Attachment 3:

Progress to Final Reports

List of Impaired Water Bodies

Waterbody ID	Waterbody Name
MA32-05	Westfield River
MA34-19	Stony Brook
MA35026	Greenwood Pond
MA41-02	Quinebaug River
MA51050	Flint Pond
MA51-04	Blackstone River
MA51-06	Blackstone River
MA74-08	Monatiquot River
MA92-03	Miles River
MA93-10	Forest River

Impaired Waters Assessment for Westfield River (MA32-05) – Final Report

Introduction

Westfield River (MA32-05) was previously assessed in a progress report titled, *Impaired Waters Assessment for Westfield River (MA32-05) – Progress Report*, submitted on 6/8/2012. The progress report stated that MassDOT would work with designers to implement BMPs in order to meet its target reduction of impervious cover (IC). After further review by the design consultants, it was verified that approximately 25 acres of MassDOT property discharges directly to the Westfield River. This report presents a summary of the findings of the progress report as well as a final assessment which includes the reduction provided by existing BMPs and the final target IC reduction determined during the Designer's comprehensive investigation.

Summary of Progress Report

Impaired Waterbody

Name: Westfield River

Location: Russell and Westfield, MA

Water Body ID: MA32-05

Impairments

According to the MassDEP Final *Year 2012 Integrated List of Waters* (MassDEP, 2013), this segment is listed under Category 5 as impaired for the following:

- Excess algal growth
- taste and odor
- Aquatic macroinvertebrates
- turbidity

According to MassDEP's *Westfield River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2005) the *Aesthetics* and *Aquatic Life Uses* are assessed as "Support" for the upper 16.8-mile reach of this segment of the Westfield River. The lower 1.0 mile reach of the river (downstream from the Westfield WWTP discharge) is assessed as impaired because of slight instream turbidity, presence of sewage fungus, excess algal growth, and sewage odor.

Site Description

The Westfield River (segment MA32-05) begins at the confluence with the Middle Branch Westfield River in Huntington, MA and flows southeasterly for 17.8 miles to the Route 20 Bridge in Westfield,

MA where the segment ends. In its upper reach, the river flows past the Huntington town center and receives discharge from the Huntington Waste Water Treatment Plant (WWTP). The river flows southeast from the Huntington WWTP and is dammed at the Littleville Power Company's Crescent Mill Dam. Downstream of the dam, the river receives wastewater and noncontact cooling water from the Texon USA facility. The river flows through steep terrain in the town of Russell and is again dammed at the Westfield River Paper Company Dam. Just downstream of the dam, the river receives discharge of treated effluent from the Russell WWTP. The river is again dammed a few miles south of the Russell WWTP at the Woronoco Dam in the village of Woronoco. The river continues southeast into the town of Westfield where the river widens and a broad floodplain is present. The Westfield WWTP discharges to the river upstream of the Route 20 Bridge.

MassDOT identified the directly contributing area based on plan review and a site visit on March 30, 2012. MassDOT's property that directly contributes stormwater runoff to the Westfield River is comprised of both non-urban and urban portions of Route 20 which runs adjacent to the Westfield River for significant stretches, from approximately 0.6 miles northwest of Interstate-90 (I-90) east to the Route 20 Bridge. Approximately 0.1 miles of the urban portion of I-90 drains to the Westfield River. Runoff from other sections flows overland and infiltrates or discharges to isolated wetlands before reaching the river and therefore is not considered a direct discharge.

There are no MassDOT owned urban roadways which directly contribute stormwater to the Westfield River upstream of I-90.

Previously Completed Progress Assessment under BMP 7U

None of the impairments for the Westfield River have been addressed by a total maximum daily load (TMDL) report. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U (*Water Quality Impaired Waters Assessment and Mitigation Plan*) of MassDOT's Storm Water Management Plan, which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of storm water on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- excess algal growth
- taste and odor
- aquatic macroinvertebrate bioassessments
- turbidity

Existing BMPs from Progress Report

Immediately upstream of the Route 20 bridge, storm water from Route 20 discharges to what was originally designed as a water quality swale. Approximately 4.3 acres of impervious cover drains to the swale via a 36" reinforced concrete pipe and headwall. The proposed check dam at the downstream end of the swale no longer exists and the swale is not currently providing water quality treatment as designed. Therefore no existing BMPS are present within the contributing watershed to Westfield River.

Target Reduction from Progress Report

In the progress report, MassDOT derived the following site parameters and target reduction for DOT's directly contributing watershed draining to the Westfield River (MA32-05) using the IC Method:

Table 1. Target IC Reduction – Progress Report

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	24.5	Acres
Target Percent Reduction in Effective IC	6.6	%
Target Reduction in Effective IC	1.6	Acres
IC Effectively Reduced by Existing BMPs	0	Acres
IC Remaining to Mitigate with Proposed BMPs	1.6	Acres

Final Assessment

Designer Investigation of Existing BMPs

After the submittal of the progress report, further investigation of the Westfield River watershed was conducted for more precise values of directly discharging area, BMP storage volume, BMP IC area treated, and percent reduction of effective IC, although in the end the effective IC value did not change. It was confirmed that there are no existing BMPs within the subwatershed.

Updated Target Reduction

After the submittal of the progress report, further investigation of MassDOT's directly contributing IC area was performed by the designers. Based on this investigation, the MassDOT Directly Contributing IC Watershed and the target reduction of impervious cover were unchanged from the progress report.

BMPs in Design

MassDOT has designed BMPs to address the target IC reduction of 1.6 acres as part of MassDOT's Impaired Waters Retrofit Initiative. MassDOT was able to design an extended detention basin to treat the MassDOT contributing area of 4.0 acres of impervious cover resulting in a reduction of effective IC of 3.0 acres.

MassDOT is constructing the BMPs possible within the existing right of way and site constraints. The design is schedule to be completed by January 2014.

However, the possibility of additional pollutant reductions will be reviewed during future programmed project work when more significant changes to drainage patterns and expanded right of way are potentially possible.

Table 2. Summary of BMPs in Design

BMP Name	BMP Type	IC Area Treated in Acres	Reduction of Effective IC in Acres
BMP 1	Extended Detention Basin	4.0	3.0

The proposed BMPs provided a total reduction of effective IC of 3.0 acres which achieves the target reduction of 1.6 acres. The installation of additional BMPs within the Westfield River subwatershed is not required as the target reduction has been satisfied.

Additional detailed information regarding the final designs for these BMPs will be included in future submittals to US EPA.

Conclusions

Table 3 summarizes the IC reductions within MassDOT's directly contributing watershed under design BMP conditions.

Table 3. Design BMP Effective IC Reductions

Parameter	Quantity	Unit of Measure
MassDOT Target Reduction in Effective IC	1.6	acres
Effective IC Reduction under Design BMPs	3.0	acres
Remaining Target	0	acres

The BMP have been designed to achieve the target reduction and will achieve 3.0 acresof effective IC reduction. .

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative. Work on Programmed Projects often includes broader scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

References

Massachusetts Department of Environmental Protection (MassDEP). (2005). Westfield River Watershed 2001 Water Quality Assessment Report. Retrieved from: MassDEP 2005 Westfield River Watershed 2001 Water Quality Assessment Report

Massachusetts Department of Environmental Protection (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. Retrieved from: MADEP 2013 MA Year 2012 Integrated List of Waters

Massachusetts Department of Transportation (MassDOT). (June, 2012). MassDOT Semi Annual Submittal under MassDOT's Impaired Waters Program.

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).

Impaired Waters Assessment for Stony Brook (MA34-19) – Final Report

Introduction

Stony Brook (MA34-19) was previously assessed in a progress report titled, *Impaired Waters Assessment for Stony Brook (MA34-19) – Progress Report*, submitted on 6/7/2012. The progress report stated that MassDOT would work with designers to implement BMPs in order to meet its target reduction of impervious cover (IC). MassDOT has since completed the design of BMPs to address its contribution of stormwater to Stony Brook. This report presents a summary of the findings of the progress report as well as a final assessment which includes the reduction provided by existing BMPs and the final target IC reduction determined during the Designer's comprehensive investigation and the BMPs in design.

Summary of Progress Report

Impaired Waterbody

Name: Stony Brook

Location: Granby, Ludlow, Chicopee, and South Hadley, MA

Water Body ID: MA34-19

Impairments

According to the MassDEP Final *Year 2012 Integrated List of Waters* (MassDEP, 2013), this segment is listed under Category 5 as impaired for the following:

- Escherichia coli
- Turbidity
- (Non-Native Aquatic Plants*)

According to MassDEP's *Connecticut River Watershed 2003 Water Quality Assessment Report* (MassDEP, 2008), the lower 3.5 miles of Stony Brook have been classified as impaired for turbidity and elevated *E. coli* bacteria, and the upper 9.8 miles have not been assessed. Additionally, the brook has been placed on alert status for aquatic life based on the results of a biological study conducted in 2003. The 0.5-mile segment of Stony Brook that flows through Upper Pond and Lower Pond is further classified as impaired for non-native macrophytes (MassDEP, 2008).

Site Description

Stony Brook is a 13.3-mile long waterway that passes through the towns of Granby, Ludlow, Chicopee, and South Hadley, MA. The brook crosses beneath Route 202 in Granby near the border

with South Hadley after flowing for approximately 7.3 miles. Stony Brook flows through South Hadley for approximately 6 miles, crossing beneath Route 116 and finally emptying into the Connecticut River.

MassDOT's property that directly contributes stormwater runoff to Stony Brook is comprised of portions of Route 202 and Route 116. The extent of MassDOT's directly contributing IC is depicted in Figure 3. Drainage along Route 202 in most of South Hadley and Granby is collected in small trunk lines that discharge to unimpaired stream segments or wetlands. Near Stony Brook, the drainage is collected in five catch basins at or near the road's low point, which is located just southwest of the river crossing. The stormwater is piped directly into Stony Brook via one of two 12" circular outfalls on the northern side of the Route 202 road bridge.

Route 116 in South Hadley is classified as urban beginning at its intersection with Route 202 and ending at its intersection with Brainerd Street and Mosier Street, which occurs just south of the Route 116 road bridge over Stony Brook. Drainage from the road's high point at Belmont Avenue appears to be piped down-grade through catch basins along the western curb before it is collected in a yard drain approximately 300 feet from the Brainerd and Mosier Street intersection. Flow to the yard drain appears to be piped northwest to Brainerd Street, where it outfalls directly into an unimpaired stream segment just 400 feet from the stream's confluence with Stony Brook. The stream segment, pictured below on the left, flows quickly and has a sandy bottom, which provides little or no treatment by the time the drainage reaches Stony Brook. Consequently, drainage from this segment of roadway has been classified as direct. The remaining urban drainage from Route 116 is collected in a catch basin on the eastern shoulder of Route 116 immediately before the intersection with Brainerd Street and Mosier Street. Drainage from this catch basin is piped directly into a different unimpaired stream segment, which flows quickly over a sandy bottom for approximately 300 feet before joining Stony Brook.

Previously Completed Progress Assessment under BMP 7U

None of the impairments for Stony Brook have been addressed by a Total Maximum Daily Load (TMDL). Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method; MassDOT, 2011), IC provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the impairment for turbidity.

The impairment for E. Coli was assessed separately in based on the methodology for assessments with a pathogen impairment.

According to MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*, the impairment for non-native aquatic plants is not related to discharges from stormwater (MassDEP, 2013). Therefore, this impairment was not considered further by MassDOT under the Impaired Waters Program.

Existing BMPs from Progress Report

The progress report explained that there are no existing BMPS within the directly contributing MassDOT watershed to mitigate the effective IC draining to Stony Brook.

Target Reduction from Progress Report

In the progress report, MassDOT derived the following site parameters and target reduction for DOT's directly contributing watershed draining to the Stony Brook (MA34-19) using the IC Method:

Table 1. Target IC Reduction – Progress Report

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	2.9	Acres
Target Percent Reduction in Effective IC	7.3	%
Target Reduction in Effective IC	0.2	Acres
IC Effectively Reduced by Existing BMPs	0	Acres
IC Remaining to Mitigate with Proposed BMPs	0.2	Acres

Final Assessment

Designer Investigation of Existing BMPs

After the submittal of the progress report, further investigation of the Stony Brook watershed was conducted for more precise values of directly discharging area, BMP storage volume, BMP IC area treated, and percent reduction of effective IC, although in the end the effective IC value did not change. It was confirmed that there are no existing BMPs within the subwatershed.

Updated Target Reduction

After the submittal of the progress report, further investigation of MassDOT's directly contributing IC area was performed by the designers. Based on this investigation, the MassDOT Directly Contributing IC Watershed and target reduction of impervious cover were unchanged from the progress report.

BMPS in Design

MassDOT has designed a BMP to address the target IC reduction of 0.2 acres as part of MassDOT's Impaired Waters Retrofit Initiative. MassDOT was able to design one infiltration basin to treat a MassDOT contributing area of 0.2 acres of impervious cover.

Table 2. Summary of BMPs in Design

BMP Name	BMP Type	IC Area Treated in Acres	Reduction of Effective IC in Acres
BMP 1	Constructed Wetland	0.2	0.2

The proposed BMP provides a total reduction of effective IC of 0.2 acres. The installation of additional BMPs within the Stony Brook subwatershed to provide treatment to meet the target reduction is not required as the infiltration basin achieves the target reduction.

Additional detailed information regarding the final designs for these BMPs will be included in future submittals to US EPA.

Conclusions

Table 3 summarizes the IC reductions within MassDOT's directly contributing watershed under design BMP conditions.

Table 3. Design BMP Effective IC Reductions

Parameter	Quantity	Unit of Measure
MassDOT Target Reduction in Effective IC	0.2	acres
Effective IC Reduction under Design BMPs	0.2	acres
Remaining Target	0	acres

The BMPs have been designed to the achieve the target reduction and will achieve 0.2 acres of effective IC reduction. Additional BMPs do not need to be constructed as the BMP meets the target.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative. Work on Programmed Projects often includes broader scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

References

Massachusetts Department of Environmental Protection (MassDEP). (2008). Connecticut River Watershed 2003 Water Quality Assessment Report. Retrieved from: MassDEP 2003 Connecticut River Watershed 2003 Water Quality Assessment Report

Massachusetts Department of Environmental Protection (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. Retrieved from: MADEP 2013 MA Year 2012 Integrated List of Waters

Massachusetts Department of Transportation (MassDOT). (June, 2012). MassDOT Semi Annual Submittal under MassDOT's Impaired Waters Program.

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).

Impaired Waters Assessment for Greenwood Pond (MA35026) – Final Report

Introduction

Greenwood Pond (MA35026) was previously assessed in a progress report titled, *Impaired Waters Assessment for Greenwood Pond (MA35026) – Progress Report*, submitted on 6/8/2012. The progress report stated that MassDOT would work with designers to implement BMPs in order to meet its target reduction of phosphorus (TP) loading. MassDOT has since completed the design of BMPs to address its contribution of stormwater to Greenwood Pond. This report presents a summary of the findings of the progress report as well as a final assessment which includes the reduction provided by existing BMPs and the final target TP loading reduction determined during the Designer's comprehensive investigation and the BMPs in design and their estimated resulting TP loading removals.

Summary of Progress Report

Impaired Waterbody

Name: Greenwood Pond

Location: Templeton, MA

Water Body ID: MA35026

Impairments

According to the MassDEP Final *Year 2012 Integrated List of Waters* (MassDEP, 2013), this segment is listed under Category 4a as impaired for the following:

- Aquatic Plants (Macrophytes)

Greenwood Pond is impaired for aquatic plants (macrophytes) and is covered by a Total Maximum Daily Load (TMDL) for phosphorus according to MassDEP's Total Maximum Daily Loads of Phosphorus for Selected Millers Basin Lakes [CN 123.2] (MassDEP, 2003).

Site Description

Route 2 runs east-west through the middle of Greenwood Pond. Route 2 is a divided, two-lane roadway with small, piped stormwater collection systems discharging to outfalls along either side, some of which discharge directly to Greenwood Pond. To the east of Greenwood Pond, stormwater is collected in catch basins and piped through two trunks lines which discharge upstream of the

pond approximately 500 feet away. To the west of the pond catch basins discharge directly to the side of the roadway. Approximately 0.4 acres of MassDOT urban area drains to Greenwood Pond.

Previously Completed Progress Assessment under BMP 7R

The TMDL for phosphorus for Greenwood Pond addresses the impairment of aquatic plants (macrophytes). Therefore, MassDOT assessed the contribution of phosphorus from MassDOT urban area property directly draining to this water body to address these impairments. The assessment was completed using the approach described in BMP 7R (TMDL Watershed Review).

Existing BMPs from Progress Report

The progress report identifies an existing swale; however it was determined that stormwater was not infiltrating due the close proximity to groundwater in this location. Therefore, the swale does not provide a reduction in the phosphorus load.

Target Reduction from Progress Report

In the progress report, MassDOT derived the following site parameters and target reduction for DOT's directly contributing watershed draining to the Greenwood Pond (MA35026) using the TMDL Method for TP as shown in Table 1.

Table 1. Site Parameters and Target TP Reduction – Progress Report

Parameter	Quantity	Unit of Measure
TP Loading from DOT's Directly Contributing Watershed	0.55	lb/yr
Target Percentage Reduction in TP Loading	71	%
Target TP Loading from DOT's Directly Contributing Watershed	0.4	lb/yr
TP Loading Remaining to Mitigate with Existing BMPs	0	lb/yr
IC Remaining to Mitigate with Proposed BMPs	0.4	lb/yr

Final Assessment

Designer Investigation of Existing BMPs

After the submittal of the progress report, further investigation of the Greenwood Pond (MA35026) subwatershed by the design contractor did not identify any additional existing BMPs associated with the direct discharges from MassDOT property into the pond.

Updated Target Reduction

After the submittal of the progress report, further investigation of MassDOT's directly contributing area was performed by the designers. Based on this investigation, the MassDOT Directly

Contributing Watershed remained unchanged. Thus, the target reduction of TP loading (71%) also remained the same. The remaining target reduction of effective TP loading is 0.4 lb/yr.

BMPs in Design

MassDOT has completed the design of BMPs to address the remaining 0.4 lb/yr of TP loading reduction as part of MassDOT's Impaired Waters Retrofit Initiative. There is currently one infiltration swale proposed to be constructed.

Table 2. Summary of BMPs in Design

BMP Name	BMP Type	Area Treated in Acres	Reduction of TP lb/yr
BMP 1	Infiltration Swale	0.77	0.63

The proposed BMP provides a reduction of total Phosphorus of 0.63 lb/yr , which achievesthe target reduction of 0.4 lb/yr.

Additional detailed information regarding the final designs for these BMPs will be included in future submittals to US EPA.

Conclusions

Table 3 summarizes the IC reductions within MassDOT's directly contributing watershed under design BMP conditions.

Table 3. Design BMP Effective IC Reductions

Parameter	Quantity	Unit of Measure
Target Reduction in TP loading	0.4	lb/yr
TP Loading reduction with proposed BMPs	0.6	lb/yr
Remaining Target	0	lb/yr

The BMP has been designed to achieve the target reduction and will achieve 0.63 lb/yr reduction of total Phosphorus. Additional BMPs are not required as the target reduction is satisfied.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative. Work on Programmed Projects often includes broader scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

References

Massachusetts Department of Environmental Protection (MassDEP) (2003). Total Maximum Daily Loads of Phosphorus for Selected Millers Basin Lakes. Retrieved from MassDEP 2003 TMDLs of Phosphorus for Selected Millers Basin Lakes

Massachusetts Department of Environmental Protection (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. Retrieved from: MADEP 2013 MA Year 2012 Integrated List of Waters

Massachusetts Department of Transportation (MassDOT). (June, 2012). MassDOT Semi Annual Submittal under MassDOT's Impaired Waters Program.

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).

Impaired Waters Assessment for Quinebaug River (MA41-02) – Final Report

Introduction

Quinebaug River (MA41-02) was previously assessed in a progress report titled, *Impaired Waters Assessment for Quinebaug River (MA41-02) – Progress Report*, submitted on 6/8/2013. The progress report stated that MassDOT would work with designers to implement BMPs in order to meet its target reduction of impervious cover (IC). This report presents a summary of the findings of the progress report as well as a final assessment which includes the reduction provided by existing BMPs and the final target IC reduction determined during the Designer's comprehensive investigation.

Summary of Progress Report

Impaired Waterbody

Name: Quinebaug River

Location: Southbridge, MA

Water Body ID: MA41-02

Impairments

Quinebaug River (MA41-02) is listed under Category 5, "Waters requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). According to this list, Quinebaug River segment MA41-02 is impaired for the following:

- (debris/floatables/trash*)
- turbidity
- excess algal growth

MassDEP's *French and Quinebaug River Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009) listed the Aquatic Life Use with an "Alert" status because of evidence of instream toxicity to P. promelas. All other uses were not assessed.

Site Description

The Quinebaug River Segment MA41-02 flows for 6.5 miles from the Sturbridge WWTP outfall to the confluence with Cady Brook in Southbridge. Much of the segment is protected and undeveloped because it is within the boundary of the US Army Corps of Engineers Westville Dam Flood Control Project.

Stomwater runoff from MassDOT property is conveyed to the segment through a system of catch basins, drainage pipes, swales and unnamed streams. The MassDOT property directly contributing stormwater runoff to the segment is described below.

Stormwater runoff from Interstate Route 84 is collected in catch basins and routed through drain pipes and grass swales to an unnamed stream running parallel with the highway. The unnamed stream discharges to Quinebaug River Segment MA41-02. Approximately 1,200 feet north of the Quinebaug River, the unnamed stream flows through a large area of wetlands. Runoff flowing through the wetlands is considered an indirect discharge to impaired waters, and runoff entering the unnamed stream downstream of the wetlands is considered a direct discharge.

Stormwater runoff from Route 131 is collected in catch basins and routed through drain pipes and ditches to the Quinebaug River. The ditches have significant pitch, limited vegetation, and are eroded in some areas. The Route 131 directly contributing area starts approximately 135 feet uphill of Fiske Hill Road and continues to the Quinebaug River.

Previously Completed Progress Assessment under BMP 7U

None of the impairments for the Quinebaug River have been addressed by a TMDL. Therefore, MassDOT assessed the impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of storm water on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- turbidity
- excess algal growth.

According to MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*, the impairment for (debris/floatables/trash*) is not caused by pollutants (MassDEP, 2013). Therefore, this impairment is not considered further.

Existing BMPs from Progress Report

Based on the site visit, there are no existing BMPs within MassDOT's directly contributing watershed to Quinebaug River segment MA41-02 that are mitigating potential storm water quality impacts. Therefore, no effective IC reduction is provided by existing MassDOT BMPs.

Target Reduction from Progress Report

In the progress report, MassDOT derived the following site parameters and target reduction for DOT's directly contributing watershed draining to the Quinebaug River (MA41-02) using the IC Method:

Table 1. Target IC Reduction – Progress Report

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	7.2	Acres
Target Percent Reduction in Effective IC	38	%
Target Reduction in Effective IC	2.7	Acres
IC Effectively Reduced by Existing BMPs	0	Acres
IC Remaining to Mitigate with Proposed BMPs	2.7	Acres

Final Assessment

Designer Investigation of Existing BMPs

After the submittal of the progress report, further investigation of the Quinebaug River was conducted for more precise values of directly discharging area, BMP storage volume, BMP IC area treated, and percent reduction of effective IC, although in the end the effective IC value did not change. It was confirmed that there are no existing BMPs within the subwatershed.

Updated Target Reduction

After the submittal of the progress report, further investigation of MassDOT's directly contributing IC area was performed by the designers. Based on this investigation, the MassDOT Directly Contributing IC Watershed and target reduction of impervious cover were unchanged from the progress report.

BMPs in Design

MassDOT has designed BMPs to address the target IC reduction of 2.7 acres as part of MassDOT's Impaired Waters Retrofit Initiative. MassDOT was able to design median infiltration swales, a gravel wetland and an infiltration basin to treat a total of 6.9 acres of MassDOT contributing area as part of the resurfacing project. This design is scheduled to be completed by May 2014.

MassDOT is constructing the BMPs possible within the existing right of way and site constraints as part of a Programmed Project Work Initiative.

Table 2. Summary of BMPs in Design

BMP Name	BMP Type	IC Area Treated in Acres	Reduction of Effective IC in Acres
BMP 1	Median infiltration swales	1.9	1.9
BMP 2	Gravel wetland	2.3	2.3
BMP 3	Infiltration basin	2.7	2.7

The proposed BMPs provide a total reduction of effective IC of 6.9 acres which achieves the target reduction of 2.7 acres. Therefore additional BMPs are not required.

Additional detailed information regarding the final designs for these BMPs will be included in future submittals to US EPA.

Conclusions

Table 3 summarizes the IC reductions within MassDOT's directly contributing watershed under design BMP conditions.

Table 3. Design BMP Effective IC Reductions

Parameter	Quantity	Unit of Measure
MassDOT Target Reduction in Effective IC	2.7	acres
Effective IC Reduction under Design BMPs	6.9	acres
Remaining Target	0	acres

The BMPs have been designed to achieve the target reduction and will achieve 6.9 acres of effective IC reduction. The treatment provided achieves the target reduction; therefore, additional BMPS are not necessary within this watershed.

This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

References

Massachusetts Department of Environmental Protection (MassDEP). (2009). French & Quinebaug River Watershed 2004-2008 Water Quality Assessment Report. Retrieved from: MassDEP 2009 French and Quinebaug River Watershed 2004-2008 Water Quality Assessment Report

Massachusetts Department of Environmental Protection (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. Retrieved from: MADEP 2013 MA Year 2012 Integrated List of Waters

Massachusetts Department of Transportation (MassDOT). (June, 2013). MassDOT Semi Annual Submittal under MassDOT's Impaired Waters Program.

Massachusetts Department of Transportation (MassDOT). (2011). Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method).

Impaired Waters Assessment for Flint Pond (MA51050) – Final Report

Introduction

Flint Pond (MA51050) was previously assessed in a progress report titled, *Impaired Waters Assessment for Flint Pond (MA51050) – Progress Report*, submitted on 6/8/2013. The progress report stated that MassDOT would work with designers to implement BMPs in order to meet its target reduction of impervious cover (IC). After further review by the design consultants, it was determined that the target reduction was 2.8 lbs/year of total phosphorus from the watershed contributing to Flint Pond. This report presents a summary of the findings of the progress report as well as a final assessment which includes the reduction provided by existing BMPs and the final target IC reduction determined during the Designer's comprehensive investigation.

Summary of Progress Report

Impaired Waterbody

Name: Flint Pond

Location: Shrewsbury, MA

Water Body ID: MA51050

Impairments

Flint Pond (MA51050) is listed under Category 4a, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Flint Pond is impaired for the following:

- (Eurasian water milfoil, myriophyllum spicatum*)
- (non-native aquatic plants*)
- aquatic plants (macrophytes)
- turbidity

Flint Pond (MA51050) is covered in MassDEP's *Total Maximum Daily Loads (TMDL) of Phosphorus for Selected Northern Blackstone Lakes* [CN 70.1] (MassDEP, 2002b) as well as MassDEP's *Blackstone River Watershed 2003-2007 Water Quality Assessment Report* (MassDEP, 2010). The water quality assessment report states that segment MA51050 of Flint Pond is impaired due to non-native aquatic macrophyte infestations, Eurasian Water Milfoil (Myriophyllum spicatum). The TMDL states:

"The lakes"…(including Flint Pond)…"were listed on the state '303d' list for a variety of pollutant and stressors including low dissolved oxygen, turbidity, nutrients, and over-abundance of nuisance

aquatic plants. All of the pollutants and stressors are indicators of nutrient enriched systems, better known as the process of eutrophication. In freshwater systems the primary nutrient known to accelerate eutrophication is phosphorus. Therefore, in order to prevent further degradation in water quality and to ensure that each lake meets state water quality standards the TMDL establishes a phosphorus limit for each lake and outlines corrective actions to achieve that goal." (MassDEP, 2002b)

Therefore, MassDOT used this TMDL to assess MassDOT's potential contribution to the impairments of turbidity and the aquatic plants (macrophytes) for Flint Pond.

Site Description

Flint Pond is comprised of two segments, segment MA51050 and segment MA51188. Segment MA51050 is assessed in this report. Segment MA51050 of Flint Pond is located in Shrewsbury, Massachusetts, and lays upstream of Segment MA51188 of Flint Pond. It has a surface area of approximately 92 acres. The total watershed draining to segment MA51050 is approximately 23 square miles and the subwatershed is approximately 11 square miles. .

There are several MassDOT-owned urban roadways within the subwatershed of Segment MA51050 of Flint Pond. These include Interstate 290, Route 9, Maple Avenue, Route 20 and Route 122. The drainage along each of these roadways is briefly described below:

Interstate 290
The portion of I-290 within the subwatershed discharges stormwater runoff to Lake Quinsigamond and Shirley Street Pond, which are upstream of Flint Pond. Therefore, I-290 does not discharge directly to Flint Pond.

Route 9
The portion of Route 9 within the subwatershed discharges to wetland areas and to Lake Quinsigamond, upstream of Flint Pond. Therefore, Route 9 does not discharge directly to Flint Pond.

Maple Avenue
Stormwater runoff from Maple Ave discharges to wetland areas over 1.4 miles away from Segment MA51050 of Flint Pond and therefore is indirect.

Route 20
The portion of Route 20 within the subwatershed of Segment MA51188 of Flint Pond is curbed and is generally crowned in the center of the roadway. Both Segments 51188 and 51050 of Flint Pond about this portion of Route 20, as well as Lake Quinsigamond (MA51125). Although the road is curbed on both sides, there are only a few stormwater drainage features along this stretch of Route 20. There are, however, various outfalls along the sides of the road as observed during field investigation. There is one outfall draining to Segment MA51050. Based on the locations of these outfalls and the topography of the roadway, a portion of Route 20 is considered direct in this assessment.

Route 122
Route 122 is over 1.2 miles away from Segment MA51050 of Flint Pond. Segment MA51050 and Route 122 are separated by several roads, a railroad track, and commercial and residential area. Therefore, Route 122 is considered indirect in this assessment.

Previously Completed Progress Assessment under BMP 7R

The TMDL for phosphorus for Flint Pond addresses the impairment of aquatic plants (macrophytes) and turbidity. Therefore, MassDOT assessed the contribution of phosphorus from MassDOT property directly draining to this water body to address this impairment. The assessment was completed using the approach described in BMP 7R (TMDL Watershed Review).

According to the final *Massachusetts Year 2012 Integrated List of Waters*, non-native aquatic plants and Eurasian water milfoil, myriophyllum spicatum, are non-pollutant stressors ,which indicates that restoration will require measures other than TMDL development and implementation. As a result, MassDOT has concluded that storm water runoff from its roadways does not contribute to these impairments found in Flint Pond.

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled *Total Maximum Daily Loads of Phosphorus for Lake Quinsigamond and Flint Pond* [CN 115] (MassDEP, 2002a) does not specify the breakdown of land use within the watershed. However, the report does provide a figure of the watershed on Page 33. The subbasin with UniqID 23031 in USGS's Massachusetts DS-451 nested subbasins layer is approximately the same as the watershed shown in the TMDL except it includes area downstream of the lower segment of Flint Pond. Therefore, MassDOT re-delineated this subbasin to eliminate this area, and used the resulting basin and MassGIS's Land Use layer to determine the breakdown of land use areas within the watershed. The land uses of commercial, industrial, residential, and transportation (an area of approximately 6,735 acres) were used in the calculations described below. The TMDL report does not list the current phosphorus loading and target phosphorus loading based on land use. Instead, it lists loadings for five sources including atmosphere, base flow, storm flow, and two NPDES-permitted point sources (see page 16 of the TMDL report). The current and target phosphorus loadings reported for Storm Flow were used for the calculations.

Existing BMPs from Progress Report

There are no existing BMPs within MassDOT's directly contributing watershed to Flint Pond that are mitigating potential stormwater quality impacts. Therefore, no effective IC reduction is currently provided.

Target Reduction from Progress Report

In the progress report, MassDOT calculated its current TP loading rate (3.4 lb/yr) and its target TP WLA (0.4 lb/yr) using values provided in MassDEP's TMDL report and USGS and MassGIS datalayers. The difference between these two values represents the target reduction in TP that MassDOT will aim to achieve to comply with the WLA. For the watershed directly contributing to Flint Pond, this target reduction is 3.0 lb/yr, or 88%.

Final Assessment

Updated Target Reduction

After the submittal of the progress report, further investigation of MassDOT's directly contributing IC area was performed by the designers. Based on additional detailed field review and MassDOT Layout and Construction Plan review, the MassDOT Directly Contributing Watershed was updated

to 2.4 acres. The review of the MassDOT Layout and Construction Plans required an adjustment to the right of way width. The target reduction required was also updated to 2.8 lb/yr.

Existing and Proposed BMPs

The designer's investigation confirmed that there are no existing BMPs for Flint Pond. During the investigation, it was determined that the MassDOT Route 20 ROW is eighty (80) feet wide and consists of two 12' wide travel lanes, two 10' wide shoulders, a 6' to 9' wide sidewalk in each direction as well as a significant number of curb cuts for local roadways, residents and businesses. This limits the available ROW shoulder area for the construction of stormwater BMPs, Due to site constraints and the limitations of the retrofit initiative, the construction of a BMP for the treatment of directly contributing area is not feasible for this segment.

Conclusions

MassDOT evaluated its property within the directly contributing watershed to Segment MA51050 of Flint Pond to identify existing BMPs. This assessment of Flint Pond has shown that MassDOT has no existing BMPs in place, and therefore, discharges stormwater directly to Flint Pond without providing treatment. MassDOT reviewed their property and determined that, due to the lack of available space within right of way, the placement of a BMP for the treatment of directly contributing impervious cover is not feasible under the Retrofit Initiative.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative. Work on Programmed Projects often includes broader scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

References

MassDEP. (2002a). Total Maximum Daily Loads of Phosphorus for Lake Quinsigamond and Flint Pond. Available at: MADEP 2002a TMDL of Phosphorus for Lake Quinsigamond and Flint Pond

MassDEP. (2002b). Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes. Available at: MADEP 2002b TMDL of Phosphorus for Selected Northern Blackstone Lakes

Massachusetts Department of Environmental Protection (MassDEP). (2010). Blackstone River Watershed 2003-2007 Water Quality Assessment Report. Retrieved from: MassDEP 2012 Blackstone River Watershed 2003-2007 Water Quality Assessment Report

Massachusetts Department of Environmental Protection (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. Retrieved from: MADEP 2013 MA Year 2012 Integrated List of Waters

Massachusetts Department of Transportation (MassDOT). (June, 2013). MassDOT Semi Annual Submittal under MassDOT's Impaired Waters Program.

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Impaired Waters Assessment for Blackstone River (MA51-04) Including Former Segments Rice City Pond (51131) and Riverdale Impoundment (51136) – Final Report

Introduction

Blackstone River (MA51-04) was previously assessed in a progress report titled, *Impaired Waters Assessment for Blackstone River (MA51-04) Including Former Segments Rice City Pond (51131) and Riverdale Impoundment (51136) – Progress Report*, submitted on 6/8/2013. The progress report stated that MassDOT would work with designers to implement BMPs in order to meet its target reduction of impervious cover (IC). After further review by the design consultants, it was confirmed that the target reduction percentage was 16.3%. This report presents a summary of the findings of the progress report as well as a final assessment which includes the reduction provided by existing BMPs and the final target IC reduction determined during the Designer's comprehensive investigation.

Summary of Progress Report

Impaired Waterbody

Name: Blackstone River including former segments Rice City Pond, and Riverdale Impoundment

Location: Grafton, Northbridge and Uxbridge, MA

Water Body IDs: MA51-04, MA51131, and MA51136

Impairments

The Blackstone River (MA51-04) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*. The Blackstone River is impaired for the following designated uses: aesthetics, fish consumption, fish, other aquatic life and wildlife habitat, primary contact recreation, and secondary contact recreation. The causes of these designated use impairments are listed as the following chemical, physical, and biological characteristics:

- aquatic macroinvertebrate bioassessments
- cadmium
- copper
- lead
- nutrient/eutrophication biological indicators
- (other flow regime alterations*)

- PCB(s) in fish tissue
- (physical substrate habitat alterations*)
- sedimentation/siltation
- taste and odor
- turbidity
- phosphorus (total)
- fish bioassessments
- Escherichia coli
- DDT
- Excess algal growth

Site Description

The MA51-04 segment of the Blackstone River is 8.8 miles long and extends from the Fisherville Dam in Grafton to the outlet of Rice City Pond (MA51131) in Uxbridge. Rice City Pond (MA51131) and Riverdale Impoundment (MA51136) are considered run-of-river impoundments along the Blackstone River since their estimated retention times are less than one day (MassDEP, 2010). Water quality assessments prior to 2010 listed these water bodies separately.

State Route 122 is situated along the Blackstone River (MA51-04) throughout this reach of the river. There are many areas of Route 122 with stormwater sewers that discharge directly to tributary streams that are in close proximity to the Blackstone River. There are also many sections of roadway that discharge to low-lying areas that do not appear to have established outlets. The soils along Route 122 in the Blackstone River (MA51-04) subwatershed are primarily classified as hydrologic soil group (HSG) type A or B, so infiltration of stormwater runoff from Route 122 is likely occurring at many outfall locations. As a result, there are many sections of Route 122 that are not considered to be directly discharging to the Blackstone River because roadway runoff appears to be naturally infiltrating near the outfalls.

MassDOT's property that directly contributes stormwater runoff to the Blackstone River (MA51-04) consists of approximately 2.27 miles (7.8 acres) of Route 122 and approximately 2,870 square feet of the Route 122A/Main Street bridge over the Blackstone River. The northernmost segment of Route 122 that directly discharges to the Blackstone River extends from approximately 0.44 miles north to approximately 0.16 miles south of the Route 122 and Route 122A/Main Street intersection in Grafton. The northern 0.37 miles of this road segment drains via catch basins and storm drains that discharge directly to a channelized tributary stream that flows into the Blackstone River within 0.27 miles of this point. The southern 0.23 miles of this road segment drains via catch basins and storm drains to three outfalls that are assumed to daylight adjacent to the Blackstone River, though due to private property access and lack of drainage plans for this area, this assumption could not be confirmed.

A 0.48-mile segment of Route 122 that directly contributes runoff to the Blackstone River is situated between approximately 325 feet northwest of the King Street intersection and 380 feet southeast of the Milford Road intersection with Route 122**.** This road area drains via catch basins and storm drains that discharge directly into a tributary stream that flows approximately 0.25 miles from Route 122 to the Blackstone River.

Approximately 0.62 miles of Route 122 from Mahoney Lane to approximately 500 feet southeast of Wards Lane in Northbridge drain via catch basins and storm drains to three outfalls. The northwestern 0.40 mile portion of this Route 122 segment is assumed to drain into the culvert that conveys a tributary stream under the road. The tributary stream flows into the Blackstone River approximately 450 feet from Route 122. The two outfalls on the southeastern portion of this

segment of Route 122 discharge to forested areas within 40 feet of the Blackstone River. Some points of concentrated overbank flow also exist along this road segment.

MassDOT property in Northbridge includes the Route 122 bridge over the Blackstone River that is approximately 0.32 miles south of the center of Northbridge. This bridge is in the process of being rebuilt. It is assumed that drainage from this bridge will be a direct discharge to the Blackstone River. MassDOT does not own the 0.77 mile portion of Route 122 within the center of the village of Northbridge.

Approximately 0.45 miles of Route 122 from Dudley Avenue to the intersection with Church Street is drained by catch basins and storm drains. Details of this storm drainage system could not be derived from available drawings. Observations of pipe inverts indicate the 1.5-acre area of this road segment drains north to an outfall pipe that discharges to a highly eroded drainage channel. This channel appears to lead to the Blackstone River within 0.25 miles of Route 122.

Drainage from other segments of Route 122 within the Blackstone River (MA51-04) watershed were identified and evaluated for their potential direct contribution to the Blackstone River. Road segments not described above were considered not directly contributing stormwater runoff to the Blackstone River, thus were not included in the calculations of MassDOT property subject to pollutant load reduction.

Previously Completed Progress Assessment under BMP 7U

None of the following impairments for the Blackstone River have been addressed by a TMDL. Therefore, MassDOT assessed the impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- nutrient/eutrophication biological indicators
- sedimentation/siltation
- turbidity
- metals (cadmium, copper, and lead)
- aquatic macroinvertebrate bioassessments
- taste and odor

According to MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*, the impairment of physical substrate habitat alterations and other flow regime alterations are not caused by pollutants (MassDEP, 2013). Therefore, these impairments are not considered further.

MassDOT concluded that the impairment for PCB(s) in fish tissue and DDT are unrelated to stormwater runoff, as addressed in the August 2012 Progress Report submittal. Therefore, these impairments are not considered further.

The impairment for fecal coliform was assessed separately for pathogen impairments.

Existing BMPs from Progress Report

There are no existing BMPs in the Blackstone River (MA51-04) directly contributing watershed that are mitigating potential stormwater quality impacts prior to discharge to the Blackstone River. Therefore, no effective IC reduction is currently provided.

Target Reduction from Progress Report

In the progress report, MassDOT derived the following site parameters and target reduction for DOT's directly contributing watershed draining to the Blackstone River (MA51-04) using the IC Method:

Table 1. Target IC Reduction – Progress Report

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	7.8	acres
Target Percent Reduction in Effective IC	16	%
Target reduction in Effective IC	1.3	acres
IC Effectively reduced by Existing BMPS	0	acres
IC Remaining to Mitigate with Proposed BMPs	1.3	acres

Final Assessment

Updated Target Reduction

After the submittal of the progress report, further investigation of MassDOT's directly contributing IC area was performed by the designers. Based on additional detailed field review and MassDOT Layout and Construction Plan review, the MassDOT Directly Contributing IC Watershed was updated from 7.8 acres to 6.3 acres. Thus, the target reduction of impervious cover, 16% of this IC watershed, was also updated by the designers from 1.3 acres to 1.0 acres based on these more in-depth field evaluations. See Table 2 below.

Table 2. Target IC Reduction – Designer Investigation

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	6.3	acres
Target Percent Reduction in Effective IC	16	%
Target Reduction in Effective IC	1.0	acres
IC Effectively Reduced by Existing BMPs	0	acres
IC Remaining to Mitigate with Proposed BMPs	1.0	acres

Existing and Proposed BMPs

The designer's investigation confirmed that there are no existing BMPs for Blackstone River (MA51-04). During the investigation, it was determined that the MassDOT Route 122 ROW is generally fifty (50) feet wide and consists of two 12' wide travel lanes, two 4' wide shoulders, a 4' wide sidewalk in varying locations as well as a number of curb cuts for local roadways, residents and businesses. This limits the available ROW shoulder area for the construction of stormwater BMPs,

Due to site constraints and the limitations of the Retrofit Initiative, the construction of a BMP for the treatment of directly contributing impervious cover is not feasible.

Conclusions

MassDOT owned roadways within the Blackstone River segment MA51-04 were investigated and approximately 6.3 acres of MassDOT impervious cover contributes stormwater directly to the Blackstone River. There are currently no existing BMPs associated with direct discharges from MassDOT property into the Blackstone River segment MA51-04. MassDOT reviewed their property and determined that, due to the lack of available space within right of way, the placement of a BMP for the treatment of directly contributing impervious cover is not feasible under the Retrofit Initiative.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative. Work on Programmed Projects often includes broader scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

References

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Impaired Waters Assessment for Blackstone River (MA51-06) – Final Report

Introduction

Blackstone River (MA51-06) was previously assessed in a progress report titled, *Impaired Waters Assessment for Blackstone River (MA51-06) – Progress Report*, submitted on 6/8/2013. The progress report stated that MassDOT would work with designers to implement BMPs in order to meet its target reduction of impervious cover (IC). After further review by the design consultants, it was verified that approximately 5.5 acres of stormwater from MassDOT property discharges directly to the Blackstone River. This report presents a summary of the findings of the progress report as well as a final assessment which includes the reduction provided by existing BMPs and the final target IC reduction determined during the Designer's comprehensive investigation.

Summary of Progress Report

Impaired Waterbody

Name: Blackstone River

Location: Millville and Blackstone, MA

Water Body ID: MA51-06

Impairments

The Blackstone River (MA51-06) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013*)*. The Blackstone River is impaired for the following designated uses: aquatic life, fish consumption, primary contact recreation, secondary contact recreation, and aesthetics. The causes of these designated use impairments are listed as the following chemical, physical, and biological characteristics:

- lead
- phosphorus (total)
- total suspended solids (TSS)
- copper
- cadmium
- PCB(s) in fish tissue
- (other flow regime alterations*)
- DDT

Site Description

The MA51-06 segment of the Blackstone River is approximately 3.8 miles long and extends from the railroad trestle due north of Collins Drive in Millville to the Rhode Island border west of Route 122 (Main Street) in Blackstone. This segment of the Blackstone River flows southeast from Millville and becomes impounded by the Tupperware Dam in Blackstone to form Millville Pond. The river is directed northeast to the Milliville Pond Impoundment through a power canal where it is used to generate hydropower by Synergics Hydropower. A portion of the Blackstone River is by-passed around the Tupperware Dam into the native channel that flows south into Rhode Island. The eastern portion of this segment of the Blackstone River flows along the southern side of Main Street in Blackstone into Rhode Island.

The subwatershed for this segment of the Blackstone River is approximately 2.86 square miles. MassDOT's property that directly contributes stormwater runoff to the Blackstone River (MA51-06) consists of approximately 1.39 miles (4.7 acres) of Route 122. The directly contributing areas are described from north to south as follows:

Direct Drainage Area 1 – Route 122

Direct Drainage Area 1 is approximately 0.90 acres of Route 122 between 0.17 and 0.45 miles west of the western bridge over the Blackstone River in Blackstone, MA. This area discharges from two outfalls directly into the Blackstone River. The eastern portion of this drainage area is relatively flat and properties on the southern side Route 122 appear to receive some runoff which likely discharge directly to the Blackstone River since much of the area along this side of the road is impervious. This impervious drainage area consists of 0.9 acres of MassDOT roadway.

Direct Drainage Area 2 – Route 122

Stormwater runoff from approximately 880 feet of Route 122 west of the western bridge over the Blackstone River drains to a wetland that is adjacent to Blackstone River. There is considerable erosion along the roadside directly into the wetland area. The wetland likely provides some removal of pollutants to the Blackstone River, but due to its apparent hydraulic connection to the Blackstone River this drainage area is considered to be direct. This impervious drainage area consists of 0.5 acres of MassDOT roadway.

Direct Drainage Area 3 – Route 122

Stormwater runoff from Route 122 between the two bridges over the Blackstone River in Blackstone appears to discharge from the 36" outfall located in the abutment of the western bridge directly into the Blackstone River. Drainage drawings for much of this area are not available, but catch basins along this road segment were confirmed during the site visit. No other outfalls were identified during the site visit. This impervious drainage area consists of 1.2 acres of MassDOT roadway.

Direct Drainage Area 4 – Route 122

Approximately 0.33 miles of Route 122 from the eastern bridge over the Blackstone River east to Bridge Street is curbed and is drained via catch basins and a storm drain. Based on the topography in this area, and the presence of storm drains along Bridge Street and 1st Avenue, this portion of Route 122 is presumed to discharge directly to the Blackstone River. Drainage drawings are not available for this area. This impervious drainage area consists of 1.5 acres of MassDOT roadway.

Direct Drainage Area 5 – Route 122

Direct Drainage Area 5 is an approximately 0.36 mile segment of Route 122 from the Rhode Island border to St. Paul Street. This road segment is curbed, and based upon available drainage drawings stormwater runoff from this area directly discharges from three outfalls directly into the Blackstone River. This impervious drainage area consists of 1.4 acres of MassDOT roadway.

Previously Completed Progress Assessment under BMP 7U

None of the following impairments for the Blackstone River have been addressed by a TMDL. Therefore, MassDOT assessed the impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- metals (cadmium, copper, and lead)
- phosphorus (total)
- total suspended solids (TSS)

According to MassDEP's final *Massachusetts Year 2012 Integrated List of Waters*, the impairment of other flow regime alterations is not caused by pollutants (MassDEP, 2011). Therefore, this impairment is not considered further.

MassDOT concluded that the impairment for PCB(s) in fish tissue and DDT are unrelated to stormwater runoff, as addressed in the December 2012 Progress Report submittal. Therefore, these impairments are not considered further.

The impairment for fecal coliform was also assessed separately as a pathogen impairment.

Existing BMPs from Progress Report

There are no existing BMPs in the Blackstone River (MA51-06) directly contributing watershed that are mitigating potential stormwater quality impacts prior to discharge to the Blackstone River. Therefore, no effective IC reduction is currently provided.

Target Reduction from Progress Report

In the progress report, MassDOT derived the following site parameters and target reduction for DOT's directly contributing watershed draining to the Blackstone River (MA51-06) using the IC Method:

Table 1. Target IC Reduction – Progress Report

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	5.5	acres
Target Percent Reduction in Effective IC	34.8	%
Target Reduction in Effective IC	1.9	acres
IC Effectively Reduced by Existing BMPs	0	acres
IC Remaining to Mitigate with Proposed BMPs	1.9	acres

Final Assessment

Updated Target Reduction

After the submittal of the progress report, further investigation of MassDOT's directly contributing IC area was performed by the designers. Based on this investigation, the MassDOT Directly Contributing IC Watershed remained to be 5.5 acres. Thus, the target reduction of impervious cover, 34.8% of this IC watershed, also remained 1.9 acres based on these more in-depth field evaluations. See Table 2 below.

Table 2. Target IC Reduction – Designer Investigation

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	5.5	acres
Target Percent Reduction in Effective IC	35	%
Target Reduction in Effective IC	1.9	acres
IC Effectively Reduced by Existing BMPs	0	acres
IC Remaining to Mitigate with Proposed BMPs	1.9	acres

Existing and Proposed BMPs

The designer's investigation confirmed that there are no existing BMPs for Blackstone River (MA51-06). During further investigation it was determined that the MassDOT Route 122 ROW is generally fifty (50) feet wide and consists of two 12' wide travel lanes, two varying width (2' to 8') shoulders, a varying width (4' to 8') sidewalk in one or both directions as well as a significant number of curb cuts for local roadways, residents and businesses, This limits the available ROW shoulder area for the construction of stormwater BMPs. Therefore, due to site constraints and the limitations of the Retrofit Initiative, the construction of a BMP for the treatment of directly contributing impervious cover is not feasible for this segment.

Conclusions

MassDOT owned roadways within the Blackstone River segment MA51-06 were investigated and approximately 5.5 acres of MassDOT impervious cover contributes stormwater directly to the Blackstone River. There are currently no existing BMPs associated with direct discharges from MassDOT property into the Blackstone River. MassDOT reviewed their property and determined

that, due to the lack of available space within right of way, the placement of a BMP for the treatment of directly contributing impervious cover is not feasible under the Retrofit Initiative.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative. Work on Programmed Projects often includes broader scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

References

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

Summary

		Stormwater	Non-Stormwater[2]
Impaired Water[1]	**Impairments:**	Aquatic macroinvertebrate bioassessments, dissolved oxygen, fecal coliform	Physical substrate alterations
	Category:	5 (Waters requiring a TMDL)	
	Final TMDLs:	None	
	WQ Assessment:	Boston Harbor 1999 Water Quality Assessment Report[3]	
Location	**Towns:**	Braintree	
	MassDOT Roads:	Route 3, Route 37 (Washington Street & Hancock Street), Plain Street	
Assessment Method(s)	**7R (TMDL Method)**	☐	
	7U (IC Method)	☒	
BMPs	**Existing:**	2 Infiltration Basins	
	Proposed:	5 Infiltration Basins, 1 Infiltration Trench	

	Impervious Cover (acres)	
	Progress Report[4]	Final Report
MassDOT Contributing Area and Targets		
Directly Contributing Area	26.9	31.5
Contributing Area Reduction Target	19.5	22.9
Existing BMPs Reduction	2.9	4.5[5]
Proposed BMPs Reduction	n/a	9.6
Remaining Reduction to Meet Target	16.6	14.7

[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] 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

[3] MassDEP, 1999. Boston Harbor 1999 Water Quality Assessment Report. Available at http://www.mass.gov/dep/water/resources/70wqar1.pdf

[4] MassDOT, December 2011, Impaired Waters Assessment for Monatiquot River (MA74-08) – Progress Report Available at http://www.mhd.state.ma.us/downloads/projDev/Year2_ImpairedWatersAssessment_1.pdf

[5] The design proposes enhancing existing BMPs to provide additional treatment and therefore existing and proposed treatment is not additive since enhanced basins are also included in Proposed Treatment calculation.

MassDOT previously performed an initial progress report assessment of Monatiquot River (MA74-08) which was submitted to EPA on 12/8/2011. The progress report summarizes the MassDOT roadways directly draining to the receiving water and calculates a target pollutant removal rate, based on assessment methodologies developed as part of MassDOT's Impaired Waters Program, to address pollutants from the roadway which are potentially entering the stream/ lake. The next step was for MassDOT to work with its design consultant to implement BMPs and MassDOT has since initiated the design. This report presents a summary of any changes in drainage areas (and thus target reductions) determined during the more detailed review, identifies the reductions provided by the proposed BMPs and summarizes the progress towards meeting the overall target.

Site Description

The Impaired Waters Assessment Progress Report includes an analysis of the subwatershed for Monatiquot River, using MassDOT's IC Method, to provide a quantitative value to the amount of additional stormwater retrofits needed to meet the targeted impervious cover of 9 percent[6] within the MassDOT roadway drainage areas. During this assessment the designer identified minor revisions to the progress report targets as reflected in the Summary Table. In addition, revisions to the specific BMPs assessed are included in the summaries provided for each BMP.

In the progress report, the subwatershed for Monatiquot River was estimated to be 3,131 acres, of which 1,029 acres (32.9 percent of the subwatershed) are considered to be comprised of impervious surfaces. To reduce the effective IC within the subwatershed to 9 percent or less, 747 acres of effective IC, representing 72.6 percent of the existing impervious area, would need to be reduced through stormwater BMP measures. Applying this same percentage to the approximately 31.5 acres of MassDOT roadway area that was identified as directly draining to Monatiquot River, suggests that approximately 22.9 acres of effective IC would need to be reduced.

The approximate 31.5 acres of MassDOT roadway that discharges directly to Monatiquot River is associated with Route 3, Route 37, and Plain Street. In general, runoff from these surfaces is collected in drainage structures (catch basins, drop inlets) that discharge directly to the river, in some cases via drainage ditches in the roadway shoulder.

Existing BMPs

The designer performed further investigation of the Monatiquot River (MA74-08) watershed and found that two of the previously identified locations do not act as BMPs.

The designer found upon field verification that the topographic relief at BMP 3 does not provide stormwater treatment prior to discharge due to the absence of outlet control measures. The designer also found that EX BMP4 does not provide stormwater treatment due to lack of outlet control. EX BMP1 and EX BMP2 function as described in the progress report. Pollutant removals for EX BMP1 and 2 have been included in the impervious cover reduction computations. No additional existing BMPs treat roadway runoff before reaching the impaired water segment.

[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

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 Monatiquot River (MA74-08) using the methodologies described below.

MassDOT has identified a subset of water body impairments in the Monatiquot River Watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for the Monatiquot River include physical substrate alterations**.** 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.[7]

BMP 7U for Impervious Cover Related Impairments

As discussed in more detail in the progress report, MassDOT used the approach outlined in the Description of MassDOT's Application of Impervious Cover method in BMP 7U as a basis for this assessment. The methodology concludes that when a watershed has less than 9% impervious cover (IC), stormwater is not likely the cause of the impairment. MassDOT used the long-term continuous simulation model (the assessment model)[8] to estimate effective IC.

MassDOT assessed Monatiquot River (MA74-08) using the methodologies described in the progress report. Due to additional information identified during design, the designer updated the existing conditions assessment model to estimate the effective IC of the MassDOT contributing drainage areas. The table below shows the updated existing BMPs, their MassDOT drainage areas and effective IC reductions. The output from the model showing effective IC analysis for existing BMPs is attached.

The designer revised the directly discharging area (Figure 2) from those included in the Progress Report since they found that the directly discharging area is larger than previously determined. The additional discharging area is located south of the Monatiquot River crossing on Route 3.

MassDOT Directly Contributing Watershed

	Progress Report	Final Report
Directly Contributing Area	n/a	40.3 acres
Directly Contributing IC Area	26.9 acres	31.5 acres
Percent Impervious	n/a	78.2%
Target Effective IC Reduction (72.6% Reduction of DOT Directly Contributing IC)	19.5 acres	22.9 acres
Target Effective IC	n/a	56.7 %

[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] MassDOT, June 2012. Long-Term Continuous Simulation for Pollutant Loading and Treatment for MassDOT Impaired Waters Program. Available at: http://www.mhd.state.ma.us/downloads/projDev/ImpairedWaters_2/Attachment7.pdf

Existing Conditions

BMP Name	BMP Type	Contributing Effective IC (acres)	Estimated % Reduction	Estimated Reduction Effective IC (acres)
Ex BMP 1	Infiltration Basin	1.6	218%	3.6
EX BMP 2	Infiltration Basin	0.2	863%	1.6
Total*		**31.5**	**14%**	**4.4**

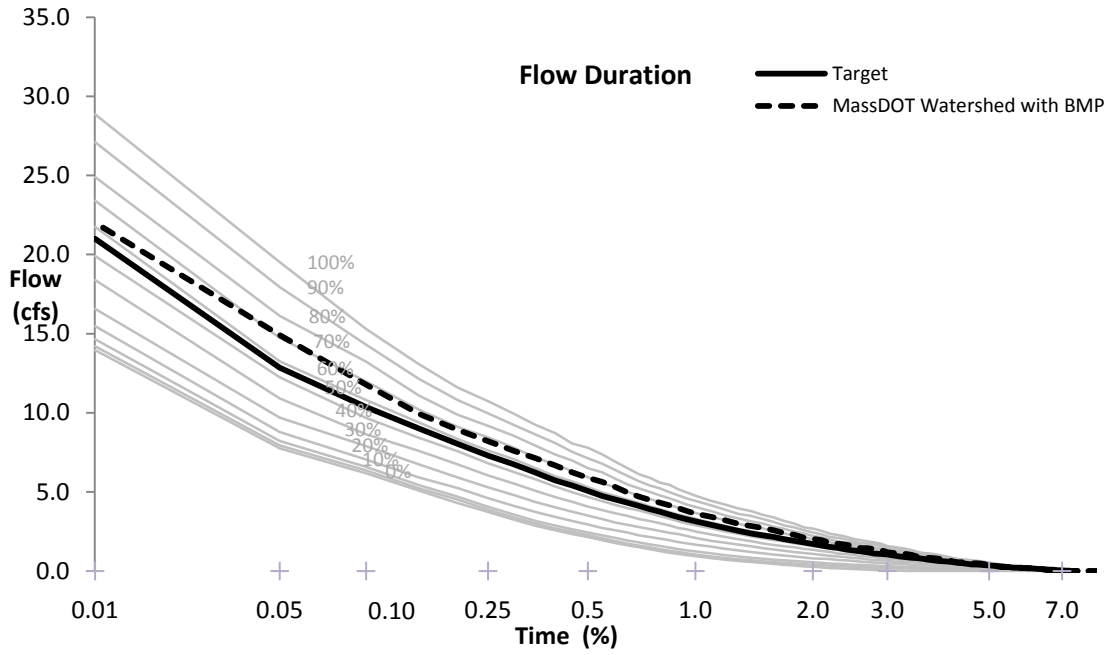
* Total Effective IC reduction based on the assessment model results for the total MassDOT directly discharging drainage area to the receiving water (not sum of individual BMP reductions).

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

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

Existing Median Annual Load Comparisons

Simulated IC Watersheds	Runoff (ac-ft)	Phos. (lb.)	TSS (lb.)
0%IC	29	2	142
5%IC	34	3	697
10% IC	39	5	1,479
20% IC	49	10	4,086
30% IC	59	18	8,337
40% IC	69	28	14,074
50% IC	79	41	21,084
Target (56% IC)	**85**	**49**	**25,683**
60% IC	88	54	28,750
70% IC	98	68	36,492
80% IC	108	81	44,209
90% IC	118	95	51,734
100% IC	127	108	59,389
Conditions without BMPs	107	72	38,424
Conditions with Existing BMPs	96	68	36,972
Reduction %	**10%**	**4%**	**4%**
Effective IC	**68%**	**71%**	**71%**



Effective IC Results

Existing IC	31.5 acres
Estimated Effective IC with Existing BMPs	27.1 acres
IC Reduction % with Existing BMPs	14%
Estimated Effective IC*	68%

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

Under existing conditions, MassDOT's estimated effective IC continues to exceed the target as described above. To mitigate the effects of IC, MassDOT will implement stormwater BMPs to the maximum extent practical given site constraints with the goal of meeting the target reduction.

This assessment has identified locations for potential stormwater BMPs and estimated the effective IC and pollutant treatment accounting for their treatment. The Proposed Mitigation Plan section describes the BMPs and their target reduction performance.

Proposed Mitigation Plan

In this assessment, MassDOT has identified six stormwater BMPs that may be implemented on MassDOT property to mitigate the effective IC to address the Monatiquot River impairments. These BMPs include five infiltration basins and one infiltration trench, shown with their estimated contributing drainage areas in Figure 3. These locations were chosen based on a thorough

review of the drainage systems, topography, property lines, soils evaluation and other site constraints. Below is a description of these proposed BMPs.

PR BMP 1 & 2 (Enhanced EX BMP1 and EX BMP2)
Infiltration Basins 1 and 2 are proposed modifications to existing BMPs 1 and 2 and are located in the infield of the Route 3/Union Street Interchange. They each take pavement from the interchange. Additional stormwater will be directed to Basin 1 via a paved waterway and two flared sections and Basin 2 via a paved waterway and a flared end sections compared to existing conditions. Soils in Basin 1 are classified as silty clay loam and in Basin 2 as clay, consistent with their behavior as vegetated wetlands.

PR BMP 6, 7 & 9
Infiltration Basins 6, 7 and 9 are located between the Union Street Ramps and Route 3 on both the Northbound and Southbound sides of the highway. They each take pavement flows from Route 3 Northbound and Southbound including six lanes, two 10-foot shoulders and 12-feet of paved median. Stormwater will enter each basin via flared end sections. Soils in Basin 6 are classified as loam, in Basin 7 and 9 as sandy loam based on field explorations.

PR BMP 8
Infiltration Trench 8 is located between the Southbound off ramp to Union Street and Route 3. It takes pavement flows from Route 3 Northbound and Southbound including six lanes, two 10-foot shoulder and 12-feet of paved median. Stormwater will enter the trench via a new manhole which redirects flows from an existing 12-inch drain line. Soils in Trench 8 are classified as sandy loam.

The table below shows the proposed conditions, including BMPs with their MassDOT drainage areas and effective IC reductions. The outputs from the assessment model showing effective IC analysis for each BMP are attached.

Proposed Conditions

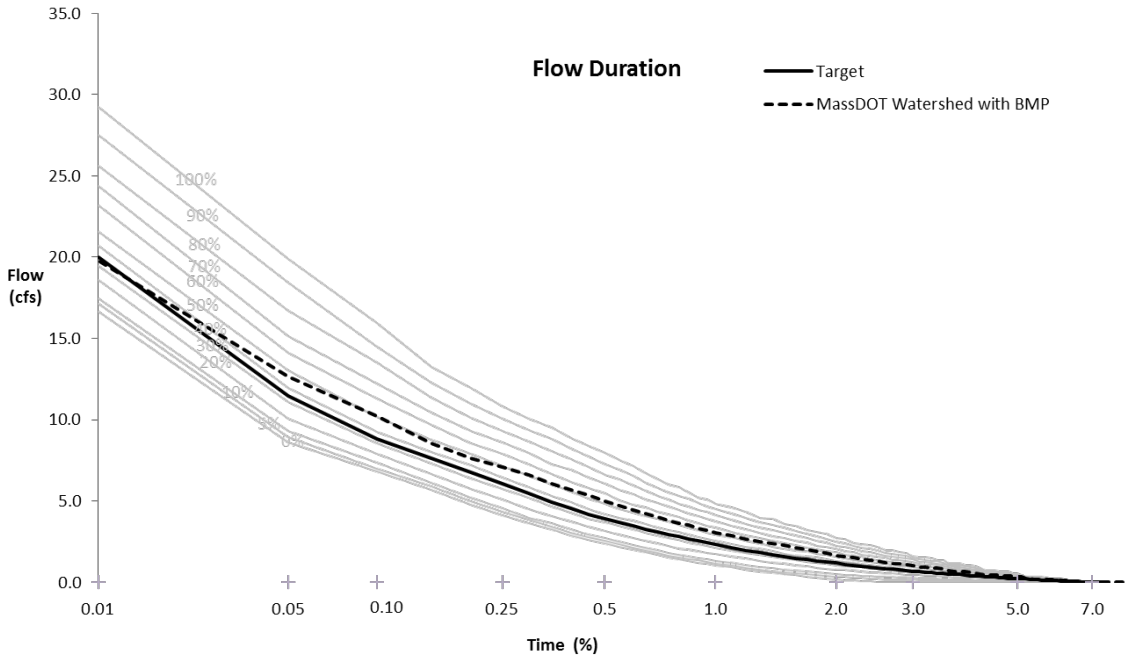
Watershed	BMP Type	Contributing Effective IC (acres)	Estimated Percent Reduction	Estimated Reduction Effective IC (acres)
PR BMP 1*	Infiltration Basin	3.0	170%	5.1
PR BMP 2*	Infiltration Basin	1.1	241%	2.7
PR BMP 6	Infiltration Basin	0.6	77%	0.5
PR BMP 7	Infiltration Basin	0.8	104%	0.8
PR BMP 9	Infiltration Basin	1.2	81%	1.0
PR BMP 8	Infiltration Trench	0.8	70%	0.6
Total**		**31.5**	**30%**	**9.6**
Target				**22.9**

* Enhanced existing condition BMPs.
** Total effective IC and phosphorus load reduction based on the assessment model results for the total MassDOT directly discharging drainage area to the receiving water (not sum of individual BMP reductions).

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

Proposed Median Annual Load Comparisons

Simulated IC Watersheds	Runoff (ac-ft)	TP (lb.)	TSS (lb.)
0%IC	31.3	2.3	153
5%IC	36.3	7.7	3,178
10% IC	41.3	12.9	6,236
20% IC	51.2	23.7	12,350
30% IC	61.1	34.7	18,465
40% IC	71.0	45.7	24,579
50% IC	80.7	56.7	30,694
Target 56% IC	**86.4**	**63.2**	**34,363**
60% IC	90.3	67.6	36,808
70% IC	99.9	78.6	42,923
80% IC	109.6	89.6	49,038
90% IC	119.7	100.5	55,152
100% IC	129.7	111.5	61,294
Existing Conditions	96	68	36,972
Proposed Conditions	82.4	39.5	36,680
Reduction %	**14%**	**1%**	**1%**
Effective IC	**52%**	**60%**	**60%**



Effective IC Results

Existing IC	31.5 acres
Proposed Estimated Effective IC	21.9 acres
IC Reduction % under Proposed Conditions	30%
Estimated Effective IC*	54%

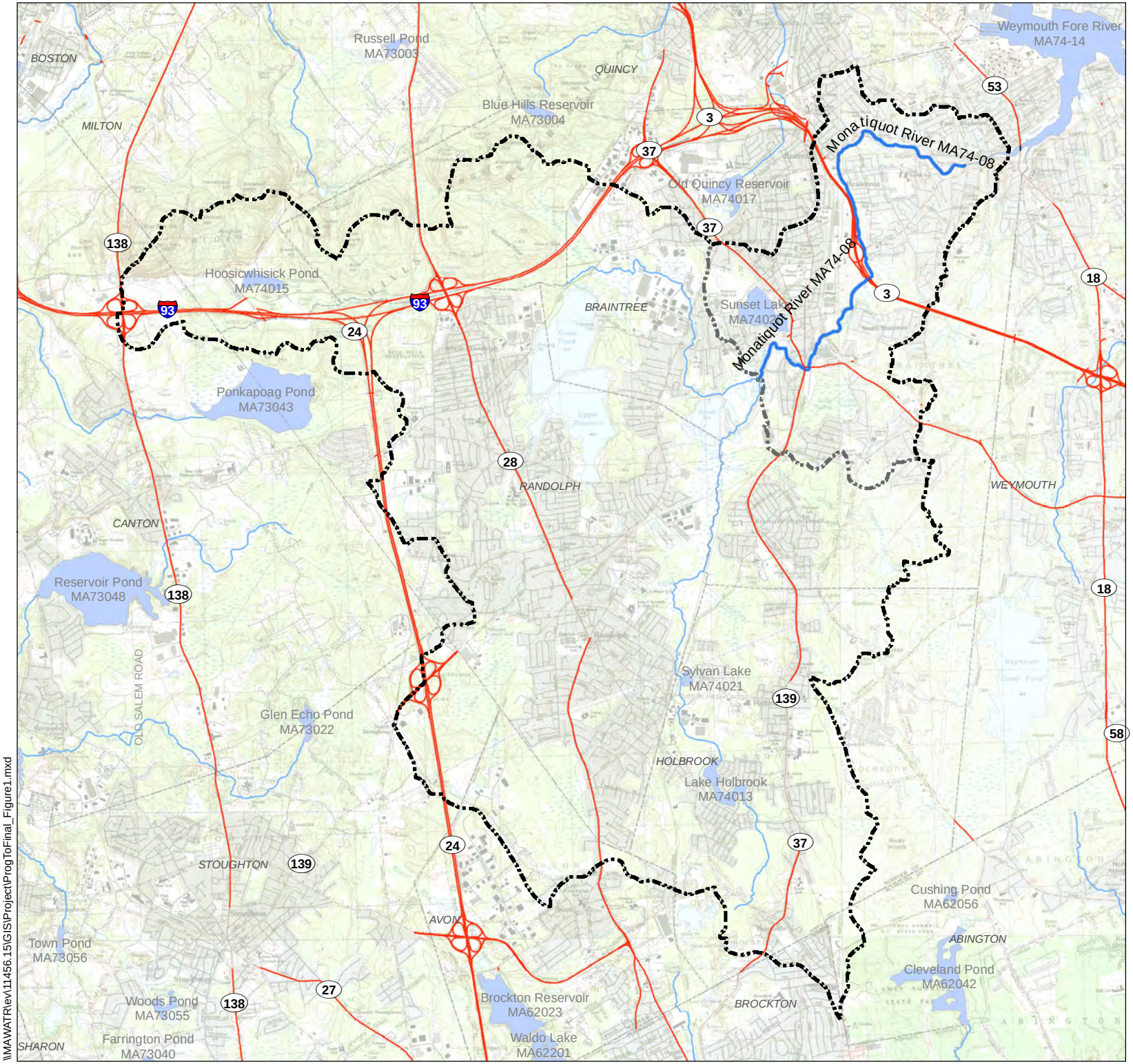
*Average of estimated effective IC for annual median runoff volume, phosphorus and TSS loads, and flow duration

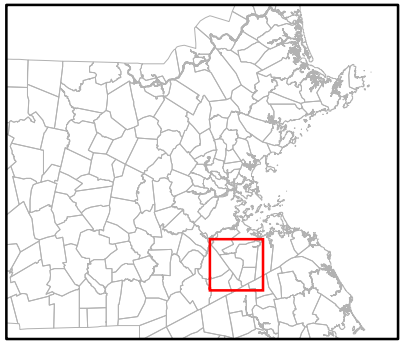
MassDOT estimated the effective IC under proposed conditions by comparing the annual median runoff volume, phosphorus and TSS loads, and flow distribution statistics (flow duration) from MassDOT drainage area to the receiving water to those results for simulated IC watersheds.

MassDOT has designed BMPs to address the target reduction as part of MassDOT's Impaired Waters Program Retrofit Initiative. The proposed project includes five infiltration basins and infiltration trench. The design plans for these proposed BMPs were completed and successfully permitted with the approval by the Town of Braintree Conservation Commission. The installation of additional BMPs within the Monatiquot River subwatershed to provide further treatment was not achievable due to varying site constraints. During design the consultant determined that site topography, existing utilities, wetland resource areas, and inability to convey water to potential BMP areas reduced the area available for construction. The BMPs do not fully meet the IC target.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of the Monatiquot 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 annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs and finalized assessments including reduction achieved by finalized BMP designs.





Assessed Segment

Total Watershed

Subwatershed

MassDOT Roadways in Urban Area

MassDOT Roadways

Impaired Lakes

Impaired Streams

N

0 3,000 6,000 Feet

1 inch = 6,000 feet

Figure 1

Monatiquot River (MA74-08) Watersheds

December 2013

massDOT Massachusetts Department of Transportation Highway Division

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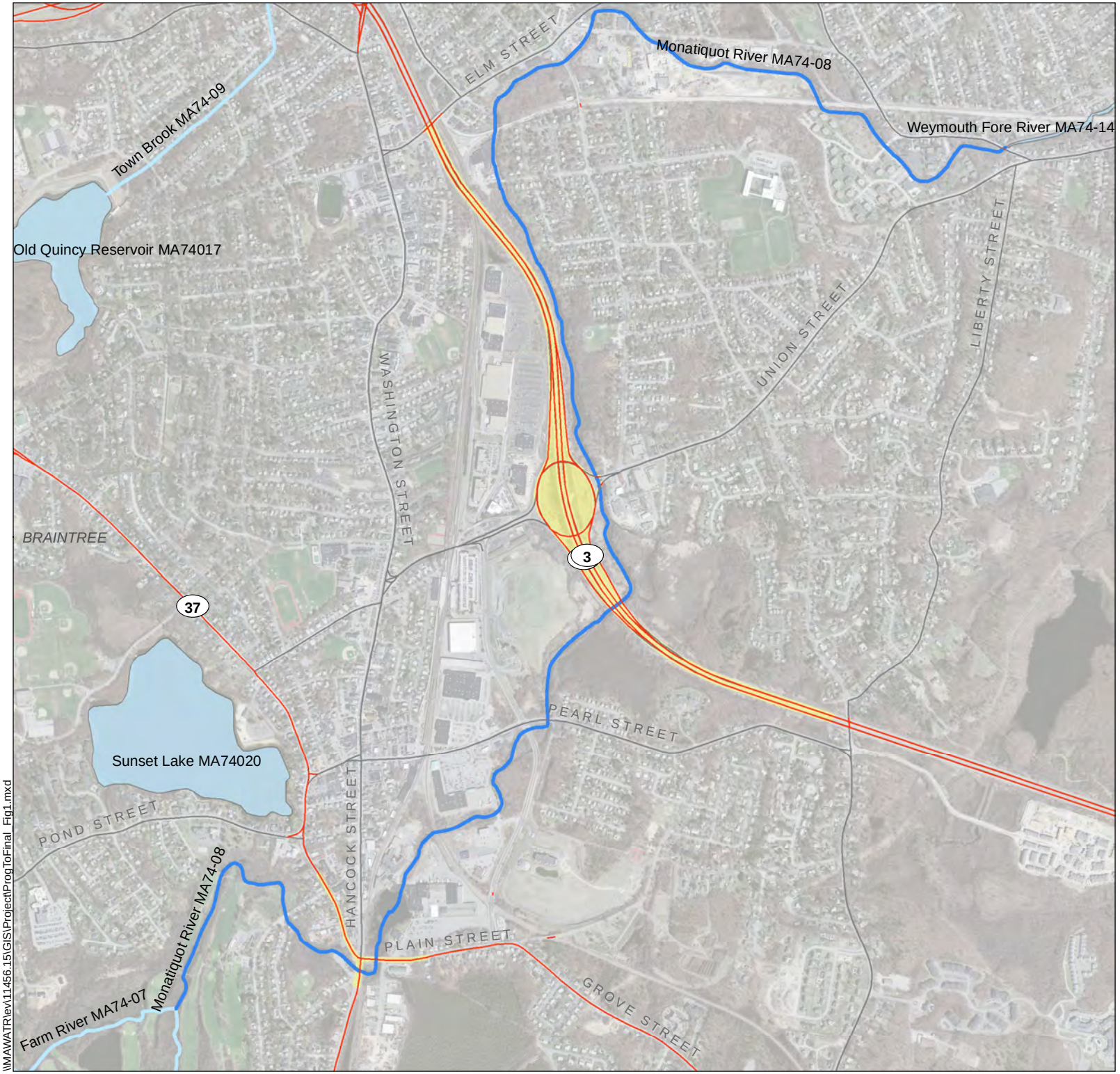

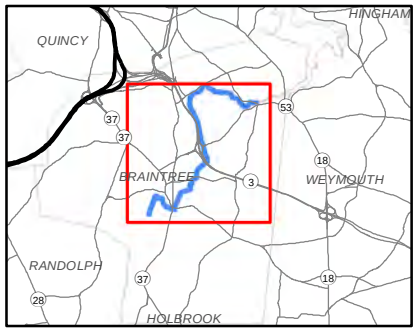

MassDOT Directly Discharging Area

MassDOT Roadways in Urban Area

Assessed Segment

Impaired Streams

Impaired Lakes

N

0 750 1,500 Feet

1 inch = 1,500 feet

Figure 2

Monatiquot River (MA74-08)
Directly Contributing
MassDOT Watershed

December 2013

massDOT
Massachusetts Department of Transportation
Highway Division

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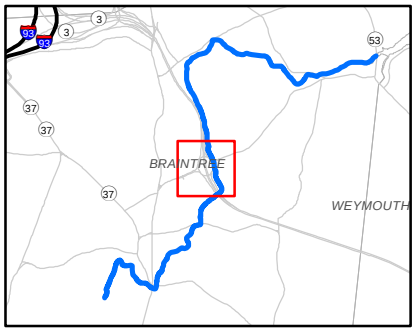

MassDOT Roadways in Urban Area

Proposed BMPs

Proposed BMP Watersheds

Assessed Segment

DEP Wetlands

N

0 150 300 Feet

1 inch = 300 feet

Figure 3

Monatiquot River (MA74-08)
Proposed BMPs

December 2013

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Massachusetts Department of Transportation
Highway Division

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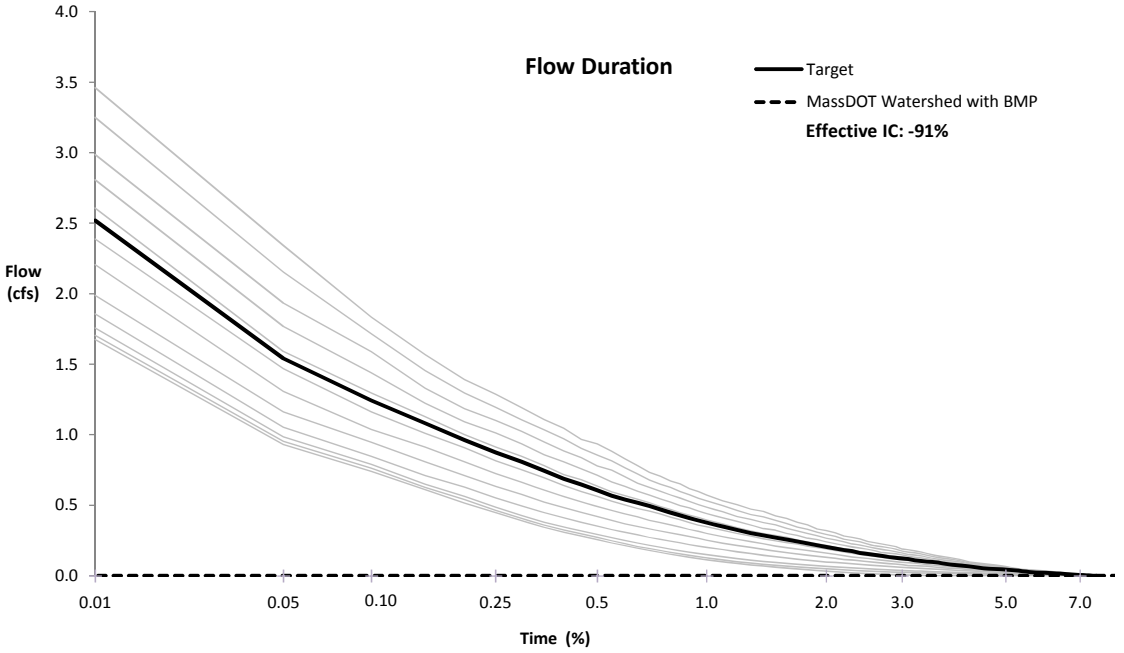
Result Summary

9.3 EX BMP 1



Median Annual Load Comparison Table

Condition	Runoff (ac-ft)	Phos. (lb.)	TSS (lb.)
0%IC	3.5	0.3	17
5%IC	4.1	0.4	84
10% IC	4.7	0.6	177
20% IC	5.9	1.2	490
30% IC	7.1	2.2	1,000
40% IC	8.3	3.4	1,688
50% IC	9.5	4.9	2,529
60% IC	10.7	6.5	3,449
70% IC	11.8	8.1	4,377
80% IC	13.0	9.8	5,303
90% IC	14.2	11.3	6,206
100% IC	15.3	13.0	7,124
Watershed Load	7.71	2.67	1,282
BMP Output	-	-	-
Target	10.20	5.84	3,081
Reduction %	**100%**	**100%**	**100%**
Effective IC	**-28%**	**-8%**	**-1%**

Result Summary

Metric	Area (%)	Area (acres)
Watershed Area		4.8
Watershed IC (no BMP)	34%	1.6
Target IC Reduction	56%	0.9
Effective IC w/BMP	-40%	-1.9
IC Reduction	218%	3.6

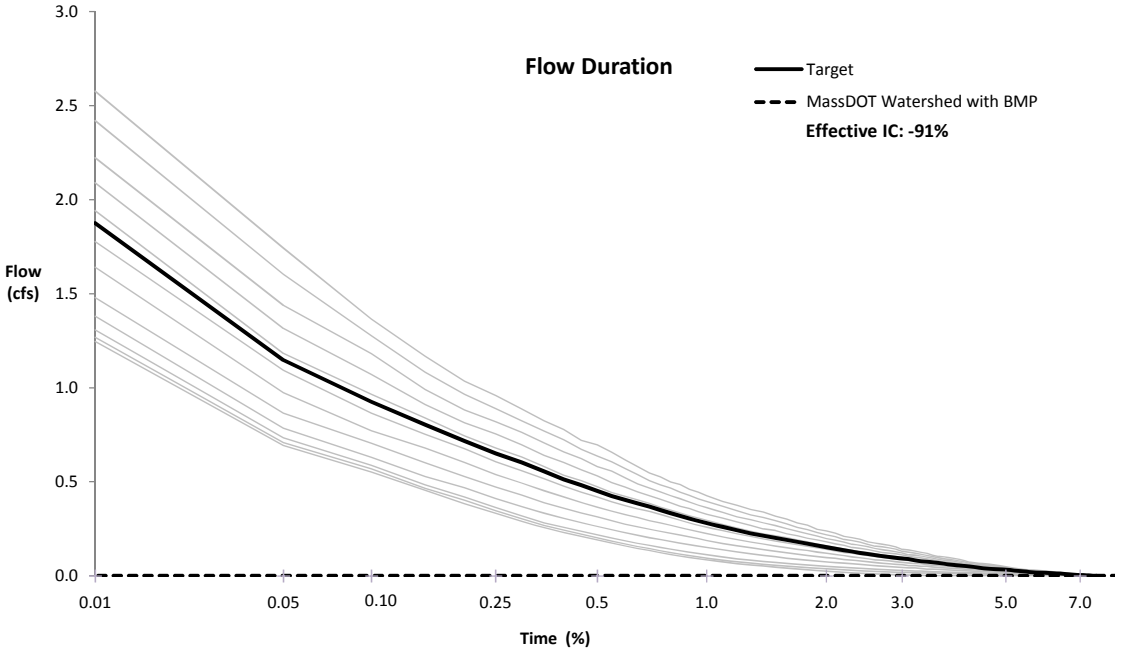
Watershed Data

Metric	IC (acres)	Total (acres)
Direct Wateshed	1.6	4.8
Indirect Watershed	-	-
Total	1.6	4.8

* Effective IC calculated as follows:
1. Interpolate effective IC separately for each metric via interpolation of reference tables/curves
   a. For TSS, P and Flow volume, calculate effective percentage% by using linear interpolation of percentage to closest load/volume values
   b. For flow duration, calculate average of individually interpolated values taken at equal probability intervals (based on normal distribution)
2. Determine the maximum IC indictor for the flow metrics (TSS load and TP load)
3. Take the average of the three IC indicators (runoff volume, maximum of TSS and TP load, flow duration) as the representative effective IC for the watershed

Result Summary

8.3 EX BMP 2



Median Annual Load Comparison Table

Condition	Runoff (ac-ft)	Phos. (lb.)	TSS (lb.)
0%IC	2.6	0.2	13
5%IC	3.1	0.3	62
10% IC	3.5	0.4	132
20% IC	4.4	0.9	365
30% IC	5.3	1.6	744
40% IC	6.2	2.5	1,256
50% IC	7.1	3.6	1,882
60% IC	7.9	4.8	2,567
70% IC	8.8	6.0	3,258
80% IC	9.7	7.3	3,947
90% IC	10.5	8.4	4,619
100% IC	11.4	9.7	5,302
Watershed Load	3.22	0.45	154
BMP Output	-	-	-
Target	7.59	4.34	2,293
Reduction %	**100%**	**100%**	**100%**
Effective IC	**-28%**	**-8%**	**-1%**

Result Summary

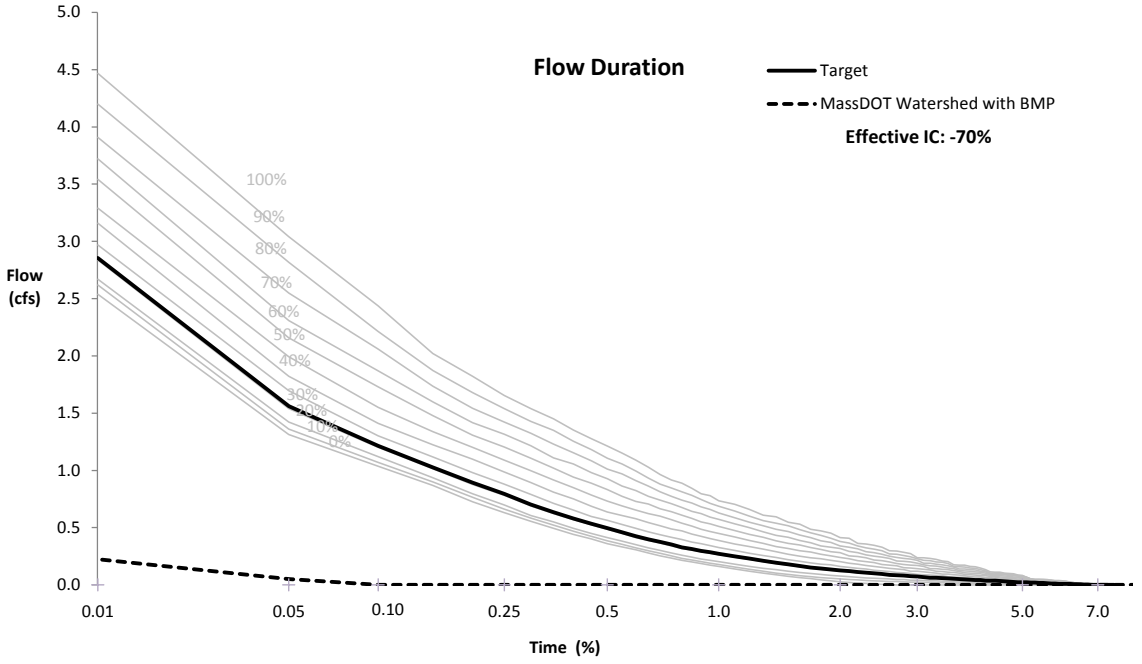
Metric	Area (%)	Area (acres)
Watershed Area		3.6
Watershed IC (no BMP)	5%	0.2
Target IC Reduction	56%	0.1
Effective IC w/BMP	-40%	-1.4
IC Reduction	863%	1.6

Watershed Data

Metric	IC (acres)	Total (acres)
Direct Wateshed	0.2	3.6
Indirect Watershed	-	-
Total	0.2	3.6

* Effective IC calculated as follows:
1. Interpolate effective IC separately for each metric via interpolation of reference tables/curves
   a. For TSS, P and Flow volume, calculate effective percentage% by using linear interpolation of percentage to closest load/volume values
   b. For flow duration, calculate average of individually interpolated values taken at equal probability intervals (based on normal distribution)
2. Determine the maximum IC indictor for the flow metrics (TSS load and TP load)
3. Take the average of the three IC indicators (runoff volume, maximum of TSS and TP load, flow duration) as the representative effective IC for the watershed

Result Summary
10.7 BMP 1



Median Annual Load Comparison Table

Condition	Runoff (ac-ft)	Phos. (lb.)	TSS (lb.)
0%IC	4.8	0.3	23
5%IC	5.5	1.2	485
10% IC	6.3	2.0	952
20% IC	7.8	3.6	1,886
30% IC	9.3	5.3	2,820
40% IC	10.8	7.0	3,753
50% IC	12.3	8.7	4,687
60% IC	13.8	10.3	5,621
70% IC	15.3	12.0	6,554
80% IC	16.7	13.7	7,488
90% IC	18.3	15.4	8,422
100% IC	19.8	17.0	9,360
Watershed Load	12.57	8.45	4,539
BMP Output	-	-	-
Target	8.02	3.85	2,010
Reduction %	**100%**	**100%**	**100%**
Effective IC	**-32%**	**-2%**	**0%**

Result Summary

Metric	Area (%)	Area (acres)
Watershed Area		6.2
Watershed IC (no BMP)	48%	3.0
Target IC Reduction	56%	1.7
Effective IC w/BMP	-34%	-2.084517
IC Reduction	170%	5.1

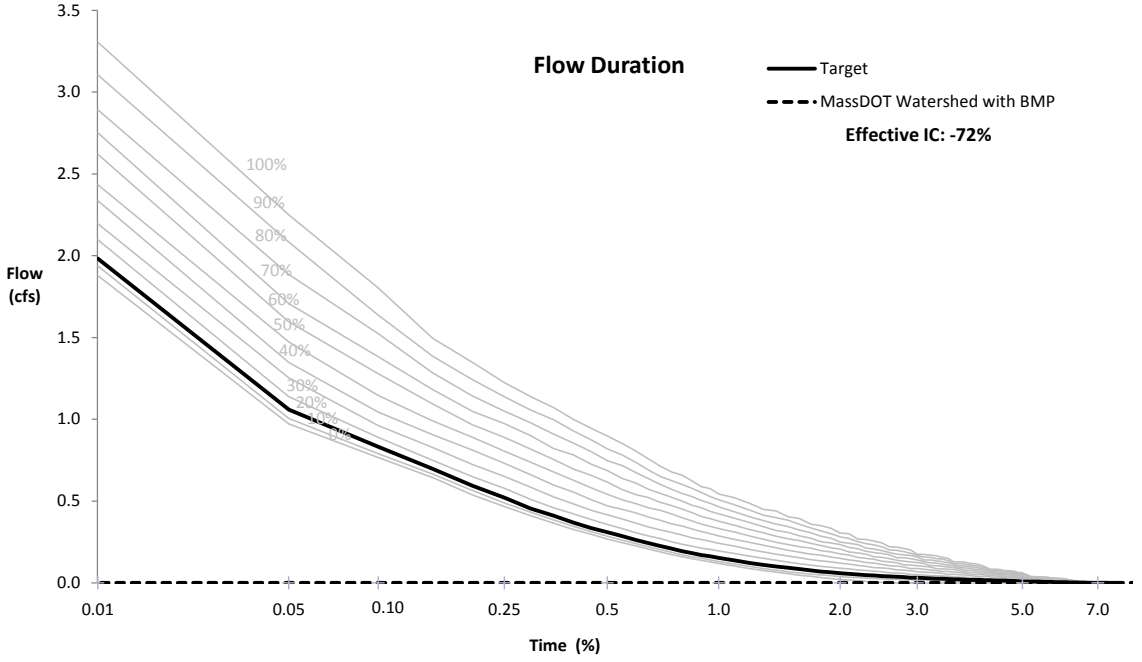
Watershed Data

Metric		IC (acres)	Total (acres)
Direct Wateshed		-	3.2
Indirect Watershed		3.0	3.0
	Total	3.0	6.2

* Effective IC calculated as follows:

1. Interpolate effective IC separately for each metric via interpolation of reference tables/curves
   a. For TSS, P and Flow volume, calculate effective percentage% by using linear interpolation of percentage to closest load/volume values
   b. For flow duration, calculate average of individually interpolated values taken at equal probability intervals (based on normal distribution)
2. Determine the maximum IC indictor for the flow metrics (TSS load and TP load)
3. Take the average of the three IC indicators (runoff volume, maximum of TSS and TP load, flow duration) as the representative effective IC for the watershed

Result Summary
5.7 BMP 2



Median Annual Load Comparison Table

Condition	Runoff (ac-ft)	Phos. (lb.)	TSS (lb.)
0%IC	3.5	0.3	17
5%IC	4.1	0.9	359
10% IC	4.7	1.5	704
20% IC	5.8	2.7	1,395
30% IC	6.9	3.9	2,086
40% IC	8.0	5.2	2,776
50% IC	9.1	6.4	3,467
60% IC	10.2	7.6	4,158
70% IC	11.3	8.9	4,848
80% IC	12.4	10.1	5,539
90% IC	13.5	11.4	6,230
100% IC	14.7	12.6	6,924
Watershed Load	6.84	3.31	1,705
BMP Output	-	-	-
Target	4.74	1.55	756
Reduction %	**100%**	**100%**	**100%**
Effective IC	**-32%**	**-2%**	**0%**

Result Summary

Metric	Area (%)	Area (acres)
Watershed Area		4.6
Watershed IC (no BMP)	24%	1.1
Target IC Reduction	56%	0.6
Effective IC w/BMP	-34%	-1.569094
IC Reduction	241%	2.7

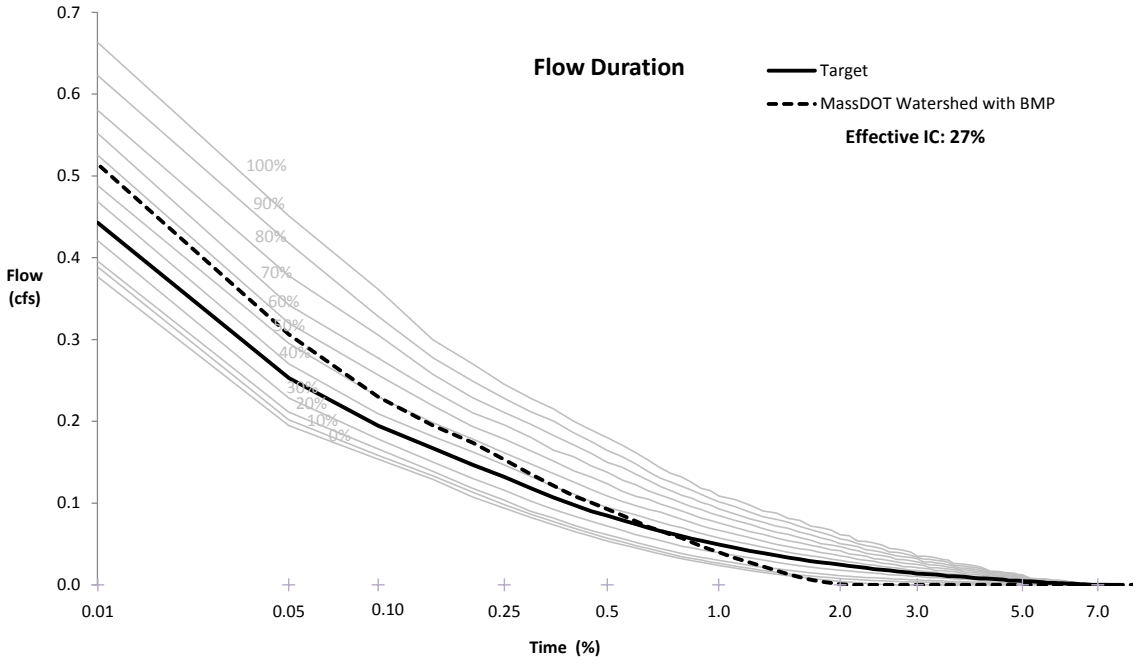
Watershed Data

Metric		IC (acres)	Total (acres)
Direct Wateshed		-	3.4
Indirect Watershed		1.1	1.1
	Total	1.1	4.6

* Effective IC calculated as follows:

1. Interpolate effective IC separately for each metric via interpolation of reference tables/curves
   a. For TSS, P and Flow volume, calculate effective percentage% by using linear interpolation of percentage to closest load/volume values
   b. For flow duration, calculate average of individually interpolated values taken at equal probability intervals (based on normal distribution)
2. Determine the maximum IC indictor for the flow metrics (TSS load and TP load)
3. Take the average of the three IC indicators (runoff volume, maximum of TSS and TP load, flow duration) as the representative effective IC for the watershed

Result Summary
8.7 BMP 6



Median Annual Load Comparison Table

Condition	Runoff (ac-ft)	Phos. (lb.)	TSS (lb.)
0%IC	0.7	0.1	3
5%IC	0.8	0.2	72
10% IC	0.9	0.3	141
20% IC	1.2	0.5	280
30% IC	1.4	0.8	418
40% IC	1.6	1.0	557
50% IC	1.8	1.3	695
60% IC	2.0	1.5	834
70% IC	2.3	1.8	972
80% IC	2.5	2.0	1,111
90% IC	2.7	2.3	1,249
100% IC	2.9	2.5	1,388
Watershed Load	2.20	1.77	968
BMP Output	1.02	0.23	70
Target	1.40	0.81	430
Reduction %	**53%**	**87%**	**93%**
Effective IC	**14%**	**7%**	**5%**

Result Summary

Metric	Area (%)	Area (acres)
Watershed Area		0.9
Watershed IC (no BMP)	70%	0.6
Target IC Reduction	56%	0.4
Effective IC w/BMP	16%	0.1461691
IC Reduction	77%	0.5

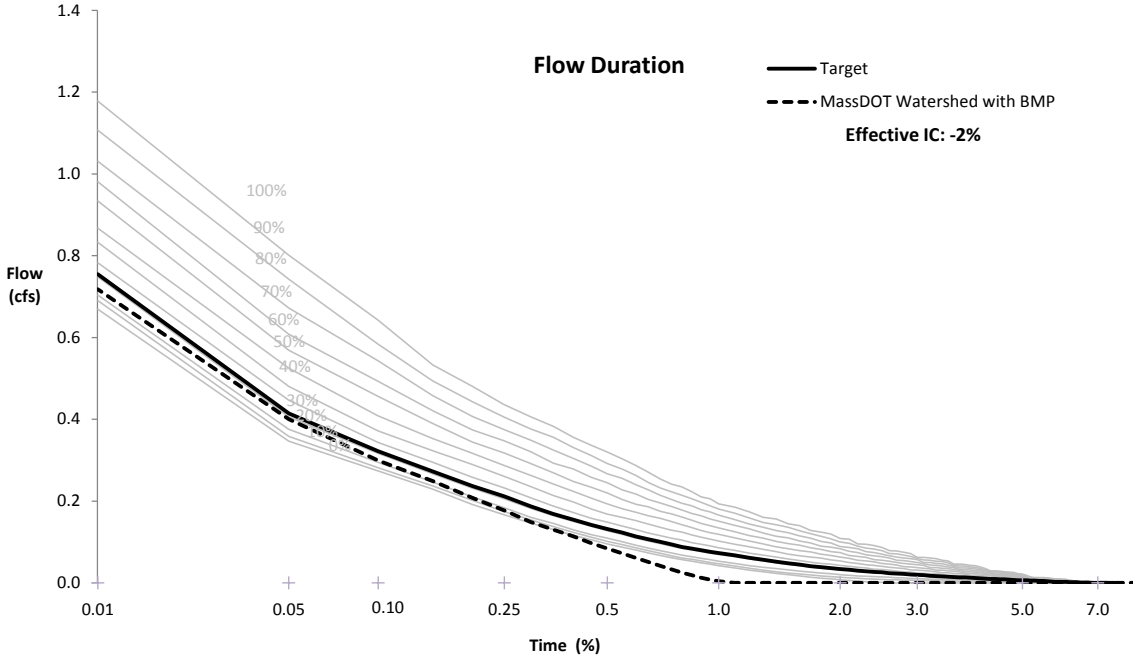
Watershed Data

Metric	IC (acres)	Total (acres)
Direct Wateshed	-	0.3
Indirect Watershed	0.6	0.6
Total	0.6	0.9

* Effective IC calculated as follows:

1. Interpolate effective IC separately for each metric via interpolation of reference tables/curves
   a. For TSS, P and Flow volume, calculate effective percentage% by using linear interpolation of percentage to closest load/volume values
   b. For flow duration, calculate average of individually interpolated values taken at equal probability intervals (based on normal distribution)
2. Determine the maximum IC indictor for the flow metrics (TSS load and TP load)
3. Take the average of the three IC indicators (runoff volume, maximum of TSS and TP load, flow duration) as the representative effective IC for the watershed

Result Summary
6.7 BMP 7



Median Annual Load Comparison Table

Condition	Runoff (ac-ft)	Phos. (lb.)	TSS (lb.)
0%IC	1.3	0.1	6
5%IC	1.5	0.3	128
10% IC	1.7	0.5	251
20% IC	2.1	1.0	497
30% IC	2.5	1.4	743
40% IC	2.9	1.8	990
50% IC	3.2	2.3	1,236
60% IC	3.6	2.7	1,482
70% IC	4.0	3.2	1,728
80% IC	4.4	3.6	1,974
90% IC	4.8	4.0	2,220
100% IC	5.2	4.5	2,468
Watershed Load	3.00	2.28	1,240
BMP Output	1.01	0.17	46
Target	2.14	1.05	547
Reduction %	**66%**	**93%**	**96%**
Effective IC	**-6%**	**2%**	**2%**

Result Summary

Metric	Area (%)	Area (acres)
Watershed Area		1.6
Watershed IC (no BMP)	50%	0.8
Target IC Reduction	56%	0.5
Effective IC w/BMP	-2%	-0.035249
IC Reduction	104%	0.8

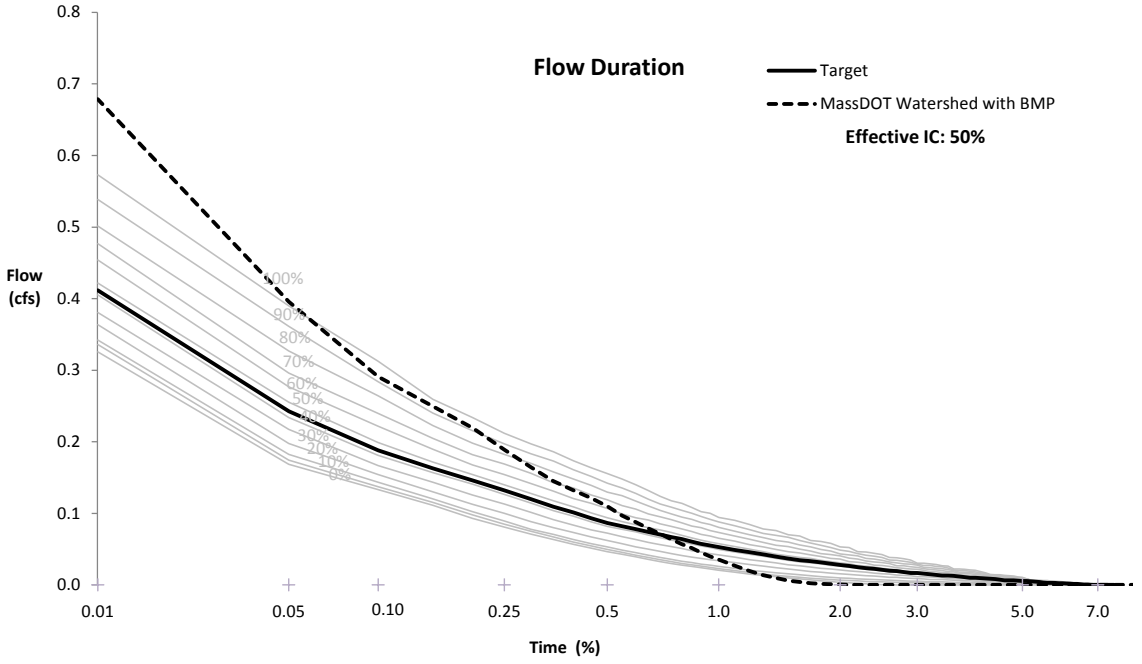
Watershed Data

Metric		IC (acres)	Total (acres)
Direct Wateshed		-	0.8
Indirect Watershed		0.8	0.8
	Total	0.8	1.6

* Effective IC calculated as follows:

1. Interpolate effective IC separately for each metric via interpolation of reference tables/curves
   a. For TSS, P and Flow volume, calculate effective percentage% by using linear interpolation of percentage to closest load/volume values
   b. For flow duration, calculate average of individually interpolated values taken at equal probability intervals (based on normal distribution)
2. Determine the maximum IC indictor for the flow metrics (TSS load and TP load)
3. Take the average of the three IC indicators (runoff volume, maximum of TSS and TP load, flow duration) as the representative effective IC for the watershed

Result Summary
7.7 BMP 8



Median Annual Load Comparison Table

Condition	Runoff (ac-ft)	Phos. (lb.)	TSS (lb.)
0%IC	0.6	0.0	3
5%IC	0.7	0.1	62
10% IC	0.8	0.3	122
20% IC	1.0	0.5	242
30% IC	1.2	0.7	362
40% IC	1.4	0.9	481
50% IC	1.6	1.1	601
60% IC	1.8	1.3	721
70% IC	2.0	1.5	841
80% IC	2.1	1.8	960
90% IC	2.3	2.0	1,080
100% IC	2.5	2.2	1,200
Watershed Load	2.55	2.19	1,204
BMP Output	1.18	0.24	73
Target	1.47	0.98	529
Reduction %	**53%**	**89%**	**94%**
Effective IC	**29%**	**9%**	**6%**

Result Summary

Metric	Area (%)	Area (acres)
Watershed Area		0.8
Watershed IC (no BMP)	100%	0.8
Target IC Reduction	56%	0.4
Effective IC w/BMP	30%	0.2334843
IC Reduction	70%	0.6

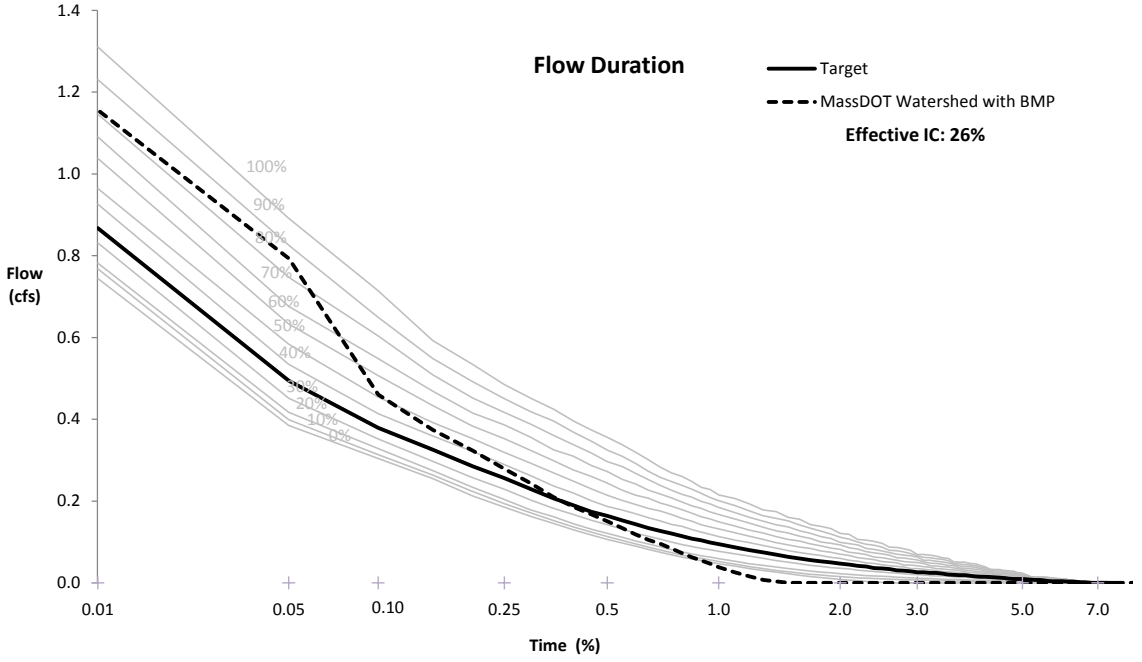
Watershed Data

Metric		IC (acres)	Total (acres)
Direct Wateshed		-	-
Indirect Watershed		0.8	0.8
	Total	0.8	0.8

* Effective IC calculated as follows:

1. Interpolate effective IC separately for each metric via interpolation of reference tables/curves
   a. For TSS, P and Flow volume, calculate effective percentage% by using linear interpolation of percentage to closest load/volume values
   b. For flow duration, calculate average of individually interpolated values taken at equal probability intervals (based on normal distribution)
2. Determine the maximum IC indictor for the flow metrics (TSS load and TP load)
3. Take the average of the three IC indicators (runoff volume, maximum of TSS and TP load, flow duration) as the representative effective IC for the watershed

Result Summary
1.7 BMP 9



Median Annual Load Comparison Table

Condition	Runoff (ac-ft)	Phos. (lb.)	TSS (lb.)
0%IC	1.4	0.1	7
5%IC	1.6	0.3	142
10% IC	1.8	0.6	279
20% IC	2.3	1.1	553
30% IC	2.7	1.6	827
40% IC	3.2	2.0	1,100
50% IC	3.6	2.5	1,374
60% IC	4.0	3.0	1,648
70% IC	4.5	3.5	1,921
80% IC	4.9	4.0	2,195
90% IC	5.4	4.5	2,469
100% IC	5.8	5.0	2,744
Watershed Load	4.17	3.34	1,826
BMP Output	1.70	0.40	123
Target	2.70	1.52	807
Reduction %	**59%**	**88%**	**93%**
Effective IC	**7%**	**6%**	**4%**

Result Summary

Metric	Area (%)	Area (acres)
Watershed Area		1.8
Watershed IC (no BMP)	67%	1.2
Target IC Reduction	56%	0.7
Effective IC w/BMP	13%	0.2302042
IC Reduction	81%	1.0

Watershed Data

Metric	IC (acres)	Total (acres)
Direct Wateshed	-	0.6
Indirect Watershed	1.2	1.2
Total	1.2	1.8

* Effective IC calculated as follows:

1. Interpolate effective IC separately for each metric via interpolation of reference tables/curves
   a. For TSS, P and Flow volume, calculate effective percentage% by using linear interpolation of percentage to closest load/volume values
   b. For flow duration, calculate average of individually interpolated values taken at equal probability intervals (based on normal distribution)
2. Determine the maximum IC indictor for the flow metrics (TSS load and TP load)
3. Take the average of the three IC indicators (runoff volume, maximum of TSS and TP load, flow duration) as the representative effective IC for the watershed

Impaired Waters Assessment for Miles River (MA92-03) – Final Report

Introduction

Miles River (MA92-03) was previously assessed in a progress report titled, *Impaired Waters Assessment for Miles River (MA92-03) – Progress Report*, submitted on 12/7/2012. The progress report stated that MassDOT would work with designers to implement BMPs in order to meet its target reduction of impervious cover (IC). After further review by the design consultants, it was verified that approximately 1.6 acres of MassDOT property discharges directly to the Miles River. This report presents a summary of the findings of the progress report as well as a final assessment which includes the reduction provided by existing BMPs and the final target IC reduction determined during the Designer's comprehensive investigation.

Summary of Progress Report

Impaired Waterbody

Name: Miles River

Location: Beverly, Wenham, Hamilton, and Ipswich, MA

Water Body ID: MA92-03

Impairments

The Miles River (MA92-03) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters (MassDEP, 2013)*. The Miles River is impaired for the following:

- aquatic macroinvertebrate bioassessments
- dissolved oxygen
- fecal coliform

According to MassDEP's *Ipswich River Watershed 2000 Water Quality Assessment Report* (MassDEP, 2004), Miles River is impaired for benthic macroinvertebrate bioassessment and the suspected causes are dissolved oxygen, nutrient enrichment, and low flow alterations. The report also suspects flow alterations from water diversions, golf courses, and grazing in riparian zone affect the water body, but it is unclear what the impacts are on the Miles River. The *Draft Pathogen TMDL for the Ipswich River Watershed* (MassDEP, no date) documents bacteria concentrations between 20 – 740 cfu/100mL in samples taken from the Miles River.

Site Description

The Miles River (MA92-03) flows for 8.9 miles from the outlet of Longham Reservoir in Beverly to the confluence with the Ipswich River in Ipswich. The impaired stream segment Long Causeway Brook (MA92-20) flows into Miles River at the Ipswich/Hamilton townline. The Miles River total and subwatershed are the same.

AECOM performed a field assessment of the Miles River subwatershed on September 6, 2012. The focus of the field assessment was on the MassDOT-owned urban road sections that directly discharge stormwater runoff to the impaired water body.

At the crossing of Route 1A (County Road) with Long Causeway Brook stormwater runoff from Route 1A discharges directly into the tributary. This section of Long Causeway Brook is a Category 3 stream based on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* and is approximately 1,300 ft from the Miles River. According to field observation, the stream has a narrow cross section with wide floodplain/wetlands area outside channel banks; therefore since runoff from this road discharges to the tributary, this road section was not characterized to discharge direct stormwater runoff to Miles River.

MassDOT's property that directly contributes stormwater runoff to the Miles River is comprised of approximately 1.57 acres of Route 1A. The directly contributing roadway is near where the Miles River culvert under Route 1A is located. The two-lane Route 1A bridge is about 24 feet wide with a 45-feet wide right-of-way. Based on field observation, stormwater runoff from the road is captured by catch basins and subsequently discharged into the Miles River. Because road curbing only exists along the west side of Route 1A, some of the stormwater runoff can bypass the catch basins and flow overland before entering Miles River.

Southwest of the bridge and south of the Miles River there is a two-lane road/drive way that is separated from Route 1A by a grassy area. A drop inlet in the middle of the grassy area appears to capture runoff from the unnamed road and is piped to Miles River. Research of the MassHighway Layout Plans database reveals that the road was once the approach section to the County Road bridge over Miles River before Route 1A was realigned to its current bridge crossing location in the 1950s. Further communication with MassDOT confirms that MassDOT owns both the grassy area and the no-name road.

Previously Completed Progress Assessment under BMP 7U

None of the following impairments for the Miles River have been addressed by a final TMDL. Therefore, MassDOT assessed the impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- aquatic macroinvertebrate bioassessments
- dissolved oxygen

The impairment for fecal coliform was assessed separately for pathogen impairments.

Existing BMPs from Progress Report

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

Target Reduction from Progress Report

In the progress report, MassDOT derived the following site parameters and target reduction for DOT's directly contributing watershed draining to the Miles River (MA92-03) using the IC Method:

Table 1. Target IC Reduction – Progress Report

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	1.6	Acres
Target Percent Reduction in Effective IC	10.8	%
Target reduction in Effective IC	0.2	Acres
IC Effectively reduced by Existing BMPS	0	Acres
IC Remaining to Mitigate with Proposed BMPs	0.2	Acres

Final Assessment

Designer Investigation of Existing BMPs

After the submittal of the progress report, further investigation of the Miles River was conducted for more precise values of storage volume, IC area treated, and percent reduction of effective IC, although in the end the effective IC value did not change. It was confirmed that there are no existing BMPs within the subwatershed.

Updated Target Reduction

After the submittal of the progress report, further investigation of MassDOT's directly contributing IC area was performed by the designers. Based on this investigation, the MassDOT Directly Contributing IC Watershed remained unchanged as 1.6 acres. Thus, the target reduction of impervious cover, 10.8% of this IC watershed, was also unchanged by the designers as 0.2 acres. See Table 2 below.

Table 2. Target IC Reduction – Designer Investigation

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	1.6	acres
Target Percent Reduction in Effective IC	10.8	%
Target reduction in Effective IC	0.2	acres
IC Effectively reduced by Existing BMPS	0	acres

BMPS in Design

MassDOT has designed BMPs to address the target IC reduction of 1.6 acres as part of MassDOT's Impaired Waters Retrofit Initiative. MassDOT was able to design one infiltration basin to treat a MassDOT contributing area of 0.46 acres of impervious cover.

Based on field observations on September 6, 2012, there is opportunity to install an infiltration BMP adjacent to Route 1A Bridge over Miles River that would treat a portion of the MassDOT directly contributing watershed. There is space within a grassy land area to retain and treat some of the direct runoff from Route 1A roadway.

Table 3. Summary of BMPs in Design

BMP Name	BMP Type	IC Area Treated in Acres	Reduction of Effective IC in Acres
BMP 1	Infiltration Basin	0.4	0.4

The proposed BMPs provide a total reduction of effective IC of 0.4 acres.
Additional detailed information regarding the final designs for these BMPs will be included in future submittals US EPA.

Conclusions

Table 4 summarizes the IC reductions within MassDOTs directly contributing watershed under design BMP conditions.

Table 4. Design BMP Effective IC Reductions

Parameter	Quantity	Unit of Measure
MassDOT Target Reduction in Effective IC	0.2	acres
Effective IC Reduction under Design BMPs	0.4	acres
Remaining Target	0	acres

The one BMP has been designed to achieve the target reduction and will achieve 0.43 acres of effective IC reduction.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative. Work on Programmed Projects often includes broader scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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Impaired Waters Assessment for Forest River (MA93-10) – Final Report

Introduction

Forest River (MA93-10) was previously assessed in a progress report titled, *Impaired Waters Assessment for Forest River (MA93-10) – Progress Report*, submitted on 6/8/2013. The progress report stated that MassDOT would work with designers to implement BMPs in order to meet its target reduction of impervious cover (IC). After further review by the design consultants, it was determined that approximately 4.9 acres of stormwater from MassDOT property discharges directly to Forest River. This report presents a summary of the findings of the progress report as well as a final assessment which includes the reduction provided by existing BMPs and the final target IC reduction determined during the Designer's comprehensive investigation.

Summary of Progress Report

Impaired Waterbody

Name: Forest River

Location: Salem, MA

Water Body ID: MA93-10

Impairments

Forest River (MA93-10) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Forest River is impaired for the following:

- dissolved oxygen saturation

According to MassDEP's *North Shore Coastal Watersheds 2002 Water Quality Assessment Report* (MassDEP, 2007), Forest River is impaired due to organic enrichment/low dissolved oxygen and pathogens as well as flow alteration and other habitat alteration. The report recommends operating the existing tidal gates at the mouth of Forest River (at the Route 114 crossing of the River) in a manner that maximizes tidal flushing in order to benefit the overall ecology of the Forest River. The report also recommends conducting biological, habitat, and water quality monitoring, and conducting bacteria sampling.

Site Description

Forest River is a 16.6 acre water body located in Salem, MA. Forest River (MA93-10) and Salem Harbor (MA93-21) are separated by tide gates at the MassDOT Route 114 Bridge. During a site visit on April 25, 2013, it was determined that drainage outfalls on the Route 114 bridge are directly discharging to Salem Harbor. Therefore, this bridge was not considered in this analysis. Land use surrounding Forest River is undeveloped upland and wetland area surrounded by primarily residential development. The Salem State University (South Campus) is located on Harrison Road, immediately west of the Route 1A crossing of the Forest River.

The watershed of MassDOT's property directly contributing stormwater is comprised of approximately 0.7 miles of Loring Avenue (Route 1A). Stormwater is collected through a series of catch basins and is conveyed through a closed drainage system to outfalls that directly discharge to Forest River. Route 1A north of the MassDOT directly contributing watershed was determined to be an indirect discharge to Forest River. Stormwater from this section first flows through wetlands, allowing infiltration and resulting treatment.

Previously Completed Progress Assessment under BMP 7U

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

- dissolved oxygen saturation

Existing BMPs from Progress Report

There are no existing BMPs within MassDOT's directly contributing watershed to Segment MA93-10, Forest River that are mitigating potential stormwater quality impacts. Therefore, no effective IC reduction is currently provided.

Target Reduction from Progress Report

In the progress report, MassDOT derived the following site parameters and target reduction for DOT's directly contributing watershed draining to the Forest River (MA93-10) using the IC Method:

Table 1. Target IC Reduction – Progress Report

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	4.9	acres
Target Percent Reduction in Effective IC	70.5	%
Target reduction in Effective IC	3.5	acres
IC Effectively reduced by Existing BMPS	0	acres
IC Remaining to Mitigate with Proposed BMPs	3.5	acres

Final Assessment

Updated Target Reduction

After the submittal of the progress report, further investigation of MassDOT's directly contributing IC area was performed by the designers. Based on this investigation, the MassDOT Directly Contributing IC Watershed remained 4.9 acres. Thus, the target reduction of impervious cover, 70.5% of this IC watershed also remained 3.5 acres based on these more in-depth field evaluations. See Table 2 below.

Table 2. Target IC Reduction – Designer Investigation

Parameter	Quantity	Unit of Measure
IC in Directly Contributing Watershed	4.9	acres
Target Percent Reduction in Effective IC	70.5	%
Target reduction in Effective IC	3.5	acres
IC Effectively reduced by Existing BMPS	0	acres
IC Remaining to Mitigate with Proposed BMPs	3.5	acres

Existing and Proposed BMPs

The designer's investigation confirmed that there are no existing BMPs for Forest River (MA93-10). Further investigation of MassDOT's property showed that a water line is buried on the site. Therefore, due to site constraints including existing utilities, and the limitations of the Retrofit Initiative, the construction of a BMP for the treatment of directly contributing impervious cover is not feasible for this segment.

Conclusions

MassDOT owned roadways near the Forest River, segment MA93-10, were investigated and approximately 4.9 acres of MassDOT impervious cover contributes stormwater directly to the Forest River. There are currently no existing BMPs associated with direct discharges from MassDOT property into the Forest River. MassDOT reviewed their property and determined that, due to the lack of available space within right of way, the placement of a BMP for the treatment of directly contributing impervious cover is not feasible under the Retrofit Initiative.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative. Work on Programmed Projects often includes broader scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

References

Massachusetts Department of Environmental Protection (MassDEP). (2007). North Shore Coastal Watersheds 2002 Water Quality Assessment Report. Retrieved from: MassDEP North Shore Coastal Watersheds 2002 Water Quality Assessment Report

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