Attachment 1:

Impaired Waters Assessments – Final Reports (IC/TMDL)

List of Impaired Water Bodies

Waterbody ID	Waterbody Name
MA36003	Alden Pond*
MA51-31	Singletary Brook*
MA74-10	Furnace Brook
MA81053	Grove Pond*
MA81-17	Nonacoicus Brook*
MA82020	Lake Cochituate
MA82097	Saxonville Pond
MA82112	Waushakum Pond
MA82125	Lake Cochituate
MA82127	Lake Cochituate
MA82A-22	Unnamed Tributary
MA82A-26	Sudbury River
MA83-18	Shawsheen River
MA93-42	North River

*****Not on original L-1 List.

Impaired Waters Assessment for Alden Pond (MA36003)

Summary

		Stormwater
Impaired Waters[1]	**Impairments**	Nutrients/Eutrophication Biological Indicators
	Category:	5 (Waters requiring a TMDL)
	Final TMDLs	None
	WQ Assessment	Chicopee River Watershed 1998 Water Quality Assessment Report (MassDEP, 2001) [2]
Location	**Towns:**	Ludlow
	MassDOT Roads:	Piney Lane
Assessment Methods(s)	**7R (TMDL Method)**	☐
	7U (IC Method)	☒
BMPs	**Existing:**	None
		Impervious Cover (IC)
MassDOT Area and Targets	**Directly Contributing Area**	0.03 acres
	Contributing Area Reduction Target	0.003 acres
	Existing BMPs Reduction	0 acres
	Remaining Reduction to Meet Target	0.003 acres

Site Description

Alden Pond (MA36003) is a 4.0 acre pond located in the Chicopee River Watershed in Ludlow, MA. The pond lies between Alden Street and Piney Lane, approximately 0.67 miles southeast of the Springfield Reservoir. Alden Pond's 13.5 square mile (8,669 acre) total watershed extends north from the pond to the intersection of Route 21 and Route 181 in Belchertown, approximately

1 MassDEP, 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, 2001. Chicopee River Basin 1998 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/eea/agencies/massdep/water/watersheds/water-quality-assessments.html

2.7 miles to the west and 1.0 miles to the east (**Figure 1**). MassDEP's Water Quality Assessment Report[3] for this receiving water states that the trophic state is eutrophic.

Alden Pond's subwatershed is 40 acres and is shown in **Figure 1.** The surrounding land use is generally residential. Alden Pond is fed from the north by Springfield Reservoir and Broad Brook through three arch culverts and outlets to the south into the continuation of Broad Brook and the Chicopee River. The section of Piney Lane that crosses over the three culverts at the northern end of Alden Pond is the only MassDOT owned roadway within the Alden Pond subwatershed (**Figure 2**).

Site limitations in the Alden Pond watershed include limited ROW and steep slopes to edge of water body. MassDOT's ROW only includes the roadway over the culverts to Alden Pond. Guardrail is located on either side of the roadway and the water's edge is within 10-ft 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 assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Alden Pond (MA36003) using the methodologies described below.

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Alden Pond's (MA36003) following impairments: Nutrients/eutrophication biological indicators. 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 as a basis, described in EPA's Stormwater TMDL Implementation Support Manual[5]. 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 (Alden Pond) to determine the IC area and set a target. Watersheds are based on the USGS Dataset 451 and modified as necessary using topography.[6] MassGIS's

[3] MassDEP, 2001. Chicopee River Basin 1998 Water Quality Assessment Report. Retrieved from: http://www.mass.gov/eea/agencies/massdep/water/watersheds/water-quality-assessments.html

[4] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[5] ENSR 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/regionalpgrfs.html

[6] 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 was used to determine the IC of the watersheds.[7] The total and sub watersheds are shown in Figure 1.

Table 1 Impaired Segment Watershed

	Total Watersh	Subwatershed
Watershed Area	8669 acres	40 acres
Impervious Cover (IC) Area	407 acres	4.3* acres
Percent Impervious	4.7%	10.5%
IC Area at 9% Goal	N/A	3.6 acres
Target Effective IC Reduction	N/A	10.0%

*Rounding accounts for differences in calculations

The subwatershed is greater than 9% impervious indicating that stormwater is a likely contributor to the impairment. To meet the 9% effective IC target, the effective IC within the subwatershed will need to be reduced. Therefore, the effective IC of MassDOT's directly contributing area should also be reduced by the same percentage. The following table shows how MassDOT calculated the target effective IC for MassDOT's contributing property. Figure 2 shows MassDOT's directly contributing watershed.

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	0.03 acres
Directly Contributing IC Area	0.03 acres
Percent Impervious	100%
Contributing Area Reduction Target (Effective IC) (10.0% Reduction of DOT Directly Contributing IC)	0.003 acres
Target Effective IC	90.0%
Target Effective IC	0.027 acres

Under existing conditions, MassDOT's estimated effective IC exceeds the target as described above.

This assessment was not able to identify practical locations for stormwater management improvements within the current MassDOT right-of-way. Based on the relatively small MassDOT contributing area construction of stormwater BMPs is not warranted.

Proposed Mitigation Plan

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Alden 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.

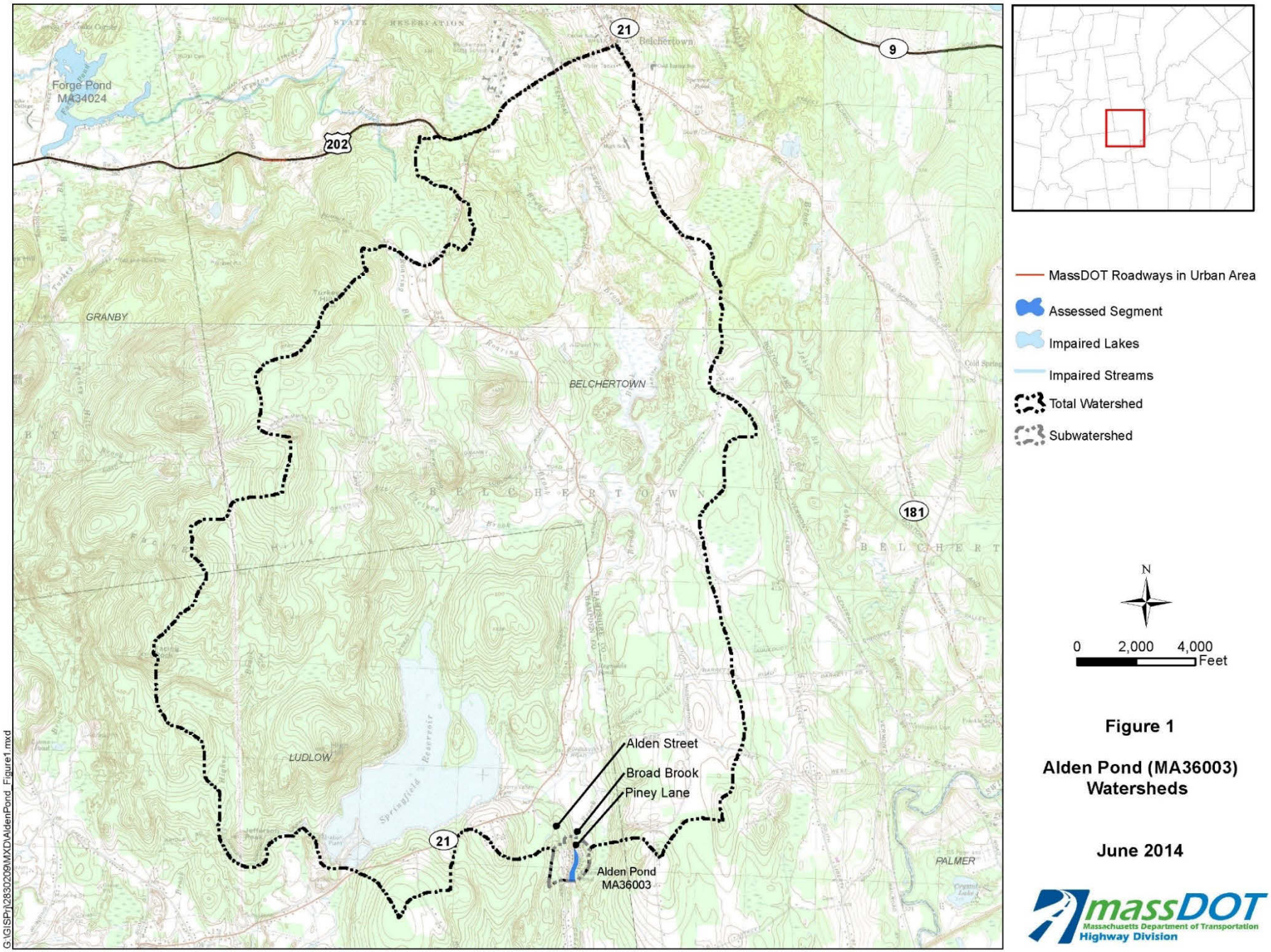

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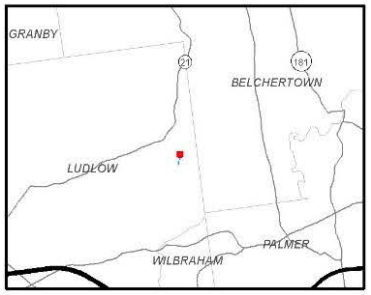
Figure 1

Alden Pond (MA36003) Watersheds

June 2014

MassDOT Massachusetts Department of Transportation Highway Division



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- MassDOT Directly Discharging Area
- Assessed Segment
- Impaired Streams
- NHD Flowlines
- DEP Wetlands

N

0 25 50 Feet

Figure 2

Alden Pond (MA36003)
Directly Contributing
MassDOT Watershed

June 2014

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Highway Division

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06/08/2014

Impaired Waters Assessment for Singletary Brook (MA51-31)

Summary

Impaired Water[2]		Stormwater	Non-Stormwater[1]
	Impairments:	Aquatic Plants (Macrophytes)	(non-native aquatic plants*)
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs:	None	
	WQ Assessment:	*Blackstone River Watershed 2003-2007 Water Quality Assessment Report*.[3]	
Location	**Towns:**	Millbury, MA	
	MassDOT Roads:	Route 146, West Main Street.	
Assessment Method(s)	**7R (TMDL Method)**	☐	
	7U (IC Method)	☒	
BMPs	**Existing:**	None	
	Proposed:	4 swales	
			Impervious Cover (IC)
MassDOT Contributing Area and Targets	**Directly Contributing Area**		5.0 acres
	Contributing Area Reduction Target		1.8 acres
	Existing BMPs Reduction		0 acres
	Remaining Reduction to Meet Target		1.8 acres

[1] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[2] MassDEP, 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

[3] MassDEP, 2010. *Blackstone River Watershed 2003-2007 Water Quality Assessment Report*. Available at: http://www.mass.gov/eea/docs/dep/water/resources/3baapp/51wqar10.pdf

Site Description

Singletary Brook (MA51-31) is a 1.5 mile long stream that headwaters from the outlet of Singletary Pond in Millbury, MA and extends to the confluence with the Blackstone River in Millbury (Figure 1). The segment excludes the approximately 0.4 miles through Brierly Pond (MA51010) which is designated as its own water body in the Massachusetts Year 2012 Integrated List of Waters. MassDEPs Blackstone River Watershed Report[4] for this receiving water identifies that there is too little data to assess the Aquatic Life Use and insufficient spatial coverage to assess primary and secondary recreational uses and aesthetic use.

The total watershed for Singletary Brook is approximately 3,701 acres and the subwatershed is 1,081 acres. The total and subwatersheds are shown in Figure 1. Within the subwatershed there are two MassDOT owned roadways that contribute stormwater runoff directly to Singletary Brook: West Main Street and Route 146.

West Main Street contributes stormwater runoff to the portion of Singletary Pond that is downstream of Brierly Pond. West Main Street is adjacent to Brierly Pond; however, as shown in Figure 3 a portion of the roadway directs flow to a catch basin located to the northeast. This catch basin discharges stormwater to the portion of Singletary Brook, downstream of Brierly Pond, where it flows under the roadway. Stormwater runoff from other portions of W. Main Street south of the portion directly discharging to Singletary Brook is shown to discharge to Brierly Pond, as indicated in the Brierly Pond (MA51010) assessment, or to a non impaired stream segment east of the roadway.

Stormwater runoff from portions of Route 146, both northbound and southbound, also directly discharges to Singletary Brook (Figure 3). Route 146 is a two lane state road with a jersey barrier median. Singletary Brook flows beneath Route 146 north of Sycamore Street. From a high point to the south of the Brook, stormwater from Route 146 is directed to catch basins located on the shoulders of the roadway and in the median. These drainage systems discharge flow to Singletary Brook.

From the interchange of Route 146 with Elm St/Elmwood St/West Main St, stormwater runoff is discharged to a roadside ditch adjacent to the north bound lanes. This ditch conveys flow to Singletary Brook and is therefore considered direct discharge to the water body (Figure 3).

The area adjacent to Route 146 contains wooded areas, steep slopes including rock outcrops and some wetland areas. There is a narrow vegetated right-of-way along Route 146. These factors limit MassDOT's ability to construct BMPs within the right-of-way.

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.

[4] MassDEP, 2010. *Blackstone River Watershed 2003-2007 Water Quality Assessment Report*. Available at: http://www.mass.gov/eea/docs/dep/water/resources/3baapp/51wqar10.pdf

Assessment

In cases where a TMDL has been approved, MassDOT assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Singletary Brook (MA51-31) using the methodologies described below.

MassDOT has identified a subset of water body impairments in the Singletary Brook watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for the Singletary Brook include (non-native aquatic plants*). 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-pollutant impairments are not specifically addressed as part of the Impaired Waters Program.[5]

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Singletary Brook's (MA51-31) following impairments: Aquatic Plants (Macrophytes). 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 as a basis, 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 (Singletary Brook) to determine the IC area and set a target. The total watershed and the subwatershed are shown in Figure 1.

[5] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[6] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[7] ENSR 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/regionalpgrfs.html

Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	3,701 acres	1,081 acres
Impervious Cover (IC) Area	305 acres	151 acres
Percent Impervious	8.2 %	14 %
IC Area at 9% Goal	*	97.3 acres
Target Effective IC Reduction	*	35.6 %

* Total Watershed is less than 9%; however water body was assessed under BMP 7U due to the MassDOT roadway crossing the water body and the subwatershed containing more than 9% IC.

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

MassDOT Directly Contributing Watershed

Directly Contributing Area	5.0 acres
Directly Contributing IC Area	5.0 acres
Percent Impervious	100%
Contributing Area Reduction Target (Effective IC) (35.6% Reduction of DOT Directly Contributing IC)	1.8 acres
Target Effective IC	64%
Target Effective IC	3.2 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 within the right of way of Route 146, and estimated the effective IC accounting for their treatment. The Proposed Mitigation Plan section describes the BMPs and their IC reduction performance.

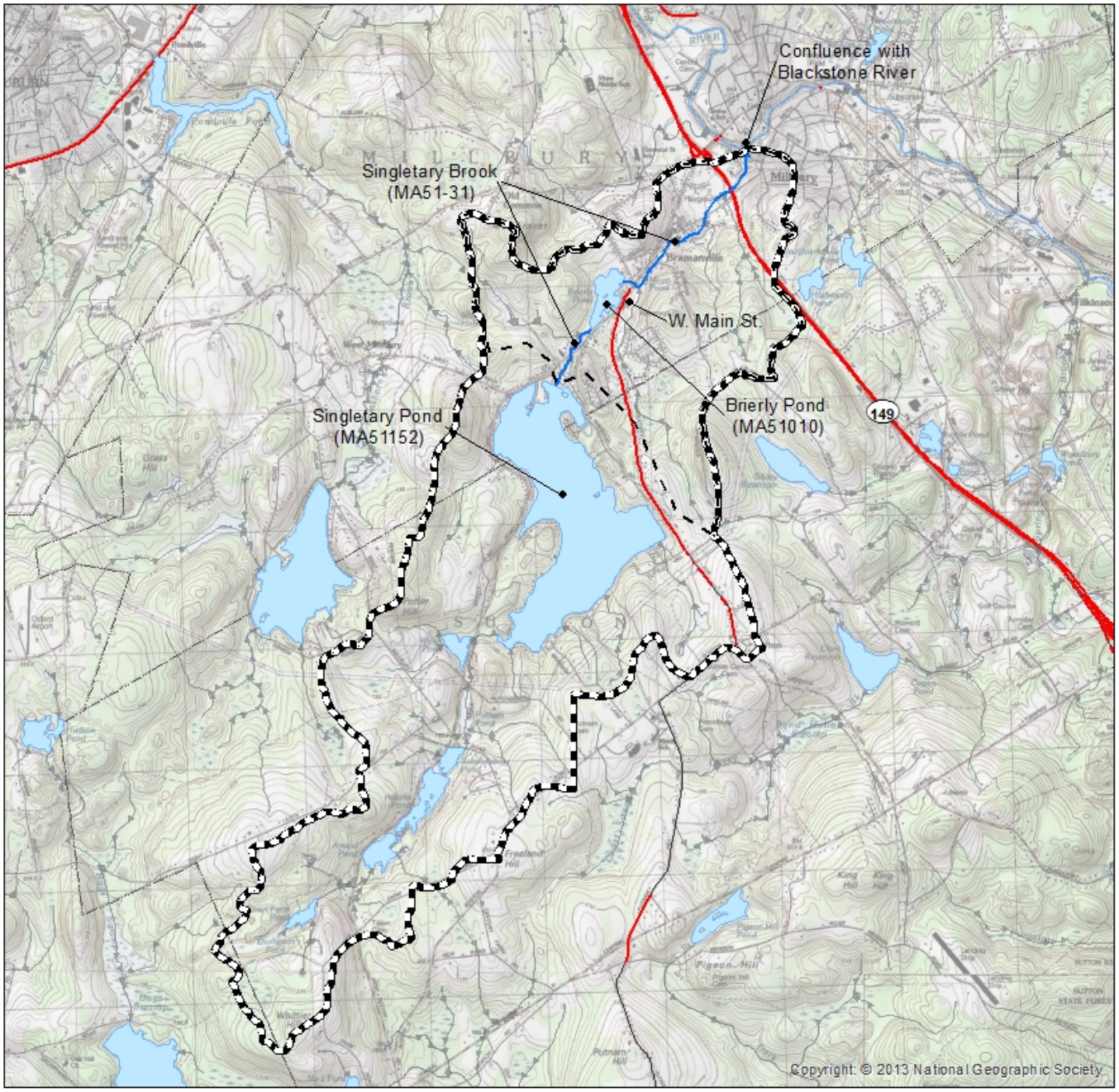
Proposed Mitigation Plan

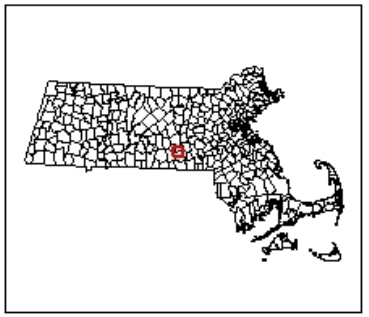
MassDOT has identified that additional control measures are needed to reduce its effective IC and phosphorus loading within the directly contributing watershed to achieve the targeted reduction and that appropriate locations are potentially available for control measures as shown on Figure 4. Additional BMPs are not considered feasible due to limited right-of-way or open space adjacent to the roadways within the watershed area. MassDOT will now work with its design consultants to identify other locations suitable for construction of additional BMPs to treat 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 and phosphorus load reduction to the maximum extent practical.

Once the design of the proposed BMPs is further along, MassDOT will provide an update with additional information and summarize the final effective IC reduction based on the designed retrofit project BMPs.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Singletary 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.





subwatershed
Totalwatershed
Singletary Brook
Impaired Stream Segment
Impaired Water Bodies
Non-Impaired Stream Segment
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.25 0.5 1 Miles

Figure 1

Singletary Brook
Total Watershed
MA51-31

June 2014

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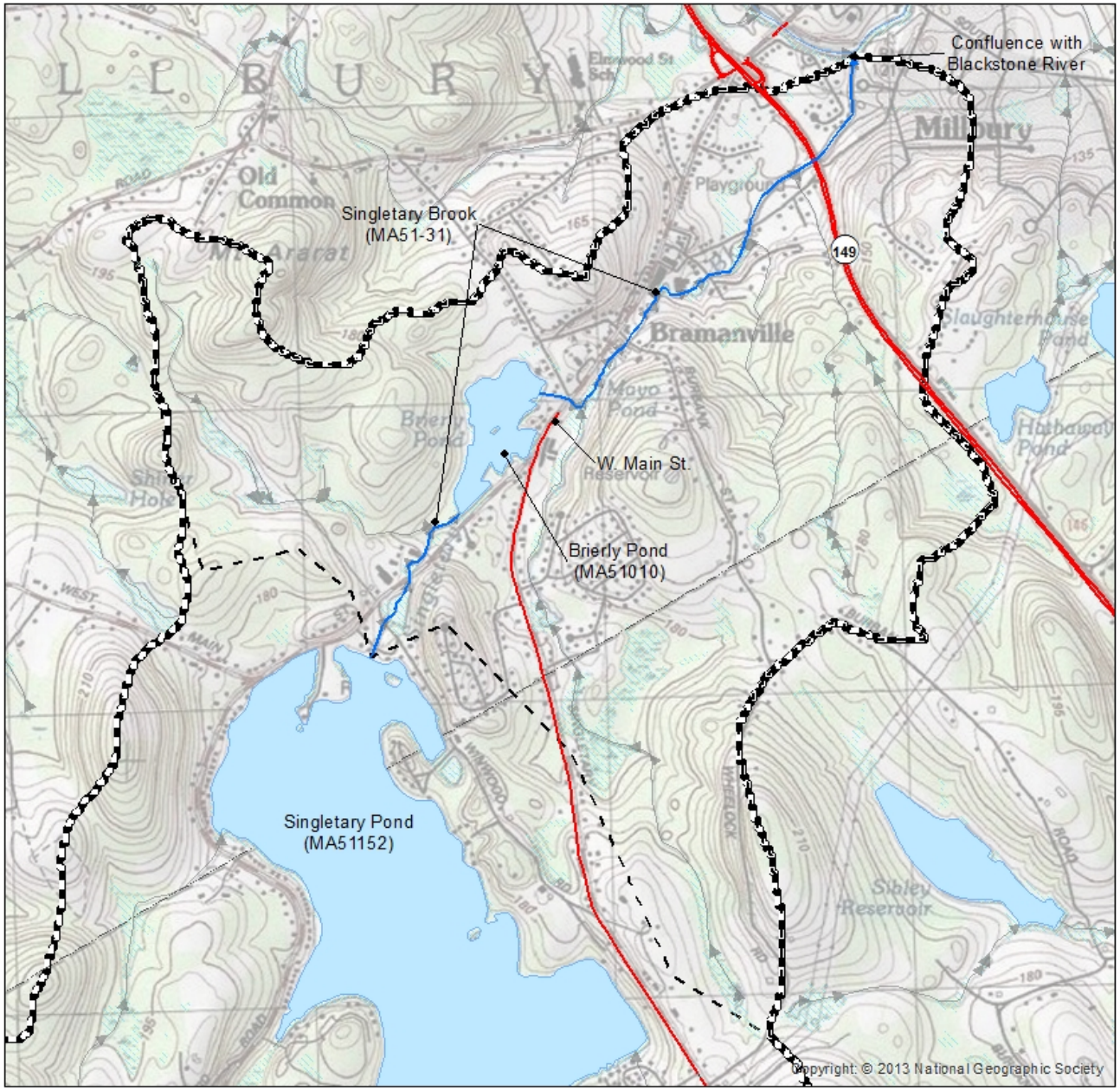

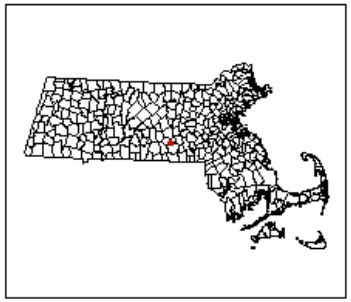

Singletary Brook
Impaired Stream Segment
Impaired Water Bodies
Non-Impaired Stream Segment
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries
subwatershed
Totalwatershed

N

0 0.1 0.2 0.4
Miles

Figure 2
Singletary Brook
Subwatershed
MA51-31

June 2014

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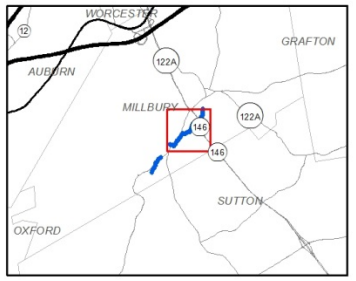


- Assessed Segment
- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Impaired Streams
- Impaired Lakes
- MassDOT Directly Discharging Area

N

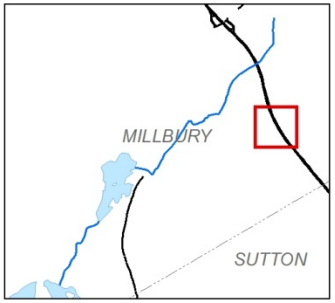
0 480 960 Feet

Figure 3

Singletary Brook (MA51-31)
Directly Contributing
MassDOT Watershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division



Impaired Stream Segment
Proposed BMP - Swale
Impaired Water Bodies
Non-Impaired Stream Segment
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 30 60 120 180
Feet

Figure 4
Proposed BMP
Singletary Brook (MA51-31)
MassDOT

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

06/08/2014

Impaired Waters Assessment for Furnace Brook (MA74-10)

Summary

		Stormwater	
Impaired Water[1]	**Impairments:**	Dissolved Oxygen	
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs:	None	
	WQ Assessment:	*Weymouth and Weir River Basin 2004 Water Quality Assessment Report*[2]	
Location	**Towns:**	Quincy	
	MassDOT Roads:	I-93, Bates Ave Bridge, Robertson St. Bridge, Stedman St. Bridge and Boulevard St. Bridge	
Assessment Method(s)	**7R (TMDL Method)**	☐	
	7U (IC Method)	☒	
BMPs	**Existing:**	None	
	Proposed:	None	
			Impervious Cover (IC)
MassDOT Area and Targets	**Directly Contributing Area**		11.1 acres
	Contributing Area Reduction Target		7.6 acres
	Existing BMPs Reduction		0 acres
	Remaining Reduction to Meet Target		7.6 acres

[1] MassDEP, 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, 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

Furnace Brook (MA74-10) begins at the headwaters north of Blue Hills Reservoir in Quincy and flows 4.2 miles until its confluence with Blacks Creek in Quincy. Portions of Furnace Brook (MA74-10) are culverted underground. According to MassDEP's *Weymouth and Weir River Basin 2004 Water Quality Assessment Report*[3], this segment is impaired for low dissolved oxygen, which may be caused by stormwater runoff. Although no impairment for mercury is listed, the report does state that all applicable statewide fish consumption advisories issued by the MA Department of Public Health apply, due to mercury contamination. There are no National Pollutant Discharge Elimination System Permits (NPDES) listed in the *Weymouth and Weir River Basin 2004 Water Quality Assessment Report* for Furnace Brook (MA74-10).

MassDOT's property within the subwatershed to Furnace Brook (MA74-10) includes a portion of I-93 and bridges located at Bates Avenue, Robertson Street, Stedman Street, and Boulevard Street (See Figure 1). The section of I-93 is 3 or 4 lanes on the north and south bound sides with a jersey barrier median. In the case of Furnace Brook, the subwatershed is also the total watershed, which is shown in Figure 1.

Water is conveyed to catch basins along the median and shoulders of I-93, north and southbound, which outlet to the Furnace Brook (MA74-10), via outfalls in the Furnace Brook Rotary. This was confirmed during a field observation and MassDOT Plan set 8385.

The watershed also includes a portion of Willard Street, which is owned by MassDOT South of Furnace Brook (Figure 1). Based on MassDOT Plan set 2053 and field observations, Willard Street does not directly contribute to Furnace Brook (MA74-10) as the runoff flows away from Furnace Brook via sheet flow.

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 assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Furnace Brook (MA74-10) using the methodologies described below.

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Furnace Brook's (MA74-10) following impairments: additional impairments. Therefore, MassDOT assessed the stormwater-related impairments not addressed by a TMDL using the approach outlined in the Description of MassDOT's Application of

[3] MassDEP, 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

Impervious Cover Method in BMP 7U[4] which was developed using the EPA Region I's Impervious Cover (IC) Method as a basis, described in EPA's Stormwater TMDL Implementation Support Manual.[5] 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 (Furnace Brook) to determine the IC area and set a target. The total watershed and the subwatershed are shown in Figure 1.

Impaired Segment Watershed

	Total and Subwatershed
Watershed Area	2,529 acres
Impervious Cover (IC) Area	715 acres
Percent Impervious	28.3 %
IC Area at 9% Target	228 acres
Target Effective IC Reduction	68.1 %

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

MassDOT Directly Contributing Watershed

Directly Contributing Area	11.1 acres
Directly Contributing IC Area	11.1 acres
Percent Impervious	100%
Contributing Area Reduction Target (Effective IC) (68.1% Reduction of DOT Directly Contributing IC)	7.6 acres
Target Effective IC	31.5%
Target Effective IC	3.5 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 section discusses the site constraints and mitigation plan.

[4] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[5] ENSR 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/regionalpgrfs.html

Proposed Mitigation Plan

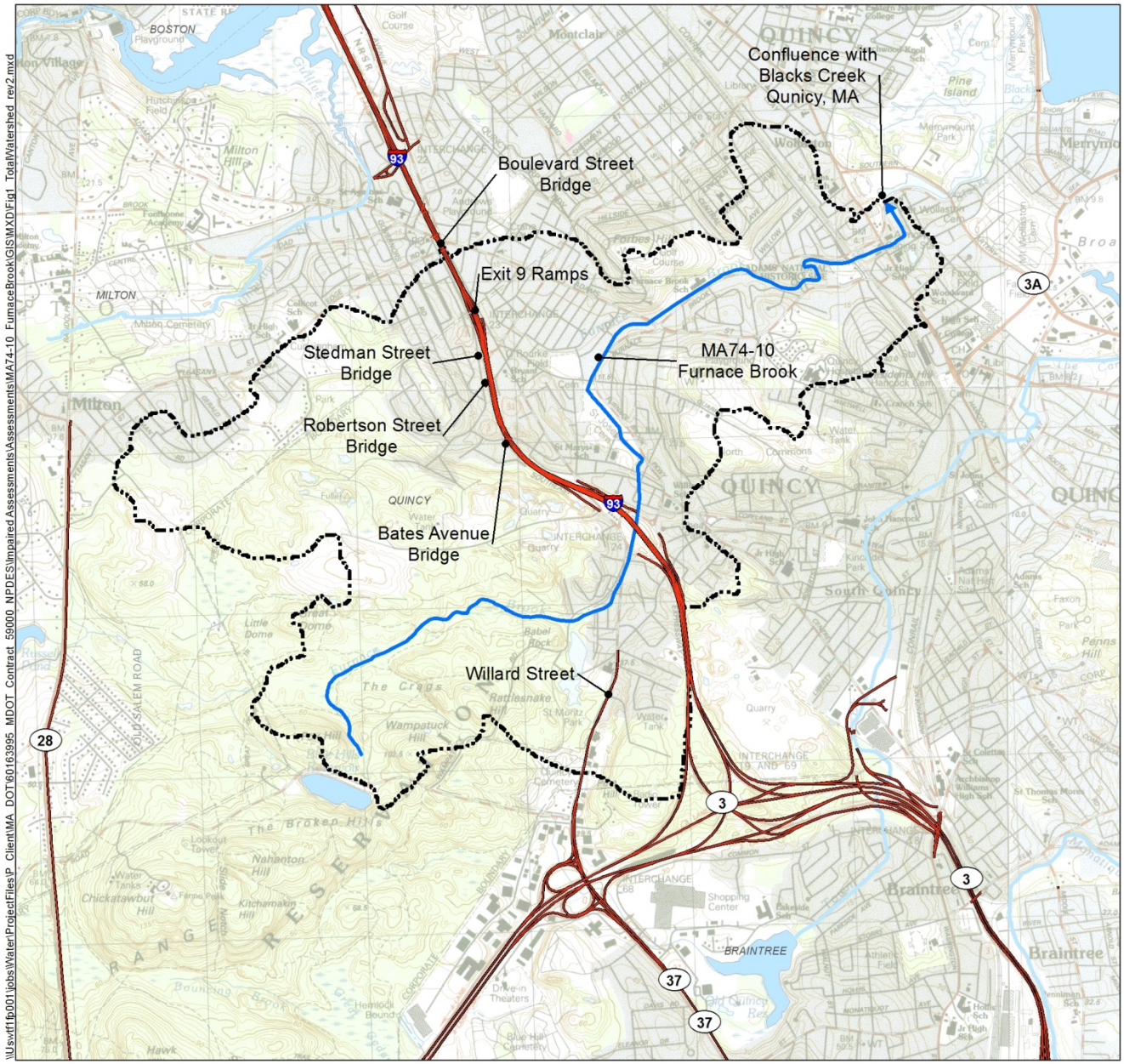
During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified BMPs that can be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an known adverse impact on historical or archeological resources, based on a desktop review. Projects that meet these requirements can be implemented under the Impaired Waters Program Retrofit initiative.

Site limitations in the Furnace Brook watershed include existing infrastructure such as bridge abutments, utilities, and a limited right-of way. Specifically, the area within the rotary is not feasible for a BMP retrofit due to the area presence of large- diameter utilities including CSO conveyance conduits. In addition, land ownership in the vicinity of the rotary also limits the implementation of a BMP as the land is owned by Department of Conservation and Recreation Department limiting the availability for a BMP retrofit.

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 Furnace Brook given the site constraints.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Furnace 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

Total and Subwatershed

Assessed Segment

Impaired Streams

Impaired Lakes

N

0 0.25 0.5 Miles

Figure 1

Furnace Brook (MA74-10)
Total and Subwatershed

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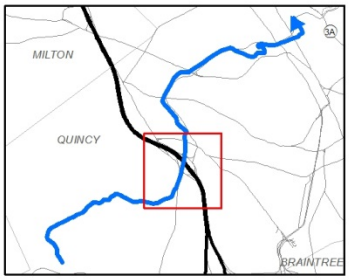
\\Uswtf1fp001\jobs\Water\ProjectFiles\P_Client\MA_DOT\60163995_MDOT_Contract_59000_NPDES\ImpairedAssessments\Assessments\MA74-10_FurnaceBrook\GIS\MXD\Fig1_TotalWatershed_rev2.mxd



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

N

0 255 510 Feet

Figure 2

**Furnace Brook (MA74-10)
Directly Contributing
MassDOT Watershed**

June 2014

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Highway Division

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Impaired Waters Assessment for Grove Pond (MA81053)

Summary

		Stormwater	Non-Stormwater
Impaired Waters[2]	Impairments	Aquatic plants (macrophytes), arsenic, DEHP (di-sec-octyl phthalate), polycyclic aromatic hydrocarbons (PAHs) (aquatic ecosystems), sediment biassays – chronic toxicity freshwater	Non-native aquatic plants, mercury in fish tissue
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs	None	
	WQ Assessment	Nashua River Watershed 2003 Water Quality Assessment Report[3]	
Location	Towns:	Ayer	
	MassDOT Roads:	Route 2A, Route 110 and Route 111	
Assessment Methods(s)	7R (TMDL Method)	☐	
	7U (IC Method)	☒	
BMPs	Existing:	None	

		Impervious Cover (IC)
MassDOT Area and Targets	Directly Contributing Area	4.6 acres
	Contributing Area Reduction Target	3.0 acres
	Existing BMPs Reduction	0.0 acres
	Remaining Reduction to Meet Target	3.0 acres

1 MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

2 MassDEP, 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

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

Site Description

Grove Pond (MA81053) is located south of Route 2A/Route 111 and east of the Boston and Maine Railroad near the center of Ayer. Grove Pond has a surface area of approximately 67 acres which receives flow from upstream wetlands and water bodies. The downstream end of Grove Pond directs water to Plow Shop Pond (MA81103) via a culvert underneath the Boston and Maine Railroad. MassDEP's Water Quality Assessment Report[4] for this receiving water identified the Aquatic Life Use, Primary and Secondary Contact Uses with an "Impaired" status due to the introduction of non-native organisms (accidental or intentional), contaminated sediments and contaminated groundwater. The receiving water also is identified with an "Impaired" status for the Fish Consumption Use due to atmospheric deposition – toxics and Aesthetics Use due to the introduction of non-native organisms (accidental or intentional).

The total and subwatersheds of Grove Pond are shown on Figure 1A, which includes the towns of Ayer, Bolton, Groton and Harvard. Figure 1B shows the MassDOT property in the Grove Pond subwatershed, which includes portions of Route 2A, Route 110, Route 111 and their roundabout. The subwatershed is comprised of commercial, industrial, medium density and multifamily residential land with the majority of the subwatershed consisting of forested land and open space.

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 2A/Route110/Route 111 roundabout is thirty-six feet wide, curbed and stormwater runoff is primarily collected by catch basins along the inner edge of the roundabout. The variable width approach roads to the roundabout, which are Route 2A, Route 110, Route 111, Sandy Pond Road and Barnum Road, are also curbed within the MassDOT property limits and stormwater runoff is collected by catch basins along the roadway edges. Runoff from both the roundabout and the approach roads enter the catch basins and pipes convey the stormwater to outfalls located northwest and southwest of the roundabout which discharge to two wetlands directly upstream of Grove Pond. Field verification determined that these discharges are direct based upon the minimal residence time of stormwater discharges in the wetlands prior to reaching Grove Pond.

The majority of the collected stormwater flows from the roundabout and the Route 2A/Route 110, Sandy Pond Road and Route 110/Route 111 approach roads is conveyed to a headwall where it discharges via a 30 inch pipe. The drainage infrastructure upstream of the 30 inch pipe passes through the infield area of the roundabout where there is room for a potential stormwater BMP pending the results of further site investigations.

Through field verification it was determined that the western portions of the Route 2A/Route 111 entrance and exit roads of the roundabout and the Route 2A/Route 111 bridge over the Boston and Maine Railroad do not discharge to Grove Pond. Runoff from the entrance and exit road of the roundabout is discharged to Balch Pond while runoff from the bridge is discharged to Schoolhouse Pond and a wetland system downstream of Plow Shop Pond.

Grove Pond is a drinking water source, and the Town of Ayer operates drinking water wells to the south of the pond. Grove Pond is also located within the Squannassit Area of Critical Environmental Concern (ACEC). The Zone II Wellhead Protection Area, location of the wells and Squannassit ACEC are shown on Figure 2.

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

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 assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Grove Pond (MA81053) using the methodologies described below.

MassDOT has identified a subset of water body impairments in the Grove Pond watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for Grove Pond include non-native aquatic plants and 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 impairments are not specifically addressed as part of the Impaired Waters Program.[5]

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Grove Pond's (MA81053) following impairments: aquatic plants (macrophytes), arsenic, DEHP (di-sec-octyl phthalate), polycyclic aromatic hydrocarbons (PAHs) (aquatic ecosystems), and sediment biassays – chronic toxicity freshwater. 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 as a basis, 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 (Grove Pond) to determine the IC area and set a target. Watersheds are based on the USGS Dataset 451 and modified as necessary using topography.[8] MassGIS's impervious surfaces data layer was used to determine the IC of the watersheds.[9] The total contributing watershed and the subwatershed are shown in Figure 1.

[5] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[6] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[7] ENSR 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/regionalpgrfs.html

[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	10,293 acres	382 acres
Impervious Cover (IC) Area	972 acres	97 acres
Percent Impervious	9.4%	25%
IC Area at 9% Target	926 acres	34 acres
Target Effective IC Reduction	4.7%	65%

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

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	8.9 acres
Directly Contributing IC Area	4.6 acres
Percent Impervious	52%
Contributing Area Reduction Target (Effective IC) (65% Reduction of DOT Directly Contributing IC)	3.0 acres
Target Effective IC	18%
Target Effective IC	1.6 acres

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

Proposed Mitigation Plan

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 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 further along, MassDOT will provide an update with additional information and summarize the final effective IC reduction based on the designed retrofit project BMPs.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Grove 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.

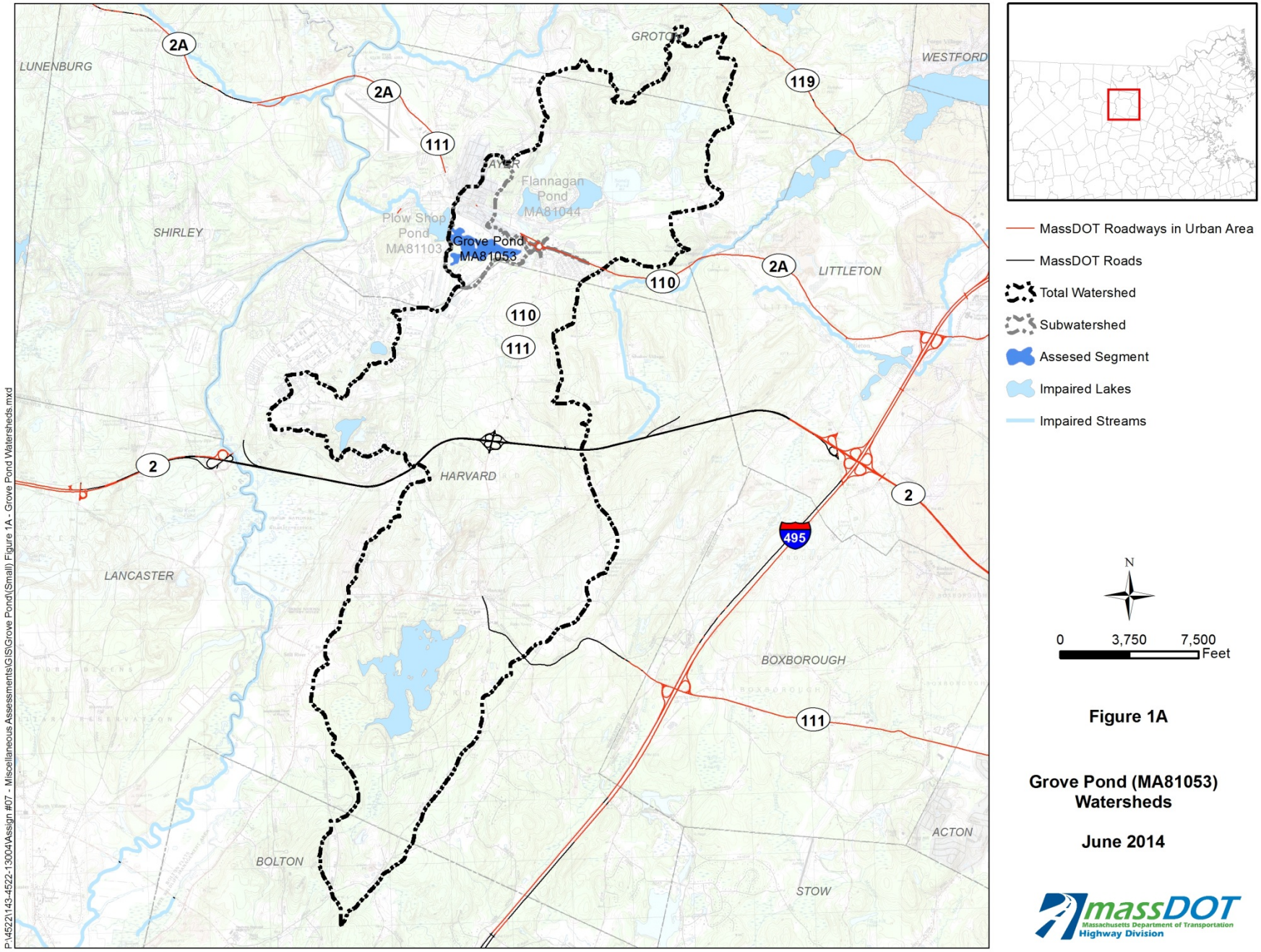

Figure 1A

Grove Pond (MA81053) Watersheds

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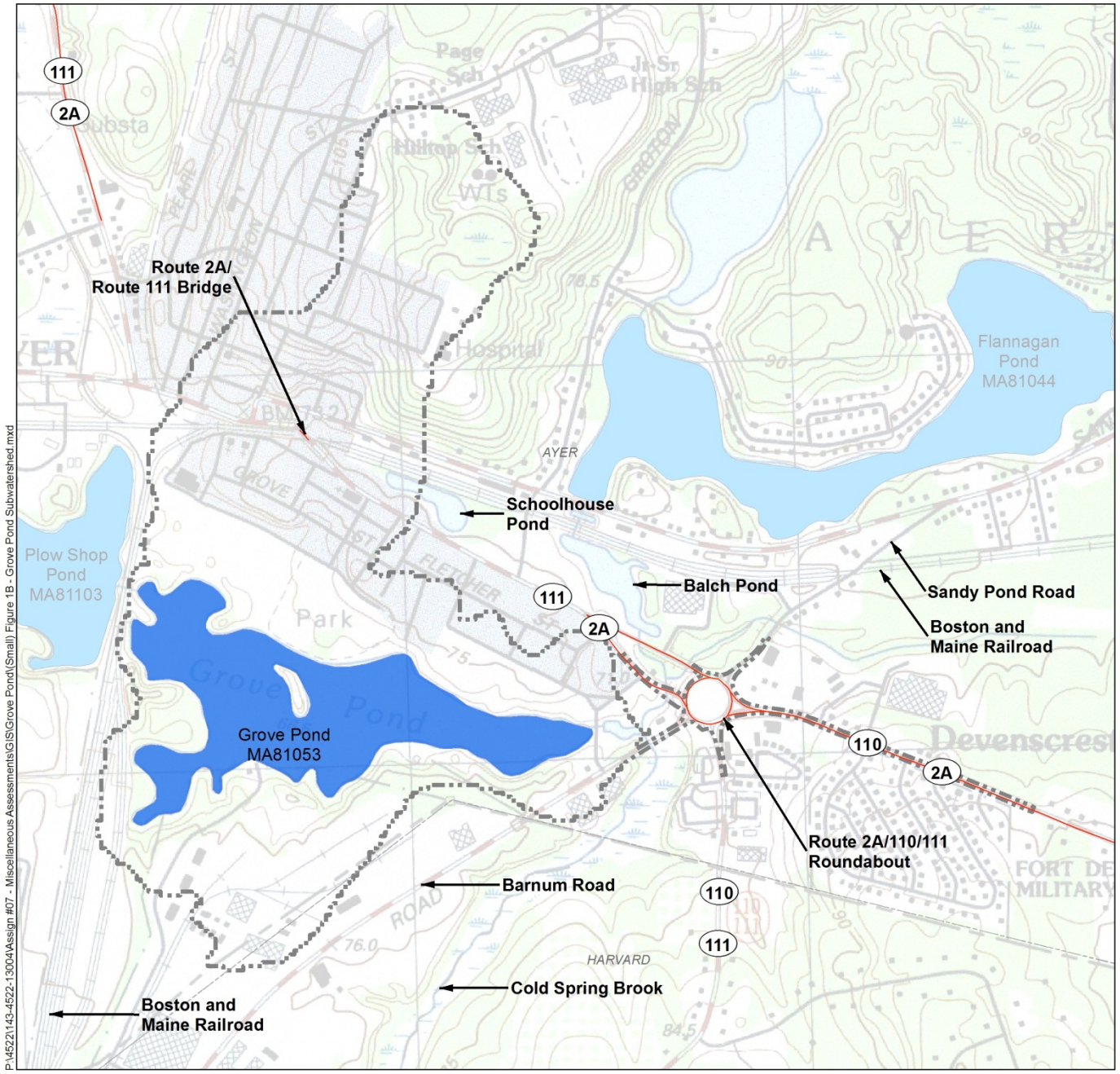

MassDOT Roadways in Urban Area

MassDOT Roads

Subwatershed

Assesed Segment

Impaired Lakes

Impaired Streams

N

0 650 1,300 Feet

Figure 1B

Grove Pond (MA81053) Subwatershed

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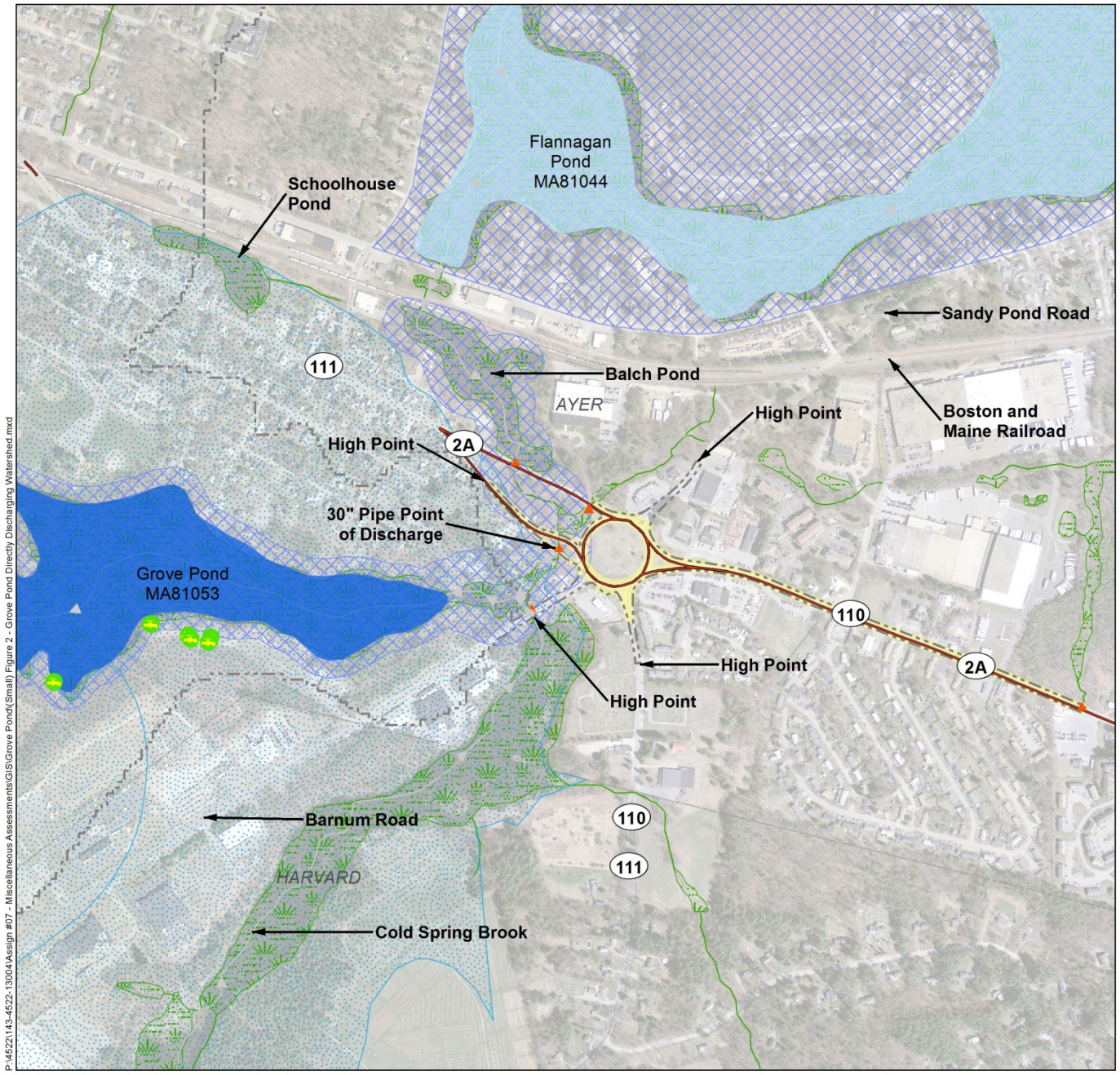

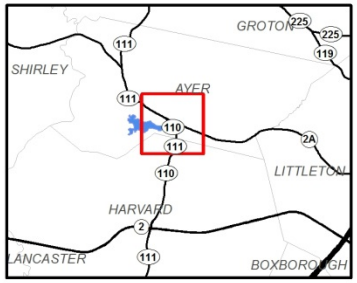

- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roads
- Subwatershed
- Assesed Segment
- Impaired Streams
- Impaired Lakes
- MassDOT Directly Discharging Area
- DEP Wetlands
- NHDFlowline
- Community Groundwater Source
- Areas of Critical Environmental Concern
- Zone II Wellhead Protection Areas

N

0 450 900 Feet

Figure 2

Grove Pond (MA81053) Directly Contributing MassDOT Watershed

June 2014

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Impaired Waters Assessment for Nonacoicus Brook (MA81-17)

Summary

		Stormwater
Impaired Waters[1]	**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:**	Ayer
	MassDOT Roads:	Route 2A, Route 110, Route 111 and West Main Street Bridge
Assessment Methods(s)	**7R (TMDL Method)**	☐
	7U (IC Method)	☒
BMPs	**Existing:**	None
		Impervious Cover (IC)
MassDOT Area and Targets	**Directly Contributing Area**	0.5 acres
	Contributing Area Reduction Target	0.4 acres
	Existing BMPs Reduction	0.0 acres
	Remaining Reduction to Meet Target	0.4 acres

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

Site Description

Nonacoicus Brook (MA81-17) originates at the outlet of Plow Shop Pond (MA81103) near the center of Ayer and flows northwest for 1.4 miles to its confluence with the Nashua River (MA81-05) at the Ayer/Shirley Town Line. MassDEP's Water Quality Assessment Report[3] for this receiving water identified the Aquatic Life Use with an "Impaired" status due to violations of the dissolved oxygen criterion.

The total and subwatersheds of Nonacoicus Brook are shown on Figure 1A, which includes the towns of Ayer, Bolton, Groton and Harvard. Figure 1B shows the MassDOT property in the Nonacoicus Brook subwatershed, which includes portions of Route 2A, Route 110, Route 111 and the West Main Street Bridge. The subwatershed to Nonacoicus Brook is comprised of commercial, industrial, medium density and multifamily residential land with the majority of the subwatershed consisting of forested land and open space.

Figure 2 shows the MassDOT directly discharging area. The West Main Street Bridge is fifty feet wide, curbed, and consists of two lanes, shoulders and sidewalks. Runoff from the bridge enters municipal catch basins, while municipal pipes within Sculley Road and West Main Street convey the stormwater to municipal outfalls located west of Nonacoicus Brook. MassDOT property in this area is limited as it's bounded by the West Main Street bridge abutments to the east and west and the Boston and Maine Railroad to the north and south.

Through field verification it was determined that the portions of Route 2A/Route 111 within the subwatershed northeast of Nonacoicus Brook and the Route 2A/Route 111 bridge over the Boston and Maine Railroad do not discharge to Nonacoicus Brook. Runoff from Route 2A/Route 111 to the northeast of Nonacoicus Brook and the eastern half of the Route 2A/Route 111 bridge is discharged to a wetland system upstream of Nonacoicus Brook where treatment likely occurs while runoff from the western half of the bridge is discharged to Schoolhouse Pond.

Nonacoicus Brook is located within the Squannassit Area of Critical Environmental Concern (ACEC). The Squannassit ACEC and limits of the adjacent Zone II Wellhead Protection Area are shown on Figure 2.

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 assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Nonacoicus Brook (MA81-17) using the methodologies described below.

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Nonacoicus Brook's (MA81-17) dissolved oxygen impairment. Therefore, MassDOT assessed the stormwater-related impairments not addressed by

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

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 as a basis, described in EPA's Stormwater TMDL Implementation Support Manual.[5] 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 (Nonacoicus Brook) to determine the IC area and set a target. Watersheds are based on the USGS Dataset 451 and modified as necessary using topography.[6] MassGIS's impervious surfaces data layer was used to determine the IC of the watersheds.[7] The total contributing watershed and the subwatershed are shown in Figure 1.

Table 1 Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	11,972 acres	2,063 acres
Impervious Cover (IC) Area	1,468 acres	594 acres
Percent Impervious	12%	29%
IC Area at 9% Target	1,077 acres	186 acres
Target Effective IC Reduction	27%	69%

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

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	0.5 acres
Directly Contributing IC Area	0.5 acres
Percent Impervious	100%
Contributing Area Reduction Target (Effective IC) (69% Reduction of DOT Directly Contributing IC)	0.4 acres
Target Effective IC	20%
Target Effective IC	0.1 acres

[4] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[5] ENSR 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/regionalpgrfs.html

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

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

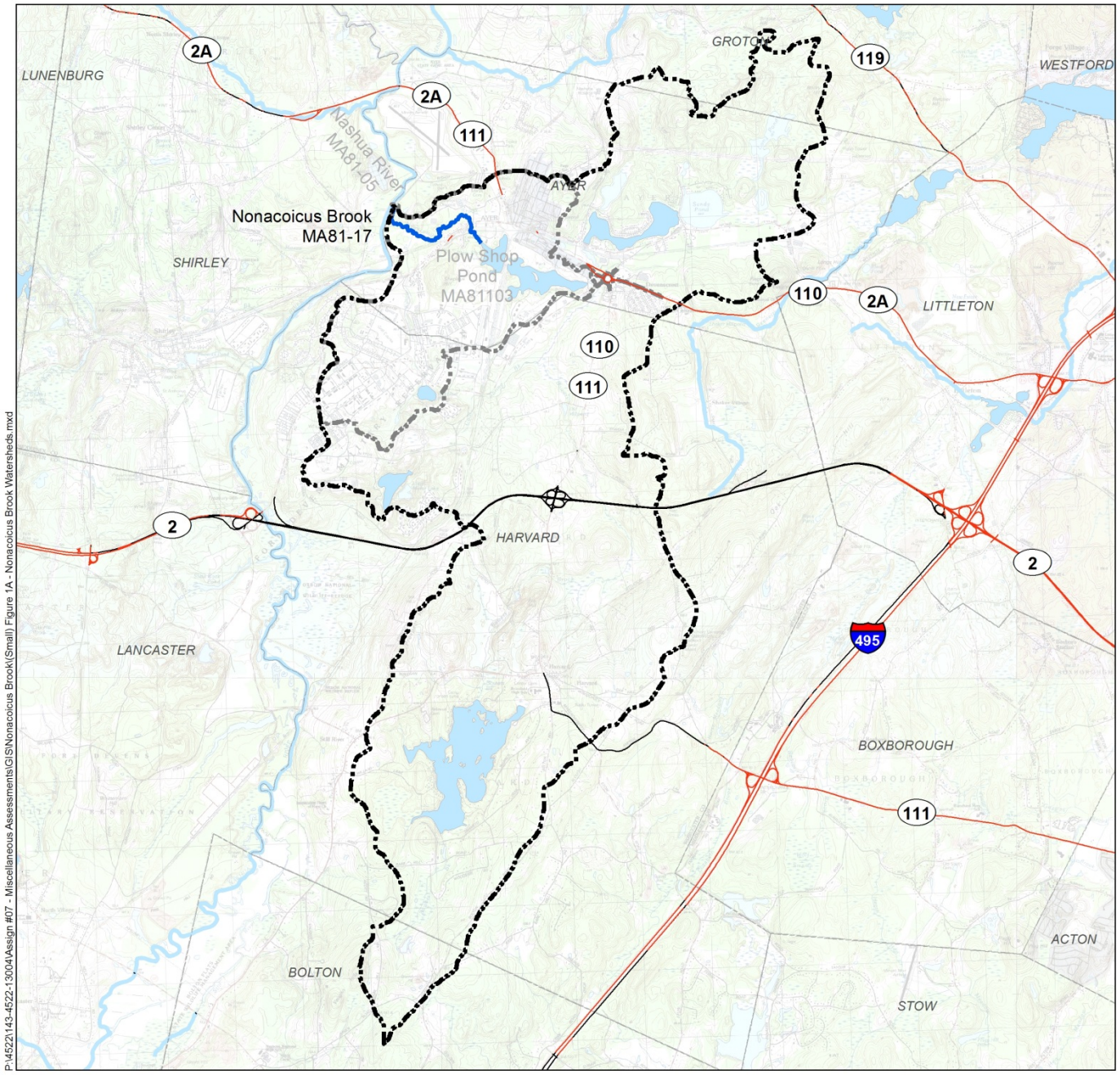
This assessment was not able to identify practical locations for stormwater management improvements within the current MassDOT right-of-way. The Proposed Mitigation Plan section discusses the site constraints and mitigation plan.

Proposed Mitigation Plan

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

The limited MassDOT property, which is limited to the perimeter of the West Main Street Bridge, is the main site constraint restricting this area for potential 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 Nonacoicus Brook given the site constraints.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Nonacoicus 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 Roads

Total Watershed

Subwatershed

Assesed Segment

Impaired Lakes

Impaired Streams

N

0 3,750 7,500 Feet

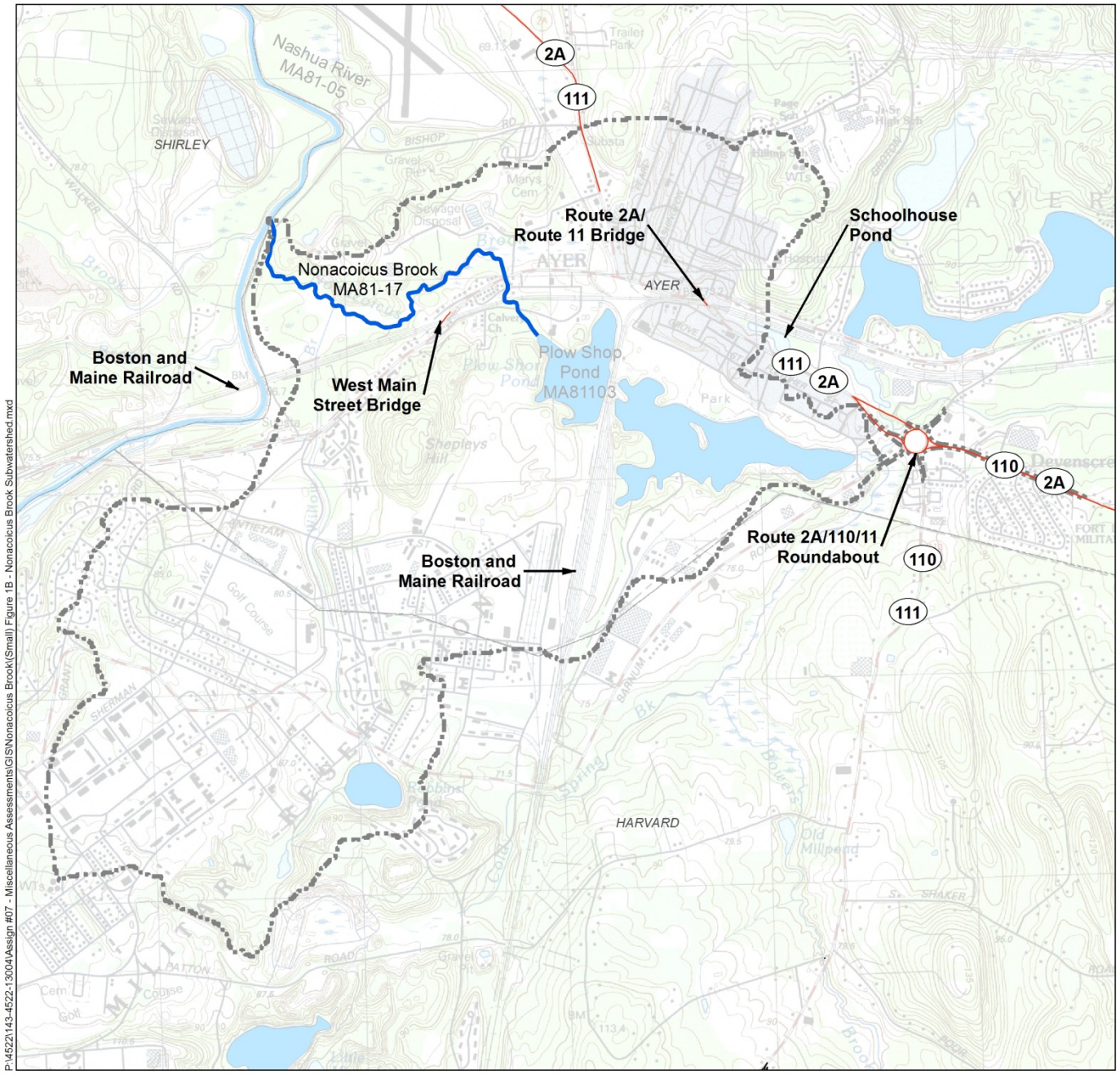
Figure 1A

Nonacoicus Brook (MA81-17) Watersheds

June 2014

massDOT Massachusetts Department of Transportation Highway Division

P:\14522\143-4522-13004\Assign #07 - Miscellaneous Assessments\GIS\Nonacoicus Brook\(Small) Figure 1A - Nonacoicus Brook Watersheds.mxd



MassDOT Roadways in Urban Area

MassDOT Roads

Subwatershed

Assesed Segment

Impaired Lakes

Impaired Streams

N

0 1,250 2,500 Feet

Figure 1B

Nonacoicus Brook (MA81-17) Subwatershed

June 2014

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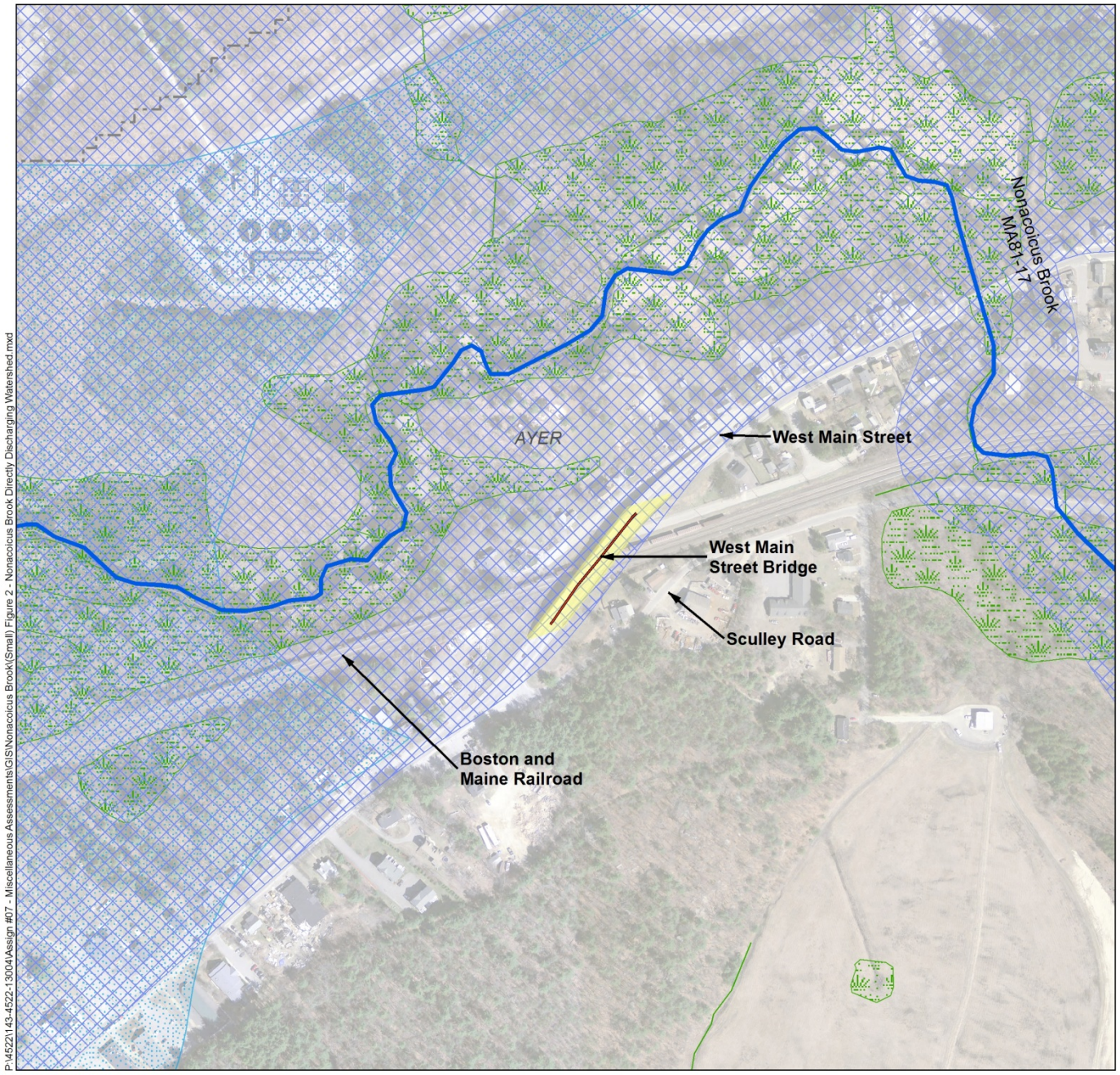
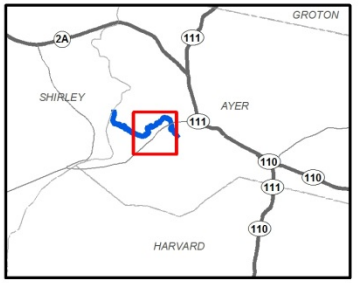
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roads
- Subwatershed
- Assesed Segment
- Impaired Streams
- Impaired Lakes
- MassDOT Directly Discharging Area
- DEP Wetlands
- NHDFlowline
- Areas of Critical Environmental Concern
- Zone II Wellhead Protection Areas

N

0 200 400 Feet

Figure 2

Nonacoicus Brook (MA81-17) Directly Contributing MassDOT Watershed

June 2014

massDOT Massachusetts Department of Transportation Highway Division

P:\14522\143-4522-13004\Assign #07 - Miscellaneous Assessments\GIS\Nonacoicus Brook\(Small) Figure 2 - Nonacoicus Brook Directly Discharging Watershed.mxd

Impaired Waters Assessment for Lake Cochituate (MA82020)

Summary

		Stormwater	Non-Stormwater[1]
Impaired Waters[2]	**Impairments**	Dissolved oxygen	PCB in fish tissue, Eurasian water milfoil (Myriophyllum spicatum)
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs	None	
	WQ Assessment	SuAsCo Watershed Year 2001 Water Quality Assessment Report[3]	
Location	**Towns:**	Natick/Framingham/Wayland	
	MassDOT Roads:	Interstate 90 (Massachusetts Turnpike)	
Assessment Methods(s)	**7R (TMDL Method)**	☐	
	7U (IC Method)	☒	
BMPs	**Existing:**	None	

		Impervious Cover (IC)
MassDOT Area and Targets	**Directly Contributing Area**	11.0 acres
	Contributing Area Reduction Target	2.5 acres
	Existing BMPs Reduction	0.0 acres
	Remaining Reduction to Meet Target	2.5 acres

[1] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[2] MassDEP, 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

[3] MassDEP, April 2013. SuAsCo Watershed Year 2001 Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar5.pdf

Site Description

Lake Cochituate (MA82020) is the northern most part of four Lake Cochituate basins: Segment MA82127 (South Basin), Segment MA82126 (Carling Basin), Segment MA82125 (Middle Basin), and Segment MA82020 (North Basin). The North Basin of Lake Cochituate (Segment MA82020) is in Natick, Framingham, and Wayland as shown in Figure 1. The north basin receives flow from the Middle Basin to the south. Flow outlets from this basin into an unnamed tributary (MA82A-22), locally known as Cochituate Brook, and is in current recreational use for boating.

A brief description of the impairments in Lake Cochituate (North Basin) is found in the SuAsCo Watershed Year 2001 Water Quality Assessment Report.[4] In 2003, Aquatic Life Use in Lake Cochituate was assessed as impaired due to the inhabitation of non-native aquatic macrophyte species. In the same year, Eurasian milfoil (Myriophyllym spicatum) was identified in the lake. In 2014, the Metropolitan Area Planning Commission (MAPC) wrote the Lake Cochituate Nonpoint Source Pollution Water Quality Management Plan[5] which identifies impervious cover/stormwater runoff as a key contributor to the impairments and designates the watershed as highly impervious. The report outlines recommendations to address the water quality degradation associated with stormwater runoff. Recommendations include structural and non-structural BMPs for residential, commercial and roadway uses.

Route I-90 divides the Middle Basin (MA82125) from the North Basin (MA82020) of Lake Cochituate. A Jersey barrier is in place to separate eastbound and westbound travel lanes. There is a crown through the center of the travel lanes and gradual berms and guardrails are present along the edge of the roads.

The delineation of the directly discharging area from the MassDOT-owned I-90 to Lake Cochituate (MA82020) is shown in Figure 2. The area extends one mile west of the I-90 crossing of Commonwealth Road to North Main Street (the high point). Stormwater runoff flows to the North Basin of Lake Cochituate as sheet flow, paved waterways and via pipes connected to catch basins located along portions of the fast lane of I-90 in the directly discharging area. Roadway sheet flow is collected in ditches along travel lanes and outlets to Lake Cochituate. The right-of-way ranges from 10 to 50 feet from the edge of the westbound and eastbound lanes in the directly discharging area. A culvert is located west of Commonwealth Road and hydraulically connects the Middle Basin (MA82125) to the North Basin (MA82020) of Lake Cochituate. Along the westbound median, fiber optic cable flags are present. The area is bordered by trees/shrubs, sound barriers and wetland pockets scattered throughout.

MassDOT's field review of its directly discharging area indicated that there is potential for construction of stormwater retrofit BMPs within the existing ditches in the shoulders of both the eastbound and westbound travel lanes along I-90.

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.

[4] MassDEP, April 2013. SuAsCo Watershed Year 2001 Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar5.pdf

[5] MAPC, April 2014. Lake Cochituate Source Pollution Watershed Management Plan. Available at: http://www.mapc.org/sites/default/files/Doc_3_Cochituate_Intro__Chapters_1_-_4.pdf

Assessment

In cases where a TMDL has been approved, MassDOT assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed the North Basin of Lake Cochituate (MA82020) using the methodologies described below.

MassDOT has identified a subset of water body impairments in Lake Cochituate (MA82020) which are not related to stormwater runoff. Specific impairments unrelated to stormwater for Lake Cochituate include PCB in fish tissue and Eurasian water milfoil. 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-pollutant impairments are not specifically addressed as part of the Impaired Waters Program.[6]

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Lake Cochituate's (MA82020) impairments. 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 as a basis, described in EPA's Stormwater TMDL Implementation Support Manual[8]. 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 (North Basin of Lake Cochituate) to determine the IC area and set a reduction target. Watersheds are based on the USGS Dataset 451 and modified as necessary using topography.[9] MassGIS's impervious surfaces data layer was used to determine the IC of the watersheds.[10] The total watershed and the subwatershed are shown in Figure 1.

[6] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[7] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[8] ENSR 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/regionalpgrfs.html

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

[10] 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	11,375 acres	636 acres
Impervious Cover (IC) Area	2,496 acres	74 acres
Percent Impervious	22%	12%
IC Area at 9% Goal	1,024 acres	57 acres
Target Effective IC Reduction	59%	23%

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

Table 2 MassDOT Directly Contributing Watershed

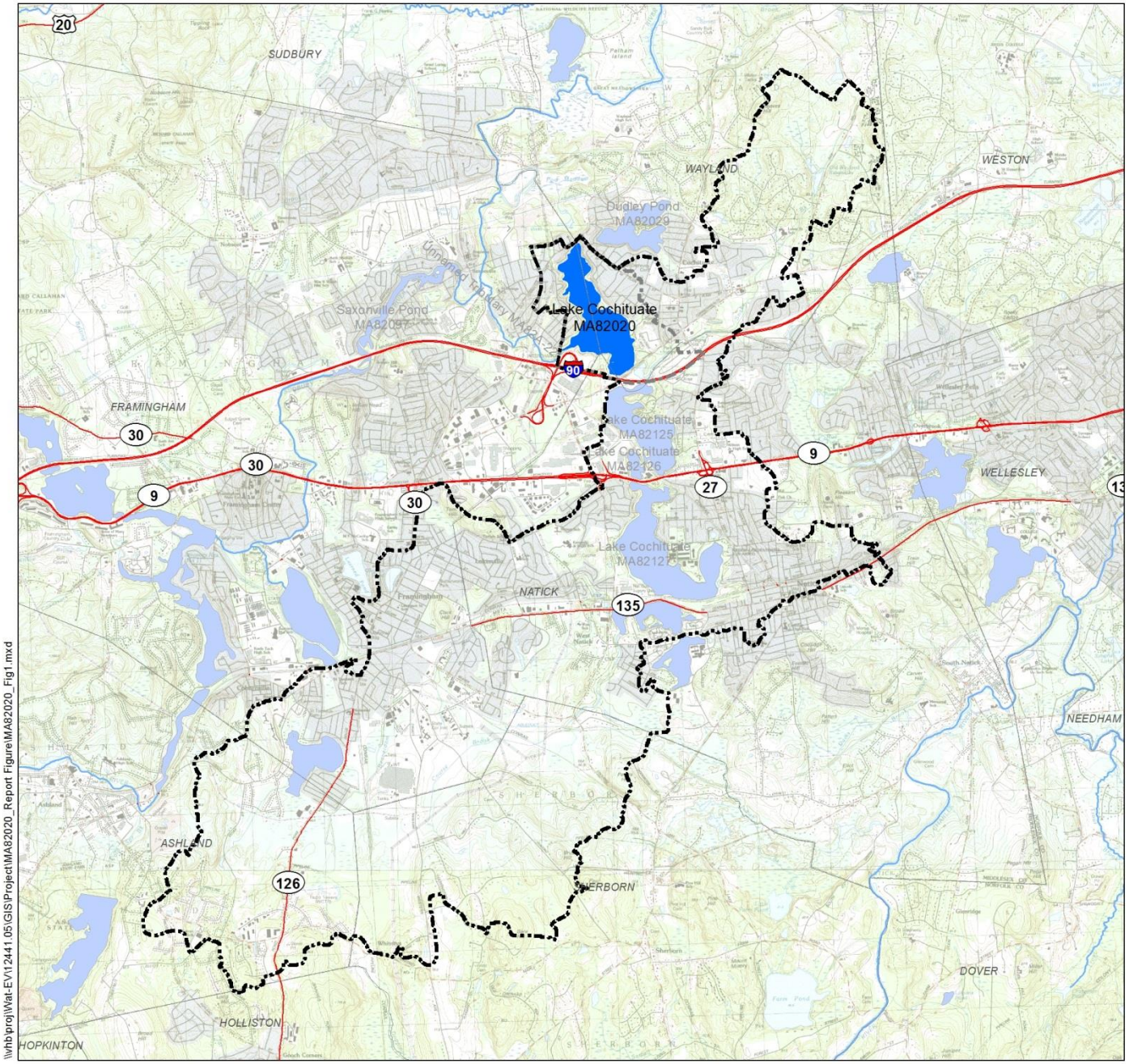
Directly Contributing Area	18.0 acres
Directly Contributing IC Area	11.0 acres
Percent Impervious	61%
Contributing Area Reduction Target (Effective IC) (23% Reduction of DOT Directly Contributing IC)	2.5 acres
Target Effective IC	47%
Target Effective IC	8.5 acres

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

Proposed Mitigation Plan

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 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 potential BMPs. The design consultants will develop construction plans for final recommended BMPs that are viable for construction and that will aim to provide the target IC reduction to the maximum extent practical.

Once the design of the proposed BMPs is further along, MassDOT will provide an update with additional information and summarize the final effective IC reduction based on the designed retrofit project BMPs. MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Lake Cochituate (North Basin), 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

Total Watershed

Subwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 3,000 6,000 Feet

1 inch = 6,000 feet

Figure 1

Lake Cochituate (MA82020) Watersheds

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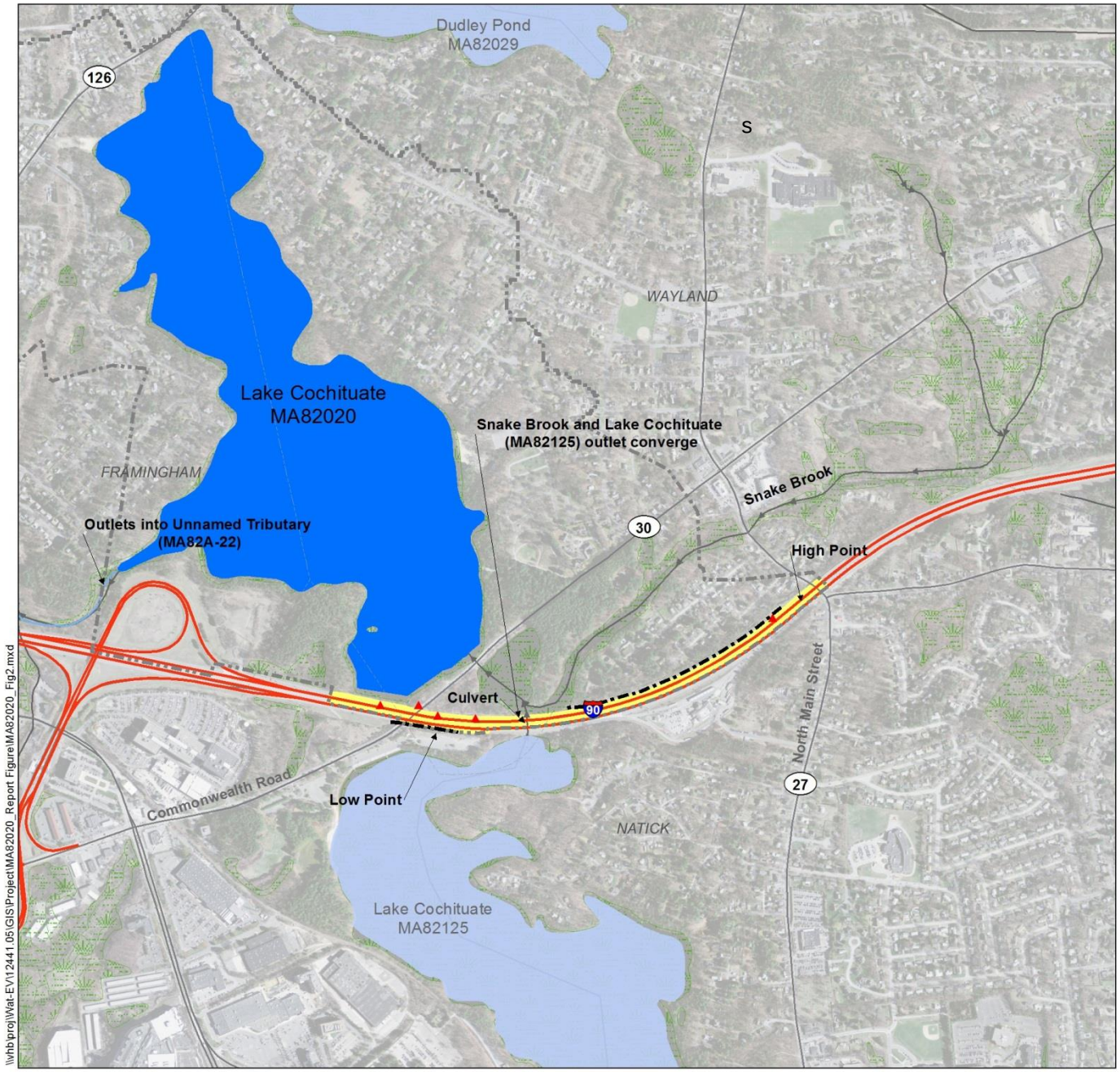

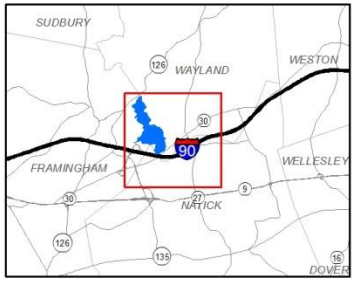

- Ditch/Paved Waterways
- MassDOT Outfalls
- Subwatershed
- MassDOT Roadways in Urban Area
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- NHD Flowline
- MassDOT Directly Discharging Area
- DEP Wetlands

N

0 600 1,200
Feet

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Figure 2

**Lake Cochituate (MA82020)
Directly Contributing
MassDOT Watershed**

June 2014

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Impaired Waters Assessment for Saxonville Pond (MA82097)

Summary

		Stormwater	Non-Stormwater[1]
Impaired Waters[2]	**Impairments**	Aquatic plants (Macrophytes)	Non-native aquatic plants, mercury in fish tissue
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs	None	
	WQ Assessment	SuAsCo Watershed 2001 Water Quality Assessment Report[3]	
Location	**Town:**	Framingham	
	MassDOT Roads:	I-90	
Assessment Methods(s)	**7R (TMDL Method)**	☐	
	7U (IC Method)	☒	
BMPs	**Existing:**	None	
		Impervious Cover (IC)	
MassDOT Area and Targets	**Directly Contributing Area**	8.6 acres	
	Contributing Area Reduction Target	5.8 acres	
	Existing BMPs Reduction	0.0 acres	
	Remaining Reduction to Meet Target	5.8 acres	

1 MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

2 MassDEP, 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

3 MassDEP, 2001. SuAsCo Watershed 2001 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar5.pdf

Site Description

Saxonville Pond (MA82097) is a 59-acre pond located in Framingham, Massachusetts. The pond was originally formed as a result of the construction of the Saxonville Dam, which impounded the Sudbury River for power generation. Segment MA82A-26 of the Sudbury River flows into Saxonville Pond from the west at a location just south of Interstate 90 (I-90) near the Framingham service plaza. Saxonville Pond flows northeast under I-90 and terminates at the Saxonville Dam adjacent to Central Street in Framingham. Segment MA82A-03 of the Sudbury River begins at the downstream base of the dam.

The total watershed to Saxonville Pond is 85.3 square miles and is shown in Figure 1a. It includes all of Southborough and portions of Framingham, Marlborough, Northborough, Westborough, Upton, Hopkinton, and Ashland. The subwatershed, which lies entirely within Framingham, is 7.1 square miles and is shown in Figure 1b. The subwatershed is composed primarily of medium to high-density residential land with areas along Route 9 occupied by commercial space.

According to the 2001 Water Quality Assessment Report for the SuAsCo Watershed, aquatic life within Saxonville Pond (MA82097) is impaired for non-native aquatic plants and fish consumption is impaired for mercury.[4] Primary contact, secondary contact, and aesthetics have not yet been assessed; however primary and secondary contact recreational uses have been identified with an "Alert" status due to elevated amounts of fecal coliform.

Figure 2 shows the portion of MassDOT property that discharges directly to Saxonville Pond. The directly discharging roadway includes approximately 0.6 miles of I-90. I-90 is a divided highway running east to west with three lanes of travel and two wide shoulders in either direction. I-90 is crowned in both directions between the second and third travel lanes. The grading directs runoff from each third travel lane toward catch basins within the median. Runoff from the outside lanes sheet flows laterally off the road. Some of the sheet flow is conveyed to Saxonville Pond by drainage ditches that run parallel to the road. The remainder flows short distances over land directly into the pond. The limits of MassDOT's right-of-way are also depicted in Figure 2. There is room for potential stormwater BMPs along the eastbound and westbound shoulders of I-90.

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 assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Saxonville Pond (MA82097) using the methodologies described below.

MassDOT has identified a subset of water body impairments in the Saxonville Pond watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for the Saxonville Pond include non-native aquatic plants and mercury in fish tissue. In accordance with

4 MassDEP, 2001. SuAsCo Watershed 2001 Water Quality Assessment Report. Available at:
http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar5.pdf

MassDOT's Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater in the December 8, 2012 EPA submittal, the non-pollutant impairments are not specifically addressed as part of the Impaired Waters Program.[5]

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Saxonville Pond's (MA82097) Aquatic plants (Macrophytes) impairment. 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 as a basis, 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 (Saxonville Pond) to determine the IC area and set a reduction target. Watersheds are based on the USGS Dataset 451 and modified as necessary using topography.[8] MassGIS's impervious surfaces data layer was used to determine the IC of the watersheds.[9] The total watershed is shown in Figure 1a, and the subwatershed is shown in Figure 1b.

Table 1 Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	54,569 acres	4,552 acres
Impervious Cover (IC) Area	8,279 acres	1,251 acres
Percent Impervious	15%	28%
IC Area at 9% Target	4,911 acres	410 acres
Target Effective IC Reduction	41%	67%

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

5 MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

6 MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

7 ENSR 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/regionalpgrfs.html

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 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	21.5 acres
Directly Contributing IC Area	8.6 acres
Percent Impervious	40%
Contributing Area Reduction Target (Effective IC) (67% Reduction of DOT Directly Contributing IC)	5.8 acres
Target Effective IC	13%
Target Effective IC	2.8 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 section describes the next steps for the potential BMPs to reduce the effective IC.

Proposed Mitigation Plan

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 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 based on the designed retrofit project BMPs.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Saxonville 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.

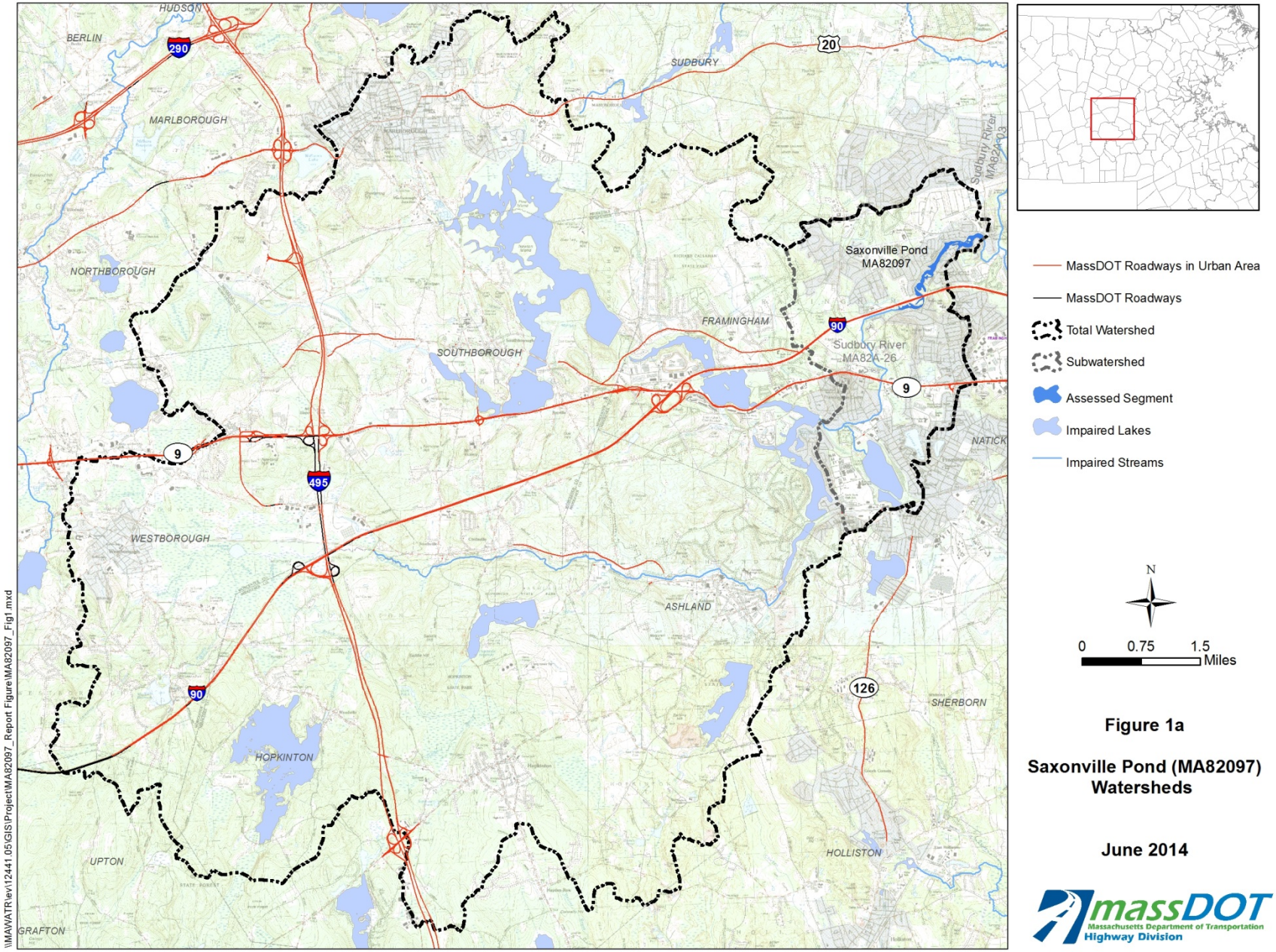

Figure 1a

Saxonville Pond (MA82097) Watersheds

June 2014

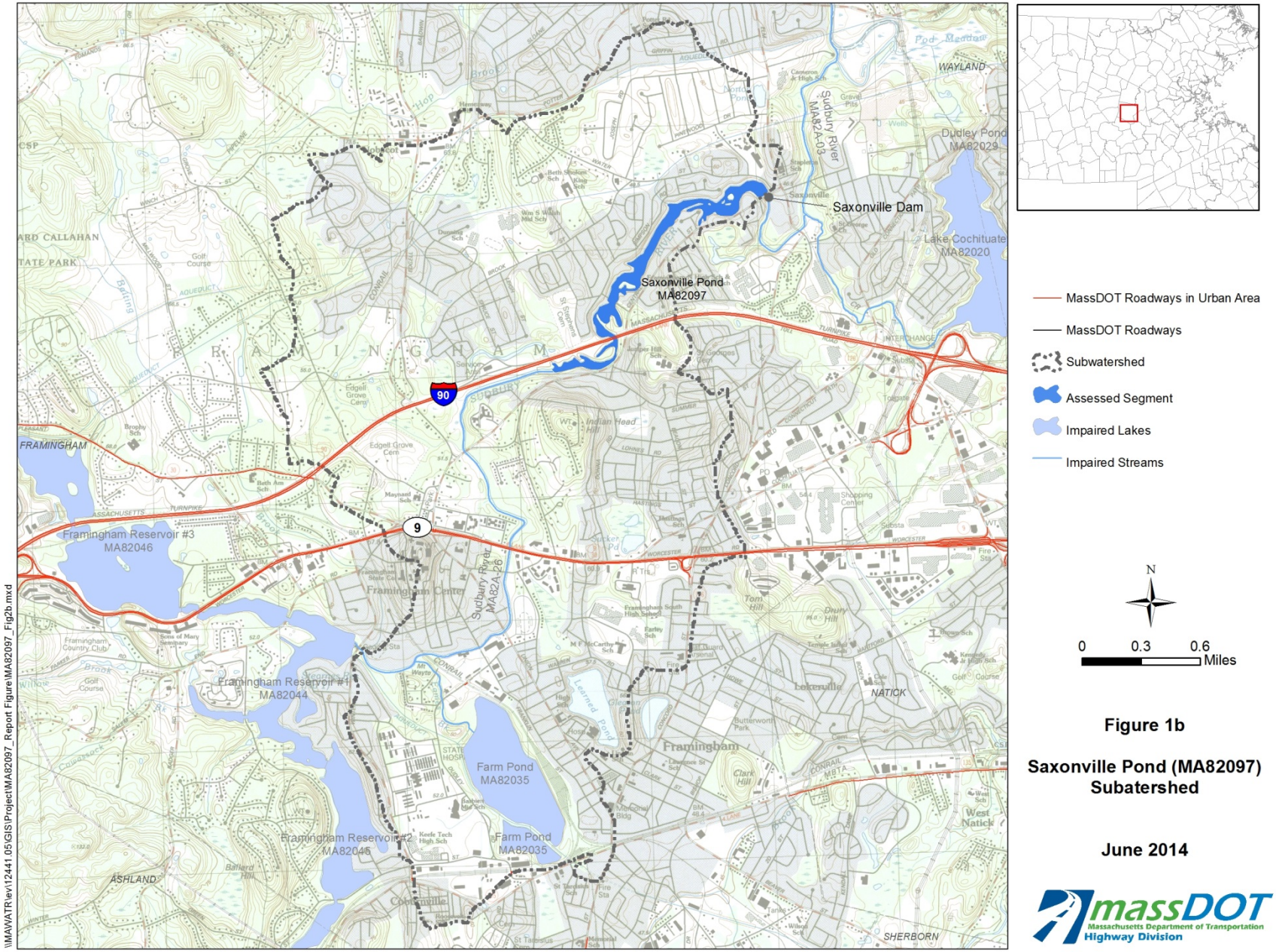

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Figure 1b

Saxonville Pond (MA82097) Subatershed

June 2014

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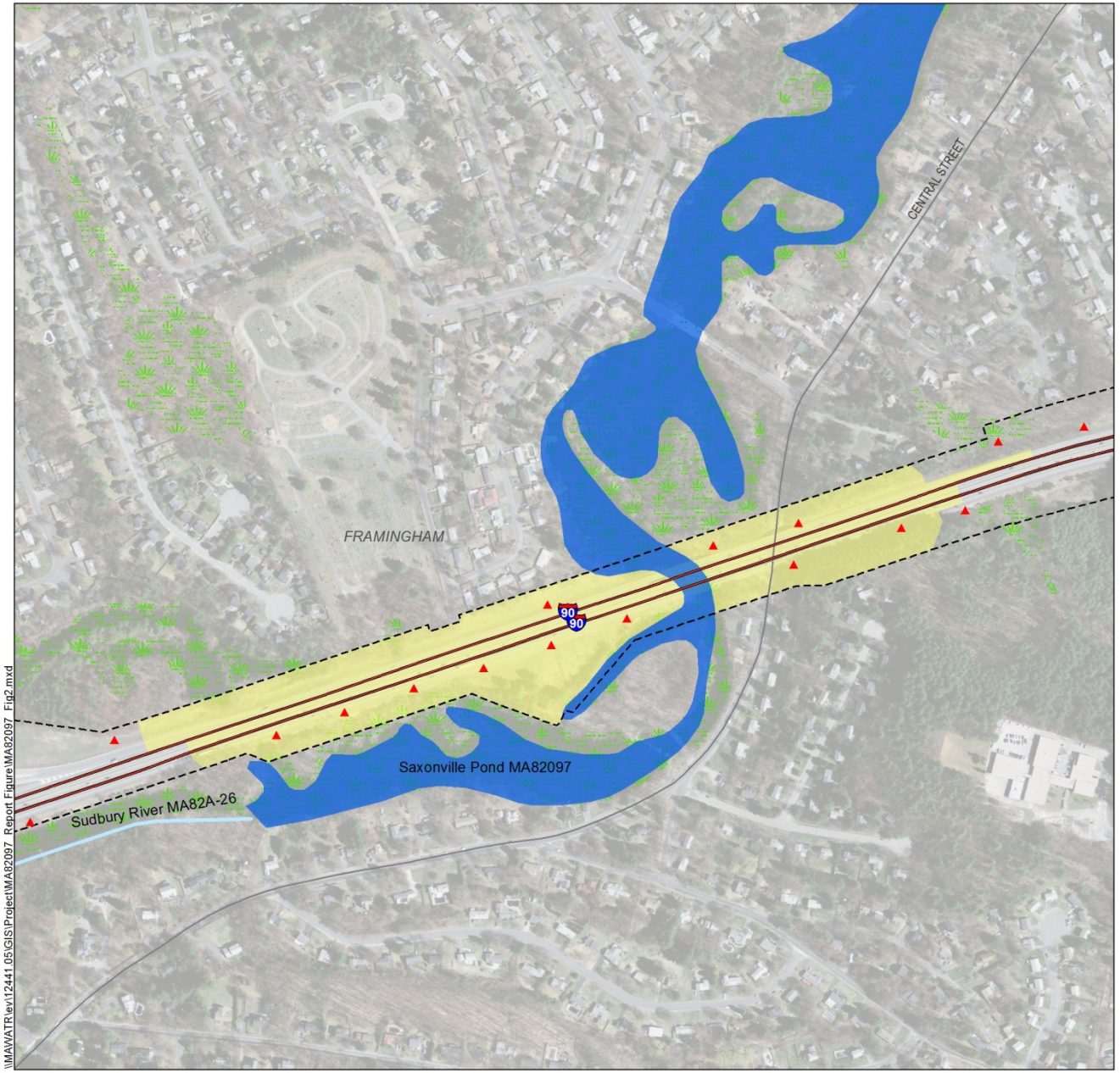

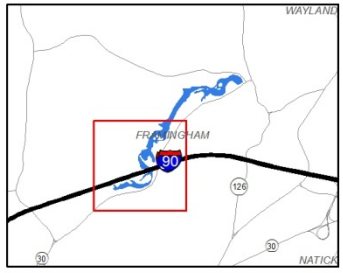

- MassDOT Outfalls
- State Layout Line
- MassDOT Roadways in Urban Area
- MassDOT Directly Discharging Area
- Assessed Segment
- Impaired Streams
- DEP Wetlands

N

0 250 500 Feet

Figure 2

Saxonville Pond (MA82097)
Directly Contributing
MassDOT Watershed

June 2014

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massDOT Massachusetts Department of Transportation Highway Division

06/08/2014

Impaired Waters Assessment for Waushakum Pond (MA82112)

Summary

		Stormwater	Non-Stormwater[1]
Impaired Waters[2]	**Impairments**	Dissolved oxygen, total phosphorus, turbidity, aquatic plants	Non-native aquatic plants
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs	None	
	WQ Assessment	SuAsCo 2001 Water Quality Assessment Report[3]	
Location	**Towns:**	Framingham and Ashland	
	MassDOT Roads:	Route 126	
Assessment Methods(s)	**7R (TMDL Method)**	☐	
	7U (IC Method)	☒	
BMPs	**Existing:**	None	

	Impervious Cover (IC)
Directly Contributing Area	1.4 acres
Contributing Area Reduction Target	0.8 acres
Existing BMPs Reduction	0.0 acres
Remaining Reduction to Meet Target	0.8 acres

MassDOT Area and Targets

1 MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

2 MassDEP, 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

3 MassDEP, 2001 SuAsCo 2001 Water Quality Assessment Report, Lakes/References. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar5.pdf

Site Description

Waushakum Pond (MA82112), is located in Framingham and Ashland, Massachusetts. Waushakum Pond covers 87 acres and receives flow from surrounding wetlands and eventually outlets into Lake Cochituate via a small stream system, shown on Figure 1. MassDEP's Water Quality Assessment Report[4] calls out stormwater and geese presence as sources of pollution. MassDOT roadway Route 126 is located on the eastern edge of the watershed and contributes stormwater runoff to the pond. The surrounding watershed consists of mostly medium to high density residential area and wetland resource area.

Route 126 directly discharges stormwater to Waushakum Pond. The portion of Route 126 that directly discharges to Waushakum Pond, as shown on Figure 2, is a narrow two lane road, one lane for each direction of travel. The roadway is lined with curbing and is crowned at the center of the road. MassDOT's right-of-way area is limited to the perimeter of the roadway and does not include the sidewalks lining the edges of the roadway. Dense residential and business area surrounds the roadway. Runoff from the road enters catch basins located in the shoulders of the roadway and pipes convey the stormwater to outfalls located in the narrow pervious area between the pond and Route 126.

Stormwater that directly discharges from Route 126 is limited by two physical factors, the high point of the road and the outlet location from Waushakum Pond, which is culverted under Route 126. Runoff from just north of the outlet of Waushakum Pond to the high point of the road, approximately 1270 feet of roadway, shown on Figure 2, directly contributes stormwater to Waushakum Pond. The stormwater runoff from this area is collected by catch basins in the roadway that conveys the stormwater to an outfall at the shore of Waushakum Pond. The stormwater runoff from Route 126, south of the outlet, is collected in catch basins which discharge directly into the outflow culvert of the pond, stormwater from this section of roadway does not enter the pond.

Existing BMPs

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

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. MassDOT separately assesses the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Waushakum Pond (MA82112) using these methodologies as described below.

MassDOT has identified a subset of water body impairments in the Waushakum Pond watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for the Waushakum Pond include non-native aquatic plants. In accordance with MassDOT's Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater in the

[4] MassDEP, 2001 SuAsCo 2001 Water Quality Assessment Report, Lakes/References. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar5.pdf

December 8, 2012 EPA submittal, the non-stormwater impairments are not specifically addressed as part of the Impaired Waters Program.[5]

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Waushakum Pond's (MA82112) impairments. 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 Impervious Cover (IC) Method as a basis, described in EPA's Stormwater TMDL Implementation Support Manual.[7] Consistent with the findings of EPA and others, MassDOT concluded that when a watershed has less than 9% IC, stormwater was not the likely cause of the impairment.

MassDOT calculated the following values for the contributing watershed of the impaired water (Waushakum Pond) to determine the IC area and set a target for reduction. Watersheds used for the assessment are based on the USGS Dataset 451 and modified as necessary using topography.[8] MassGIS's impervious surfaces data layer was used to determine the IC of the watersheds.[9] The total watershed for the pond is shown in Figure 1.

Table 1 Impaired Waterbody Watershed

	Watershed
Watershed Area	1,435 acres
Impervious Cover (IC) Area	324 acres
Percent Impervious	23%
IC Area at 9% Goal	129 acres
Target Effective IC Reduction	60%

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

[5] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[6] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[7] ENSR 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/regionalpgrfs.html

[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 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	1.4 acres
Directly Contributing IC Area	1.4 acres
Percent Impervious	100%
Contributing Area Reduction Target (Effective IC) (60% Reduction of DOT Directly Contributing IC)	0.8 acres
Target Effective IC	40%
Target Effective IC	0.6 acres

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

Proposed Mitigation Plan

During this assessment phase of the Impaired Waters Program, MassDOT has focused on determining the directly contributing areas and identifying the potential for BMPs that can be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects that meet these requirements for BMP construction can be implemented under the Impaired Waters Program Retrofit initiative.

The limited MassDOT owned area is the main site constraint restricting this area for potential BMPs. MassDOT ownership is limited to the perimeter of the roadway. Residential houses, driveways and sidewalks surround the roadway restricting the area for surface treatment. Potential for underground leaching basins is also restricted due to the limited shoulder width. Based on the review of MassDOT's directly contributing drainage area and the site constraints as cited, no BMPs have been identified that can be implemented on MassDOT property to address the impairments of the Waushakum Pond.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Waushakum 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 opportunities for construction of 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.

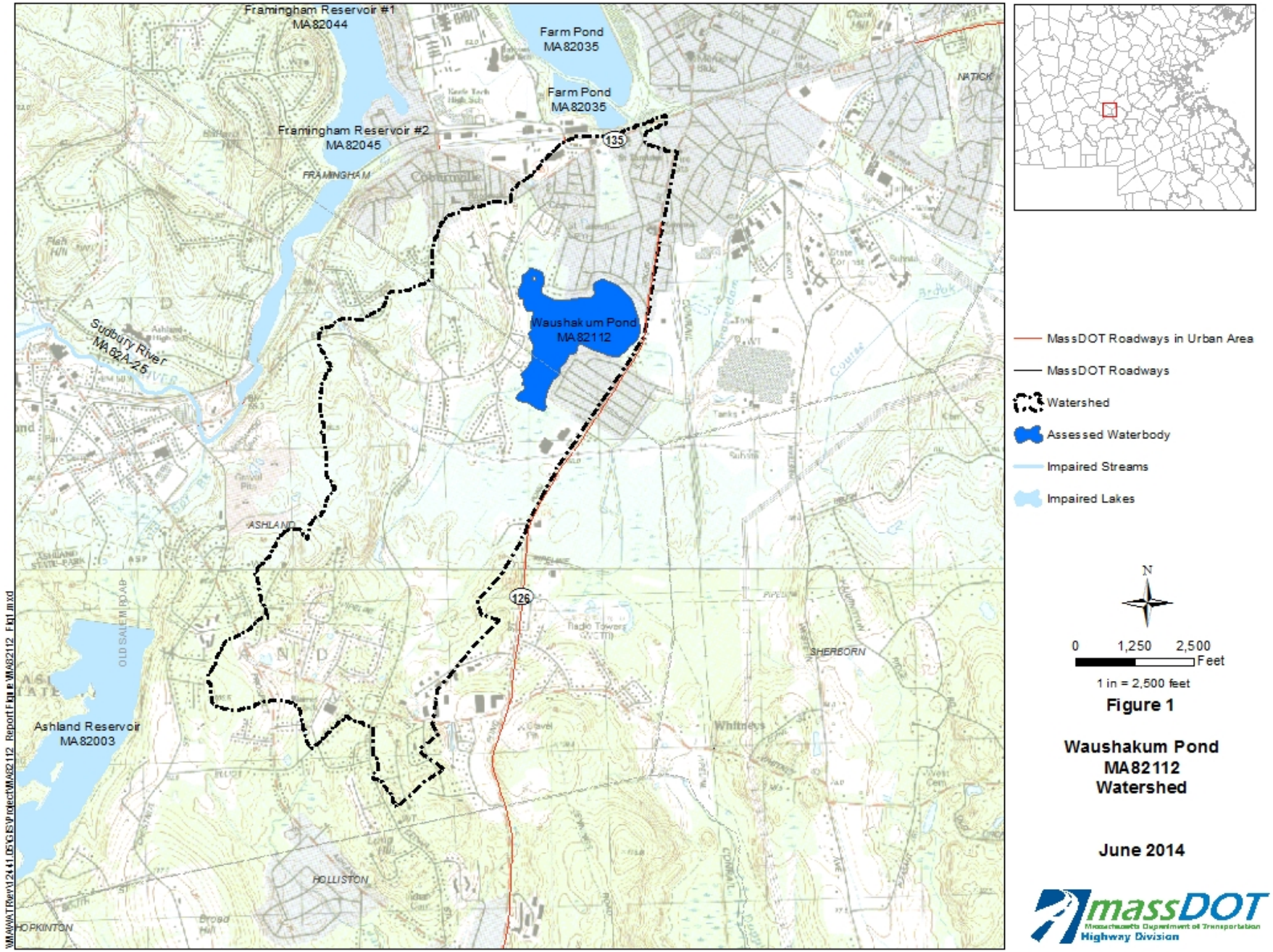

Figure 1

Waushakum Pond
MA82112
Watershed

June 2014

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Highway Division

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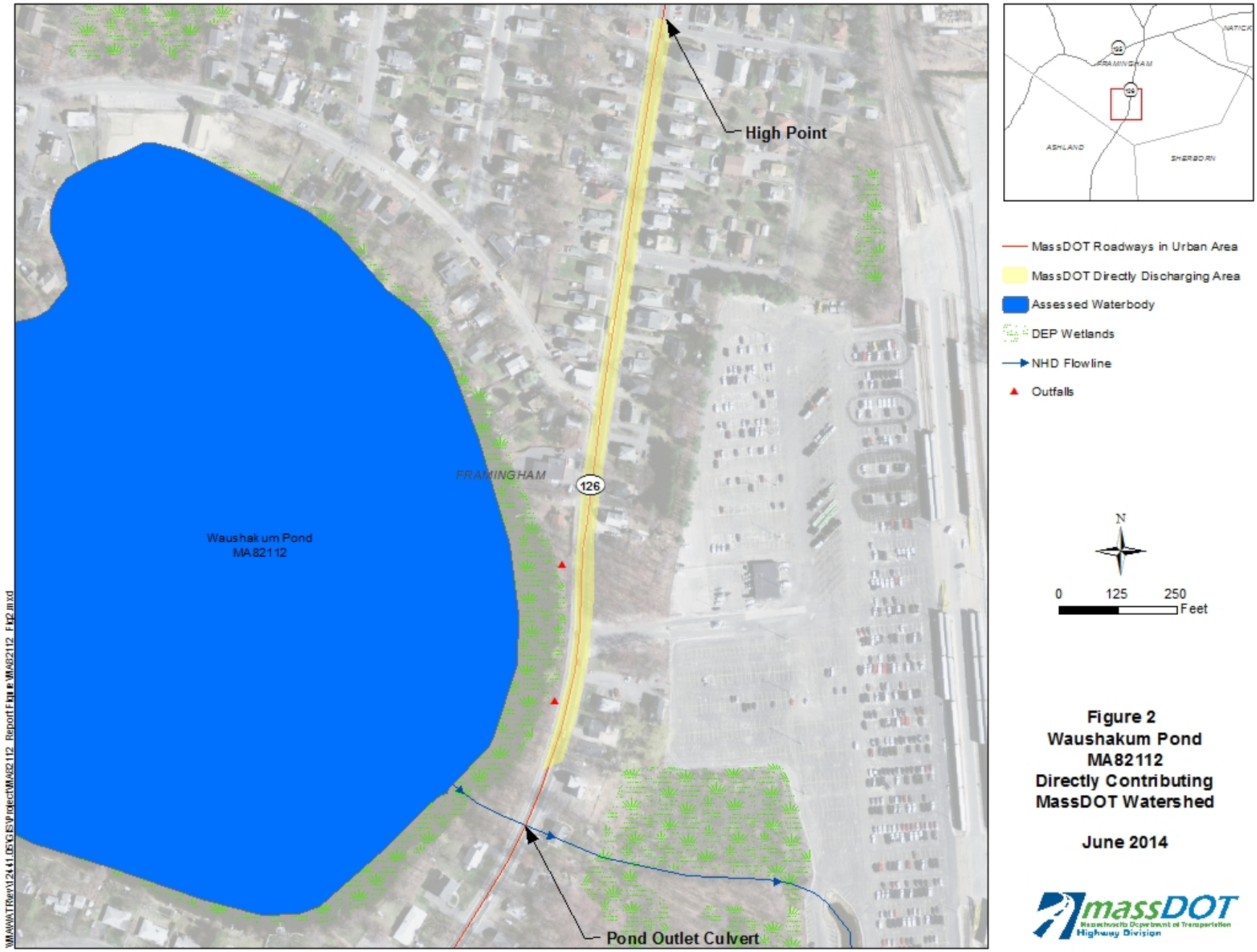

Figure 2
Waushakum Pond
MA82112
Directly Contributing
MassDOT Watershed

June 2014

Impaired Waters Assessment for Lake Cochituate (MA82125)

Summary

		Stormwater	Non-Stormwater[1]
Impaired Waters[2]	**Impairments**	Dissolved oxygen, enterococcus	Non-native aquatic plants, PCB in fish tissue, Eurasian water milfoil, Myriophyllum spicatum
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs	None	
	WQ Assessment	SuAsCo Watershed 2001 Water Quality Assessment Report[3]	
Location	**Towns:**	Natick, Wayland	
	MassDOT Roads:	Route 9, Route 27, Interstate 90	
Assessment Methods(s)	**7R (TMDL Method)**	☐	
	7U (IC Method)	☒	
BMPs	**Existing:**	None	
			Impervious Cover (IC)
MassDOT Area and Targets	**Directly Contributing Area**		20.9 acres
	Contributing Area Reduction Target		13.8 acres
	Existing BMPs Reduction		0.0 acres
	Remaining Reduction to Meet Target		13.8 acres

1 MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

2 MassDEP, 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

3 MassDEP, 2001. SuAsCo Watershed 2001 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar4.pdf

Site Description

Flow from Segment MA82127 flows north through the Carling Basin to the Middle Basin and eventually to the North Basin. Lake Cochituate (MA82125) is a 135-acre lake in the towns of Framingham, Natick and Wayland. It is the middle basin of four Lake Cochituate Basins: Segment MA82127 (South Basin), Segment MA82126 (Carling Basin), Segment MA82125 (Middle Basin), and Segment MA82020 (North Basin). Carling Basin acts as a connecting waterbody between the South Basin and the Middle Basin. This Middle Basin is connected by a culvert underneath I-90 that directs water to the North Basin. Figure 1A shows the total and subwatersheds of Lake Cochituate (MA82125), which includes the towns of Ashland, Framingham, Natick and Sherborn. Urbanized areas make up most of the subwatershed and about one third of the total watershed. Forest and residential areas make up most of the remaining two thirds of the total watershed. According to MassDEP's Water Quality Assessment Report[4], MA82125 is impaired for aquatic life (non-native aquatic plants), fish consumption (PCBs in fish tissue) and primary contact recreational use (enterococci). There is a boat ramp and a public beach providing recreational access to the lake, both of which are maintained by the Massachusetts Department of Conservation and Recreation. MA82125 was not assessed for secondary contact or aesthetics.

Figure 1B shows the MassDOT-owned roadways discharging to the middle basin, which are I-90, Route 9 and Route 27. Interstate 90 runs east-west along the northern edge of the middle basin, and Route 9 runs east-west along the southern edge of the basin. Route 27 runs north-south in the eastern portion of the basin.

Figure 2A shows the portion of I-90 and the Natick Service Plaza that directly discharge to MA82125. The east and west bound lanes are separated by a jersey barrier and both directions of travel lanes crown at the outside of the innermost lanes. The directly discharging portion of I-90 is about 3,500 feet long and includes the middle and outer lanes of the eastbound road. Catch basins in the interior shoulder collect sheet flow from the innermost lane and narrow interior shoulder and drain northward to MA82020. Catch basins on the outer shoulder collect sheet flow from the middle and outer lanes and drain northward to MA82120; however there is no curbing along the road to direct sheet flow to the catch basins. It was evident during the field assessment that runoff from the middle and outer lanes can flow off the eastbound shoulder edge into grass swales that drain to MA82125 and in some areas can flow to MA82125 directly from the roadway. The runoff not collected by catch basins is considered a direct discharge.

Stormwater from the Natick Service Place is collected by catch basins and drained to a manmade ditch, represented by the dotted line in Figure 2A, that runs along the south edge of the plaza. The ditch also receives sheet flow from I-90 east of the plaza. The ditch directs stormwater along the edge of the plaza, and it outlets into a natural grass swale along the side of I-90. From there the stormwater flows west to MA82125 and is considered a direct discharge. There is potential for improvements to this ditch to allow for stormwater treatment at the Natick Service Plaza and in the grass swales along I-90.

Flow from I-90 runoff to the west of the cross culverts flows directly to a ditch, which directs runoff to the cross culvert that drains north to MA82020, and does not enter MA82125.

[4] MassDEP, 2001. SuAsCo Watershed Year 2001 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar5.pdf

Figure 2B shows the discharging area of Route 9 and Route 27 to the south and east of MA82125. Route 9 has two lanes and a shoulder for each direction of travel, which are separated by a jersey barrier. The road is crowned in the middle of the road, and catch basins are located in the shoulders of both sides of the road. A high point separates stormwater flow on Route 9 to the west and to the east. The west section of Route 9 drains from the catch basins on either side of the road to an outfall at the southernmost edge of MA82125 and is considered direct discharge. Leaching catch basins may be feasible in this area depending on results of further reviews. The section east of the high point at the interchange includes sections of Route 9 and Route 27. Stormwater from these sections is piped north along Route 27 to a manmade dirt channel. The channel directly discharges the stormwater west to the eastern edge of MA82125.

The MassDOT directly discharging areas to MA82125 are within both a Zone I and Zone II Wellhead Protection Area. The Zone I Wellhead Protection Area includes the Town of Natick drinking water wells, which are shown in Figure 2B.

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. The swale behind the Natick Service Plaza is not considered a BMP because it is only meant to convey runoff away from the plaza.

Assessment

In cases where a TMDL has been approved, MassDOT assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Lake Cochituate (MA82125) using the methodologies described below.

MassDOT has identified a subset of water body impairments in the Lake Cochituate watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for Lake Cochituate include non-native aquatic plants and 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 impairments are not specifically addressed as part of the Impaired Waters Program.[5]

BMP 7U for Pathogen Impairment

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[6] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's South East Expressway study measured bacterial concentration in stormwater runoff[7] and data indicate that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g. illicit discharges, sewer utilities, pet waste, and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

[5] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[6] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/dep/water/resources/capecod1.pdf

[7] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommends implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. 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.

MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff notes signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, Resident Engineers overseeing construction projects also note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this IDDE training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and proceeds to work with owners of confirmed illicit discharges to remove these flows, and thereby minimize pathogen contributions to receiving waters.

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen impaired waterbody. At these prioritized rest stops, which includes the Natick Service Plaza, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired waterbody and will be providing pet waste removal bags and disposal cans.

MassDOT believes the existing efforts are consistent with the current and draft MS4 permit's requirements.

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Lake Cochituate's (MA82125) impairments. 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 as a basis, 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 (Lake Cochituate) to determine the IC area and set a target. Watersheds are based on the USGS Dataset 451 and modified as necessary using topography.[10] MassGIS's

[8] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[9] ENSR 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/regionalpgrfs.html

[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 was used to determine the IC of the watersheds.[11] The total watershed and the subwatershed are shown in Figure 1.

Table 1 Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	9,175 acres	2,023 acres
Impervious Cover (IC) Area	2,203 acres	538 acres
Percent Impervious	24%	27%
IC Area at 9% Goal	826 acres	182 acres
Target Effective IC Reduction	63%	66%

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

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	30.0 acres
Directly Contributing IC Area	20.9 acres
Percent Impervious	69.5 %
Contributing Area Reduction Target (Effective IC) (66% Reduction of DOT Directly Contributing IC)	13.8 acres
Target Effective IC	23.5%
Target Effective IC	7.1 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 section describes the next steps for the potential BMPs to reduce the effective IC.

Proposed Mitigation Plan

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 directly contributing IC as part of MassDOT's Impaired Waters Retrofit Initiative for the I-90 area. The project designer will gather additional information in this phase, such as soil data, wetland

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

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.

A programmed project at the Route 9 and Route 27 interchange (MassDOT project number 605313) is in design. The 25% design which has been completed includes proposed BMPs to address directly discharging stormwater within the interchange ramp infields. Construction of the project is currently slated for Summer 2019.

Once the design of the proposed BMPs is further along, MassDOT will provide an update with additional information and summarize the final effective IC reduction based on the designed retrofit project BMPs.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Lake Cochituate, 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.

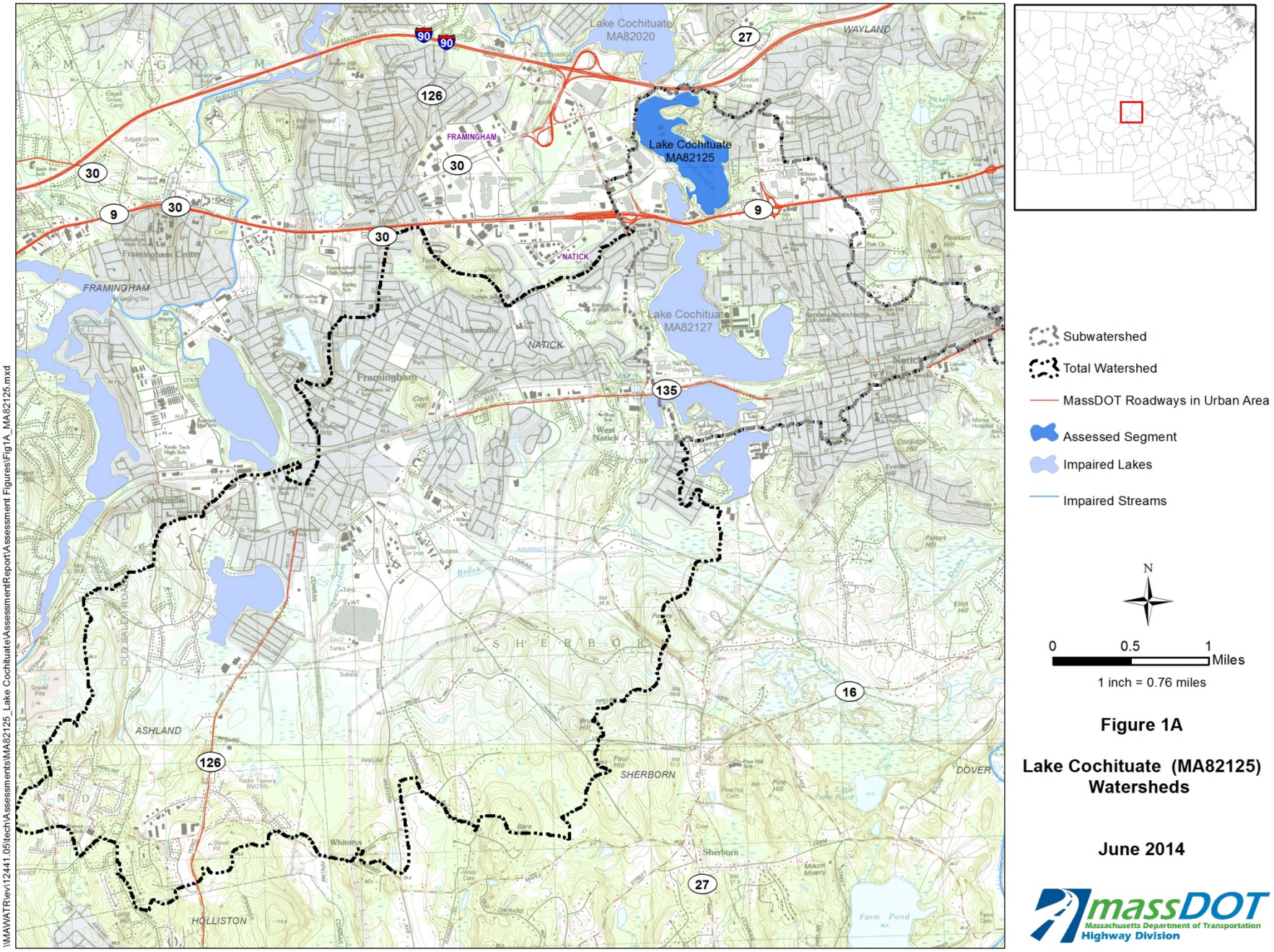

Figure 1A

Lake Cochituate (MA82125) Watersheds

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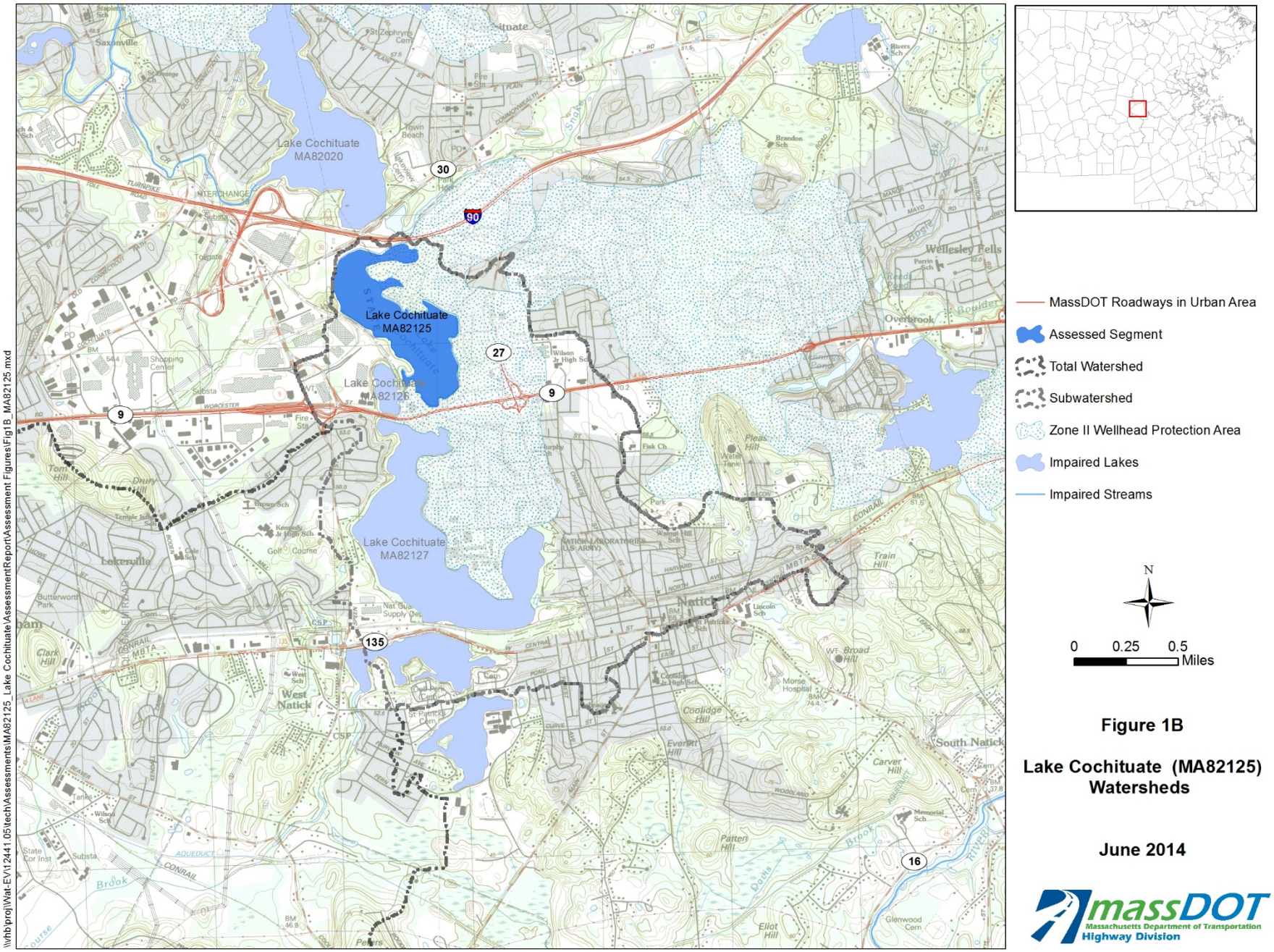

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Figure 1B

Lake Cochituate (MA82125) Watersheds

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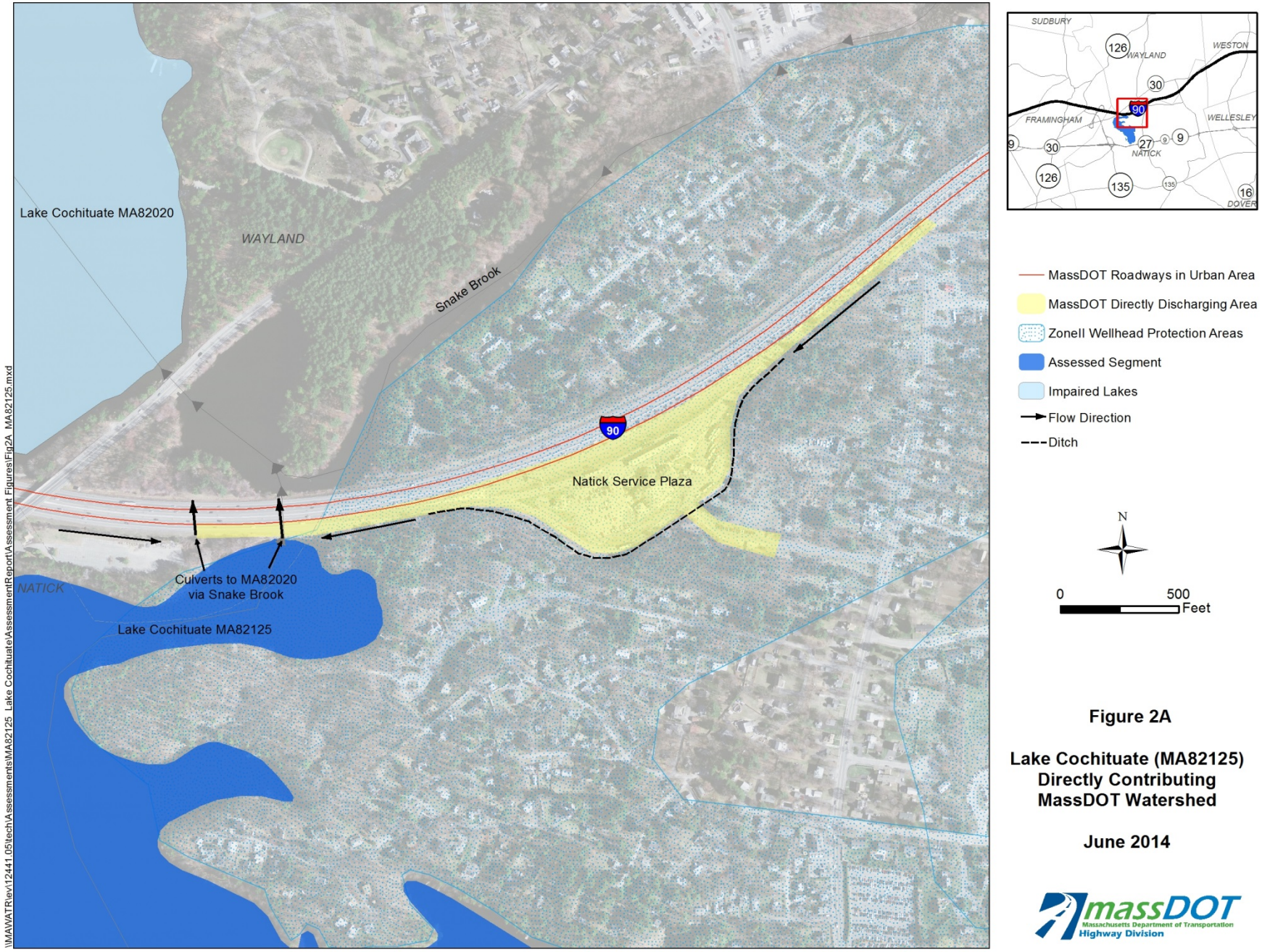

Figure 2A

Lake Cochituate (MA82125)
Directly Contributing
MassDOT Watershed

June 2014

MassDOT Roadways in Urban Area
MassDOT Directly Discharging Area
ZoneII Wellhead Protection Areas
Assessed Segment
MassDOT Outfalls
Flow Direction
Flow Direction

N

0 500 Feet

Figure 2B

Lake Cochituate (MA82125)
Directly Contributing
MassDOT Watershed

June 2014

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massDOT Massachusetts Department of Transportation Highway Division

06/08/2014

Impaired Waters Assessment for Lake Cochituate (MA82127)

Summary

		Stormwater	Non-Stormwater[1]
Impaired Waters[2]	**Impairments**	Dissolved oxygen	Non-native aquatic plants, Eurasian water milfoil, myriophyllum spicatum, PCB in fish tissue
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs	None	
	WQ Assessment	SuAsCo Watershed Year 2001 Water Quality Assessment Report[3]	
Location	**Towns:**	Natick	
	MassDOT Roads:	Route 9 and Speen Street ramps	
Assessment Methods(s)	**7R (TMDL Method)**	☐	
	7U (IC Method)	☒	
BMPs	**Existing:**	None	

	Impervious Cover (IC)
Directly Contributing Area	14.0 acres
Contributing Area Reduction Target	6.2 acres
Existing BMPs Reduction	0.0 acres
Remaining Reduction to Meet Target	6.2 acres

MassDOT Area and Targets

1 MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

2 MassDEP, 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

3 MassDEP, 2001. SuAsCo Watershed Year 2001 Water Quality Assessment Report: SuAsCo Watershed Lake Assessments. DWM CN 92.0. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar5.pdf

Site Description

Lake Cochituate (MA82127) is within the town of Natick, Massachusetts. It is the southernmost lake of four Lake Cochituate Basins: Segment MA82127 (South Basin), Segment MA82126 (Carling Basin), Segment MA82125 (Middle Basin), and Segment MA82020 (North Basin). Flow from Segment MA82127 flows north through the Carling Basin to the Middle Basin and eventually to the North Basin. As shown on Figure 1A, the total watershed to Segment MA82127 includes portions of Natick, Sherborn, Framingham, and Ashland. The subwatershed, shown on Figure 1B, is completely within Natick and represents a very densely populated residential and commercial area. According to the 2001 SuAsCo Watershed Water Quality Assessment Report, Lake Cochituate (South Basin) is impaired for aquatic life and fish consumption. The Water Quality Assessment Report also references the Army Natick Research and Development Superfund site located on the banks of the lake; however, the report noted the site was not a likely source of the PCB in fish tissue impairment.

MassDOT-owned roads around Segment MA82127 include Route 9 to the north, Route 135 to the south, and various bridges to the southeast of the lake. As shown in Figure 2, Route 9 at the Speen Street interchange is the only MassDOT-owned property which directly discharges stormwater to this segment of Lake Cochituate. Route 9 at the Speen Street interchange is two lanes in each direction and includes a series of ramp systems. Stormwater from Route 9 in this area is collected in catch basins along the roadway. Catch basins west of the interchange and the interchange ramps discharge into a concrete ditch south of Route 9 within a ramp infield. Flow from the ditch enters a headwall at the eastern end of the ditch and is piped to an outfall south of Route 9 at its crossing of the Lake Cochituate culvert. The Lake Cochituate culvert at this location carries flow from the South Basin to the Middle Basin of Lake Cochituate. Catch basins east of the interchange area contribute to this piped system downstream of the ditch. Prior to being discharged through the outfall, stormwater is first intercepted by an existing oil/water separator discussed in the Existing BMPs section below. There is potential to retrofit the existing concrete ditch into a stormwater BMP.

Route 135, south of Segment MA82127, slopes away from Lake Cochituate and all stormwater discharges to Fisk Pond (MA82038). This area does not directly discharge to Lake Cochituate. Various MassDOT-owned bridges over the MBTA Framingham Commuter rail line are also within the Lake Cochituate watershed, as shown on Figure 1B. These bridges were determined to not directly discharge to Lake Cochituate.

Lake Cochituate is a drinking water source, and the Town of Natick operates drinking water wells to the southeast of the Route 9 crossing of Lake Cochituate. The Zone II Wellhead Protection Area and the location of the wells are shown on Figure 2. Route 9 in this area is a MassDOT Reduced Salt Zone.

Existing BMPs

MassDOT identified one existing BMP in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment. A large oil/water separator which includes a sand and gravel filter bed with weep holes is in place to treat stormwater from Route 9 prior to the outfall to Lake Cochituate. MassDOT installed this structure in 1977 and does not have any records of this structure being maintained. Due to this lack of maintenance, MassDOT has not attributed any treatment credit to this BMP.

Assessment

In cases where a TMDL has been approved, MassDOT assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Lake Cochituate (MA82127) using the methodologies described below.

MassDOT has identified a subset of water body impairments in the Lake Cochituate watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for Lake Cochituate South Basin include non-native aquatic plants, Eurasian water milfoil, myriophyllum spicatum, and 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.[4]

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Lake Cochituate's (MA82127) impairments. 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[5] which was developed using the EPA Region I's Impervious Cover (IC) Method as a basis, 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 and the subwatershed of the impaired water (Lake Cochituate MA82127) to determine the IC area and set a reduction target. Watersheds are based on the USGS Dataset 451 and were modified as necessary using topography.[7] MassGIS's impervious surfaces data layer was used to determine the IC of the watersheds.[8] The total watershed and the subwatershed are shown in Figure 1 and the subwatershed is shown on Figure 1B.

Table 1 Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	8,529 acres	1,391 acres
Impervious Cover (IC) Area	2,034 acres	373 acres
Percent Impervious	24%	27%

[4] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[5] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[6] ENSR 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/regionalpgrfs.html

[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

	Total Watershed	Subwatershed
IC Area at 9% Target	768 acres	125 acres
Target Effective IC Reduction	62%	66%

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

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	14.0 acres
Directly Contributing IC Area	9.3 acres
Percent Impervious	66%
Contributing Area Reduction Target (Effective IC) (66% Reduction of DOT Directly Contributing IC)	6.2 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 section describes the next steps for the potential BMPs to reduce the effective IC.

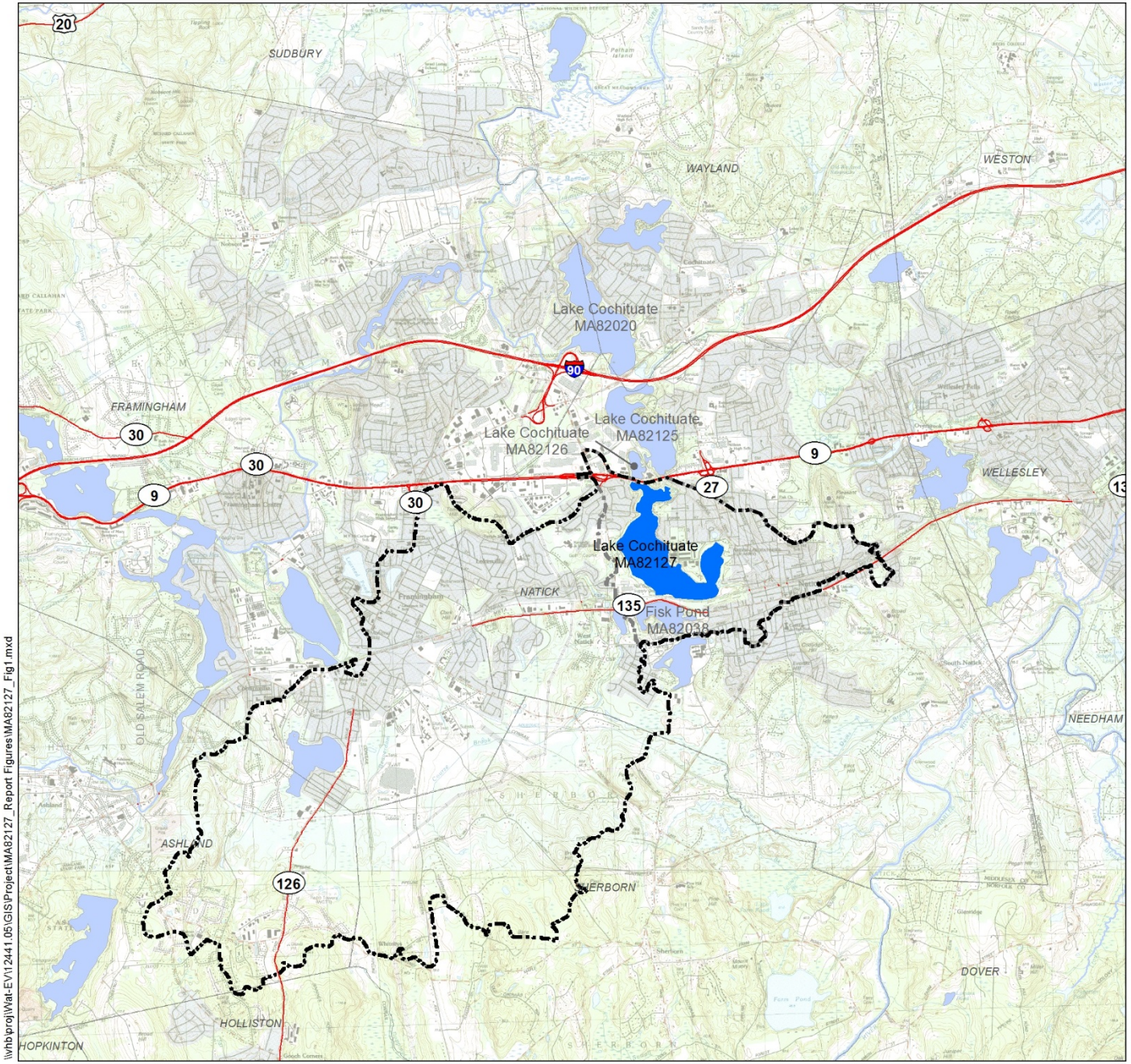
Proposed Mitigation Plan

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 specific 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.

Additionally, MassDOT will work with its maintenance team to develop a maintenance approach for the existing oil and water separator in place. Regular maintenance of this structure will allow for additional reduction in effective IC.

Once the design of the proposed BMPs and a maintenance approach for the existing BMP are further along, MassDOT will provide an update with additional information and summarize the final effective IC reduction based on the designed retrofit project BMPs.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Lake Cochituate, 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

Total Watershed

Subwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 3,000 6,000 Feet

Figure 1A

Lake Cochituate (MA82127) Watersheds

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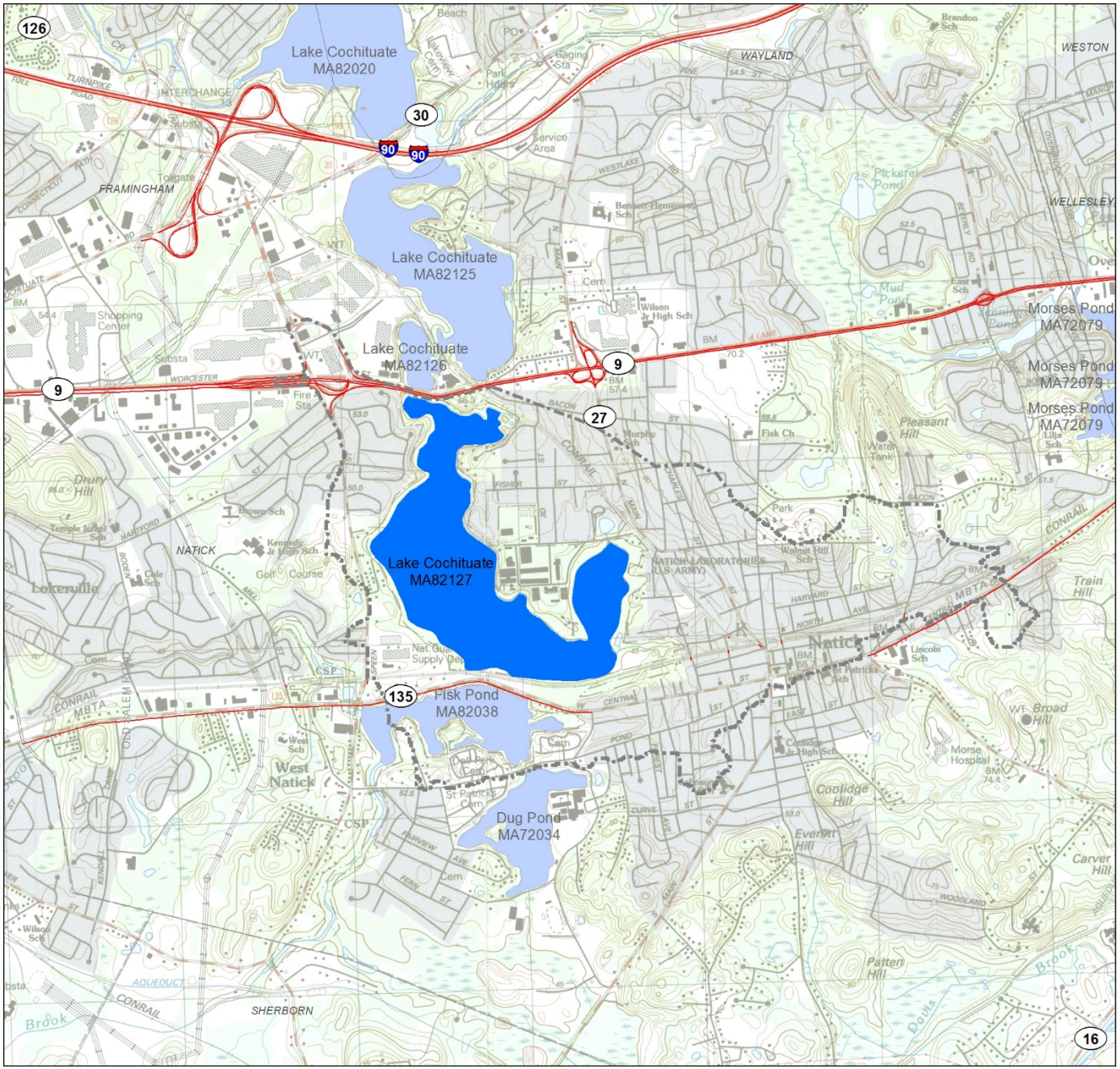

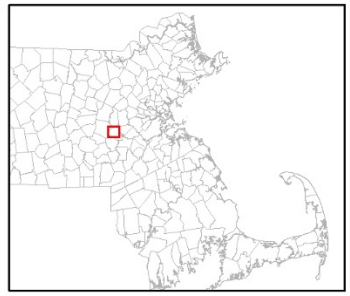

MassDOT Roadways in Urban Area
Subwatershed
Assessed Segment
Impaired Lakes
Impaired Streams

N

0 1,250 2,500 Feet

Figure 1B

Lake Cochituate (MA82127) Subwatershed

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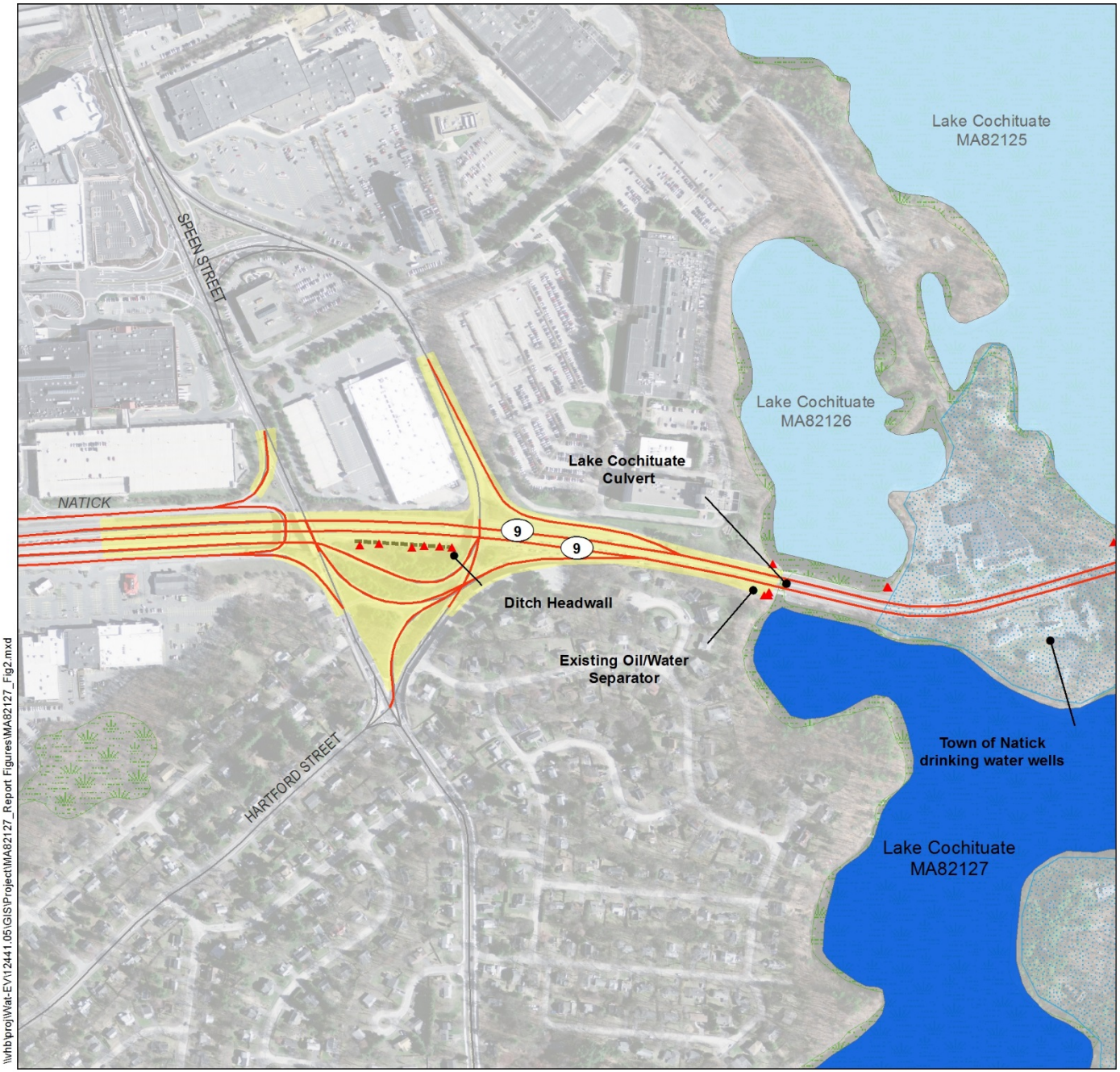

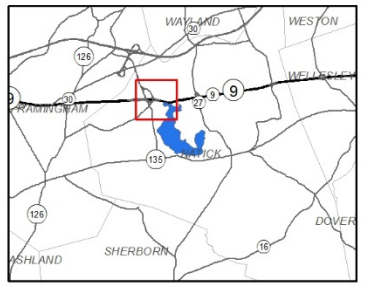

- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Assessed Segment
- Impaired Lakes
- MassDOT Directly Discharging Area
- Ditch
- DEP Wetlands
- Zonell Wellhead Protection Areas

N

0 250 500 Feet

Figure 2

**Lake Cochituate (MA82127)
Directly Contributing
MassDOT Watershed**

June 2014

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Highway Division

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06/08/2014

Impaired Waters Assessment for Unnamed Tributary (MA82A-22)

Summary

		Stormwater
Impaired Waters	**Impairments**[1]	Aquatic macroinvertebrate bioassessments, nutrient/eutrophication biological indicators
	Category:	5 (Waters requiring a TMDL)
	Final TMDLs	None
	WQ Assessment	SuAsCo 2001 Water Quality Assessment Report, Sudbury Subwatershed[2]
Location	**Towns:**	Framingham
	MassDOT Roads:	Interstate 90
Assessment Methods(s)	**7R (TMDL Method)**	☐
	7U (IC Method)	☒
BMPs	**Existing:**	None
		Impervious Cover (IC)
MassDOT Area and Targets	**Directly Contributing Area**	14.4 acres
	Contributing Area Reduction Target	10.9 acres
	Existing BMPs Reduction	0 acres
	Remaining Reduction to Meet Target	10.9 acres

[1] MassDEP, 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, 2001. SuAsCo 2001 Water Quality Assessment Report, Sudbury Subwatershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar3.pdf

Site Description

Unnamed Tributary, segment MA82A-22, is locally known as Cochituate Brook, as it is the outlet of the North Basin of Lake Cochituate. Unnamed Tributary flows for 1.3 miles, as shown on Figure 1a and 1b from its head water, from the North Basin of Lake Cochituate to the Sudbury River. The total and sub-watersheds of Unnamed Tributary consist of mostly medium to high density residential area and forest. MassDEP's Water Quality Assessment Report[3] lists municipal urbanized high density area and discharges from municipal separate storm sewers as sources of impairments.

The MassDOT roadways located within Unnamed Tributary's subwatershed include Interstate 90 (I-90), the interchange between I-90 and Route 30, and Route 9, however only I-90 and a small portion of the interchange ramp to Route 30 directly contribute to Unnamed Tributary. The portion of I-90 that directly discharges to Unnamed Tributary consists of three lanes and two shoulders for both I-90 East and I-90 West. There is an impervious median with concrete barriers that separate I-90 East and West. Stormwater along this portion is collected in catch basins located in the inside and outside shoulders of the highway. The catch basins discharge into the pervious shoulder area. A combination of grassed and paved drainage ditches located in the shoulders convey stormwater from the catch basin outlets directly to Unnamed Tributary.

In two locations, the drainage ditches convey stormwater to headwalls which transport stormwater under residential and commercial areas directly to the Unnamed Tributary. Most of the stormwater runoff that is discharged into the pervious shoulder of I-90 East is collected in drainage ditches which lead to culverts that convey the stormwater to the pervious shoulders of I-90 West. Stormwater runoff from a section of I-90, discharges to a non-impaired stream which flows directly into Unnamed Tributary, as shown in Figure 2. This area is considered directly discharging due to its proximity and quick time of concentration to Unnamed Tributary. Stormwater runoff from MassDOT property that drains to the non-impaired stream south of the culvert under I-90, is considered indirectly discharging due to its distance from Unnamed Tributary. This distance potentially allows for the non-impaired stream to naturally treat any pollutants present in the runoff. There are several pockets of wetland resource areas located within MassDOT's directly contributing area to Unnamed Tributary. Some stormwater runoff flows briefly through the wetlands which outlet into Unnamed Tributary.

Existing BMPs

MassDOT did not identify any existing BMPs in place to treat roadway runoff from the directly discharging area.

Assessment

In cases where a TMDL has been approved, MassDOT assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Unnamed Tributary (MA82A-22) using the methodologies described below.

[3] MassDEP, 2001. SuAsCo 2001 Water Quality Assessment Report, Sudbury Subwatershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar3.pdf

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address Unnamed Tributary's (MA82A-22) impairments. 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 Impervious Cover (IC) Method, as described in EPA's Stormwater TMDL Implementation Support Manual.[5] 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 (Unnamed Tributary) to determine the IC area and set a target for reduction. Watersheds used in this analysis were based on the USGS Dataset 451 and modified as necessary using topography.[6] MassGIS's impervious surfaces data layer was used to determine the IC of the watersheds.[7] The total watershed which includes all upstream contributing water bodies and the subwatershed which includes just the watershed to Unnamed Tributary are shown in Figure 1a. The subwatershed is shown on Figure 1b.

Table 1 Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	13,033 acres	2,213 acres
Impervious Cover (IC) Area	3,265 acres	820 acres
Percent Impervious	25%	37%
IC Area at 9% Goal	1,173 acres	199 acres
Target Effective IC Reduction	64%	76%

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

[4] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[5] ENSR 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/regionalpgrfs.html

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

[7] 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	32.6 acres
Directly Contributing IC Area	14.4 acres
Percent Impervious	44%
Contributing Area Reduction Target (Effective IC) (76% Reduction of DOT Directly Contributing IC)	10.9 acres
Target Effective IC	10.7%
Target Effective IC	3.5 acres

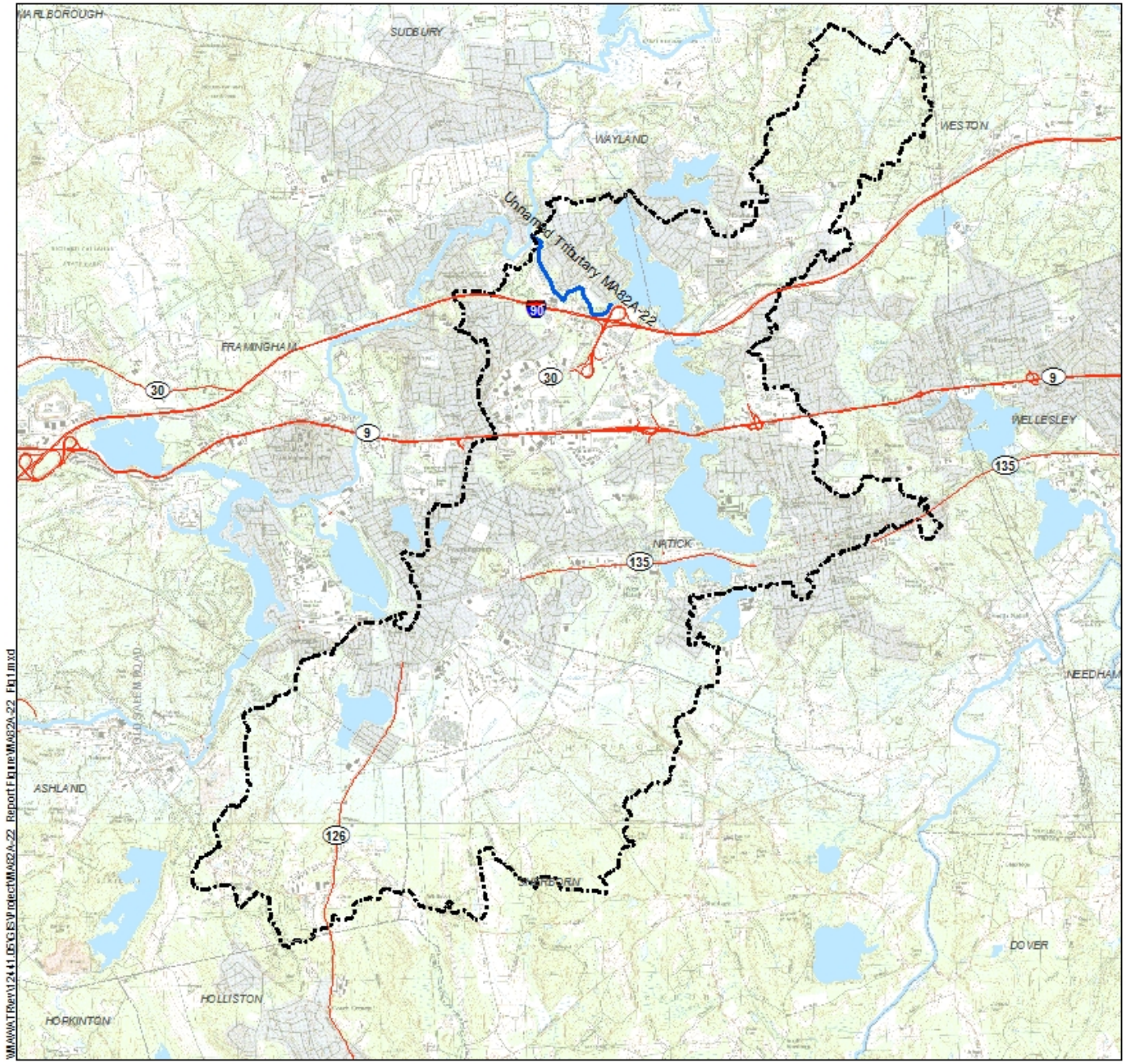
The Proposed Mitigation Plan section describes the next steps for evaluating potential BMPs to reduce the effective IC.

Proposed Mitigation Plan

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. Control measures such as infiltration BMPs could be located within the directly contributing area to infiltration stormwater before it reaches Unnamed Tributary. Potential infiltration swales could be constructed along the shoulders of I-90 and potential infiltration basins could be constructed within the interchange islands that connect Rt. 30 to I-90. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat 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 with additional information and summarize the final effective IC reduction based on the designed retrofit project BMPs.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Unnamed Tributary, 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
Total Watershed
Assessed Segment
Impaired Streams
Impaired Lakes

N

0 3,000 6,000
Feet

Figure 1a

Unnamed Tributary
MA82A-22
Total Watershed

June 2014

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Highway Division

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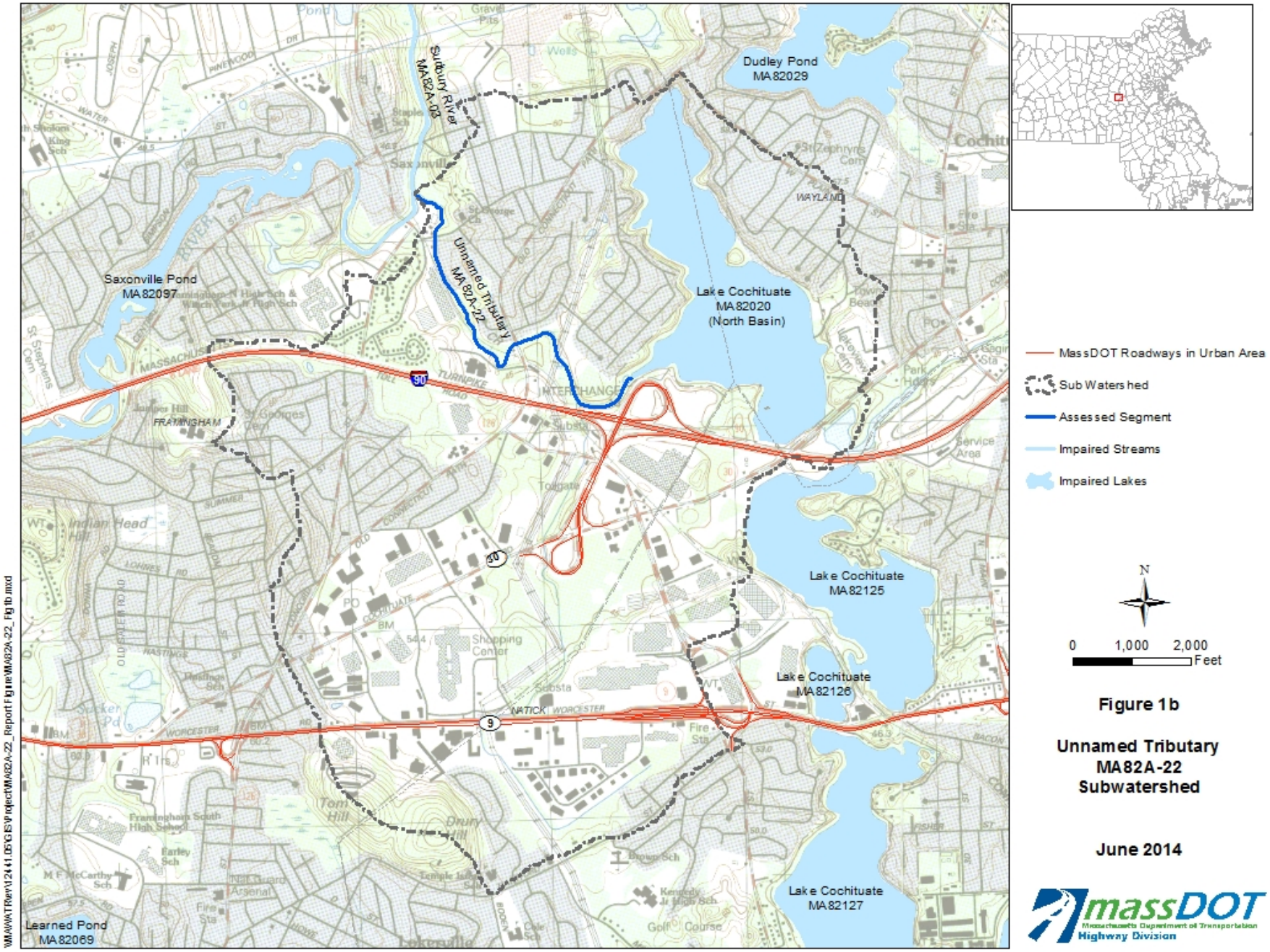

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Figure 1b

Unnamed Tributary MA82A-22 Subwatershed

June 2014

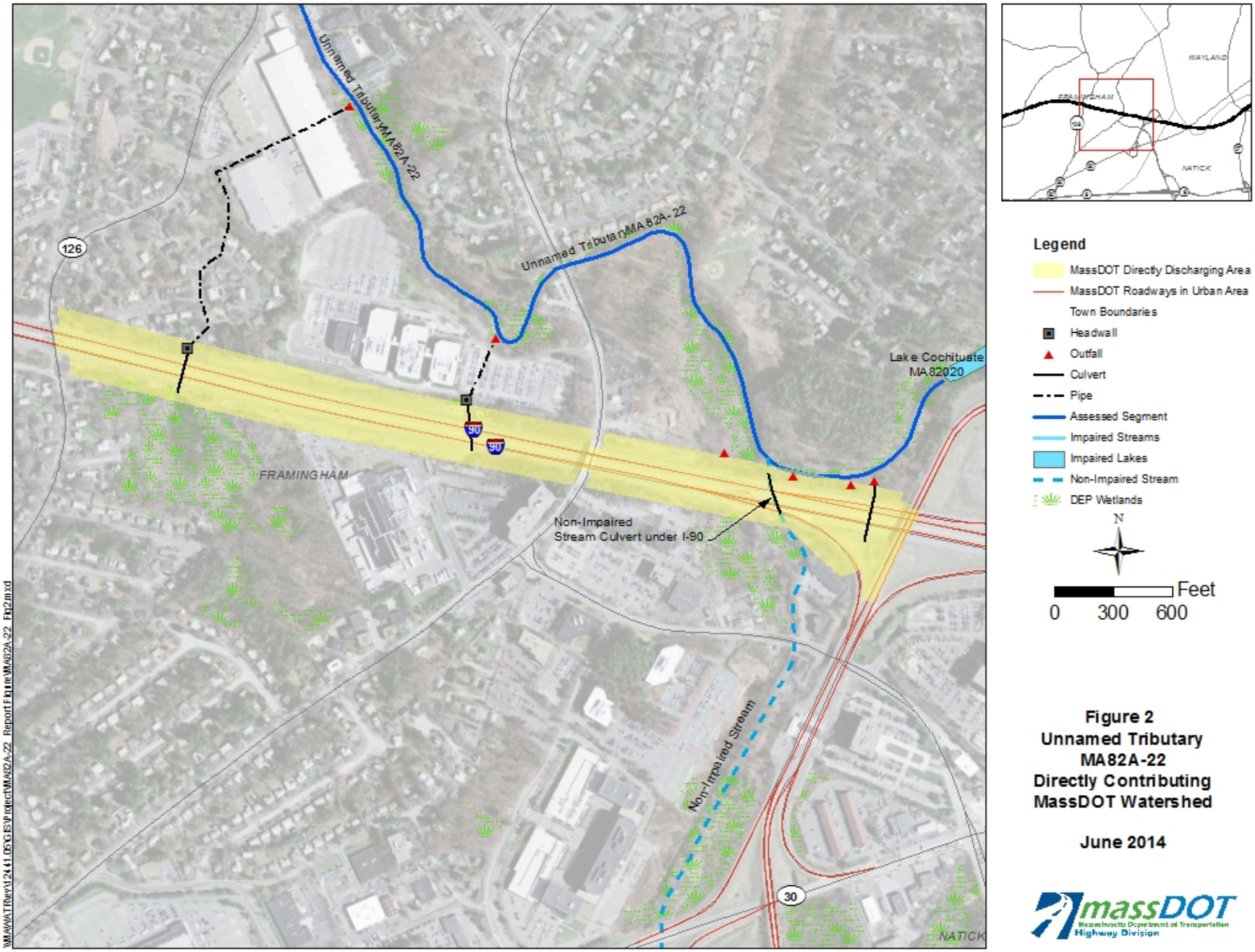


Figure 2
Unnamed Tributary
MA82A-22
Directly Contributing
MassDOT Watershed

June 2014

massDOT Massachusetts Department of Transportation Highway Division

06/08/2014

Impaired Waters Assessment for Sudbury River (MA82A-26)

Summary

		Stormwater	Non-Stormwater[1]
Impaired Waters[2]	**Impairments**	Aquatic macroinvertebrate bioassessments	Mercury in fish tissue
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs	None	
	WQ Assessment	SuAsCo Watershed 2001 Water Quality Assessment Report[3]	
Location	**Town:**	Framingham	
	MassDOT Roads:	I-90, Route 9	
Assessment Methods(s)	**7R (TMDL Method)**	☐	
	7U (IC Method)	☒	
BMPs	**Existing:**	None	
		Impervious Cover (IC)	
MassDOT Area and Targets	**Directly Contributing Area**	27.9 acres	
	Contributing Area Reduction Target	19.3 acres	
	Existing BMPs Reduction	0.0 acres	
	Remaining Reduction to Meet Target	19.3 acres	

1 MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

2 MassDEP, 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

3 MassDEP, 2001. SuAsCo Watershed 2001 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar3.pdf

Site Description

Sudbury River (MA82A-26) is a 2.8-mile-long river segment located in Framingham, Massachusetts. The entire Sudbury River is 32.7 miles long and ultimately joins with the Assabet River to form the headwaters of the Concord River. Segment MA82A-26 of the Sudbury River begins at the outlet from Framingham Reservoir #1 (MA82044). The river flows northeast, passing under Route 9 and briefly running parallel to Interstate 90 (I-90) before entering Saxonville Pond (MA82097) near the I-90 Framingham service plaza.

The total watershed to Sudbury River (MA82A-26) is 83.0 square miles and is shown in Figure 1a. It includes all of Southborough and portions of Framingham, Marlborough, Northborough, Westborough, Upton, Hopkinton, and Ashland. The subwatershed, which lies entirely within Framingham, is 4.8 square miles and is shown in Figure 1b. The subwatershed is composed primarily of forest and medium to high-density residential land with areas along Route 9 occupied by commercial space.

According to the 2001 Water Quality Assessment Report for the SuAsCo Watershed, aquatic life within Sudbury River (MA82A-26) is impaired for benthic macroinvertebrate assessment. [4] The suspected source is listed as the upstream impoundment, referring to Saxonville Pond, which is impounded by the Saxonville Dam. Fish consumption is impaired for mercury, with the Nyanza Superfund Site identified as a known source. Primary contact and secondary contact have not yet been assessed; however the primary contact recreational use has been identified with an “Alert” status due to elevated amounts of fecal coliform. The aesthetics use as been assessed as support based on turbidity observed by the Division of Watershed Management.

Figures 2a and 2b show the portion of MassDOT property that discharges directly to Sudbury River. The directly discharging roadway includes approximately 0.7 miles of I-90, a portion of the Framingham service plaza along I-90, and approximately 1.1 miles of Route 9. I-90 is a divided highway running east to west with three lanes of travel and two wide shoulders in either direction. I-90 is crowned in both directions between the second and third travel lanes. The grading directs runoff from each third travel lane toward catch basins within the median, all of which outlet south of I-90 and directly to the Sudbury River. Runoff from the outside lanes sheet flows laterally off the road. Some of the sheet flow is conveyed to Sudbury River by drainage ditches that run parallel to the road. The remainder flows short distances over land directly into the river. Stormwater from the service plaza is piped into a ditch and ultimately culverted under I-90 and directly into Sudbury River. Some of that stormwater is first piped into a small depression near the entrance to the plaza, but the depression does not have outlet control and thus does not qualify as an existing BMP.

The Route 9 directly discharging drainage infrastructure is designed to collect stormwater in trunk lines and pipe it to outfalls along the banks of Sudbury River (shown on Figure 2A). Route 9 is a divided highway running east to west with two lanes of travel in either direction. Route 9 is crowned in the median, so all stormwater is collected by catch basins along the shoulders. East of the river crossing, the trunk line runs along the westbound shoulder and outlets at the bridge abutment. West of the river crossing, the primarily trunk line lies within the median and outlets at a headwall along the westbound shoulder. There is room for potential stormwater BMPs along the eastbound and westbound shoulders of I-90. There is also potential to implement leaching catch basins at select locations outside of the travel lanes along Route 9.

4 MassDEP, 2001. SuAsCo Watershed 2001 Water Quality Assessment Report. Available at:
http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/82wqar5.pdf

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 assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed Sudbury River (MA82A-26) using the methodologies described below.

MassDOT has identified a water body impairment in the Sudbury River watershed which is not related to stormwater runoff. The specific impairment unrelated to stormwater for the Sudbury River 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-pollutant impairments are not specifically addressed as part of the Impaired Waters Program.[5]

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address the Sudbury River's (MA82A-26) aquatic macroinvertebrate bioassessments impairment. 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 as a basis, 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 (Sudbury River) to determine the IC area and set a reduction target. Watersheds are based on the USGS Dataset 451 and modified as necessary using topography.[8] MassGIS's impervious surfaces data layer was used to determine the IC of the watersheds.[9] The total watershed is shown in Figure 1a, and the subwatershed is shown in Figure 1b.

5 MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

6 MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

7 ENSR 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/regionalpgrfs.html

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	53,106 acres	3,089 acres
Impervious Cover (IC) Area	7,927 acres	899 acres
Percent Impervious	15%	29%
IC Area at 9% Target	4,780 acres	278 acres
Target Effective IC Reduction	40%	69%

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

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	38.0 acres
Directly Contributing IC Area	27.9 acres
Percent Impervious	73%
Contributing Area Reduction Target (Effective IC) (69% Reduction of DOT Directly Contributing IC)	19.3 acres
Target Effective IC	23%
Target Effective IC	8.6 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 section describes the next steps for the potential BMPs to reduce the effective IC.

Proposed Mitigation Plan

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 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 based on the designed retrofit project BMPs.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Sudbury 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, reduction achieved by finalized BMP designs and progress made towards meeting target effective IC reductions.

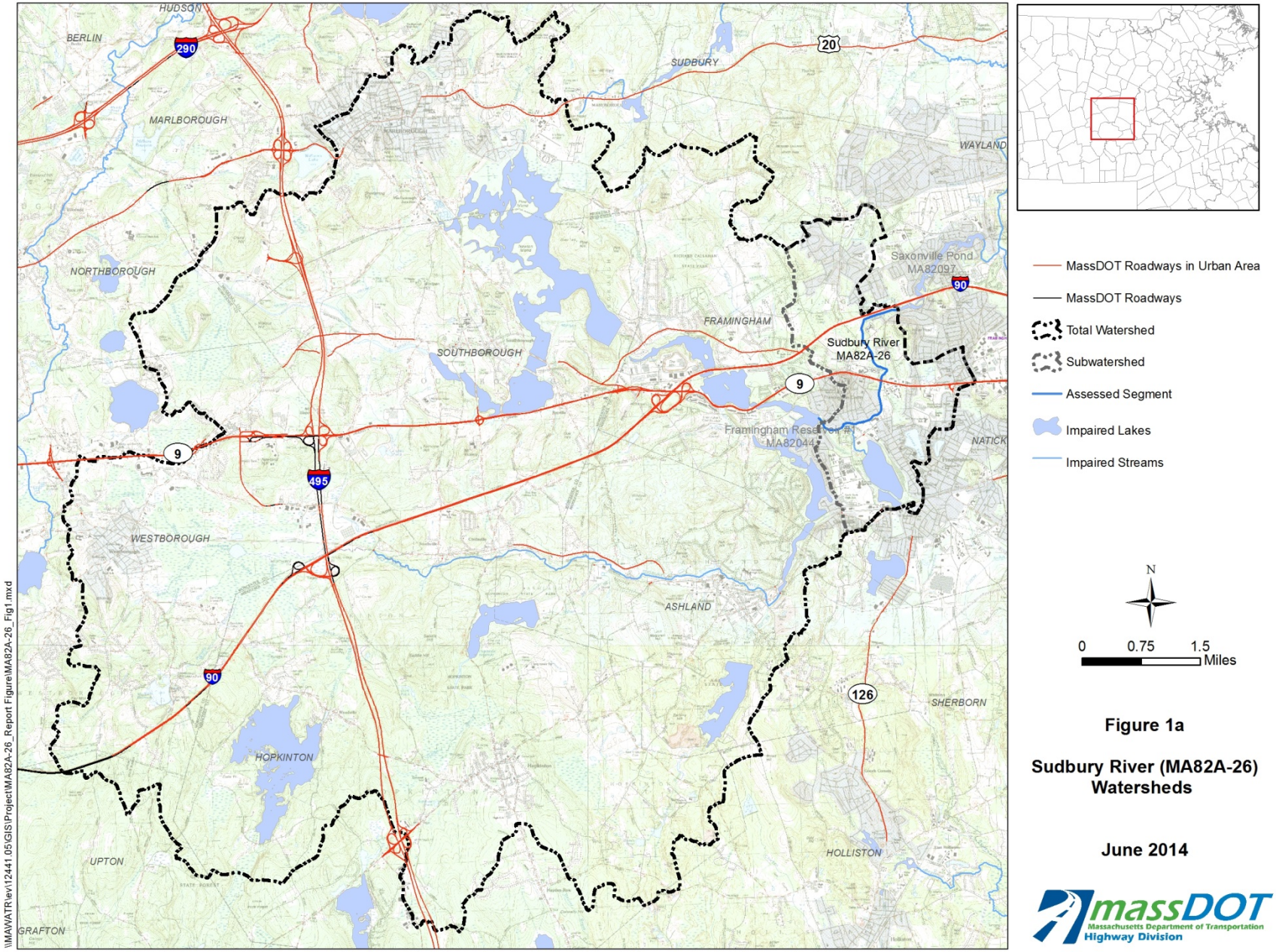
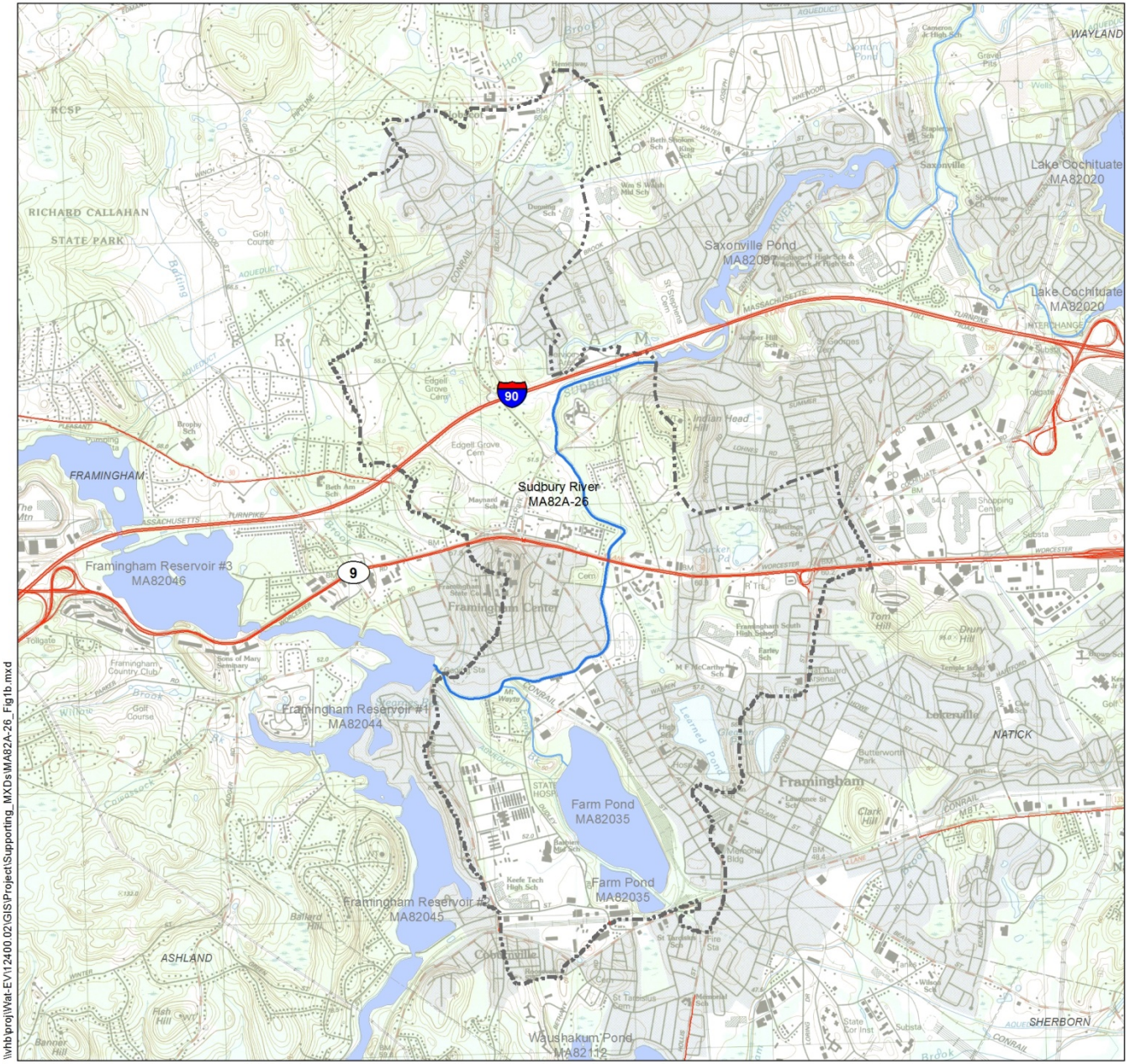
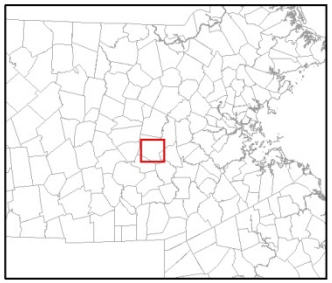


Figure 1a

Sudbury River (MA82A-26) Watersheds

June 2014





MassDOT Roadways in Urban Area

MassDOT Roadways

Subwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 0.3 0.6 Miles

Figure 1b

Sudbury River (MA82A-26) Subwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

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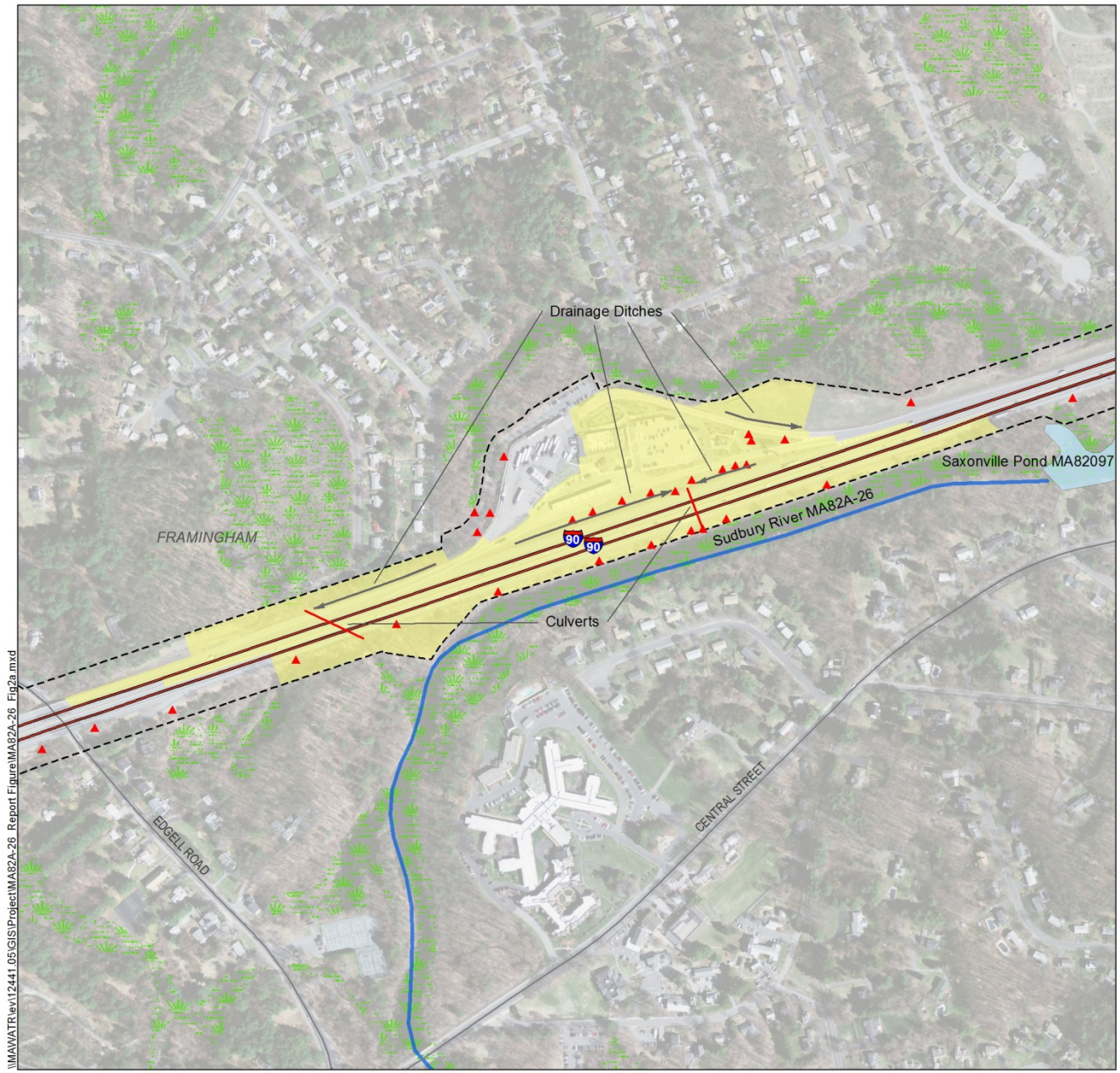


- MassDOT Outfalls
- State Layout Line
- MassDOT Roadways in Urban Area
- MassDOT Directly Discharging Area
- Assessed Segment
- Impaired Lakes
- DEP Wetlands

N

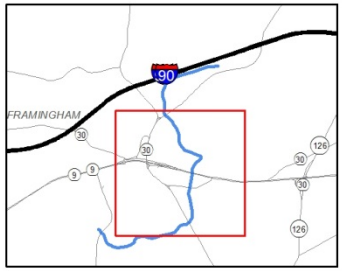
0 250 500 Feet

Figure 2a

Sudbury River (MA82A-26)
Directly Contributing
MassDOT Watershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division



- MassDOT Outfalls
- State Layout Line
- MassDOT Roadways in Urban Area
- MassDOT Directly Discharging Area
- Assessed Segment
- Impaired Lakes
- DEP Wetlands

N

0 350 700 Feet

Figure 2b

Sudbury River (MA82A-26)
Directly Contributing
MassDOT Watershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for the Shawsheen River (MA83-18)

Summary

		Stormwater	Non-Stormwater[1]
Impaired Water[2]	**Impairments**	Fecal coliform, dissolved oxygen	Mercury in fish tissue
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs	Bacteria TMDL for the Shawsheen River Basin CN 122.0[3]	
	WQ Assessment	Shawsheen River Watershed 2000 Water Quality Assessment Report CN 86.0[4]	
Location	**Towns:**	Andover, Tewksbury, Wilmington, and Billerica	
	MassDOT Roads:	Interstate 93, Route 38, and Salem Road Bridge (Route 129)	
Assessment Methods(s)	**7R (TMDL Method)**	☒	
	7U (IC Method)	☒	
BMPs	**Existing:**	None	

		Impervious Cover (IC)
MassDOT Area and Targets	**Directly Contributing Area**	11.5 acres
	Contributing Area Reduction Target	6.5 acres
	Existing BMPs Reduction	0 acres
	Remaining Reduction to Meet Target	6.5 acres

1 MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

2 MassDEP, 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

3 MassDEP, 2002. Bacteria TMDL for the Shawsheen River Basin, Report MA83-01-2002-24. Available at http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/shawshee.pdf.

4 MassDEP, 2003. Shawsheen River Watershed 2000 Water Quality Assessment Report. Available at http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/83wqar.pdf.

Site Description

Figure 1 presents the Shawsheen River (MA83-18) watershed. This impaired reach of the Shawsheen River (MA83-18) extends approximately 10.1 miles between the Burlington Water Department's surface water intake in Billerica to the Ballardville Impoundment Dam in Andover. The reach flows in the northeast direction through Billerica, Tewksbury, and Andover. A small portion of the segment forms the boundary between Billerica and Wilmington.

According to the MassGIS 2005 land use dataset,[5] the majority of the total contributing watershed is occupied by forested and residential areas. The subset of the watershed area that directly contributes to the impaired segment (referred to herein as the 'subwatershed') is occupied by residential (45%) and forested (34%) areas. Other land uses/covers in the subwatershed include wetlands (12%), industrial (5%), and commercial (3%).

The Shawsheen River Watershed 2000 Water Quality Assessment Report[6] indicates that this reach is impaired because of unknown toxicity, organic enrichment and low dissolved oxygen, and pathogens. Two sites within the watershed are included on the EPA New England National Priorities List, the Roy Bros Haulers Site (EPA ID MAD009870643) and the Sutton Brook Disposal Area (EPA ID MA980520696). Other historic permitted discharges to the river include uncontaminated cooling water from BTL Specialty Resins Corporation, non-contact cooling water from Praxair, Inc., and stormwater from Shawsheen Rubber, Praxair Inc., Wing's Used Auto Parts, and the municipal stormwater systems for Billerica, Tewksbury, Woburn, and Wilmington.

The water quality report indicates that this reach of the Shawsheen River is listed as 'not assessed' for aquatic life, aesthetics and/or fish consumption (in the upper 9 miles). It is listed as 'impaired' for fish consumption in the lower 1.1 miles. It is listed as 'supporting' primary and secondary contact. The primary contact recreational use is qualified with an 'alert' status because occasional elevated fecal coliform bacteria counts have been observed in the vicinity of Route 129 at the Billerica/ Wilmington corporate boundary.

MassDOT roadways cross the impaired reach at three locations within the subwatershed: Interstate 93 (I-93) crosses in Andover, Tewksbury and North Reading; State Route 38 crosses in Tewksbury; and Salem Road Bridge crosses at the corporate boundary between Wilmington and Billerica at the Middlesex/Shawsheen Aqueduct.

Interstate 93

Figure 2a illustrates the MassDOT property along I-93 that directly contributes to this reach of the Shawsheen River. Approximately 4,400 linear feet of I- 93 drains to three outfalls adjacent to the Shawsheen River. In this area, I-93 occupies three travel lanes and one breakdown lane (in each direction of travel). The breakdown lane may be used for travel during commuting hours, so, effectively, there are four travel lanes in each direction. The right of way is 300 feet wide. The inner lane is graded to drain to the grassy depression in the median. The outer three lanes are graded to drain to the gravel and grassed shoulder. The width of the paved lanes (4) is approximately 48 feet each for both directions of travel, the median is approximately 32 feet wide. The right shoulder consists of gravel and grass; there is no curb or gutter. It is approximately 12 feet wide. The left shoulder consists of gravel and grass; there is no curb or gutter. It is approximately 4 feet wide.

[5] [5] MassGIS, 2005. MassGIS Data – Land Use (2005). Available at http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/lus2005.html

[6] MassDEP, 2003. Shawsheen River Watershed 2000 Water Quality Assessment Report. Available at http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/83wqar.pdf.

The contributing area to Outfall 1 occupies approximately 270 linear feet north of the Shawsheen River. It includes the inner lane for both the north and southbound travel areas and the outer three lanes for the northbound travel areas. Stormwater flows to catchbasins on the paved shoulders and collects in a cross culvert which discharges directly to the Shawsheen River through a pipe that daylights in the bridge abutment. Two other outfalls, located to the north of Outfall 1, on the east side of the highway, discharge to depressions in a wooded area. Observations made during field inspections, conducted during the spring 2014, support the conclusion that runoff to these depressions infiltrates to groundwater and does not flow overland to the river.

The contributing area to Outfall 2 occupies approximately 600 linear feet of the southbound outer three lanes and approximately 340 linear feet of the southbound inner lane and all northbound lanes. Stormwater flows to catchbasins on the paved shoulders and collects in a cross culvert which discharges to a wet area approximately 300 feet from the Shawsheen River channel.

The contributing area to outfall 3 occupies approximately 3,700 linear feet south of the Shawsheen River. It includes the inner lane for both the north and southbound travel lanes, the outer three lanes for the southbound travel lanes, and portions of the outer three lanes for the northbound travel lanes. Catch basins on the paved sections of the shoulder, both near the median and the outer shoulder, intercept some of the stormwater and collect it into a trunk line that terminates at a wetland adjacent to the Shawsheen River. Field observations indicate that most of the runoff to the outer shoulders bypasses the catch basins on the paved shoulders and flows overland onto the grassy shoulders. On the southbound outer shoulder, catch basins located in the grassy shoulder direct water back to the trunk line. On the northbound outer shoulder, runoff collects in low-lying depressions. Field observations indicate that runoff that reaches these depressions does not flow overland to the river.

Outfalls 1 and 3 are located in areas of Priority Habitat. Outfalls 2 and 3 are located in protected open space areas adjacent to wetlands.

There is ample room in the MassDOT right-of-way for surface BMPs. The right shoulders are large, grassy, and flat. BMP possibilities include swales, forebays and detention basins. The median may be wide enough to accommodate a swale. Preliminary design for surface BMPs should include a determination of the depth of the existing stormwater conveyance network.

State Route 38

Figure 2b illustrates the MassDOT property along State Route 38 that directly contributes to this reach of the Shawsheen River. Approximately 2,500 linear feet of State Route 38 drains directly to the Shawsheen River at Outfall 4. Route 38 consists of two lanes, one in each direction of travel. The surface width is approximately 26 feet; the width of the right-of-way varies from 46 to 50 feet. There is no shoulder. The quality of the pavement is poor and irregular with undulations and depressions throughout. Both sides of the road have curbs, which are in poor condition. There are many curb cuts for access to adjacent commercial properties. It appears that some access driveways have degraded such that they no longer exclude road runoff. Stormwater runoff runs downgradient (to the southwest) through some commercial parking lots to vegetated areas behind the lots. In general, stormwater that does not leave the roadway flows to the northwest along the edge of the road and is intercepted by in-line catch basins that drain to a reinforced concrete pipe (Outfall 4) that protrudes from the southeastern bank of the Shawsheen River. There is no room in the MassDOT right-of-way for surface BMPs. There is the potential that leaching basins could be located at higher elevations depending on the infiltration rates of surrounding soils, groundwater depths, and site utilities.

Salem Road Bridge (Route 129)

Figure 2c illustrates the MassDOT property along the Salem Road Bridge that directly contributes to this reach of the Shawsheen River. Approximately 65 feet of Salem Road is occupied by a MassDOT bridge crossing of the Shawsheen River. The surface width is approximately 26 feet and the right-of-way width is approximately 50 feet. Stormwater from the bridge flows downgradient to the east and runs off overland to the south directly to the river. The area adjacent to the bridge is designated as protected open space owned by the Wilmington Conservation Commission and part of the Middlesex Canal Archaeological and Historic District. There is no room in the MassDOT right-of-way for surface BMPs.

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assessed the waterbody for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed the Shawsheen River (MA83-18) using the methodologies described below.

MassDOT has identified a subset of water body impairments in the Shawsheen River watershed which are not related to stormwater runoff. The specific impairment unrelated to stormwater for the Shawsheen River includes 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.[7]

BMP 7R for Pathogen TMDL (CN 122.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP).[8] The Shawsheen River (MA83-18) is covered by the Bacteria TMDL for the Shawsheen River Basin.[9] The TMDL states that sources of indicator bacteria include illicit sewer connections, sewer line leaks, septic systems, and urban stormwater runoff. Recommended TMDL implementation measures include controlling point sources, septic tank contributions, and urban runoff. The TMDL also emphasizes the need for additional monitoring of wet weather sources and in-stream conditions.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[10] Therefore, it is

[7] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[8] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[9] MassDEP, 2002. Bacteria TMDL for the Shawsheen River Basin, Report MA83-01-2002-24. Available at http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/shawshee.pdf.

[10] ibid.

difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's South East Expressway study measured bacterial concentration in stormwater runoff[11] and data indicate that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g. illicit discharges, sewer utilities, pet waste, and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommends implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. 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.

MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff notes signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, Resident Engineers overseeing construction projects also note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this IDDE training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and proceeds to work with owners of confirmed illicit discharges to remove these flows, and thereby minimize pathogen contributions to receiving waters.

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen impaired waterbody. At these prioritized rest stops, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired waterbody and will be providing pet waste removal bags and disposal cans.

MassDOT believes the existing efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations.

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address the Shawsheen River's (MA83-18) dissolved oxygen impairment. 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[12] which was developed using the EPA Region I's Impervious Cover (IC) Method as a basis, described in EPA's Stormwater TMDL Implementation Support Manual[13].

[11] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

[12] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[13] ENSR 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/regionalpgrfs.html

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 (Shawsheen River) to determine the IC area and set a target. Watersheds are based on the USGS Dataset 451 and modified as necessary using topography.[14] MassGIS's impervious surfaces data layer was used to determine the IC of the watersheds.[15] The total watershed and the subwatershed are shown in Figure 1.

Table 1 Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	42,071 acres	10,297 acres
Impervious Cover (IC) Area	8,438 acres	2,136 acres
Percent Impervious	20%	21%
IC Area at 9% Goal	3,786 acres	927 acres
Target Effective IC Reduction	55%	57%

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

Table 2 MassDOT Directly Contributing Watershed

Directly Contributing Area	26.1 acres
Directly Contributing IC Area	11.5 acres
Percent Impervious	44%
Contributing Area Reduction Target (Effective IC) (57% Reduction of DOT Directly Contributing IC)	6.5 acres
Target Effective IC	19%
Target Effective IC	5.0 acres

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

Proposed Mitigation Plan

MassDOT has identified that additional control measures are needed to reduce its effective IC and pathogens loading 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 directly contributing IC as part of MassDOT's Impaired Waters Retrofit Initiative. The project

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

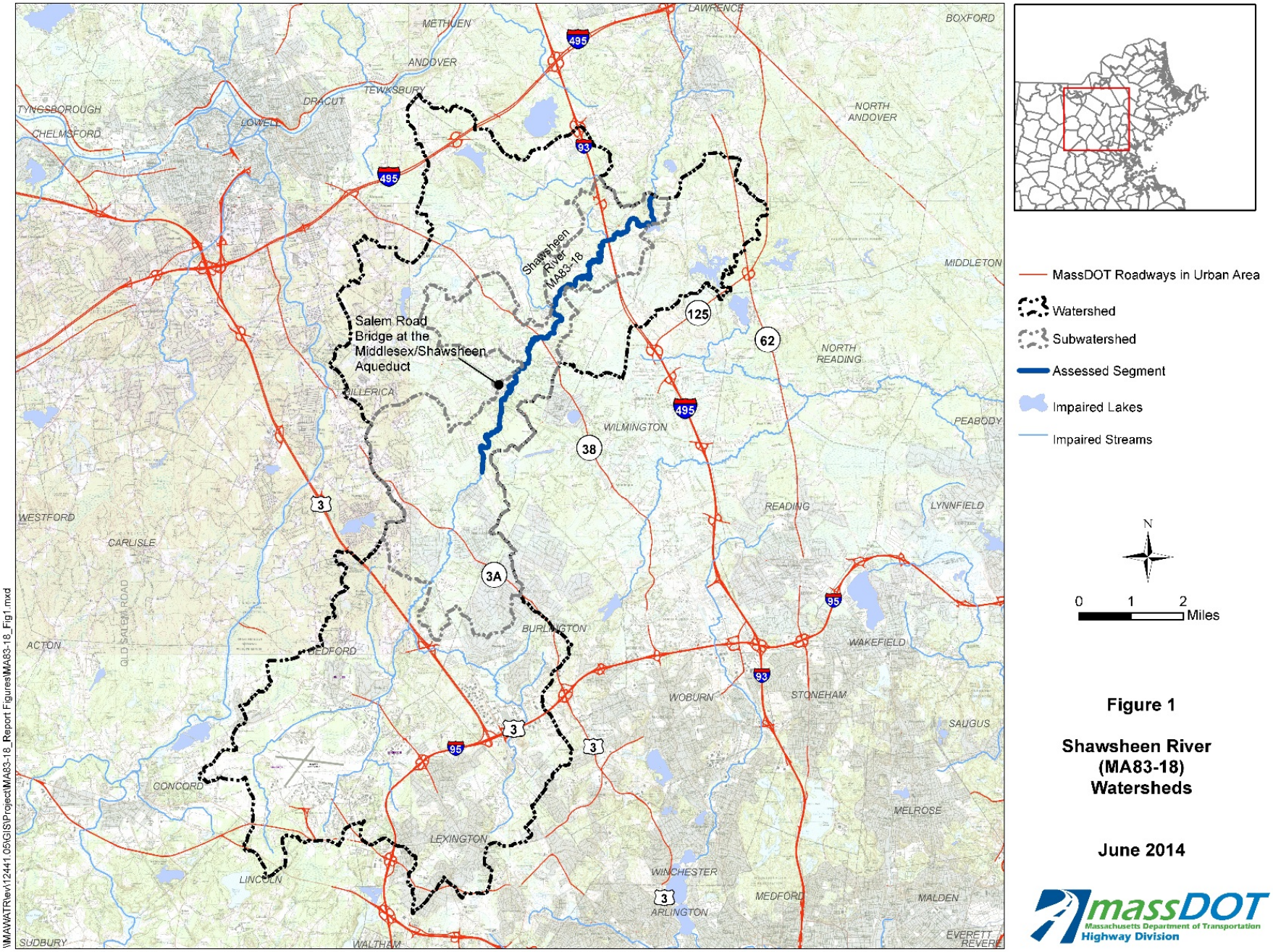
[15] MassGIS Impervious Surfaces datalayer taken from 2005 orthoimagery. Available at: http://www.mass.gov/mgis/impervious_surface.htm

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 and pollutant load reduction to the maximum extent practical.

Once the design of the proposed BMPs are finalized, MassDOT will provide an update with additional information and summarize the final pathogens and effective IC reduction based on the designed retrofit project BMPs.

For the pathogen impairment, MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters, that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be 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 the Shawsheen 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, reduction achieved by finalized BMP designs and progress made towards meeting target effective IC reductions and pathogens load reductions.



\\MAWATR\ev\12441.05\GIS\Project\MA83-18_Report Figures\MA83-18_Fig1.mxd

Figure 1

Shawsheen River (MA83-18) Watersheds

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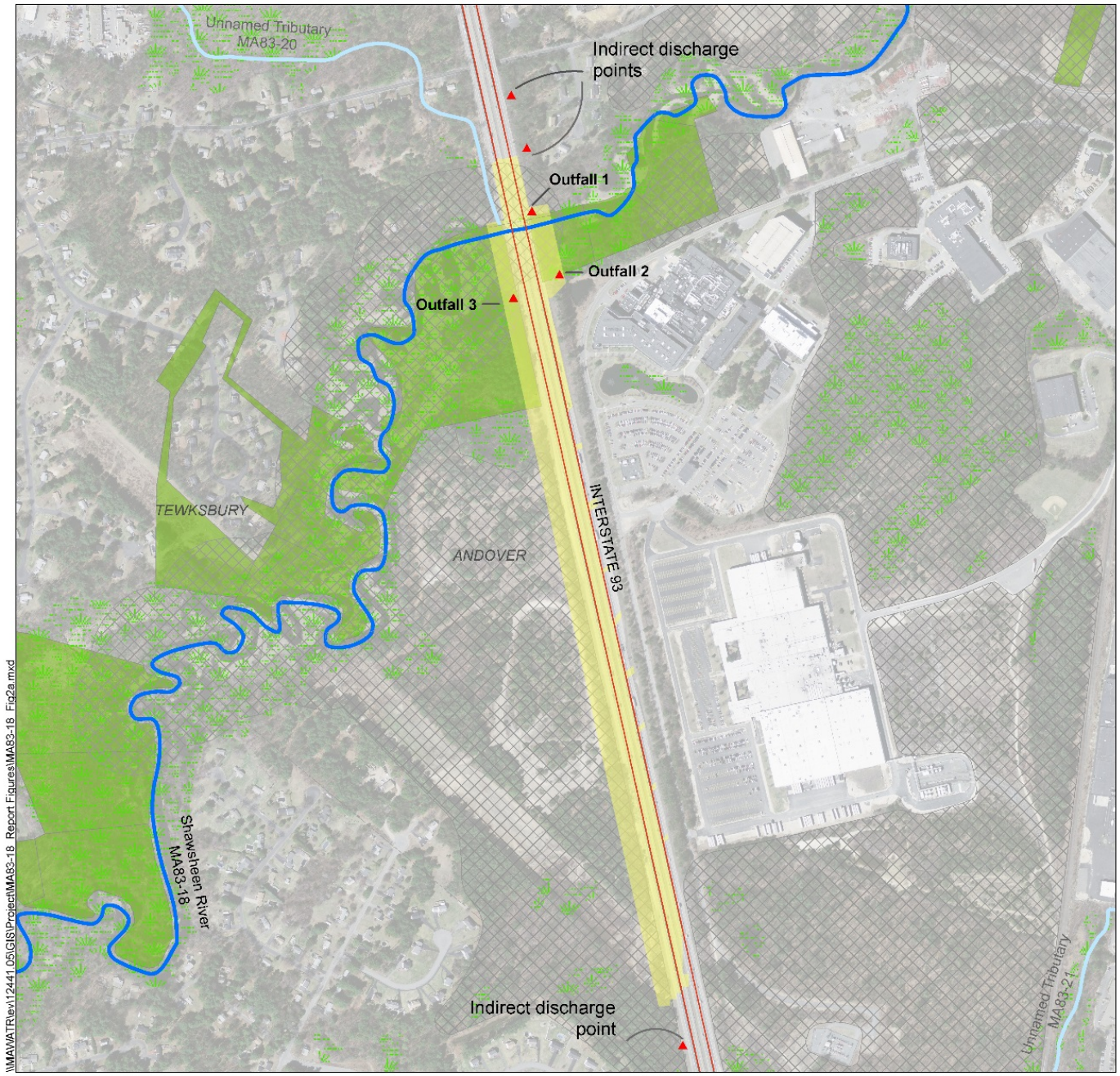
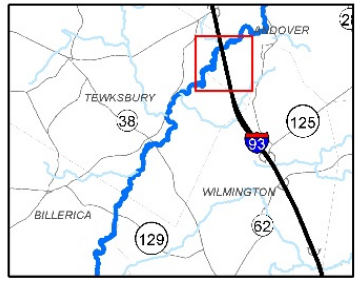




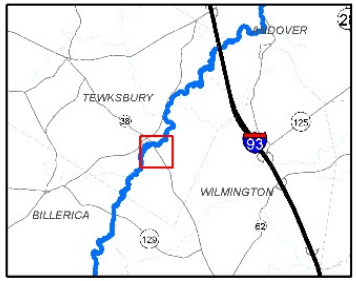
MassDOT Roadways in Urban Area
Impaired Streams
Assessed Segment
MassDOT Outfalls
MassDOT Directly Discharging Area
Priority Habitats of Rare Species
Protected Recreational and Open Space
Wetlands

N

0 350 700 Feet

Figure 2a
Shawsheen River
(MA83-18)
Directly Contributing
MassDOT Watershed

June 2014



- Historical Resource Sites
- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Assessed Segment
- MassDOT Directly Discharging Area
- Protected and Recreational Open Space
- Wetlands

N

0 200 400 Feet

Figure 2b
Shawsheen River
(MA83-18)
Directly Contributing
MassDOT Watershed

June 2014

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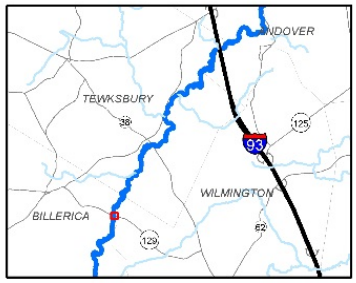
Highway Division



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Impaired Streams
- MassDOT Directly Discharging Area
- MHC Historic Districts
- Protected and Recreational Open Space
- Wetlands

N

0 40 80 Feet

Figure 2c
Shawsheen River
(MA83-18)
Directly Contributing
MassDOT Watershed

June 2014

MassDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for North River (MA93-42)

Summary

		Stormwater
Impaired Water[1]	**Impairments:**	Ammonia (un-ionized), dissolved oxygen and fecal coliform
	Category:	5 (Waters requiring a TMDL)
	Final TMDLs:	*Final Pathogen TMDL for North Coastal Watershed*[2]
	WQ Assessment:	*North Shore Coastal Watersheds 2002 Water Quality Assessment Report*[3]
Location	**Towns:**	Salem
	MassDOT Roads:	Route 114 (North St.) and Route 107 (Salem Bypass or Sargeant James Ayube Memorial Drive)
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☒
BMPs	**Existing:**	None
	Proposed:	Retrofitting existing Basin
		Impervious Cover (IC)
MassDOT Contributing Area and Targets	**Directly Contributing Area**	4.0 acres
	Contributing Area Reduction Target	3.2 acres
	Existing BMPs Reduction	0 acres
	Remaining Reduction to Meet Target	3.2 acres

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

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

Site Description

North River (MA93-42) begins at the Route 114 (North Street) bridge in Salem and extends approximately 1 mile to its confluence with the Danvers River in Salem, MA. Upstream of the North River, Goldthwaite Brook (MA 93-05) flows into a stretch of Proctor Brook (MA 93-39) approximately 2.9 miles in length. At the downstream end of the 2.9 mile stretch, the Proctor Brook channel widens for a stretch of over 0.5 miles. This segment, Proctor Brook (MA93-40), flows to the Route 114 bridge where it turns into the North River (MA93-42), the subject of this assessment (Figure 1). Each segment identified above is classified as impaired according to the *North Coastal Watersheds 2002 Water Quality Assessment Report*[4]. The report indicates that Segment 93-42 is impaired for shellfish harvesting due to elevated fecal coliform bacteria. Suspected sources include discharge from separate storm sewer systems, marinas/boating pumpout releases and sanitary on-vessel discharges.

MassDOT's property directly contributing stormwater runoff to the North River (MA93-42) is comprised of portions of Route114 (North Street) and Route 107 (Salem Bypass, or Sergeant James Ayube (SJA) Memorial Drive) (see Figure 2 and 3). Route 114 is a single lane road in each direction and it is located in a developed area of Salem. Route 107 is a two lane roadway with a jersey barrier median. On the west side of Route 107, railroad tracks are located between the road and the River, while the east side of the road is comprised of developed areas consisting of condominiums and residences.

MassDOT owns two bridges on Route 114 (North Street). Drainage from each bridge is captured by down gradient catch basins and piped to discharge points within the culvert conveying Proctor Brook to the North River.

Drainage from an approximately 0.6 mile stretch of Route 107 (Salem bypass/SJA Memorial Drive) flows to catch basins and is directed to two of three outfalls discharging to the North River (Figure 3). A portion of this roadway discharges to existing basins before discharging to North River via outfalls. The basins are described further below.

Drainage from approximately 1,100 feet of Route 107 is piped to a basin/depression adjacent to the roadway (shown in Figure 3 as the proposed BMP watershed). MassDOT Plan set 5402, sheet 56 indicates that the area is a detention basin; however, the basin was not observed to include any overflow/spillway areas, control structure for flow, or other characteristics that would indicate that the water is being treated before discharging to the North River. Drainage from Route 107 is directed through drainage ditches or directly from catch basins within the roadway to the basin. In addition, drainage from residential streets is also directed to the basin. The outlet structure consists of a headwall and an 18 inch-pipe that extends from the basin to the North River by extending beneath Route 107 and the railroad. This area/basin has the potential to be used for a BMP, as displayed in **Photos 1 and 2** but is not considered a BMP in its current state**.** The photos show the well vegetated basin and the outlet structure.

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

Photo 1.

Photo 2.

The northern end of Route 107 within the subwatershed of the North River does not directly contribute drainage to the North River, as the runoff is collected into catch basins and piped to the Danvers River (MA93-09), which will be addressed in a separate assessment.

Existing BMPs

MassDOT identified an existing basin in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment. However, the existing basin is not providing treatment.

Assessment

In cases where a TMDL has been approved, MassDOT assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. MassDOT has separately assessed the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology. MassDOT assessed North River (MA93-42) using the methodologies described below.

BMP 7R for Pathogen TMDL (CN 155.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP).[5] North River (MA93-42) is covered by North River is covered by MassDEP's *Final Pathogen TMDL for the North Coastal Watershed*[6]. According to the Final TMDL, sources of indicator bacteria in the North Coastal River watershed were found to be many and varied. Most of the bacteria sources in the North Coastal River watershed are believed to be failing sewer line infrastructure, failing septic systems, combined sewer overflows (CSO's) and animal waste. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process by first prioritizing areas based on available data while considering their impact to downgradient resources. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky

[5] Massachusetts Department of Transportation (MassDOT), July 22, 2010. *BMP 7R: TMDL Watershed Review*. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

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

or improperly connected sanitary sewer flows and best management practices to mitigate storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[7] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's South East Expressway study measured bacterial concentration in stormwater runoff[8] and data indicated that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g. illicit discharges, sewer utilities, pet waste and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicate that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommends implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. 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.

MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff notes signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, Resident Engineers overseeing construction projects also note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this IDDE training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and proceeds to work with owners of confirmed illicit discharges to remove these flows, and thereby minimize pathogen contributions to receiving waters.

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen impaired water body. At these prioritized rest stops, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and will be providing pet waste removal bags and disposal cans.

MassDOT believes the existing efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations.

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[7] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/dep/water/resources/capecod1.pdf

[8] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

BMP 7U for Impervious Cover Related Impairments

A Final TMDL is not in place to address North River's (MA93-42) following impairments: Ammonia (un-ionized) 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[9] which was developed using the EPA Region I's Impervious Cover (IC) Method as a basis, described in EPA's Stormwater TMDL Implementation Support Manual.[10] 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 (North River) to determine the IC area and set a target. The total watershed and the subwatershed are shown in Figure 1 and Figure 2.

Impaired Segment Watershed

	Total Watershed	Subwatershed
Watershed Area	7,664 acres	330 acres
Impervious Cover (IC) Area	2,515 acres	143 acres
Percent Impervious	32.8 %	43.3 %
IC Area at 9% Target	689 acres	29.7 acres
Target Effective IC Reduction	72.5 %	79.2 %

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

MassDOT Directly Contributing Watershed

Directly Contributing Area	4.0 acres
Directly Contributing IC Area	4.0 acres
Percent Impervious	100 %
Contributing Area Reduction Target (Effective IC) (79.2% Reduction of DOT Directly Contributing IC)	3.2 acres
Target Effective IC	20%
Target Effective IC	0.8 acres

[9] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.mhd.state.ma.us/downloads/projDev/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[10] ENSR 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/regionalpgrfs.html

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 section describes the next steps for the potential BMPs to reduce the effective IC.

Proposed Mitigation Plan

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 (Figure 3). MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat 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 further along, MassDOT will provide an update with additional information and summarize the final effective IC reduction based on the designed BMPs.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of North 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, reduction achieved by finalized BMP designs and progress made towards meeting target effective IC reductions.

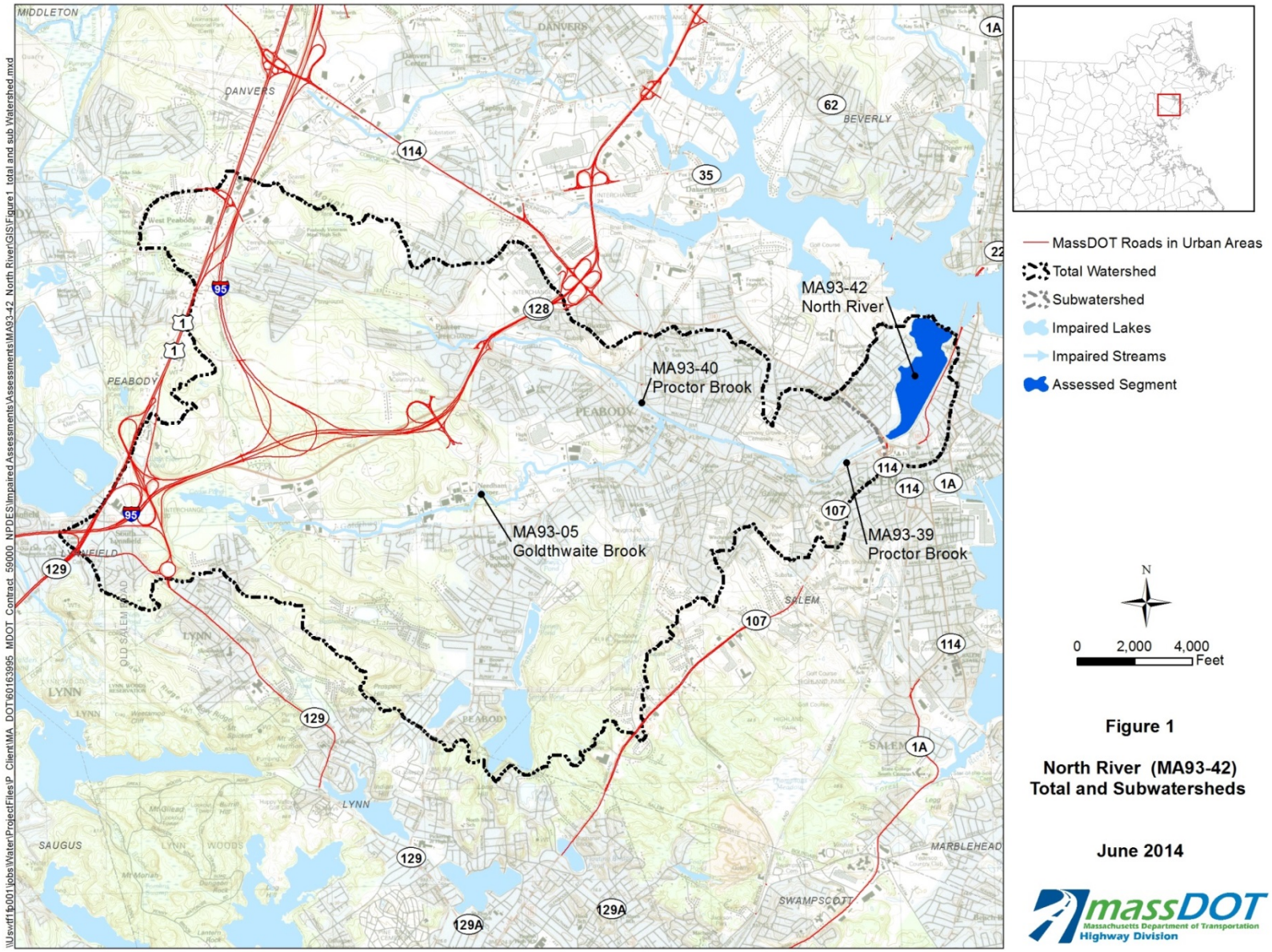

Figure 1

North River (MA93-42)
Total and Subwatersheds

June 2014

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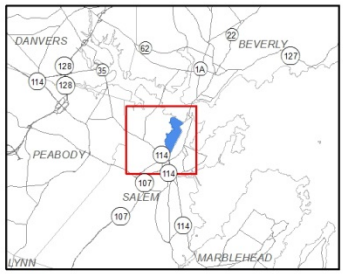

- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Subwatershed
- Total Watershed
- Impaired Streams
- Assessed Segment
- Impaired Lakes
- MassDOT Directly Discharging Area
- DEP Wetlands

N

0 500 1,000 Feet

Figure 2

North River (MA93-42)
Directly Contributing
MassDOT Watershed

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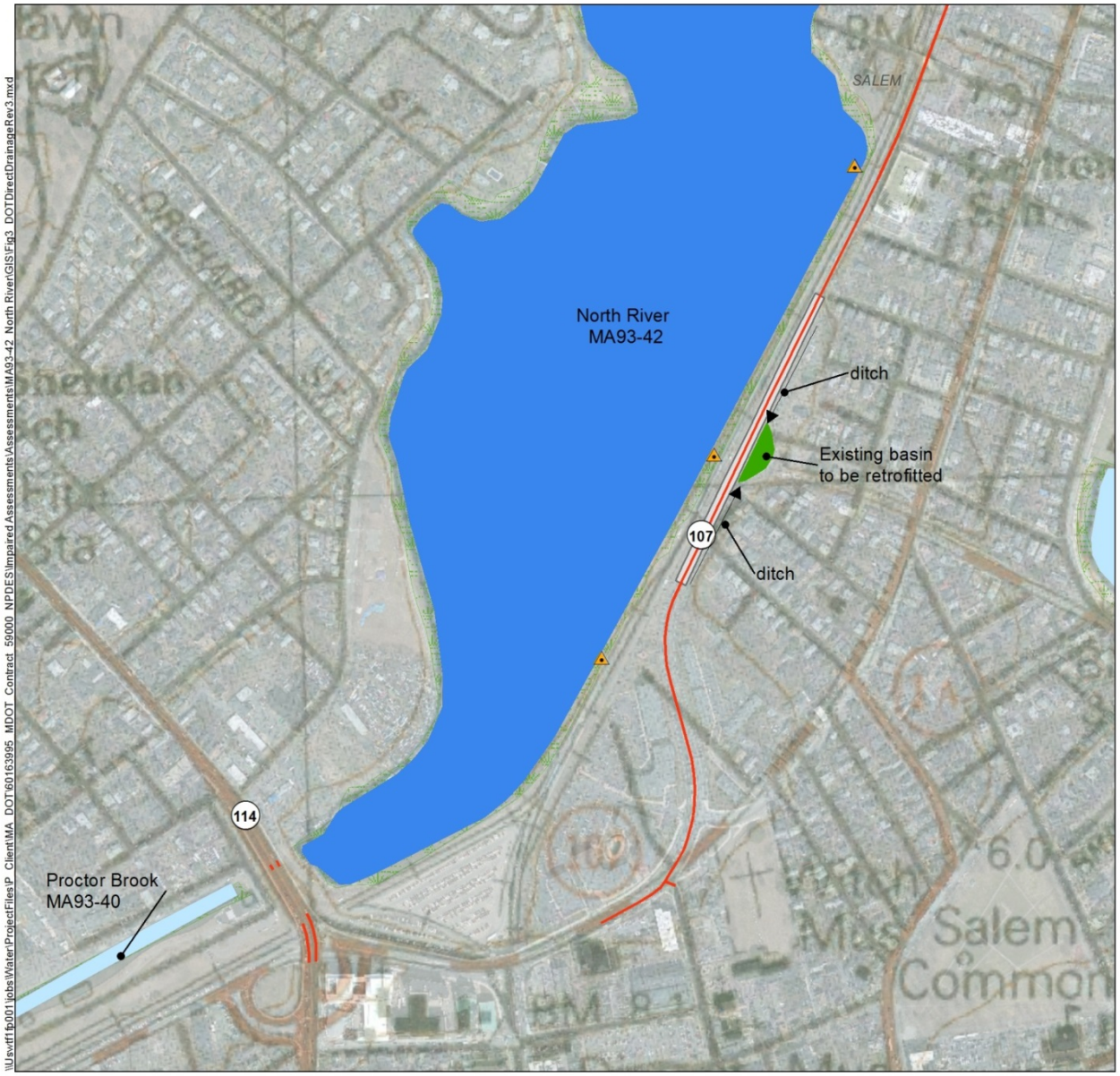

MassDOT Roadways in Urban Area
Stormwater Outfalls
Assessed Segment
Proposed BMP Watersheds
Proposed/Existing BMPs
DEP Wetlands

N

0 250 500
Feet

Figure 3

North River (MA93-42)
Proposed/Existing BMPs

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