MassDOT Semi Annual Submittal

(June 8, 2011 – December 7, 2011)

NPDES MS4 General Permit Compliance
Water Quality Impaired Waters Assessment and Mitigation Plan

December 8, 2011

Deval L. Patrick, Governor
Timothy P. Murray, Lt. Governor
Jeffrey B. Mullan, Secretary & CEO
Frank DePaola, Acting Administrator

massDOT
Massachusetts Department of Transportation
Highway Division

December 8, 2011

David Gray
U.S. Environmental Protection Agency, Region 1
5 Post Office Square - Suite 100, Mail Code #OEP06-1
Boston, MA 02110

Subject: Semi Annual Submittal under MassDOT's Impaired Waters Program

Dear Mr. Gray,

The attached report documents MassDOT's semi-annual report on the Impaired Waters Program for 2011. As part of MassDOT's June 9, 2010 and July 23, 2010 submittals to EPA, MassDOT committed to assessing, for possible mitigation, 684 impaired water bodies using the processes outlined in BMP 7U: Impaired Waters Assessment and Mitigation Plan (the "Impaired Waters Program") and BMP 7R: TMDL Watershed Review.

During the first half of this annual reporting period, MassDOT completed assessments on 30 water bodies from Appendix L-1 (dated July 22, 2010, included in MassDOT's July 23 submittal). In addition, MassDOT completed 17 progress reports. The progress reports include an evaluation of the potential contribution of storm water from MassDOT to the impaired water body and a calculation of the targeted reduction of effective impervious area and/or pollutant loading reduction.

Previously, MassDOT also included preliminary conceptual designs of BMPs in assessments where reductions in effective impervious cover or pollutant loading were recommended. However, as previous projects progressed to design and construction, it became clear that there were too many site specific unknowns (e.g. survey, site specific soils, infiltration rates, etc) to provide effective conceptual recommendations prior to the final design of the BMPs. In some cases, further site investigation determined that the BMPs included in the preliminary assessment were not optimal[1]. Therefore, going forward MassDOT's initial submissions will frequently be in the form of progress reports, which MassDOT and its consultants will use to select and design BMPs. Following the selection of BMPs, MassDOT will update the progress reports and submit final assessments that include the final designs of proposed BMPs.

This submittal is based on the 2008 Final Integrated Waters List ("303d list") and the proposed 2010 Final Integrated Waters List. Just before completing this submittal, the 2010 list was finalized and many of the pollutants were revised in the final list to provide more detail regarding the impairment type (e.g. mercury vs. overall metals impairment). Due to the short time frame before completing this submittal, most of the assessments have not been updated to include the final 2010 list. Future submittals will use the 2010 final list in identifying impairments.

This submittal includes the following attachments:

[1] Note that, for any prior projects where final selected BMPs differ in location or design from those included in MassDOT's original assessments, the annual report will include a description of the final BMPs and the basis for such differences.

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1. **Impaired Waters Assessments:** Attachment 1 includes 5 complete assessments for impaired waterbodies (3 within TMDL watersheds) including:

Waterbody ID	Waterbody Name	Impairment	TMDL Impairment (if applicable)	Recommendations/ Notes
MA51043	Eddy Pond	Noxious aquatic plants, (Exotic species)*	Noxious aquatic plants	TMDL Method; No further treatment required
MA51-16	Dark Brook	Cause Unknown	-	IC Method; Installation of 17 infiltration BMPs (13 swales, 3 basins and 1 extended detention basin) proposed in assessment; Assigned to Design Contractor for Final Design
MA61-01	Lee River	Nutrients, Organic enrichment/Low DO, Pathogens	-	IC Method; <9 % IC so no reduction necessary
MA51039	Dorothy Pond	Non-native aquatic macrophyte species, Turbidity	Phosphorus	TMDL Method; 16 Proposed BMP (14 infiltration swales and 2 vegetated filter strips) locations identified; Assigned to Design Contractor for Final Design

2. **Impaired Waters Progress Reports:** Attachment 2 includes 17 progress reports for the impaired waters listed below including 5 within TMDL watersheds. These progress reports include target reductions in pollutant loading and impervious cover. These assessments will now be forwarded to MassDOT design contractors for design and permitting of proposed BMPs to meet the target reductions to the maximum extent practicable.

Waterbody ID	Waterbody Name	Impairment	TMDL Impairment (if applicable)	Recommendations/ Notes
MA51-01	Kettle Brook	Cause Unknown, Nutrients, Organic enrichment/Low DO, (Flow alteration*), Pathogens, Debris/Floatables/Trash	-	IC Method; Target Reduction = 7.3 IC acres
MA51087	Leesville Pond	Nutrients , Organic enrichment/Low DO , (Exotic species*)	Nutrients, Organic enrichments/ Low DO	TMDL Method; Target Reduction = 18 lbs TP/yr (82% reduction)

Waterbody ID	Waterbody Name	Impairment	TMDL Impairment (if applicable)	Recommendations/ Notes
MA51156	Smiths Pond	Turbidity	Turbidity	TMDL Method; Target Reduction = 3 lbs TP/yr (77% reduction)
MA71-01	Aberjona River	Cause Unknown, Metals, Unionized Ammonia, Nutrients, Organic enrichment/Low DO, (Other habitat alterations*), Pathogens	-	IC Method; Target Reduction = 40.2 IC acres
MA93032	Hawkes Pond	Turbidity	-	IC Method
MA93-34	Saugus River	Excess Algal Growth, Fish-Passage Barrier, (Physical substrate habitat alterations*), Fecal Coliform, Turbidity, Nitrogen (Total), Phosphorus (Total), aquatic plants (Macrophytes)	-	IC Method
MA93-35	Saugus River	(Low flow alterations*), Fecal Coliform, (Alteration in stream-side or littoral vegetative covers)	-	Target Only; IC Method
MA61-02	Lee River	Pathogens, Taste, odor and color, Noxious aquatic plants, (Objectionable deposits*), Nitrogen (Total), Oxygen, Dissolved	-	IC Method;
MA61-04	Cole River	Nutrients, Organic enrichment/Low DO, Pathogens, Chlorophyll a	-	IC Method
MA71040	Spy Pond	Pesticides, Nutrients, Organic enrichment/Low DO, Noxious aquatic plants, (Exotic species*)	-	IC Method
MA71-04	Alewife Brook	Metals, Nutrients, Organic enrichment/Low DO, Pathogens, Oil and grease, Taste, odor and color, (Objectionable deposits*)	-	IC Method

Waterbody ID	Waterbody Name	Impairment	TMDL Impairment (if applicable)	Recommendations/ Notes
MA74-08	Monatiquot River	Cause Unknown, Organic enrichment/ Low DO, (Other habitat alterations*), Pathogens	-	IC Method
MA72-14	Mine Brook	Habitat Assessment (Streams), Temperature, Water	-	IC method

3. **No Discharge from MassDOT Outfalls Assessments or Unrelated Impairments:** Attachment 3 includes 25 assessments (6 within TMDL watersheds) where desktop review or field review of the subbasin indicates that MassDOT urban roads do not drain directly to the receiving water in question, the impairment is not storm water related or the MassDOT road draining to the impaired waterbody is completely within non-urbanized area and therefore not subject to the Retrofit Program.

Waterbody ID	Waterbody Name	Impairment	TMDL Impairment (if applicable)	Notes
MA51160	Stoneville Pond	Noxious aquatic plants, (Exotic species)*	Noxious aquatic plants	No Discharge
MA51032	Curtis Ponds	Noxious aquatic plants, (Exotic species)*	Noxious aquatic plants	No Discharge
MA51033	Curtis Ponds	Siltation, Noxious aquatic plants	Noxious aquatic plants	No Discharge
MA51004	Auburn Pond	Noxious aquatic plants, (Exotic species)*	Noxious aquatic plants	No Discharge
MA61-05	Quequechan River	Other habitat Alterations	-	Impairment unrelated to storm water
MA93-30	Beaverdam Brook	Oxygen, Dissolved, Fecal Coliform	-	No Discharge
MA93-31	Mill River	Oxygen, Dissolved, Fecal Coliform, Total Suspended solids (TSS), Turbidity	-	No Discharge
MA93056	Pillings Pond	Chlorophyll, Dissolved Oxygen saturation, Excess Algal Growth, Secchi disk transparency, Phosphorus (Total), Oxygen, Dissolved	-	No Discharge
MA93060	Lake Quannapowitt	Excess Algal Growth, Non-native aquatic plants, Turbidity, DDT	-	No Discharge
MA62213	Winnecunnet Pond	Exotic species	-	Impairment unrelated to stormwater

Waterbody ID	Waterbody Name	Impairment	TMDL Impairment (if applicable)	Notes
MA62131	Lake Nippenicket	Metals	Mercury	Impairment unrelated to stormwater
MA62205	Watson Pond	Turbidity, exotic species	-	No Discharge
MA62166	Lake Sabbatia	Organic Enrichment/ Low DO, exotic species	-	No Discharge
MA62084	Gushee Pond	Exotic species	-	No Discharge
MA61-07	Mount Hope Bay	Nutrients, Organic enrichment/Low DO, Thermal modifications, Pathogens, Chlorophyll a, Fishes Bioassessments	-	No Discharge
MA61011	Lewin Brook Pond	Metals	Metals	Impairment unrelated to stormwater
MA61-03	Cole River	(Fish-Passage Barrier*)	-	Impairment unrelated to stormwater
MA62228	Whittenton Impoundment	Exotic Species	-	No Discharge
MA73037	Ganawatte Farm Pond	Noxious aquatic plants, Organic enrichment/Low DO, Turbidity		No Discharge
MA62075	Fulton Pond	Pesticides		No Discharge
MA62029	Cabot Pond	Pesticides		Direct but non-urbanized; not included in program
MA62091	Hodges Pond	Pesticides		No Discharge
MA62112	Vandys Pond	Exotic species		No Discharge
MA62077	Gavins Pond	Exotic species		No Discharge
MA73034	Neponset Reservoir	Exotic Species, Turbidity, Noxious Aquatic Plants		No Discharge

MassDOT's two design contractors (VHB and Tetratech) are developing design and construction documents for BMPs proposed in previously submitted assessments and progress reports. MassDOT has advertised several district specific FY11 Retrofit contracts to provide for construction of the BMPs identified in these assessments and then designed by the design contractors. All bids have been received for these contracts and MassDOT is waiting to award the contracts. The following is a summary of the progress on design of BMPs recommended in previous submittal assessments to date:

- **Lowes Pond**: Design has been finalized. Construction of this additional estimated ~$970k (office estimate) of BMPs were included in the resurfacing contract advertised

this summer. A pre-construction meeting was held in early December and construction is expected this week.

- **Blackstone River** (MA51-03): 100% design is complete and includes modification of one basin and providing outlet control on 5 others for additional water quality treatment. Project will move to construction under the FY 11 Retrofit contract which is currently waiting to be awarded.

- **Burncoat Park Pond** (MA51012):100% design is complete and includes 3 infiltration basins. Project will move to construction under the FY 11 Retrofit contract which is currently waiting to be awarded.

- **Mill Pond** (MA84038): Proposed BMP(s) is under design. Conceptual design recommendations included installation of one infiltration basin, if subsurface conditions permit.

- **Beaver Brook** (MA84B-02): Proposed BMPs are under design. Conceptual design recommendations included modification of 10 existing swales to create 9 infiltration swales and 1 infiltration basin. Under design.

This submittal brings the total number of impaired waters assessments to 177 in the first 18 months of the program. Of these impaired waters assessments, 81 have included waters with TMDLs. These 81 waterbodies with TMDLs represent 39% of the 209 waterbodies with TMDLs included in the waterbody assessment list (Appendix L-1) submitted to EPA. This exceeds our commitment of reviewing 20% of TMDL waterbodies each year (and thus 30% in 18 months). In addition, this assessment includes progress reports for 13 water bodies including 2 within TMDL watersheds. These progress reports represent substantial additional progress towards the completion goals.

MassDOT welcomes any input or feedback from the EPA on the assessments included in this and all future progress reports. If you have any questions or concerns, or would like to meet to discuss this submittal, please feel free to contact me at (617) 973-7419.

Yours sincerely,

(Signature on Original)

Henry Barbaro
Supervisor of Wetlands & Water Resources
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cc: Kathleen Woodward, Esq., EPA Region I
Al Caldarelli, Esq., MassDOT

Attachment 1:
Impaired Waters Assessment

Impaired Waters Assessment for Eddy Pond (MA51043)

Impaired Waterbody

Name: Eddy Pond

Location: Auburn, MA

Water Body ID: MA51043

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): noxious aquatic plants, exotic species

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010b): noxious aquatic plants, exotic species

Eddy Pond is listed in both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters* as a Category 4c water body and is covered by a Total Maximum Daily Load (TMDL) for phosphorus according to MassDEP's *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002).

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5)(a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Eddy Pond is a water body in Auburn, MA of approximately 99 acres (MassDEP, 2010a). The pond lays downstream of approximately 19 acres of wetlands and outlets to Dark Brook (MA51-16) through a 24-inch corrugated metal pipe. MassDOT's Interstate 395 (I-395) runs north to south along the west edge of Eddy Pond. Eddy Pond is connected to a body of open water along the southbound lane of I-395 via a 48-inch reinforced concrete pipe and a 72-inch reinforced concrete pipe. I-395 is a divided, two-lane roadway with small, piped storm water collection systems discharging to outfalls along either side. The cloverleaf interchange of I-395 and Route 20 (Rte 20) includes piped storm water collection systems which discharge to both Eddy Pond and Dark Brook.

The watershed of MassDOT's property directly contributing storm water runoff to Eddy Pond is comprised of a stretch of I-395 northbound approximately 1.3 miles long, about 0.3 miles of I-395 southbound, about 0.6 miles of Rte 20, and portions of the ramps connecting Rte 20 and I-395 as well as the ramp from the Mass Turnpike (Interstate 90) to I-395 southbound. All of these contributing MassDOT-owned roads are classified as urban. Figure 1 shows Eddy Pond and the surrounding MassDOT-owned roads.

Assessment under BMP 7R for Phosphorus

The TMDL for phosphorus for Selected Northern Blackstone Lakes addresses the impairment for Noxious Aquatic Plants for Eddy Pond. Therefore, MassDOT assessed the contribution of phosphorus from MassDOT property directly draining to this water body to address this impairment. The assessment was completed using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002) can be summarized as follows in reference to Eddy Pond:

- Pollutant of Concern: Phosphorus
- Impairment for Eddy Pond Addressed in TMDL: Noxious aquatic plants
- Applicable Waste Load Allocation (WLA): See Tables 3 (p. 57), 2f (p. 44), and 4f (p. 59) of TMDL.
  - Description of Associated Land Use: Commercial/Industrial
  - Commercial/Industrial Land Use Current Load (TP): 66 kg/yr (145.5 lb/yr)
  - Commercial/ Industrial Land Use Target WLA (TP): 65 kg/yr (143.3 lb/yr)
  - Commercial/Industrial Area in Watershed: 32.0 ha (79.1 acres)
  - Commercial/Industrial Land Use Target Areal WLA (TP): 2.03 kg/ha/yr (1.81 lb/acre/yr)
- Applicable Recommendations: "Public Education, NPS Survey, Lake Management Plan, Residential BMPs, Urban BMPs, Highway BMPs, In-Lake Management" (Table 7, page 66).

Estimated Loading from MassDOT

The loading of total phosphorus (TP) from MassDOT property contributing storm water runoff to Leesville Pond was estimated using the following assumptions and calculations:

- MassDOT estimates the TP loading from its impervious areas as 1.60 lb/acre/yr. This loading rate is based on data collected in a study of storm water runoff conducted by the United States Geological Survey (USGS) (Smith and Granato, 2010). The study analyzed storm water samples from 12 sites located on highways operated by MassDOT across Massachusetts between September 2005 and September 2007. Samples were taken under a variety of weather conditions during this period.
- MassDOT estimates the TP loading from its pervious areas as 0.6 lb/acre/yr. This loading rate is based on the loading rate for hayland provided in the United States Environmental Protection Agency's (EPA) document EPA 440/5-80-011, "Modeling phosphorus loading and Pond response under uncertainty: a manual and compilation of export coefficients" (Reckhow, 1980). Hayland was chosen to represent the pervious right-of-way areas which are typically cleared areas that are mowed only once per year.
- MassDOT calculated its total estimated TP loading rate using the estimated loading rates listed above. MassDOT property contributing stormwater directly to Eddy Pond is 18.8

acres of impervious area and 60.8 acres of pervious area. The TP loading is 67 lb/yr without accounting for existing BMPs or treatment throughout the watershed.

- MassDOT calculated its target TP WLA using the TMDL target areal WLA of 1.81 lb/ac/yr and the total area of MassDOT property within the TMDL watershed directly draining to Eddy Pond (79.6 acres). The target TP WLA for MassDOT runoff is 144 lb/yr.

Assessment and Mitigation Plan

MassDOT calculated its current TP loading rate (67 lb/yr) and its target TP WLA (144 lb/yr) using values provided in MassDEP's TMDL report. The difference between these two values represents the target reduction in TP that MassDOT should aim to achieve to comply with the WLA. For the watershed directly contributing to Eddy Pond, no reduction is warranted because MassDOT's current TP loading rate is less than the target TP WLA.

Conclusions

The total estimated TP loading rate for Eddy Pond is currently less than the target areal WLA stated in the TMDL. Therefore, no further measures are warranted to address the impairments described herein.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2002). Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes. CN 70.1. Retrieved from: http://www.mass.gov/dep/water/resources/blaktmdl.pdf

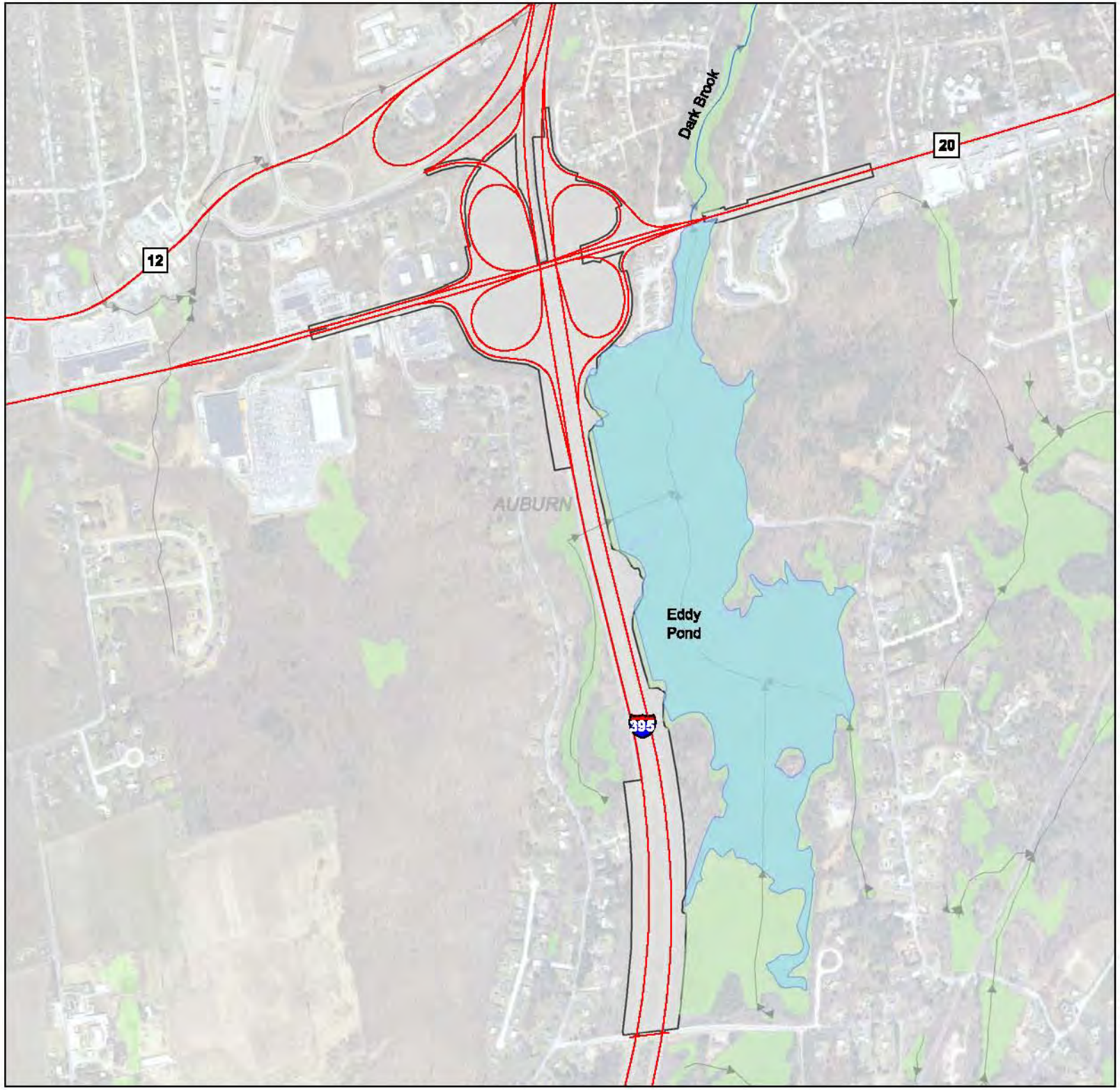
Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

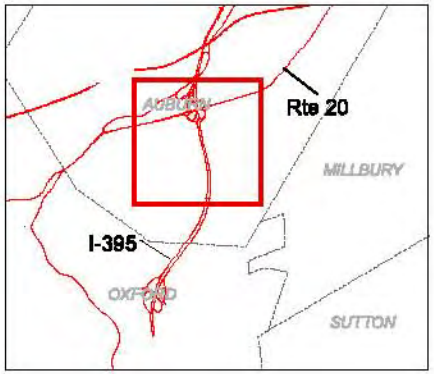
Massachusetts Department of Environmental Protection (MassDEP). (2010a). Blackstone River Watershed 2003-2007 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/dep/water/resources/wqassess.htm#wqar

Massachusetts Department of Environmental Protection (MassDEP). (2010b). Massachusetts Year 2010 Integrated List of Waters - Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list3.pdf

Reckhow, K.H., Beaulac, M., &Simpson, J. (1980). Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients. U.S. Environmental ProtectionAgency, EPA-440/5-80-011, 214 p.

Smith, K.P., & Granato, G.E. (2010). Quality of storm water runoff discharged from Massachusetts highways, 2005-07: U.S. Geological Survey Scientific Investigations Report 2009-5269, 198 p.





MassDOT Watershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 500 1,000 2,000

Feet

1 in = 1,000 feet

Figure 1

Eddy Pond
(MA51043)

September 2011

Moving Massachusetts Forward
massDOT

Impaired Waters Assessment for Dark Brook (MA51-16)

Impaired Waterbody

Name: Dark Brook

Location: Auburn, MA

Water Body ID: MA51-16

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): cause unknown

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010b): cause unknown

Dark Brook (MA51-16) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Blackstone River Watershed 2003-2007 Water Quality Assessment Report* (MassDEP, 2010a), a 0.1-mile reach of Dark Brook which flows through Auburn Pond (MA51004) is assessed as impaired due to non-native aquatic macrophyte infestation. This report also states that Auburn Pond will no longer be assessed as its own lake segment and will now be considered a run of the river impoundment. Auburn Pond is covered by a TMDL for phosphorus according to MassDEP's *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002).

As described below, MassDOT recommends the implementation of various BMPs for Dark Brook based on the IC Method. While these recommendations for BMPs address impairments specific to Dark Brook, all receiving water bodies downstream of the BMPs will benefit from the improvements. Auburn Pond (MA51004) is located midstream of Dark Brook, downstream of the existing and proposed BMPs. During site visits on August 3 and 4, 2011, it was determined that storm water runoff from MassDOT property does not directly contribute to Auburn Pond. For this reason, it was determined that further assessment of Auburn Pond is not required under the Retrofit Initiative. However, the BMPs recommended for Dark Brook will assist in phosphorus removal for the watershed surrounding Auburn Pond, as recommended by the TMDL. Refer to the Impaired Waters Assessment for Auburn Pond (MA51004) for further information.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Dark Brook is a water body in Auburn, MA which flows from Eddy Pond at Route 20 (Rte 20) for approximately 1.6 miles, runs through Auburn Pond for about 0.1 miles, and continues approximately 1.1 miles until it flows into Kettle Brook (MA51-01). The 0.1-mile reach of Dark Brook through Auburn Pond is classified as impaired according to the *Blackstone River Watershed 2003-2007 Water Quality Assessment Report*. The brook runs parallel to Route 12 (Rte 12) for the majority of its reach until it passes under Rte 12 downstream of Auburn Pond.

The watershed of MassDOT's property directly contributing storm water runoff to Dark Brook is comprised of portions of Rte 12, Rte 20, Interstate 90 (I-90), I-290, the four cloverleaf ramps connecting I-395/I-290 to Rte 20 and the ramp from I-290 EB to Rte 12 SB (see Figure 2).

Storm water from approximately 7 acres of the Rte 12 catchment area flows directly from outfalls into Dark Brook where it runs parallel to the road. Storm water from the remainder of the contributing Rte 12 watershed as well as the I-290 and I-90 watersheds generally discharges through outfalls to series of conveyance ditches connected by culverts and eventually flows into Dark Brook. Storm water from the contributing Rte 20 watershed is conveyed through a drainage system which outfalls directly to Dark Brook.

Assessment under BMP 7U

The impairment for Dark Brook (cause unknown) has not been addressed by a TMDL. Therefore, MassDOT assessed this impairment using the approach described in BMP 7U, MassDOT Application of IC Method (MassDOT, 2011), of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U, impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the impairment of cause unknown.

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% impervious cover, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of the impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where

it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U, When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Dark Brook (MA51-16)):

Total Watershed		
Watershed Area	7,280	acres
Impervious Cover (IC) Area	1,018	acres
Percent Impervious	14.0	%
IC Area at 9% Goal	655	acres
Target Reduction % in IC	35.7	%

Subwatershed		
Subwatershed Area	2,715	acres
Impervious Cover (IC) Area	770	acres
Percent Impervious	28.4	%
IC Area at 9% Goal	244	acres
Target Reduction % in IC	68.3	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	31.2	acres
MassDOT's Target Reduction in Effective IC (68.3% of DOT Directly Contributing IC)	21.3	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairment. The subwatershed should target a reduction of its effective IC by 68.3% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 21.3 acres of effective IC.

Existing BMPs

MassDOT has three existing BMPs in the Dark Brook subwatershed that are mitigating potential storm water quality impacts. In our analysis, existing BMPs receive credit for removing the effect of IC depending on their type, size relative to the IC that they process, and the local soil conditions. The soil in the area associated with the existing BMPs is characterized as hydrologic group B (loam). The total effective IC reduction provided by the existing MassDOT BMPs described below is approximately 1.1 acres (see Table 1 attached).

Ex-BMP-1

A stretch of the median along I-290 is about 50 feet wide. The roadway of I-290 eastbound (EB) is crowned at its center. Sheet flow from the inside half of the roadway runs perpendicular to the road for about 25 feet at about a 7% slope into a relatively flat, grassy area in the median. Based on the slope along the length of the median, it appears that in the event of a large amount of runoff, sheet flow runs to the low point in the center of the median and then travels about 680 feet north to a dropped-down catch basin. This grassy area was characterized as a vegetated filter strip and achieves 74% effective IC removal.

Ex-BMP-1. Vegetated Filter Strip.

Ex-BMP-2

The roadway of I-290 westbound (WB) is also crowned at its center. Sheet flow from the inside half of the roadway runs perpendicular to the road for about 25 feet at about a 25% slope into a relatively flat, grassy area in the median. There is no evidence of water collecting in this vegetated area. Based on the slope along the length of the median, it appears that in the event of a large amount of runoff, sheet flow runs to the low point in the center of the median and then travels about 680 feet north to the dropped-down catch basin, similar to Ex-BMP-1. This grassy area was characterized as a vegetated filter strip and achieves 72% effective IC removal. During the design process, the consultants and MassDOT will consider observing this area as well as that of Ex-BMP-1 during rain events to confirm that both BMPs are acting as vegetated filter strips. If they are not,

there is potential to install an infiltration swale along the low point where the two slopes meet at the center of the median.

Ex-BMP-2. Vegetated filter strip.

Ex-BMP-3

The right-of-way along I-90 WB is wooded and well-vegetated. The roadway of I-90 WB is crowned at its center and sheet flow from the outer half of the roadway is conveyed through ditches (described in Pr-BMP-1 and Pr-BMP-2) to a low, flat, well-vegetated area where water must fill to a depth of 1 foot in order to flow out. This area measures approximately 30 feet by 50 feet and consists of dead leaves and small leafy vegetation. Water appears to infiltrate in this basin. If this basin overflows in large storm events, it does not appear to happen often as there is not a prominent channel through which water leaves the basin. This low area was characterized as an infiltration basin, but will be investigated further during proposed BMP design to determine if enhancements are required to improve the treatment of this basin. If so, grading could be provided as well as a berm and controlled outlet where water exits the basin in overflow events. This basin achieves 71% effective IC removal under current conditions.

Ex-BMP-3. Infiltration Basin.

Summary of Existing BMPs

BMP Name	BMP Type	Soil Type	Depth of Runoff Treated (inches)	IC Area Treated (acres)	Reduction of Effective IC* (%)	Reduction of Effective IC (acres)
Ex-BMP-1	Vegetated Filter Strip	B – Loam 0.52 in/hr	0.6	0.39	74	0.29
Ex-BMP-2	Vegetated Filter Strip	B – Loam 0.52 in/hr	0.6	0.46	72	0.33
Ex-BMP-3	Infiltration Basin	B – Loam 0.52 in/hr	0.6	0.68	72	0.49
Total						1.11

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target of 21.3 acres (see Table 1 attached), MassDOT will consider locations where additional BMPs could be implemented. While these considerations for BMPs address impairments specific to Dark Brook, all receiving water bodies downstream will benefit from the improvements.

During site visits on August 3rd, 4th, and 17th, 2011, fifteen proposed BMP locations were identified. The BMPs proposed below were determined to be feasible. The locations for potential BMPs were identified along the rights-of-way of I-290, I-395, and I-90, as well as ramps along these roadways. While Dark Brook runs parallel to Rte 12 for much of its length, there is little to no right-of-way along this roadway due to development directly adjacent to the road.

As shown in Figures 3 and 4, the existing and proposed BMPs lay in series. The direction of storm water flow through the BMPs is shown in these figures. For proposed BMPs which lay in series with the existing BMPs, the performance of the existing BMPs was taken into account when determining the IC reduction and phosphorus removal that will be achieved if the proposed BMPs are implemented. The individual BMP watersheds are shown in Figures 5 and 6.

The IC reductions as well as the phosphorus removals provided by MassDOT BMPs under the proposed conditions described below are listed in Table 2 attached. Under these conditions, the recommended BMPs working along with the existing BMPs will achieve a total effective IC reduction of 10.2 acres.

Pr-BMP-1

Systems of channels along I-90 convey storm water from the highway to Dark Brook. Sheet flow from I-90 WB flows into an existing 255 feet long trapezoidal channel with dry vegetation consisting of grass and dead leaves. This channel drains to a 36 inch culvert which carries water from this ditch under the Exit 10 off-ramp to another ditch (described in Pr-BMP-2). MassDOT will consider constructing an infiltration swale in this channel by maintaining its existing dimensions of a bottom width of 4 feet and side slopes of 1 vertical to 2 horizontal (1:2) and installing check dams. This will achieve 99% effective IC removal.

Location for Pr-BMP-1, infiltration swale.

Pr-BMP-2

Storm water from the existing ditch described in Pr-BMP-1 flows under the Exit 10 off-ramp into an existing trapezoidal channel lined with dead leaves and sand which runs along the base of the sloped I-90 WB right-of-way. The dimensions of this channel vary along its 310-foot length. MassDOT will consider constructing an infiltration swale in this channel by cleaning out the sediment, planting vegetation, and installing check dams. A trapezoidal swale with a bottom width of 3 feet, top width of 5 feet, and rise of 2 feet will not require a great amount of excavation and will achieve 100% effective IC removal.

Location for Pr-BMP-2, infiltration swale.

Pr-BMP-3

In the event of a large storm, it appears that water flows out of the basin described as Ex-BMP-3, over sloped land, and into a 120 feet long existing ditch, also along the base of the sloped I-90 WB right-of-way. Catch basins along I-90 also discharge water to this ditch via Outfall 20494. The ditch consists of dry vegetation until it reaches the outfall where broken pavement lines the channel. This ditch meets Oxford Street North perpendicularly and storm water flows out onto the road. There is a catch basin located next to the outlet of the ditch, but there is no feature presently corralling flow into this basin. MassDOT will consider constructing an infiltration swale along this ditch by removing the broken pavement, planting vegetation, and installing check dams. This would entail excavating to construct a trapezoidal channel with a bottom width of 2 feet, a height of 1 foot, and side slopes of 1:2.5. Pr-BMP-3 will provide 97% effective IC removal.

Location for Pr-BMP-3, infiltration swale.

Existing outflow of storm water onto Oxford St N.

Pr-BMP-4

Storm water is conveyed from the ditch described in Pr-BMP-3, under Oxford St North, and into an existing 250 feet long ditch which also runs along the I-90 WB right-of-way. This ditch is eroded and stony with poor vegetation and varying dimensions. In addition to receiving storm water from the series of ditches upstream, catch basins transmit storm water from the left half of the I-90 WB roadway to this ditch via outfall 20441. MassDOT will consider constructing an infiltration swale in this ditch by cleaning out rocks, planting vegetation, and installing check dams. A trapezoidal swale with a bottom width of 4 feet, a rise of 1 foot, and side slopes of 1:3 will provide 95% effective IC removal.

Location for Pr-BMP-4, infiltration swale.

Pr-BMP-5

In the northwest corner of the intersection of I-290 and I-90, there is a low, flat, sandy area with little vegetation. This area is bordered by a 6 foot berm on its north side and a 20 foot tall hill to I-90 WB on its south side. Storm water from the ditch described in Pr-BMP-4 enters this area as well as storm water from I-90 which outlets via Outfall 3607. After flowing into this basin, water flows under I-290 through a 54 inch culvert. MassDOT will consider constructing a 110 feet by 40 feet by 1.5 feet infiltration basin in this area. This will entail cleaning out the sand, plant vegetation, and installing a high level outlet which will connect to the existing 54 inch culvert. This basin will provide 92% effective IC removal.

Location for Pr-BMP-5, infiltration basin.

Pr-BMP-6

Storm water from the existing basin described in Pr-BMP-5 flows through the 54 inch culvert and outlets into an existing 260 feet long channel which is lined with a heavy accumulation of sand and some leaf litter. In addition to receiving water from the series of ditches and basins upstream, this ditch also receives storm water from I-90 via Outfalls 3609 and 20495. This ditch carries water to a 54 inch culvert which runs under Rte 12 and is currently about 90% full of sediment. MassDOT will consider cleaning the sediment from this ditch and culvert and excavating to construct an infiltration swale with check dams. A trapezoidal channel with a bottom width of 4 feet, a 2 feet rise, and 1:1 side slopes will achieve 94% effective IC removal.

Location for Pr-BMP-6, infiltration swale.

Existing culvert, 90%-filled with sediment.

Pr-BMP-7

After passing through the 54 inch culvert under Rte 12, storm water from the ditch described in Pr-BMP-6 enters a 520 feet long ditch of varying dimensions which runs north parallel to Rte 12 NB. This is the final channel in the series of conveyance ditches beginning with that described in Pr-BMP-1 before storm water meets Dark Brook. In addition to the storm water from the ditches upstream, this channel also receives storm water from I-90 via Outfalls 20423, 20424 and 20440 and water from Rte 2 via Outfall 11445. The beginning of this channel is lined with pavement and accumulated with sediment. Continuing downstream, the channel is overgrown with dry vegetation. MassDOT will consider excavating and constructing a trapezoidal infiltration swale along this channel with a bottom width of 5 feet, a rise of 1 foot, side slopes of 1:2.5, and 1 foot tall check dams. This will provide 97% effective IC removal.

MassDOT will investigate for the presence of wetlands along the channel before moving forward with the design of this BMP. Patches of wetland vegetation were identified along the extent of the channel; However, there does not appear to be standing water in the channel.

Location for Pr-BMP-7, infiltration swale.

Pr-BMP-8

The low area in the southwest corner of the intersection of I-90 and Rte 12 receives storm water from 1.04 acres of I-90 via Outfall 3608. It appears that water entering this basin currently flows to a dropped down catch basin in a short paved channel off the right shoulder of Rte 12 SB. MassDOT will consider excavating a 45 feet by 125 feet section of this area to a depth of 3 feet for the installation of an extended detention basin. It is also suggested that the dropped down catch basin be replaced with a 1 inch orifice controlled outlet. This basin will provide 80% effective IC removal.

Location for Pr-BMP-8, extended detention basin.

Pr-BMP-9

A paved channel runs along the base of the I-90 EB sloped right-of-way. Storm water from I-90 enters this ditch as sheet flow and is also piped to the ditch via Outfall 20486. The trapezoidal paved channel has a bottom width of 1 foot, a height of 1.5 feet, and 1:1 side slopes, and sits in the bottom of a much larger ditch. It drains to a catch basin on Oxford St North. MassDOT will consider stripping the pavement and installing check dams the height of the existing channel, 1.5 feet, along the 660-foot long channel. This would provide 95% effective IC removal. The potential to create higher check dams and achiever greater effective reductions in IC will be investigated.

Location of Pr-BMP-9, infiltration swale.

Pr-BMP-10

A 0.33-acre portion of I-290 WB contributes storm water to a 355-foot long grassy ditch alongside the right shoulder via sheet flow and Outfall 3600. This ditch conveys water to a 10 inch culvert which connects to the drainage system along Water Street below I-290. MassDOT will consider installing a trapezoidal infiltration swale along the entire extent of this ditch, with a bottom width of 2 feet, a rise of 2 feet, and side slopes of 1:2. This swale would provide 96% effective IC removal.

Location of Pr-BMP-10, infiltration swale.

Pr-BMP-11

The roadway of I-290 WB is crowned at its center. The outer half of the roadway contributes sheet flow to a 340 feet long grassy ditch which runs alongside the shoulder. This ditch conveys storm water to a 10 inch culvert which carries it to Outfall 3405 inside the ramp from I-290 EB to Rte 12 SB. MassDOT will consider excavating this channel to construct a trapezoidal infiltration swale with check dams along its entire length, with a bottom width of 4 feet, a rise of 1 foot, and side slopes of 1:5.5. This swale would achieve 96% effective IC removal.

Location of Pr-BMP-11, infiltration swale.

Pr-BMP-12

The ramp from I-290 EB to Rte 12 SB contributes storm water to a 295 foot long grassy swale along its right shoulder via sheet flow. The end of this existing channel is paved and corrals water into a catch basin. MassDOT will consider the implementation of a trapezoidal infiltration swale along this existing channel, with a bottom width of 4 feet, a depth of 3 feet, and side slopes of 3:5.5. This would achieve 97% effective IC removal.

Location of Pr-BMP-12, infiltration swale.

Pr-BMP-13

A 1.03-acre portion of I-90 WB contributes storm water to a 890 feet long swale which runs along the right shoulder via sheet flow and drainage systems to Outfall 20438. This ditch conveys storm water directly to Dark Brook. The beginning of this swale is grassy and, continuing down-slope, becomes lined with leafy debris. The dimensions of the channel change throughout its length. MassDOT will consider constructing a trapezoidal infiltration swale with check dams along the entire length of the existing ditch with a bottom width of 3 feet, a depth of 2 feet, and side slopes of 2:1. This swale would provide 95% effective IC removal.

Location of Pr-BMP-13, infiltration swale. Grassy upstream section of existing ditch.

Location of Pr-BMP-13, infiltration swale. Leafy downstream section of existing ditch.

Pr-BMP-14

A 2.03-acre area of I-90 EB contributes storm water to a 900 feet long grassy ditch along the right shoulder via sheet flow and Outfalls 20491, 20492, 20489 and 20490. The dimensions of this ditch vary along its length. Dark Brook directly receives water from this ditch before passing under I-90. MassDOT will consider constructing an infiltration swale with check dams along the extent of this ditch, with a bottom width of 4 feet, a depth of 2 feet, and side slopes of 2:5.5. This swale would provide 97% effective IC removal.

Location of Pr-BMP-14, infiltration swale.

Pr-BMP-15

The southern portions of the ramps from I-395 NB to Rte 20 WB and from Rte 20 WB to I-395 NB contribute storm water directly to Dark Brook through a drainage system which outfalls at the brook via Outfall 11454. While there is not space for a BMP to be installed at this outfall, there is space to daylight pipes between the two ramps. Currently, a pipe spans beneath this grassy area, connecting catch basins from the 395-to-20 ramp to catch basins on the 20-to-395 ramp. This system then connects to a trunk line running east along Rte 20 and is piped to Outfall 11454. MassDOT will consider daylighting the pipe which spans across the area between the ramps and excavating and constructing an infiltration basin in this area. This would entail redirecting the pipe which runs down the 395-to-20 ramp into the proposed infiltration basin. A 30 feet by 65 feet by 2 feet deep basin will provide 96% effective IC removal. MassDOT uses a portion of this area to park equipment, but the equipment may need to be relocated in order to provide adequate space to install the proposed BMP. There is also the potential to redirect the trunk-line along Rte 20 to the proposed infiltration basin to treat a greater amount of storm water.


Location for Pr-BMP-15, infiltration basin.

Conclusions

The entire watershed of MassDOT-owned roadways was investigated to identify existing BMPs and locations for new BMPs to be implemented. The proposed conditions are presented in the sections above and are summarized as follows:

Summary of Proposed Conditions

BMP Name	BMP Type	Effective IC Percent Reduction	Effective IC Reduction (acres)	Notes for Consideration during design**
Ex-BMP-1	Vegetated Filter Strip	74%	0.29	Confirm acting as BMP during rain event; If not, construct infiltration swale
Ex-BMP-2	Vegetated Filter Strip	72%	0.33	Confirm acting as BMP during rain event; If not, construct infiltration swale
Ex-BMP-3*	Infiltration Basin	97%	0.12	Determine if enhancements are necessary to improve treatment of basin
Pr-BMP-1*	Infiltration Swale	99%	0.21	Convert existing channel
Pr-BMP-2*	Infiltration Swale	100%	0.34	Convert existing channel
Pr-BMP-3*	Infiltration Swale	97%	0.09	Convert existing ditch
Pr-BMP-4*	Infiltration Swale	95%	0.22	Convert existing ditch
Pr-BMP-5*	Infiltration Basin	92%	1.11	Convert existing low, flat, sandy area
Pr-BMP-6*	Infiltration Swale	94%	0.41	Convert existing channel
Pr-BMP-7*	Infiltration Swale	97%	0.37	Convert existing ditch
Pr-BMP-8*	Extended Detention Basin	80%	1.02	Excavate and convert existing low area
Pr-BMP-9	Infiltration Swale	95%	0.65	Convert existing paved channel
Pr-BMP-10	Infiltration Swale	96%	0.31	Convert existing grassy ditch
Pr-BMP-11*	Infiltration Swale	96%	0.36	Convert existing grassy ditch
Pr-BMP-12	Infiltration Swale	97%	0.91	Convert existing grassy swale
Pr-BMP-13	Infiltration Swale	95%	0.98	Convert existing grassy / leafy debris swale
Pr-BMP-14	Infiltration Swale	97%	1.97	Convert existing grassy ditch
Pr-BMP-15	Infiltration Basin	96%	0.52	Convert existing grassy area; Daylighting of pipe would be required
Total			**10.2**	

*Denotes a BMP in series.
**See sections titled Existing BMPs and Proposed BMPs for more details on notes.

This assessment of Dark Brook (MA51-16) has shown that, under the proposed conditions, the existing BMPs and proposed BMPs collectively provide 48% of the target reduction in IC. The following table summarizes the effective IC removal of the existing and proposed BMPs. Attached Figures 2 and 3 show the locations of the existing and proposed BMPs.

Impervious Cover Reduction

IC in Directly Contributing Watershed	31.2	acres
Required Reduction in Effective IC	21.3	acres
IC Effectively Reduced by Existing BMPs under Existing Conditions	1.1	acres
IC Reduction Provided under Proposed Conditions	10.2	acres

As described above, the BMPs proposed in this assessment were determined to be feasible within the current right of way and road drainage constraints. Additional reductions in effective impervious cover were determined to not be practicable due to site constraints including limited available land and wetland vegetation in existing conveyance ditches. Because the proposed conditions in this assessment only account for a portion of the target IC reduction, MassDOT will consider investigating the drainage systems along Rte 12 to determine if it is feasible to redirect more storm water into the proposed BMPs for treatment. During design, the consultants will review with MassDOT the proposed conditions presented in this assessment and also any additional drainage modifications that could be made to Route 12 systems to redirect more storm water to the proposed BMPs, thereby providing additional treatment.

MassDOT will now work with its design consultants to develop design plans for the proposed BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide treatment to the maximum extent practicable.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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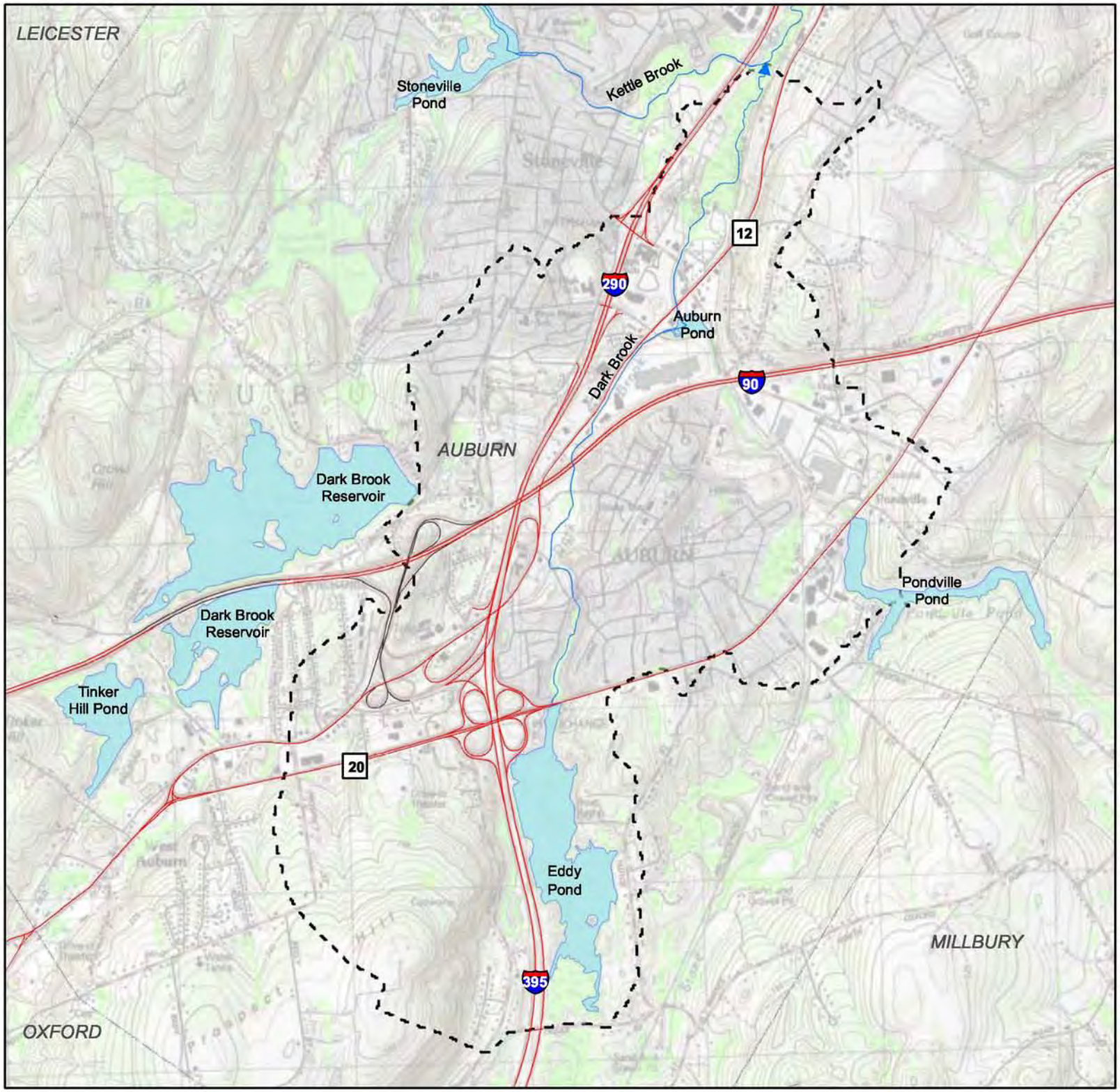
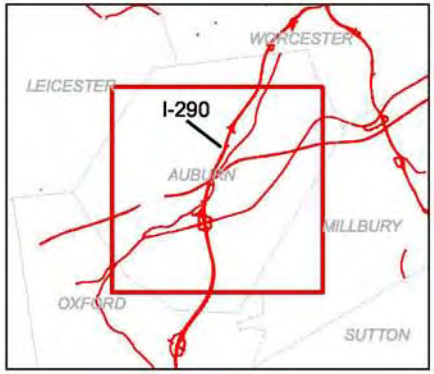
Table 1: Reduction Provided by MassDOT BMPs under Existing Conditions

BMP Name	BMP Type	Soil Classification	Contributing Watershed Impervious Area (ac)	Contributing Watershed Pervious Area (ac)	Pre-BMP TP Load (lb/yr)	Provided TP Percent Removal	Provided TP Load Removal (lbs/yr)	Effective IC Percent Reduction	Effective IC Reduction (sq. ft)
Ex-BMP-1	Vegetated Filter Strip	B - Loam 0.52 in/hr	0.39	-	0.9	88%	0.8	74%	0.29
Ex-BMP-2	Vegetated Filter Strip	B - Loam 0.52 in/hr	0.46	-	1.0	86%	0.8	72%	0.33
Ex-BMP-3	Infiltration Basin	B - Loam 0.52 in/hr	0.68	3.34	3.1	86%	2.7	71%	0.49
Total			1.53	3.34	4.9	86%	4.3	72%	1.11

Table 2: Reduction Provided by MassDOT BMPs under Proposed Conditions

BMP Name	BMP Type	Soil Classification	Contributing Watershed Impervious Area (ac)	Contributing Watershed Pervious Area (ac)	Pre-BMP TP Load (lb/yr)	Provided TP Percent Removal	Provided TP Load Removal (lbs/yr)	Effective IC Percent Reduction	Effective IC Reduction (ac)
Ex-BMP-1	Vegetated Filter Strip	B - Loam 0.52 in/hr	0.39	-	0.9	88%	0.8	74%	0.29
Ex-BMP-2	Vegetated Filter Strip	B - Loam 0.52 in/hr	0.46	-	1.0	86%	0.8	72%	0.33
Ex-BMP-3*	Infiltration Basin	B - Loam 0.52 in/hr	0.13	0.19	1.8	99%	1.8	97%	0.12
Pr-BMP-1*	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.21	2.68	2.0	31%	0.6	99%	0.21
Pr-BMP-2*	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.34	0.40	2.2	33%	0.7	100%	0.34
Pr-BMP-3*	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.10	0.22	0.3	25%	0.1	97%	0.10
Pr-BMP-4*	Infiltration Swale	B - Loam 0.52 in/hr	0.23	0.60	1.0	31%	0.3	95%	0.22
Pr-BMP-5*	Infiltration Basin	B - Loam 0.52 in/hr	1.20	0.50	3.0	97%	2.9	92%	1.11
Pr-BMP-6*	Infiltration Swale	B - Loam 0.52 in/hr	0.44	0.64	1.2	29%	0.3	94%	0.41
Pr-BMP-7*	Infiltration Swale	B - Loam 0.52 in/hr	0.39	0.99	2.1	36%	0.8	97%	0.37
Pr-BMP-8*	Extended Detention Basin	B - Loam 0.52 in/hr	1.28	1.42	3.7	14%	0.5	80%	1.02
Pr-BMP-9	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.68	1.33	1.9	19%	0.4	95%	0.65
Pr-BMP-10	Infiltration Swale	B - Loam 0.52 in/hr	0.33	0.53	0.9	34%	0.3	96%	0.32
Pr-BMP-11*	Infiltration Swale	B - Loam 0.52 in/hr	0.38	0.67	1.1	33%	0.4	96%	0.36
Pr-BMP-12	Infiltration Swale	B - Loam 0.52 in/hr	0.94	1.22	2.3	36%	0.8	97%	0.91
Pr-BMP-13	Infiltration Swale	B - Loam 0.52 in/hr	1.03	1.75	2.8	32%	0.9	95%	0.98
Pr-BMP-14	Infiltration Swale	B - Loam 0.52 in/hr	2.03	2.66	5.0	36%	1.8	97%	1.97
Pr-BMP-15	Infiltration Swale	B - Loam 0.52 in/hr	0.55	0.64	1.3	33%	0.4	96%	0.52
Total			11.09	16.42	34.3	43%	14.6	92%	10.23





Dark Brook (MA51-16) Subwatershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 1,250 2,500 5,000

Feet

1 in = 2,500 feet

Figure 1

Dark Brook (MA51-16) Subwatershed

December 2011

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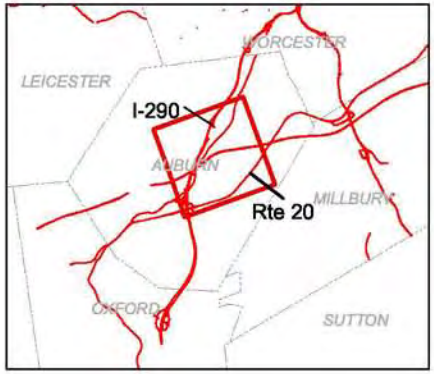

MassDOT Watershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 625 1,250 2,500

Feet

1 in = 1,250 feet

Figure 2

Dark Brook (MA51-16)
Directly Contributing MassDOT Watershed

December 2011

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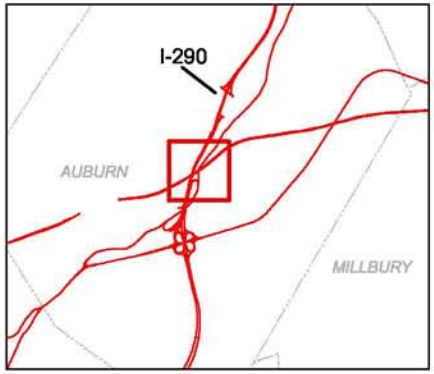
massDOT



- Direction of Drainage
- Existing BMPs
- Proposed BMP - Basins
- Proposed BMP - Swales
- Impaired Water Bodies
- Impaired Stream Segments
- Non-Impaired Stream Segments
- MassDOT Roads in Urban Areas
- Town Boundaries

N

0 220 440 880

Feet

1 in = 440 feet

Figure 3

Dark Brook (MA51-16)
Existing and Proposed BMPs
Sheet 1 of 2

December 2011

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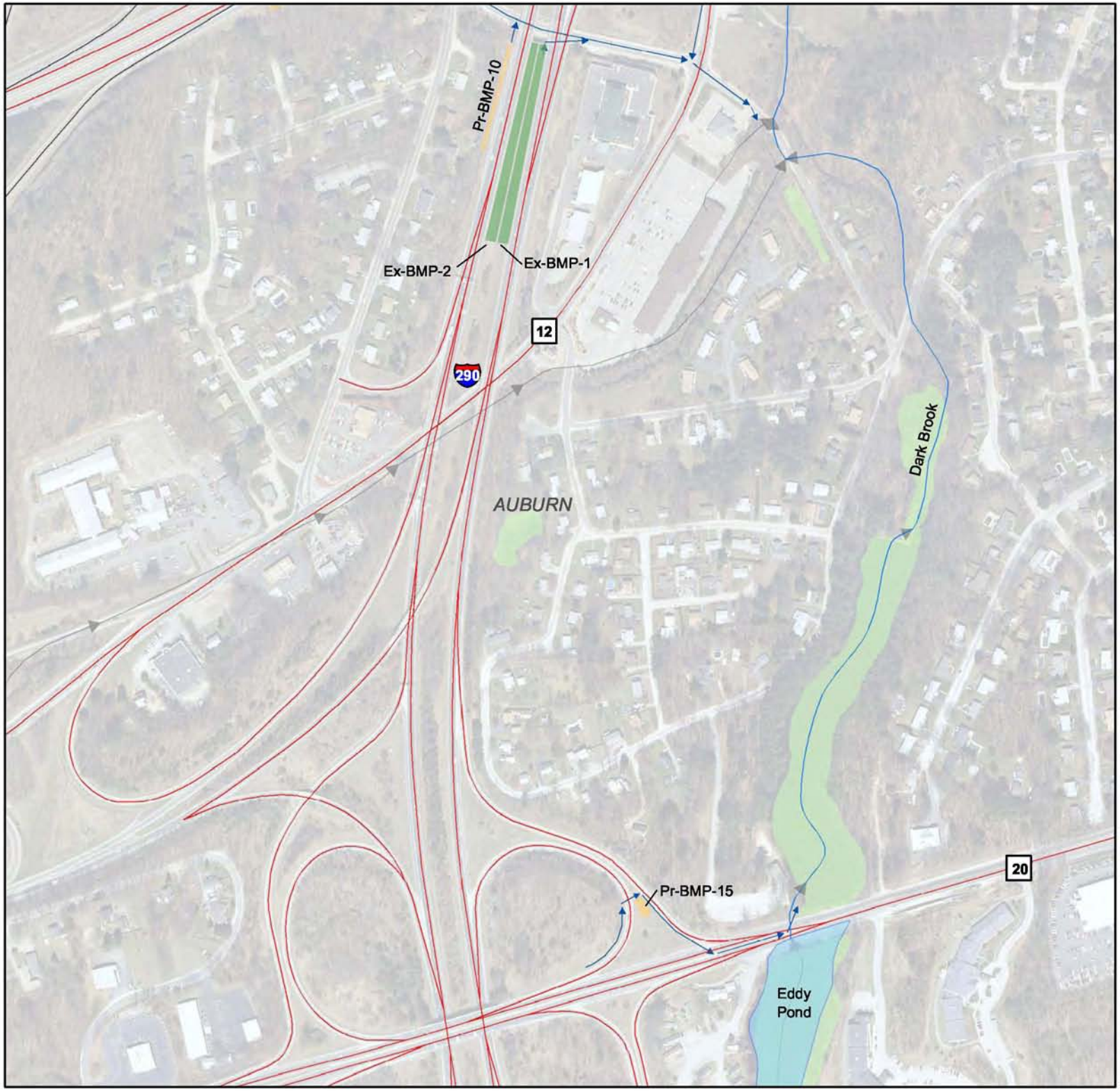

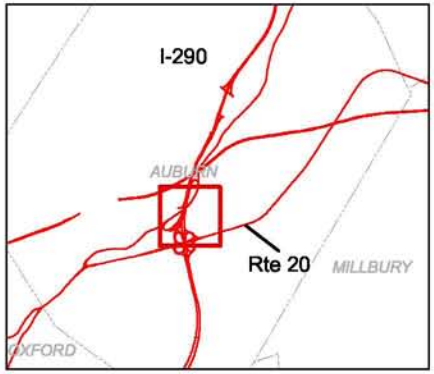

- Direction of Drainage
- Existing BMPs
- Proposed BMP - Basins
- Proposed BMP - Swales
- Impaired Water Bodies
- NWI Wetland Areas
- Impaired Stream Segments
- Non-Impaired Stream Segments
- MassDOT Roads in Urban Areas
- Town Boundaries

N

0 220 440 880

Feet

1 in = 440 feet

Figure 4

Dark Brook (MA51-16)
Existing and Proposed BMPs
Sheet 2 of 2

December 2011

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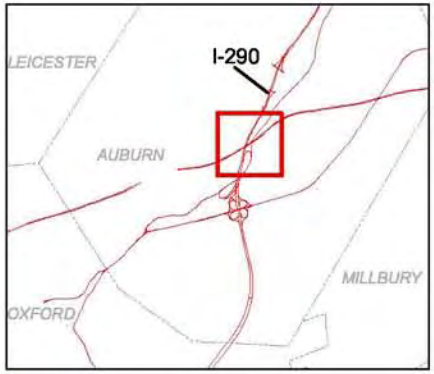

- Proposed BMP - Swales
- Proposed BMP - Basins
- Existing BMPs
- Impaired Stream Segments
- Impaired Water Bodies
- Non-Impaired Stream Segments
- NWI Wetland Areas
- MassDOT Roads in Urban Areas
- BMP Watersheds
- Town Boundaries

N

0 250 500 1,000

Feet

1 in = 500 feet

Figure 5

Dark Brook (MA51-16)
BMP Watersheds
Sheet 1 of 2

December 2011

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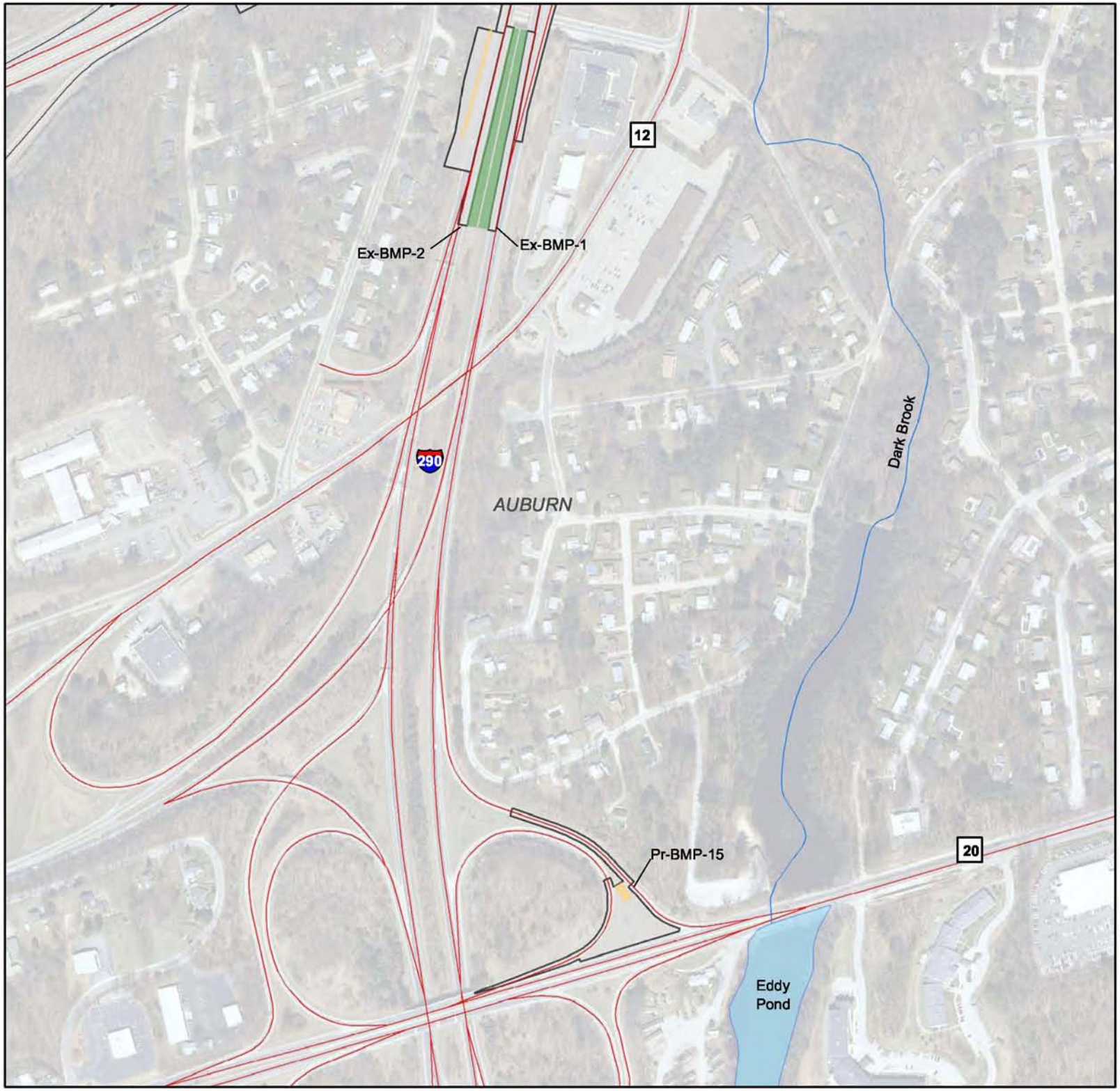

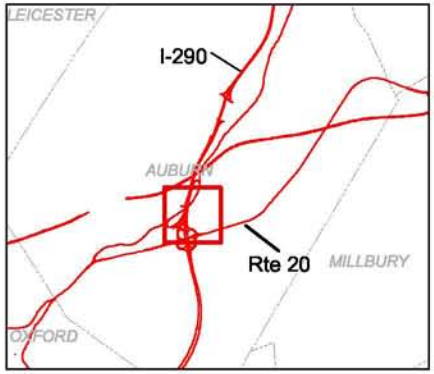

BMP Watersheds
Existing BMPs
Proposed BMP - Swales
Proposed BMP - Basins
Impaired Water Bodies
Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 220 440 880

Feet

1 in = 440 feet

Figure 6

Dark Brook (MA51-16)
BMP Watersheds
Sheet 2 of 2

December 2011

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Impaired Waters Assessment for Lee River (MA61-01)

Impaired Waterbody

Name: Lee River

Location: Swansea and Somerset, MA

Water Body ID: MA61-01

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): nutrients, organic

Proposed *Massachusetts Year 2010 Integrated List of Waters*: nutrient/eutrophication biological indicators, fecal coliform

Lee River (MA61-01) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009c), this 0.02 square mile segment area of Lee River (MA61-01) is impaired due to elevated fecal coliform bacteria.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.
- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (3)(b) 4 Bacteria*.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall

not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies/ 100 ml; b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department.

Site Description

Lee River is comprised of two segments, MA61-01 and MA61-02. The first segment of Lee River (MA61-01) is a 0.53-mile long warm water fishery located in Swansea and Somerset, MA (MassDEP, 2009c). This segment begins at its convergence with the non-impaired Lewin Brook and flows into a second segment, Lee River (MA61-02), when it passes under Route 6 (Rte 6). The subwatershed of Lee River is shown in Figure 1.

During site visits performed on October 5th and 6th 2011, it was determined that MassDOT's property that directly contributes storm water runoff to Lee River (MA61-01) is comprised of a portion of the westbound lanes of Rte 6 (see Figure 2). Where the river lays adjacent to Rte 6, the roadway is crowned at its center and a curb captures and directs storm water from the westbound lanes to catch basins which discharge to Lee River (MA61-01). No existing BMPs were identified in the Lee River (MA61-01) subwatershed during the site visits.

Assessment under BMP 7U

The following impairments for Lee River (MA61-01) have not been addressed by a TMDL: nutrients and organic enrichment/low DO. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- nutrients
- organic enrichment/low DO

As described below the impairment for pathogens is assessed separately.

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed

had less than 9% impervious cover, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction is then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

Because there are no existing BMPs for Lee River (MA61-01), there was no effective IC reduction to take into account when performing these calculations.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Lee River (MA61-01)):

Total Watershed and Subwatershed*

Watershed Area	2,471	acres
Impervious Cover (IC) Area	213	acres
Percent Impervious	8.6	%
IC Area at 9% Goal	223	acres
Target Reduction % in IC	0	%

*The subwatershed and the total watershed are the same in the case of Lee River (MA61-01).

Reductions Applied to DOT Direct Watershed

MassDOT's IC Area **Directly** Contributing to Impaired Segment	0.9	acres
MassDOT's Target Reduction in Effective IC	0	acres

For the subwatershed contributing to Lee River (MA61-01), no reduction in impervious area is warranted because the percent of impervious cover within the subwatershed meets the 9%

maximum IC target. This indicates that storm water from this watershed may not be the cause of the impairments.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in storm water vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to storm water management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in storm water runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in storm water runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform in urban storm water from other sources ranging between 14,000 and 17,000 have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other storm water systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the storm water system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.

- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from storm water runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other storm water systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for storm water that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive storm water management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive storm water management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for storm water discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of storm water management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing

storm water discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing storm water management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual storm water permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

Because the IC cover within the Lee River (MA61-01) subwatershed (8.6%) is less than the 9% maximum IC target, no additional treatment is warranted under the Impaired Waters program.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal watershed permits and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the storm water management plan and those under consideration for reducing the effective IC from MassDOT are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen

reductions to the maximum extent practicable and are consistent with the intent of its existing storm water permit and the applicable Pathogen TMDLs.

As an overall program, MassDOT will re-evaluate opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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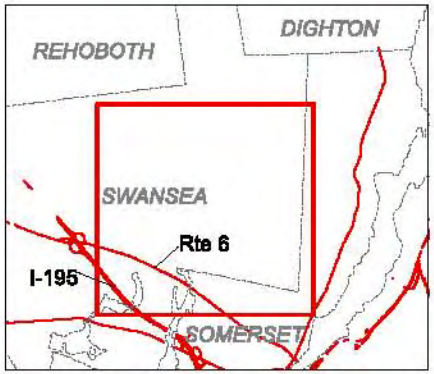

Lee River (MA61-01) Subwatershed
Impaired Stream Segments
Impaired Water Bodies
NWI Wetland Areas
MassDOT Urban Area Roads
Town Boundaries

N

0 1,000 2,000 4,000

Feet

1 in = 2,000 feet

Figure 1

Lee River (MA61-01) Subwatershed

October 2011

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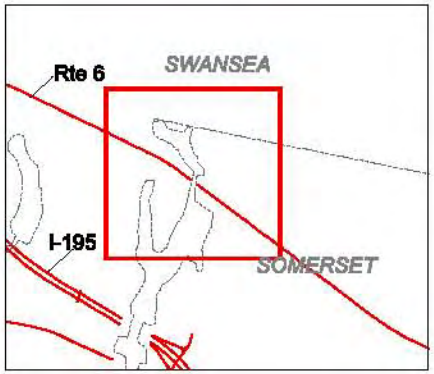

MassDOT Watershed
Impaired Stream Segments
Impaired Water Bodies
Non-Impaired Stream Segments
NWI Wetland Areas
MassDOT Urban Area Roads
Town Boundaries

N

0 250 500 1,000

Feet

1 in = 500 feet

Figure 2

Lee River (MA61-01)
Directly Contributing MassDOT Watershed

October 2011

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Impaired Waters Assessment for Dorothy Pond (MA51039)

Impaired Waterbody

Name: Dorothy Pond

Location: Millbury, MA

Water Body ID: MA51039

Impairments

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011): eurasian water milfoil (Myriophyllum spicatum), non-native aquatic plants, and turbidity

Dorothy Pond (MA51039) is listed as a Category 4a water body, "TMDL is completed", on MassDEP's final *Year 2010 Integrated List of Waters*. Dorothy Pond is covered in MassDEP's *Total Maximum Daily Loads (TMDL) of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002) as well as MassDEP's *Blackstone River Watershed 2003-2007 Water Quality Assessment Report* (MassDEP, 2010). The TMDL states:

"The lakes"…(including Dorothy Pond)…"were listed on the state '303d' list for a variety of pollutant and stressors including low dissolved oxygen, turbidity, nutrients, and over-abundance of nuisance aquatic plants. All of the pollutants and stressors are indicators of nutrient enriched systems, better known as the process of eutrophication. In freshwater systems the primary nutrient known to accelerate eutrophication is phosphorus. Therefore, in order to prevent further degradation in water quality and to ensure that each lake meets state water quality standards the TMDL establishes a phosphorus limit for each lake and outlines corrective actions to achieve that goal." (MassDEP 2002)

Therefore, MassDOT used this TMDL to assess DOT's potential contribution to the impairments of turbidity and the over-abundance of nuisance plants (Non-Native Aquatic Plants and Eurasian Water Milfoil) for Dorothy Pond.

As described below, MassDOT will consider the implementation of proposed BMPs for Dorothy Pond based on the TMDL Method (BMP 7R). This method determines the amount of treatment provided by existing and proposed BMPs to reach the required TMDL load reduction.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- *314 CMR 4.05 (5)(a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Dorothy Pond (MA51039) is a water body in Millbury, MA of approximately 136 acres with a contributing watershed area of approximately 2,413 acres as shown in Figure 1. For the purposes of this assessment, Dorothy Pond includes the main body of the pond and two smaller basins that flank Interstate 90 (I-90) as shown in Figure 2. Because there is a documented, historical sedimentation and water quality issue at Dorothy Pond, MassDOT included these smaller basins in the assessment even though the impaired waters GIS shapefile only indicates the main water body as impaired. Broad Meadow Brook, a non-impaired stream, drains into the northern-most basin of Dorothy Pond at the I-90 overpass, and three other unnamed tributaries drain into the pond including:

- a non-impaired stream drains into the west side of the basin south of I-90;
- a natural ditch drains into the east side of the main pond; and
- a non-impaired stream drains into the southwestern finger of the main pond.

Again, due to the documented, historical sedimentation and water quality issue at Dorothy Pond, MassDOT considered the section of I-90 that drains through the 1,400-foot long natural ditch as direct discharge in order to be conservative. The locations of Broad Meadow Brook and the three unnamed tributaries can be seen in Figure 2.

The watershed of MassDOT's property directly contributing storm water runoff to Dorothy Pond includes an approximately 7,500-foot stretch of I-90, covering a total area of 42.4 acres. Systems of piped catch basins along I-90 contribute storm water runoff to outfalls which drain to paved swales and conveyance ditches in the right-of-ways and eventually discharge directly to Dorothy Pond. The MassDOT watershed is shown in Figure 2.

There is a groundwater well located along the edge of the northern basin of Dorothy Pond. Its corresponding Zone II wellhead protection area covers a section of MassDOT property as shown in Figure 2. Proposed BMPs within the Zone II should comply with Standard 6 of the Massachusetts Stormwater Standards.

Assessment under BMP 7R (TMDL Method)

The TMDL for phosphorus for Selected Northern Blackstone Lakes addresses all of the pollutants of concern that Dorothy Pond is listed as impaired for: turbidity, non-native aquatic plants, and Eurasian Water Milfoil. Therefore, MassDOT assessed the contribution of phosphorus from MassDOT property directly draining to this water body to address these impairments. The assessment was completed using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002) can be summarized as follows in reference to Dorothy Pond:

- Pollutant of Concern: Phosphorus
- Impairment for Dorothy Pond Addressed in TMDL: Turbidity, Non-Native Aquatic Plants, and Eurasian Water Milfoil
- Applicable Waste Load Allocation (WLA): See Tables 2e (p. 43) and 4e (p. 59) of TMDL.
  - Description of Associated Land Use: Commercial/Industrial
  - Commercial/Industrial Land Use Current Load (TP): 60 kg/yr (132 lb/yr)
  - Commercial/ Industrial Land Use Target WLA (TP): 57 kg/yr (126 lb/yr)

  - Commercial/Industrial Area in Watershed: 88.7 ha (219 acres)
  - Commercial/Industrial Land Use Target Areal WLA (TP): 0.64 kg/ha/yr (0.58 lb/acre/yr)
- Applicable Recommendations: "Public Education, NPS Survey, Lake Management Plan, Residential BMPs, Urban BMPs, Highway BMPs, and In-Lake Management" (Table 7, page 66).

Estimated Loading from MassDOT

The loading of total phosphorus (TP) from MassDOT property contributing stormwater runoff to Dorothy Pond was estimated using the following assumptions and calculations:

- MassDOT estimates the TP loading from its impervious areas as 1.6 lb/acre/yr. This loading rate is based on data collected in a study of storm water runoff conducted by the United States Geological Survey (USGS) (Smith and Granato, 2010). The study analyzed storm water samples from 12 sites located on highways operated by MassDOT across Massachusetts between September 2005 and September 2007. Samples were taken under a variety of weather conditions during this period.
- MassDOT estimates the TP loading from its pervious areas as 0.6 lb/acre/yr. This loading rate is based on the loading rate for hayland provided in the United States Environmental Protection Agency's (EPA) document EPA 440/5-80-011, "Modeling phosphorus loading and Pond response under uncertainty: a manual and compilation of export coefficients" (Reckhow, 1980). Hayland was chosen to represent the pervious right-of-way areas which are typically cleared areas that are mowed only once per year.
- MassDOT calculated its total estimated TP loading rate using the estimated loading rates listed above. MassDOT property contributing stormwater directly to Dorothy Pond is 21.9 acres of impervious area and 20.5 acres of pervious area. The TP loading is 47 lb/yr without accounting for existing BMPs or treatment throughout the watershed.
- MassDOT calculated its target TP WLA using the TMDL target areal WLA of 0.58 lb/ac/yr and the total area of MassDOT property within the TMDL watershed directly draining to Dorothy Pond (42.4 acres). The target TP WLA for MassDOT runoff is 24 lb/yr.

Assessment and Mitigation Plan

MassDOT calculated its current TP loading rate (47 lb/yr) and its target TP WLA (24 lb/yr) using values provided in MassDEP's TMDL report. The difference between these two values represents the target reduction in TP that MassDOT should aim to achieve to comply with the WLA. For the watershed directly contributing to Dorothy Pond, this target reduction is 23 lb/yr, or 49%. As explained in BMP 7R, MassDOT's pollutant loading analysis provides only a preliminary estimate of the level of pollutant reductions that may be recommended. In light of the variability of data on stormwater discharges, MassDOT will rely on a variety of other factors apart from numeric guidelines, including site constraints, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

During a site visit on October 26, 2011, no existing BMPs were recognized at Dorothy Pond. There are five paved swales, eight natural ditches, and a number of very small, natural waterways along the highway. However, none of the swales or ditches are designed according to the MassDEP Stormwater Handbook, and they do not provide significant improvement in water quality for stormwater runoff. Thus, there is currently no TP reduction being provided.

Next Steps

Because no TP reduction is currently being provided, MassDOT will consider locations where additional BMPs could be implemented to reach the required reduction of 23 lb/yr.

During a site visit on October 26th, 2011, sixteen proposed BMP locations were identified. The BMPs proposed below were identified based on MassDOT property that had dry ground and were determined to be feasible within site constraints and without a great amount of reconstruction. Ditches that had standing water or flowing water were not chosen for BMP locations since the infiltration capabilities would be minor. The locations for all potential BMPs were identified along the MassDOT right-of-ways of I-90.

As shown in Figures 3a and 3b, some of the proposed BMPs are stand-alone and some lay in series. The direction of storm water flow through the BMPs and the location of the Zone II wellhead protection area are shown in these figures. For proposed BMPs which lay in series, the performance of the previous BMP is taken into account when determining phosphorus removal that will be achieved. The individual BMP watersheds are shown in Figures 4a and 4b.

The phosphorus removals provided by MassDOT BMPs under the proposed conditions described below are listed in Table 1. Under these conditions, the proposed BMPs will achieve a total load reduction of 8.2 lb/year.

Pr-BMP-1

An individual system of catch basins (meaning there is no stormwater trunk-line) along I-90 EB conveys stormwater runoff to an existing ditch along I-90. Sheet flow from the middle and right lanes also contribute runoff to the ditch. The existing ditch is approximately 244 feet long with vegetation consisting of plants and dead leaves. MassDOT will consider constructing an infiltration swale in this channel by maintaining its existing, approximate dimensions of a bottom width of 3 feet and side slopes of 1 vertical to 1 horizontal (1:1) and installing check dams. During the design phase, if it is feasible to increase the side slopes to 1:2, this would be preferable. Pr-BMP-1 will achieve 24% phosphorus removal.

Location for Pr-BMP-1, infiltration swale.

Pr-BMP-2

An individual system of catch basins along I-90 EB conveys stormwater runoff to an existing ditch along I-90. Sheet flow from the middle and right lanes also contribute runoff to the ditch, and the ditch also receives runoff from Pr-BMP-1 directly uphill. The existing ditch is approximately 82 feet long with vegetation consisting of plants and dead leaves. There are rocks and some trash in the ditch. MassDOT will consider constructing an infiltration swale in this channel by removing the rocks and trash, maintaining its existing, approximate dimensions of a bottom width of 2 feet and side slopes of 1:1, and installing check dams. During the design phase, if it is feasible to increase the side slopes to 1:2, this would be preferable. Pr-BMP-2 will achieve 11% phosphorus removal.


Location for Pr-BMP-2, infiltration swale.

Pr-BMP-3

An individual system of catch basins along I-90 EB conveys stormwater runoff to an existing ditch along I-90. Sheet flow from the middle and right lanes also contribute runoff to the ditch. The existing ditch is approximately 320 feet long with heavy vegetation. MassDOT will consider constructing an infiltration swale in this ditch by maintaining its existing, approximate dimensions of a bottom width of 2 feet and side slopes of 1:2 and installing check dams. Pr-BMP-3 will achieve 22% phosphorus removal.

Location for Pr-BMP-3, infiltration swale.

Pr-BMP-4

An individual system of catch basins along I-90 EB conveys stormwater runoff to an existing paved swale along I-90. Sheet flow from the middle and right lanes also contribute runoff to the swale, and the swale also receives runoff from Pr-BMP-3 directly uphill. The existing swale's pavement is broken in many locations due to erosion and the swale has some steep-sloped sections. The existing swale is approximately 110 feet long with branches, rocks, and debris in its path. The section of swale between the end of pavement and the 24" culvert under Millbury Ave is filled with rocks, sediment, and debris. The 24" culvert is approximately 70% filled. MassDOT will consider constructing an infiltration swale by removing the broken pavement, rocks, and debris, planting vegetation, and installing check dams. The proposed infiltration swale would maintain its existing, approximate dimensions of a bottom width of 2 feet and side slopes of 1:1. During the design phase, if it is feasible to increase the side slopes to 1:2, this would be preferable. Pr-BMP-5 will achieve 14% phosphorus removal.

Location for Pr-BMP-4, infiltration swale.

Location for Pr-BMP-4, infiltration swale. Close-up of section of swale in poor condition.

Pr-BMP-5

A paved ditch conveys stormwater runoff from the middle and right lanes of I-90 EB down a steep slope to the bottom of the right-of-way to an existing paved swale. This paved swale also receives stormwater runoff from the Pr-BMP-4 via the 24" culvert under Millbury Ave. The existing paved swale is approximately 103 feet long and has potential as a location for an infiltration swale. MassDOT will consider constructing an infiltration swale in this area by removing the pavement and constructing a swale with a bottom width of 2 feet and side slopes of 1:1 and installing check dams. During the design phase, if it is feasible to increase the side slopes to 1:2, this would be preferable. Pr-BMP-5 will achieve 36% phosphorus removal.

Pr-BMP-6

The low-point of the MassDOT watershed draining to Dorothy Pond on I-90 EB has three individual systems of catch basins that convey stormwater runoff to the right-of-way on the west side of the pond. Sheet flow from the middle and right lanes also contribute runoff to the right-of-way. Stormwater runoff currently flows into an existing, small waterway at the bottom of slope that runs along the adjacent property owner's land and drains directly into Dorothy Pond. There is potential to construct an infiltration swale higher up on the slope than the existing waterway, at the base of the stormwater outfall structures. There are some trees and brush currently in the right-of-way. MassDOT will consider clearing some of the brush and excavating to construct an infiltration swale with a bottom width of 2 feet and side slopes of 1:1 and installing check dams to intercept the stormwater before it reaches the existing, small waterway. During the design phase, if it is feasible to construct the side slopes as 1:2, this would be preferable. Because Pr-BMP-6 is located within a Zone II wellhead protection area, this BMP must comply with Standard 6 of the Stormwater Regulations. Pretreatment, such as deep-sump catch basins, is necessary in order to remove at least 44% total suspended solids (TSS) before entering the infiltration swale, otherwise the swale must be lined. Pr-BMP-6 will achieve 21% phosphorus removal.

Location for Pr-BMP-6, infiltration swale.

Location for Pr-BMP-6, infiltration swale. Looking northwest.

Pr-BMP-7a

An individual system of catch basins along I-90 EB conveys stormwater runoff to an existing ditch along I-90. Sheet flow from the middle and right lanes also contribute runoff to the ditch. The existing ditch is approximately 465 feet long with vegetation, rocks, dead leaves, and some trash. MassDOT will consider constructing an infiltration swale in this ditch by maintaining its existing, approximate dimensions of a bottom width of 2 feet and side slopes of 1:1 and installing check dams. During the design phase, if it is feasible to increase the side slopes to 1:2, this would be preferable. Pr-BMP-7a will achieve 36% phosphorus removal.

Location for Pr-BMP-7a, infiltration swale.

Pr-BMP-7b

There is an existing grassy section of land adjacent to I-90 that does not qualify as a vegetated filter strip but could be converted into a vegetated filter strip. Sheet flow from the middle and right lanes of I-90 currently contribute runoff to the section of land. The existing area is approximately 9,130 square feet and has low slopes. MassDOT will consider extending this grass cover to a minimum of 25 feet in length from the highway so this area qualifies as a vegetated filter strip. Pr-BMP-7b will achieve 98% phosphorus removal.

Pr-BMP-8

An individual system of catch basins along I-90 EB conveys stormwater runoff to an existing paved swale along I-90. The existing swale is approximately 345 feet long and the pavement is overgrown with grass in some locations. MassDOT will consider constructing an infiltration swale by removing the paved swale and installing a slightly larger swale at a minimum of 25 feet from the highway edge with a bottom width of 3 feet and side slopes of 1:2 and installing check dams. This proposed infiltration swale will receive runoff from Pr-BMP-7a (infiltration swale) directly uphill through a culvert under Oak Pond Ave and Pr-BMP-7b (vegetated filter strip) directly adjacent. Because a section of Pr-BMP-8 is located within a Zone II wellhead protection area, this BMP must comply with Standard 6 of the Stormwater Regulations. Pretreatment, such as deep-sump catch basins, is necessary in order to remove at least 44% total suspended solids (TSS) before entering the infiltration swale, otherwise the swale must be lined. Pr-BMP-8 will achieve 36% phosphorus removal.

Location for Pr-BMP-8, infiltration swale.

Pr-BMP-9

A paved ditch conveys stormwater runoff from the middle and right lanes of I-90 WB at the Wheelock Ave overpass down a slope to the right-of-way area. Sheet flow from the middle and right lanes also contribute runoff to this area. The right-of-way area has heavy vegetation, but there is a trail that stormwater runoff has formed during large storms. MassDOT will consider excavating to construct an infiltration swale in this area 177 feet in length with a bottom width of 2 feet and side slopes of 1:2 and installing check dams. Pr-BMP-9 will achieve 36% phosphorus removal.

Location for Pr-BMP-9, infiltration swale.

Pr-BMP-10a

An individual system of catch basins along I-90 WB conveys stormwater runoff to an existing ditch along I-90. Sheet flow from the middle and right lanes also contribute runoff to the ditch. The existing ditch is approximately 762 feet long with vegetation, rocks, dead leaves, and some trash. MassDOT will consider constructing an infiltration swale in this ditch by maintaining its existing, approximate dimensions of a bottom width of 2 feet and side slopes of 1:1 and installing check dams. During the design phase, if it is feasible to increase the side slopes to 1:2, this would be preferable. Pr-BMP-10a will achieve 36% phosphorus removal.

Location for Pr-BMP-10a, infiltration swale.

Pr-BMP-10b

There is an existing grassy section of land adjacent to I-90 that does not qualify as a vegetated filter strip but could be converted into a vegetated filter strip. Sheet flow from the middle and right lanes of I-90 currently contribute runoff to the section of land. The existing area is approximately 8,010 square feet and has low slopes. MassDOT will consider extending this grass cover to a minimum of 25 feet in length from the highway so this area qualifies as a vegetated filter strip. Pr-BMP-10b will achieve 99% phosphorus removal.

Pr-BMP-11

An individual system of catch basins along I-90 WB conveys stormwater runoff to an existing paved swale along I-90. The existing swale is approximately 442 feet long. MassDOT will consider constructing an infiltration swale by removing the paved swale and installing a slightly larger swale at a minimum of 25 feet from the highway edge with a bottom width of 3 feet and side slopes of 1:2 and installing check dams. This proposed infiltration swale will receive runoff from Pr-BMP-10a (infiltration swale) directly uphill and Pr-BMP-10b (vegetated filter strip) directly adjacent. Because Pr-BMP-11 is located within a Zone II wellhead protection area, this BMP must comply with Standard 6 of the Stormwater Regulations. Pretreatment, such as deep-sump catch basins, is necessary in order to remove at least 44% total suspended solids (TSS) before entering the infiltration swale, otherwise the swale must be lined. Pr-BMP-11 will achieve 36% phosphorus removal.

Pr-BMP-12

An individual system of catch basins along I-90 WB conveys stormwater runoff to an existing paved and earthen swale along I-90. Sheet flow from the middle and right lanes also contribute runoff to the swale. The existing swale is approximately 849 feet long and is mostly paved, with some areas of an earthen bottom. Some areas are heavy with vegetation, rocks, and leaves. MassDOT will consider constructing an infiltration swale in this area by maintaining its existing, approximate dimensions of a bottom width of 2 feet and side slopes of 1:1 and installing check dams. During the design phase, if it is feasible to increase the side slopes to 1:2, this would be preferable. Pr-BMP-12 will achieve 31% phosphorus removal.


Location for Pr-BMP-12, infiltration swale.

Pr-BMP-13

Two individual systems of catch basins and a paved ditch along I-90 WB convey stormwater runoff to an existing paved swale along I-90. Sheet flow from the middle and right lanes also contribute runoff to the swale, and the swale also receives runoff from Pr-BMP-12 directly uphill through a 24" culvert that runs under Millbury Ave. The existing swale is approximately 759 feet long and has a lot of dead branches, dead leaves, and some rocks in its path. MassDOT will consider constructing an infiltration swale in this area by removing the pavement and debris and maintaining its existing, approximate dimensions with a bottom width of 3 feet and side slopes of 1:1 and installing check dams. During the design phase, if it is feasible to increase the side slopes to 1:2, this would be preferable. Because a section of Pr-BMP-13 is located within a Zone II wellhead protection area, this BMP must comply with Standard 6 of the Stormwater Regulations. Pretreatment, such as deep-sump catch basins, is necessary in order to remove at least 44% total suspended solids (TSS) before entering the infiltration swale, otherwise the swale must be lined. Pr-BMP-13 will achieve 21% phosphorus removal.


Location for Pr-BMP-13, infiltration swale.

Pr-BMP-14

An individual system of catch basins along I-90 WB conveys stormwater runoff to an existing paved swale along I-90. Sheet flow from the middle and right lanes also contribute runoff to the swale. The existing swale is approximately 223 feet long and is filled with vegetation and dead leaves. MassDOT will consider constructing an infiltration swale in this area by maintaining its existing, approximate dimensions of a bottom width of 2 feet and side slopes of 1:1 and installing check dams. During the design phase, if it is feasible to increase the side slopes to 1:2, this would be preferable. Pr-BMP-14 will achieve 36% phosphorus removal.

Location for Pr-BMP-14, infiltration swale.

Conclusions

The entire watershed of MassDOT-owned roadways was investigated to identify existing BMPs and locations for new BMPs to be implemented. The proposed BMP recommendations are presented in the sections above and summarized as follows:

Table 1. Summary of Proposed BMP Recommendations

BMP Name	BMP Type	TP Removal	TP Removal (lb/yr)	Notes for Consideration during design**
Pr-BMP-1*	Infiltration Swale	24%	0.44	Convert existing ditch
Pr-BMP-2*	Infiltration Swale	11%	0.24	Convert existing ditch
Pr-BMP-3*	Infiltration Swale	22%	0.41	Convert existing ditch
Pr-BMP-4*	Infiltration Swale	14%	0.32	Convert existing paved (but heavily eroded) swale
Pr-BMP-5*	Infiltration Swale	36%	0.81	Convert existing paved ditch
Pr-BMP-6	Infiltration Swale	21%	0.45	Excavate and convert existing vegetated area; pretreatment (deep sump CBs) is necessary because this area is in a Zone II
Pr-BMP-7a*	Infiltration Swale	36%	0.66	Convert existing ditch
Pr-BMP-7b*	Vegetated Filter Strip	98%	0.71	Convert existing grassy area
Pr-BMP-8*	Infiltration Swale	36%	0.99	Convert existing paved swale; pretreatment (deep sump CBs) is necessary because this area is in a Zone II
Pr-BMP-9	Infiltration Swale	36%	0.20	Excavate/convert existing vegetated area
Pr-BMP-10a*	Infiltration Swale	36%	0.61	Convert existing ditch
Pr-BMP-10b*	Vegetated Filter Strip	99%	0.54	Convert existing grassy area
Pr-BMP-11*	Infiltration Swale	36%	0.56	Convert existing paved swale; pretreatment (deep sump CBs) is necessary because this area is in a Zone II
Pr-BMP-12*	Infiltration Swale	31%	0.67	Convert existing paved and earthen swale
Pr-BMP-13*	Infiltration Swale	21%	0.68	Convert existing paved swale; pretreatment (deep sump CBs) is necessary because this area is in a Zone II
Pr-BMP-14	Infiltration Swale	36%	0.17	Convert existing paved swale
Total			**8.22**	

*Denotes a BMP in series with another BMP.
**See section titled Next Steps for more details on notes.

This assessment of Dorothy Pond (MA510369) has shown that, under the proposed conditions, the proposed BMPs collectively provide 36% of the target load reduction in phosphorus. The following

table summarizes the load reduction of the proposed BMPs. Attached Figures 3a and 3b show the locations of the proposed BMPs.

Load Reduction	
Total Estimated Load in MassDOT Contributing Property	47 lb/yr
Waste Load Allocation for MassDOT's Directly Contributing Property	24 lb/yr
MassDOT's Required Load Reduction	23 lb/yr
Phosphorus Load Reduced by Proposed Conditions	8.5 lb/yr

As described above, the BMPs proposed in this assessment were determined to be feasible within the current right of way and road drainage constraints. Additional reductions in phosphorus load were determined to not be practicable due to site constraints including limited available land, existing natural wetlands, and the evidence of a high water table in existing conveyance ditches. Because the proposed conditions in this assessment only account for a portion of the load reduction required, MassDOT will consider investigating the drainage systems and soil conditions along I-90 to determine if it is feasible to implement more proposed BMPs for treatment. During design, the consultants will review with MassDOT the proposed conditions presented in this assessment and also any additional drainage modifications that could be made to I-90 drainage systems to provide additional treatment to the maximum extent practicable. MassDOT will also consider replacing the catch basins on I-90 within the MassDOT directly contributing watershed with deep sump catch basins that have outlet pipes at a low slope in order to reduce high velocities flowing into the proposed infiltration swales. Many of the stormwater outlet pipes were designed with very steep slopes which have contributed to erosion at the base of the embankments. In addition, many of the existing stormwater outlet pipes discharging to the right-of-ways have eroded away, creating sinkholes in the I-90 embankments.

MassDOT will now work with its design consultants to develop design plans for the proposed BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide treatment to the maximum extent practicable.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the load reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

References

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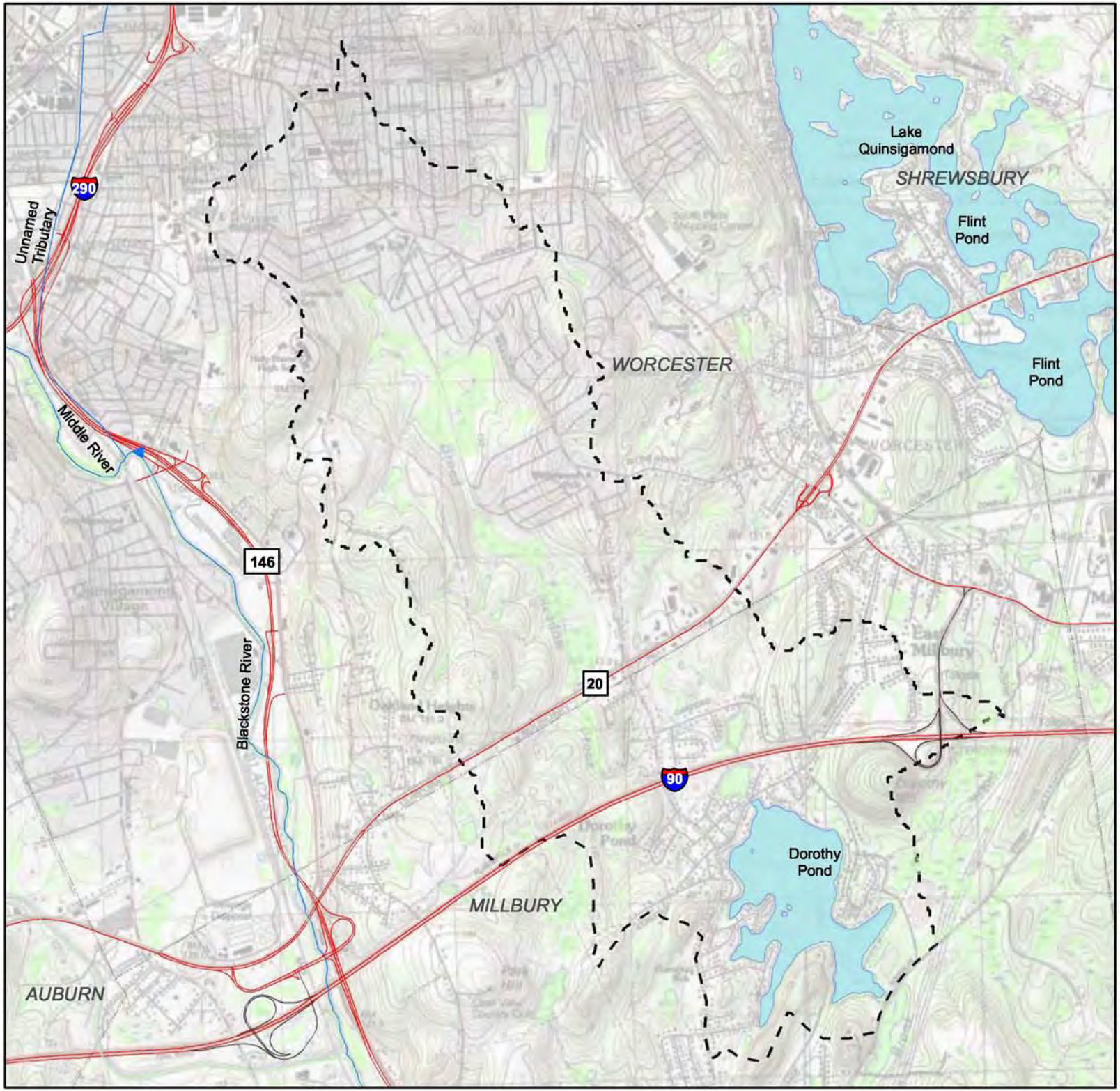

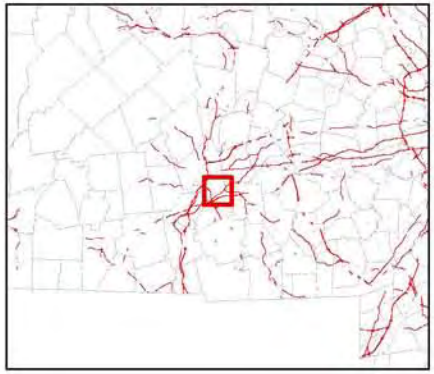

Dorothy Pond (MA51039) Subwatershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 1,250 2,500 5,000

Feet

1 in = 2,500 ft

Figure 1

Dorothy Pond (MA51039) Subwatershed

December 2011

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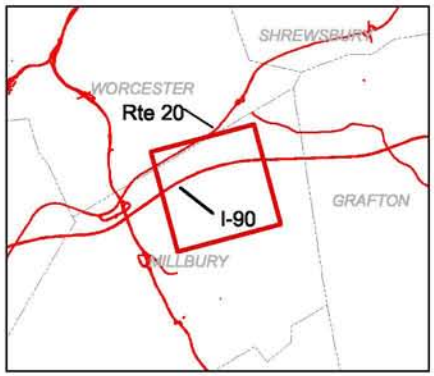

Direction of Drainage
MassDOT Watershed
Impaired Water Bodies
NWI Wetland Areas
DEP Approved Zone II
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 500 1,000 2,000

Feet

1 in = 1,000 feet

Figure 2

Dorothy Pond (MA51039)
Directly Contributing MassDOT Watershed

December 2011

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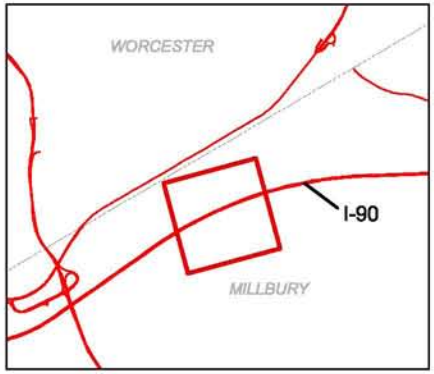
massDOT



Proposed BMP - Swales
Direction of Drainage
Impaired Water Bodies
DEP Approved Zone II
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 200 400 800

Feet

1 in = 400 feet

Figure 3a

Dorothy Pond (MA51039)
Proposed BMPs
Sheet 1 of 2

December 2011

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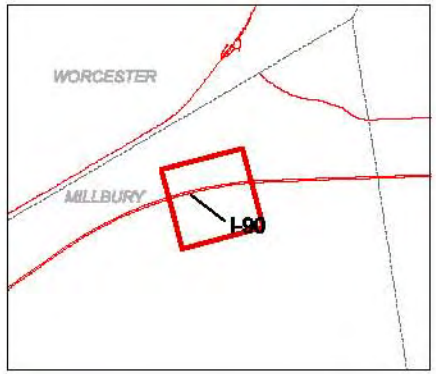
massDOT



- Proposed BMP - Vegetated Filter Strips
- Proposed BMP - Swales
- Direction of Drainage
- Impaired Water Bodies
- Impaired Stream Segments
- Non-Impaired Stream Segments
- DEP Approved Zone II
- MassDOT Roads in Urban Areas
- Town Boundaries

N

0 175 350 700

Feet

1 in = 350 feet

Figure 3b

Dorothy Pond (MA51039)
Proposed BMPs
Sheet 2 of 2

Decemberr 2011

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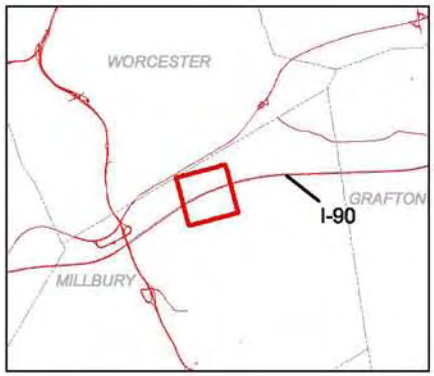
massDOT



Proposed BMP - Swales
Direction of Drainage
BMP Watersheds
Impaired Water Bodies
DEP Approved Zone II
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 200 400 800

Feet

1 in = 400 feet

Figure 4a

Dorothy Pond (MA51039)
BMP Watersheds
Sheet 1 of 2

December 2011

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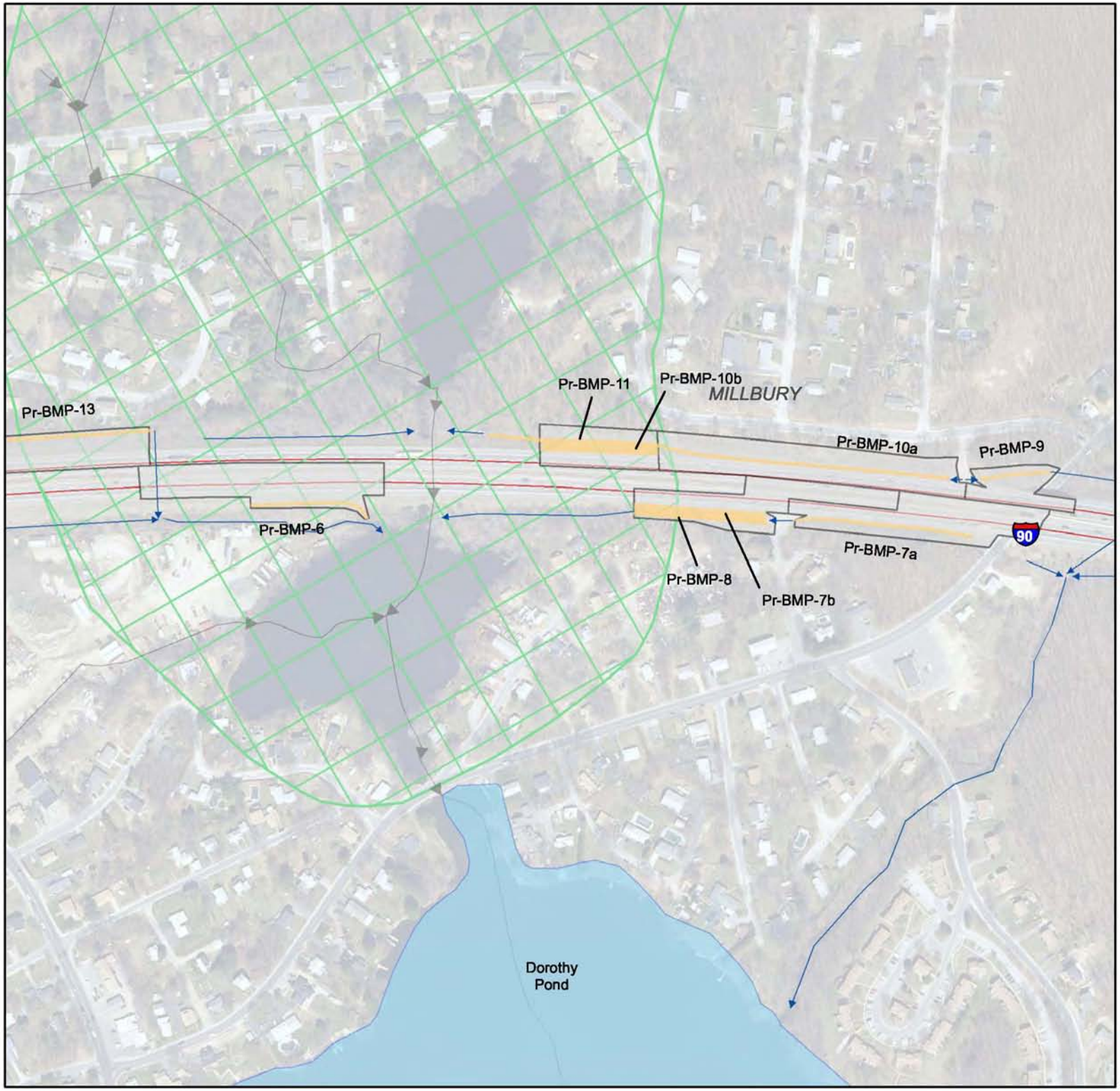

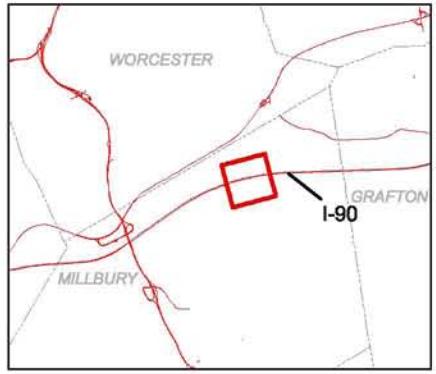

Proposed BMP - Vegetated Filter Strips
Proposed BMP - Swales
Direction of Drainage
BMP Watersheds
Impaired Water Bodies
Impaired Stream Segments
Non-Impaired Stream Segments
DEP Approved Zone II
MassDOT Roads in Urban Areas
Town Boundaries

N

0 175 350 700

Feet

1 in = 350 feet

Figure 4b

Dorothy Pond (MA51039)
BMP Watersheds
Sheet 2 of 2

December 2011

Moving Massachusetts Forward
massDOT

Attachment 2:
Impaired Waters Progress Reports

Impaired Waters Assessment for Kettle Brook (MA51-01) – Progress Report

Impaired Waterbody

Name: Kettle Brook

Location: Leicester, Auburn, and Worcester, MA

Water Body ID: MA51-01

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): cause unknown, nutrients, organic enrichment/low DO, flow alteration, pathogens

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010b): cause unknown, nutrients, organic enrichment/Low DO, flow alteration, pathogens, debris/floatables/trash

Kettle Brook (MA51-01) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Blackstone River Watershed 2003-2007 Water Quality Assessment Report* (MassDEP, 2010a), a 0.5-mile reach of Kettle Brook, which flows through Curtis Pond North (MA51032), is impaired due to non-native aquatic macrophyte infestation. This report also states that Smiths Pond (MA51156) and Stoneville Pond (MA51160), which are located along Kettle Brook, will now be considered run of the river impoundments and will no longer be assessed as their own lake segments. For the purposes of this assessment we only focused on the Kettle Brook segment. The other segments will be considered in separate assessments to be consistent with the 2008 list of integrated waters.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b) 5 Solids*. These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- *314 CMR 4.05 (5) (b) Bottom Pollutants or Alterations*. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.
- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the

Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.

- *314 CMR 4.05 (5)(e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.
- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (3)(b) 4 Bacteria*.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
    - b. For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Kettle Brook begins at Waite Pond (MA 51170), continues 1.8 miles and then flows through Smiths Pond, continues 2 miles before it flows through Stoneville Pond (MA51160), flows another 1.1 miles until it merges with Dark Brook (MA51-16), continues 0.9 miles until it flows through Leesville Pond (MA51087) and Curtis Ponds North (MA51032) and South (MA51033). The 0.5-mile reach of Kettle Brook through Curtis Pond North is classified as impaired according to the *Blackstone River Watershed 2003-2007 Water Quality Assessment Report*.

MassDOT's property directly contributing stormwater runoff to Kettle Brook is comprised of portions of Rte 9, Rte 12, and I-290 (see Figure 2). The subwatershed of Kettle Brook is shown in Figure 1. Route 122 does not directly contribute to Kettle Brook.

Assessment under BMP 7U

The following impairments for Kettle Brook have not been addressed by a TMDL: cause unknown, nutrients, organic enrichment/Low DO, flow alteration and debris/floatables/trash. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of storm water on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- cause unknown
- nutrients
- organic enrichment/low DO
- flow alteration
- debris/floatables/trash

As described below the impairment for pathogens is assessed separately.

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% impervious cover, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the

USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Kettle Brook (MA51-01)):

Total Watershed		
Watershed Area	20,855	acres
Impervious Cover (IC) Area	2,545	acres
Percent Impervious	12.2	%
IC Area at 9% Goal	1,877	acres
Target Reduction % in IC	26.2	%

Subwatershed		
Subwatershed Area	7,159	acres
Impervious Cover (IC) Area	1,001	acres
Percent Impervious	14.0	%
IC Area at 9% Goal	644	acres
Target Reduction % in IC	35.6	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	20.4	acres
MassDOT's Target Reduction in Effective IC (35.6% of DOT Directly Contributing IC)	7.3	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairment. The subwatershed should target a reduction of its effective IC by 35.6% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 7.3 acres of effective IC.

Existing BMPs

MassDOT has two existing BMPs in the Kettle Brook subwatershed that are mitigating potential storm water quality impacts prior to discharge to Kettle Brook. Figure 3 shows the BMP locations. In our analysis, existing BMPs receive credit for removing the effect of IC depending on their type, size relative to the IC that they process, and the local soil conditions. The soil in the area associated with the existing BMPs is characterized as hydrologic group B (loam).

Ex-BMP-1
The roadway of I-290 eastbound is curbed along much of its length with 3 inch, sloped curbs. It appears that in large storm events, sheet flow may flow over this curb and into a low area alongside the highway, that is well-vegetated with tall plants (3 foot average) and leafy debris. This area has no standing water and appears to infiltrate storm water efficiently. This area measures about 50 feet by 200 feet, and water would have to fill to a height of 2 to 3 feet before flowing out over land. This low area was characterized as an infiltration basin with an effective IC removal efficiency of 97%, providing a reduction of 0.86 acres of IC.

Ex-BMP-1. Infiltration Basin.

Ex-BMP-2
A second low area was located along the I-290 eastbound roadway. Although this portion of I-290 also has a sloped, 3 inch curb, the low, heavily-vegetated area adjacent to the eastbound roadway appears to receive storm water as sheet flow from the roadway. It does not receive storm water via ditch conveyance. This area measures about 50 feet by 40 feet, and water would have to fill to a height of 2 feet before flowing out over land. This area was characterized as an infiltration basin with an effective IC removal efficiency of 97%, providing a reduction of 0.22 acres of IC.

Ex-BMP-2. Infiltration Basin.

Summary of Existing BMPs

BMP Name	BMP Type	Soil Type	Depth of Runoff Treated (inches)	IC Area Treated (acres)	Reduction of Effective IC* (%)	Reduction of Effective IC (acres)
Ex-BMP-1	Infiltration Basin	B - Loam 0.52 in/hr	5.0	0.88	97	0.86
Ex-BMP-2	Infiltration Basin	B - Loam 0.52 in/hr	4.1	0.22	97	0.22
Total						1.07

*Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT 2011)

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 7.3 acres, MassDOT will consider the implementation of additional BMPs.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in storm water vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to storm water management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in storm water runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in storm water runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform in urban storm water from other sources ranging between 14,000 and 17,000 have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other storm water systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the storm water system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from storm water runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other storm water systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for storm water that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive storm water management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive storm water management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for storm water discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of storm water management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing storm water discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit

connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing storm water management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual storm water permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

The entire watershed of MassDOT-owned roadways was investigated to identify existing BMPs. This assessment of Kettle Brook has shown that the existing BMPs provide about 15% of the target reduction in IC.

The following table summarizes the effective IC removal of the existing BMPs.

Impervious Cover Reduction		
IC in Directly Contributing Watershed	20.4	acres
Required Reduction in Effective IC	7.3	acres
IC Effectively Reduced by Existing BMPs	1.1	acres
IC Remaining to Mitigate with Proposed BMPs	6.2	acres

To achieve the targeted reduction in IC, removal of an additional 6.2 acres of effective IC is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal watershed permits and pathogen

TMDLs for Massachusetts waters that the BMPs outlined in the storm water management plan and those under consideration for reducing the effective IC from MassDOT are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing storm water permit and the applicable Pathogen TMDLs.

As an overall program, MassDOT will re-evaluate opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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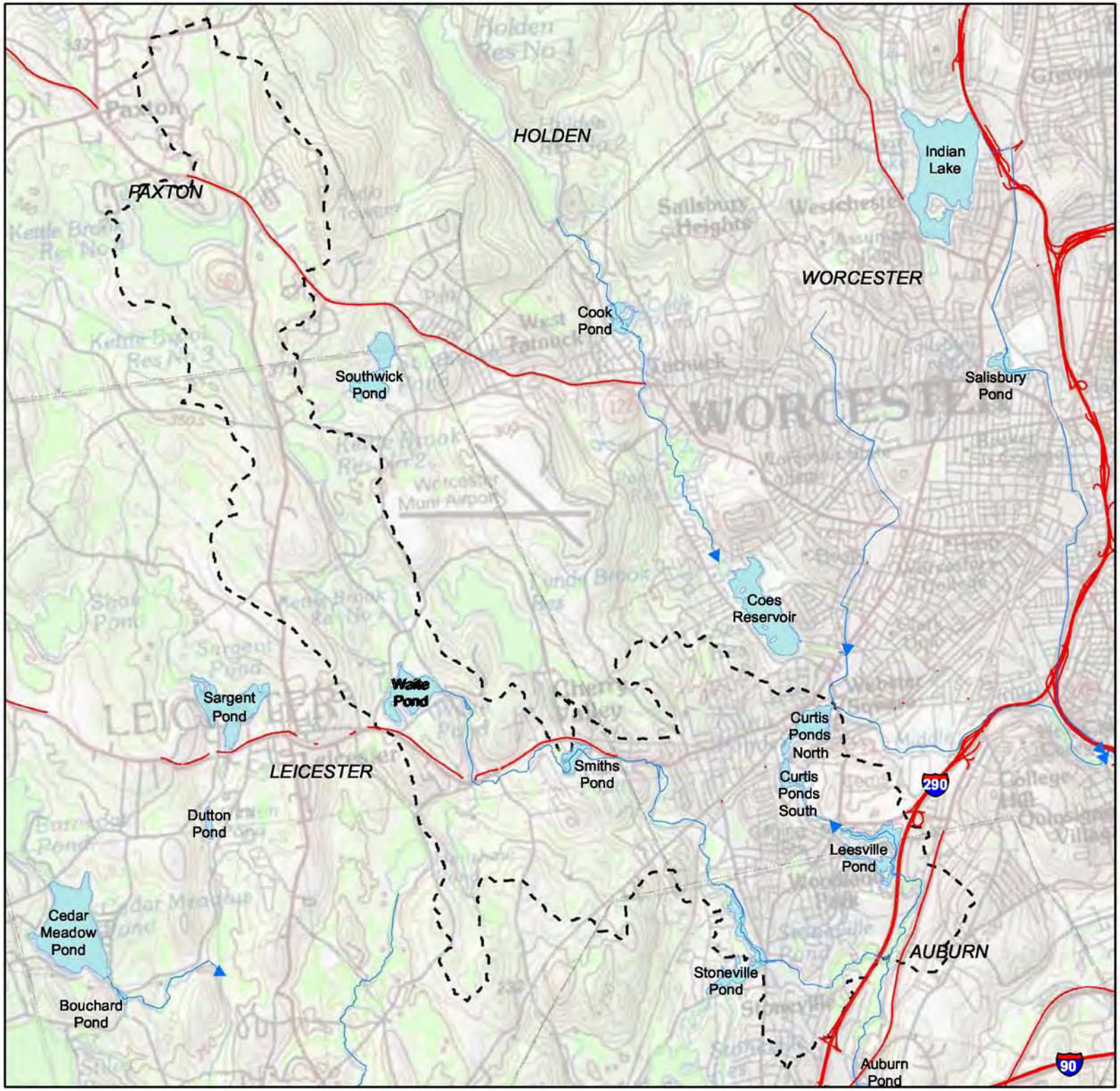
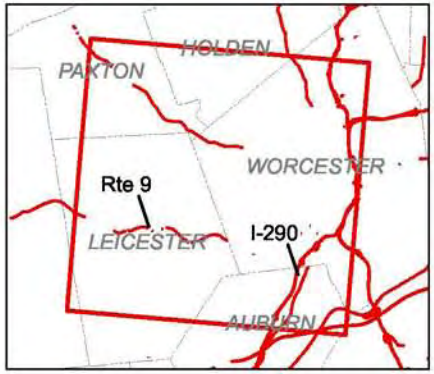




Kettle Brook (MA51-01) Subwatershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
MassDOT Urban Area Roads
Town Boundaries

N

0 2,500 5,000 10,000
Feet

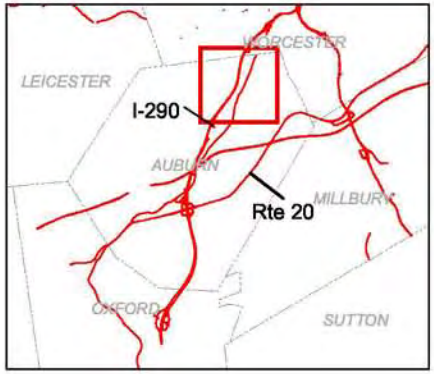
1 in = 5,000 feet

Figure 1

Kettle Brook (MA51-01) Subwatershed

December 2011

Moving Massachusetts Forward
massDOT



MassDOT Watershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 500 1,000 2,000

Feet

1 in = 1,000 feet

Figure 2
Kettle Brook (MA51-01)
Directly Contributing MassDOT Watershed

December 2011

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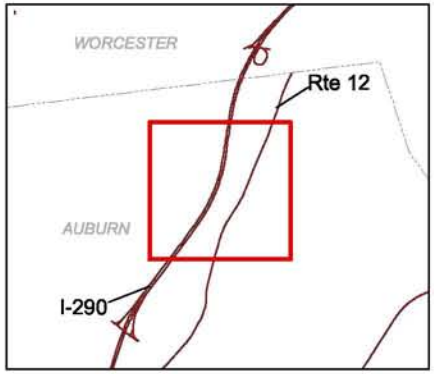

Existing BMPs
BMP Watersheds
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 250 500 1,000

Feet

1 in = 500 feet

Figure 3

Kettle Brook (MA51-01)
Existing BMPs

December 2011

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Impaired Waters Assessment for Leesville Pond (MA51087) – Progress Report

Impaired Waterbody

Name: Leesville Pond

Location: Auburn/Worcester, MA

Water Body ID: MA51087

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): nutrients, organic enrichment/Low DO, exotic species

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010b): nutrients, organic enrichment/Low DO, exotic species

Leesville Pond (MA51087) is listed as a Category 4c water body on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. Leesville Pond is covered by a Total Maximum Daily Load (TMDL) for phosphorus according to MassDEP's *Total Maximum Daily Load of Phosphorus for Leesville Pond* [CN 117.0] (MassDEP, 2002).

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.
- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris,

scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Leesville Pond is a water body in Auburn and Worcester, MA of approximately 50.5 acres with a contributing watershed of about 15,700 acres (MassDEP, 2002). The pond lays midstream of Kettle Brook (MA51-01), approximately 6.8 miles downstream of the start of Kettle Brook at Waite Pond (MA51170). According to the *Blackstone River Watershed 2003-2007 Water Quality Assessment Report* (MassDEP, 2010a), Leesville Pond is impaired for non-native aquatic macrophyte infestation.

Interstate 290 (I-290) runs north to south, adjacent to the east side of the pond. I-290 is a divided, two-lane roadway with small, piped storm water collection systems discharging to outfalls along either side, some of which discharge directly to Leesville Pond. Storm water runoff from the ramp from Rte 12 to I-290 eastbound drains to the land inside the ramp and is culverted under I-290 and conveyed to Leesville Pond via ditches. The watershed of MassDOT property directly contributing storm water runoff to Leesville Pond is comprised of a 0.5-mile stretch of I-290 eastbound, a 0.7-mile stretch of I-290 westbound, the ramp from Rte 12 to I-290 eastbound, and the land inside this ramp. Figure 1 shows the MassDOT contributing watershed.

Assessment under BMP 7R for Nutrients, Organic Enrichment and Low DO

The TMDL for phosphorus for Leesville Pond addresses the impairment of nutrients and organic enrichment/low DO. Therefore, MassDOT assessed the contribution of phosphorus from MassDOT property directly draining to this water body to address these impairments. The assessment was completed using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled *Total Maximum Daily Loads of Phosphorus for Leesville Pond* [CN 117.0] (MassDEP, 2002) can be summarized as follows:

- Pollutant of Concern: Phosphorus
- Impairment for Leesville Pond Addressed in TMDL: Nutrients and Organic Enrichment/Low DO
- Applicable Waste Load Allocation (WLA): See p. 14 and Tables 1 (p. 13), and 2 (p. 16) of TMDL Report.
  - Description of Associated Land Use: Commercial/Industrial
  - Commercial/Industrial Land Use Current Load (TP): 176 kg/yr (388 lbs/yr)
  - Commercial/ Industrial Land Use Target WLA (TP): 89 kg/yr (196 lbs/yr)
  - Commercial/Industrial Area in Watershed: 483 ha (1194 acres)
  - Commercial/Industrial Land Use Target Areal WLA (TP): 0.18 kg/ha/yr (0.16 lb/acre/yr)

Estimated Loading from MassDOT

The loading of total phosphorus (TP) from MassDOT property contributing storm water runoff to Leesville Pond was estimated using the following assumptions and calculations:

- MassDOT estimates the TP loading from its impervious areas as 1.60 lb/acre/yr. This loading rate is based on data collected in a study of storm water runoff conducted by the United States Geological Survey (USGS) (Smith and Granato, 2010). The study analyzed storm water samples from 12 sites located on highways operated by MassDOT across Massachusetts between September 2005 and September 2007. Samples were taken under a variety of weather conditions during this period.
- MassDOT estimates the TP loading from its pervious areas as 0.6 lb/acre/yr. This loading rate is based on the loading rate for hayland provided in the United States Environmental Protection Agency's (EPA) document EPA 440/5-80-011, "Modeling phosphorus loading and Pond response under uncertainty: a manual and compilation of export coefficients" (Reckhow, 1980). Hayland was chosen to represent the pervious right-of-way areas which are typically cleared areas that are mowed only once per year.
- MassDOT calculated its total estimated TP loading rate using the estimated loading rates listed above. MassDOT property contributing storm water directly to Leesville Pond is 8.2 acres of impervious area and 15.2 acres of pervious area. The TP loading is 22 lb/yr without accounting for existing BMPs or treatment throughout the watershed.
- MassDOT calculated its target TP WLA using the TMDL target areal WLA of 0.16 lb/ac/yr and the total area of MassDOT property within the TMDL watershed directly draining to Leesville Pond (23.4 acres). The target TP WLA for MassDOT runoff is 4 lb/yr.

Assessment and Mitigation Plan

MassDOT calculated its current TP loading rate (22 lb/yr) and its target TP WLA (4 lb/yr) using values provided in MassDEP's TMDL report. The difference between these two values represents the target reduction in TP that MassDOT should aim to achieve to comply with the WLA. For the watershed directly contributing to Leesville Pond, this target reduction is 18 lb/yr, or 82%. As explained in BMP 7R, MassDOT's pollutant loading analysis provides only a preliminary estimate of the level of pollutant reductions that may be recommended. In light of the variability of data on stormwater discharges, MassDOT will rely on a variety of other factors apart from numeric guidelines, including site constraints, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

During a site visit on August 30, 2011, no existing BMPs were identified in the DOT watershed to Leesville Pond. Thus, there is currently no TP reduction being provided.

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 22 lb/yr, the implementation of additional BMPs will be considered by MassDOT.

Assessment under BMP 7U for Exotic Species

In compliance with the assessment protocol outlined in BMP 7U in the "Description of MassDOT's Application of Impervious Cover Method" (MassDOT, 2011), MassDOT proceeded with Step 1 to determine whether or not storm water runoff could potentially be linked to the impairments listed for Leesville Pond that are not covered in the TMDL. Exotic species is the only remaining impairment not covered in the TMDL for Leesville Pond. However, exotic species is not linked to storm water runoff. According to the final *Massachusetts Year 2008 Integrated List of Waters*, exotic species are a non-pollutant stressor which indicates that restoration will require measures other than TMDL development and implementation. As a result, MassDOT has concluded that storm water runoff from its roadways does not contribute to the impairments of exotic species found in Leesville Pond.

Conclusions

As described above, MassDOT concludes that the impairment for exotic species is unrelated to storm water runoff. Therefore, further assessment of this water body is not warranted under the Impaired Waters program.

To meet the TMDL for the nutrients, organic enrichment, and low DO, a target TP load reduction of 18 lb/yr is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target load reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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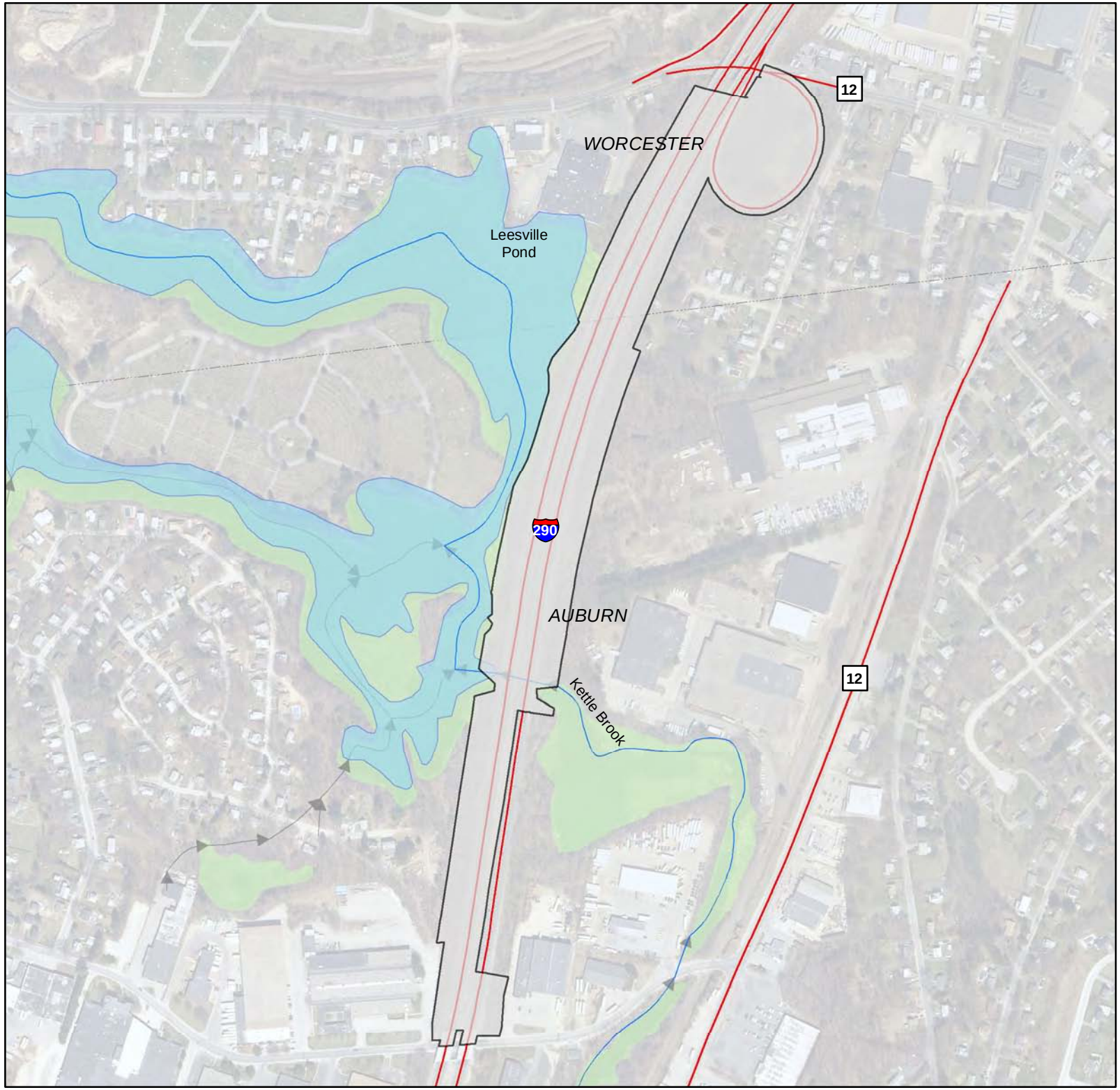

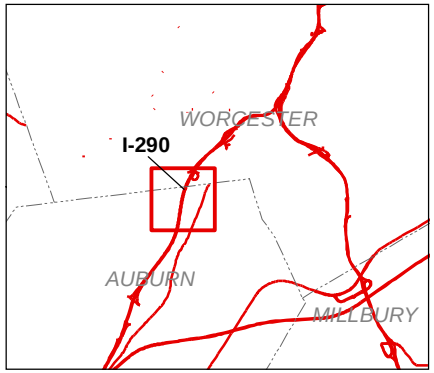

MassDOT Watershed

Impaired Water Bodies

NWI Wetland Areas

Impaired Stream Segments

Non-Impaired Stream Segments

MassDOT Urban Area Roads

Town Boundaries

N

0 250 500 1,000

Feet

1 in = 500 feet

Figure 1

Leesville Pond
(MA51087)

September 2011

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Impaired Waters Assessment for Smiths Pond (MA51156) – Progress Report

Impaired Waterbody

Name: Smiths Pond

Location: Leicester, MA

Water Body ID: MA51156

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): turbidity

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010b): turbidity

Smiths Pond (MA51156) is listed in both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters* as a Category 4a water body and is covered by MassDEP's *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDOT, 2002). MassDEP's *Blackstone River Watershed 2003-2007 Water Quality Assessment Report* (MassDEP, 2010a) groups Smiths Pond with Kettle Brook (MA51-01) and states that Smiths Pond will no longer be assessed as its own lake segment, but will instead be considered a run of the river impoundment along Kettle Brook. However, Smiths Pond was considered separately to be consistent with the 2008 list of integrated waters. Because Smiths Pond has a TMDL, MassDOT used the TMDL Method (BMP 7R) to determine the amount of treatment provided by existing BMPs and the additional load reduction required to meet the TMDL.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.

Site Description

Smiths Pond (MA51156) is a water body in Leicester, MA of approximately 20 acres with a contributing watershed area of approximately 6,240 acres (MassDEP, 2002). As shown in Figure 1, the pond lays midstream along Kettle Brook (MA51-01), approximately 1.8 miles downstream of the start of Kettle Brook at Waite Pond (MA51170). MassDOT's Route 9 (Rte 9) runs east to west along the northern edge of Smiths Pond. Systems of piped catch basins along an 1,800-foot stretch of Rte 9 contribute storm water to outfalls which discharge directly to a short section of Lynde Brook, a non-impaired stream, which then travels before entering Smiths Pond. This drainage is shown in Figure 2. To be conservative and because the TMDL specifically mentions Route 9 in its discussion of contributing areas, MassDOT included this stretch of Rte 9 as highway directly contributing runoff to Smiths Pond.

Assessment under BMP 7R (TMDL Method)

The TMDL for phosphorus for Selected Northern Blackstone Lakes addresses the impairment for turbidity for Smiths Pond. Therefore, MassDOT assessed the contribution of phosphorus from MassDOT urban areas to this water body to address this impairment. The assessment was completed using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* (MassDEP, 2002) can be summarized as follows in reference to Smiths Pond:

- Pollutant of Concern: Phosphorus
- Impairment for Smiths Pond Addressed in TMDL: Turbidity
- Applicable Waste Load Allocation (WLA): See Tables 2m (p. 51) and 4m (p. 61) of TMDL.
  - Description of Associated Land Use: Commercial/Industrial
  - Commercial/Industrial Land Use Current Load (TP): 81 kg/yr (179 lb/yr)
  - Commercial/ Industrial Land Use Target WLA (TP): 39 kg/yr (86 lb/yr)
  - Commercial/Industrial Area in Watershed: 103 ha (255 acres)
  - Commercial/Industrial Land Use Target Areal WLA (TP): 0.38 kg/ha/yr (0.34 lb/acre/yr)
- Applicable Recommendations: "Public Education, NPS Survey, Lake Management Plan, Residential BMPs, Urban BMPs, Highway BMPs, and In-Lake Management" (Table 7, page 66).

Estimated Loading from MassDOT

The loading of total phosphorus (TP) from MassDOT property contributing storm water runoff to Smiths Pond was estimated using the following assumptions and calculations:

- MassDOT estimates the TP loading from its impervious areas as 1.6 lb/acre/yr. This loading rate is based on data collected in a study of storm water runoff conducted by the United States Geological Survey (USGS) (Smith and Granato, 2010). The study analyzed storm water samples from 12 sites located on highways operated by MassDOT across Massachusetts between September 2005 and September 2007. Samples were taken under a variety of weather conditions during this period.
- MassDOT estimates the TP loading from its pervious areas as 0.6 lb/acre/yr. This loading rate is based on the loading rate for hayland provided in the United States Environmental Protection Agency's (EPA) document EPA 440/5-80-011, "Modeling phosphorus loading and Pond response under uncertainty: a manual and compilation of export coefficients" (Reckhow, 1980). Hayland was chosen to represent the pervious right-of-way areas which are typically cleared areas that are mowed only once per year.
- MassDOT calculated the total estimated TP loading rate using the estimated loading rate and area listed above. This TP loading from pervious and impervious areas is 1.5 lb/ac/yr without accounting for existing BMPs or treatment throughout the watershed (2.1 acres of impervious area and 0.2 acres of pervious area). In terms of pounds per year, this TP loading is 3.5 lb/yr.

- MassDOT calculated the target TP WLA for its storm water runoff to Smiths Pond using the target areal WLA of 0.34 lb/ac/yr included in the TMDL report and the area directly draining from MassDOT urban areas (2.3 acres). This target TP WLA for MassDOT urban runoff is 0.8 lb/yr.

Assessment and Mitigation Plan

MassDOT calculated its current TP loading rate (3.5 lb/yr) and its target TP WLA (0.8 lb/yr) using values provided in MassDEP's TMDL report. The difference between these two values represents the target reduction in TP that MassDOT should aim to comply with the WLA. For the watershed directly contributing to Smiths Pond, this target reduction is about 2.7 lb/yr, or 77%. As explained in BMP 7R, MassDOT's pollutant loading analysis provides only a preliminary estimate of the level of pollutant reductions that may be recommended. In light of the variability of data on stormwater discharges, MassDOT will rely on a variety of other factors apart from numeric guidelines, including site constraints, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

During a site visit on August 31, 2011, no existing BMPs were recognized at Smiths Pond. Thus, there is currently no TP reduction being provided.

Conclusions

To meet the TMDL, a target TP load reduction of 2.7 lb/yr is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of one or more BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for the BMPs that will aim to provide the target load reduction or treatment to the maximum extent practicable. Once the design of the proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program. Additionally, proposed BMPs for the MassDOT roadway discharging to Kettle Brook, upstream of Smiths Pond will have positive impact on the phosphorus loading to the pond.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

References

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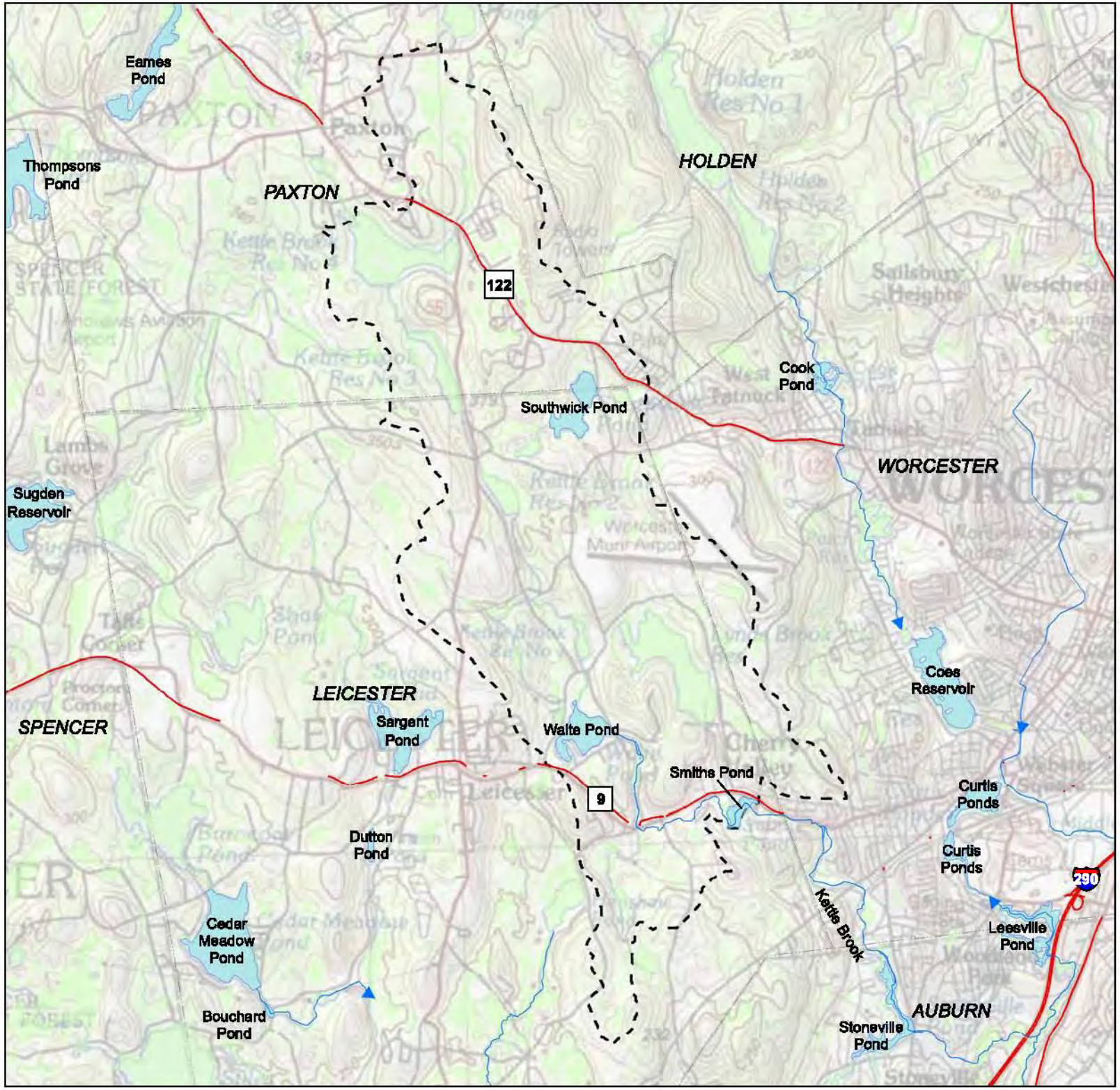
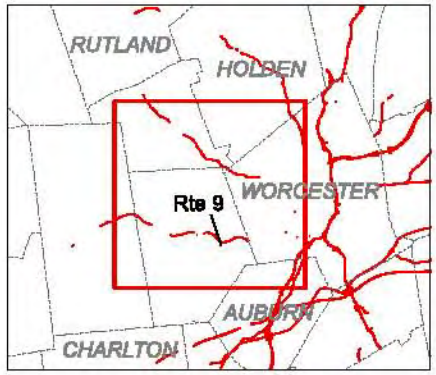
Smith, K.P., & Granato, G.E. (2010). Quality of storm water runoff discharged from Massachusetts highways, 2005-07: U.S. Geological Survey Scientific Investigations Report 2009-5269, 198 p.





Smiths Pond Subwatershed

Impaired Water Bodies

NWI Wetland Areas

Impaired Stream Segments

MassDOT Urban Area Roads

Town Boundaries

N

0 2,500 5,000 10,000

Feet

1 in = 5,000 feet

Figure 1

Smiths Pond (MA51156) Subwatershed

September 2011

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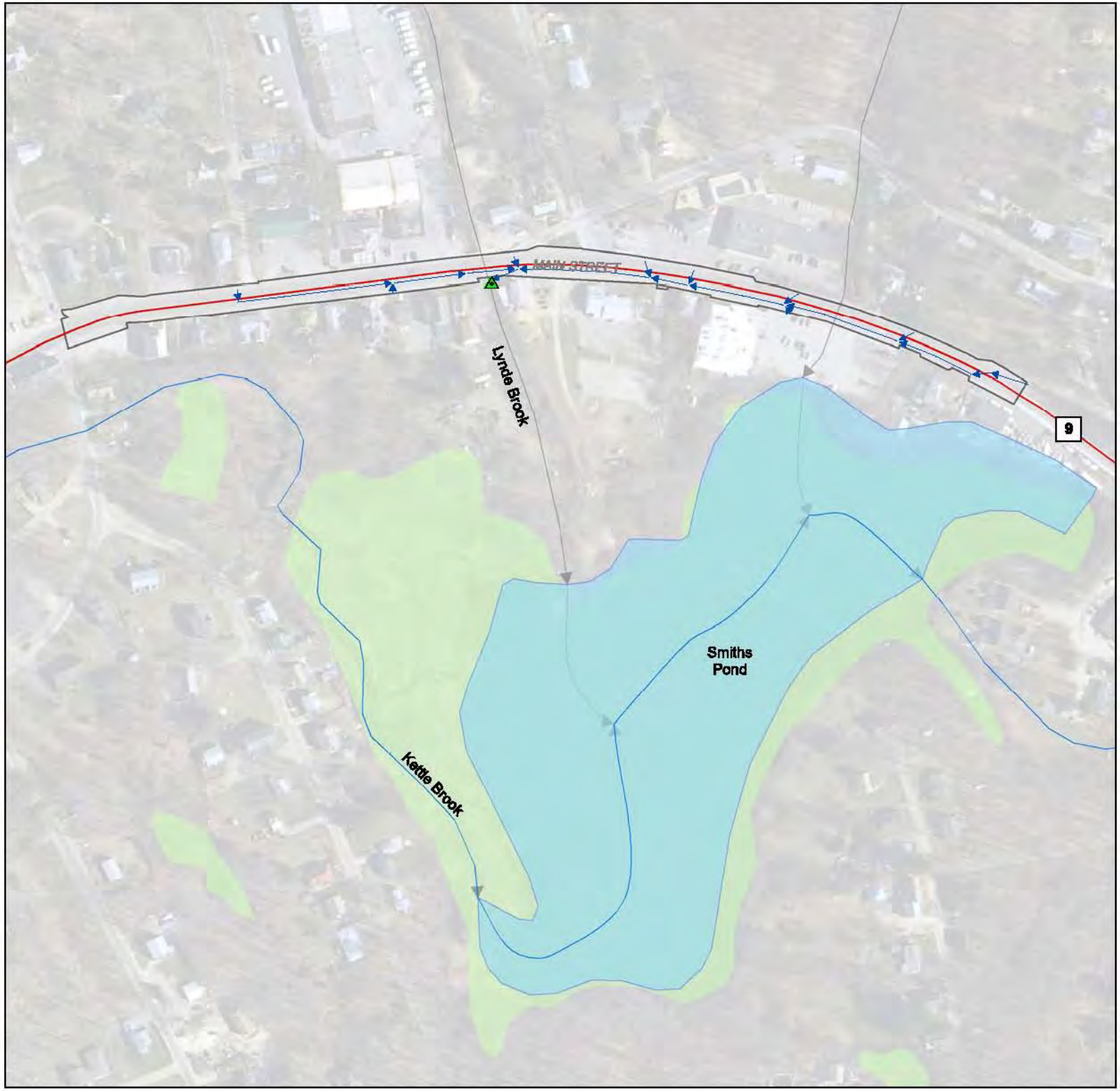

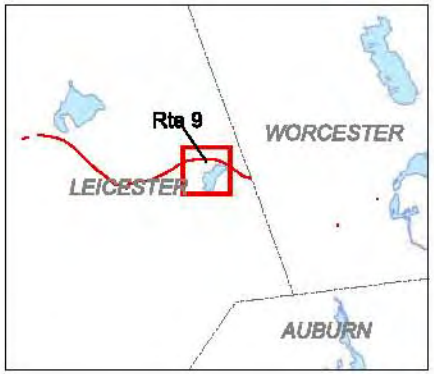

MassDOT Watershed

Direction of Drainage

Stormwater Outfalls

Impaired Water Bodies

NWI Wetland Areas

Impaired Stream Segments

Non-Impaired Stream Segments

MassDOT Urban Area Roads

N

0 125 250 500

Feet

1 in = 250 feet

Figure 2

Drainage near
Smiths Pond (MA51156)

September 2011

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Impaired Waters Assessment for Aberjona River (MA71-01) – Progress Report

Impaired Waterbody

Name: Aberjona River

Location: Reading, Winchester, Woburn, MA

Water Body ID: MA71-01

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): cause unknown, metals, unionized ammonia, nutrients, organic enrichment/ low DO, other habitat alterations and pathogens

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010b): cause unknown, metals, unionized ammonia, nutrients, organic enrichment/ low DO, other habitat alterations and pathogens

Aberjona River (MA71-01) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Mystic River Watershed and Coastal Drainage Area 2004-2008 Water Quality Assessment Report* (MassDEP, 2010a), unspecified urban stormwater is listed as an impairment source for the following designated uses: aquatic life use, primary contact, secondary contact and aesthetics. The aesthetics use is impaired due to moderate turbidity consistently noted by DWM biologists in Judkins Pond and Mill Pond sections of the Aberjona River during surveys conducted in 2004.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- *314 CMR 4.05 (5)(a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for

POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.

- *314 CMR 4.05 (5) (b) Bottom Pollutants or Alterations*. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.
- *314 CMR 4.05 (5)(e) Toxic Pollutants. Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.
- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (3)(b) 4 Bacteri*a.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies/ 100 ml;
    - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department.

Site Description

Aberjona River begins just south of Birch Meadow Drive in Reading, MA and flows 9.2 miles south to the inlet of Upper Mystic Lake at Mystic Valley Parkway in Winchester, MA. A portion of Aberjona River from Atlantic Avenue to Constitution Way in Woburn is culverted and channelized in the median of Commerce Way. The river flows through pond segments Judkins Pond and Mill Pond. Two NPDES Permits associated with the river are Parkview Condominium Associated (MAG250009) and Olin Corporation (MAG910074).

MassDOT's property that directly contributes stormwater runoff to the Aberjona River is comprised of portions of I-93 and its ramps, I-95 and its ramps, Washington Street, Cedar/ Salem Street, Montvale Avenue, portions of Mishawum Road and the Olympia Ave bridge over the MBTA rail tracks. The subwatershed of Aberjona River and the MassDOT roads is shown in Figure 1.

Assessment under BMP 7U

The following impairments for the Aberjona River have not been addressed by a TMDL: cause unknown, metals, unionized ammonia, nutrients, organic enrichment/ low DO and other habitat alterations. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- cause unknown
- metals
- unionized ammonia
- nutrients
- organic enrichment/low DO
- other habitat alterations

As described below the impairment for pathogens is assessed separately.

MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011) applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% impervious cover, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the

USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water Aberjona River (MA71-01):

Total Watershed		
Watershed Area	16,139	acres
Impervious Cover (IC) Area	5,682	acres
Percent Impervious	35.2	%
IC Area at 9% Goal	1,452	acres
Target Reduction % in IC	74.4	%

Subwatershed		
Watershed Area	9,561	acres
Impervious Cover (IC) Area	3,641	acres
Percent Impervious	38.1	%
IC Area at 9% Goal	860	acres
Target Reduction % in IC	76.4	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	56.3	acres
MassDOT's Target Reduction in Effective IC (76.4%) of DOT Directly Contributing IC)	43.0	acres

The Aberjona subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairments. The subwatershed should target a reduction of its effective IC by 76.4% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 43.0 acres of effective IC.

Existing BMPs

MassDOT has one existing BMP in the Aberjona River subwatershed that is mitigating potential storm water quality impacts prior to discharge to Aberjona River. Figure 2 shows the BMP location. In MassDOT's analysis, existing BMPs receive credit for removing the effect of IC depending on their type, size relative to the IC that they process, and the local soil conditions. Natural Resources Conservation Service (NRCS) soils data indicates that the soil in the area associated with the existing BMP or the nearby adjacent area do not have an assigned hydrologic soil group (HSG). For this assessment, the soils were conservatively assumed to have an infiltration rate similar to HSG C (silt loam).

Ex-BMP-1
The Exit 37 C on/ off ramps of Interstate-93 near Atlantic Avenue in Reading, MA collect approximately 2.9 acres of stormwater and discharges to a dry infiltration basin at the corner of Atlantic Ave and Commerce Way. The infiltration basin is approximately 16,400 sq. ft in surface area and has a maximum depth of 3 feet. The infiltration basin has excellent cover of grass and vegetation with no standing water. There is a concrete control structure outlet with a 12 inch diameter low level inlet with invert approximately 2 feet above the ground surface. The control structure directly discharges to the Aberjona River via a 36 inch HDPE pipe. Based on the assumption that soils are HSG C, the infiltration basin has an effective IC removal efficiency of 95 %, providing a reduction of 2.8 acres of IC.

Existing BMP 1. Infiltration Basin.

Summary of Existing BMPs

BMP Name	BMP Type	Soil Type	Depth of Runoff Treated (inches)	IC Area Treated (acres)	Reduction of Effective IC* (%)	Reduction of Effective IC (acres)
Ex-BMP-1	Infiltration Basin	C – Silt Loam – 0.27 in/hr	4.1	2.9	95	2.8
Total						2.8

*Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT 2011)

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 43.0 acres, MassDOT will consider the implementation of additional BMPs.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in storm water vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to storm water management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in storm water runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in storm water runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform in urban storm water from other sources ranging between 14,000 and 17,000 have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other storm water systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the storm water system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from storm water runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other storm water systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for storm water that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive storm water management programs involving the use of BMPs. Massachusetts and EPA believe that

> BMP based Phase II permits involving comprehensive storm water management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for storm water discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of storm water management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing storm water discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing storm water management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program

at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual storm water permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

AECOM investigated the entire watershed of MassDOT-owned roadways contributing to Aberjona River to identify existing BMPs. This assessment of Aberjona River has shown that the existing BMPs provide approximately 5% of the target reduction in IC.

The following table summarizes the effective IC removal of the existing BMPs and the reduction required to meet the 9% IC target:

Impervious Cover Reduction	
IC in Directly Contributing Watershed	56.3 acres
Required Reduction in Effective IC	43.0 acres
IC Effectively Reduced by Existing BMPs	2.8 acres
IC Remaining to Mitigate with Proposed BMPs	40.2 acres

To achieve the targeted reduction in IC, removal of an additional 40.2 acres of effective IC is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal watershed permits and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the storm water management plan and those under consideration for reducing the effective IC from MassDOT are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing storm water permit and the applicable Pathogen TMDLs.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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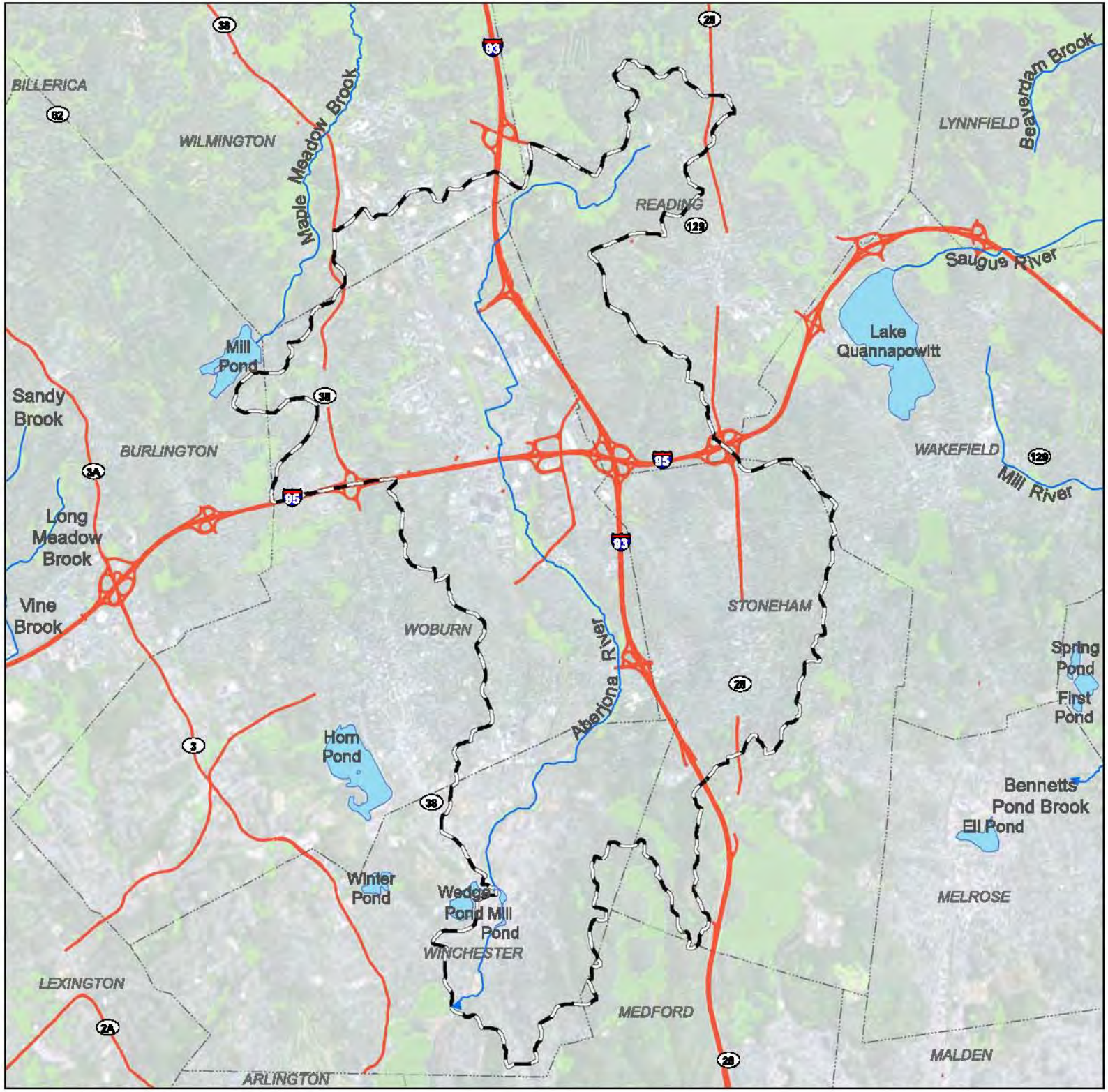

Figure 1
Subwatershed
Aberjona River (MA71-01)

Retrofit Project 4-1
Impaired Waters Assessment
September 2011

Moving Massachusetts Forward
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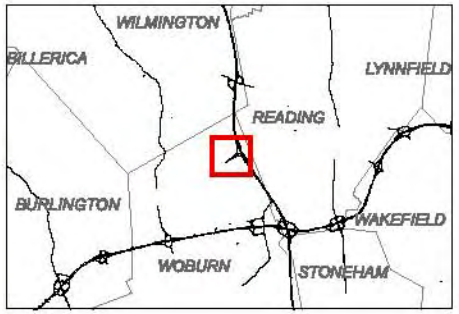

BMP Watershed
Existing BMPs
Impaired Water Body
Impaired Stream Segment
Non-Impaired Stream Segments
NWI Wetland Area
MassDOT Roads In Urban Areas
Town Boundaries

N

0 200 400 800 Feet

1 inch = 400 feet

Figure 2
Existing BMPs
Aberjona River (MA71-01)

Retrofit Project 4-1
Impaired Waters Assessment
September 2011

Moving Massachusetts Forward
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Impaired Waters Assessment for Hawkes Pond (MA93032) – Progress Report

Impaired Waterbody

Name: Hawkes Pond

Location: Lynnfield and Saugus, MA

Water Body ID: MA93032

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): turbidity

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): turbidity

Hawkes Pond (MA93032) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*.

Relevant Water Quality Standards:

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.

Site Description

Hawkes Pond is a drinking water reservoir with an area of 65.2 acres located in the towns of Lynnfield and Saugus, Massachusetts (Figure 1). The stream inlets discharging to the pond are located in the northern side of the pond near Interstate 95 (I-95). The outlet, which is located on the southern side of the pond abutting Route 1 in Saugus, discharges to the lower portion of Hawkes Brook. Hawkes Brook joins the Saugus River approximately 0.4 miles from the pond outlet. The Lynn Water & Sewer Commission (LWSC) diverts water from the upper portion of the Saugus River (segment MA93-34) into Hawkes Pond to maintain water levels in the reservoir. Tributaries to Hawkes Pond also include the upper reach of Hawkes Brook and two unnamed tributaries (Figure 2).

The Hawkes Pond subwatershed, as delineated by the contributing drainage from Hawkes Brook and the unnamed tributaries, is approximately 2,397 acres. This watershed consists of densely developed residential land in the northern and eastern portions of the watershed and undeveloped area around Walden Pond and the Lynn Woods Reservation. Due to the diversion of water from the Saugus River, the total watershed area considered for this assessment also includes the watershed for the upper portion of the Saugus River. The total watershed area is approximately 9,351 acres.

Based on available drainage information and site visits, the drainage from Route 1 in the Hawkes Pond watershed does not discharge directly to Hawkes Pond. Storm water from the Route 1 segment within the watershed is conveyed to outlets south of Hawkes Pond and to the eastern side of Route 1 toward Walden Pond and its outlet stream.

Drainage from I-95 on the eastern side Interchange 43 is conveyed to two tributary streams that flow into Hawkes Pond (Figure 3a and 3b). The stormwater outfalls from I-95 in this area are in close proximity to Hawkes Pond and, to be conservative, the outfalls are considered direct discharges. Approximately 21.7 acres of MassDOT impervious surface near Interchange 43 drain directly to Hawkes Pond. Drainage along this segment of I-95 consists of catch basins with outfalls that either discharge directly into tributary streams or discharge in areas where channelized storm flow to the tributary is apparent.

Assessment under BMP 7U

The impairment listed for Hawkes Pond (MA93032), turbidity, has not been addressed by a TMDL. Therefore, MassDOT assessed this impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess turbidity.

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the level of impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed has less than 9% impervious cover, MassDOT concludes that storm water is not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of downstream end of impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces datalayer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/ properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to

determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis report* (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the watershed contributing to the impaired water (Hawkes Pond (MA93032)):

Total Watershed		
Watershed Area	9,351	acres
Impervious Cover (IC) Area	1,999	acres
Percent Impervious	21	%
IC Area at 9% Goal	842	acres
Target Reduction % in IC	58	%

Subwatershed		
Watershed Area	2,397	acres
Impervious Cover (IC) Area	365	acres
Percent Impervious	15	%
IC Area at 9% Goal	216	acres
Target Reduction % in IC	41	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	21.7	acres
MassDOT's Target Reduction in Effective IC (41% of DOT Directly Contributing IC)	8.9	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairment. The subwatershed should target a reduction of its effective IC by 41% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 8.9 acres of effective IC.

Existing BMPs

MassDOT has one existing BMP in the Hawkes Pond subwatershed that is mitigating potential storm water quality impacts prior to discharge to Hawkes Pond. In some areas, infiltration may

occur during low-flow events, but due to the topography in these areas, runoff to the nearby impaired water is likely during moderate and high-flow events. The MassDOT stormwater drainage systems focused on in this assessment are comprised of stormwater outfalls that discharge directly into the impaired water, into one of its tributaries, or into a wetland that abuts the impaired water.

Ex-BMP-1

The existing BMP (Ex-BMP-1) identified is located approximately 500 feet west of the Interchange 43 northbound off-ramp (Figure 3a). Two storm water outfalls discharge into a flat, low-lying area. The eastern side of this area has an earthen berm that directs storm water flow to the west where infiltration appears to occur. Approximately 4.1 acres of MassDOT impervious surface drain to this basin area. No discrete outlet or drainage channel was observed in this area. The soil in this area is mapped by NRCS as hydrologic soil group B on the eastern portion of the area, and C on the western portion. For this assessment, this low topographic area is characterized as an infiltration basin with an effective IC removal efficiency of 80% providing a reduction of 3.3 acres of IC.

Summary of Existing BMP

BMP Name	BMP Type	Soil Type	Depth of Runoff Treated (inches)	IC Area Treated (acres)	Reduction of Effective IC* (%)	Reduction of Effective IC (acres)
Ex-BMP-1	Infiltration Basin	C - Silt Loam - 0.27 in/hr	0.9	4.1	80	3.3

*Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT 2011)

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 8.9 acres, MassDOT will consider the implementation of additional BMPs.

Conclusions

The entire watershed of MassDOT-owned roadways was investigated to identify existing BMPs. This assessment of Hawkes Pond has shown that the existing BMP provides approximately 37% of the target reduction in IC.

The following table summarizes the effective IC removal of the existing BMP.

Impervious Cover Reduction

IC in Directly Contributing Watershed	21.7	acres
Required Reduction in Effective IC	8.9	acres
IC Effectively Reduced by Existing BMPs	3.3	acres
IC Remaining to Mitigate with Proposed BMPs	5.6	acres

To achieve the targeted reduction in IC, removal of an additional 5.6 acres of effective IC is required. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC

reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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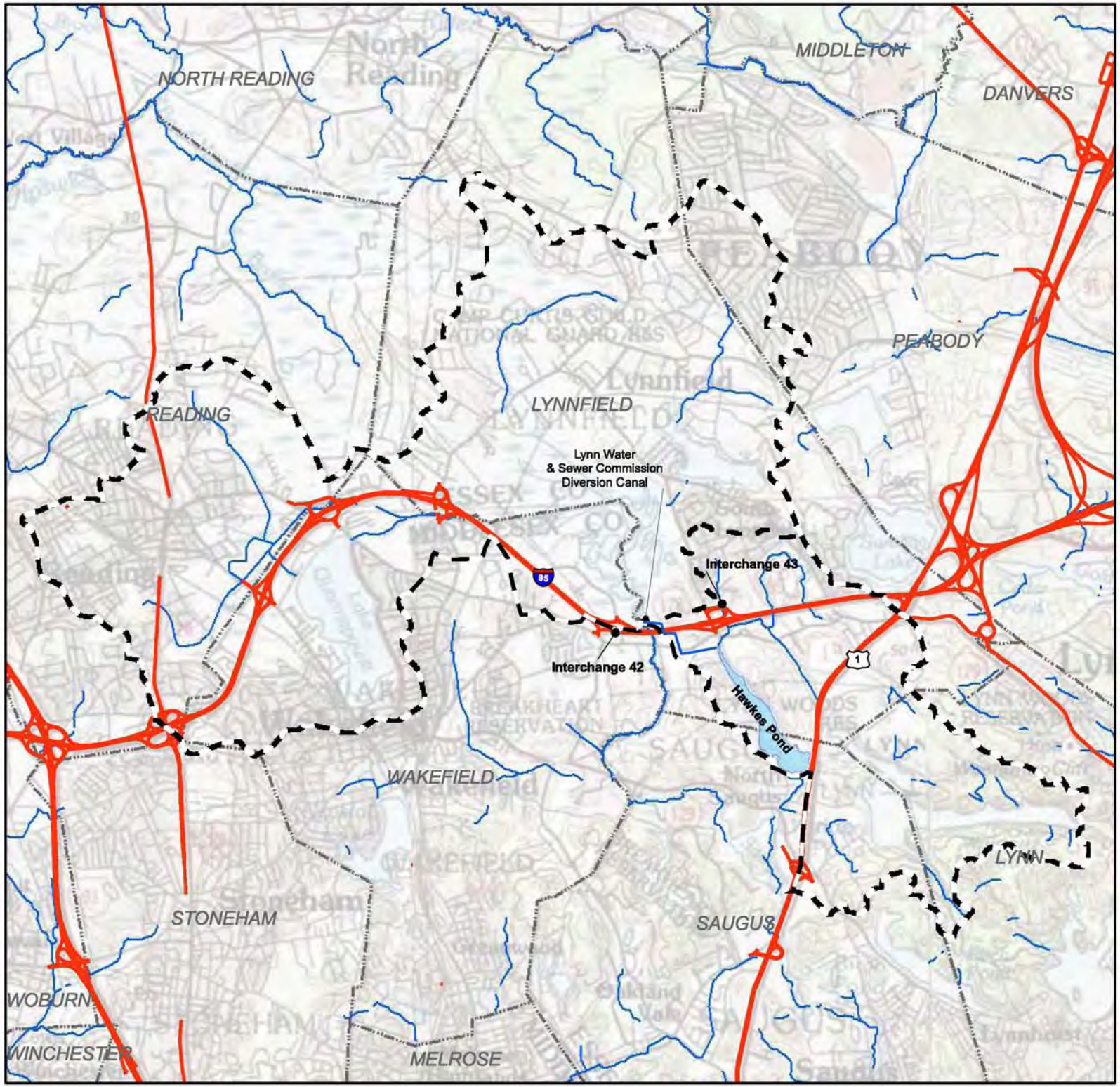

Hawkes Pond (MA93032)
MassDOT Roads in Urban Areas
Town Boundary
Stream/River
Hawkes Pond Watershed
Hawkes Pond Subwatershed

N

0 0.6 1.2 Miles

Figure 1
Hawkes Pond Watershed MA93032

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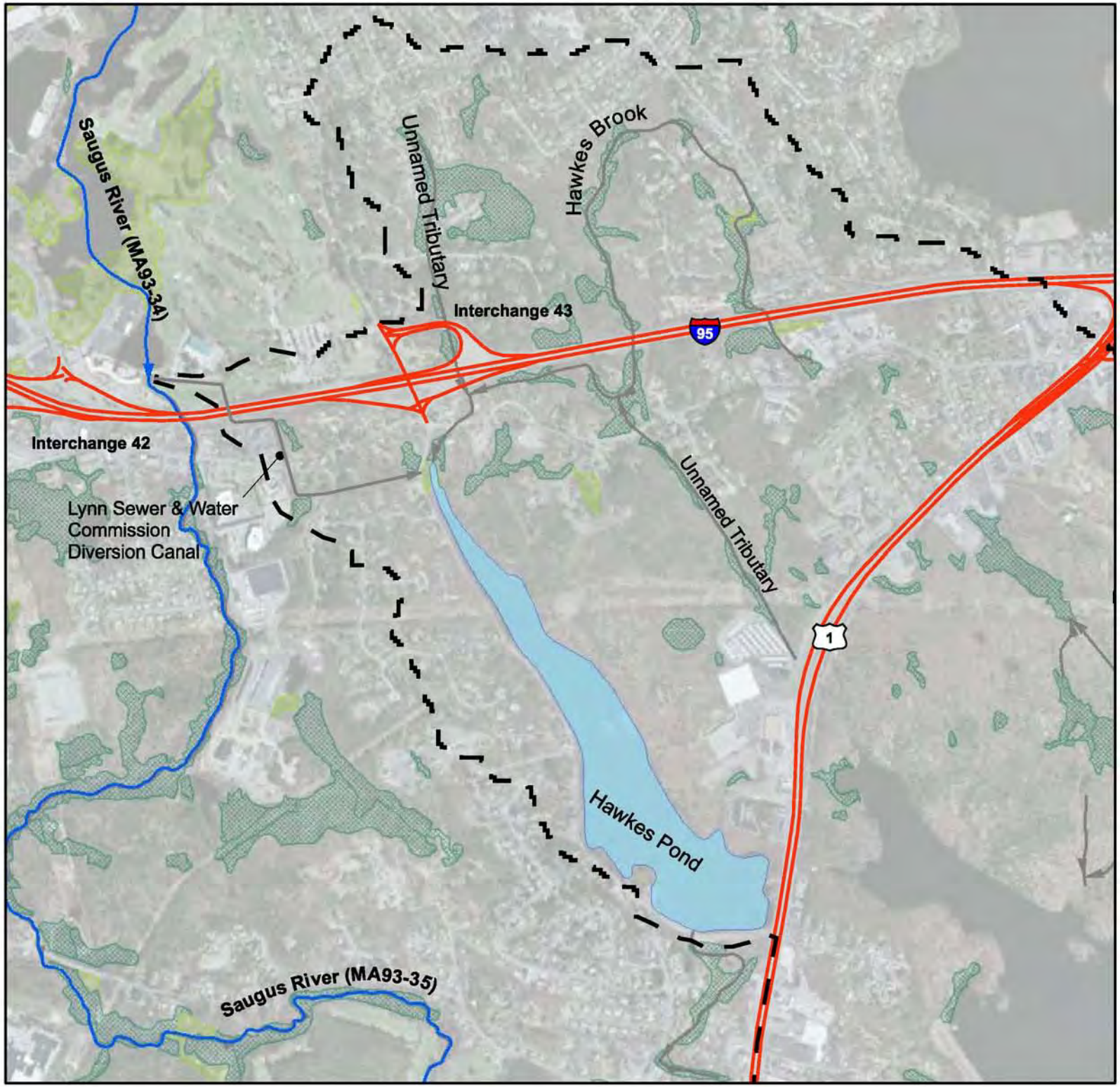

- Non-Impaired Stream Segment
- Saugus River
- MassDOT Roads in Urban Areas
- Hawkes Pond Subwatershed Boundary
- Hawkes Pond (MA93032)

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

N

0 1,000 2,000 Feet

Figure 2
Contributing Streams
Hawkes Pond
MA93032

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- Stormwater Outfall
- Hawkes Pond (MA93032)
- Hawkes Pond Subwatershed Boundary
- Existing BMP
- Existing BMP Watershed
- MassDOT Directly Contirbuting Watershed
- MassDOT Roads in Urban Areas
- Non-Impaired Stream Segment

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

N

0 300 600 Feet

Figure 3a
MassDOT Drainage Areas
Hawkes Pond
Watershed
MA93032

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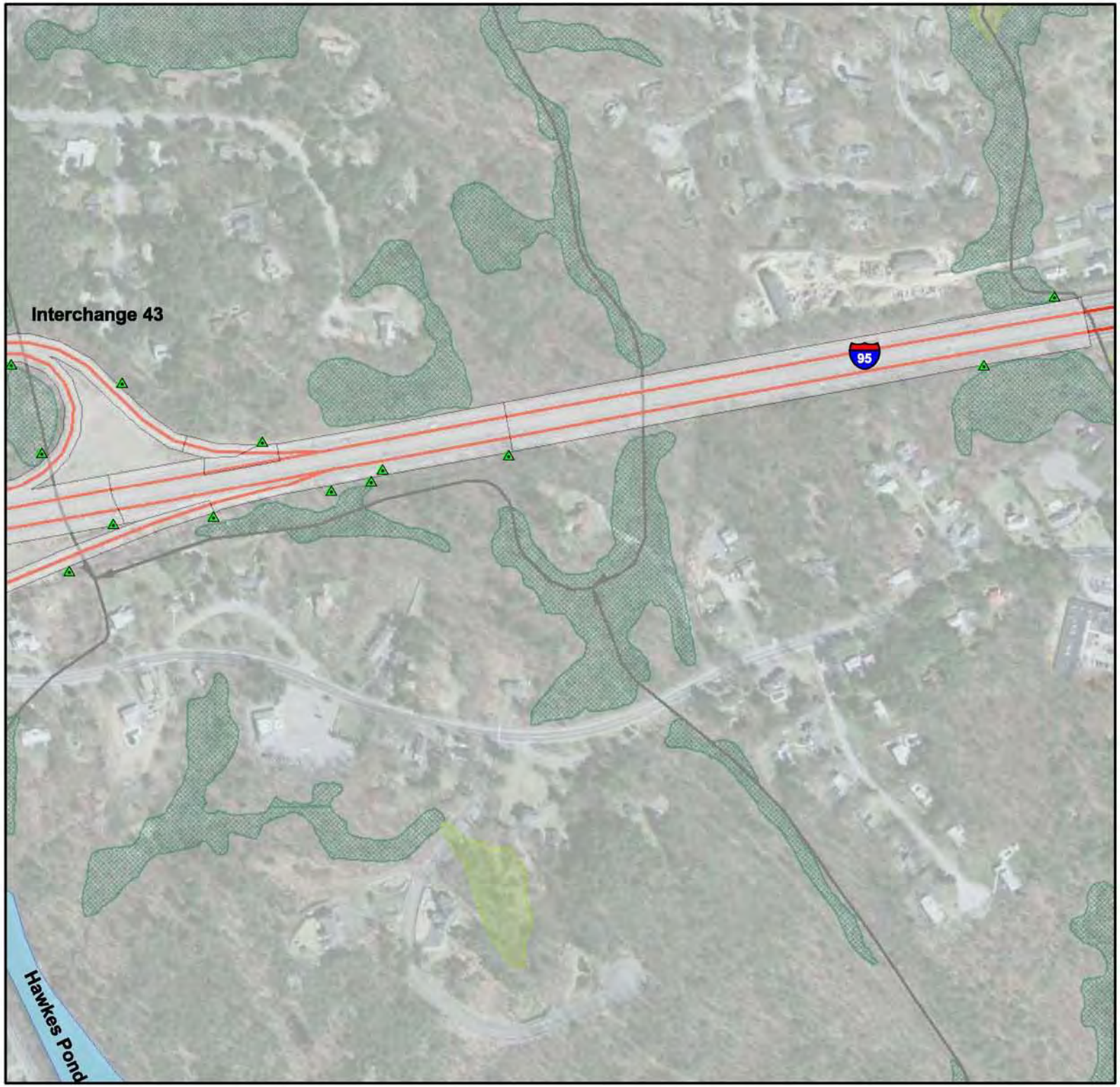
massDOT



- Stormwater Outfall
- Hawkes Pond (MA93032)
- 3 Hawkes Pond Subwatershed Boundary
- MassDOT Directly Contirbuting Watershed
- MassDOT Roads in Urban Areas
- Non-Impaired Stream Segment

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

N

0 300 600 Feet

Figure 3b
MassDOT Drainage Areas
Hawkes Pond
Watershed
MA93032

September 2011

massDOT

Impaired Waters Assessment for Saugus River (MA93-34) – Progress Report

Impaired Waterbody

Name: Saugus River

Location: Lynnfield and Wakefield, MA

Water Body Segment ID: MA93-34

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): excess algal growth, fish-passage barrier, (physical substrate habitat alterations), fecal coliform, turbidity, total nitrogen, total phosphorus, aquatic plants (macrophytes)

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): excess algal growth, fish-passage barrier, (physical substrate habitat alterations), fecal coliform, turbidity, total nitrogen, total phosphorus, aquatic plants (macrophytes)

Saugus River (MA93-34) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*.

Relevant Water Quality Standards:

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b) 4 Bacteria*.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
    - b. For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

- *314 CMR 4.05 (3)(b)5 Floating or suspended solids*. These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- *314 CMR 4.05 (5)(a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *314 CMR 4.05 (5)(b) Bottom Pollutants or Alterations*. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.
- *314 CMR 4.05 (5)(c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.

Site Description

Saugus River segment MA93-34 is an approximately 3.1-mile stream segment that is located in the towns of Lynnfield and Wakefield, Massachusetts between the outlet of Lake Quannapowitt (MA93060) in Wakefield and Saugus River segment MA93-35 at the Lynn Water & Sewer Commission (LWSC) diversion canal near Interstate 95 (Figure 1). The LWSC canal diverts water from the Saugus River to Hawkes Pond (MA93032) which is a drinking water reservoir.

From the outlet of Lake Quannapowitt, the Saugus River flows east through an undeveloped wetland area. An unnamed tributary that drains a watershed area that is located west of Interstate 95 (I-95) joins the Saugus River in this wetland (Figure 1). The Saugus River flows beneath the I-95 north-bound ramp at Interchange 41, and I-95 immediately east of the on-ramp. From this area, the Saugus River flows northeast and south through a large wetland (Reedy Meadow) to the LWSC diversion canal and the beginning of the downstream Saugus River segment MA93-35.

The Saugus River (segment MA93-34) total contributing watershed is approximately 6,955 acres and includes Lake Quannapowitt (MA93060), Beaverdam Brook (MA93-30) and extensive wetland areas (Figure 1). The subwatershed that contributes directly to the assessed impaired segment of the Saugus River (MA93-34) is approximately1,930 acres (Figure 1). Within this subwatershed there are approximately 51 acres of impervious cover owned by MassDOT. Approximately 13.0 acres of this impervious cover drain directly to the Saugus River through systems of piping, swales, and overland flow.

Direct storm water discharges from MassDOT property to the impaired water occur at the following locations.

Interstate 95 - Interchange 40

At Interchange 40 drainage from southern portion of the Route129 roundabout is provided by catch basin inlets that are assumed to drain to the Saugus River (Figure 2a). Drainage drawings for Route 129 were not available to confirm this conveyance system; however, the drainage appears to outlet into the Saugus River in the culvert under Route 129.

Interstate 95 - Interchange 41

Main Street in Lynnfield passes beneath I-95 at Interchange 41. The Saugus River flows from the west through a box culvert under Main Street, through the cloverleaf area, and under the north-bound on- and off-ramps (Figure 2b). Drainage from the northbound off-ramp at this interchange (MassDOT property) is conveyed off the curbed ramp via catch basin inlets that discharge at two locations within the cloverleaf area. The upper catch basin discharges to a vegetated area where some infiltration may occur; however, no outlet-controlled infiltration structure currently exists. The catch basin that is located lower on the off-ramp outlets at the approximate elevation of the Saugus River. The outlet pipe was partially submerged at the time of the site visit. The curbed northbound on-ramp is drained by catch basins and storm drains that connect to a 24-inch pipe that, based on available drainage drawings, discharges into the Saugus River at the Main Street culvert. Design contractors will need to assess soil conditions, groundwater elevation, land availability and catch basin invert elevations to determine the feasibility of this location for the installation of a stormwater BMP.

Interstate 95 Culvert

The Saugus River flows from a natural wetland area located east of Interchange 41, under I-95 to a large natural wetland named Reedy Meadow (Figure 1). Storm water drainage from MassDOT property into Saugus River in the area east of Interchange 41 occurs from the northbound and southbound lanes via catch basin inlets and direct outfalls. According to the available drainage drawings, the catch basin that is situated near the high point of the northbound on-ramp at Interchange 41 has an outlet that discharges directly into a natural wetland that abuts the Saugus River (Figure 2b).

The drainage from I-95 on the eastern side of Interchange 41 is conveyed via catch basins and storm drains to two outfalls located on the northern side of I-95 into the wetland (Figure 2b). The Saugus River passes through this wetland and there appears to be a channel in the wetland that could provide a rapid flow path for storm water from the highway to the Saugus River. The highway shoulder along the wetland at these outfall locations has a relatively steep slope and ranges from approximately 20 to 50 feet wide, thus a BMP installation in this area may be infeasible. Another outfall into this wetland is located approximately 60 feet northwest of the Saugus River crossing. This outfall is from a network of approximately ten catch basins that drain the northbound and southbound lanes of I-95 adjacent to the cloverleaf.

There are two outfalls from I-95 catch basins on the southbound lane that are located west of the Saugus River/ I-95 crossing. They discharge into a large wetland that abuts the Saugus River so they are considered to be direct discharges for this assessment. The outfalls were partially submerged in the wetland at the time of the site visit (August 11, 2011). The installation of stormwater BMPs for these outfalls is constrained by the natural wetlands at the outfalls.

Drainage from the southbound on- and off-ramps at Interchange 41 is conveyed via catch basins and storm drain pipes to an outfall that is located on the eastern shoulder of the off-ramp. This outfall discharges to an area that drains directly to the wetland that abuts the Saugus River. Some of the storm water that discharges from this outfall likely infiltrates prior to flowing into the wetland; however, there is currently no outlet-controlled infiltration structure in place.

Assessment under BMP 7U

The following impairments for Saugus River Segment MA93-34 have not been addressed by a TMDL: excess algal growth, fish-passage barrier, physical substrate habitat alterations, turbidity, total nitrogen, total phosphorus and aquatic plants (macrophytes). Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- excess algal growth
- physical substrate habitat alterations
- turbidity
- total nitrogen
- total phosphorus
- aquatic plants (macrophytes)

As described below, the impairments for fecal coliform (pathogens) and fish-passage barrier are assessed separately.

MassDOT's Application of Impervious Cover Method in BMP 7U which applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential stormwater impacts on the impaired water and evaluate the level of impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed has less than 9% impervious cover, MassDOT concludes that storm water is not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

The Lynn Waterways concrete dam, located at the end point of the Saugus River Segment MA93-34, is the cause of the fish-passage barrier impairment that is listed for this stream segment (MassDEP, 2007). The impairment is unrelated to stormwater, and thus MassDOT has determined that further assessment of the impairment of fish-passage barrier to the Saugus River Segment MA93-34 is not required.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of downstream end of impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces datalayer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the

degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/ properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis report* (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Saugus River (MA93-34)):

Total Watershed		
Watershed Area	6,955	acres
Impervious Cover (IC) Area	1,635	acres
Percent Impervious	24	%
IC Area at 9% Goal	626	acres
Target Reduction % in IC	62	%
Watershed		
Watershed Area	1,930	acres
Impervious Cover (IC) Area	346	acres
Percent Impervious	18	%
IC Area at 9% Goal	174	acres
Target Reduction % in IC	50	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	13.0	acres
MassDOT's Target Reduction in Effective IC (50% of DOT Directly Contributing IC)	6.5	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairment. The subwatershed should target a reduction of its effective IC by

50% to reach the 9% goal. Therefore, MassDOT should reduce aim to reduce its effective IC by the same percentage by removing the effect of 6.5 acres of effective IC.

Existing BMPs

There are currently no BMPs associated with the direct discharges from MassDOT property into the Saugus River segment MA93-34. In some areas, infiltration may occur during low-flow events, but due to the topography in these areas, runoff to the nearby impaired water is likely during moderate and high-flow event. The MassDOT stormwater drainage systems focused on in this assessment are comprised of stormwater outfalls that discharge directly into the impaired water or into a wetland that abuts the impaired water.

Next Steps

Because MassDOT does not have any existing BMPs to mitigate the target reduction of 6.5 acres, MassDOT will consider the implementation of additional BMPs.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in storm water vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to storm water management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in storm water runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in storm water runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform in urban storm water from other sources ranging between 14,000 and 17,000 have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other storm water systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the storm water system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from storm water runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other storm water systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for storm water that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive storm water management programs involving the use of BMPs. Massachusetts and EPA believe that

> BMP based Phase II permits involving comprehensive storm water management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for storm water discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of storm water management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing storm water discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing storm water management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program

at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual storm water permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

This assessment for segment MA93-34 of the Saugus River has identified no existing BMPs associated with the direct drainage from MassDOT's roadways/ properties in the watershed.

The following table summarizes the effective IC reduction requirements.

Impervious Cover Reduction		
IC in Directly Contributing Watershed	13.0	acres
Required Reduction in Effective IC	6.5	acres
IC Effectively Reduced by Existing BMPs	0.0	acres
IC Remaining to Mitigate with Proposed BMPs	6.5	acres

To achieve the targeted reduction in IC, removal of 6.5 acres of effective IC is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal watershed permits and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the storm water management plan and those under consideration for reducing the effective IC from MassDOT are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing storm water permit and the applicable Pathogen TMDLs.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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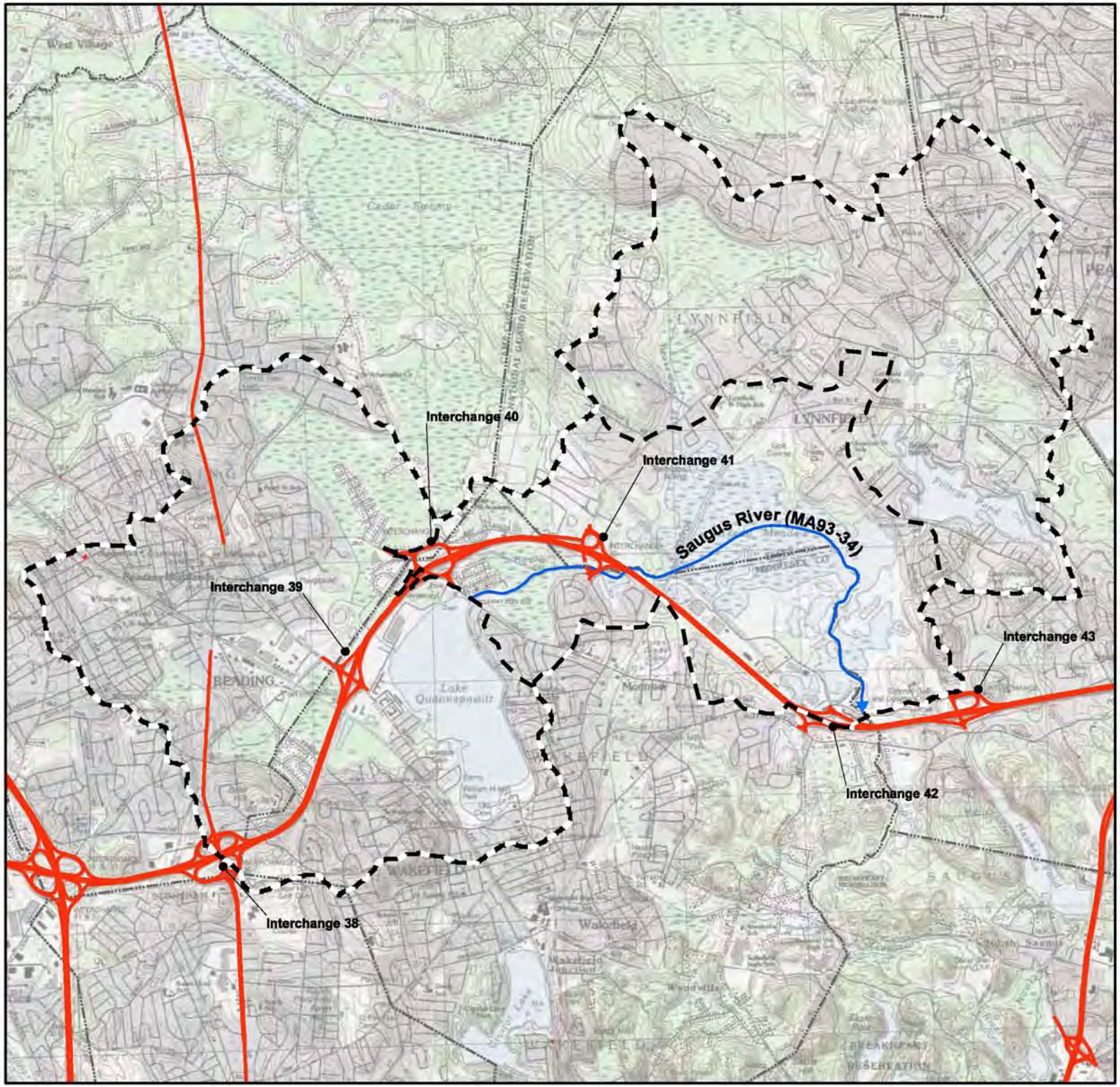

MA93-34
MassDOT Roads in Urban Areas
Town Boundary
Segment MA93-34 Subwatershed
Upstream Saugus River Watershed

N

0 0.5 1 Miles

Figure 1
Saugus River Watershed MA93-34

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- Stormwater Outfall
- Saugus River (MA93-34)
- Non-Impaired Stream Segment
- MassDOT Roads in Urban Areas
- MassDOT Directly Contributing Watershed
- Segment MA93-34 Subwatershed Boundary

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

N

0 300 600 Feet

Figure 2a
MassDOT Drainage Areas
Saugus River
Watershed
MA93-34

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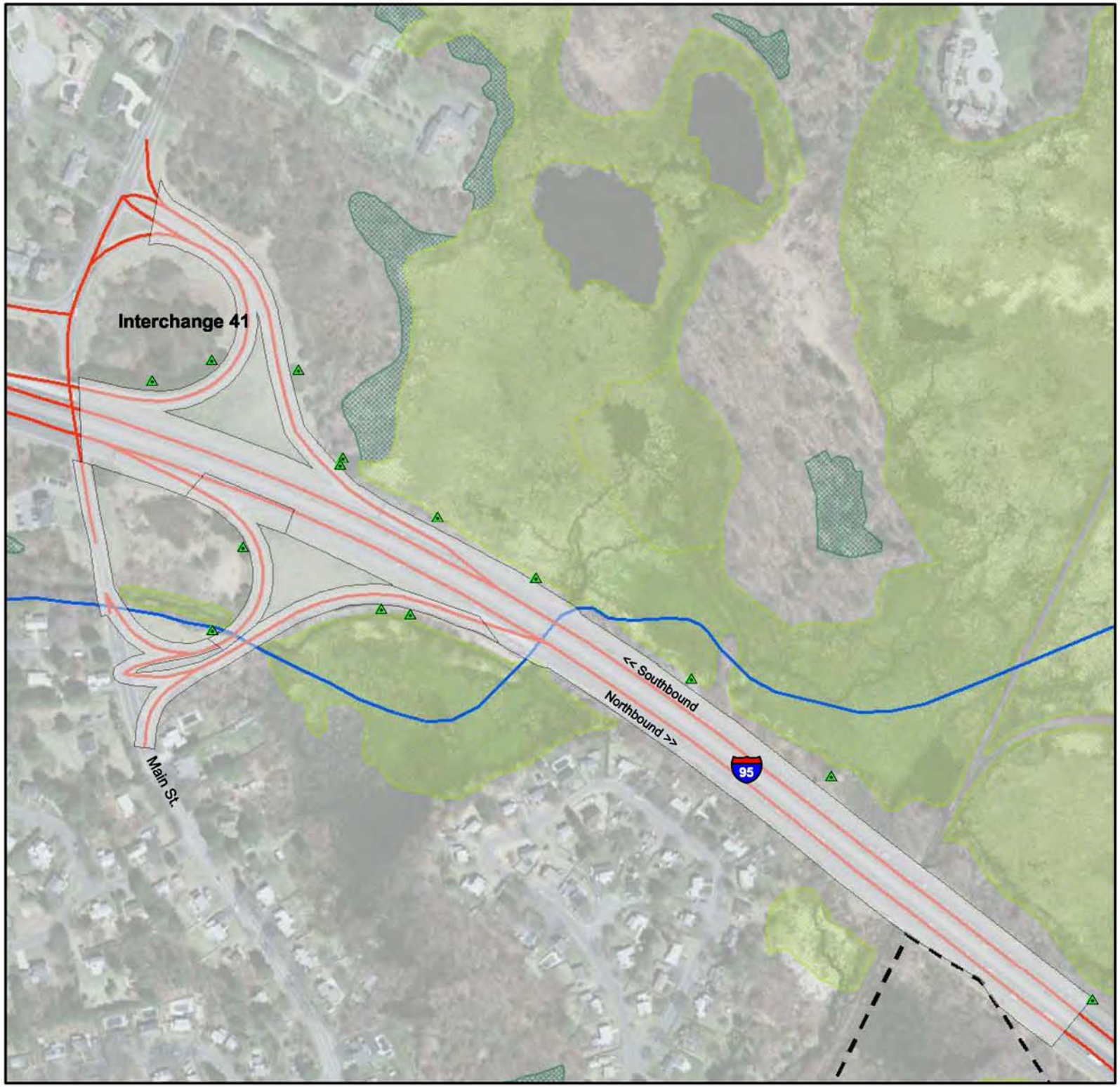

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Figure 2b
MassDOT Drainage Areas
Saugus River
Watershed
MA93-34

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- *314 CMR 4.05 (5)(b) Bottom Pollutants or Alterations*. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.

Site Description

Saugus River segment MA93-35 is an approximately 5.4-mile stream segment that passes along the border of Lynnfield and Wakefield and through the town of Saugus, Massachusetts between the Lynn Water & Sewer Commission (LWSC) diversion canal near Interstate 95 and the Historic Saugus Iron Works site on Bridge Street, Saugus (Figure 1). The LWSC canal diverts water from the upstream Saugus River segment MA93-34 to Hawkes Pond (MA93032) which is a drinking water reservoir. This diversion and resulting impacts to aquatic habitat along the Saugus River segment MA93-35 has been studied and minimum stream flows recommended (Gomez and Sullivan 2002).

From the LWSC Diversion Canal, the Saugus River flows south under I-95 through residential and undeveloped forested areas along the Wakefield and Lynnfield border. Approximately 0.2 miles south of the river crossing at Route 129, the Saugus River veers east into Saugus where it passes though primarily forested, undeveloped areas until it reaches Route 1. The Saugus River flows under Route 1 at the Lynn Fells Parkway exit and continues through residential areas to the Historic Saugus Iron Works site at Bridge Street in Saugus.

The Saugus River (segment MA93-35) total contributing watershed is approximately 15,904 acres and includes the upstream Saugus River segment (MA93-34), Lake Quannapowitt (MA93060), Beaverdam Brook (MA93-30), Pillings Pond (MA93056), Hawkes Pond (MA93032), and Mill River (MA93-31). The subwatershed that contributes directly to the assessed impaired segment of the Saugus River (MA93-35) is approximately 4,173 acres (Figure 1). Within this subwatershed there are approximately 22 acres of impervious cover owned by MassDOT. Approximately 16.0 acres of this impervious cover drain directly to the Saugus River through systems of piping, swales, and overland flow.

Direct stormwater discharges from MassDOT property to the impaired water occur at the following locations.

<u>I-95 - Interchange 42</u>

Storm water from approximately 0.9 acres of the southbound lane, east of Interchange 42, drains via catch basins and drain pipes to relatively flat vegetated areas adjacent to the highway (Figure 2a). Some infiltration is likely occurring at these locations during low-flow events; however, during moderate and high flow events runoff from these areas flows overland into the Saugus River, as evidenced by erosion and decaying hay bales and silt fence located along the top of the river bank. Land area is physically available for the installation of stormwater BMPs in these areas. Property right-of-way, access, and soil conditions would need to be evaluated to determine the suitability of these areas for BMPs.

Approximately 3.6 acres of MassDOT property that includes a portion of the southbound lane and much of the northbound lane on the eastern side of Interchange 42 near the Saugus River drain via catch basins and storm drains directly to the river (Figure 2a). The storm drains on the northbound portion of I-95 located between Interchange 42 and the Saugus River discharge into a stone-lined channel on private property that conveys the storm water a distance of approximately 50 feet to the Saugus River. Due to the site constraints of these stormwater conveyances, the installation of storm water BMP's for this drainage area does not appear feasible.

Route 1

The portion of Route 1 located within the Saugus River watershed, north of the Saugus River, is drained via a series of catch basins and drainage pipes that discharge at two locations into the Saugus River (Figure 2b). The northernmost stormwater outfall discharges directly into the riparian wetland along the Saugus River adjacent to two 36-inch concrete pipes that provide drainage from a wetland that is situated on the eastern side of Route 1. Approximately 1.2 acres of impervious surface drain to this outfall. No stormwater BMPs currently exist for this drainage. Due to the limitation in available land and close proximity of the outfall to the wetland, stormwater treatment for this drainage area would be constrained by the natural wetland.

The drainage along Route 1 from the area south of the above segment to the catch basins approximately 400 feet north of the Saugus River is assumed to discharge directly to the Saugus River in an area west of the retail parking lots (Figure 2b). MassDOT drainage plans for this area, dated 1967, do not accurately identify the location of outfalls from this portion of the stormwater drainage system. The outfall associated with this drainage area was not located during the site visit. Approximately 1.8 acres of impervious surface drain to this outfall.

Approximately 0.9 acres of the Route 1 southbound lane near the Lynn Fells Parkway exit drains via catch basins and a 12-inch concrete pipe to an outfall on the upstream, western bridge abutment into the Saugus River. This outfall could not be field verified due to thick vegetation in this area.

The Route 1 northbound lane in the area near the Saugus River crossing drains via catch basins that connect to two 12-inch concrete pipes that discharge directly into the Saugus River approximately 170 feet downstream from the bridge abutment (outfall ID's 12556 and 12557)(Figure 2b). There are no stormwater BMPs for this drainage area. Approximately 2.2 acres of Mass DOT impervious surface drains to these discharges.

The upper eastern side of the northbound Route 1 ramp from the Lynn Fells Parkway drains via catch basins that discharge to the area inside the clover leaf. This area is a topographic low area that appears to function as an infiltration basin (see the *Existing BMPs* section of this assessment report). Approximately 1.2 acres of MassDOT impervious cover drain to this area.

The lower portion of the northbound Route 1 on-ramp drains via two catch basins and outfalls (outfall ID's 12554 and 12555) into an established drainage channel that conveys storm water to the Saugus River (Figure 2b). The channel does not currently function as a stormwater BMP because there is no outlet control; however, there appears to be good potential for a BMP installation at this location based on topography and the distance from the river. Approximately 0.3 acres of MassDOT impervious surface drains to these outfalls.

The western side of the northbound Route 1 ramp is drained by catch basins that discharge to Bennetts Pond Brook which meets the Saugus River immediately southeast of the northbound Route 1 cloverleaf (Figure 2b). No existing stormwater BMPs were identified for this drainage area and due to the close proximity of the discharges to the brook, opportunities for BMP measures may be limited.

An area from approximately 500 feet south of the Route 1 ramp at Lynn Fells Parkway to the ramp is drained via catch basins and 12-inch concrete drain pipes to the Bennetts Pond Brook. No stormwater BMPs exist for this drainage and due to the direct nature of the discharge, installation of a BMP is likely to be infeasible.

Assessment under BMP 7U

The following impairments for Saugus River Segment MA93-34 have not been addressed by a TMDL: low flow alterations and alteration in stream-side and littoral vegetative covers. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U (MassDOT, 2011) of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U, impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the impairment of alteration in stream-side or littoral vegetative covers.

As described below, the impairments for low flow alterations and fecal coliform (pathogens) are assessed separately.

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential stormwater impacts on the impaired water and evaluate the level of impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed has less than 9% impervious cover, MassDOT concludes that storm water is not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

Low flow alterations is listed as an impairment due to the stream diversion from the upstream segment of the Saugus River to Hawkes Pond. This results in low-flow conditions in the Saugus River during summer and fall when the LWSC refills the storage reservoir. Limitations to this diversion withdrawal have been recommended to protect the aquatic habitat in the Saugus River (Gomez and Sullivan 2002). The impairment is unrelated to stormwater, and thus MassDOT has determined that further assessment of the impairment of low-flow alterations to the Saugus River Segment MA93-35 is not required.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of downstream end of impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces datalayer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/ properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations.

This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the stormwater infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Saugus River (MA93-35)):

Total Watershed		
Watershed Area	15,904	acres
Impervious Cover (IC) Area	3,843	acres
Percent Impervious	24	%
IC Area at 9% Goal	1,431	acres
Target Reduction % in IC	63	%

Subwatershed		
Watershed Area	4,171	acres
Impervious Cover (IC) Area	1,011	acres
Percent Impervious	24	%
IC Area at 9% Goal	375	acres
Target Reduction % in IC	63	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	16.0	acres
MassDOT's Target Reduction in Effective IC (63% of DOT Directly Contributing IC)	10.1	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairment. The watershed should target a reduction of its effective IC by 63% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 10.1 acres of effective IC.

Existing BMPs

There is one existing BMP associated with the direct discharges from MassDOT property into the Saugus River segment MA93-35. In some areas, infiltration may occur during low-flow events, but due to the topography in these areas, runoff to the nearby impaired water is likely during moderate

and high-flow event. The MassDOT stormwater drainage systems focused on in this assessment are comprised of stormwater outfalls that discharge directly into the impaired water or into a wetland that abuts the impaired water.

Ex-BMP-1

The existing BMP (Ex-BMP-1) identified for this segment of the Saugus River is located within the cloverleaf at the Route 1 northbound ramp from the Lynn Fells Parkway (Figure 2b). The relatively undisturbed low topographic area inside the cloverleaf functions as an infiltration basin. Approximately 1.2 acres of MassDOT impervious surface drains to five outfalls within the basin area. There is a 36-inch concrete outlet pipe from this area that acts as a high level outlet. This low topographic area is characterized as an infiltration basin with an effective IC removal efficiency of 96% providing a reduction of 1.1 acres of IC.

Summary of Existing BMP

BMP Name	BMP Type	Soil Type	Depth of Runoff Treated (inches)	IC Area Treated (acres)	Reduction of Effective IC*(%)	Reduction of Effective IC (acres)
Ex-BMP-1	Infiltration Basin	B - Loam 0.52 in/hr	1.8	1.2	96	1.1

*Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT 2011)

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 10.1 acres, MassDOT will consider the implementation of additional BMPs.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in storm water vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to storm water management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in storm water runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in storm water runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform in urban storm water from other sources ranging between 14,000 and 17,000 have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other storm water systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the storm water system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from storm water runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other storm water systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for storm water that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive storm water management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive storm water management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for storm water discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of storm water management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing storm water discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In

- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing storm water management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, EPA has indicated that MassDOT will be covered under an individual storm water permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

The entire watershed of MassDOT-owned roadways was investigated to identify existing BMPs. This assessment of Saugus River has shown that the existing BMPs provide about 11% of the target reduction in IC.

The following table summarizes the effective IC removal of the existing BMPs.

Impervious Cover Reduction		
IC in Directly Contributing Watershed	16.0	acres
Required Reduction in Effective IC	10.1	acres
IC Effectively Reduced by Existing BMPs	1.1	acres
IC Remaining to Mitigate with Proposed BMPs	9.0	acres

To achieve the targeted reduction in IC, removal of an additional 9.0 acres of effective IC is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal watershed permits and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the storm water management plan and those under consideration for reducing the effective IC from MassDOT are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing storm water permit and the applicable Pathogen TMDLs.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional

opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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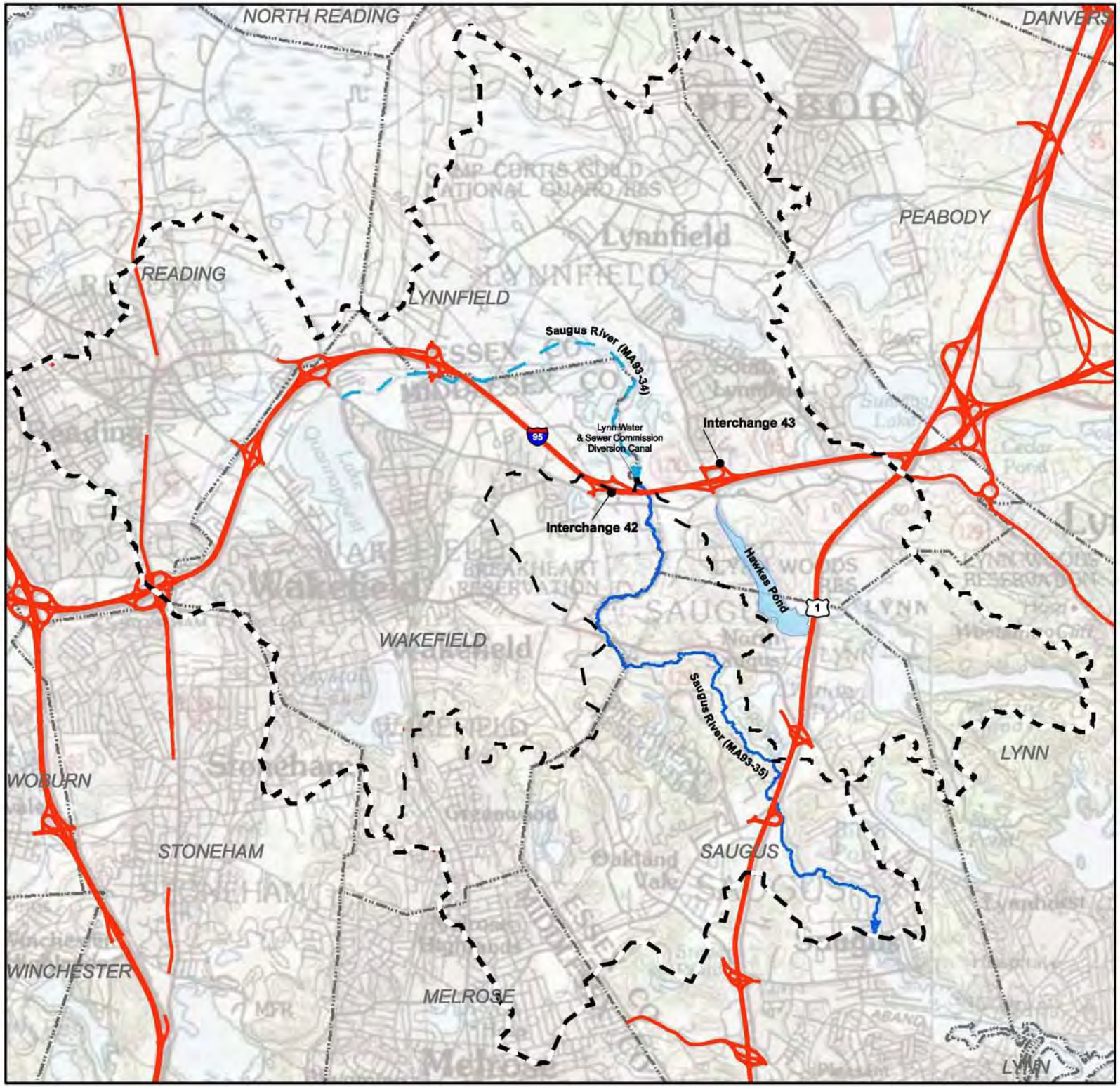

Segment MA93-35 Subwatershed
Saugus River Watershed
MassDOT Roads in Urban Areas
Hawkes Pond (MA93032)
Saugus River (MA93-34)
Saugus River (MA93-35)
Town Boundary

N

0 0.5 1 Miles

Figure 1
Saugus River Watershed MA93-35

September 2011

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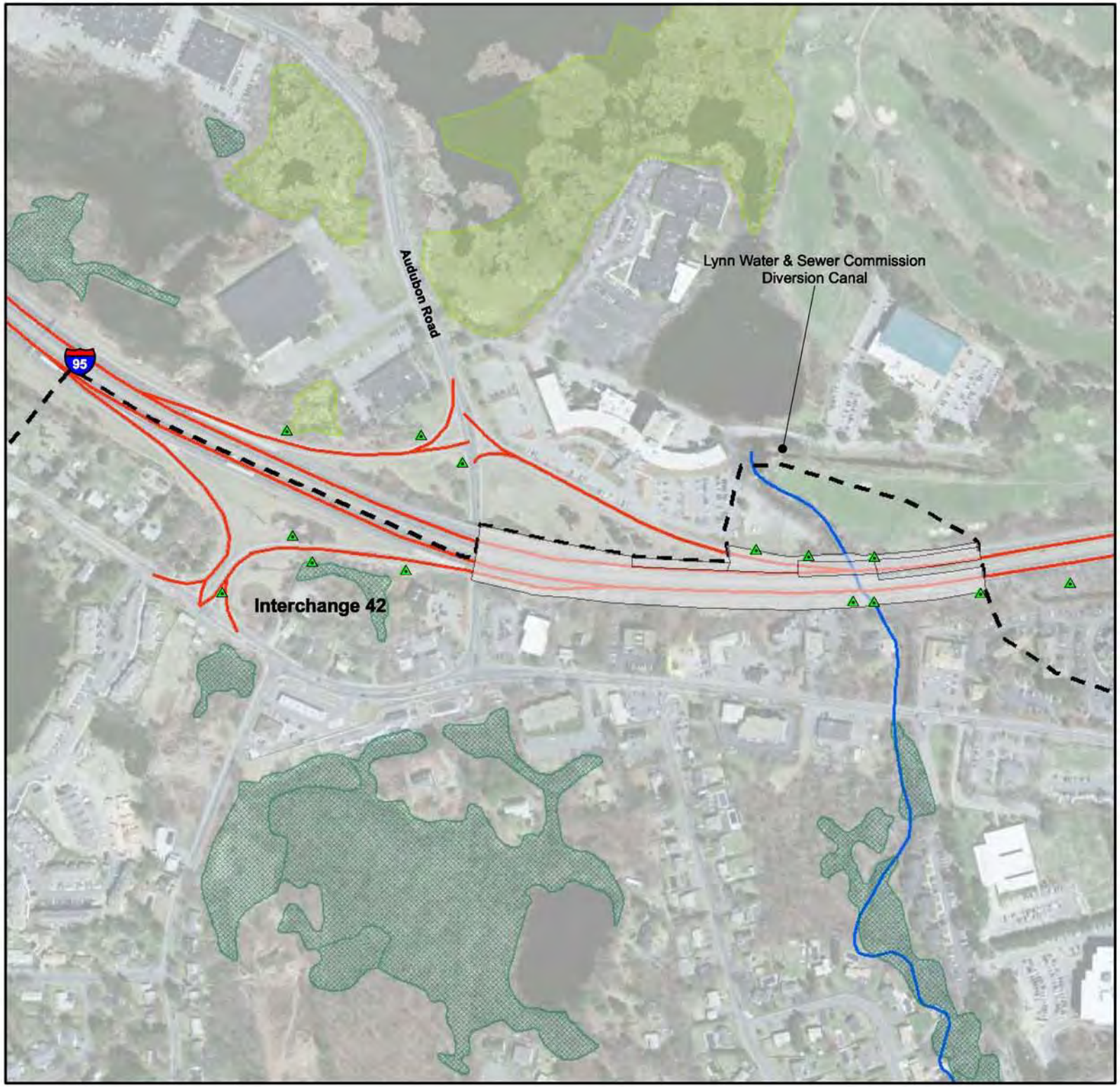

- Stormwater Outfall
- Existing BMP Watershed
- MassDOT Directly Contributing Watershed
- Segment MA93-35 Subwatershed Boundary
- Existing BMP

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- MassDOT Roads in Urban Areas
- Saugus River (MA93-34)
- Non-Impaired Stream Segment

N

0 300 600 Feet

Figure 2a
MassDOT Drainage Areas
Saugus River
Watershed
MA93-35

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- Stormwater Outfall
- Existing BMP Watershed
- MassDOT Directly Contributing Watershed
- Segment MA93-35 Subwatershed Boundary
- Existing BMP

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- MassDOT Roads in Urban Areas
- Saugus River (MA93-34)
- Non-Impaired Stream Segment

N

0 300 600 Feet

Figure 2b
MassDOT Drainage Areas
Saugus River
Watershed
MA93-35

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Impaired Waters Assessment for Lee River (MA61-02) – Progress Report

Impaired Waterbody

Name: Lee River

Location: Swansea and Somerset, MA

Water Body ID: MA61-02

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): pathogens, taste, odor, and color

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): fecal coliform, taste and odor, chlorophyll *a*, total nitrogen, dissolved oxygen, debris/floatables/trash

Lee River 02 (MA61-02) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009c), this segment is impaired due to low dissolved oxygen, elevated total nitrogen, elevated chlorophyll *a*, and elevated total coliform bacteria.

Relevant Water Quality Standards

- Water Body Classification: Class SA
- *314 CMR 4.05 (4)(a) 5 Solids*. These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- *314 CMR 4.05 (4)(a) 8 Taste and Odor*. None other than of natural origin.
- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.
- *314 CMR 4.05 (4)(a) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l. Where natural background conditions are lower, DO shall not be less than natural background. Natural

seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.

- *314 CMR 4.05 (4)(a) 4 Bacteria*.
    - a. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
    - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed a geometric mean of 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all samples taken within the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Lee River is comprised of two segments, MA61-01 and MA61-02. The first segment of Lee River (MA61-01) is 0.53 miles long and flows into the second segment (MA61-02) at Route 6 (Rte 6). Lee River (MA61-02) then continues approximately 2.55 miles until it flows into Mount Hope Bay (MA61-07). This second segment is covered in this assessment. The subwatershed of Lee River (MA61-02) is shown in Figure 1.

During site visits performed on October 5th and 6th 2011, it was determined that MassDOT's property that directly contributes stormwater runoff to Lee River (MA61-02) is comprised of portions of Rte 6, Rte 103, I-195, Lees River Avenue and the ramps connecting it to I-195, and the ramp from Rte 103 East to I-195 East (see Figure 2). No existing BMPs were identified for discharges to this segment of the Lee River (MA61-02). However, it was noted that the median of I-195 is a potential location for the implementation of BMPs.

Assessment under BMP 7U

The following impairments for Lee River (MA61-02) have not been addressed by a TMDL: taste, odor, and color, chlorophyll *a*, total nitrogen, dissolved oxygen, and debris/floatables/trash. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- taste, odor, and color

- chlorophyll *a*
- total nitrogen
- dissolved oxygen
- debris/floatables/trash

As described below the impairment for pathogens is assessed separately.

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% impervious cover, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction is then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

Because there are no existing BMPs for Lee River (MA61-02), there was no effective IC reduction to take into account when performing these calculations.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Lee River (MA61-02)):

Total Watershed		
Watershed Area	4,216	acres
Impervious Cover (IC) Area	553	acres
Percent Impervious	13.1	%
IC Area at 9% Goal	379	acres
Target Reduction % in IC	31.4	%

Subwatershed		
Subwatershed Area	2,205	acres
Impervious Cover (IC) Area	405	acres
Percent Impervious	18.4	%
IC Area at 9% Goal	198	acres
Target Reduction % in IC	51.0	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	37.8	acres
MassDOT's Target Reduction in Effective IC (51.0% of DOT Directly Contributing IC)	19.2	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairment. The subwatershed should target a reduction of its effective IC by 51.0% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 19.2 acres of effective IC.

Next Steps

Because the target total mitigation of impervious surface is 19.2 acres and there are no existing BMPs, MassDOT will consider the implementation of BMPs in the I-195 median and right-of-way under the MassDOT Retrofit Initiative.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in storm water vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to storm water management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in storm water runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in storm water runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform in urban storm water from other sources ranging between 14,000 and 17,000 have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other storm water systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the storm water system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from storm water runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other storm water systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for storm water that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive storm water management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive storm water management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for storm water discharges in TMDLs." (MassDEP no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of storm water management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing storm water discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In

- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing storm water management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual storm water permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

To achieve the targeted reduction in IC, the mitigation of 19.2 acres of effective IC is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal watershed permits and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the storm water management plan and those under consideration for reducing the effective IC from MassDOT are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing storm water permit and the applicable Pathogen TMDLs.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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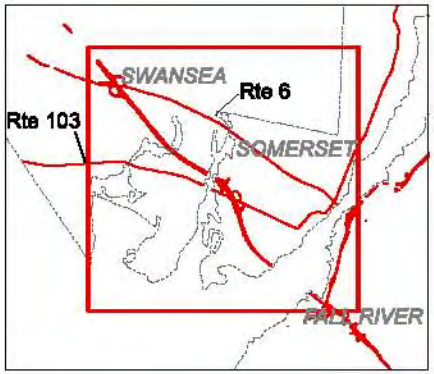


Lee River (MA61-02) Subwatershed
Impaired Stream Segments
Impaired Water Bodies
NWI Wetland Areas
MassDOT Urban Area Roads
Town Boundaries

N

0 1,250 2,500 5,000

Feet

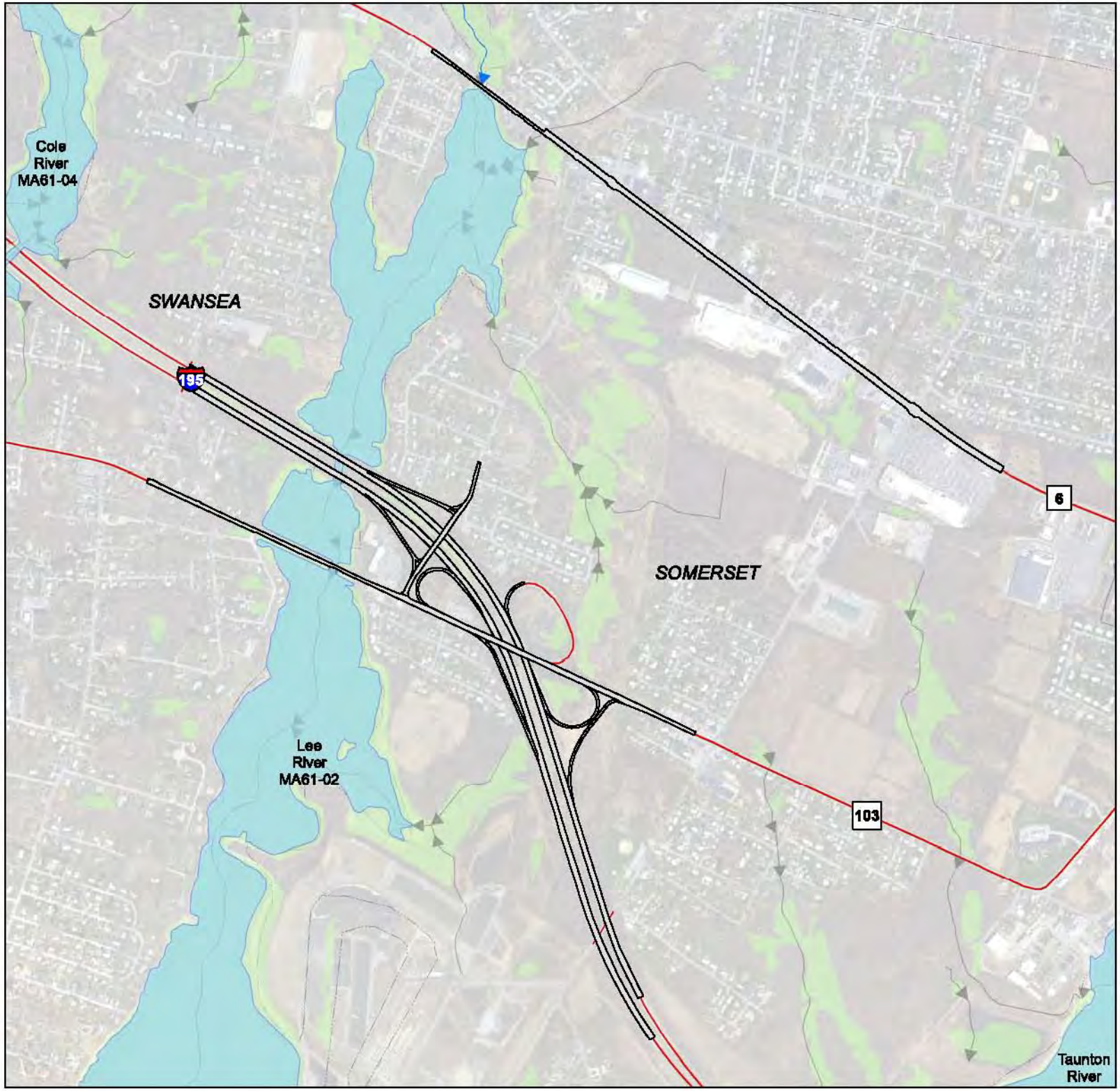
1 in = 2,500 feet

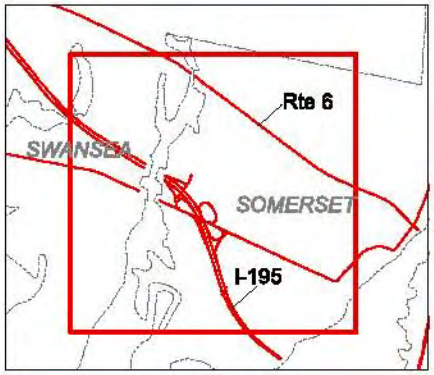
Figure 1

Lee River (MA61-02) Subwatershed

October 2011

Moving Massachusetts Forward massDOT





MassDOT Watershed
Impaired Stream Segments
Impaired Water Bodies
Non-Impaired Stream Segments
NWI Wetland Areas
MassDOT Urban Area Roads
Town Boundaries

N

0 625 1,250 2,500

Feet

1 in = 1,250 feet

Figure 2

Lee River (MA61-02)
Directly Contributing MassDOT Watershed

October 2011

Moving Massachusetts Forward
massDOT

Impaired Waters Assessment for Cole River (MA61-04) – Progress Report

Impaired Waterbody

Name: Cole River

Location: Swansea and Somerset, MA

Water Body ID: MA61-04

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): nutrients, organic enrichment/low DO, pathogens

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): total nitrogen, dissolved oxygen, fecal coliform, chlorophyll *a*

Cole River (MA61-04) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009c), this segment is impaired for low dissolved oxygen, elevated total nitrogen, elevated chlorophyll a, and elevated total fecal coliform bacteria due to general urban storm water, discharges from municipal separate storm sewer systems, failing septic systems, and illicit connections to storm sewers.

Relevant Water Quality Standards

- Water Body Classification: Class SA
- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.
- *314 CMR 4.05 (4)(a) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l. Where natural background conditions are lower, DO shall not be less than natural background. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (4)(a) 4 Bacteria*.

- a. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5))
- b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed a geometric mean of 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all samples taken within the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department.

Site Description

Cole River is comprised of two segments, MA61-03 and MA61-04. The first segment of the Cole River (MA61-03) is 1.6 miles long and flows into the second segment (MA61-04) just after passing under Route 6 (Rte 6). Cole River (MA61-04) then continues approximately 2.4 miles until it flows into Mount Hope Bay (MA61-07). The subwatershed of Cole River (MA61-04) is shown in Figure 1.

During site visits performed on October 5th and 6th 2011, it was determined that MassDOT's property that directly contributes storm water runoff to Cole River (MA61-04) is comprised of portions of Rte 6, Rte 103, and I-195 (see Figure 2).

Assessment under BMP 7U

The following impairments for Cole River (MA61-04) have not been addressed by a TMDL: nutrients, organic enrichment/low DO and chlorophyll *a*. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- nutrients
- organic enrichment/low DO
- chlorophyll *a*

As described below the impairment for pathogens is assessed separately.

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the impervious cover reduction required to ensure that storm water

is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% impervious cover, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Cole River (MA61-04)):

Total Watershed		
Watershed Area	9,106	acres
Impervious Cover (IC) Area	923	acres
Percent Impervious	10.1	%
IC Area at 9% Goal	820	acres
Target Reduction % in IC	11.2	%

Subwatershed		
Subwatershed Area	1,368	acres
Impervious Cover (IC) Area	252	acres
Percent Impervious	18.4	%
IC Area at 9% Goal	123	acres
Target Reduction % in IC	51.2	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	20.8	acres
MassDOT's Target Reduction in Effective IC (51.2% of DOT Directly Contributing IC)	10.6	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairment. The subwatershed should target a reduction of its effective IC by 51.2% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 10.6 acres of effective IC.

Existing BMPs

MassDOT has two existing BMPs in the Cole River (MA61-04) subwatershed that are mitigating potential storm water quality impacts prior to discharge to Cole River. Figure 3 shows the BMP locations and their watersheds. In our analysis, existing BMPs receive credit for removing the effect of IC depending on their type, size relative to the IC that they process, and the local soil conditions. The soil in the area associated with the existing BMPs is characterized as hydrologic group B (loam).

Ex-BMP-1

At the west extent of the I-195 eastbound watershed directly contributing to Cole River (MA61-04), the roadway is relatively flat. Sheet flow from the entire roadway flows for about 46 feet perpendicularly from the roadway into a grassy area in the median. This area in the median is dry, well-vegetated with varying grass heights, has a slope of about 15%, and extends about 297 feet along the median. Based on the slope along the length of the median, it appears that in the event of a large amount of runoff, sheet flow runs to the low point in the center of the median and then travels east towards Cole River (MA61-04). This grassy area was characterized as a vegetated filter strip and is estimated to achieve 21% IC removal for the area draining to it, or a 0.1 acre effective IC reduction.

Ex-BMP-1. Vegetated Filter Strip.

Ex-BMP-2

Similar to the section of I-195 eastbound described above, the roadway of I-195 westbound directly contributing to Cole River (MA61-04) is relatively flat. Sheet flow from the entire roadway flows for about 46 feet perpendicularly to the roadway into a second grassy area in the median. This area is dry, well-vegetated with varying grass heights, has a slope of about 15%, and extends about 297 feet along the median. Based on the slope along the length of the median, it appears that in the event of a large amount of runoff, sheet flow runs to the low point in the center of the median and then travels east towards Cole River (MA61-04). This grassy area was characterized as a vegetated filter strip and is estimated to achieve 22% IC removal, or a 0.1 acre effective IC reduction.

Ex-BMP-2. Vegetated Filter Strip.

Summary of Existing BMPs

BMP Name	BMP Type	Soil Type	Depth of Runoff Treated (inches)	IC Area Treated (acres)	Reduction of Effective IC* (%)	Reduction of Effective IC (acres)
Ex-BMP-1	Vegetated Filter Strip	D	0.2	0.4	21	0.1
Ex-BMP-2	Vegetated Filter Strip	D	0.2	0.4	22	0.1
Total						0.2

*Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT 2011)

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 10.6 acres, MassDOT will consider the implementation of additional BMPs.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in storm water vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to storm water management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in storm water runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in storm water runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform in urban storm water from other sources ranging between 14,000 and 17,000 have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other storm water systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the storm water system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from storm water runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other storm water systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for storm water that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive storm water management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive storm water management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for storm water discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of storm water management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing storm water discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing storm water management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual storm water permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

The entire watershed of MassDOT-owned roadways was investigated to identify existing BMPs. This assessment of Cole River (MA61-04) has shown that the existing BMPs provide 1.7% of the target reduction in IC.

The following table summarizes the effective IC removal of the existing BMPs.

Impervious Cover Reduction		
IC in Directly Contributing Watershed	20.8	acres
Required Reduction in Effective IC	10.6	acres
IC Effectively Reduced by Existing BMPs	0.2	acres
IC Remaining to Mitigate with Proposed BMPs	10.4	acres

To achieve the targeted reduction in IC, the mitigation of an additional 10.4 acres of effective IC is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal watershed permits and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the storm water management plan and those under consideration for reducing the effective IC from MassDOT are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing storm water permit and the applicable Pathogen TMDLs.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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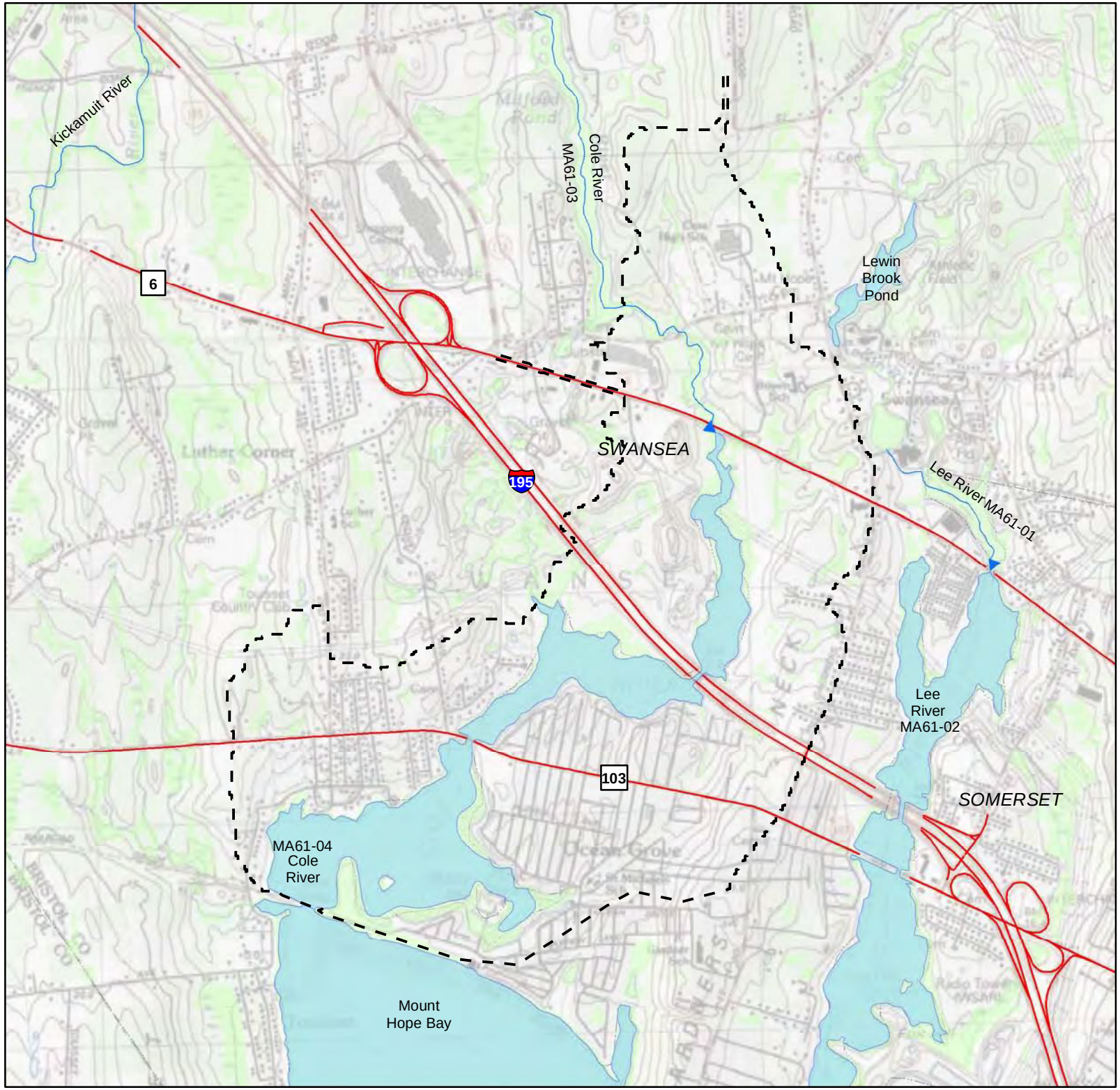

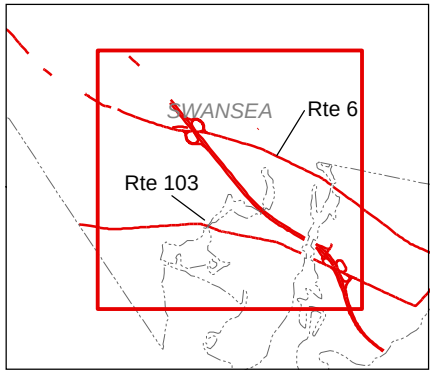

Cole River (MA61-04) Subwatershed
Impaired Stream Segments
Impaired Water Bodies
NWI Wetland Areas
MassDOT Urban Area Roads
Town Boundaries

N

0 1,000 2,000 4,000

Feet

1 in = 2,000 feet

Figure 1

Cole River (MA61-04) Subwatershed

October 2011

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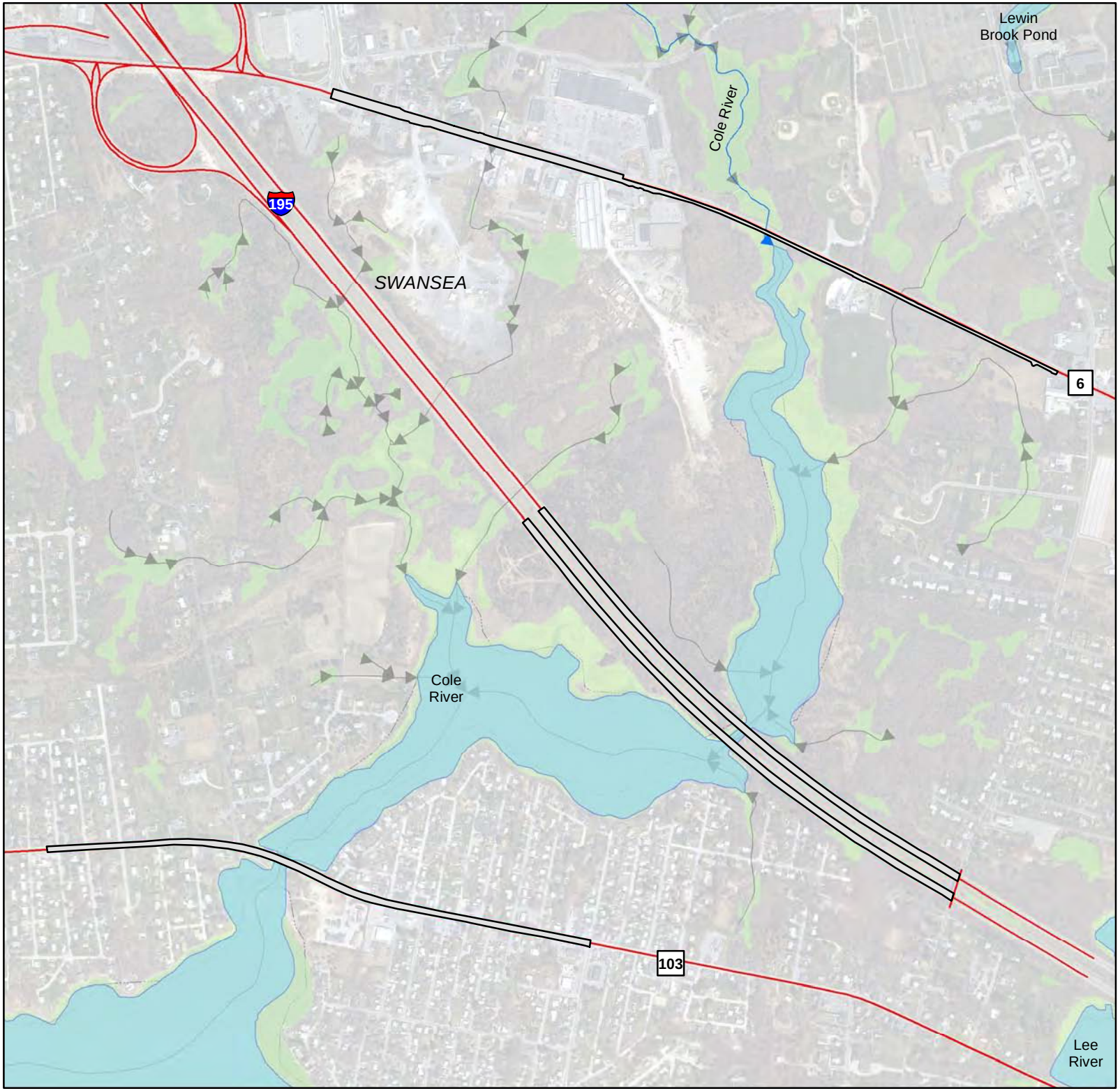

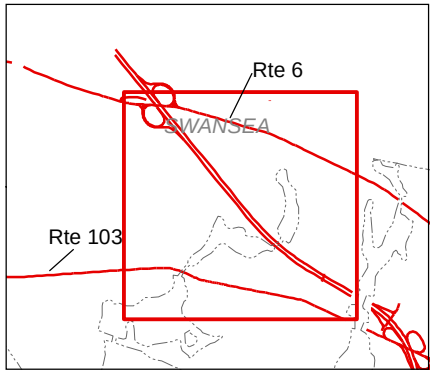

MassDOT Watershed
Impaired Water Bodies
Impaired Stream Segments
Non-Impaired Stream Segments
NWI Wetland Areas
MassDOT Urban Area Roads
Town Boundaries

N

0 500 1,000 2,000

Feet

1 in = 1,000 feet

Figure 2

Cole River (MA61-04)
Directly Contributing MassDOT Watershed

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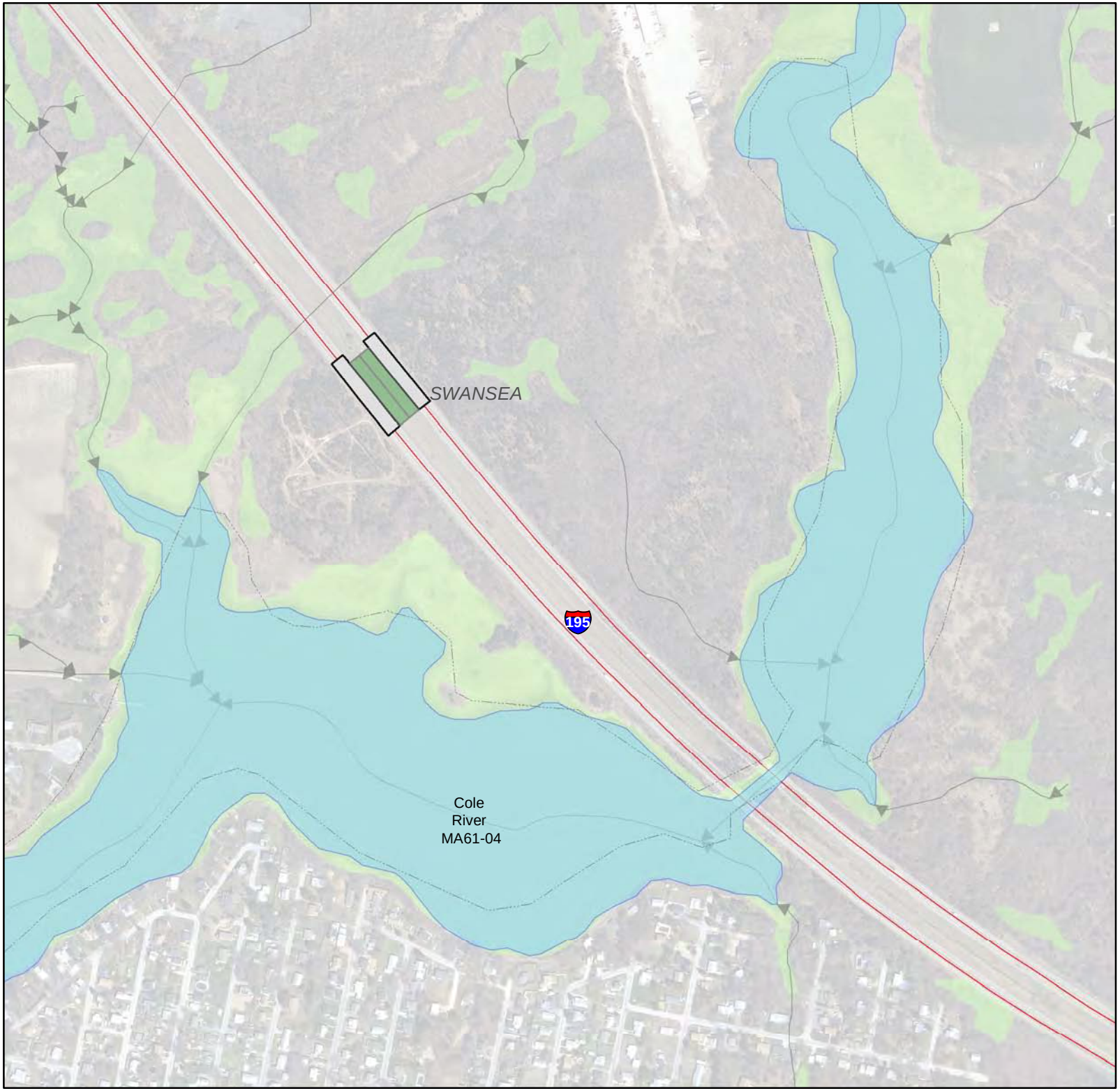

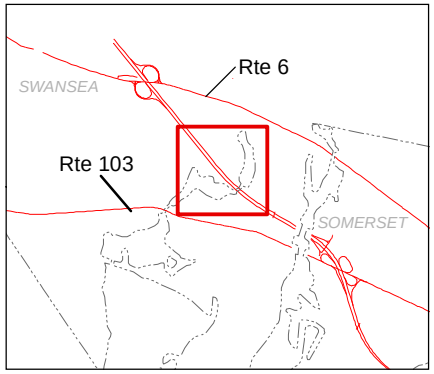

Existing BMPs
BMP Watersheds
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 250 500 1,000

Feet

1 in = 500 feet

Figure 3

Cole River (MA61-04)
Existing BMPs

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Impaired Waters Assessment for Spy Pond (MA71040) – Progress Report

Impaired Waterbody

Name: Spy Pond

Location: Arlington, MA

Water Body ID: MA71040

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): pesticides, nutrients, organic enrichment/low dissolved oxygen (DO), noxious aquatic plants, exotic species

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010a): pesticides, nutrients, organic enrichment/low DO, noxious aquatic plants, exotic species

Spy Pond (MA71040) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and proposed *Massachusetts Year 2010 Integrated List of Waters*. Spy Pond is also listed in the *Draft Pathogen TMDL for the Boston Harbor Watershed* (MassDEP, 2011). Since the water body is not impaired for pathogens, this TMDL is a protective TMDL.

According to MassDEP's *Mystic River Watershed and Coastal Drainage Area 2004-2008 Water Quality Assessment Report* (MassDEP, 2010b), Spy Pond is a Class B water body. The report assessed Spy Pond for the Aquatic Life and Fish Consumption designated use classifications. The Aquatic Life Use is reported to be impaired due to the presence of non-native aquatic plants. The Fish Consumption Use is reported to be impaired due to the presence of pesticides (DDT and Chlordane) from an unknown source. Although Spy Pond was not assessed for the Primary Contact, Secondary Contact, or Aesthetics designated use classifications, all three have been placed on "Alert Status" due to evidence of algal blooms.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *301 CMR 4.05 (3)(b) Class B.* These waters are designated as a habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. Where designated in 314 CMR 4.06, they shall be suitable as a source of public water supply with appropriate treatment ("Treated Water Supply"). Class B waters shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.
- *301 CMR 4.05 (3)(b) 1 Dissolved Oxygen.* Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.

- *301 CMR 4.05 (5)(a) Aesthetics.* All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

- *301 CMR 4.05 (5)(c) Nutrients.* Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.

- *301 CMR 4.05 (5)(e) Toxic Pollutants.* All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the *National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002* published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

Site Description

Spy Pond is located in the town of Arlington, Massachusetts. The pond has a surface area of approximately 98.4 acres and is part of the Boston Harbor Watershed and the Mystic River sub-basin. Spy Pond is fed by a combination of groundwater and surface runoff and outlets to Little Pond in Belmont via a 36-inch concrete culvert, ultimately draining to the Mystic River. The photograph below shows the outlet structure controlling flow into the 36-inch culvert.

Spy Pond has a contributing watershed of approximately 696 acres consisting primarily of urbanized, residential areas in Arlington. The majority of the pond is surrounded by residential properties and recreational areas, including athletic fields and parks. MA Route 2/Concord Turnpike in Belmont and Arlington borders the southwestern portion of the pond, extending approximately 1,760 feet along its shoreline. Refer to Figure 1 for the location of the Spy Pond watershed relative to Route 2.

MassDOT, which owns Route 2, also maintains 13 stormwater outfalls along Spy Pond's shoreline. Approximately 38 acres of MassDOT roadways drain directly to Spy Pond via these 13 outfalls. These roadways include Route 2, its entry/exit ramps, several overpasses, and Frontage Road along the northern edge of Route 2. Refer to Figures 2a-2c for MassDOT's watershed contributing directly to Spy Pond. During a field visit on Monday October 17, 2011, it was confirmed that MassDOT currently has no BMPs in place to mitigate the effects of its IC discharging directly to Spy Pond.

Of MassDOT's 13 outfalls contributing stormwater directly to Spy Pond, 12 are relatively small in diameter (12-inch through 18-inch) and drain two acres or less of roadway each. One outfall is 54 inches in diameter and drains nearly 30 acres of MassDOT roadways. The photograph below shows this 54-inch outfall.

In addition to draining MassDOT roadways, this 54-inch outlet drains several local municipal roadways in the Town of Arlington and the Town of Belmont with stormwater collection systems that tie directly into MassDOT's stormwater collection system. On December 9, 2008, AECOM, working as a consultant for MassDOT, performed an Illicit Discharge Detection review of MassDOT's stormwater system discharging to Spy Pond to address a complaint by Mystic River Watershed Association (MyRWA) regarding high pathogen levels in stormwater discharge samples. AECOM's findings indicate that the following roads in the Town of Arlington have stormwater collection systems tied directly into MassDOT's system:

- Cedar Avenue
- Park Avenue
- Bellington Street
- Hillcrest Street
- Spring Street
- Morton Road
- Jason Street

AECOM's findings also indicate that the following roads in the Town of Belmont have stormwater collection systems tied directly into MassDOT's system:

- Frontage Road to the south of Route 2 (travelling eastbound, its name changes to several times to Bellington Street/Beatrice Circle/Radcliffe Road/Lake Street)
- Clifton Street
- Pleasant Street

These drainage areas are included in the sub-watershed to Spy Pond in the assessment below but are not included in the MassDOT impervious area calculations since they are owned by other entities.

Assessment under BMP 7U

The following impairments for Spy Pond have not been addressed by a TMDL: pesticides, nutrients, organic enrichment/low dissolved oxygen (DO), noxious aquatic plants, and exotic species. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- Pesticides
- Nutrients
- Organic enrichment/low DO
- Noxious aquatic plants
- Exotic species

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% impervious cover, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

Spy Pond is also listed in the Draft Pathogen TMDL for the Boston Harbor Watershed. Since the water body is not impaired for pathogens, this TMDL is a protective TMDL. As described in MassDOT's Impaired Waters Assessment for Pathogens (to be finalized in 2012), MassDOT's approach to water bodies that are impaired for pathogens is to comply with our current IDDE program outlined in their Storm Water Management Plan (SWMP). Additionally, many types of BMPs installed to reduce the effective impervious cover and address other impairments will also substantially reduce pathogen loading from storm water.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As

explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Spy Pond (MA71040)):

Total Watershed and Subwatershed*		
Watershed Area	696	acres
Impervious Cover (IC) Area	240	acres
Percent Impervious	34.5	%
IC Area at 9% Goal	62.6	acres
Target Reduction % in IC	73.9	%

*The subwatershed and the total watershed are the same in the case of Spy Pond (MA71040).

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	38.0	acres
MassDOT's Target Reduction in Effective IC (73.9% of DOT Directly Contributing IC)	28.1	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairments. The subwatershed should target a reduction of its effective IC by 35.6% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 28.1 acres of effective IC.

Next Steps

Because MassDOT should aim to reduce the amount of effective IC discharging directly to Spy Pond by 28.1 acres to meet the 9% target, MassDOT will consider the implementation of BMPs for mitigation.

Conclusions

The entire watershed of MassDOT-owned roadways was investigated to identify existing BMPs. This assessment of Spy Pond has shown that there are no existing BMPs in place to mitigate the effects of MassDOT's impervious cover.

The following table summarizes the reduction required to meet the 9% IC target.

Impervious Cover Reduction

IC in Directly Contributing Watershed	38.0	acres
Required Reduction in Effective IC	28.1	acres
IC Effectively Reduced by Existing BMPs	0.0	acres
IC Remaining to Mitigate with Proposed BMPs	28.1	acres

To achieve the targeted reduction in IC, removal of 28.1 acres of effective IC is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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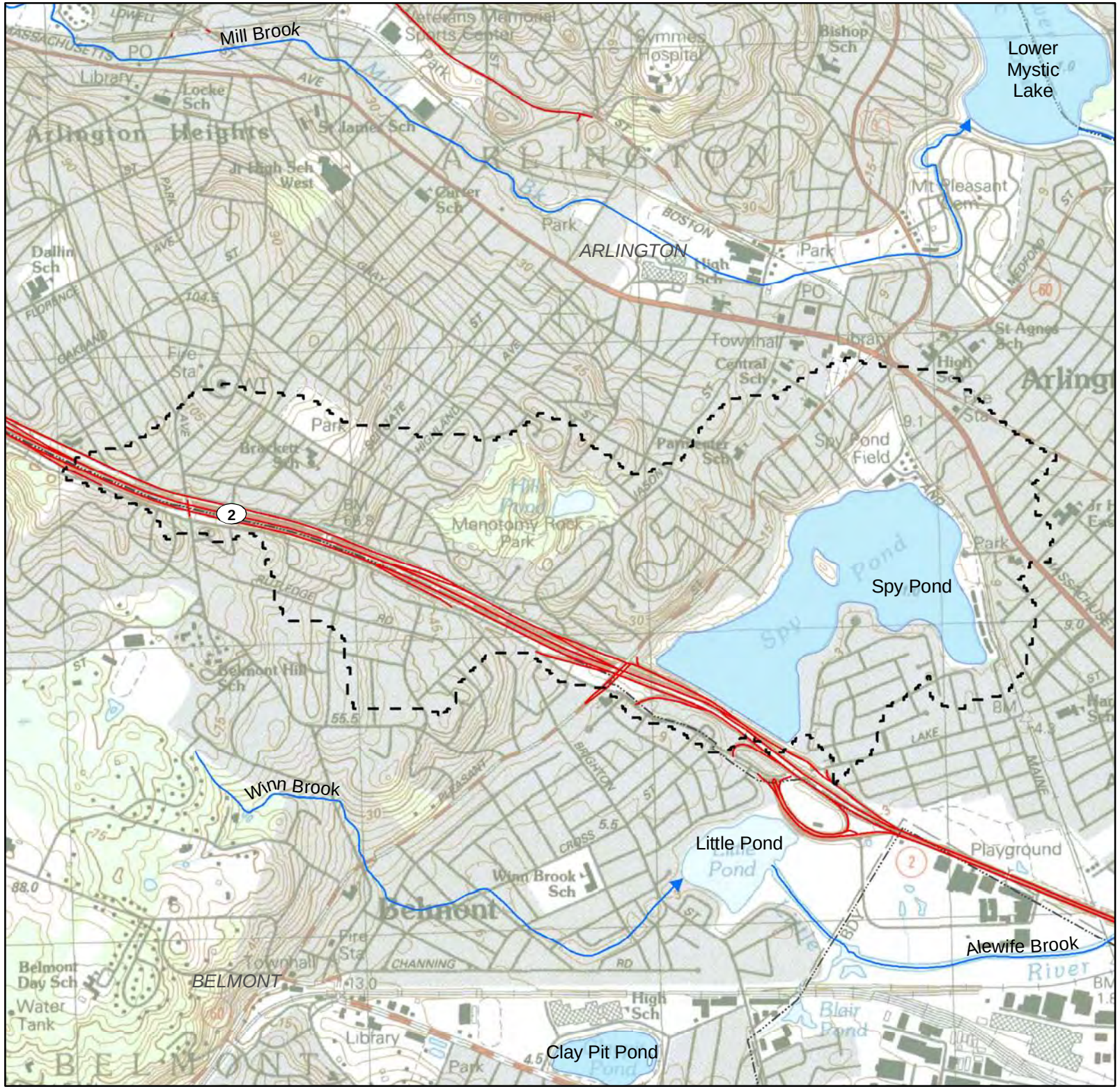
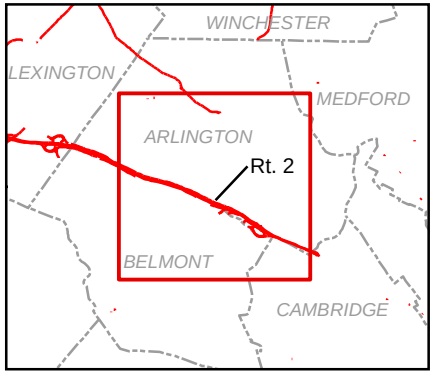




Spy Pond Subwatershed

Impaired Waterbody

Impaired Stream Segment

MassDOT Road in Urban Area

Town Boundary

N

0 750 1,500 3,000

Feet

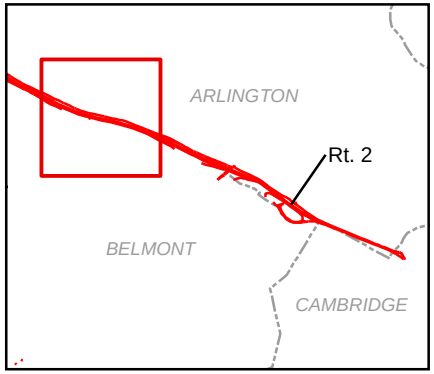
1 inch = 1,500 feet

Figure 1

Spy Pond (MA71040) Subwatershed

October 2011

Moving Massachusetts Forward. massDOT



MassDOT Direct Watershed

Impaired Waterbody

NWI Wetland Area

Impaired Stream Segment

NHD Flowline

MassDOT Road in Urban Area

Town Boundary

N

0 250 500 1,000

Feet

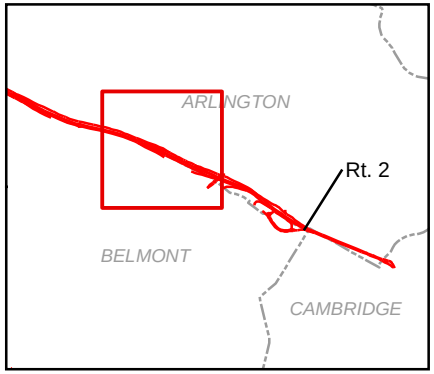
1 inch = 500 feet

Figure 2a

Spy Pond (MA71040)
Directly Contributing
MassDOT Watershed

November 2011

Moving Massachusetts Forward. massDOT



MassDOT Direct Watershed
Impaired Waterbody
NWI Wetland Area
Impaired Stream Segment
NHD Flowline
MassDOT Road in Urban Area
Town Boundary

N

0 250 500 1,000

Feet

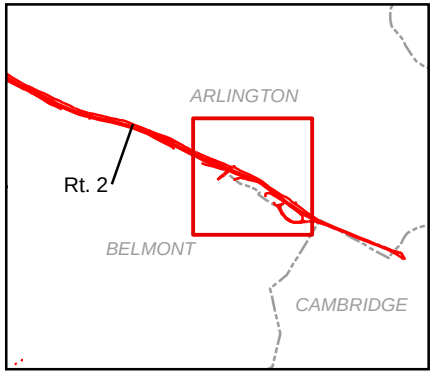
1 inch = 500 feet

Figure 2b

Spy Pond (MA71040)
Directly Contributing
MassDOT Watershed

November 2011

Moving Massachusetts Forward. massDOT



MassDOT Direct Watershed

Impaired Waterbody

NWI Wetland Area

Impaired Stream Segment

NHD Flowline

MassDOT Stormwater Outfall

MassDOT Road in Urban Area

Town Boundary

N

0 250 500 1,000

Feet

1 inch = 500 feet

Figure 2c

Spy Pond (MA71040)
Directly Contributing
MassDOT Watershed

November 2011

Moving Massachusetts Forward. massDOT

Impaired Waters Assessment for Alewife Brook (MA71-04) – Progress Report

Impaired Waterbody

Name: Alewife Brook

Location: Belmont, Cambridge, Arlington, & Somerville, MA

Water Body ID: MA71-04

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): metals, nutrients, organic enrichment/low dissolved oxygen (DO), pathogens, oil and grease, taste, odor, color, objectionable deposits

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010a): metals, nutrients, organic enrichment/low DO, pathogens, oil and grease, taste, odor, color, objectionable deposits

Alewife Brook (MA71-04) is listed under Category 5, "Waters Requiring a TMDL", on both the MassDEP final *Massachusetts Year 2008* and proposed *Massachusetts Year 2010 Integrated List of Waters*. Alewife Brook is also listed in the *Draft Pathogen TMDL for the Boston Harbor Watershed* (MassDEP, 2005).

According to MassDEP's *Mystic River Watershed and Coastal Drainage Area 2004-2008 Water Quality Assessment Report* (MassDEP, 2010b), Alewife Brook is a Class B water body. According the report, combined sewer overflows (CSOs) and "unspecified urban stormwater" are the main sources of impairment for all of the assessed designated use classifications. The impairments of the Aquatic Life Use are also attributed to "contaminated sediments".

Relevant Water Quality Standards

- Water Body Classification: Class B
- *301 CMR 4.05 (3)(b) Class B.* These waters are designated as a habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. Where designated in 314 CMR 4.06, they shall be suitable as a source of public water supply with appropriate treatment ("Treated Water Supply"). Class B waters shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.
- *301 CMR 4.05 (3)(b) 1 Dissolved Oxygen.* Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (3)(b) 4 Bacteria*.

- a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
- b. For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

- *301 CMR 4.05 (3)(b) 5 Solids.* These waters shall be free from floating, suspended and settleable solids in concentrations and combinations that would impair any use assigned to this Class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- *301 CMR 4.05 (3)(b) 6 Color and Turbidity.* These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this Class.
- *301 CMR 4.05 (3)(b) 7 Oil and Grease.* These waters shall be free from oil, grease and petrochemicals that produce a visible film on the surface of the water, impart an oily taste to the water or an oily or other undesirable taste to the edible portions of aquatic life, coat the banks or bottom of the water course, or are deleterious or become toxic to aquatic life.
- *301 CMR 4.05 (3)(b) 8 Taste and Odor.* None in such concentrations or combinations that are aesthetically objectionable, that would impair any use assigned to this Class, or that would cause tainting or undesirable flavors in the edible portions of aquatic life.
- *301 CMR 4.05 (5)(a) Aesthetics.* All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *301 CMR 4.05 (5)(c) Nutrients.* Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.

- *301 CMR 4.05 (5)(e) Toxic Pollutants.* All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the *National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002* published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

Site Description

Alewife Brook begins at the outlet of Little Pond in Belmont and flows northeast for approximately 2.3 miles before discharging to the Mystic River at the Arlington/Somerville/Medford border. The upper portion of the brook in Belmont and Cambridge is also identified as Little River, and its name changes to Alewife Brook at the Arlington/Cambridge border. Alewife Brook is a part of the Boston Harbor watershed and Mystic River sub-basin.

At one point in time, there were 13 active CSOs discharging to Alewife Brook. Currently, only eight CSOs remain active. Five have recently been closed, and two more are planned to be closed as a result of sewer separation projects by the City of Cambridge (MWRA, 2011). The current active CSOs are operated by the following entities:

- City of Cambridge (MA0101974)
- City of Somerville (MA0101982)
- Massachusetts Water Resources Authority (MA0103284)

There are also a significant number of stormwater outfalls that discharge directly to Alewife Brook. Major roadways contributing stormwater to Alewife Brook include the Alewife Brook Parkway, the Mystic Valley Parkway, and Route 2/Concord Turnpike. Refer to Figure 1 for the location of these roadways relative to Alewife Brook.

The Massachusetts Department of Conservation and Recreation (DCR) owns the Alewife Brook Parkway and the Mystic Valley Parkway. The Alewife Brook Parkway is a significant contributor of stormwater to Alewife Brook, as it runs parallel to the brook for approximately 1.5 miles from the Mystic Valley Parkway south to Route 2/Concord Turnpike. The Mystic Valley Parkway itself crosses Alewife Brook just upstream of its confluence with the Mystic River and contributes only a small amount of stormwater via several outfalls near the crossing.

MassDOT owns MA Route 2/Concord Turnpike, which crosses Alewife Brook at the eastern limit of MassDOT's right-of-way just before the Cambridge/Arlington border. Route 2 is a divided, multi-lane highway with piped storm water collection systems discharging to outfalls along either side. Alewife

Brook is channeled beneath Route 2 through a concrete culvert approximately 16 feet wide. The photograph below shows the upstream end of this culvert.

A site visit was performed on October 17, 2011 to review MassDOT's stormwater collection systems within the Alewife Brook watershed. It was determined that approximately 1.1 acres of impervious cover (IC) along Route 2 and its entry/exit ramps in the vicinity of the culvert drain directly to Alewife Brook. Refer to Figure 2 for the location of MassDOT's directly contributing IC. It was confirmed that MassDOT currently has no BMPs in place to mitigate the effects of its IC discharging directly to Alewife Brook.

Assessment under BMP 7U

The following impairments for Alewife Brook have not been addressed by a TMDL: metals, nutrients, organic enrichment/low dissolved oxygen (DO), oil and grease, taste, odor, color, and objectionable deposits. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- metals
- nutrients
- organic enrichment/low DO
- oil and grease
- taste, odor, and color
- objectionable deposits

As described below the impairment for pathogens is assessed separately.

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed

had less than 9% impervious cover, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

Of the nine impairments for which Alewife Brook is listed on MassDEP's Final Year 2008 and Proposed Year 2010 Integrated List of Waters, only pathogens have been addressed by a TMDL. The TMDL for this impairment is in draft form. The Retrofit Initiative does not address draft TMDLs since they have not been finalized. As such, MassDOT assessed its contribution to all impairments of Alewife Brook using the approach described in BMP 7U which applies to impairments that have been assigned to a water body prior to completion of a TMDL.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's Stormwater *Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Alewife Brook (MA71-04)):

Total Watershed		
Watershed Area	5,675	acres
Impervious Cover (IC) Area	2,576	acres
Percent Impervious	45.4	%
IC Area at 9% Goal	510.8	acres
Target Reduction % in IC	80.2	%

Subwatershed		
Watershed Area	3,396	acres
Impervious Cover (IC) Area	1,726	acres
Percent Impervious	50.8	%
IC Area at 9% Goal	305.5	acres
Target Reduction % in IC	82.3	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	1.1	acres
MassDOT's Target Reduction in Effective IC (82.3% of DOT Directly Contributing IC)	0.9	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairment. The subwatershed should target a reduction of its effective IC by 82.3% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 0.9 acres of effective IC.

Next Steps

Because MassDOT should aim to reduce the amount of effective IC discharging directly to Alewife Brook by 0.9 acres to meet the 9% target, MassDOT will consider the implementation of BMPs for mitigation.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in storm water vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to storm water management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in storm water runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in storm water runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform in urban storm water from other sources ranging between 14,000 and 17,000 have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other storm water systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the storm water system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from storm water runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other storm water systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for storm water that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive storm water management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive storm water management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for storm water discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of storm water management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing storm water discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit

connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing storm water management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual storm water permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

The entire watershed of MassDOT-owned roadways was investigated to identify existing BMPs. This assessment of Alewife Brook has shown that there are no existing BMPs in place to mitigate the effects of MassDOT's impervious cover.

The following table summarizes the reduction required to meet the 9% IC target.

Impervious Cover Reduction	
IC in Directly Contributing Watershed	1.1 acres
Required Reduction in Effective IC	0.9 acres
IC Effectively Reduced by Existing BMPs	0.0 acres
IC Remaining to Mitigate with Proposed BMPs	0.9 acres

To achieve the targeted reduction in IC, removal of 0.9 acres of effective IC is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal watershed permits and pathogen

TMDLs for Massachusetts waters that the BMPs outlined in the storm water management plan and those under consideration for reducing the effective IC from MassDOT are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing storm water permit and the applicable Pathogen TMDLs.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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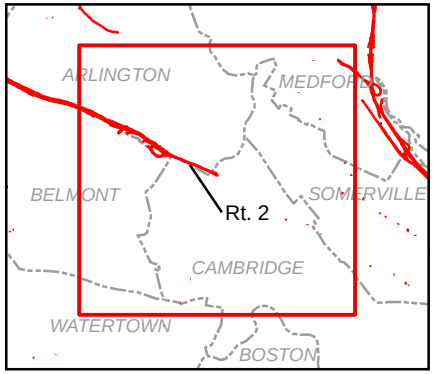

Alewife Brook Subwatershed

Impaired Waterbody

Impaired Stream Segment

MassDOT Road in Urban Area

Town Boundary

N

0 1,000 2,000 4,000

Feet

1 inch = 2,000 feet

Figure 1

Alewife Brook (MA71-04) Subwatershed

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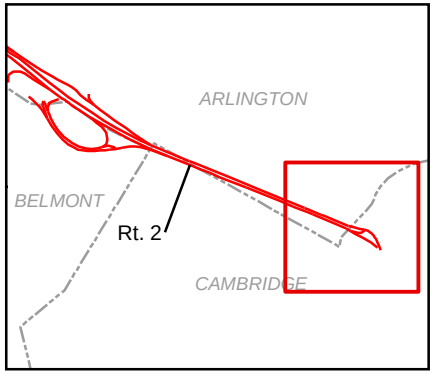

MassDOT Direct Watershed

Impaired Waterbody

NWI Wetland Area

Impaired Stream Segment

NHD Flowline

MassDOT Road in Urban Area

Town Boundary

N

0 100 200 400

Feet

1 inch = 200 feet

Figure 2

Alewife Brook (MA71-04)
Directly Contributing
MassDOT Watershed

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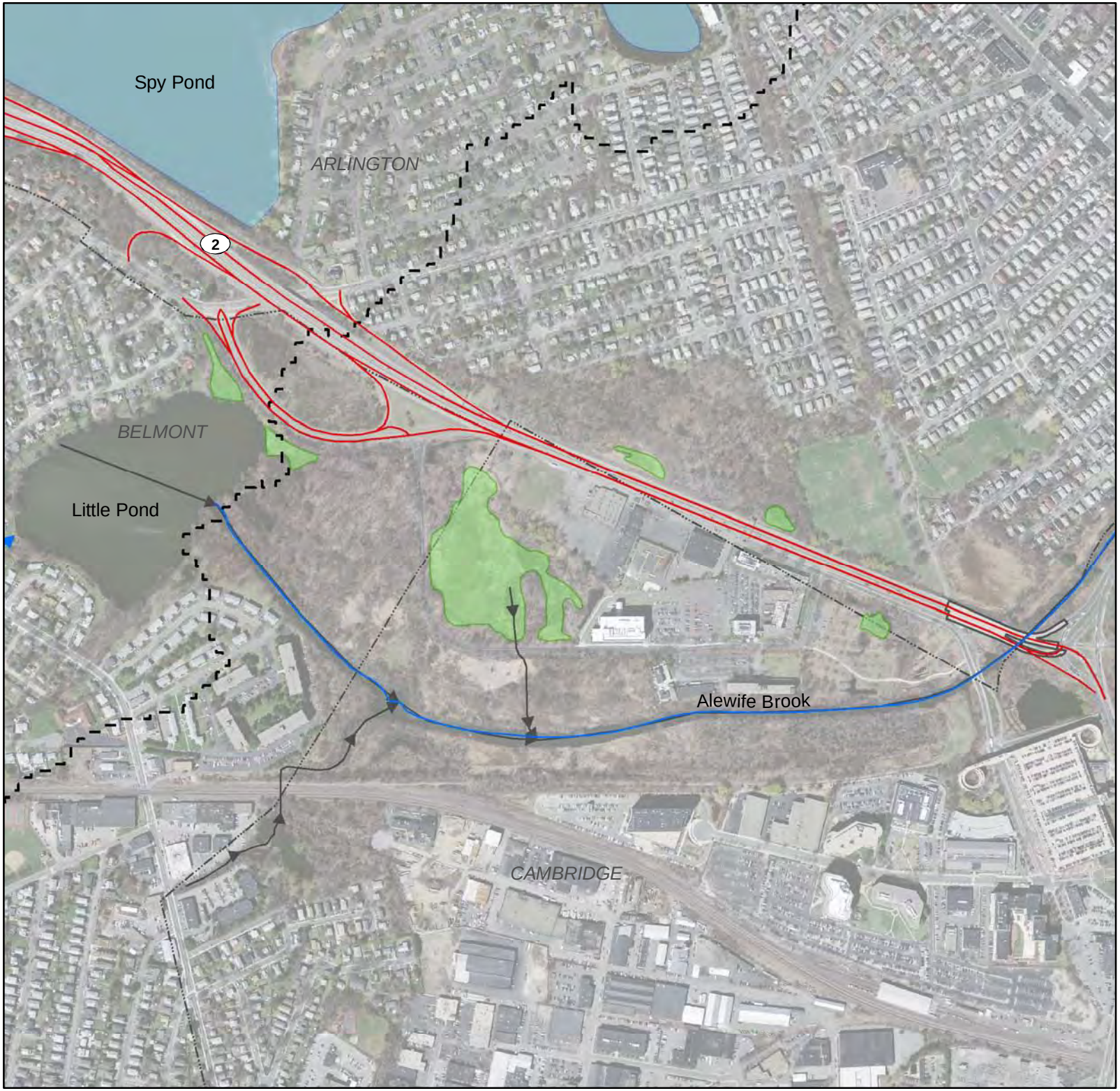

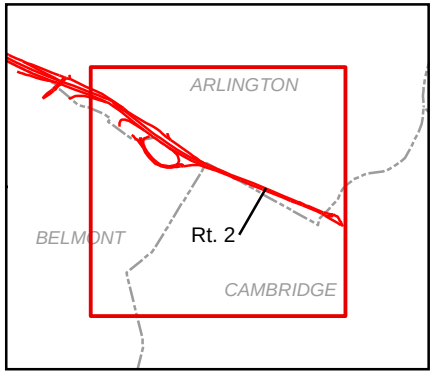

Alewife Brook Subwatershed

MassDOT Direct Watershed

Impaired Waterbody

Wetland Recieving MassDOT Runoff

Impaired Stream Segment

NHD Flowline

MassDOT Road in Urban Area

Town Boundary

N

0 250 500 1,000

Feet

1 inch = 500 feet

Figure 3

Alewife Brook (MA71-04)
Additional Waterbodies Recieving MassDOT Runoff

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Impaired Waters Assessment for Monatiquot River (MA74-08) – Progress Report

Impaired Waterbody

Name: Monatiquot River

Location: Braintree, MA

Water Body ID: MA74-08

Impairments

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011): aquatic macroinvertebrate bioassessments, dissolved oxygen, fecal coliform, (physical substrate alterations)

Monatiquot River (MA74-08) is listed under Category 5, "Waters Requiring a TMDL", on the MassDEP final *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Boston Harbor Watershed 1999 Water Quality Assessment Report* (MassDEP, 2002), the Monatiquot River is not supporting designated aquatic life use due to unknown reasons and habitat alteration associated with hydromodification, sanitary sewer overflows (SSO) and urban runoff/ storm sewers. The Water Quality Assessment Report also identifies the Monatiquot River as also not supporting designated primary and secondary contact uses due to pathogens that have been caused by urban runoff/storm sewers and municipal point sources (sanitary sewer overflows (SSO)).

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b)(5) Solids*. These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- *314 CMR 4.05 (5)(b) Bottom Pollutants or Alterations*. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.
- *314 CMR 4.05 (5)(e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of

aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (3)(b) 4 Bacteria*.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
    - b. For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;
- *314 CMR 4.05 (5)(a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

The Monatiquot River (MA74-08) is an approximately 4.3 mile river segment that begins at the confluence of Cochato and Farm rivers in Braintree and ends its confluence with Fore River at Route 53 in Braintree (Figure 1). Approximately 0.75 miles downstream from the confluence of Cochato and Farm rivers, the Monatiquot River flows beneath Route 37 and Plain Street (Figure 2a). The Monatiquot River flows north from these bridges approximately one mile to the bridge at Route 3 located on the south side of Interchange 17 (Figure 2b). The Monatiquot River flows north along the eastern side of Route 3 for approximately one mile and receives storm water drainage from most of the Route 3 road surface along this road segment. From the Route 3 area, the Monatiquot River flows east through residential areas to Route 53 where it becomes Fore River.

The Monatiquot River subwatershed is primarily comprised of dense residential and commercial land use.

The subwatershed of the Monatiquot River is shown in Figure 1. MassDOT's property directly contributing stormwater runoff to the Monatiquot River is comprised of portions of Route 37, Plain Street, and Route 3 (Figures 2a through 2d).

Assessment under BMP 7U

The following impairments for the Monatiquot River segment MA74-08 have not been addressed by a TMDL: aquatic macroinvertebrate bioassessments, dissolved oxygen and physical substrate alterations. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of storm water on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- aquatic macroinvertebrate bioassessments
- dissolved oxygen
- physical substrate alterations

As described below, the impairment for fecal coliform (pathogens) is assessed separately.

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% impervious cover, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines,

including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Monatiquot River (MA74-08)):

Watershed		
Watershed Area	18,512	acres
Impervious Cover (IC) Area	4,126	acres
Percent Impervious	22.3	%
IC Area at 9% Goal	1,666	acres
Target Reduction % in IC	59.6	%

Subwatershed		
Subwatershed Area	3,131	acres
Impervious Cover (IC) Area	1,029	acres
Percent Impervious	32.9	%
IC Area at 9% Goal	282	acres
Target Reduction % in IC	72.6	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	26.9	acres
MassDOT's Target Reduction in Effective IC (72.6% of DOT Directly Contributing IC)	19.5	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairment. The subwatershed should target a reduction of its effective IC by 72.6% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 19.5 acres of effective IC.

Existing BMPs

MassDOT has four existing BMPs in the Monatiquot River subwatershed that are mitigating potential storm water quality impacts prior to discharge to the Monatiquot River (Figures 2b, 2c, and 2d). In our analysis, existing BMPs receive credit for removing the effect of IC depending on their type, size relative to the IC that they process, and the local soil conditions. The hydrologic soil groups (HSG) of the areas associated with the existing BMPs are not available because these areas are either situated on urban soils or udorthents (wet substratum). The nearest non-urban or non-udorthents soils are located along Monatiquot River and these soils correspond to an HSG D. HSG D is applied for the estimated IC removal efficiency calculations as a conservative approximation of the soil conditions at these BMP locations.

Ex-BMP-1

The Route 3 overpass at Interchange 17 in Braintree is drained by catch basins and storm-drain pipes that discharge into the low-lying grassy area on the eastern side of the rotary (Figure 2b). Drainage plans for this area indicate the grassy area is drained by a culvert that discharges to an area outside of the northeastern portion of the rotary. The outlet of the culvert was located during the field visit, but the inlet could not be located; thus it is assumed to be filled with sediment and not effectively draining the area. Portions of this eastern side of the rotary had saturated soils and some standing water (<6-inches) was present during the field visit. The roadway is more than four feet higher than much of this area inside the rotary. There is no evidence that storm water has overflowed this rotary area and it appears that storm water that collects in this area infiltrates. This area is characterized as an infiltration basin with an effective IC removal efficiency of 93%, providing a reduction of 1.48 acres of IC.

There is evidence that storm water has flowed over four low points in the curb into the low-lying grassy areas within this rotary. This has likely contributed to some effective IC removal; however, the amount of stormwater that drains over the curb cannot be quantified. Engineered curb cuts around this rotary may provide additional IC removal.

Ex-BMP-1. Infiltration Basin.

Ex-BMP-2

A catch basin on the southwestern portion of the rotary at Interchange 17 discharges into the grassy wetland area within the rotary (Figure 2b). There are no outlets from this area, so storm water that collects and flows into this area infiltrates and is lost through evaporation and transpiration. The road is generally more than three feet higher than the grassy wetland area, and no signs of overflow

from this area were identified. This area is characterized as an infiltration basin with an effective IC removal efficiency of 93%, providing a reduction of 0.29 acres of IC.

Ex-BMP-2. Infiltration Basin.

Ex-BMP-3

Storm water is conveyed from Route 3 near Interchange 17 to the east via catch basins and multiple outfall pipes (Figure 2d). Most of the outfalls from the drainage along the portion of Route 3 near the Monatiquot River discharge into eroded channels that drain directly to the river. Most of these outfalls are within 50 feet of the river. One of the outfalls, that is approximately 100 feet from the Monatiquot River, discharges into an area that appears to have sufficient topographic relief to function as an infiltration basin. The infiltration area is approximately 60 feet by 15 feet and has a depth below the surrounding topography of approximately two feet. Deposited sediments are visible throughout this area. This area is characterized as an infiltration basin with an effective IC removal efficiency of 60%, providing a reduction of 0.41 acres of IC.

Ex-BMP-3. Infiltration Basin.

Ex-BMP-4

The swale along the western side of the southbound exit ramp at Interchange 17 has a high point in the swale which creates an area where infiltration of storm water apparently occurs (Figure 2c). This swale is densely vegetated with grasses and Japanese Knotweed. An area approximately 200 feet by 15 feet appears to be available for infiltration along this swale. The high point in the swale provides approximately two feet of depth for storage of runoff. Improvements to this swale, including the area down-gradient of this BMP area, could considerably increase the effectiveness of stormwater treatment from associated drainage areas. This existing BMP area is characterized as an infiltration swale with an effective IC removal efficiency of 92%, providing a reduction of 0.72 acres of IC.

Ex-BMP-4. Infiltration Swale.

Summary of Existing BMPs

BMP Name	BMP Type	Soil Type	Depth of Runoff Treated (inches)	IC Area Treated (acres)	Reduction of Effective IC* (%)	Reduction of Effective IC (acres)
Ex-BMP-1	Infiltration Basin	D	15.7	1.59	93%	1.48
Ex-BMP-2	Infiltration Basin	D	9.3	0.31	93%	0.29
Ex-BMP-3	Infiltration Basin	D	0.7	0.68	60%	0.41
Ex-BMP-4	Infiltration Swale	D	1.9	0.78	92%	0.72
Total						2.90

*Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT 2011)

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 19.5 acres, MassDOT will consider the implementation of additional BMPs.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in storm water vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to storm water management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in storm water runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in storm water runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform in urban storm water from other sources ranging between 14,000 and 17,000 have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other storm water systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the storm water system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from storm water runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other storm water systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for storm water that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive storm water management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive storm water management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for storm water discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of storm water management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing storm water discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a

WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing storm water management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual storm water permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

The entire watershed of MassDOT-owned roadways was investigated to identify existing BMPs. This assessment of the Monatiquot River has shown that the existing BMPs provide about 15% of the target reduction in IC.

The following table summarizes the effective IC removal of the existing BMPs.

Impervious Cover Reduction	
IC in Directly Contributing Watershed	26.9 acres
Required Reduction in Effective IC	19.5 acres
IC Effectively Reduced by Existing BMPs	2.9 acres
IC Remaining to Mitigate with Proposed BMPs	16.6 acres

To achieve the targeted reduction in IC, removal of an additional 16.6 acres of effective IC is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal watershed permits and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the storm water management plan and those under consideration for reducing the effective IC from MassDOT are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing storm water permit and the applicable Pathogen TMDLs.

As an overall program, MassDOT will re-evaluate opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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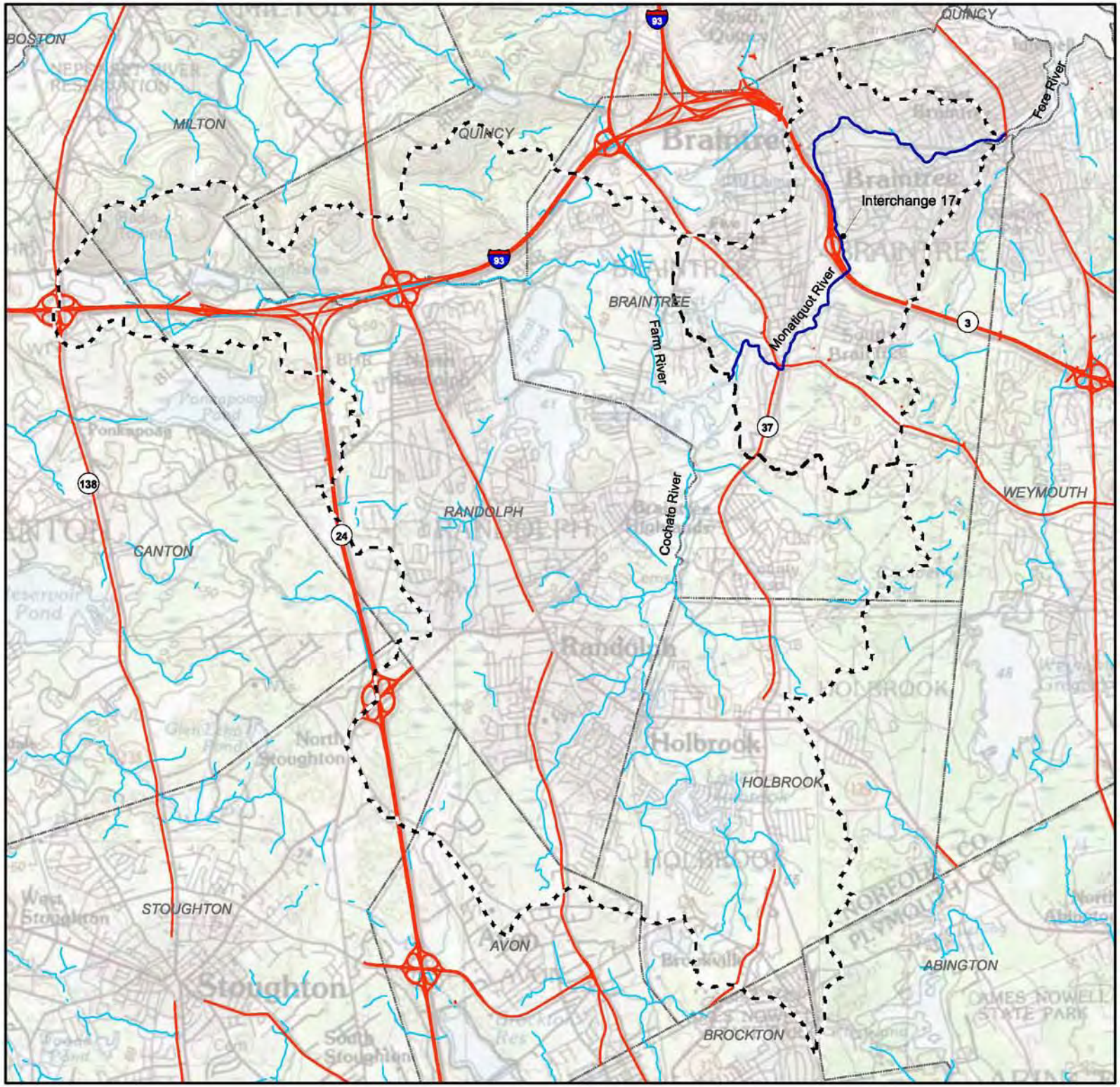
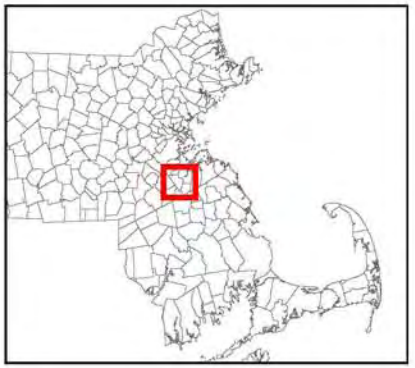




Monatiquot River (MA74-08)
Stream/River
MassDOT Roads in Urban Areas
Town Boundary
Monatiquot River Watershed
Total Watershed
Sub-Watershed

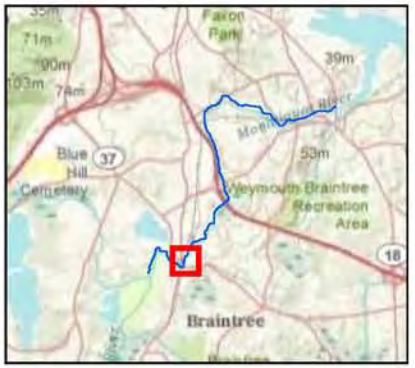
N

0 1 2 Miles

Figure 1
Monatiquot River Watershed MA74-08

December 2011

massDOT



- Stormwater Outfall
- MassDOT Property Drainage Areas
- MassDOT Road Centerline
- Monatiquot River (MA74-08)
- Non-Impaired Stream Segment

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

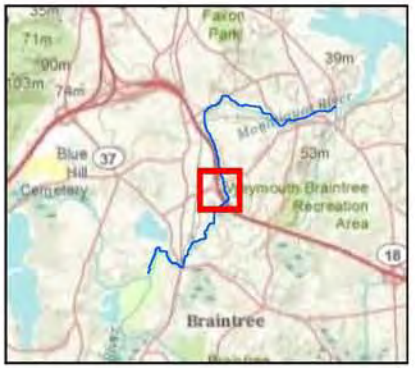
N

0 100 200 300 Feet

Figure 2a
MassDOT Drainage Areas
Monatiquot River
Watershed
MA74-08

December 2011

massDOT



- Stormwater Outfall
- Existing BMPs
- MassDOT IC Draining to Existing BMP
- MassDOT Property Drainage Areas
- MassDOT Road Centerline
- Monatiquot River (MA74-08)
- Non-Impaired Stream Segment

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

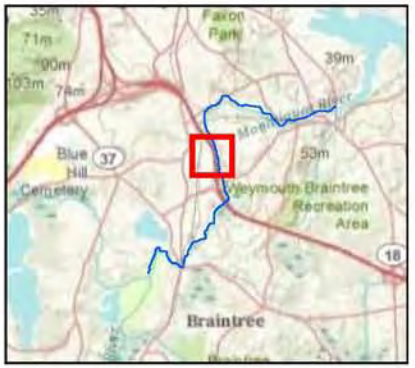
N

0 100 200 300 Feet

Figure 2b
MassDOT Drainage Areas
Monatiquot River
Watershed
MA74-08

December 2011

massDOT



- Stormwater Outfall
- Existing BMPs
- MassDOT IC Draining to Existing BMP
- MassDOT Property Drainage Areas
- MassDOT Road Centerline
- Monatiquot River (MA74-08)
- Non-Impaired Stream Segment

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

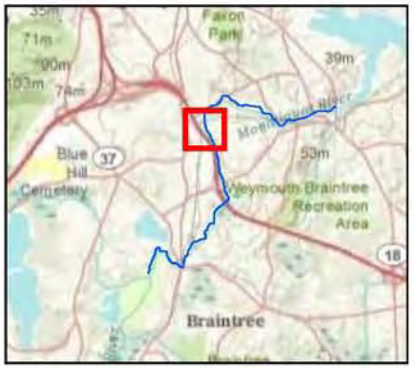
N

0 100 200 300 Feet

Figure 2c
MassDOT Drainage Areas
Monatiquot River
Watershed
MA74-08

December 2011

massDOT



- Stormwater Outfall
- Existing BMPs
- MassDOT IC Draining to Existing BMP
- MassDOT Property Drainage Areas
- MassDOT Road Centerline
- Monatiquot River (MA74-08)
- Non-Impaired Stream Segment

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

N

0 100 200 300 Feet

Figure 2d
MassDOT Drainage Areas
Monatiquot River
Watershed
MA74-08

December 2011

massDOT

Impaired Waters Assessment for Mine Brook (MA72-14) – Progress Report

Impaired Waterbody

Name: Mine Brook

Location: Franklin, MA

Water Body ID: MA72-14

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008b): stream habitat assessment, water temperature

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): stream habitat assessment, water temperature

Mine Brook (MA72-14) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Charles River Watershed 2002-2006 Water Quality Assessment Report* (MassDEP, 2008a), an 8.9-mile reach of Mine Brook is impaired due to elevated temperature.

Relevant Water Quality Standards

- Water Body Classification: Class B
- 314 CMR 4.05 (3)(b) 2 Temperature.
    - a. Shall not exceed 68°F (20°C) based on the mean of the daily maximum temperature over a seven day period in cold water fisheries, unless naturally occurring. Where a reproducing cold water aquatic community exists at a naturally occurring higher temperature, the temperature necessary to protect the community shall not be exceeded and the natural daily and seasonal temperature fluctuations necessary to protect the community shall be maintained. Temperature shall not exceed 83°F (28.3°C) in warm water fisheries. The rise in temperature due to a discharge shall not exceed 3°F (1.7°0C) in rivers and streams designated as cold water fisheries nor 5°F (2.8°C) in rivers and streams designated as warm water fisheries (based on the minimum expected flow for the month); in lakes and ponds the rise shall not exceed 3°F (1.7°0C) in the epilimnion (based on the monthly average of maximum daily temperature);
    - b. natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained. There shall be no changes from natural background conditions that would impair any use assigned to this Class, including those conditions necessary to protect normal species diversity, successful migration, reproductive functions or growth of aquatic organisms;

Site Description

Mine Brook, located in Franklin, MA, begins in the Franklin State Forest and runs 8.9 miles until it flows into the Charles River (MassDEP, 2008a). The brook passes under West Central Street and Route 140 (Rte 140) which are classified as MassDOT urban roadways at these locations. Mine Brook passes under a non-urban portion of Interstate 495 (I-495) at two locations and also passes under an urban portion at a third location.

The subwatershed of Mine Brook is shown in Figure 1. MassDOT's property directly contributing stormwater runoff to Mine Brook is comprised of portions of West Central Street, Rte 140, Washington Street, and I-495 (see Figures 2a and 2b). Storm water from West Central Street discharges to Mine Brook via curb cuts where the brook passes under the roadway. Drainage systems along Rte 140 pipe storm water to the system below along I-495 which discharges to Mine Brook. Similarly, storm water from the Washington Street bridge is piped to the system along I-495 below. Drainage systems along I-495 carry storm water to conveyance ditches which discharge to Mine Brook.

Assessment under BMP 7U

The following impairments for Mine Brook have not been addressed by a TMDL: stream habitat assessment and water temperature. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- stream habitat assessment
- water temperature

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% impervious cover, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where

it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target, and is not meant to imply that any reductions below that target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties.

This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Mine Brook (MA72-14)):

Total Watershed and Subwatershed*

Watershed Area	10,063	acres
Impervious Cover (IC) Area	1,689	acres
Percent Impervious	16.8	%
IC Area at 9% Goal	906	acres
Target Reduction % in IC	46.4	%

*The subwatershed and the total watershed are the same in the case of Mine Brook (MA72-14).

Reductions Applied to DOT Direct Watershed

MassDOT's IC Area **Directly** Contributing to Impaired Segment	33.8	acres
MassDOT's Target Reduction in Effective IC (46.4% of DOT Directly Contributing IC)	15.7	acres

The subwatershed is greater than 9% impervious which indicates that the storm water may be contributing to the impairment. The subwatershed should target a reduction of its effective IC by 46.4% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC by the same percentage by removing the effect of 15.7 acres of effective IC.

Existing BMPs

MassDOT has two existing BMPs which mitigate potential storm water quality impacts prior to discharge to Mine Brook. Figure 3 shows the BMP locations. In our analysis, existing BMPs

receive credit for removing the effect of IC depending on their type, size relative to the IC that they process, and the local soil conditions. The soil in the area associated with existing BMP 1 (Ex-BMP-1) is characterized as hydrologic group B (loam) and the soil at Ex-BMP-2 is characterized as group D.

Ex-BMP-1

During a site visit on November 10, 2011, a large basin was identified adjacent to the Rte 140 southbound roadway. The basin is well-vegetated with grass and brush about 2 feet tall and was dry when observed in the field. Thus it appears to infiltrate storm water efficiently. This area measures about 56 feet by 103 feet with a maximum depth of 6 feet. The only outlet is a high-level riprap spillway, as shown in the photograph below. This area was characterized as an infiltration basin with an effective IC removal efficiency of 96%, providing a reduction of 2.9 acres of IC.

Ex-BMP-1. Infiltration Basin.

Ex-BMP-2

A second basin was identified, located adjacent to the railroad track where it runs between Rte 140 and West Central Street. This basin is well-vegetated with wetland vegetation. When observed in the field, the basin contained standing water with a depth of about 1 foot. This area measures about 42 feet by 142 feet with a maximum depth of 5 feet. The basin has a low-level 10-inch orifice with an invert approximately 18 inches above the bottom of the basin as well as a high-level emergency riprap spillway. This area was characterized as an extended detention basin. Based on the BMP 7U IC Method, this basin does not achieve a reduction in effective IC area. This is likely due to the 10-inch outlet orifice which is too large to provide an adequate period of detention for storm water.

Ex-BMP-2. Extended Detention Basin.

Summary of Existing BMPs

BMP Name	BMP Type	Soil Type	Depth of Runoff Treated (inches)	IC Area Treated (acres)	Reduction of Effective IC* (%)	Reduction of Effective IC (acres)
Ex-BMP-1	Infiltration Basin	B - Loam 0.52 in/hr	1.8	3	96	2.9
Ex-BMP-2	Extended Detention Basin	D	4.5	1.1	0	0
Total						2.9

*Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT 2011)

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 15.7 acres, MassDOT will consider the implementation of additional BMPs.

Conclusions

The entire watershed of MassDOT-owned roadways was investigated to identify existing BMPs. This assessment of Mine Brook has shown that the existing BMPs provide about 18% of the target reduction in IC.

The following table summarizes the effective IC removal of the existing BMPs.

Impervious Cover Reduction	
IC in Directly Contributing Watershed	33.8 acres
Required Reduction in Effective IC	15.7 acres
IC Effectively Reduced by Existing BMPs	2.9 acres
IC Remaining to Mitigate with Proposed BMPs	12.8 acres

To achieve the targeted reduction in IC, removal of an additional 12.8 acres of effective IC is recommended. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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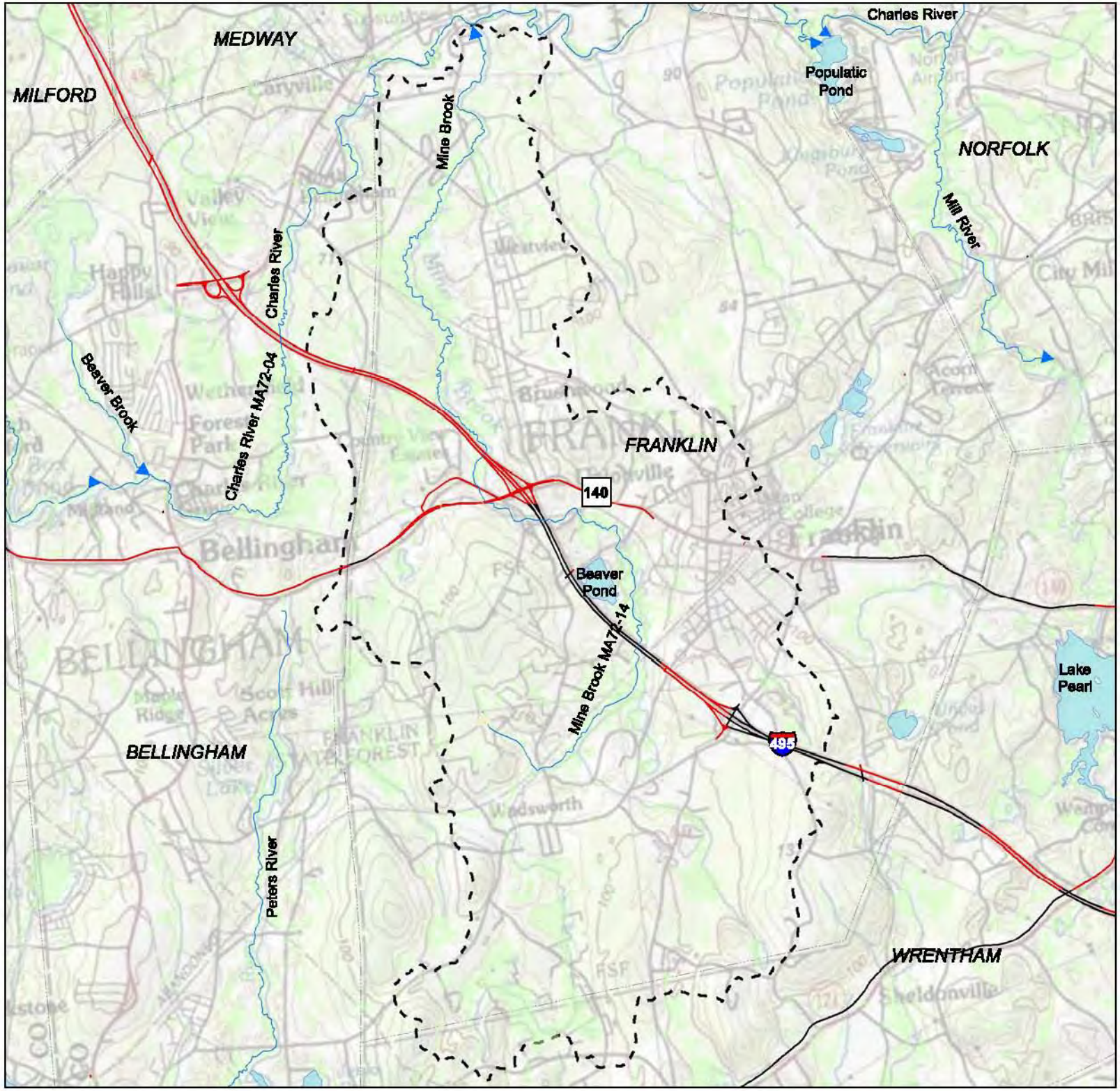

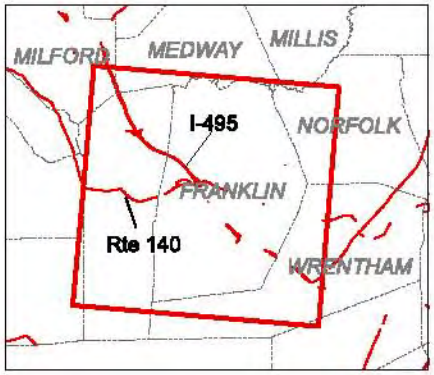

Mine Brook (MA72-14) Subwatershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
MassDOT Urban Area Roads
MassDOT Roads
Town Boundaries

N

0 2,500 5,000 10,000

Feet

1 in = 5,000 feet

Figure 1

Mine Brook (MA72-14) Subwatershed

December 2011

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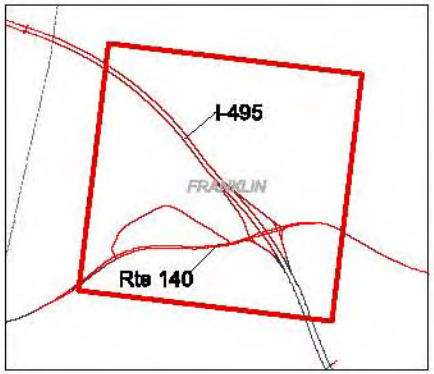

MassDOT Watershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 375 750 1,500

Feet

1 in = 750 feet

Figure 2a
Mine Brook (MA72-14)
Directly Contributing MassDOT Watershed (1 of 2)

December 2011

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massDOT

MassDOT Watershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 250 500 1,000

Feet

1 in = 500 feet

Figure 2b
Mine Brook (MA72-14)
Directly Contributing MassDOT Watershed (2 of 2)

December 2011

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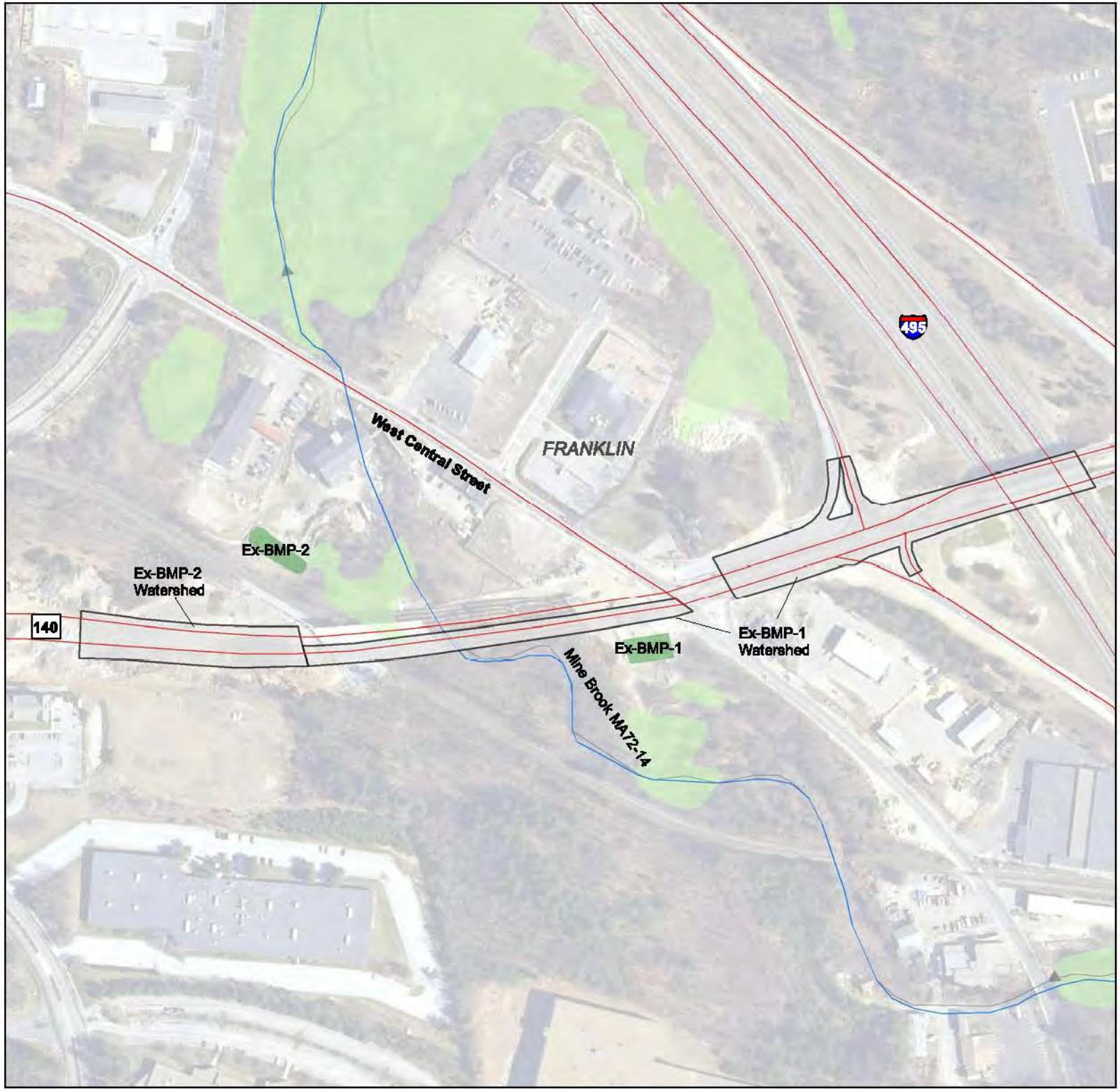

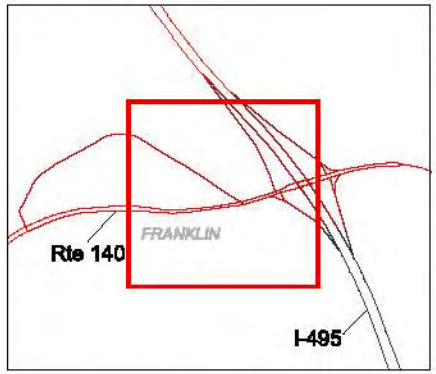

- Existing BMPs
- BMP Watersheds
- Impaired Water Bodies
- NWI Wetland Areas
- Impaired Stream Segments
- Non-Impaired Stream Segments
- MassDOT Roads in Urban Areas
- MassDOT Roads
- Town Boundaries

N

0 150 300 600

Feet

1 in = 300 feet

Figure 3

Mine Brook (MA72-14)
Existing BMPs

December 2011

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Attachment 3:
Assessments which Identified no Discharges from MassDOT Outfalls to Impaired Segments under Review or Unrelated Impairments

Impaired Waters Assessment for Stoneville Pond (MA51160)

Impaired Waterbody

Name: Stoneville Pond

Location: Auburn, MA

Water Body ID: MA51160

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): noxious aquatic plants, exotic species

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010b): noxious aquatic plants, exotic species

Stoneville Pond (MA51160) is listed in both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters* as a Category 4c water body and is covered by MassDEP's *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002).

MassDEP's *Blackstone River Watershed 2003-2007 Water Quality Assessment Report* (MassDEP, 2010a) groups Stoneville Pond with Kettle Brook (MA51-01) and states that Stoneville Pond will no longer be assessed as its own lake segment, but will instead be considered a run of the river impoundment along Kettle Brook. However, Stoneville Pond was considered separately to be consistent with the *Year 2008 Integrated List of Waters*.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5)(a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Stoneville Pond (MA51160) is a water body in Auburn, MA of approximately 43 acres with a contributing watershed area of approximately 11,600 acres (MassDEP, 2002). The pond lays midstream of Kettle Brook (MA51-01), approximately 4.1 miles downstream of the start of Kettle Brook at Waite Pond (MA51170). According to the Blackstone River Watershed 2003-2007 Water Quality Assessment Report, a 0.7-mile reach of Kettle Brook (MA51-01) through Stoneville Pond is listed as impaired due to noxious aquatic species.

Assessment under BMP 7U for No Discharge Determination

Based on a site visit on August 31, 2011 it was determined that MassDOT does not directly contribute runoff to Stoneville Pond. The nearest MassDOT-owned urban roadways, Interstate 290 (I-290) and the James Street bridge over the Conrail track in Worcester, are over 3,000 feet from Stoneville Pond. During the site visit it was determined that storm water from I-290 is discharged to other water bodies (see Figure 1).

Conclusions

Because MassDOT property does not directly contribute storm water runoff to Stoneville Pond, further assessment of this water body is not warranted under the Impaired Waters program.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

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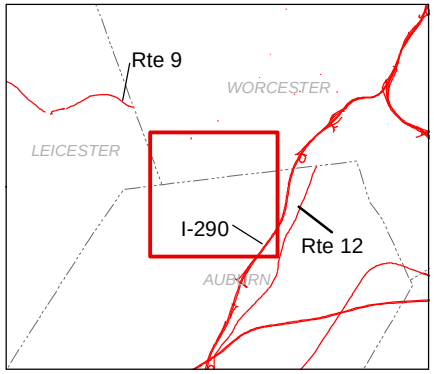

MassDOT Watershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 500 1,000 2,000

Feet

1 in = 1,000 feet

Figure 1

Stoneville Pond (MA51160)

September 2011

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Impaired Waters Assessment for Curtis Pond North (MA51032)

Impaired Waterbody

Name: Curtis Pond North

Location: Worcester, MA

Water Body ID: MA51032

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): noxious aquatic plants, exotic species

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): noxious aquatic plants, exotic species

Curtis Pond North is listed in both MassDEP's final *Massachusetts Year 2008* list and the proposed *Massachusetts Year 2010 Integrated List of Waters* as a Category 4c water body and is covered by MassDEP's *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002).

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Curtis Pond North (MA51032) is a water body in Worcester, MA of approximately 31 acres with a contributing watershed area of approximately 20,900 acres (MassDEP, 2002). Kettle Brook (MA51-01) flows through Curtis Pond South and ends at Curtis Pond North which flows into Middle River (MA51-02). Curtis Ponds North (MA51032) and South (MA51033) are divided by the Conrail track. MassDOT roadways in urban areas within the watershed are limited to two bridges illustrated in Figure 1.

Assessment under BMP 7U for No Discharge Determination

Based on a site visit on August 31, 2011, it was determined that runoff from MassDOT urban areas does not directly contribute runoff to Curtis Pond North. The nearest MassDOT-owned urban roadways are the Webster Street and Mill Street bridges over Middle River. Figure 1 shows Curtis Pond North and the bridges. During the site visit it was determined that the Mill

Street bridge does not have any drainage features, and that storm water runoff flows south off of the bridge and along Mill Street. Similarly, there is no drainage system on the Webster Street bridge. Runoff from this bridge flows northeast off of the bridge and along Webster Street. It appeared during the site visit that the runoff from the bridges flows into the Worcester MS4 drainage systems along their respective streets and discharges to Middle River which was not included in this Impaired Assessment. Therefore, MassDOT has determined that the runoff from these bridges does not directly discharge to Curtis Pond North.

Conclusions

MassDOT property does not directly contribute storm water runoff to Curtis Pond North. Therefore, further assessment of this water body is not warranted under the Impaired Waters program.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

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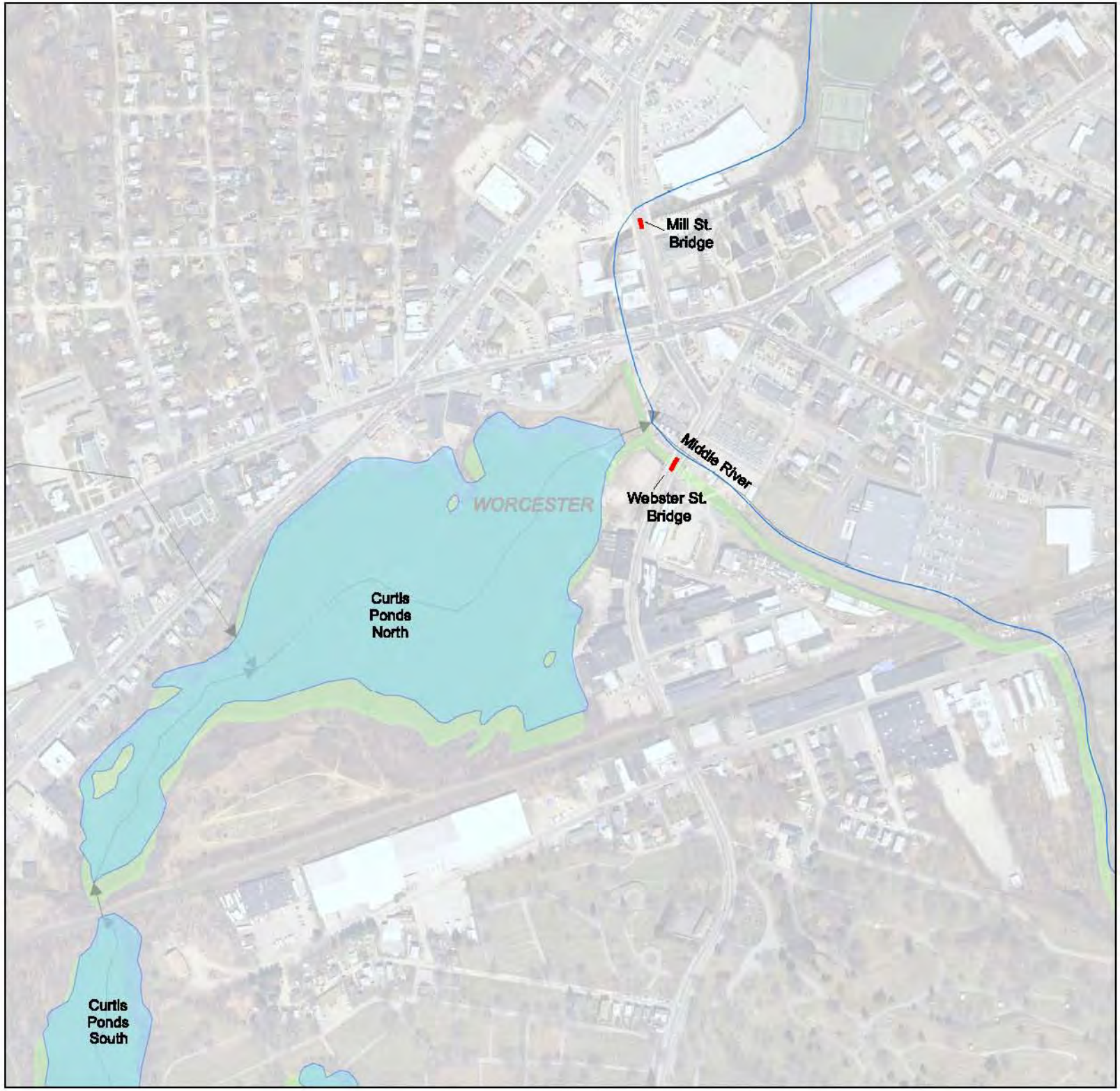

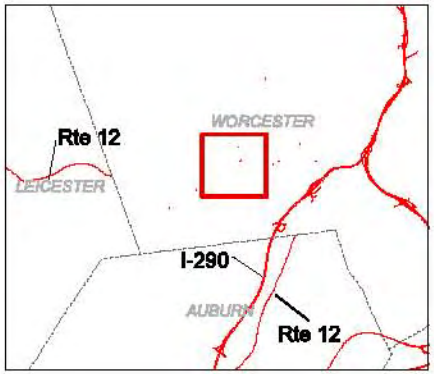

Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 250 500 1,000

Feet

1 in = 500 feet

Figure 1

Curtis Pond North
(MA51032)

September 2011

Moving Massachusetts Forward
massDOT

Impaired Waters Assessment for Curtis Pond South (MA51033)

Impaired Waterbody

Name: Curtis Pond South

Location: Worcester, MA

Water Body ID: MA51033

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): siltation, noxious aquatic plants

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): siltation, noxious aquatic plants

Curtis Pond South is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*, and is covered by MassDEP's *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002).

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5)(a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *314 CMR 4.05 (5) (b) Bottom Pollutants or Alterations*. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.

Site Description

Curtis Pond South (MA51033) is a water body in Worcester, MA of approximately 14 acres with a watershed area of approximately 20,300 acres (MassDEP, 2002). Curtis Ponds North (MA51032) and South (MA51033) are divided by the Conrail track. Kettle Brook (MA51-01) flows through Curtis Pond South and ends at Curtis Pond North.

The nearest MassDOT-owned roads are I-290 and the Heard Street Bridge over the railroad. During site visits on August 30 and 31, 2011, it was determined that storm water from I-290 discharges to Leesville Pond (MA51087) and Kettle Brook (MA51-01) and not to Curtis Pond South. There are no drainage features on the Heard Street bridge and runoff from the bridge roadway flows off the bridge and along Heard Street. While it is uncertain whether this runoff

enters the Worcester MS4 drainage systems along Heard Street and is then conveyed to Curtis Pond South, MassDOT performed the assessment as a potential direct discharge to determine if any action by MassDOT would be necessary. Figure 1 shows the surface area of the Heard Street Bridge which has potential to contribute direct runoff to Curtis Pond South.

Assessment under BMP 7R for Phosphorus

The TMDL for phosphorus for Selected Northern Blackstone Lakes addresses the impairment for Noxious Aquatic Plants for Curtis Pond South. Therefore, MassDOT assessed the contribution of phosphorus from MassDOT urban areas to this water body to address this impairment. The assessment was completed using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002) can be summarized as follows in reference to Curtis Pond South:

- Pollutant of Concern: Phosphorus
- Impairment for Curtis Pond South Addressed in TMDL: Noxious aquatic plants
- Applicable Waste Load Allocation (WLA): See Tables 2d (p. 42) and 4d (p. 59) of TMDL.
  - Description of Associated Land Use: Commercial/Industrial
  - Commercial/Industrial Land Use Current Load (TP): 188.8 kg/yr (416.2 lb/yr)
  - Commercial/ Industrial Land Use Target WLA (TP): 175 kg/yr (385.8 lb/yr)
  - Commercial/Industrial Area in Watershed: 552.8 ha (1366.0 acres)
  - Commercial/Industrial Land Use Target Areal WLA (TP): 0.32 kg/ha/yr (0.28 lb/acre/yr)
- Applicable Recommendations: "Public Education, NPS Survey, Lake Management Plan, Residential BMPs, Urban BMPs, Highway BMPs, In-Lake Management" (Table 7, page 66).

Estimated Loading from MassDOT

The loading of total phosphorus (TP) from MassDOT property contributing storm water runoff to Curtis Pond South was estimated using the following assumptions and calculations:

- MassDOT estimates the TP loading from its impervious areas as 1.60 lb/acre/yr. This loading rate is based on data collected in a study of storm water runoff conducted by the United States Geological Survey (USGS) (Smith and Granato, 2010). The study analyzed storm water samples from 12 sites located on highways operated by MassDOT across Massachusetts between September 2005 and September 2007. Samples were taken under a variety of weather conditions during this period.
- No pervious areas existed in the MassDOT directly contributing property to Curtis Pond South so no calculations were done for pervious area.
- MassDOT calculated the total estimated TP loading from MassDOT urban area using the estimated loading rate (1.60 lb/ac/yr) and area of the Heard Street Bridge (0.07 acres) to be 0.11 lb/yr. This loading estimate does not account for any existing BMPs or attenuation before the runoff reaches the pond.

- MassDOT calculated the target TP WLA for its storm water runoff to Curtis Pond South using the target areal WLA of 0.28 lb/ac/yr included in the TMDL report and the area of the Heard Street Bridge (0.07 acres). This target TP WLA for MassDOT urban runoff is 0.02 lb/yr.

Assessment and Mitigation Plan

MassDOT's estimated TP loading (0.11 lb/yr) is insignificant (0.003%) compared to the overall load to the pond (1,607.6 kg/ yr or 3,544.2 lb/yr) (MassDEP, 2002). Therefore, the pollutant load from this bridge is *de minimis*.

Conclusions

The area owned by MassDOT represents a diminutive fraction of the TP loading of Curtis Pond South (0.003%). Therefore, MassDOT concludes that it represents a *de minimis* source of phosphorus to the pond. Therefore, no further measures are warranted.

As an overall program, MassDOT will identify opportunities for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. Work on programmed projects which often include broader scale road layout changes may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments.

References

Massachusetts Department of Environmental Protection (MassDEP). (2002). Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes. CN 70.1. Retrieved from: http://www.mass.gov/dep/water/resources/blaktmdl.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

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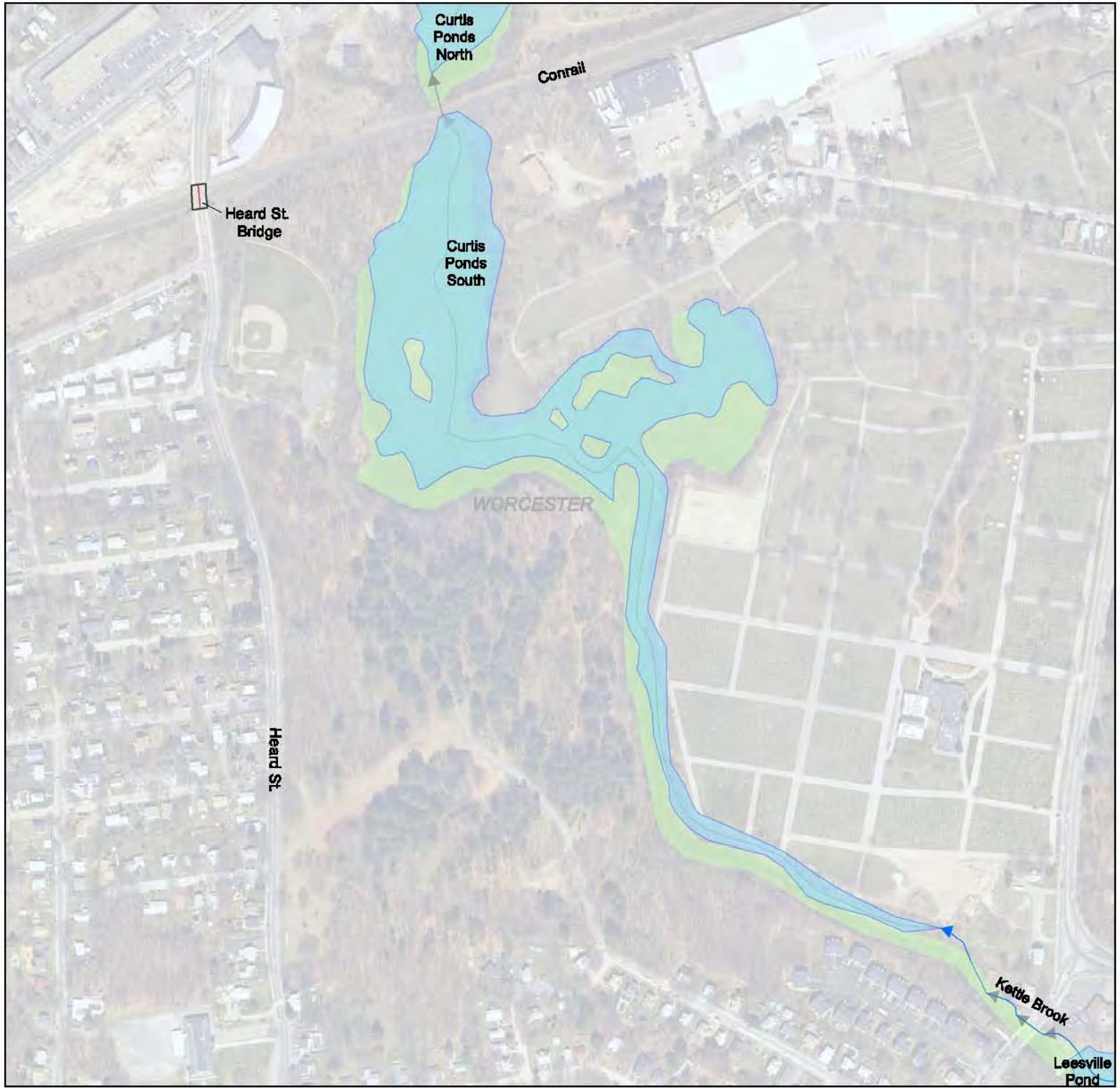

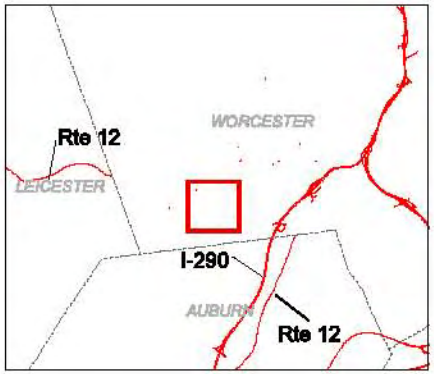

MassDOT Contributing Watershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
MassDOT Roads in Urban Areas
Town Boundaries

N

0 200 400 800

Feet

1 in = 400 feet

Figure 1

Curtis Pond South (MA51033)

September 2011

Moving Massachusetts Forward massDOT

Impaired Waters Assessment for Auburn Pond (MA51004)

Impaired Waterbody

Name: Auburn Pond

Location: Auburn, MA

Water Body ID: MA51004

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): noxious aquatic plants, exotic species

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010b): noxious aquatic plants, exotic species

Auburn Pond is listed as a Category 4c water body on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters* and is covered by a Total Maximum Daily Load (TMDL) for Phosphorus according to MassDEP's *Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002).

MassDEP's *Blackstone River Watershed 2003-2007 Water Quality Assessment Report* (MassDEP, 2010a) states that a 0.1-mile reach of Dark Brook (MA51-16) through Auburn Pond is listed as impaired due to non-native aquatic macrophyte infestation and that Auburn Pond will now be assessed with Dark Brook and will no longer be assessed as an independent lake segment. However, Auburn Pond was considered separately to be consistent with the *Year 2008 Integrated List of Waters.* Because Auburn Pond has a TMDL, Auburn Pond was assessed using BMP 7R (TMDL method) to determine the required load reduction to meet the TMDL.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Auburn Pond (MA51004) is a water body in Auburn, MA of approximately 6.5 acres with a contributing watershed area of approximately 7,040 acres (MassDEP, 2002). The pond lays midstream of Dark Brook, approximately 1.6 miles downstream of the start of Dark Brook at Route 20. After passing through Auburn Pond, Dark Brook continues another 1.1 miles before merging with Kettle Brook (MA51-01).

MassDOT owns Route 12 (Rte 12) which runs north-south to the west of Auburn Pond. Rte 12 is a two-lane roadway with an impervious width of approximately 60 feet and a right of way extending approximately 5 feet from each side of the roadway at various locations.

Assessment under BMP 7R (TMDL Method)

During site visits performed on August 3 and 4, 2011, it was determined that storm water runoff from MassDOT property does not directly discharge to Auburn Pond. Along the stretch of Rte 12 adjacent to Auburn Pond, systems of catch basins located on the shoulders of both lanes instead discharge directly to Dark Brook via outfalls at the Rte 12 bridge over Dark Brook. Storm water from the intersection of Rte 12 and Auburn Street also discharges to Dark Brook via a 24-inch precast concrete culvert (see Figure 2). Therefore, it was determined that runoff from Rte 12 does not directly discharge to Auburn Pond and further assessment of this water body is not required under the Impaired Waters Program.

Nevertheless, MassDOT was simultaneously performing the assessment of Dark Brook using the IC Method (BMP 7U) (MassDOT, 2011) and identified existing and proposed BMPs to address impairments. Since these existing and proposed BMPs will have a load reduction impact on Auburn Pond, which is midstream of Dark Brook and downstream of all BMPs (Figures 3 and 4), we have reviewed the reduction in greater detail within this assessment for informational purposes. Refer to the *Impaired Waters Assessment for Dark Brook (MA51-16)* for further BMP information. Tables 1 and 2 attached show the treatment provided by the existing and proposed BMPs for Dark Brook. The existing and proposed BMPs provide 11.03 acres of effective IC reduction and an overall TP removal of 19.5 lb/yr. The TMDL states the current TP load to Auburn Pond is 322 lb/yr and the target TP load is 205 lb/yr which requires a TP removal of 117 lb/yr (36% reduction for overall watershed). The existing and proposed BMPs will assist in meeting the TMDL reduction for Auburn Pond.

Conclusions

MassDOT property does not directly contribute storm water runoff to Auburn Pond. Therefore, further assessment of this water body is not warranted to address the impairments described herein. MassDOT proposed BMPs as part of the Dark Brook Impaired Assessment which will positively impact Auburn Pond which lies midstream of Dark Brook.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2002). Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes. CN 70.1. Retrieved from: http://www.mass.gov/dep/water/resources/blaktmdl.pdf

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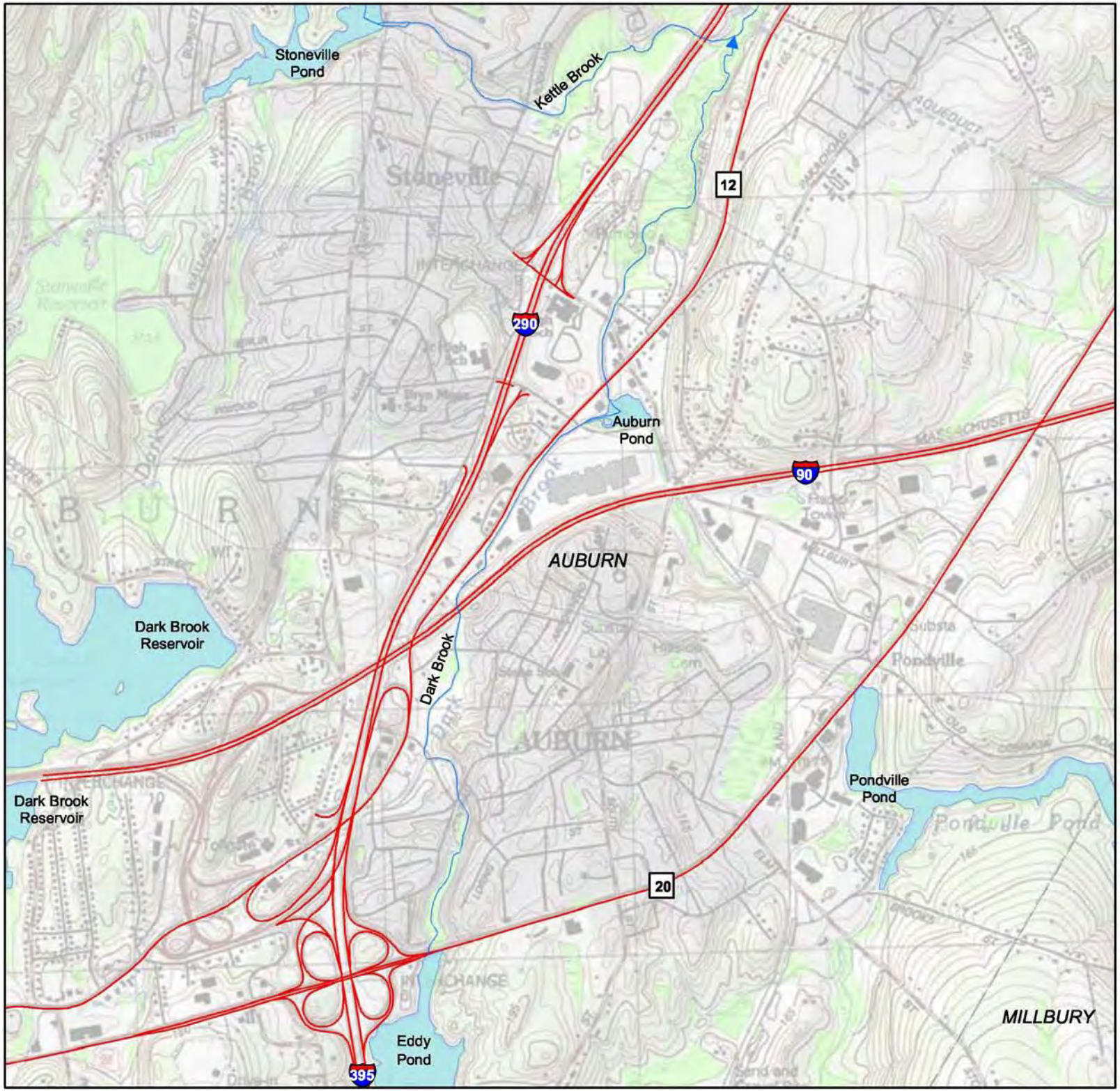
Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).

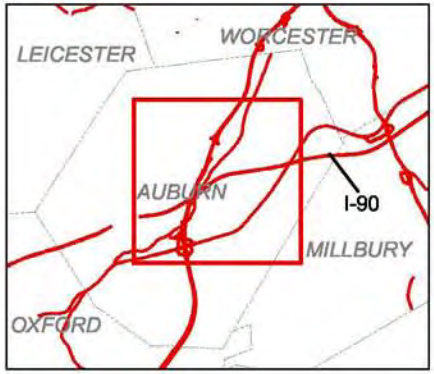
Table 1: Reduction Provided by MassDOT BMPs under Existing Conditions

BMP Name	BMP Type	Soil Classification	Contributing Watershed Impervious Area (ac)	Contributing Watershed Pervious Area (ac)	Pre-BMP TP Load (lb/yr)	Provided TP Percent Removal	Provided TP Load Removal (lbs/yr)	Effective IC Percent Reduction	Effective IC Reduction (sq. ft)
Ex-BMP-1	Vegetated Filter Strip	B - Loam 0.52 in/hr	0.39	-	0.9	88%	0.8	74%	0.29
Ex-BMP-2	Vegetated Filter Strip	B - Loam 0.52 in/hr	0.46	-	1.0	86%	0.8	72%	0.33
Ex-BMP-3	Infiltration Basin	B - Loam 0.52 in/hr	0.68	3.34	3.1	86%	2.7	71%	0.49
Total			1.53	3.34	4.9	86%	4.3	72%	1.11

Table 2: Reduction Provided by MassDOT BMPs under Proposed Conditions

BMP Name	BMP Type	Soil Classification	Contributing Watershed Impervious Area (ac)	Contributing Watershed Pervious Area (ac)	Pre-BMP TP Load (lb/yr)	Provided TP Percent Removal	Provided TP Load Removal (lbs/yr)	Effective IC Percent Reduction	Effective IC Reduction (ac)
Ex-BMP-1	Vegetated Filter Strip	B - Loam 0.52 in/hr	0.39	-	0.9	88%	0.8	74%	0.29
Ex-BMP-2	Vegetated Filter Strip	B - Loam 0.52 in/hr	0.46	-	1.0	86%	0.8	72%	0.33
Ex-BMP-3*	Infiltration Basin	B - Loam 0.52 in/hr	0.13	0.19	1.8	99%	1.8	97%	0.12
Pr-BMP-1*	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.21	2.68	2.0	31%	0.6	99%	0.21
Pr-BMP-2*	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.34	0.40	2.2	33%	0.7	100%	0.34
Pr-BMP-3*	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.10	0.22	0.3	25%	0.1	97%	0.10
Pr-BMP-4*	Infiltration Swale	B - Loam 0.52 in/hr	0.23	0.60	1.0	31%	0.3	95%	0.22
Pr-BMP-5*	Infiltration Basin	B - Loam 0.52 in/hr	1.20	0.50	3.0	97%	2.9	92%	1.11
Pr-BMP-6*	Infiltration Swale	B - Loam 0.52 in/hr	0.44	0.64	1.2	29%	0.3	94%	0.41
Pr-BMP-7*	Infiltration Swale	B - Loam 0.52 in/hr	0.39	0.99	2.1	36%	0.8	97%	0.37
Pr-BMP-8*	Extended Detention Basin	B - Loam 0.52 in/hr	1.28	1.42	3.7	14%	0.5	80%	1.02
Pr-BMP-9	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.68	1.33	1.9	19%	0.4	95%	0.65
Pr-BMP-10	Infiltration Swale	B - Loam 0.52 in/hr	0.33	0.53	0.9	34%	0.3	96%	0.32
Pr-BMP-11*	Infiltration Swale	B - Loam 0.52 in/hr	0.38	0.67	1.1	33%	0.4	96%	0.36
Pr-BMP-12	Infiltration Swale	B - Loam 0.52 in/hr	0.94	1.22	2.3	36%	0.8	97%	0.91
Pr-BMP-13	Infiltration Swale	B - Loam 0.52 in/hr	1.03	1.75	2.8	32%	0.9	95%	0.98
Pr-BMP-14	Infiltration Swale	B - Loam 0.52 in/hr	2.03	2.66	5.0	36%	1.8	97%	1.97
Pr-BMP-15	Infiltration Swale	B - Loam 0.52 in/hr	0.55	0.64	1.3	33%	0.4	96%	0.52
Total			11.09	16.42	34.3	43%	14.6	92%	10.23





Impaired Water Bodies

NWI Wetland Areas

Impaired Stream Segments

MassDOT Urban Area Roads

Town Boundaries

N

0 875 1,750 3,500

Feet

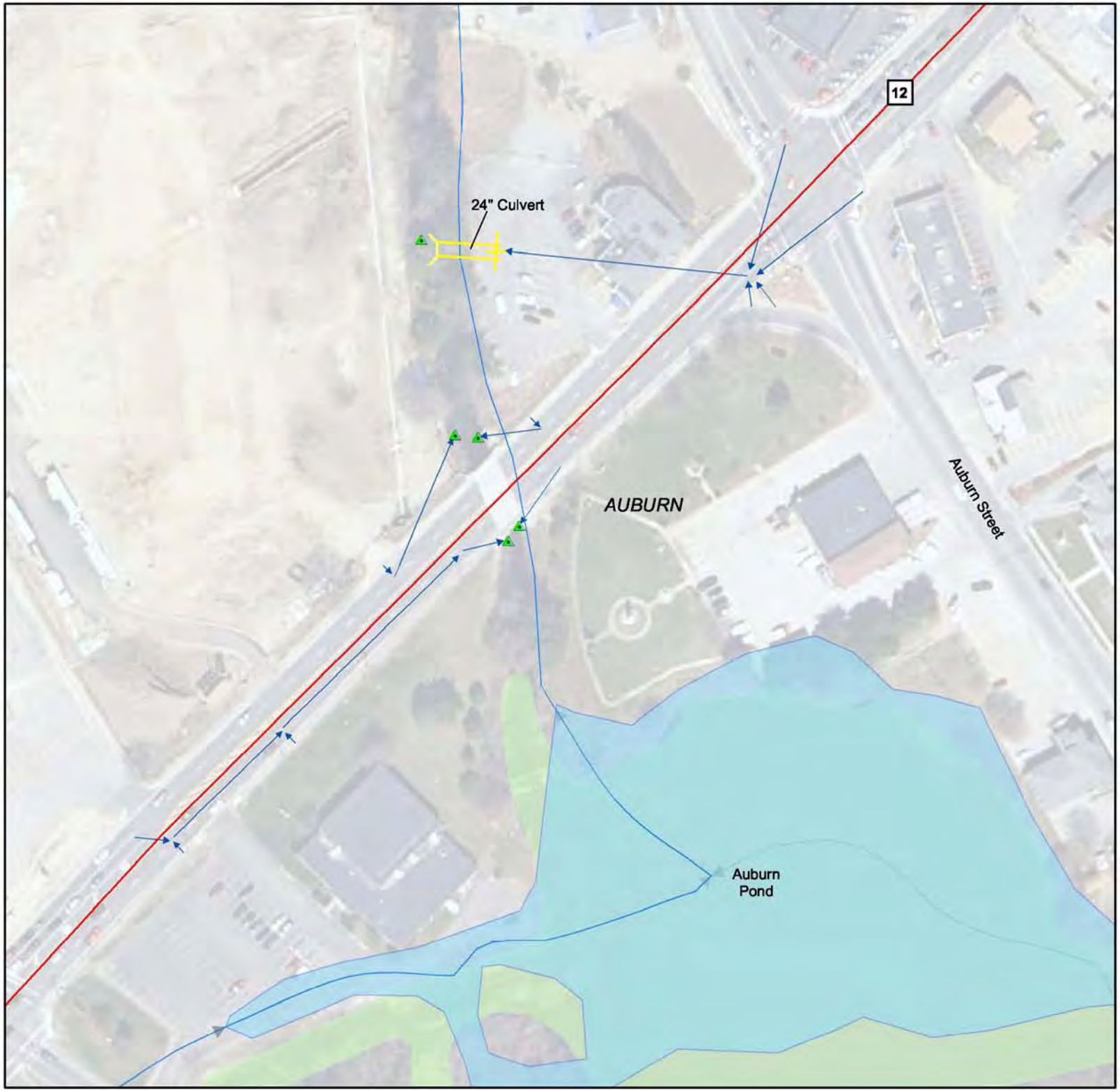
1 in = 1,750 feet

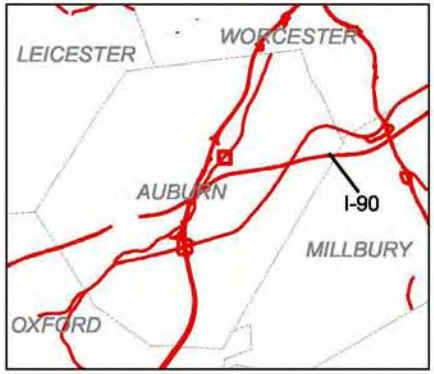
Figure 1

Auburn Pond (MA51156)

December 2011

Moving Massachusetts Forward massDOT





- Direction of Drainage
- Stormwater Outfalls
- Impaired Water Bodies
- NWI Wetland Areas
- Impaired Stream Segments
- Non-Impaired Stream Segments
- MassDOT Urban Area Roads
- Town Boundaries

N

0 62.5 125 250

Feet

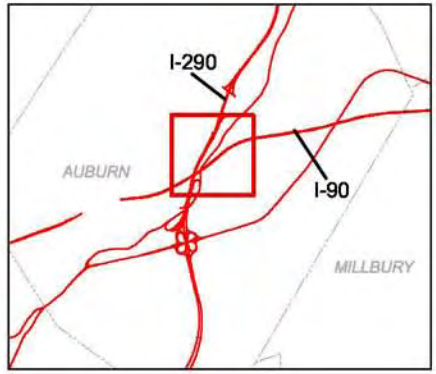
1 in = 125 feet

Figure 2

Drainage near Auburn Pond (MA51156)

December 2011

Moving Massachusetts Forward massDOT



- Direction of Drainage
- Existing BMPs
- Proposed BMP - Basins
- Proposed BMP - Swales
- Impaired Water Bodies
- Impaired Stream Segments
- Non-Impaired Stream Segments
- MassDOT Roads in Urban Areas
- Town Boundaries

N

0 300 600 1,200

Feet

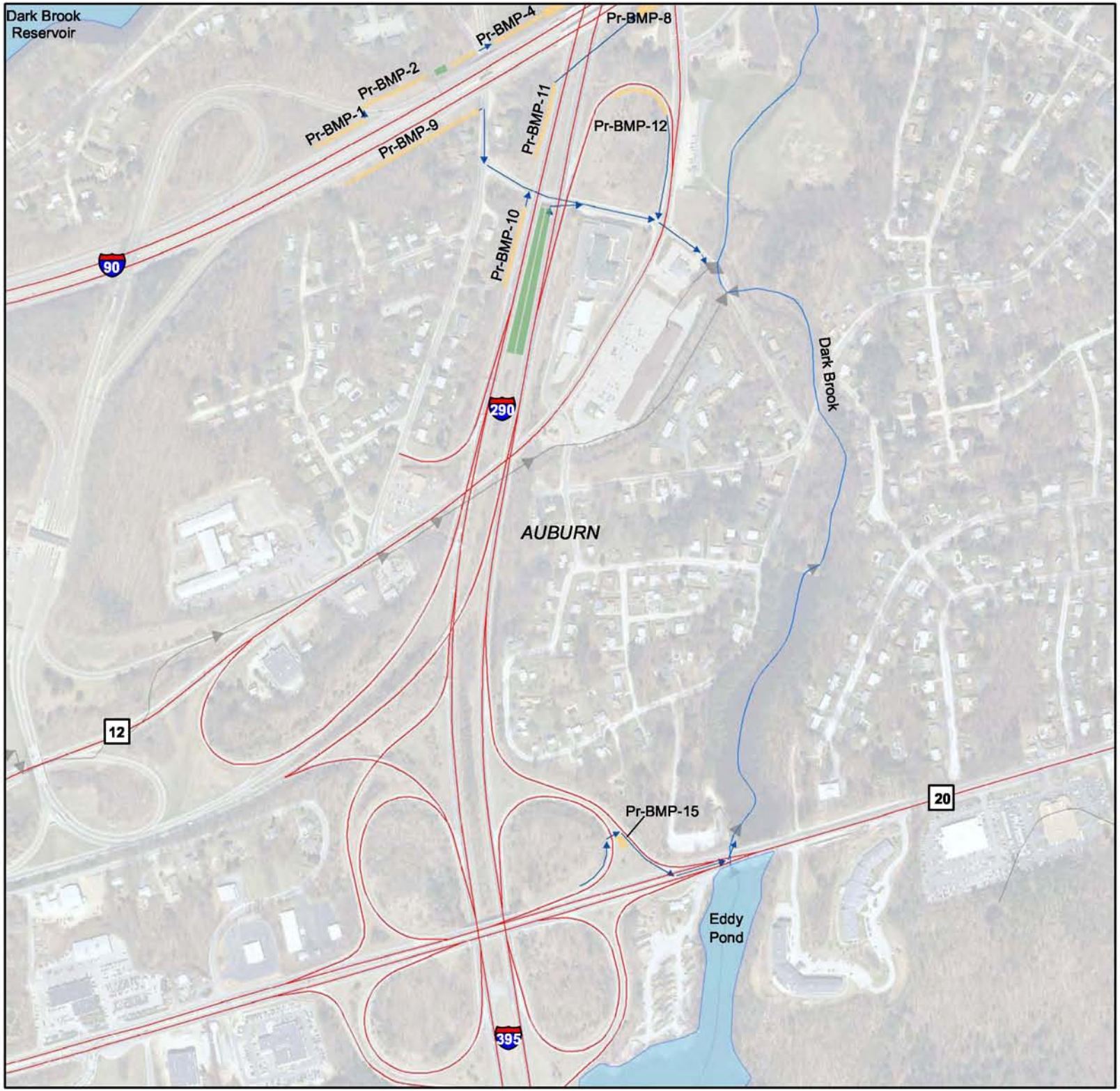
1 in = 600 feet

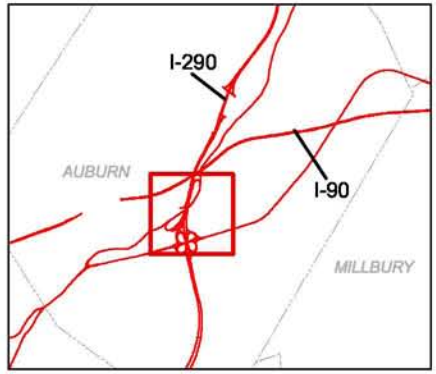
Figure 3

Auburn Pond (MA51004) and BMPs for Dark Brook (MA51-16) Sheet 1 of 2

December 2011

Moving Massachusetts Forward massDOT





Existing BMPs
Proposed BMP - Basins
Proposed BMP - Swales
Impaired Water Bodies
Impaired Stream Segments
Non-Impaired Stream Segments
Direction of Drainage
MassDOT Roads in Urban Areas
Town Boundaries

N

0 300 600 1,200

Feet

1 in = 600 feet

Figure 4

Auburn Pond (MA51004) and BMPs for Dark Brook (MA51-16) Sheet 2 of 2

December 2011

Moving Massachusetts Forward massDOT

Impaired Waters Assessment for Quequechan River (MA61-05)

Impaired Waterbody

Name: Quequechan River

Location: Fall River, MA

Water Body ID: MA61-05

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): habitat alterations

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): habitat alterations

The Quequechan River (MA61-05) is listed on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters* as a Category 4c water body, corresponding to an "impairment not caused by a pollutant". According to both lists, the impairment is related to habitat alteration.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b) Class B*. These waters are designated as a habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. Where designated in 314 CMR 4.06, they shall be suitable as a source of public water supply with appropriate treatment ("Treated Water Supply"). Class B waters shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.
- *314 CMR 4.05 (5)(a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

The Quequechan River (MA61-05) is located within the town of Fall River, Massachusetts. The river is 2.4 miles long and lies geographically within the Mount Hope Bay watershed. The Mount Hope Bay watershed drains approximately 112 square miles of land, which includes the Quequechan River subwatershed.

The Quequechan River flows northwest from its origins in South Watuppa Lake. It forms a series of ponds and wetlands on either side of Route 24 and I-195 before entering a large culvert on the northern side of I-195. From there, it flows through a contained underground passage beneath the city of Fall River to its confluence with the Taunton River. See Figure 1.

Assessment under BMP 7U

In compliance with the specific steps outlined in BMP 7U (MassDOT, 2011), MassDOT first assessed if the impairment to the Quequechan River is related to stormwater. According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004–2008 Water Quality Assessment Report* (MassDEP, 2009), the Quequechan River is impaired on its lower 0.9 miles for habitat quality degradation resulting from channelization. The impairment is unrelated to stormwater, and thus MassDOT has determined that further assessment of this water body is not required.

Conclusions

Because the impairment of habitat alterations to the Quequechan River is unrelated to stormwater, further assessment of this water body is not warranted under the Impaired Waters program.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

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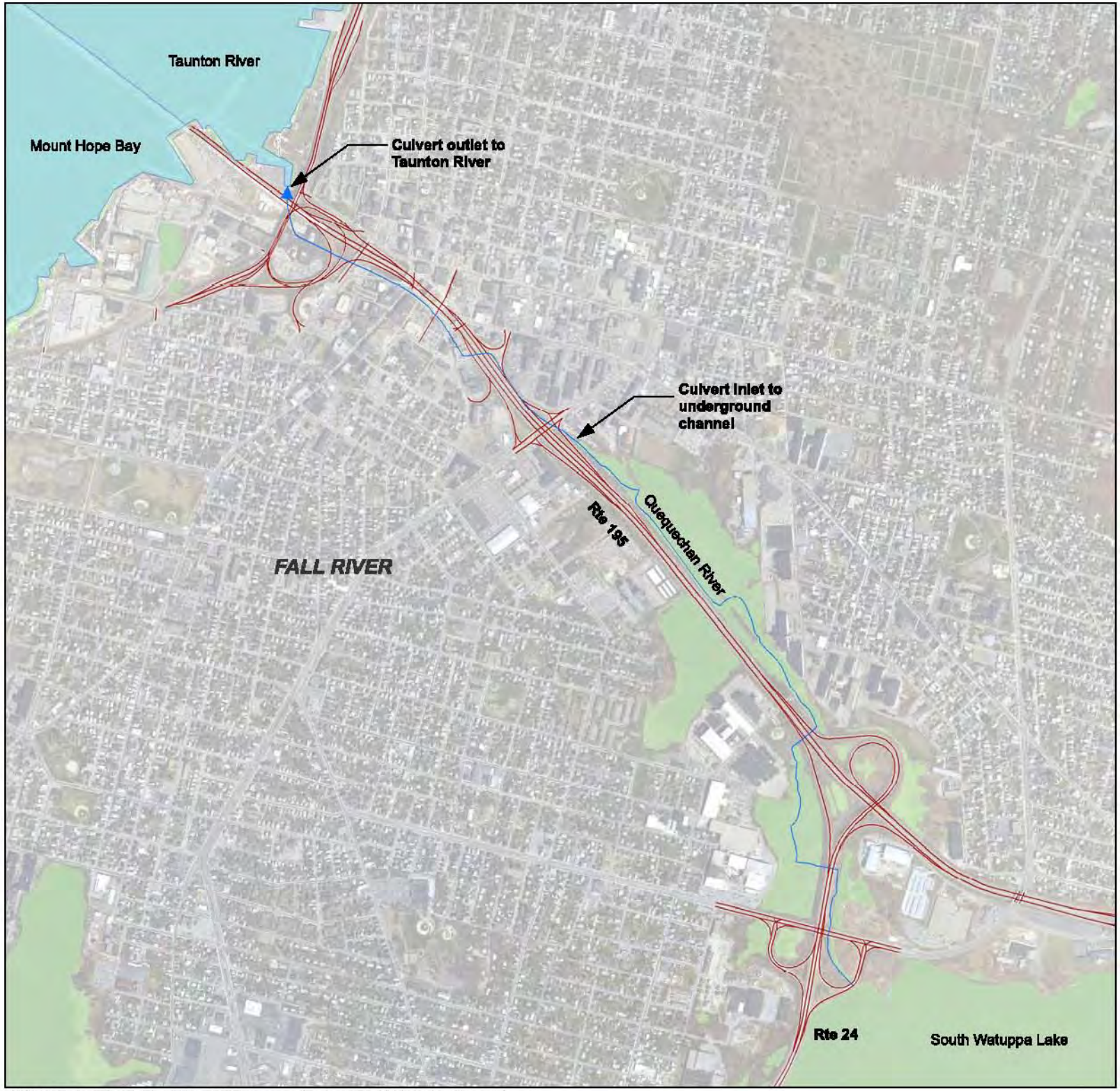

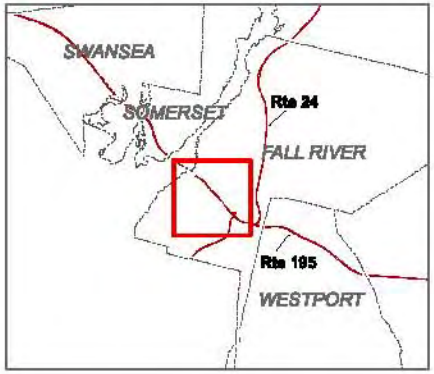

Impaired Stream Segments

Impaired Water Bodies

NWI Wetland Areas

MassDOT Urban Area Roads

Town Boundaries

N

Feet

0 750 1,500 3,000

1 inch = 1,500 feet

Figure 1

Quequechan River
MA61-05

October 2011

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Impaired Waters Assessment for Beaverdam Brook (MA93-30)

Impaired Waterbody

Name: Beaverdam Brook

Location: Lynnfield, MA

Water Body ID: MA93-30

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): dissolved oxygen, fecal coliform

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): dissolved oxygen, fecal coliform

Beaverdam Brook (MA93-30) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*.

Relevant Water Quality Standards:

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b)1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (3)(b) 4 Bacteria*.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
    - b. For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100

ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Beaverdam Brook (MA93-30) is approximately 1.5 miles long and flows through a forested wetland located west Main Street in the Town of Lynnfield, Massachusetts (Figure 1). Beaverdam Brook has a contributing watershed area of approximately 1,062 acres and discharges to Reedy Meadow which drains south to the Saugus River. The Beaverdam Brook watershed consists of high density residential areas and wetlands (Figure 1).

Assessment under BMP 7U for No Discharge Determination

In compliance with the specific steps outlined in BMP 7U (MassDOT, 2011), MassDOT performed a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. Because a desktop review of the Beaverdam Brook area could not make this determination, MassDOT proceeded to a site survey as indicated in Step 3 of BMP 7U. Based on the watershed mapping and field verification performed on August 11th, 2011 of drainage to Beaverdam Brook, there is no MassDOT property within the watershed for Beaverdam Brook (Figure 1).

Conclusions

Because MassDOT property does not directly contribute storm water runoff to Beaverdam Brook, further assessment of this water body is not warranted under the Impaired Waters program.

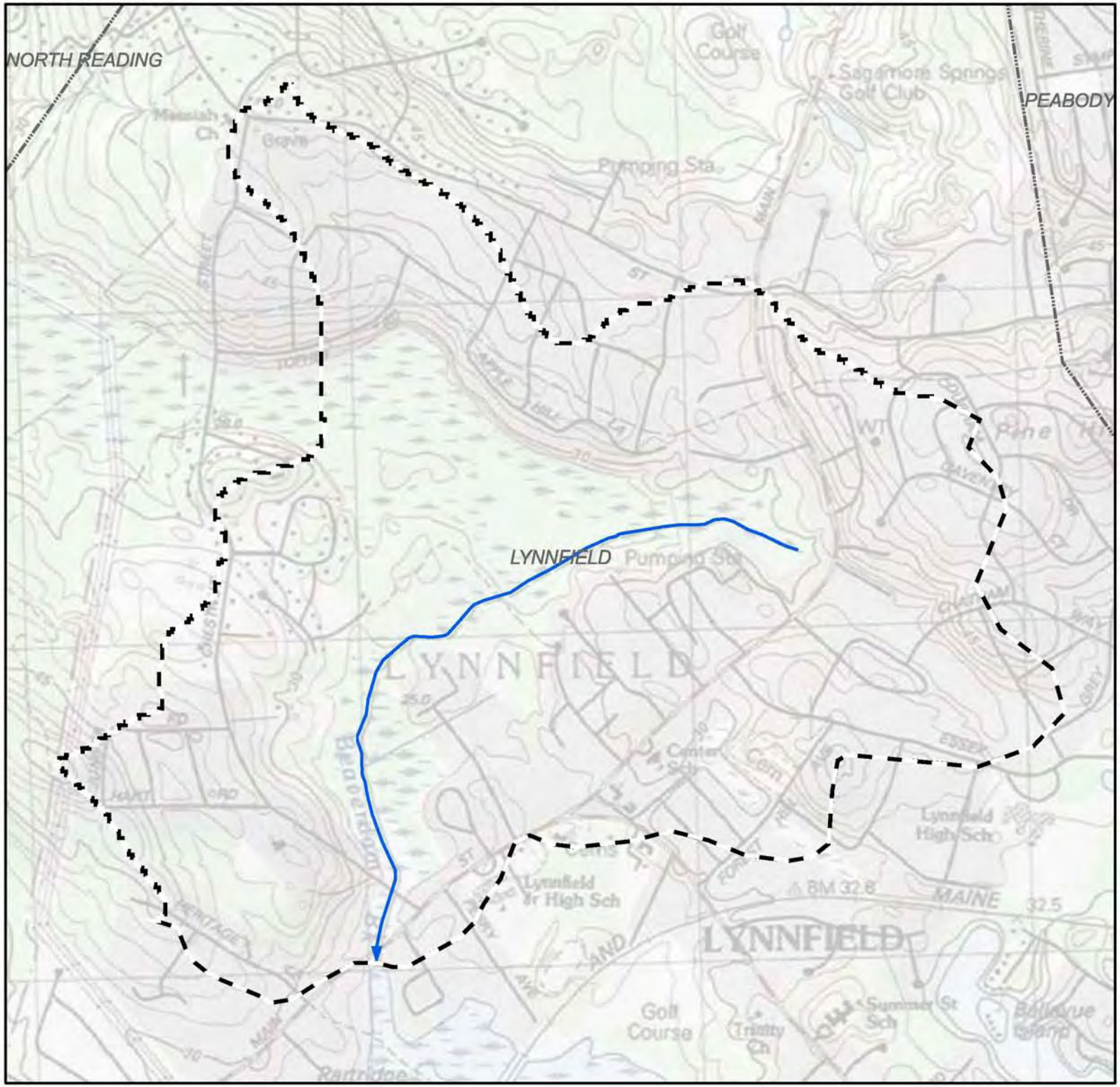
MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2010). Massachusetts Year 2010 Integrated List of Waters - Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list3.pdf

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).



MassDOT Roads in Urban Areas
Town Boundary
Beaverdam Brook Watershed
Beaverdam Brook (MA93-30)

N

0 0.2 0.4 Miles

Figure 1
Beaverdam Brook Watershed MA93-30

October 2011

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Impaired Waters Assessment for Mill River (MA93-31)

Impaired Waterbody

Name: Mill River

Location: Wakefield, MA

Water Body ID: MA93-31

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): dissolved oxygen, fecal coliform, total suspended solids (TSS), and turbidity

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): dissolved oxygen, fecal coliform, total suspended solids (TSS), and turbidity

Mill River (MA93-31) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*.

Relevant Water Quality Standards:

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b)1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (3)(b) 4 Bacteria*.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
    - b. For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100

ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

- *314 CMR 4.05 (3)(b)5 Solids*. These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- *314 CMR 4.05 (3)(b)6 Color and Turbidity.* These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.

Site Description

Mill River (MA93-31) is an approximately 2 mile long headwaters stream segment that flows through an urbanized area in the Town of Wakefield, Massachusetts (Figure 1). Mill River discharges into the Saugus River at the Route 129 bridge at the Saugus/Wakefield town line. Mill River has a contributing watershed area of approximately 2,200 acres. MassDOT's consultant, AECOM, confirmed that while the northernmost portion of the watershed abuts Interstate 95, highway drainage from this area is directed to the north into the Saugus River watershed, not the Mill River watershed.

Assessment under BMP 7U for No Discharge Determination

In compliance with the specific steps outlined in BMP 7U (MassDOT, 2011), MassDOT performed a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. Because a desktop review of the Mill River area could not make this determination, MassDOT proceeded to a site survey as indicated in Step 3 of BMP 7U. Based on the watershed mapping and field verification of drainage to Mill River performed on August 11th, 2011, there is no MassDOT property within the watershed for Mill River (Figure 1).

Conclusions

Because MassDOT property does not directly contribute storm water runoff to Mill River, further assessment of this water body is not warranted under the Impaired Waters program.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2010). Massachusetts Year 2010 Integrated List of Waters - Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list3.pdf

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).

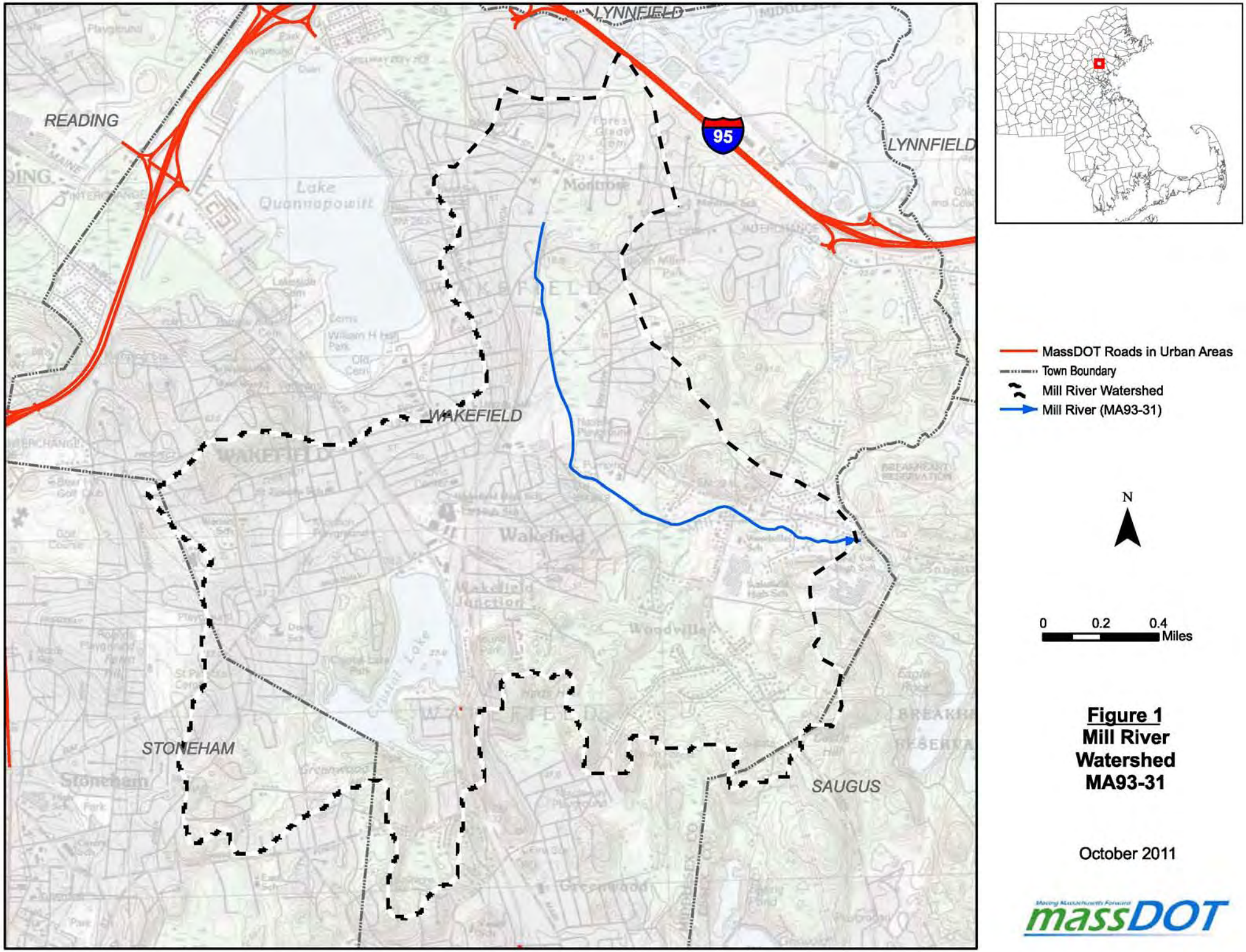

Figure 1
Mill River Watershed MA93-31

October 2011

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Impaired Waters Assessment for Pillings Pond (MA93056)

Impaired Waterbody

Name: Pillings Pond

Location: Lynnfield, MA

Water Body ID: MA93056

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): chlorophyll, dissolved oxygen saturation, excess algal growth, secchi disk transparency, and phosphorus (total)

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): dissolved oxygen added

Pillings Pond (MA93056) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*.

Relevant Water Quality Standards:

- Water Body Classification: Class B
- *314 CMR 4.05 (5)(c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.
- *314 CMR 4.05 (3)(b)1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (3)(b)6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- *314 CMR 4.05 (5)(a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris,

scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Pillings Pond (MA93056) is located in the Town of Lynnfield, Massachusetts. This pond has a surface area of 90.3 acres and a contributing watershed area of approximately 1,190 acres. Pillings Pond discharges to Reedy Meadow which drains south to the Saugus River.

The Pillings Pond watershed primarily consists of urbanized areas in Lynnfield with some small wetland areas (Figure 1). Impairments have been attributed to non-point source loading from residential lawns and internal nutrient loading in the North Shore Coastal Watersheds 2002 Water Quality Assessment Report (MassDEP 2007).

Assessment under BMP 7U for No Discharge Determination

In compliance with the specific steps outlined in BMP 7U (MassDOT, 2011), MassDOT performed a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. Since a desktop review of the Pillings Pond area could not make this determination, MassDOT proceeded to a site survey as indicated in Step 3 of BMP 7U. Based on the watershed mapping and field verification of drainage to Pillings Pond performed on August 11th, 2011, there is no MassDOT property within the watershed for Pillings Pond (Figure 1).

Conclusions

Because MassDOT property does not directly contribute storm water runoff to Pillings Pond, further assessment of this water body is not warranted under the Impaired Waters program.

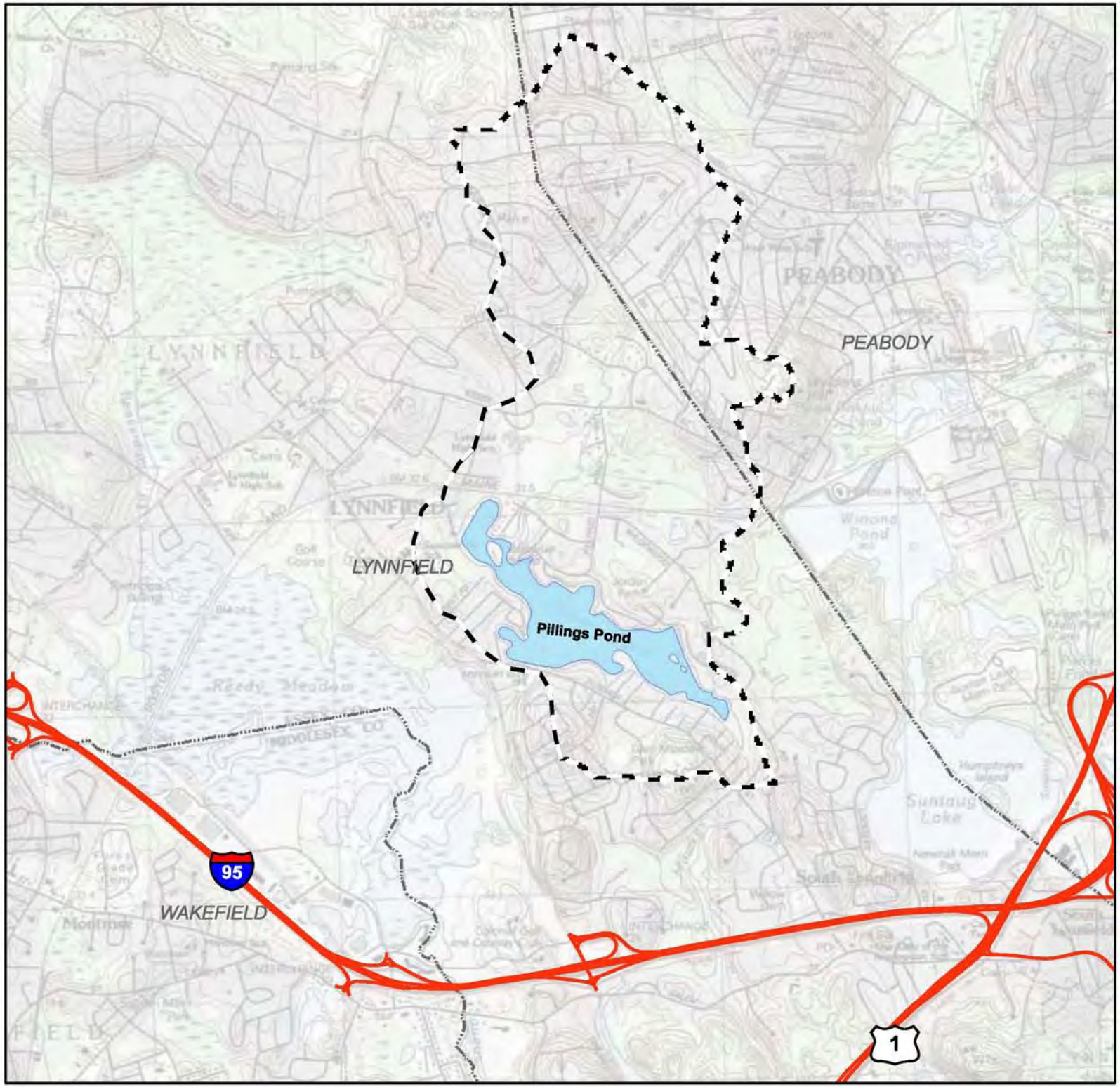
MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2010). Massachusetts Year 2010 Integrated List of Waters - Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list3.pdf

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).



Pillings Pond (MA93056)
MassDOT Roads in Urban Areas
Town Boundary
Pillings Pond Watershed

N

0 0.3 0.6 Miles

Figure 1
Pillings Pond Watershed MA93056

September 2011

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Impaired Waters Assessment for Lake Quannapowitt (MA93060)

Impaired Waterbody

Name: Lake Quannapowitt

Location: Wakefield, MA

Water Body Segment ID: MA93060

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): excess algal growth, non-native aquatic plants, turbidity

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): excess algal growth, non-native aquatic plants, turbidity, and DDT

Lake Quannapowitt (MA93060) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*.

Relevant Water Quality Standards:

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b)7 Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- *314 CMR 4.05 (5)(a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species or aquatic life.
- *314 CMR 4.05 (5)(e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals

permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

Site Description

Lake Quannapowitt is a 246-acre lake located in Wakefield Massachusetts adjacent to Interstate 95 and Route 129 (Figure 1). The outlet of Lake Quannapowitt is the beginning of the upper reach of the Saugus River (MA93-34). The Lake Quannapowitt watershed consists of approximately 667 acres of a high-density residential land use. The watershed area derived for this lake in the USGS 451 HUC8 watershed drainage area data includes approximately 1,820 acres that is located north of Interstate 95 in the Lake Quannapowitt watershed. However, the AECOM field visit for this assessment identified an earthen berm along the shore of the lake and confirmed the presence of a canal that together effectively causes much of the northern watershed area to drain east through a wetland and the canal to a convergence point with the Saugus River, downstream from Lake Quannapowitt. The watershed area for Lake Quannapowitt was re-defined for this assessment as presented on Figure 1. Approximately 244 acres in the watershed are identified as being impervious based on the MassGIS Impervious Surface raster data.

Of the 244 acres of impervious surface within the Lake Quannapowitt watershed, 9.6 acres are owned by MassDOT. Approximately 9.1 acres of the MassDOT property in this watershed is located southwest of Lake Quannapowitt in areas where either no established drainage channels are present or storm water migrates into a large natural wetland. Due to the distance (more than 2,400 feet) between the storm water discharge from the MassDOT property in these areas and the lake, as well as the presence of the large wetland, runoff from this Mass DOT property is not considered a direct discharge to Lake Quannapowitt for this assessment.

Approximately 0.5 acre of MassDOT property in the Lake Quannapowitt watershed is located at Interchange 40 of Interstate 95 (Figure 2). A catch basin located at the north-bound lane off ramp discharges into a forested wetland that abuts the highway (Figure 2). This natural wetland discharges through a culvert into Lake Quannapowitt. Since the discharge first passes through this large wetland, the storm water discharge from this 0.5 acre portion of MassDOT owned property is not a direct discharge to Lake Quannapowitt.

Assessment under BMP 7U for No Discharge Determination

In compliance with the specific steps outlined in BMP 7U (MassDOT, 2011), MassDOT performed a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. Since a desktop review of the Lake Quannapowitt area could not make this determination, MassDOT proceeded to a site survey as indicated in Step 3 of BMP 7U. Based on watershed mapping and field verification of drainage to Lake Quannapowitt performed on August 10th and 11th, 2011, there are no direct discharges from MassDOT property to Lake Quannapowitt.

Conclusions

Because MassDOT property does not directly contribute storm water runoff to Lake Quannapowitt, further assessment of this water body is not warranted under the Impaired Waters program.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

Massachusetts Department of Environmental Protection (MassDEP) (2010). Massachusetts Year 2010 Integrated List of Waters - Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list3.pdf

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).

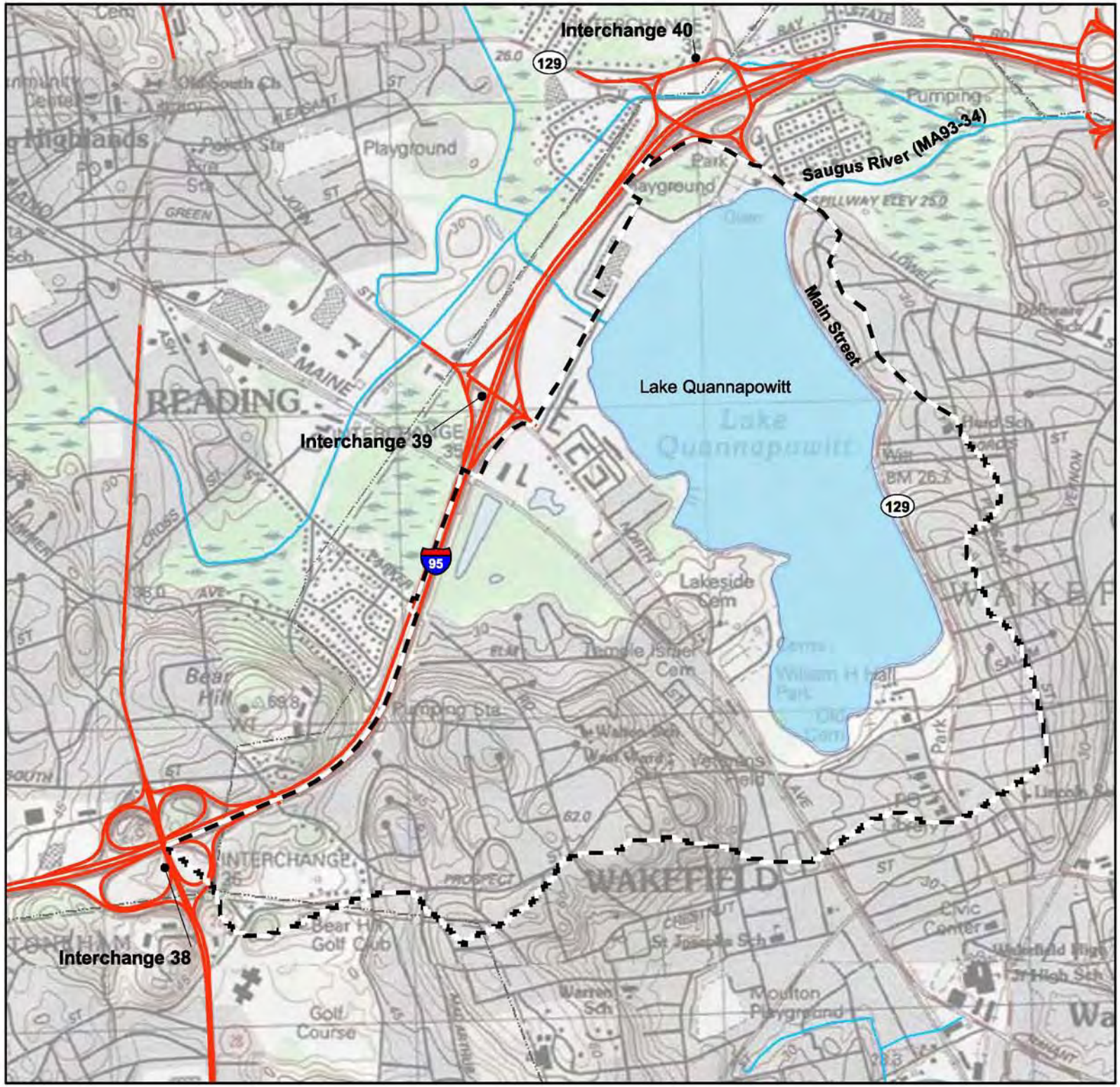

Figure 1
Lake Quannapowitt Watershed MA93060

September 2011

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- Stormwater Outfall
- Stream/River
- MassDOT Roads in Urban Areas
- MassDOT Property Drainage Area
- Lake Quannapowitt Watershed Boundary

NWI Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

N

0 500 1,000 Feet

Figure 2
MassDOT Drainage Areas
Lake Quannapowitt
Watershed
MA93060

September 2011

massDOT

Impaired Waters Assessment for Gushee Pond (MA62084), Lake Nippenicket (MA62131), Lake Sabbatia (MA62166), Watson Pond (MA62205) & Winnecunnet Pond (MA62213)

Impaired Waterbodies

- Gushee Pond (MA62084)
- Lake Nippenicket (MA62131)
- Lake Sabbatia (MA62166)
- Watson Pond (MA62205)
- Winnecunnet Pond (MA62213)

Impairments

According to both the final *Massachusetts Year 2008 Integrated List of Waters* and the proposed *Massachusetts Year 2010 Integrated List of Waters*, the waterbodies evaluated under this assessment have the following impairments:

- Gushee Pond (MA62084): Category 4c waterbody impaired for exotic species
- Lake Nippenicket (MA62131): Category 4c waterbody impaired for metals and exotic species; also part of the Northeast Region TMDL for Mercury
- Lake Sabbatia (MA62166): Category 5 waterbody impaired for organic enrichment/low DO and exotic species
- Watson Pond (MA62205): Category 5 waterbody impaired for nutrients (TP), organic enrichment/Low DO, noxious aquatic plants, turbidity, and exotic species
- Winnecunnet Pond (MA62213): Category 4c waterbody impaired for exotic species

Relevant Water Quality Standards

The waterbodies evaluated under this assessment have the following beneficial use classifications:

- Gushee Pond (MA62084): Class B
- Lake Nippenicket (MA62131): Class B
- Lake Sabbatia (MA62166): Class B
- Watson Pond (MA62205): Class B
- Winnecunnet Pond (MA62213): Class A

Based on the impairments listed above, the following Massachusetts Surface Water Quality Standards are applicable to one or more of the waterbodies evaluated under this assessment:

- *301 CMR 4.05 (3)(a) Class A.* These waters include waters designated as a source of public water supply and their tributaries. They are designated as excellent habitat for fish, other aquatic life and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation, even if not allowed. These waters shall have excellent aesthetic value. These waters are protected as Outstanding Resource Waters.
- *301 CMR 4.05 (3)(b) Class B.* These waters are designated as a habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. Where designated in 314 CMR 4.06, they shall be suitable as a source of public water supply with appropriate treatment ("Treated Water Supply"). Class B waters shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.
- *301 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *301 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this Class.
- *301 CMR 4.05 (5)(a) Aesthetics.* All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *301 CMR 4.05 (5)(c) Nutrients.* Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.
- *301 CMR 4.05 (5)(e) Toxic Pollutants.* All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the *National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002* published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total

recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

Site Description

The waterbodies investigated under this assessment are located within the Taunton River watershed in southeastern Massachusetts. The following sections briefly describe each waterbody and identify the Mass-DOT owned roads that are close by.

Gushee Pond (MA62084)

Gushee Pond is approximately 27 acres in size and is located approximately 800 feet southwest of the intersection of MassDOT's Route 24 (Rt. 24) and Interstate 495 (I-495) in Raynham. The pond is surrounded by wetlands and forms the headwaters of the Forge River. Other MassDOT-owned roadways near Gushee Pond include Route 138 (Rt. 138) to the west and Route 44 (Rt. 44) to the south.

Although Gushee Pond is in close proximity to both Rt. 24 and I-495, there are no direct storm water discharges to this waterbody from MassDOT's property. During a site visit on December 21, 2010, it was confirmed that local topography and the presence of wetlands between the pond and MassDOT's roadways prevent the direct discharge of highway runoff to this impaired waterbody. Refer to Figure 1 for the location of Gushee Pond relative to MassDOT's roadways.

Lake Nippenicket (MA62131)

Lake Nippenicket is approximately 354 acres in size and is located approximately 3,000 feet northwest of the intersection of Rt. 24 and I-495. The majority of the lake lies in Bridgewater, while a small portion of the southwestern corner lies in Raynham. The lake is almost completely surrounded by wetlands and forms the headwaters of the Town River. Other MassDOT-owned roadways near Lake Nippenicket include Rt. 138 to the west and a small portion of Pleasant Street in Bridgewater to the southeast.

Although Lake Nippenicket is in close proximity to both Rt. 24 and I-495, there are no direct storm water discharges to this waterbody from MassDOT's property. During a site visit on December 21, 2010, it was confirmed that local topography and the presence of residential development, wetlands, and other waterbodies between the lake and MassDOT's roadways prevent the direct discharge of highway runoff to this impaired waterbody. Refer to Figure 1 for the location of Lake Nippenicket relative to MassDOT's roadways.

Lake Sabbatia (MA62166)

Lake Sabbatia is approximately 237 acres in size and is located just less than one mile south of the intersection of Bay Street and I-495 in Taunton. The lake is mostly surrounded by residential development and borders Watson State Park. Lake Sabbatia is fed by the Snake River and outlets through a dam into the Mill River. The only other MassDOT-owned roadway near Lake Sabbatia is Rt. 138 to the east.

Lake Sabbatia is a significant distance from any MassDOT-owned roadway. During a site visit on December 21, 2010, it was confirmed that local topography and the presence of heavy residential/commercial properties between MassDOT roadways and Lake Sabbatia prevent the direct discharge of highway runoff to this impaired waterbody. Refer to Figure 1 for the location of Lake Sabbatia relative to MassDOT's roadways.

Watson Pond (MA62205)

Watson Pond is approximately 78 acres in size and is located approximately 2,000 feet south of the intersection of Bay Street and I-495 in Taunton, just north of Lake Sabbatia. The pond is surrounded mostly by forest and wetlands and is a part of Watson Pond State Park. Although Watson Pond is hydraulically connected to Lake Sabbatia, the two remain separate waterbodies. The only other MassDOT-owned roadway near Watson Pond is Rt. 138 to the east.

Much like Lake Sabbatia, Watson Pond is a significant distance from any MassDOT-owned roadway. During a site visit on December 21, 2010, it was confirmed that local topography and the presence of heavy residential/commercial properties, wetlands, and other waterbodies between MassDOT roadways and Watson Pond prevent the direct discharge of highway runoff to this impaired waterbody. Refer to Figure 1 for the location of Watson Pond relative to MassDOT's roadways.

Winnecunnet Pond (MA62228)

Winnecunnet Pond is approximately 148 acres in size and is located approximately 1,000 feet north of the intersection of Bay Street and I-495 in Norton. The pond is bordered by residential development along approximately 50 percent of its shoreline, and the remainder is surrounded by wetlands. Winnecunnet Pond is fed by the Canoe River and Mulberry Meadow Brook and outlets to the Snake River. There are no other MassDOT-owned roadways in the vicinity of the Pond.

Although Winnecunnet Pond is relatively close to I-495 and Bay Street, there are no direct storm water discharges to this waterbody from MassDOT's property. During a site visit on December 21, 2010, it was confirmed that local topography and the presence of residential properties, wetlands, and other waterbodies between MassDOT's roadways and the pond prevent the direct discharge of highway runoff to this impaired waterbody. Refer to Figure 1 for the location of Winnecunnet Pond relative to MassDOT's roadways.

Assessment under BMP 7U for No Discharge Determination

In compliance with the assessment protocol outlined in BMP 7U (MassDOT, 2011), MassDOT proceeded with Step 1 to determine whether or not storm water runoff could potentially be linked to the impairments listed for each of the five subject waterbodies. Of the six listed impairments for the subject waterbodies, exotic species and metals (specifically mercury) are not linked to storm water runoff. According to the final *Massachusetts Year 2008 Integrated List of Waters*, exotic species are a non-pollutant stressor which indicates that restoration will require measures other than TMDL development and implementation. Furthermore, storm water has been shown to be a *de minimis* contributor to waterbodies impaired with mercury (NEIWPCC, 2010). As a result, MassDOT has concluded that storm water runoff from its roadways does not contribute to the impairments of exotic species and metals found in Gushee Pond (MA62084), Lake Nippenicket (MA62131), and Winnecunnet Pond (MA62213).

Both Lake Sabbatia (MA62166) and Watson Pond (MA62205), however, are listed for impairments that have historically been linked to storm water runoff. For these two waterbodies, MassDOT proceeded with Step 2 of BMP 7U and performed a desktop review of each waterbody's sub-basin to identify any direct storm water discharges from MassDOT-owned roadways. Since a desktop review of these two waterbodies and their contributing watersheds could not eliminate the possibility of direct discharges from MassDOT's property, MassDOT performed a field visit on December 21, 2010. Based on this site visit, it was confirmed that there are no direct discharges from its roadways to either Lake Sabbatia (MA62166) or Watson Pond (MA62205).

Conclusions

Although MassDOT owns major highways within the watersheds of the five waterbodies investigated under this assessment, the natural features surrounding each waterbody prevent direct storm water discharges from MassDOT's property. Therefore, no further measures are warranted to address the impairments described herein.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Massachusetts Department of Environmental Protection. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2010). Massachusetts Year 2010 Integrated List of Waters - Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts Department of Environmental Protection. Retrieved from: http://www.mass.gov/dep/water/resources/10list3.pdf

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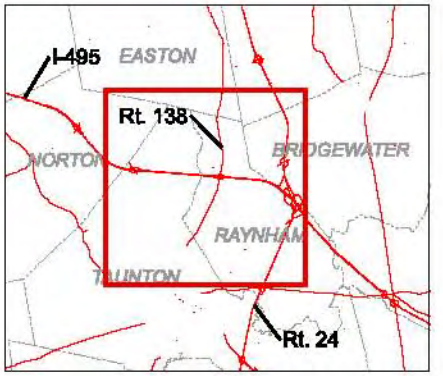
Mass Wildlife. (1993). Winnecunnet Pond. In *Pond Maps*. Retrieved from: http://www.mass.gov/dfwele/dfw/habitat/maps/ponds/pdf/dfwwinne.pdf

Mass Wildlife. (2007). Lake Nippenicket. In *Pond Maps*. Retrieved from: http://www.mass.gov/dfwele/dfw/habitat/maps/ponds/pdf/dfwnippe.pdf

Mass Wildlife. (2007). Lake Sabbatia. In *Pond Maps*. Retrieved from: http://www.mass.gov/dfwele/dfw/habitat/maps/ponds/pdf/dfwsabbi.pdf

New England Interstate Water Pollution Control Commission (NEIWPCC). (2007). Northeast Regional Mercury Total Maximum Daily Load. Retrieved from: http://www.neiwpcc.org/mercury/mercury-docs/FINAL%20Northeast%20Regional%20Mercury%20TMDL.pdf



Impaired Stream Segment

Impaired Water Body

NWI Wetland Area

MA DOT Roads

MassDOT Roads in Urban Areas

Town Boundaries

N

0 2,000 4,000 8,000

Feet

1 in = 4,000 feet

Figure 1

Gushee Pond (MA62084)
Lake Nippenicket (MA62131)
Lake Sabbatia (MA62166)
Watson Pond (MA62205)
Winnecunnet Pond (MA62228)

October 2011

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Impaired Waters Assessment for Mount Hope Bay (MA61-07)

Impaired Waterbody

Name: Mount Hope Bay

Location: Swansea, MA

Water Body ID: MA61-07

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): unknown toxicity, nutrients, organic enrichment/low DO, thermal modifications, pathogens

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010a): fishes bioassessments, total nitrogen, water temperature, fecal coliform, chlorophyll *a*

Mount Hope Bay (MA61-07) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009), Mount Hope Bay (MA61-07) is impaired for thermal modification contributing to the collapse of fishery, low dissolved oxygen, elevated total nitrogen, elevated chlorophyll *a*, and elevated total fecal coliform bacteria.

Relevant Water Quality Standards

- Water Body Classification: Class SA
- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.
- *314 CMR 4.05 (5)(e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background

concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

- *314 CMR 4.05 (4)(a) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l. Where natural background conditions are lower, DO shall not be less than natural background. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (4)(a) 2 Temperature*.
    - a. Shall not exceed 85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°0C), and the rise in temperature due to a discharge shall not exceed 1.5°0F (0.8°0C);
    - b. there shall be no change from natural background that would impair any uses assigned to this class including those conditions necessary to protect normal species diversity, successful migration, reproductive functions or growth of aquatic organisms;
- *314 CMR 4.05 (4)(a) 4 Bacteria*.
    - a. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
    - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed a geometric mean of 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all samples taken within the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Mount Hope Bay is a water body in Swansea, MA comprised of two segments, MA61-06 and MA61-07. Mount Hope Bay (segment MA61-07) covers approximately 1.8 square miles and extends from the mouth of Cole River (MA61-04) to the line extending between Brayton Point, Somerset, MA to the Massachusetts/Rhode Island state border (MassDEP, 2010b). Lee River (MA61-02) also flows into this segment of Mount Hope Bay. See Figure 1.

Assessment under BMP 7U for No Discharge Determination

Based on site visits on October 5th and 6th, 2011, it was determined that MassDOT does not directly contribute runoff to Mount Hope Bay (MA61-07). The nearest MassDOT-owned urban roadways are Interstate 195 and Route 103. These roadways discharge storm water to Cole River (MA61-04) and Lee River (MA61-02) which are reviewed under separate assessments.

Conclusions

Because MassDOT property does not directly contribute storm water runoff to Mount Hope Bay, further assessment of this water body is not warranted under the Impaired Waters program.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2009). Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/dep/water/resources/6153wq08.pdf.

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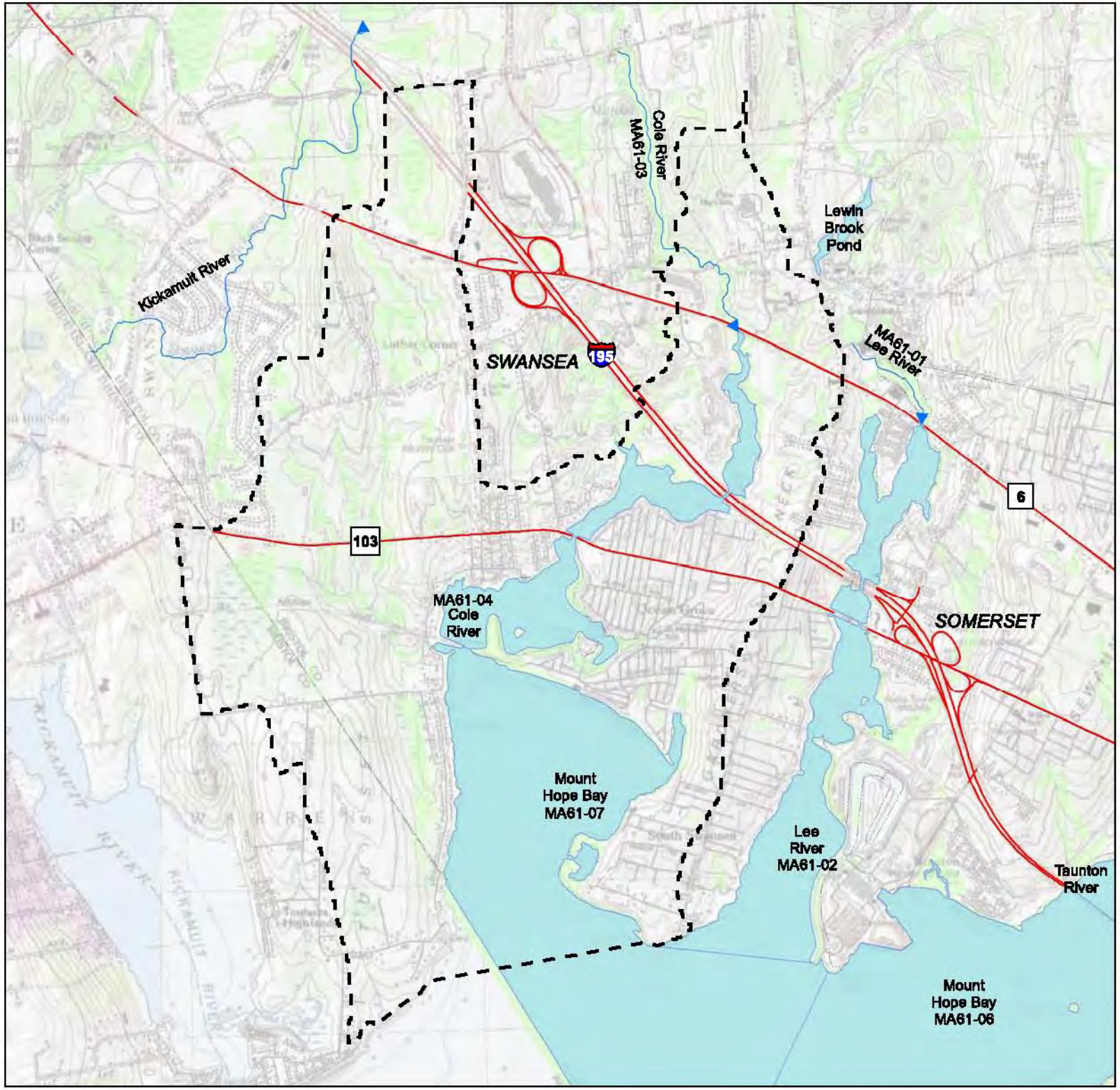

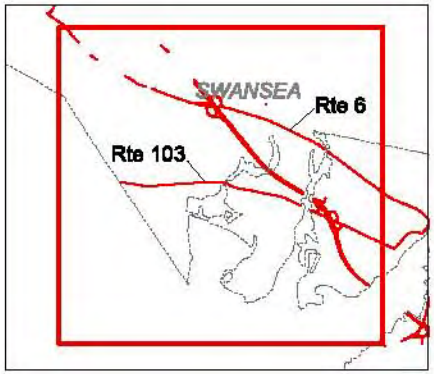

- Mount Hope Bay (MA61-07) Subwatershed
- Impaired Water Bodies
- NWI Wetland Areas
- Impaired Stream Segments
- MassDOT Urban Area Roads
- Town Boundaries

N

0 1,500 3,000 6,000

Feet

1 in = 3,000 feet

Figure 1

Mount Hope Bay (MA61-07) Subwatershed

October 2011

Moving Massachusetts Forward massDOT

Impaired Waters Assessment for Lewin Brook Pond (MA61011)

Impaired Waterbody

Name: Lewin Brook Pond

Location: Swansea, MA

Water Body ID: MA61011

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): metals

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010b): mercury in fish tissue

Lewin Brook Pond (MA61011) is listed in both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters* under Category 4a, "TMDL is Completed", and is covered by a TMDL. According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009), Lewin Brook Pond is impaired for elevated mercury in fish tissue due to atmospheric deposition.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5)(e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

Site Description

Lewin Brook Pond is a water body in Swansea, MA of approximately 11 acres (MassDEP, 2010a) which lays upstream of Lee River (MA61-01). Figure 1 shows the Lewin Brook Pond subwatershed.

Assessment under BMP 7U for No Discharge Determination

In compliance with the assessment protocol outlined in BMP 7U (MassDOT, 2011), MassDOT proceeded with Step 1 to determine whether or not storm water runoff could potentially be linked to the impairment for this water body. According to Northeast Regional Mercury TMDL, storm water has been shown to be a *de minimis* contributor to water bodies impaired with mercury (NEIWPCC, 2007). As a result, MassDOT has concluded that storm water runoff from its roadways does not contribute to the impairment of metals in Lewin Brook Pond.

Conclusions

MassDOT-owned property does not contribute to the impairment of metals for Lewin Brook Pond (MA61011). Therefore, MassDOT has determined that further assessment of this water body is not warranted under the Impaired Waters program.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

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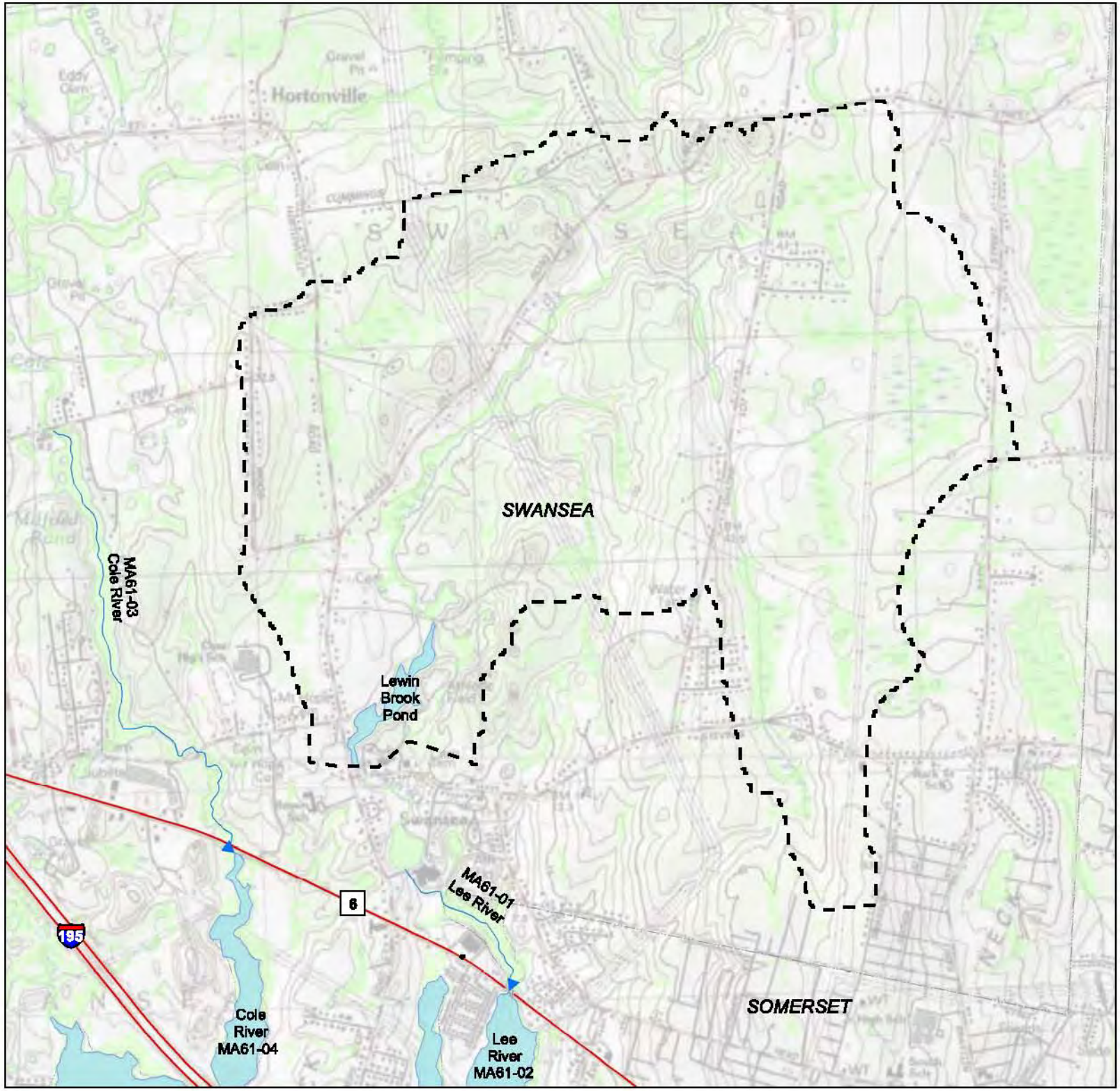

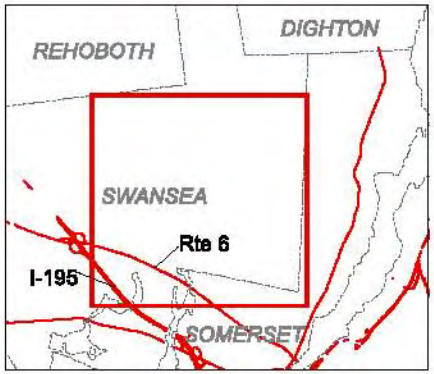

Lewin Brook Pond (MA61011) Subwatershed
Impaired Stream Segments
Impaired Water Bodies
NWI Wetland Areas
MassDOT Urban Area Roads
Town Boundaries

N

0 1,000 2,000 4,000

Feet

1 in = 2,000 feet

Figure 1

Lewin Brook Pond (MA61011) Subwatershed

October 2011

Moving Massachusetts Forward
massDOT

Impaired Waters Assessment for Cole River (MA61-03)

Impaired Waterbody

Name: Cole River

Location: Swansea, MA

Water Body ID: MA61-03

Impairments

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): fish-passage barrier

Cole River (MA61-03) is listed under Category 4c Waters, "Impairment not Caused by a Pollutant", on MassDEP's proposed *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009), a 1.6-mile segment of Cole River (MA61-03) is impaired due to inefficient/degraded fish passages. Specifically, the Milford Pond Dam at the upstream end of the river segment does not have a fish passage structure and, downstream, the Route 6 Dam has a notched weir-pool fishway which is inefficient for fish passage. These dams are not owned by MassDOT and the impairment is not storm water related, therefore the impairment for Cole River (MA61-03) will not be investigated further.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5) (b) Bottom Pollutants or Alterations*. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.

Site Description

Cole River (MA61-03) is a 1.6-mile long warm water fishery located in Swansea, MA (MassDEP, 2009). This segment begins at Wood Street and flows into Cole River segment 04 (MA61-04) shortly after it passes under Route 6 (Rte 6). The subwatershed of Cole River (MA61-03) is shown in Figure 1.

Assessment under BMP 7U

In compliance with the assessment protocol outlined in BMP 7U (MassDOT, 2011), MassDOT proceeded with Step 1 to determine whether or not storm water runoff could potentially be linked to the impairment for this water body. Because the impairment of fish-passage barrier in Cole River (MA61-03) is a result of dam structures, MassDOT concluded that storm water runoff from its roadways does not contribute to the impairment.

Conclusions

MassDOT-owned property does not contribute to the impairment of a fish-passage barrier for Cole River (MA61-03). Therefore, MassDOT has determined that further assessment of this water body is not warranted under the MassDOT Impaired Waters Program.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2009). Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/dep/water/resources/6153wq08.pdf.

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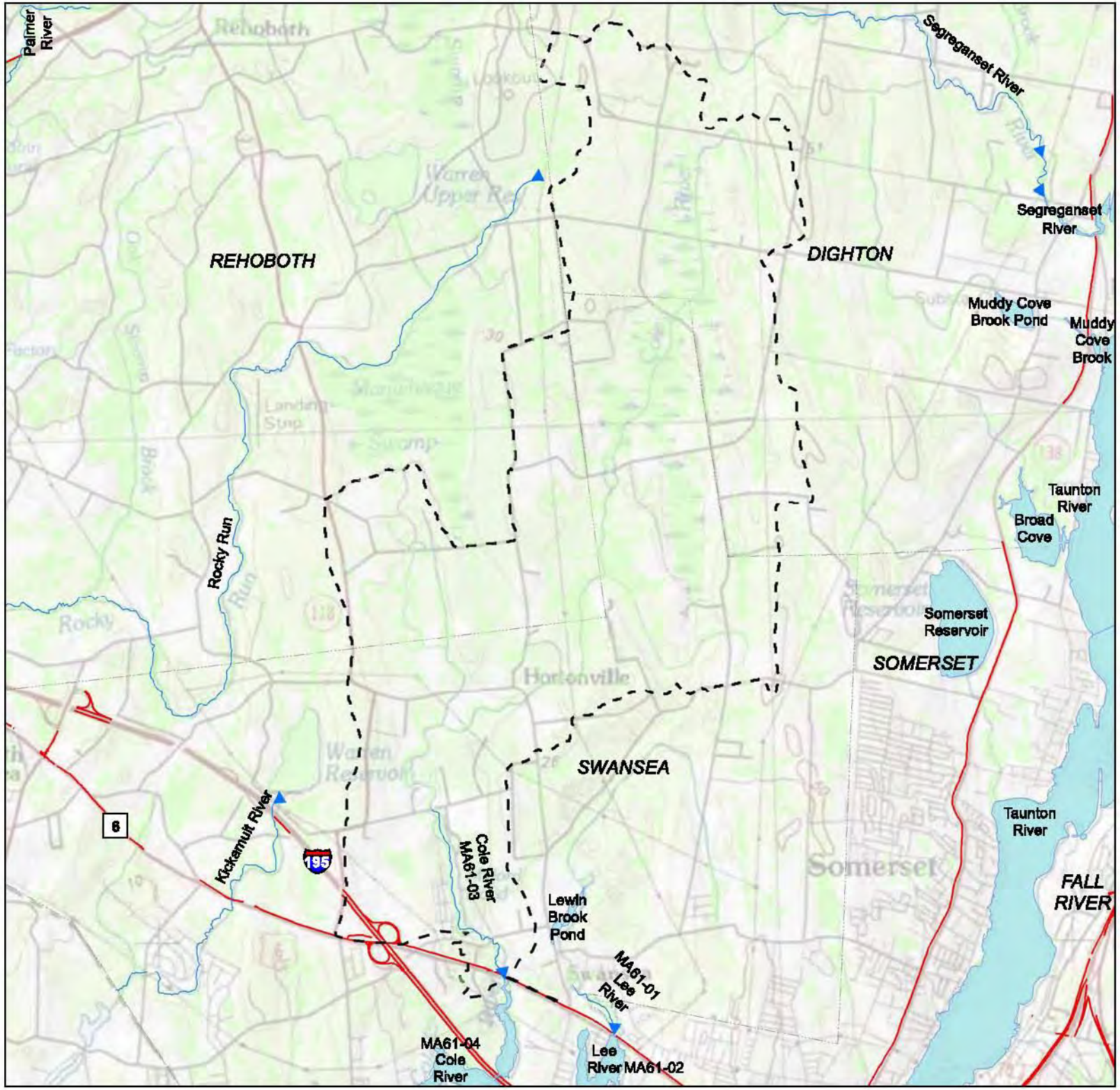
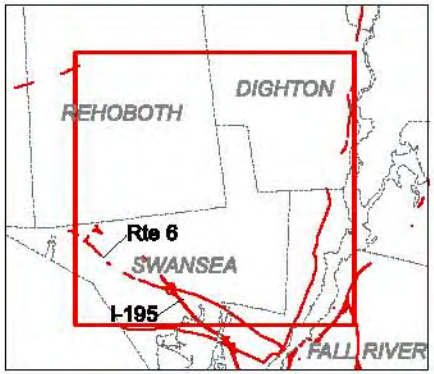




Cole River 03 (MA61-03) Subwatershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
MassDOT Urban Area Roads
Town Boundaries

N

0 2,500 5,000 10,000

Feet

1 in = 5,000 feet

Figure 1

Cole River (MA61-03) Subwatershed

October 2011

Moving Massachusetts Forward
massDOT

Impaired Waters Assessment for Whittenton Impoundment (MA62228)

Impaired Waterbody

Name: Whittenton Impoundment

Location: Taunton, MA

Water Body ID: MA62228

Impairments

Final *MassachusettsYear 2010 Integrated List of Waters* (MassDEP, 2011): non-native aquatic plants

The Whittenton Impoundment is listed under Category 4c, "Impairment not Caused by a Pollutant", on MassDEP's final *Massachusetts Year 2010 Integrated List of Waters* and is not addressed by a TMDL. MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2005) also states that the Whittenton Impoundment is impaired due to a non-native aquatic macrophyte species.

Relevant Water Quality Standards

- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

The Whittenton Impoundment (MA62228) is a water body in Taunton, MA of approximately 20 acres (MassDEP, 2005) with a contributing watershed area of approximately 26,280 acres. It lays directly downstream of Lake Sabbatia (MA62166) and outlets to Mill River (MA62-29) (see Figure 1). Along much of its stretch, the Whittenton Impoundment is buffered by approximately 100 feet of wetlands or forested area. At the southern end of the impoundment, residential and industrial development are located within 100 feet of the water body.

Interstate 495 (I-495) is the only MassDOT-owned roadway in the watershed of the Whittenton Impoundment. I-495 runs east to west through the subwatershed, north of Lake Sabbatia and Watson Pond (MA62205), which flows to Lake Sabbatia. As described in the *Impaired Waters Assessment for Gushee Pond (MA62084), Lake Nippenicket (MA62131), Lake Sabbatia (MA62166), Watson Pond (MA62205) & Winnecunnet Pond (MA62213)* (MassDOT, 2011) performed by MassDOT's consultant under the Impaired Waters Program, it was determined that the local topography and the presence of heavy residential/commercial properties between I-495 and these water bodies prevent the direct discharge of highway runoff to Lake Sabbatia and Watson Pond. Therefore, runoff from I-495 does not directly contribute to the Whittenton Impoundment.

Assessment under BMP 7U

Based on the watershed delineation for the Whittenton Impoundment and the findings described in the *Impaired Waters Assessment for Gushee Pond (MA62084), Lake Nippenicket (MA62131), Lake Sabbatia (MA62166), Watson Pond (MA62205) & Winnecunnet Pond (MA62213)*, it was determined that MassDOT-owned property does not directly discharge to the Whittenton Impoundment.

Conclusions

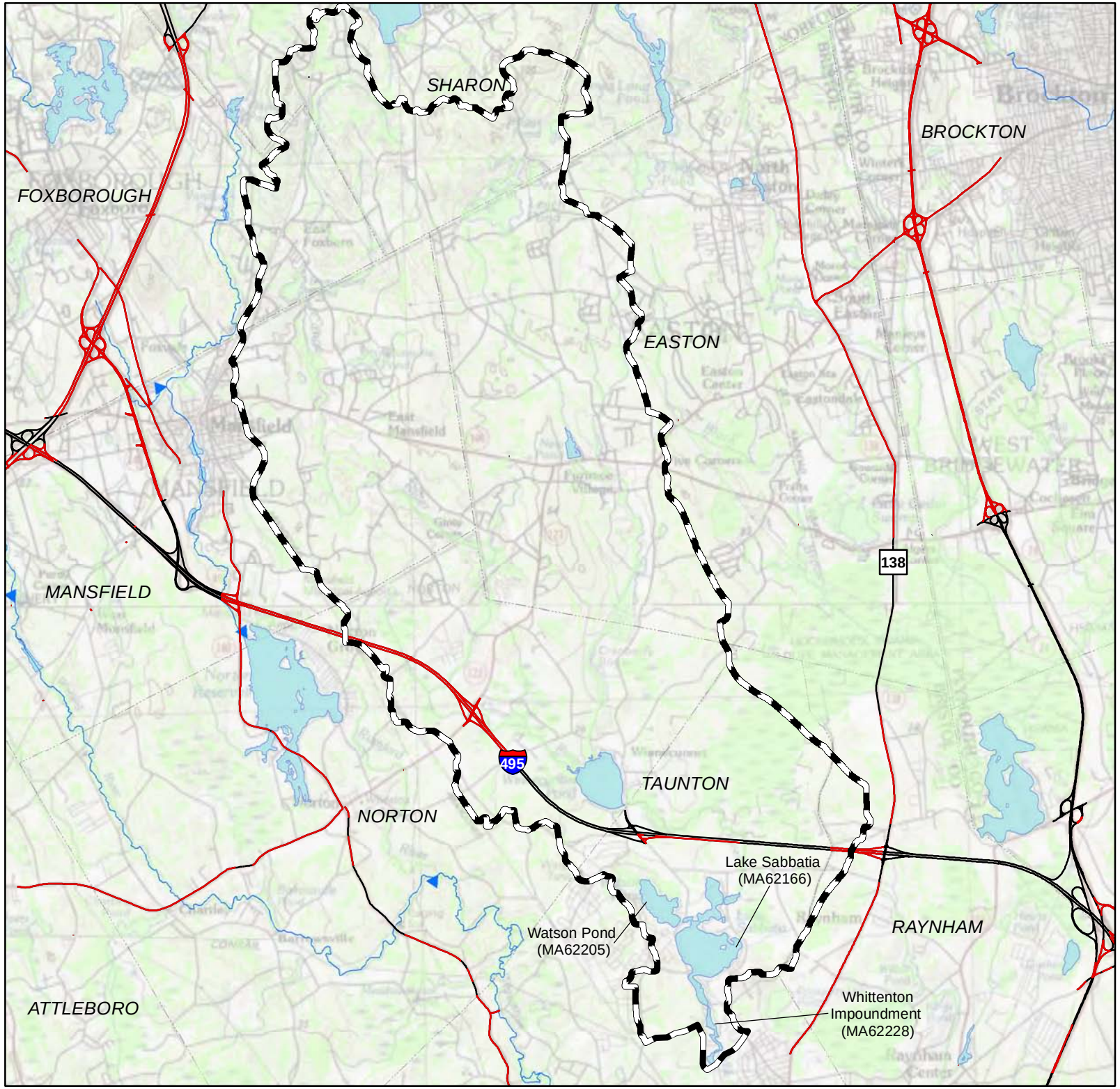
Because MassDOT property does not directly contribute storm water runoff to the Whittenton Impoundment, further assessment of this water body is not warranted under the Impaired Waters program.

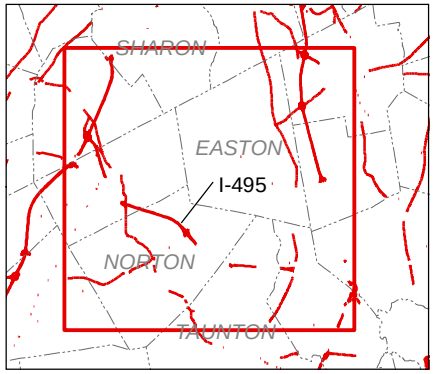
MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2005). Taunton River Watershed 2001 Water Quality Assessment Report. Available at: http://www.mass.gov/dep/water/resources/wqassess.htm.

Massachusetts Department of Environmental Protection (MassDEP). (2011). Massachusetts Year 2010 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Available at: http://www.mass.gov/dep/water/resources/10list6.pdf.





Whittendon (MA62228) Watershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
MassDOT Urban Area Roads
MassDOT Roads
Town Boundaries

N

0 4,000 8,000 16,000

Feet

1 in = 8,000 feet

Figure 1

Whittenton Impoundment (MA62228) Watershed

December 2011

Moving Massachusetts Forward. massDOT

Impaired Waters Assessment for Ganawatte Farm Pond (MA73037)

Impaired Waterbody

Name: Ganawatte Farm Pond

Location: Walpole/ Sharon/ Foxborough

Water Body ID: MA73037

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): organic enrichment/low DO, noxious aquatic plants, turbidity

Proposed *MassachusettsYear 2010 Integrated List of Waters* (MassDEP, 2010a): organic enrichment/low DO, noxious aquatic plants, turbidity

Ganawatte Farm Pond is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. The pond is not included in the Water Quality Assessment Report for its respective watershed, the Neponset River Watershed, due to insufficient data (MassDEP, 2010b).

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.

Site Description

Ganawatte Farm Pond (MA73037) is a water body of approximately 29 acres which extends across Walpole, Sharon, and Foxborough, MA (see Figure 1). Water from the pond flows under Pine Street and into School Meadow Brook (MA73-06).

MassDOT owns Route 1 (Rte 1) which runs nearby Ganawatte Farm Pond. This roadway is curbed and conveys storm water through a system of catch basins and manholes.

Assessment under BMP 7U for No Discharge Determination

During a site visit performed on November 18, 2011, it was determined that storm water runoff from MassDOT property does not directly discharge to Ganawatte Farm Pond.

Along a 500-foot stretch of Rte 1, systems of catch basins located on the outside shoulders discharge storm water to a low, wooded area bounded by Rte 1, Pine Street and the off ramp from Rte 1 North to Pine Street. Water flows from this outfall, across the low area to an outlet pipe, then to a catch basin on the off ramp and likely to the catch basins and manholes at the entrance to Hilltop Drive (see Figure 2).

Continuing along Pine Street and approaching the pond, there were no additional storm water features and no curbing. The field crew observed that the appropriate location for an outfall for the drainage system appeared to be on the northeast side of Pine Street across from the entrance to Hilltop Drive. This is a low, dropped-down woodsy area between the street and School Meadow Brook. However, an outfall could not be identified along this side of Pine Street and could potentially be buried. Also, no outfalls were identified at Ganawatte Farm Pond or at any other location along Pine Street. It was therefore concluded that storm water from Rte 1 does not directly contribute to Ganawatte Farm Pond.

Conclusions

MassDOT property does not directly contribute storm water runoff to Ganawatte Farm Pond. Therefore, further assessment of this water body is not warranted under the Impaired Waters program.

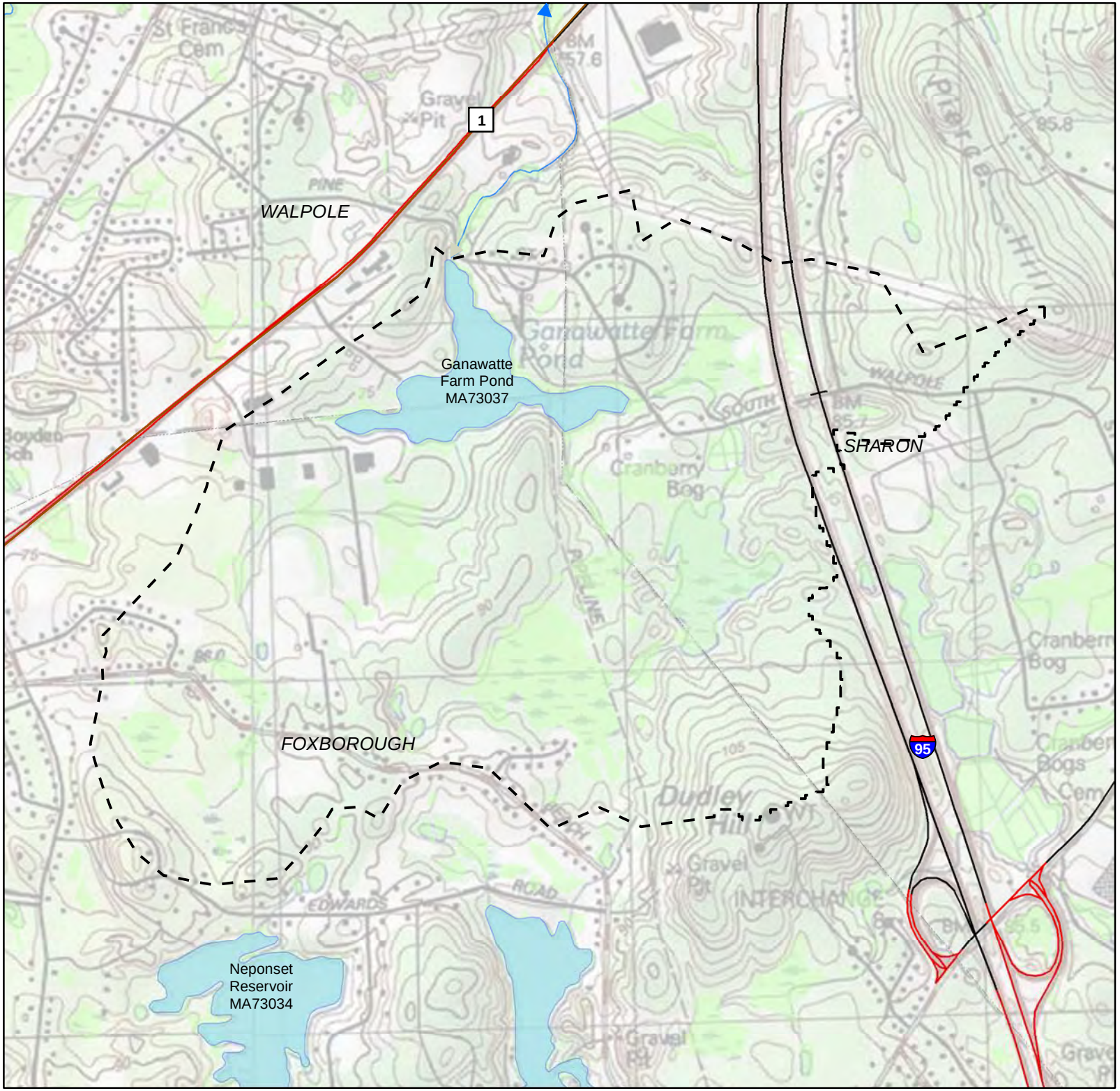
MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2010a). Massachusetts Year 2010 Integrated List of Waters - Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list3.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2010b). Neponset River Watershed 2004 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/dep/water/resources/73wqar10.pdf



Ganawatte Farm Pond (MA73037) Subwatershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
MassDOT Urban Area Roads
MassDOT Roads
Town Boundaries

N

0 625 1,250 2,500

Feet

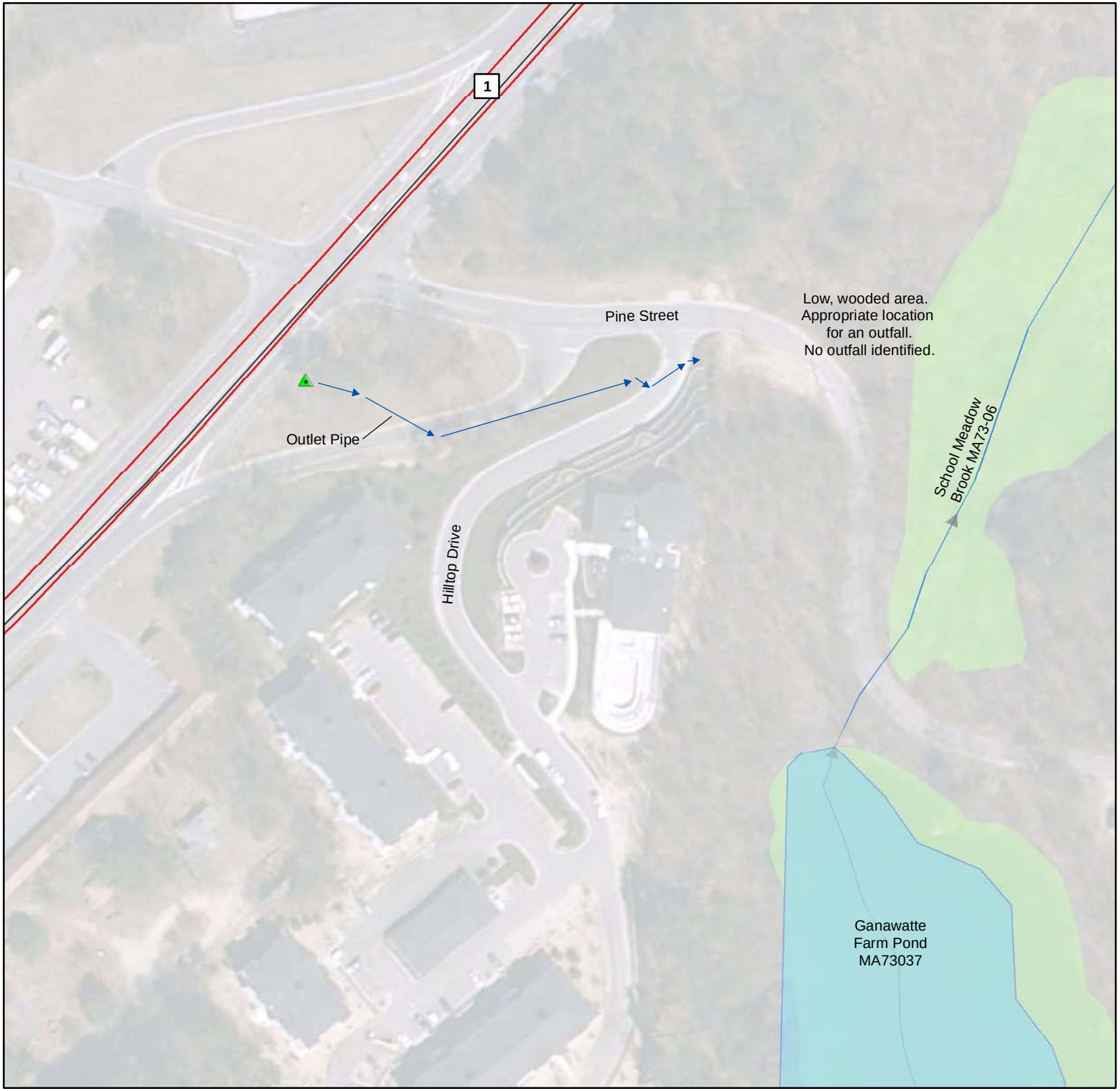
1 in = 1,250 feet

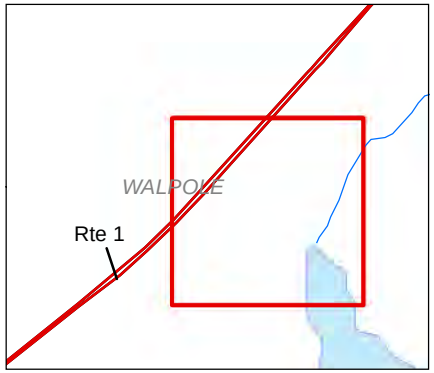
Figure 1

Ganawatte Farm Pond (MA73037) Subwatershed

December 2011

Moving Massachusetts Forward. massDOT





- Outfall
- Direction of Drainage
- Impaired Water Bodies
- NWI Wetland Areas
- Impaired Stream Segments
- Non-Impaired Stream Segments
- MassDOT Urban Area Roads
- MassDOT Roads
- Town Boundaries

N

0 62.5 125 250

Feet

1 in = 125 feet

Figure 2

Drainage near Ganawatte Farm Pond (MA73037)

December 2011

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Impaired Waters Assessment for Fulton Pond (MA62075)

Impaired Waterbody

Name: Fulton Pond

Location: Mansfield, MA

Water Body ID: MA62075

Impairments

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011): Dioxin (including 2,3,7,8-TCDD) and Pentachlorophenol (PCP)

Fulton Pond is listed as a Category 5 water body, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2010 Integrated List of Waters*.

Relevant Water Quality Standards:

- *314 CMR 4.05 (5)(3) Toxic Pollutants.* All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

Site Description

Fulton Pond is approximately 9.3 acres in size and is located east of Copeland Drive near Mansfield Center in the town of Mansfield, Massachusetts. The location of the pond and surrounding MassDOT-owned roads are shown in Figure 1. The contributing watershed consists of commercial, industrial and high density residential areas. Rumford River (MA62-39) flows through Fulton Pond.

The fish consumption use for Fulton Pond is impaired due to elevated levels of dioxin/ pesticide. According to the *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP,

2005) the dioxin/ pesticide contamination is associated with the Hatheway & Patterson Company Superfund site. No other data are available so all other uses are not assessed.

Assessment under BMP 7U for No Discharge Determination

In compliance with the specific steps outlined in BMP 7U (MassDOT, 2011), MassDOT first determined that pesticide impairments could be related to storm water as part of Step 1. Step 2, requires that MassDOT perform a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. Since a desktop review of the Fulton Pond area could not make this determination, MassDOT proceeded to a site survey as indicated in Step 3 of BMP 7U. During a site visit on October 26, 2011, it was confirmed that MassDOT drainage in the vicinity of Fulton Pond is piped via a 24" RCP where it discharges to Rumford River downstream of Fulton Pond. Based on the watershed mapping and field verification, there is no MassDOT property that discharges directly to Fulton Pond (Figure 1).

Conclusions

Further assessment of this water body is not warranted under the Impaired Waters program since MassDOT property does not directly contribute stormwater runoff to Fulton Pond. MassDOT is analyzing Rumford River under a separate impaired assessment. Any BMPs implemented under the Rumford River Impaired Assessment upstream of Fulton Pond will have a positive impact on Fulton Pond.

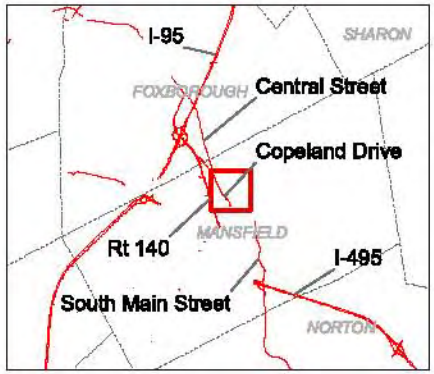
MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2005).Taunton River Watershed 2001 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/dep/water/resources/62wqar3.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2011). Massachusetts Year 2010 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list6.pdf

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).



Stormwater Outfall

Impaired Water Body

Impaired Stream Segment

Non-Impaired Stream Segments

NWI Wetland Area

MassDOT Urban Area Road

Town Boundaries

N

0 250 500 1,000

Feet

1 in = 500 feet

Figure 1

Fulton Pond (MA62075)

November 2011

Moving Massachusetts Forward massDOT

Impaired Waters Assessment for Cabot Pond (MA62029)

Impaired Waterbody

Name: Cabot Pond

Location: Mansfield, MA

Water Body ID: MA62029

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008): Pesticides

Proposed *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010): Pesticides

Cabot Pond is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the proposed *Massachusetts Year 2010 Integrated List of Waters*. MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2005) states that Cabot Pond is impaired due to dioxin/pesticide contamination associated with the Hatheway & Patterson Company Superfund site.

Relevant Water Quality Standards

- Water Body Classification: Class B
- *314 CMR 4.05 (5)(3) Toxic Pollutants.* All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

Site Description

Cabot Pond is approximately 8.7 acres in size and is located between Route 140 and South Main Street in the town of Mansfield, Massachusetts. The location of the pond and surrounding MassDOT owned roads is shown in Figure 1. The contributing watershed consists mostly of residential and forest areas. There is a golf course adjacent to Cabot Pond to the northwest. Rumford River (MA62-39) flows through Cabot Pond.

South Main Street is a MassDOT owned urban area road. Storm water from this roadway discharges west to an unnamed stream and wetland area which flows south to the Rumford River. MassDOT owns Route 140 which is a non-urban roadway from the junction of Route 140 and I-495 north to School Street and is an urban road from School Street north to the junction of Route 140 and I-95. Stormw ater from the urban portion of Route 140 discharges to the shoulders on the east and west side and flows to a non-impaired, unnamed stream before eventually discharging to Cabot Pond. Storm water from the non-urban portion of Route 140 discharges to the east side of the road to a drainage ditch which flows directly to Cabot Pond.

The fish consumption use for Cabot Pond is impaired due to elevated levels of dioxin/ pesticide. According to the *Taunton River Watershed 2001 Water Quality Assessment Report*, the dioxin/ pesticide contamination is associated with the Hatheway & Patterson Company Superfund site. No other data are available so all other uses are not assessed.

Assessment under BMP 7U for No Discharge Determination

In compliance with the specific steps outlined in BMP 7U, MassDOT first determined that pesticide impairments could be related to storm water as part of Step 1. Step 2 requires that MassDOT perform a desktop review of the sub-basin to determine if MassDOT outfalls from urban area roads directly discharge to the receiving water under assessment. Since a desktop review of the Cabot Pond area could not make this determination, MassDOT proceeded to a site survey as indicated in Step 3 of BMP 7U. Based on the watershed mapping and field verification of drainage to Cabot Pond performed on October 28, 2011, there is no MassDOT urban area property that discharges directly to Cabot Pond (Figure 1); storm water from the urban portion of Route 140 discharges to a non-impaired, unnamed stream. A concrete lined drainage ditch discharges stormwater from a non-urban area road, but non-urbanized area roads are not subject to the EPA MS4 general permit and therefore not included in the Retrofit Initiative that this assessments is being conducted under. Therefore, this assessment is considered a “no discharge” under this program and further assessment of this water body is not warranted.

Conclusions

Further assessment of this water body is not warranted under the Impaired Waters program since MassDOT urban property does not directly contribute stormwater runoff to Cabot Pond. MassDOT is analyzing Rumford River under a separate impaired assessment. Any BMPs implemented under the Rumford River Impaired Assessment upstream of Cabot Pond will have a positive impact on Cabot Pond.

MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2005). Taunton River Watershed 2001 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/dep/water/resources/wqassess.htm.

Massachusetts Department of Environmental Protection (MassDEP). (2008). Massachusetts Year 2008 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/08list2.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2010). Massachusetts Year 2010 Integrated List of Waters - Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list3.pdf

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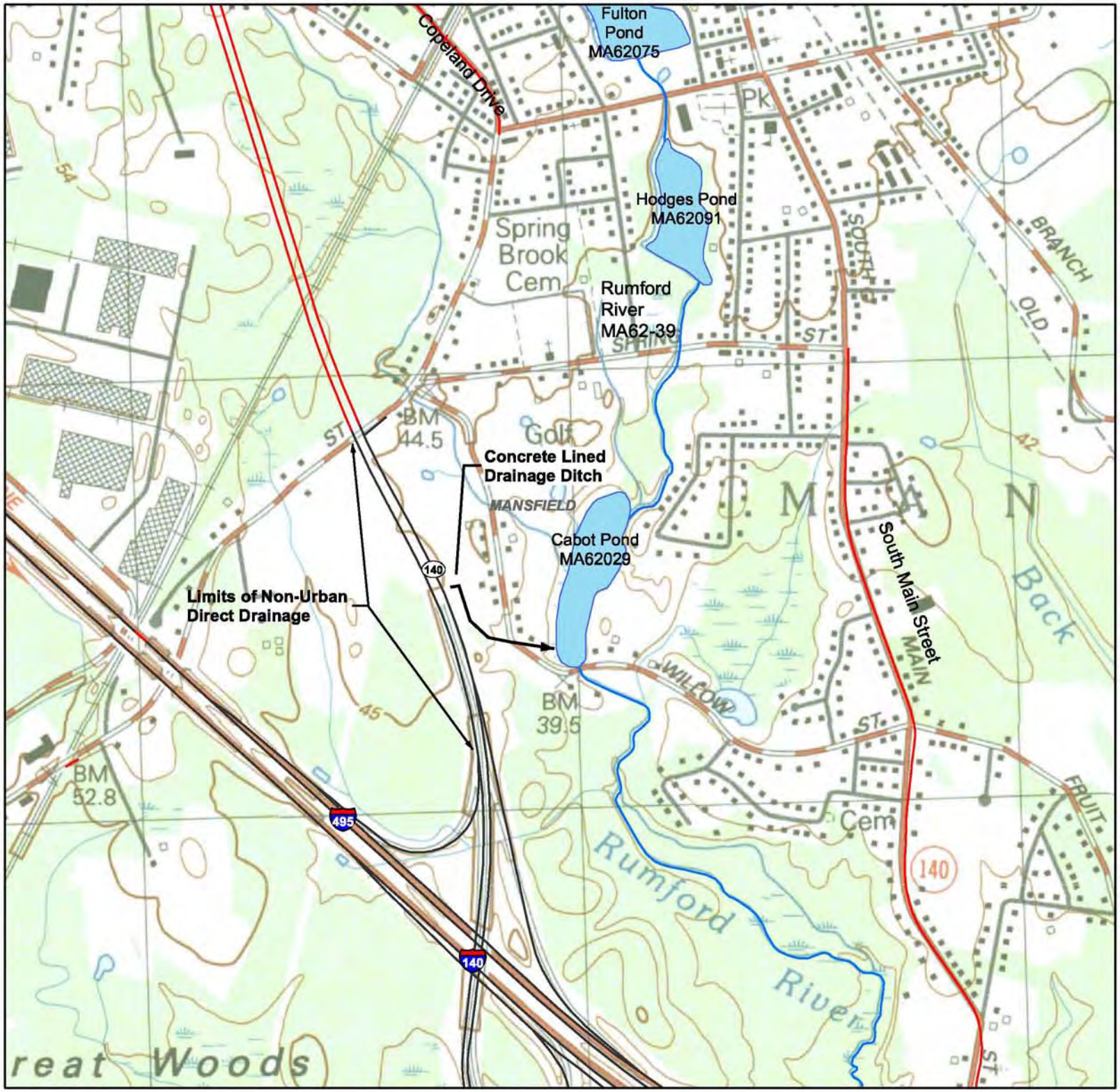
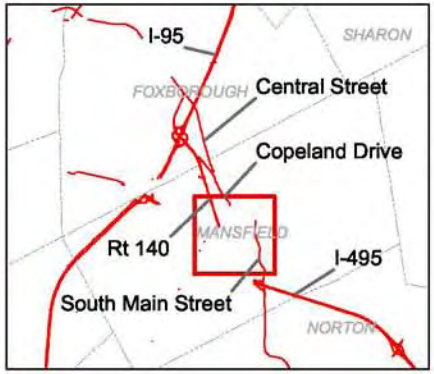




Impaired Water Body

Impaired Stream Segment

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 500 1,000 2,000

Feet

1 in = 1,000 feet

Figure 1

Cabot Pond (MA62029)

December 2011

Moving Massachusetts Forward massDOT

Impaired Waters Assessment for Hodges Pond (MA62091)

Impaired Waterbody

Name: Hodges Pond

Location: Mansfield, MA

Water Body ID: MA62091

Impairments

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011): Dioxin (including 2,3,7,8,-TCDD) and Pentachlorophenol (PCP)

Hodges Pond is listed as a Category 5 water body, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2010 Integrated List of Waters*.

Relevant Water Quality Standards:

- *314 CMR 4.05 (5)(3) Toxic Pollutants.* All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

Site Description

Hodges Pond (also known as Kingman Pond) is approximately 7.0 acres in size and is located between School Street and South Main Street in the town of Mansfield, Massachusetts. The location of the pond and surrounding MassDOT-owned roads is shown in Figure 1. The contributing watershed consists of most residential and forest areas. Rumford River (MA62-39) flows through Hodges Pond, and Fulton Pond (MA62075) is directly upstream of Hodges Pond.

Storm water from Copeland Drive discharges directly to Rumford River upstream of Hodges Pond. Storm water from South Main Street discharges downstream of Hodges Pond.

The fish consumption use for Hodges Pond is impaired due to elevated levels of dioxin/ pesticide. According to the *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2005) the dioxin/ pesticide contamination is associated with the Hatheway & Patterson Company Superfund site. No other data are available so all other uses are not assessed.

Assessment under BMP 7U for No Discharge Determination

In compliance with the specific steps outlined in BMP 7U (MassDOT, 2011), MassDOT first determined that pesticide impairments could be related to storm water as part of Step 1. Step 2 requires that MassDOT perform a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. Since a desktop review of the Hodges Pond area could not make this determination, MassDOT proceeded to a site survey as indicated in Step 3 of BMP 7U. Based on the watershed mapping and field verification performed on October 26, 2011 of drainage to Hodges Pond, there is no MassDOT property that discharges directly to Hodges Pond (Figure 1).

Conclusions

Further assessment of this water body is not warranted under the Impaired Waters program since MassDOT property does not directly contribute stormwater runoff to Hodges Pond. MassDOT is analyzing Rumford River under a separate impaired assessment. Any BMPs implemented under the Rumford River Impaired Assessment upstream of Hodges Pond will have a positive impact on Hodges Pond.

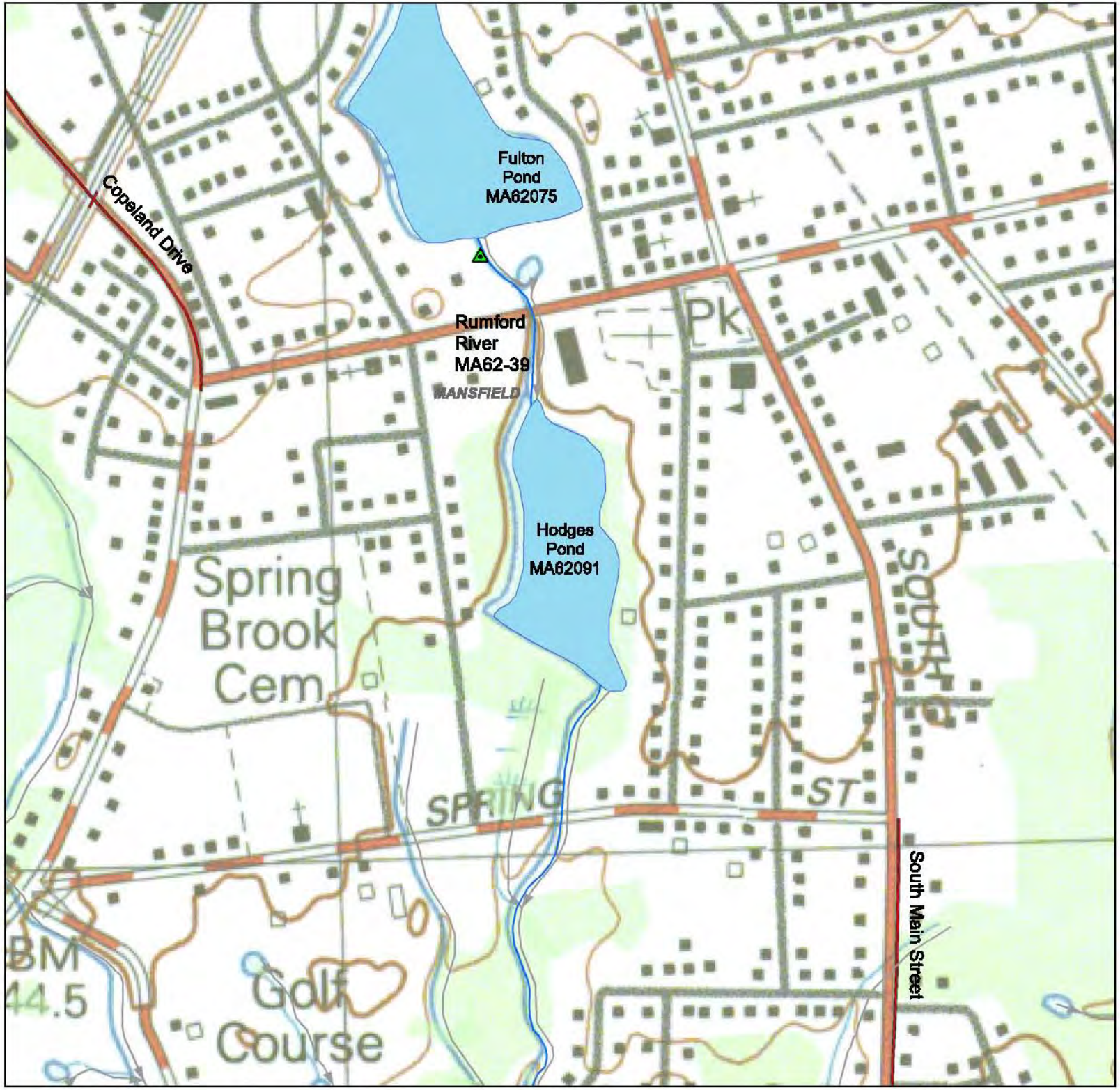
MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

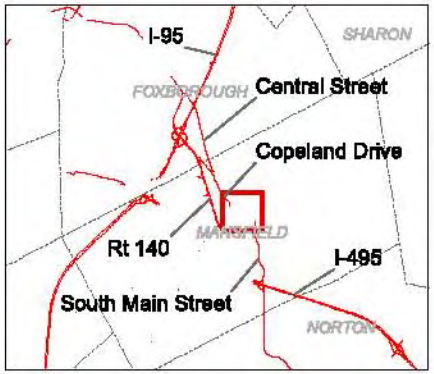
References

Massachusetts Department of Environmental Protection (MassDEP). (2005). Taunton River Watershed 2001 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/dep/water/resources/62wqar3.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2011). Massachusetts Year 2010 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list6.pdf

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).





Stormwater Outfall

Impaired Water Body

Impaired Stream Segment

Non-Impaired Stream Segments

NWI Wetland Area

MassDOT Urban Area Road

Town Boundaries

N

0 250 500 1,000

Feet

1 in = 500 feet

Figure 1

Hodges Pond (MA62091)

November 2011

Moving Massachusetts Forward massDOT

Impaired Waters Assessment for Vandys Pond (MA62112)

Impaired Waterbody

Name: Vandys Pond

Location: Foxborough, MA

Water Body ID: MA62112

Impairments

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011): non-native aquatic plants

Vandys Pond is listed as a Category 4c water body on MassDEP's final *Massachusetts Year 2010 Integrated List of Waters*. As a Category 4c water body, impairments listed are not caused by a pollutant and the water body does not require a TMDL.

Relevant Water Quality Standards:

- *Not Applicable*: Impairment is not caused by a pollutant

Site Description

Vandys Pond (formerly known as Mcavoy Pond) is approximately 8.6 acres in size and is located east of Interstate-95 in the town of Foxborough, Massachusetts. The location of the pond and surrounding MassDOT-owned roads is shown in Figure 1. The contributing watershed consists of primarily forest and residential areas. Rumford River (MA62-39) flows through Vandys Pond.

According to the *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2005), the aquatic life use for Vandys Pond is impaired due to the presence of *Myriophyllum heterophyllum,* a non-native aquatic plant. No other data are available so all other uses are not assessed.

Assessment under BMP 7U for No Discharge Determination

In compliance with BMP 7U (MassDOT, 2011), MassDOT performed a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. MassDOT determined stormwater does not discharge directly to the impaired waterbody during desktop analysis. Stormwater from MassDOT property near Vandys Pond, discharges to the shoulder, and travels more than 3,000 feet through non-impaired wetlands and streams before reaching Vandys Pond (Figure 1). MassDOT determined that no discharge from its roadways impacts Vandys Pond because the streams upstream of Vandys Pond are non-impaired.

Conclusions

Further assessment of this water body is not warranted under the Impaired Waters program since MassDOT property does not directly contribute stormwater runoff to Vandys Pond. MassDOT is analyzing Rumford River under a separate impaired assessment. Any BMPs implemented under the Rumford River Impaired Assessment upstream of Vandys Pond will have a positive impact on Vandys Pond.

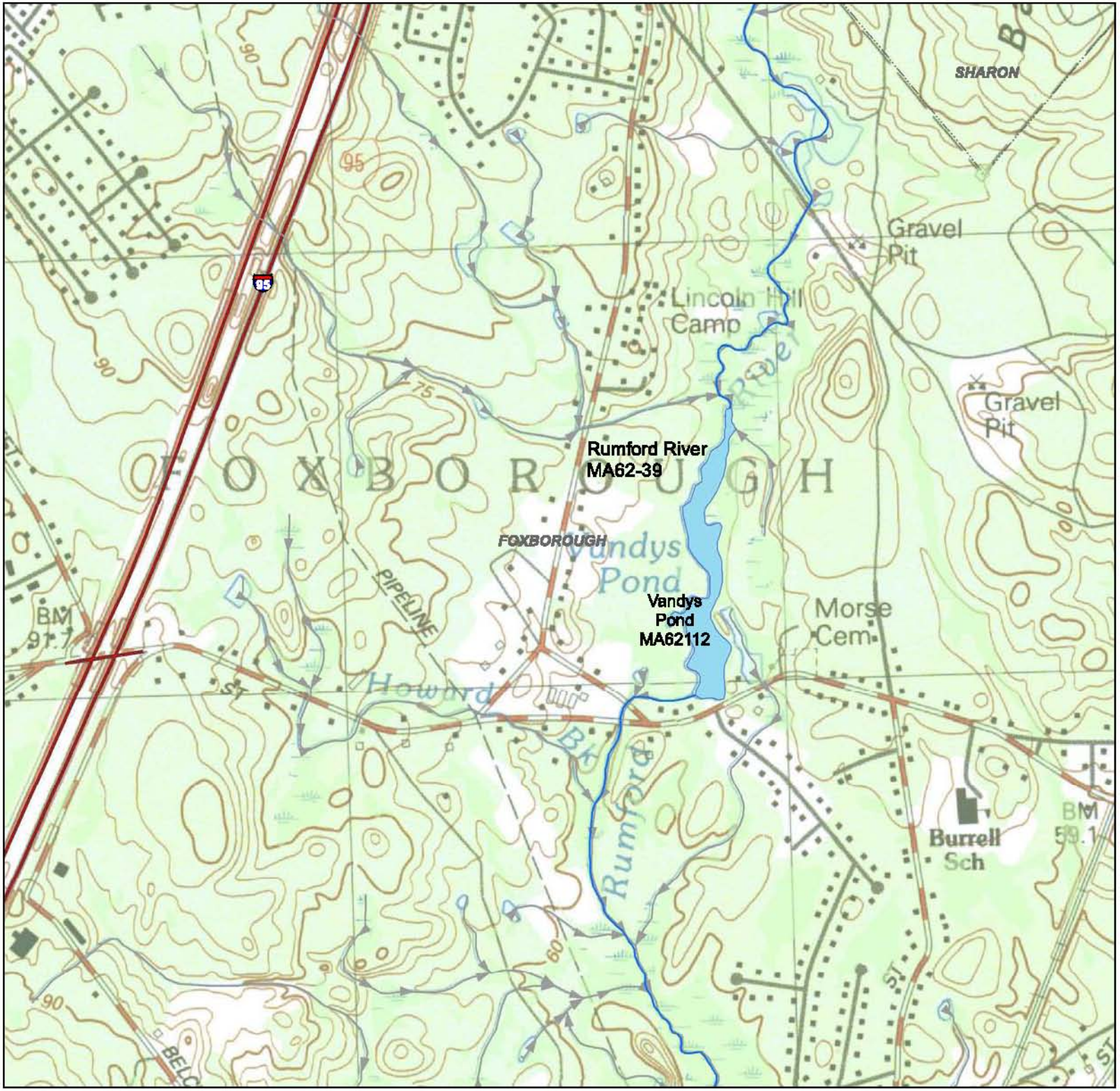
MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

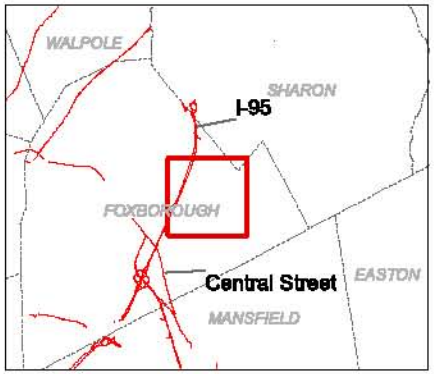
References

Massachusetts Department of Environmental Protection (MassDEP). (2005). Taunton River Watershed 2001 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/dep/water/resources/62wqar3.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2011). Massachusetts Year 2010 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list6.pdf

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).





Impaired Water Body

Impaired Stream Segment

Non-Impaired Stream Segments

NWI Wetland Area

MassDOT Urban Area Road

Town Boundaries

N

0 500 1,000 2,000

Feet

1 in = 1,000 feet

Figure 1

Vandys Pond (MA62112)

November 2011

Moving Massachusetts Forward. massDOT

Impaired Waters Assessment for Gavins Pond (MA62077)

Impaired Waterbody

Name: Gavins Pond

Location: Foxborough/ Sharon, MA

Water Body ID: MA62077

Impairments

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011): non-native aquatic plants

Gavins Pond is listed as a Category 4c water body on MassDEP's final *Massachusetts Year 2010 Integrated List of Waters*. As a Category 4c water body, impairments listed are not caused by a pollutant and the water body does not require a TMDL.

Relevant Water Quality Standards:

- *Not Applicable*: Impairment is not caused by a pollutant

Site Description

Gavins Pond is approximately 17.6 acres in size and is located east of Interstate-95 in the towns of Foxborough and Sharon, Massachusetts. The location of the pond and surrounding MassDOT-owned roads is shown in Figure 1. The contributing watershed consists of primarily forest and residential areas. Rumford River (MA62-39) originates at the south side of Gavins Pond.

According to the *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2005), the aquatic life use for Gavins Pond is impaired due to the presence of the non-native aquatic species *Myriophyllum heterophyllum* and the non-native wetland species *Lythrum salicaria*. No other data are available so all other uses are not assessed.

Assessment under BMP 7U for No Discharge Determination

In compliance with BMP 7U (MassDOT, 2011), MassDOT performed a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. Based on the watershed mapping and field verification performed on November 1, 2011 of drainage to Gavins Pond, there is no MassDOT property that discharges directly to Gavins Pond (Figure 1). The closest outfall discharges to a wetland and flows nearly a mile through an unnamed stream and Billings Brook, both of which are not impaired, before reaching Gavins Pond.

Conclusions

Further assessment of this water body is not warranted under the Impaired Waters program since MassDOT property does not directly contribute stormwater runoff to Gavins Pond.

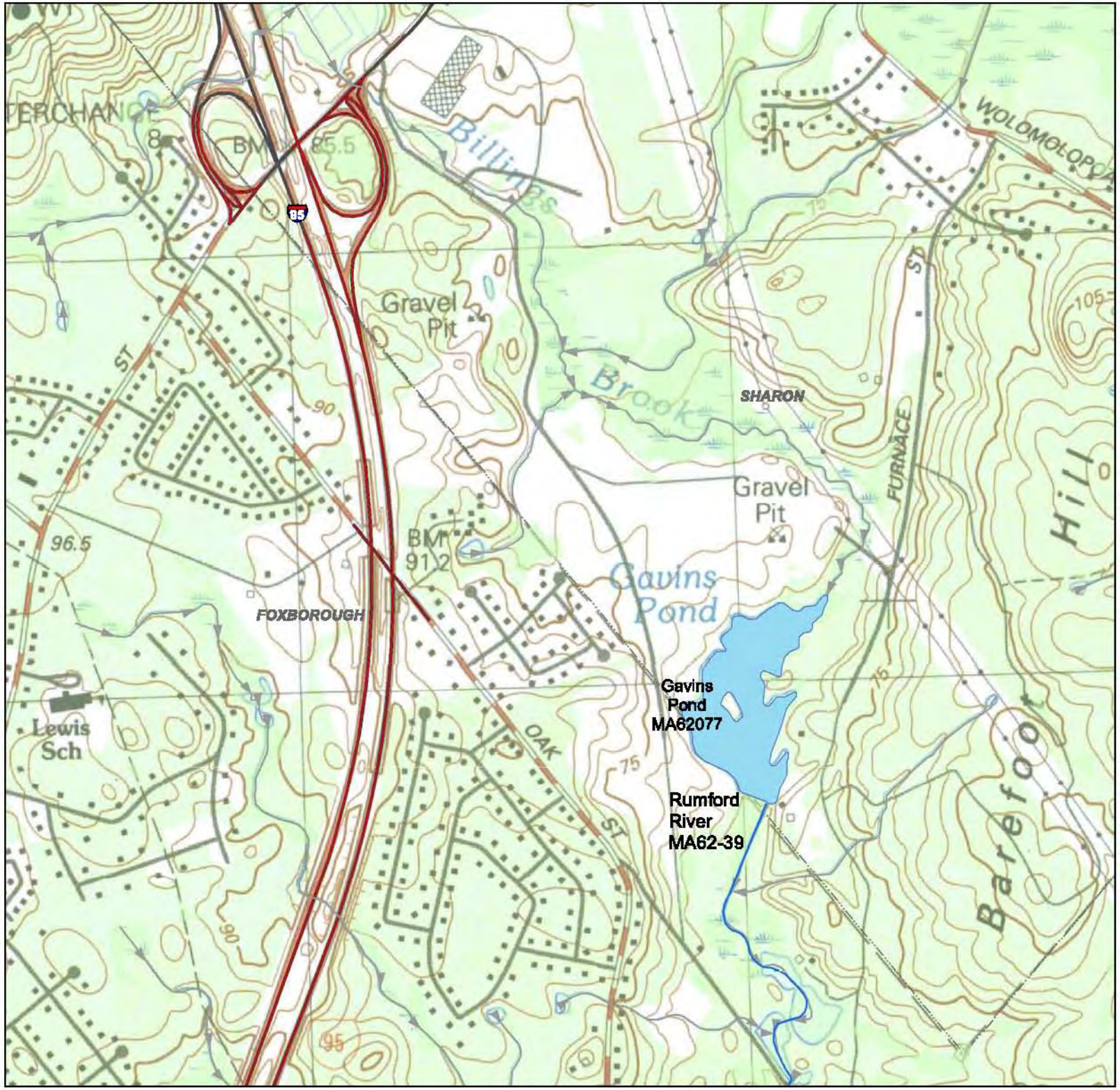
MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

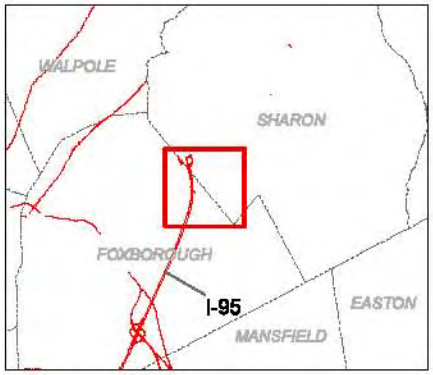
References

Massachusetts Department of Environmental Protection (MassDEP). (2005). Taunton River Watershed 2001 Water Quality Assessment Report., Retrieved from: http://www.mass.gov/dep/water/resources/62wqar3.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2011). Massachusetts Year 2010 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list6.pdf

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).





NWI Wetland Area

Impaired Water Body

Impaired Stream Segment

Non-Impaired Stream Segment

MassDOT Urban Area Road

MA DOT Roads

Town Boundaries

N

0 500 1,000 2,000

Feet

1 in = 1,000 feet

Figure 1

Gavins Pond (MA62077)

November 2011

Moving Massachusetts Forward massDOT

Impaired Waters Assessment for Neponset Reservoir (MA73034)

Impaired Waterbody

Name: Neponset Reservoir

Location: Foxborough, MA

Water Body ID: MA73034

Impairments

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011): non-native aquatic plants, excess algal growth, turbidity

Neponset Reservoir is listed as a Category 5 water body, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2010 Integrated List of Waters*.

Relevant Water Quality Standards:

- Water Body Classification: Class B
- *314 CMR 4.05 (3) (b) 6 Turbidity.* These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- *314 CMR 4.05 (5) (a) Aesthetics.* All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Neponset Reservoir is approximately 311 acres in size and is located west of Interstate-95 in the town of Foxborough, Massachusetts. The location of the pond and surrounding MassDOT-owned roads is shown in Figure 1. The contributing watershed consists of primarily forest and residential areas. Neponset River (MA73-01) originates at the east side of Neponset Reservoir.

MassDOT owns I-95, Route 1, and Route 140 which all have roadway located near the Neponset Reservoir. Storm water from I-95 is part of a different sub basin than the Neponset Reservoir, and therefore, does not flow to Neponset Reservoir. Route 1 to the northwest of Neponset Reservoir is downstream of the reservoir, and therefore, storm water runoff from this roadway does not impact the water body. Storm water from Route 140 discharges to a non-impaired, unnamed stream approximately 500 feet east of North Street. The unnamed stream flows away from the reservoir.

According to *Neponset River Watershed 2004 Water Quality Assessment Report* (MassDEP, 2010), the aquatic life use for Neponset Reservoir is impaired due to the presence of the non-native aquatic species *Cambomba caroliniana.* No other data are available so all other uses are not assessed.

Assessment under BMP 7U for No Discharge Determination

In compliance with the specific steps outlined in BMP 7U (MassDOT, 2011), MassDOT first determined that turbidity and excess algal growth impairments could be related to storm water as part of Step 1. Step 2, requires that MassDOT perform a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. Since a desktop review of the Neponset Reservoir area could not make this determination, MassDOT proceeded to a site survey as indicated in Step 3 of BMP 7U. Based on the watershed mapping and field verification performed on October 28, 2011of drainage to Neponset Reservoir, there is no MassDOT property that discharges directly to Neponset Reservoir (Figure 1).

Conclusions

Further assessment of this water body is not warranted under the Impaired Waters program since MassDOT property does not directly contribute storm water runoff to Neponset Reservoir.

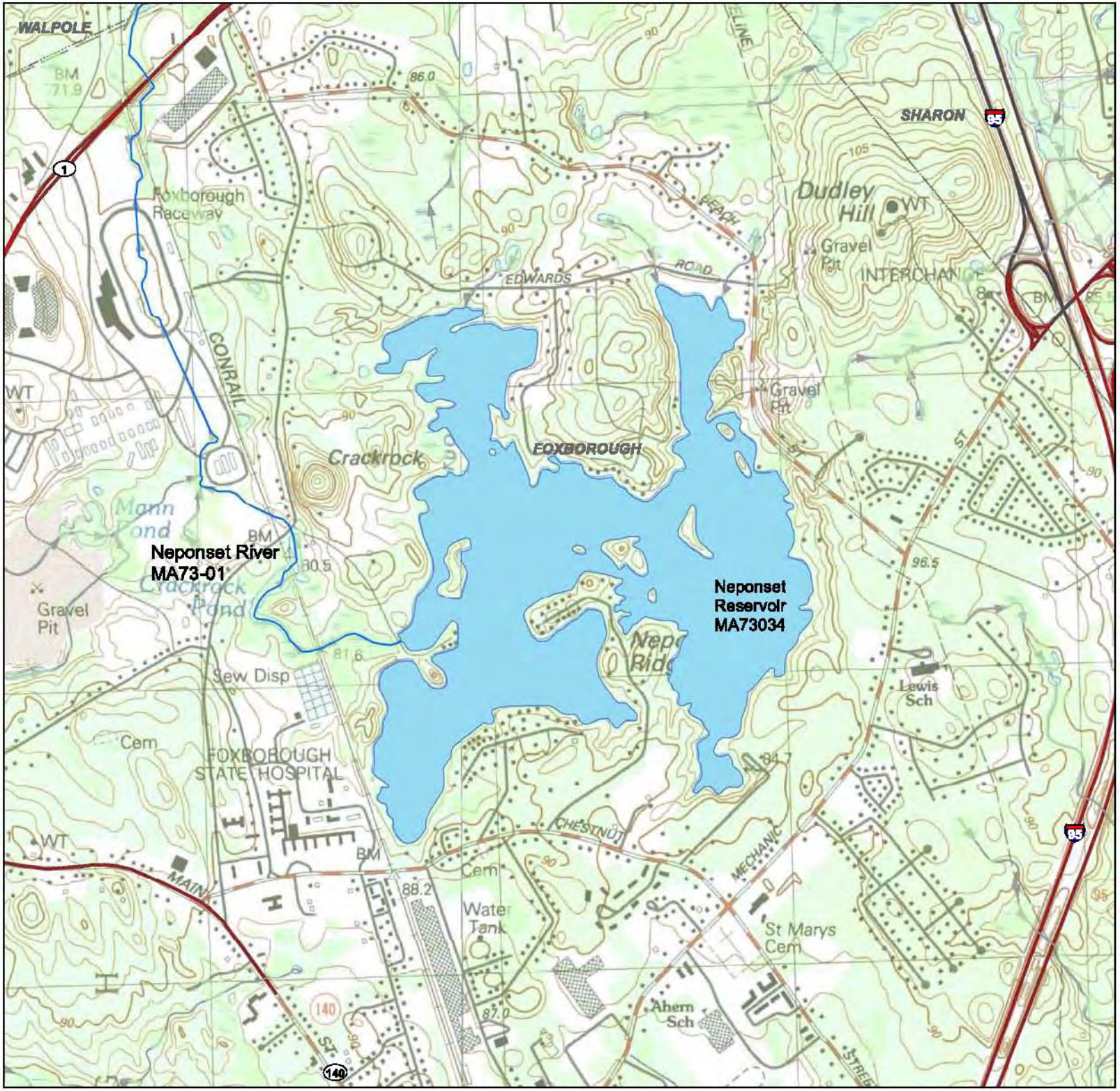
MassDOT will continue to implement the good housekeeping measures outlined in its Stormwater Management Plan (SWMP).

References

Massachusetts Department of Environmental Protection (MassDEP). (2010). Neponset River Watershed 2004 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/dep/water/resources/73wqar10.pdf

Massachusetts Department of Environmental Protection (MassDEP). (2011). Massachusetts Year 2010 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: http://www.mass.gov/dep/water/resources/10list6.pdf

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).



NWI Wetland Area

Impaired Water Body

Impaired Stream Segment

Non-Impaired Stream Segment

MassDOT Urban Area Road

MA DOT Roads

Town Boundaries

N

0 750 1,500 3,000

Feet

1 in = 1,500 feet

Figure 1

Neponset Reservoir (MA73034)

November 2011

Moving Massachusetts Forward massDOT