Attachment 1:

Impaired Waters Assessments – Final Reports (IC/TMDL)

Attachment 1 includes 8 completed assessments for 9 impaired water bodies that required a full assessment and were completed using either the IC or TMDL methodology. One of the assessments covers two water bodies.

List of Impaired Water Bodies

MA35017	Lake Denison*
MA35-01	Millers River*
MA41057	Pistol Pond*
MA70-02	Boston Inner Harbor
MA73-19	Beaver Brook*
MA74-18	Hingham Harbor* (submitted for MA70-08 Hingham Harbor, on Appendix L-1 list)
MA81046	Fort Pond*
MA93-54	Salem Harbor (covers two Appendix L-1 list assessment, MA93-21 and MA93-25)

*Not on original L-1 List.

6/08/2015

Impaired Waters Assessment for Lake Denison (MA35017)

Summary

Impaired Water[1]	Impairments:	Stormwater:	*Dissolved Oxygen*
		Non-Stormwater:[2]	*Mercury in Fish Tissue*
	Category:	*4A (TMDL is completed)*	
	Final TMDLs:	*Total Maximum Daily Loads of Phosphorus for Selected Millers Basin Lakes*[3]	
	WQ Assessment:	*Millers River Watershed 2000 Water Quality Assessment Report*[4]	
Location	Towns:	*Winchendon*	
	MassDOT Roads:	*Route 202, Main Street*	
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☐	
BMPs	Existing:	*None*	
MassDOT Area and Targets			Phosphorous
	Directly Contributing Load:		*3.7 lbs/yr*
	Contributing Area Target:		*5.4 lbs/yr*
	Existing BMPs Reduction:		*0.0 lbs/yr*
	Remaining Reduction to Meet Target:		*0.0 lbs/yr*

[1] MassDEP, March 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[3] MassDEP, May 2003. Total Maximum Daily Loads of Phosphorus for Selected Millers Basin Lakes. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/millers.pdf

[4] MassDEP, March 2004. Millers River Watersheds 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/35wqar.pdf

Site Description

Lake Denison (MA35017) is an 84-acre lake in Winchendon, Massachusetts. Lake Denison is fed by an unnamed stream from the north and three other unnamed streams from the east. Lake Denison outlets to an unnamed stream at the southwestern corner, which eventually flows to the Millers River (MA35-02). The total watershed and subwatershed for Lake Denison are the same and are approximately 6.3-square miles, as shown in Figure 1. Land use within the watershed is comprised of mostly forest, with other prominent uses being water, wetlands, and commercial/industrial.

MassDEP's Water Quality Assessment Report[5] for Lake Denison lists Primary Contact, Secondary Contact, and Aesthetics as "support" because they meet surface water quality standards. Fish Consumption is listed as "impaired" due to mercury. Aquatic Life is listed as "not assessed" for this waterbody. The EPA's *2012 Waterbody Report for Lake Denison*[6] lists Aquatic Life as "impaired" due to dissolved oxygen and Fish Consumption as "impaired" due to mercury. The source of the dissolved oxygen impairment is listed as "source unknown." The probable source of the mercury impairment is listed as "atmospheric depositions."

MassDOT-owned roadways within the total watershed include portions of Route 202 (Baldwinville State Road) and Main Street. Both roadways are shown to be alternating between roadways in urban areas and non-urban areas. As a conservative approach, MassDOT has considered roadways in both urban and non-urban areas to be contributing to Lake Denison. Main Street is located north of Lake Denison and does not directly contribute stormwater runoff to Lake Denison. Stormwater runoff sheet flows off the roadway into densely vegetated areas. Route 202 is located east of Lake Denison and runs in a general north-south direction. Route 202 is an uncurbed two-lane roadway, approximately 30 feet in width with relatively flat topography. There are three stream crossings along Route 202 that receive stormwater runoff from Route 202 and discharge to Lake Denison. Figure 2 illustrates the directly contributing area of Route 202 that discharges to the streams and are considered contributing to Lake Denison, as best determined from a site visit in March 2015 and record plans. At the stream crossings, runoff from Route 202 is either captured in catch basins and piped to the streams or directly discharges via overland flow. The southern-most stream passes under Route 202 through a concrete pipe, at the intersection with Alger Street. The middle stream passes under Route 202 through two concrete pipes, 1,600 feet north of Alger Street. The northern-most stream passes under Route 202 through a concrete pipe, 2,600 feet north of Alger Street.

Existing BMPs

MassDOT did not identify any existing BMPs in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the waterbody for the impairments covered by the TMDL under the BMP 7R methodology.[7] MassDOT separately assesses the

[5] MassDEP, March 2004. Millers River Watersheds 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/35wqar.pdf

[6] EPA, 2012, 2012 Waterbody Report for Lake Denison, Available at: http://ofmpub.epa.gov/tmdl_waters10/attains_waterbody.control?p_au_id=MA35017&p_cycle=2012&p_state=MA&p_report_type=

[7] MassDOT, July 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[8] MassDOT assessed Lake Denison (MA35017) using the methodologies described below.

MassDOT has identified a water body impairment in the Lake Denison watershed that is not related to stormwater runoff. This impairment is mercury in fish tissue. In accordance with MassDOT's *Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater* in the December 8, 2012 EPA submittal, the non-stormwater related impairments are not specifically addressed as part of the Impaired Waters Program.[2]

This assessment has been completed based on the *Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*.[1] MassDEP has released a proposed *Massachusetts Year 2014 Integrated List of Waters,* which has been reviewed for any proposed changes to the condition of the water bodies.[9] The condition of Lake Denison is not proposed to change.

BMP 7R for Phosphorus TMDL (CN 123.2)

The *Total Maximum Daily Load (TMDL) of Phosphorus for Selected Millers Basin Lakes (CN 123.2)* [3] addresses the impairment dissolved oxygen for this water body. Therefore, MassDOT assessed the contribution of phosphorus from MassDOT properties to this waterbody using the approach described in BMP 7R[7] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL and the Description of MassDOT's TMDL Method.[10] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Phosphorus
- Applicable Waste Load Allocation (WLA): See Tables 4.7 (Page 78) and V.7 (Page 110) of TMDL Report.
  - Description of Land Use Associated with Highways: Commercial/Industrial
  - Commercial/Industrial Land Use Current Load (TP): 62 kilograms per year (kg/yr)
  - Commercial/Industrial Land Use WLA (TP): 35 kg/yr
  - Percent Load Reduction (TP): 43.5%
  - Commercial/Industrial Area in Watershed: 0.09 square miles or 2.6% (based on total watershed area of 3.5 square miles.)
  - Commercial/Industrial Land Use Area WLA: 1.5 kilograms per hectare per year (kg/ha/yr) (1.3 pounds per acre per year (lbs/ac/yr)) (calculated)

[8] MassDOT, April 2010. BMP 7U: Water Quality Impaired Waters Assessment and Mitigation Plan. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[9] MassDEP, June 2014. Massachusetts Year 2014 Integrated List of Waters – Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/14iwlistp.pdf

[10] MassDOT, June 2012. Description of MassDOT's TMDL Method in BMP 7R. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year2/Attachment6.pdf

For the phosphorus assessment under BMP 7R, MassDOT used results from previously completed studies by the U.S. EPA[11] and the USGS[12] to estimate pollutant loads from its property and treatment through existing BMPs, if present. MassDOT has estimated the phosphorus loading from impervious areas as 1.6 lbs/acre/yr and from pervious areas as 0.6 lbs/acre/yr. Table 1 summarizes the loading analysis results and how the TMDL WLA applies to the MassDOT directly discharging area.

Table 1 Annual MassDOT Watershed Phosphorous Loading under Existing Conditions

Watershed/BMP ID	Watershed Size (acres)	Pre-BMP Annual Load (lbs/yr)	BMP Pollutant Load Reduction (lbs/yr)	Post-BMP Annual Load (lbs/yr)	Estimated Annual Removal Efficiency
Total Directly Contributing	4.1	3.7	0.0	3.7	0.0%
Contributing Area Target (WLA)[1]				5.4	

[1] MassDOT's Contributing Area Target (WLA) is developed by multiplying the applicable Land Use Area WLA defined in the TMDL by the MassDOT Directly Contributing Watershed Area.

No BMPs currently exist to treat stormwater from MassDOT's property directly discharging to Lake Denison (MA35017). Under existing conditions, MassDOT's estimated directly contributing annual phosphorus load does not exceed the TMDL target. Within the MassDOT directly contributing watershed there is far more pervious area than impervious area (100 foot right-of-way width with a 30 foot roadway width), resulting in the annual phosphorus load to be lower than the TMDL target.

Proposed Mitigation Plan

During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified opportunities for BMPs that could be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects meeting those requirements can be implemented under the Impaired Waters Program Retrofit initiative.

MassDOT has identified that additional control measures are not needed to reduce its phosphorus loading within the directly contributing watershed to achieve the targeted reduction because the annual phosphorus loading is lower than the TMDL target.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Lake Denison, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. 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 NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for

[11] Reckhow, Kenneth H., Michael N. Beaulac, and Jonathan T. Simpson, June 1980. Modeling Phosphorus Loading and Lake Response under Uncertainty: A Manual and Compilation of Export Coefficients. U.S. Environmental Protection Agency, EPA 440580011. Available at: http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=00001KWE.PDF

[12] Smith, Kirk P. and Gregory E. Granato, 2010. Quality of Stormwater Runoff Discharged from Massachusetts Highways, 2005-07. U.S. Geological Survey Scientific Investigations Report 2009-5269. Available at: http://pubs.usgs.gov/sir/2009/5269/disc_content_100a_web/sir2009-5269_s508.pdf

construction of BMPs, reduction achieved by finalized BMP designs and progress made toward meeting target phosphorus load reductions.

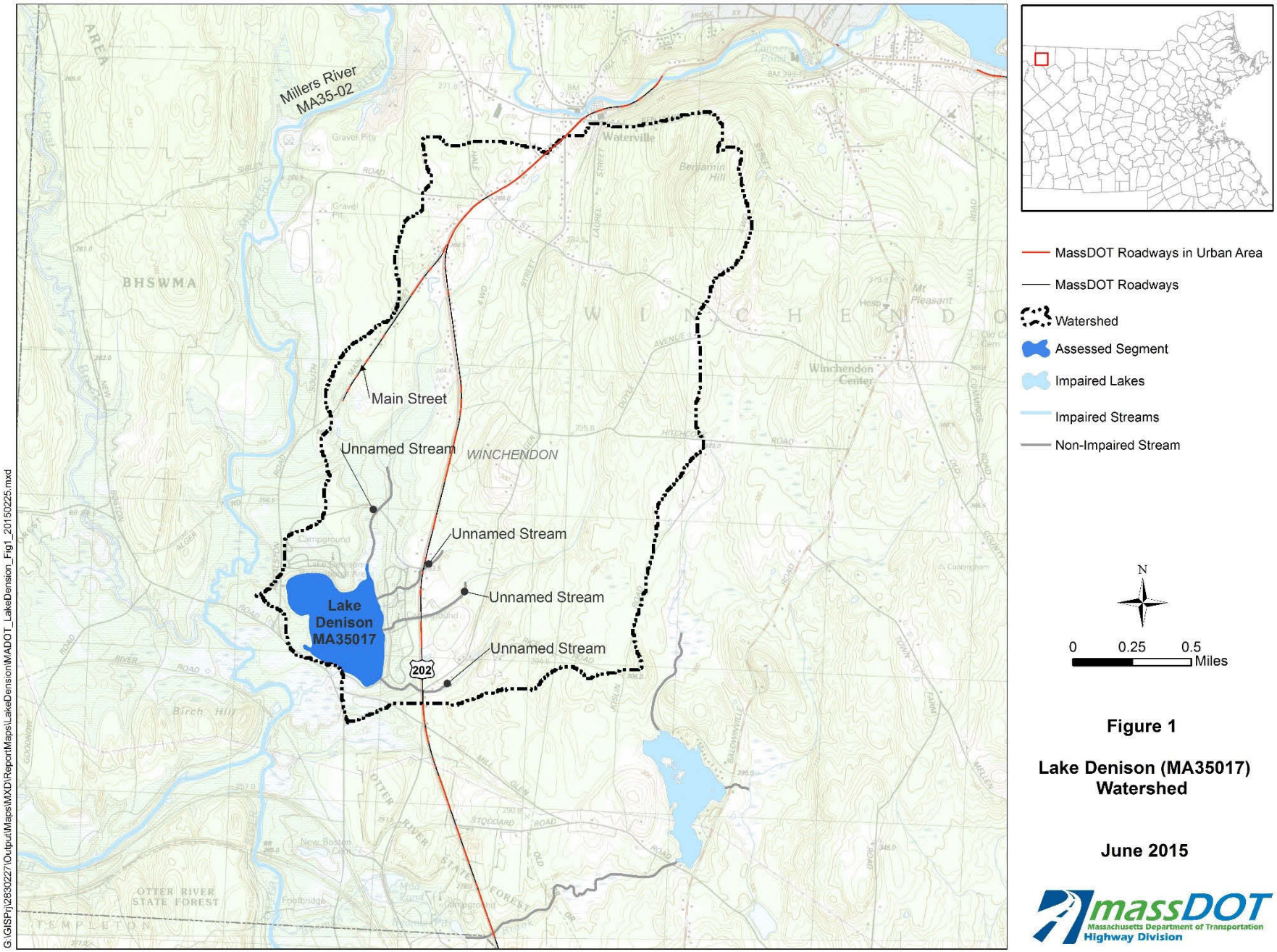

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Figure 1

Lake Denison (MA35017) Watershed

June 2015

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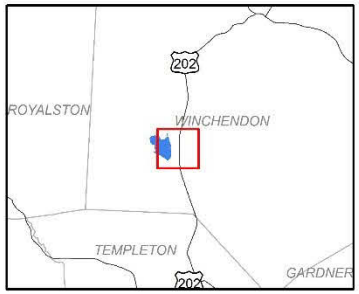

- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Watershed
- Assessed Segment
- Impaired Streams
- Non-Impaired Stream
- MassDOT Directly Discharging Area
- Potential Vernal Pools
- NHESP Priority & Estimated Habitats
- MADEP Wetlands

N

0 250 500 Feet

Figure 2

Lake Denison (MA35017)
Directly Contributing
MassDOT Watershed

June 2015

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Highway Division

6/08/2015

Impaired Waters Assessment for Millers River (MA35-01)

Summary

Impaired Water[1]	Impairments:	Stormwater:	*Ambient Bioassays – Chronic Aquatic Toxicity, Fecal Coliform, Phosphorus (Total)*
		Non-Stormwater:[2]	*PCB in Fish Tissue*
	Category:	*5 (Waters requiring a TMDL)*	
	Final TMDLs:	*None*	
	WQ Assessment:	*Millers River Watershed 2000 Water Quality Assessment Report*[3]	
Location	Towns:	*Winchendon*	
	MassDOT Roads:	*Route 12, Route 202, Route 119, Route 140*	
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒	
BMPs	Existing:	*None*	
MassDOT Area and Targets			Impervious Cover (IC)
	Directly Contributing Area:		*2.2 acres*
	Contributing Area Reduction Target:		*0.7 acres*
	Existing BMPs Reduction:		*0.0 acres*
	Remaining Reduction to Meet Target:		*0.7 acres*

Site Description

Millers River (MA35-01) is a 3.3-mile segment in Winchendon, Massachusetts. This segment of the Millers River begins at the outlet of Whitney Pond (MA35101) and flows in a westerly direction. The

[1] MassDEP, March 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[3] MassDEP, March 2004. Millers River Watersheds 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/35wqar.pdf

segment ends at the Winchendon Waste Water Treatment Plant, where Millers River (MA35-02) segment begins. Millers River is classified as Class B because it is designated as a habitat for fish and is used for primary and secondary contact recreation. This segment is also a Cold Water Fishery with Combined Sewer Overflows (CSOs). According to the *Millers River Watershed 2000 Water Quality Assessment Report*[3] the CSO designation for this segment of the Millers River should be removed in future Massachusetts Surface Water Quality Standards since overflows from the collection system were eliminated in December 2003. The total watershed and subwatershed to Millers River are located in both New Hampshire and Massachusetts, as shown in Figure 1A. The total watershed is approximately 83 square miles and the subwatershed is approximately 4 square miles. Land use within the Massachusetts portion of the watershed is comprised of mostly forest, with other prominent land uses being residential and wetlands.

MassDEP's *Millers River Watershed 2000 Water Quality Assessment Report*[3] for Millers River lists Aquatic Life and Fish Consumption as "impaired". The impairment status of Aquatic life is due to ambient bioassay, chronic aquatic toxicity and the source of the impairment is listed as "source unknown". The impairment of Fish Consumption is due to mercury in the upper 0.8-mile reach and mercury and PCBs in the lower 2.4-mile reach. The source of the mercury impairment is listed as "source unknown" and the source of the PCBs is due to contaminated sediments and releases from waste sites or dumps. A suspected source of the mercury impairment is atmospheric deposition. Primary Contact, Secondary Contact, and Aesthetics are listed as "not assessed" for this waterbody.

MassDOT-owned roads within the subwatershed includes portions of Route 202 and Route 12, as shown in Figure 1B. The MassDOT-owned portion of Route 12 is a bridge over Millers River between Lake Street and Water Street. Route 12 is a two-lane roadway with curbing and a sidewalk on one side over the bridge. Route 202 is a two-lane roadway and runs parallel to the Millers River for approximately 0.5 miles within the subwatershed. The right-of-way along this section of Route 202 is generally 45 feet wide. Each lane is 12 feet wide with a 4-foot shoulder. There is a 5-foot sidewalk with curbing on the southbound side of the roadway. There is also guardrail along various portions of this section of Route 202. Runoff along Route 202 is captured in drop inlets and catch basins and then is directly discharged to Millers River in several locations. See Figure 2 for outfall locations along Route 202.

Existing BMPs

MassDOT did not identify any existing BMPs in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the waterbody for the impairments covered by the TMDL under the BMP 7R methodology.[4] MassDOT separately assesses the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[5] MassDOT assessed Millers River (MA35-01) using the methodologies described below.

[4] MassDOT, July 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[5] MassDOT, April 2010. BMP 7U: Water Quality Impaired Waters Assessment and Mitigation Plan. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

MassDOT has identified a water body impairment in the Millers River watershed that is not related to stormwater runoff. This impairment is PCB in fish tissue. In accordance with MassDOT's *Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater* in the December 8, 2012 EPA submittal, the non-stormwater related impairments are not specifically addressed as part of the Impaired Waters Program.[2]

This assessment has been completed based on the *Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*.[1] MassDEP has released a proposed *Massachusetts Year 2014 Integrated List of Waters,* which has been reviewed for any proposed changes to the condition of the water bodies.[6] The condition of Millers River is not proposed to change.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7U[7] of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body not covered by a final TMDL.

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7U Pathogen Methodology.[8]

BMP 7U for Impervious Cover Related Impairments

A final TMDL is not in place to address Millers River's (MA35-01) following impairments: ambient bioassays – chronic aquatic toxicity and phosphorus (total). Therefore, MassDOT assessed the stormwater-related impairments not addressed by a TMDL using the approach outlined in the Description of MassDOT's Application of Impervious Cover Method in BMP 7U[7] which was developed using the EPA Region I's Impervious Cover (IC) Method, described in EPA's Stormwater TMDL Implementation Support Manual.[9] 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 calculated the following values for the total contributing watershed and the subwatershed of the impaired water (Millers River) to determine the IC area and set a reduction target. Watersheds are based on the USGS Dataset 451[10] and modified as necessary using topography. MassGIS's

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[6] MassDEP, June 2014. Massachusetts Year 2014 Integrated List of Waters – Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/14iwlistp.pdf

[7] MassDOT, April 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/IC_MethodApplication2011Apr6.pdf

[8] MassDOT, December 2014. Description of MassDOT's Application of BMP 7U for Pathogen Related Impairments. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year5/Attachment5.pdf

[9] ENSR, March 2006. Stormwater TMDL Implementation Support Manual for US EPA Region 1. ENSR International & EPA Region 1, Boston, MA. Available at http://www.epa.gov/region1/eco/tmdl/pdfs/Stormwater-TMDL-Implementation-Support-Manual.pdf

[10] USGS Data Series 451 Local and Cumulative Impervious Cover of Massachusetts Stream Basins Available at: http://pubs.usgs.gov/ds/451/

impervious surfaces data layer[11] was used to determine the IC of the watersheds. The total watershed and the subwatershed are shown in Figures 1A and 1B.

Table 1 Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	54,421 acres	2,394 acres
Impervious Cover (IC) Area	2,429 acres	323 acres
Percent Impervious	4.5%	13.5%
IC Area at 9% Effective IC Target	4,898 acres	216 acres
Target Effective IC Reduction	0%	33%

The subwatershed's percent impervious is greater than 9%, indicating that stormwater is a likely contributor to the impairment. To meet the 9% effective IC target, the effective IC within the subwatershed will need to be reduced by the percentage calculated in Table 1. MassDOT then uses the same target percent reduction for their directly contributing watershed as shown in Table 2.

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	2.6 acres
Directly Contributing IC Area	2.2 acres
Percent Impervious	85%
Directly Contributing Area Effective IC Reduction Target (33% Target Effective IC Reduction of MassDOT Directly Contributing IC Area)	0.7 acres
Target Effective IC	58%
Target Effective IC	1.5 acres

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 practical given site constraints.

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

Proposed Mitigation Plan

During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified opportunities for BMPs that could be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects meeting those requirements can be implemented under the Impaired Waters Program Retrofit initiative.

[11] MassGIS Impervious Surfaces datalayer taken from 2005 orthoimagery. Available at: http://www.mass.gov/mgis/impervious_surface.htm

Site limitations in the Millers River watershed include limited right-of-way and steep slopes. With the right-of-way generally being 45 feet wide through this section of Route 202 there is only a total of approximately 8 feet of available space beyond the roadway and sidewalk (about 4 feet on either side). Additionally, along the southbound side of Route 202 the existing outfalls are located on steep slopes and are beyond the state highway layout. Runoff from the Route 12 bridge flows towards catch basins located outside of the state highway layout.

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 Millers River given the site constraints.

With respect to the fecal coliform impairment, 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. As discussed in MassDOT's BMP 7U Pathogen Methodology, MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements in regard to pathogens.

In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the subwatershed of this water body. MassDOT will be installing signs at rest stops within the subwatersheds of pathogen impaired waterbodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

MassDOT has concluded that the BMPs outlined in the SWMP are consistent with its existing permit requirements for Millers River (MA35-01). These measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from MassDOT roadways to be a contributing source it is unlikely to warrant action relative to other sources of pathogens in the watershed.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Millers River, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. 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 NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, and reduction achieved by finalized BMP designs.

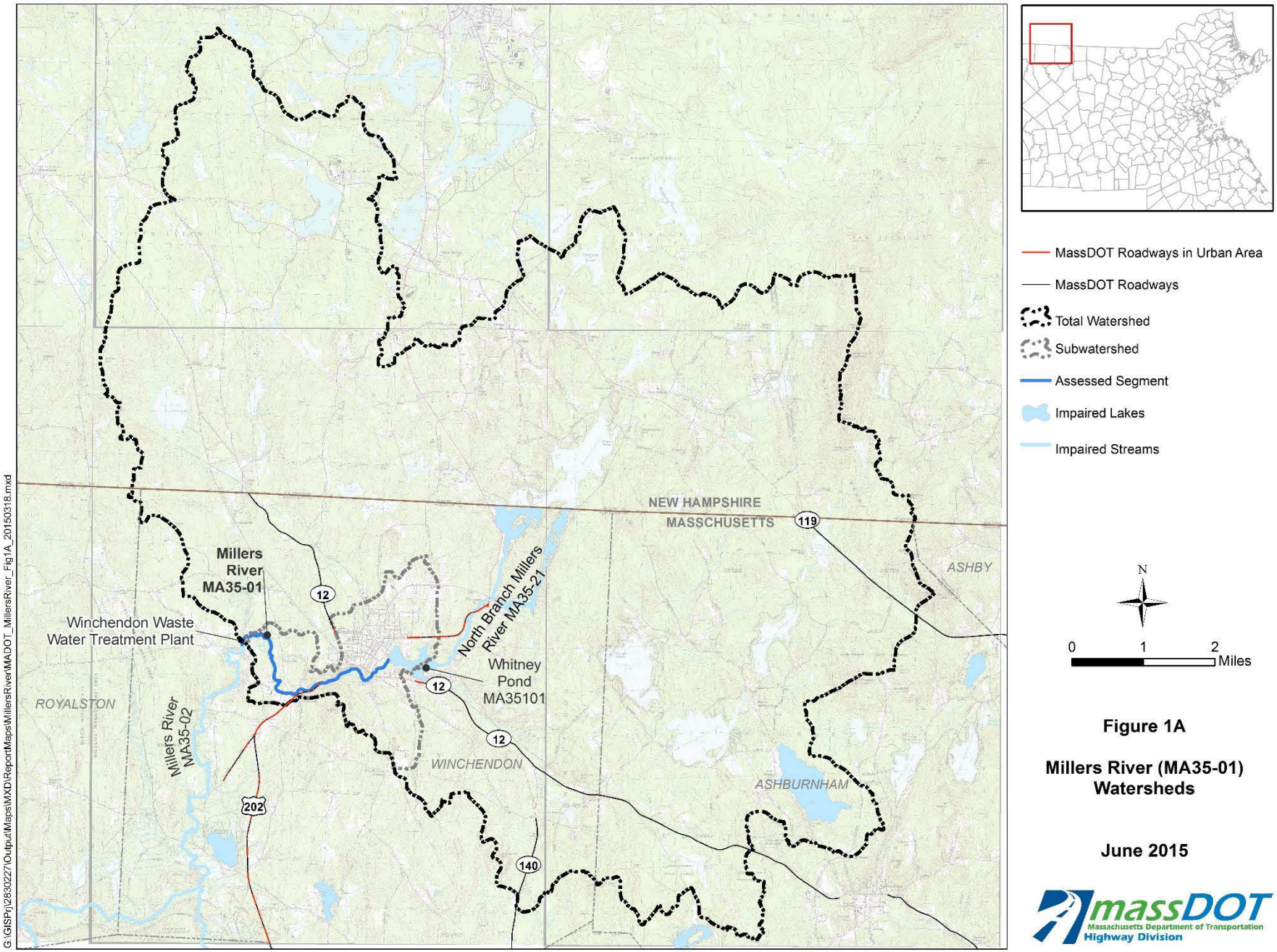

Figure 1A

Millers River (MA35-01) Watersheds

June 2015

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Highway Division

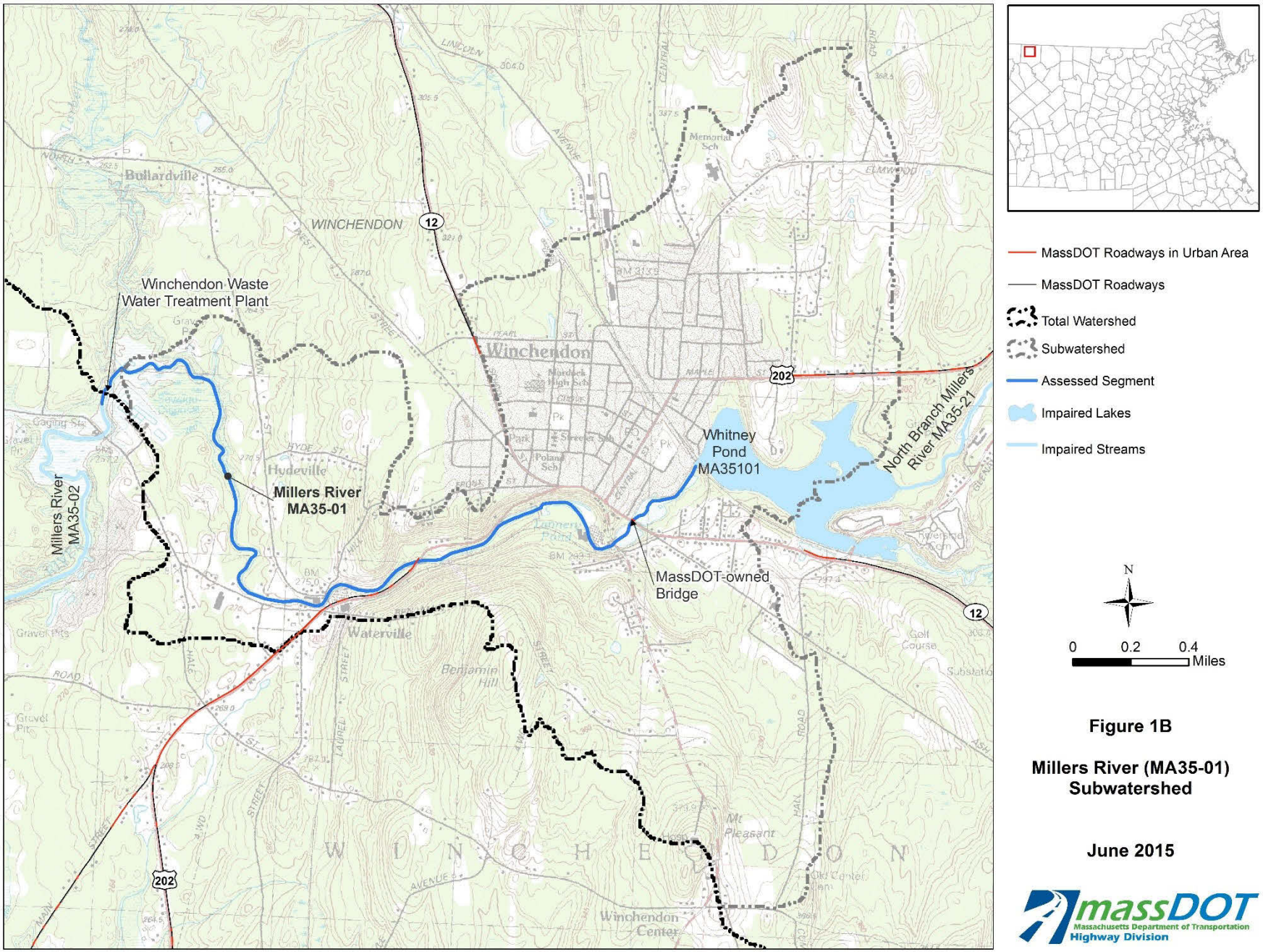

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Figure 1B

Millers River (MA35-01) Subwatershed

June 2015

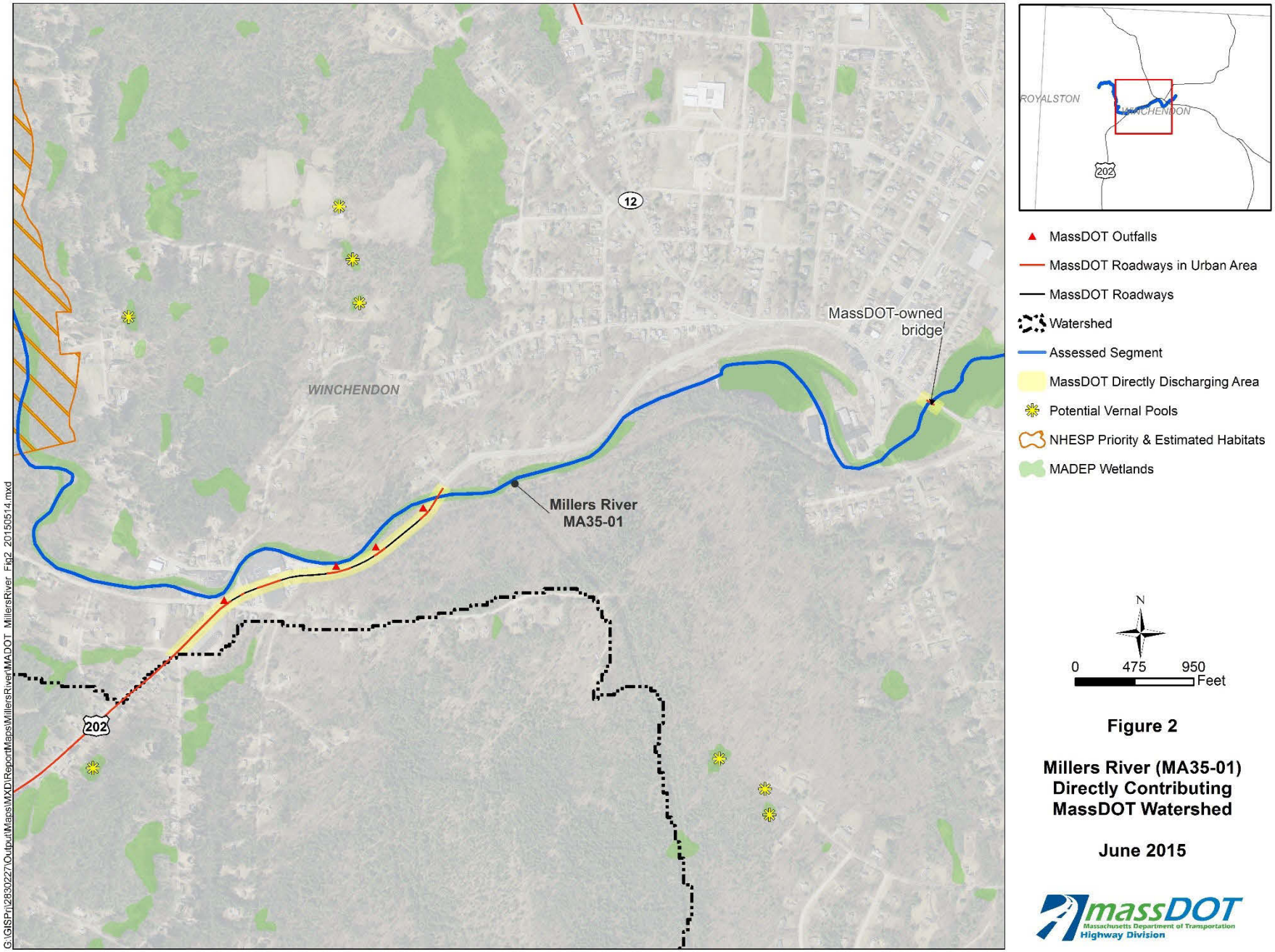


Figure 2

Millers River (MA35-01) Directly Contributing MassDOT Watershed

June 2015

06/08/2015

Impaired Waters Assessment for Pistol Pond (MA41057)

Summary

Impaired Water[1]	Stormwater Impairments:	*Aquatic Plants (Macrophytes), Dissolved Oxygen, Secchi Disk Transparency*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*None*
	WQ Assessment:	*French and Quinebaug River Watersheds 2004-2008 Water Quality Assessment Report*[2]
Location	Towns:	*Sturbridge*
	MassDOT Roads:	*Interstate 84, Interstate 90, Route 20 and Route 49*
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*

MassDOT Area and Targets	Impervious Cover (IC)
Directly Contributing Area:	*5.5 acres*
Contributing Area Reduction Target:	*2.5 acres*
Existing BMPs Reduction:	*0.0 acres*
Remaining Reduction to Meet Target:	*2.5 acres*

Site Description

Pistol Pond (MA41057) is located southeast of the Interstate 84 and Route 20 interchange in Sturbridge, Massachusetts. Pistol Pond has a surface area of approximately 5 acres which receives flows from Hobbs Brook along its northern bank via a culvert under Route 20. Flows exit the pond at its southern bank into Hobbs Brook which travels southwest for approximately 1.4 miles to its confluence with Quinebaug River (MA41-02).

[1] MassDEP, March 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDEP, November 2009. French and Quinebaug River Watersheds 2004-2008 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/3baapp/4142wqar04.pdf

MassDEP's *French and Quinebaug River Watersheds 2004-2008 Water Quality Assessment Report*[2] has identified the Aquatic Life use with an "impaired" status due to extremely low dissolved oxygen conditions. The likely contributors to this condition are the proximity of major roadways as well as the extensive wetlands associated with the waterbody. Additionally, moderate to high chlorophyll a concentrations are possible indicators of algal blooms. Due to low Secchi disk transparency, the Primary Contact, Secondary Contact, and Aesthetics uses have been classified as "impaired". The suspected source of this impairment is stormwater runoff from surrounding roads, highways and bridges. The Fish Consumption use was "not assessed".

The total watershed and subwatershed of Pistol Pond are shown on Figure 1A totaling approximately 3.8 square miles and 890 acres respectively and are located in Charlton, East Brookfield and Sturbridge, Massachusetts. Since MassDEP's *French and Quinebaug River Watersheds 2004-2008 Water Quality Assessment Report*[2] states one of the likely contributors of the impairment being the proximity of major roadways, and due to the substantial presence of adjacent roadways, a finer delineation of the subwatershed to Pistol Pond was completed. Figure 1B shows the MassDOT-owned roadways in the Pistol Pond subwatershed, which include Interstate 84, Interstate 90, Route 20 and Route 49. MassDOT's only urban property within the subwatershed to Pistol Pond is a portion of Route 20. While MassDOT is only required to review their urban roadways, due to the findings in the report, MassDOT is taking the conservative approach and is reviewing both urban and non-urban roadways directly discharging to Pistol Pond. The watershed to Pistol Pond is comprised of wetland areas, water surfaces, low density residential areas and commercial areas with a majority of the watershed consisting of forested land.

Figure 2 shows the MassDOT directly discharging area, the limits of which were determined by the existing drainage infrastructure and roadway high points. Route 20 eastbound, west of Pistol Pond, consists of three lanes that merge into two with variable width shoulders. Stormwater runoff from this section of Route 20 is collected by catch basin along both edges of the roadway. Flows entering the drainage infrastructure on the southern edge of Route 20 are discharged to a manmade drainage channel and conveyed directly to the northwestern bank of Pistol Pond. Flows entering the drainage infrastructure on the northern edge of Route 20 are conveyed to a MassDOT stormwater outfall that directly discharges into Pistol Pond at its northwestern bank.

The on-ramp to Interstate 84 eastbound from Route 20 westbound consists of one 22-foot travel lane while Route 20 westbound west of this ramp consists of two travel lanes and variable width shoulders. Stormwater runoff from these sections of roadway is collected by catch basins along the edge of the road and are discharged to a wetland system north of Route 20 that is synonymous with Pistol Pond. The Route 20 right-of-way width east of the off-ramp from Interstate 84 eastbound is variable, and consists of four travel lanes, a turning lane and variable width shoulders. Stormwater runoff from this section of roadway is collected by catch basins along both edges of the road, and is conveyed to MassDOT stormwater outfalls that discharge directly into Pistol Pond.

It appears there is room in the southern shoulder of Route 20 eastbound west of Pistol Pond, in the infield area between Route 20 westbound and eastbound, as well as in the infield area between Route 20 westbound, the off-ramp from Route 20 westbound to Interstate 84 eastbound and the off-ramp from Interstate 84 to Route 20 westbound to install a BMP.

Existing BMPs

MassDOT did not identify any existing BMPs in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the waterbody for the impairments covered by the TMDL under the BMP 7R methodology.[3] MassDOT separately assesses the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[4] MassDOT assessed Pistol Pond (MA41057) using the methodologies described below.

This assessment has been completed based on the *Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*.[1] MassDEP has released a proposed *Massachusetts Year 2014 Integrated List of Waters,* which has been reviewed for any proposed changes to the condition of the water bodies.[5] The condition of Pistol Pond is not proposed to change.

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Pistol Pond's (MA41057) following impairments: aquatic plants (macrophytes), dissolved oxygen and secchi disk transparency. Therefore, MassDOT assessed the stormwater-related impairments not addressed by a TMDL using the approach outlined in the Description of MassDOT's Application of Impervious Cover Method in BMP 7U[6] which was developed using the EPA Region I's Impervious Cover (IC) Method, described in EPA's Stormwater TMDL Implementation Support Manual.[7] 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 calculated the following values for the total contributing watershed and the subwatershed of the impaired water (Pistol Pond) to determine the IC area and set a reduction target. Watersheds are based on the USGS Dataset 451[8] and modified as necessary using topography. MassGIS's impervious surfaces data layer[9] was used to determine the IC of the watersheds. The total watershed and the subwatershed are shown in Figures 1A and 1B.

[3] MassDOT, July 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[4] MassDOT, April 2010. BMP 7U: Water Quality Impaired Waters Assessment and Mitigation Plan. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[5] MassDEP, June 2014. Massachusetts Year 2014 Integrated List of Waters – Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/14iwlistp.pdf

[6] MassDOT, April 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/IC_MethodApplication2011Apr6.pdf

[7] ENSR, March 2006. Stormwater TMDL Implementation Support Manual for US EPA Region 1. ENSR International & EPA Region 1, Boston, MA. Available at http://www.epa.gov/region1/eco/tmdl/pdfs/Stormwater-TMDL-Implementation-Support-Manual.pdf

[8] USGS Data Series 451 Local and Cumulative Impervious Cover of Massachusetts Stream Basins Available at: http://pubs.usgs.gov/ds/451/

[9] MassGIS Impervious Surfaces datalayer taken from 2005 orthoimagery. Available at: http://www.mass.gov/mgis/impervious_surface.htm

Table 1 Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	3,402 acres	886 acres
Impervious Cover (IC) Area	225 acres	142 acres
Percent Impervious	6.6%	16.0%
IC Area at 9% Effective IC Target	306 acres	80 acres
Target Effective IC Reduction	0%	44%

While the total watershed is less than 9%, the subwatershed's percent impervious is greater than 9%, indicating that stormwater is a likely contributor to the impairment of this segment. To meet the 9% effective IC target, the effective IC within the subwatershed will need to be reduced by the percentage calculated in Table 1. MassDOT then uses the same target percent reduction for their directly contributing watershed as shown in Table 2.

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	14.5 acres
Directly Contributing IC Area	5.6 acres
Percent Impervious	39%
Directly Contributing Area Effective IC Reduction Target (44% Target Effective IC Reduction of MassDOT Directly Contributing IC Area)	2.5 acres
Target Effective IC	22%
Target Effective IC	3.1 acres

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 practical given site constraints.

This assessment has identified locations for potential stormwater BMPs. The Proposed Mitigation Plan describes the next steps for the potential BMPs to reduce the effective IC.

Proposed Mitigation Plan

During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified opportunities for BMPs that could be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects meeting those requirements can be implemented under the Impaired Waters Program Retrofit initiative.

MassDOT has identified that additional control measures are needed to reduce its effective IC within the directly contributing watershed to achieve the targeted reduction and that appropriate locations are potentially available for control measures. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat stormwater runoff from directly contributing IC as part of MassDOT's Impaired Waters Retrofit Initiative. The project designer will

gather additional information in this phase, such as soil data, wetland delineations, and site survey, to further refine the proposed BMPs. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction to the maximum extent practical.

Once the design of the proposed BMPs is finalized, MassDOT will provide an update in the NPDES permit annual report with BMP information and summarize the final effective IC reduction.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Pistol Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. 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 NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs and reduction achieved by finalized BMP designs.

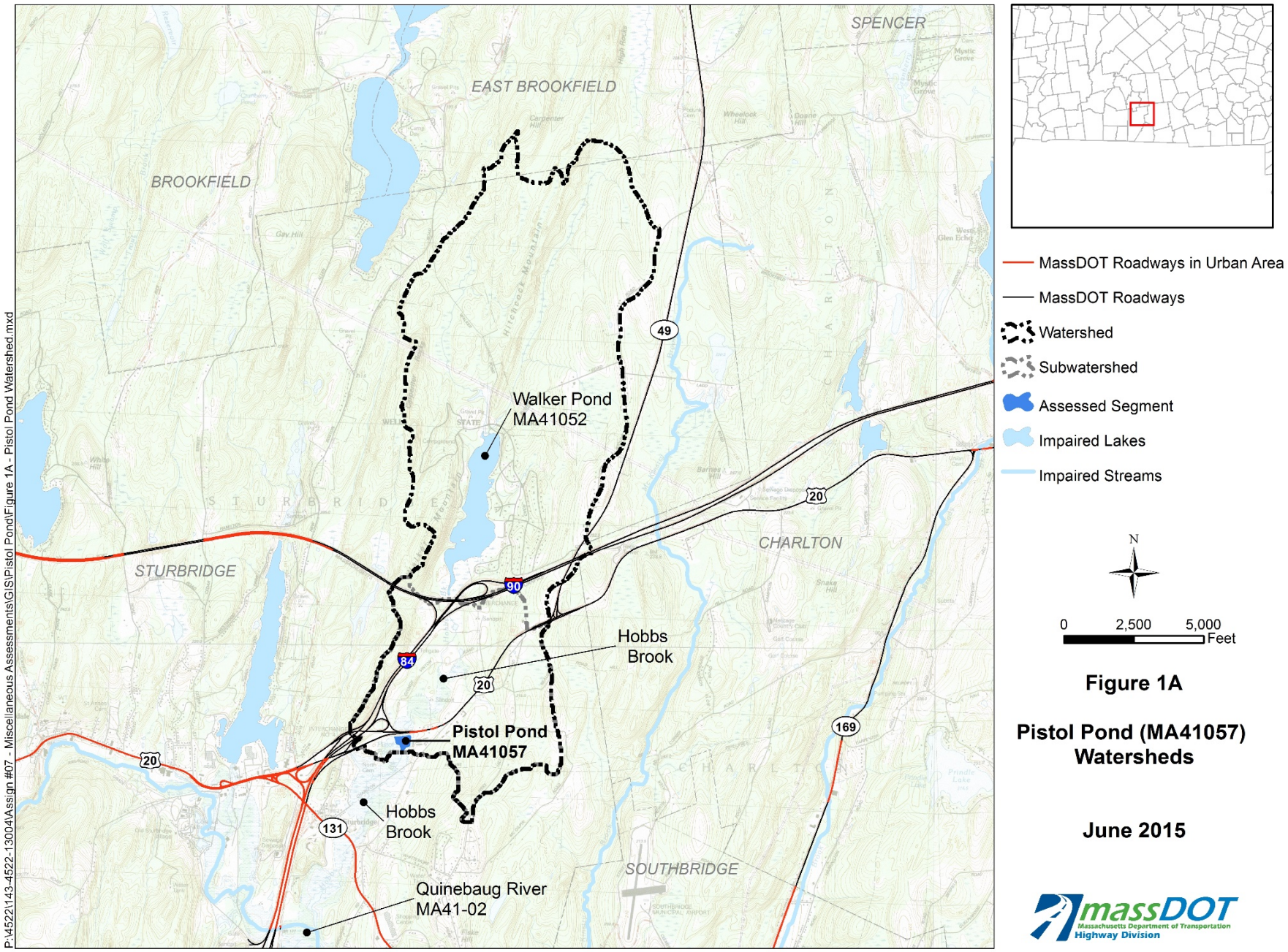
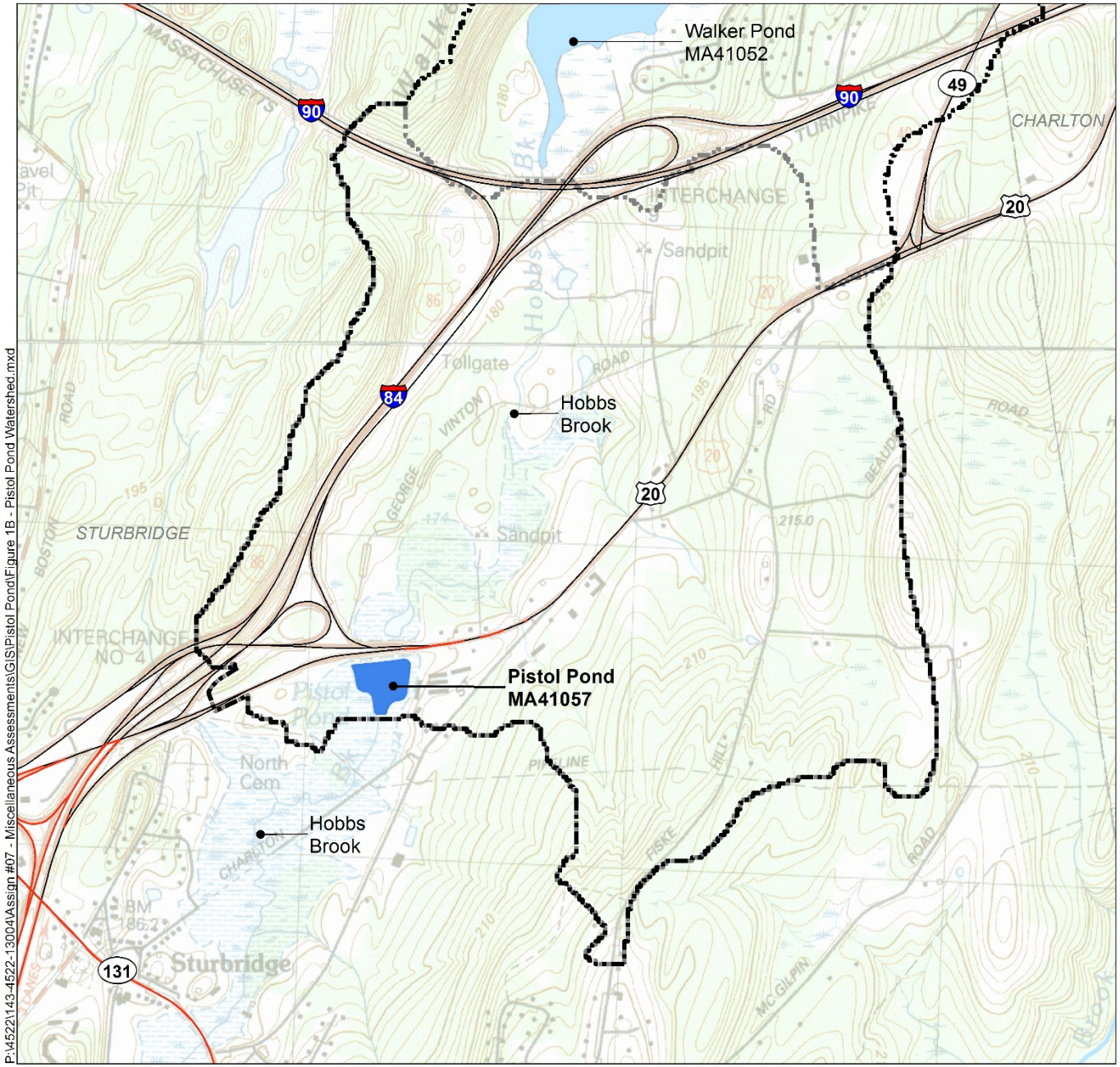
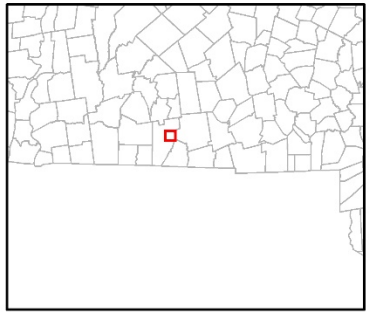


Figure 1A

Pistol Pond (MA41057) Watersheds

June 2015





MassDOT Roadways in Urban Area

MassDOT Roadways

Watershed

Subwatershed

Assessed Segment

Impaired Lakes

N

0 800 1,600 Feet

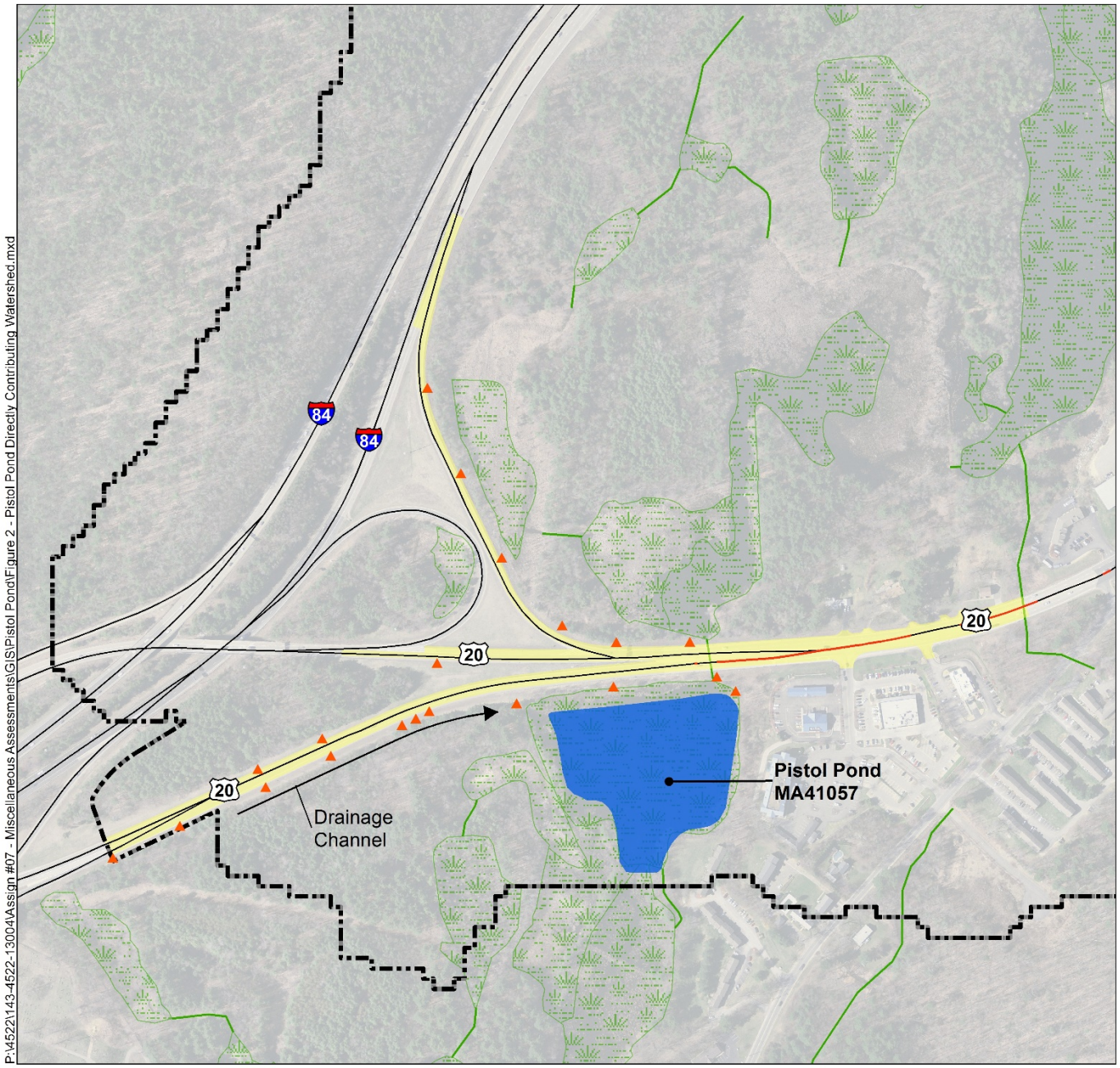
Figure 1B

Pistol Pond (MA41057) Subwatershed

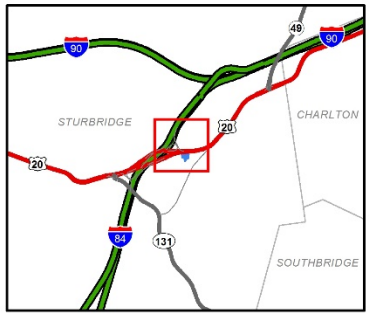
June 2015

massDOT
Massachusetts Department of Transportation
Highway Division

P:\45221\143-4522-13004\Assign #07 - Miscellaneous Assessments\GIS\Pistol Pond\Figure 1B - Pistol Pond Watershed.mxd



P:\4522\1143-4522-13004\Assign #07 - Miscellaneous Assessments\GIS\Pistol Pond\Figure 2 - Pistol Pond Directly Contributing Watershed.mxd



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Watershed
- Subwatershed
- Assessed Segment
- MassDOT Directly Discharging Area
- DEP Wetlands
- Hydrologic Connection

N

0 250 500 Feet

Figure 2

Pistol Pond (MA41057)
Directly Contributing
MassDOT Watershed

June 2015

MassDOT
Massachusetts Department of Transportation
Highway Division

06/08/2015

Impaired Waters Assessment for Boston Inner Harbor (MA70-02)

Summary

Impaired Water[1]	Impairments:	Stormwater:	*Enterococcus, Fecal Coliform, Other, Dissolved Oxygen*
		Non-Stormwater:[2]	*PCB in Fish Tissue*
	Category:	*5 (Waters requiring a TMDL)*	
	Final TMDLs:	*None*	
	WQ Assessment:	*Boston Harbor 2004 – 2008 Water Quality Assessment Report*[3]	
Location	Towns:	*Boston*	
	MassDOT Roads:	*I-90, I-93, Route 1, Route 1A, Albany Street, B Street, Bradston Street, Congress Street, Frontage Road, Haul Road, Massachusetts Avenue Connector, West Fourth Street*	
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒	
BMPs	Existing:	*6 Gravel Detention Basins, 1 Bioretention Basin, 2 Water Quality Swales, 2 Filterra Structures, and 16 Stormceptors*	
MassDOT Area and Targets			Impervious Cover (IC)
	Directly Contributing Area:		*236.8 acres*
	Contributing Area Reduction Target:		*211.3 acres*
	Existing BMPs Reduction:		*7.8 acres*
	Remaining Reduction to Meet Target:		*203.5 acres*

[1] MassDEP, March 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[3] MassDEP, 2010. Boston Harbor 2004 – 2008 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/3baapp/70wqar08.pdf

Site Description

Boston Inner Harbor (MA70-02) is defined as the water body beginning from the Mystic and Chelsea Rivers (Chelsea/Boston) and extending to the line between Governors Island and Fort Independence (East Boston/South Boston), including the Fort Point, Reserved, and Little Mystic Channels in Boston, Massachusetts. Boston Inner Harbor is located within the Boston Harbor Watershed and is approximately 2.6 square miles in size.

According to the *Boston Harbor 2004 – 2008 Water Quality Assessment Report,*[3] the Aquatic Life Use within Fort Point Channel is "impaired" due to low dissolved oxygen concentrations in the channel. The Fish Consumption Use is assessed as "impaired" due to the current MA DPH fish consumption advisory resulting from elevated levels of PCB in fish tissue and other contaminants in fish/shellfish. The Shellfish Harvesting Use is assessed as "impaired" based on elevated fecal coliform bacteria counts. Primary and Secondary Contact Recreation and Aesthetic Uses are assessed as "impaired" in Fort Point Channel due to elevated enterococci bacteria. The remaining portions of Boston Inner Harbor are assessed as "support" for Primary and Secondary Contact. Suspected sources of the impairments include: wet weather discharges (point source, sanitary sewer overflows (SSO) and combined sewer overflows (CSO)), MS4 discharges, industrial point source discharges, upstream sources, contaminated sediments, and discharges from biosolids (sludge) storage.

Boston Inner Harbor's total watershed covers approximately 387 square miles and is shown in Figure 1A. The watershed has diverse land use coverage including residential, commercial, industrial, transportation, and forest land use types. The subwatershed is shown in Figure 1B and covers approximately 8.8 square miles and lies completely within Boston city limits. Land use within the subwatershed is almost completely urban and consists of residential, commercial, industrial, and transportation land use types.

The subwatershed to Boston Inner Harbor was delineated using multiple available data sources, including Boston Water and Sewer Commission (BWSC) and Massachusetts Water Resources Authority (MWRA) reports and evaluations described below. As preliminary guidance in delineating the extent of the subwatershed, MassDOT used the drainage area delineation to Fort Point Channel completed as part of a BWSC Fort Point Channel Hydraulic Evaluation and Water Quality Assessment. MassDOT then analyzed how the Fort Point Channel delineation compared with MassDOT's previous delineation to Dorchester Bay (MA70-03) as part of the Dorchester Bay Impaired Waters Assessment.[4] The delineation of Dorchester Bay's subwatershed involved an in-depth review of the BWSC storm drain and CSO drainage networks. MassDOT then refined the subwatershed delineation to Boston Inner Harbor using BWSC's storm drain and CSO networks, which were available in GIS format. MassDOT utilized the network trace capabilities of the data to trace all upstream drainage networks which outfall to Boston Inner Harbor.

A significant portion of the stormwater infrastructure owned and operated by MassDOT within the Boston Inner Harbor directly contributing watershed outlets through CSOs. For this assessment, MassDOT assumed that all CSO systems which outfall to Boston Inner Harbor should be included within the subwatershed as directly contributing. This is based on the conclusion offered by BWSC

[4] MassDOT, 2013. Year 4 Impaired Waters Assessments – Impaired Waters Program. Dorchester Bay (MA70-03). Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attach_2.pdf

that “the potential for a CSO discharge increases when the amount of rainfall exceeds 0.5 inches,” which implies that CSO discharges could occur for rain events greater than or equal to 0.5 inches.[5]

Some of the land area adjacent to the subwatersheds to Boston Inner Harbor and Dorchester Bay drains directly to MWRA’s North Dorchester Bay CSO Storage Tunnel Project (NDBST), which was completed in 2011 and includes a 2.1-mile long, 17-foot diameter storage tunnel with 19 million gallons of storage capacity (shown in Figure 1B). The NDBST stores stormwater and combined sewage/stormwater until it can be pumped to Deer Island for treatment. Stormwater from land adjacent to Boston Inner Harbor’s subwatershed drains to the NDBST and is treated at Deer Island and therefore does not directly discharge to Boston Inner Harbor. The contributing watershed which drains to the NDBST was evaluated previously as part of the Dorchester Bay Impaired Waters Assessment.[4]

MassDOT’s property directly contributing stormwater runoff to Boston Inner Harbor is comprised of approximately 245 acres of land including roadways and associated ramps, parking lots, buildings, and depots. For this assessment, MassDOT included only above-ground property within the directly contributing watershed to Boston Inner Harbor (as shown by the shaded areas in Figures 2A, 2B, and 2C). It was assumed that because subsurface roadways do not receive direct rainfall, they should not be included within the stormwater calculations. As a result, in locations where MassDOT owns subsurface roadways but does not own the above ground property, the area was not included in the directly contributing watershed analysis. The various buildings in the directly discharging area include pump stations, maintenance facilities, ventilation buildings, and other MassDOT-owned properties. Stormwater runoff generated from these properties drains into closed stormwater or CSO systems that ultimately have primary or overflow discharges directly to Boston Inner Harbor. Roadways (and associated ramps) within the subwatershed include: I-90, I-93, Route 1, Route 1A, Albany Street, B Street, Bradston Street, Congress Street, Frontage Road, Haul Road, Massachusetts Avenue Connector, and West Fourth Street. These roadways range from two-lane city streets to eight-lane highways with raised medians and high occupancy vehicle (HOV) lanes. Runoff from these roadways enters closed stormwater or CSO systems that ultimately have primary or overflow discharges directly to Boston Inner Harbor. Approximately 237 acres of MassDOT impervious surfaces discharge stormwater runoff directly to Boston Inner Harbor. MassDOT’s directly contributing watershed is shown in Figure 2A.

Based on a preliminary desktop analysis, it appears there is some potential for proposed BMPs at various locations within the subwatershed to Boston Inner Harbor. These locations include the shoulders, medians, interchange areas, and adjacent MassDOT-owned property along I-93, the Massachusetts Avenue Connector, and I-90. However, the subwatershed to Boston Inner Harbor is highly developed, so locations that seem promising at the assessment stage may become infeasible as limited right-of-way, utility conflicts and other potential site constraints are identified further in the design process.

Existing BMPs

MassDOT identified a total of 27 BMPs within the Boston Inner Harbor subwatershed that treat stormwater runoff from MassDOT property prior to discharging to the harbor. As part of MassDOT’s Interstate 93 Viaduct Parking Lots project (Project No. 607827), seven BMPs were included in the 100% design, which was submitted in September 2014. These BMPs included six gravel detention basins and one bioretention basin under the I-93 Viaduct north of West Fourth Street in Boston. Soils within the project area are contaminated for asbestos, and as a result, all seven BMPs are lined to prevent infiltration. Stormwater from the I-93 Viaduct is collected and piped directly to the BMPs

[5] BWSC, 2014. Combined Sewer Systems & Outfall Maps. Available at: http://www.bwsc.org/about_bwsc/systems/outfall_maps/outfall_maps.asp

below, where stormwater runoff is treated as it is stored within the gravel and compost media substrates.

MassDOT identified four additional BMPs in the MassDOT District 6 parking lot located at 185 Kneeland Street. There are two water quality swales and two Filterra bioretention structures located within the grass islands of the District 6 parking lot. Stormwater enters the BMPs through openings in the curbing. It appears these BMPs were constructed within the past two years as part of the parking lot expansion, and the BMPs are in good condition. Soil types in the parking lot were unknown and assumed to be hydrologic soil group (HSG) type C.

Additionally, MassDOT identified 16 Stormceptor stormwater quality treatment systems within the directly contributing watershed to Boston Inner Harbor. These Stormceptors were installed during the Central Artery/Tunnel Project (the Big Dig). Limited inventory information including the Project Identifier (Structure ID), model type, holding capacity, and dimensions was available for the 16 Stormceptors. The existing BMP locations are shown in Figure 2B and Figure 2C.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the waterbody for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Boston Inner Harbor (MA70-02) using the methodologies described below.

MassDOT has identified a water body impairment in the Boston Inner Harbor watershed that is not related to stormwater runoff. This impairment is PCB in fish tissue. In accordance with MassDOT's *Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater* in the December 8, 2012 EPA submittal, the non-stormwater related impairments are not specifically addressed as part of the Impaired Waters Program.[2]

This assessment has been completed based on the *Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*.[1] MassDEP has released a proposed *Massachusetts Year 2014 Integrated List of Waters,* which has been reviewed for any proposed changes to the condition of the water bodies.[8] The condition of Boston Inner Harbor is not proposed to change.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (*Enterococcus* and fecal coliform) impairments using the approach described in BMP 7U[7] of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body not covered by a final TMDL. Boston

[6] MassDOT, July 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[7] MassDOT, April 2010. BMP 7U: Water Quality Impaired Waters Assessment and Mitigation Plan. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[8] MassDEP, June 2014. Massachusetts Year 2014 Integrated List of Waters – Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/14iwlistp.pdf

Inner Harbor (MA70-02) is covered by the *Draft Pathogen TMDL for the Boston Harbor Watershed.*[9] MassDOT included an informational review of the draft report as part of this assessment even though, due to their draft status, draft TMDLs are not formally part of the Impaired Waters Retrofit program.

The Draft Pathogen TMDL for the Boston Harbor Watershed identifies several potential stormwater-related sources of bacteria to waters draining to the Boston Inner Harbor, including urban runoff/storm sewers, CSO discharges, illicit sewer connections, and unknown sources. The TMDL states that during rain events fecal matter from domestic animals and wildlife are transported directly to surface waters via the storm drain systems. Municipalities that operate regulated municipal separate storm sewer systems (MS4s) under the NPDES Phase I and Phase II Programs must develop and implement storm water management plans (SWMPs) that employ measureable goals for the following six minimum control measures:

1. Public education and outreach,
2. Public participation/involvement,
3. Illicit discharge detection and elimination,
4. Construction site runoff control,
5. Post construction runoff control, and
6. Pollution prevention/good housekeeping.

The TMDL recommends that municipalities not regulated under the Phase I or II should implement the exact same six minimum control measures to reduce stormwater contamination. Additionally, the BWSC and the City of Boston have been making efforts to improve stormwater quality through the elimination of existing CSOs. Both entities also implement public education programs that inform the general public about stormwater and the importance of not dumping waste into the streets. To supplement these educational efforts, the City of Boston has a dog fouling ordinance, the “Pooper Scooper Law,” that requires dog owners to properly dispose of dog waste.

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT’s BMP 7U Pathogen Methodology.[10]

BMP 7U for Impervious Cover Related Impairments

A final TMDL is not in place to address Boston Inner Harbor’s (MA70-02) following impairments: dissolved oxygen and other. Therefore, MassDOT assessed the stormwater-related impairments not addressed by a TMDL using the approach outlined in the Description of MassDOT’s Application of Impervious Cover Method in BMP 7U[11] which was developed using the EPA Region I’s Impervious

[9] MassDEP. Draft Pathogen TMDL for the Boston Harbor Watershed (excluding the Neponset River sub-basin). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/bharbor1.pdf

[10] MassDOT, December 2014. Description of MassDOT’s Application of BMP 7U for Pathogen Related Impairments. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year5/Attachment5.pdf

[11] MassDOT, April 2011. Description of MassDOT’s Application of Impervious Cover Method in BMP 7U. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/IC_MethodApplication2011Apr6.pdf

Cover (IC) Method, described in EPA's Stormwater TMDL Implementation Support Manual.[12] 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 calculated the following values for the total contributing watershed and the subwatershed of the impaired water (Boston Inner Harbor) to determine the IC area and set a reduction target. The sources used to delineate the subwatershed are discussed in the Site Description section. The total watershed delineation was based on the USGS Dataset 451[13] and modified to reflect the established subwatershed boundary. MassGIS's impervious surfaces data layer[14] was used to determine the IC of the watersheds. The total watershed and the subwatershed are shown in Figures 1A and 1B.

Table 1 Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	247,922 acres	5,634 acres
Impervious Cover (IC) Area	64,137 acres	4,703 acres
Percent Impervious	26%	84%
IC Area at 9% Effective IC Target	22,313 acres	507 acres
Target Effective IC Reduction	65%	89%

The total and subwatershed's percent impervious are greater than 9%, indicating that stormwater is a likely contributor to the impairment. To meet the 9% effective IC target, the effective IC within the subwatershed will need to be reduced by the percentage calculated in Table 1. MassDOT then uses the same target percent reduction for their directly contributing watershed as shown in Table 2.

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	245.4 acres
Directly Contributing IC Area	236.8 acres
Percent Impervious	97%
Directly Contributing Area Effective IC Reduction Target (89% Target Effective IC Reduction of MassDOT Directly Contributing IC Area)	211.3 acres
Target Effective IC	10%
Target Effective IC	25.5 acres

Next, MassDOT created a site-specific, continuous, long-term hydrologic and pollutant simulation model (the assessment model)[15] to estimate the effective IC of the MassDOT contributing drainage areas given treatment by existing BMPs. Table 3 shows the existing BMPs, their MassDOT

[12] ENSR, March 2006. Stormwater TMDL Implementation Support Manual for US EPA Region 1. ENSR International & EPA Region 1, Boston, MA. Available at http://www.epa.gov/region1/eco/tmdl/pdfs/Stormwater-TMDL-Implementation-Support-Manual.pdf

[13] USGS Data Series 451 Local and Cumulative Impervious Cover of Massachusetts Stream Basins Available at: http://pubs.usgs.gov/ds/451/

[14] MassGIS Impervious Surfaces datalayer taken from 2005 orthoimagery. Available at: http://www.mass.gov/mgis/impervious_surface.htm

[15] MassDOT, June 2012. Long-Term Continuous Simulation for Pollutant Loading and Treatment for MassDOT Impaired Waters Program. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year2/Attachment7.pdf

drainage areas, and their effective IC reductions. The output from the assessment model showing effective IC analysis for existing BMPs is attached.

Table 3 Existing Conditions

BMP Name	BMP Type	Contributing Effective IC (acres)	Estimated Percent Reduction	Estimated Effective IC Reduction (acres)
EX BMP 1 (1.3)	Gravel Basin	0.33	54%	0.18
EX BMP 2 (2.3)	Gravel Basin	0.08	47%	0.04
EX BMP 3 (3.3)	Gravel Basin	0.05	52%	0.02
EX BMP 4 (4.3)	Bioretention Basin	0.22	100%	0.22
EX BMP 5 (5.3)	Gravel Basin	0.10	49%	0.05
EX BMP 7 (7.3)	Gravel Basin	0.28	63%	0.18
EX BMP 8 (8.3)	Gravel Basin	0.16	53%	0.08
EX SWALE 11 (11.3)	Water Quality Swale	0.47	44%	0.21
EX SWALE 12 (12.3)	Water Quality Swale	0.30	56%	0.16
EX LCB 13 (13.3)	Filterra Structure	0.34	72%	0.24
EX LCB 14 (14.3)	Filterra Structure	0.23	88%	0.20
WQCS 17	Stormceptor System	1.50	26%	0.38
WQCS 18	Stormceptor System	1.50	26%	0.38
WQCS 19	Stormceptor System	1.50	26%	0.38
WQCS 24	Stormceptor System	1.50	26%	0.38
WQCS 25	Stormceptor System	1.60	26%	0.41
WQCS 26	Stormceptor System	1.50	26%	0.38
WQCS 27	Stormceptor System	1.50	26%	0.38
WQCS 28	Stormceptor System	1.50	26%	0.38
WQCS 29	Stormceptor System	1.50	26%	0.38
WQCS 30	Stormceptor System	1.50	26%	0.38
WQCS 31	Stormceptor System	1.50	26%	0.38
WQCS 32	Stormceptor System	1.50	26%	0.38
WQCS 33	Stormceptor System	1.50	26%	0.38
WQCS 34	Stormceptor System	1.50	26%	0.38
WQCS 35	Stormceptor System	1.60	26%	0.41
WQCS 36	Stormceptor System	1.60	26%	0.41
Total Directly Discharging Area		**236.8**	**3%**	**7.8**
Target Effective IC Reduction				211.3
Remaining Reduction to Meet Target				**203.5**

MassDOT estimated the effective IC under existing conditions by comparing the annual median runoff volume, phosphorus and TSS loads, and flow distribution statistics (flow duration) from MassDOT drainage area to the receiving water to those results for simulated IC watersheds. The following table displays the acres of IC the existing BMPs mitigate compared to the target reduction.

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 practical given site constraints.

This assessment has identified locations for potential stormwater BMPs. The Proposed Mitigation Plan describes the next steps for the potential BMPs to reduce the effective IC.

Proposed Mitigation Plan

During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified opportunities for BMPs that could be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects meeting those requirements can be implemented under the Impaired Waters Program Retrofit initiative.

MassDOT has identified that additional control measures are needed to reduce its effective IC within the directly contributing watershed to achieve the targeted reduction and that appropriate locations are potentially available for control measures. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat stormwater runoff from directly contributing IC as part of MassDOT's Impaired Waters Retrofit Initiative. The project designer will gather additional information in this phase, such as soil data, wetland delineations, and site survey, to further refine the proposed BMPs. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction to the maximum extent practical.

Once the design of the proposed BMPs is finalized, MassDOT will provide an update in the NPDES permit annual report with BMP information and summarize the final effective IC reduction.

With respect to the *Enterococcus* and fecal coliform impairments, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review and source control. As discussed in MassDOT's BMP 7U Pathogen Methodology, MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements in regard to pathogens.

In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the subwatershed of this water body. MassDOT will be installing signs at rest stops within the subwatersheds of pathogen impaired waterbodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

MassDOT has concluded that the BMPs outlined in the SWMP are consistent with its existing permit requirements for Boston Inner Harbor. These measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from MassDOT roadways to be a contributing source it is unlikely to warrant action relative to other sources of pathogens in the watershed.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Boston Inner Harbor, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. 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 NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target effective IC reductions.

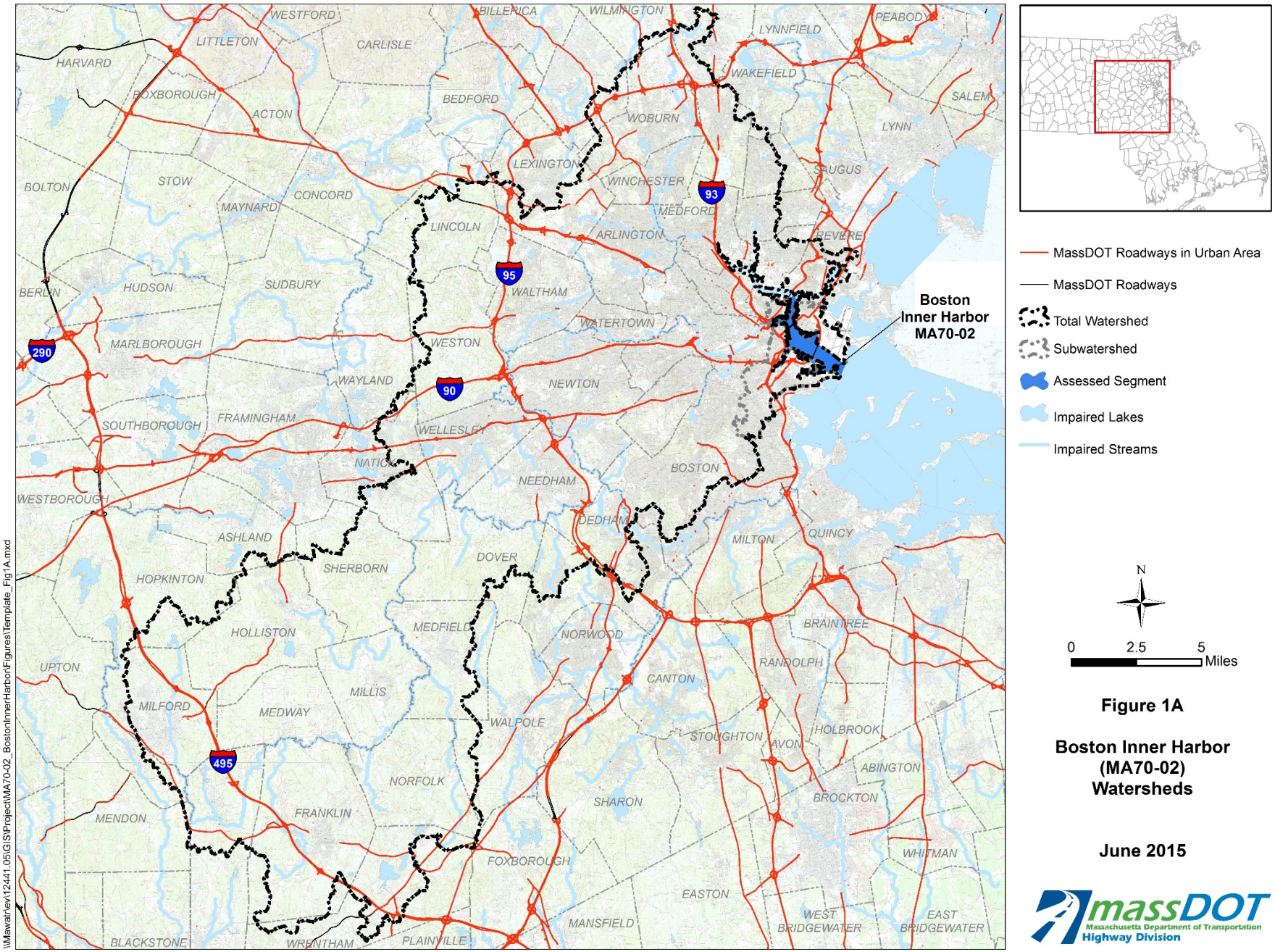


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Figure 1A

Boston Inner Harbor (MA70-02) Watersheds

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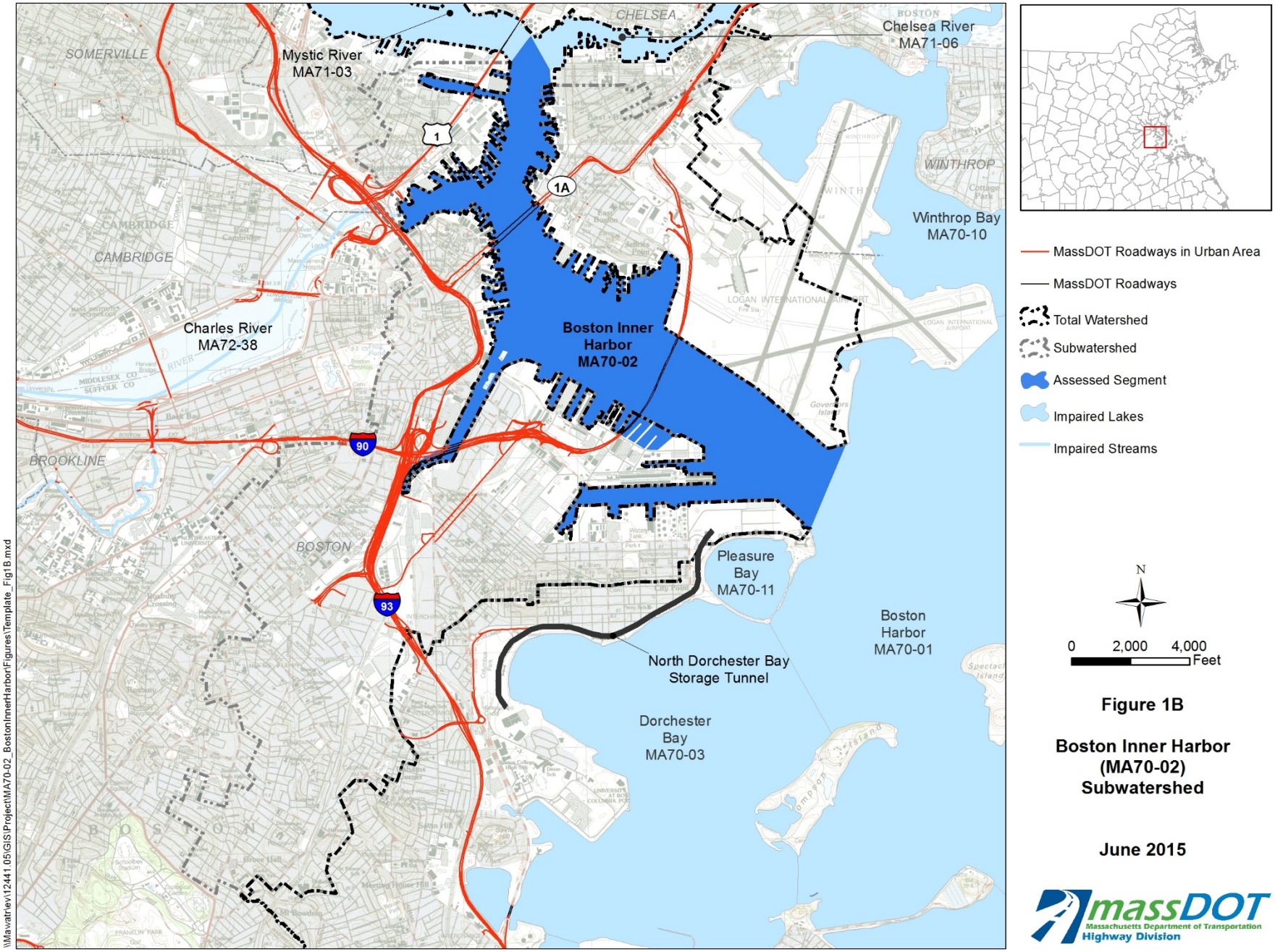

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Figure 1B

Boston Inner Harbor (MA70-02) Subwatershed

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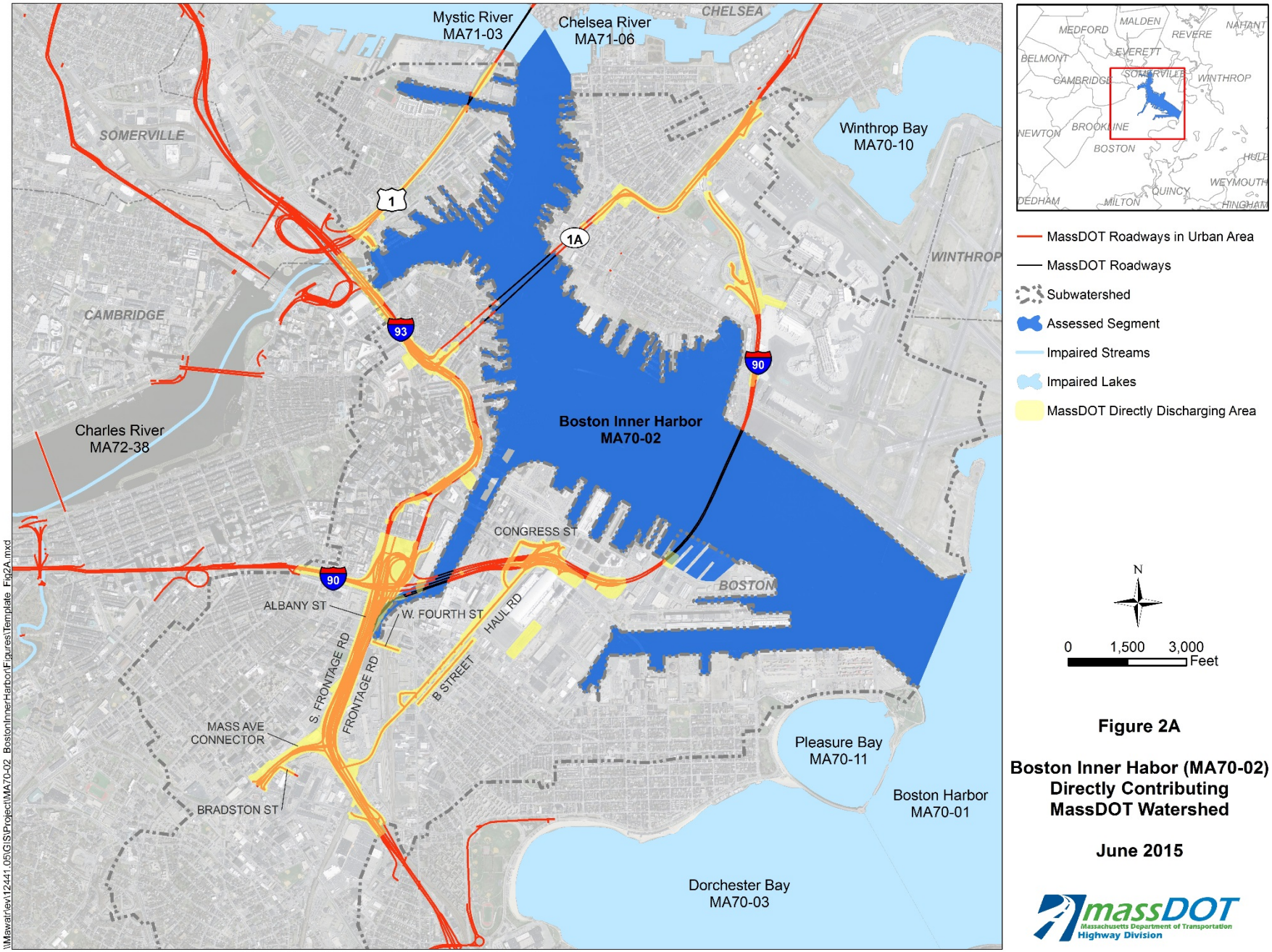

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Figure 2A

Boston Inner Habor (MA70-02)
Directly Contributing
MassDOT Watershed

June 2015

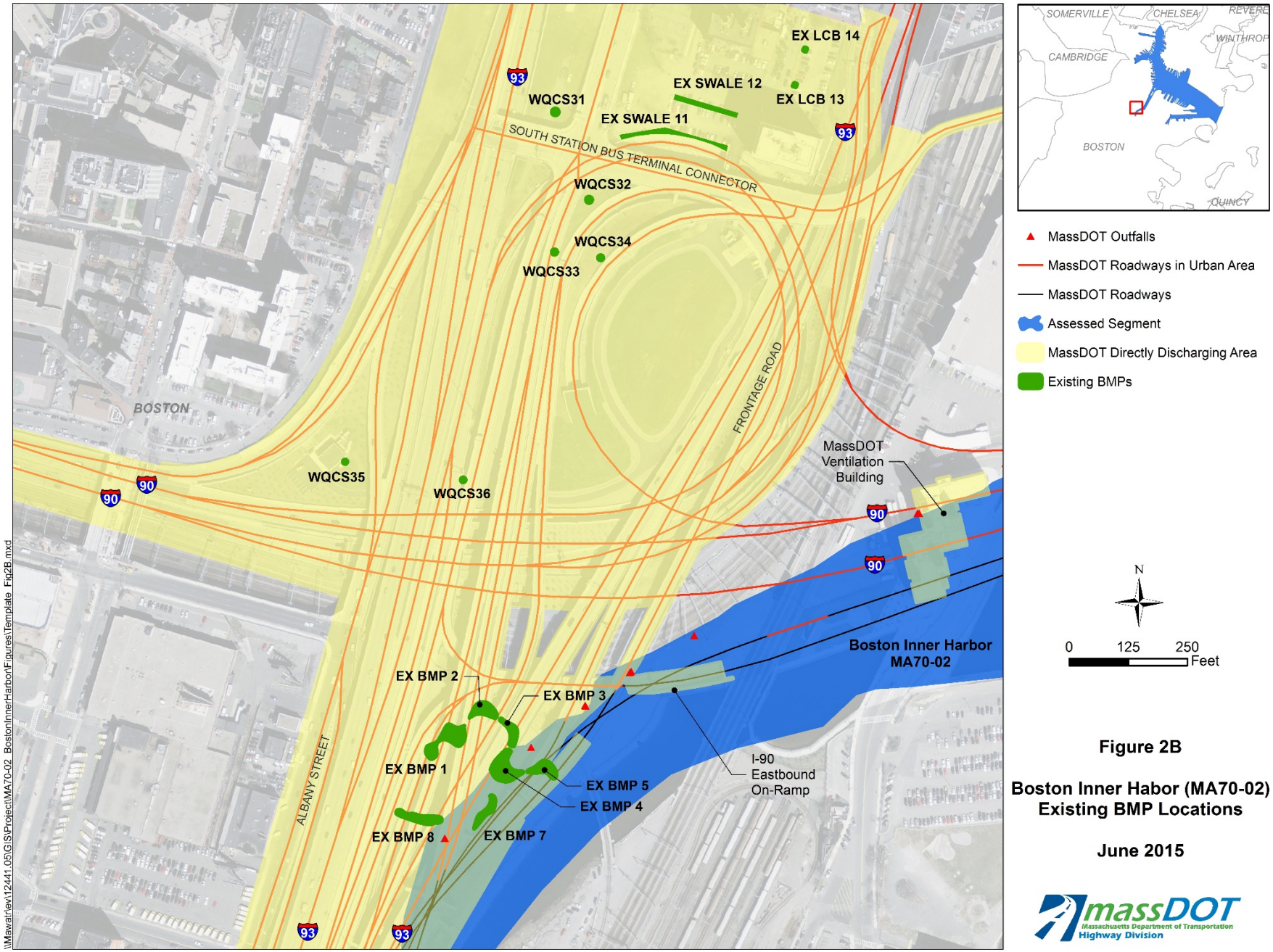

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Figure 2B

Boston Inner Habor (MA70-02)
Existing BMP Locations

June 2015

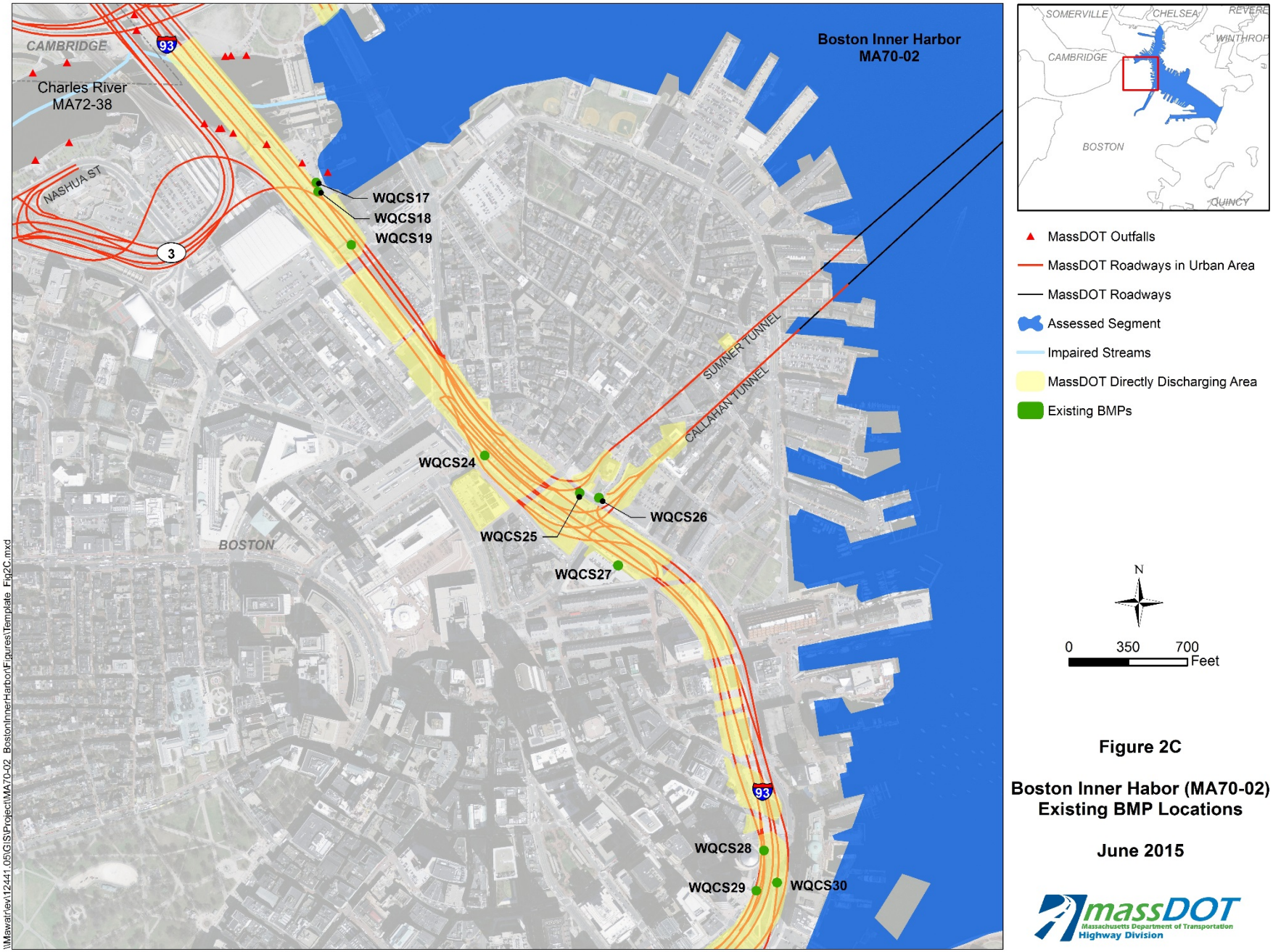

Figure 2C

Boston Inner Habor (MA70-02)
Existing BMP Locations

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Impaired Waters Assessment for Beaver Brook (MA73-19)

Summary

Impaired Water[1]	*Stormwater* Impairments:	*Aquatic Macroinvertebrate Bioassessments, Dissolved Oxygen*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*None*
	WQ Assessment:	*Neponset River Watershed 2004 Water Quality Assessment Report*[2]
Location	Towns:	*Sharon*
	MassDOT Roads:	*Route 27, Maskwonicut Street*
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*

MassDOT Area and Targets	Impervious Cover (IC)
Directly Contributing Area:	*0.12 acres*
Contributing Area Reduction Target:	*0.02 acres*
Existing BMPs Reduction:	*0.00 acres*
Remaining Reduction to Meet Target:	*0.02 acres*

Site Description

Beaver Brook (MA73-19) is a 3.5-mile long Class B waterway located west of downtown Sharon, Massachusetts (Figure 1). The stream flows from its headwaters in the Moose Hill Reservation (a wildlife sanctuary near Moose Hill Street in southwest Sharon) northeasterly to its confluence with Massapoag Brook. The watershed to this segment consists of undeveloped or lightly developed residential land in the southern and eastern portion, while the western portion of the watershed includes parts of downtown Sharon.

[1] MassDEP, March 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDEP, February 2010. Neponset River Watershed 2004 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/73wqar10.pdf

MassDEP's *Neponset River Watershed 2004 Water Quality Assessment Report* identified the Primary and Secondary uses as "Support".[2] The Aquatic Life, Fish Consumption, and Aesthetics Uses were not assessed. The only two MassDOT roadways within the watershed are two bridges that span the Massachusetts Bay Transit Authority (MBTA) Providence/Stoughton commuter rail line: the Lance Corporal Daniel J. Dabreu Memorial bridge (which carries Route 27 (Depot Street)) and the Maskwonicut Street bridge. The Maskwonicut Street bridge is currently undergoing complete reconstruction.

Lance Corporal Daniel J. Dabreu Memorial Bridge is a 350-foot long bridge that carries one lane of traffic for Route 27 (Depot Street) in each direction. Curbing on the bridge consists of eight-inch granite curbs. During a site visit on March 25, 2015, it was determined that the western portion of MassDOT-owned Route 27 (Depot Street) bridge directly contributes to Beaver Brook (Figure 2). All stormwater within the directly contributing watershed flows west along the curb line of Depot Street to a set of catch basins (located near the access road to the rail station) that are part of a municipally-owned closed drainage system. These catch basins drain directly to Beaver Brook. There are no scuppers or drains on the bridge itself. Stormwater from the eastern half of the bridge flows to municipally-owned catch basins and discharge to wetlands that are greater than 1,000 feet from Beaver Brook. This is not considered a direct discharge to Beaver Brook. Steep slopes, wetlands, and lack of MassDOT-owned right-of-way exist at the outfall location.

The Maskwonicut Street bridge is a 35-foot wooden bridge that spans the MBTA railway line (Figure 3). It carries one lane of traffic in each direction. The bridge is currently closed for reconstruction. There are no drainage pipes or any indication of bridge drainage being discharged below the deck or to Beaver Brook. Municipal catch basins on Maskwonicut Street are located at a low point in the roadway approximately 175 feet west of the bridge and appear to discharge directly to Beaver Brook via drainage swales on the south side of the roadway.

Both bridges are located within a Zone II wellhead protection area for a series of groundwater public-supply wells along Beaver Brook. The Dabreu Memorial Bridge is located approximately 500 feet upstream of Sharon's largest pumping well (Well #4; 4266000-03G). Both bridges are located adjacent to protected open space.

Existing BMPs

MassDOT did not identify any existing BMPs in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the waterbody for the impairments covered by the TMDL under the BMP 7R methodology.[3] MassDOT separately assesses the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[4] MassDOT assessed Beaver Brook (MA73-19) using the methodologies described below.

[3] MassDOT, July 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[4] MassDOT, April 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/IC_MethodApplication2011Apr6.pdf

This assessment has been completed based on the *Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*.[1] MassDEP has released a proposed *Massachusetts Year 2014 Integrated List of Waters,* which has been reviewed for any proposed changes to the condition of the water bodies.[5] The condition of Beaver Brook is not proposed to change.

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Beaver Brook's (MA73-19) following impairments: aquatic macroinvertebrate bioassessments and dissolved oxygen. Therefore, MassDOT assessed the stormwater-related impairments not addressed by a TMDL using the approach outlined in the *Description of MassDOT's Application of Impervious Cover Method in BMP 7U*[4] which was developed using the EPA Region I's Impervious Cover (IC) Method, described in EPA's Stormwater TMDL Implementation Support Manual.[6] 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 calculated the following values for the total contributing watershed of the impaired water (Beaver Brook) to determine the IC area and set a reduction target. For this water body, the subwatershed was the same as the total watershed. Watersheds are based on the USGS Dataset 451[7] and modified as necessary using topography. MassGIS's impervious surfaces data layer[8] was used to determine the IC of the watersheds. The total watershed is shown in Figure 1.

Table 1 Impaired Segment Watershed

	Total Watershed
Watershed Area	2,007 acres
Impervious Cover (IC) Area	208 acres
Percent Impervious	10.4%
IC Area at 9% Effective IC Target	181 acres
Target Effective IC Reduction	13.1%

The total watershed's percent impervious is greater than 9%, 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 the percentage calculated in Table 1. MassDOT then uses the same target percent reduction for their directly contributing watershed as shown in Table 2.

[5] MassDEP, June 2014. Massachusetts Year 2014 Integrated List of Waters – Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/14iwlistp.pdf

[6] ENSR, March 2006. Stormwater TMDL Implementation Support Manual for US EPA Region 1. ENSR International & EPA Region 1, Boston, MA. Available at http://www.epa.gov/region1/eco/tmdl/pdfs/Stormwater-TMDL-Implementation-Support-Manual.pdf

[7] USGS Data Series 451 Local and Cumulative Impervious Cover of Massachusetts Stream Basins Available at: http://pubs.usgs.gov/ds/451/

[8] MassGIS Impervious Surfaces datalayer taken from 2005 orthoimagery. Available at: http://www.mass.gov/mgis/impervious_surface.htm

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	0.12 acres
Directly Contributing IC Area	0.12 acres
Percent Impervious	100%
Directly Contributing Area Effective IC Reduction Target (13.1% Target Effective IC Reduction of MassDOT Directly Contributing IC Area)	0.02 acres
Target Effective IC	83%
Target Effective IC	0.10 acres

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 practical given site constraints.

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

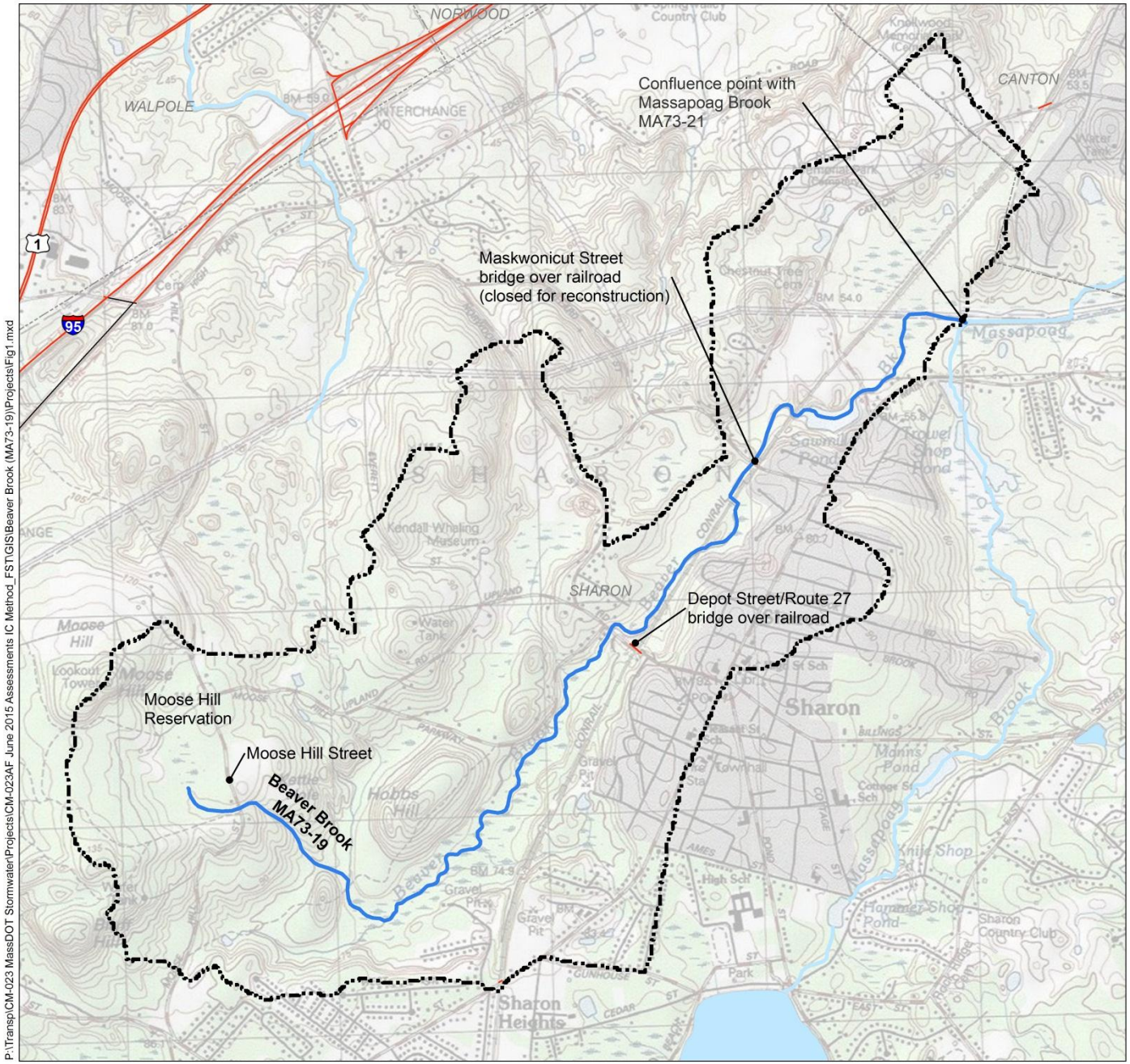
Proposed Mitigation Plan

During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified opportunities for BMPs that could be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects meeting those requirements can be implemented under the Impaired Waters Program Retrofit initiative.

Site limitations in the Beaver Brook watershed include: steep roadway sideslopes, lack of MassDOT-owned right-of-way, and wetlands. MassDOT roadways directly contributing to Beaver Brook flow into a municipally owned drainage system that directly discharges into the assessed segment.

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 Beaver Brook given the site constraints.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Beaver Brook, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. 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 NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target effective IC reductions.



MassDOT Roadways in Urban Area

MassDOT Roadways

Total and Subwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 0.25 0.5 Miles

Figure 1

Beaver Brook (MA73-19) Watersheds

June 2015

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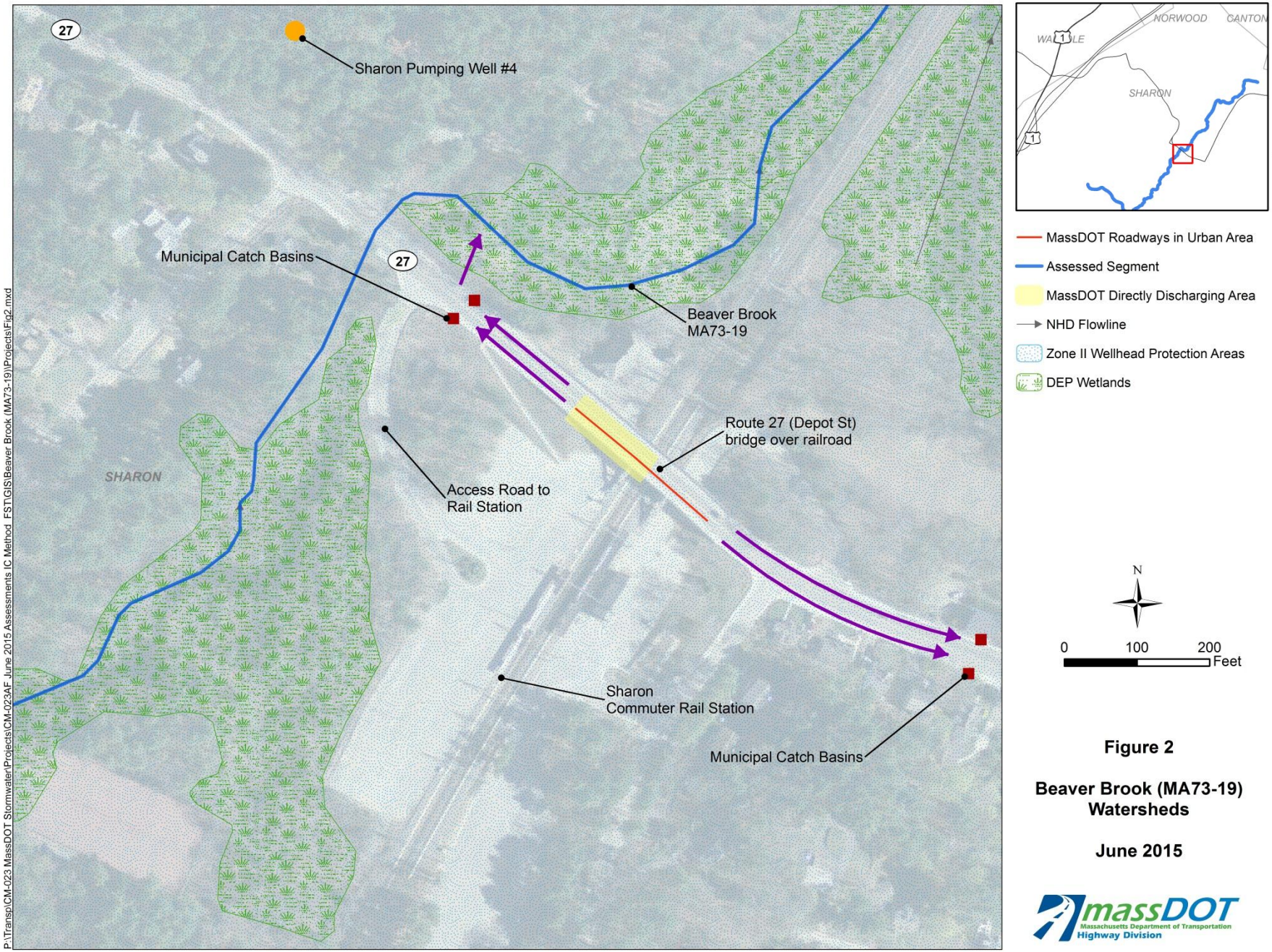

Figure 2

Beaver Brook (MA73-19) Watersheds

June 2015

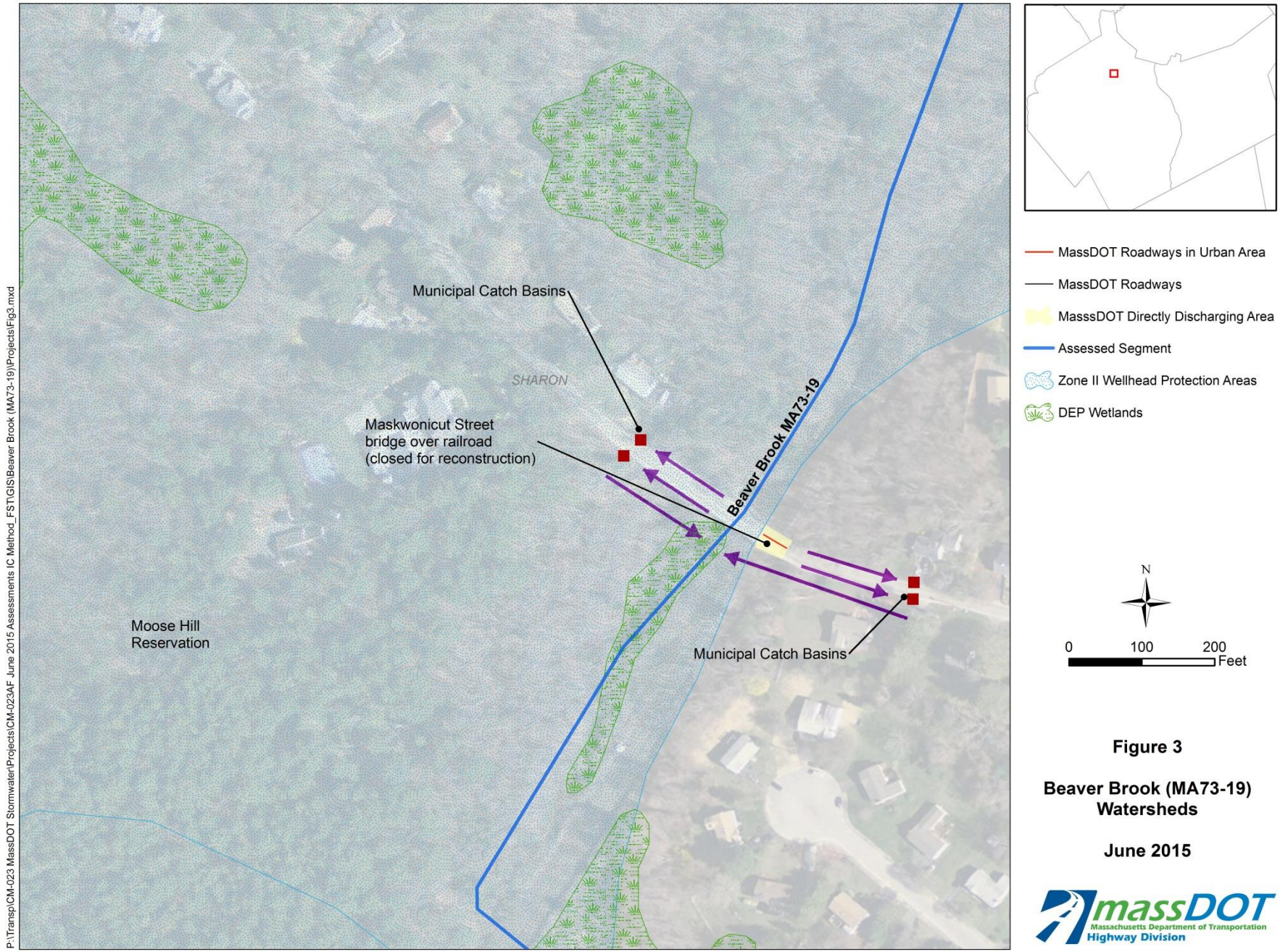

Figure 3

Beaver Brook (MA73-19) Watersheds

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Impaired Waters Assessment for Hingham Harbor (MA74-18)

Summary

Impaired Water[1]	Impairments:	Stormwater:	*Fecal Coliform, Other (contaminants in fish/shellfish)*
		Non-Stormwater:[2]	*PCB in Fish Tissue*
	Category:	*5 (Waters requiring a TMDL)*	
	Final TMDLs:	*None*	
	WQ Assessment:	*Weymouth and Weir River Basin 2004 Water Quality Assessment Report*[3]	
Location	Towns:	*Hingham*	
	MassDOT Roads:	*Route 3A, Summer Street*	
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒	
MassDOT Area and Targets			Impervious Cover (IC)
	Directly Contributing Area:		*7.4 acres*
	Contributing Area Reduction Target:		*4.5 acres*
	Existing BMPs Reduction:		*0.0 acres*
	Remaining Reduction to Meet Target:		*4.5 acres*

[1] MassDEP, March 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts" Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[3] MassDEP, April 2010, *Weymouth and Weir River Basin 2004 Water Quality Assessment Report* Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/74wqar04.pdf

Site Description

Hingham Harbor (MA74-18) is a tidal water body inside a line from Crows Point to Worlds End within the Town of Hingham, Massachusetts. It is a Class SA waterbody with an area of 1.12 square miles, and opens to Hingham Bay (MA70-07). The watershed for Hingham Harbor is shown on Figure 1. The watershed is densely developed with residential and commercial properties, the Hingham Harbor Marina, public parks, public beach and parking area, and undeveloped wetland areas.

MassDEP"s *Weymouth and Weir River Basin 2004 Water Quality Assessment Report* identified the Aquatic Life Use with an "impaired" status due to estuarine bioassessment (loss of eelgrass bed habitat; last reported sighting in 1951).[3] The source of this impairment is reported as unknown. The Fish Consumption Use is assessed as "impaired" due to PCBs in fish tissue. The source of this impairment is also unknown. The Shellfish Use is listed as "impaired" due to fecal coliform. The source is unknown. The Primary and Secondary Contact Uses are listed as "support," and the Aesthetics Use was not assessed. The Other Use has been deemed „impaired" due to contaminants in fish and shellfish.[1, 3] The source of this impairment is reported as unknown.

The portion of the MassDOT roadways that directly discharge to Hingham Harbor include Route 3A from a point approximately 350 feet west of North Street east to 900 feet beyond the Route 3A roundabout. Stormwater also discharges to Hingham Harbor from MassDOT-owned Summer Street from Route 3A to Button Cove Road (Figure 2). Following review, it was determined that the remaining urban area roads in the watershed discharge to wetlands or via overland flow and infiltrate into the ground and are therefore not considered direct discharges to Hingham Harbor.

Existing BMPs

MassDOT did not identify any existing BMPs in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the waterbody for the impairments covered by the TMDL under the BMP 7R methodology.[4] MassDOT separately assesses the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[5] MassDOT assessed Hingham Harbor (MA74-18) using the methodologies described below.

MassDOT has identified a water body impairment in the Hingham Harbor watershed that is not related to stormwater runoff. This impairment is PCB in fish tissue. In accordance with MassDOT's *Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater* in the December 8, 2012 EPA submittal, the non-stormwater related impairments are not specifically addressed as part of the Impaired Waters Program.[2]

This assessment has been completed based on the *Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314*

[4] MassDOT, July 2010. BMP 7R: TMDL Watershed Review. Available at:
http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[5] MassDOT, April 2010. BMP 7U: Water Quality Impaired Waters Assessment and Mitigation Plan. Available at:
http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

and 303(d) of the Clean Water Act.[1] MassDEP has released a proposed *Massachusetts Year 2014 Integrated List of Waters,* which has been reviewed for any proposed changes to the condition of the water bodies.[6] The condition of Hingham Harbor is not proposed to change.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7U[5] of MassDOT"s Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body not covered by a final TMDL.

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT"s BMP 7U Pathogen Methodology.[7]

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Hingham Harbor"s (MA74-18) following impairments: Other. Therefore, MassDOT assessed the stormwater-related impairments not addressed by a TMDL using the approach outlined in the Description of MassDOT"s Application of Impervious Cover Method in BMP 7U[8] which was developed using the EPA Region I"s Impervious Cover (IC) Method, described in EPA"s Stormwater TMDL Implementation Support Manual.[9] 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 calculated the following values for the total contributing watershed of the impaired water (Hingham Harbor) to determine the IC area and set a reduction target. For this waterbody, the subwatershed was the same as the total watershed. Watersheds are based on the USGS Dataset 451[10] and modified as necessary using topography. MassGIS"s impervious surfaces data layer[11] was used to determine the IC of the watersheds. The total and subwatershed is shown on Figure 1.

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[6] MassDEP, June 2014. Massachusetts Year 2014 Integrated List of Waters – Proposed Listing of the Condition of Massachusetts" Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/14iwlistp.pdf

[7] MassDOT, December 2014. Description of MassDOT"s Application of BMP 7U for Pathogen Related Impairments. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/IC_MethodApplication2011Apr6.pdf

[8] MassDOT, April 2011. Description of MassDOT"s Application of Impervious Cover Method in BMP 7U. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/IC_MethodApplication2011Apr6.pdf

[9] ENSR, March 2006. Stormwater TMDL Implementation Support Manual for US EPA Region 1. ENSR International & EPA Region 1, Boston, MA. Available at http://www.epa.gov/region1/eco/tmdl/pdfs/Stormwater-TMDL-Implementation-Support-Manual.pdf

[10] USGS Data Series 451 Local and Cumulative Impervious Cover of Massachusetts Stream Basins Available at: http://pubs.usgs.gov/ds/451/

[11] MassGIS Impervious Surfaces datalayer taken from 2005 orthoimagery. Available at: http://www.mass.gov/mgis/impervious_surface.htm

Table 1 Impaired Segment Watershed

	Total and Subwatershed
Watershed Area	1,511.4 acres
Impervious Cover (IC) Area	347.2 acres
Percent Impervious	23.0%
IC Area at 9% Effective IC Target	136.0 acres
Target Effective IC Reduction	60.8%

The total and subwatershed"s percent impervious is greater than 9%, 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 the percentage calculated in Table 1. MassDOT then uses the same target percent reduction for their directly contributing watershed as shown in Table 2.

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	7.4 acres
Directly Contributing IC Area	6.9 acres
Percent Impervious	93%
Directly Contributing Area Effective IC Reduction Target (60.82% Target Effective IC Reduction of MassDOT Directly Contributing IC Area)	4.2 acres
Target Effective IC	36%
Target Effective IC	2.7 acres

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 practical given site constraints.

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

Proposed Mitigation Plan

During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified opportunities for BMPs that could be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects meeting those requirements can be implemented under the Impaired Waters Program Retrofit initiative.

The following site limitations in the Hingham Harbor watershed were identified during a site visit April 9, 2015: lack of MassDOT-owned right-of-way, adjacent public open space (Steamboat Wharf, Monument Park, and Hingham Bathing Beach), wetlands, and the highly developed nature of the surrounding properties.

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 Hingham Harbor given the site constraints.

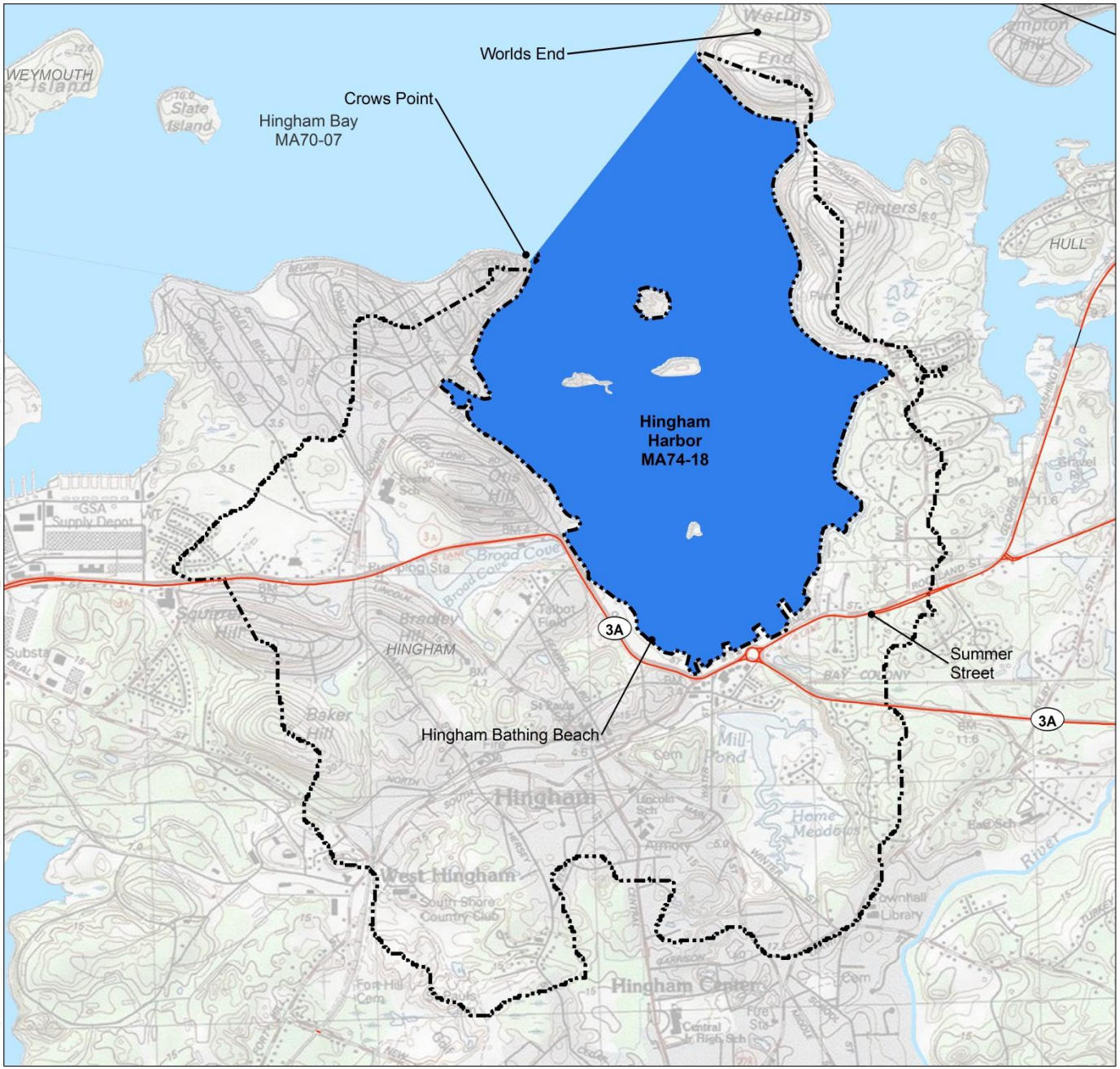
With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT"s BMP 7U Pathogen Methodology, MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements in regard to pathogens.

In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the subwatershed of this water body. MassDOT will be installing signs at rest stops within the subwatersheds of pathogen-impaired waterbodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT"s stormwater management system. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

MassDOT has concluded that the BMPs outlined in the SWMP are consistent with its existing permit requirements for Hingham Harbor. These measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from MassDOT roadways to be a contributing source it is unlikely to warrant action relative to other sources of pathogens in the watershed.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Hingham Harbor, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. 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 NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target effective IC reductions.



MassDOT Roadways in Urban Area

MassDOT Roadways

Total and Subwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 0.25 0.5 Miles

Figure 1

Hingham Harbor (MA74-18) Watersheds

June 2015

massDOT
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Highway Division

- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Total and Subwatershed
- Assessed Segment
- Impaired Lakes
- MassDOT Directly Discharging Area
- DEP Wetlands

N

0 300 600 Feet

Figure 2

Hingham Harbor (MA74-18)
Directly Contributing
MassDOT Watershed

June 2015

massDOT
Massachusetts Department of Transportation
Highway Division

06/08/2015

Impaired Waters Assessment for Fort Pond (MA81046)

Summary

Impaired Water[1]	Stormwater Impairments:	*Dissolved Oxygen*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*None*
	WQ Assessment:	*Nashua River Watershed 2003 Water Quality Assessment Report*[2]
Location	Towns:	*Lancaster*
	MassDOT Roads:	*Route 2 and Route 70*
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*

MassDOT Area and Targets	Impervious Cover (IC)
Directly Contributing Area	*5.0 acres*
Contributing Area Reduction Target:	*0.9 acres*
Existing BMPs Reduction:	*0.0 acres*
Remaining Reduction to Meet Target:	*0.9 acres*

Site Description

Fort Pond (MA81046) is located north of Route 2 and east of Route 70 in Lancaster, Massachusetts (Figure 1). Fort Pond has a surface area of approximately 76 acres and receives flows at its northwestern tip from an unnamed stream. Flows exit Fort Pond on its eastern banks to Tophet Swamp by way of Bow Brook.

[1] MassDEP, March 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDEP, August 2008. Nashua River Watershed 2003 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/81wqar08.pdf

MassDEP's *Nashua River Watershed 2003 Water Quality Assessment Report*[2] identified the Aquatic Life use with an "impaired" status due to low dissolved oxygen levels. All other uses were "not assessed".

Figure 1 shows the total and subwatershed of Fort Pond, which are the same, totaling approximately 520 acres and are located in Lancaster, Massachusetts. The MassDOT-owned roadways within the urban area in the Fort Pond watershed include portions of Route 2, its on- and off-ramps to both Fort Pond Road and Old Union Turnpike at exit 35 and a portion of the Route 70. These roads are also shown on Figure 1. The watershed to Fort Pond is comprised of low density residential with the majority of the watershed consisting of forested land, water and wetlands.

Figure 2 shows the MassDOT directly discharging area, the limits of which were determined by the existing drainage infrastructure and roadway high points. The Route 2 right-of-way width, which includes the MassDOT-owned portion of Route 70, is variable, consisting of four divided lanes and variable width shoulders that transition into exit lanes near the off-ramps at exit 35. The east and westbound lanes of Route 2 are separated by 100-foot wide vegetated median which is densely populated with trees on the eastern side of the Route 70 bridge over Route 2, but more sparsely populated on the western side of the bridge. Stormwater runoff from these roadways is collected by catch basins along the edge of the road and drop inlets within the median and along the roadway shoulders. The flows are then conveyed to one of two MassDOT stormwater outfalls located north of Fort Pond Service Road. While MassDOT is only required to review their urban roadways, due to these finding, MassDOT is taking the conservative approach and is reviewing both urban and non-urban roadways directly discharging to Fort Pond.

Portions of Route 2 just outside the eastern limits of the Flint Pond watershed discharge stormwater flows towards Little Spectacle Pond. Runoff from the Route 2 on-ramp from Old Turnpike Road, the outer travel lane and shoulder are routed to two existing stormwater BMPs. Runoff from the inner lane and shoulder of Route 2 channelize within the median where they are routed via an 18 inch culvert to the south side of Route 2 eastbound eventually draining to Little Spectacle Pond.

Fort Pond is located just north of the Central Nashua River Valley Area of Environmental Concern (ACEC), which lies south of Route 2 and east of Route 70. Additionally, there are two wells located west of Route 70, a community groundwater source north of Route 2 and a non-community groundwater source south of Route 2. The location of the wells and the Central Nashua River Valley ACEC are shown on Figure 2.

It appears there is room in the southern shoulder of Route 2 eastbound on the western side of the Route 70 overpass as well as in the infield areas of exit 35 to install a BMP.

Existing BMPs

MassDOT did not identify any existing BMPs in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the waterbody for the impairments covered by the TMDL under the BMP 7R methodology.[3] MassDOT separately assesses the

[3] MassDOT, July 2010. BMP 7R: TMDL Watershed Review. Available at:
http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[4] MassDOT assessed Fort Pond (MA81046) using the methodologies described below.

This assessment has been completed based on the *Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*.[1] MassDEP has released a proposed *Massachusetts Year 2014 Integrated List of Waters,* which has been reviewed for any proposed changes to the condition of the water bodies.[5] The condition of Fort Pond is not proposed to change.

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Fort Pond's (MA81046) following impairment: dissolved oxygen. Therefore, MassDOT assessed the stormwater-related impairments not addressed by a TMDL using the approach outlined in the Description of MassDOT's Application of Impervious Cover Method in BMP 7U[6] which was developed using the EPA Region I's Impervious Cover (IC) Method, described in EPA's Stormwater TMDL Implementation Support Manual.[7] 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 calculated the following values for the total contributing watershed of the impaired water (Fort Pond) to determine the IC area and set a reduction target. For this water body, the subwatershed was the same as the total watershed. Watersheds are based on the USGS Dataset 451[8] and modified as necessary using topography. MassGIS's impervious surfaces data layer[9] was used to determine the IC of the watersheds. The total watershed is shown in Figure 1.

Table 1 Impaired Segment Watershed

	Total Watershed
Watershed Area	515 acres
Impervious Cover (IC) Area	56 acres
Percent Impervious	11%
IC Area at 9% Effective IC Target	46 acres
Target Effective IC Reduction	18%

[4] MassDOT, April 2010. BMP 7U: Water Quality Impaired Waters Assessment and Mitigation Plan. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[5] MassDEP, June 2014. Massachusetts Year 2014 Integrated List of Waters – Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/14iwlistp.pdf

[6] MassDOT, April 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/IC_MethodApplication2011Apr6.pdf

[7] ENSR, March 2006. Stormwater TMDL Implementation Support Manual for US EPA Region 1. ENSR International & EPA Region 1, Boston, MA. Available at http://www.epa.gov/region1/eco/tmdl/pdfs/Stormwater-TMDL-Implementation-Support-Manual.pdf

[8] USGS Data Series 451 Local and Cumulative Impervious Cover of Massachusetts Stream Basins Available at: http://pubs.usgs.gov/ds/451/

[9] MassGIS Impervious Surfaces datalayer taken from 2005 orthoimagery. Available at: http://www.mass.gov/mgis/impervious_surface.htm

The total watershed's percent impervious is greater than 9%, 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 the percentage calculated in Table 1. MassDOT then uses the same target percent reduction for their directly contributing watershed as shown in Table 2.

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	18.8 acres
Directly Contributing IC Area	5.0 acres
Percent Impervious	27%
Directly Contributing Area Effective IC Reduction Target (18% Target Effective IC Reduction of MassDOT Directly Contributing IC Area)	0.9 acres
Target Effective IC	22%
Target Effective IC	4.1 acres

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 practical given site constraints.

This assessment has identified locations for potential stormwater BMPs. The Proposed Mitigation Plan describes the next steps for the potential BMPs to reduce the effective IC.

Proposed Mitigation Plan

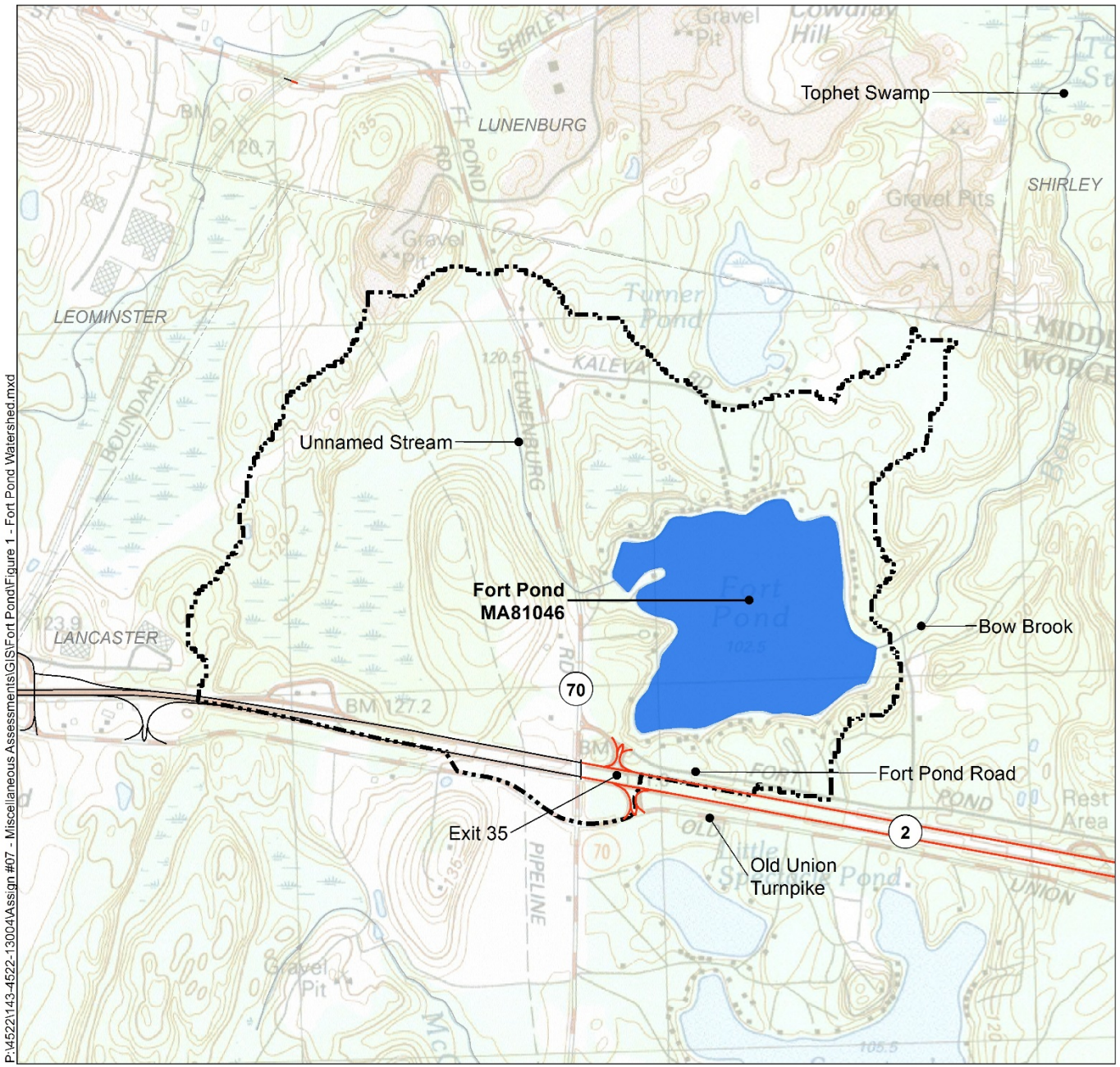
During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified opportunities for BMPs that could be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects meeting those requirements can be implemented under the Impaired Waters Program Retrofit initiative.

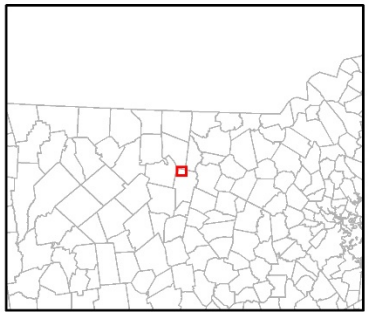
MassDOT has identified that additional control measures are needed to reduce its effective IC within the directly contributing watershed to achieve the targeted reduction and that appropriate locations are potentially available for control measures. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat stormwater runoff from directly contributing IC as part of MassDOT's Impaired Waters Retrofit Initiative. The project designer will gather additional information in this phase, such as soil data, wetland delineations, and site survey, to further refine the proposed BMPs. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction to the maximum extent practical.

Once the design of the proposed BMPs is finalized, MassDOT will provide an update in the NPDES permit annual report with BMP information and summarize the final effective IC reduction.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Fort Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. 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 NPDES permit annual reports

to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target effective IC reductions.





MassDOT Roadways in Urban Area

MassDOT Roadways

Watershed

Assessed Segment

NHD Flow Arrow

N

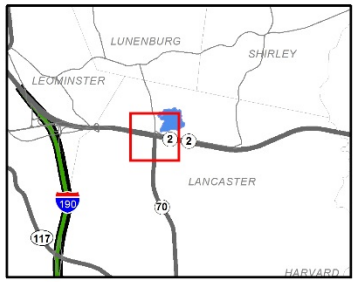
0 700 1,400 Feet

Figure 1

Fort Pond (MA81046) Watershed

June 2015

MassDOT Massachusetts Department of Transportation Highway Division



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roads
- Watershed
- Assesed Segment
- MassDOT Directly Discharging Area
- Community Groundwater Source
- Non-Community Groundwater Source
- DEP Wetlands
- Hydrologic Connection
- Areas of Critical Environmental Concern (ACEC)

N

0 300 600 Feet

Figure 2

Fort Pond (MA81046) Directly Contributing MassDOT Watershed

June 2015

massDOT
Massachusetts Department of Transportation
Highway Division

P:\45221143-4522-13004\Assign #07 - Miscellaneous Assessments\GIS\Fort Pond\Figure 2 - Fort Pond Directly Contributing Watershed.mxd

Impaired Waters Assessment for Salem Harbor (MA93-54)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments, Fecal Coliform*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the North Coastal Watershed*[2]
	WQ Assessment:	*North Shore Coastal Watersheds 2002 Water Quality Assessment Report*[3] and *EPA 2012 Waterbody Report for Salem Harbor*[4]
Location	Towns:	*Salem, Marblehead*
	MassDOT Roads:	*Route 114, Route 1A, Route 107*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method**)** ☒
BMPs	Existing:	*None*

MassDOT Area and Targets	Impervious Cover (IC)
Directly Contributing Area:	*0.08 acres*
Contributing Area Reduction Target:	*0.06 acres*
Existing BMPs Reduction:	*0.00 acres*
Remaining Reduction to Meet Target:	*0.06 acres*

[1] MassDEP, March 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDEP, March 2012. Final Pathogen TMDL for the North Coastal Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/ncoastl1.pdf

[3] MassDEP, March 2007. North Shore Coastal Watersheds 2002 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/93wqar06.pdf

[4] EPA, 2012. 2012 Waterbody Report for Salem Harbor. Available at: http://ofmpub.epa.gov/tmdl_waters10/attains_waterbody.control?p_au_id=MA93-54&p_cycle=2012&p_state=MA&p_report_type=

Site Description

Salem Sound (MA93-54) is a 4.9-square-mile waterbody demarcated as the waters landward of an imaginary line connecting Naugus Head, Marblehead; the northwest point of Bakers Island, Salem; Hospital Point, Beverly; and Juniper Point, Salem. Refer to Figure 1A for the waterbody location. The extents of waterbody MA93-54 were established in the *Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*.[1] Its seaward boundaries are shared with Salem Sound (MA93-55) to the north and Salem Sound (MA93-56) to the east. Its landward boundaries are shared with Beverly Harbor (M93-20) to the west and Forest River (MA93-10) to the south.

The area occupied by the Salem Harbor (MA93-54) waterbody segment was originally covered by former segment Salem Harbor (MA93-21) and a portion of former segment Salem Sound (MA93-25). Salem Sound (MA93-25) was divided into three sections as of the 2012 version of the Integrated List of Waters to form part of Salem Harbor (MA93-54), and all of Salem Sound (MA93-55 and MA93-56). Former segment Salem Sound (MA93-25), which was included in the list of potential impaired water bodies receiving MassDOT stormwater runoff in the 2010 EPA enforcement order, is fully covered under the assessments for these three waterbodies. An assessment for former segment Salem Harbor (MA93-21) was submitted to the EPA in December 2012.[5] Waterbody segment MA93-21 was listed under the "No MassDOT Discharge" appendix.

The section targeting Salem Harbor in the *North Shore Coastal Watersheds 2002 Water Quality Assessment Report* is written for former waterbody MA93-21.[3] Based on the EPA's *2012 Waterbody Report for Salem Harbor* (MA93-54), Secondary Contact Recreation is in "good" standing. Primary Contact Recreation; Shellfish Harvesting; and Fish, Other Aquatic Life, and Wildlife are "impaired," with the probable source listed as discharges from municipal separate storm sewer systems. Aesthetics and Fish Consumption have not been assessed.[4]

The subwatershed to Salem Harbor (MA93-54) covers approximately 4.3 square miles in portions of both Salem and Marblehead, as shown in Figure 1A. The total watershed covers approximately 6.3 square miles, occupying a larger portion of Salem. The subwatershed wraps around the northwestern side of Salem Harbor, omitting a tributary basin within the total watershed that is roughly circular in shape. Along the southeastern side of Salem Harbor, the subwatershed includes Forest River (MA93-10) and extends west beyond Route 107. MassDOT roadways within the urban area in the subwatershed include a bridge along Route 114 and stretches of Route 107 and Route 1A. Land use in the subwatershed is primarily high and medium density residential areas. The remaining major land uses are a mixture of forested areas, wetlands, commerce, and industry.

After review of MassDOT roadways within the urban area and U.S. Geological Survey (USGS) topographic data, it was determined that the urban, MassDOT-owned portion of Route 107 in the watershed discharges stormwater to non-impaired tributaries that flow over a mile before reaching Salem Harbor. Stormwater discharges from the urban, MassDOT-owned portion of Route 1A enter Forest River (MA93-10) prior to reaching Salem Harbor. Thus, neither roadway directly discharges to Salem Harbor.

MassDOT owns a short section of Route 114 that directly discharges stormwater to Salem Harbor (MA93-54). Route 114 includes a 55-foot bridge that spans the point where Forest River (MA93-10)

[5] MassDOT, December 2012. MassDOT Semi Annual Submittal: NPDES MS4 General Permit Compliance Water Quality Impaired Waters Assessment and Mitigation Plan. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year3/Year3_ImpairedWatersAssessment_1.pdf

becomes Salem Harbor. The bridge has one lane for each direction of travel and sidewalks on both sides.

Existing BMPs

MassDOT did not identify any existing BMPs in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the waterbody for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Salem Harbor (MA93-54) using the methodologies described below.

This assessment has been completed based on the *Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*.[1] MassDEP has released a proposed *Massachusetts Year 2014 Integrated List of Waters,* which has been reviewed for any proposed changes to the condition of the water bodies.[8] The condition of Salem Harbor is not proposed to change.

BMP 7R for Pathogen TMDL (CN 155.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R[6] of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL. Salem Harbor (MA93-54) is covered by the *Final Pathogen TMDL for the North Coastal Watershed.*[2]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to be consistent with relevant TMDLs and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[9]

The North Coastal Watershed has both point and non-point sources of bacteria pollution, as identified in the TMDL report. The watershed encompasses densely populated areas that are upwards of 30% impervious and include housing developments, commercial buildings, roads, and parking lots. These impervious areas contribute a high amount of stormwater runoff with moderate to high bacterial loadings that affect the surrounding estuaries. Salem Harbor is one of six major harbors in the North

[6] MassDOT, July 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[7] MassDOT, April 2010. BMP 7U: Water Quality Impaired Waters Assessment and Mitigation Plan. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[8] MassDEP, June 2014. Massachusetts Year 2014 Integrated List of Waters – Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/14iwlistp.pdf

[9] MassDOT, December 2014. Description of MassDOT's Application of BMP 7R for Pathogen Related Impairments.

Coastal Watershed. Some services to the boating area, such as maintaining, mooring, fueling, and launching, can involve pollutant discharges directly into the harbor areas that affect the estuaries. Samples taken from the area show high bacteria levels, especially after large storms. The main bacteria sources include boat waste, failing sewer line infrastructure, failing septic systems, and animal waste.

Salem Harbor (MA93-54) is listed as high priority for dry weather, with a special note of the possible illicit discharges during dry weather, and medium priority for wet weather.

In addition to the generic recommendations discussed in the MassDOT Pathogen Methodology, Section 8.3 of the *Final Pathogen TMDL for the North Coastal Watershed* recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Address pet waste as a water quality issue.
- Reduce public geese feeding, especially along lakes where both geese and people congregate.
- Provide technical and funding assistance for the implementation of municipal stormwater plans and ensure that consent judgments are completed in a timely manner.
- Encourage communities and watershed groups to take advantage of the interest that the Natural Resources Conservation Service (NRCS) has in working with communities to identify sources of stormwater contamination and evaluate remedial options.
- Educate communities to consider permit and development strategies that address stormwater runoff – implement BMPs and Low Impact Development (LID).

The TMDL report also indicates that structural BMPs may be appropriate to address runoff from impervious areas in instances where fecal coliform concentrations cannot be reduced by other means.

The following initiatives, also identified in Section 8.3 of the TMDL, are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the North Coastal Watershed in Marblehead and Salem:

- Public education on stormwater is included in stormwater information flyers mailed out to all residents annually (Marblehead).
- Pet waste disposal barrels are located in all public parks (Marblehead).
- All stormwater outfalls and their receiving waters have been mapped (Marblehead).
- A draft stormwater illicit connection by-lay was created (Marblehead).
- Salem Sound Coast Watch (SSCW) has established a website that allows the City to post stormwater-related information and data (Salem).
- SSCW sponsors beach cleanups and volunteer water quality monitoring with results published every two weeks on website (Salem).
- City of Salem conducts visual surveys of outfalls during dry weather each year including weekly sampling at 18 locations between June and August (Salem).

BMP 7U for Impervious Cover Related Impairments

A final TMDL is not in place to address Salem Harbor's (MA93-54) following impairment: estuarine bioassessments. Therefore, MassDOT assessed the stormwater-related impairment not addressed

by a TMDL using the approach outlined in the Description of MassDOT's Application of Impervious Cover Method in BMP 7U[10] which was developed using the EPA Region I's Impervious Cover (IC) Method, described in EPA's Stormwater TMDL Implementation Support Manual.[11] 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 calculated the following values for the total contributing watershed and the subwatershed of the impaired water (Salem Harbor) to determine the IC area and set a reduction target. Watersheds are based on the USGS Dataset 451[12] and modified as necessary using topography. MassGIS's impervious surfaces data layer[13] was used to determine the IC of the watersheds. The total watershed and the subwatershed are shown in Figure 1A.

Table 1 Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	4,006 acres	2,724 acres
Impervious Cover (IC) Area	1,540 acres	1,015 acres
Percent Impervious	38%	37%
IC Area at 9% Effective IC Target	361 acres	245 acres
Target Effective IC Reduction	77%	76%

The total and subwatershed's percent impervious are greater than 9%, indicating that stormwater is a likely contributor to the impairment. To meet the 9% effective IC target, the effective IC within the subwatershed will need to be reduced by the percentage calculated in Table 1. MassDOT then uses the same target percent reduction for their directly contributing watershed as shown in Table 2.

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	0.08 acres
Directly Contributing IC Area	0.08 acres
Percent Impervious	100%
Directly Contributing Area Effective IC Reduction Target (76% Target Effective IC Reduction of MassDOT Directly Contributing IC Area)	0.06 acres
Target Effective IC	24%
Target Effective IC	0.02 acres

[10] MassDOT, April 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/IC_MethodApplication2011Apr6.pdf

[11] ENSR, March 2006. Stormwater TMDL Implementation Support Manual for US EPA Region 1. ENSR International & EPA Region 1, Boston, MA. Available at http://www.epa.gov/region1/eco/tmdl/pdfs/Stormwater-TMDL-Implementation-Support-Manual.pdf

[12] USGS Data Series 451 Local and Cumulative Impervious Cover of Massachusetts Stream Basins Available at: http://pubs.usgs.gov/ds/451/

[13] MassGIS Impervious Surfaces datalayer taken from 2005 orthoimagery. Available at: http://www.mass.gov/mgis/impervious_surface.htm

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 practical given site constraints.

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

Proposed Mitigation Plan

During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified opportunities for BMPs that could be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects meeting those requirements can be implemented under the Impaired Waters Program Retrofit initiative.

The primary site limitation prohibiting BMP construction is the limited MassDOT right-of-way. MassDOT's directly contributing watershed is a 55-foot bridge along Route 114 that is only two lanes wide with an additional 4-foot sidewalk on both sides. The abutting sections of Route 114 to the east and west of the bridge are municipally-owned. MassDOT's property line runs directly along the edge of the bridge on all four sides, allowing no space for 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 the Salem Harbor given the site constraints.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review and source control. As discussed in MassDOT's BMP 7R Pathogen Methodology, MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the *Final Pathogen TMDL for the North Coastal Watershed*,[2] MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the subwatershed of this water body. MassDOT will be installing signs at rest stops within the subwatersheds of pathogen impaired waterbodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

Although the TMDL report also identifies the benefits structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains towards meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present,

there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

MassDOT has concluded that the BMPs outlined in the SWMP are consistent with its existing permit requirements for Salem Harbor. 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. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from MassDOT roadways to be a contributing source it is unlikely to warrant action relative to other sources of pathogens in the watershed.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Salem Harbor, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. 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 NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target effective IC reductions.

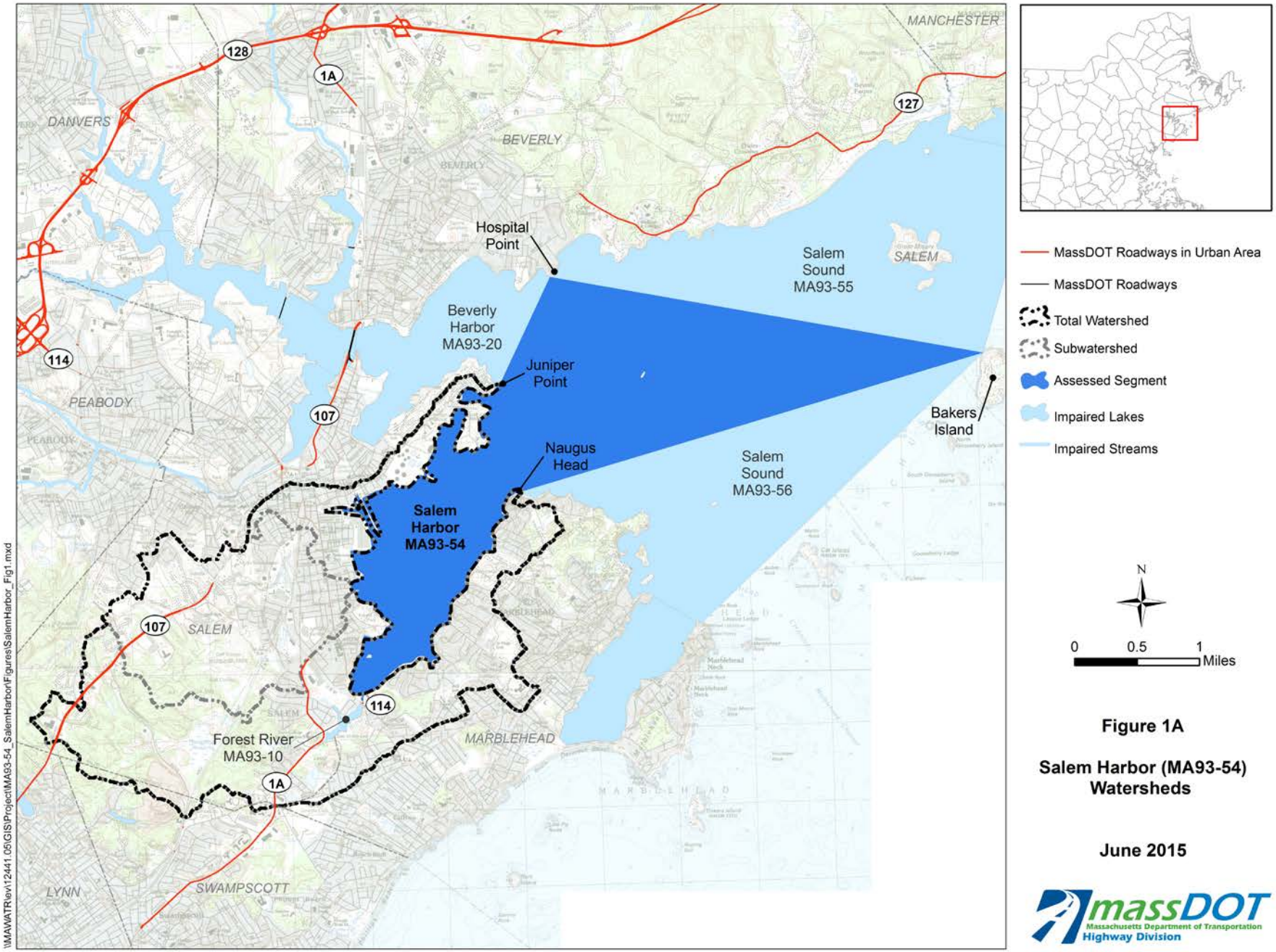


Figure 1A

Salem Harbor (MA93-54) Watersheds

June 2015

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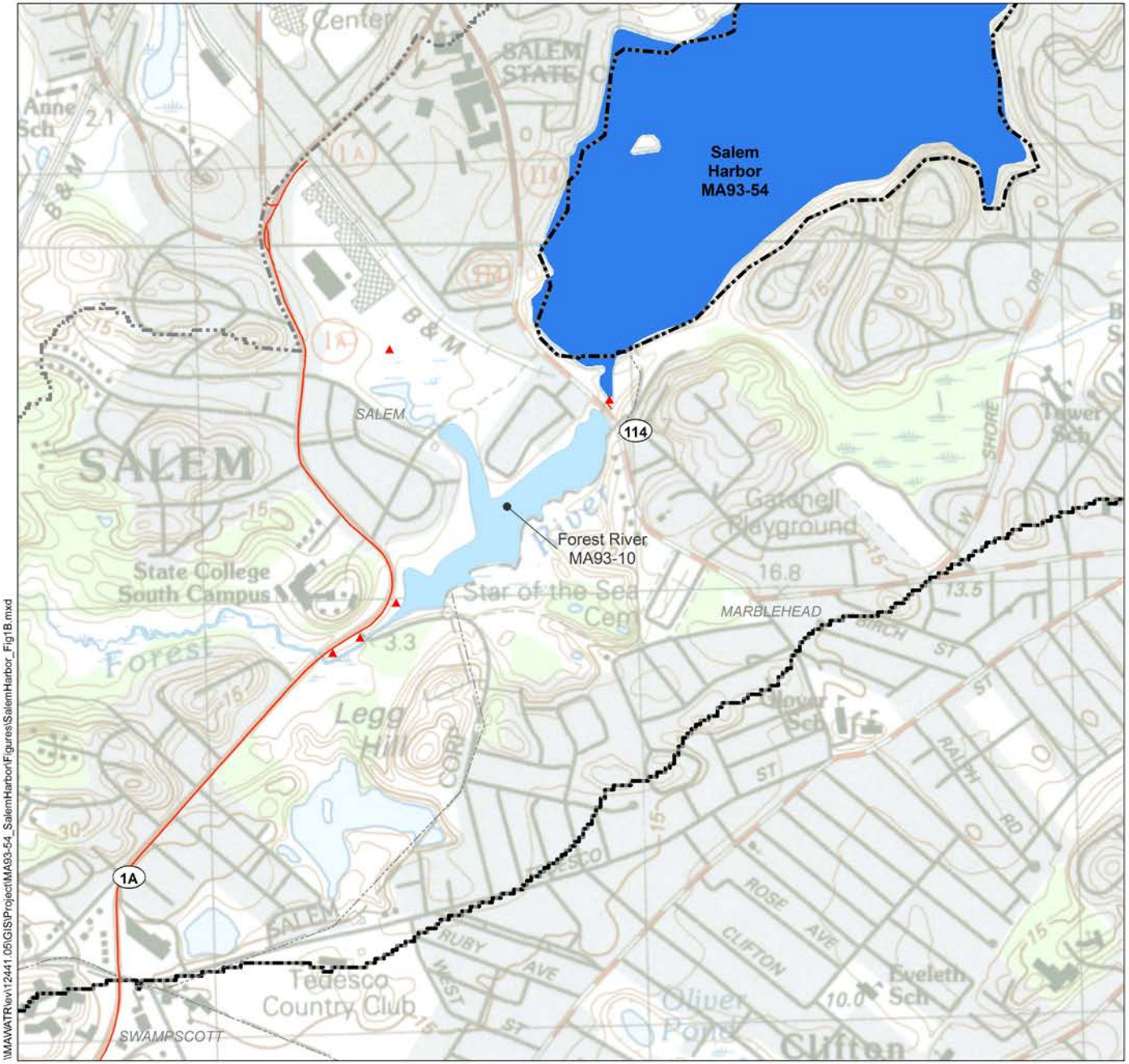

- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Total Watershed
- Subwatershed
- Assessed Segment
- Impaired Lakes
- Impaired Streams

N

0 500 1,000 Feet

Figure 1B

Salem Harbor (MA93-54)
Subwatershed Detail

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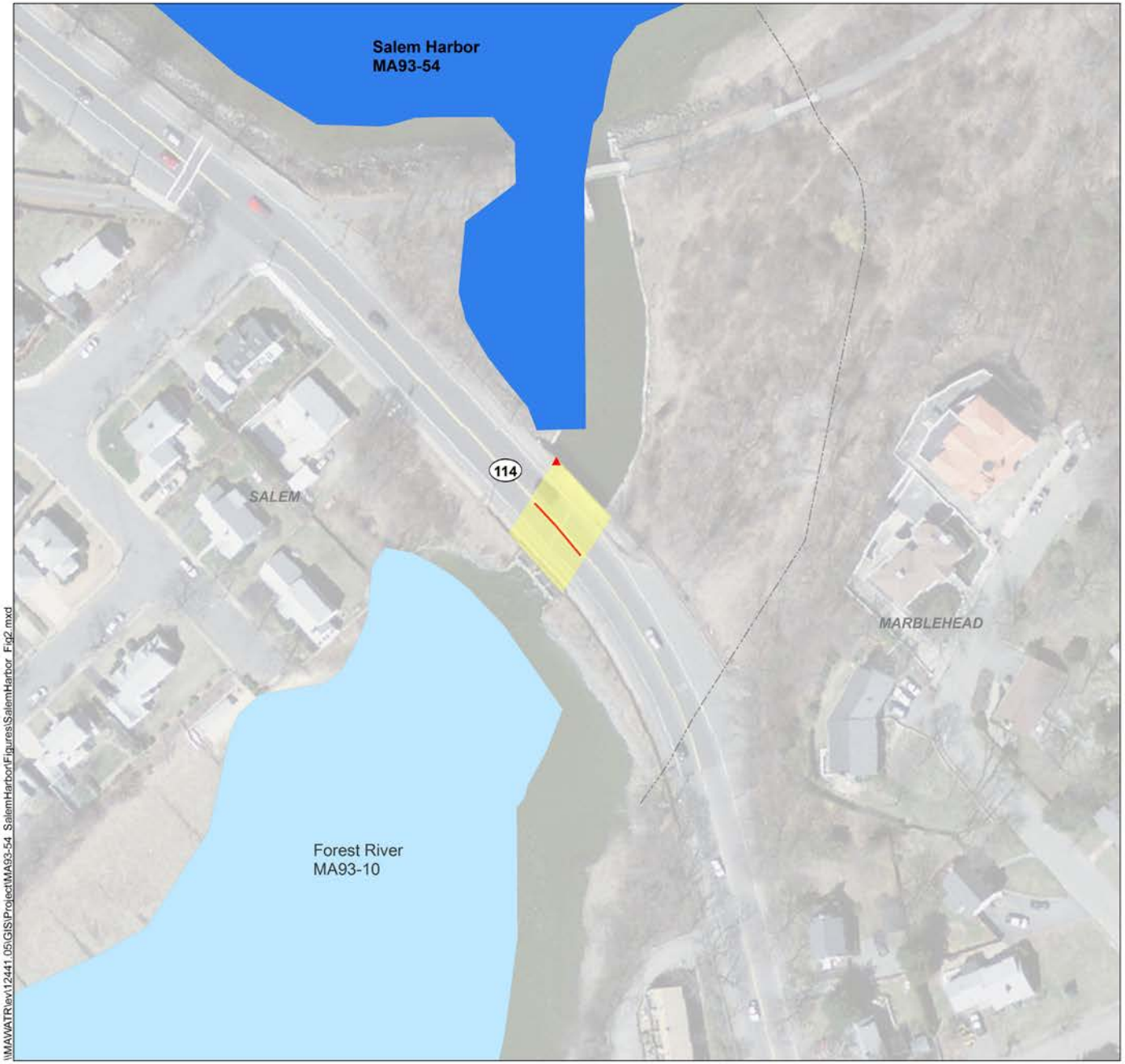

MassDOT Outfalls
MassDOT Roadways in Urban Area
MassDOT Roadways
Assessed Segment
Impaired Lakes
MassDOT Directly Discharging Area

N

0 50 100 Feet

Figure 2

**Salem Harbor (MA93-54)
Directly Contributing
MassDOT Watershed**

June 2015

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