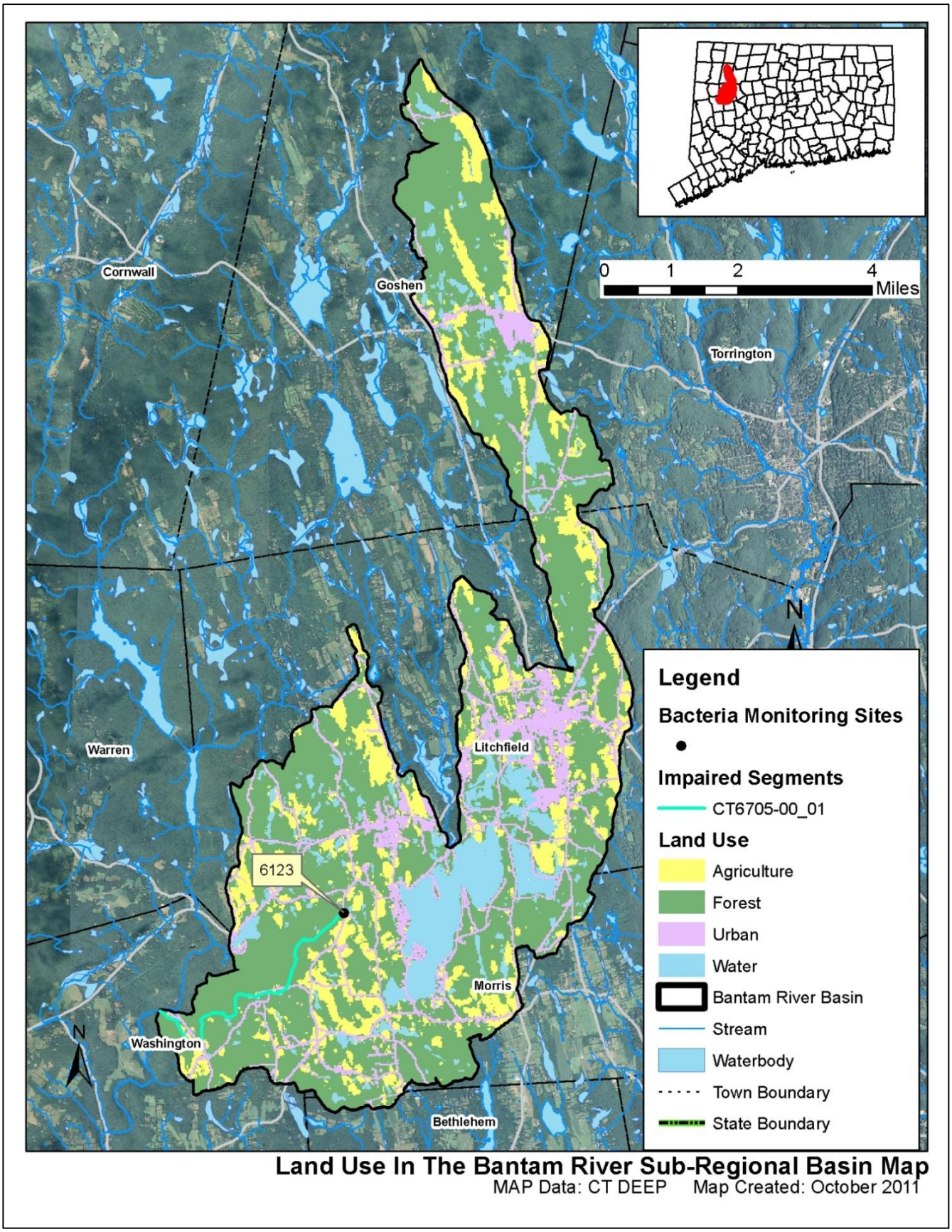


Figure 4: GIS map featuring land use for the Bantam River watershed at the sub-regional level



WHY IS A TMDL NEEDED?

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

Table 2: Sampling station location description for the impaired segment in the Bantam River watershed (stations organized downstream to upstream)

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT6705-00_01	Bantam River	6123	most upstream West Morris Road Crossing top end of fly fishing only sections	Morris	41.704670	-73.250180

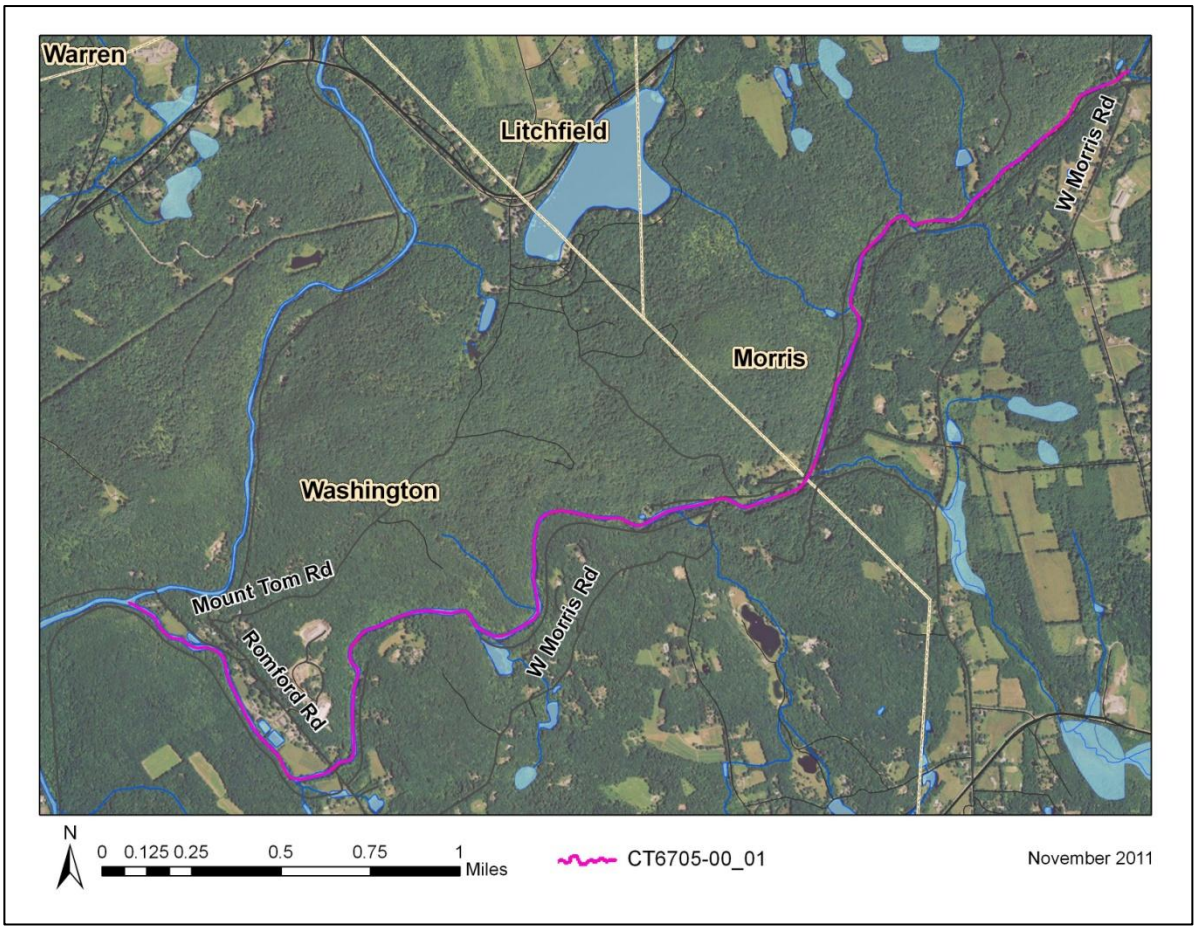
The Bantam River's impaired segment (CT6705-00_01) is a Class AA freshwater river (Figure 5). Its applicable designated uses include existing or proposed drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from one sampling location, Station 6123, in 2010 (Table 2).

The water quality criteria for *E. coli*, along with bacteria sampling results in 2010, are presented in Table 9. The annual geometric mean was calculated for Station 6123 and exceeded the WQS for *E. coli* in 2010. Single sample values at this station exceeded the WQS for *E. coli* once in 2010.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for Station 6123 for wet-weather and dry-weather sampling days, where appropriate (Table 9). The geometric mean during wet-weather at Station 6123 exceeded the WQS for *E. coli* during wet-weather and was four times greater than dry-weather values.

Due to the elevated bacteria measurements presented in Table 9, this segment of the Bantam River did not meet CT's bacteria WQS, was identified as impaired, and was placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

Figure 5: Aerial map of the impaired segment of the Bantam River



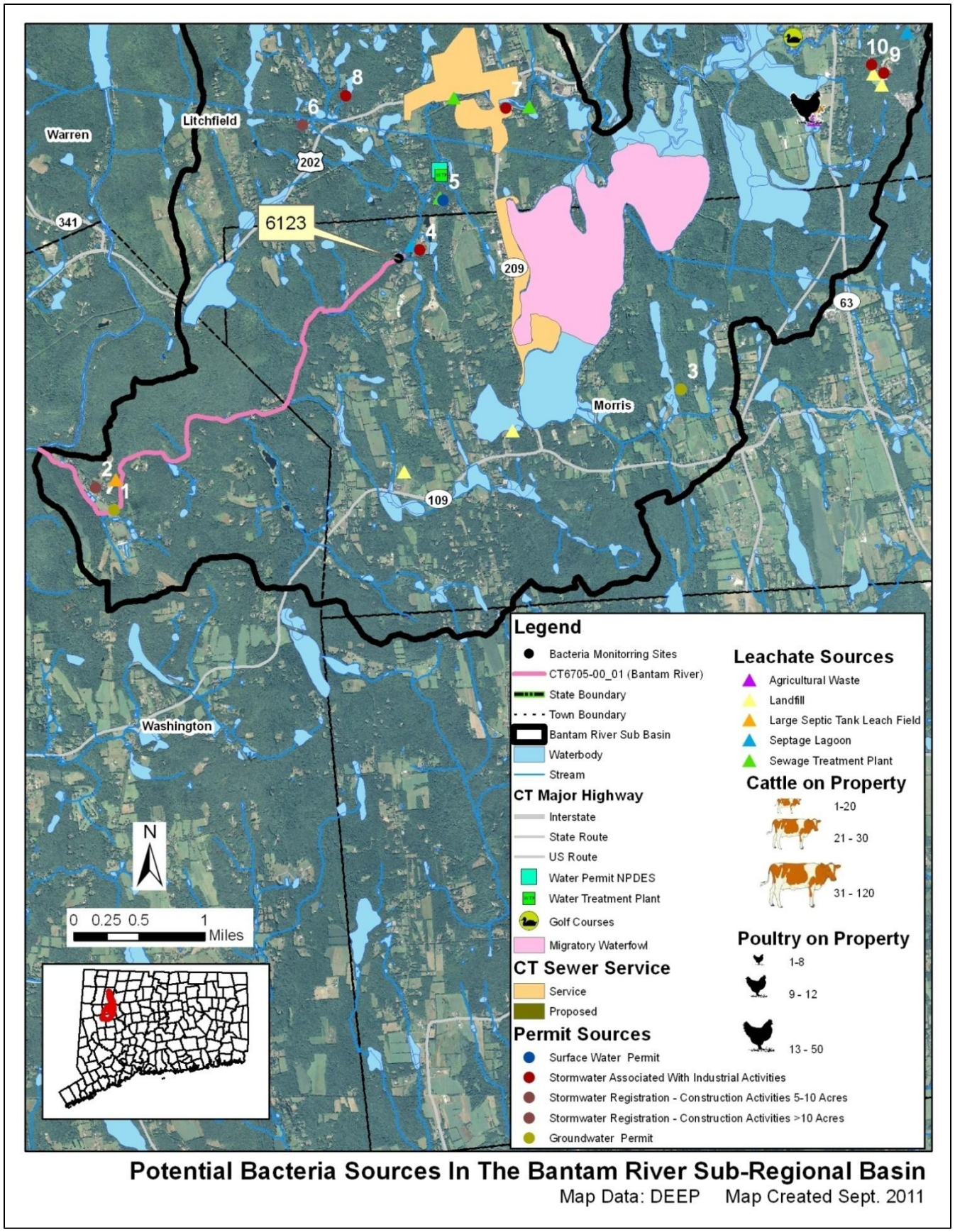
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study 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 suggest 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. 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 Bantam River watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/Pets	Other
Bantam River CT6705-00_01	x	x		x	x	x	x	

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



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

Point Sources

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

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	8
GSM	Part B Municipal Stormwater MS4	0
GSN	Stormwater Registration – Construction	2
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	2

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Bantam River watershed. When available, bacteria data from the one of the industrial permitted facilities in the watershed are shown in Table 6. Though this data cannot be compared to a water quality standard as there is no recreation standard for fecal coliform bacteria, multiple samples were very high from the Town of Morris (GSI001287) with exceedances of 30,000 and 2,000,000 colonies/100 mL. Samples taken the following year did not confirm lower bacteria levels since results were above the maximum enumeration level of 2,000 colonies/100 mL for those samples.

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 Bantam River watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Bantam	Firstlight Hydro Generating Company, Ne Hydro Generating Co	GSI001938	Stormwater Associated With Industrial Activities	Bantam Hydroelectric Station	8
Bantam	Bantam Supply Co. Inc.	GSI002266	Stormwater Associated With Industrial Activities	Bantam Bulk Plant	7
Bantam	Town Of Litchfield	CT0100803	Surface Water Permit	Litchfield WPCF	5
Goshen	Town Of Goshen	GSI001276	Stormwater Associated With Industrial Activities	Goshen Public Works Department	13
Litchfield	State Of Connecticut Department Of Transportation	GSI000034	Stormwater Associated With Industrial Activities	Litchfield Maintenance Facility	11
Litchfield	Ding'S Auto Sales & Salvage, Inc.	GSI000776	Stormwater Associated With Industrial Activities	Dings Auto Sales & Salvage, Inc.	9
Litchfield	Town Of Litchfield	GSI000811	Stormwater Associated With Industrial Activities	Litchfield Recycling Facility	10
Litchfield	Town Of Litchfield	GSI000875	Stormwater Associated With Industrial Activities	Litchfield Highway Garage	12
Litchfield	C. A. Litchfield Land, Llc	GSN002147	Stormwater Registration - Construction Activities >10 Acres	Shepaug Crossing	6
Morris	Episcopal Diocese Of Connecticut	UI0000213	Groundwater Permit	Camp Washington	3
Morris	Towne & Aurell	GSI002289	Stormwater Associated With Industrial Activities	West Morris Road Quarry	4
Washington Depot	Rumsey Hall School	UI0000359	Groundwater Permit	Rumsey Hall School	1
Washington Depot	Rumsey Hall School	GSN001781	Stormwater Registration - Construction Activities 5-10 Acres	Rumsey Hall Street	2

Table 6: Industrial permits in the Bantam River watershed and available fecal coliform data (colonies/100mL). The result 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
Morris	Town of Morris	GSI1287	Bantam River	Outfall #1	09/25/01	30,000
Morris	Town of Morris	GSI1287	Bantam River	Outfall #2	09/25/01	2,000,000
Morris	Town of Morris	GSI1287	Bantam River, Basin #6705	Outfall #1	08/29/02	>2,000
Morris	Town of Morris	GSI1287	Bantam River, Basin #6705	Outfall #2	08/29/02	>2,000

Municipal Stormwater Permitted Sources

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

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

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

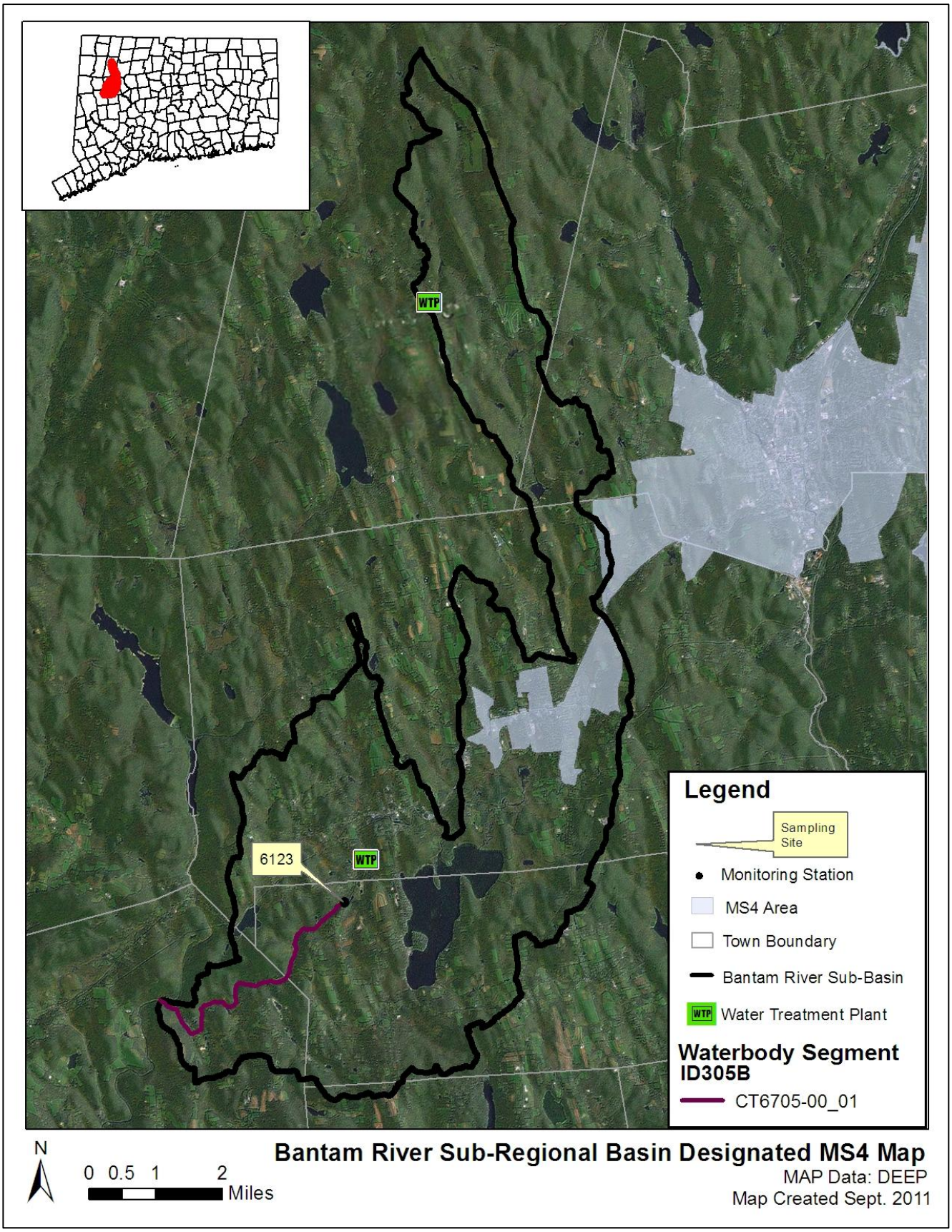
While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some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

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

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

The impaired segment of the Bantam River is located in the Towns of Morris and Washington. As there are no urbanized locations, as defined by the U.S. Census Bureau, around the impaired segment, the towns are not MS4 areas and are not required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the CT DEEP (Figure 7). In addition, the portion of the watershed upstream of the impaired segment is located in Litchfield, which has a waiver from the MS4 program as cited above. Information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Figure 7: MS4 areas of the Bantam River watershed



Publicly Owned Treatment Works

As shown in Figures 6 and 7, there is one publicly owned treatment works (POTWs), or wastewater treatment plants, in the Bantam River watershed affecting the impaired segment. The Litchfield Water Treatment Plant is located in the southern portion of the watershed and discharges to the Bantam River upstream of the impaired segment near the Morris-Litchfield town line. Bacteria data from the discharge of the Litchfield Water Treatment Plant are included in Table 7. The plant did not exceed its permit limits on any date sampled.

Table 7: Wastewater treatment plant Fecal Coliform (colonies/100 mL) data discharging to the Bantam River

Town	Permitee	Permit Number	Receiving Water	Date	30-Day Geometric Mean	7-Day Geometric Mean
Litchfield	Litchfield WPCF	CT0100803	Bantam River	05/31/2009	6	19
Litchfield	Litchfield WPCF	CT0100803	Bantam River	06/30/2009	8	14
Litchfield	Litchfield WPCF	CT0100803	Bantam River	07/31/2009	8	17
Litchfield	Litchfield WPCF	CT0100803	Bantam River	08/31/2009	2	3
Litchfield	Litchfield WPCF	CT0100803	Bantam River	09/30/2009	3	16
Litchfield	Litchfield WPCF	CT0100803	Bantam River	05/31/2010	9	33
Litchfield	Litchfield WPCF	CT0100803	Bantam River	06/30/2010	10	28
Litchfield	Litchfield WPCF	CT0100803	Bantam River	07/31/2010	2	3
Litchfield	Litchfield WPCF	CT0100803	Bantam River	08/31/2010	3	16
Litchfield	Litchfield WPCF	CT0100803	Bantam River	09/30/2010	5	19
Litchfield	Litchfield WPCF	CT0100803	Bantam River	05/31/2011	3	4
Litchfield	Litchfield WPCF	CT0100803	Bantam River	06/30/2011	6	18
Litchfield	Litchfield WPCF	CT0100803	Bantam River	07/31/2011	22	50
Litchfield	Litchfield WPCF	CT0100803	Bantam River	08/31/2011	13	15
30-Day Geometric Mean Permit Limit = 200 colonies/100 mL **7-Day Geometric Mean Permit Limit = 400 colonies/100 mL**						

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 Bantam River watershed are described below.

Insufficient Septic Systems and Illicit Discharges

As shown in Figure 6, portions of the watershed are serviced by sanitary sewers. Households and businesses in the non-serviced portions of the watershed must rely on onsite wastewater treatment systems, such as septic systems. A large septic tank leach field located near the downstream terminus of

the impaired segment along Romford Road in Washington was also identified in Figure 6. Given the number of septic systems in the area, there may be failed septic systems in the watershed that are currently undetected. Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Towns of Morris and Washington do not have their own health department. These municipalities are part of the Torrington Area Health District (http://www.tahd.org /).

As shown in Figure 6, there are several areas in the watershed that are serviced by a sanitary sewer upstream of the impaired segment. Sewer system leaks or other possible illicit discharges that are located within the Bantam River watershed near the river may be contributing bacteria to the waterbody.

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 15% of the Bantam River watershed. There are many areas where agricultural lands are close to the Bantam River, particularly along West Morris Road, Burgess Road, and Stoddard Road in Morris, and along Romford Road in Washington. As shown in Figure 6, there are several large poultry and cattle farms along a tributary to the impaired segment of the Bantam River in Litchfield. Agricultural areas near the impaired segment and its tributaries are potentially carrying pollutants, including bacteria, into the Bantam River.

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Bantam River watershed represent another potential source of bacteria. 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, golf courses, agricultural crop fields, and ponds. There are multiple recreational fields adjacent to the impaired segment along Romford Road in Washington. The Rumsey Boarding School athletic fields are located along the Bantam River in this area. The Bantam River watershed is comprised of 12% surface water. The small lakes and ponds in the watershed provide areas for geese and other waterfowl to congregate. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and in the ponds 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.

Also, urban development surrounds portions of the impaired segment of the Bantam River (Figure 4). When not properly disposed, waste from domestic animals, such as dogs, can enter surface waters directly or through stormwater infrastructure. Therefore, domestic animal waste may also be contributing to bacteria concentrations in the Bantam River.

Stormwater Runoff from Developed Areas

While the majority of the Bantam River watershed is forested and undeveloped, there are several developed areas in proximity to the impaired segment. Approximately 15% of the land use in the

watershed is considered urban (Figures 4 and 9). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000).

A large portion (96%) of the Bantam River watershed is characterized by 0-6% impervious cover, and 4% is characterized by 7-11% impervious cover (Figure 8). Although the amount of impervious cover in the watershed seems low, there are multiple road crossings along the impaired segment of the Bantam River that can carry large volumes of stormwater into the river during storm events. The proximity of impervious surfaces to the Bantam River indicate that stormwater runoff from developed areas are a potential source of bacterial contamination.

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

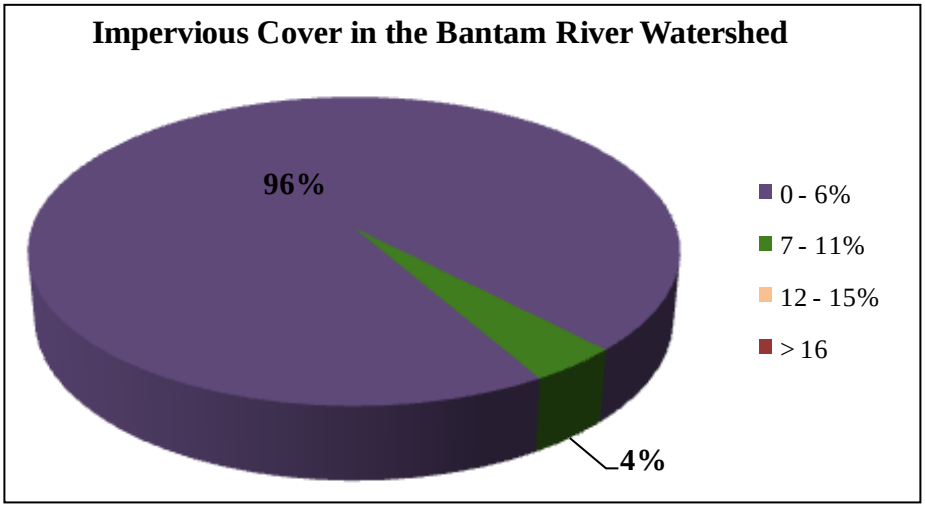
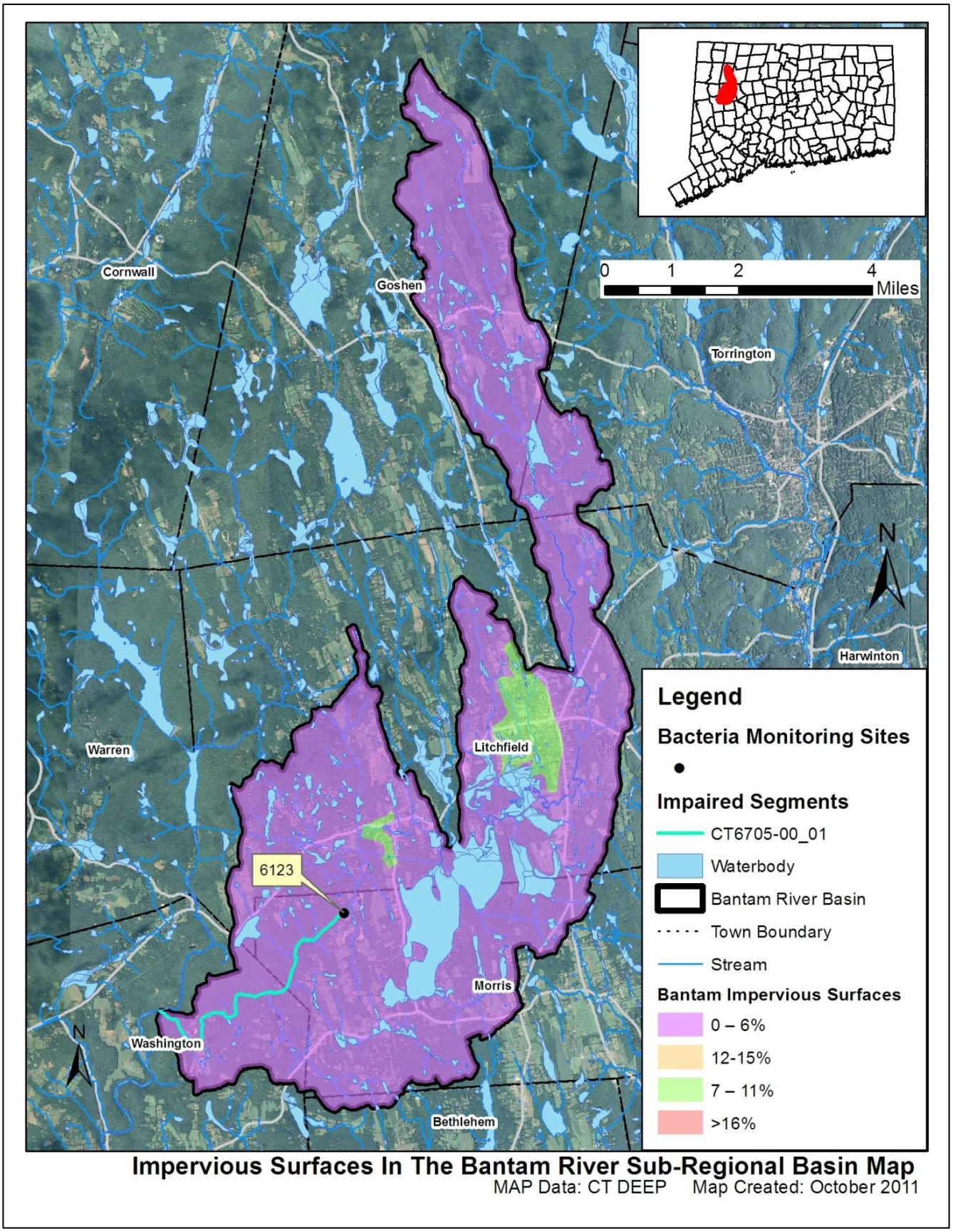


Figure 9: Impervious cover (%) for the Bantam River sub-regional watershed



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 Bantam River. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

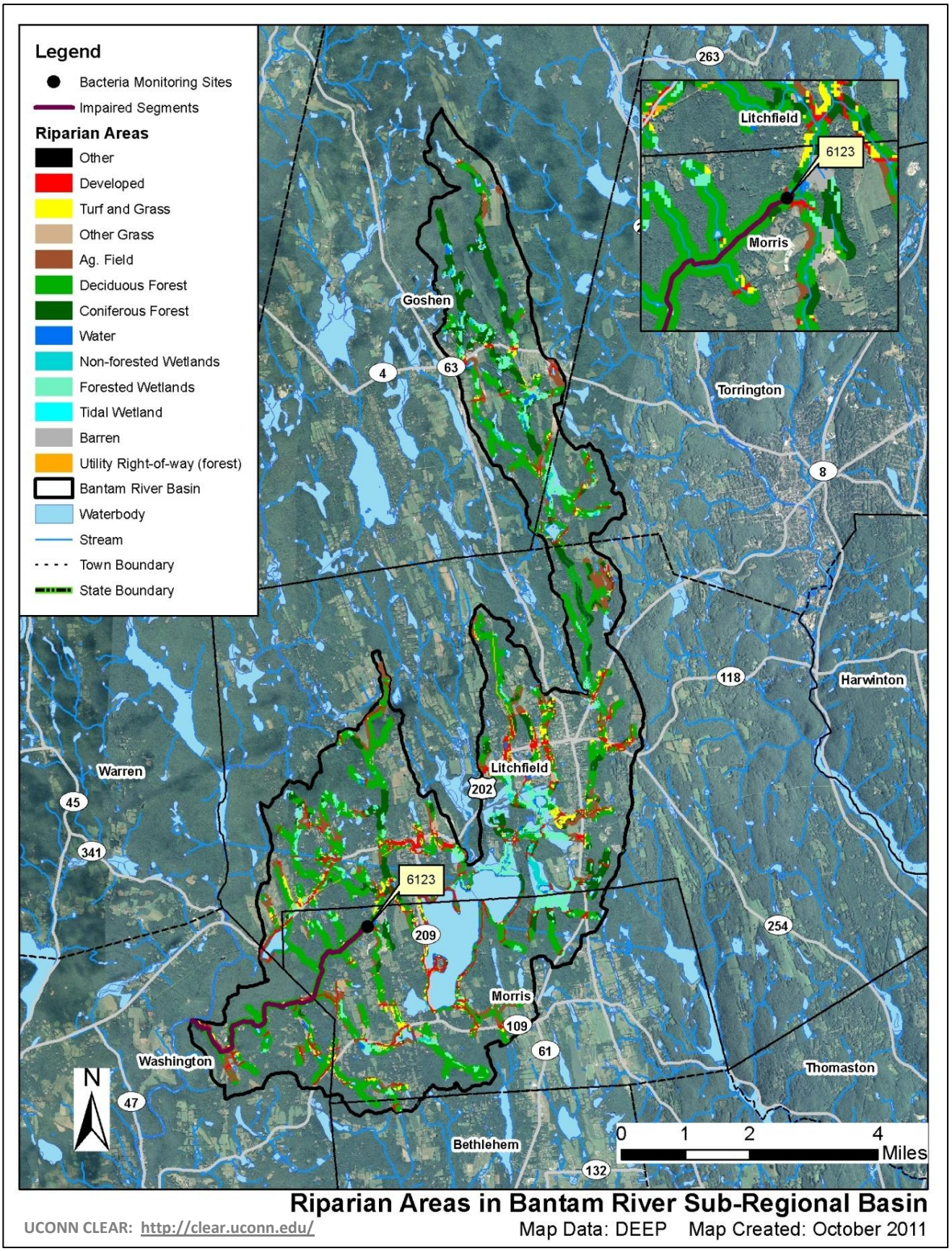
Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their 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 majority of the riparian zone for the impaired segment of the Bantam River is characterized by forested land use. There are also areas with development, turf grass, and agricultural land uses within the riparian zone of the Bantam River's impaired segment, especially near its confluence with the Shepaug River in Washington (Figure 10). As previously mentioned, developed and agricultural areas are potential sources of bacterial contamination.

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



RECOMMENDED NEXT STEPS

Future mitigative activities are necessary to ensure the long-term protection of the impaired segment of the Bantam River and have been prioritized below.

1) Develop a system to monitor septic systems.

Most of the residents in the watershed surrounding the impaired segment rely on septic systems (Figure 6). If not already in place, Morris and Washington should establish programs to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could also be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems.

2) Ensure there are sufficient buffers on agricultural lands along Bantam River.

If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place. Particular attention should be paid to those agricultural operations located along the impaired segment and its tributaries.

3) Continue monitoring permitted sources.

Previous sampling of discharge from permitted sources within the watershed has shown elevated levels of fecal coliform bacteria, an indicator of bacterial pollution (Table 6). Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

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

Table 8 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 Bantam River watershed.

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

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

Table 8. TMDLs, WLAs, and LAs for Recreation Use

		Instantaneous *E. coli* (#/100mL)						Geometric Mean *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA[6]**			**LA[6]**			**WLA[6]**	**LA[6]**
	Recreational Use	[1]	[2]	[3]	[1]	[2]	[3]	**All**	**All**
AA	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235[7]	410[7]	576[7]				126[7]	
	Stormwater (non-MS4)				235[7]	410[7]	576[7]		126[7]
	Wildlife direct discharge				235[7]	410[7]	576[7]		126[7]
	Human or domestic animal direct discharge[5]				235	410	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.

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

Morris and Washington can take measures to minimize waterfowl-related impacts such as encouraging residents and businesses to allow tall, coarse vegetation to grow in the riparian areas of the impaired segment of the Bantam River that are frequented by waterfowl, particularly within parks, golf courses and recreational fields. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shoreline will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans, may contribute to water quality impairments in the Bantam River watershed and can harm human health and the environment.

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

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

A portion of the Bantam River watershed, upstream of the impaired segment, relies on a municipal sewer system (Figure 6). Ensuring there are no leaks or overflows from the sanitary sewer in this area should be made a priority. It is important for Litchfield to develop a program to evaluate its sanitary sewer and reduce leaks and overflows, especially in the areas near the Bantam River. This program should include periodic inspections of the sewer line.

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

Since 15% of the watershed is considered urban and developed areas are located near the impaired segment, stormwater runoff is likely contributing bacteria to the waterbody. To identify specific areas that are contributing bacteria to the impaired segment, the towns should conduct wet-weather sampling at stormwater outfalls that discharge directly to the Bantam River. To treat stormwater runoff, the town should also identify areas along the more developed sections of the Bantam River, particularly along the impaired segment, to install BMPs that encourage stormwater to infiltrate into the ground before entering the Bantam River. These BMPs would disconnect impervious areas and reduce pollutant loads to the river. More detailed information and BMP recommendations can be found in the core TMDL document.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 9: Bantam River Bacteria Data

Waterbody ID: CT6705-00_01

Characteristics: Freshwater, Class AA, Existing or Proposed Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **4%**

Single Sample: **95%**

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

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

Station Name	Station Location	Date	Results	Wet/ Dry	Geomean
6123	Upstream of West Morris Road crossing	5/18/2010	10	dry	
6123	Upstream of West Morris Road crossing	6/2/2010	81†	wet	
6123	Upstream of West Morris Road crossing	6/15/2010	31	dry	
6123	Upstream of West Morris Road crossing	6/24/2010	63	wet	
6123	Upstream of West Morris Road crossing	7/6/2010	63	dry	
6123	Upstream of West Morris Road crossing	7/12/2010	160	wet	**131* (4%)**
6123	Upstream of West Morris Road crossing	7/22/2010	170	wet	
6123	Upstream of West Morris Road crossing	7/29/2010	200	wet	
6123	Upstream of West Morris Road crossing	8/5/2010	**8200* (95%)**	wet	
6123	Upstream of West Morris Road crossing	8/12/2010	120†	dry	
6123	Upstream of West Morris Road crossing	9/2/2010	365†	dry	

Shaded cells indicate an exceedance of water quality criteria

†**Average of two duplicate samples**

***Indicates single sample and geometric mean values used to calculate the percent reduction**

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

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
6123	Upstream of West Morris Road crossing	2010	6	5	131	247	61

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gage at the Norfolk 2 SW in Norfolk, 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