MassDOT Quarter 1 Submittal

(June 8 – September 7, 2010)

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

September 8, 2010

Deval L. Patrick, Governor
Timothy P. Murray, Lt. Governor
Jeffrey B. Mullan, Secretary & CEO
Luisa Paiewonsky, Administrator

massDOT
Massachusetts Department of Transportation
Highway Division

September 8, 2010

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

Subject: Quarter 1 Submittal under Impaired Waters Program

Dear Mr. Gray,

As part of MassDOT's June 9, 2010 and July 23, 2010 submittals to EPA, MassDOT committed to assessing, for possible mitigation, 684 impaired water bodies over a five-year period through BMP 7U: Impaired Waters Assessment and Mitigation Plan (the "Impaired Waters Program") and BMP 7R: TMDL Watershed Review. MassDOT committed to immediately commence work on BMP 7U by assessing at least 25 water bodies within the first quarter (by September 8, 2010). MassDOT will provide annual reports on its progress to EPA (with quarterly reports during the first year and semi-annual reports thereafter). The attached report documents MassDOT's review during the first quarter of the Impaired Waters Program.

During the first quarter, MassDOT completed assessments under BMPs 7R and 7U on 37 water bodies and is providing a status report on two (2) additional impaired segments from Appendix L-1 (dated July 22, 2010, included in MassDOT's July 23 submittal). The results of these assessments are included in Attachments 1-2. Each of the reports contained in Attachment 1 includes all relevant assessments for the water body listed, i.e., under either/both BMP 7R (impairments covered by TMDL reports) and BMP 7U (other impairments not covered by TMDL reports).

As stated in BMP 7U, MassDOT will place priority in assessing the 684 water bodies in Appendix L-1 on those waters with the greatest number of outfalls and urban road miles within 500 feet of the water body (there are 226 water bodies with at least one MassDOT outfall within 500 feet of the water body). However, because the number of outfalls and impairments in this high-priority group will, by definition, require the most complex and time-consuming analysis, MassDOT intends to simultaneously assess other water bodies requiring less analysis for each progress report, so that it can make sufficient progress towards meeting its five-year goal for completion of all assessments. For instance, MassDOT may assess, in addition to the water bodies in the priority group described above, water bodies for which a desk top review will be sufficient to complete its analysis (such as those in Attachment 2), sites with relatively few outfalls in the entire watershed, or water bodies covered by a common TMDL report.

As described in Appendix L-5 of BMP 7U (included in MassDOT's July 23 submittal), MassDOT has developed initial schedules for the implementation of any new best management practices (BMPs) that may be warranted as a result of its assessments

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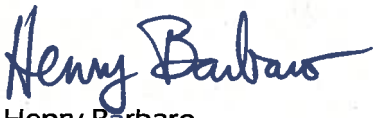
under BMPs 7U and 7R. MassDOT is committed to implementing new BMP recommendations as soon as practicable, following the issuance of each semi-annual report to the EPA. As shown in the attached progress reports on the Blackstone River (MA51-03) and Cambridge Reservoir Upper Basin (MA72156) (Attachment 1), MassDOT anticipates that it will implement a number of structural BMPs to mitigate the effects of stormwater at these sites. Once the BMP recommendations are completed by the December 2010 semi-annual report, MassDOT will immediately begin the process of implementing the new BMPs, as set forth in Appendix L-5.

As stated in Appendix L-5, in addition to completing "retrofit" projects, MassDOT is also continuing to seek opportunities to implement structural BMPs as part of planned construction projects. To that end, MassDOT has developed a new environmental initiative for planned construction projects, called the "Impaired Waterbody Program for Programmed Projects. Programmed projects are highway construction projects that are included in MassDOT's fiscal budget. This new initiative ensures that every construction project under design has been assessed for the impact of highways on impaired waterbodies. The first step in implementing this initiative was to educate the designers. MassDOT staged several training seminars to internal design and project development staff as well as external design consultants in late August and early September. The trainings focused on educating the designers on MassDOT's new initiative for programmed projects, including the requirement that any new structural BMPs that may be warranted be incorporated into the final project design for each construction project. Approximately, 71 designers, representing about 48 different corporations, attended the external design consultant training, and in house trainings reached 77 design, project and environmental staff. A follow up seminar for design consultants has been scheduled for September 27, 2010. Designers are now required to summarize any proposed stormwater BMP measures during the 25% design stage through a standard form, and will work with the Environmental Section to ensure that the relevant water body impairments (including any TMDL reports governing the water body) are adequately addressed. MassDOT will coordinate this process with its on-going assessments under BMP 7U and 7R to ensure consistency in its assessments. By addressing the impairments during construction projects, MassDOT will have greater opportunities to install robust treatment BMPs with less site constraints than for a retrofit project. New structural BMPs installed or included in design as part of MassDOT's Impaired Waterbody Program for Programmed Projects will be summarized in MassDOT's annual reports.

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

Yours sincerely,



Henry Barbaro
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cc: Kathleen Woodward, Esq., EPA Region I
William Hicks, Esq., MassDOT

Attachment 1:
Impaired Segments Assessments with Discharges from MassDOT Outfalls

Impaired Waters Assessment for Bents Pond (MA35007)

Impaired Waterbody

Bents Pond (MA35007)

Impairments

Noxious Aquatic Plants, Turbidity

Relevant Water Quality Standards

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

Site Description

MassDOT owns the Route 2A (West Broadway) bridge that crosses between Bents Pond and Travers Pond. MassDOT only owns the bridge; the remainder of Route 2A in this area is owned by the Town of Gardner. The bridge is approximately 47 feet long by 34 feet wide and covers approximately 0.015 hectares (0.04 acres). The Bents Pond watershed is estimated to be greater than 2,000 hectares (MassDEP 2002).

MassDOT's Appendix L-1 of Impaired Waterbodies included in BMP 7U (dated July 22, 2010) indicated that MassDOT has two outfalls within 500 feet of Bents Pond. This outfall number was based on an automated review of GIS data. A field investigation on October 12, 2009 and verified the two outfalls and identified a third outfall (Figure 1). Below is an overview of each outfall.

- Outfall 8498 discharges on the north side of the bridge into Travers Pond just upstream of Bents Pond. Travers Pond is not listed as impaired. This outfall is located on MassDOT property; however this outfall drains portions of Route 2A located to the east of the bridge. It does not discharge stormwater from MassDOT property. This outfall is a corrugated pipe protruding from a stone headwall (Figure 2). Runoff from this outfall is not treated by a structural BMP.
- Outfall 1715 is located to the east of the bridge. This outfall drains areas to the east of the bridge (non-MassDOT property) and is not located on MassDOT property. Therefore, this outfall is not considered further in this assessment.

- Outfall 8494 is located to the west of the bridge. This outfall is not located on MassDOT property. However, stormwater from MassDOT's bridge drains to the west, combines with additional runoff from Route 2A, is collected by catchbasins, and then discharges through this outfall.

MassDOT assessed this water body using the approach described in BMP 7R (TMDL Watershed Review).

Assessment under BMP 7R for Noxious Aquatic Plants and Turbidity

The TMDL that covers Bents Pond addresses both of the impairments (noxious aquatic plants and turbidity) listed for this water body. Therefore, MassDOT assessed this water body using the approach described in BMP 7R (TMDL Watershed Review). No further assessment was conducted under BMP 7U (Water Quality Impaired Waters Assessment and Mitigation Plan).

TMDL

Final TMDLs for Phosphorus for Selected Millers River Basin Lakes

- Pollutant of Concern: Phosphorus
- Impairment's addressed in TMDL: Noxious Aquatic Plants, Turbidity
- Applicable Waste Load Allocation: See Tables 4.2 (pg 76) and V.2 (pg 105).
  - Description of Associated Land Use: Commercial/Industrial
  - Commercial/Industrial Land Use Current Load (TP): 92 kg/yr
  - Commercial/ Industrial Land Use WLA (TP): 31 kg/yr
  - Commercial/Industrial Area in Watershed: 116.6 ha
  - Commercial/Industrial Land Use Areal WLA: 0.27 kg/ha/yr
- Applicable Recommendations:
  - "Better management of road sanding, salting, regular sweeping, and installation of BMPs" (Table 6, page 88)

Estimated Loading from MassDOT

The loading of total phosphorus (TP) from the area of the bridge was estimated using the following assumptions and calculations:

- TP loading rates were estimated based on data collected in a study of stormwater runoff from highways operated by MassDOT conducted by USGS. (Smith and Granato in press). This study collected stormwater samples from 12 sites located on Highways operated by MassDOT across Massachusetts between September 2005 and September 2007. Samples were taken under a variety of weather conditions during this period. Based on this data, MassDOT estimated the TP loading from impervious areas as 1.9 kg/Ha/yr.
- Estimated MassDOT area that drains to Bents Pond = 0.015 hectares
- Estimated load from MassDOT area = 0.03 kg/yr.

Assessment and Mitigation Plan

The estimated areal loading from MassDOT highways that discharges to Bents Pond through outfall 8494 of 1.9 kg/ha/yr based on the USGS data is higher than the calculated areal WLA (0.27 kg/ha/yr). The basis for the areal WLA is provided above in the TMDL section of this assessment. However, the total loading from MassDOT (0.02 kg/yr) is insignificant (less than 0.001%) compared to the overall load to the pond (501 kg/yr; MassDEP 2002). Therefore, the pollutant load from this bridge is *de minimus*.

Despite this, MassDOT considered the potential for installing additional BMPs to reduce its total phosphorus loading. Stormwater from the bridge runs directly onto the portion of Route 2A owned by the Town of Gardner. The sides of the bridge constrain the ability to add structural BMPs and stormwater is not collected until it leaves MassDOT property. Therefore, it would not be practicable to install a BMP to treat this runoff on MassDOT property.

Runoff discharged from Outfall 8498 is only from the Town of Gardner road and it discharges to Travers Pond, which is not impaired. Since MassDOT only owns the bridge and none of the road upstream of the bridge retrofitting structural BMPs for Outfall 8498 would be infeasible due to the space constraints.

MassDOT often performs the design, permitting and construction of roadway upgrades/ repairs for towns. If future work is proposed by the Town or MassDOT along Route 2, MassDOT will consider whether structural BMPs to address phosphorus are warranted. In addition, during MassDOT construction projects within the Bents Pond watershed, MassDOT's goal will be to implement additional BMPs to remove phosphorus from the storm water discharges. This work will be completed as part of MassDOT's new Impaired Waterbodies Programmed Projects program.

The Final TMDLs for Phosphorus for Selected Millers River Basin Lakes recommends good housekeeping practices for MassHighway. These include better management of road sanding, salting, and regular sweeping. On isolated portions of MassDOT roads, like the Bents Pond Bridge, sanding, salting and sweeping are not conducted by MassDOT. The maintenance is instead conducted by the Town, under an agreement with MassDOT. Implementing additional measures would be impracticable given the extremely limited contribution of this segment of roadway to the phosphorus loading to Bents Ponds.

Conclusions

The area owned by MassDOT represents only a minute fraction of the watershed of Bents Pond (less than 0.001%). Therefore, MassDOT concludes that it represents a *de minimus* source of phosphorus to Bents Pond. Therefore, no further measures are warranted.

Despite this MassDOT commits that if the Town (through MassDOT) or MassDOT conducts future work along Route 2A, MassDOT will consider whether structural BMPs to address phosphorus are warranted. In addition, MassDOT will continue to implement the good housekeeping measures outlined in its SWMP.

References

MassDEP 2002. Total Maximum Daily Load of Phosphorus for Selected Millers Basin Lakes. Available at: http://www.mass.gov/dep/water/resources/millers.pdf

Smith, K.P., and Granato, G.E., In press, Quality of stormwater runoff discharged from Massachusetts highways,2005–07: U.S. Geological Survey Scientific Investigations Report 2009–5269, 198 p

Mass DOT Outfall

Non-MassDOT Outfall*

MassDOT Urban Area Roads

Non-MassDOT Roads

Estimated Outfall Drainage Area

*Outfalls were included in MassDOT's outfall inventory. Site visit and ROW review indicated outfalls owned by Town of Gardner.

**Stormwater infrastructure locations are estimated.

Figure 1.
Bents Pond
Route 2A (West Broadway)
Gardner, MA

September 2010

N

250 125 0 250 Feet

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Figure 2. Bents Pond- Outfall 8498

5 ft wide x 10 ft long wooded/wetland buffer between Rt 2A and Outfall 8498 is not owned by MassDOT. This limited space would constrain construction of upgradient BMPs.

Corrugated metal pipe in stone headwall discharges directly into Travers Pond.

Impaired Waters Assessment for Charles River in Bellingham (MA72-04)

Impaired Stream Segment

Charles River (MA72-04)

Impairments

Escherichia coli (E.coli), fish bioassessments, other flow regime alterations, mercury in fish tissue[1], other, chlordane[2], and DDT[2].

Relevant Water Quality Standards:

- Water Body Class: B
- 314 CMR 4.05(4)(b)(4b) Bacteria. the geometric mean of all *E. coli* samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml"
- 314 CMR 4.05(5)(e) Toxic Pollutants. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the *National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002* published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department.
- US EPA Ambient Water Quality Criteria: Chlordane. The freshwater acute value is 0.17 µg/l. The freshwater chronic value is 0.00463 µg/l (USEPA 2002).

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[1] As described in BMP 7R, the Northeast Regional Mercury TMDL report expressly states that local sources of mercury in storm water are de minimis and MassDOT will not implement any additional control measures with respect to mercury for these TMDL waters. Therefore, no assessment of this impairment was conducted.

[2] This impairment is only listed in the Draft Massachusetts Year 2010 Integrated List of Waters. It is not included in the 2008 Integrated List of Waters.

- US EPA Ambient Water Quality Criteria: DDT. The freshwater acute value is 1.1 µg/l. The freshwater chronic value is 0.001 µg/l (USEPA 2002).

Site Description

Approximately 19.5 acres of I-495 in Bellingham, Massachusetts drains to Segment MA72-04 of the Charles River. At this site, I-495 is divided. The northbound and southbound lanes are each approximately 55 feet wide, including the shoulder. The length of highway corridor contributing to the discharge point is approximately 2,000 feet (Figure 1). MassDOT's contributing watershed area is comprised of impervious highway, grass, forested wetland and non-forested wetland.

This site has a significant number of BMPs which have been designed to achieve the maximum extent possible storm water treatment (VHB 2010). The runoff from 16 acres of the MassDOT property (82 percent) is treated by structural BMPs while 3.5 acres (18 percent) drains by sheet flows to the Charles River (VHB 2010).

- Approximately 10.3 acres (53 percent of the total area) drains to a 2 acre vegetated swale that is approximately 6 inches deep and designed to contain a volume associated with a 3 year, 24-hr rain event (3.4 inches).
- Approximately 3.9 acres (20 percent of the total area) of the site drains to the newly constructed bioretention swale and vegetated swale, and the remaining 1.8 acres (9 percent of the total area) drains to leaching catch basins (VHB 2010).

These BMPs have been designed to achieve the maximum extent possible stormwater treatment.

This water body has been assessed under BMP 7R which applies to impairments covered by a TMDL for the *e. coli* impairment and BMP 7U which applies to impairments not covered by TMDLs.

Assessment under BMP 7R for *E. Coli* Impairment

The Final Pathogen TMDL for the Charles River Watershed addresses the *E. Coli* impairment for Charles River (MA72-04). Therefore, MassDOT assessed this water body using the approach described in BMP 7R. This TMDL was developed using fecal coliform as an indicator bacteria for fresh waters; however, the TMDL addresses the impairment for *E*. *Coli*.

TMDL

Final Pathogen TMDL for the Charles River Watershed

- Pollutant of Concern: Fecal Coliform, *E. coli*
- Segment Impairment Addressed by TMDL: *E. coli*
- Applicable Waste Load Allocation per TMDL (segment MA72-04): See Table 7-4 of the TMDL (page 62).
  - Description of Associated Land Use: Impervious Cover
  - Total loading capacity: 8.42 x 10^{10} colonies/day
  - WLA: 1.0 x 10^{10} colonies/day
  - Total impervious area within the watershed: 1,190.4 acres
  - Areal impervious WLA: 8.4 x 10^{6} colonies/acre/day

  - Fecal coliform concentration-based WLA target for Class B waters: “Shall not exceed a geometric mean of 200 organisms in any set of representative samples, not shall 10% of the samples exceed 400 organisms” (Table ES-3).

- Applicable Recommendations:
  - “At a minimum, intensive application of non-structural BMPs is needed throughout the watershed to reduce pathogen loadings as well as loadings of other storm water pollutants (e.g., nutrients and sediments) contributing to use impairment in the Charles River Watershed. Depending on the degree of success of the non-structural storm water BMP program, structural controls may become necessary (page 64 of the TMDL).”
  - “Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals (Page 69 of the TMDL).”

Estimated Loading from MassDOT

There are no site-specific data regarding pathogen concentrations in stormwater from this site. However, a study conducted on the South East Expressway measured bacterial concentrations in stormwater runoff (Smith 2002). This study yielded fecal coliform concentration data with a geometric mean of 186 organisms/100 ml. While the area draining into the Charles River is different, these data represent a reasonable estimate of the concentration of fecal coliform in runoff from MassDOT roadways. Concentrations of pathogens in stormwater runoff from roadways can vary widely. Therefore, the concentrations in runoff from this site may be significantly different. However, the concentrations may be significantly higher than the applicable water quality standards.

MassDOT has substantial structural and non-structural BMPs that significantly reduce bacteria loading from this segment. Runoff from more than 80% of the site is treated by structural BMPs that substantially reduce pathogen concentrations in stormwater. The remaining portion of the site travels as sheet flow; pathogen loads from this runoff are likely to be reduced by infiltration and travel through vegetation.

As described above, the vegetated swale is designed to retain storm water associated with a 3 year, 24-hr rain event. Therefore, during most years there will not be runoff from the 10.3 acres that drains to the vegetated swales assuming the swales are not already inundated with water. This will eliminate the bacteria runoff from more than 50% of the site under normal conditions.

Another 3.9 acres of the site drains to a bioretention swale and a vegetated swale. Pathogen loads are also reduced by the leaching catch basins that infiltrate some of the runoff from 1.8 acres of the site. While there are insufficient site-specific data to quantitatively estimate the performance of these features at reducing the pathogen loading, they are likely to reduce pathogen loads from the area they treat.

In addition, MassDOT implements a variety of non-structural BMP programs in accordance with their existing Storm Water Management Plan (SWMP). Those BMPs can help reduce potential pathogen loading to Charles River at the I-495 crossing.

- BMP 1F: Post Contact Names for Municipal Drainage Concerns
- BMP 3D: Illicit Connection Review
- BMP 6A-1: Source control – 511 program

- BMP 6A-2: Source control – Adopt-A-Highway program
- BMP 6C-1: Maintenance program

MassDOT will continue implementation of these and other non-structural BMPs outlined in their SWMP.

Assessment and Mitigation Plan

These structural and non-structural BMPs are consistent with the pathogen TMDL's requirements and recommendations. The TMDL recognizes that:

> "setting and achieving TMDLs should be an iterative process, with realistic goals over a reasonable timeframe and adjusted as warranted based on ongoing monitoring. The concentrations set out in the TMDL represent reductions that will require substantial time and financial commitment to be attained. A comprehensive control strategy is needed to address the numerous and diverse sources of pathogens in the Charles River watershed. given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish (Page 64)."
>
> "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals (Page 69)."

Based on this, the existing BMPS in place at the Bellingham site, both structural and non-structural, are consistent with TMDL. In addition, these BMPs achieve the maximum treatment possible given site constraints.

Assessment for Flow Alterations, Fish Bioassessments, Other, Chlordane, and DDT Under BMP 7U

The impairments for other flow regime alterations, other, chlordane, and DDT have not been addressed by a TMDL. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U (Water Quality Impaired Waters Assessment and Mitigation Plan).

According to the Charles River Watershed 2002-2006 Water Quality Assessment Report the flow alteration impairment is a result of flow alterations from water diversion and dams/impoundments (MassDEP 2008). Four dams, including the North Bellingham, Caryville, Bellingham, and West Medway Dams, currently exist within this waterbody segment. Therefore, stormwater discharges from MassDOT are not causing the flow alterations impairment for this segment of the Charles.

MassDEP has indicated that the impairment for fish bioassessment is likely related to high phosphorus concentrations and low DO concentrations and the habitat alterations associated with dams and impoundments. In addition, MassDEP has indicated that stormwater runoff is a *potential* contributor to this impairment (MassDOT 2008). As described above, this site has significant structural BMPs in place that treat runoff from the majority of the site. These BMPs have been estimated to reduce phosphorus loading by nearly 50% (VHB 2010). Therefore, the runoff from this site is not causing the impairment for fish bioassessment. In addition, as described above, these BMPs are the maximum extent practicable at this location.

This segment of the Charles River is also impaired for "other" impairments. The basis for this impairment is unclear and is not defined in the Charles River Watershed 2002-2006 Water Quality Assessment Report. However, it is likely related to cumulative impacts of the flow regime alterations, chlordane and DDT, and other factors unrelated to MassDOT. Furthermore, the 303(d) list indicates that this impairment is caused by a "non-pollutant." Therefore, based on available information, runoff originating from MassDOT property at Bellingham is not causing the "other" impairment.

While Chlordane and DDT can be found on occasion in stormwater, they are agricultural pesticides not used by MassDOT and should not be draining from MassDOT property. Neither compound is used any longer and is banned by US EPA. The Nationwide Urban Runoff Program (NURP; USEPA 1983) found that DDT was detected in only 1% of stormwater samples. Chlordane was detected in 17% of the samples assessed in the NURP; the use of this compound was banned in 1983, the date of the NURP study. Therefore, chlordane is less likely to be present in stormwater runoff than when the NURP study was conducted. Therefore, it is very unlikely to be found in significant quantities in stormwater runoff from MassDOT. The impairments related to Chlordane and DDT are not caused by runoff from MassDOT property.

Conclusions

The majority of stormwater runoff from MassDOT's property at the I-495 Crossing in Bellingham is treated by existing structural BMPs. Approximately half of the generated stormwater originating from MassDOT discharges to a vegetated swale. Overflow from the swale collects in a catch basin and discharges to the Charles River. The remaining stormwater flows either to a newly constructed bioretention swale or through five new leaching basins. MassDOT also implements numerous non-structural BMP programs that, in conjunction with the structural BMPs, can provide controls that provide pathogen reductions consistent with the Final Pathogen TMDL for the Charles River Watershed.

MassDEP has indicated that the impairment for fish bioassessment is likely related to high phosphorus concentrations and low DO concentrations and habitat alterations associated with dams and impoundments. In addition, MassDEP has indicated that stormwater runoff is a potential contributor to this impairment. The significant structural BMPs at this location help ensure that the discharge from this location is not causing this impairment.

MassDEP determined that the impairments for low flow alterations and other flow regime alterations at this site are caused by water withdrawals and dams (MassDEP 2008). Therefore, MassDOT has concluded that stormwater from this site does not cause these impairments.

Similarly, the stormwater runoff from MassDOT's Bellingham property is not causing the impairments for chlordane or DDT. Although, there are no site-specific data on these constituents they are very unlikely to be present in runoff from MassDOT roadways in significant concentrations. DDT and Chlordane pesticides were widely used for agricultural purposes in the past. However, both compounds have been banned by US EPA and are very unlikely to be found in stormwater runoff from MassDOT.

References

AECOM. 2009. Evaluating Highway Runoff's Effect on Receiving Waters at Three Sites in Massachusetts.

MA DEP. 2007. Final Pathogen TMDL for the Charles River Watershed January 2007. Available at: http://www.mass.gov/dep/water/resources

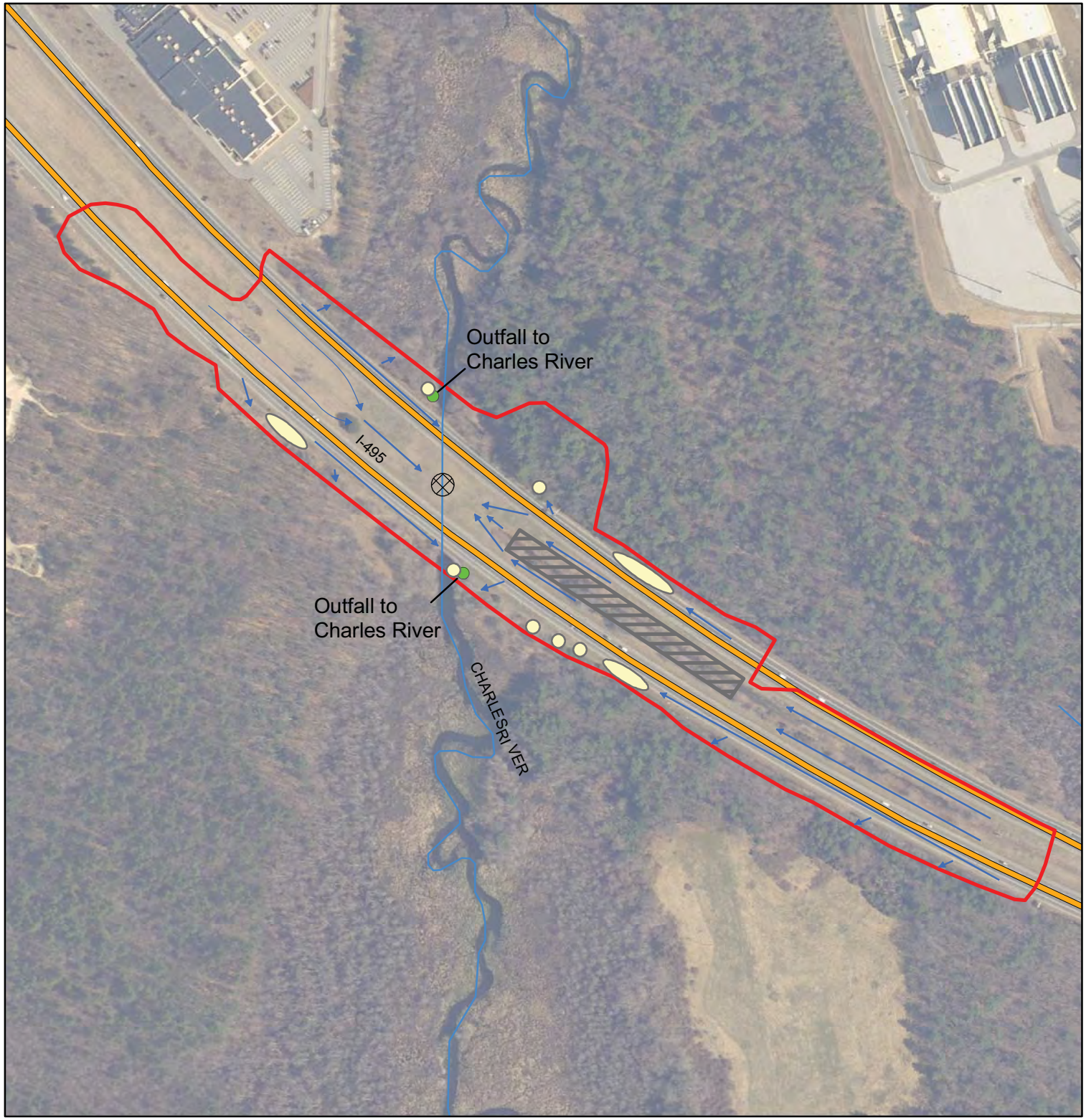
MassDEP 2008. Charles River Watershed 2002-2006 Water Quality Assessment Report. Available at: http://www.mass.gov/dep/water/resources/72wqar07.pdf

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

US EPA 1983. Results of the Nationwide Urban Runoff Program. Volume 1 – Final Report. EPA WH-554

US EPA 2002. National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002

VHB. 2010. MassDOT Stormwater Mitigation Summary. Document # 10829.19



MassDOT Outfall
MassDOT Urban Area Roads
Estimated Outfall Drainage Area
Bioretention Area-not to scale
Leaching Basin-not to scale
Vegetated Swale-not to scale
Catch Basin

Figure 1.
Charles River (MA72-04)
Interstate 495

September 2010

N

0 105 210 420 630 840
Feet

Moving Massachusetts Forward.
massDOT
Highway

Impaired Waters Assessment for Charles River (MA72-01)

Impaired Water Body

Charles River (MA72-01-2008)

Impairments[1]

Low flow alterations, Other flow regime alterations, Oxygen, Dissolved

Relevant Water Quality Standards:

- Water Body Class: A, Public Water Supply
- 4.05 (3)(a) 1. Dissolved Oxygen. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.

Site Description

MassDOT owns Interstate 495 (I-495) which that crosses over the Charles River in Milford, MA (Figure 1). Approximately 58 acres of MassDOT right-of-way (ROW) drains to the Charles River Segment MA72-01. The contributing area is comprised of impervious highway, grass, and forest. Runoff from MassDOT property drains through a stormwater system containing several best management practices (BMPs). During typical conditions most runoff from this site discharges to Cedar Swamp Pond. During extreme precipitation events some storm water is discharged through one outfall to the Charles River. This assessment reviews the discharge to the Charles River. MassDOT will complete an assessment of the discharge to Cedar Swamp Pond in the future.

At this site, I-495 is divided. The northbound and southbound lanes are each approximately 55 feet wide, including the shoulder. The length of highway corridor contributing to the discharge point is approximately 3,800 feet (Figure 1).

Runoff from MassDOT's contributing watershed to the Charles River is conveyed via catch basins and swales in the medians. Several previously marked outfalls have been determined to contribute to the stormwater system and BMPs and discharge through one primary outfall to the Charles River.

Approximately 55.5 acres of MassDOT property drains to the detention pond with a low stage overflow that diverts water to Cedar Swamp Pond. This detention pond has a two-stage outlet. The low-stage outlet diverts stormwater south through the Milford MS4 system to Cedar Swamp Pond

[1] The 2008 303(d) list indicates that this segment is impaired for mercury in fish tissue. The draft 2010 303(d) list indicates that this listing was the result of a typographical error. Therefore, no assessment of this impairment was conducted.

(aka Milford Pond). A headwall approximately controls flow into the high-stage outlet that discharges to the Charles River.

Based on a hydrologic analysis of the contributing watershed and the existing detention pond without any additional BMPs, it was calculated that storm events with 4 inches or less of rain over a 24-hour period will not result in any discharge to the Charles River from a majority (more than 95%) of the site. These flows will instead outlet to the detention pond via the low level outlet system which discharges to Cedar Swamp Pond (MA72016)[2]. The 4-inch storm is approximately equivalent to the 20% annual chance storm event (5-year storm event). Therefore, there is a 20% chance each year that a storm event of this size or larger would occur.

To supplement the treatment provided by the detention basin, MassDOT designed and constructed one bioretention area and three bioretention swales within the last year. These newly added BMPs treat runoff from approximately 61% of the site and will retain a portion of the flow.

Approximately 4% of the MassDOT site (2.5 acres) discharging directly to the Charles River consists primarily of grass and forested ROW.

This segment is covered by a draft TMDL for nutrients. Although this TMDL is still draft, it represents the best available evidence of the potential contribution of stormwater to the Charles River impairment for dissolved oxygen. Therefore, the water body has been assessed under BMP 7R which applies to impairments covered by TMDLs. The impairments for low flow alterations and other flow regime alterations are considered under BMP 7U which covers impairments without TMDLs.

Assessment of Impairment for Dissolved Oxygen under BMP 7R:

The Draft Total Maximum Daily Load for Nutrients in the Upper/Middle Charles River covers this segment of the Charles River and addresses the impairments for Dissolved Oxygen. Although this TMDL is still draft, it represents the best available information for assessing the relative contribution of various pollutant sources that contribute to the dissolved oxygen impairment from this segment. Similarly, it provides the necessary information to assess the reductions in pollutant loading needed to ensure that discharges are not causing the dissolved oxygen impairment. Therefore, MassDOT assessed the dissolved oxygen impairment of this water body using the information in the draft TMDL and the approach described in BMP 7R (TMDL Watershed Review).

TMDL

Draft Total Maximum Daily Load for Nutrients in the Upper/Middle Charles River. Massachusetts

- Pollutant of Concern: Phosphorus
- Segment Impairment Addressed by TMDL: Dissolved Oxygen
- Applicable Waste Load Allocation: See Table ES-3 Phase III Final Report.
  - Description of Associated Land Use: Transportation
  - Transportation Land Use Current Load (TP): 2,167 kg/yr

[2] Cedar Swamp Pond will be addressed in a separate assessment.

- Transportation Land Use WLA (TP): 759 kg/yr
- Commercial/Industrial/Transportation Area in Watershed: 15.9 sq miles or 5.9% (reported in Phase III Calibration Report Table 5. Transportation not separated from Commercial/Industrial during TMDL analysis)
- Commercial/Industrial/Transportation Land Use Areal WLA: 0.72 kg/ha/yr (calculated)

- Applicable Recommendations Section 7.2 Phase III Final Report
  - Management of Stormwater systems - Page 83 Phase III Final Report:
    - "Comprehensive programs will be necessary to achieve the phosphorus reduction and water quality goals of this TMDL. Programs should build upon existing stormwater management accomplish the following tasks:
      - characterize the drainage areas that contribute to discharges requiring permit coverage under the Permittee's jurisdiction
      - implement a comprehensive Illicit Discharge Detection and Elimination (IDDE) program
      - prioritize source areas for stormwater management and control
      - identify site-specific and regional opportunities for implementation of BMPs
      - include the necessary structural and non-structural best management practices (BMPs) that, upon implementation, will achieve reductions in phosphorus loadings from the NPDES covered drainage areas that are consistent with the phosphorus load reductions identified in this TMDL)
    - Management of illicit discharges to stormwater drainage systems"

Estimated Loading from MassDOT

As described above, during typical storm events there is no discharge or associated phosphorus loading to the Charles River from approximately 55.5 acres of the MassDOT property. During the rare storm events that do cause discharge from this portion of the site, a significant portion of the discharge continues to drain to Cedar Swamp Pond. Runoff from 61% of the MassDOT area is treated by newly installed BMPs. The following table lists the BMPs, contributing areas, estimated phosphorus removal percentages based on the Massachusetts Department of Environmental Protection Stormwater Management Standards (2008), and removal percentages used for calculations as part of the design of the recent improvements (VHB 2010).

BMP	Contributing Impervious Watershed (acres)	Phosphorus Removal Rate From MA Stormwater Standards	Phosphorus Removal Rate used in Calculation
Bioretention Swales (3)	33.2	30% - 90%	65%
Bioretention Areas (2)	6.4	30% - 90%	65%
Detention Pond	55.6	10% - 30%	10%

In addition, the calculations included existing small wetlands located in the medians and right of way areas which provide an estimated 25% phosphorus removal. These removal rates reflect those assumed during VHB's analysis and design of the BMPs (VHB 2010).

In combination, the diversion of the vast majority of flow and the multiple existing BMPs make the average annual discharge of phosphorus to the Charles River from the 55.5 acres that drains to the

detention pond *de minimus*. Average areal total phosphorus (TP) loading rates from highway impervious surface are estimated based on data collected in a study of stormwater runoff from highways operated by MassDOT conducted by USGS (Smith and Granato in press). This study collected stormwater samples from 12 sites located on highways operated by MassDOT across Massachusetts between September 2004 and September 2009. These sites and sampling program was designed to generate representative data for a range of highways and to be transferable to other highways characterized by different construction techniques, land use, and geography. Samples were taken under a variety of weather conditions during this period. Based on this data, estimated TP loading from impervious areas is 1.9 kg/ha/yr.

Using this loading rate with the portion of MassDOT property that discharges directly to the Charles River (1.0 hectares), the loading from MassDOT is calculated as 1.9 kg/yr. This equates to an areal loading rate of 0.080 kg/ha/yr for the entire 58 acre site. This is much lower than the areal WLA of 0.72 kg/ha/yr.

This value is conservative because the 2.5 acres that flows from MassDOT ROW directly to the Charles River is vegetated with forest and grass. Therefore, the P loading from this land use is likely to be significantly less than the 1.9 kg/ha/yr from impervious areas. The loading rate estimated from MassDOT during a typical year in which there was not any discharge from this pond (i.e. there were not any storms greater than 4 inches within 24 hours). Although the loading would be slightly higher during a year with a more substantial storm, the impact on the average annual load would likely be insignificant.

Assessment and Mitigation Plan:

MassDOT has provided treatment to the maximum extent practicable in the area and has shown treatment and load reductions that result in an estimated areal loading rate to the Charles River that is much less than the areal WLA. Therefore no additional measures are necessary to be consistent with the Draft Charles River TMDL.

MassDOT will continue practices to maintain the stormwater system and bioretention ponds and swales, and detention pond in this area including the following activities:

- BMP 3D: Perform illicit discharge inspection as part of NPDES stormwater permit
- BMP 6C-1 Maintenance Program.

MassDOT will continue implementation of these and other non-structural BMPs outlined in their SWMP.

Assessment of Consistency with Final Pathogen TMDL for the Charles River Watershed under BMP 7R

Although this segment of the Charles River is not impaired for pathogens, it is covered by the Final Pathogen TMDL for the Charles River Watershed. Therefore, this represents pollution prevention TMDL for this water body segment. A pollution prevention TMDL is intended to maintain and protect existing water quality

The WLA for this segment is based on achieving an end of pipe concentration of fecal coliforms that is equal to the water quality standard. Consequently, this assessment is based on achieving a reduction in pathogens equivalent to that required to a geometric mean concentration of 20 cfu/100 ml.

TMDL

Final Pathogen TMDL for the Charles River Watershed

- Pollutant of Concern: Fecal Coliform, *E. coli*
- Segment Impairment Addressed by TMDL: *E.coli*
- Applicable Waste Load Allocation per TMDL (segment MA72-01): See Table 7-4 of the TMDL (page 62).
  - Description of Associated Land Use: Impervious Surface
  - WLA: 1.1 x 10^8 colonies/day
  - Total impervious area: 166 acres
  - Areal impervious WLA: 6.6 x 10^5 colonies/acre/day
  - Fecal coliform concentration-based WLA target for Class A waters: Not to exceed an arithmetic mean of 20 organisms per 100 ml in any set of representative samples, nor shall 10% of the samples exceed 100 organisms per 100 ml
- Applicable Recommendations:
  - "Municipalities that operate regulated municipal separate storm sewer systems (MS4s) must develop and implement a storm water management plan (SWMP) which must employ, and set measurable goals for the following six minimum control measures:
    1. public education and outreach particularly on the proper disposal of pet waste,
    2. public participation/involvement,
    3. illicit discharge detection and elimination,
    4. construction site runoff control,
    5. post construction runoff control, and
    6. pollution prevention/good housekeeping." (Page 68 of TMDL)
       - "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory technology standard for MS4s that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals. The bacteria quality of storm water discharges must be such that water quality criteria are met in the waterbody." (page 69 of TMDL)

Estimated Loading from MassDOT

There is no site-specific data regarding pathogen concentrations in stormwater from MassDOT roadways. However, a study conducted on the South East Expressway measured bacterial concentrations in stormwater runoff (Smith 2002). This study found fecal coliform concentrations in runoff from highway had a geometric mean of 186 organisms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely. Therefore, the concentrations in runoff from this site may be significantly different that literature values.

While the area draining into Charles River is substantially different, these data represent a reasonable estimate of the concentration of fecal coliforms in runoff from MassDOT roadways. There are currently no structural BMPs in place that would reduce the concentration of pathogens

from the outfall in question although the overall load will be reduced because of infiltration provided by the BMPs.

As described above, discharge from more than 95% of the area operated by MassDOT is *de minimus* on an average annual basis. Drainage structures in place divert a vast majority of the stormwater from this site to Cedar Swamp Pond. Therefore, fecal coliform loading to this segment of the Charles River is reduced by 95% by this drainage configuration alone. This reduction is consistent with the applicable WLA[3].

In addition, MassDOT already implements a variety of non-structural BMP programs in accordance with their existing Storm Water Management Plan (SWMP). The BMPs that can help reduce potential pathogen loading to the Charles River include:

- BMP 1F: Post Contact Names for Municipal Drainage Concerns
- BMP 3D: Perform illicit discharge inspection as part of NPDES stormwater permit
- BMP 6A-1: Source control – 511 program
- BMP 6A-2: Source control – Adopt-A-Highway program
- BMP 6C-1: Maintenance program

In order to further address pathogen loading in this location, MassDOT will conduct illicit discharge detection efforts within the next year and eliminate any illicit connections detected as soon as possible.

Assessment and Mitigation Plan

These efforts are consistent with the pathogen TMDL's requirements and recommendations. The TMDL recognizes that "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges…. The bacteria quality of storm water discharges must be such that water quality criteria are met in the waterbody" (Page 69). Since the water body under current conditions has not been found to exceed the water quality criteria for pathogens (i.e. the water body has not been classified as impaired for pathogens), stormwater discharges from MassDOT are consistent with this statement. Furthermore, the existing BMPs reduce pathogen discharges by more than 95%. Based on this, the structural and non-structural measures it has in place are consistent with the TMDL requirements.

Assessment for Low Flow and Other Flow Regime Alterations under BMP 7U

The TMDL that covers this segment of the Charles River does not address the other impairments of the segment including low flow alterations and other flow regime alterations. Therefore, this water body is assessed using the approach described in BMP 7U (Water Quality Impaired Waters Assessment and Mitigation Plan).

Water is withdrawn from this segment by the Milford Water Company. The Charles River Watershed 2002-2006 Water Quality Assessment Report indicates that the impairment of this section is cause by flow alterations from water diversion and dams/impoundments (MassDEP

[3] Due to the high variability in pathogen concentration in stormwater, a quantitative assessment of pathogen loading versus the WLA was not conducted. However, a reduction of 95% is likely to achieve the WLA.

2008). Therefore, stormwater discharges from MassDOT are not causing the impairments related to flow regime alterations for this segment of the Charles.

Conclusions

The majority of stormwater from MassDOT property is diverted to Cedar Swamp Pond and does not reach the Charles River. As a result, the estimated areal loading rate to the Charles River from the site is much lower than the areal WLA for phosphorus provided in the Upper Charles River Nutrient TMDL. This diversion of storm water flow also reduces pathogen loading by approximately 95%. This reduction, in combination with non-structural BMPs is consistent with the pollution prevention TMDL established for pathogens. MassDOT has recently installed significant structural BMPs to provide additional stormwater treatment at this site. Therefore, further actions by MassDOT are not warranted for this location to be consistent with TMDL requirements for pathogens or nutrients.

The impairments for low flow alterations and other flow regime alterations have been determined by MassDEP to be caused by flow alterations from water diversion and dams and impoundments. Therefore, MassDOT is not causing these impairments and need not take further action at this location.

The loading from this site to Cedar Swamp Pond will be addressed during the assessment of that water body.

References

MA DEP 2007. Final Pathogen TMDL for the Charles River Watershed January 2007. Available at: http://www.mass.gov/dep/water/resources

MassDEP 2008. Charles River Watershed 2002-2006 Water Quality Assessment Report. Available at: http://www.mass.gov/dep/water/resources/72wqar07.pdf

MassDEP 2009. Draft Total Maximum Daily Load for Nutrients in the Upper/Middle Charles River, Massachusetts. Available at: http://www.mass.gov/dep/water/resources/ucharles.pdf

Smith, K.P., and Granato, G.E., In press, Quality of stormwater runoff discharged from Massachusetts highways,2005–07: U.S. Geological Survey Scientific Investigations Report 2009–5269, 198 p.

VHB. 2010. MassDOT Stormwater Mitigation Summary. Document # 10829.19

MassDOT Outfall

MassDOT Urban Area Roads

Estimated Outfall Drainage Area

Existing BMPs - not to scale

Figure 1.
Charles River (MA72-01)
Interstate 495 and Route 85

September 2010

N

0 375 750 1,125 1,500 Feet

Moving Massachusetts Forward. massDOT Highway

Impaired Waters Assessment for Spectacle Pond (MA36142)

Impaired Waterbody

Spectacle Pond (MA36142)

Impairments

Noxious Aquatic Plants

Relevant Water Quality Standards

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

TMDL

Final TMDLs of Phosphorus for Selected Chicopee Basin Lakes

- Pollutant of Concern: Phosphorus
- Impairment's addressed in TMDL: Noxious Aquatic Plants
- Applicable Waste Load Allocation: None. TMDL only has a Load Allocation.
- Applicable Recommendations:
  - ""Regulate road sanding, salting, regular sweeping, and installation of BMPS" (Table 6, Pg 52).

Site Description

MassDOT owns Boston Road which passes to the south of Spectacle Pond (MA36142). Approximately 1,500 ft of Boston Road and 200 ft of Spectacle Pond Road drain to Spectacle Pond through two MassDOT outfalls (Figure 1).

MassDOT's Appendix L-1 of Impaired Waterbodies (dated July 22, 2010) indicated four MassDOT outfalls within 500 feet of Spectacle Pond. This outfall number was based on an automated review of GIS data. A field visit of this site on October 21, 2009 and review of the drainage in the area indicated that recent drainage improvement construction on Boston Road altered the drainage system and consolidated 7 previously existing outfalls (four in outfall inventory plus three identified in the field) into two active outfalls. This construction also installed new BMPs (Figure 1).

- Outfall 17882 drains approximately 1,500 ft of Boston Road (Figure 1). This outfall has a newly installed manhole that discharges to a rip-rap plunge pool. The plunge pool slows the velocity of stormwater and captures sediment prior to discharge into Spectacle Pond. After runoff discharges from the plunge pool it travels over a vegetated filter for

approximately 20 feet allowing for additional infiltration and pollutant uptake as the soils are sandy (Figure 2).

- Outfall 17883 drains approximately 200 ft of Boston Road (Figure 1). In addition, this outfall appears to drain portions of Spectacle Road (which is not owned by MassDOT) and the surrounding land. BMPs have recently been installed at this outfall, including a rip rap swale, plunge pool and vegetated buffer. The rip rap swale and plunge pool slow the velocity of stormwater, reduce erosion and capture pollutants. The vegetated filter allows for additional pollutant uptake and infiltration prior to discharge to the pond (Figure 3).

During the site visit, the outfalls were assessed for illicit discharges. Field staff did not observe any dry weather flow from either of the outfalls.

This water body has been assessed under BMP 7R TMDL Watershed Review, which applies to impairments covered by a TMDL for the noxious aquatic plants impairment

Assessment under BMP 7R for Noxious Aquatic Plants

The TMDL of Phosphorus for Selected Chicopee Basin Lakes addresses Spectacle Pond's impairment for noxious aquatic plants. This TMDL does not contain a WLA for discharges to Spectacle Pond. Instead all pollutant sources to this water body have a load allocation (LA). As described in Step 4 of BMP 7R, for TMDLs without an applicable WLA, MassDOT will rely on BMP recommendations in the TMDL to determine whether existing control measures are adequate. The TMDL recommends that MassDOT (MassHighway) "Regulate road sanding, salting, regular sweeping, and installation of BMPs." The BMPs described below are consistent with this recommendation and therefore no further measures are necessary.

The MassDOT outfalls that drain to Spectacle Pond have significant structural stormwater BMPs and other features that reduce phosphorus loading. These include:

- Outfall 17882:
  - Rip rap plunge pool
  - 20 feet of overland flow across sandy soils that promote infiltration
- Outfall 17883
  - Riprap swale
  - Plunge pool
  - Overland flow

In combination, these BMPs significantly reduce the loading of phosphorus to Spectacle Pond. The riprap swale for Outfall 17883 provides a stable conveyance of flow to the next BMP. The riprap will also slow down the runoff and allow for settling of solids. The riprap plunge pool at each outfall slows down the runoff as it exits the pipe/swale and allow solids (with pollutants attached) to settle out. The runoff then flows over the vegetated area via sheet flow infiltrating into the soil along the way. The vegetation also provides pollutant uptake. These BMPs provide significant pollutant removal for the stormwater before it discharges to the pond.

MassDOT also implements a number of non-structural BMPs statewide. These include management of road sanding, salting, and regular sweeping. As part of its overall Storm Water Management Plan, MassDOT has implemented measures to improve these practices including:

- BMP 6A-3: Deicing Programs and Reduced Salt Areas,
- BMP 6C-1 Maintenance Program,
- BMP 6F Snow and Ice Control GEIR Policy and Program Review,
- BMP 6J Salt Storage BMP/ Pollution Prevention,
- BMP 6K Deicing Equipment Improvements,
- BMP 6L Enhanced Weather Forecasting Information,
- BMP 6N Deicing Alternative Technologies, and
- BMP 6O Deicing Research.

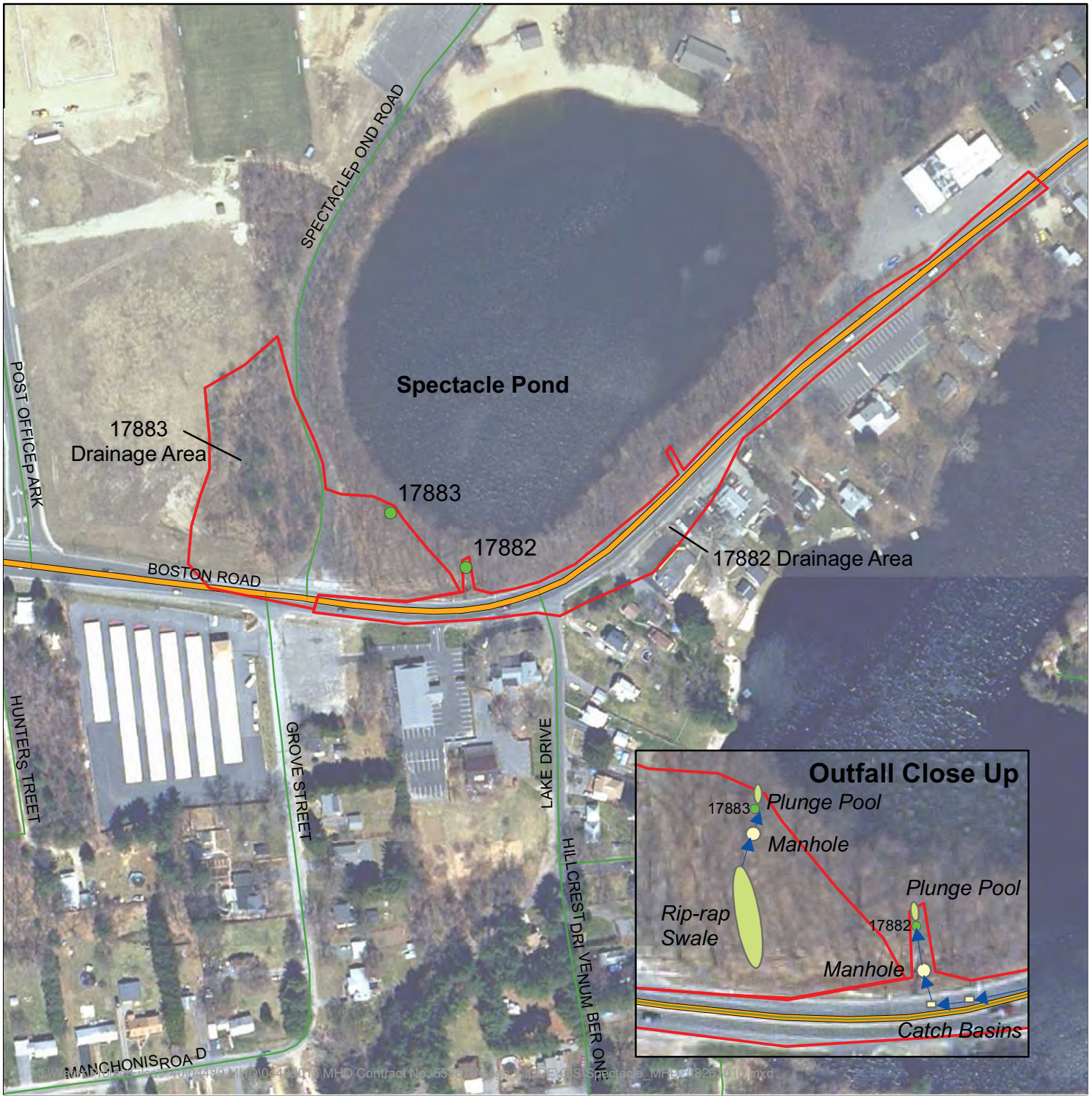
The structural and non-structural BMPs that MassDOT implements at this location are consistent with the TMDL's recommended BMPs.

Conclusions

The TMDL for Spectacle Pond which addresses the impairment for noxious aquatic plants does not contain a WLA for phosphorus. Therefore, as described in BMP 7R MassDOT relied on the recommendations of the TMDL to address the impairment in question. As described above, the TMDL recommends regulating road sanding, salting, sweeping and installation of BMPs. The stormwater runoff from MassDOT to Spectacle Pond is treated by a variety of structural BMPs. In addition, MassDOT implements a number of non-structural BMPs. These BMPs are consistent with the recommendations of the TMDL for Spectacle Pond. Therefore, no further action will be taken.

References

MassDEP 2002. Total Maximum Daily Loads of Phosphorus for Selected Chicopee Basin Lakes. Available at: http://www.mass.gov/dep/water/resources/conntmdl.pdf



Mass DOT Outfall

MassDOT Urban Area Roads

Non-Mass DOT Roads

Estimated Outfall Drainage Area

Figure 1.
Spectacle Pond
Route 20
(Old Boston Post Rd)
N. Wilbraham, MA

September 2010

N

200 100 0 200 Feet

massDOT Highway

Impaired Waters Assessment for West Falmouth Harbor (MA95-22)

Impaired Waterbody

West Falmouth Harbor (MA95-22)

Impairments

Nutrients, Pathogens, Other Habitat Alterations

Relevant Water Quality Standards

- Water Body Classification: SA
- 314 CMR 4.05 (4)(a)(4a) Bacteria. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the *Guide for the Control of Molluscan Shellfish* (more stringent regulations may apply).
- 314 CMR 4.05 (5)(b) Bottom Pollutants or Alterations. All surface waters shall be free from pollutants in concentrations or combinations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish or adversely affect populations of non-mobile or sessile benthic organisms.
- 314 CMR (5)(c) Nutrients. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.

Site Description

MassDOT discharges through an outfall off of Old Dock Road in Falmouth, MA in between Chapoquoit Road and Shore Road/West Falmouth Highway (Figure 1). This outfall is not located on MassDOT property. While MassDOT does not own or operate Old Dock Road, it does own Shore Road/West Falmouth Highway, approximately 2,100 linear feet of which ultimately drains through the Old Dock Road outfall. The total MassDOT property draining through the outfall is estimated to be 0.98 hectares. A system of catch basins collects stormwater from Shore Road/West

Falmouth Highway and routes it through the outfall that discharges directly into West Falmouth Harbor. The total watershed area for the Harbor is 1,085 hectares.

MassDOT maintains numerous other outfalls along Shore Road/West Falmouth Highway and Route 28 (Figure 1) none of which drain through the Old Dock Road outfall. These outfalls range from approximately 1,200 to 3,400 feet away from the shoreline of West Falmouth Harbor. The TMDL for total nitrogen states that because of the high infiltrations of the soils of Cape Cod" it is unlikely that runoff would be channeled as a point source directly to a waterbody from areas more than 200 feet away." Therefore, since these MassDOT outfalls lie beyond 200 feet from West Falmouth Harbor it is very unlikely that any discharge from these outfalls reaches West Falmouth Harbor. In the unlikely event that flow from these outfalls reaches West Falmouth Harbor, it would be substantially reduced (due to infiltration) in volume and represent a *de minimus* source of pollutants. Therefore, these outfalls will not be considered further.

This water body has been assessed under BMP 7R TMDL Watershed Review, which applies to impairments covered by TMDLs for nitrogen/other habitat alterations and pathogen impairments.

Assessment under BMP 7R for Nutrients and Other Habitat Alterations Impairments

The West Falmouth Harbor Embayment System – Total Maximum Daily Loads for Total Nitrogen addresses the nutrient and other habitat alterations impairments for this water body. Therefore, MassDOT assessed the nitrogen contribution to this water body using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

West Falmouth Harbor Embayment System – Total Maximum Daily Loads for Total Nitrogen

- Pollutant of Concern: Total Nitrogen
- Impairment Addressed: Nutrients, Other Habitat Alterations
- Applicable Waste Load Allocation per TMDL (for West Falmouth Harbor, segment MA95-22, including Outer and Inner West Falmouth Harbor, Snug Harbor, and Mashapaquit Creek): See Tables 4 and 5 of the TMDL (pages 15 and 20, respectively) and Appendix C.
  - Description of Associated Land Use: Impervious area within 200 ft of Shoreline
  - Total WLA: 113.15 kg/year
  - Total impervious area within 200 feet of shoreline: 5.5 hectares
  - Areal WLA: 20.57 kg/hectare/year
- Applicable Recommendations:
  - "Since the majority of the nitrogen loading comes from septic systems, fertilizer, and storm water that infiltrates into the groundwater, the allocation of nitrogen for any storm water pipes that discharge directly to any of the embayments is insignificant compared to the overall groundwater load. (page 16 of the TMDL)."
  - "…based on the fact that there are few storm water discharge pipes within NPDES Phase II communities that discharge to embayments or waters that are connected to embayments, the total waste load allocation for these sources is considered to be insignificant. …This conservative load is obviously negligible when compared to other sources (pages 16 and 17 of the TMDL)."

Estimated Loading from MassDOT

Estimated Total Nitrogen loading from Shore Road/West Falmouth Highway was calculated using the following assumptions and calculations:

- Nitrogen loading rates were estimated based on data collected in a study of stormwater runoff from highways operated by MassDOT conducted by USGS. (Smith and Granato in press). This study collected stormwater samples from 12 sites located on MassDOT highways between September 2004 and September 2009. Samples were taken under a variety of weather conditions during this period. Based on these data, we have estimated the total nitrogen loading from impervious highway areas to be 16 kg/hectare/yr.
- Estimated MassDOT area that drains to West Falmouth Harbor = 0.98 hectares
- Estimated load from MassDOT area = 16 kg/yr.

Assessment and Mitigation Plan

According to the West Falmouth Harbor Embayment System – Total Maximum Daily Loads for Total Nitrogen, the Total Nitrogen stormwater load to West Falmouth Harbor is insignificant (pages 16 and 17 of the TMDL). The TMDL has an areal WLA of 20.57 kg/hectare/yr while the estimated loading rate based on USGS data for similar roads is 16 kg/hectare/yr. Therefore, MassDOT's total nitrogen loading is compliant with the TMDL's WLA and further measures are not proposed.

Assessment under BMP 7R for Pathogen Impairment

The Final Pathogen TMDL for the Buzzards Bay Watershed covers the pathogen impairments for West Falmouth Harbor. Therefore, this pathogen impairment for this water body was assessed using the approach described in BMP 7R (TMDL Watershed Review). The WLA for stormwater is based on the water quality standard of a geometric mean of 14 organisms/100 ml (MPN).

TMDL

Final Pathogen TMDL for the Buzzards Bay Watershed

- Pollutant of Concern: Fecal Coliform, E. Coli, Enterococcus
- Impairments addressed: Pathogens
- Applicable Waste Load Allocation per TMDL (for West Falmouth Harbor only – segment MA95-22): See Table 7-2b of the TMDL (page 97).
  - Description of Associated Land Use: Impervious area within 200 ft of Shoreline
  - Total loading capacity: 2.27×10^7 colonies/day
  - WLA: 5.31×10^6 colonies/day
  - Total impervious area within 200 feet of shoreline:: 0.35 hectares[1]

[1] The total impervious area is based on values presented in Table 7-2b of the Pathogen TMDL. MassDOT review shows this is inaccurate and an underestimate of the impervious area in the watershed. The total watershed area in this table is not consistent with the value in the Total Nitrogen TMDL. The TMDL calculated WLA based on the estimated runoff from the impervious area and the applicable water quality standard for pathogens. Therefore, a similar approach was used for assessing compliance with the WLA.

  - Areal WLA: 1.53 x 10^7 Fecal coliform colonies/hectare/day
  - Fecal coliform concentration-based target for Class SA waters: geometric mean of 14 organisms/100 ml (MPN), nor shall 10 percent of samples be >= 28 org/100 ml
- Applicable Recommendations:
  - "segments impaired during wet weather should be evaluated for storm water BMP implementation opportunities starting with application of less costly non-structural practices (see page 100 of the TMDL)."

Estimated Loading from MassDOT

There are no site-specific data regarding pathogen concentrations in stormwater from MassDOT roadways. However, a study conducted on the South East Expressway measured bacterial concentrations in stormwater runoff (Smith 2002). This study found fecal coliform concentration data with a geometric mean of 186 organisms/100 ml. There are currently no structural BMPs in place that would reduce the concentration of pathogens from the outfall in question

Concentrations of pathogens in stormwater runoff from roadways can vary widely. Therefore, the concentrations in runoff from this site may be significantly different than those measured in the South East Expressway study.

Assessment and Mitigation Plan

MassDOT already implements a variety of non-structural BMP programs in accordance with their existing Storm Water Management Plan (SWMP). Those BMPs that can help reduce potential pathogen loading to West Falmouth Harbor include:

- BMP 1F: Post Contact Names for Municipal Drainage Concerns
- BMP 3D: Illicit Discharge Detection Review
- BMP 6A-1: Source control – 511 program
- BMP 6A-2: Source control – Adopt-A-Highway program
- BMP 6C-1: Maintenance program

Furthermore, the potential to retrofit additional structural BMPs was considered. The site has severe space constraints that make retrofitting structural BMPs capable of significantly reducing pathogen loading impracticable at this location. The outfall itself is not located on MassDOT property. Therefore, MassDOT could not practicably retrofit an end-of-pipe BMP. There is very limited right of way along Shore Road/West Falmouth Highway (See Figure 2). While it may be possible to install narrow infiltration swales/ trenches along this road, the limited space available would limit their effectiveness. Further, use of BMPs along the roadway can potentially lead to hazards for pedestrians. As shown in Figure 2, there is a path off the roadways used by pedestrians. BMPs would block this area for pedestrians and require them to walk closed to the traffic. Therefore, it has been concluded that retrofitting structural BMPs at this location is impracticable.

In order to further address pathogen loading in this location, MassDOT will conduct illicit discharge detection efforts by the end of the year and eliminate any illicit connections detected. Finally, during the next reconstruction effort on Shore Road/West Falmouth Highway MassDOT will consider whether structural BMPs to address pathogens can be incorporated into the project as part of MassDOT's new Impaired Waterbody Program for Programmed Projects.

MassDOT efforts, as described above, are consistent with the pathogen TMDL's requirements and recommendations. The TMDL recognizes that

> "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (Page 108-109)
>
> "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(Page 109)

Furthermore, the contribution of pathogens from MassDOT is likely to be small relative to other sources of pathogens in the watershed. The area operated by MassDOT (0.98 ha) is only a small fraction of watershed that drains to West Falmouth Harbor (1,085 ha; MassDEP 2007).

In addition, the Final Pathogen TMDL for the Buzzards Bay Watershed states that failing septic systems near the embayment serve as one of the largest sources of pathogen loading for the Harbor (page vii of the TMDL Executive Summary and page 56). This source is clearly out of MassDOT's control.

Based on all of the considerations described above, the non-structural measures MassDOT has in place (e.g. 511 Program, and Adopt-A-Highway program) and is proposing (e.g. IDDE efforts) are consistent with the pathogen TMDL requirements.

Conclusions

Relative to other sources, MassDOT's contribution of total nitrogen to West Falmouth Harbor is insignificant and consistent with the applicable WLA. Therefore, no further action is needed to be consistent with the total nitrogen TMDL for this water body. MassDOT assessed the potential to install additional structural BMPs for pathogens. However, there is not sufficient space to install BMPs that would significantly reduce the discharge of pathogens. Instead MassDOT proposes non-structural BMPs for reducing any discharge of pathogens.

MassDOT does not propose retrofitting structural BMPs at this location. As described above, stormwater runoff from MassDOT is consistent with the areal WLA for total nitrogen; therefore, no further measures are necessary to be consistent with this TMDL or to address the impairments it covers (nutrients and other habitat alterations). The pathogen TMDL calls for substantial reductions in loading from stormwater. However, it recognizes this will require significant time and an iterative adaptive management approach. Therefore, MassDOT will continue to implement its existing BMPs that reduce pathogen loading. In addition, MassDOT will re-visit the use of structural BMPs and/or reconfigure the drainage system when road reconstruction work is planned for Shore Road/West Falmouth Highway as part of MassDOT's Impaired Waterbody Program for Programmed Projects. MassDOT also commits to implementing its Illicit Discharge Detection and Elimination (IDDE) program along this section of highway by the end of this year to potentially identify connections and reduce potential pathogen loading to West Falmouth Harbor.

References

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MassDOT Outfalls to Impaired Waterbodies

MassDOT Outfall

MassDOT Urban Area Roads

Figure 1.
West Falmouth Harbor
West Falmouth, MA

September 2010

N

950 475 0 950 Feet

Moving Massachusetts Forward. massDOT Highway

J:\Water\ProjectFiles\P40\04489 MHD\04489015 MHD Contract No. 55867\Assgn 9 IDDE\GIS\WestFalmouth_MHD_08092010.mxd

Figure 2. Shore Road/West Falmouth Highway

Views of Shore Road/West Falmouth Highway illustrating the space constraints to installing structural BMPs

Impaired Waters Assessment for Blackstone River (MA51-03)

Status Update

Impaired Waterbody

Blackstone River (MA51-03)

Impairments

Unknown toxicity, Priority organics, Metals, Nutrients, Organic enrichment, Flow alteration, Other habitat alterations, Pathogens, Suspended solids, Turbidity, Objectionable deposits

Relevant Water Quality Standards

- Water Body Class: B
  - Warm Water Fishery. Waters in which the maximum mean monthly temperature generally exceeds 68° F (20° C) during the summer months and are not capable of sustaining a year-round population of cold water stenothermal aquatic life.
  - Combined Sewer Overflow or CSO. This segment has been identified as impacted by the discharge of combined sewer overflows. A CSO is any intermittent overflow, bypass or other discharge from a municipal combined sewer system which results from a wet weather flow in excess of the dry weather carrying capacity of the system.

- 314 CMR 4.05 (3)(b)(5)(b) Bacteria. For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department.
- 314 CMR 4.05 (3)(b)(5) Solids. These waters shall be free from floating, suspended and settleable solids in concentrations and combinations that would impair any use assigned to this Class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- 314 CMR 4.05 (3)(b)(6) Color and Turbidity. These waters shall be free from color and turbidity in concentrations or combinations.
- 314 CMR 4.05 (5)(b) Bottom Pollutants or Alterations. All surface waters shall be free from pollutants in concentrations or combinations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish or adversely affect populations of non-mobile or sessile benthic organisms.
- 314 CMR (5)(c) Nutrients. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or

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

- 314 CMR 4.05 (5)(a) Aesthetics. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- 314 CMR 4.05 (5)(e) Toxic Pollutants. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations. Site specific criteria, human health risk levels and permit limits will be established in accordance with the following:

    1. Site Specific Criteria: Where EPA recommended criteria for a specific pollutant are not available or where the Department determines that they are invalid due to site specific physical, chemical or biological considerations, the Department shall use a site specific criterion as the allowable receiving water concentration for the affected waters. In all cases, at a minimum, site specific criteria shall not exceed safe exposure levels determined by toxicity testing using methods approved by the Department. The Department will adopt any such site specific criteria as revisions to 314 CMR 4.00 in accordance with M.G.L. c. 30A.

    2. Human Health Risk Levels. Where EPA has not set human health risk levels for a toxic pollutant, the human health based regulation of the toxic pollutant shall be in accordance with guidance issued by the Department of Environmental Protection's Office of Research and Standards. The Department's goal is to prevent all adverse health effects which may result from the ingestion, inhalation or dermal absorption of toxins attributable to waters during their reasonable use as designated in 314 CMR 4.00. When this goal is not attainable, the Department will use a goal of 10-6 as the acceptable excess lifetime cancer risk level for individual carcinogens.

Site Description

Segment MA51-03 is a 10.7 mile segment of the Blackstone River located south of Worcester. Highway 146/122A and Route 20 intersect adjacent to the Blackstone River. Segment MA51-03 parallels Highway 146/122A for much of its reach and passes underneath Highway 146/122A and Route 20 approximately 5 times. At this site, Highway 146 is a divided highway with four lanes of traffic (two northbound lanes and two southbound lanes). Approximately 4.2 miles of the highway are within 0.5 mile of Segment MA51-03. Road construction occurred at this site from 1997 through 2005. As a result, much of the stormwater infrastructure includes stormwater best management practices (BMPs). Roads and outfalls are shown in Figure 1.

As part of the complete assessment for this segment, MassDOT will review the TMDL and associated waste load allocations (WLA) for this water body using the approach described in BMP 7R (TMDL Watershed Review). In addition, MassDOT will review the other assessments for this water body under BMP 7U.

Assessment under BMP 7R TMDL Watershed Review

There is currently a TMDL for pathogens for this segment of the Blackstone River. Therefore, this segment will be assessed under BMP 7R.

Based on the Water Quality Assessment Report performed in 1998 for the Blackstone River Basin, pathogens loading to this segment may be related to the sanitary sewers in the area. From the assessment "The City of Worcester DPW Storm Water Management Program, Illicit Connections Program identified an illicit sewer connection discharging to this segment of the Blackstone River that was repaired in November 1999 (City of Worcester DPW 2000). It should also be noted that the Worcester CSO Treatment Facility discharges screened and disinfected combined sewer overflow (up to 350 MGD during storm events) to "Mill Brook" at the upstream end of this segment."

Assessment under BMP 7U Water Quality Impaired Waters Assessment and Mitigation Plan

There is no current TMDL that covers this segment of the Blackstone River for impairments other than pathogens. Therefore, MassDOT will assess this water body using the approach described in BMP 7U (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that do not have a TMDL. A review under this BMP will be conducted for the following impairments:

- Unknown toxicity
- Priority organics
- Metals
- Nutrients
- Organic enrichment
- Flow alteration
- Other habitat alterations
- Suspended solids
- Turbidity

- Objectionable deposits

Outfall Evaluations

At this stage, a broad preliminary assessment of the impaired segment and MassDOT's related stormwater practices has been conducted. Available design plans associated with the 1997-2005 roadway construction and performed a site visit were collected. The following sections describe the current status of MassDOT's stormwater management in the area and provides a preliminary set of recommended BMPs to address this segment of the Blackstone River's impairments.

During MassDOT's outfall inventory, AECOM identified several stormwater features in the area of this Blackstone River segment. Appendix L-1 (dated July 22nd) included 69 outfalls to the Blackstone River. These outfalls are shown on Figure 1. After more detailed review of design plans from the recent road construction and on-site review, MassDOT's consultant was able to determine that only 28 outfalls discharge directly to the river. The remaining outfalls included in the outfall inventory were part of the stormwater system and intermediary to the final discharge to the river segment. Of these 28 outfalls discharging to the river, 6 discharge runoff that is treated by existing identified BMPs. The remaining outfalls discharging to the river require more investigation to determine if their systems contain BMPs and provide any treatment.

The remaining intermediate outfalls at the site discharge to other upstream water bodies, structural BMPs, and outlet structures as follows:

- Bridge scuppers
- Detention ponds
- Swales
- Outfalls not discharging directly to the river and requiring more investigation.

Existing BMPs

The stormwater runoff draining to this portion of the Blackstone River is primarily collected with underground, piped stormwater systems consisting of catch basins, manholes, and conveyance piping. A significant portion of the runoff collected by these systems is treated with structural BMPs to provide flow attenuation and treatment via vegetation, infiltration, and detention. These structural BMPs include the following:

- Riprap pads, swales, and plunge pools
- Vegetated swales
- Detention ponds
- Stormwater wetland areas
- Oil water separators

A preliminary investigation of the watershed contributing to this segment of the Blackstone River reveals that there are 12 detention ponds being used to treat stormwater in conjunction with riprap pads, swales, oil/sediment separators, and plunge pools which are used to trap sediment and prevent scouring. Vegetated swales are commonly used throughout the watershed to collect runoff from roadways and convey runoff to stormwater inlets and outfalls. There are stormwater wetland areas to provide additional attenuation and treatment. Many of these BMPs are shown on Figure 1.

Proposed BMPs

During the site visit several areas were identified where structural stormwater BMPs could be added to the system to provide additional treatment. At this stage, AECOM focused our review on the outfalls which discharge untreated water. Figure 1 shows areas that were identified for potential BMPs.

The impairments listed for this segment of the Blackstone River are extensive and varied. Infiltration BMPs and BMPs that include retention and vegetation provide the most treatment for a range of pollutants. The use of infiltration BMPs is limited based on the existing soils at the site. This preliminary assessment has identified 19 areas as possible areas for BMP construction or improvement. Based on the NRCS Soil Conservation Service soils mapping, soils at 12 of these areas are classified as hydrologic soil group A (sand, loamy sand, or sandy loam) or B (silt loam or loam). Soils in groups A and B are more appropriate for infiltration BMPs and therefore infiltration practices may be possible for many of the untreated systems.

For some of the outfalls, large areas are available that would be suitable for larger BMPs such as bioretention ponds. For others, only small areas adjacent to the road could be used for BMPs such as vegetated swales, linear infiltration trenches, or even underground infiltration. During this assessment, MassDOT will consider the potential for BMPs located on property associated with Interstate 90 Massachusetts Turnpike.

Conclusions and Next Steps

This preliminary assessment for segment MA51-03 of the Blackstone River has shown that several BMPs have been installed as part of recent construction of Route 146/122A. Despite these BMPs, there are still several outfalls that discharge untreated stormwater to the Blackstone River. There appears to be physical space and potentially well-draining soils for additional BMPs. A final determination of the need for and practicability of additional BMPs will be made following the completion of this assessment. The complete assessment will also include review of the existing BMPs and the treatment provided.

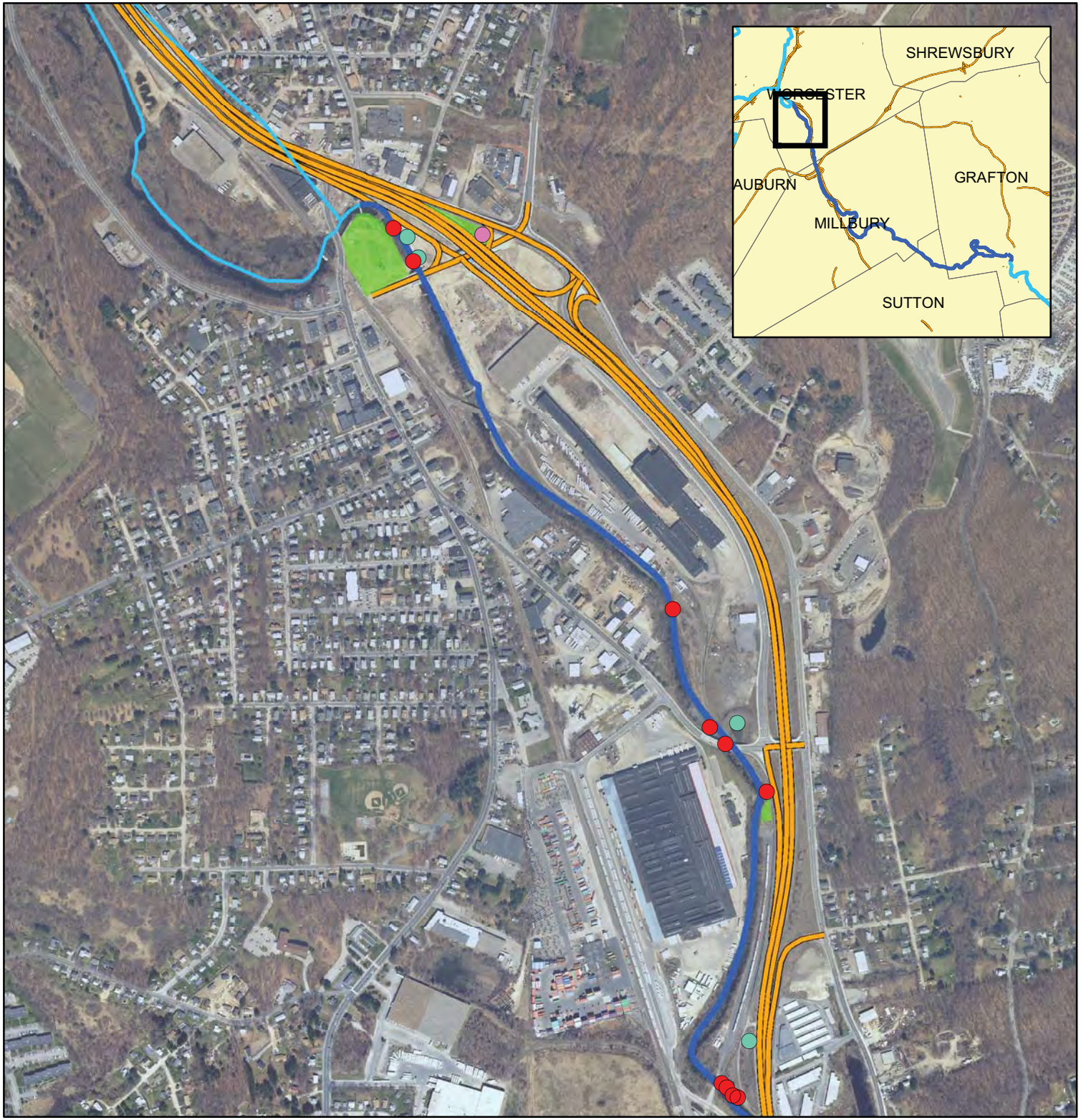
The next steps for this assessment include:

- Review existing documentation including the Blackstone River pathogen TMDL, Blackstone River Basin Water Quality Assessment Reports (1998 and 2003-2007)
- Generate preliminary BMP designs if determined necessary for untreated stormwater systems and outfalls.
  - Identify existing stormwater infrastructure
  - Determine contributing watershed to each system
  - Determine broad scale site restraints
  - Choose appropriate BMPs for contributing runoff and site constraints
  - Generate preliminary design
  - Assess current non-structural BMPs and modify or add as necessary
- Assess current BMPs for their effectiveness in addressing the impairments. Generate preliminary BMP designs if review determines additional controls are necessary and feasible for stormwater systems and outfalls with existing BMPs.

  - Identify existing stormwater infrastructure
  - Determine contributing watershed to each system
  - Determine broad scale site restraints
  - Choose appropriate BMPs for contributing runoff and site constraints
  - Generate preliminary design
  - Assess current non-structural BMPs and modify or add as necessary
- Generate preliminary BMP designs, if necessary, for systems that currently have BMPs.
- Include complete assessment in December submittal.

References

Mass DEP 1998. Water Quality Assessment Report 1998 Blackstone River Basin, Commonwealth of Massachusetts Executive Office of Environmental Affairs. Available at: http://www.state.ma.us/dep/brp/wm/wmpubs.htm



MassDOT Outfalls

- Directly Discharging to River
- Indirectly Connected to River
- Discharging to Detention Pond
- Discharging to Swale
- Discharging via Bridge Scupper
- Potential BMP Area
- Blackstone River
- Blackstone River (MA51-03)
- MassDOT Urban Area Roads

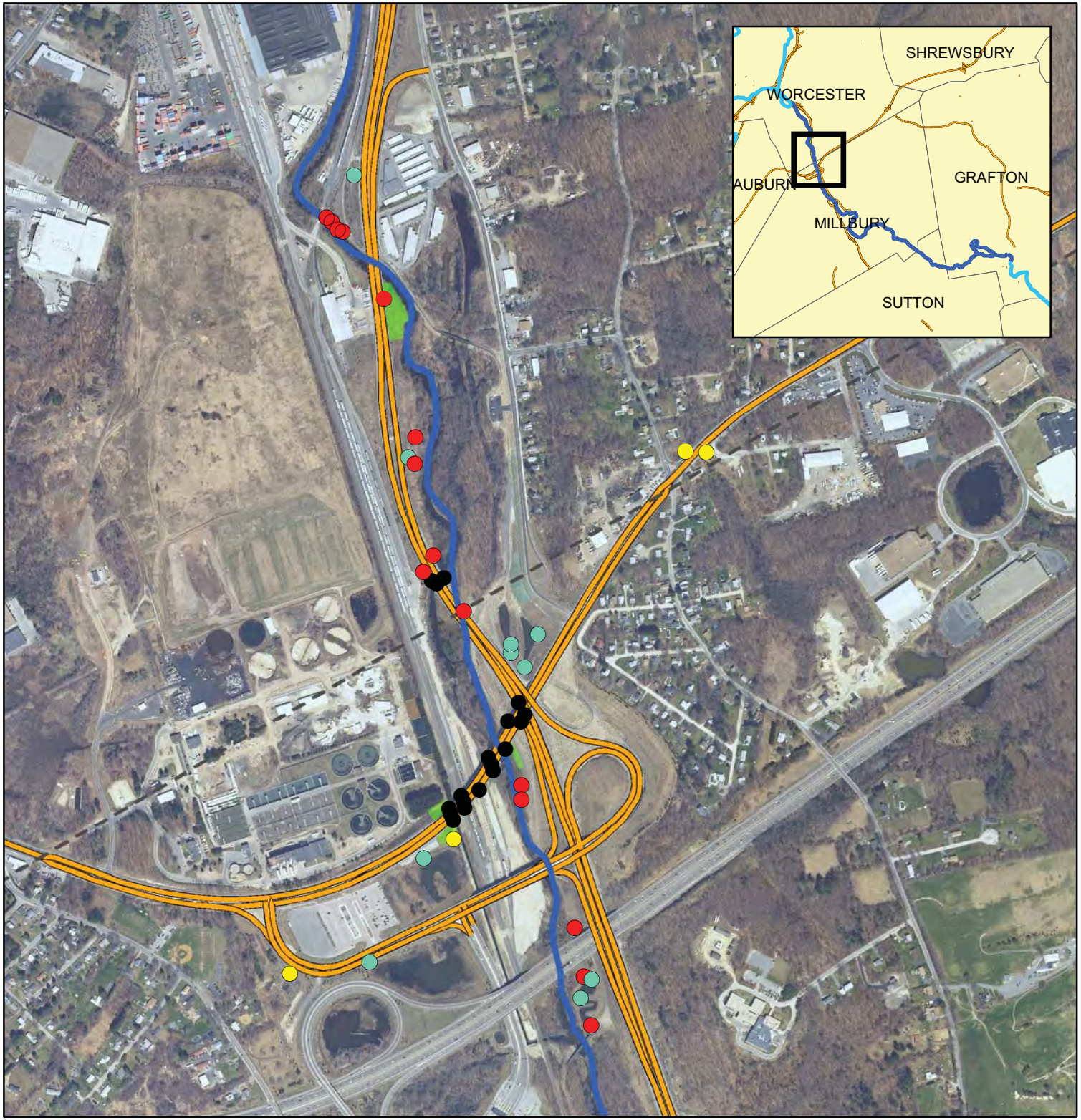
Figure 1 (1 of 4)
Blackstone River (MA51-03)
Highway 146 /122A

September 2010

N

0 375 750 1,125 1,500 Feet

Moving Massachusetts Forward. massDOT Highway



MassDOT Outfalls

- Directly Discharging to River
- Indirectly Connected to River
- Discharging to Detention Pond
- Discharging to Swale
- Discharging via Bridge Scupper
- Potential BMP Area
- Blackstone River
- Blackstone River (MA51-03)
- MassDOT Urban Area Roads

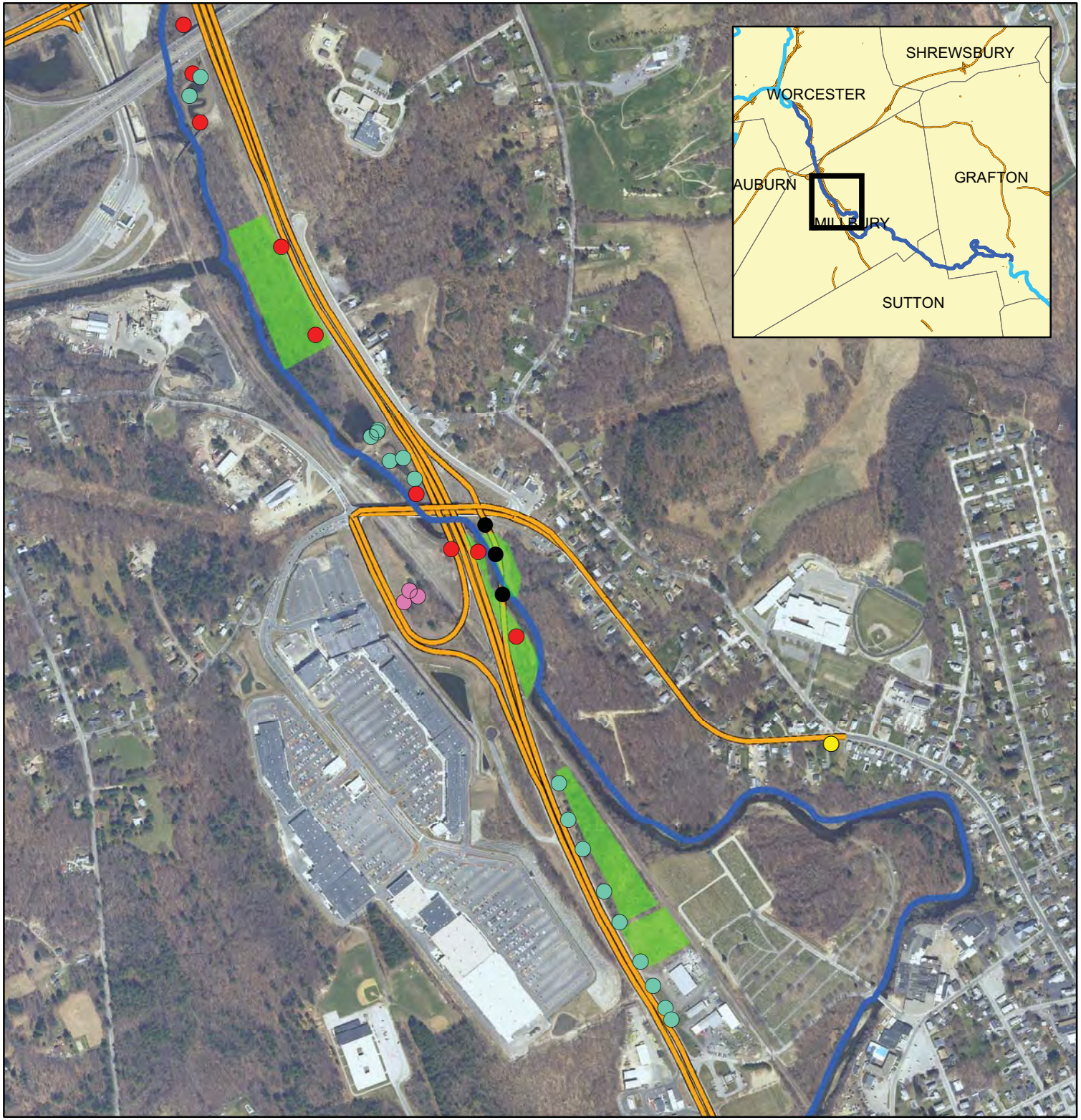
Figure 1 (2 of 4)
Blackstone River (MA51-03)
Highway 146 /122A

September 2010

N

0 375 750 1,125 1,500 Feet

Moving Massachusetts Forward. massDOT Highway



MassDOT Outfalls

- Directly Discharging to River
- Indirectly Connected to River
- Discharging to Detention Pond
- Discharging to Swale
- Discharging via Bridge Scupper
- Potential BMP Area
- Blackstone River
- Blackstone River (MA51-03)
- MassDOT Urban Area Roads

Figure 1 (3 of 4)
Blackstone River (MA51-03)
Highway 146 /122A

September 2010

N

0 375 750 1,125 1,500 Feet

Moving Massachusetts Forward. massDOT Highway

MassDOT Outfalls

- Directly Discharging to River
- Indirectly Connected to River
- Discharging to Detention Pond
- Discharging to Swale
- Discharging via Bridge Scupper
- Potential BMP Area
- Blackstone River
- Blackstone River (MA51-03)
- MassDOT Urban Area Roads

Figure 1 (4 of 4)
Blackstone River (MA51-03)
Highway 146 /122A

September 2010

N

0 375 750 1,125 1,500
Feet

Moving Massachusetts Forward.
massDOT Highway

Impaired Waters Assessment for Cambridge Reservoir Upper Basin (MA72156)

Status Update

The assessment presented below is a status update and not a full assessment. The full assessment is ongoing as there are several outstanding issues to be addressed prior to completion of this assessment. MassDOT plans to complete this assessment by the submittal of the semi-annual report on December 8, 2010.

Impaired Waterbody

Cambridge Reservoir, Upper Basin (MA72156)

Impairments

Noxious Aquatic Plants, Turbidity

Relevant Water Quality Standards:

- Water Body Class: A
- Class A. These waters include waters designated as a source of public water supply and their tributaries. They are designated as excellent habitat for fish, other aquatic life and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation, even if not allowed. These waters shall have excellent aesthetic value. These waters are protected as Outstanding Resource Waters.314 CMR 4.05 (3)(a) 5.Solids. These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- 314 CMR 4.05 (3)(a)6. Color and Turbidity. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- 314 CMR 4.05 (3) (a) 8. Taste and Odor. None other than of natural origin.
- 314 CMR 4.05 (5) (a) Aesthetics. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

MassDOT has considerable property in the watershed of the Upper Cambridge Reservoir (Figure 1) These include, Route 2A in Lincoln, Route 128 from North of Route 2A to Route 2 and Route 2 which traverses the southern boundary of the Upper Cambridge Reservoir. In addition there are interchanges at both Route 2A and Route 2, a maintenance facility near the interchange between Route 2A and Route 128 and a rest area on the northbound side of Route 128 just south of Route 2A. MassDOT owns at least 27 outfalls that discharge to the reservoir directly or to a perennial or

intermittent waterway that then discharges to the Upper Cambridge Reservoir. At least 20 other outfalls are in the watershed of the Upper Cambridge reservoir but either discharge indirectly to the reservoir via wetlands or discharge to closed drainage systems within the watershed. A watershed map and outfalls are presented in Figure 1.

This water body has been assessed under BMP 7U which applies to impairments not covered by TMDLs.

Assessment under BMP 7U for Nutrients and Other Habitat Alterations Impairments

Excessive turbidity in the Upper Cambridge Reservoir likely originates from either inorganic sediment originating in stormwater or resuspended from the reservoir or organic sources related to phytoplankton growth in the reservoir associated with excessive phosphorus loading. Both sediment and phosphorus are present in typical highway runoff; there are likely many other sources in the watershed as well.

The impairments for noxious aquatic plants may also be related to the input of both nutrients and sediments to the Upper Cambridge Reservoir. Therefore, the assessment under BMP 7U focuses on phosphorus loading to the reservoir as a surrogate for the impairments.

Estimated Loading from MassDOT:

MassDOT estimated the loading of total phosphorus (TP) from their roadways in the watershed using the following assumptions and calculations:

- MassDOT has estimated TP loading rates based on data collected in a study of stormwater runoff from highways operated by MassDOT conducted by USGS. (Smith and Granato in press). This study collected stormwater samples from 12 sites located on Highways operated by MassDOT across Massachusetts between September 2004 and September 2009. Samples were taken under a variety of weather conditions during this period. Based on this data, we have estimate TP loading from impervious areas as 1.9 kg/Ha/yr.

The estimated load from MassDOT to Upper Cambridge Reservoir is currently being prepared. It is pending confirmation of flow routing in several areas. MassDOT will estimate the drainage areas for all of the MassDOT outfalls discharging to the Upper Cambridge Reservoir and the nutrient loads associated with each outfall or group of outfalls. These estimates will be used to identify the most appropriate location(s) for BMPs if necessary. MassDOT will consider further opportunities for installation of BMPs where appropriate.

Assessment and Mitigation Plan

MassDOT recently installed a number of BMPs along Route 2A to the west of the Route 128 cloverleaf. These include vegetated swales and a retention/detention pond to capture and treat runoff from the north side of the road. Most discharges from the south side of the road drain to a large wetland complex where attenuation of pollutants is expected to be significant. Runoff from the intersection of Massachusetts Avenue and Route 2A is merged with treated runoff from the BMPs on the north side of the road and forms the headwaters of a small brook near the southeast corner. There is some evidence of sediment in this brook suggesting that there is some transport of sediment and or nutrients from the highway towards Upper Cambridge Reservoir. However, water from this spot travels a circuitous path to the reservoir and additional attenuation can be expected before discharge to the reservoir. No further action is warranted along this stretch of roadway.

Runoff from the inner cloverleaf exit (128 South to Route 2A East) is contained in a large wetland complex inside the cloverleaf. It is assumed that runoff from the other three cloverleaf sections at the intersection of 128 and Route 2A is similarly discharged to closed basins inside the cloverleafs. Therefore storm water from these areas does not discharge to the Upper Cambridge Reservoir; no further action is warranted in these cloverleafs

Drainage from the interchange of Route 2A and Route 128 forms the headwaters of Lexington Brook which runs along Route 128, under Lincoln Street and into the Upper Cambridge Reservoir. The Brook was likely straightened during construction of Route 128 to run along the highway. An approximately 100 yard section of the brook runs through a culvert parallel to Route 128 before the brook reaches the reservoir. A large culvert, transporting runoff from the northbound side of 128, discharges to the brook just downstream of the culverted section of Lexington Brook. This culvert likely carries runoff from the northbound lanes of 128 and the rest area to Upper Cambridge reservoir via Lexington Brook (this will be confirmed prior to finalizing this assessment). The brook then passes a USGS gage and enters the reservoir.

Runoff from the outer lane entrance (Route 2A East to 128 South) enters the Lexington Brook from the eastern side through a series of 8 catch basins and outfalls. Each of these catch basins captures drainage from between 100 and 300 feet of the entrance ramp. In addition, runoff from the DOT Maintenance facility enters Lexington Brook from the western side through direct drainage. There is no opportunity for attenuation of suspended solids or phosphorus beyond what may be captured in the catch basin. Because the highway is so close to the brook, there is little room for installation of additional BMPs along the southbound lane (5 outfalls). However, it may be possible to route water from the three outfalls on the entrance ramp to the triangular piece of land between Route 128, the entrance ramp from Route 2A East to 128 South and the exit ramp from 128 to Route 2A East. A detention/infiltration basin located in the triangle may remove phosphorus and solids from the stormwater that is currently discharged directly to the brook. Alternatively, this stormwater could be discharged to the wetland complex inside the cloverleaf where it would be retained and infiltrated to groundwater. It is also possible that infiltration BMPs could be constructed at the maintenance facility to treat stormwater prior to entry to the brook. The areas with potential for BMP construction are shown in Figure 2.

Drainage from approximately 1,000 feet of the Northbound lane of Route 128 (collected in 4 catch basins north of Lincoln Street) and the rest area enters Lexington Brook several hundred yards upstream of the Reservoir via an approximately 48 inch culvert. This outfall apparently greatly increases the streamflow in the brook during wet weather as the channel is noticeably wider and deeper downstream of the outfall. There is little opportunity for attenuation of phosphorus or suspended solids prior to discharge into the Upper Cambridge Reservoir once this water enters the brook. There are few opportunities for installation of BMPs along the northbound side of the highway however, the installation of infiltration BMP's south of the rest area may be possible. The installation of BMPs at the rest area will be investigated further. The area with the potential for BMP construction is shown in Figure 2.

South of the mouth of Lexington Brook is an outfall directly to the Upper Cambridge Reservoir. It is assumed that this outfall serves 4 catch basins from approximately 1000 feet of the northbound lanes of Route 128 south of Lincoln Street. Retrofit of structural BMPs is impracticable; there is no opportunity for attenuation of phosphorus or suspended solids between the outfall and the reservoir or along the northbound side of 128 where the runoff is collected.

South of the outfall from the northbound lane are two smaller outfalls from the southbound lane. These outfalls appear to conduct rather low volumes of water and discharge approximately 150 feet from the reservoir. There is little evidence of channel erosion between the discharge point and the reservoir. Observation of both flow paths to the reservoir suggest that flows are typically low or

discharges from these outfalls infiltrate prior to reaching the reservoir. Therefore, these outfalls represent only a de minimus source of pollutants. No further action is warranted here.

There are 3 outfalls from catch basins located on the exit ramp from Route 128 South to Route 2 West. These 3 outfalls collect runoff from an approximately 750 foot stretch of the exit ramp. Unlike the outfalls from Route 28 just to the north, there is evidence of transport of sediments from these outfalls to the reservoir. Sediment deposition can be seen along the channel from the outfalls to the reservoir. There is potential to install BMPs in the triangular area bounded by the exit Ramp from Route 128 South to Route 2 west, Route 2 and the entrance ramp from Route 2 West to Route 128 South. There is an existing catch basin located in this triangle. Installation of a detention/infiltration BMP coupled with rerouting the exit outfalls to this BMP prior to discharge to the reservoir would result in removal of a portion of the phosphorus and suspended solids carried in the runoff. The area with the potential for BMP construction is shown in Figure 2.

There are three catch basins and outfalls that discharge directly to the Upper Cambridge reservoir from the causeway formed by Route 2 as it passes between the Upper and Middle portions of the Cambridge Reservoir. These three outfalls collect runoff from approximately 300 feet of the westbound lanes of Route 2. There is no opportunity for retrofitting additional BMP's along the narrow causeway. Because these outfalls enter the Upper Reservoir at a location very near the outlet to the Middle Cambridge Reservoir, it is likely that during times of active withdrawal of water from the reservoir (summer and fall), water discharging from these outfalls does not mix with the upper reservoir water but rather is transported to the middle reservoir. However, during the winter and spring when the reservoir is refilling, water from these outfalls is more likely to circulate through the upper reservoir and play a role in upper reservoir water quality.

Conclusions

The area owned by MassDOT represents a substantial portion of the watershed of the upper Cambridge Reservoir. There are several areas along Route 2A with extensive BMPs already in place. MassDOT is considering the installation of additional structural BMPs elsewhere in the watershed to treat stormwater runoff. Based on a preliminary analysis, 4 areas have been identified where infiltration BMPs will be considered. These areas are presented in Figure 2. Each of these areas is in proximity to an outfall that currently discharges to the Upper Cambridge Reservoir and are currently owned by MassDOT. Potential BMPs include:

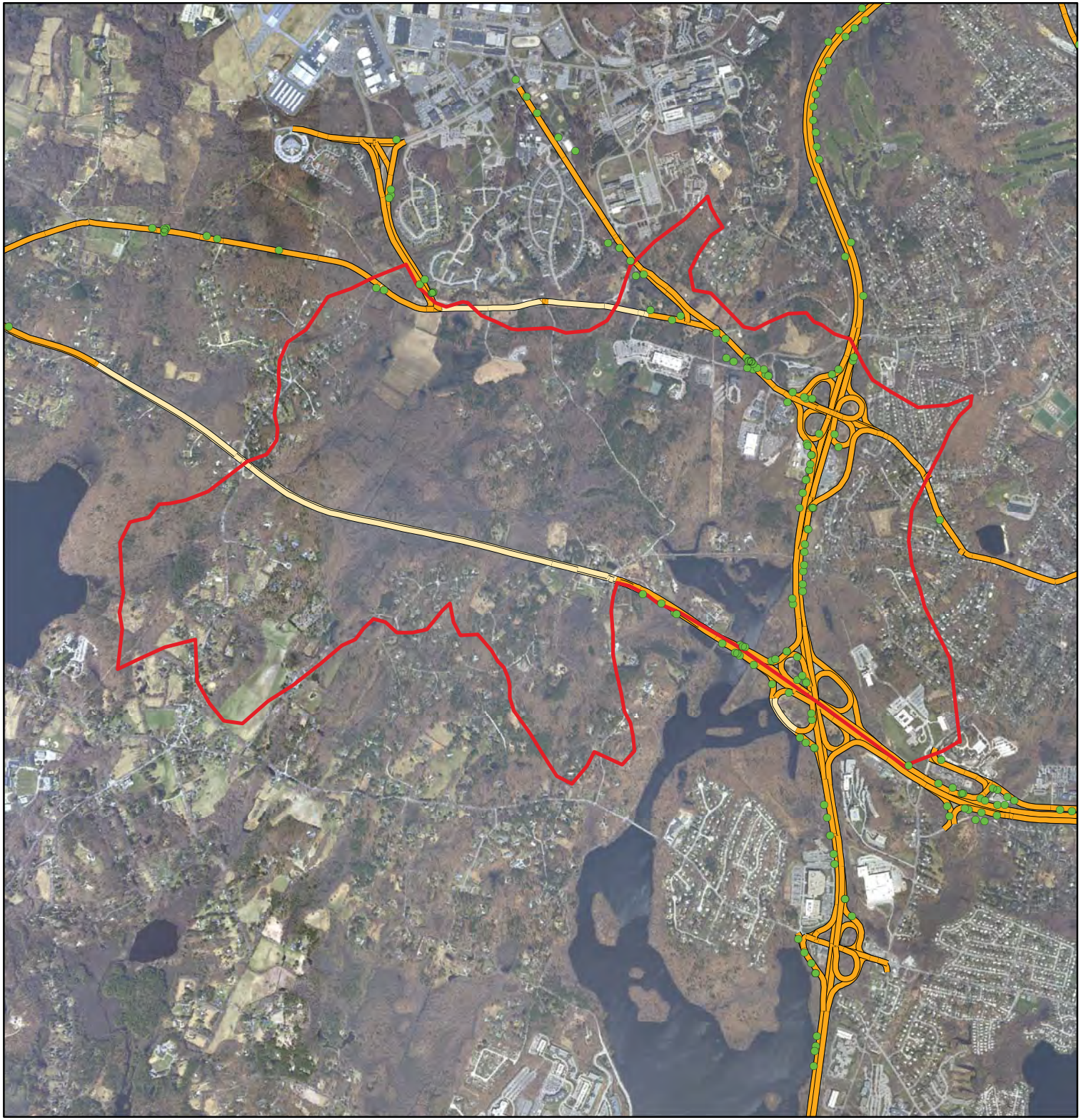
- An infiltration BMP to capture runoff from 3 outfalls to Lexington Brook from the entrance ramp to 128 South from Route 2A East. This BMP would be located in the triangle formed by the entrance ramp from Route 2A east to Route 128 South, the exit from Route 128 South to Route 2A East and Route 128 South.
- An infiltration BMP to capture runoff from the MassDOT maintenance facility prior to discharge into Lexington Brook.
- An infiltration or detention BMP to capture runoff from the northbound rest area on Route 128 at Route 2A.
- An infiltration BMP to capture runoff from 3 outfalls to the Upper Cambridge Reservoir from the exit ramp from Route 128 South to Route 2 West. This BMP would be located in the triangle formed by the exit ramp from Route 128 South to Route 2 West, the entrance ramp from Route 2 West to Route 128 South and Route 2 West.

MassDOT will evaluate specific site conditions at the candidate sites described above and develop schematic designs for BMPs that will reduce the nutrient and solids export from MassDOT property to the Upper Cambridge Reservoir. The criteria used to determine suitability of identified sites for

BMP installation include soil type, depth to groundwater, gradient from highway area to be treated and hydrology. In addition, MassDOT will confirm drainage areas where drainage plans are not available and identify further areas where BMP installation may be appropriate. This assessment will be completed for the quarterly report to be delivered in December 2010.

References

Smith, K.P., and Granato, G.E., In press, Quality of stormwater runoff discharged from Massachusetts highways, 2005–07: U.S. Geological Survey Scientific Investigations Report 2009–5269, 198 p.



Mass DOT Outfall
Mass DOT Urban Area Roads
Waterbody Drainage Area

Figure 1.
Cambridge Reservoir
Interstate 95 and Route 2

September 2010

N

0 750 1,500 3,000 4,500 6,000
Feet

Moving Massachusetts Forward.
massDOT
Highway

Mass DOT Outfall

Mass DOT Urban Roads

Potential BMPs - Infiltration Areas - not to scale

General drainage direction to potential BMP

Figure 2.
Cambridge Reservoir

Interstate 95 and Route 2

September 2010

N

0 325 650 975 1,300 Feet

Moving Massachusetts Forward. massDOT Highway

Attachment 2:
Assessments which Identified no Discharges from MassDOT Outfalls to Impaired Segments under Review

Under Step 2 of BMP 7U, MassDOT committed to map the locations of MassDOT outfalls relative to 303(d) waters. This step included "*performing a desktop review of the sub-basin of the 303(d) water body to determine the specific locations of MassDOT outfalls and their receiving waters. This procedure will help determine whether MassDOT's outfalls in fact are potentially discharging in to the water body at issue, and will identify the number of outfalls that may need to be addressed through a mitigation plan. If MassDOT concludes based on its mapping that MassDOT's outfalls clearly are not discharging to the 303(d) water, it will document the basis for the conclusion and will conduct no further assessment of the water body at issue.*" Step 2 of BMP 7R includes a similar desktop review.

Appendix L-1 identified waterbodies that potentially received runoff from MassDOT urban roads and included Category 4a and 5 impaired waterbodies. In 2009, USGS published a new GIS datalayer of nested sub-basins[1]. These new more detailed sub-basins allowed AECOM to, in most cases, define the specific watershed to an individual impaired segment. In some cases the sub-basin continued to include more than one impaired waterbody (and other non-impaired waterbodies). As part of MassDOT's review, sub-basins were reviewed to determine which of the impaired segments included in the sub-basin may potentially receive stormwater discharge from the MassDOT urban area roads in the sub-basin.

The figures in this section summarize the desktop review. The figures show the impaired waterbody segment being assessed in dark blue. The other impaired waterbody segments within the sub-basin are in bright blue. MassDOT urban area roads are indicated in red with the outfalls identified as green circles. AECOM reviewed each sub-basin and determined the receiving water for each outfall's discharge using topography shown on the USGS topos. Future field work will document whether the discharge potentially reaches the impaired water body segment or infiltrates into the ground before reaching the receiving water. Once the receiving waters were documented, AECOM identified those impaired waterbodies within the sub-basin that do not receive a discharge from DOT outfalls. Some of the figures include impaired segments with no MassDOT outfalls shown but the impaired segment extends to another subbasin and therefore, we have not included as complete in our assessments. The impaired segment as a whole will be reviewed in future reviews.

The following figures indicate the impaired waterbody segments where our review indicated that the segments do not receive discharges from MassDOT roads and therefore no further review is necessary.

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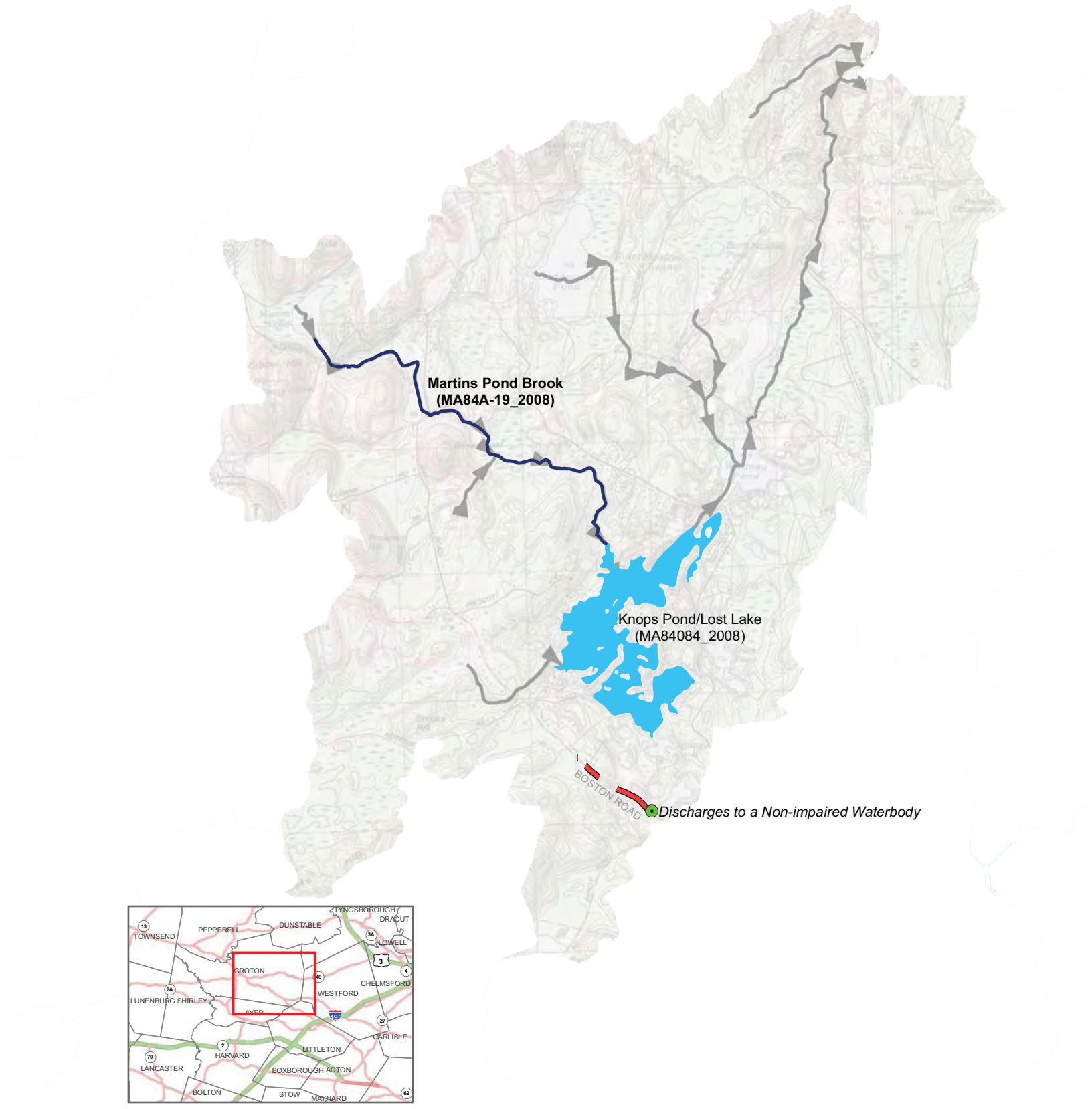
[1] MassGIS states the purpose of the datalayer as follows: "This data layer was created in cooperation with the Environmental Protection Agency (EPA) to assist local communities in environmental planning and stormwater runoff studies. The purpose of this data layer is to provide basin boundaries and impervious surface data at a more discretized scale than is available with current Watershed Boundary Dataset (WBD) subdivisions." The GIS layer is available at http://water.usgs.gov/GIS/metadata/usgswrd/XML/ds451_subbasins.xml.

Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Martins Pond Brook (MA84A_19_2008)

Subbasin 13063



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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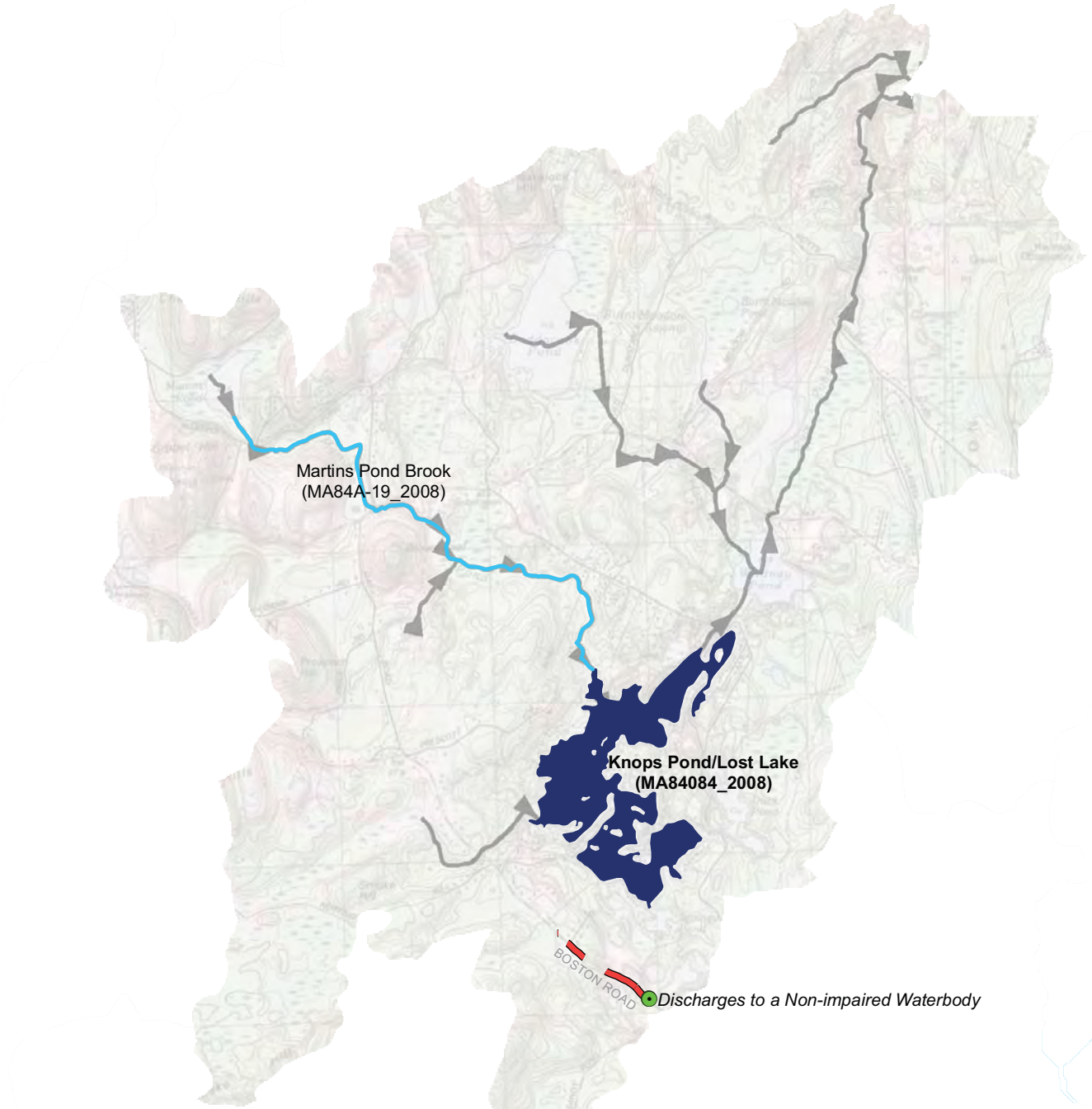
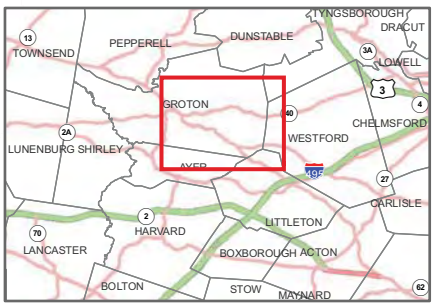
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Knops Pond/Lost Lake (MA84084_2008)

Subbasin 13063





- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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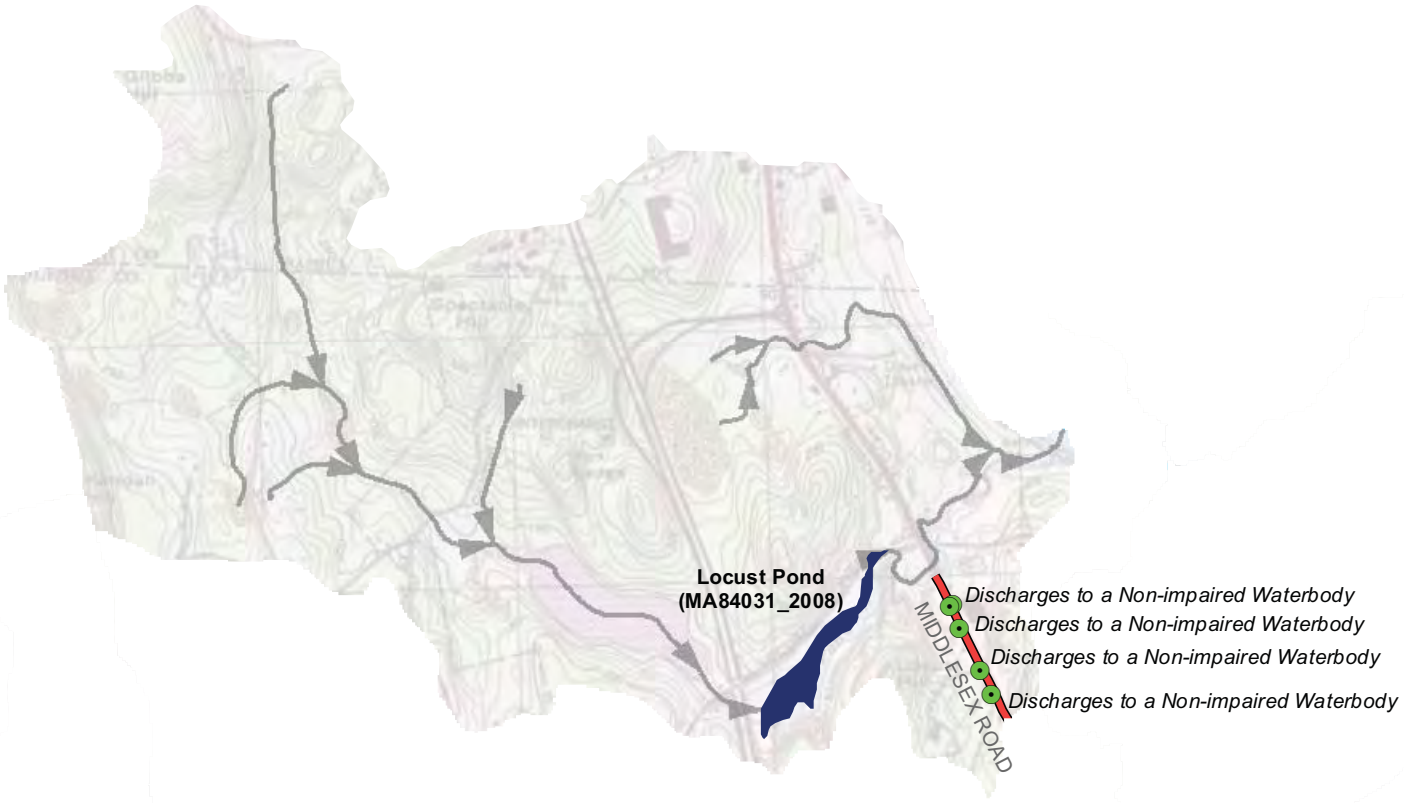
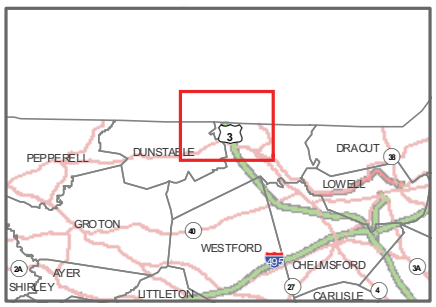
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Locust Pond (MA84031_2008)

Subbasin 13067





MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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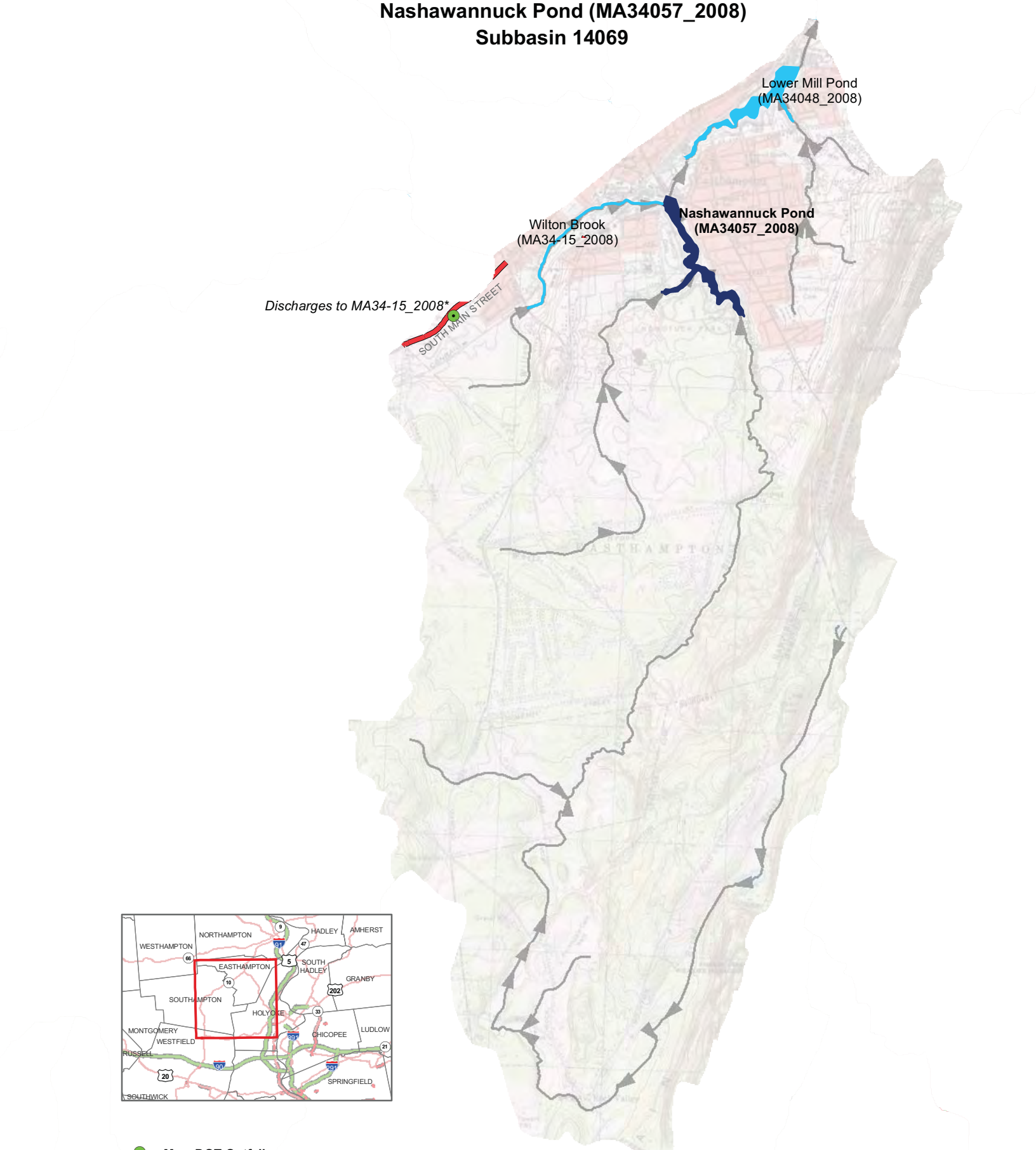
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Nashawannuck Pond (MA34057_2008)

Subbasin 14069



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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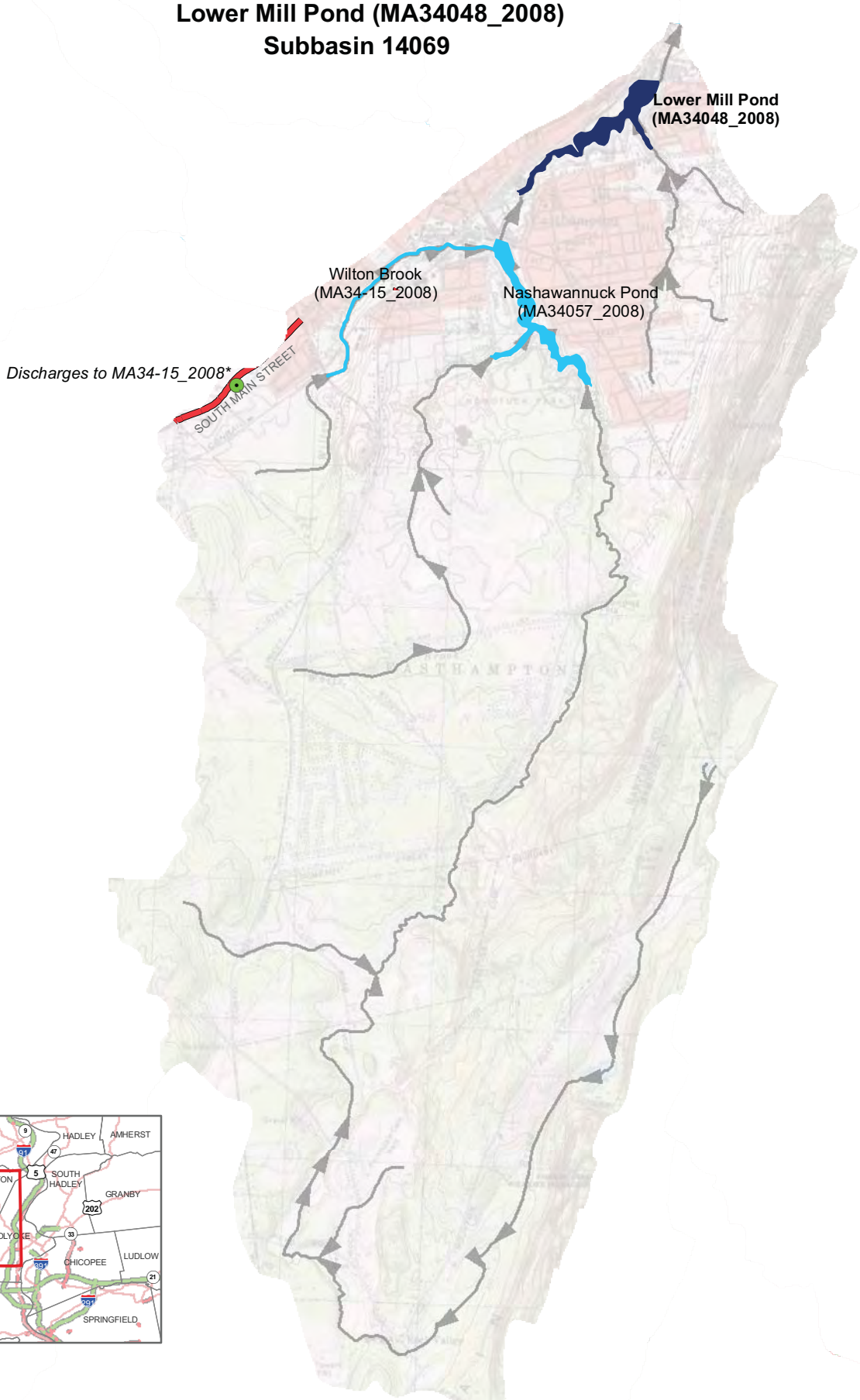
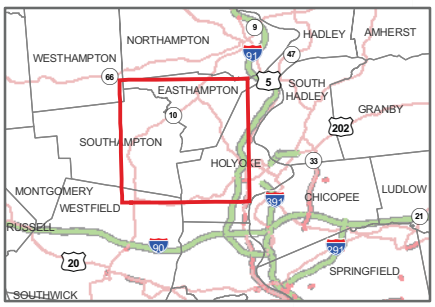
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Lower Mill Pond (MA34048_2008)

Subbasin 14069





- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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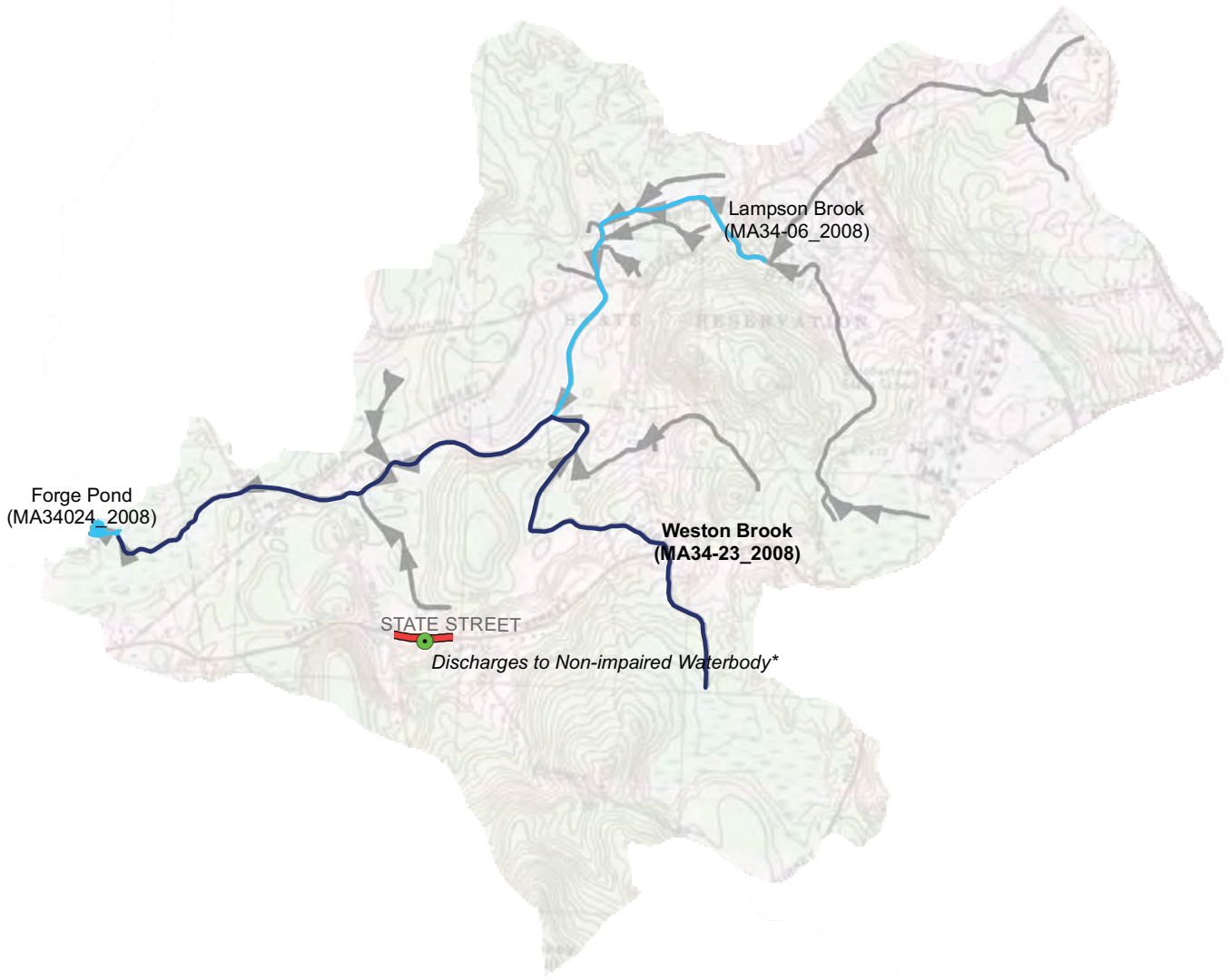
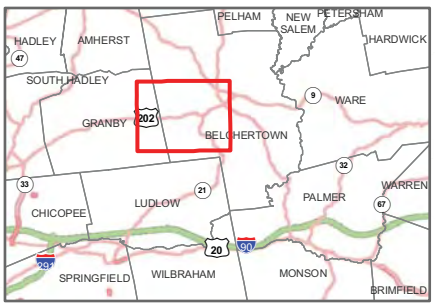
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Weston Brook (MA34-23_2008)

Subbasin 14076





MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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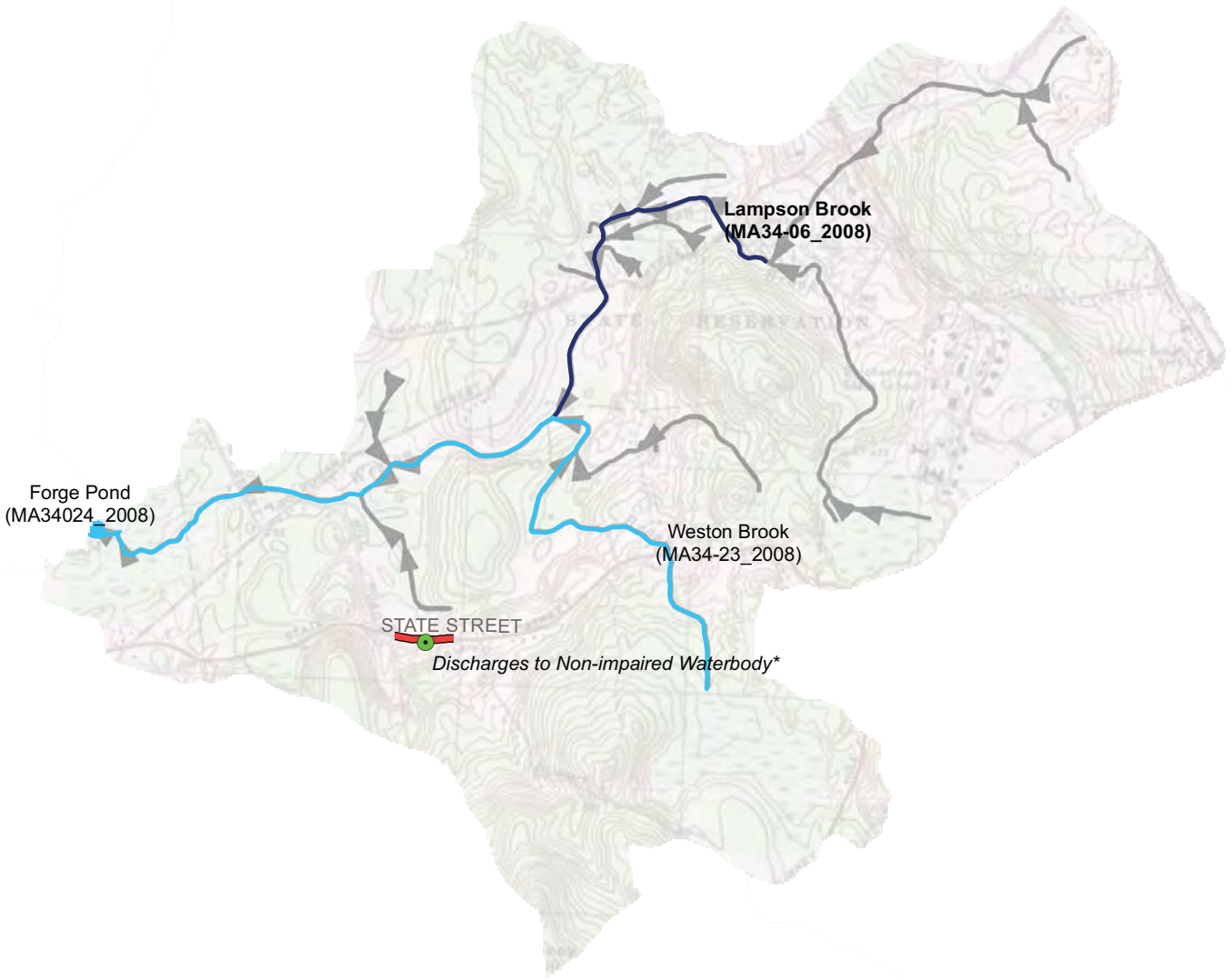
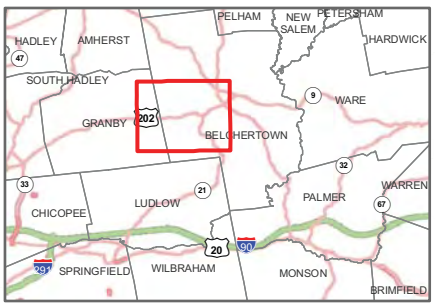
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Lampson Brook (MA34-06_2008)
Subbasin 14076





MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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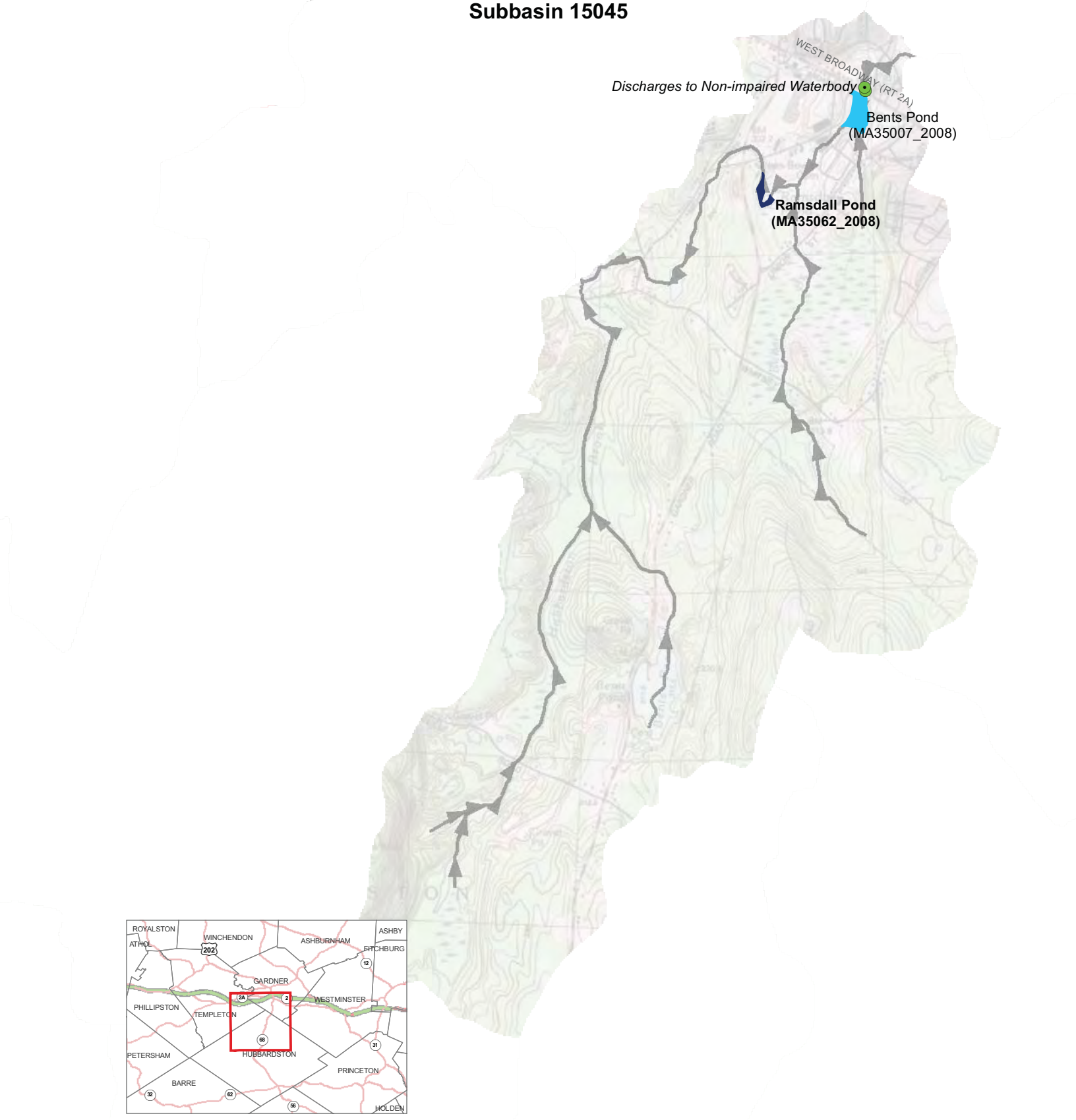
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Ramsdall Pond (MA35062_2008)

Subbasin 15045



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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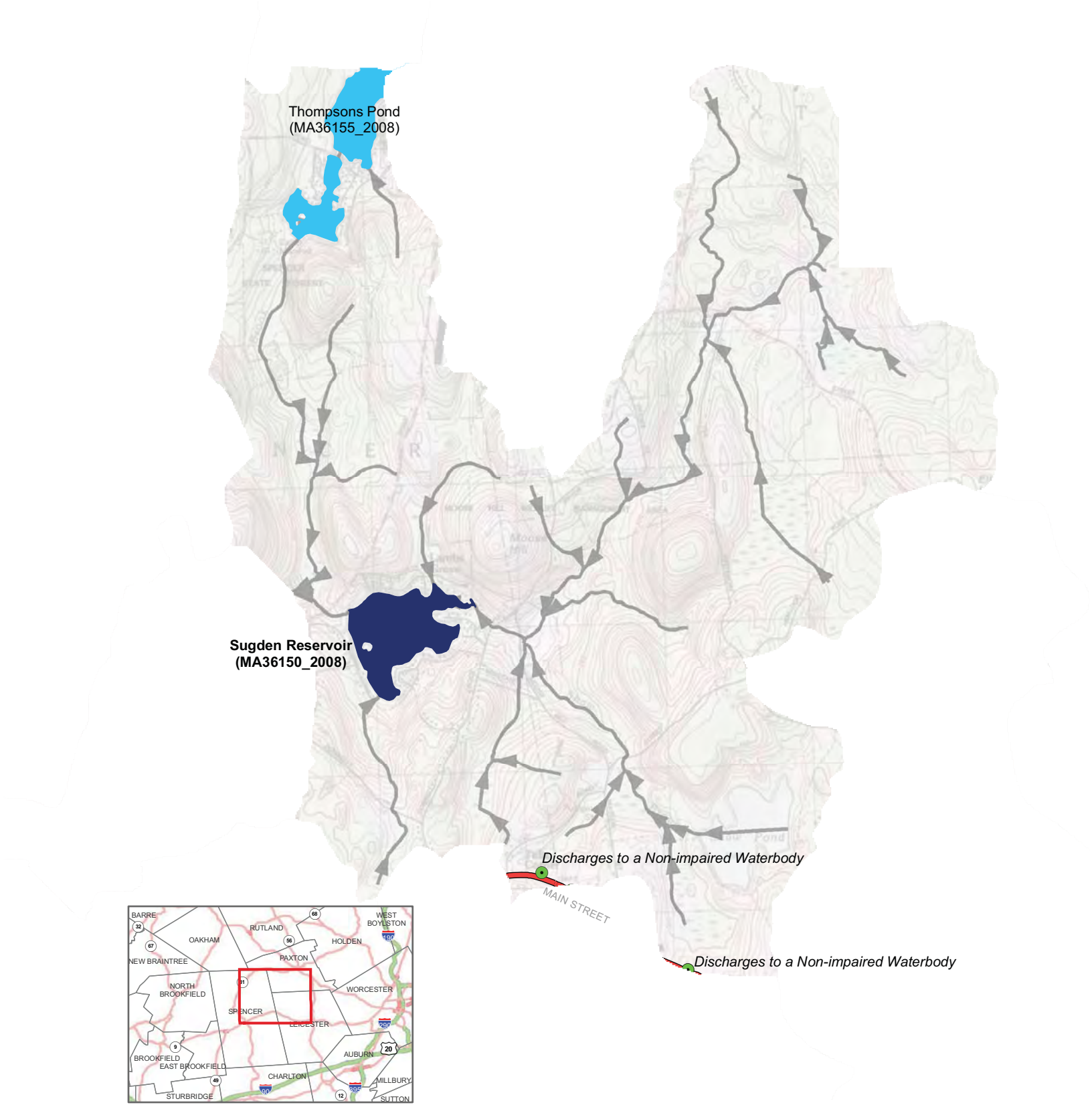
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Sugden Reservoir (MA36150_2008)
Subbasin 17092



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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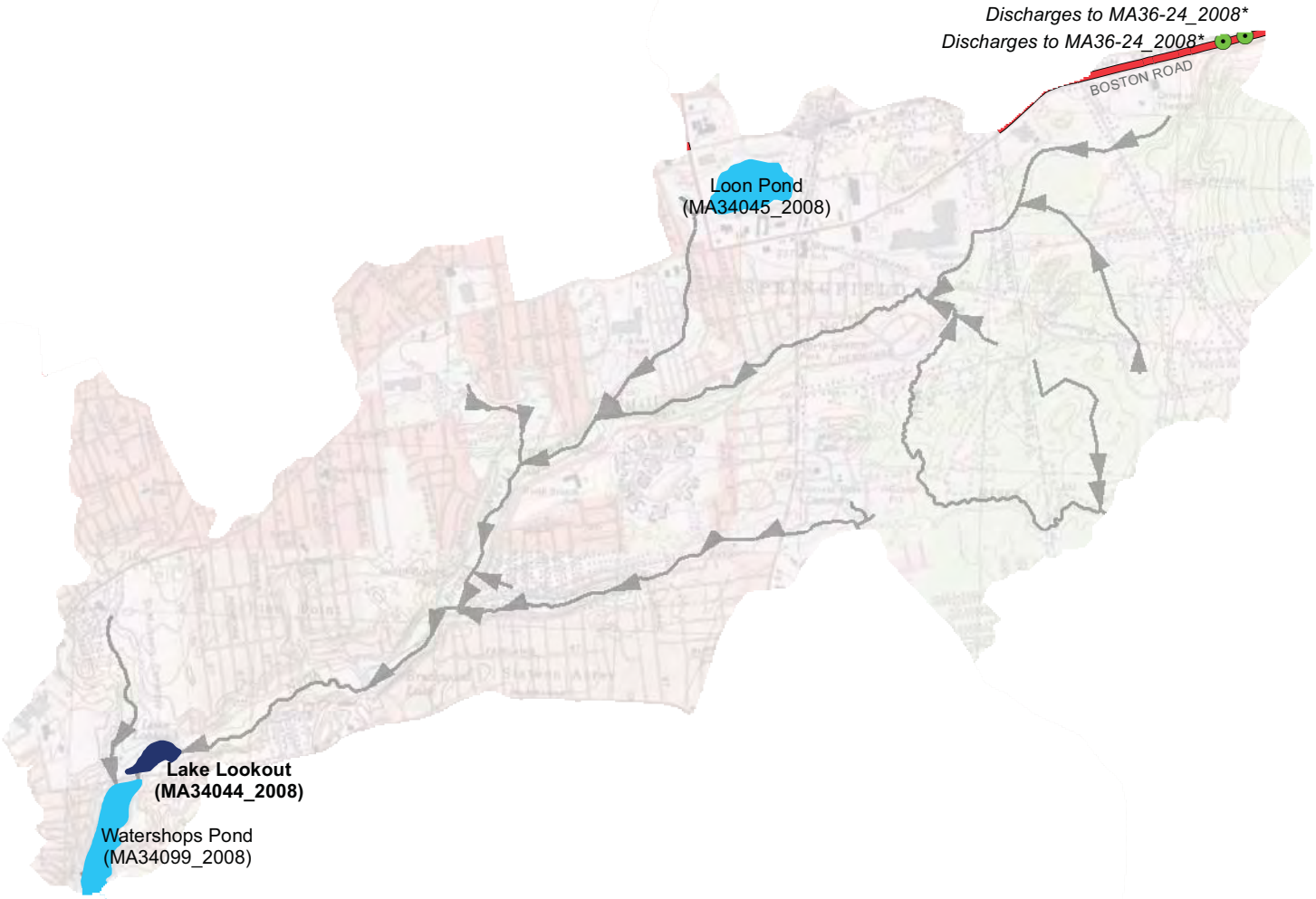
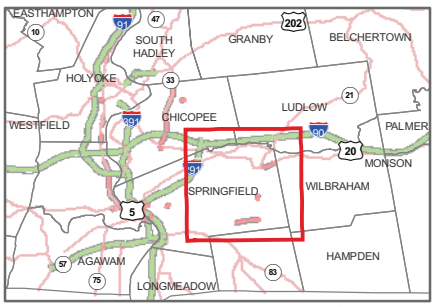
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Lake Lookout (MA34044_2008)

Subbasin 18012





- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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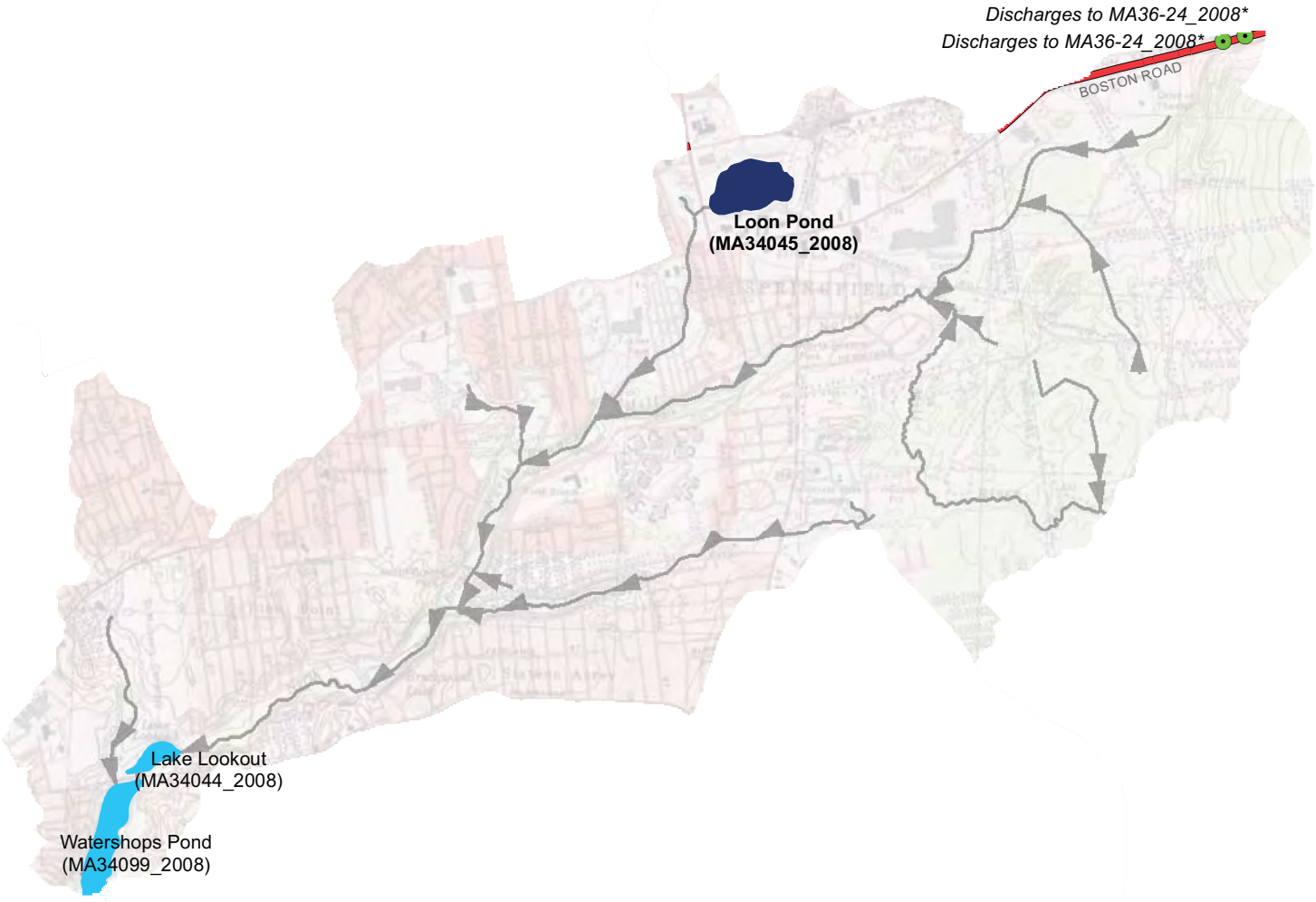
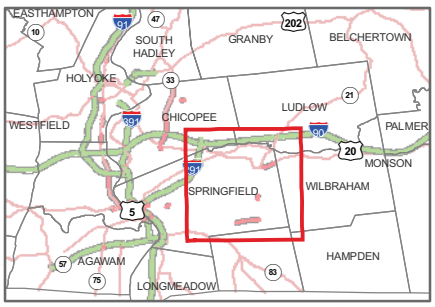
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Loon Pond (MA34045_2008)

Subbasin 18012





MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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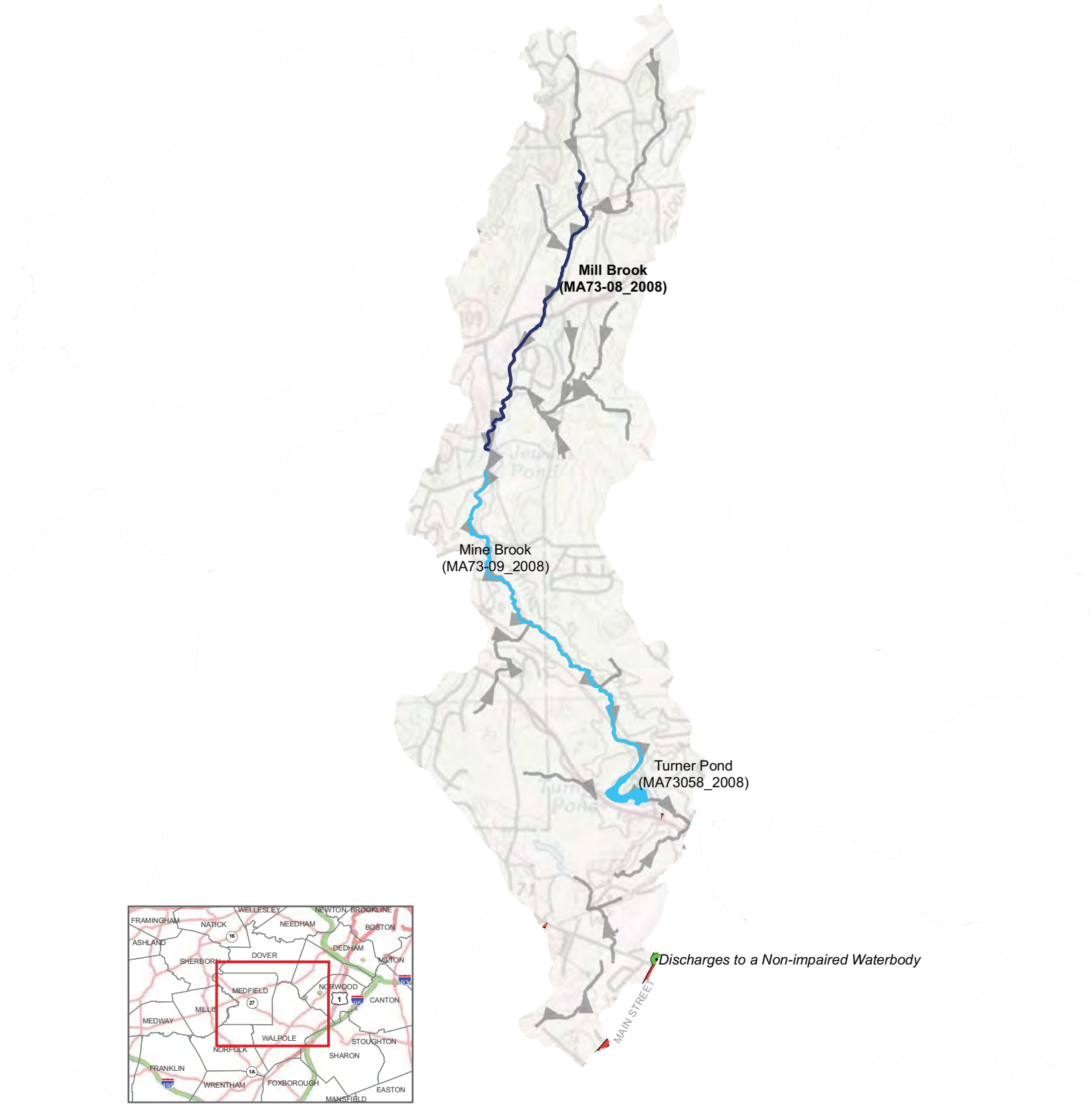
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Mill Brook (MA73-08_2008)
Subbasin 21016



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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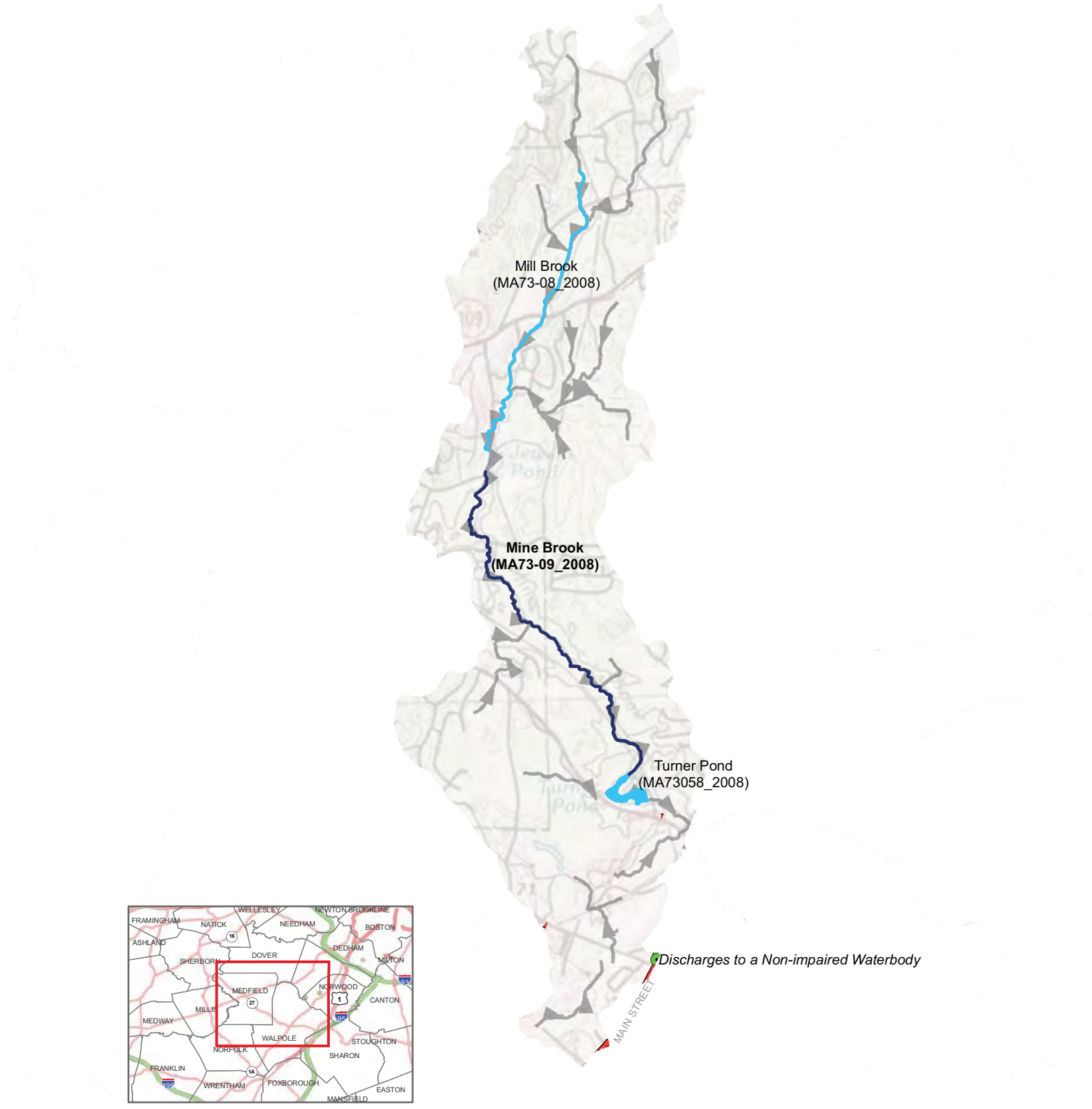
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Mine Brook (MA73-09_2008)
Subbasin 21016



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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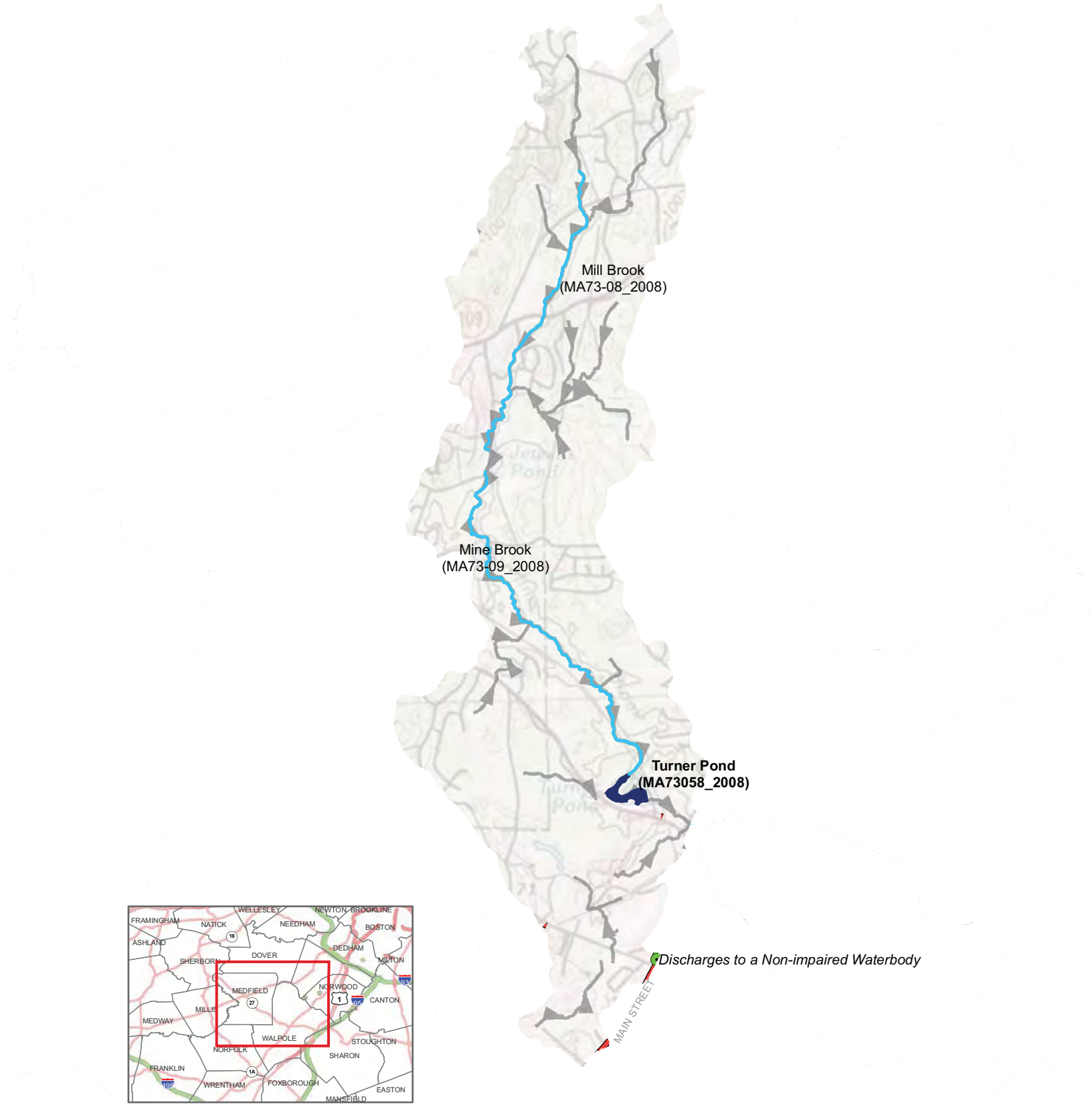
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Turner Pond (MA73058_2008)
Subbasin 21016



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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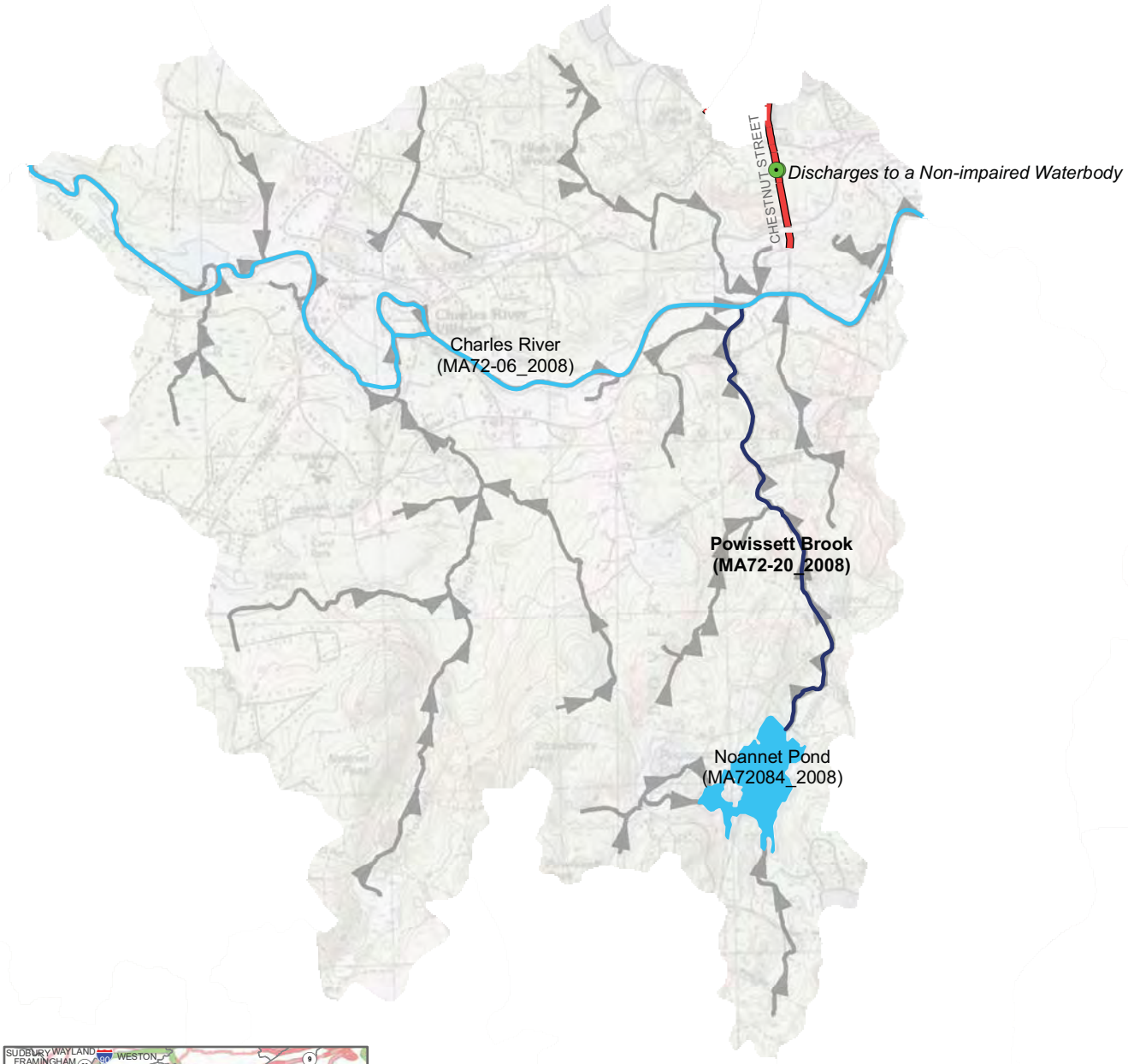
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Powissett Brook (MA72-20_2008)
Subbasin 21035



MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assesed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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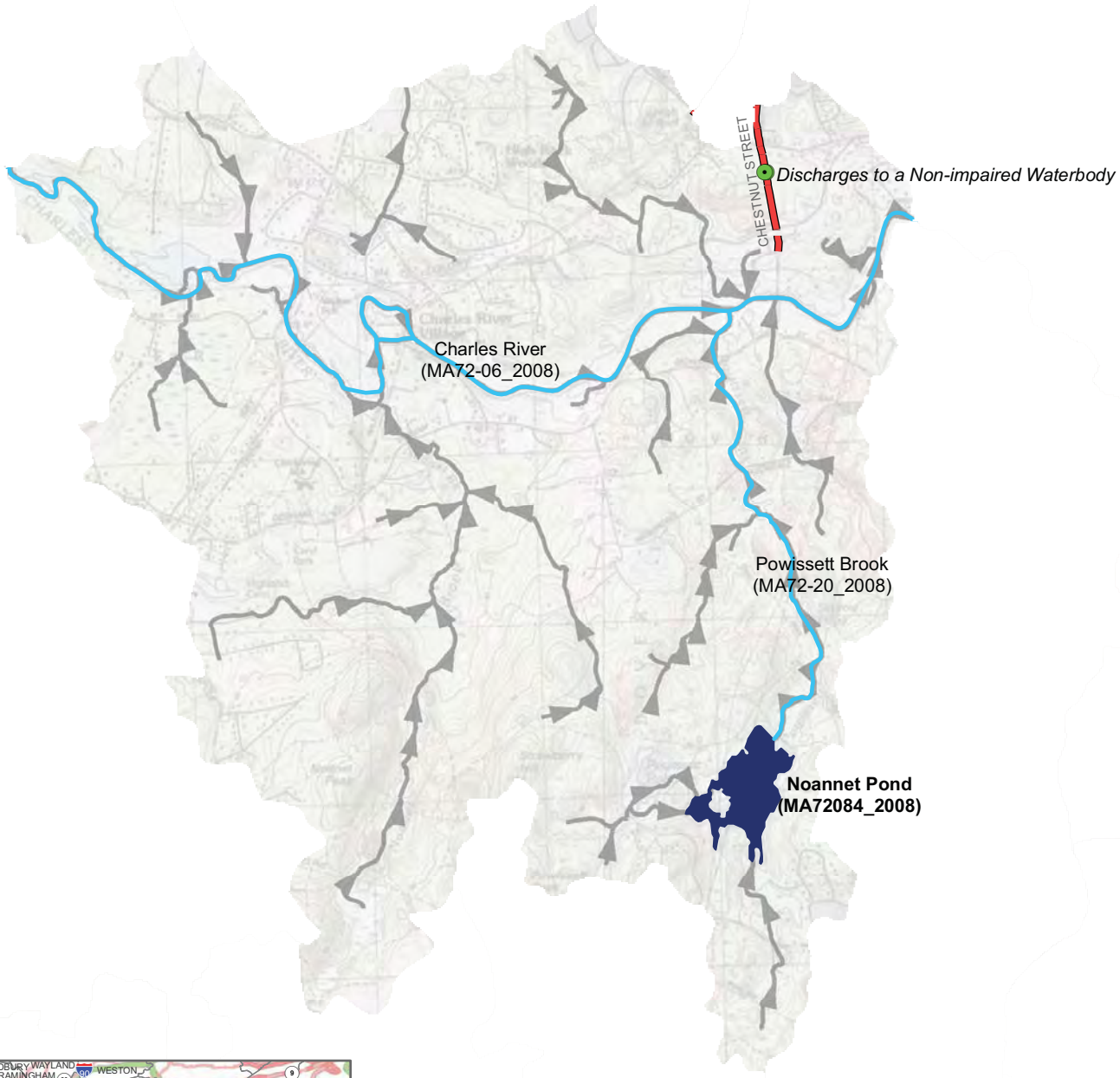
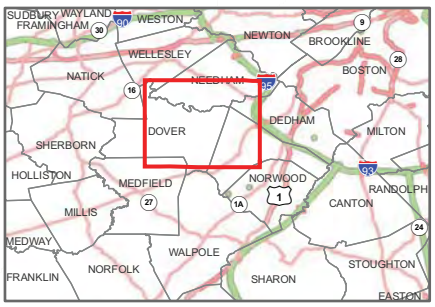
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Noannet Pond (MA72084_2008)
Subbasin 21035





MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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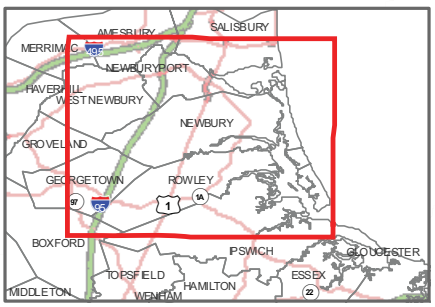
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Parker River (MA91-02_2008)

Subbasins 21044, 21045, 21046, 21048, 21049, 21183, 21213, 21214, 21215



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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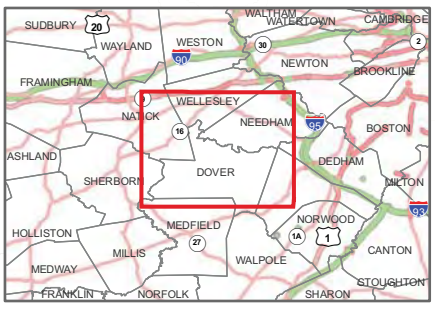
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Charles River (MA72-06_2008)
Subbasins 21109, 21105, 21035



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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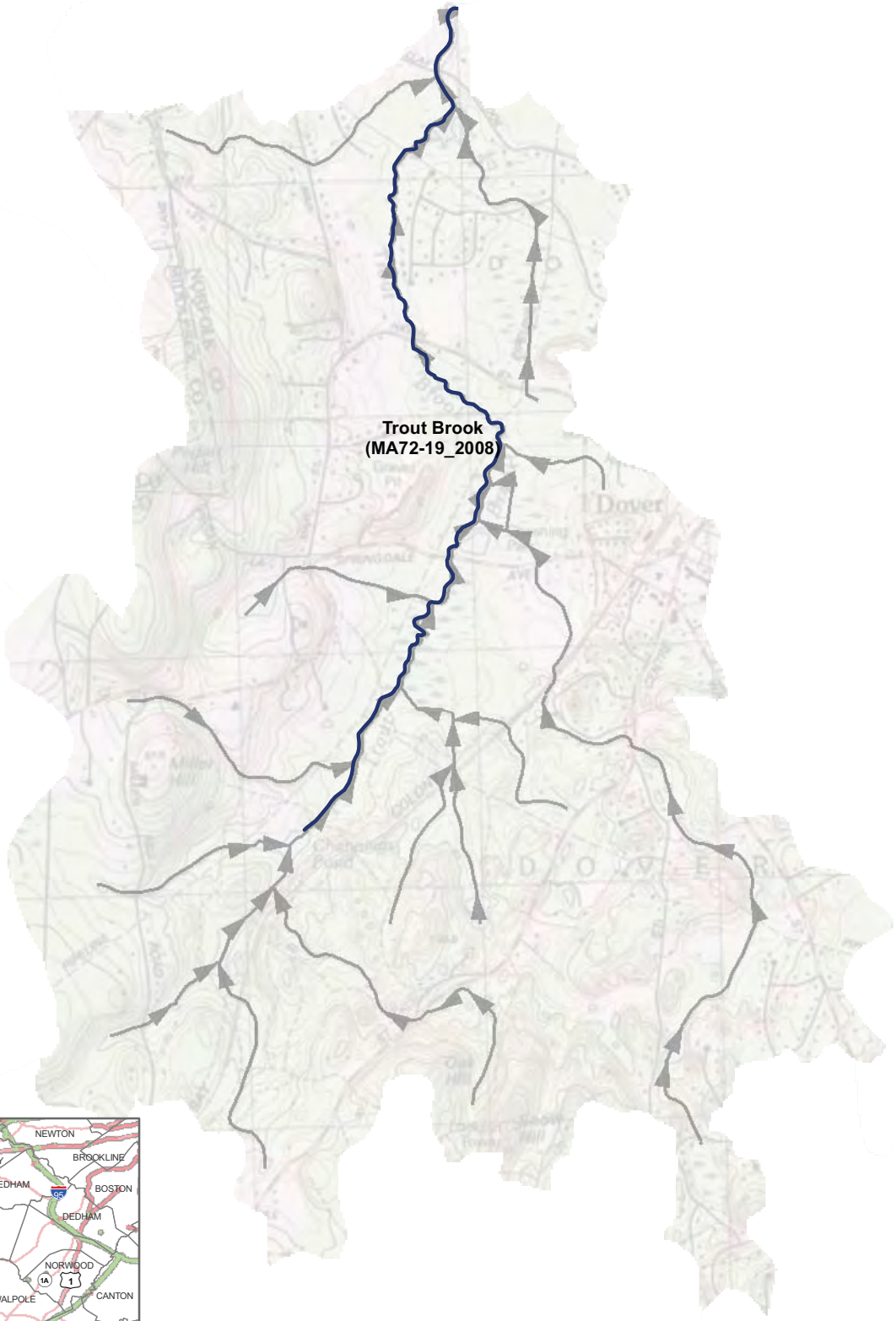
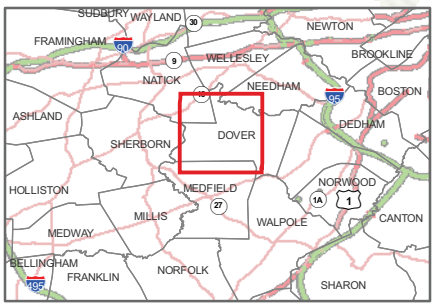
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Trout Brook (MA72-19_2008)

Subbasin 21111





- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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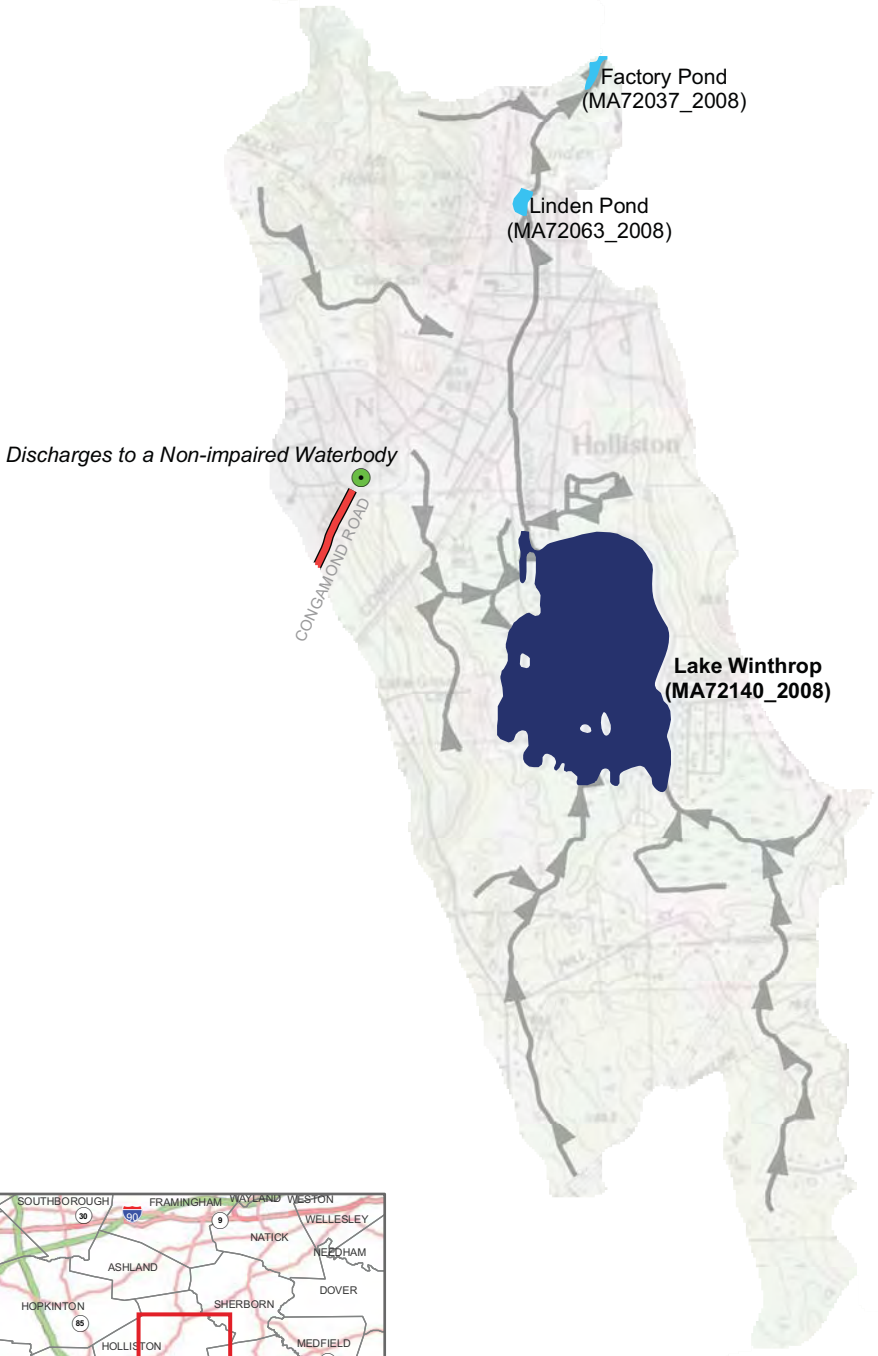
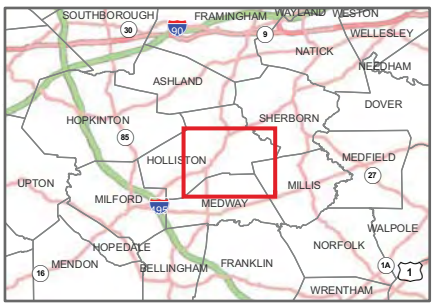
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Lake Winthrop (MA72140_2008)

Subbasin 21118





MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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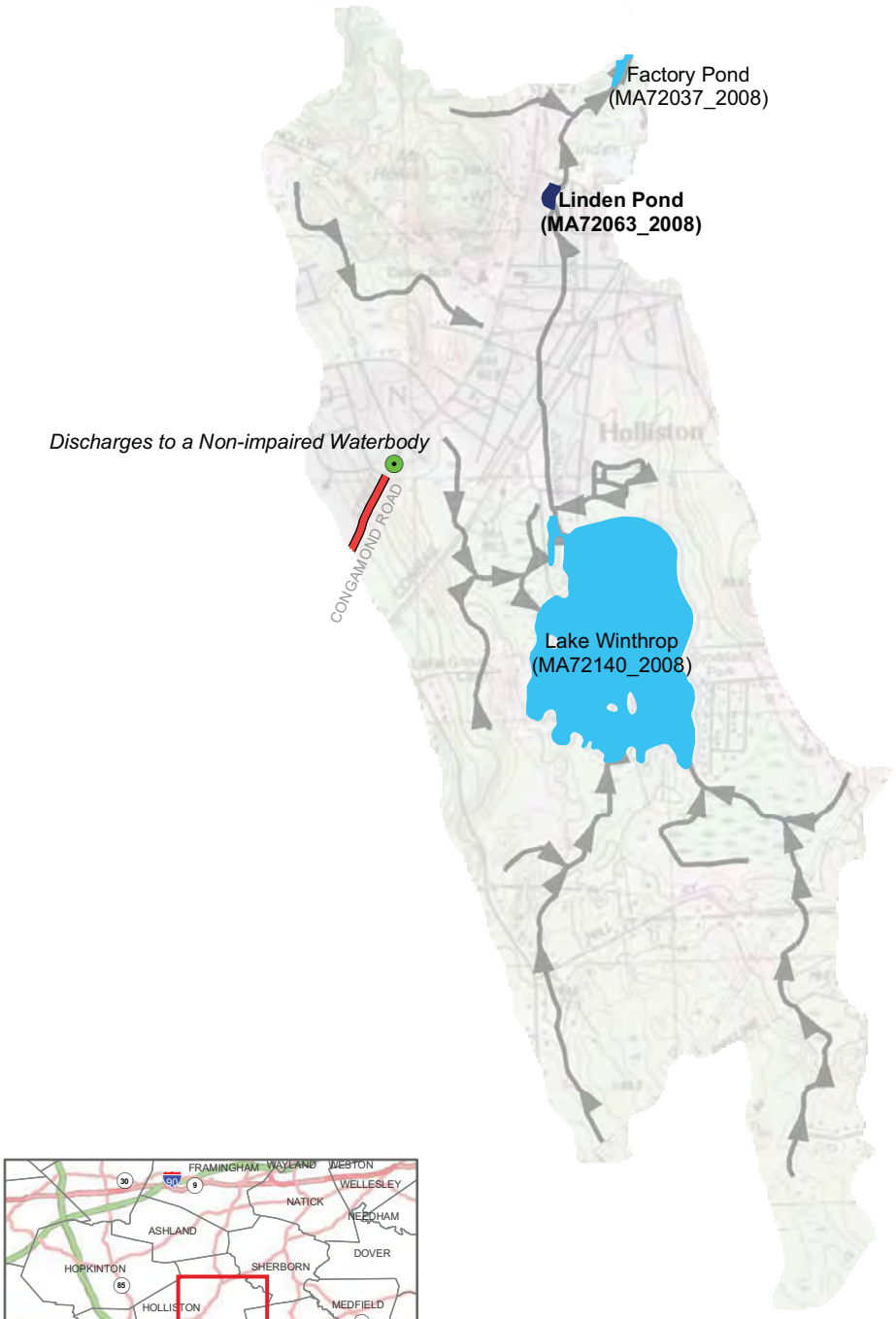
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Linden Pond (MA72063_2008)

Subbasin 21118



- **MassDOT Outfall**
- **MassDOT Urban Roads**
- **Non-impaired Waterbody Segment**
- **Impaired Waterbody Being Assessed**
- **Non-impaired Waterbody Segment with Flow Direction**

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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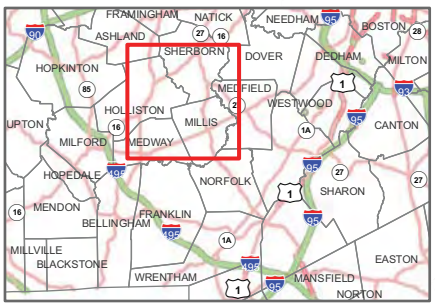
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Bogastow Brook (MA72-16_2008)

Subbasins 21123 & 21131



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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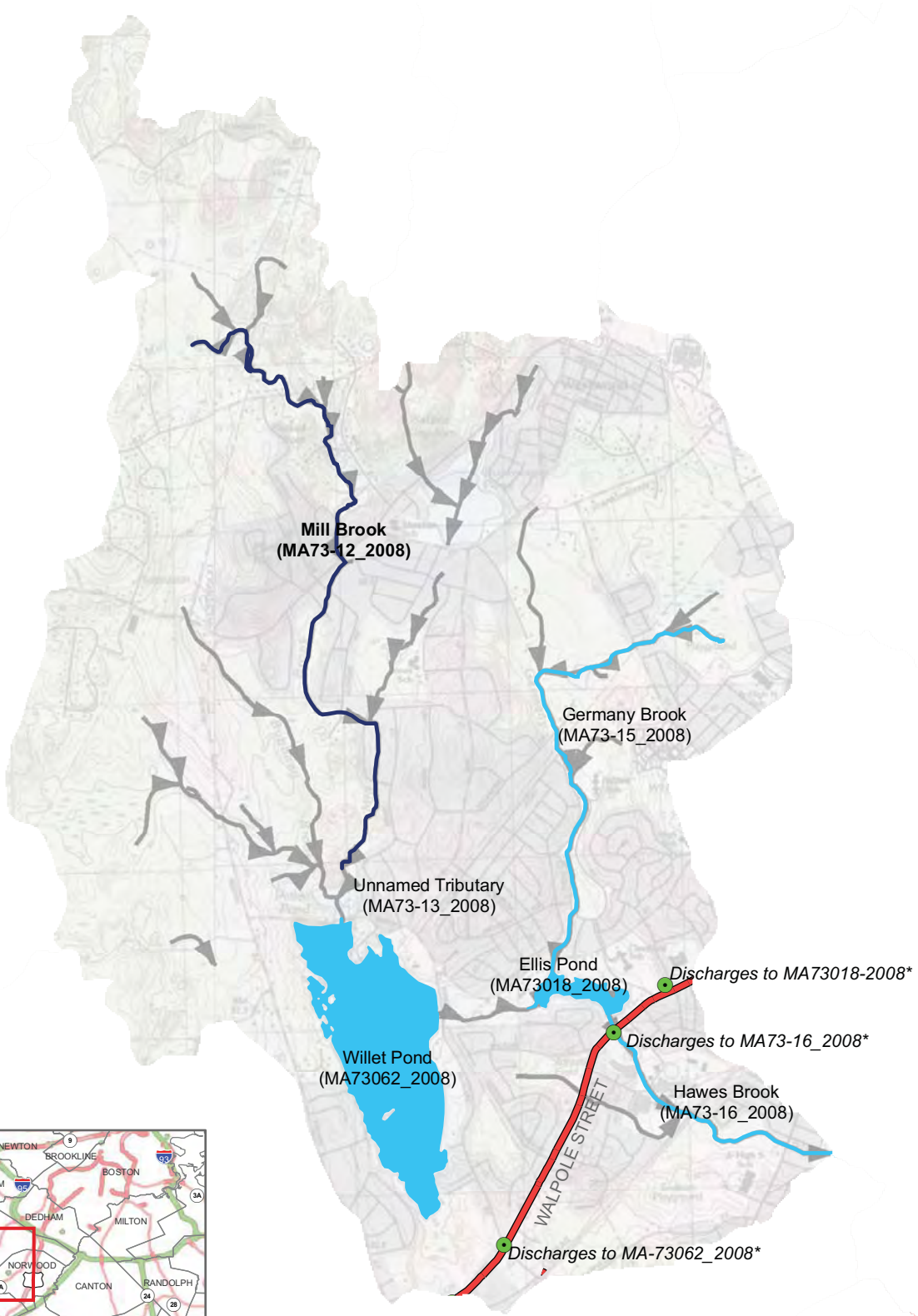
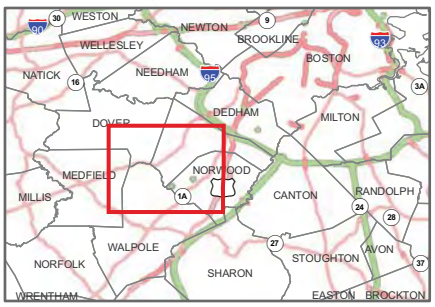
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Mill Brook (MA73-12_2008)
Subbasin 21135





- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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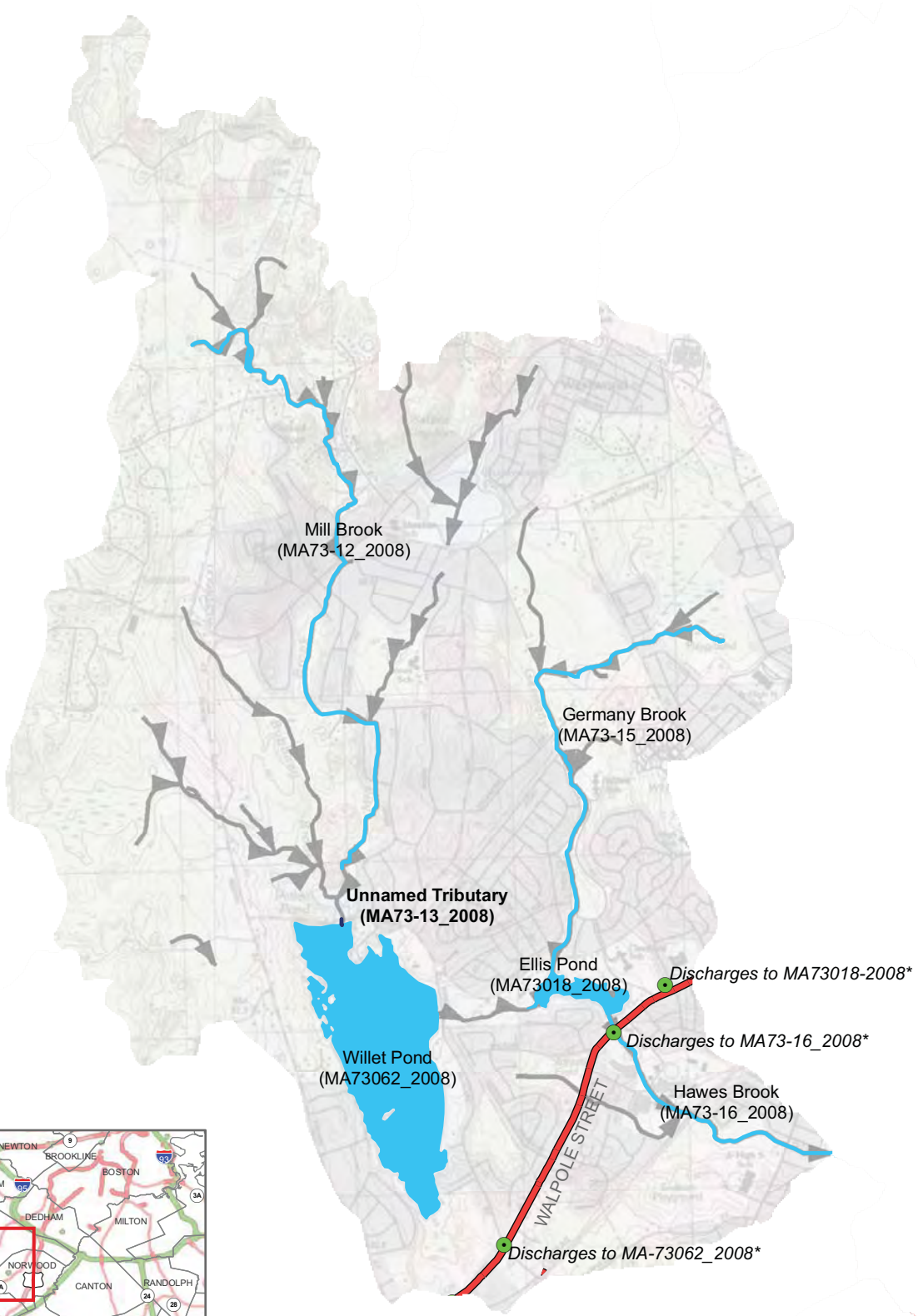
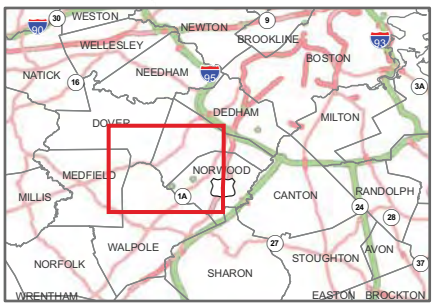
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Unnamed Tributary (MA73-13_2008)
Subbasin 21135





MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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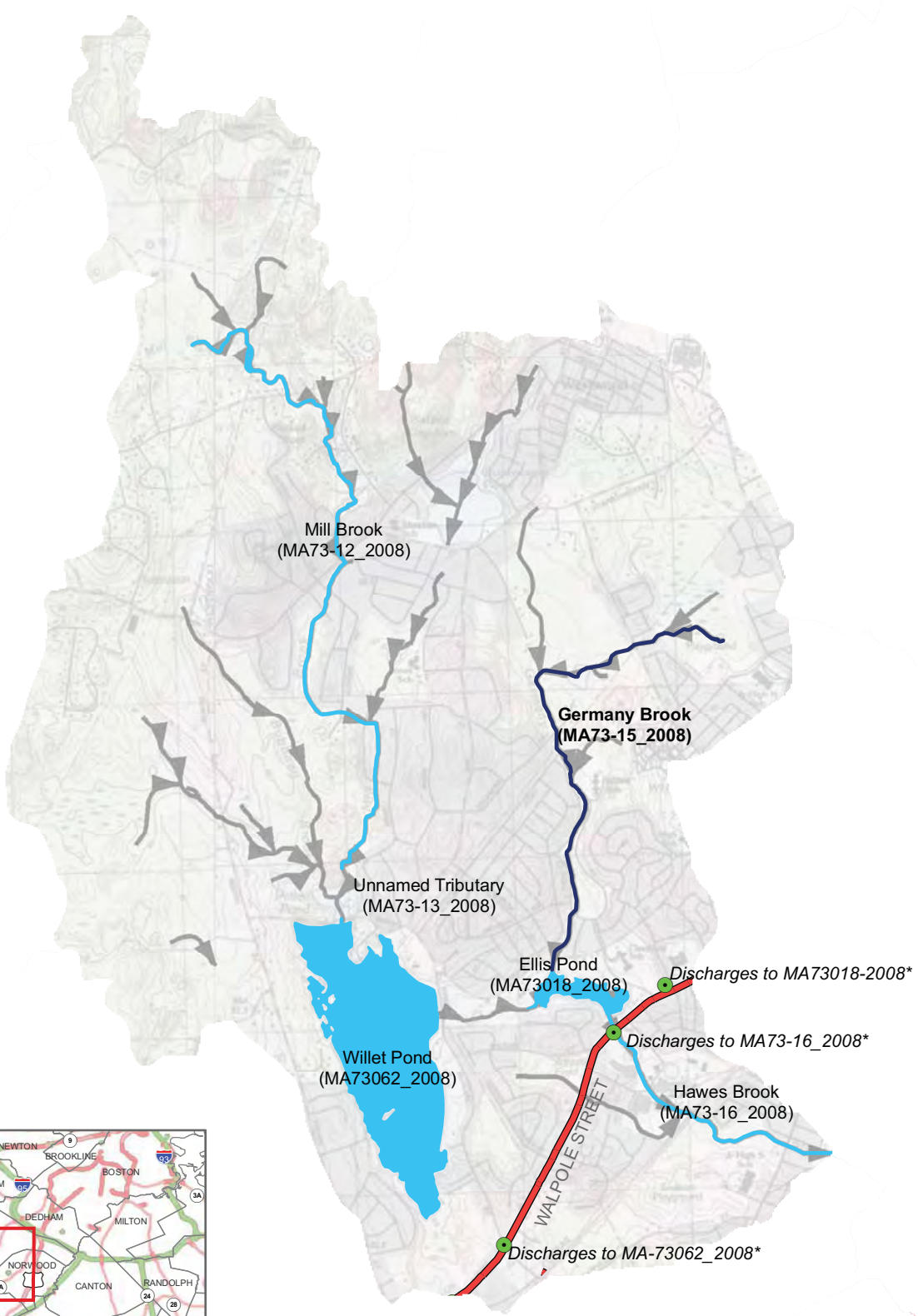
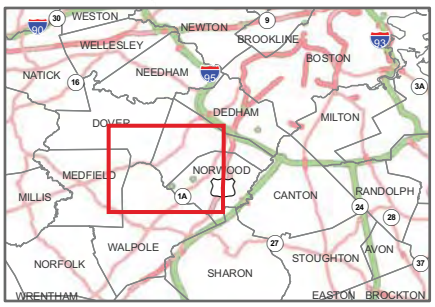
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Germany Brook (MA73-15_2008)
Subbasin 21135





MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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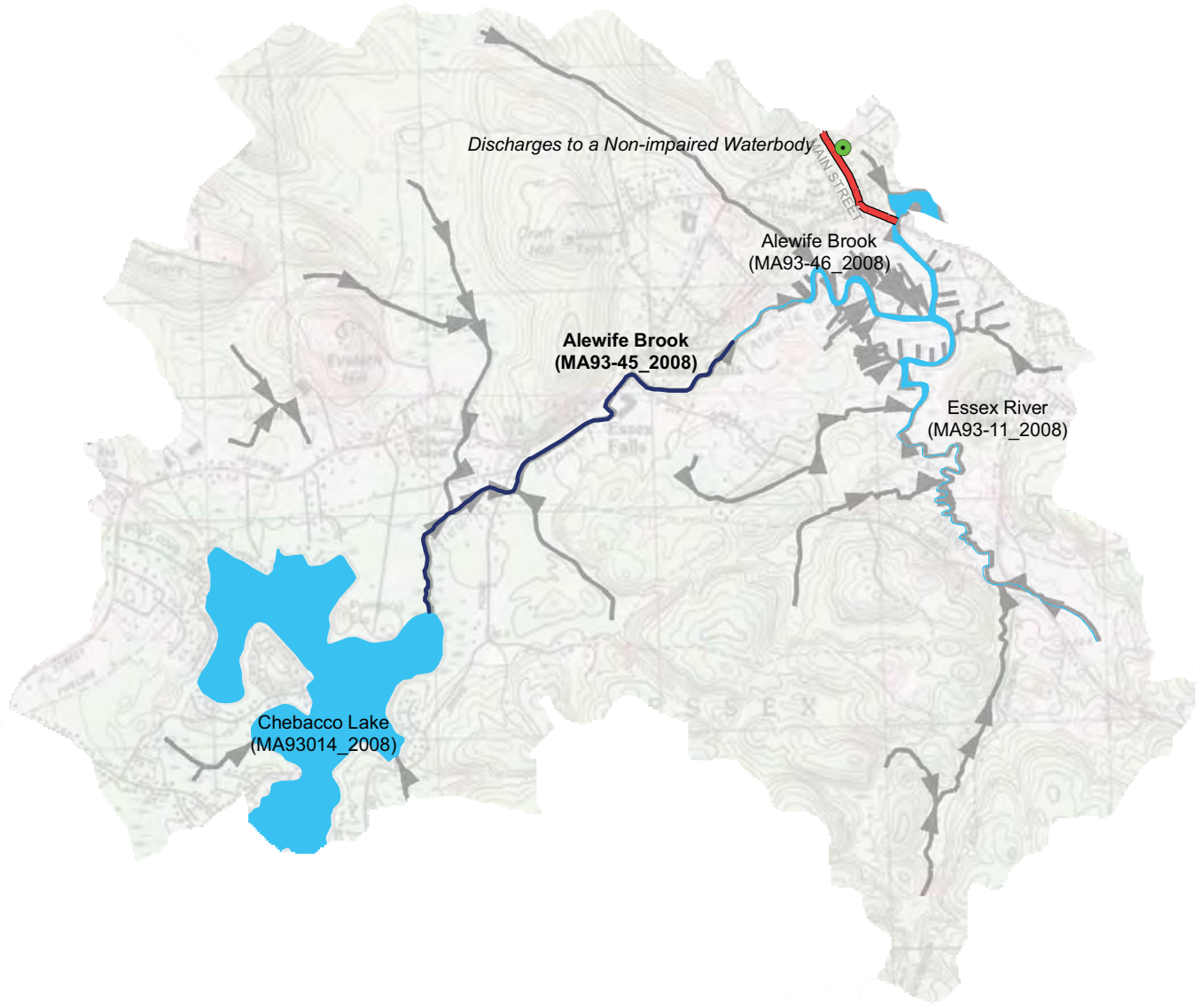
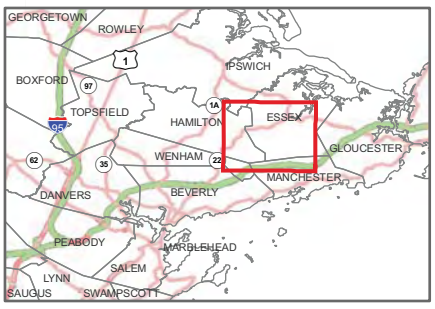
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Alewife Brook (MA93-45_2008)
Subbasin 21206





- **MassDOT Outfall**
- **MassDOT Urban Roads**
- **Non-impaired Waterbody Segment**
- **Impaired Waterbody Being Assessed**
- **Non-impaired Waterbody Segment with Flow Direction**

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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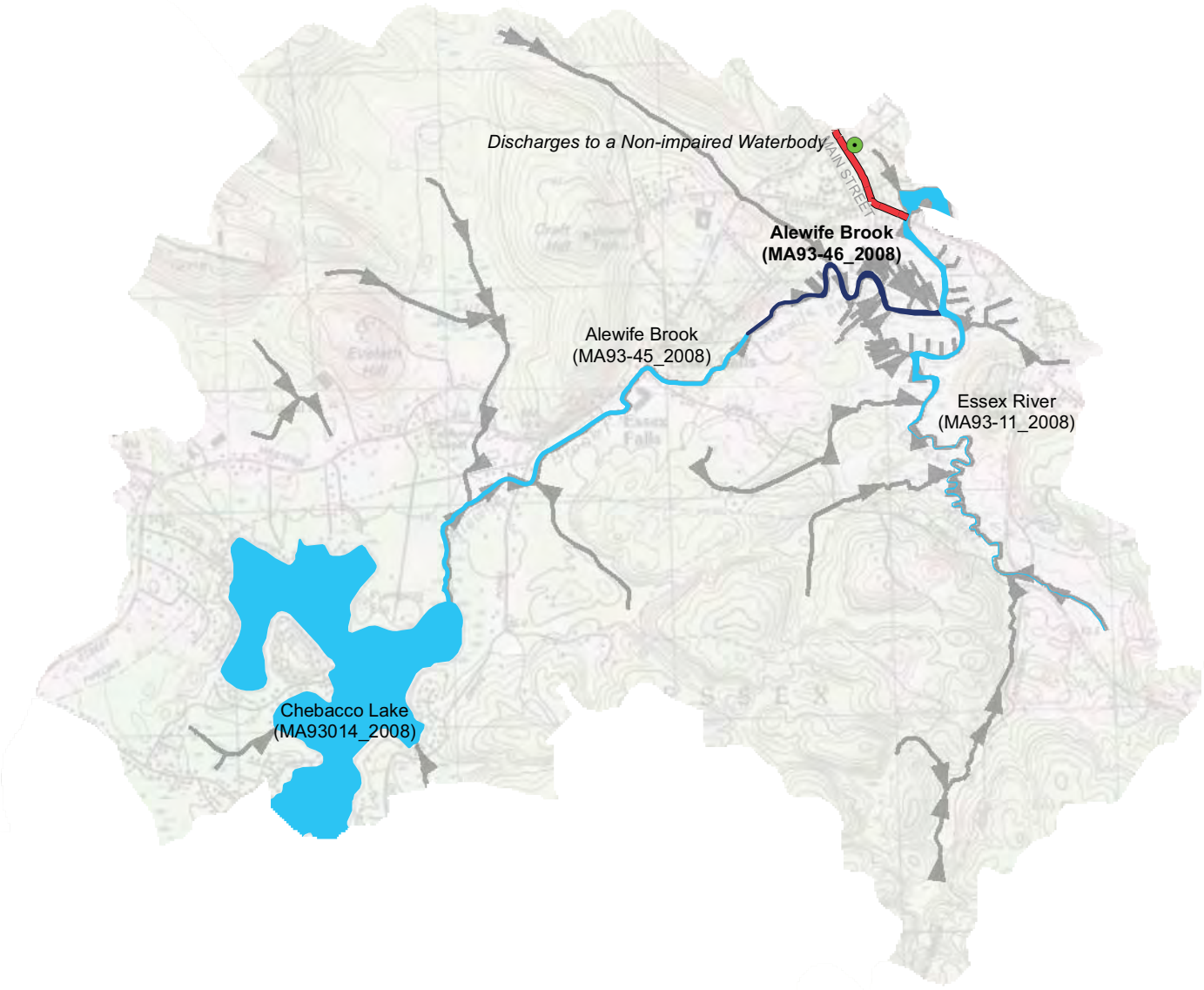
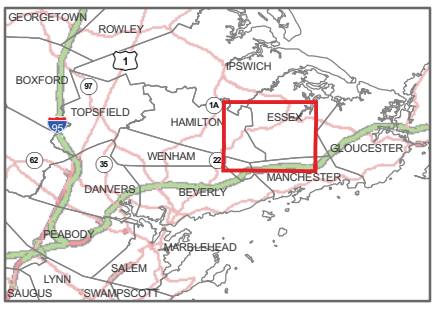
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Alewife Brook (MA93-46_2008)
Subbasin 21206





- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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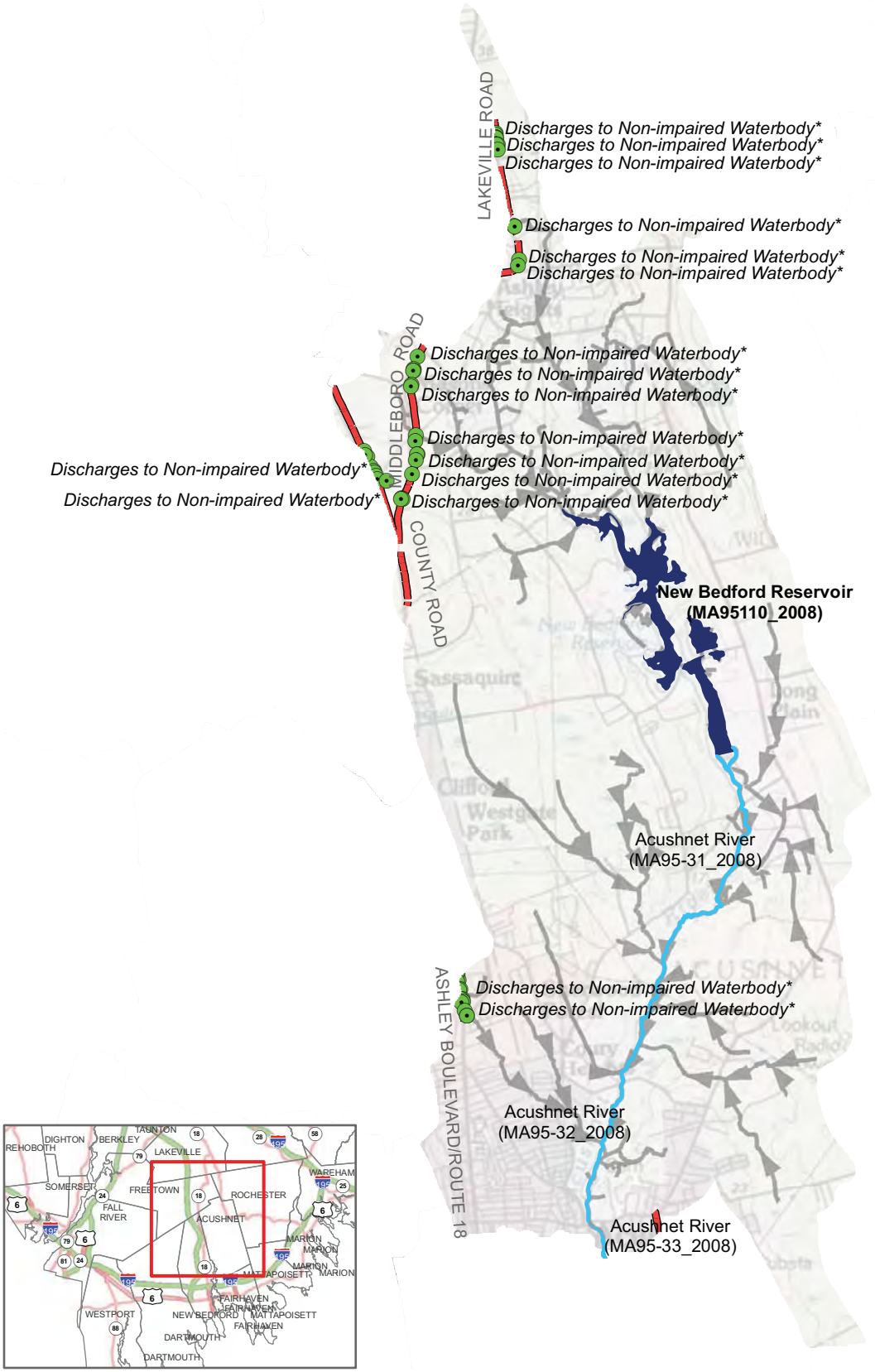
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

New Bedford Reservoir (MA95110_2008)

Subbasins 22005, 22051, 22052



MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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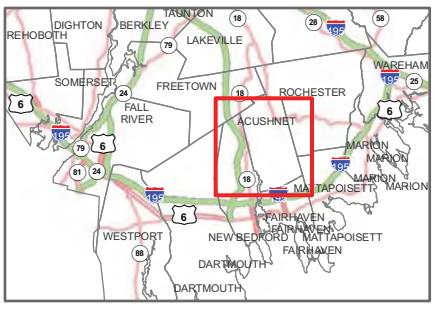
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Acushnet River (MA95-31_2008)

Subbasin 22005



MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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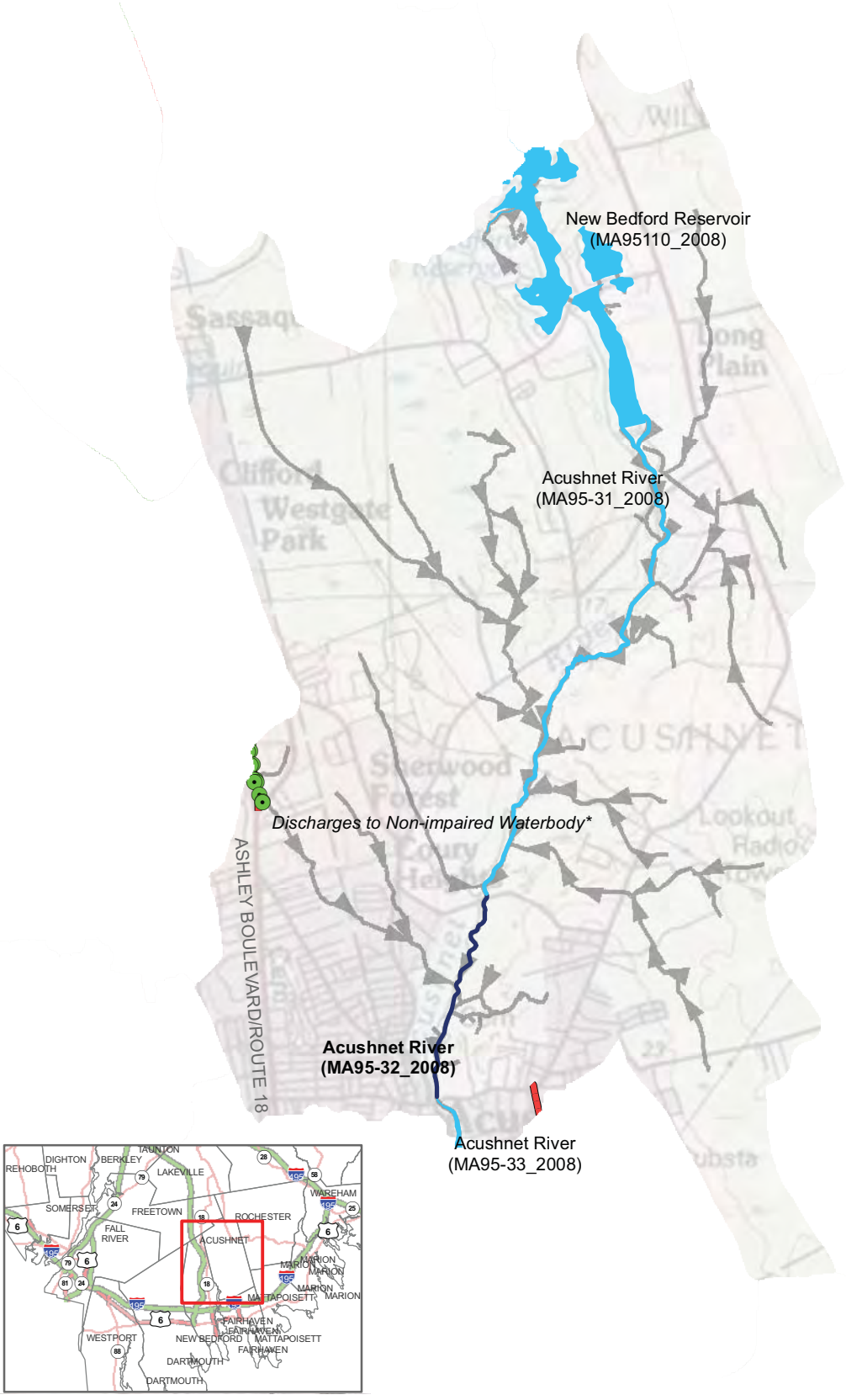
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Acushnet River (MA95-32_2008)

Subbasin 22005



MassDOT Outfall

MassDOT Urban Roads

Non-impaired Waterbody Segment

Impaired Waterbody Being Assessed

Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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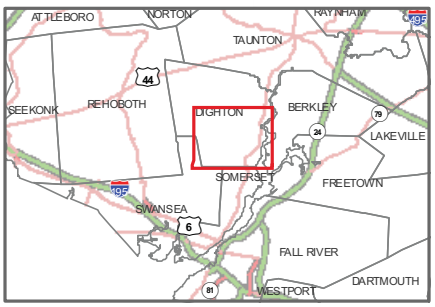
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Muddy Cove Brook Pond (MA62124_2008)

Subbasin 24129



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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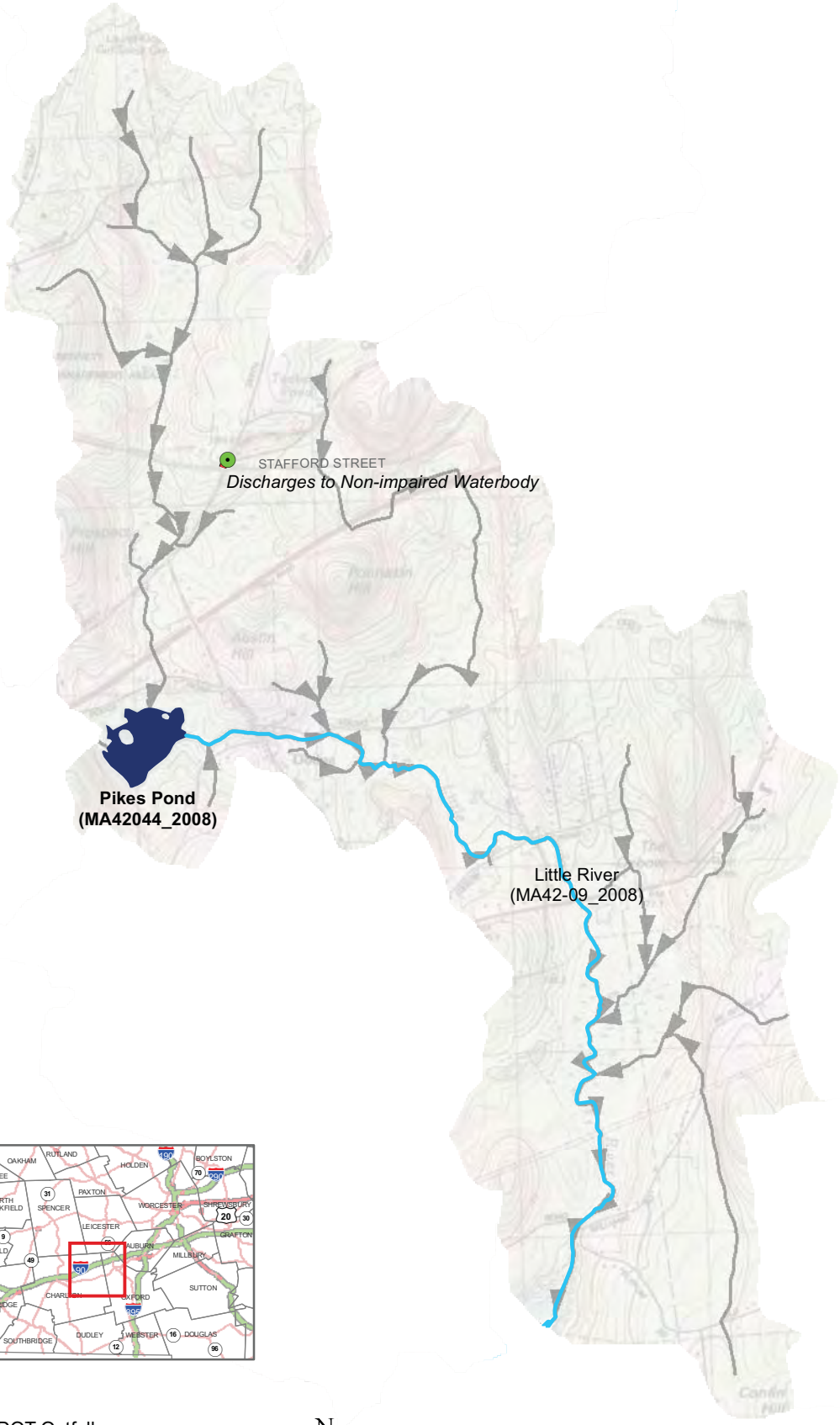
Impaired Waterbodies that do not Receive Discharge from MassDOT Outfalls

Pikes Pond (MA42044_2008)

Subbasin 25018



- MassDOT Outfall
- MassDOT Urban Roads
- Non-impaired Waterbody Segment
- Impaired Waterbody Being Assessed
- Non-impaired Waterbody Segment with Flow Direction

N

Note: Since impaired waterbody does not receive discharge from a MassDOT outfall, impaired waterbody assessment complete.

* Preliminary identification of receiving water. Subsequent efforts may lead to revisions of the receiving water.

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