Massachusetts Department of Transportation
Semi Annual Submittal under MassDOT's Impaired Water Program

Attachment 1: Impaired Waters Assessment, Final Reports

MA72-09 Stop River

MA73-28 Mother Brook

MA73-29 Pine Tree Brook including Popes Pond

MA82B-03 Assabet River

MA82B-05 Assabet River

MA82A-09 Concord River

MA93-18 Gloucester Harbor

MA93024 Floating Bridge Pond

Impaired Waters Assessment for Stop River (MA72-09)

Impaired Waterbody

Name: Stop River

Location: Wrentham and Norfolk, MA

Water Body ID: MA72-09

Impairments

According to the MassDEP Final Year 2012 List of Integrated Waters, Stop River is listed under Category 5 as impaired for dissolved oxygen, ambient bioassays – chronic aquatic toxicity, and total phosphorus.

Stop River is addressed in the Final *TMDL for Nutrients in the Upper/Middle Charles River (CN 272.0),* which addresses the dissolved oxygen and total phosphorus impairments.

The *Charles River Watershed 2002-2006 Water Quality Assessment Report* states that the upper 1.6 miles of the river supports aquatic life, while the lower 4.0 miles of the river is impaired for this use. NPDES discharges are listed among the main causes of the impairments to this segment.

Relevant Water Quality Standards

- Water Body Classification: B

- 301 CMR § 4.05 (3)(b) – *Class B. These waters are designed as 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 (3)(b)(1) – *Dissolved Oxygen. a. 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)(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.*

Summary

MassDOT has assessed stormwater impacts from MassDOT properties discharging to Stop River using BMP 7R to address the Phosphorus TMDL and BMP 7U to address the impairments not covered by a TMDL. The following sections describe the methodology for these assessments. Based on this assessment, MassDOT determined that a 5.8-pound reduction in annual phosphorus loading and an 1.0-acre reduction in effective impervious cover (IC) would be needed to meet the targets for this watershed.

No existing stormwater best management practices (BMPs) are present to reduce annual phosphorus loads for MassDOT directly discharging properties. MassDOT has also concluded that after review of site constraints and other factors, suitable areas do not remain for MassDOT to install stormwater BMPs for runoff draining to Stop River.

See the **Proposed Mitigation Plan** section of this assessment for more information.

Reductions Applied to MassDOT Direct Watershed

	Effective IC (Acres)	Phosphorus Load (Pounds/year)
MassDOT's Area Directly Contributing to Impaired Segment	2.7	7.5
Target Reduction	1.0	5.8
Reduction Provided in Proposed Conditions	0	0

Site Description

The Stop River (Segment MA72-09) is within the Towns of Norfolk and Wrentham, Massachusetts. The headwaters originate in Walpole approximately 775 feet northeast of the Winter Street and Route 1A (Dedham Street) intersection. The watershed of the Stop River is shown on Figure 1.

The Stop River flows northeast, nearly parallel to Route 1A for approximately 6,500 feet, before flowing north and crossing Route 1A. The Stop River flows north and through Highland Lake, to the segment end at the Walpole/Norfolk Town boundary, east of the Norfolk Wastewater Treatment Plant. The river is impaired due to dissolved oxygen, total phosphorus, and ambient bioassays – chronic aquatic toxicity. According to the 2006 Water Quality Assessment Report, the primary land uses of the 10.6 square mile subwatershed are forest (48%), residential (29%), and open land (8%).

MassDOT-owned properties within the subwatershed to Segment MA72-09 include the Main Street Bridge over the MBTA Commuter Rail Line in Norfolk and Route 1A in Norfolk and Wrentham. Route 1A from the Cedar Street intersection in Walpole southwest to the intersection of Geordan Avenue in Wrentham is within the Stop River subwatershed, a total length of approximately 3 miles. The Stop River crosses under Route 1A at two points within the subwatershed. Route 1A is an urban minor arterial, carrying one travel lane in each direction. The roadway is curbed for the majority of the length within the watershed, with curb cuts at uneven intervals allowing stormwater to flow into the adjacent areas. Land uses along Route 1A include undeveloped/forested land, commercial, retail, and residential.

Stormwater from the Main Street Bridge over the MBTA Commuter Rail likely discharges into the railroad bed below and stormwater from the bridge is not considered directly discharging to the Stop River. The Stop River is over 1 mile to the east and stormwater likely flows to an unnamed tributary to Stop River which crosses the railroad tracks between the bridge and Stop River. Stormwater along Route 1A from the Cedar Street intersection to the Walpole/Norfolk town line is discharged through a closed stormwater system and flows through a wooded area north of the Massachusetts Correctional Institute of Walpole facility before reaching a wetland system surrounding Stop River. This section of roadway is not considered directly discharging to the Stop River. Approximately 3,600 feet of Route 1A from the Walpole/Norfolk town boundary southwest towards the Stop River is also considered not directly discharging. In this section, curb cuts in the roadway direct stormwater into the wooded area owned by the Massachusetts Department of Corrections surrounding the roadway. No direct path to the wetlands surrounding Stop River is present.

Approximately 2,800 linear feet of Route 1A discharges stormwater directly to the Stop River at its northern Route 1A crossing. At the river crossing, approximately 1,400 feet of Route 1A discharges stormwater directly to Stop River via a series of curb cuts. Stormwater from an additional 1,400 feet of Route 1A, including the Route 115 (Pine Street/Pond Street) intersection, is collected in catch basins and directed through a closed system to Stop River. At the southern Stop River crossing, stormwater from approximately 1,280 feet of Route 1A discharges directly to the Stop River via a series of curb cuts. Approximately 3,500 feet of Route 1A between the northern and southern Stop River crossings discharge stormwater to unnamed tributaries to the Stop River and are not considered direct discharges. MassDOT directly discharging areas are delineated in Figure 2.

The area surrounding the Stop River is designated as a Zone II Wellhead Protection Area by the Massachusetts Department of Environmental Protection (MassDEP) as it supplies drinking water to the MCI Cedar Junction facility. Numerous sites identified as MassDEP 21E sites (oil and hazardous waste spill sites) are surrounding the northern Stop River crossing of Route 1A. Soils within the directly discharging area are generally B soils, indicating moderate for infiltration rates.

No existing BMPs are present to treat discharges from MassDOT roadways to the Stop River.

Assessment Under BMP 7R for Impairments Addressed by Phosphorus TMDL (CN 272.0)

The Total Maximum Daily Load for Nutrients in the Upper/Middle Charles River, Massachusetts (CN 272.0) addresses the dissolved oxygen and phosphorous impairments for this water body. Therefore, MassDOT assessed the contribution of phosphorus from MassDOT properties to this water body using the approach described in BMP 7R of MassDOT's Stormwater Management Plan (TMDL Watershed Review), which applies to impairments that have been addressed by a TMDL.

Pollutant of Concern: Phosphorus

Impairment Addressed: dissolved oxygen and phosphorous

Applicable Waste Load Allocation: See Table ES-3 of the Nutrient TMDL Final Report.

Description of Associated Land Use: Transportation

Transportation Land Use Current Load (TP): 2,167 kg/yr

Transportation Land Use WLA (TP): 759 kg/yr

Commercial/Industrial/Transportation Area in Watershed: 15.9 sq miles or 5.9% (reported in Phase III Calibration Report Table 5. Transportation not separated from Commercial/Industrial during TMDL analysis)

Commercial/Industrial/Transportation Land Use Areal WLA: 0.72 kg/ha/yr (calculated)

Applicable Recommendations: Section 7.2 Phase III Final Report

Management of Stormwater systems - Page 87 Nutrient TMDL Final Report

"Comprehensive programs will be necessary to achieve the phosphorus reduction and water quality goals of this TMDL. Programs should build upon existing stormwater management accomplish the following tasks:

characterize the drainage areas that contribute to discharges requiring permit coverage under the Permittee's jurisdiction

implement a comprehensive Illicit Discharge Detection and Elimination (IDDE) program

prioritize source areas for stormwater management and control

identify site-specific and regional opportunities for implementation of BMPs

include the necessary structural and non-structural best management practices (BMPs) that, upon implementation, will achieve reductions in phosphorus loadings from the NPDES covered drainage areas that are consistent with the phosphorus load reductions identified in this TMDL)

To complete the BMP 7R Phosphorus Assessment, MassDOT used a site-specific, continuous, long-term hydrologic and pollutant simulation model (the assessment model) to estimate annual median pollutant loads from its property and treatment through both existing and proposed BMPs, if present. The assessment model was run for a 10-year period using hourly Boston rainfall data to capture a range of meteorological conditions and estimate annual median pollutant loads. The

pollutant loading portion of the assessment model was calibrated to match pollutant runoff data from the USGS Highway-Runoff Database (Version 1.0, September 2009). The assessment model directly evaluates BMP effects on hydrology (detention, infiltration) and pollutant loads (losses through infiltration, settling, filtration, and biological treatment). For a more detailed description of this approach, see Long-Term Continuous Simulation for Pollutant Loading and Treatment for MassDOT Impaired Waters Program (MassDOT, June 2012).

The following table summarizes the assessment model results for the MassDOT directly contributing watershed to the Charles River for existing conditions.

Annual Watershed Phosphorus Loading under Existing Conditions

Watershed/ BMP ID	Watershed Size (Acres)	Pre- BMP Annual Load (pounds/year)	Post-BMP Annual Load (pounds/year)	Estimated Annual Removal Efficiency
Total Directly Contributing MassDOT Watershed	2.7	7.5	7.5	0%

The assessment model predicts that the existing annual median phosphorus load from the MassDOT directly contributing watershed is approximately 7.5 pounds. Based on the TMDL, MassDOT's WLA target should be 0.72 kg/ha/yr (0.64 lbs/ac/yr) or 1.7 pounds of phosphorus per year for MassDOT's directly contributing watershed.

BMP 7R Phosphorus Mitigation Plan

Under existing conditions, MassDOT's estimated directly contributing annual phosphorus load exceeds the TMDL WLA. To mitigate this load, MassDOT will implement stormwater BMPs to the maximum extent given the site constraints.

MassDOT was not able to identify practical locations for stormwater management improvements within the current MassDOT right-of-way. The Proposed Mitigation Plan section discusses the site constraints and mitigation plan.

Assessment for Ambient Bioassays – Chronic Aquatic Toxicity Under BMP 7U

The Charles River Phosphorus TMDL does not address all of the impairments for the Stop River, in particular ambient bioassays – chronic aquatic toxicity. 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 not been addressed by a TMDL.

For the stormwater-related impairments for this water body not covered by a TMDL, MassDOT used an application of EPA Region I's Impervious Cover (IC) Method described in EPA's Stormwater TMDL Implementation Support Manual (ENSR 2006). MassDOT used this method to assess potential stormwater impacts on the impaired water and develop the target IC to ensure that stormwater is not the cause of the impairments. The IC Method relates an aquatic system's health (i.e., state of impairment) to the percentage of IC in its contributing watershed. This method is largely based on the work of the Center for Watershed Protection, which has compiled and evaluated extensive data relating watershed IC to the hydrologic, physical, water quality, and biological conditions of aquatic systems (Schueler, 2003). Water quality in tributary streams, rivers,

lakes and ponds is a direct reflection of loading from the watershed (Wetzel, 2001); therefore, the IC method can be used as a surrogate for pollutant loading when evaluating water quality impairments and their causes. Consistent with the findings of EPA and others, MassDOT concluded that when a watershed had less than 9% IC, stormwater was not the likely cause of the impairment.

MassDOT developed the target IC reduction using the approach outlined in *Description of MassDOT's Application of Impervious Cover Method in BMP 7U* (MassDOT, 2011). The MassDOT IC method for the impaired waters of the Charles River basin includes the following steps:

Calculate the percent IC of the water body's entire contributing watershed (total watershed to downstream end of impaired segment) and that of the local watershed contributing directly to the impaired segment (referred to as the subwatershed in this analysis) to determine whether stormwater has a potential to cause the impairments of the receiving water body.

For subwatersheds with greater than 9% IC, calculate the amount of IC reduction needed to achieve 9%. For subwatersheds with less and 9% IC, perform no further analysis under BMP 7U.

Calculate percentage of IC in the MassDOT directly contributing drainage area.

Apply reduction of IC necessary for the subwatershed to achieve 9% to MassDOT contributing drainage area as a target to address the stormwater impairments. Calculate resulting target IC for MassDOT drainage area.

In the case where BMPs are in place or where BMPs are proposed, derive IC reduction rates for the BMPs using MassDOT's assessment model based on size, function, and contributing watersheds of the BMPs. See the Long-Term Continuous Simulation for Pollutant Loading and Treatment for MassDOT Impaired Waters Program.

BMP 7U Assessment

Using the approach described above, MassDOT calculated the following values for the total contributing watershed of the impaired water (Stop River) to determine the IC target. Figure 1 shows the Stop River watershed boundaries. For the Stop River, MassDOT determined that the total watershed (total watershed upstream of the downstream end of the impaired segment) and the subwatershed (local watershed contributing directly to the impaired segment) were the same.

Watershed Impervious Cover

	Total Watershed
Watershed Area	6,874 acres
Impervious Cover (IC) Area	818 acres
Percent Impervious	11%
IC Area at 9% Goal	619 acres
Target Reduction % in IC	24%

The watersheds is greater than 9% impervious which indicates that stormwater is a likely contributor to the impairment. To meet the 9% effective IC target, the effective IC within the watershed will need to be reduced by 24%. Therefore, the effective IC of MassDOT's directly contributing area should also be reduced by the same percentage to meet the target. The following table shows the resulting targets for MassDOT's contributing property.

Reductions Applied to DOT Direct Watershed

MassDOT's Area Directly Contributing to Impaired Segment	2.7 acres
MassDOT's IC Area Directly Contributing to Impaired Segment	2.7 acres
MassDOT's Percent Impervious	100%
MassDOT's Target Reduction in Effective IC (24% of DOT Directly Contributing IC)	1.0 acre
Target Effective IC	76%

MassDOT's directly contributing area includes 2.7 acres of IC. To meet the target reduction of effective IC, MassDOT should mitigate the effect of 1.0 acre of IC. Equivalently, MassDOT's contributing drainage area should act as a watershed of 76% IC.

BMP 7U Mitigation Plan

Under existing conditions, MassDOT's estimated effective IC exceeds the target as described above. To mitigate the effects of IC, MassDOT will implement stormwater BMPs to the maximum extent practicable.

MassDOT was not able to identify practical locations for stormwater management improvements within the current MassDOT right-of-way. The Proposed Mitigation Plan section discusses the site constraints and mitigation plan.

Proposed Mitigation Plan to Address Phosphorus and Impervious Cover

MassDOT is reviewing the Charles River basin as an entire watershed and has committed to constructing stormwater BMP retrofit projects to address impaired waters. During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified BMPs that can be constructed entirely on MassDOT property without resulting in substantial wetland impacts or result in an adverse impact on historical or archeological resources. Projects that meet these requirements can utilize the Federal Highway Administration's Alternative Contracting mechanism (SEP-14) created for this program. MassDOT will advance designs for BMPs where practicable in the watershed above and beyond the target mitigation to compensate for areas like the Stop River, where site constraints prohibit BMPs.

Based on the review of MassDOT's directly contributing drainage area, no BMPs have been identified that can be implemented on MassDOT property to address the impairments of Stop River given the site constraints described below.

Primary site constraints include the limited right-of-way area owned by MassDOT and protected wetland area. Construction of BMPs can only be proposed within MassDOTs right-of-way and due to the limited right-of-way, there are no appropriate or allowable locations to construct BMPs. Wetlands surrounding Stop River also limit the area where BMPs can be proposed, wetlands are restricted lands and construction is prohibited within these areas.

In addition, BMP implementation through MassDOT's programmed projects are carefully evaluated and implemented where practicable, and documented through the MassDOT Water Quality Data Form..

Conclusions

MassDOT has assessed stormwater impacts from MassDOT properties directly discharging to the Stop River using BMP 7R to address the Phosphorus TMDL and BMP 7U to address impairments linked to IC. This assessment found that no existing BMPs treat stormwater discharges from MassDOT properties. Site constraints, including wetlands and limited right of way, dictated that no locations on MassDOT property are applicable for stormwater improvements related to discharges to the Stop River.

Reductions Applied to DOT Direct Watershed

	Effective IC (Acres)	Phosphorus Load (lbs/yr)
MassDOT's Area Directly Contributing to Impaired Segment	2.7	7.5
Target Reduction	1.0	5.8
Reduction Provided in Proposed Conditions	0	0

The above table summarizes the target reductions in effective IC and phosphorus loading. To meet the targets for the Stop River, MassDOT needs to treat stormwater discharges from MassDOT-owned property to reduce effective IC by 1 acre and annual phosphorus loads by 5.8 pounds. No treatment BMPs are being proposed as part of this assessment due to site constraints.

As an overall program, MassDOT will re-evaluate the potential need for structural BMPs to address pollutant loading when roadwork is conducted as programmed projects for the area. Further work by MassDOT 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 address impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs and finalized assessments including reduction achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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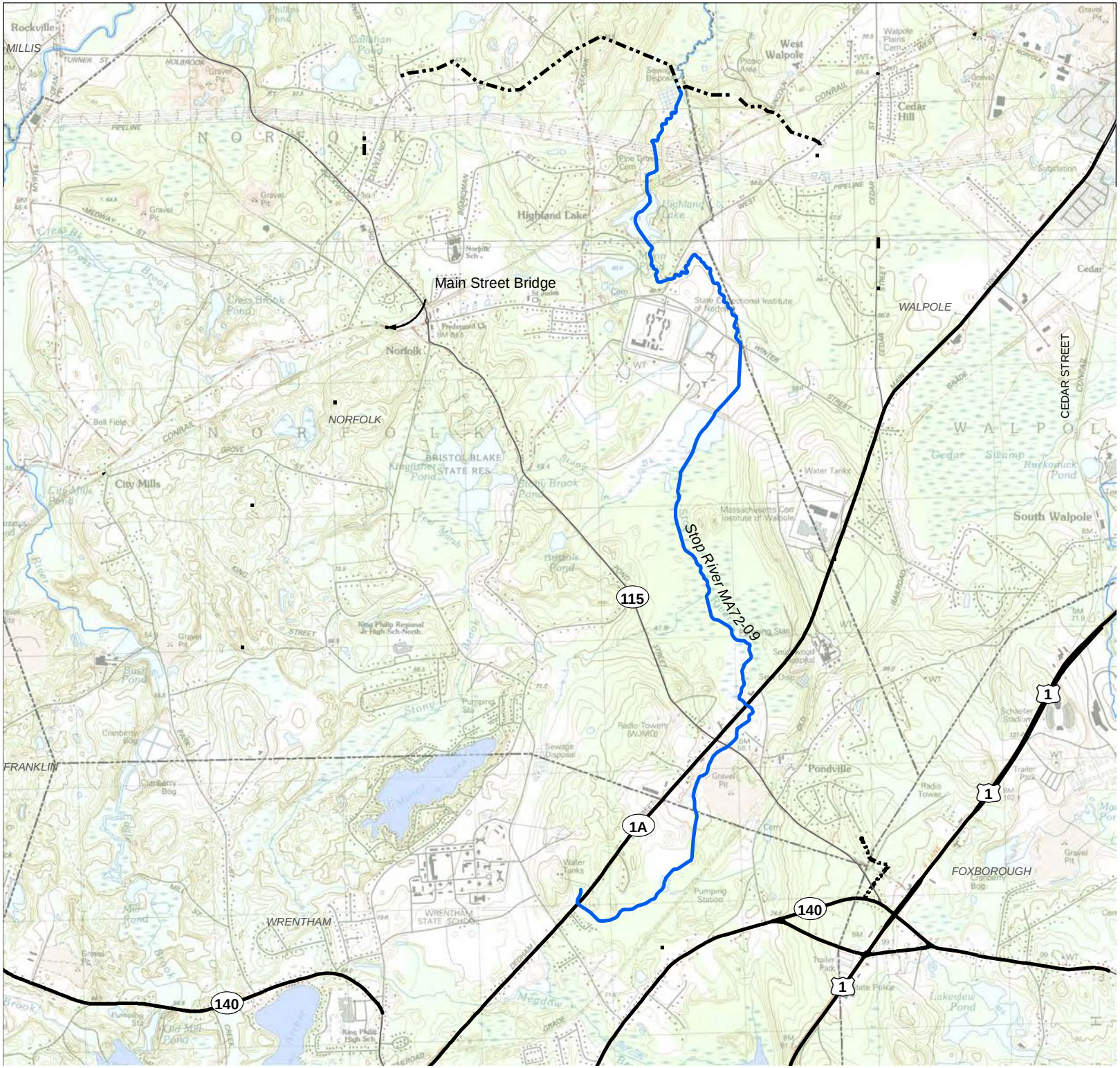

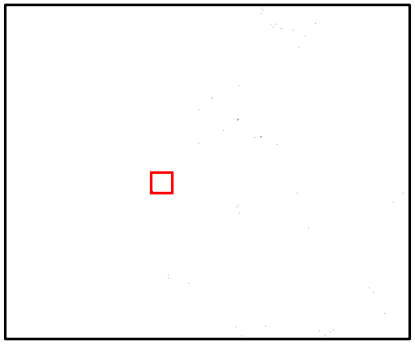

Assessed Segment

MassDOT Roadways

Watershed

Impaired Lakes

Impaired Streams

N

0 0.5 1 Miles

Figure 1

Stop River (MA72-09) Watersheds

June 2013

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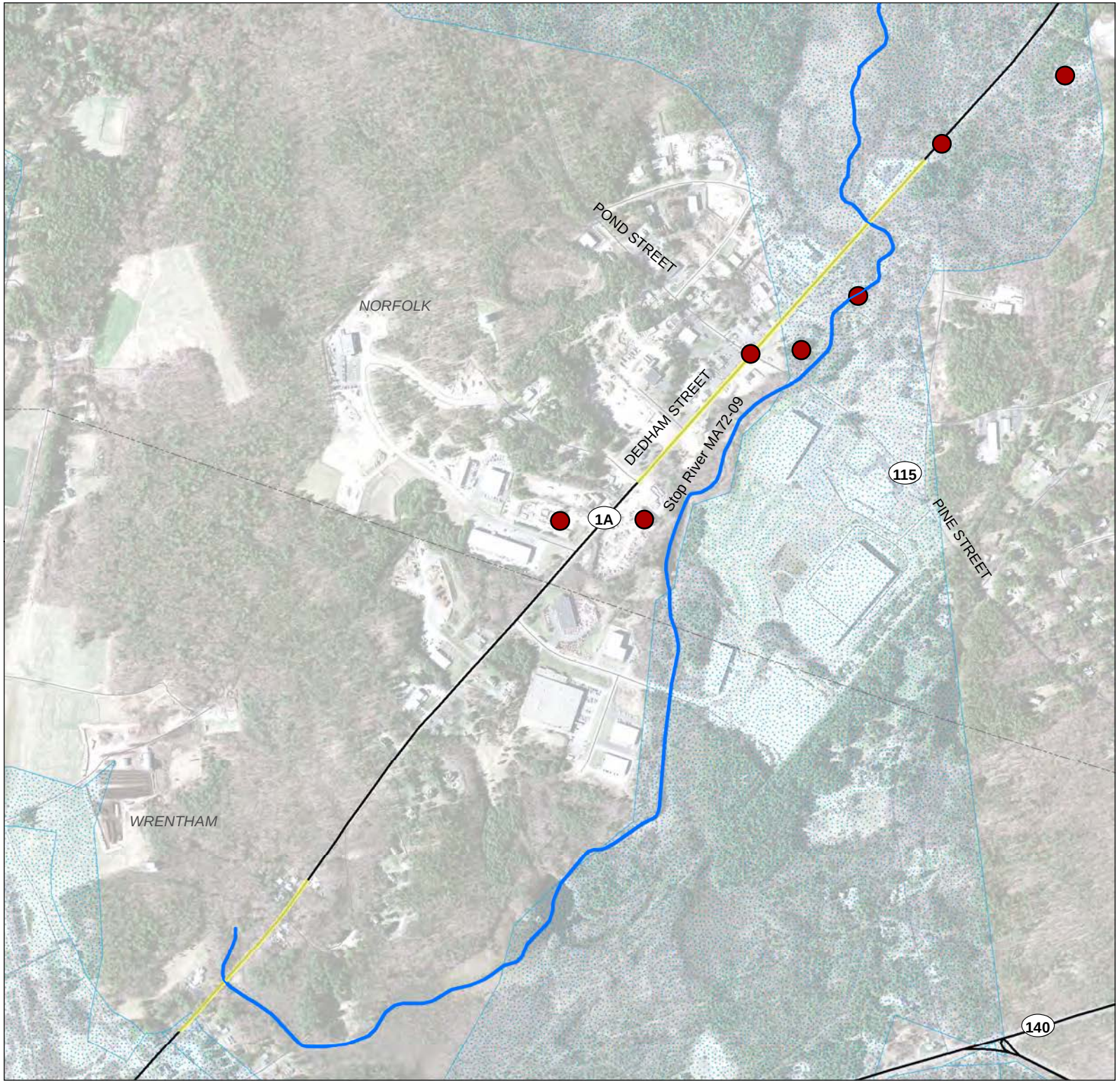

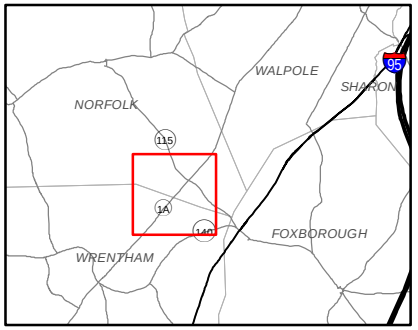

Assessed Segment

MassDOT Roadways

MassDOT Directly Discharging Watershed

ZoneII Wellhead Protection Areas

MassDEP Chapter 21 E Sites

N

0 750 1,500 Feet

Figure 2

Stop River (MA72-09) Directly Contributing MassDOT Watershed

June 2013

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Mother Brook (MA73-28)

Impaired Water Body

Name: Mother Brook

Location: Dedham and Boston, MA

Water Body ID: MA73-28

Impairments

Mother Brook (MA73-28) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP 2013). The causes for Mother Brook impairment are listed as the following:

- phosphorus (total)
- taste and odor
- color
- fecal coliform
- Escherichia coli
- dissolved oxygen
- DDT
- PCB in fish tissue
- mercury in fish tissue
- (low flow alterations*)

Mother Brook (MA73-28) also falls under the jurisdiction of MassDEP's *Bacteria TMDL for Neponset River Basin* (MassDEP, 2002).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- *314 CMR 4.04 (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) 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 (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.
- *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.

Site Description

Mother Brook (MA73-28) flows from its headwaters at the Charles River Diversion in Dedham, Massachusetts to the confluence with the Neponset River in Boston (Figure 1). This river segment is approximately 3.56 miles long and passes through highly urbanized and industrial areas.

A portion of Washington Street in Dedham drains directly to Mother Brook; however, in 2012 MassDOT relinquished ownership of this road to the Town of Dedham. Thus, runoff from Washington Street is no longer considered a direct discharge from MassDOT.

There are two bridges over railroad tracks within the Mother Brook watershed that are owned by MassDOT. One bridge located on Walnut Street drains to the Dedham Municipal Separate Storm Sewer System (MS4). According to the drainage maps provided on the Town of Dedham GIS website, the storm drains that receive runoff from this MassDOT bridge discharge directly into Mother Brook at the High Street Bridge (Figure 2a). The other MassDOT bridge within the Mother Brook watershed has divided drainage between Mother Brook and the Neponset River (Figure 2b). The western portion of the bridge drains along Reservation Road to a catch basin and storm drain that appears to discharge directly to Mother Brook. The eastern portion of the bridge drains to the east where there is a storm drain system that is assumed to discharge into the Neponset River due to the river's close proximity to the roads and drainage system in this area.

Assessment under BMP 7U

Of the impairments listed for Mother Brook, four are potentially linked to stormwater runoff and have not been addressed by a TMDL. Therefore, MassDOT assessed the 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:

- phosphorus (total)
- taste and odor
- color
- dissolved oxygen

MassDOT concluded that the impairment for PCBs is unrelated to storm water runoff. The Nationwide Urban Runoff Program (NURP) conducted by the EPA found that PCB was detected in less than 1% of stormwater samples collected (EPA, 1983). Therefore, MassDOT concluded that stormwater runoff from its roadways does not contribute to the impairments of PCBs.

The *Nationwide Urban Runoff Program* (NURP) conducted by the EPA found that DDT was detected in less than 1% of 121 samples collected and that it "should be considered to pose a minimal threat to the quality of surface waters from runoff contamination" (EPA, 1983). Therefore, MassDOT concluded that storm water runoff from its roadways does not contribute to the impairment of DDT.

The *Northeast Regional Mercury TMDL* indicates that stormwater is a *de minimis* source of mercury contamination. According to the TMDL, the majority of mercury in stormwater comes from atmospheric deposition, and therefore the most effective reductions in mercury loading can be achieved through controls on atmospheric deposition (NEIWPCC, 2007). Accordingly, MassDOT has concluded that stormwater runoff from its roadways is a *de minimis* contributor to the mercury impairment.

According to MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*, the impairment of low flow alterations is not caused by pollutants (MassDEP, 2013). Therefore, this impairment is not considered further.

The impairment caused by fecal coliform and E.coli is assessed separately in the section titled Assessment of Pathogen Impairment.

MassDOT's Application of the Impervious Cover Method

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

Assessment

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 stormwater 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. IC 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 stormwater was a potential cause of the impairment, MassDOT calculated the degree to which IC 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 failing to meet the 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 IC 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 IC 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 IC

reductions is described in BMP 7U. When the reduction in effective IC 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 Mother Brook (MA73-28):

Table 1. Site Parameters for Mother Brook (MA73-28)

Total and Subwatershed		
Watershed Area	1770	acres
Impervious Cover (IC) Area	637	acres
Percent Impervious	35.9**	%
IC Area at 9% Goal	160	acres
Target Reduction % in IC	74.9	%
Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	0.2*	acres
MassDOT's Target Reduction in Effective IC (74.9% of DOT Directly Contributing IC)	0.1*	acres

*Acreage was rounded

**Rounding accounts for differences in calculations.

The subwatershed is greater than 9% impervious cover, indicating that stormwater likely contributes to the impairments assessed under this methodology. In order to reach the 9% target, effective IC within the subwatershed should be reduced by 74.9%. Therefore, MassDOT's target is to reduce effective IC within its own directly contributing watershed by the same percentage, or 0.1 acres.

Existing BMPs

There are no existing BMPs in the Mother Brook (MA73-28) directly contributing watershed that are mitigating potential stormwater quality impacts prior to discharge to Mother Brook.

Mitigation Plan

There are no existing structural BMPs in place to mitigate the effects of MassDOT impervious surfaces that directly discharge to Mother Brook. Therefore, MassDOT considered the implementation of additional BMPs to reach the target reduction of 0.1 acres.

Based on the review of MassDOT's directly contributing drainage area, the installation of structural BMPs to address the impairments of Mother Brook is not feasible for the MassDOT direct drainage areas due to the limited land availability and close proximity of the Town of Dedham and the City of Boston MS4. Drainage from both bridges in the Mother Brook watershed discharge to the MS4s that outfall directly into Mother Brook.

Assessment of Pathogen Impairment under BMP 7U

MassDOT assessed the pathogen 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. Pathogen concentrations in stormwater 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 pathogen concentrations in stormwater 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 stormwater management.

In addition, while there is a positive relationship between IC 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 stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater 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 bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest 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 along 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 stormwater 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 stormwater 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 crosses 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 stormwater 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 stormwater systems and a large number of other factors.

Assessment

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 stormwater 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 stormwater 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 stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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 stormwater 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 contain 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 stormwater 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

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater 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 stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters.

Conclusions

MassDOT used the IC Method to assess Mother Brook (MA73-28) for the impairments identified in MassDEP's final *Massachusetts Year 2010 Integrated List of Waters*. Results indicate that MassDOT should reduce its effective IC within its directly contributing subwatershed by **0.1** acres to achieve the targeted reduction in effective IC. MassDOT evaluated its property within the directly contributing watershed to Mother Brook to identify existing BMPs and found that no BMPs exist to reduce effective IC. This information is summarized in Table 2 below.

Table 2. Effective IC Reductions under Existing & Proposed Conditions

IC in Directly Contributing Watershed	0.2	acres
Target Reduction in Effective IC	0.1	acres
IC Effectively Reduced by Existing BMPs	0	acres
IC Remaining to Mitigate	**0.1**	**acres**

MassDOT should reduce its effective IC within the directly contributing watershed by an additional 0.12 acres to achieve the targeted reduction in IC. However, site limitations in the Mother Brook subwatershed include limited right-of-way and the close proximity of MS4 storm drains that discharge directly into Mother Brook. Therefore, no further action will be taken as part of the Retrofit Initiative of the MassDOT Impaired Waters program for this water body.

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

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative. 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 progress made towards meeting target IC reductions, plans for construction of additional BMPs, and finalized assessments including reductions achieved by finalized BMP designs. MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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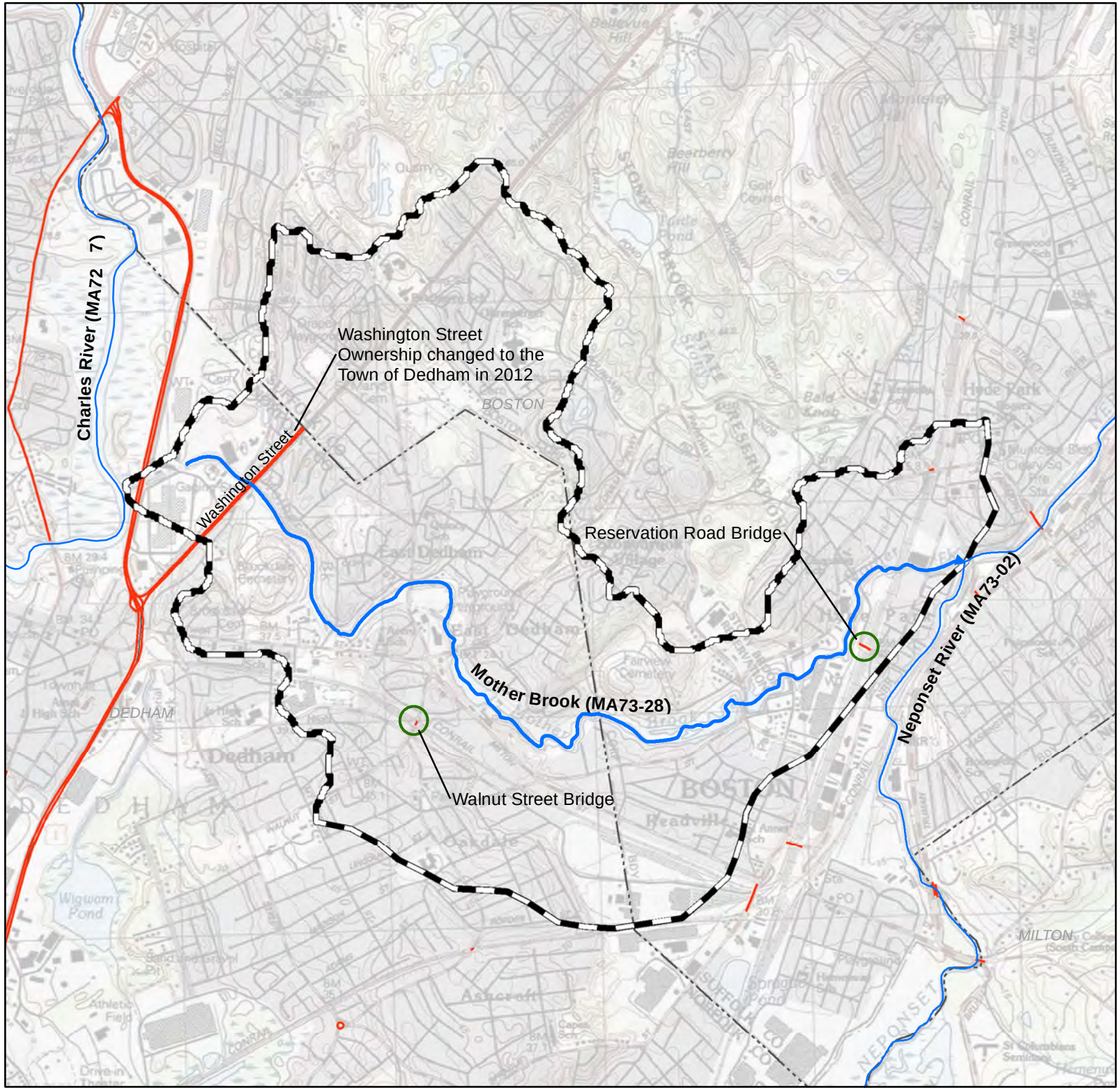

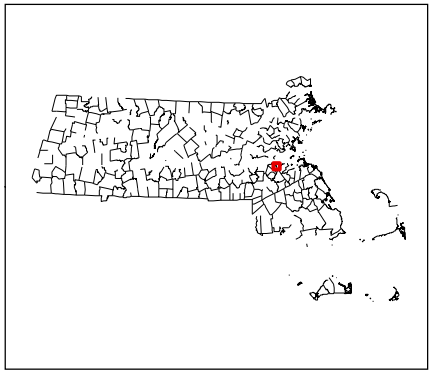

Mother Brook (MA73-28)
Impaired Stream Segment
Impaired Water Body
Total and Subwatershed
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.2 0.4 0.6 0.8 Miles

1 in = 0.4 miles

Figure 1

Mother Brook
Total and Subwatershed
MA73-28

June 2013

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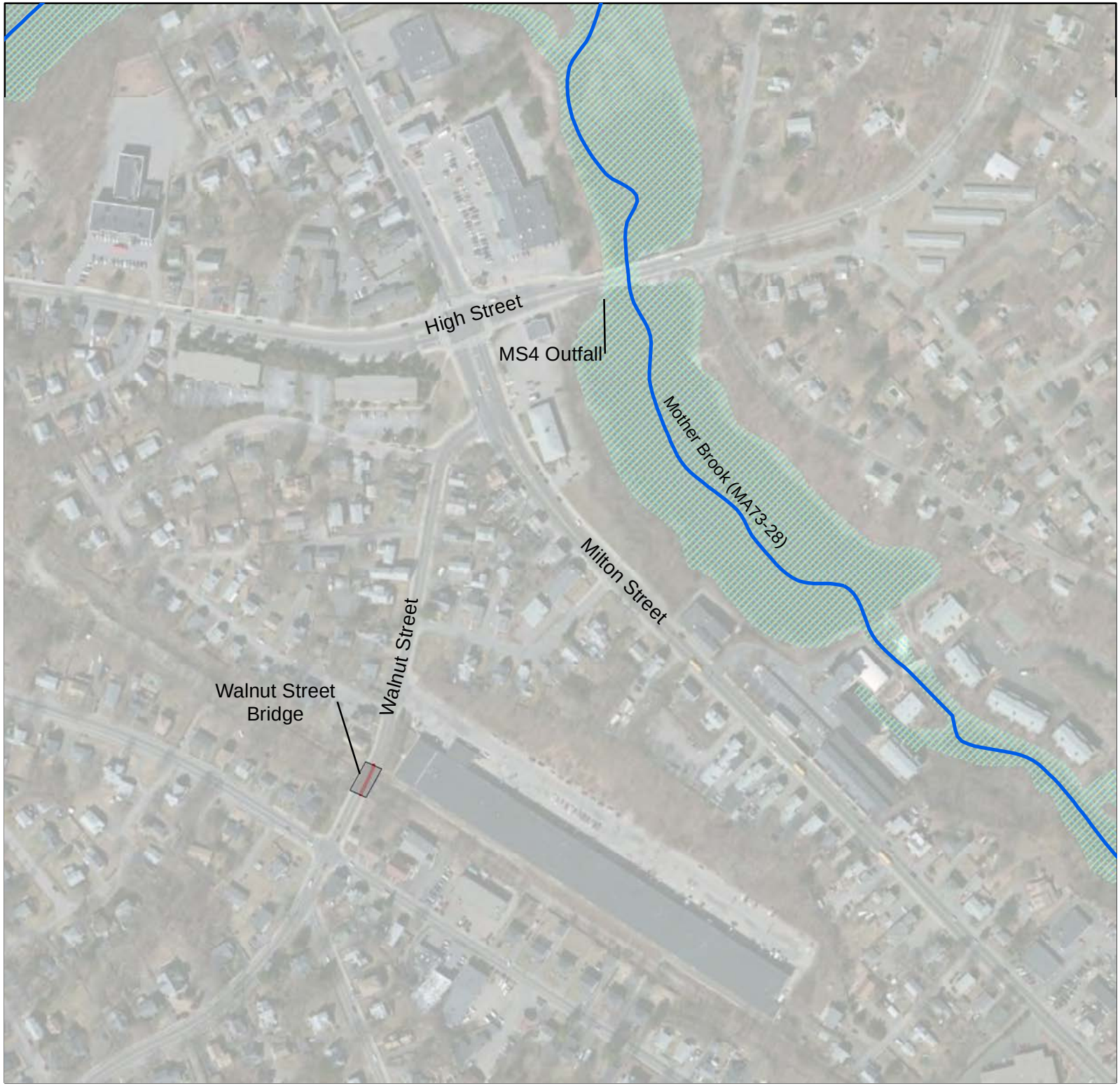

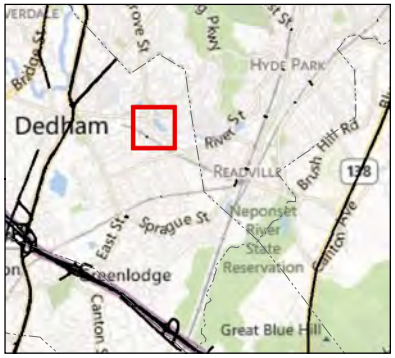

Mother Brook (MA73-28)

Impaired Stream Segment

Mother Brook Watershed

MassDOT Directly Contributing Watershed

NWI Wetland Areas

N

0 150 300 450 600 Feet

1 inch = 300 feet

Figure 2a

Mother Brook
MA73-28
Directly Contributing
MassDOT Watershed

1 of 2

June 2013

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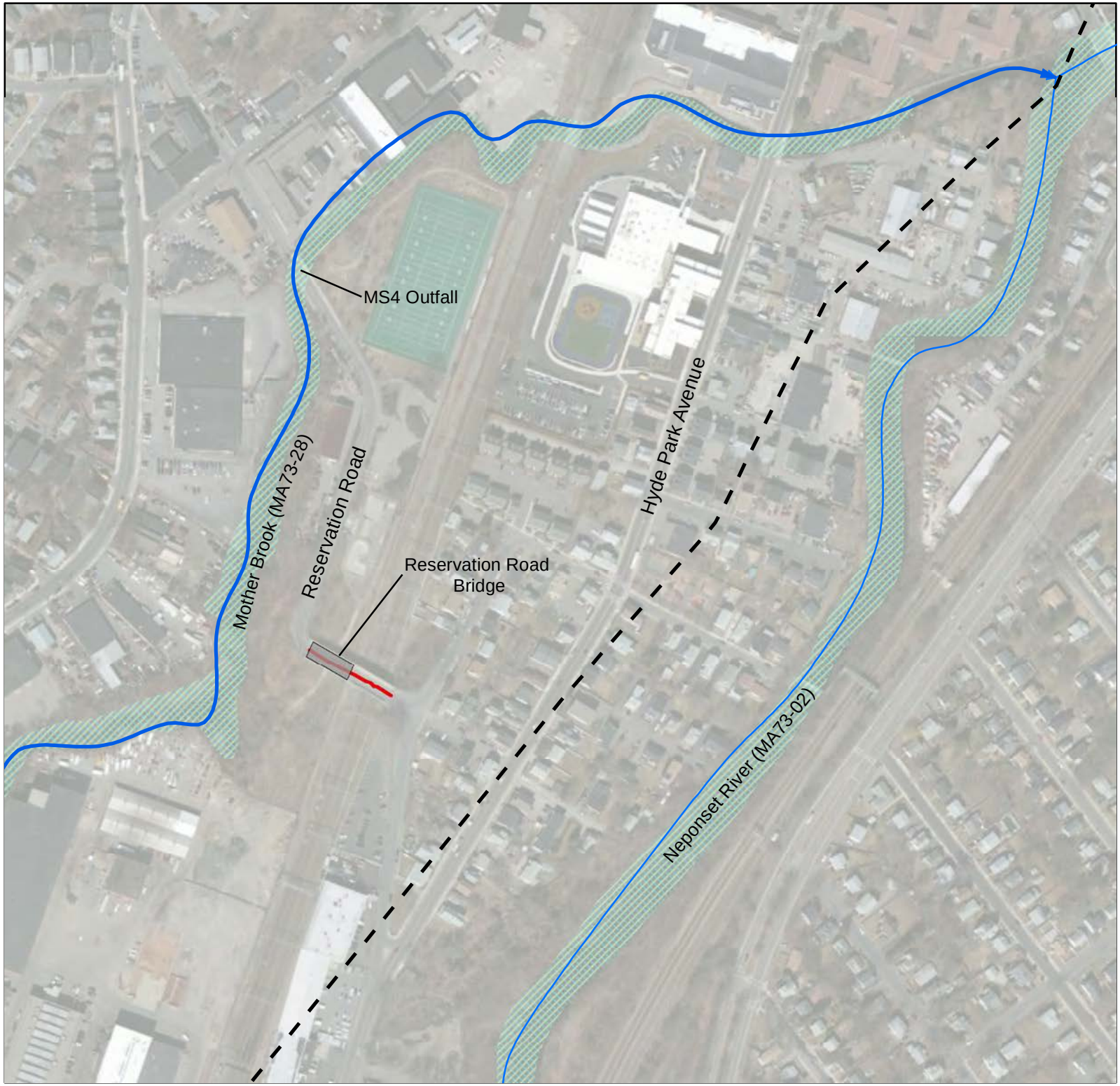
Highway Division



Mother Brook (MA73-28)

Impaired Stream Segment

Mother Brook Watershed

MassDOT Directly Contributing Watershed

NWI Wetland Areas

N

0 150 300 450 600 Feet

1 inch = 300 feet

Figure 2b

Mother Brook
MA73-28
Directly Contributing
MassDOT Watershed

2 of 2

June 2013

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Impaired Waters Assessment for Pine Tree Brook (MA73-29) including Popes Pond (MA73044)

Impaired Water Body

Name: Pine Tree Brook

Location: Milton, MA

Water Body ID: MA73-29

Impairments

Pine Tree Brook (MA73-29) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). The causes for Pine Tree Brook impairment are listed as the following:

- fecal coliform
- Escherichia coli
- dissolved oxygen
- turbidity
- aquatic plants (macrophytes)
- (physical substrate habitat alterations*)

The MassDEP's *Neponset River Watershed 2004 Water Quality Assessment Report* (MassDEP, 2010) identifies aquatic life and primary contact impairments of Pine Tree Brook due to dissolved oxygen and E.coli, respectively. Pine Tree Brook (MA73-29) is included in the *Total Maximum Daily Loads of Bacteria for Neponset River Basin*, CN 121.0 (MassDEP, 2002).

Popes Pond (formerly MA73044) was listed separately in the final *Massachusetts Year 2008 Integrated List of Waters* and the final *Massachusetts Year 2010 Integrated List of Waters;* however, it is included with Pine Tree Brook in the final *Massachusetts Year 2012 Integrated List of Waters*.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen.* a. 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) 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)(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)(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.

Site Description

Pine Tree Brook (MA73-29) flows from the outlet of Hillside Pond at the Milton and Quincy border through Popes Pond (formerly MA73044) to the Neponset River in Milton (Figure 1). Pine Tree Brook is approximately 4.6 miles long and extends from its headwaters in a large area of forested wetlands through moderate and densely developed residential areas to its confluence with the Neponset River at the Boston city line. Popes Pond is located within a conservation area so there is no development along the pond shoreline.

Approximately 1.6 miles of Route 138 and 2.3 miles of Route 28, which are MassDOT roads, pass through the watershed. Based on drainage maps and field verification of drainage areas, 0.65 miles of Route 138 are considered to drain directly to Pine Tree Brook. MassDOT roads that do not drain directly to Pine Tree Brook drain to tributary streams.

Approximately 2.8 acres of Route 138 in Milton between Robbins Street and Blue Hill Terrace drain to Pine Tree Brook downstream from Popes Pond via the Town of Milton municipal separate storm sewer system (MS4) (Figure 2). This portion of Route 138 is a curbed, two-lane road that is highly developed with single residence homes. The Route 138 northbound lane in this area primarily drains down-slope to the east to catch basins on adjacent streets. The Route 138 southbound lane in this area drains via catch basins and a trunk-line storm drain that discharges to the Town of Milton MS4 drain pipe near Victoria Street. According to the Town of Milton storm drain map available on the town website, two storm-drain pipes from this road segment discharge directly into Pine Tree Brook, downstream from Popes Pond (Figure 2). Approximately 760 feet of the Route 138 northbound lane between Robbins Street and Craig Street drains via the Town of Milton MS4 to outfalls that discharge into Trout Brook (Figure 2). Due to the close proximity of these outfalls to Pine Tree Brook, this road segment is also considered a MassDOT area of impervious cover that directly contributes to Pine Tree Brook.

There is an approximately 620 foot segment of Route 138 between Craig Street and Adanac Road that drains east to Town of Milton roads where the municipal separate storm sewer system (MS4) conveys stormwater to an outfall on private property in a wetland that abuts Popes Pond (Figure 2).

Assessment under BMP 7U

None of the following impairments for Pine Tree Brook have been addressed by a TMDL. 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:

- dissolved oxygen
- turbidity
- aquatic plants (macrophytes)

According to the MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*, the impairment of physical substrate habitat alterations is not caused by pollutants (MassDEP, 2013). Therefore, this impairment is not considered further in this assessment.

The impairment for fecal coliform and E.coli is assessed separately in the section titled Assessment of Pathogen Impairment.

MassDOT's Application of the Impervious Cover Method

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

Additional information regarding this method is provided in MassDOT's Application of IC Method document.

Assessment

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 stormwater 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. IC 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 stormwater was a potential cause of the impairment, MassDOT calculated the degree to which IC 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 failing to meet the 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 IC 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 IC 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 IC reductions is described in BMP 7U. When the reduction in effective IC 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 Pine Tree Brook (MA73-29):

Table 1. Site Parameters for Pine Tree Brook (MA73-29)

Total and Subwatershed		
Watershed Area	4900	acres
Impervious Cover (IC) Area	726	acres
Percent Impervious	14.8	%
IC Area at 9% Goal	441	acres
Target Reduction % in IC	39.3	%
Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	3.6	acres
MassDOT's Target Reduction in Effective IC (39.3% of DOT Directly Contributing IC)	1.4	acres

The subwatershed is greater than 9% impervious cover, indicating that stormwater likely contributes to the impairments assessed under this methodology. In order to reach the 9% target, effective IC within the subwatershed should be reduced by 39.3%. Therefore, MassDOT's target is to reduce effective IC within its own directly contributing watershed by the same percentage, or 1.4 acres.

Existing BMPs

There are no existing BMPs in the Pine Tree Brook (MA73-29) directly contributing watershed that are mitigating potential stormwater quality impacts prior to discharge to the Pine Tree Brook.

Mitigation Plan

There are no existing structural BMPs in place to mitigate the effects of MassDOT impervious surfaces that directly discharge to Pine Tree Brook. Therefore, MassDOT considered the implementation of additional BMPs to reach the target reduction of 1.4 acres.

Based on the review of MassDOT's directly contributing drainage area, the installation of structural BMPs to address the impairments of Pine Tree Brook is not feasible for the MassDOT direct drainage areas due to the direct connection between the stormwater drainage from Route 138 to the Town of Milton MS4. Also, there are no locations along the directly contributing section of Route 138 that are suitable for stormwater diversions or treatment. The outfalls from the MS4 in this area appear to be located on private or Town properties, thus end-of-pipe structural BMPs are not considered feasible.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R 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 covered by a final TMDL. Pathogen concentrations in stormwater 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 pathogen concentrations in stormwater 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 stormwater management.

In addition, while there is a positive relationship between IC 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 stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater 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 bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest 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 along 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 stormwater 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 stormwater 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 crosses 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 stormwater 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 stormwater systems and a large number of other factors.

Assessment

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 stormwater 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 stormwater 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 stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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 stormwater 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 contain 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 stormwater 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

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater 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 stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters.

Conclusions

MassDOT used the IC Method to assess Pine Tree Brook (MA73-29) for the impairments identified in MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*. Results indicate that MassDOT should reduce its effective IC within its directly contributing watershed by **1.4** acres to achieve the targeted reduction in effective IC. MassDOT evaluated its property within the directly contributing watershed to Pine Tree Brook to identify existing BMPs and found that no BMPs exist to reduce effective IC. This information is summarized in Table 2 below.

Table 2. Effective IC Reductions under Existing & Proposed Conditions

IC in Directly Contributing Watershed	3.6	acres
Target Reduction in Effective IC	1.4	acres
IC Effectively Reduced by Existing BMPs	0	acres
IC Remaining to Mitigate	**1.4**	**acres**

MassDOT should reduce its effective IC within the directly contributing watershed by an additional 1.4 acres to achieve the targeted reduction in IC. However, site limitations in the Pine Tree Brook watershed include direct connections of Route 138 drainage to the MS4 storm drains that discharge directly into Pine Tree Brook on private or Town properties. Also, there are no suitable locations for stormwater diversions or treatment along the directly contributing section of Route 138. The outfalls from the MS4 near Popes Pond appear to be located on private or Town properties, thus end-of-pipe structural BMPs are not considered feasible. Therefore, no structural BMPs will be implemented for this water body as part of the Retrofit Initiative of the MassDOT Impaired Waters program.

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

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative. 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 progress made towards meeting target IC reductions, plans for construction of additional BMPs, and finalized assessments including reductions achieved by finalized BMP designs. MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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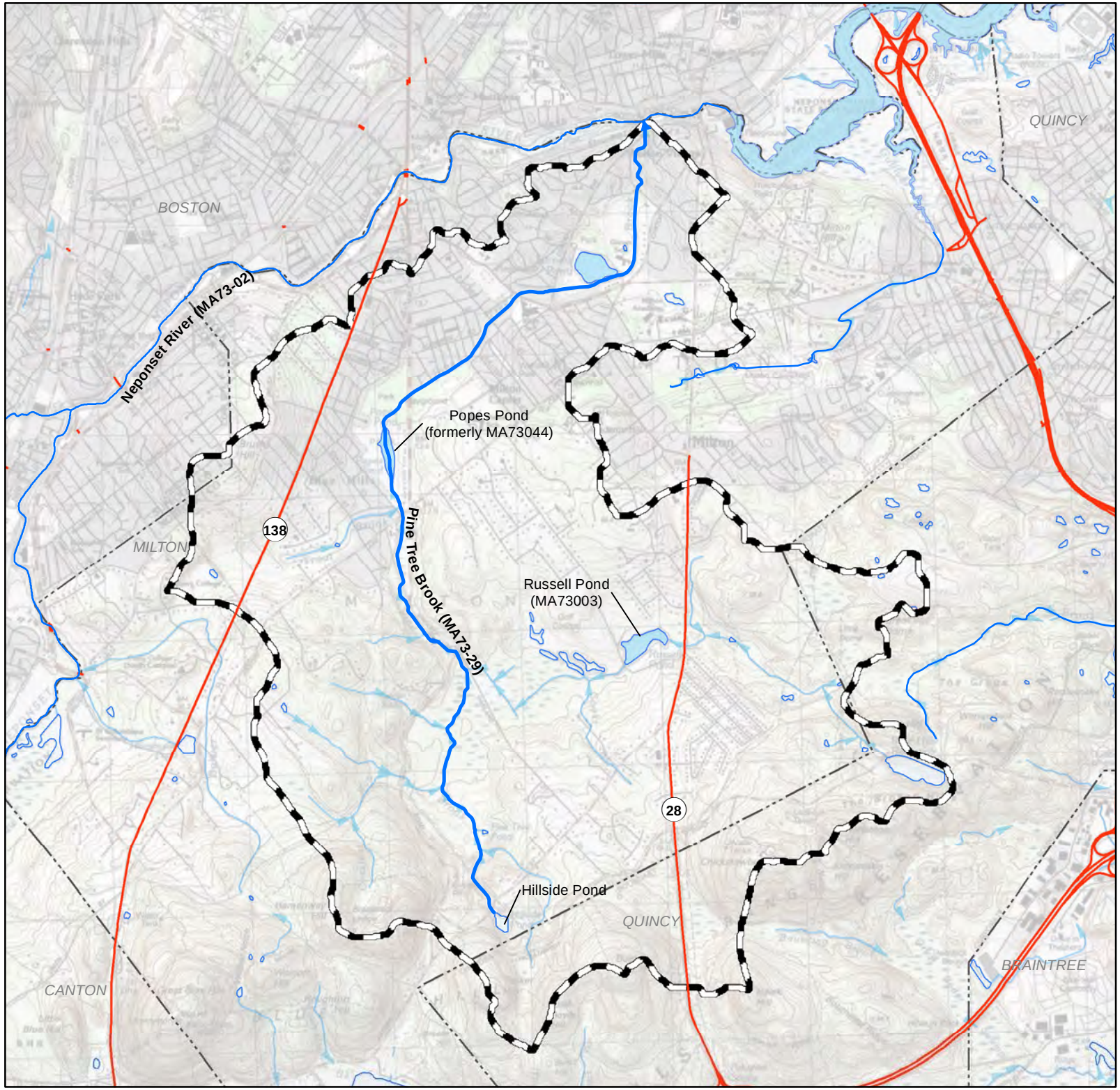

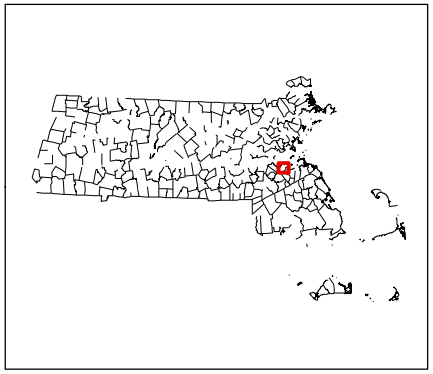

Total and Subwatershed
Pine Tree Brook (MA73-29)
Impaired Stream Segment
Impaired Water Body
Non-Impaired/Non-Assessed Lake
Non-Impaired/Non-Assessed Stream
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.3 0.6 0.9 1.2 Miles

1 in = 0.6 miles

Figure 1

Pine Tree Brook
Total and Subwatershed
MA73-29

June 2013

massDOT
Massachusetts Department of Transportation
Highway Division

MassDOT Outfall

Milton MS4 Outfall

Pine Tree Brook (MA73-29)

Non-Impaired/Non-Assessed Stream

Impaired Water Body

MassDOT Directly Contributing Watershed

Pine Tree Brook Watershed

NWI Wetland Areas

MassDOT Roads in Urban Area

N

0 300 600 900 1,200 Feet

1 inch = 600 feet

Figure 2

Pine Tree Brook MA73-29 Directly Contributing MassDOT Watershed

June 2013

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Assabet River (MA82B-03)

Impaired Water Body

Name: Assabet River

Location: Northborough, MA

Water Body ID: MA82B-03

Impairments

Assabet River (MA82B-03) is listed under Category 5, "Waters Requiring a TMDL" on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). The following impairments for the Assabet River segment (MA82B-03) have not been addressed through the development of a TMDL:

- fecal coliform
- (debris/floatables/trash*)
- (non-native aquatic plants*)
- taste and odor

The *Assabet River TMDL for Total Phosphorus (CN 201.0)* (MassDEP, 2004) was developed to address impairments related to phosphorus within the Assabet River. The following additional impairments for the Assabet River segment (MA82B-03) have been addressed through the development of a TMDL:

- total phosphorus
- excess algal growth

Additionally, MassDEP's *SuAsCo Watershed Year 2001 Water Quality Assessment Report* (MassDEP, 2001) states that known pollution sources include municipal point source discharges; and suspected pollution sources include internal nutrient recycling, discharge from municipal separate storm sewer systems, highway/bridge/road runoff, residential districts, and municipal urbanized high density areas. Assabet River is also covered by a draft Total Maximum Daily Load (TMDL) for pathogens according to MassDEP's Draft Pathogen TMDL for the Concord River Watershed (MassDEP, no date).

Relevant Water Quality Standards

Water Body Classification: Class B, Warm Water Fishery

Applicable State Regulations:

- *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;

- *314 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.
- *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) 4 Bacteria*.

  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 per 100 ml;

  b. 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

The Assabet River Segment (MA82B-03) flows for 2.4 miles from the Route 20 Dam in Northborough to the Marlborough West Wastewater Plant discharge. The segment is classified as impaired according to the *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). The segment watershed is shown in Figure 1 and the subwatershed is shown in Figure 2.

Stomwater runoff from MassDOT property is conveyed to the Assabet River segment through a system of catchbasins and drainage pipes. The MassDOT property directly contributing stormwater runoff to the Assabet River Segment MA82B-03 is illustrated on Figure 3 and includes Route 20 from west of School St. to Stratton Way. The stormwater discharge outfalls to the Assabet River are located directly under the Rte 20 bridge. Field investigations indicated that stormwater runoff from MassDOT property east of Stratton Way drains to wetlands and is therefore considered indirect discharge.

Assessment under BMP 7U

Four of the impairments for Assabet River Segment (MA82B-03) have not been addressed by a TMDL. Therefore, MassDOT assessed the 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 impairment:

- taste and odor.

According to MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*, the impairments for (debris/floatables/trash*) and (non-native aquatic plants*) are not caused by pollutants (MassDEP, 2013). Therefore, these impairments are not considered further.

The impairment for fecal coliform is assessed separately in the section titled Assessment of Pathogen Impairment.

MassDOT's Application of the Impervious Cover Method

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

Assessment

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 stormwater 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. IC 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 stormwater was a potential cause of the impairment, MassDOT calculated the degree to which IC 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 failing to meet the 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 IC 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 IC 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 IC reductions is described in BMP 7U. When the reduction in effective IC 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 Assabet River (MA82B-03):

Table 1. Site Parameters for Assabet River (MA82B-03)

Total Watershed		
Watershed Area	22,600	acres
Impervious Cover (IC) Area	3,140	acres
Percent Impervious	13.9	%
Subwatershed		
Subwatershed Area	849	acres
Impervious Cover (IC) Area	138	acres
Percent Impervious	16.3	%
IC Area at 9% Goal	76	acres
Target Reduction % in IC	44.9	%
Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	2.8	acres
MassDOT's Target Reduction in Effective IC (44.9% of DOT Directly Contributing IC)	1.3	acres

The subwatershed is greater than 9% impervious cover, indicating that stormwater likely contributes to the impairments assessed under this methodology. In order to reach the 9% target, effective IC within the subwatershed should be reduced by 44.9%. Therefore, MassDOT's target is to reduce effective IC within its own directly contributing watershed by the same percentage, or 1.3 acres.

Assessment under BMP 7R

The *Assabet River Total Maximum Daily Load for Total Phosphorus [CN 201.0]* addresses the following impairments for this water body:

- total phosphorus
- excess algal growth

Therefore, MassDOT assessed the contribution of total phosphorus from MassDOT urban areas to this water body using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled *Assabet River Total Maximum Daily Load for Total Phosphorus [CN 201.0]* can be summarized as follows:

- Pollutant of Concern: Total Phosphorus
- Impairments for Assabet River Addressed in TMDL: total phosphorus and , excess algal growth Applicable Waste Load Allocation (WLA):
    - Description of Associated Land Use: Urban. The landuse for this TMDL was based on MassGIS data from 1990 – 1991. For the purposes of this assessment, urban landuse was used to represent roadway.
    - Urban Land Use Current Load (TP): No information provided
    - Urban Land Use Target WLA (TP): 1.0 lbs/day or 365 lb/yr. The TMDL identifies a target of 1.0 lbs/day for watershed non-point sources, specifically runoff combined with groundwater that is not from the natural background of the watershed (page 40 of TMDL). Therefore, the assumption that urban landuse has a TMDL of 1.0 lbs/day is conservative because it not only includes phosphorus sources from runoff but also from groundwater.
    - Urban Area in Watershed: 17,289 acres. The urban area was calculated by combining the urban area (10.5% of watershed) and commercial area (5% of watershed). The total Assabet River watershed area is 111,542 acres (page 3 of the TMDL).
    - Urban Land Use Target Areal WLA (TP): 0.02 lb/acre/yr.

Estimated Loading from MassDOT

The loading of total phosphorus (TP) from MassDOT property directly contributing stormwater runoff to Assabet River 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 stormwater runoff conducted by the United States Geological Survey (USGS) (Smith and Granato, 2010). The study analyzed stormwater 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 Assabet River is 2.84 acres of impervious area and 0.31 acres of pervious area, as shown on Figure 3. The TP loading is 4.72 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 0.02 lb/ac/yr and the total area of MassDOT property within the TMDL watershed directly draining to Assabet River (3.15 acres). The target TP WLA for MassDOT runoff is 0.07 lb/yr.

Assessment

MassDOT calculated its current TP loading rate (4.7 lb/yr) and its target TP WLA (0.07 lb/yr) using values provided in MassDEP's TMDL report. The difference between these two values represents the target reduction in TP that MassDOT will aim to achieve to comply with the WLA. For the watershed directly contributing to Assabet River, this target reduction is 4.7 lb/yr. 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.

There are no existing BMPs in the Assabet River (MA82B-03) directly contributing watershed that are mitigating potential stormwater quality impacts prior to discharge to Assabet River. Thus, there is currently no TP reduction being provided.

Table 2: Loading from MassDOT's Directly Contributing Property Relative to TMDL WLA

Total Area	3.15	ac
Target Areal WLA	0.02	lb/ac/yr
Total Estimated Load	4.7	lb/yr
WLA for MassDOT's Directly Contributing Property	0.07	lb/yr
MassDOT's Required Load Reduction	4.7*	lb/yr

*Rounding accounts for differences in calculation.

Existing BMPs

Based on the site visit, there are no existing BMPs within MassDOT's directly contributing watershed to segment MA82B-03 that are mitigating potential storm water quality impacts. Therefore, no effective IC reduction or phosphorus loading reduction is provided by existing MassDOT BMPs.

Mitigation Plan

Because there are no existing BMPs mitigating impervious surface or reducing total phosphorus loading, MassDOT considered the implementation of BMPs to meet the 1.3 acre target reduction in impervious cover and 4.7 lb/yr in total phosphorus loading.

Based on the review of MassDOT's directly contributing drainage area, no BMPs have been identified that can be implemented on MassDOT property to address the impairments of the Assabet River (MA82B-03) due to site constraints and limited area within the right of way. The right of way consists primarily of roadway, shoulder, and sidewalk. Also, the drainage pipes discharge directly below the Route 20 bridge and no room is available at the pipe outlet. Therefore, there is no land available to implement stormwater infiltration BMPs to mitigate the effect of stormwater runoff.

Assessment of Pathogen Impairment under BMP 7U

MassDOT assessed the pathogen 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. Pathogen concentrations in stormwater 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 pathogen concentrations in stormwater 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 stormwater management.

In addition, while there is a positive relationship between IC 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 stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater 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 bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest 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 along 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 stormwater 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 stormwater 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 crosses 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 stormwater 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 stormwater systems and a large number of other factors.

Assessment

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 stormwater 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 stormwater 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 stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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 stormwater 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 contain 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 stormwater 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.

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater 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 stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters.

Conclusions

MassDOT used both the IC Method and the TMDL Method to assess Assabet River (MA82B-03) for the impairments identified in MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*. To meet target reductions in impervious cover to meet the 9% goal MassDOT should reduce impervious cover within the urban area directly contributing watershed to Assabet River by 1.3 acres. To meet guidelines set forth in the TMDL for total phosphorus MassDOT should reduce its TP loading within the urban area directly contributing watershed by 4.65 lb/yr to achieve the targeted reduction. MassDOT evaluated its property within the directly contributing watershed to the Assabet River to identify existing BMPs and found that no BMPs exist to reduce effective IC and total phosphorus loading.

MassDOT should reduce impervious cover and TP loading to the Assabet River to meet target impervious cover reduction and guidelines set forth in the TMDL; however, the site constraints and limited right-of-way area indicate that the construction of stormwater infiltration BMPs along the directly contributing MassDOT roadways is infeasible. Therefore, no further action will be taken as part of the Retrofit Initiative of the MassDOT Impaired Waters program.

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

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative. 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 progress made towards meeting target IC reductions, plans for construction of additional BMPs, and finalized assessments including reductions achieved by finalized BMP designs. MassDOT will also continue to implement non-structural BMPs that reduce the impacts of stormwater.

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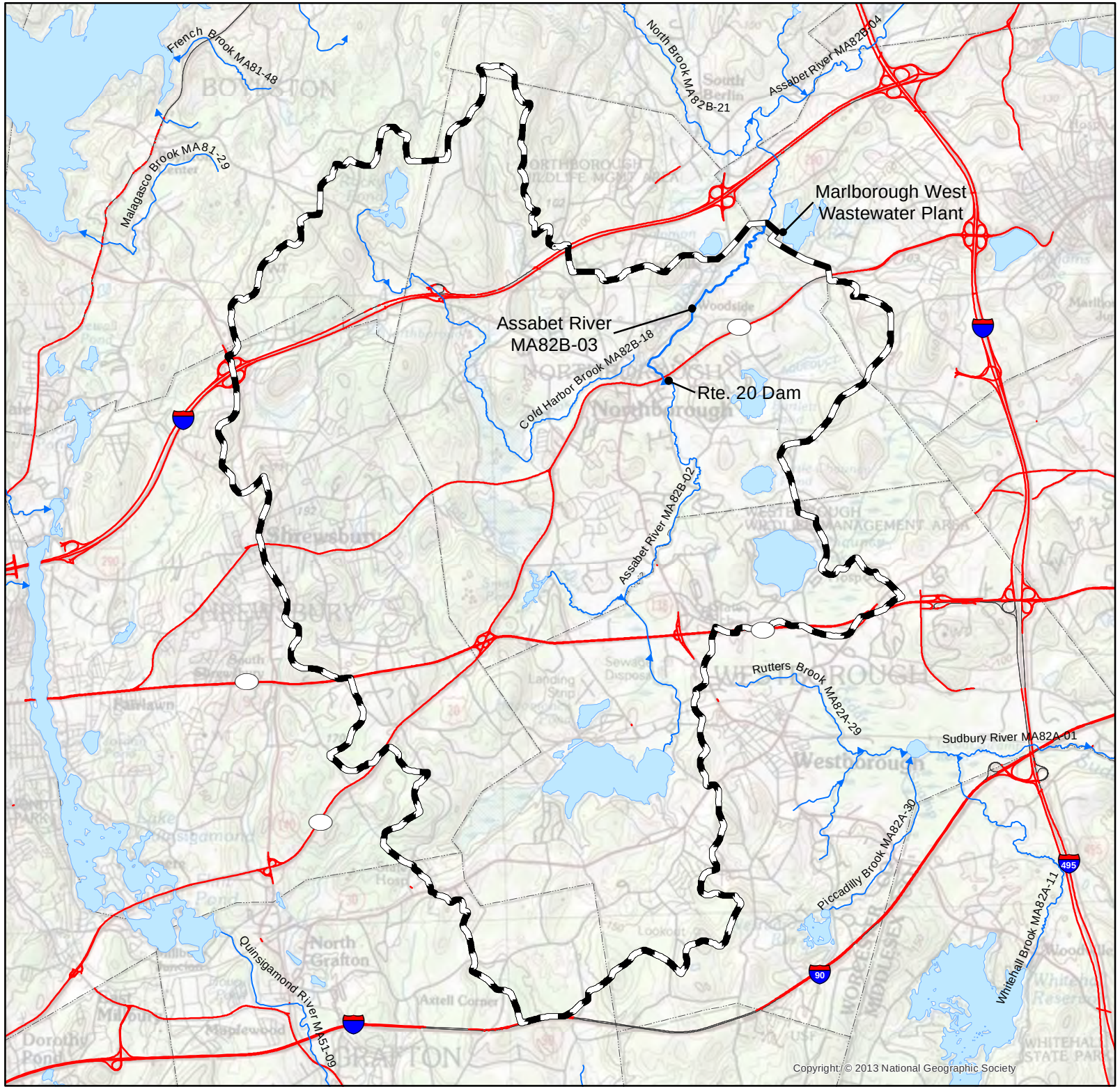
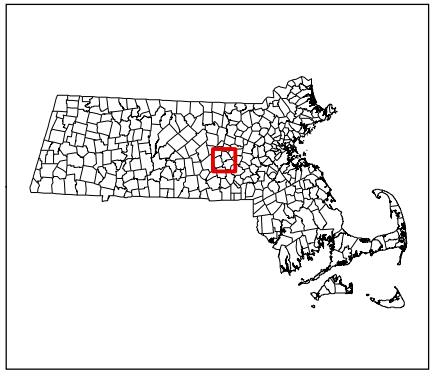




Total Watershed

Assabet River

Impaired Stream Segment

Impaired Water Bodies

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 3,500 7,000 Feet

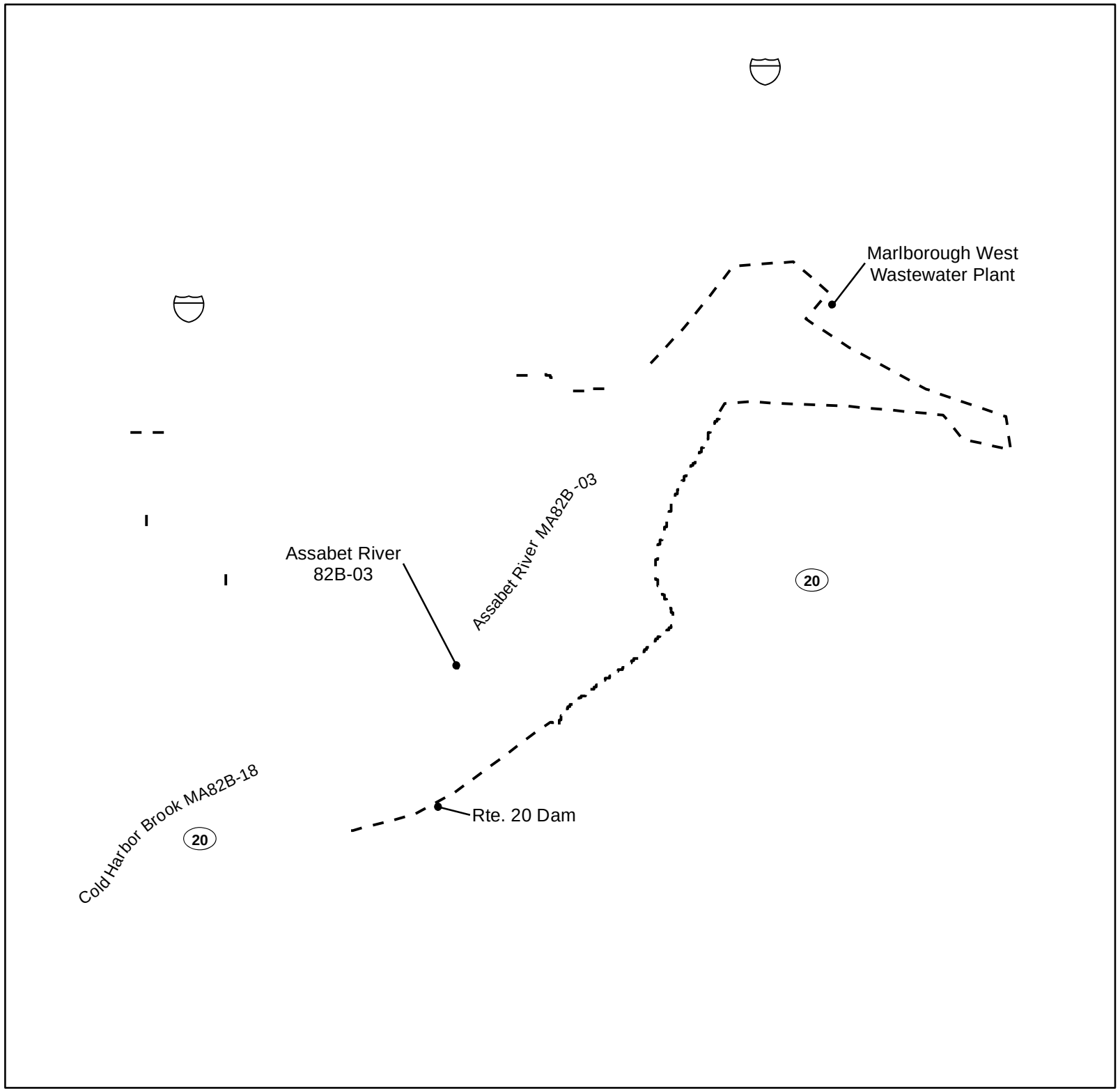
1 in = 7,000 feet

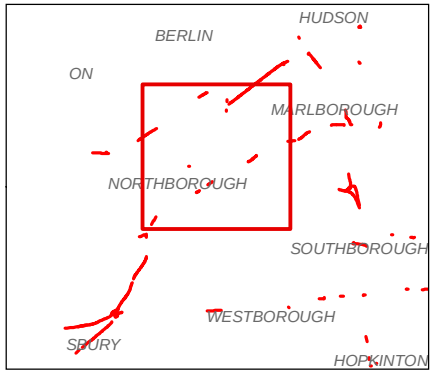
Figure 1

Assabet River Total Watershed MA82B-03

June 2013

massDOT
Massachusetts Department of Transportation
Highway Division





Subwatershed
Total Watershed
Assabet River
Impaired Stream Segment
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 1,000 2,000 Feet

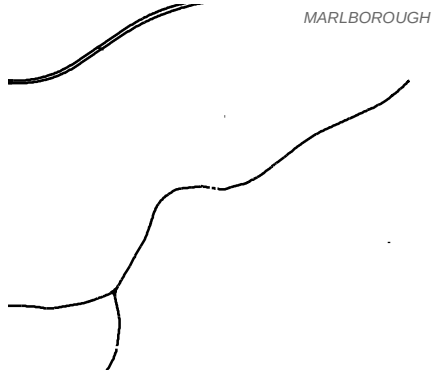
1 in = 2,000 feet

Figure 2

Assabet River Subwatershed MA82B-03

June 2013

massDOT
Massachusetts Department of Transportation
Highway Division



DOT Direct Pervious Watershed

DOT Direct IC Watershed

Stormwater Outfalls

Assabet River

Impaired Stream Segment

Impaired Water Bodies

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 100 200 300 Feet

1 inch = 300 feet

Figure 3

Assabet River (MA82B-03) MassDOT Directly Contributing Watershed

June 2013

Moving Massachusetts Forward. massDOT

Impaired Waters Assessment for Assabet River (MA82B-05)

Impaired Water Body

Name: Assabet River

Location: Maynard, Stow and Hudson, MA

Water Body ID: MA82B-05

Impairments

Assabet River segment (MA82B-05) is listed under Category 5, "Waters Requiring a TMDL" on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). The following impairments for the Assabet River segment (MA82B-05) have not been addressed through the development of a TMDL:

- (debris/floatables/trash*)
- (non-native aquatic plants*)
- fecal coliform
- taste and odor

The *Assabet River TMDL for Total Phosphorus (CN 201.0)* (MassDEP, 2004) was developed to address impairments related to phosphorus within the Assabet River. The following additional impairments for the Assabet River segment (MA82B-05) have been addressed through the development of a TMDL:

- aquatic plants (macrophytes)
- excess algal growth
- nutrient/eutrophication biological indicators
- dissolved oxygen
- total phosphorus

Additionally, MassDEP's *SuAsCo Watershed Year 2001 Water Quality Assessment Report* (MassDEP, 2001) states that known pollution sources include municipal point source discharges; and suspected pollution sources include hydrostructure/flow regulation/modification, internal nutrient recycling, highway/road/bridge runoff, municipal urbanized high density areas, and discharges from municipal separate storm sewer systems. Assabet River is also covered by a draft Total Maximum Daily Load (TMDL) for pathogens according to MassDEP's Draft Pathogen TMDL for the Concord River Watershed (MassDEP, no date).

Relevant Water Quality Standards

Water Body Classification: Class B, Warm Water Fishery

Applicable State Regulations:

- *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) 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) 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.
- *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 (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

The Assabet River Segment (MA82B-05) flows for 8.2 miles through Maynard, Stow and Hudson, Massachusetts. The segment originates at the Hudson Wastewater Treatment Plant discharge in Hudson to the USGS stream gage at the intersection of Routes 27/62 in Maynard. The segment is classified as impaired according to the *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). The segment watershed is shown on Figure 1 and the subwatershed is shown on Figure 2. The subwatershed

also includes portions of Assabet River Segment MA82B-04 since that is part of the USGS hydrounit containing segment MA82B-05.

The MassDOT roadways with direct discharge to the impaired waters are shown in Figures 3 through 5 and include three bridges which cross the Assabet River: Route 62 and Route 117 in Maynard, and Route 62 in Stow. MassDOT owns only the bridges and minimal to no property surrounding the bridges. The approach roadways are owned and operated by the respective towns.

Stormwater runoff from the Route 62 bridge in Maynard flows to the municipal drainage system located adjacent to the bridge, and then discharges to the Assabet River from Walnut Street. Runoff from the eastbound side of the Route 117 bridge in Maynard flows through a curb cut next to the bridge and then discharges to the Assabet River. Runoff on the westbound side of the bridge flows to the municipal drainage system on Main Street and then discharges to the Assabet River. Runoff from the Route 62 bridge in Stow is collected by bridge scuppers and discharged directly to the Assabet River.

Assessment under BMP 7U

Four of the impairments for Assabet River Segment (MA82B-05) have not been addressed by a TMDL. Therefore, MassDOT assessed the 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 impairment:

- taste and odor.

According to MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*, the impairments for (debris/floatables/trash*) and (non-native aquatic plants*) are not caused by pollutants (MassDEP, 2013). Therefore, these impairments are not considered further.

The impairment for fecal coliform is assessed separately in the section titled Assessment of Pathogen Impairment.

MassDOT's Application of the Impervious Cover Method

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

Assessment

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 stormwater 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. IC 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 stormwater was a potential cause of the impairment, MassDOT calculated the degree to which IC 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 failing to meet the 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 IC 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 IC 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 IC reductions is described in BMP 7U. When the reduction in effective IC 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 Assabet River (MA82B-05):

Table 1. Site Parameters for Assabet River (MA82B-05)

Total Watershed		
Watershed Area	74,000	acres
Impervious Cover (IC) Area	8,750	acres
Percent Impervious	11.8	%
Subwatershed		
Subwatershed Area	6,880	acres
Impervious Cover (IC) Area	1,020	acres
Percent Impervious	14.8	%
IC Area at 9% Goal	619	acres
Target Reduction % in IC	39.1	%
Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	0.3	acres
MassDOT's Target Reduction in Effective IC (39.1% of DOT Directly Contributing IC)	0.1	acres

The subwatershed is greater than 9% impervious cover, indicating that stormwater likely contributes to the impairments assessed under this methodology. In order to reach the 9% target, effective IC within the subwatershed should be reduced by 39.1%. Therefore, MassDOT's target is to reduce effective IC within its own directly contributing watershed by the same percentage, or 0.1 acres.

Assessment under BMP 7R

The *Assabet River Total Maximum Daily Load for Total Phosphorus [CN 201.0]* addresses the impairments for total phosphorus, dissolved oxygen, excess algal growth, aquatic plants (macrophytes) and nutrient/eutrophication biological indicators for this water body. Therefore, MassDOT assessed the contribution of total phosphorus from MassDOT urban areas to this water body using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled *Assabet River Total Maximum Daily Load for Total Phosphorus [CN 201.0]* can be summarized as follows:

- Pollutant of Concern: Total Phosphorus
- Impairments for Assabet River Addressed in TMDL: total phosphorus, dissolved oxygen, excess algal growth, aquatic plants (macrophytes), and nutrient/eutrophication biological indicators
- Applicable Waste Load Allocation (WLA):
    - Description of Associated Land Use: Urban. The landuse for this TMDL was based on MassGIS data from 1990 – 1991. For the purposes of this assessment, urban landuse was used to represent roadway.
    - Urban Land Use Current Load (TP): No information provided
    - Urban Land Use Target WLA (TP): 1.0 lbs/day or 365 lb/yr. The TMDL identifies a target of 1.0 lbs/day for watershed non-point sources, specifically runoff combined with groundwater that is not from the natural background of the watershed (page 40 of TMDL). Therefore, the assumption that urban landuse has a TMDL of 1.0 lbs/day is conservative because it not only includes phosphorus sources from runoff but also from groundwater.
    - Urban Area in Watershed: 17,289 acres. The urban area was calculated by combining the urban area (10.5% of watershed) and commercial area (5% of watershed). The total Assabet River watershed area is 111,542 acres (page 3 of the TMDL).
    - Urban Land Use Target Areal WLA (TP): 0.02 lb/acre/yr.

Estimated Loading from MassDOT

The loading of total phosphorus (TP) from MassDOT property directly contributing stormwater runoff to Assabet River 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 stormwater runoff conducted by the United States Geological Survey (USGS) (Smith and Granato, 2010). The study analyzed stormwater 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 Assabet River is 0.3 acres of

impervious area and 0 acres of pervious area. The TP loading is 0.5 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 0.02 lb/ac/yr and the total area of MassDOT property within the TMDL watershed directly draining to Assabet River (0.3 acres). The target TP WLA for MassDOT runoff is 0.007 lb/yr.

Assessment

MassDOT calculated its current TP loading rate (0.5 lb/yr) and its target TP WLA (0 lb/yr) using values provided in MassDEP's TMDL report. The difference between these two values represents the target reduction in TP that MassDOT will aim to achieve to comply with the WLA. For the watershed directly contributing to Assabet River, this target reduction is 0.5 lb/yr. 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.

There are no existing BMPs in the Assabet River (MA82B-05) directly contributing watershed that are mitigating potential stormwater quality impacts prior to discharge to Assabet River. Thus, there is currently no TP reduction being provided.

Table 2: Loading from MassDOT's Directly Contributing Property Relative to TMDL WLA

Total Area	0.3	ac
Target Areal WLA	0.02	lb/ac/yr
Total Estimated Load	0.5	lb/yr
WLA for MassDOT's Directly Contributing Property	0.01	lb/yr
MassDOT's Required Load Reduction	0.5	lb/yr

Existing BMPs

Based on the site visit, there are no existing BMPs within MassDOT's directly contributing watershed to segment MA82B-03 that are mitigating potential storm water quality impacts. Therefore, no effective IC reduction or phosphorus loading reduction is provided by existing MassDOT BMPs.

Mitigation Plan

Because there are no existing BMPs mitigating impervious surface or reducing total phosphorus loading, MassDOT considered the implementation of BMPs to meet the 0.1 acre target reduction in impervious cover and 0.5 lb/yr in total phosphorus loading.

Based on the review of MassDOT's directly contributing drainage area, no BMPs have been identified that can be implemented on MassDOT property to address the impairments of the Assabet River (MA82B-05) due to site constraints. The Rte 62 and Rte 117 bridges are owned by MassDOT, but the roadways on either side of the bridge are owned by municipalities. Therefore, there is no land available to implement stormwater infiltration BMPs to mitigate the effect of the bridge stormwater runoff.

Assessment of Pathogen Impairment

MassDOT assessed the pathogen 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. Pathogen concentrations in stormwater 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 pathogen concentrations in stormwater 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 stormwater management.

In addition, while there is a positive relationship between IC 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 stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater 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 bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest 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 along 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 stormwater 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 stormwater 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 crosses 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 stormwater 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 stormwater systems and a large number of other factors.

Assessment

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 stormwater 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 stormwater 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 stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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 stormwater 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 contain 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 stormwater 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.

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater 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 stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters.

Conclusions

MassDOT used both the IC Method and the TMDL Method to assess Assabet River (MA82B-05) for the impairments identified in MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*. To meet target reductions in impervious cover to meet the 9% goal MassDOT should reduce impervious cover within the urban area directly contributing watershed to Assabet River by 0.1 acres. To meet guidelines set forth in the TMDL for total phosphorus MassDOT should reduce its TP loading within the urban area directly contributing watershed by 0.5 lb/yr to achieve the targeted reduction. MassDOT evaluated its property within the directly contributing watershed to the Assabet River to identify existing BMPs and found that no BMPs exist to reduce effective IC and total phosphorus loading.

MassDOT should reduce impervious cover and TP loading to the Assabet River to meet target impervious cover reduction and guidelines set forth in the TMDL. However, the site constraints and limited right-of-way area indicate that the construction of stormwater infiltration BMPs along the directly contributing MassDOT roadways is infeasible. Therefore, no further action will be taken as part of the Retrofit Initiative of the MassDOT Impaired Waters program.

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

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative. 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 progress made towards meeting target IC reductions, plans for construction of additional BMPs, and finalized assessments including reductions achieved by finalized BMP designs. MassDOT will also continue to implement non-structural BMPs that reduce the impacts of stormwater.

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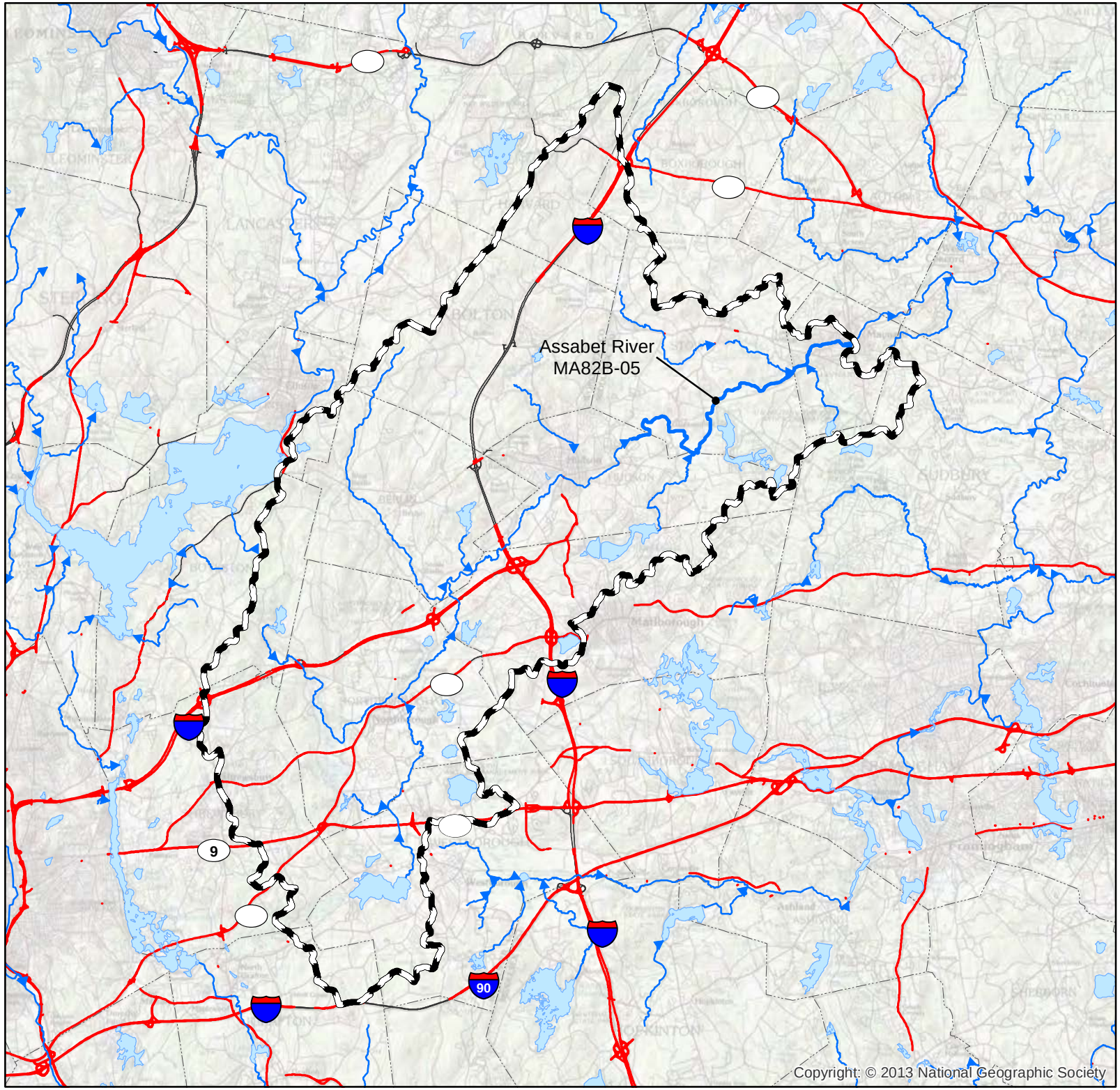
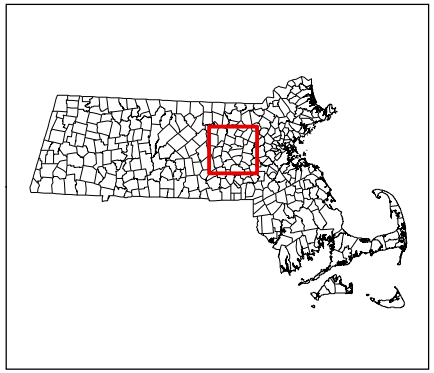




Total Watershed
Assabet River
Impaired Stream Segment
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 7,500 15,000 Feet

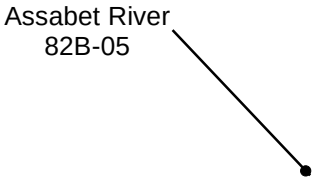
1 in = 15,000 feet

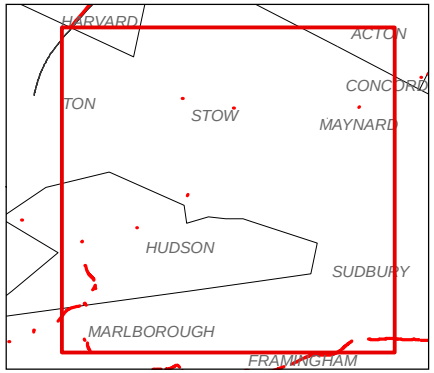
Figure 1

Assabet River
Total Watershed
MA82B-05

June 2013

massDOT
Massachusetts Department of Transportation
Highway Division





Subwatershed

Total Watershed

Assabet River

Impaired Stream Segment

Impaired Water Bodies

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 2,250 4,500 Feet

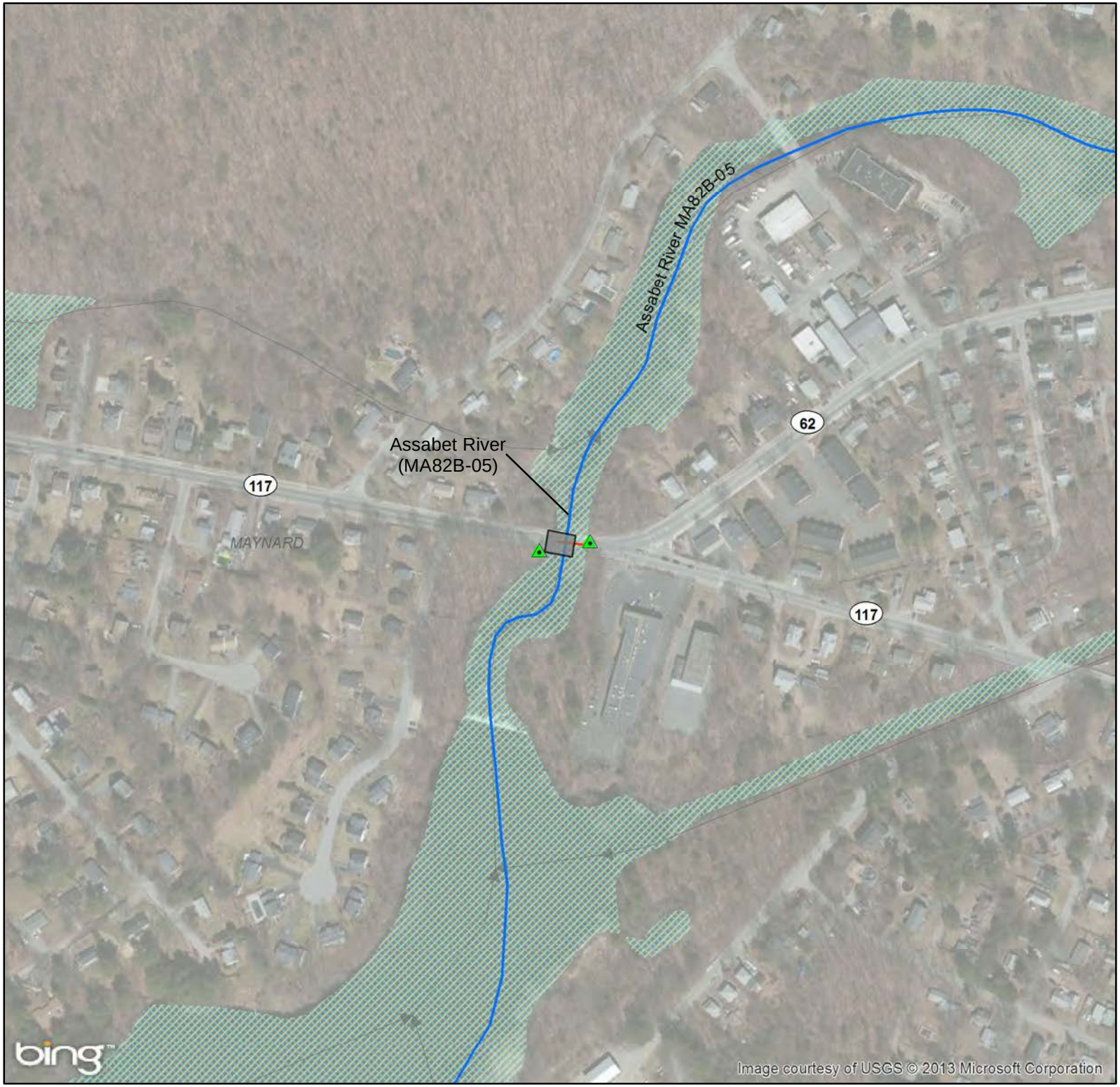
1 in = 4,500 feet

Figure 2

Assabet River Subwatershed MA82B-05

June 2013

massDOT
Massachusetts Department of Transportation
Highway Division



DOT Direct IC Watershed

Stormwater Outfalls

Assabet River

Impaired Stream Segment

Impaired Water Bodies

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 100 200 300 Feet

1 inch = 300 feet

Figure 3

Assabet River (MA82B-05) MassDOT Directly Contributing Watershed

June 2013

Moving Massachusetts Forward. massDOT

DOT Direct IC Watershed

Stormwater Outfalls

Assabet River

Impaired Stream Segment

Impaired Water Bodies

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 100 200 300 Feet

1 inch = 300 feet

Figure 4

Assabet River (MA82B-05) MassDOT Directly Contributing Watershed

June 2013

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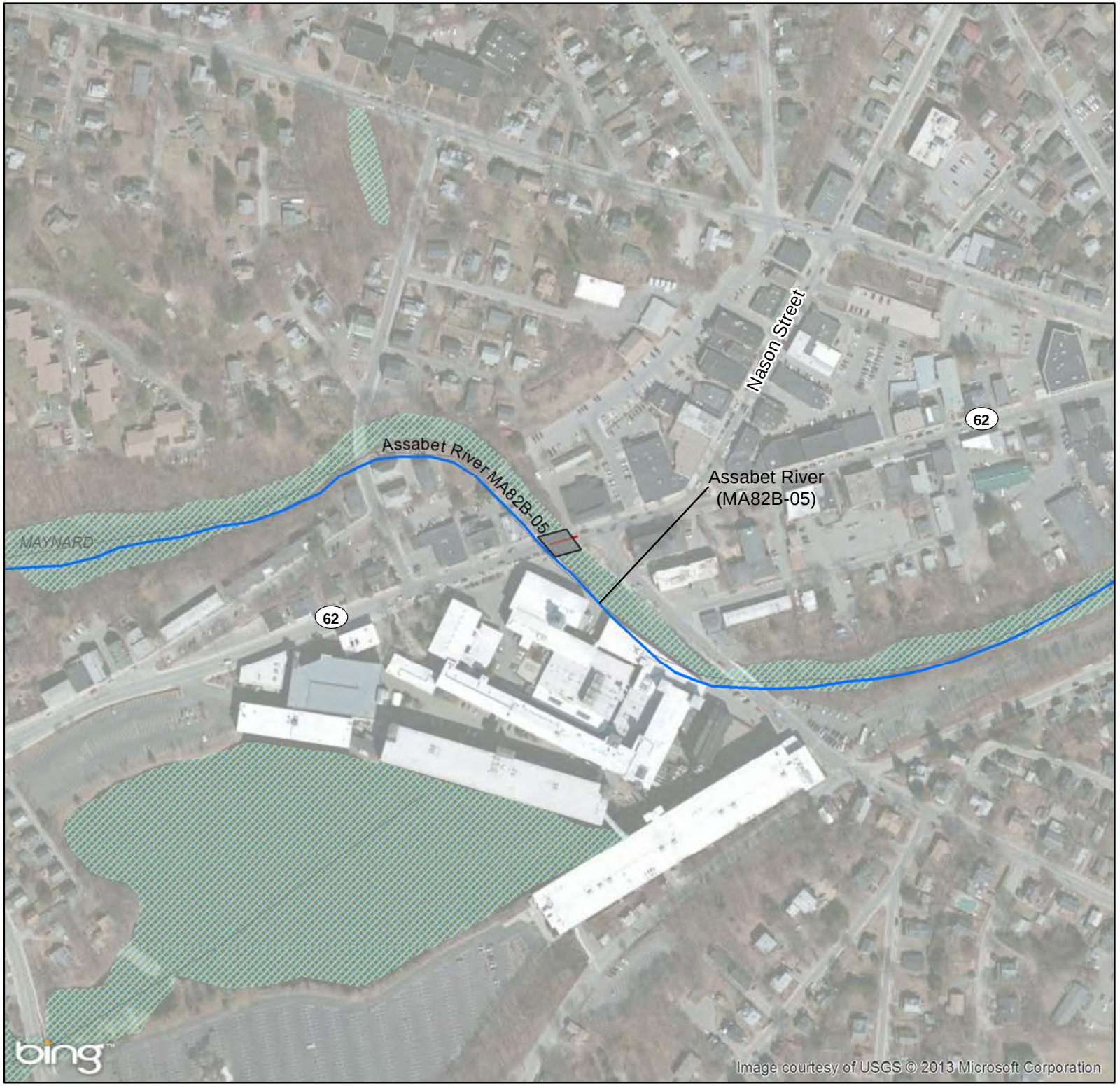

DOT Direct IC Watershed

Stormwater Outfalls

Assabet River

Impaired Stream Segment

Impaired Water Bodies

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 100 200 300 Feet

1 inch = 300 feet

Figure 5

Assabet River (MA82B-05) MassDOT Directly Contributing Watershed

June 2013

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Impaired Waters Assessment for Concord River (MA82A-09)

Impaired Water Body

Name: Concord River

Location: Lowell, MA

Water Body ID: MA82A-09

Impairments

Concord River (MA82A-09) is listed under Category 5, “Waters Requiring a TMDL”, on MassDEP’s final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Concord River is impaired for the following:

- mercury in fish tissue
- total phosphorus
- fecal coliform
- excess algal growth
- (debris/floatable/trash*)

According to MassDEP’s *SuAsCo Watershed Year 2001 Water Quality Assessment Report* (MassDEP, 2005), the Concord River is impaired for mercury. The source of the mercury was traced to the Nyanza Superfund Site, and a fish consumption advisory was issued for the pond. Concord River is not covered by a final TMDL report.

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)(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.
- *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 (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) 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

The segment of the Concord River in review spans 0.9 miles, from Rogers Street bridge to the confluence with the Merrimack River in Lowell, MA. As shown in Figure 1, while MassDOT urban roads are in the total watershed, only one bridge is located within the subwatershed (Figure 2).This bridge has potential direct stormwater discharge to Concord River.

MassDOT owns this bridge on Route 110 (Church Street) over the Concord River, shown in Figure 3. MassDOT owns the bridge and minimal to no property surrounding the bridge. The approaching roadway is owned and operated by the respective towns. There are two stormwater outfalls at each end of the bridge. Therefore, stormwater runoff flows off the bridges and into the municipal stormwater system. Based on topography of the sites, the municipal system likely drains to Concord River.

Assessment under BMP 7U

None of the impairments for the Concord River have been addressed by a TMDL. Therefore, MassDOT assessed the 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
- total phosphorus

According to Northeast Regional Mercury TMDL (NEIWPCC, 2007), regulated stormwater is considered to be a de minimis contributor to the waste load allocation for mercury. Additionally, the primary source of mercury in stormwater in Massachusetts is atmospheric deposition, which must be controlled by targeting sources that emit into the air. Based on the TMDL, the impairment for mercury in fish tissue has been excluded from the IC Method and deemed "unrelated to stormwater," so no further action is necessary for this pollutant (NEIWPCC, 2007).

The impairment for fecal coliform is assessed separately in the section titled Assessment of Pathogen Impairment. According to MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*, the impairment for (Debris/Floatables/Trash*) is not caused by a pollutant (MassDEP, 2013). Therefore, this impairment is not considered further.

MassDOT's Application of the Impervious Cover Method

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

Assessment

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 stormwater 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. IC 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 stormwater was a potential cause of the impairment, MassDOT calculated the degree to which IC 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 failing to meet the 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 IC 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 IC 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 IC reductions is described in BMP 7U. When the reduction in effective IC 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 Concord River (MA82A-09):

Table 1. Site Parameters for Concord River (MA82A-09)

Total Watershed		
Watershed Area	256,000	acres
Impervious Cover (IC) Area	26,200	acres
Percent Impervious	10.2	%
Subwatershed		
Subwatershed Area	439	acres
Impervious Cover (IC) Area	258	acres
Percent Impervious	58.8	%
IC Area at 9% Goal	39.5	acres
Target Reduction % in IC	84.5	%
Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	0.1	acres
MassDOT's Target Reduction in Effective IC (84.5% of DOT Directly Contributing IC)	0.1	acres

The subwatershed is greater than 9% impervious cover, indicating that stormwater likely contributes to the impairments assessed under this methodology. In order to reach the 9% target, effective IC within the subwatershed should be reduced by 84.5%. Therefore, MassDOT's target is to reduce effective IC within its own directly contributing watershed by the same percentage, or 0.10 acres.

Existing BMPs

There are no existing BMPs in the Concord River directly contributing watershed that are mitigating potential stormwater quality impacts prior to discharge to Concord River.

Mitigation Plan

Because there is no mitigation of impervious cover achieved by existing MassDOT BMPs to meet the target reduction of 0.10 acres, MassDOT considered the implementation of BMPs.

Assessment of Pathogen Impairment

MassDOT assessed the pathogen 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. Pathogen concentrations in stormwater 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 pathogen concentrations in stormwater 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 stormwater management.

In addition, while there is a positive relationship between IC 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 stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater 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 bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest 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 along 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 stormwater 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 stormwater 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 crosses 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 stormwater 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 stormwater systems and a large number of other factors.

Assessment

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 stormwater 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 stormwater 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 stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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 stormwater 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 contain 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 stormwater 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

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater 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 stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters.

Conclusions

MassDOT used the IC Method to assess Concord River (MA82A-09) for the impairments identified in MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*. Results indicate that MassDOT should reduce its effective IC within its directly contributing subwatershed by 0.10 acres to achieve the targeted reduction in effective IC. MassDOT evaluated its property within the directly contributing watershed to Concord River to identify existing BMPs and found that no BMPs exist to reduce effective IC. This information is summarized in Table 2 below.

Table 2. Effective IC Reductions under Existing & Proposed Conditions

IC in Directly Contributing Watershed	0.1	acres
Target Reduction in Effective IC	0.1	acres
Effective IC Reduced by Existing BMPs	0	acres
Effective IC Reduced by Proposed BMPs	0	acres
IC Target Remaining	**0.1**	**acres**

MassDOT should reduce its effective IC within the directly contributing watershed by 0.10 acres to achieve the targeted reduction in IC. However, the site constraints and limited right-of-way area indicate that the construction of stormwater infiltration BMPs along the directly contributing MassDOT roadways is infeasible. Therefore, no further action will be taken as part of the Retrofit Initiative of the MassDOT Impaired Waters program.

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

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative. 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 progress made towards meeting target IC reductions, plans for construction of additional BMPs, and finalized assessments including reductions achieved by finalized BMP designs. MassDOT will also continue to implement non-structural BMPs that reduce the impacts of stormwater.

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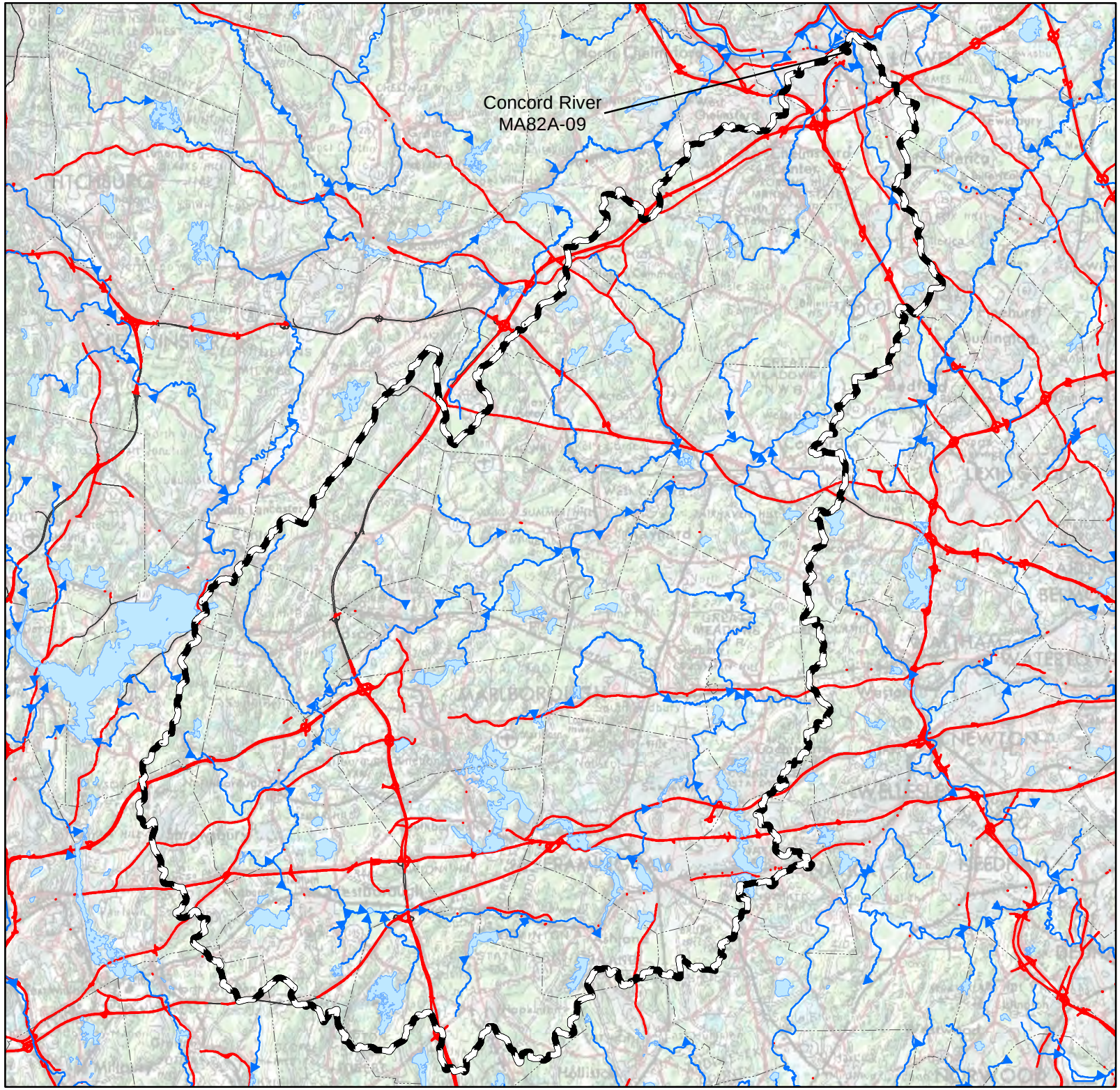
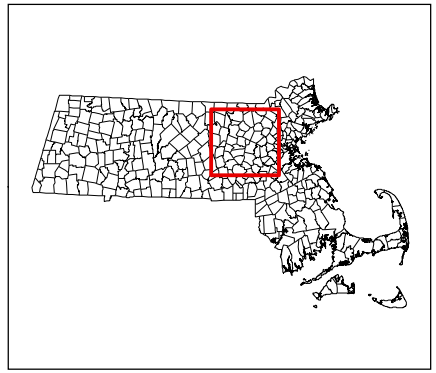




Total Watershed

Concord River

Impaired Stream Segment

Impaired Water Bodies

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 1 2 4 6 8 Miles

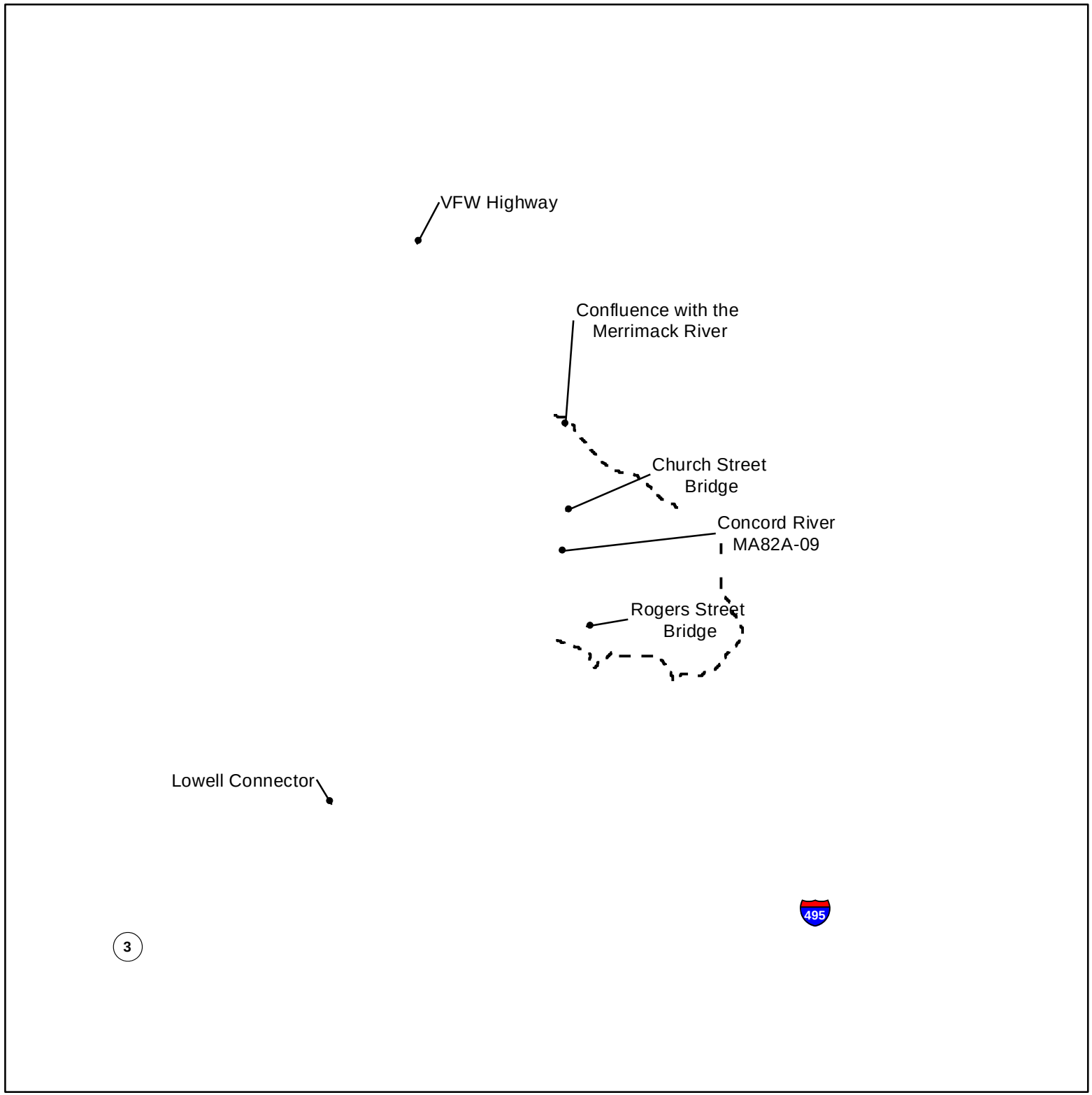
1 in = 4 miles

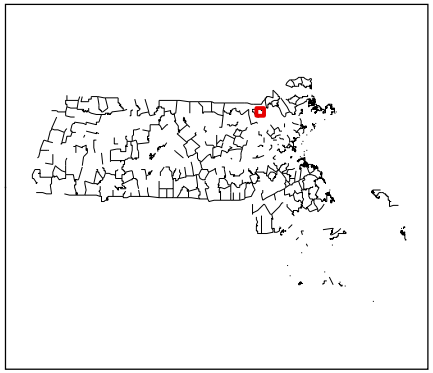
Figure 1

Concord River
Total Watershed
MA82A-09

June 2013

massDOT
Massachusetts Department of Transportation
Highway Division





Total Watershed
Subwatershed
Concord River
Impaired Stream Segment
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.25 0.5 0.75 1 Miles

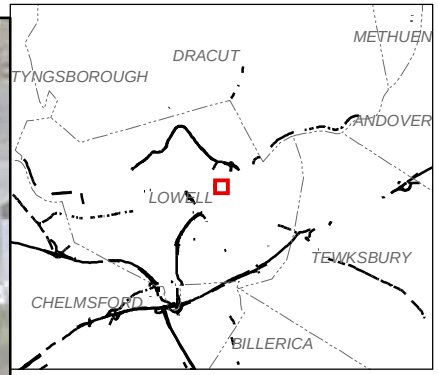
1 in = 0.5 miles

Figure 2

Concord River Subwatershed MA82A-09

June 2013

massDOT Massachusetts Department of Transportation Highway Division



Stormwater Outfalls

DOT Direct IC Watershed

Impaired Stream Segment

Impaired Water Bodies

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 125 250

1 inch = 167 feet

Figure 3

Concord River (MA82A-09)
MassDOT Directly Contributing Watershed

June 2013

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Gloucester Harbor (MA93-18)

Impaired Waterbody

Name: Gloucester Harbor

Location: Gloucester, Massachusetts

Water Body ID: MA93-18

Impairments

According to the MassDEP Final Year 2012 Integrated List of Waters, this segment is listed under Category 5 as impaired for combined biota/habitat bioassessments, dissolved oxygen and fecal coliform bacteria.

The *Final Pathogen TMDL for the North Coastal Watershed March 2012 (CN 155.0)* addresses the fecal coliform bacteria impairment of Gloucester Harbor.

The *North Shore Costal Watersheds 2002 Water Quality Assessment Report* lists combined sewer overflows, discharges from municipal separate storm sewer systems, dredging for navigation channels, changes in tidal circulation/flushing, changes in ordinary stratification and bottom water hypoxia/anoxia among the main causes of impairments to this segment.

Relevant Water Quality Standards

- Water Body Classification: SB/CSO
- 314 CMR § 4.05 (4) (b) - *Class SB. 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. In certain waters, habitat for fish, other aquatic life and wildlife may include, but is not limited to, seagrass. Where designated in the tables to 314 CMR 4.00 for shellfishing, these waters shall be suitable for shellfish harvesting with depuration (Restricted and Conditionally Restricted Shellfish Areas). These waters shall have consistently good aesthetic value.*
- 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 (4)(b)(1) – *Dissolved Oxygen. Shall not be less than 5.0 mg/l. Seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained. Where natural background conditions are lower, DO shall not be less than natural background.*
- 314 CMR § 4.05 (4)(b)(4) – Bacteria.

  a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 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 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 of the samples taken during 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.

Summary

MassDOT has assessed stormwater impacts from MassDOT properties discharging to the Gloucester Harbor using BMP 7R to address the Pathogen TMDL and BMP 7U to address impairments not covered by a TMDL. The following sections describe the methodology for these assessments. Based on this assessment, MassDOT determined that a 1.6-acre reduction in effective impervious cover (IC) would be needed to meet the target for this watershed.

MassDOT has concluded that one existing best management practice (BMPs) provides approximately 0.7 acres of effective IC reduction. MassDOT has determined that site constraints and other factors limit the potential for MassDOT to install stormwater BMPs to treat runoff before draining to Gloucester Harbor.

See the **Proposed Mitigation Plan** section of this assessment for more information.

Reductions Applied to MassDOT Direct Watershed

	Effective IC (Acres)
MassDOT's Area Directly Contributing to Impaired Segment	2.6
Target Reduction	1.6
Reduction Achieved by Existing BMPs	0.7
Reduction Provided in Proposed Conditions	0
Remaining Reduction to Meet Target	0.9

Site Description

The Gloucester Harbor (Segment MA93-18) is within the City of Gloucester, Massachusetts. The harbor is 2.32 square miles and includes the Inner Harbor, Western Harbor, Smith Cove, Harbor Cove, Freshwater Cove, Southeast Harbor, Old House Cove, Lighthouse Cove, and Wonson Cove. Figure 1 shows the harbor and its associated watershed. The Annisquam River is not included as a part of this segment. The harbor is impaired due to dissolved oxygen, fecal coliform bacteria, and combined biota/habitat bioassessments. Land use in the watershed to Gloucester Harbor includes residential, forest and open land, and urban. The Gloucester downtown commercial district is included in the Gloucester Harbor watershed.

MassDOT-owned properties within the watershed to Segment MA93-18 include Route 127 (Western Avenue) from approximately 700 feet east of Old Salem Road east to the crossing of the Blynman Canal. Route 127 runs north to south in this area, parallel to the harbor. Route 127 is a Minor Urban Arterial and carries one lane of traffic in each direction. Stormwater runoff from Route 127 is collected in catch basins along the roadway which outfall on the eastern side of the roadway.

Stormwater from Route 127 from the western limits of the watershed northeast to just beyond Buswell Pond is not considered to be directly discharging to Gloucester Harbor. Stormwater from this section of roadway flows into swales perpendicular to the roadway and through wooded areas and wetland systems before reaching Gloucester Harbor. The stormwater from the roadway adjacent to Buswell Pond enters into the unnamed stream that carries flow from Buswell Pond to Gloucester Harbor.

Stormwater from Route 127 approximately 500 feet north of Buswell Pond, north to the southern entrance of Stage Fort Park discharges directly to Gloucester Harbor. Catch basins carry flow through pipes to outfalls along the rocky cliffs or seawalls of Gloucester Harbor. Additionally, approximately 900 feet of Route 127 at the intersection with Essex Street, near the bridge over the Blynman Canal, discharges through an outfall in the seawall along the beach to Gloucester Harbor. Figure 2 shows the MassDOT directly discharging area to Gloucester Harbor.

Soils within the MassDOT directly discharging watershed to Gloucester Harbor are generally A and B soils, however many rock outcrops were observed during a site visit. Gloucester Harbor is designated as Essential Fish Habitat (EFH) by the New England Fisheries Management Council (NEFMC).

One existing BMP was located which treats stormwater discharges from Route 127, at the southern entrance of Stage Fort Park. The existing BMP is shown on Figure 3 and discussed in the BMP 7U Assessment section of this assessment.

Assessment under BMP 7R for Pathogens

The *Pathogen Total Maximum Daily Load (TMDL) for the North Coastal Watershed (CN 0155.0)* covers the Gloucester Harbor. The TMDL states that sources of indicator bacteria in the North Coastal Watershed were found to be many and varied. The TMDL lists sources as including failing septic systems, combined sewer overflows (CSO), sanitary sewer overflows (SSO), sewer pipes connected to storm drains, certain recreational activities, wildlife including birds along with domestic pets and animals, and direct overland stormwater runoff.

In addition, as stated on page iv of the Executive Summary to the TMDL, *The entire [watershed] is very densely populated, with various studies indicating particularly extensive impervious surfaces (up to 30% or greater) created by dense housing developments, commercial buildings, roads, and parking lots. Stormwater runoff from these areas has moderate to high bacterial loadings, which affects the integrity of swimming and shellfishing areas in the estuary and harbor areas.*

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by orders of magnitude within a given storm event (MassDEP, 2009). Therefore, it is difficult to predict stormwater pathogen concentrations with accuracy. Due to this difficulty, MassDOT is not conducting site specific assessments of loading at each location impaired for pathogens as part of this Retrofit Program. However, MassDOT recognizes that its roadways, especially in urbanized areas, contribute to the pathogen impairment of the North Coastal Watershed and has performed a general assessment and developed a mitigation plan as described below.

BMP 7R Pathogens Assessment

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT has reviewed its existing programs and their consistency with the Pathogen TMDL for the North Coastal Watershed recommendations as well as the draft EPA National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit requirements for the North Coastal Watershed.

The Pathogen TMDL for the North Coastal Watershed recognizes that mitigation for pathogen impairments is difficult to address and emphasizes the need for an iterative adaptive management approach. The Executive Summary of the TMDL, page 97, states:

> *Setting and achieving TMDLs must be an iterative process, with realistic goals over a reasonable timeframe and adjusted as warranted based on ongoing monitoring. The concentrations set out in the TMDL represent reductions that will require substantial time and financial commitment to be attained. A comprehensive control strategy is needed to address the numerous and diverse sources of pathogens in the North Coastal watershed.*

The existing NPDES MS4 permit that covers MassDOT stormwater discharges does not provide guidance on what measures are necessary to comply with the Pathogen TMDL for the North Coastal Watershed. The fact sheet for the draft permit for MS4 stormwater discharges for the North Coastal Watershed contains some guidance on what measures EPA has determined necessary to be consistent with the Pathogen TMDL for the Charles River Watershed (the only Pathogen TMDL at the date of fact sheet publishing). Page 36 of the fact sheet states:

> *Instead of a numeric limitation for bacteria, the draft permit includes requirements for MS4s to provide education to pet owners and owners of septic systems, to implement a comprehensive illicit discharge detection and elimination program that addresses not only sources of pathogens but also sources of phosphorus, and to implement programs to address water fowl. In addition, although entitled "Phosphorus Control Plan" most of the actions needed to develop and implement a successful PCP are also effective in supporting the achievement of the WLA for the Charles River pathogen TMDL.*

As discussed above, both the Pathogen TMDL for the North Coastal Watershed and the draft North Coastal Watershed MS4 permit state that identification of illicit discharges and addressing stormwater volumes and pollutants, such as phosphorus, are the best approaches to mitigate the pathogen impairments. MassDOT has developed a mitigation plan, described below, to address the pathogen impairments using guidance from these two documents.

BMP 7R Pathogens Mitigation Plan

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 non-structural 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

MassDOT will be implementing a pet waste management program at its rest stops, including those that have discharges to pathogen impaired waters. In addition, MassDOT has requested to be covered under an Individual MS4 permit for the next permit term. A future individual permit may contain additional programmatic BMPs to address pathogens.

The structural BMPs that will be considered to reduce phosphorus loading and the effects of IC would also reduce pathogen loads. See the Proposed Mitigation Plan section of this assessment for more information on specific BMPs proposed as part of this assessment. MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations.

Assessment for Dissolved Oxygen and Combined Biota/Habitat Bioassessments under BMP 7U

The North Coastal Pathogen TMDL does not address all of the Gloucester Harbor's impairments including dissolved oxygen and combined biota/habitat bioassessments. Therefore, MassDOT assessed the stormwater-related impairments not addressed by a TMDL using the approach described in BMP 7U of MassDOT's Stormwater Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL.

For the stormwater-related impairments for this water body not covered by a TMDL, MassDOT used an application of EPA Region I's Impervious Cover (IC) Method described in EPA's Stormwater TMDL Implementation Support Manual (ENSR, 2006). MassDOT used this method to assess potential stormwater impacts on the impaired water and develop the target IC to ensure that stormwater is not the cause of the impairments. The IC Method relates an aquatic system's health (i.e., state of impairment) to the percentage of IC in its contributing watershed. This method is largely based on the work of the Center for Watershed Protection, which has compiled and evaluated extensive data relating watershed IC to the hydrologic, physical, water quality, and biological conditions of aquatic systems (Schueler, 2003). Water quality in tributary streams, rivers, lakes and ponds is a direct reflection of loading from the watershed (Wetzel, 2001); therefore, the IC method can be used as a surrogate for pollutant loading when evaluating water quality impairments and their causes. Consistent with the findings of EPA and others, MassDOT concluded that when a watershed had less than 9% IC, stormwater was not the likely cause of the impairment.

MassDOT developed the target IC reduction using the approach outlined in *Description of MassDOT's Application of Impervious Cover Method in BMP 7U* (MassDOT, 2011). Since the development of the MassDOT Application of IC Method, MassDOT has further refined its approach to evaluate MassDOT's effective IC and BMP performance. For the Gloucester Harbor, MassDOT used the long-term continuous simulation model (the assessment model) to estimate phosphorus loading and to estimate effective IC. For a more detailed description of this approach, see the Long-Term Continuous Simulation for Pollutant Loading and Treatment for MassDOT Impaired Waters Program.

MassDOT estimated the effective IC of its contributing drainage area with existing stormwater BMPs by comparing the runoff and pollutant response of its drainage area to the response of simulated watersheds with equivalent area, but varying IC from 0 to 100% (simulated IC

watersheds). The IC percentage of the watershed that produces a similar response to MassDOT's watershed was determined to be the effective IC of MassDOT's watershed.

The MassDOT IC method for the impaired waters of the Gloucester Harbor includes the following steps:

1. Locate additional stormwater BMPs to maximum extent practicable and run long-term simulation to quantify their performance. Calculate the percent IC of the water body's entire contributing watershed (total watershed to downstream end of impaired segment) and that of the local watershed contributing directly to the impaired segment (referred to as the subwatershed in this analysis) to determine whether stormwater has a potential to cause the impairments of the receiving water body.
2. For subwatersheds with greater than 9% IC, calculate the amount of IC reduction needed to achieve 9%. For subwatersheds with less and 9% IC, perform no further analysis under BMP 7U.
3. Calculate percentage of IC in the MassDOT directly contributing drainage area.
4. Apply reduction of IC necessary for the subwatershed to achieve 9% to MassDOT contributing drainage area as a target to address the stormwater impairments. Calculate resulting target IC for MassDOT drainage area.
5. In the case where BMPs are in place or where BMPs are proposed, derive IC reduction rates for the BMPs using MassDOT's assessment model based on size, function, and contributing watersheds of the BMPs.

BMP 7U Assessment

Using the approach described above, MassDOT calculated the following values for the total contributing watershed of the impaired water (Gloucester Harbor) to determine the IC target (see Figure 1). For the Gloucester Harbor, MassDOT determined that the total watershed (total watershed upstream of the downstream end of the impaired segment) and the subwatershed (local watershed contributing directly to the impaired segment) were the same.

Watershed Impervious Cover

	Total Watershed
Watershed Area	2,170 acres
Impervious Cover (IC) Area	494 acres
Percent Impervious	23 %
IC Area at 9% Goal	195 acres
Target Reduction % in IC	60%

The watershed is greater than 9% impervious indicating that stormwater is a likely contributor to the impairment. To meet the 9% effective IC target, the effective IC within the watershed will need to be reduced by 60%. Therefore, the effective IC of MassDOT's directly contributing area should also be reduced by the same percentage to meet the target. The following table shows the resulting targets for MassDOT's contributing property.

Reductions Applied to MassDOT Direct Watershed

MassDOT's Area Directly Contributing to Impaired Segment	2.7 acres
MassDOT's IC Area Directly Contributing to Impaired Segment	2.6 acres
MassDOT's Percent Impervious	96%
MassDOT's Target Reduction in Effective IC (60% of DOT Directly Contributing IC)	1.6 acres
Target Effective IC	38 %

MassDOT's directly contributing area includes 2.6 acres of IC (96 % of total contributing area). To meet the target reduction of effective IC, MassDOT should mitigate 1.6 acres of effective IC. Equivalently, MassDOT's contributing drainage area should act as a watershed of 38% IC.

Existing BMPs

One existing BMP is identified in the project area. The existing infiltration basin, shown on Figure 3, is along Route 127 near the southern entrance to Stage Fort Park in Gloucester. Two outfalls carrying stormwater from Route 127 discharge along the edge of the roadway and flow together, forming a half circle swale within Stage Fort Park, owned by the City of Gloucester. The swale is deeply eroded and contains sediment. Stormwater does not exit this pervious area and all water is infiltrated into the ground, therefore acting as an infiltration BMP.

The existing conditions assessment model was created to estimate existing potential contributing drainage areas and existing BMPs. The table below shows the existing BMP, its MassDOT drainage area and effective IC reduction. The output from the assessment model showing effective IC analysis for the existing BMP is attached. The assessment model identifies BMPs by unique ID, included in the table below.

Summary of Existing BMPs

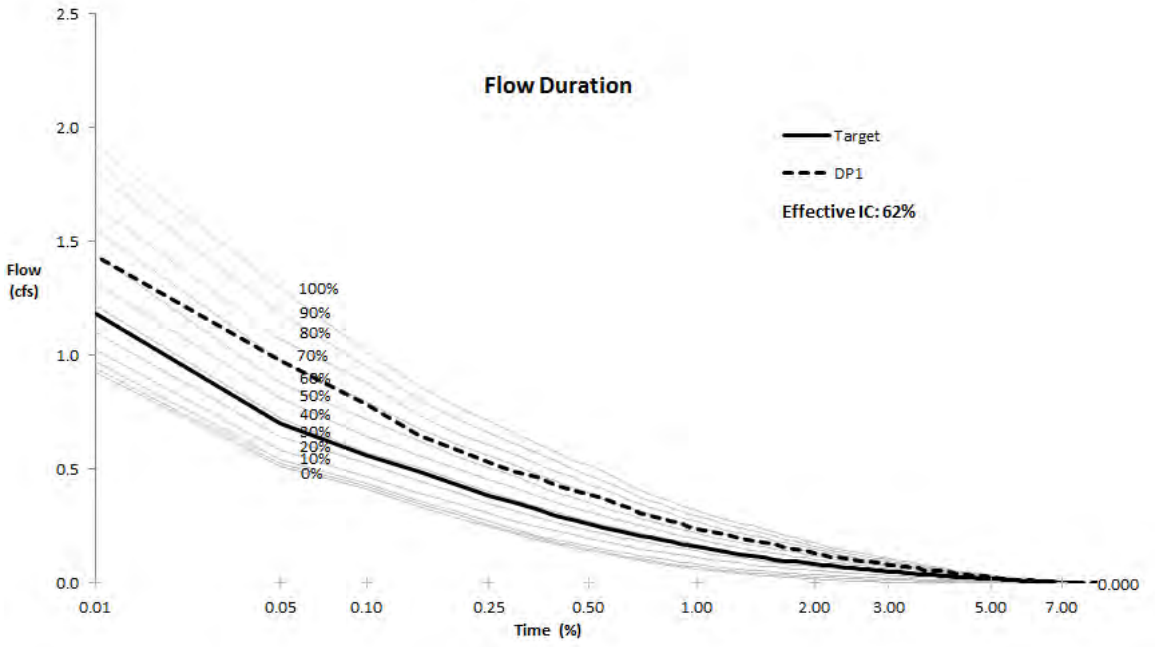
BMP Name / (BMP ID)	BMP Type	Contributing Watershed IC Area (acres)	Resulting % Removal of Contributing Watershed IC	Effective IC Area Reduction (acres)
Ex 01 (1.3)	Infiltration Basin	0.7	134%	0.9
Total*		**2.6**	**28%**	**0.7**

* Total Effective IC reduction based on the assessment model results for the total MassDOT directly discharging drainage area to the receiving water (not sum of individual BMP reductions).

Note: The predicted effective IC is determined by comparing the BMP's calculated median annual discharge volume, runoff flow/duration relationship, median annual phosphorus load and median annual total suspended solids load to predicted discharge values for benchmark watersheds with the same size and varying percent IC. In cases where analysis predicts that BMPs would discharges less runoff volume and pollutant mass than those predicted for a 0% IC (pervious, woods in good condition) benchmark watershed, then the predicted effective IC removal would be greater than 100% and reduction of effective IC area will be greater than the BMP contributing IC area.

Existing Median Annual Load Comparisons

Simulated IC Watersheds		Runoff (ac-ft)	P (lb.)	TSS (lb.)
	0% IC	1.9	0.1	9
	5% IC	2.3	0.2	46
	10% IC	2.6	0.3	98
	20% IC	3.3	0.7	271
	30% IC	3.9	1.2	553
Target	**38% IC**	**4.4**	**1.7**	**817**
	40% IC	4.6	1.9	934
	50% IC	5.3	2.7	1,399
	60% IC	5.9	3.6	1,907
	70% IC	6.5	4.5	2,421
	80% IC	7.2	5.4	2,933
	90% IC	7.8	6.3	3,432
	100% IC	8.5	7.2	3,939
	Existing Conditions	8.5	7.1	3,882
	Proposed Conditions	6.4	5.3	2,882
	Reduction %	**25%**	**26%**	**26%**
	Effective IC	**67%**	**78%**	**79%**



Effective IC Results

Existing Effective IC	2.6 ac
Proposed Estimated Effective IC	1.8 ac
IC Reduction % with Proposed BMPs	28%
Estimated Effective IC*	70%

*Average of estimated Effective IC for annual median runoff volume, phosphorus and TSS loads, and flow duration

BMP 7U Mitigation Plan

Under existing conditions, MassDOT's estimated effective IC exceeds the target as described above. To mitigate the effects of IC, MassDOT reviewed potential locations to implement stormwater BMPs to the maximum extent practical given site constraints.

MassDOT was not able to identify practical locations for stormwater management improvements within the current MassDOT right-of-way. The Proposed Mitigation Plan section discusses the site constraints and mitigation plan.

Proposed Mitigation Plan to Address Impervious Cover

During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified BMPs that can be constructed entirely on MassDOT property without resulting in substantial wetland impacts or result in an adverse impact on historical or archeological resources. Projects that meet these requirements can utilize the Federal Highway Administration's Alternative Contracting mechanism (SEP-14) created for this program.

Based on the review of MassDOT's directly contributing drainage area, no BMPs have been identified that can be implemented on MassDOT property to address the impairments of Gloucester Harbor given the site constraints described below.

No potential BMPs were identified due to site limitations; mainly the limited MassDOT right-of-way. The area surrounding MassDOT-owned Route 127 is residential or protected open space. During the assessment phase, BMPs are only proposed on MassDOT-owned properties.

In addition, BMP implementation through MassDOT's programmed projects are carefully evaluated and implemented where practicable, and documented through the MassDOT Water Quality Data Form. The potential for BMPs outside of MassDOT property will be reviewed during the design phase of these projects and through ongoing partnerships with other state and local entities.

Conclusions

MassDOT has assessed stormwater impacts from MassDOT properties directly discharging to the Gloucester Harbor using BMP 7R to address the Pathogen TMDL and BMP 7U to address impairments not covered by a TMDL. This assessment found that one existing BMPs treats stormwater discharges from MassDOT properties. No locations on MassDOT property were identified for stormwater improvements related to discharges to Gloucester Harbor.

Reductions Applied to MassDOT Direct Watershed

	Effective IC (Acres)
MassDOT's Area Directly Contributing to Impaired Segment	2.6
Target Reduction	1.6
Reduction Achieved by Existing BMP	0.7
Reduction Provided in Proposed Conditions	0

The existing BMP resulted in a reduction in effective IC of the watershed by 0.7 acres, which is less than the target reduction of 1.6 acres. No treatment BMPs are being proposed as part of this assessment due to site constraints.

As an overall program, MassDOT will re-evaluate the potential need for structural BMPs to address pollutant loading when roadwork is conducted as programmed projects for the area. Further work by MassDOT 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 address impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs and finalized assessments including reduction achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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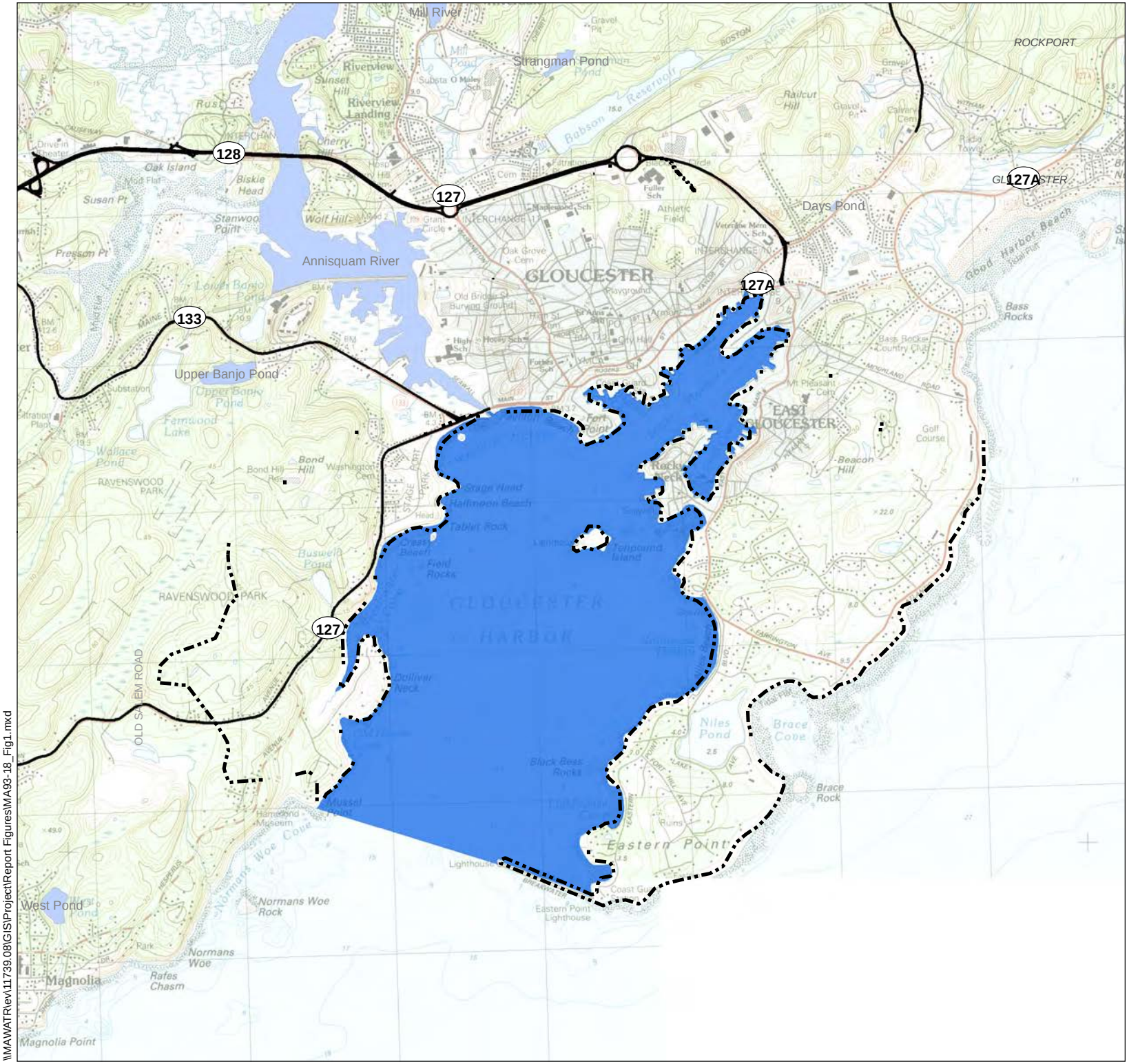

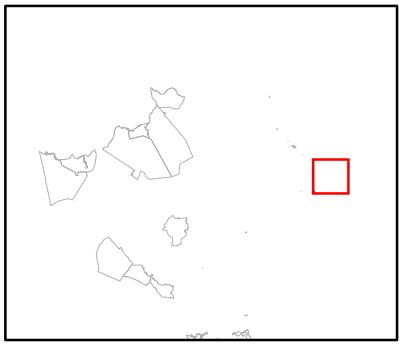

MassDOT Roadways

Impaired Lakes

Impaired Streams

Assessed Segment

Watershed

N

0 2,500 5,000 Feet

Figure 1

Gloucester Harbor (MA93-18) Watersheds

June 2013

massDOT Massachusetts Department of Transportation Highway Division

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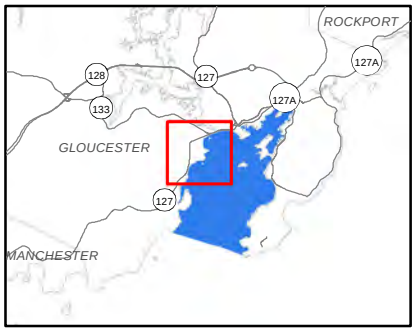

MassDOT Roadways

MassDOT Directly Discharing Area

Assessed Segment

N

0 500 1,000 Feet

Figure 2

Gloucester Harbor (MA93-18)
Directly Contributing
MassDOT Watershed

June 2013

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Highway Division

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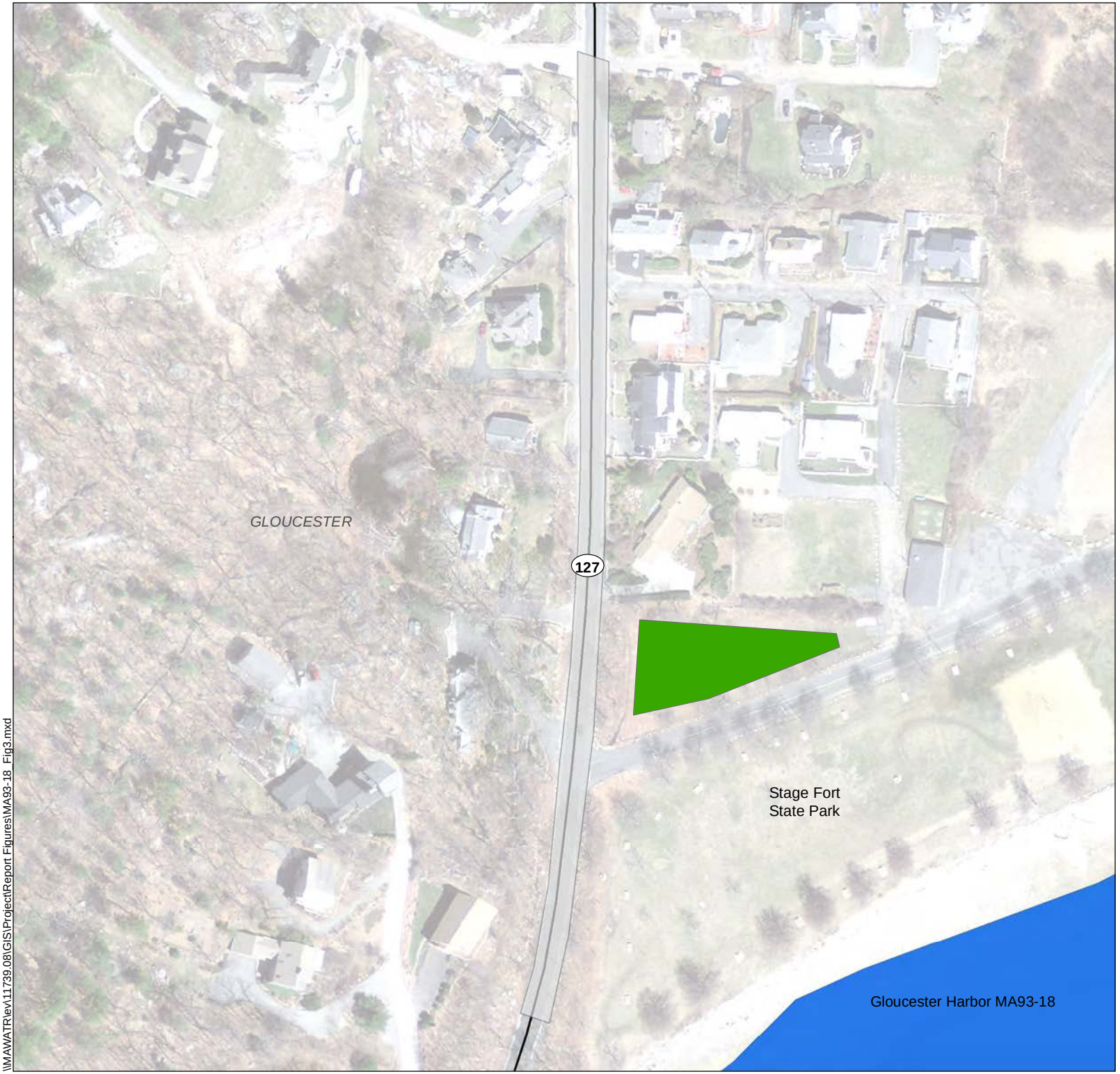

MassDOT Roadways

Assessed Segment

Existing BMP

BMP Watershed

N

0 100 200 Feet

Figure 3

Gloucester Harbor (MA93-18)
Existing BMP

June 2013

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Highway Division

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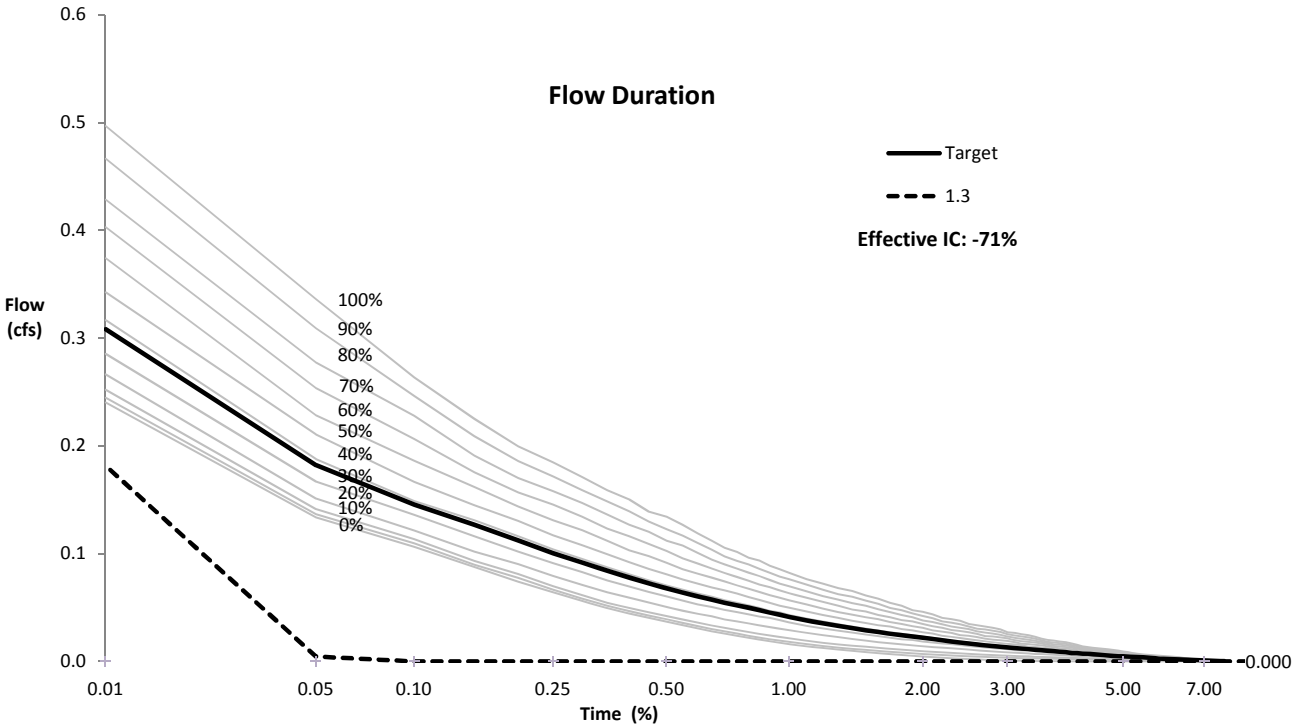
MA93-18 Assessment Model Result Summary for Impervious Cover

1.3 EX BMP 1



Median Annual Load Comparison Table

Condition	Runoff (ac-ft)	Phos. (lb.)	TSS (lb.)
0%IC	0.5	0.0	2
5%IC	0.6	0.1	12
10% IC	0.7	0.1	25
20% IC	0.9	0.2	70
30% IC	1.0	0.3	143
40% IC	1.2	0.5	242
50% IC	1.4	0.7	363
60% IC	1.5	0.9	495
70% IC	1.7	1.2	628
80% IC	1.9	1.4	761
90% IC	2.0	1.6	890
100% IC	2.2	1.9	1,022
Watershed Load	2.21	1.82	999
BMP Output	0.03	0.00	0
Target	1.15	0.44	216
Reduction %	**99%**	**100%**	**100%**
Effective IC	**-26%**	**-8%**	**-1%**

Result Summary

Metric	Area (%)	Area (acres)
Watershed Area		0.7
Watershed IC (no BMP)	98%	0.7
Target IC reduction	62%	0.4
Effective IC w/BMP	-33%	(0.2)
IC Reduction	134%	0.9

Impaired Waters Assessment for Floating Bridge Pond (MA93024)

Impaired Water Body

Name: Floating Bridge Pond

Location: Lynn, MA

Water Body ID: MA93024

Impairments

Floating Bridge Pond (MA93024) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011). Floating Bridge Pond is impaired for the following:

- excess algal growth
- phosphorus (total)
- turbidity

According to MassDEP's *North Shore Coastal Watersheds 2002 Water Quality Assessment Report* (MassDEP, 2007), Floating Bridge Pond is impaired due to nutrients, turbidity, and the presence of noxious aquatic plants. The report recommends conducting water quality monitoring to evaluate designated uses and implementing recommendations in Diagnostic/Feasibility Study for Floating Bridge Pond.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

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.

Site Description

Floating Bridge Pond is a 11.9 acre water body located in Lynn, MA. The Western Avenue (Route 107) Bridge (known as the Buchanan Bridge) bisects the pond with approximately 80 percent of the pond being east of the bridge. Land use in the area of the pond consists of residential homes on Victory Road along the north and east side of the pond and a series of commercial building along Eastern Avenue at the pond's immediate southern bank (with parking lots extending to the water's edge). A strip mall exists at the intersection of Route 107 and Eastern Avenue. Approximately 6.0 acres of wetlands abut the pond's western edge.

MassDOT's jurisdiction of Route 107 begins at the southern end of Floating Bridge Pond and continues northeast across the Buchanan Bridge into Salem Center. The watershed of MassDOT's property directly contributing stormwater to Floating Bridge Pond is comprised of approximately 0.3 miles of Route 107, extending from the southern end of the bridge at Linton Road north approximately 0.3 miles (1,800 feet) to the high point near Belleaire Avenue (Figure 3). Land use in this area is characterized by dense residential development.

Stormwater along Route 107 within the MassDOT watershed is collected through a series of catch basins and is conveyed southwest through a closed drainage system until it directly discharges into Floating Bridge Pond at the northeast quadrant of the Buchanan Bridge. Existing site conditions along Route 107 are shown in Photo 1. Along the bridge, stormwater directly discharges into Floating Bride Pond through independent catch basins and outfalls (Photo 2).

Photo 1: Existing Stormwater Infrastructure Draining to Floating Bridge Pond

Photo 2: Bridge Outfall

Assessment under BMP 7U

The impairments for Floating Bridge Pond have not been addressed by a TMDL. Therefore, MassDOT assessed the 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
- phosphorus (total)
- turbidity

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MassDOT's Application of the Impervious Cover Method

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

Assessment

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 stormwater 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. IC 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 stormwater was a potential cause of the impairment, MassDOT calculated the degree to which IC 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 failing to meet the 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 IC 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 IC 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 IC reductions is described in BMP 7U. When the reduction in effective IC 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 Floating Bridge Pond (MA93024):

Table 1. Site Parameters for Floating Bridge Pond (MA93024)

Total Watershed		
Watershed Area	4,256	acres
Impervious Cover (IC) Area	1,751	acres
Percent Impervious	41.1	%
IC Area at 9% Goal	383	acres
Target Reduction % in IC	78.1	%
Subwatershed		
Watershed Area	264	acres
Impervious Cover (IC) Area	79	acres
Percent Impervious	29.9	%
IC Area at 9% Goal	24	acres
Target Reduction % in IC	69.9	%
Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area Directly Contributing to Impaired Segment	2.4	acres
MassDOT's Target Reduction in Effective IC (69.9% of DOT Directly Contributing IC)	1.7	acres

The subwatershed is greater than 9% impervious cover, indicating that stormwater likely contributes to the impairments assessed under this methodology. In order to reach the 9% target, effective IC within the subwatershed should be reduced by 69.9%. Therefore, MassDOT's target is to reduce effective IC within its own directly contributing watershed by the same percentage, or 1.7 acres.

Existing BMPs

There are no existing BMPs in the Floating Bridge Pond directly contributing watershed that are mitigating potential stormwater quality impacts prior to discharge to Floating Bridge Pond.

Mitigation Plan

No mitigation of impervious surface is achieved by existing BMPs. Therefore, MassDOT considered the implementation of additional BMPs to reach the target reduction of 1.7 acres.

Based on the review of MassDOT's directly contributing drainage area, no potential BMPs have been identified that can be implemented on MassDOT property to address the impairments of Floating Bridge Pond given the site constraint of limited property. Along Route 107 limited right-of-way and residential development adjacent to the road prevent implementation of stormwater infiltration BMPs.

Conclusions

MassDOT used the IC Method to assess Floating Bridge Pond for the impairments identified in MassDEP's final *Massachusetts Year 2010 Integrated List of Waters*. Results indicate that MassDOT should reduce its effective IC within its directly contributing subwatershed by 1.7 acres to achieve the targeted reduction in effective IC. MassDOT evaluated its property within the directly contributing watershed to Floating Bridge Pond to identify existing BMPs and found that no BMPs exist. This information is summarized in Table 2 below.

Table 2. Effective IC Reductions under Existing and Proposed Conditions

IC in Directly Contributing Watershed	2.4	acres
Target Reduction in Effective IC	1.7	acres
Effective IC Reduced by Existing BMPs	0.0	acres
Effective IC Reduced by Proposed BMPs	0.0	acres
IC Target Remaining	**1.7**	**acres**

MassDOT should reduce its effective IC within the directly contributing watershed by an additional 1.7 acres to achieve the targeted reduction in IC. However, site limitations in the Floating Bridge Pond subwatershed including limited right-of-way and residential development adjacent to MassDOT property do not allow for the construction of stormwater infiltration BMPs that would provide effective treatment of the impervious area for this location. Therefore, no further action will be taken as part of the Retrofit Initiative of the MassDOT Impaired Waters program.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative. 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 progress made towards meeting target IC reductions, plans for construction of additional BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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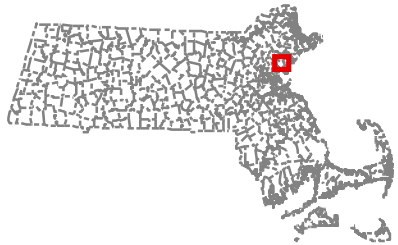

MassDOT Urban Area Roads
Floating Bridge Pond Subwatershed
Floating Bridge Pond Total Watershed
Impaired Water Bodies
Floating Bridge Pond
Impaired Stream Segments
Town Boundaries

N

0 2,000 4,000 8,000
Feet

Figure 1

Floating Bridge Pond (MA93024) Total and Sub Watershed

May 2013

Source: MassGIS, USGS 2009

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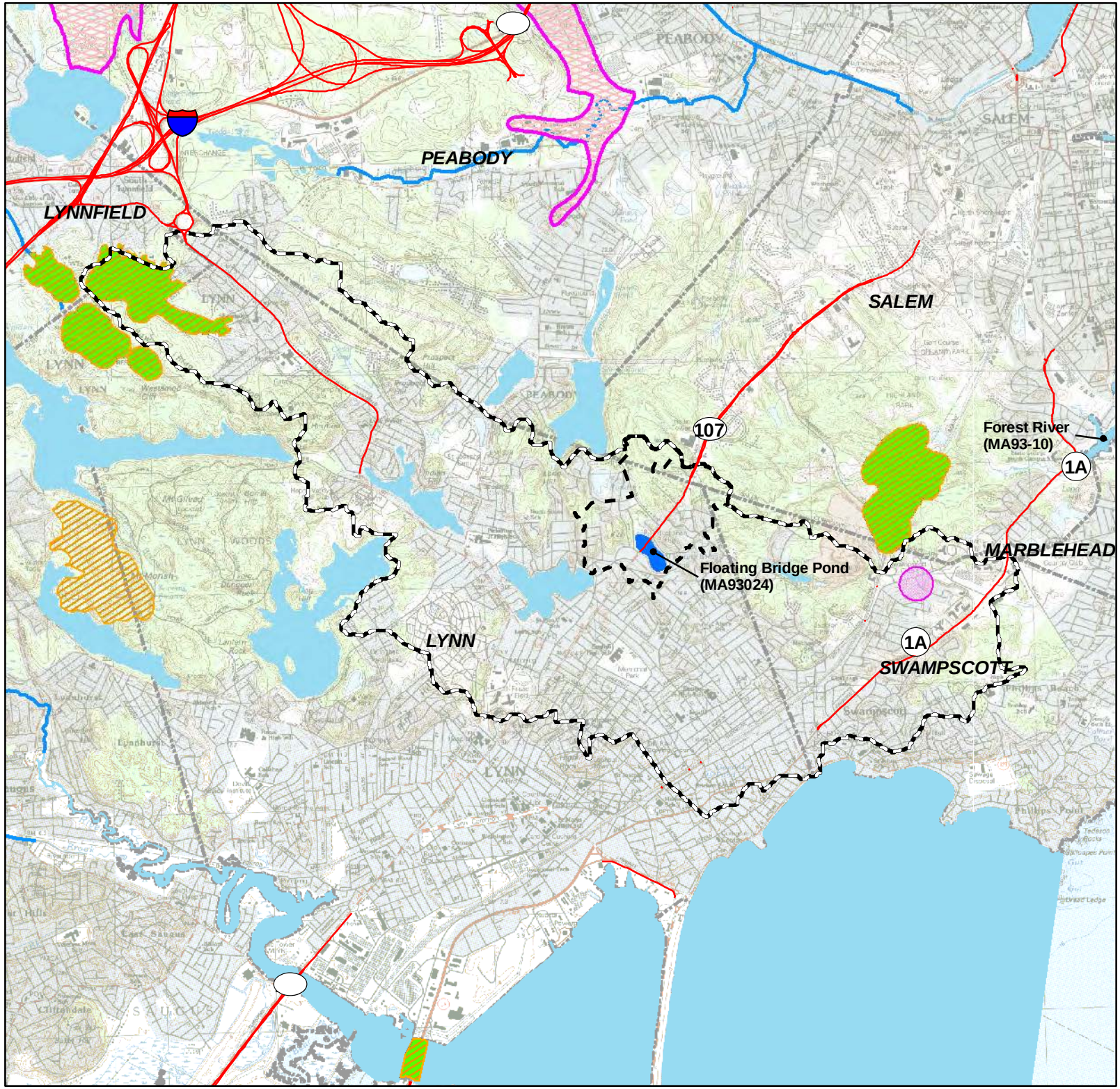
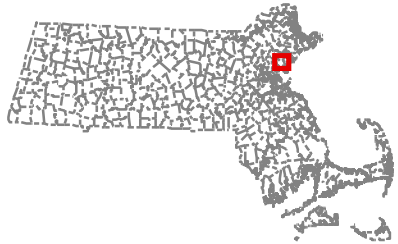
Highway Division





NHESP Estimated Habitats of Rare Species
NHESP Priority Habitats of Rare Species
DEP Interim Wellhead Protection Areas
DEP Zone II Wellhead Protection Areas
MassDOT Urban Area Roads
Floating Bridge Pond Subwatershed
Floating Bridge Pond Total Watershed
Impaired Water Bodies
Floating Bridge Pond
Impaired Stream Segments
Town Boundaries

N

0 2,000 4,000 8,000
Feet

Figure 2

Floating Bridge Pond (MA93024) NHESP Rare Species DEP Regulated Critical Areas

May 2013

Source: MassGIS, USGS 2009

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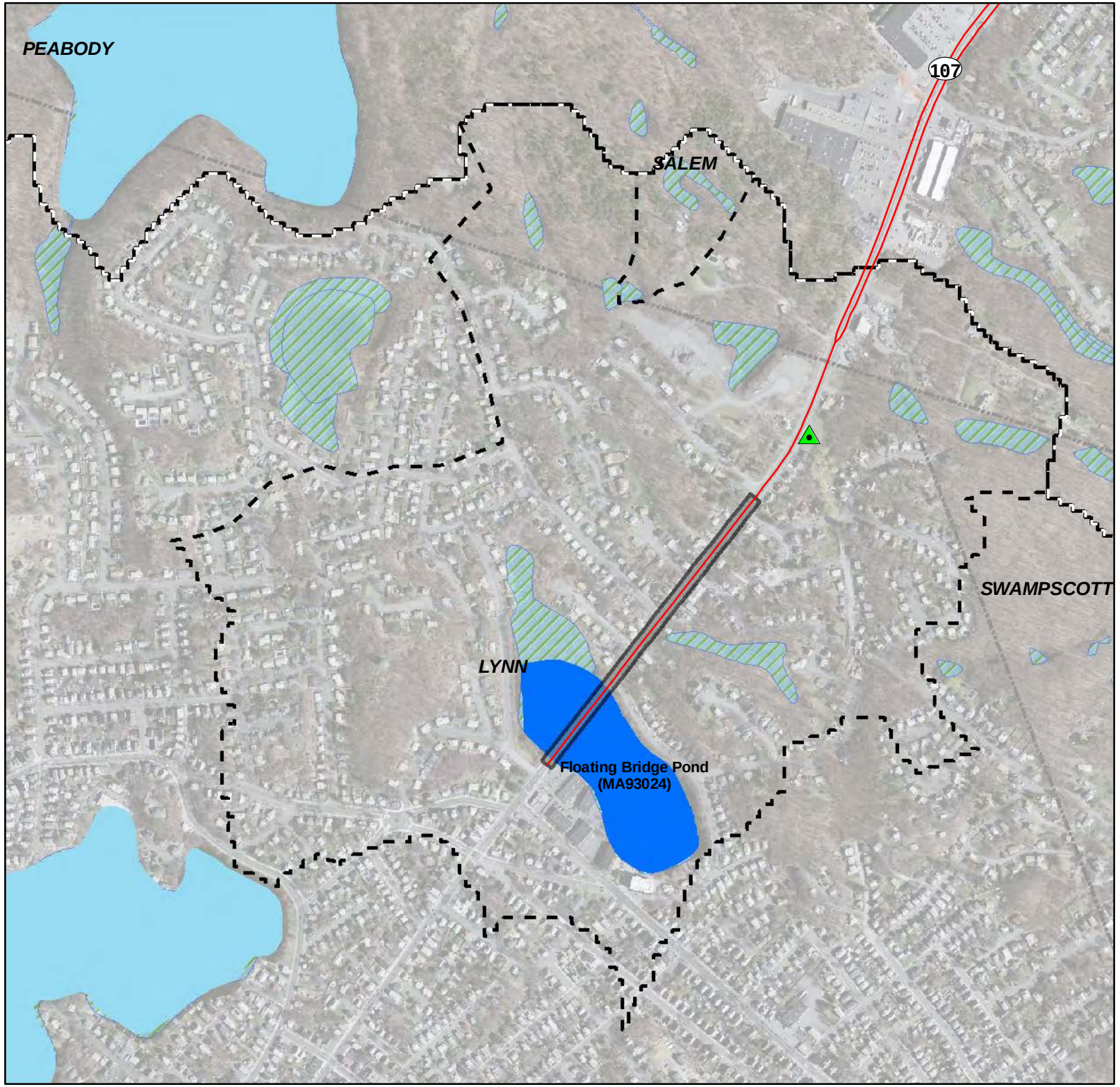
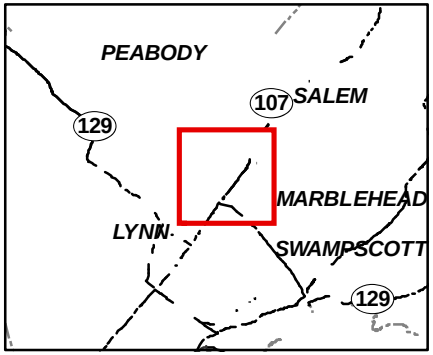
Highway Division





MassDOT Stormwater Outfalls
MassDOT Urban Area Roads
MassDOT Directly Contributing Watersheds
Floating Bridge Pond Subwatershed
Floating Bridge Pond Total Watershed
Impaired Water Bodies
Floating Bridge Pond
NWI Wetland Areas
Town Boundaries

N

0 350 700 1,400
Feet

Figure 3

Floating Bridge Pond (MA93024) Directly Contributing MassDOT Watershed

May 2013

Source: MassGIS, USGS 2009

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Massachusetts Department of Transportation
Highway Division