Trout Brook (CT4403) Summary

Trout Brook (CT4403-00_01), Trout Brook (CT4403-00_02), and Trout Brook (CT4403-00_03)

WATERSHED DESCRIPTION

The Trout Brook sub-regional basin is located in the central portion of Connecticut (Figure 1). There are multiple towns located in the watershed, including the municipalities of Avon, Farmington, Newington, and West Hartford, CT (Figure 2).

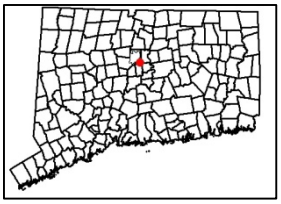


Figure 1: Watershed location in Connecticut

The Trout Brook sub-regional basin includes three segments impaired for aquatic life use. These segments were assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2012 303(d) list of impaired waterbodies. Some segments in the watershed were currently unassessed as of the writing of this document. This does not signify that no concerns exist in those segments, rather it is an indication that there are not current data to evaluate the segments as part of an assessment process. An excerpt of the 2012 Integrated Water Quality Report is included in Table 1.

Trout Brook begins at the outlet of the Woodbridge Lake Wood Pond Dam in West Hartford, CT. From upstream to downstream, the first impaired segment of the brook, Trout Brook (Segment 3) (CT4403-00_03), consists of 5.95 miles of the brook and begins at the outlet of the dam. This segment continues northerly past the Buena Vista Recreational Complex through residential neighborhoods and continues through Mooney's Woods. The brook then continues to flow in a northeasterly and easterly direction through residential neighborhoods along Cliffmore Road and Monclair Drive before it turns to flow south parallel to Trout Brook Drive and residential neighborhoods. Trout Brook then flows underground from just upstream of Farmington Avenue to Memorial Road as it continues to parallel Trout Brook Drive. This segment flows adjacent to Trout Brook Trail and Norfeldt Little League Field and ends at the crossing of Park Road (Figure 2).

Impaired Segment Facts

Impaired Segments:
1. Trout Brook (CT4403-00_01)
2. Trout Brook (CT4403-00_02)
3. Trout Brook (CT4403-00_03)

Municipalities: Avon, Farmington, Newington, and West Hartford

Impaired Segment Lengths (miles):
1. Trout Brook (4403-00_01): 1.07
2. Trout Brook (4403-00_02): 0.88
3. Trout Brook (4403-00_03): 5.95

Watershed Areas (square miles):
1. Trout Brook (4403-00_01): 17.76
2. Trout Brook (4403-00_02): 16.91
3. Trout Brook (4403-00_03): 14.39

Watershed Impervious Cover:
1. Trout Brook (4403-00_01): 23%
2. Trout Brook (4403-00_02): 22%
3. Trout Brook (4403-00_03): 19%

Water Quality Classifications: Class A

Designated Use Impairments: Habitat for Fish, Other Aquatic Life, and Wildlife

Sub-regional Basin Name and Code: Trout Brook, 4403

Regional Basin: Connecticut

Major Basin: Park

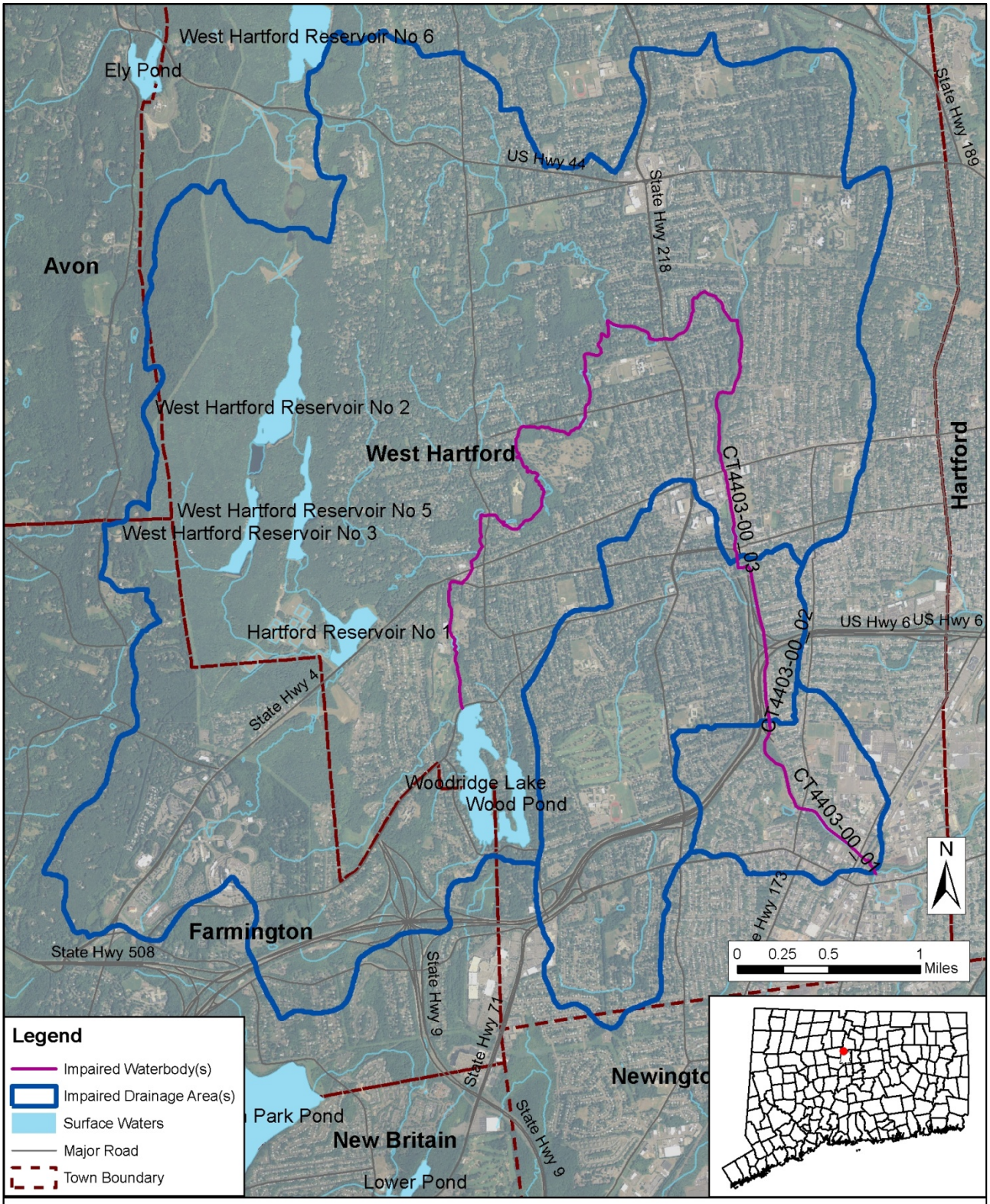
Table 1: Impaired segments in the Trout Brook Sub-Regional Basin from the Connecticut 2012 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation
CT4403-00_01	Trout Brook-01	From mouth at confluence with Piper Brook, above South Branch Park River (just DS of railroad crossing, near New Britain Avenue), West Hartford, US under Route 84 exit 42 (Trout Brook Drive) ramp.	1.07	NOT	NOT
CT4403-00_02	Trout Brook-02	From US side of Route 84 Exit 42 (Trout Brook) ramp, West Hartford, US to Park Road crossing (Entire segment flows through concrete channel).	0.88	NOT	NOT
CT4403-00_03	Trout Brook-03	From Park Road crossing (just DS of Boulevard road crossing), US to Woodbridge Lake outlet dam, West Hartford.	5.95	NOT	NOT
NOT = Designated Use Not Supported					

The second impaired waterbody, Trout Brook (Segment 2) (CT4403-00_02) consists of 0.88 miles and begins at the Park Road crossing where the entire segment flows through a concrete channel and ends on the upstream side of I-84 Exit 42 ramp (Figure 2).

The third impaired waterbody, Trout Brook (Segment 1) (CT4403-00_01), begins under I-84 at the Exit 42 (Trout Brook Drive) ramp and consists of 1.07 miles of the brook. The segment flows south, between neighborhoods and Trout Brook Drive. It continues past recreational fields in Beechland Park and begins to flow southeast as it passes underneath Quaker Lane. The brook then flows east between commercial areas on New Britain Avenue and West Hartford's Department of Public Works until it ends at the confluence with Piper Brook (Figure 2).

Figure 2: The Trout Brook Sub-Regional Basin (the location and name of each impaired segment and its watershed boundary is indicated)



Waterbody(s) within Trout Brook Subregional Basin with Impairment to Habitat for Fish, Other Aquatic Life and Wildlife

Created: CT DEEP, July 2012

For surface water quality class A, the criteria to meet aquatic life use support includes the following:

> Biological Condition: Sustainable, diverse biological communities of indigenous taxa shall be present. Moderate changes, from natural conditions, in the structure of the biological communities, and minimal changes in ecosystem function may be evident; however, water quality shall be sufficient to sustain a biological condition within the range of Connecticut Biological Condition Gradient Tiers 1-4 as assessed along a 6 tier stressor gradient of Biological Condition Gradient (See Appendix G of the Water Quality Standards).

Data used to assess these waters are summarized in Table 2.

Table 2: Data used to assess Trout Brook (CT4403-00_01), Trout Brook (CT4403-00_02), and Trout Brook (CT4403-01_03). An "x" indicates that data has been used in the assessment process.

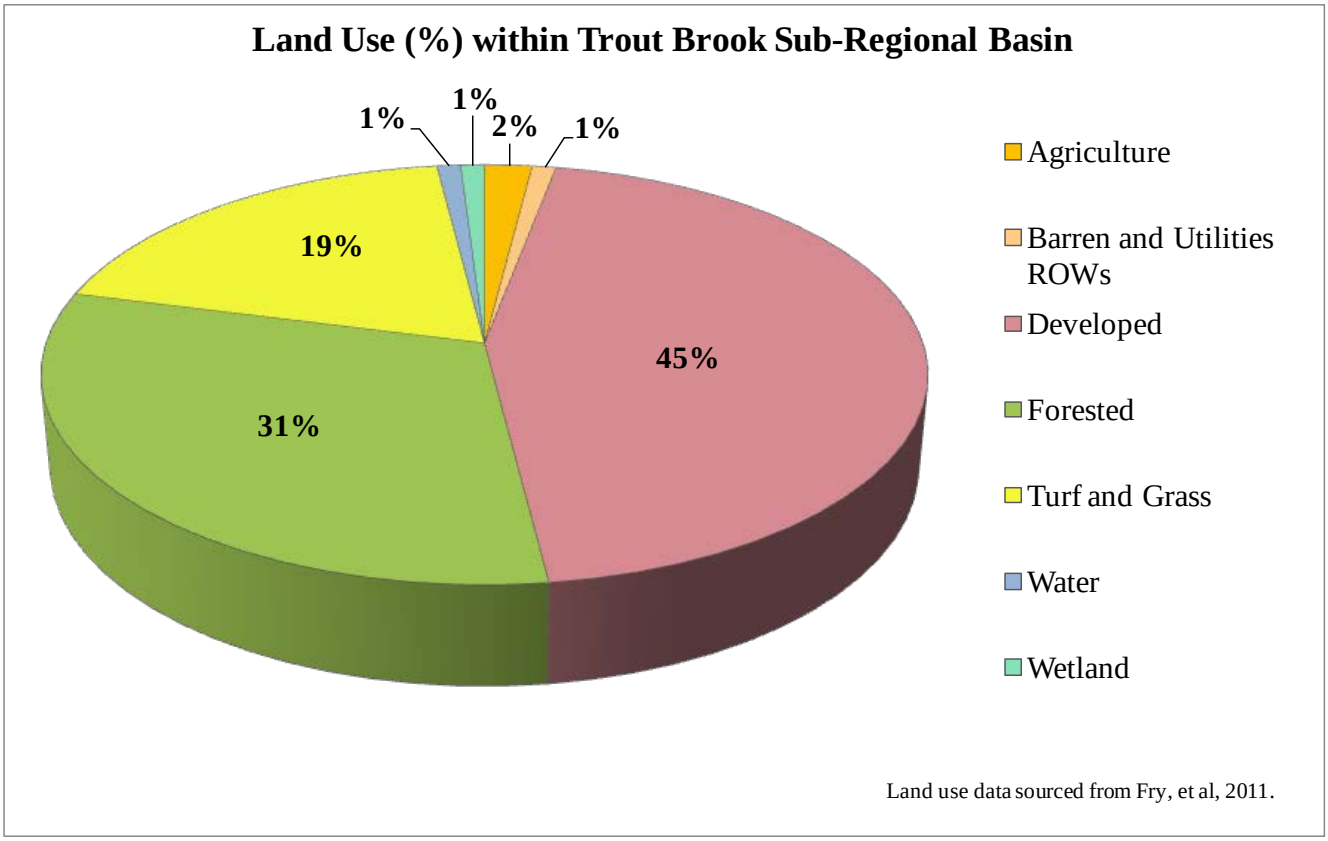
Segment ID	Waterbody Name	Macroinvertebrate Community	Fish Community	Volunteer RBV Data	Macroinvertebrate Model	Water Chemistry	Whole Effluent Toxicity	External Data	Listing Cycle
CT4403-00_01	Trout Brook-01	x	x	x		x	x	x	2000
CT4403-00_02	Trout Brook-02	x	x	x		x	x	x	2000
CT4403-01_01	Trout Brook-03	x	x	x		x	x	x	2000

Land Use in the Watershed

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

As shown in Figure 3, the Trout Brook sub-regional basin consists of 45% developed areas, 31% forests, and 19% turf and grass. Other land uses include agriculture, water, wetlands, and barren land/utility right-of-ways.

Figure 3: Land uses within the Trout Brook Sub-Regional Basin



Impervious Cover (IC)

Another way to measure land use impacts to aquatic life in streams is to evaluate the amount of impervious cover (i.e. roads, roofs, driveways, parking lots). Increasing the percentage of IC in a watershed is linked to decreasing stream health (CWP 2003, Bellucci 2007). Stormwater runoff from impervious surfaces contains pollutants such as oils, heavy metals, nutrients, bacteria sediment (USEPA 1983) and can cause temperature impacts to receiving waterbodies. The amount of stormwater pollutants transported during a rainstorm is directly related to the amount of impervious cover in the watershed.

The extent of land area associated with IC cover can be calculated by analyzing the types of land cover (developled, forested, agriculture, etc.) present in the landscape. The total percentage of impervious cover (%IC) can be compared to levels that are linked to impaired streams receiving excessive stormwater runoff. The %IC is used in the *Connecticut Watershed Response Plan for Impervious Cover* (Plan) as a surrogate to represent the impacts associated with stormwater runoff pollution. Figure 4 shows the %IC for the Trout Brook sub-regional basin. The watersheds for the impaired segments in the Trout Brook sub-regional basin have impervious surface areas of 23% (Trout Brook (Segment 1)), 22% (Trout Brook (Segment 2)), and 19% (Trout Brook (Segment 3)).

CT DEEP has determined that to limit effect of stormwater pollution an IC area of less than 12% is needed to support habitat for fish, other aquatic life and wildlife use in these waterbodies. However,

stormwater pollution is categorized under two types of pollutant loads: point and non-point sources. Point sources are permitted a waste load allocation (WLA) and regulated under the National Pollutant Discharge Elimination System (NPDES), but a load allocation (LA) is also contributed by non-point sources where no regulations are applicable. It is not feasible to draw a clear distinction between stormwater pollution originating from point and non-point sources because insufficient data are available for each parcel in the watershed and the fact that stormwater pollution is highly variable in frequency and duration. Consequently, a Margin of Safety (MOS) is incorporated into the %IC target in order to account for uncertainties regarding the relationship between water quality and sources (point and non-point). Therefore, a MOS of 1% IC was subtracted from the %IC target to account for uncertainty in the analysis, resulting in a combined target of 11% for Waste Load Allocation (WLA) and Load Allocation (LA). The reduction in impervious cover necessary to reach the target for each impaired waterbody in the Trout Brook sub-regional basin is shown in Table 3. The Plan target of 11% IC is intended to guide the application of Best Management Practices (BMP) and Low Impact Development (LID) techniques to reduce the *impact* of impervious surfaces.

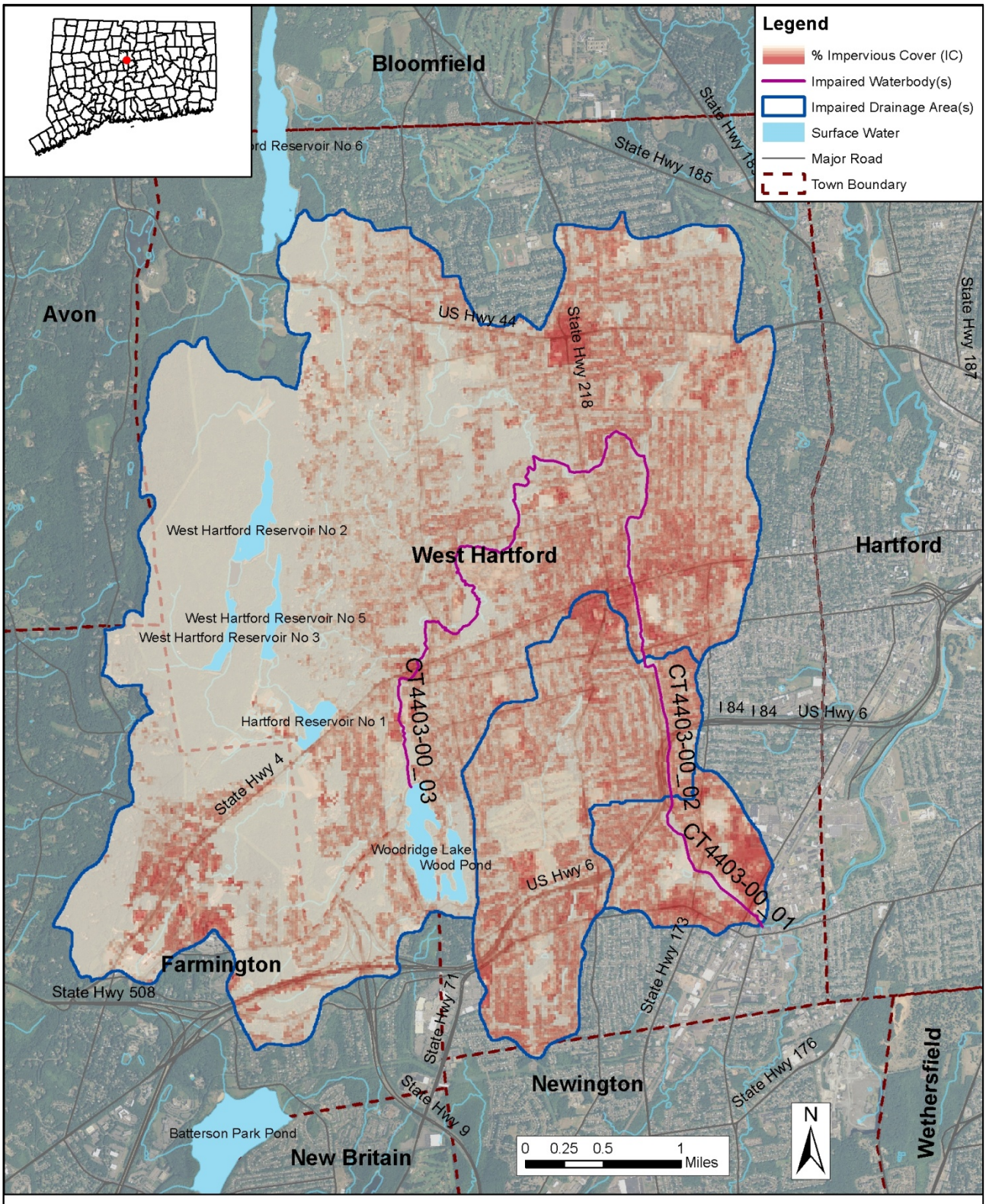
Table 3: Current impervious cover and the percent reduction necessary to achieve the Plan target for each impaired segment in the Trout Brook Sub-Regional Basin

Impaired Segment	Current Watershed Impervious Cover	%IC Target [1]	Margin of Safety (MOS)	Percent IC Reduction to Meet Plan Target
Trout Brook - 01 (CT4403-00_01)	23%	11%	1%	52%
Trout Brook -02 (CT4403-00_02)	22%	11%	1%	50%
Trout Brook -03 (CT4403-00_03)	19%	11%	1%	42%

Implementation of this Plan is directed at improving the condition of the aquatic life use support in these waterbodies. The impairments will be resolved once the instream monitoring and assessment as conducted by CT DEEP indicates an attainment of WQS. It is important to note that the aquatic life use impairment may not be due solely to the presence of IC, but that reducing the effect of IC within the basin is expected to improve water quality and support attainment of aquatic life use goals. Additionally, the IC reduction targets are guidance values to help address the component of the impairment which the current information suggests is attributable to IC due to stormwater pollutants. The reduction targets are not recommended as regulatory limits for incorporation into permits. Best Management Practices to reduce the effect of IC through stormwater management are discussed below as appropriate implementation practices for permitted and non-permitted stormwater discharges.

[1] These are target goals, not end-of pipe effluent limits, unless otherwise indicated in a permit issued pursuant to the National Pollutant Discharge Elimination System (NPDES) program.

Figure 4: Impervious cover (%) for the Trout Brook Sub-Regional Basin



Percent Impervious Cover (IC) within Trout Brook Subregional Basin with Impairment to Habitat for Fish, Other Aquatic Life and Wildlife

Created: CT DEEP, July 2012

CURRENT MANAGEMENT ACTIVITIES

Permitted Stormwater Sources

The control of stormwater pollution from regulated sources is noteworthy for addressing the effect of IC. Regulated stormwater discharges consist of those authorized under the General Permit for the Discharge of Stormwater from Municipal Separate Storm Sewer Systems (MS4 GP), General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities (Construction GP), General Permit for the Discharge of Stormwater Associated with Industrial Activity (Industrial GP), and General Permit for the Discharge of Stormwater from Commercial Activities (Commercial GP). Each of these general permits requires the implementation of control measures and some type of a stormwater management plan (for more information go to www.ct.gov/deep/stormwater).

Permitted sources existing within the watershed that could potentially contribute to impairments in the Trout Brook sub-regional basin are identified in Tables 4 and Figure 5. 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 basin.

Table 4: General categories of stormwater permitted discharges

Permit Code	Permit Description Type	Number in watershed
GSC	Stormwater Discharge Associated with Commercial Activity (Commercial GP)	3
GSI	Stormwater Associated with Industrial Activity (Industrial GP)	6
GSM	Part B Municipal Stormwater MS4 (MS4 GP)	4
GSN	Stormwater Registration – Construction (Construction GP)	0

Municipalities have been working hard to meet the challenges of stormwater management. The Towns of West Hartford, Newington, Avon, and Farmington, CT have developed and implemented programs to protect water quality. As indicated previously, all of New London and Waterford are regulated under the MS4 program. The MS4 GP requires municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants from storm sewer discharges to improve water quality. The SMP 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 new development and redevelopment
6. Pollution prevention/good housekeeping for municipal operations

Subsequent to the initial preparation and implementation of the SMP, each municipality is also required to submit an annual update outlining the steps they are taking to meet the six minimum measures. Relevant stormwater management measures are summarized below.

Town of West Hartford (Permit GSM000001) (from the 2007 Stormwater Management Plan Annual Report)

- Provided online links to CT DEEP's MS4 outreach materials.
- Delivered public awareness bulletins of new large construction projects.
- Held public meetings for new development projects, which included storm water reviews.
- Conducted stormwater outfall sampling at six locations.
- Conducted strict review of new Blue Back Square (West Hartford Center) and housing condo construction projects.
- Conducted annual water samplings at the Public Works Department site.
- Labeled catch basins that drain to watercourses.
- Cleaned 2,833 catch basins.
- Swept all town roads.

Town of Avon (Permit GSM000044) (from the 2010 Stormwater Management Plan Annual Report)

- Town received a $50,000 grant from DEP to look into Low-Impact Initiatives to minimize the effects of stormwater.
- Town received a $3,000 grant from DEP to purchase and distribute 34 rain barrels to residents.
- Continued to inspect stormwater outfalls/ structures during GIS mapping of Town's infrastructure.
- Mapped point features, including catch basins and outfalls.
- Collected drainage info on Town's drainage system, including structure type, flow status, pipe sizes, digital photos, and system connectivity.
- Continued annual catch basin inspection and cleaning.
- Continued annual repairing and rebuilding of catch basins.
- Continued annual sweeping of all 100 miles of Town streets and parking lots.
- Developed stormwater pollution prevention training, but has not been presented to Town employees yet.
- Continued inspections of construction sites for regulatory and erosion and sedimentation control compliance.
- Continued annual sampling of stormwater from Town's 6 outfalls.

Town of Farmington (Permit GSM000090) (from the 2010 Stormwater Management Plan Annual Report)

- Eliminated the use of sand during winter snow plowing efforts, and went to a salt product.

- Continued mapping of municipal storm sewer outfalls, including all public, institutional, and private storm sewers and outfalls.
- Continued to require and enforce the submission and approval of an erosion and sediment control plan whenever more than one half acre of land will be disturbed to do construction.
- Developed a "Declaration of Covenants for Maintenance of Storm and Surface Water Facility," which requires owners to maintain the stormwater management system as approved by the Town and grants the Town the right to access the property for inspection purposes.
- Continued the practice of sweeping paved streets after snowmelt.
- Monitored six stormwater outfalls during the fall of 2010.

Town of Newington (Permit GSM000060) (from the 2010 Stormwater Management Plan Annual Report)

- Established an info line through which concerned citizens can ask questions or report illicit discharges.
- Developed Storm Water Stenciling Program.
- Established a procedure for addressing complaints on stormwater quality.
- Discussed adopting any required changes to applicable illicit discharge ordinances.
- Developed a pilot program to investigate and identify illicit connections.
- Field verified the connectivity and size of all storm drainage piping.
- Recorded drainage agreements between private entities connecting into the Town drainage system.
- Completed sampling at six outfalls per year during wet weather periods.
- Created a coverage in the GIS data base illustrating the storm sewer location in relation to the parcel line data.
- Reviewed and compiled Town Storm Sewer Easement records.
- Established standard schedules and procedures for the inspection, cleaning, and maintenance of Town-owned structural BMPs.
- Continued to clean Town-owned catch basins on a four year cycle.
- Purchased Vac truck for catch basin cleaning.
- Replaced drainage structures on an as needed basis.
- Swept all Town-owned streets once per year in the spring.
- Trained all appropriate employees in best management practices relative to storm water management and good housekeeping annually.

MS4 GP discharges

MS4 dischargers must implement the Stormwater Management Plan (SMP) required by the MS4 permit reissued on January 9, 2011, and as amended. The SMP includes best management practices (BMPs) grouped into six Minimum Control Measures, which consist of Public Education and Outreach, Public

Involvement/ Participation, Illicit Discharge Detection and Elimination, Construction Site Stormwater Runoff, Post Construction Stormwater Management in New Development and Redevelopment, and Pollution Prevention/Good Housekeeping. Compliance with the MS4 GP, as amended, including implementation of the SMP and six Minimum Control Measures.

Construction GP discharges

The Construction GP regulates the runoff from construction with 5 or more acres of soil disturbance for projects with municipal land use approvals and with 1 or more acres of soil disturbance for projects without municipal land use approvals. The Construction GP requires controls to reduce the discharge of sediment during construction and includes measures to address the long term impacts related to post-construction stormwater discharges. While the Construction GP reissued on April 9, 2010 (current permit) does not address impaired waters, the proposed modified Construction GP, expected to be reissued in 2013, specifies post-construction runoff standards. These post-construction discharges require the retention and/or infiltration of stormwater using LID and runoff reduction methods. Although the proposed post-construction performance standards are not based on the percentage of impervious cover, the runoff retention standards specified will serve to reduce and/or disconnect impervious area.

Industrial GP discharges

Industrial facilities are required to develop and implement a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include control measures (similar to BMPs) to reduce or eliminate the discharge of pollutants from the site. Typically, industrial sites are highly impervious. However site constraints, and cost considerations will complicate the reduction of impervious cover. To address the effect of IC, industrial sites where site expansion or redevelopment is planned should focus on the reduction and minimization of impervious area. The industrial facility can consider which BMPs are appropriate for the site as well as those to address specific sources.

Commercial GP discharges

The Commercial GP regulates commercial sites with impervious surfaces exceeding 5 acres, such as malls and “big box” stores. The strategy to address the control of stormwater pollutants from these sites is called a Stormwater Management Plan (SMP). While the Commercial GP reissued on May 1, 2001 (current permit) does not discuss stormwater discharges to impaired waters, future versions of the permit will include measures similar to the Industrial and MS4 GPs. The commercial site can consider which BMPs are appropriate for the site as well as those to address specific sources.

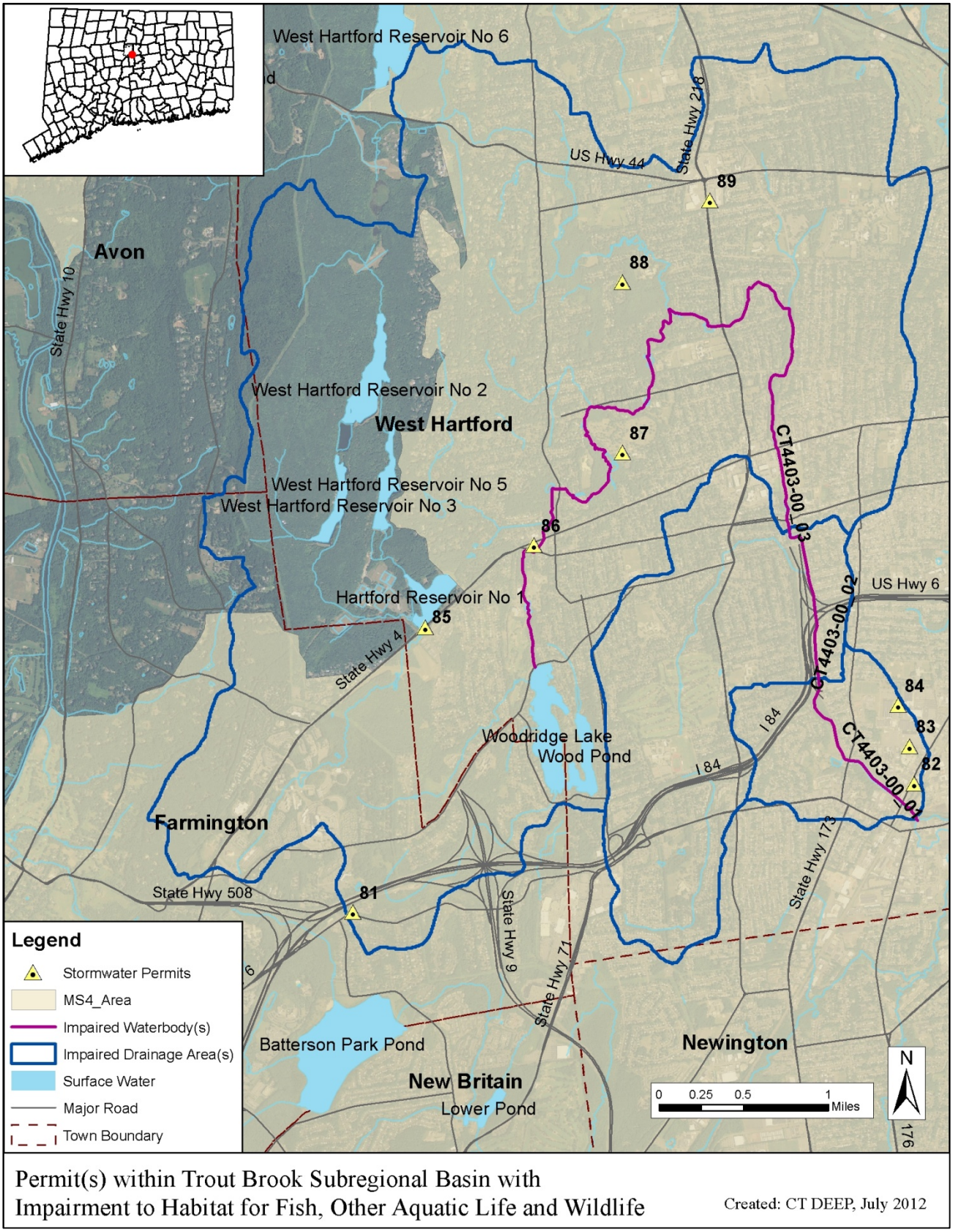
<u>Non-Regulated Discharges</u>

Many municipalities in Connecticut do not do not fall under the current MS4 permit (reissued January 9, 2011). Non-MS4 municipalities can voluntarily implement the BMPs within the MS4 permit and this document. Any facilities that discharge non-regulated stormwater can update their Pollution Prevention Plans to include BMPs that can reduce pollutants from entering surface waters. These BMPs could include revised housekeeping procedures to reduce pollutants or techniques that increase infiltration to reduce runoff. Additionally, sites or areas that are not regulated by a NPDES permit (such as small scale commercial and construction sites, residential sites, etc.) should consider implementation measures to minimize and/or disconnect impervious areas. Improving water quality within the community to address nonpoint source pollution requires actions, large and small, by the community.

Table 5: Permitted stormwater facilities within the Trout Brook Sub-Regional Basin

Municipality	Permit ID	Permittee	Permit Type	Latitude	Longitude	# in Figure 5
West Hartford	GSC000101	The Stop & Shop Supermarket Company Llc	Commercial GP	41.754	-72.767	86
West Hartford	GSC000258	Edens & Avant Realty, Inc.	Commercial GP	41.784	-72.747	89
West Hartford	GSC000296	Edens & Avant Realty, Inc.	Commercial GP	41.777	-72.757	88
Farmington	GSI000022	State Of CT Department Of Transportation	Industrial GP	41.723	-72.788	81
West Hartford	GSI000356	Har-Conn Chrome Company, Inc	Industrial GP	41.734	-72.723	82
West Hartford	GSI000391	Goodrich Engine Control Systems	Industrial GP	41.741	-72.725	84
West Hartford	GSI000978	Town Of West Hartford	Industrial GP	41.762	-72.757	87
West Hartford	GSI001227	Aiudi Connecticut, Llc	Industrial GP	41.737	-72.724	83
West Hartford	GSI001693	The Metropolitan District	Industrial GP	41.747	-72.780	85
Avon	GSM000044	Town of Avon	MS4 GP	--	--	--
Farmington	GSM000090	Town of Farmington	MS4 GP	--	--	--
Newington	GSM000060	Town of Newington	MS4 GP	--	--	--
West Hartford	GSM000001	Town of West Hartford	MS4 GP	--	--	--

Figure 5: Permitted Stormwater Facilities in the Trout Brook Sub-Regional Basin including MS4s (numbers correspond with permitted facilities listed in Table 5)



RECOMMENDED NEXT STEPS

CT DEEP can assist with reducing the effect of IC by providing technical and financial assistance to the watershed towns and local citizen watershed advocacy groups, effectively administering stormwater permitting programs, and monitoring aquatic life in the surface waters. Under Section 319 of the Clean Water Act (§319 C.W.A.), the U.S. Environmental Protection Agency awards a grant annually to the CT DEEP to fund eligible projects that control and/or abate nonpoint source pollution through a competitive bid process. More information on grant programs can be found on the Department's website (http://www.ct.gov/deep/cwp/view.asp?a=2719&q=325594&deepNav_GID=1654).

1) Reduce the effect of impervious cover in the Trout Brook Sub-Regional Basin through the implementation of Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, 45% of the Trout Brook sub-regional basin is considered developed and the municipalities within the watershed are MS4 communities regulated by the MS4 program. The amount of impervious cover in the basin ranges from 23% (Trout Brook Segment 1), to 22% (Trout Brook Segment 2), to 19% (Trout Brook Segment 3).

Reducing the effect of IC in the watershed is an important step to decrease the impacts of stormwater runoff on water quality. For new development, LID principles (http://www.ct.gov/deep/watershed) should be utilized to retain and infiltrate stormwater runoff and/or reduce the amount of runoff from IC. In developed areas, IC should be disconnected from surface waterbodies, where practicable. Disconnection of impervious surface runoff should be pursued to the degree feasible when reconstruction of a site and/or its infrastructure occurs. For example, stormwater outfalls could be redirected to vegetated areas to encourage natural filtration before reaching nearby waterbodies.

An excellent guide on how to implement a reduction in IC is found in Appendix 3 of the core document and on the web (http://clear.uconn.edu/projects/tmdl/). A retrofit assessment of the watershed would identify areas where BMPs such as gravel wetlands, porous pavement, and vegetated buffers could be implemented to most effectively treat stormwater runoff throughout the watershed. This type of assessment could be linked to existing Municipal Comprehensive or Master Plans, MS4-required SMPs or watershed management plans.

2) Prevent future degradation of Trout Brook and its tributaries by evaluating local stormwater control ordinances.

As the amount of IC in the Trout Brook sub-regional basin is greater than 12%, the adoption of a municipal stormwater ordinance can be an effective method to protect the water quality in the watershed. Stormwater ordinances can focus on different aspects of stormwater management to reduce the quantity and quality of the stormwater that reaches nearby waterbodies. Effective stormwater ordinances prohibit non-stormwater discharges (to the storm sewer or surface waterbodies) such as sanitary sewage and wastewater discharges, require the use of adequate controls to prevent erosion and sedimentation, and specify enforcement mechanisms to address non-compliance. In addition to local ordinances, the establishment of a stormwater utility (i.e. a user fee) can be an effective way to address the impact of stormwater runoff from impervious surfaces while also providing the fiscal means of addressing municipal stormwater infrastructure needs. Utility fees are usually based on the size of effective impervious area and so, strongly encourage the reduction of impervious area.

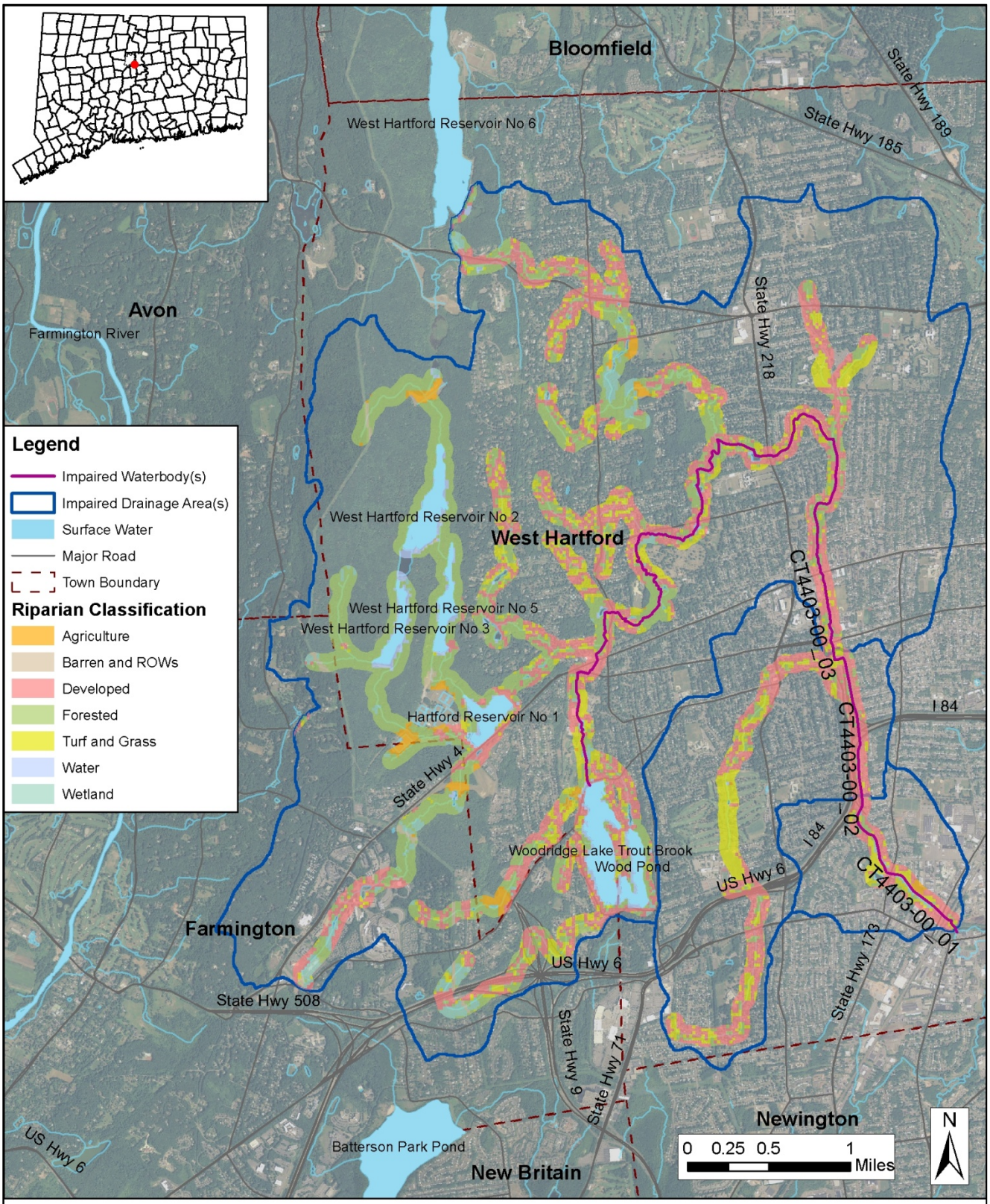
3) Protect existing buffers along the riparian corridor and other conservation lands throughout the watershed.

Riparian buffers and other natural landscapes can protect the water quality of waterbodies within a watershed. The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The incorporation of buffer requirements in the municipal land use approval process will help protect these areas near the impaired segments of the Trout Brook sub-regional basin from the effect of IC, and these streams can be protected from further degradation due to stormwater runoff.

Riparian zones differ from the uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. These areas can reduce the impacts of IC by filtering pollutants and slowing runoff. 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. They also can protect the shoreline from erosion, aid in flood control, provide habitat for wildlife, shade waters for fish, and offer scenic value. 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, 2011a).

The riparian zones for the impaired segments in the Trout Brook sub-regional basin are characterized by a mix of land uses including developed, forested, turf and grasses, and agriculture (Figure 6). The riparian zone for all three of the impaired segments is heavily developed with many playing fields and parks with open grass directly adjacent to the brook. Forest is minimal and limited to the middle reaches of the upstream impaired segment of Trout Brook (Segment 3). The IC within all developed areas is typically transporting stormwater via structured drainage systems that often discharge within the riparian areas or directly to surface waters.

Figure 8: Riparian buffer zone information for the Trout Brook Sub-Regional Basin



Riparian classification within Trout Brook Subregional Basin with Impairment to Habitat for Fish, Other Aquatic Life and Wildlife

UCONN CLEAR: http://clear.uconn.edu/
Created: CT DEEP, July 2012

4) Encourage greater citizen involvement to ensure the long-term protection of Trout Brook and its tributaries.

Groups of concerned citizens within a watershed with a shared goal of maintaining or restoring water quality for the use of its residents for future generations have shown to be effective in ensuring the long-term protection of a waterbody. These groups include watershed associations and municipal conservation commissions. Activities include water quality monitoring, developing a public education strategy, and working with local boards to upgrade existing water resource protection laws. Education of citizens regarding the management of stormwater runoff from individual properties is important to ensure long term protection.

5) Evaluate and implement Low Impact Development practices for future development and retrofit opportunities.

LID techniques and BMPs to reduce the impact of stormwater within the Trout watershed are important tools to reduce the effect of IC. A list of these techniques includes (but is not limited to): rain gardens, bioretention areas, "green streets" techniques, porous asphalt, porous concrete, permeable pavers, other permeable pavement systems, green roofs, cisterns and rain barrels, engineered vegetated swales, and tree box filters.

Some resources for more information are:

- NEMO (Nonpoint Education for Municipal Officials) is a University of Connecticut Program for local land use officials addressing the relationship of land use to natural resource protection (http://nemo.uconn.edu/)
- CT DEEP's Watershed Municipal Outreach and Low Impact Development Program (http://www.ct.gov/deep/cwp/view.asp?A=2719&Q=464958).

REFERENCES

Bellucci, C. (2007). Stormwater and aquatic life: Making the connection between impervious cover and aquatic life impairments. Pp. 1003–1018, *In* Proceedings of the Water Environment Federation TDML Conference, Bellevue, WA Water Environment Federation, Alexandria, VA.

CTDEEP (2011). State of Connecticut Water Quality Standards. **Online:** http://www.ct.gov/deep/lib/deep/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

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011, Completion of the 2006 National Land Cover Database for the conterminous United States: Photogrammetric Engineering and Remote Sensing, 77:9 858–864.

USEPA (1983). Results of the Nationwide Urban Runoff Program. Volume 1 Final Report. Water Planning Division. United States Environmental Protection Agency. Washington, D.C. 20460

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

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