Attachment 8:

Nitrogen TMDL Assessments and Nitrogen Non-TMDL Groundwater Assessments

List of Impaired Water Bodies

MA95-01	Buttermilk Bay
MA95-02	Onset Bay
MA95-03	Wareham River
MA95-05	Weweantic River
MA95-21	Herring Brook
MA95-29	Agawam River
MA95-53	Beaverdam Creek
MA95-55	Squeteague Harbor
MA95-68	Wild Harbor River
MA95-76	Little Buttermilk Bay*
MA95-77	Butler Cove*
MA95-78	Rands Harbor*
MA95-79	Fiddlers Cove*
MA95927	Oyster Pond
MA96-12	Bass River
MA96-14	Swan Pond River
MA96-20	Quashnet River
MA96-21	Waquoit Bay
MA96-36	Lewis Bay
MA96-62	Oyster Pond
MA96-63	Cotuit Bay
MA96-65	West Bay
MA96-66	North Bay
MA96-68	Town Cove
MA96-76	The River
MA96-78	Little Pleasant Bay
MA96-80	Mill Creek*
MA96-82	Hyannis Inner Harbor*

*Not on original L-1 List.

Impaired Waters Assessment for Buttermilk Bay (MA95-01) and Little Buttermilk Bay (MA95-76)

Summary

Impaired Water[1]	**Buttermilk Bay (MA95-01):**	Stormwater Impairments:	*Estuarine Bioassessments, Fecal Coliform*
		Category:	*5 (Waters requiring a TMDL)*
		Final TMDLs:	*Final Pathogen TMDL for the Buzzards Bay Watershed*[2]
		WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[3]
	Little Buttermilk Bay (MA95-76):	Stormwater Impairments:	*Estuarine Bioassessments*
		Category:	*5 (Waters requiring a TMDL)*
		Final TMDLs:	*None*
		WQ Assessment:	*None*
Location		Towns:	*Bourne, Plymouth, Wareham*
		MassDOT Roads:	*Route 25,Cranberry Highway (US 6), Onset Avenue, St. Margaret's Street, Bourne Road*
Assessment Method(s)	7R (TMDL Method) ☒		7U (Non-TMDL Method) ☒
BMPs		Existing:	*None*

MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*492 lbs/yr*
	Existing Load to Water Body:	*73,138 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.67 %*

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

[2] MassDEP. 2009. Final Pathogen TMDL for the Buzzards Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[3] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

Site Description

Buttermilk Bay (MA95-01) is a 0.66-square mile water body west of Little Buttermilk Bay (MA95-76), a 0.16-square mile water body, located north of Route 6 and the Cape Cod Canal (MA95-14) in Bourne, Massachusetts. Figure 1 illustrates the combined groundwatershed for Buttermilk Bay (MA95-01) and Little Buttermilk Bay (MA95-76). The groundwatershed for portions of Buzzards Bay, including these impaired segments, were provided by the Buzzards Bay National Estuaries Program (BBNEP)[4] as modified from the USGS groundwater delineations developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data.[5,6] Portions of Buzzards Bay are based on groundwater delineations and not ground surface topography.[5] For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Buttermilk Bay (MA95-01) and Little Buttermilk Bay (MA95-76). Little Buttermilk Bay and Buttermilk Bay are two separate segments; however they share the same groundwatershed and are connected hydraulically and were thus analyzed together.

MassDEP's Water Quality Assessment Report titled *Buzzards Bay Watershed 2000 Water Quality Assessment Report*[7] identifies the Aquatic Life Use as "impaired" and 0.16-square mile of the water body as "impaired" for Shellfishing Harvesting Use for Buttermilk Bay (MA95-01). The "impaired" status for the Aquatic Life Use is reported to be caused by estuarine bioassessment or the loss/decline of eelgrass bed habitat and possibly anthropogenic substrate alterations. Suspected sources include recreational activities, roadways, urbanized areas and municipal separate storm sewer systems. The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from municipal separate storm sewer systems. The other uses were either not assessed or partially assessed with the assessed areas supporting the designated uses. The Water Quality Assessment Report also notes that reduced tidal flushing in Little Buttermilk Bay is believed to be detrimental to water quality and that an estuarine bioassessment impairment is suspected to be caused by total nitrogen.

Figures 2a and 2b illustrate the MassDOT-owned roads within the groundwatershed that contribute runoff to the water body. It should be noted that only a portion of the MassDOT-owned roads inside the groundwatershed boundary are within an MS4-regulated urban area. Parts of the MassDOT roads are outside of the designated urban area; therefore, discharge from these roadways is not identified as contributing to the impaired segment. The groundwatershed area is predominantly forested with higher concentrations of development in the south, around the Bays, and some cranberry bogs in the northern part of the groundwatershed. Route 25 extends through the center of the Bays' groundwatershed from Wareham to Plymouth where it crosses Bourne Road. Route 25 is a four-lane divided expressway. MassDOT owns approximately 1,100 feet of Bourne Road at its intersection with Route 25. The Cranberry Highway (Route 6), a four-lane highway, crosses the

[4] BBNEP, 2014. Shapefile coverage of watershed boundaries via email from Joe Costa on September 9, 2014.

[5] U.S. Geological Survey (USGS). (2009). Groundwater contributing areas for Cape Cod and Plymouth-Carver Regions of Massachusetts. Data Series 451 (1 of 3).

[6] Walter, D.A., Masterson, J.P., and Hess, K.M., 2004, Ground-Water Recharge Areas and Traveltimes to Pumped Wells, Ponds, Streams, and Coastal Water Bodies, Cape Cod, Massachusetts, Scientific Investigations Map I-2857, 1 sheet. Available at: http://pubs.water.usgs.gov/sim20042857.

[7] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

southern end of the groundwatershed from Jennifer Drive at the western groundwatershed border extending east to the western edge of Buttermilk Bay. In addition, a small section of St. Margaret's Street is owned by MassDOT north of the intersection with Route 6 and extends north for approximately 300 feet. A section of US Route 6 which extends past the southern groundwatershed boundary and includes the Main Street/ Route 6 rotary intersection is considered "Supplemental Contributing Area". Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". Runoff within this area is collected in roadside catchbasins and discharged into Buttermilk Bay. These sections of roadway are shown in Figure 2b.

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[8] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[9] MassDOT assessed Buttermilk Bay (MA95-01) and Little Buttermilk Bay (MA95-76) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[10] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[11] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Buttermilk Bay (MA95-01) and Little Buttermilk Bay (MA95-76) is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to these water bodies using the approach described in BMP 7U[12] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[13] The Buzzards Bay Comprehensive Conservation and

[8] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[9] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

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

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

[12] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[13] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

Management Plan[14] identifies the total existing groundwatershed nitrogen load for these water bodies and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Buttermilk Bay (MA95-01) and Little Buttermilk Bay (MA95-76).

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[15] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using an average of precipitation data from New Bedford and Hyannis sites and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.8 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. [16] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 40.0 acres
- MassDOT Pervious Area: 88.0 acres
- Estimated Existing MassDOT Load: 492 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 73,138 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.67%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[11] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP).[17] Buttermilk Bay (MA95-01) (but not Little Buttermilk Bay) is covered by the Final Pathogen TMDL for the Buzzard Bay Watershed.[18]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to be consistent with relevant TMDLs and

[14] Buzzards Bay National Estuaries Program, November 2013. Buzzards Bay Comprehensive Conservation and Management Plan 2013 Update. Available at: http://buzzardsbay.org/newccmp/buzzards-bay-ccmp-2013-update.pdf

[15] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[16] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[17] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[18] MassDEP, March 2009. Final Pathogen TMDL for the Buzzard Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[19]

According to the Final TMDL, sources of indicator bacteria in the Buzzard Bay Watershed were found to be many and varied. Most of the bacteria sources in the Buzzard Bay Watershed are believed to be failing septic systems, combined sewer overflows (CSO), sanitary sewer overflows (SSO), sewer pipes connected to storm drains, certain recreational activities, wildlife including birds along with domestic pets and animals and direct overland stormwater runoff. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and BMPs to mitigate stormwater runoff volume.

The Buzzards Bay Watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include SSOs, CSOs, failing septic systems, and stormwater runoff including MS4s.

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Buttermilk Bay is listed as a medium priority due to its value as a resource for shellfishing. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated.[20]

In addition to the generic recommendations provided in the draft NPDES MS4 permits for Massachusetts and discussed in the MassDOT Pathogen Methodology, the *Final Pathogen TMDL for the Buzzards Bay Watershed*[20] (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

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

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*[20]:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management

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

[20] MassDEP, 2009. Final Pathogen TMDL for the Buzzards Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

- Watershed resident education
- Additional monitoring
- Stormwater guidance tools

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment for Buttermilk Bay (MA95-01), MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT's BMP 7R Pathogen Methodology, MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the groundwatershed for Buttermilk Bay (MA95-01). MassDOT will be installing signs at rest stops within the groundwatershed of impaired water bodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

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

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

MassDOT has concluded that the BMPs outlined in the SWMP are consistent with its existing permit requirements for Buttermilk Bay (MA95-01). These measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from MassDOT roadways to be a contributing source it is unlikely to warrant action relative to other sources of pathogens in the watershed.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Buttermilk Bay and Little Buttermilk Bay, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As

described in MassDOT's Stormwater Handbook,[21] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[21] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

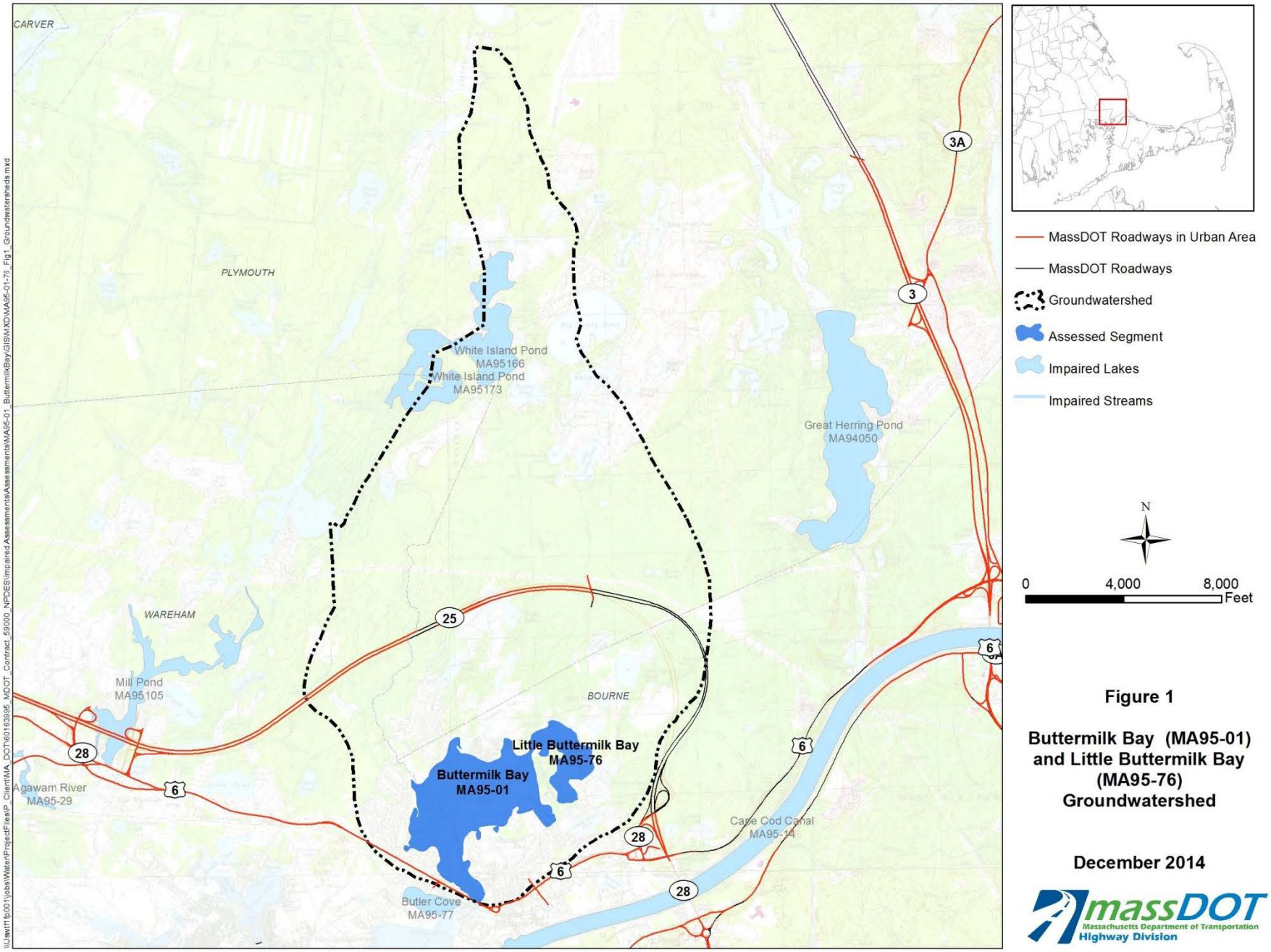

Figure 1

Buttermilk Bay (MA95-01) and Little Buttermilk Bay (MA95-76) Groundwatershed

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

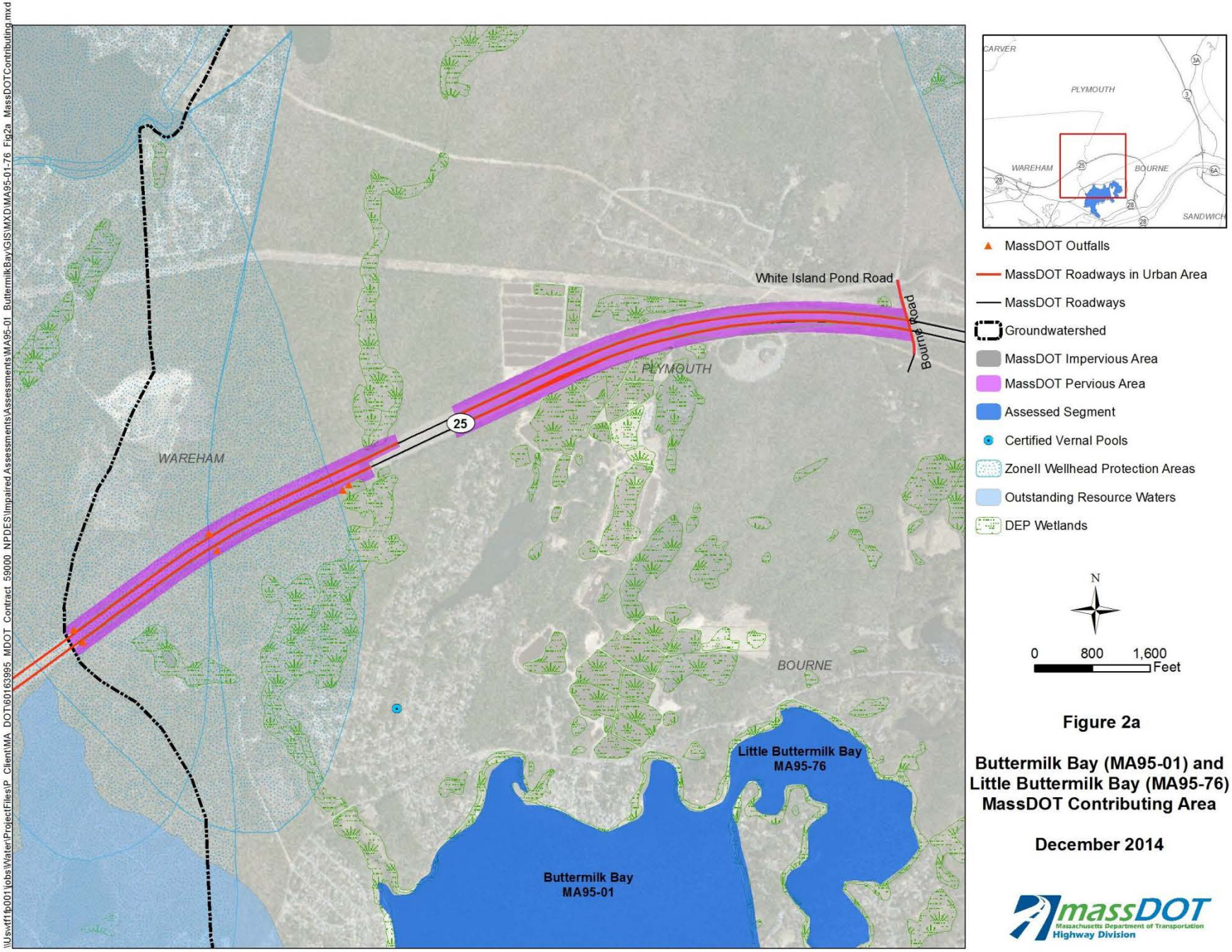

Figure 2a

Buttermilk Bay (MA95-01) and Little Buttermilk Bay (MA95-76) MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

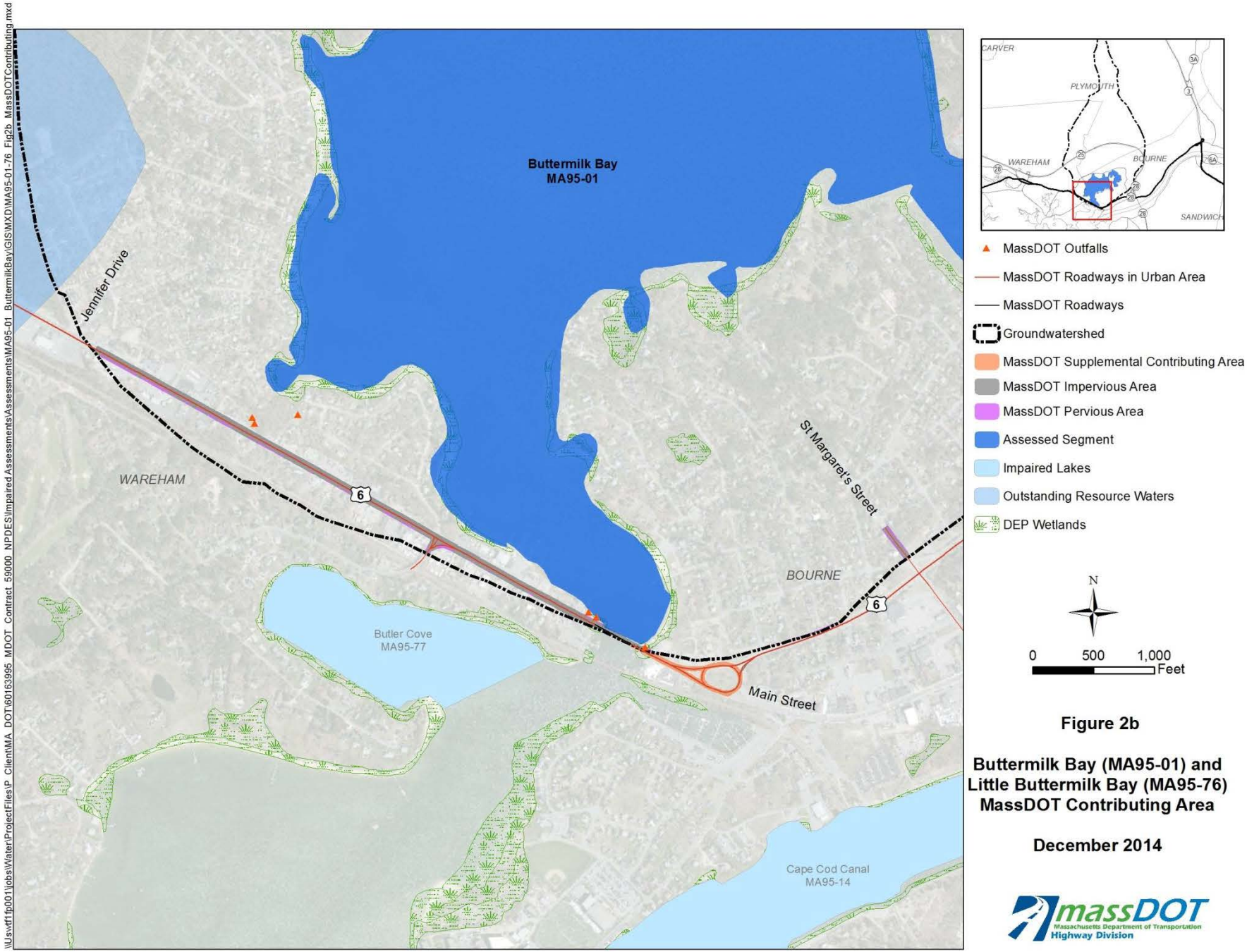

Figure 2b

Buttermilk Bay (MA95-01) and Little Buttermilk Bay (MA95-76) MassDOT Contributing Area

December 2014

12/08/2014

Impaired Waters Assessment for Onset Bay (MA95-02)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments, Fecal Coliform*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the Buzzards Bay Watershed*[2]
	WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[3]
Location	Towns:	*Wareham*
	MassDOT Roads:	*Glen Charlie Road, Route 25,Cranberry Highway (Route 6), Interchange of Route 25 and Glen Charlie Road*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*412.7 lbs/yr*
	Existing Load to Water Body:	*44,465 lbs/yr*
	DOT Contribution to Existing Load:	*0.93 %*

Site Description

Onset Bay (MA95-02) is a 0.78 square mile water body located in Wareham, Massachusetts. Figure 1 illustrates the groundwatershed for Onset Bay. The groundwatershed for this impaired segment was provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the

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

[2] MassDEP, 2009. Final Pathogen TMDL for the Buzzards Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[3] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

USGS 451 groundwater contributing areas data.[4,5] The Cape Cod and adjacent Southeastern Massachusetts Communities are based on groundwater delineations and not ground surface topography.[5] For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment.

MassDEP's Water Quality Assessment Report titled *Buzzards Bay Watershed 2000 Water Quality Assessment Report*[6] identifies the Aquatic Life Use as "impaired" and 0.15 square miles of the groundwatershed as "impaired" for Shellfishing Harvesting Use. The "impaired status" for the Aquatic Life Use is reported to be caused by estuarine bioassessment or the loss/decline of eelgrass bed habitat and possibly anthropogenic substrate alterations. Suspected sources include recreational activities, roadways, urbanized areas and municipal separate storm sewer systems. The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from municipal separate storm sewer systems. The other uses were not assessed. The report also indicated that a suspected source causing an estuarine bioassessments impairment is total nitrogen.

MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Onset Bay (MA95-02). There are no regulated wastewater discharges to the Bay; however there are three vessel sewage pump-out facilities on Onset Bay.[6] Previous efforts to manage nutrients in the Onset Bay groundwatershed resulted in a conservation restriction protecting 13 acres within the watershed and an additional 4 acres protected for wellfields. The Onset Bay groundwatershed area is predominantly forested with scattered bog areas, developed areas centered in Onset and along Route 6 as well as a country club and a golf course in the southwest of the groundwatershed.

Figure 2 illustrates the MassDOT-owned roads within the groundwatershed that contribute runoff to the water body. Route 25 is a four-lane median expressway which traverses the groundwatershed in the northern part of the groundwatershed from west of Mill Pond (MA95105). Route 6 is a four-lane highway south of Route 25 and Dick's Pond and is connected to Route 25 by Glen Charlie Road, west of Union Pond, which has interchanges with both Route 6 and Route 25. The majority of Route 25 is either collected in catch basins along the outer edge of the roadway or drains into the grassed median via overland flow where it is collected in catchbasins. Runoff from Route 6 (Cranberry Highway) drains to catchbasins and pipes located along both sides of the roadway which is conveyed to a number of outfalls along the roadway.

Additionally, approximately 0.5 acres of impervious area west of the groundwatershed boundary including portions on both Route 28 and Route6 are considered "Supplemental Contributing Area" based on field observations. Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". These areas are collected in catch basins and pipes and discharge within the Onset Bay watershed (Figure 2).

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[4] Walter, D.A., Masterson, J.P., and Hess, K.M., 2004, Ground-Water Recharge Areas and Traveltimes to Pumped Wells, Ponds, Streams, and Coastal Water Bodies, Cape Cod, Massachusetts, Scientific Investigations Map I-2857, 1 sheet. Available at: http://pubs.water.usgs.gov/sim20042857.

[5] U.S. Geological Survey (USGS). (2009). Groundwater contributing areas for Cape Cod and Plymouth-Carver Regions of Massachusetts. Data Series 451 (1 of 3).

[6] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[7] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[8] MassDOT assessed Onset Bay (MA95-02) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[9] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[10] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Onset Bay (MA95-02) is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[11] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[12] The Buzzards Bay Comprehensive Conservation and Management Plan[13] identifies the total nitrogen load in from the groundwatershed for this water body, and identifies that estuarine degradation is a result of excess nitrogen loading to the groundwatershed. Therefore, MassDOT considers the following impairments to Onset Bay (MA95-02) to be linked to elevated nitrogen: estuarine bioassessments.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[14] to estimate annual pollutant loads from its property and treatment through existing BMPs, if present. Based on the

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[7] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

[11] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[12] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[13] Buzzards Bay National Estuary Program, November 2013. Buzzards Bay Comprehensive Conservation and Management Plan 2013 Update. Available at: http://buzzardsbay.org/newccmp/buzzards-bay-ccmp-2013-update.pdf

[14] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

USGS SELDM model, which was run using an average of precipitation data from the New Bedford and Hyannis sites and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.8 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[15] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 39.2 acres
- MassDOT Pervious Area: 58.6 acres
- Estimated Existing MassDOT Load: 412.7 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 44,465 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.93%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen Non-TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[13] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP).[16] Onset Bay (MA95-02) is covered by the Final Pathogen TMDL for the Buzzard Bay Watershed.[17]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[18]

The Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. Vessel sewage pump out facilities and MS4 stormwater contributions are listed as potential sources of bacterial pollution to Onset Bay (MA95-02).[17]

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized in the TMDL based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Onset Bay is

[15] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

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

[17] MassDEP. March 2009. Final Pathogen TMDL for the Buzzard Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

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

listed as a medium priority due to its value as a resource for shellfishing. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated.[19]

In addition to the generic recommendations provided in the draft NPDES MS4 permits for Massachusetts and discussed in the MassDOT Pathogen Methodology, the *Final Pathogen TMDL for the Buzzards Bay Watershed*[19] (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

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

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*[19]:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters Use management
- Watershed resident education
- Additional monitoring
- Stormwater guidance tools

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

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

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay Pathogen TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program,

[19] MassDEP. March 2009. Final Pathogen TMDL for the Buzzard Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

MassDOT has determined that no MassDOT targeted rest stops are located within the groundwatershed of this water body. MassDOT will be installing signs at rest stops within the groundwatershed of impaired water bodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

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

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Onset Bay, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[20] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[20] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

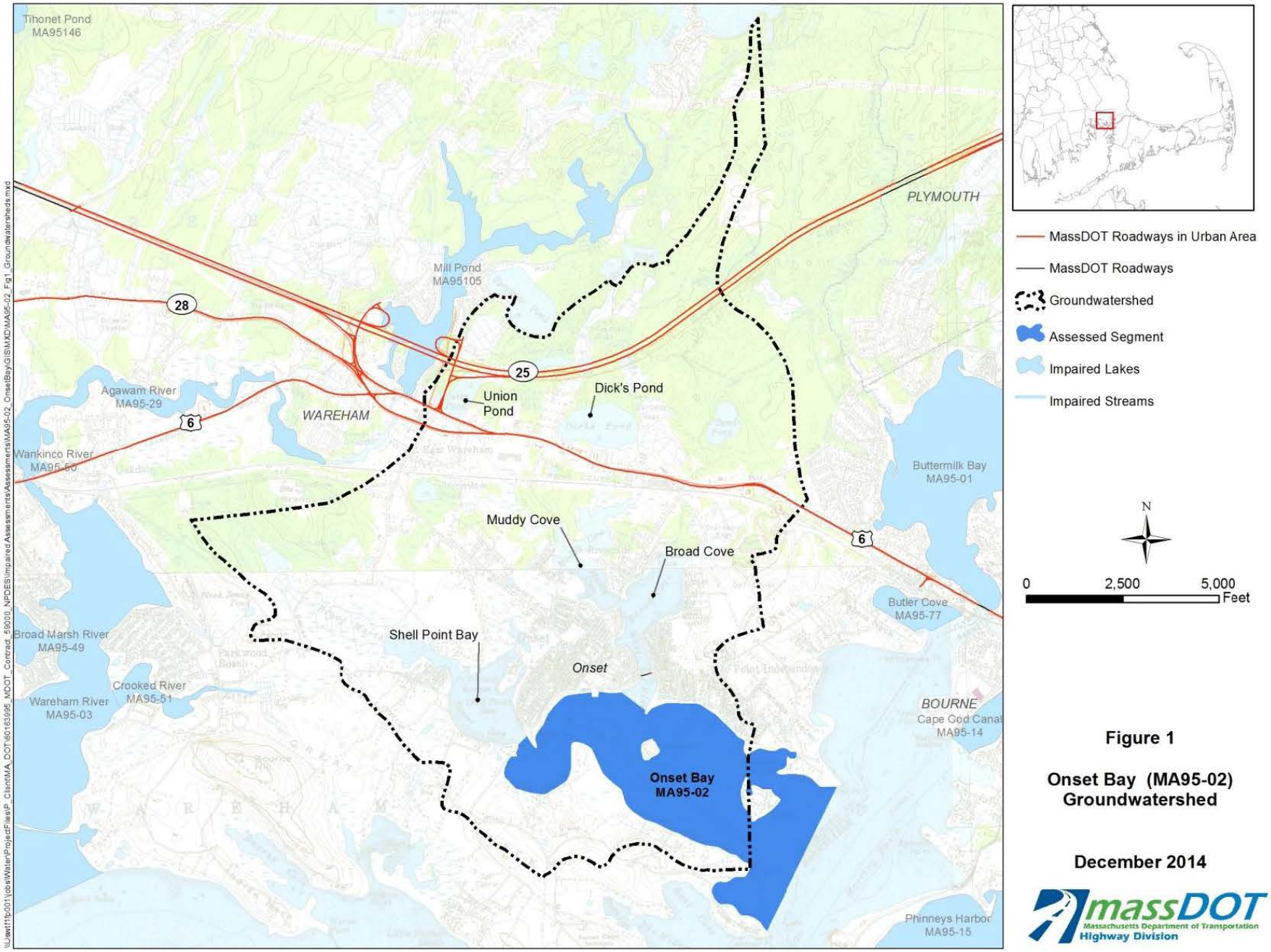
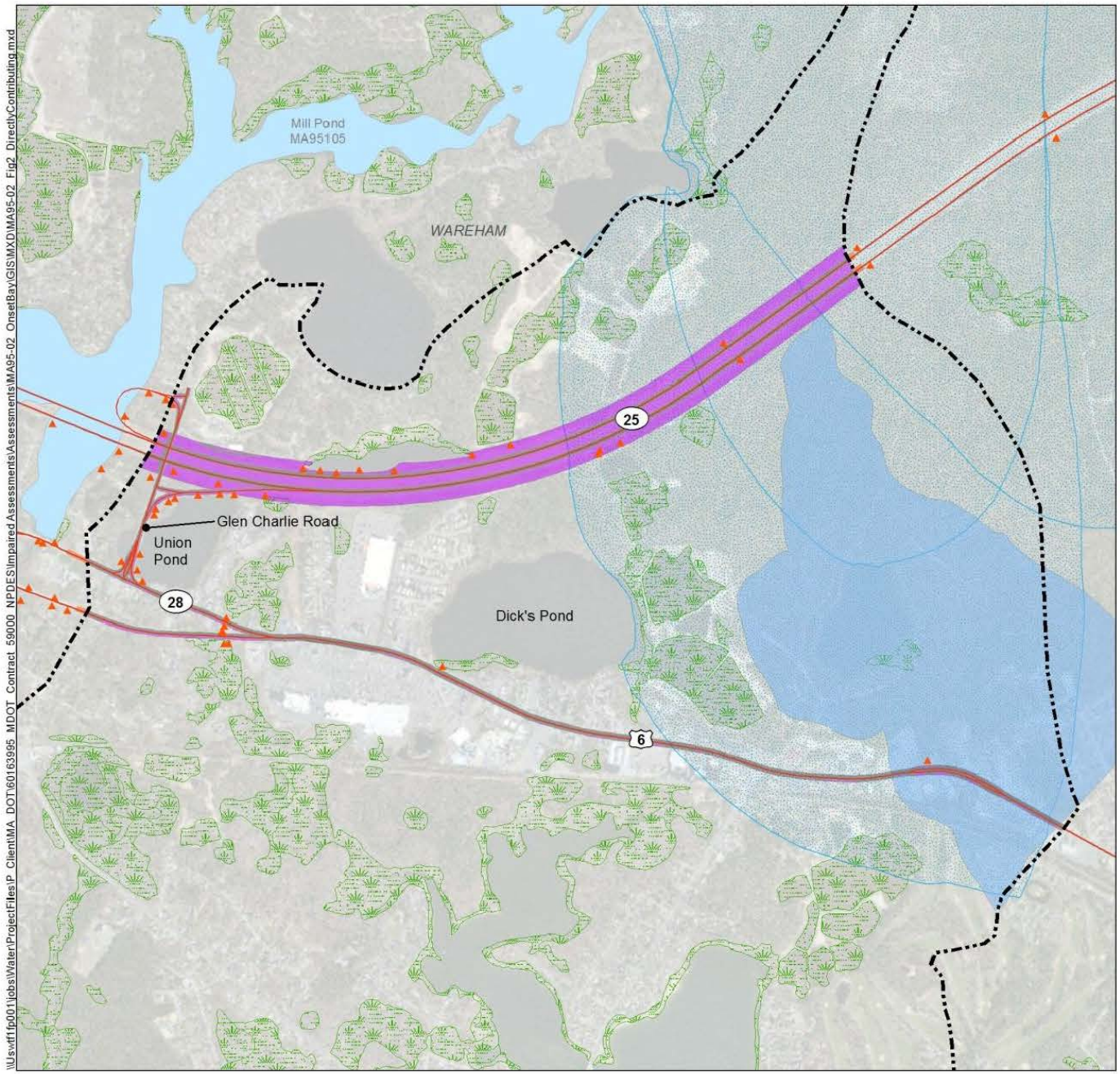
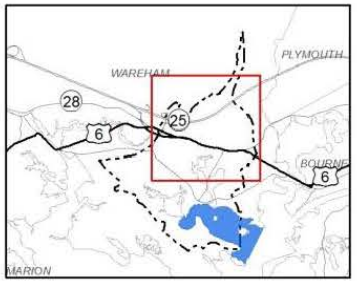


Figure 1

Onset Bay (MA95-02)
Groundwatershed

December 2014





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- MassDOT Impervious Area
- MassDOT Pervious Area
- MassDOT Supplemental Contributing Area
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

0 700 1,400 Feet

Figure 2

Onset Bay (MA95-02)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

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Impaired Waters Assessment for Wareham River (MA95-03)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments; Nitrogen (Total); Fecal Coliform*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the Buzzards Bay Watershed (CN: 251.1)*[2]
	WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[3]
Location	Towns:	*Wareham*
	MassDOT Roads:	*Route 6, Route 25, Route 28, Maple Springs Road, I-495 and I-195*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*1,067 lbs/yr*
	Existing Load to Water Body:	*104,208 lbs/yr*
	MassDOT Contribution to Existing Load:	*1.02 %*

Site Description

Wareham River (MA95-03) is a 1.2 square mile water body which extends from the confluence of the Wakinco River (MA95-50) and Agawam River (MA95-29) at the Route 6 bridge to Buzzards Bay in Wareham, Massachusetts. Figure 1 illustrates the groundwatershed for Wareham River (MA95-

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

[2] Mass DEP.2009. Final Pathogen TMDL for the Buzzards Bay Watershed March 2009 (CN 251.1). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[3] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

03). The groundwatershed for this impaired segment is based on a technical reports[4] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Wareham River (MA95-03).

MassDEP's Water Quality Assessment Report titled *Buzzards Bay Watershed 2000 Water Quality Assessment Report*[5] identifies the Aquatic Life Use as "impaired" for Wareham River (MA95-03) due to estuarine bioassessments (decline in eelgrass habitat) suspected to be caused by total nitrogen concentration. The source of the impairments is known to occur due to municipal point source discharges and suspected to also be caused by on-site treatment systems (septic systems) and crop production related to cranberry bogs. The Shellfish Harvesting Use was designated as "support" for a 0.93 square mile stretch and "impaired" for the remaining 0.25 square miles due to fecal coliform bacteria suspected to be present because of the municipal separate storm sewer systems. The Primary Contact and Secondary Contact Uses were also assessed and designated as "support" for the 0.93 square mile portion while the remaining 0.25 square mile was not assessed. The Fish Consumption and Aesthetics Uses were not assessed.

Figures 2a through 2f illustrate the MassDOT-owned roads within the groundwatershed that contribute runoff to the water body. It should be noted that portions of the MassDOT-owned road inside the groundwatershed boundary are within an MS4-regulated urban area. Parts of the MassDOT roads are outside of the designated urban area; therefore, discharge from these sections of roadway are not identified as contributing to the impaired segment. The majority of roadway runoff within the groundwatershed is through localized catch basin collection systems or sheet flow and infiltration. I-195 runs north-south and intersects Route 28 before terminating at the I-495 interchange. I-495 continues west from the I-195 interchange until it reaches the groundwatershed boundary (Figures 2a and 2b). Both I-195 and I-495 are four-lane expressways with medians; Route 25 is a six-lane expressway with a median. Route 25 begins at the I-495 and I-195 interchange and continues east in an east-west direction (Figures 2d and 2e).
Route 28 runs south and parallel to I-495 and Route 25 and in an east-west direction, extending across the groundwatershed. Route 28 intersects I-195 and Maple Springs Road. Maple Springs Road connects Route 25 with Route 28 and Route 6, as shown in Figure 2e.

Route 6 runs in a southwest- northeast direction, with two MassDOT-owned urban roadway segments within the groundwatershed. The western segment is shown in Figure 2c and the eastern segment is shown in Figures 2e and 2f extending east past the intersection with Maple Springs Road and Route 6.

Additionally, MassDOT owns two sections of Tremont Road: from Route 28 to Main Street and a railroad bridge east of Main Street. As seen in Figure 2b, both are west of the Wankinco River and south of Route 28.

[4] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Wareham River, Broad Marsh and Mark's Cove Embayment System, Wareham, Massachusetts. Unpublished Report.

[5] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

In addition, as observed during a filed visit, a section of I-195 (both eastbound and westbound lanes) extending south of the groundwatershed boundary drains north into a collection system (Figure 2b) that discharges within the groundwatershed; therefore, this area is considered "Supplemental Contributing Area". Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". Similarly, a section of Route 6 that extends approximately 150 feet south of Burr Parkway (Figure 2c) is considered supplemental as the roadway drains to a collection system that discharges within the groundwatershed.

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Wareham River (MA95-03) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. [8] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Wareham River is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[10] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[11] The MEP technical report[12] identifies the total nitrogen loading from the

[6] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

[10] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[11] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[12] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Wareham River, Broad Marsh and Mark's Cove Embayment System, Wareham, Massachusetts. Report is not yet published.

groundwatershed for this water body, and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Wareham River (MA95-03) to be linked to elevated nitrogen: estuarine bioassessments and total nitrogen.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[13] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using an average of precipitation data from the New Bedford and Hyannis sites and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.8 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[14] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 93.0 acres
- MassDOT Pervious Area: 173.9 acres
- Estimated Existing MassDOT Load: 1,067 lb/yr
- Total Existing Groundwatershed Nitrogen Load: 104,208 lb/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 1.02%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[14] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP).[15] Wareham River (MA95-03) is covered by the Final Pathogen TMDL for the Buzzards Bay Watershed.[16]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[17]

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[13] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

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[16] Mass DEP.2009. Final Pathogen TMDL for the Buzzards Bay Watershed March 2009 (CN 251.1). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[17] MassDOT. December 2014. Description of MassDOT's Application of BMP 7R for Pathogen Related Impairments. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

According to the Final TMDL, the Buzzards Bay Watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. Specifically for the Wareham River, the TMDL indicates the Warr's Marine has a vessel pump-out facility and porta-potty dump located within this segment which is a potential pathogen source. In addition, the Town of Wareham had a total of 710 stormwater pipe or road cut discharges and over half were rated as medium or high priority for remediation. The Town requested permit coverage under the NPDES program for their MS4.[18]

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized in the TMDL based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Wareham River is listed as a medium priority due to its value as a resource for shellfishing.[18]

In addition to the generic recommendations provided in the draft NPDES MS4 permits for Massachusetts and discussed in the MassDOT Pathogen Methodology, the *Final Pathogen TMDL for the Buzzards Bay Watershed*[18] (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

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

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education
- Additional monitoring
- Stormwater guidance tools

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Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

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

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the groundwatershed of this water body. MassDOT will be installing signs at rest stops within the groundwatershed of impaired water bodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

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

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of the water body, including regular roadway and drainage system maintenance, erosion and sedimentation control, street sweeping, and outreach and education. As described in MassDOT's Stormwater Handbook,[19] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are

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used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

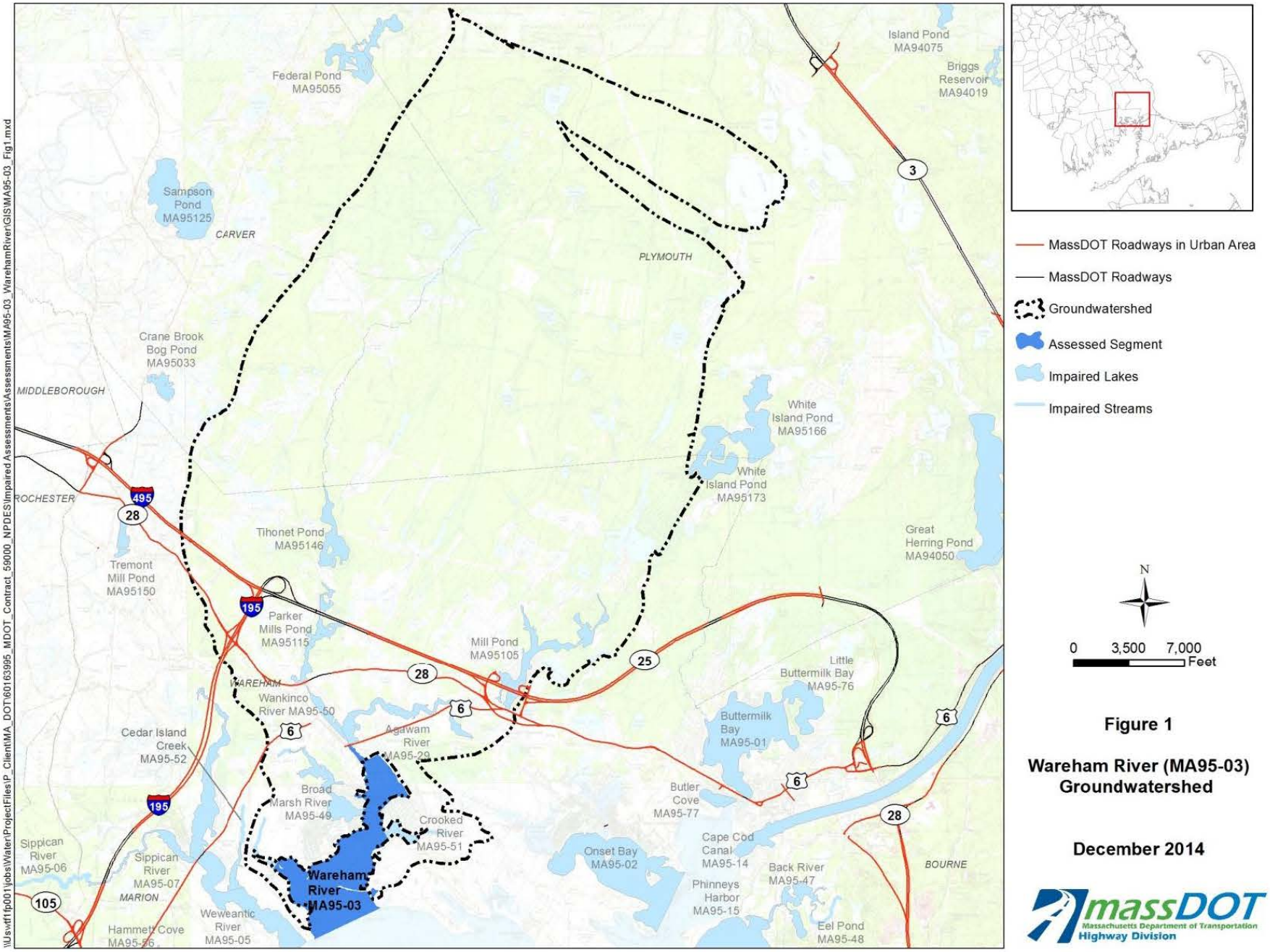
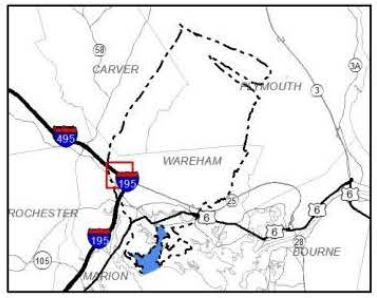


Figure 1

Wareham River (MA95-03) Groundwatershed

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Groundwatershed
- MassDOT Impervious Area
- MassDOT Pervious Area
- Assessed Segment
- DEP Wetlands

N

0 500 1,000 Feet

Figure 2a

Wareham River (MA95-03)
MassDOT Contributing Area

December 2014

MassDOT Massachusetts Department of Transportation Highway Division

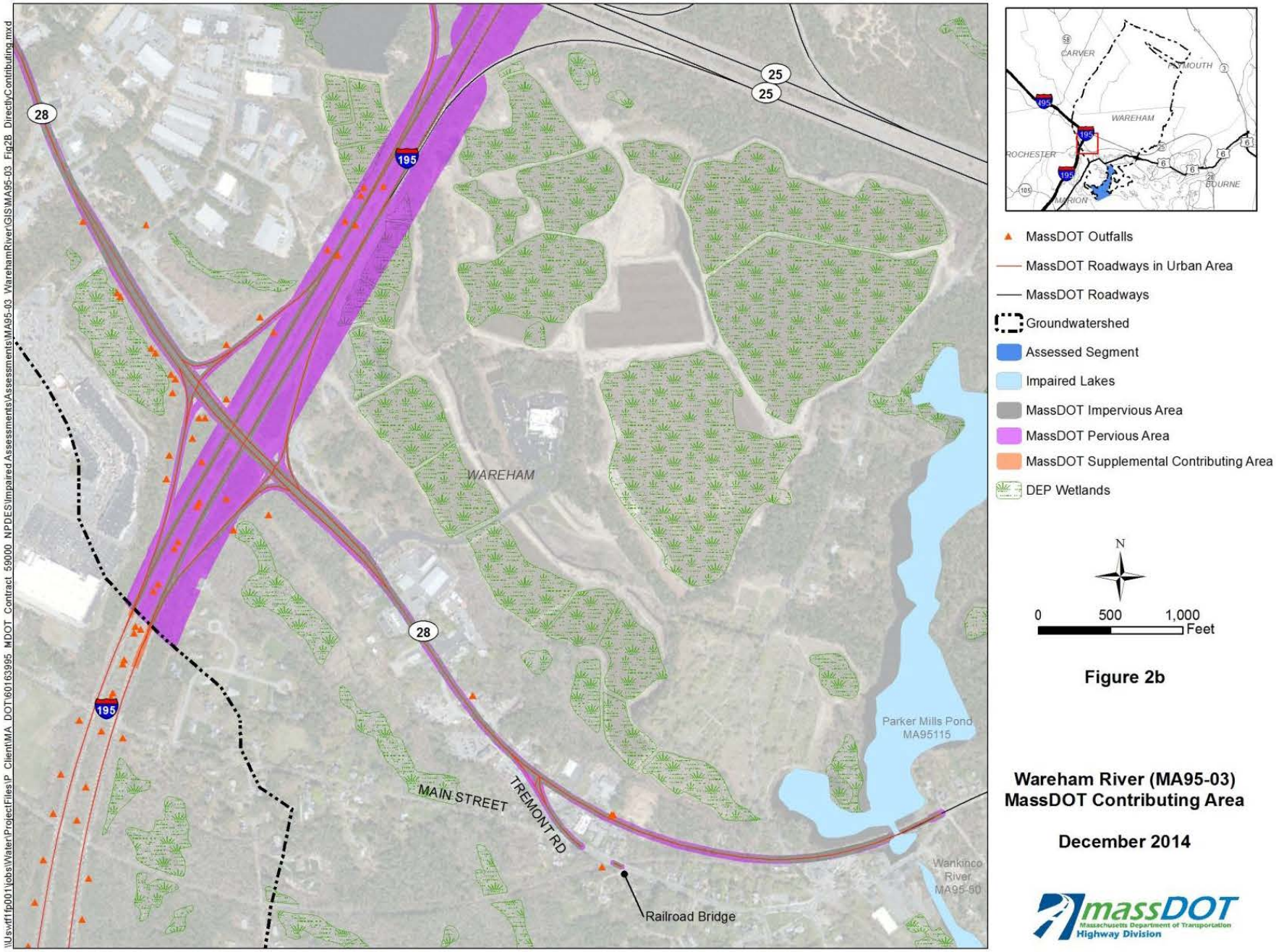
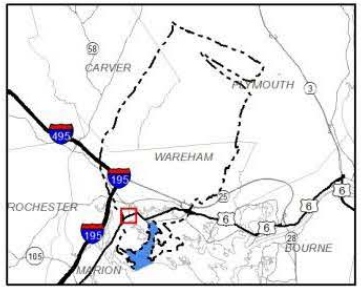


Figure 2b

Wareham River (MA95-03)
MassDOT Contributing Area

December 2014



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- DEP Wetlands

N

0 300 600 Feet

Figure 2c

Wareham River (MA95-03)
MassDOT Contributing Area

December 2014

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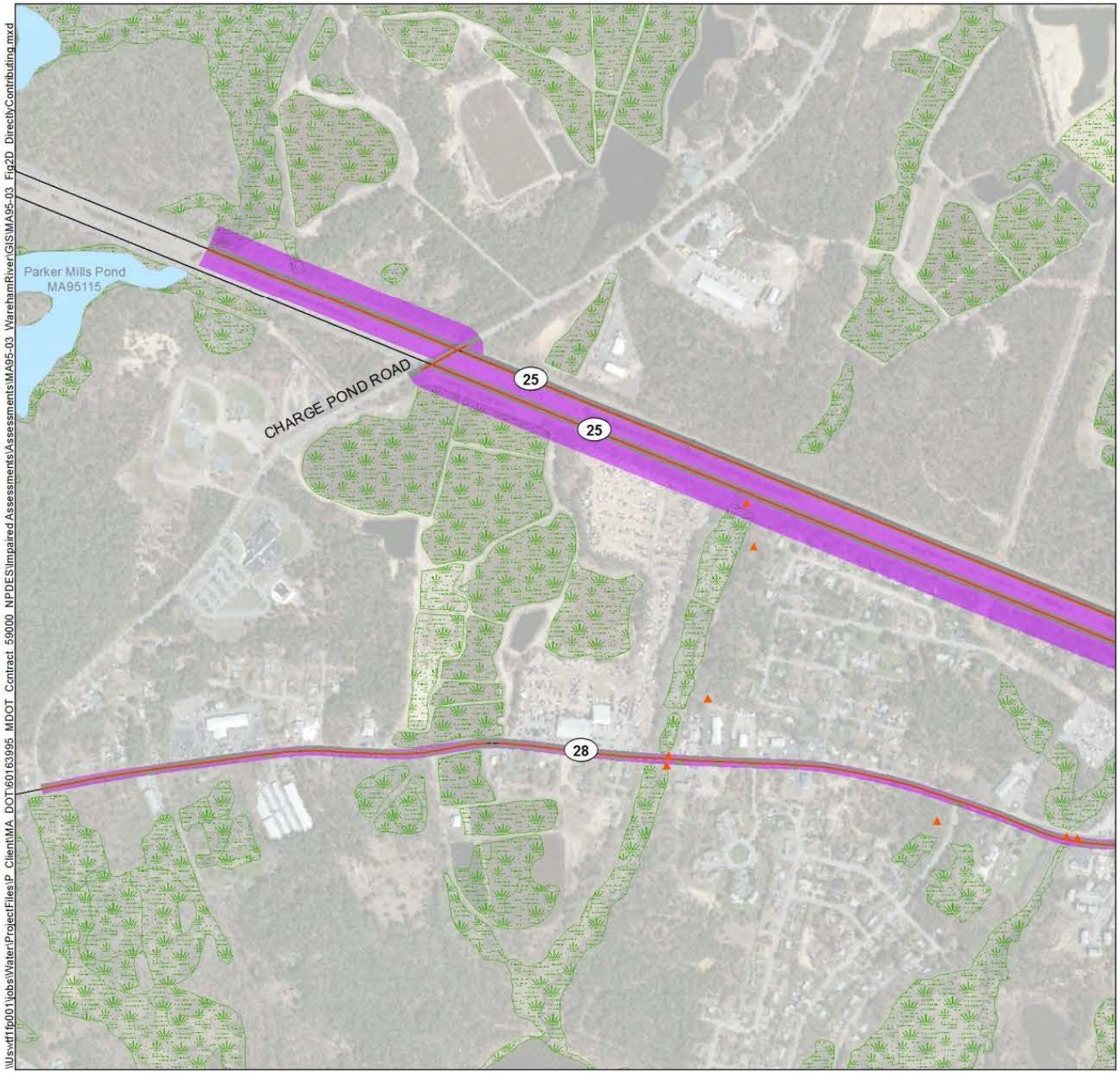
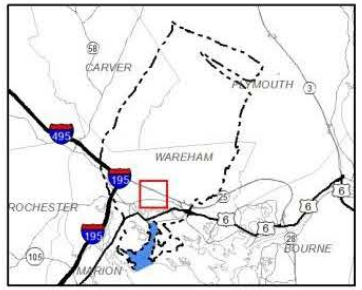
Massachusetts Department of Transportation
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Groundwatershed
- MassDOT Impervious Area
- MassDOT Pervious Area
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- DEP Wetlands

N

0 500 1,000 Feet

Figure 2d

Wareham River (MA95-03)
MassDOT Contributing Area

December 2014

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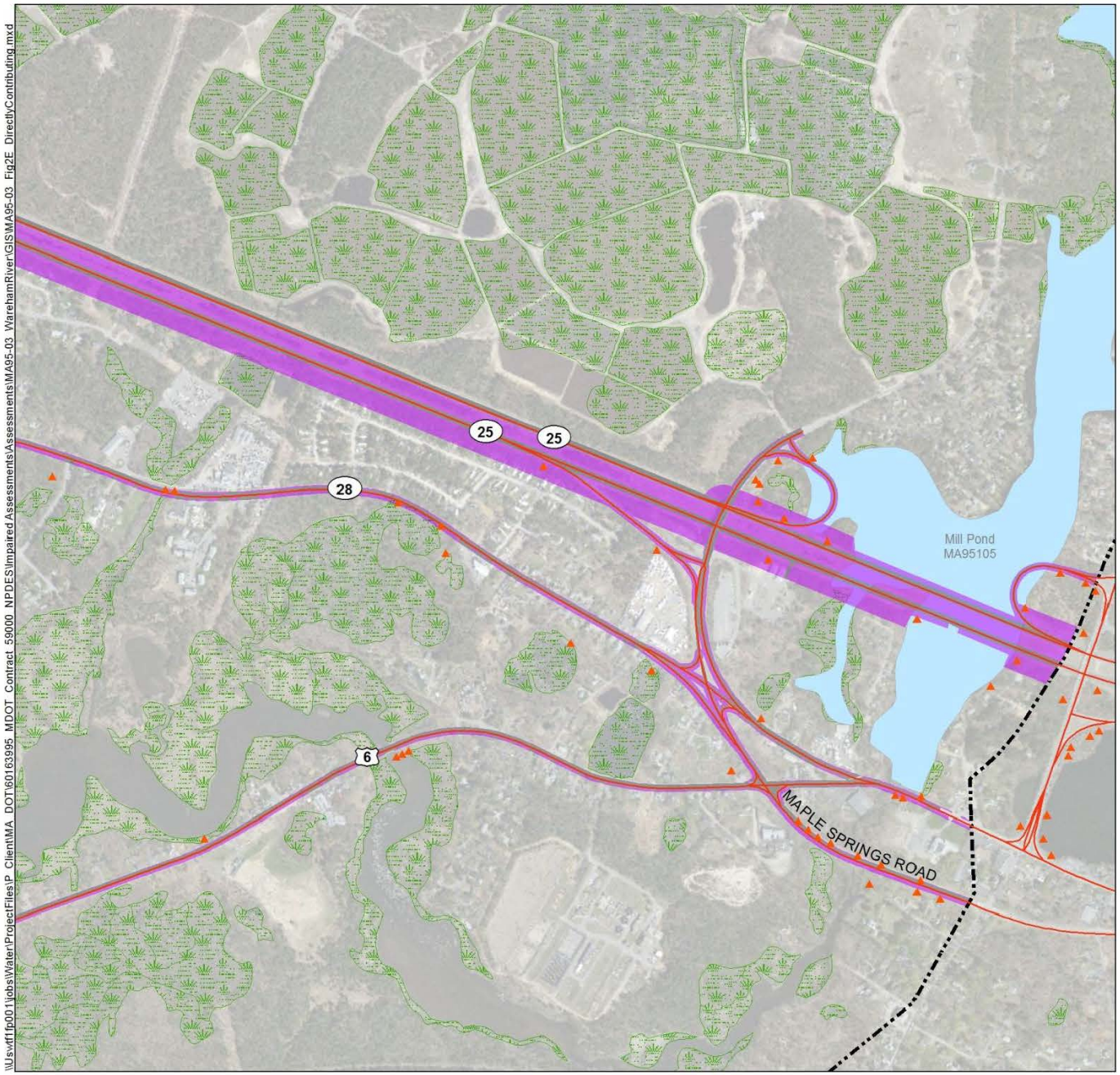
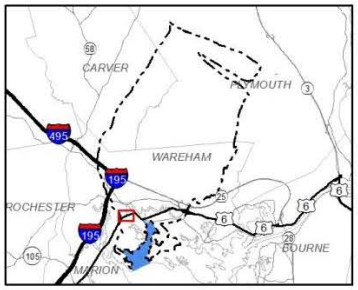
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- MassDOT Impervious Area
- MassDOT Pervious Area
- MassDOT Supplemental Contributing Area
- Assessed Segment
- Impaired Lakes
- DEP Wetlands

N

0 500 1,000 Feet

Figure 2e

Wareham River (MA95-03)
MassDOT Contributing Area

December 2014

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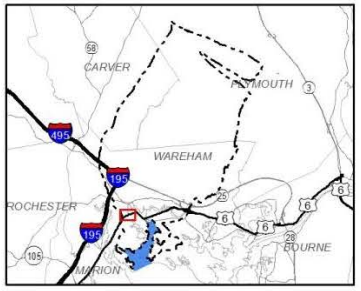
Highway Division



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- MassDOT Impervious Area
- MassDOT Pervious Area
- MassDOT Supplemental Contributing Area
- Assessed Segment
- Impaired Lakes
- DEP Wetlands

N

0 500 1,000 Feet

Figure 2f

Wareham River (MA95-03)
MassDOT Contributing Area

December 2014

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Massachusetts Department of Transportation
Highway Division

\\Uswtf1fp001\jobs\Water\ProjectFiles\P Client\MA DOT\60163995 MDOT Contract 59000 NPDES\Impaired Assessments\Assessments\MA95-03 WarehamRiver\GIS\MA95-03 Fig2F DirectlyContributing.mxd

Impaired Waters Assessment for Weweantic River (MA95-05)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments, Fecal Coliform Nitrogen (Total)*
	Category:	5 (Waters requiring a TMDL)
	Final TMDLs:	*Final Pathogen TMDL for the Buzzards Bay Watershed*[2]
	WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[3]
Location	Towns:	*Wareham, Marion, Rochester*
	MassDOT Roads:	*Route 105, Route 28, Route 6, Route 58, I-495 and I-195, and bridges on Barlow Avenue, Main Street, and Pierceville Road*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*1,339 lbs/yr*
	Existing Load to Water Body:	*363,858 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.37 %*

Site Description

Weweantic River (MA95-05) is a 0.62 square mile water body that extends from the outlet of Horseshoe Pond to the mouth of Buzzards Bay in Marion and Wareham, Massachusetts. Figure 1 illustrates the groundwatershed for Weweantic River (MA95-05).The groundwatersheds for Cape Cod and adjacent Southeastern Massachusetts Communities were provided by USGS based on

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

[2] MassDEP. 2009. Final Pathogen TMDL for the Buzzards Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[3] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data. [4,5] The Cape Cod and adjacent Southeastern Massachusetts Communities are based on groundwater delineations and not ground surface topography.[5] For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Weweantic River (MA95-05). Within the Weweantic River watershed there are approximately 9,000 acres of cranberry bogs and one vessel sewage pump-out facility.

MassDEP's Water Quality Assessment Report titled *Buzzards Bay Watershed 2000 Water Quality Assessment Report*[6] identifies the Aquatic Life Use as "impaired" and 0.45 square miles of the groundwatershed as "impaired" for Shellfishing Harvesting Use. The "impaired" status for the Aquatic Life Use is reported to be caused by estuarine bioassessment or the loss/decline of eelgrass bed habitat. Suspected sources include on-site treatment or septic systems, specialty crop production related to cranberry bogs, and recreational activities. The Shellfish Harvesting Use is reported to be impaired due to elevated fecal coliform bacteria from municipal separate storm sewer systems and on-site treatment systems. The other uses were either not assessed or "supported" the designated use during partial assessments.

Figures 2a through 2g illustrate the MassDOT-owned roads within the groundwatershed that contribute runoff to the water body. It should be noted that only a portions of the MassDOT-owned roads inside the groundwatershed boundary are within an MS4-regulated urban area. Portions of these MassDOT-owned roads are outside of the designated urban area; therefore, discharges from these roadways are not identified as contributing to the impaired segment. Figures 2a and 2b show MassDOT roads I-495, Route 58, and Route 28 in the northern part of the groundwatershed. Interstate 495, a four-lane expressway with a median, runs northwest to southeast through the center of the groundwatershed and connects to Route 58 at an interchange with two MassDOT ramps. Two sections of I-495, approximately 150 feet of both the eastbound and westbound lanes extending east of the groundwatershed boundary are collected in catchbasins and pipes which discharge within the Weweantic River groundwatershed; therefore, these areas are considered "Supplemental Contributing Area". Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". Route 58, a two-lane local road, runs from the Middleborough/Wareham border south to where it meets with Route 28. Route 28, a local two-lane road, runs loosely parallel to I-495 and extends from the interchange with Route 58 to the groundwatershed boundary.

I-195 is a four-lane expressway with a median which crosses the groundwatershed on the southeastern edge and includes two large segments. The northern segment starts at the groundwatershed boundary and extends approximately 2,300 feet south of the intersection with Barlow Ave (Figures 2c and 2d). Figure 2d also shows the pervious and impervious areas associated with a rest area located east of I-195. Runoff from these areas are considered to contribute to the groundwatershed of the Weweantic River. The southern segment of I-195 starts at the bridge over the Sippican River and extends south to the intersection with Route 105 (Figure 2f).

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[4] Walter, D.A., Masterson, J.P., and Hess, K.M., 2004, Ground-Water Recharge Areas and Traveltimes to Pumped Wells, Ponds, Streams, and Coastal Water Bodies, Cape Cod, Massachusetts, Scientific Investigations Map I-2857, 1 sheet. Available at: http://pubs.water.usgs.gov/sim20042857.

[5] U.S. Geological Survey (USGS). (2009). Groundwater contributing areas for Cape Cod and Plymouth-Carver Regions of Massachusetts. Data Series 451 (1 of 3).

[6] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

The sections of Route 105 include the western segment extending from Mary's Pond Road to I-195 (Figures 2e and 2f) and the eastern segment between Washburn Park Road and Spring Street (Figure 2f). In addition, there is approximately 100 feet of Route 105 extending past Spring Street which drains to a catch basin and pipe system which contributes drainage area to the Weweantic River groundwatershed and is considered "Supplemental".

Route 6 is a 4-lane highway running roughly parallel and to the east of I-195 and crosses the Weweantic River groundwatershed in three places along the eastern edge. The northern road area, as shown in Figures 2c and 2d, crosses the Weweantic River within the groundwatershed. South of this, as shown in Figure 2g is a 1,100-foot section of Route 6 starting approximately 150 feet north of Benson Brook Road. The southernmost section, between Briggs Lane and Converse Road, only contributes pervious area to the Weweantic groundwatershed. The roadway area is collected in a catch basin/pipe system which conveys and discharges runoff south and outside of the Weweantic River groundwatershed.

In addition, there are two MassDOT bridges within the groundwatershed, at Main Street and Pierceville Road, which both cross a rail line south of I-495 (Figure 2b).

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[7] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[8] MassDOT assessed Weweantic River (MA95-05) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[9] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[10] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Weweantic River (MA95-05) is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[8] of MassDOT's Storm Water Management Plan (Water Quality

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

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

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

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

Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[11] The Buzzards Bay Comprehensive Conservation and Management Plan[12] identifies the total existing groundwatershed nitrogen load to this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Weweantic River (MA95-05) to be linked to elevated nitrogen: estuarine bioassessments and total nitrogen.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[13] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using an average of precipitation data from New Bedford and Hyannis and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.8 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[11] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 98.7 acres
- MassDOT Pervious Area: 267.2 acres
- Estimated Existing MassDOT Load: 1,339 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 363,858 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.37%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[10] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall watershed load.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). [14] Weweantic River (MA95-05) is covered by the *Final Pathogen TMDL for the Buzzard Bay Watershed*.[15]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit

[11] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[12] Buzzards Bay National Estuary Program, November 2013. Buzzards Bay Comprehensive Conservation and Management Plan 2013 Update. Available at: http://buzzardsbay.org/newccmp/buzzards-bay-ccmp-2013-update.pdf

[13] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[14] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[15] MassDEP, March 2009. Final Pathogen TMDL for the Buzzard Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[16]

According to the Final TMDL, the Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. Municipal separate storm sewer systems and failing septic systems are suspected sources of bacterial pollution to segment MA95-05 of Weweantic River. [17]

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Weweantic River is listed as a medium priority due to its value as a resource for shellfishing. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated.[17]

In addition to the generic recommendations provided in the draft NPDES MS4 permits for Massachusetts and discussed in the MassDOT Pathogen Methodology, the *Final Pathogen TMDL for the Buzzards Bay Watershed*[17] (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

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

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education
- Additional monitoring
- Stormwater guidance tools

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

[17] MassDEP. March 2009. Final Pathogen TMDL for the Buzzard Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

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

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay Pathogen TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that there is one MassDOT targeted rest stops are located within the groundwatershed of this water body along I-195 (Figure 2d). MassDOT will be installing signs at rest stops within the groundwatershed of impaired water bodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

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

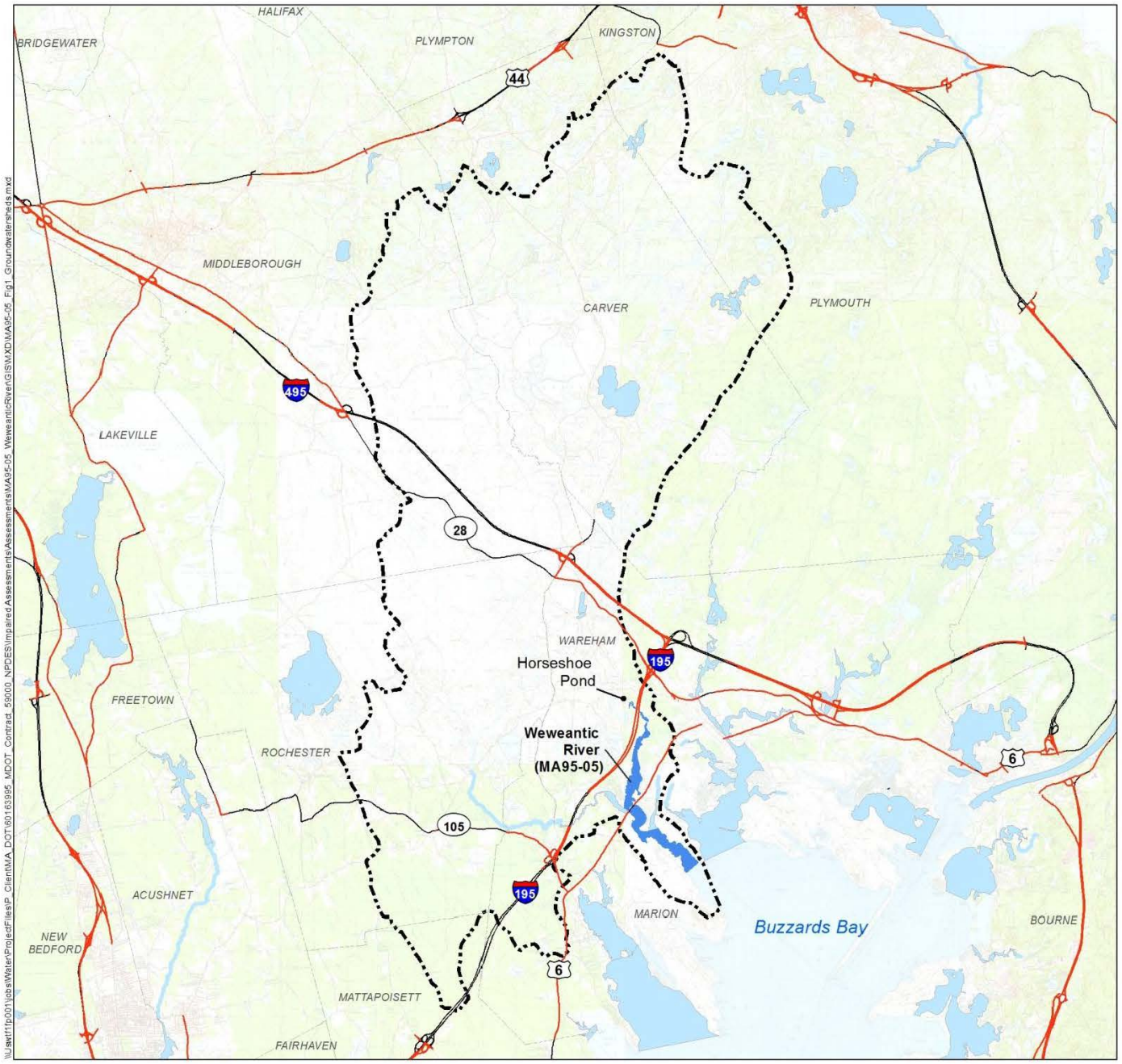
Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and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

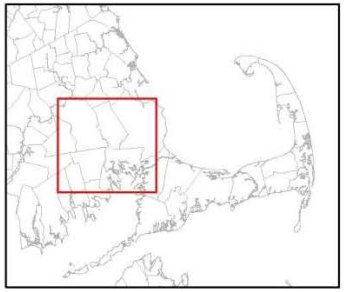
MassDOT has concluded that the BMPs outlined in the SWMP are consistent with its existing permit requirements for Weweantic River. These measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit.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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of the Weweantic River, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[18] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are

[18] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.





MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 10,000 20,000 Feet

Figure 1

Weweantic River (MA95-05) Groundwatershed

December 2014

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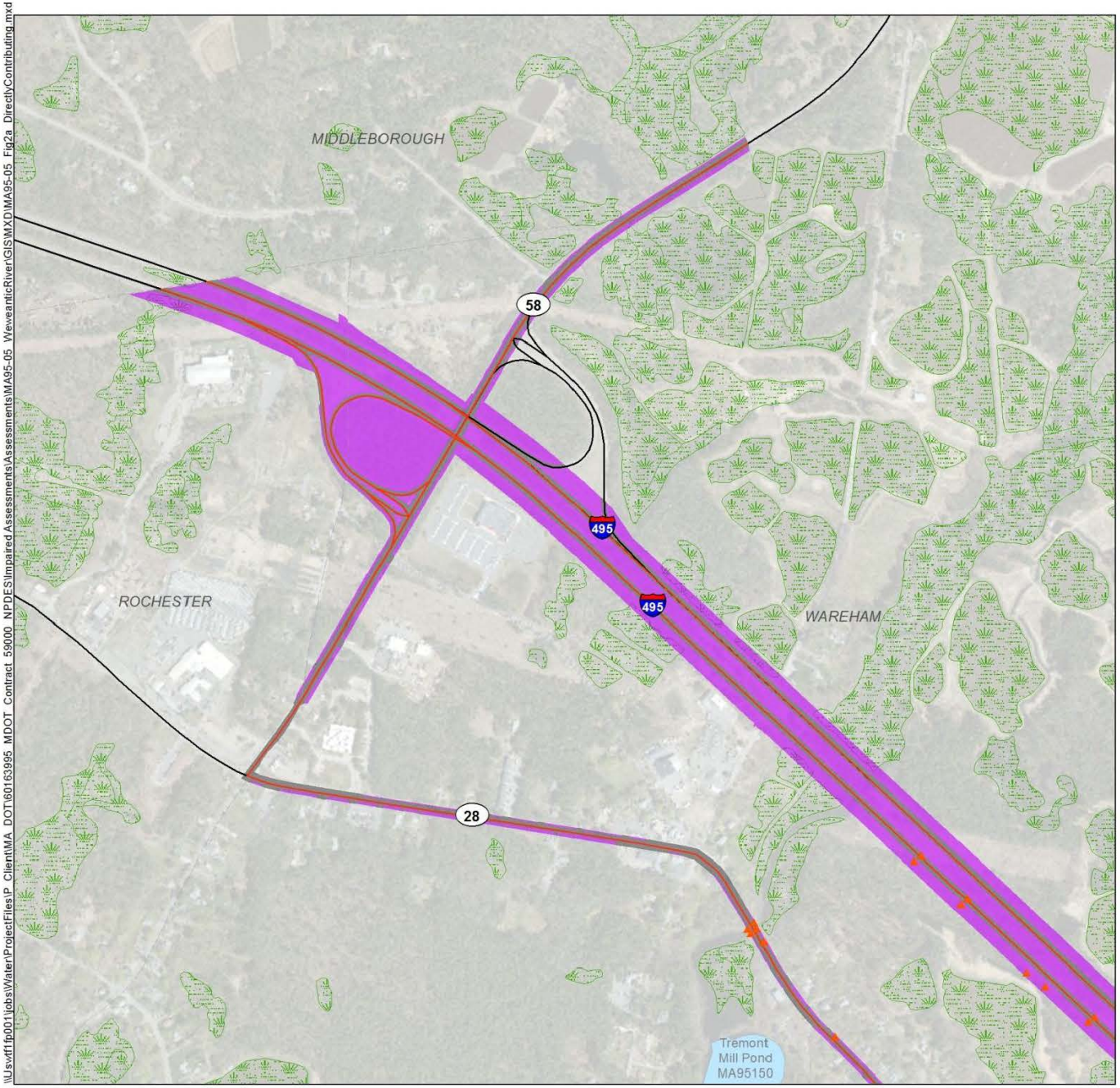

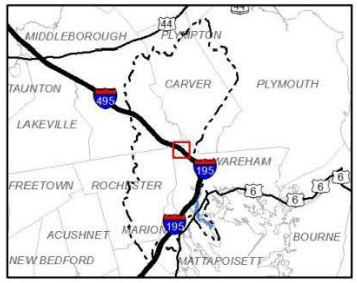

- MassDOT Outfalls
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- MassDOT Pervious Area
- DEP Wetlands

N

0 600 1,200 Feet

Figure 2a

Weweantic River (MA95-05)
MassDOT Contributing Area

December 2014

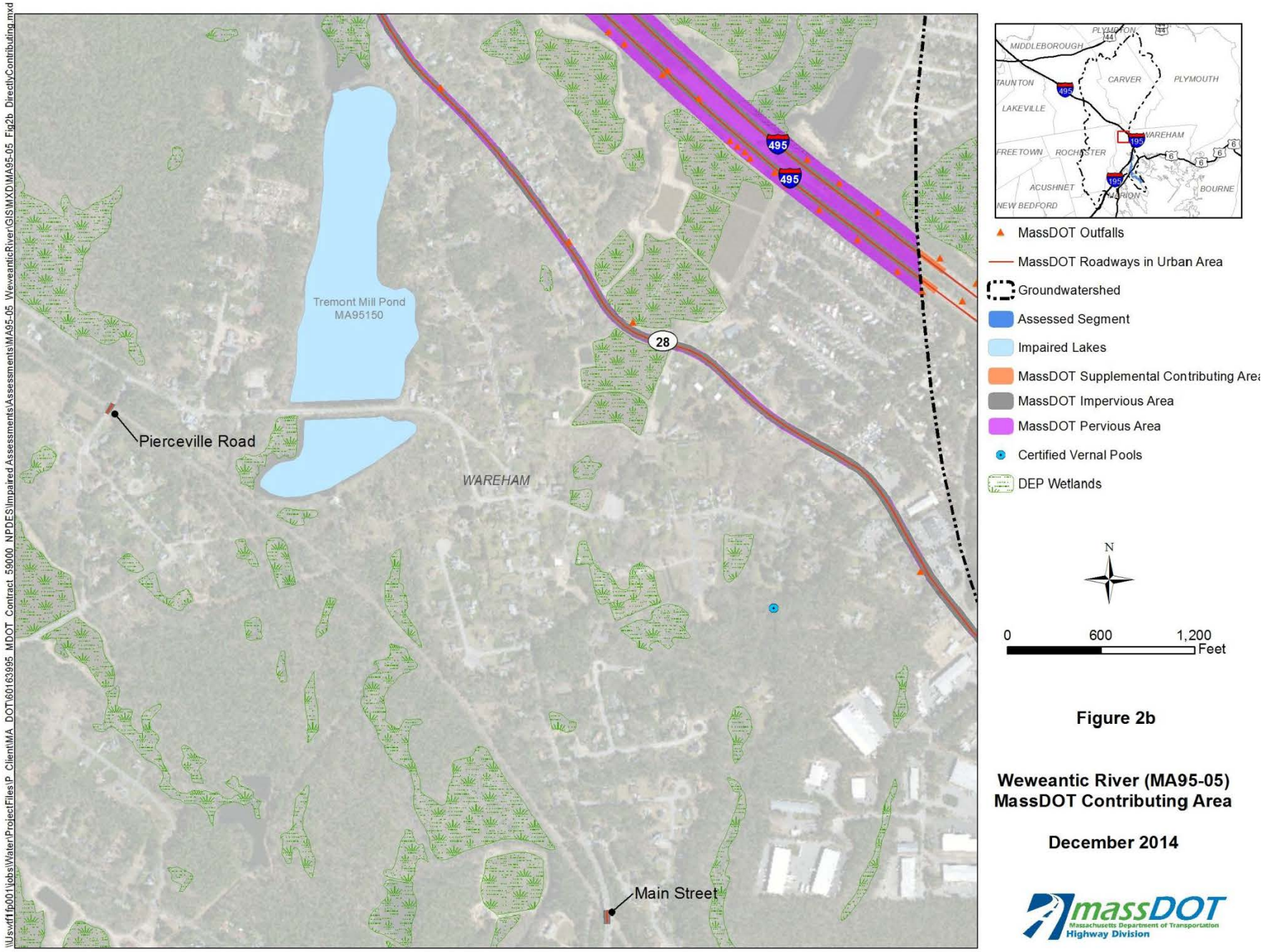

Figure 2b

Weweantic River (MA95-05)
MassDOT Contributing Area

December 2014

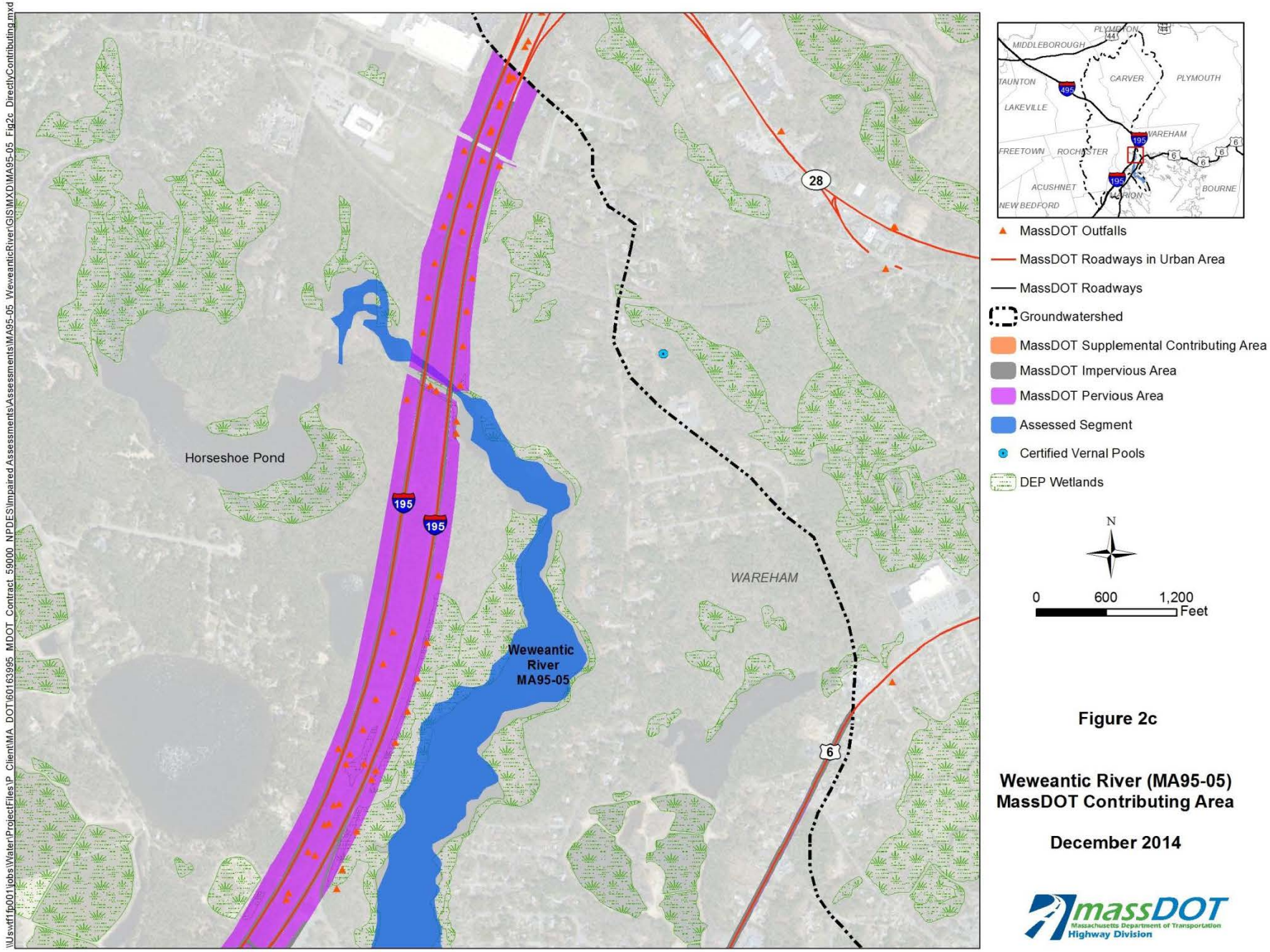

Figure 2c

Weweantic River (MA95-05)
MassDOT Contributing Area

December 2014

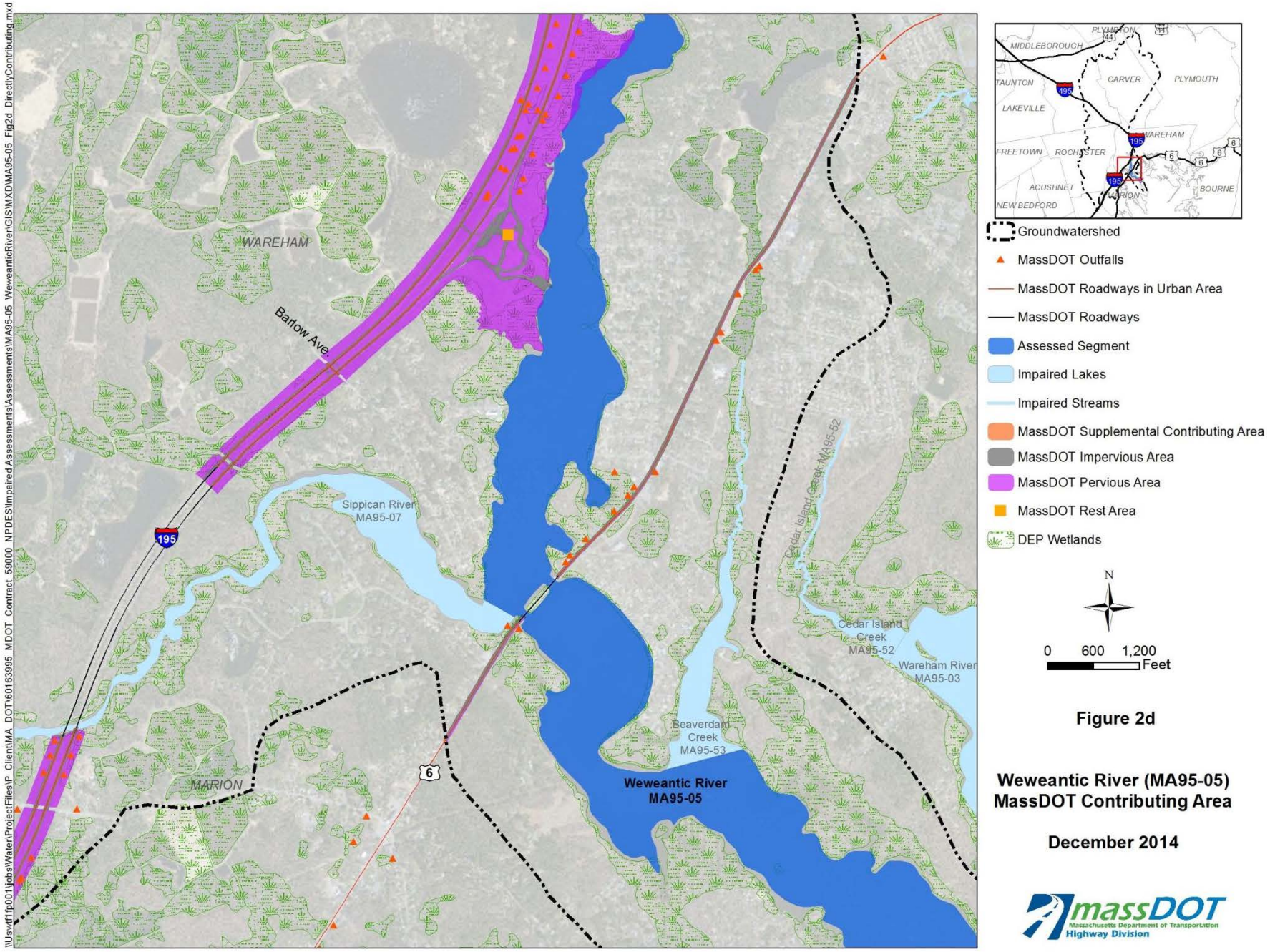

Figure 2d

Weweantic River (MA95-05)
MassDOT Contributing Area

December 2014

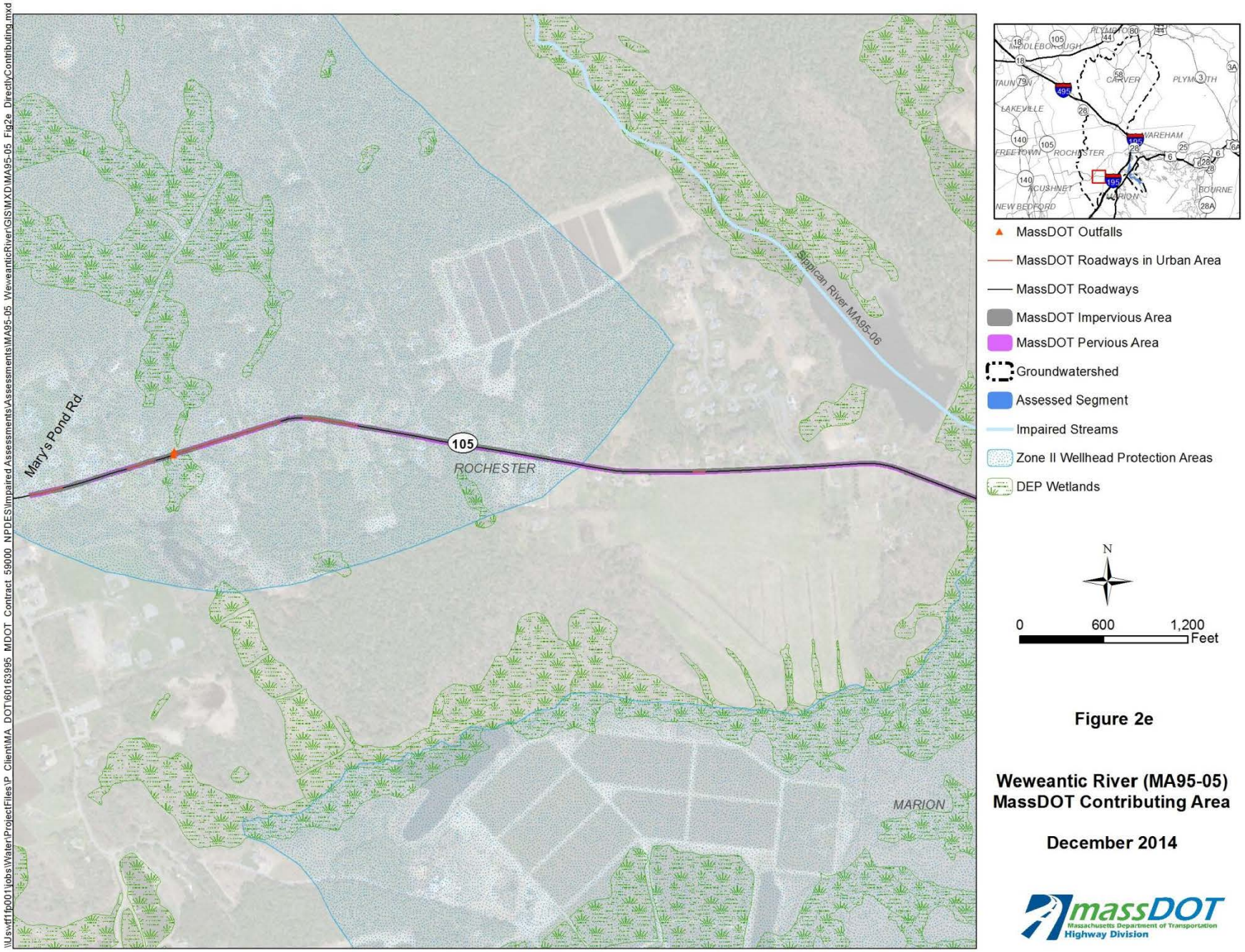

Figure 2e

Weweantic River (MA95-05)
MassDOT Contributing Area

December 2014

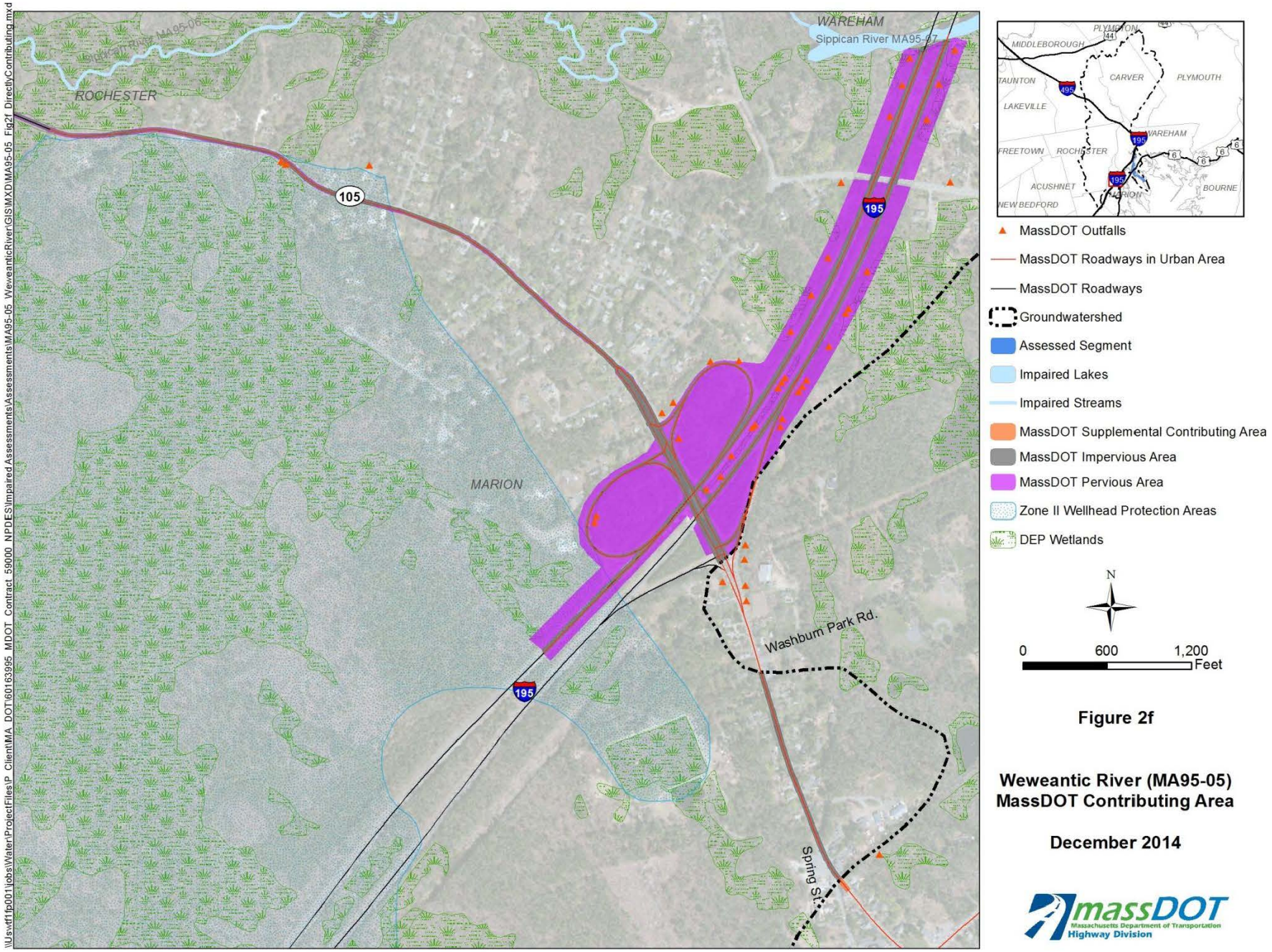

Figure 2f

Weweantic River (MA95-05)
MassDOT Contributing Area

December 2014

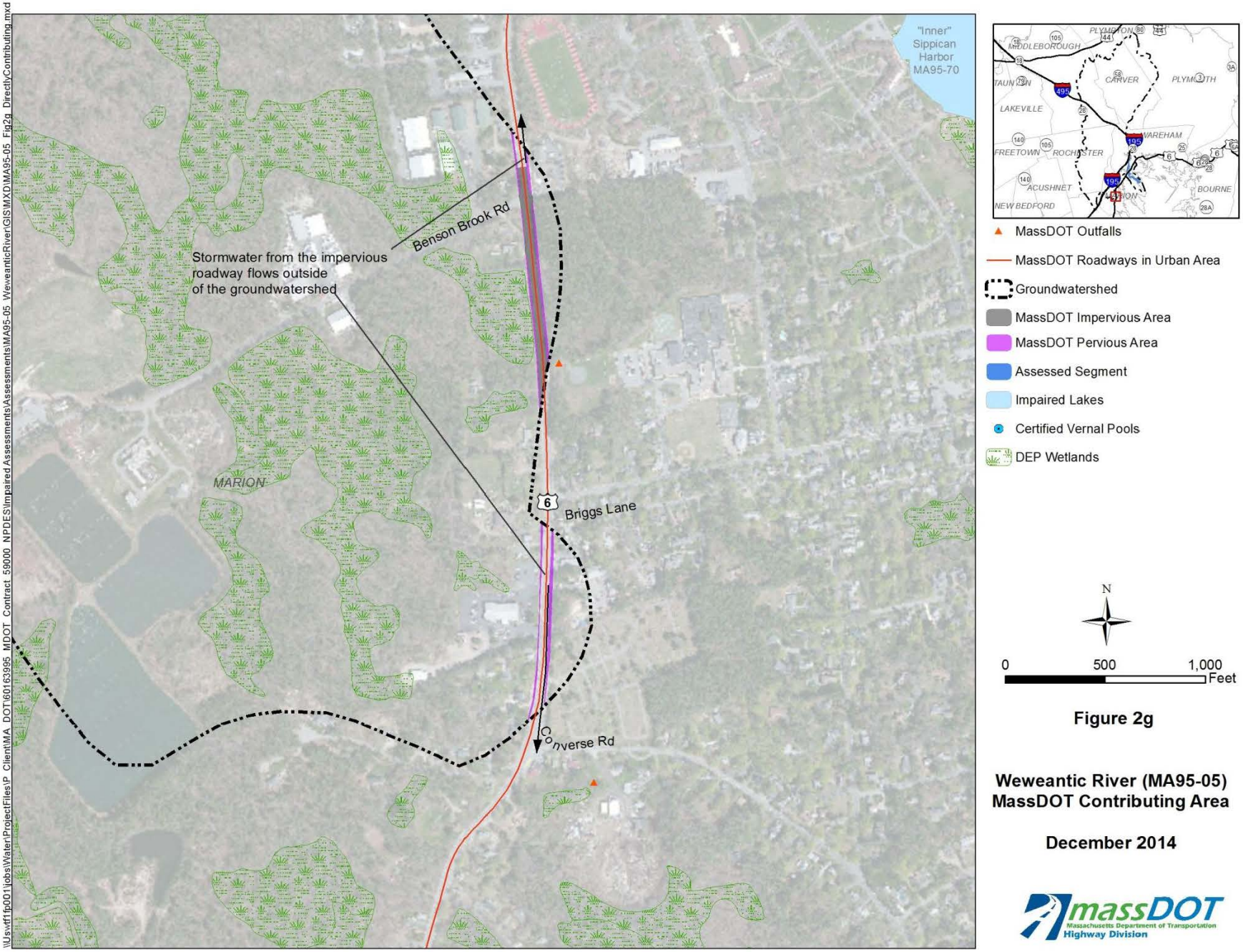

Figure 2g

Weweantic River (MA95-05)
MassDOT Contributing Area

December 2014

massDOT Massachusetts Department of Transportation Highway Division

12/08/2014

Impaired Waters Assessment for Herring Brook (MA95-21)

Summary

Impaired Water[1]	Stormwater Impairments:	*Fecal Coliform; Nutrient/Eutrophication Biological Indicators*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the Buzzards Bay Watershed*[2]
	WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[3]
Location	Towns:	*Falmouth*
	MassDOT Roads:	*Route 28A, Route 28*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*100.4 lbs/yr*
	Existing Load to Water Body:	*5,945 lbs/yr*
	MassDOT Contribution to Existing Load:	*1.69 %*

Site Description

Herring Brook (MA95-21) is a 0.01 square mile water body with headwaters located west of Route 28A and extending to the mouth of Buzzards Bay in Falmouth, Massachusetts. Figure 1 illustrates the groundwatershed for Herring Brook (MA95-21). The groundwatershed for this impaired segment

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

[2] MassDEP. 2009. Final Pathogen TMDL for the Buzzards Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[3] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

is based on technical reports[4] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Herring Brook (MA95-21).

MassDEP's Water Quality Assessment Report titled *Buzzards Bay Watershed 2000 Water Quality Assessment Report*[5] lists the Shellfish Harvesting Use as "impaired". The report states that the known cause of the impairments includes fecal coliform bacteria and the suspected source includes on-site treatment systems (septic systems). Additionally, Falmouth is a Phase II community that had submitted their Notice of Intent for permit coverage for the NPDES Municipal MS4 drainage system in 2003 and 2008. The permit would require that the town of Falmouth develop, implement and enforce a stormwater management program and reduce the discharge of pollutants from their system. In addition, the MEP report[4] states that the primary ecological threat to the estuarine resources of Herring Brook and its subembayments is degradation resulting from nitrogen enrichment stemming from the nitrogen loading to the groundwatershed.

Figure 2 shows the MassDOT-owned property within urban area that is contributing to the groundwatershed of Herring Brook. It should be noted that only portions of the MassDOT-owned roads inside the groundwatershed boundary is within an MS4-regulated urban area. Part of the MassDOT road is outside of the designated urban area including the Route 28 north bound on- and off-ramps; therefore, discharge from these portions of roadway are not identified as contributing to the impaired segment Approximately 8.2 acres of impervious area along Route 28 and Route 28A flow to drainage systems that discharge within the groundwatershed, while approximately 11.8 acres of pervious area consisting of the shoulders of Route 28 and 28A allow for drainage to infiltrate into the ground; thus contributing to the groundwatershed of Herring Brook. The northbound and southbound lanes of Route 28, north of the entry and exit ramps to and from Thomas B Landers Road, are not shown as contributing to Herring Brook as flow from the impervious roadway enters a drainage system that directs flow north and discharges outside of the Herring Brook groundwatershed.

Additionally, based on a field visit, a section of the northbound side Route 28 which extends approximately 1,000 feet south of the Herring Brook groundwatershed is considered "Supplemental Contributing Area". Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". Stormwater runoff from the road (approximately 1 acre) is collected in a drainage system that flows north and discharges within the Herring Brook groundwatershed. These portions of Route 28 are shown in Figure 2.

[4] University of Massachusetts Dartmouth and MassDEP, 2012. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Wild Harbor Embayment System Town of Falmouth, Massachusetts. Revised Draft Report, unpublished

[5] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Herring Brook (MA95-21) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act[8]. MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Herring Brook is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[7] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[10] The MEP technical report[11] identifies the total existing nitrogen loading from the Wild Harbor groundwatershed which is located downstream of Herring Brook, but does not separate out Herring Brook; therefore, nitrogen loading was determined using a mass balance approach as described in the BMP 7U for nitrogen methodology. The MEP attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Herring Brook (MA95-21) to be linked to elevated nitrogen: nutrient/eutrophication biological indicators.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[12] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using

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[6] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

[10] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[11] Buzzards Bay National Estuary Program, November 2013. Buzzards Bay Comprehensive Conservation and Management Plan 2013 Update. Available at: http://buzzardsbay.org/newccmp/buzzards-bay-ccmp-2013-update.pdf

[12] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[11] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 9.2 acres
- MassDOT Pervious Area: 11.8 acres
- Estimated Existing MassDOT Load: 100.4 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 5,945 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 1.69%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load. [13] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). [14] Herring Brook (MA95-21) is covered by the Final Pathogen TMDL for the Buzzard Bay Watershed.[15]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[16]

According to the Final TMDL, the Buzzards Bay Watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. MS4s and failing septic systems are suspected sources of bacterial pollution to segment MA95-21 of Herring Brook.[16]

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Herring Brook is listed as a medium priority due to its value as a resource for shellfishing. It is suspected that elevated dry-

[13] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[14] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[15] MassDEP. March 2009. Final Pathogen TMDL for the Buzzard Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

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

weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated.[17]

In addition to the generic recommendations provided in the draft NPDES MS4 permits for Massachusetts and discussed in the MassDOT Pathogen Methodology, the *Final Pathogen TMDL for the Buzzards Bay Watershed*[18] (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

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

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*[18]:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education
- Additional monitoring
- Stormwater guidance tools

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

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

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay Pathogen TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the groundwatershed of this water body. MassDOT will be installing signs at rest stops within the

[17] MassDEP. March 2009. Final Pathogen TMDL for the Buzzard Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

groundwatershed of impaired water bodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

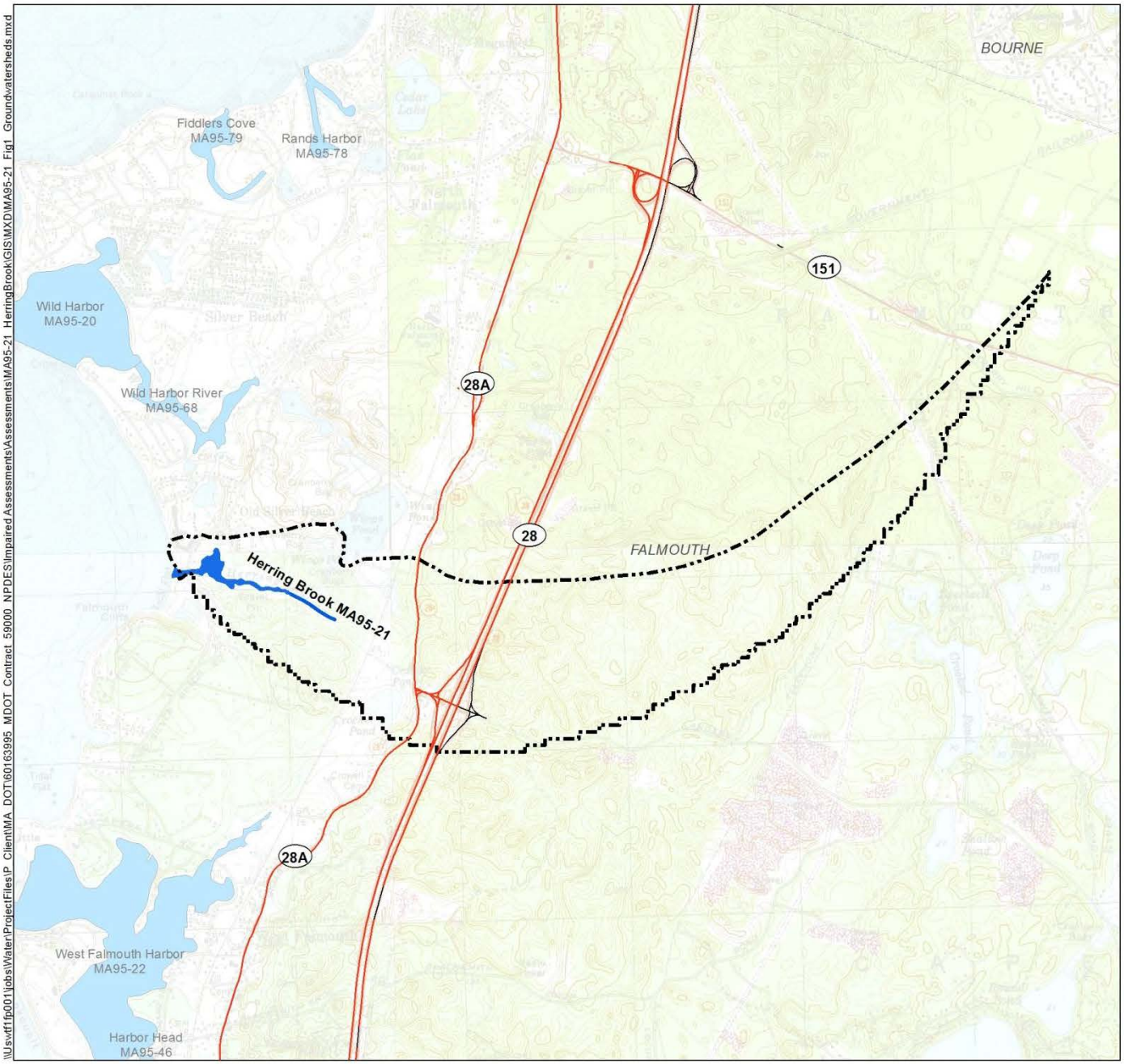
Although the TMDL report also identifies the benefits of structural BMPs to address pathogens in runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these BMPs in advance of other ongoing BMP efforts identified in the groundwatershed, given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

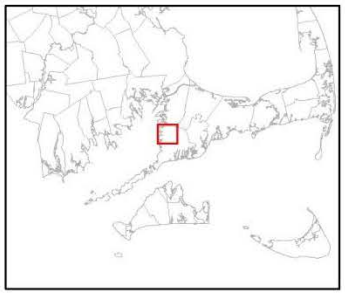
Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Herring Brook, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[18] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[18] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf





MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 2,000 4,000 Feet

Figure 1

Herring Brook (MA95-21) Groundwatersheds

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

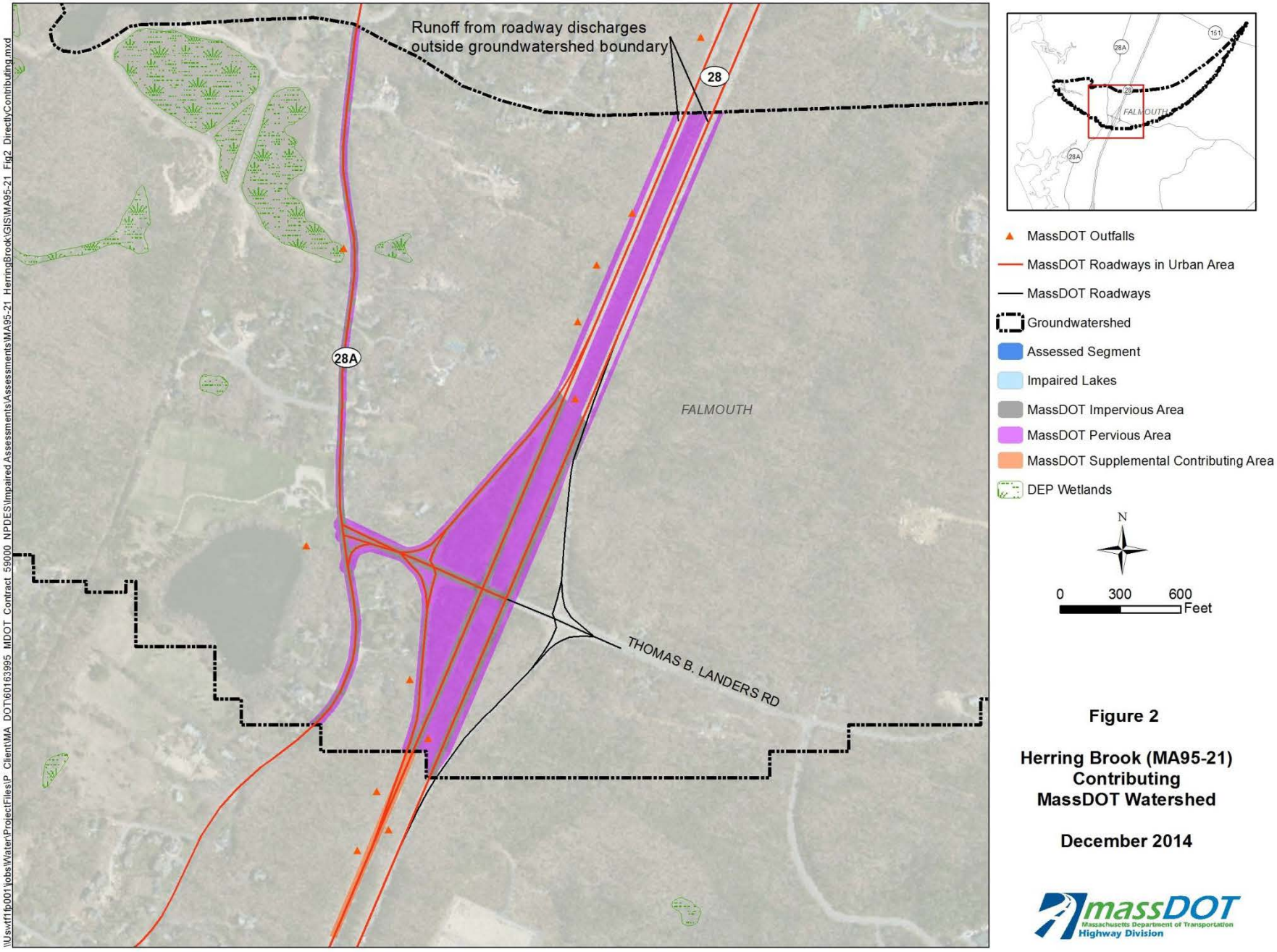


Figure 2

Herring Brook (MA95-21)
Contributing
MassDOT Watershed

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

12/08/2014

Impaired Waters Assessment for Agawam River (MA95-29)

Summary

Impaired Water[1]	Impairments:	Stormwater:	*Ammonia (Un-ionized); Excess Algal Growth; Fecal Coliform; Nitrogen (Total)*
		Non-Stormwater:[2]	*Whole Effluent Toxicity*
	Category:	*5 (Waters requiring a TMDL)*	
	Final TMDLs:	*Final Pathogen TMDL for the Buzzards Bay Watershed (CN: 251.1)*[3]	
	WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[4]	
Location	Towns:	*Wareham*	
	MassDOT Roads:	*Route 6, Route 25, Route 28, Maple Springs Road, Tremont Street, and Main Street*	
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒	
BMPs	Existing:	*None*	
MassDOT Area and Targets			Nitrogen
	Estimated MassDOT Load:		*445 lbs/yr*
	Existing Load to Water Body:		*27,580 lbs/yr*
	MassDOT Contribution to Existing Load:		*1.61 %*

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

[2] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://water.epa.gov/polwaste/npdes/basics/Whole-Effluent-Toxicity.cfm

[3] United States Environmental Protection Agency, August 2014. NPDES Permit Program Basics: Whole Effluent Toxicity. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[4] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

Site Description

Agawam River (MA95-29) is a 0.16 square mile water body that extends from the Wareham Wastewater Treatment Plant to the confluence of the Wankinco River (MA95-50) at the Route 6 Bridge in Wareham, Massachusetts. Figure 1 illustrates the groundwatershed for Agawam River (MA95-29). The groundwatershed for this impaired segment is based on technical reports[5] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Agawam River (MA95-29).

MassDEP's Water Quality Assessment Report titled *Buzzards Bay Watershed 2000 Water Quality Assessment Report*[6] identifies the Agawam River as "impaired" for the Aquatic Life and Shellfish Harvesting designated uses. The Aquatic Life Use is "impaired" due to elevated nutrients (unionized ammonia) and whole effluent toxicity. Sources are identified as municipal point source discharge as well as other suspected sources including irrigated, specialty crop production related to cranberry bogs and on-site treatment systems (septic systems). The Shellfish Harvesting Use is listed as "impaired" due to fecal coliform bacteria suspected from municipal separate storm sewer systems, and municipal point source discharges. The report also indicates that water quality degradation is attributed to nutrient discharges from the Wareham Wastewater Treatment Plant. However, the Town of Wareham is permitted (NPDES Surface Discharge MA0101893) to discharge treated sanitary wastewater to the Agawam River. This permit includes whole effluent toxicity limits.

Figures 2a and 2b illustrate the MassDOT roads within the groundwatershed that contribute runoff to the water body. It should be noted that only a portion of the MassDOT-owned roads inside the groundwatershed boundary are within an MS4-regulated urban area. Portions of the MassDOT-owned roads are outside of the designated urban area; therefore, discharges from these sections of roadway are not identified as contributing to the impaired segment. The majority of roadway runoff within the groundwatershed is through localized catch basin collection systems or sheet flow and infiltration. Route 25 is a six-lane expressway with a median crossing the southern end of the groundwatershed in an east-west direction.

Route 28 runs south of and parallel to Route 25 and in an east-west direction, extending across the groundwatershed. Route 28 intersects I-195 and Maple Springs Road. Maple Springs Road connects Route 25 with Route 28 and Route 6, as shown in Figure 2b.

Route 6 runs in a southwest- northeast direction south of both Route 25 and Route 28 extending east past its intersection with Maple Springs Road.

Additionally, MassDOT owns two sections of Tremont Street: from Route 28 to Main Street and a railroad bridge east of Main Street. As seen in Figure 2a, both are west of the Wankinco River (MA95-50) and south of Route 28 and contribute stormwater to the groundwatershed.

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[5] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Wareham River, Broad Marsh and Mark's Cove Embayment System, Wareham, Massachusetts. Unpublished Report.

[6] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment report Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[7] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[8] MassDOT assessed Agawam River (MA95-29) using the methodologies described below.

MassDOT has identified a water body impairment in the Agawam River groundwatershed which is not related to stormwater runoff. The specific impairment that is unrelated to stormwater for the Agawam River include whole effluent toxicity as it is related to waste water treatment plants.[9]

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[10] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[11] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Agawam River is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[8] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[12] The MEP technical report[13] identifies the total existing groundwatershed nitrogen load from this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Agawam River (MA95-29) to be linked to elevated nitrogen: ammonia (un-ionized), excess algal growth, and nitrogen (total).

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[7] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

[9] MassDOT, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://water.epa.gov/polwaste/npdes/basics/Whole-Effluent-Toxicity.cfm

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

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

[12] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[13] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Wareham River, Broad Marsh and Mark's Cove Embayment System, Wareham, Massachusetts. Unpublished Report.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[14] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using an average of precipitation data from the New Bedford and Hyannis sites and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.8 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[15] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 43.7 acres
- MassDOT Pervious Area: 59.2 acres
- Estimated Existing MassDOT Load: 445 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 27,580 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 1.61%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[15] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP).[16] Agawam River (MA95-29) is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed*.[17]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[18]

According to the Final TMDL, the Buzzards Bay Watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s.[17]

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[14] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[15] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[16] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[17] Mass DEP.2009. Final Pathogen TMDL for the Buzzards Bay Watershed March 2009 (CN 251.1). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

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

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Agawam River is listed as a medium priority due to its value as a resource for shellfishing. [19]

In addition to the generic recommendations provided in the draft NPDES MS4 permits for Massachusetts and discussed in the MassDOT Pathogen Methodology, the *Final Pathogen TMDL for the Buzzards Bay Watershed*[19] (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

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

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*[18]:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education
- Additional monitoring
- Stormwater guidance tools

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT's BMP 7R Pathogen Methodology,[20] MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay Pathogen TMDL report, MassDOT has documented the

[19] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

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

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

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

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Agawam River, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[21] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[21] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

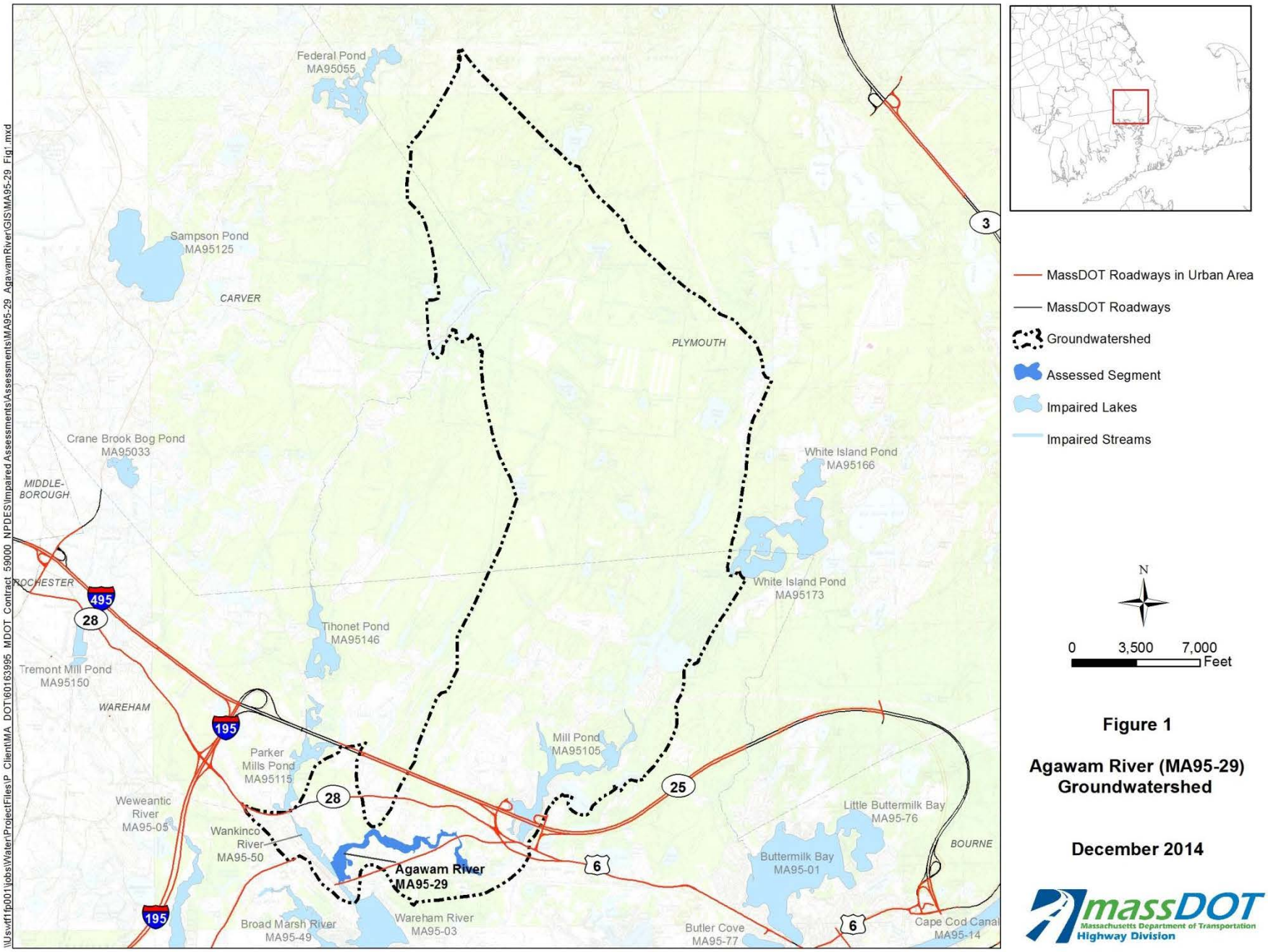


Figure 1

Agawam River (MA95-29) Groundwatershed

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

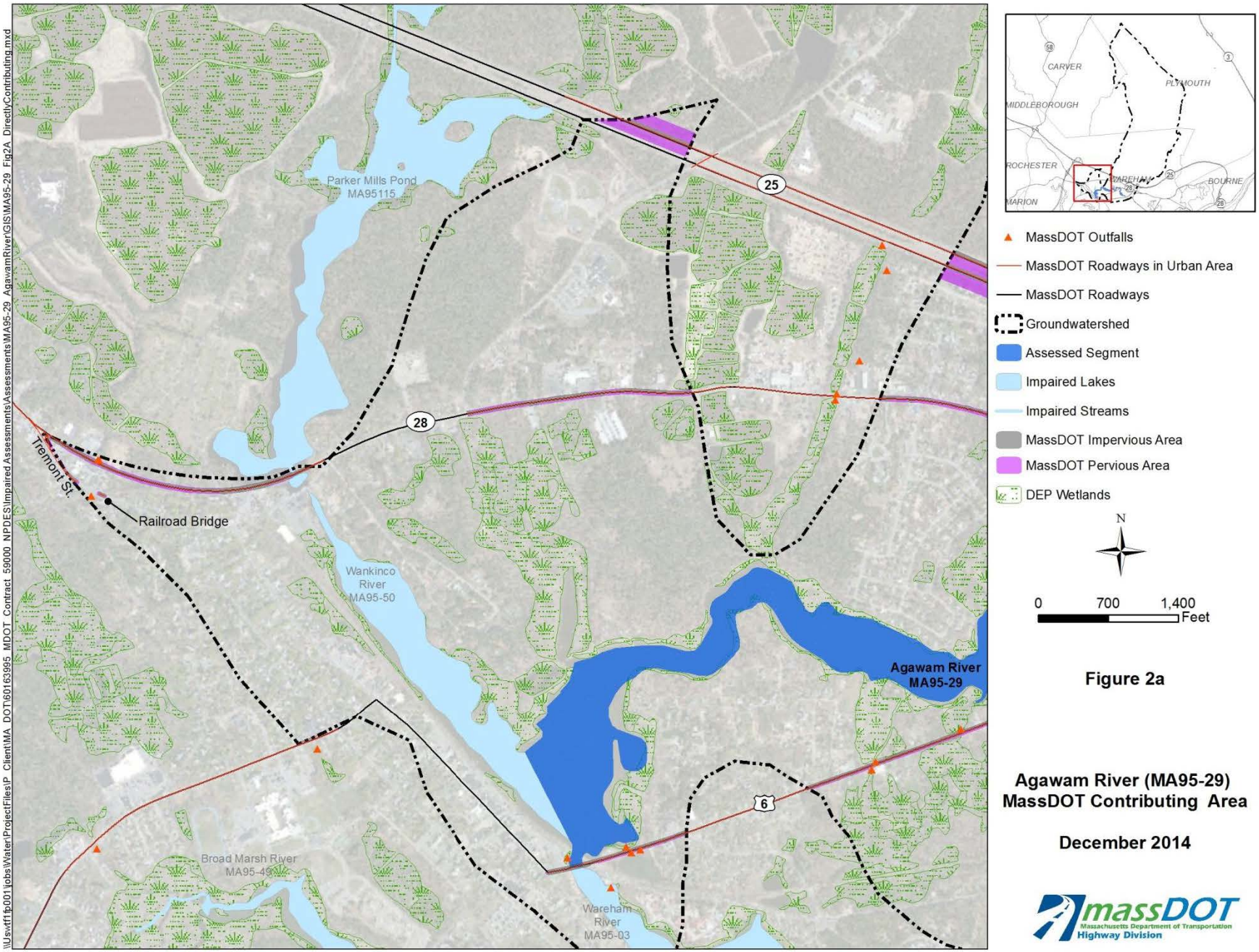
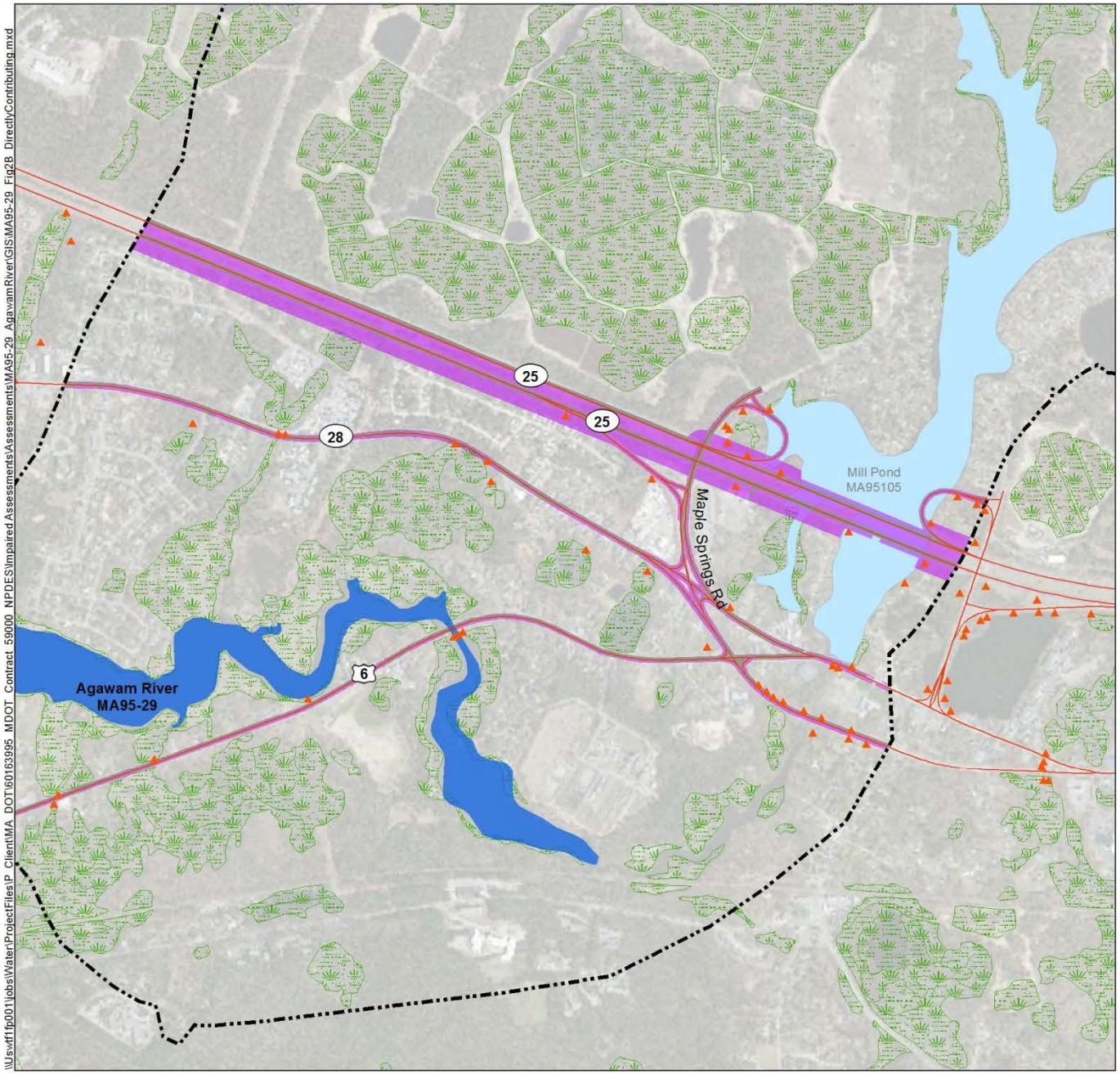


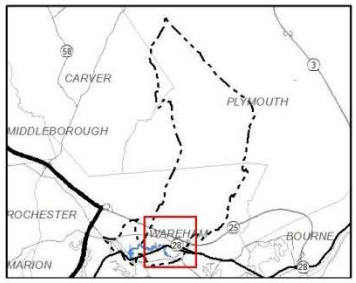
Figure 2a

Agawam River (MA95-29)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- MassDOT Impervious Area
- MassDOT Pervious Area
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- DEP Wetlands

N

0 700 1,400 Feet

Figure 2b

Agawam River (MA95-29)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Beaverdam Creek (MA95-53)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments; Nitrogen (Total); Fecal Coliform*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the Buzzards Bay Watershed (CN: 251.1)*[2]
	WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[3]
Location	Towns:	*Wareham*
	MassDOT Roads:	*Route 6*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*37.5 lbs/yr*
	Existing Load to Water Body:	*3,077 lbs/yr*
	MassDOT Contribution to Existing Load:	*1.22 %*

Site Description

Beaverdam Creek (MA95-53) is a 0.4 square mile water body which extends from the outlet of cranberry bogs along Route 6 to the confluence with the Weweantic River (MA95-05) in Wareham, Massachusetts. Figure 1 illustrates the groundwatershed for Beaverdam Creek (MA95-53). The groundwatershed for this impaired segment was provided by the Buzzards Bay National Estuaries

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

[2] Mass DEP,2009. Final Pathogen TMDL for the Buzzards Bay Watershed March 2009 (CN 251.1). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[3] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment report Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

Program (BBNEP)[4] as modified from the USGS groundwater delineations developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data.[5,6] Portions of Buzzards Bay are based on groundwater delineations and not ground surface topography.[5] For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwtershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Beaverdam Creek (MA95-53).

MassDEP's Water Quality Assessment Report titled *Buzzards Bay Watershed 2000 Water Quality Assessment Report*[7] identifies the Aquatic Life Use and Shellfishing Harvesting Use as "impaired" for Beaverdam Creek (MA95-53). The "impaired" status for the Aquatic Life Use is reported to be caused by estuarine bioassessment (decline of eelgrass bed habitat) due to the known source of nitrogen and a suspected source of on-site treatment systems (septic systems) and specialty crop production related to cranberry bogs. The Shellfish Harvesting Use is reported to be "impaired" due to fecal coliform bacteria suspected to be associated with municipal separate storm sewer systems. The other uses were not assessed.

Figure 2 illustrates the MassDOT-owned road (Route 6) within the groundwatershed that contributes runoff to the water body. Approximately 2,000 feet of Route 6 traverses the groundwatershed north of Beaverdam Creek. Approximately 5.3 acres of impervious cover along the roadway is considered contributing to the groundwatershed as the runoff is either directed to pervious areas adjacent to the roadway, or to catch basins and drainage structures that discharge via outfalls within the groundwatershed. Figure 2 illustrates the MassDOT outfalls that discharge in and near the wetlands/cranberry bogs upstream of Beaverdam Creek. Stormwater runoff that is directed to pervious area infiltrates into the ground and is considered contributing to the groundwatershed. Beginning approximately 150 feet south of Burr Parkway and extending to the northern groundwatershed boundary, a section of Route 6 drains to a collection system that directs flow outside of the watershed. Similarly, a section of Route 6 extending approximately 50 feet from the southwestern groundwatershed boundary drains to a system directing flow outside of the groundwatershed. These areas are not considered contributing to the groundwatershed of Beaverdam Creek.

Existing BMPs

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

[4] BBNEP, 2014. Shapefile coverage of watershed boundaries via email from Joe Costa on September 9, 2014.

[5] U.S. Geological Survey (USGS). (2009). Groundwater contributing areas for Cape Cod and Plymouth-Carver Regions of Massachusetts. Data Series 451 (1 of 3).

[6] Walter, D.A., Masterson, J.P., and Hess, K.M., 2004, Ground-Water Recharge Areas and Traveltimes to Pumped Wells, Ponds, Streams, and Coastal Water Bodies, Cape Cod, Massachusetts, Scientific Investigations Map I-2857, 1 sheet. Available at: http://pubs.water.usgs.gov/sim20042857.

[7] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[8] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[9] MassDOT assessed Beaverdam Creek (MA95-53) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[10] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[11] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Beaverdam Creek is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[9] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[12] The Buzzards Bay National Estuaries Program[13] identified the total existing groundwatershed nitrogen load for this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Beaverdam Creek (MA95-53) to be linked to elevated nitrogen: estuarine bioassessments and nitrogen (total).

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[14] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using and average of precipitation data from the New Bedford and Hyannis sites and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.8 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[13] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 5.3 acres
- DOT Pervious Area: 0.6 acres

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[8] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[9] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

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

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

[12] MassDOT, 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[13] Buzzards Bay National Estuary Program, September, 2014. Formal communication with Joe Costa via email September 17, 2014.

[14] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

- Estimated Existing MassDOT Load: 37.5 lb/yr
- Total Existing Groundwatershed Nitrogen Load: 3,077 lb/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 1.22%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[15] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). Beaverdam Creek (MA95-53) is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed*.[16]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[17]

According to the Final TMDL, the Buzzards Bay Watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. MS4s are a suspected source of bacterial pollution to segment MA95-53 of Beaverdam Creek.[16]

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Beaverdam Creek is listed as a medium priority due to its value as a resource for shellfishing.[16]

In addition to the generic recommendations provided in the draft NPDES MS4 permits for Massachusetts and discussed in the MassDOT Pathogen Methodology, the *Final Pathogen TMDL for the Buzzards Bay Watershed*[16] (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)

[15] MassDOT, December2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[16] Mass DEP.2009. Final Pathogen TMDL for the Buzzards Bay Watershed March 2009 (CN 251.1). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[17] MassDOT. December 2014. Description of MassDOT's Application of BMP 7R for Pathogen Related Impairments. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

- Controls for agricultural runoff, such as improved grazing management

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

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*: [18]

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education
- Additional monitoring
- Stormwater guidance tools

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

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

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

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

[18] Mass DEP.2009. Final Pathogen TMDL for the Buzzards Bay Watershed March 2009 (CN 251.1). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Beaverdam Creek, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[19] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[19] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

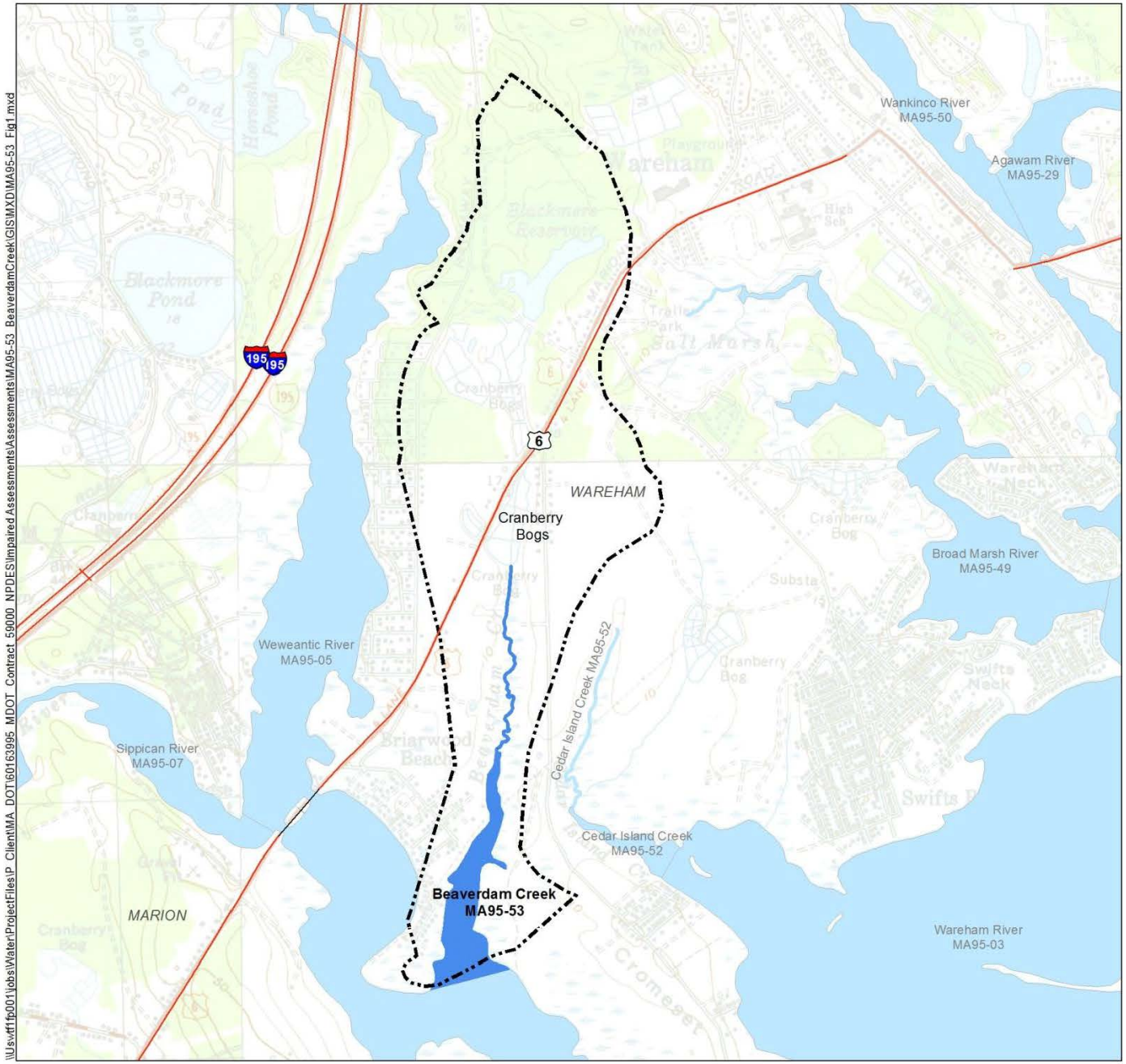
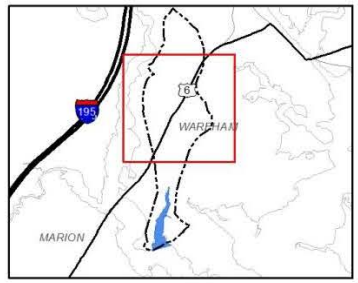


Figure 1

Beaverdam Creek (MA95-53)
Groundwatershed

December 2014



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- MassDOT Impervious Area
- MassDOT Pervious Area
- MassDOT Supplemental Contributing Area
- DEP Wetlands

N

0 300 600 Feet

Figure 2

Beaverdam Creek (MA95-53)
MassDOT Contributing Area

December 2014

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Massachusetts Department of Transportation
Highway Division

12/08/2014

Impaired Waters Assessment for Squeteague Harbor (MA95-55)

Summary

Impaired Water[1]	Stormwater Impairments:	*Nutrient/Eutrophication Biological Indicators*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*None*
	WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[2]
Location	Towns:	*Bourne, Falmouth*
	MassDOT Roads:	*Route 28 and Route 28A*
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*88.1 lbs/yr*
	Existing Load to Water Body:	*68,713 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.13 %*

Site Description

Squeteague Harbor (MA95-55) is a 0.15 square mile water body which is considered the inner harbor of the Megansett Harbor Drainage basin located in Bourne and Falmouth, Massachusetts. Figure 1 illustrates the groundwatershed for Squeteague Harbor (MA95-55). Squeteague Harbor lies east of and drains to Megansett Harbor (MA95-19). Megansett Harbor (MA95-19) is not assessed separately as it is listed as a category 2 water body in the Massachusetts 303(d) list.[1] The groundwatershed for this impaired segment was provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas

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

[2] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

data. [3,4] The Cape Cod and adjacent Southeastern Massachusetts Communities are based on groundwater delineations and not ground surface topography. [4] For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment.

MassDOT property that contributes runoff or infiltration within the watershed area is considered in this assessment as contributing to Squeteague Harbor (MA95-55). The groundwatershed analyzed corresponds to the Megansett/ Squeteague Harbor groundwatershed in the Buzzards Bay Comprehensive Conservation and Management Plan.[5] Figure 1 shows the part of Megansett Harbor estimated to be included as the receiving water body for the nitrogen analysis. The eastern half of the groundwatershed lies within the Otis National Guard Base.

MassDEP's Water Quality Assessment Report titled *Buzzards Bay Watershed 2000 Water Quality Assessment Report*[6] identifies Shellfish Harvesting, Primary Contact, and Secondary Contact Uses as "support" while all others are "not assessed". Although confidence in the data is low, an "alert" status is issued for the Aquatic Life Use since the data suggests that there has been a decline in water quality due to nutrient enrichment from nonpoint sources or other anthropogenic activities. The water quality assessment report also notes that there is a water pollution plume within the groundwatershed from previous oil, fuel, chemical, and hazardous waste disposal activities.

The combined MassDOT-owned impervious areas shown in Figures 2a and 2b amounts to 11.0 acres of impervious area, of which 2.1 acres are outside of the groundwatershed and included as supplemental contributions. Both Route 28 and Route 28A run north-south and traverse the groundwatershed to the east of the Harbor. It should be noted that only portions of the MassDOT-owned roads inside the groundwatershed boundary are within an MS4-regulated urban area. Parts of the MassDOT roads are outside of the designated urban area; therefore, discharge from this roadway is not identified as contributing to the impaired segment. Route 28A is a two-lane highway and Route 28 is a four-lane divided highway with a large pervious median separating the northbound and southbound lanes. Roadway runoff along Route 28A is collected and discharged through a number of outfalls along the route shown in Figures 2a and 2b. The majority of roadway runoff along Route 28 is collected and discharged through one outfall shown in Figure 2b that is approximately 900 feet north of the southern watershed boundary. Runoff from pervious shoulder areas sheet flow to adjacent areas along the roadway. Both impervious roadway areas and pervious areas discharging via overland flow or catch basins and pipes within the groundwatershed are considered discharging to Squeteague Harbor (MA95-55).

Based on the filed visit, two additional areas that extend beyond the boundaries of the groundwatershed are considered "Supplemental Contributing Area". Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". The northern area is shown in Figure 2a and includes approximately 800 linear feet extending north of the groundwatershed boundary along Route 28A past Long Pond Way and a section of Route 28 that is 450 feet long which is

[3] Walter, D.A., Masterson, J.P., and Hess, K.M., 2004, Ground-Water Recharge Areas and Traveltimes to Pumped Wells, Ponds, Streams, and Coastal Water Bodies, Cape Cod, Massachusetts, Scientific Investigations Map I-2857, 1 sheet. Available at: http://pubs.water.usgs.gov/sim20042857.

[4] U.S. Geological Survey (USGS). (2009). Groundwater contributing areas for Cape Cod and Plymouth-Carver Regions of Massachusetts. Data Series 451 (1 of 3).

[5] Buzzards Bay National Estuary Program, 26 November, 2013. Buzzards Bay Comprehensive Conservation and Management Plan 2013 Update. Available at: http://buzzardsbay.org/newccmp/buzzards-bay-ccmp-2013-update.pdf

[6] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

located 950 feet north of the groundwatershed boundary. Both areas collect stormwater with a drainage system that discharges within the Squeteague Harbor groundwatershed. Figure 2b shows the second supplemental area, which extends 1,000 feet south of Route 28 along the southbound lane to the intersection with Route 151. Runoff from this area is collected along the roadway and drains north into the Squeteague groundwatershed and is thus considered to be contributing area to Squeteague Harbor (MA95-55).

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[7] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[8] MassDOT assessed Squeteague Harbor (MA95-55) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[9] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[10] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Squeteague Harbor (MA95-55) is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[8] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[11] The Buzzards Bay Comprehensive Conservation and Management Plan[12] identifies the total existing groundwatershed nitrogen load for this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Squeteague Harbor (MA95-55) to be linked to elevated nitrogen: nutrient/eutrophication biological indicators.

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

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

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

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

[11] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[12] Buzzards Bay National Estuary Program, November 2013. Buzzards Bay Comprehensive Conservation and Management Plan 2013 Update. Available at: http://buzzardsbay.org/newccmp/buzzards-bay-ccmp-2013-update.pdf

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[13] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. [14] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 11.0 acres
- MassDOT Pervious Area: 8.1 acres
- Estimated Existing MassDOT Load: 88.1 lb/yr
- Total Existing Groundwatershed Nitrogen Load: 68,713 lb/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.13%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[14] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Squeteague Harbor, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[15] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[13] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[14] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[15] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

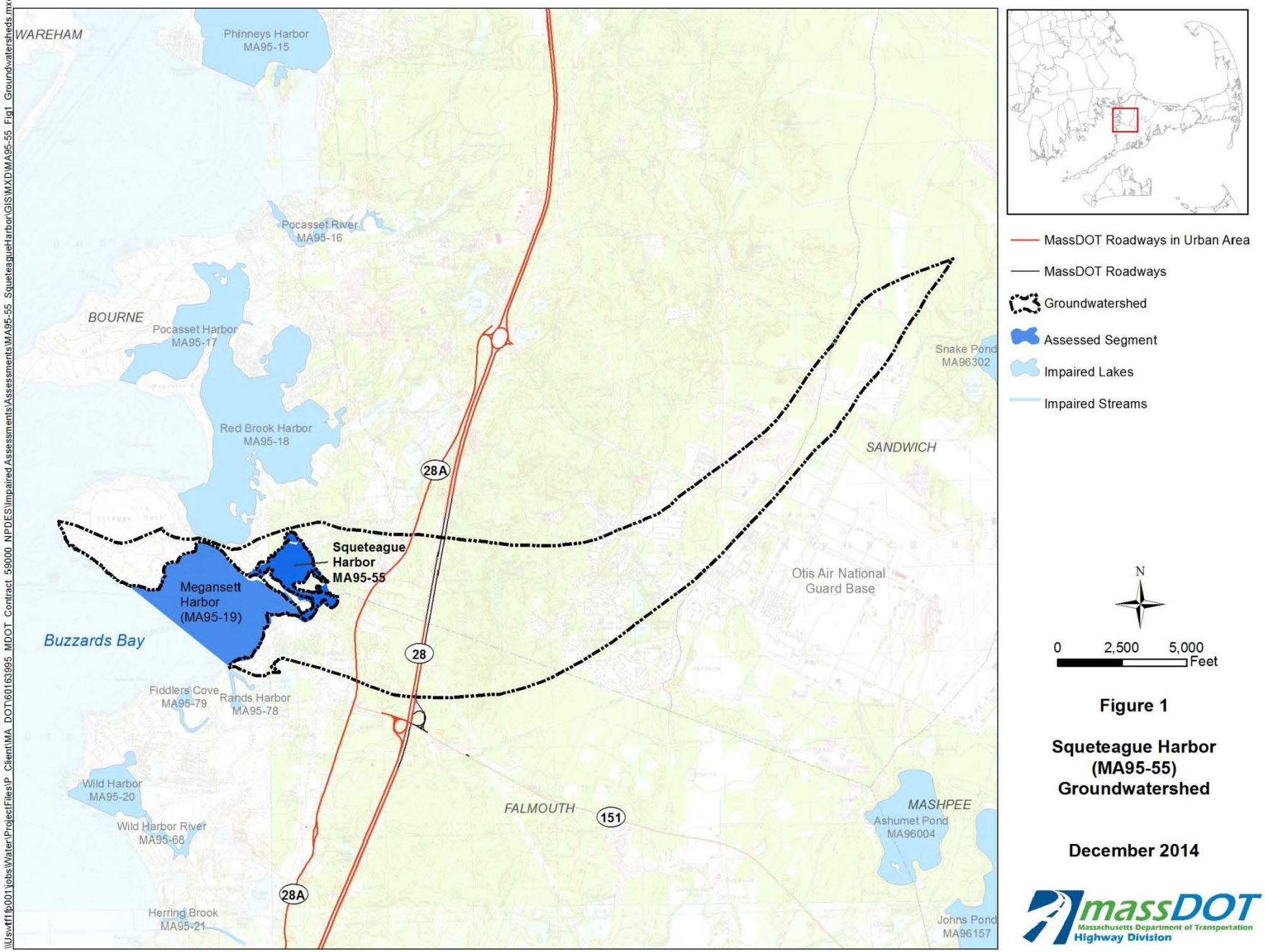


Figure 1

Squeteague Harbor (MA95-55) Groundwatershed

December 2014

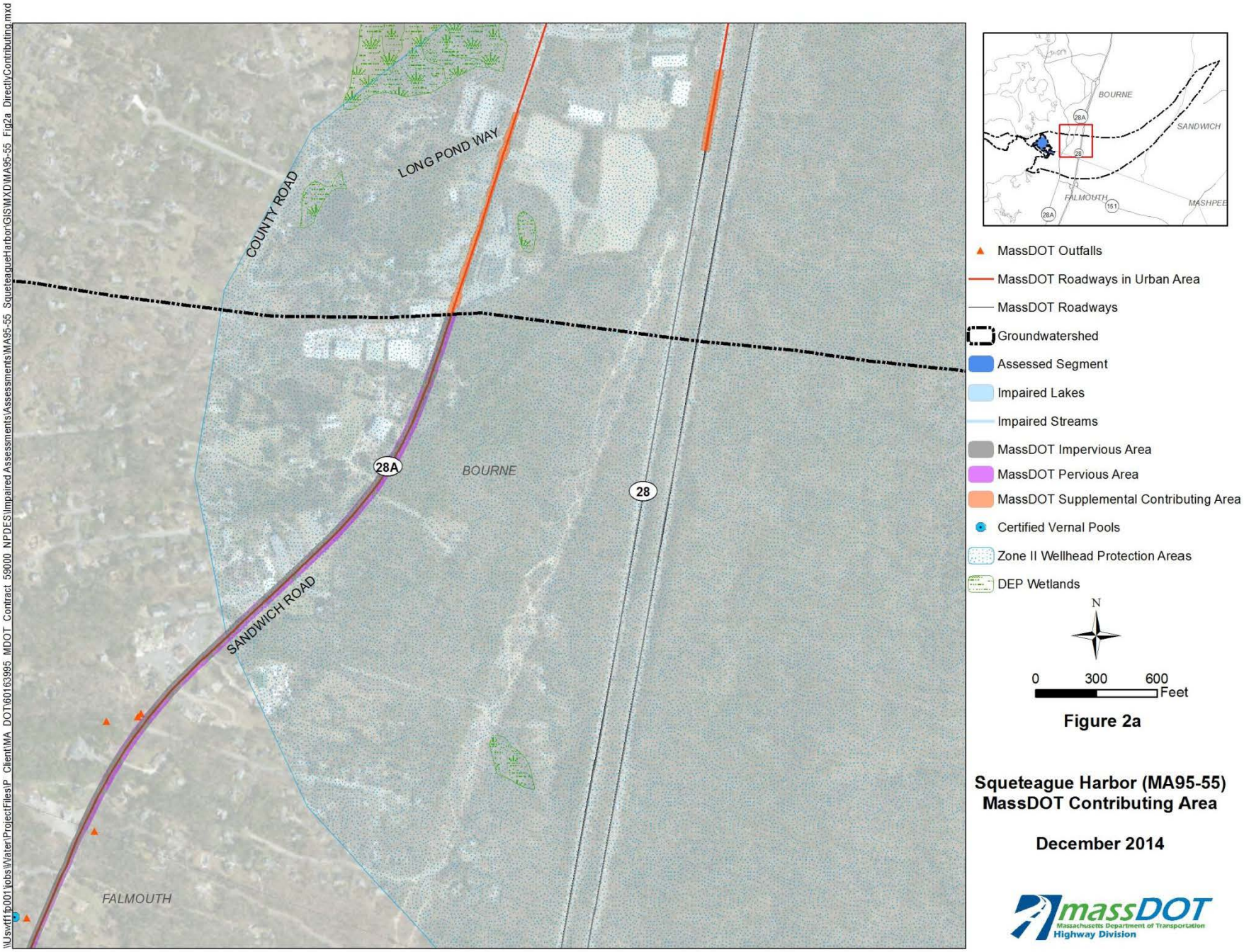
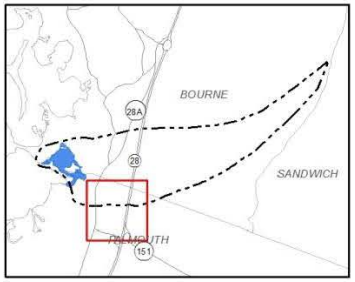


Figure 2a

Squeteague Harbor (MA95-55)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- MassDOT Impevious Area
- MassDOT Pervious Area
- MassDOT Supplemental Contributing Area
- Certified Vernal Pools
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

0 300 600 Feet

Figure 2b

Squeteague Harbor (MA95-55)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Wild Harbor River (MA95-68)

Summary

Impaired Water[1]	Stormwater Impairments:	*Fecal Coliform; Nutrient/Eutrophication Biological Indicators*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the Buzzards Bay Watershed (CN: 251.1)*[2]
	WQ Assessment:	*None*
Location	Towns:	*Falmouth*
	MassDOT Roads:	*Route 28A, Route 28, Curley Blvd*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*165.9 lbs/yr*
	Existing Load to Water Body:	*9,877 lbs/yr*
	MassDOT Contribution to Existing Load:	*1.68 %*

Site Description

Wild Harbor River (MA95-68) extends approximately 3,800 feet from the headwaters and the junction with Wild Harbor (MA95-20). The Wild Harbor River headwaters is located west Quaker Road and approximately 1,000 feet from the mouth of Wild Harbor in Falmouth, Massachusetts. Figure 1 illustrates the groundwatershed for Wild Harbor River (MA95-68). The groundwatershed for this impaired segment is based on technical reports[3] developed by the Massachusetts Estuaries

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

[2] MassDEP, 2009. Final Pathogen TMDL for the Buzzards Bay Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[3] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Wild Harbor Embayment System Town of Falmouth, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/WildHarbor/WildHarbor_MEP_FINAL-6MB.pdf

Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Wild Harbor River (MA95-68).

Although the MassDEP's Water Quality Assessment Report titled *Buzzards Bay Watershed 2000 Water Quality Assessment Report*[4] does not specifically address the water quality of Wild Harbor River (MA95-68), it is listed as one of the prominent freshwater streams along the eastern shore of Buzzards Bay. Wild Harbor River is also listed as one of the water bodies with fair water quality listed on the Baywatchers III – A Decade of Monitoring Buzzards Bay Embayments 1992-2001.[4] The report addresses Wild Harbor (MA95-20), the downstream water body which with located within the same groundwatershed as Wild Harbor River (MA95-68). The report states that the upper end of the groundwatershed is largely undeveloped because 39% of the land area is preserved in either Massachusetts Military Reservation or Crane's Wildlife Management Area. The lower section of the groundwatershed, below Route 28, is near build-out and the trend is to convert seasonal cottages to year round homes. In addition, the MEP technical report[3] states that the primary ecological threat to Wild Harbor marine resources is degradation resulting from nutrient enrichment and that the critical eutrophying nutrient is nitrogen.

Figure 2a illustrates the MassDOT-owned roads within the groundwatershed that contributes runoff to the water body. These roads include Route 28 and Route 28A which traverse the groundwatershed in a north-south direction to the east of Wild Harbor River. Route 28A is a two-lane highway which lies east of Route 28. Roadway runoff along Route 28A is collected and discharged through a number of outfalls along the route shown in Figure 2a. Route 28 is a four-lane divided highway with a large pervious median separating the northbound and southbound lanes. The majority of roadway runoff along Route 28 is collected and discharges at outfalls near a water body to the west of the roadway. Pervious shoulder areas allow runoff via sheet flow to infiltrate into the ground. Both roadway areas and pervious areas discharging via overland flow or catchbasins and pipes within the groundwatershed are considered discharging to Wild Harbor River (MA95-68). There is a MassDOT-owned bridge along Curley Boulevard, approximately 50 feet long, about 400 feet northwest of the intersection of Curley Boulevard and Route 28A that discharges within the Wild Harbor River groundwatershed.

Figure 2b shows areas north of the Wild Harbor River groundwatershed which were found to enter drainage systems that direct flow into the watershed and thus ultimately to the River. Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". The supplemental contributing area extends approximately 550 feet north of the Wild Harbor River groundwatershed on both the northbound and southbound lanes of Route 28 and approximately 900 feet of Route 28A. Stormwater runoff from the roads is collected in drainage systems that flows south and discharge within the Wild Harbor River groundwatershed.

[4] MassDEP, 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

Figure 2c shows areas south of the Wild Harbor River groundwatershed which were found to enter drainage systems that direct flow into the groundwatershed and thus ultimately to the River. The supplemental contributing area extends approximately 1,500 feet south of the Wild Harbor River groundwatershed on both the northbound and southbound lanes of Route 28 and is collected in a drainage system that flows north and discharges within the Wild Harbor River groundwatershed. The southern end of the supplemental area is near the northern ramps connecting Route 28 to Thomas B Landers Road.

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[5] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[6] MassDOT assessed Wild Harbor River (MA95-68) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[7] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[8] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Wild Harbor River is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[6] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[9] The MEP technical report[10] identifies the total existing groundwatershed nitrogen load for this water body and attributes nutrient/eutrophication biological indicators to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following

[5] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

[9] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[10] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Wild Harbor Embayment System Town of Falmouth, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/WildHarbor/WildHarbor_MEP_FINAL-6MB.pdf

impairments to Wild Harbor River (MA95-68) to be linked to elevated nitrogen: nutrient/eutrophication biological indicators.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[12] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 18.8 acres
- DOT Pervious Area: 19.7 acres
- Estimated Existing MassDOT Load: 165.9 lbs/yr
- Total Existing Watershed Nitrogen Load: 9,877 lbs/yr
- MassDOT Existing Load as a Percentage of Total Watershed Nitrogen Load: 1.68%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[12] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). Wild Harbor River (MA95-68) is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed*.[13]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[14]

According to the Final TMDL, the Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. Specifically, potential sources to the Wild

[11] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[12] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[13] Mass DEP.2009. Final Pathogen TMDL for the Buzzards Bay Watershed March 2009 (CN 251.1). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

[14] MassDOT. December 2014. Description of MassDOT's Application of BMP 7R for Pathogen Related Impairments. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

Harbor Estuary include on-site treatment systems (septic systems), highway/road runoff and MS4s.[15]

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized in the TMDL based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Wild Harbor River is not separately prioritized but Wild Harbor is designated as medium priority due its value as a resource for shellfishing.[15]

In addition to the generic recommendations provided in the draft NPDES MS4 permits for Massachusetts and discussed in the MassDOT Pathogen Methodology, the *Final Pathogen TMDL for the Buzzards Bay Watershed*[15] (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

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

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed:*[15]

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters Use management
- Watershed resident education
- Additional monitoring
- Stormwater guidance tools

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

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

[15] Mass DEP.2009. Final Pathogen TMDL for the Buzzards Bay Watershed March 2009 (CN 251.1). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/buzzbay1.pdf

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the groundwatershed of this water body. MassDOT will be installing signs at rest stops within the groundwatershed of impaired water bodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

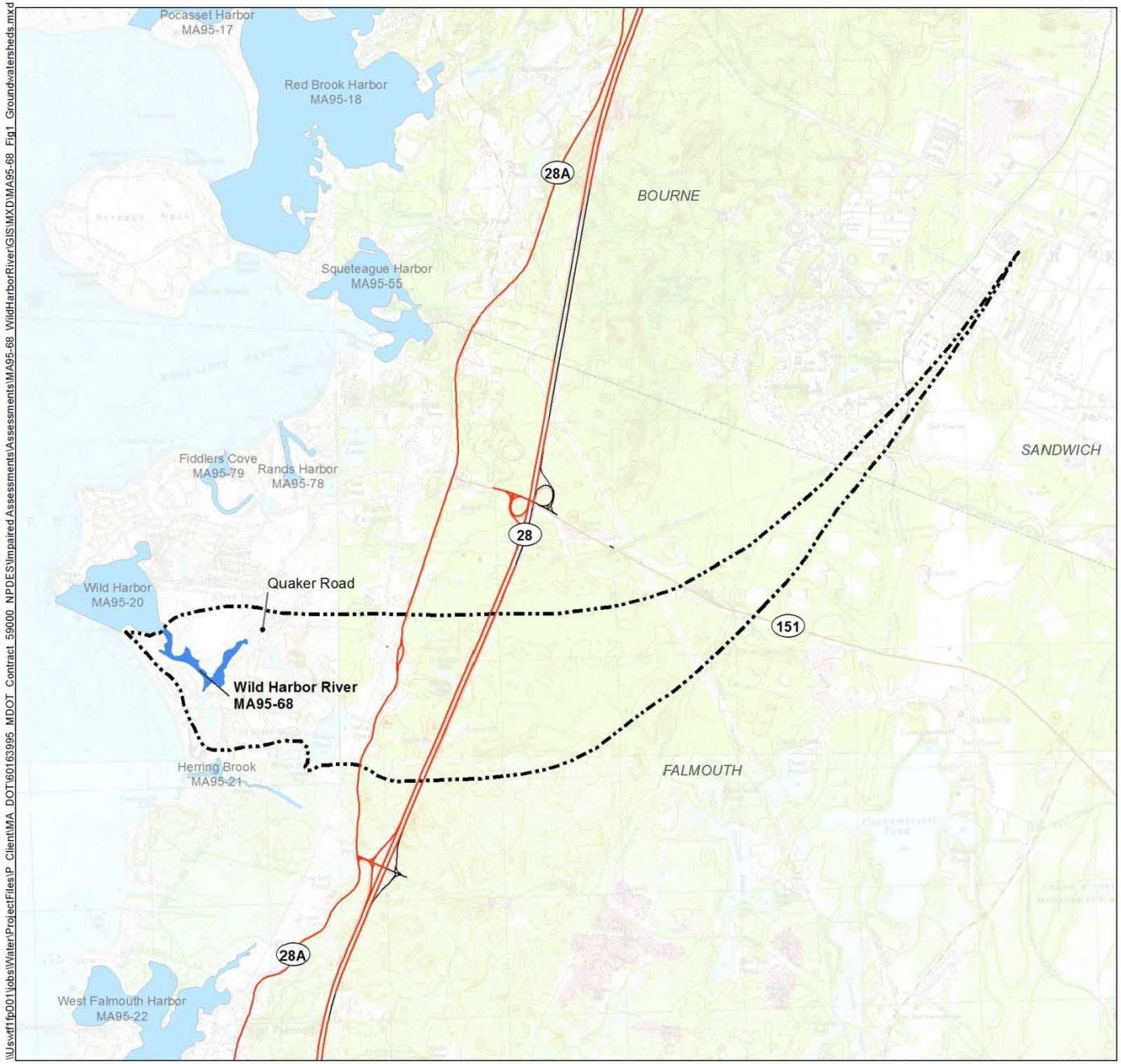
Although the TMDL report also identifies the benefits of structural BMPs to address pathogens in runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these BMPs in advance of other ongoing BMP efforts identified in the groundwatershed, given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

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Wild Harbor River, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[16] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[16] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf



MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 2,000 4,000 Feet

Figure 1

Wild Harbor River (MA95-68)
Groundwatersheds

December 2014

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Highway Division

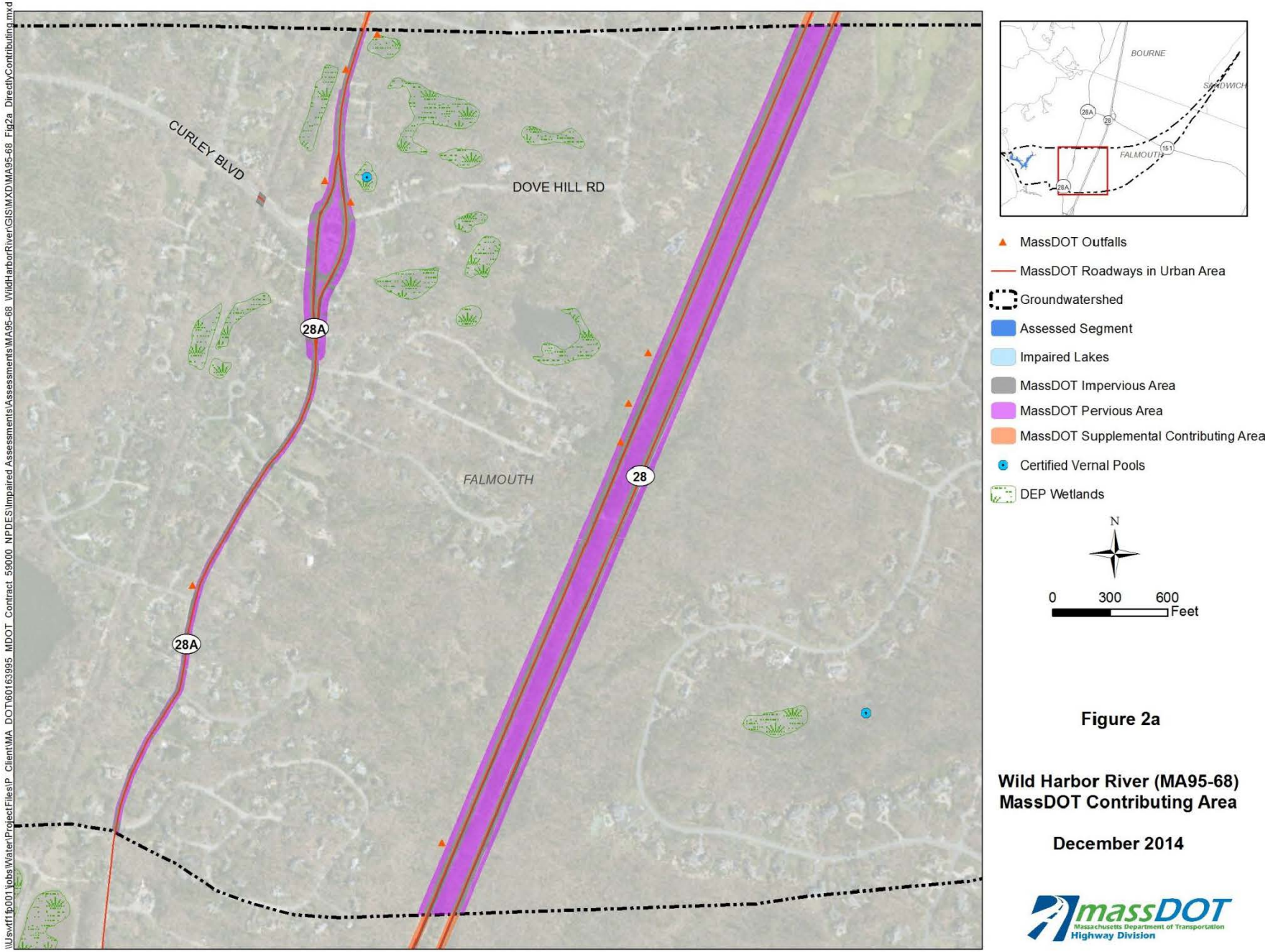


Figure 2a

Wild Harbor River (MA95-68)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

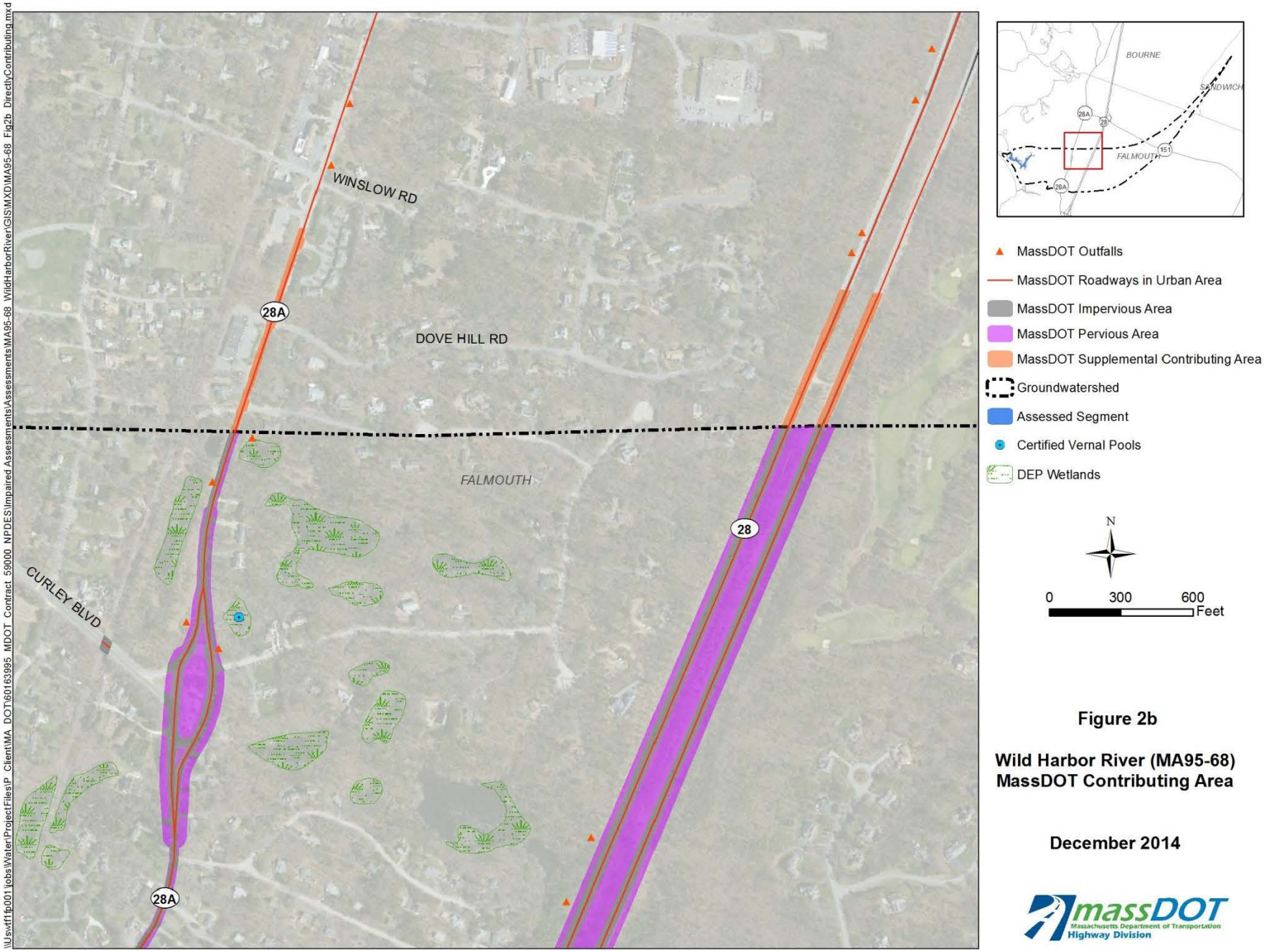


Figure 2b

Wild Harbor River (MA95-68)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

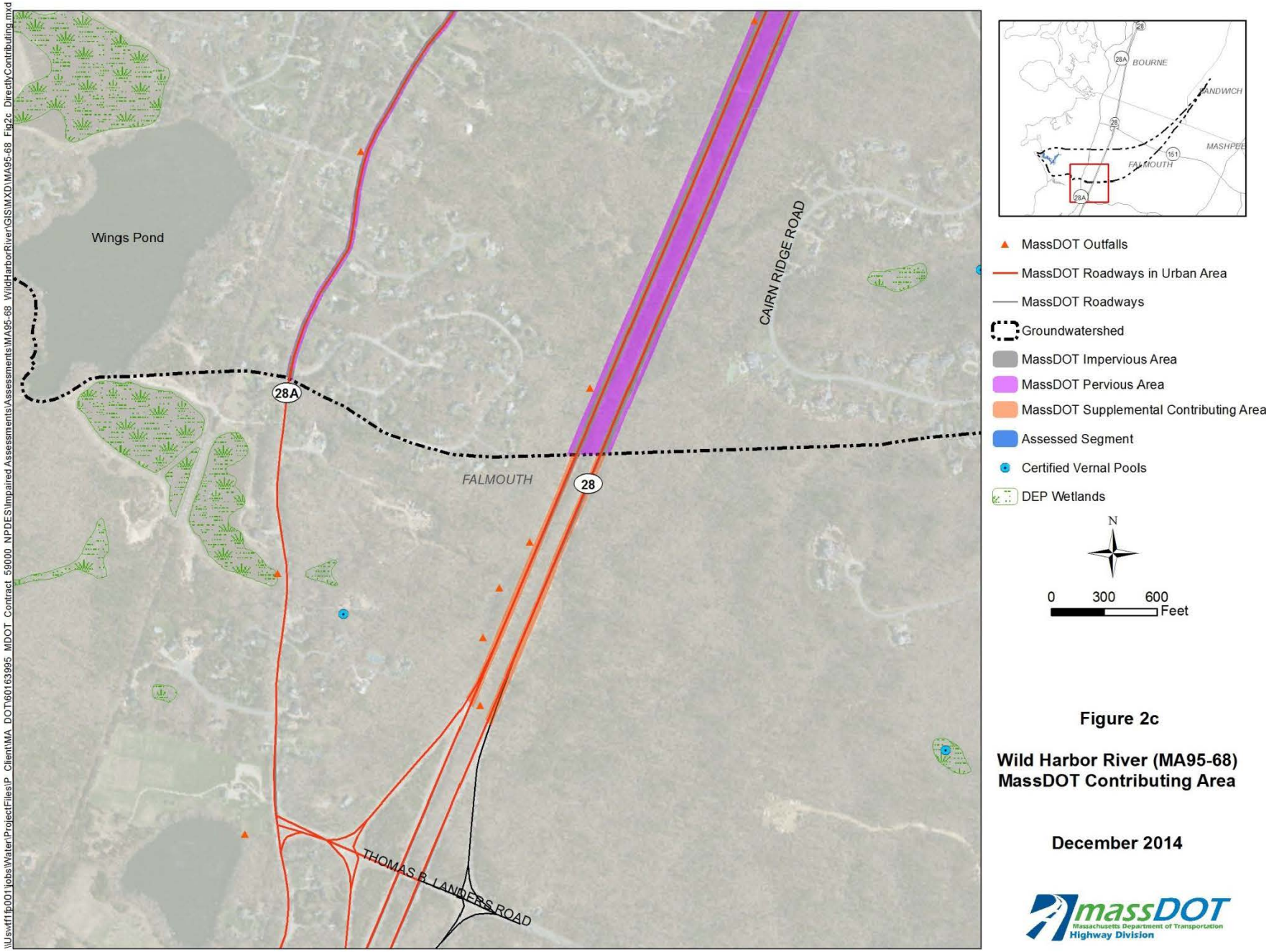


Figure 2c

Wild Harbor River (MA95-68)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

12/08/2014

Impaired Waters Assessment for Butler Cove (MA95-77)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*None*
	WQ Assessment:	*None*
Location	Towns:	*Wareham*
	MassDOT Roads:	*Route 6 and Onset Avenue*
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*10.8 lbs/yr*
	Existing Load to Water Body:	*3,016 lbs/yr*
	DOT Contribution to Existing Load:	*0.36 %*

Site Description

Butler Cove (MA95-77) is a water body in Wareham, Massachusetts that covers approximately 0.05 square miles and is located just south of Buttermilk Bay (MA95-01). Figure 1 illustrates the groundwatershed for Butler Cove (MA95-77). The groundwatershed for this impaired segment was provided by the Buzzards Bay National Estuaries Program (BBNEP)[2] as modified from the USGS groundwater delineations developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data.[3,4] Portions of Buzzards Bay are based on groundwater delineations and not

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

[2] BBNEP, 2014. Shapefile coverage of watershed boundaries via email from Joe Costa on September 9, 2014.

[3] U.S. Geological Survey (USGS). (2009). Groundwater contributing areas for Cape Cod and Plymouth-Carver Regions of Massachusetts. Data Series 451 (1 of 3).

[4] Walter, D.A., Masterson, J.P., and Hess, K.M., 2004, Ground-Water Recharge Areas and Traveltimes to Pumped Wells, Ponds, Streams, and Coastal Water Bodies, Cape Cod, Massachusetts, Scientific Investigations Map I-2857, 1 sheet. Available at: http://pubs.water.usgs.gov/sim20042857.

ground surface topography.[5] For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Butler Cove (MA95-77). Land use in Butler Cove (MA95-77) groundwatershed is primarily residential and forest with commercial in the vicinity of Route 6, as well as a golf course located in the southwest of the groundwatershed.

Figures 2a and 2b illustrate the MassDOT-owned urban roads within the groundwatershed that directly contribute runoff to the water body. Route 6 crosses the groundwatershed boundary northwest of Butler Cove (MA95-77). Route 6 is a four-lane road in this area. In addition, a small portion of Onset Avenue (approximately 100 feet) is located within the groundwatershed boundary, to the north of Butler Cove. This section of Onset Avenue is a two lane bridge over the railroad. Portions of both roads discharge primarily via sheet flow to the Butler Cove (MA95-77) groundwatershed.

Based on a site visit, the section of Route 6 located within the groundwatershed boundary contributes to Butler Cove groundwatershed via sheet flow, with the exception of approximately 150 feet of the roadway (from a high point near the western groundwatershed boundary to where Route 6 crosses the boundary). Runoff from this section of roadway flows northwest from this high point located in the vicinity of Jordan Plaza (as shown on Figure 2A) and flows outside of the groundwatershed. Asphalt and granite curbing is located occasionally on both sides of Route 6 within the groundwatershed; there is no sidewalk along this section of road.

Approximately 30 feet of Onset Avenue contributes to Butler Cove via sheet flow from a high point located on the railroad bridge (Figure 2b). Runoff from this high point flows southwest into the groundwatershed and flows northeast outside of the Butler Cove groundwatershed. Granite curbing is located on both sides of Onset Avenue within the groundwatershed where it crosses over the railroad; sidewalk is located along the southwest bound lane.

Based on the site visit, an additional 50 feet along Route 6 beyond the groundwatershed boundary to the southeast (in the vicinity of the parking lot for Mazzilli's Farm Stand and Deli, as shown on Figure 2a) flows back into the groundwatershed (via catch basins that collect flow and discharge within the watershed) and is considered “Supplemental DOT Contributing Area”. Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered “Supplemental”.

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately

[5] U.S. Geological Survey (USGS). (2009). Groundwater contributing areas for Cape Cod and Plymouth-Carver Regions of Massachusetts. Data Series 451 (1 of 3).

[6] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at:
http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Butler Cove (MA95-77) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[8] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Butler Cove is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[7] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[10] The Buzzards Bay National Estuaries Program[11] identifies the total existing groundwatershed nitrogen load for this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairmenst to Butler Cove (MA95-77) to be linked to elevated nitrogen: estuarine bioassessments.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[12] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using and average of precipitation data from the New Bedford and Hyannis sites and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.8 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[9] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Pervious Area: 0.2 acres
- Estimated Existing MassDOT Load: 10.8 lbs/yr
- Total Existing Watershed Nitrogen Load: 3,016 lbs/yr
- MassDOT Existing Load as a Percentage of Total Watershed Nitrogen Load: 0.36%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[13] In general, in areas where the MassDOT load is

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

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

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

[10] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[11] Buzzards Bay National Estuary Program, September, 2014. Formal communication with Joe Costa via email September 17, 2014.

[12] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[13] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of the water body, including regular roadway and drainage system maintenance, erosion and sedimentation control, street sweeping, and outreach and education. As described in MassDOT's Stormwater Handbook,[14] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance.

Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[14] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

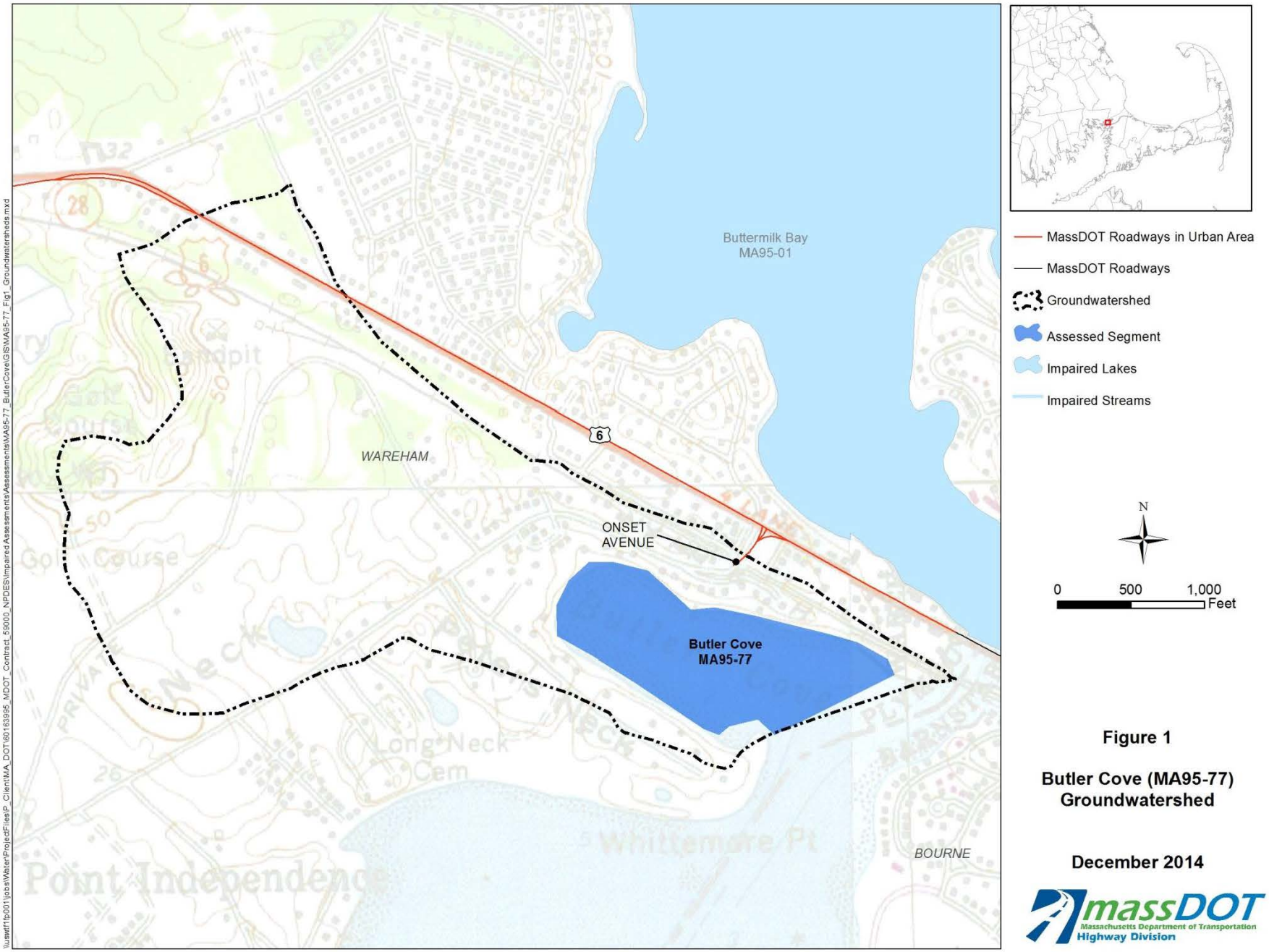


Figure 1

Butler Cove (MA95-77) Groundwatershed

December 2014

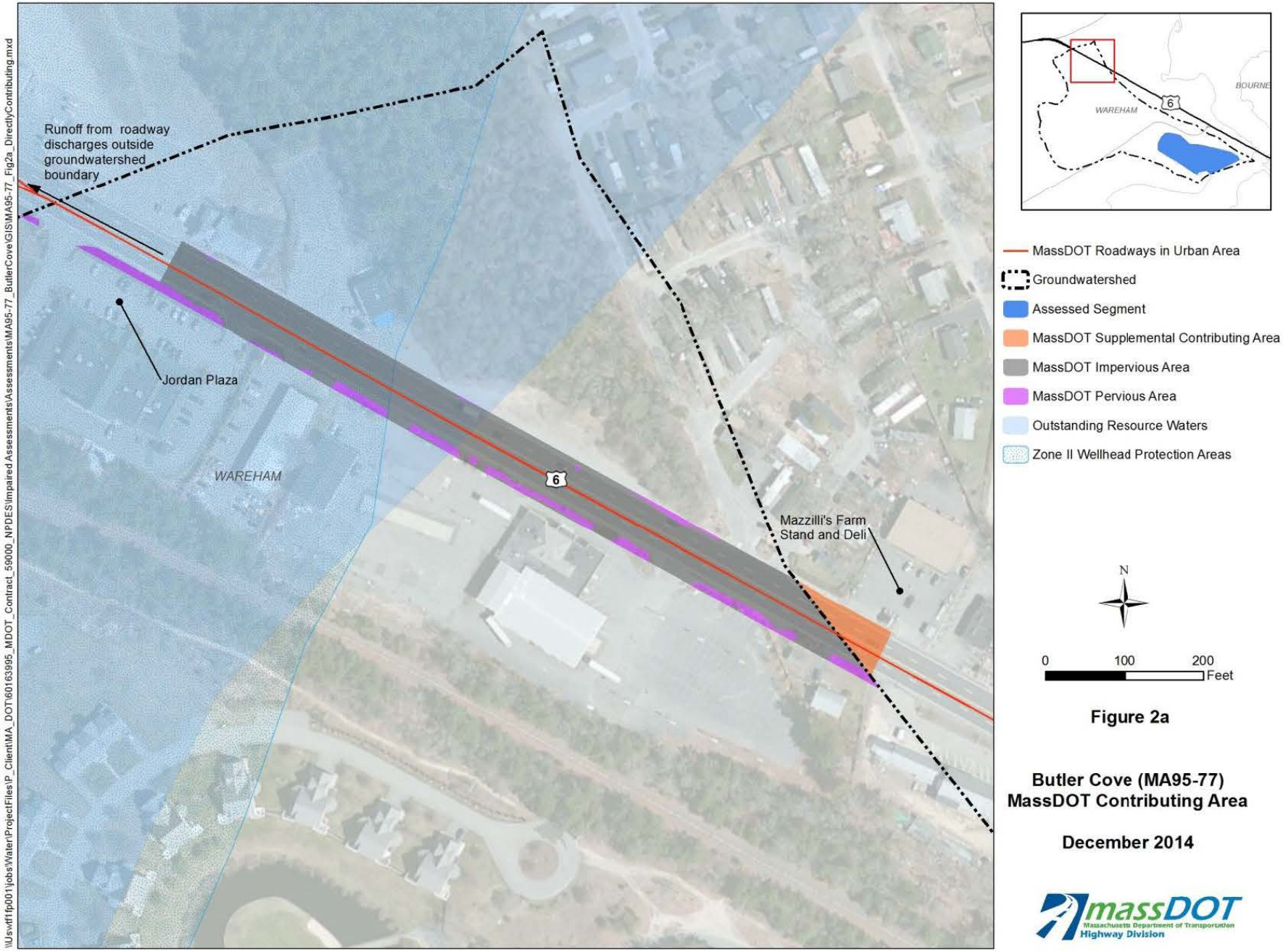
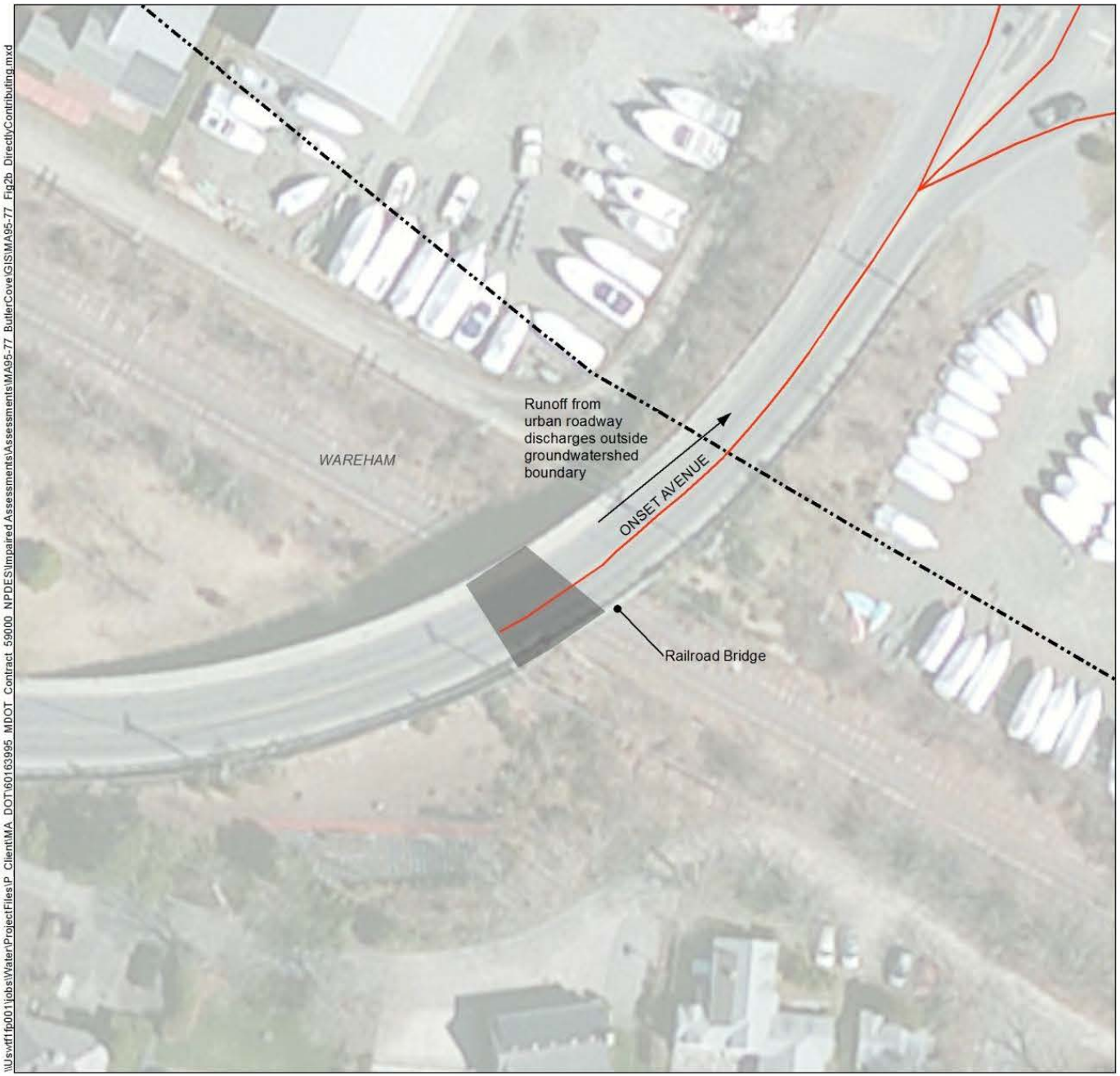
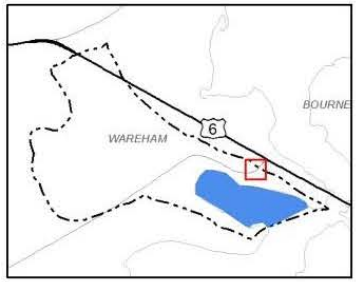


Figure 2a

Butler Cove (MA95-77)
MassDOT Contributing Area

December 2014





MassDOT Roadways in Urban Area

Groundwatershed

Assessed Segment

MassDOT Impervious Area

N

0 40 80 Feet

Figure 2b

Butler Cove (MA95-77)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

\\Uswf1fp001\jobs\Water\ProjectFiles\P_Client\MA_DOT-60163995_MDOT_Contract_59000_NPDES\Impaired Assessments\Assessments\MA95-77_ButlerCove\GIS\MA95-77_Fig2b_DirectlyContributing.mxd

massDOT Massachusetts Department of Transportation Highway Division

12/08/2014

Impaired Waters Assessment for Rands Harbor (MA95-78)

Summary

Impaired Water[1]	Stormwater Impairments:	*Nutrient/Eutrophication Biological Indicators*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*None*
	WQ Assessment:	*None*
	Towns:	*Falmouth*
Location	MassDOT Roads:	*Route 151, Route28 and Route 28A*
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*102.3 lbs/yr*
	Existing Load to Water Body:	*5,547 lbs/yr*
	MassDOT Contribution to Existing Load:	*1.84 %*

Site Description

Rands Harbor (MA95-78) is a 0.02 square mile water body located west of Route 28A in Falmouth, Massachusetts. Figure 1 illustrates the groundwatershed for Rands Harbor (MA95-78). The groundwatershed for this impaired segment is based on technical reports[2] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a

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

[2] University of Massachusetts Dartmouth and MassDEP, 2012. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Fiddlers Cove and Rands Harbor Embayment Systems, Town of Falmouth, Massachusetts. Revised Draft Report Unpublished.

discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Rands Harbor (MA95-78). The Rands Harbor groundwatershed has seen increased development and is at risk of eutrophication from human-related sources. [3] The Fiddlers Cove and Rands Harbor Massachusetts Estuaries Project report cites that managing water body impairments will require both a reduction of present land use nitrogen loads as well as management of future loads.

Figure 2 illustrates the MassDOT-owned roads within the groundwatershed that contributes runoff to the water body. Route 28 and 28A traverse the groundwatershed boundary north to south. It should be noted that only a portion of the MassDOT-owned roads inside the groundwatershed boundary is within an MS4-regulated urban area. Part of the MassDOT roads is outside of the designated urban area; therefore, discharge from this roadway is not identified as contributing to the impaired segment. MassDOT-owned urban roadway areas also include the southwest ramp connecting Route 151 to Route 28 as well as a part of Route 151 extending to Old County Road. Approximately 11.0 acres of impervious roadway drains to the groundwatershed via overland flow, infiltration or catch basins and pipes; and is considered discharging to Rands Harbor (MA95-78). Route 28, east of Route 28A is a four-lane expressway, whereas both Route 151 and Route 28A are two-lane local roads. Most outfalls are either small, localized systems with one or two catch basins and an outfall or curb cuts at a low point in the roadway where sheet-flow is allowed to drain overland to the shoulder of the roadway. Based on a field visit, a section of impervious area (about 100-feet in length) north of the groundwatershed boundary on Route 28A which drains south into collection systems, discharging within the Rands Harbor groundwatershed is considered "Supplemental Contributing Area". Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". High points also account for two sections of Route 28A (near Edgerton Road) and Route 28 southbound which drain south into collection systems which drain to the adjacent Fiddlers Cove (MA95-79) groundwatershed and are thus not included in the MassDOT contributing area for Rands Harbor.

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[4] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[5] MassDOT assessed Rands Harbor (MA95-78) using the methodologies described below.

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[3] University of Massachusetts Dartmouth and MassDEP, 2012. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Fiddlers Cove and Rands Harbor Embayment Systems, Town of Falmouth, Massachusetts. Revised Draft Report Unpublished.

[4] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[5] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. [6] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[7] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Rands Harbor is not proposed to change.

BMP 7U for Nitrogen Impairment

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[8] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[9] The MEP technical report[10] identifies the total existing groundwatershed nitrogen load for this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Rands Harbor (MA95-78) to be linked to elevated nitrogen: nutrient/eutrophication biological indicators.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[9] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 11.0 acres
- MassDOT Pervious Area: 13.7 acres
- Estimated Existing MassDOT Load: 102.3 lbs/yr
- Total Existing groundwatershed Nitrogen Load: 5,547 lbs/yr
- MassDOT Existing Load as a Percentage of Total Watershed Nitrogen Load: 1.84%

The MassDOT existing load compared to the total watershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen watershed load.[9] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall watershed load.

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

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

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

[9] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[10] University of Massachusetts Dartmouth and MassDEP, 2012. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Fiddlers Cove and Rands Harbor Embayment Systems, Town of Falmouth, Massachusetts. Revised Draft Report.

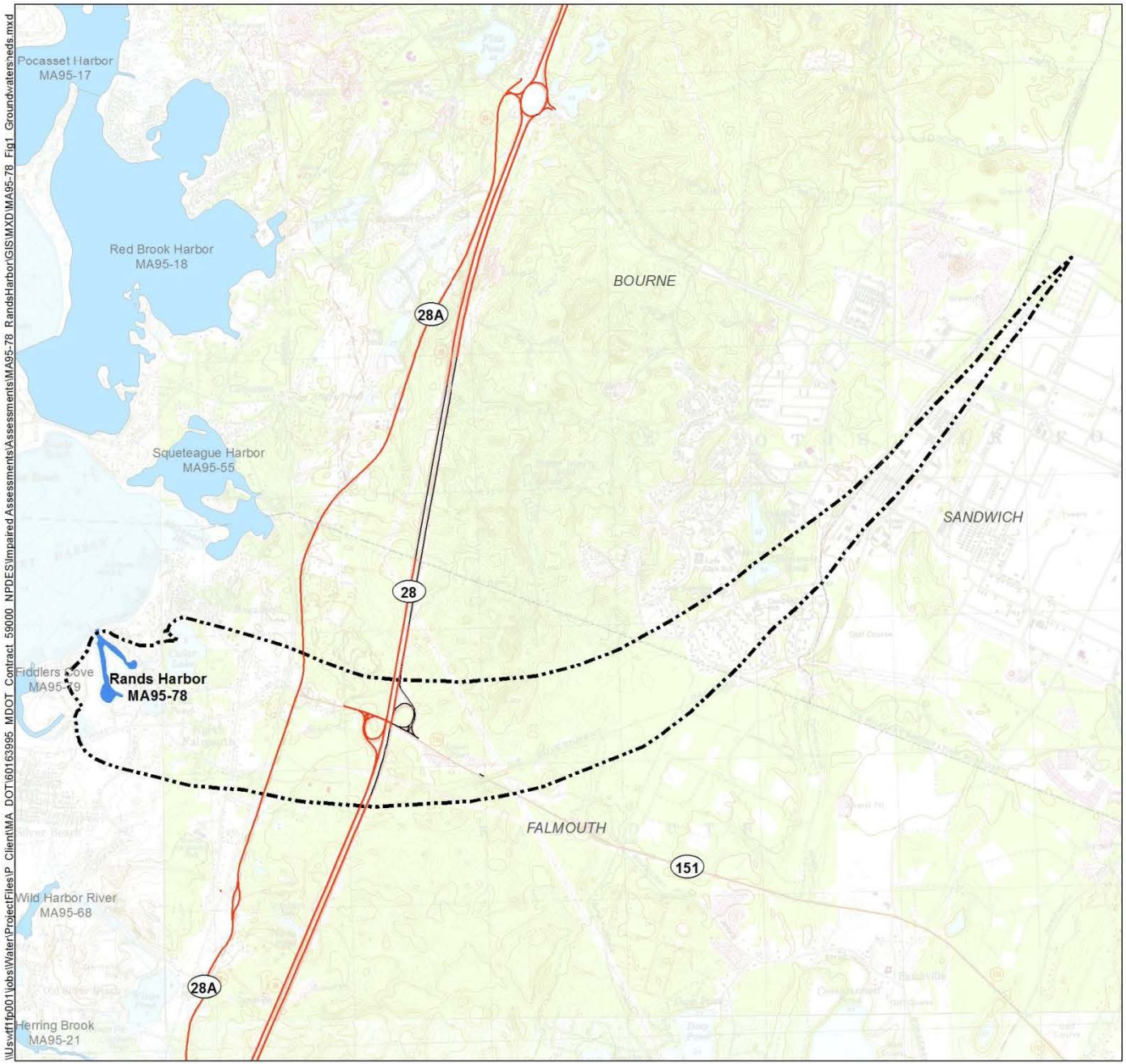
[11] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

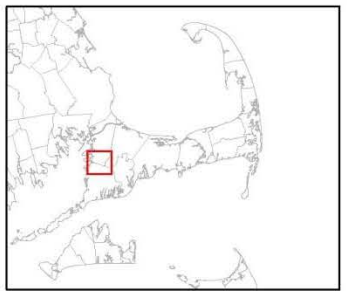
Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Rands Harbor, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[12] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[12] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf





MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 2,500 5,000 Feet

Figure 1

Rands Harbor (MA95-78) Groundwatershed

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

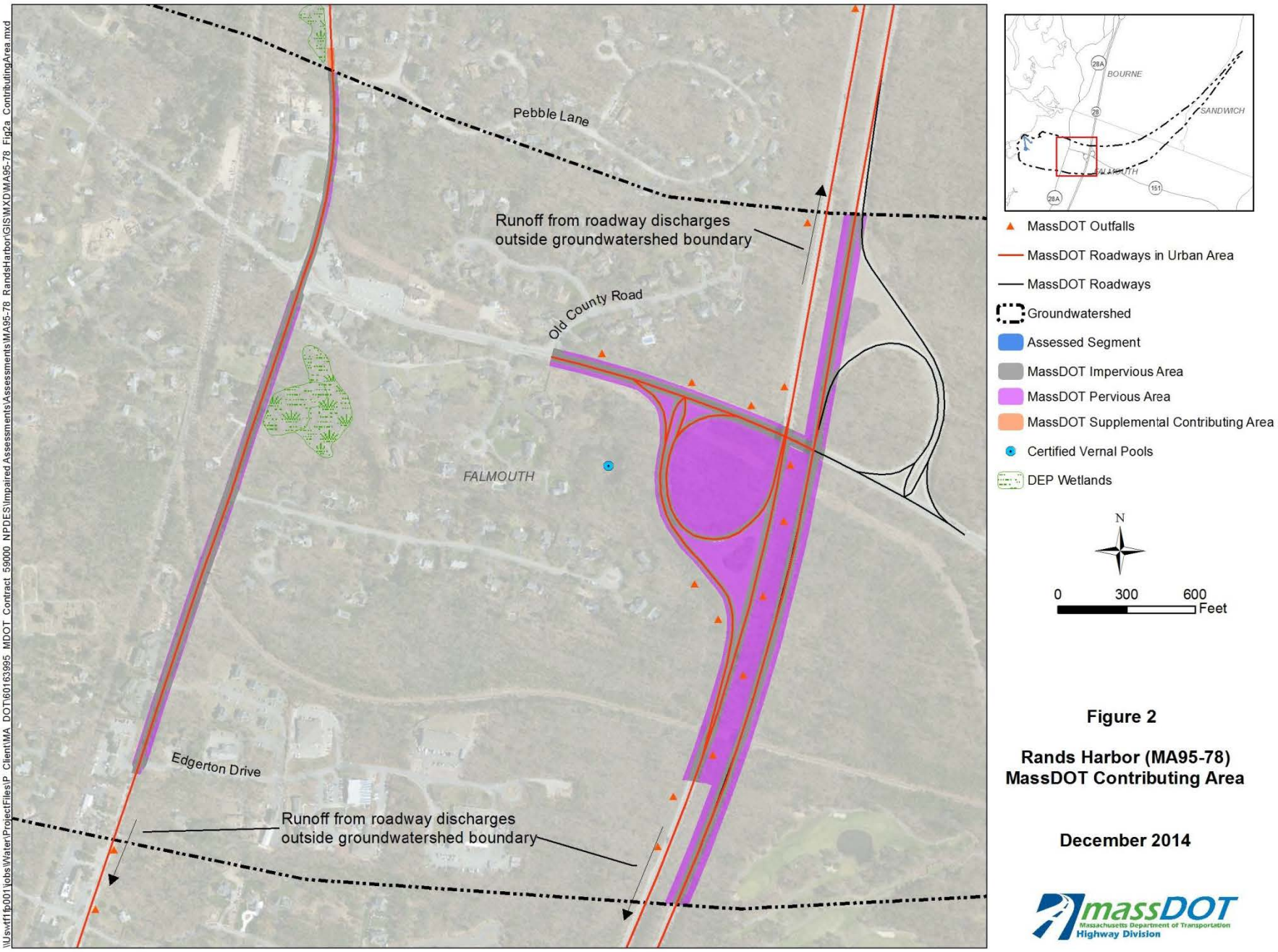


Figure 2

Rands Harbor (MA95-78)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

12/08/2014

Impaired Waters Assessment for Fiddlers Cove (MA95-79)

Summary

Impaired Water[1]	Stormwater Impairments:	*Nutrient/Eutrophication; Biological Indicators*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*None*
	WQ Assessment:	*None*
	Towns:	*Falmouth*
Location	MassDOT Roads:	*Route 28 and Route 28A*
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*19.9 lbs/yr*
	Existing Load to Water Body:	*4,644 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.43 %*

Site Description

Fiddlers Cove (MA95-79) is a 0.01 square mile water body located west of Route 28A in Falmouth, Massachusetts. Figure 1 illustrates the groundwatershed for Fiddlers Cove (MA95-79). The groundwatershed for this impaired segment is based on technical reports[2] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a

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

[2] University of Massachusetts Dartmouth and MassDEP, 2012. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Fiddlers Cove and Rands Harbor Embayment Systems, Town of Falmouth, Massachusetts. Unpublished Revised Draft Report.

discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment.

MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Fiddlers Cove (MA95-79). The Fiddlers Cove groundwatershed has seen increased development and is at risk of eutrophication from human-related sources. The Fiddlers Cove and Rands Harbor Massachusetts Estuaries Project report cites that managing water body impairments will require both a reduction of present land use nitrogen loads as well as management of future loads[3].

Figure 2 illustrates the MassDOT-owned roads within the groundwatershed that contributes runoff to the water body. Route 28 and 28A traverse the groundwatershed boundary north to south. Approximately 2.4 acres of impervious roadway drains to the groundwatershed via overland flow, infiltration or catch basins and pipes; therefore, the section of roadway is considered discharging to Fiddlers Cove (MA95-79). Route 28, east of Route 28A is a four-lane expressway, whereas Route 28A is a two-lane local road. Most outfalls are either small, localized systems with one or two catch basins, outfalls or curb cuts at a low point in the roadway where sheet flow is allowed to drain overland to the shoulder of the roadway.

Based on a field visit, high points on Route 28 and Route 28A create two additional areas of impervious roadway located north of the groundwatershed boundary which drain south into collection systems that discharge within the Fiddlers Cove groundwatershed. Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered “Supplemental Contributing Area”. These portions of roadway, are shown in Figure 2.

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[4] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[5] MassDOT assessed Fiddlers Cove (MA95-79) using the methodologies described below.

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

[3] University of Massachusetts Dartmouth and MassDEP, 2012. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Fiddlers Cove and Rands Harbor Embayment Systems, Town of Falmouth, Massachusetts. Revised Draft Report.

[4] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[5] MassDOT, 6 April, 2011788. Description of MassDOT’s Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

and 303(d) of the Clean Water Act.[6] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[7] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Fiddlers Cove is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[8] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[9] The MEP technical report[10] identifies the total existing groundwatershed nitrogen load for this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Fiddlers Cove (MA95-79) to be linked to elevated nitrogen: nutrient/eutrophication biological indicators.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[9] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 2.4 acres
- MassDOT Pervious Area: 2.0 acres
- Estimated Existing MassDOT Load: 19.9 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 4,644 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.43%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[9] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

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

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

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

[9] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[10] University of Massachusetts Dartmouth and MassDEP, 2012. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Fiddlers Cove and Rands Harbor Embayment Systems, Town of Falmouth, Massachusetts. Revised Draft Report.

[11] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

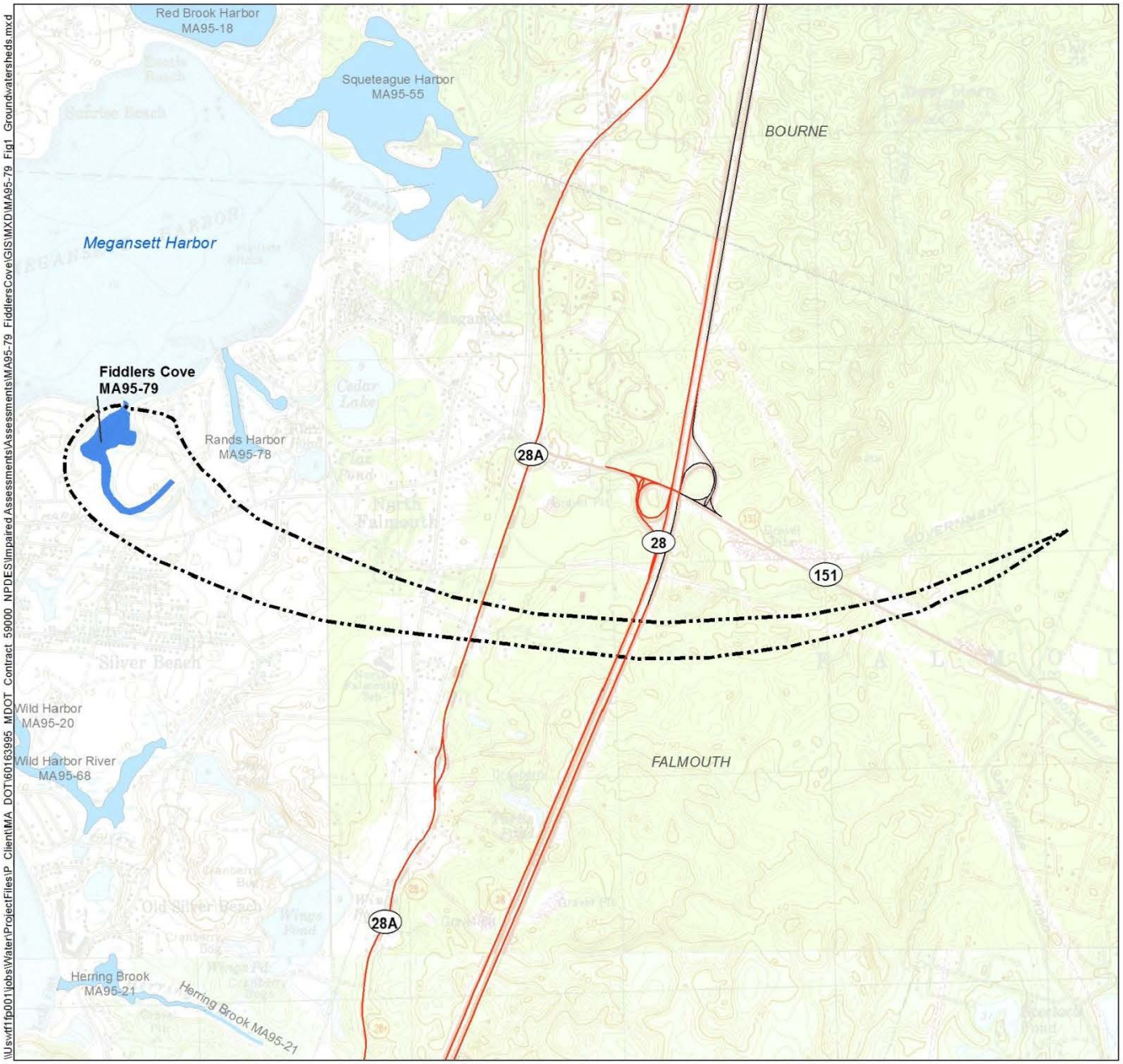
Proposed Mitigation Plan

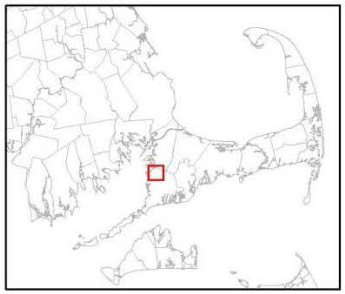
As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Fiddlers Cove, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[12] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance.

Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs, and progress made towards meeting target reductions.

[12] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf





MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 1,000 2,000 Feet

Figure 1

Fiddlers Cove (MA95-79) Groundwatershed

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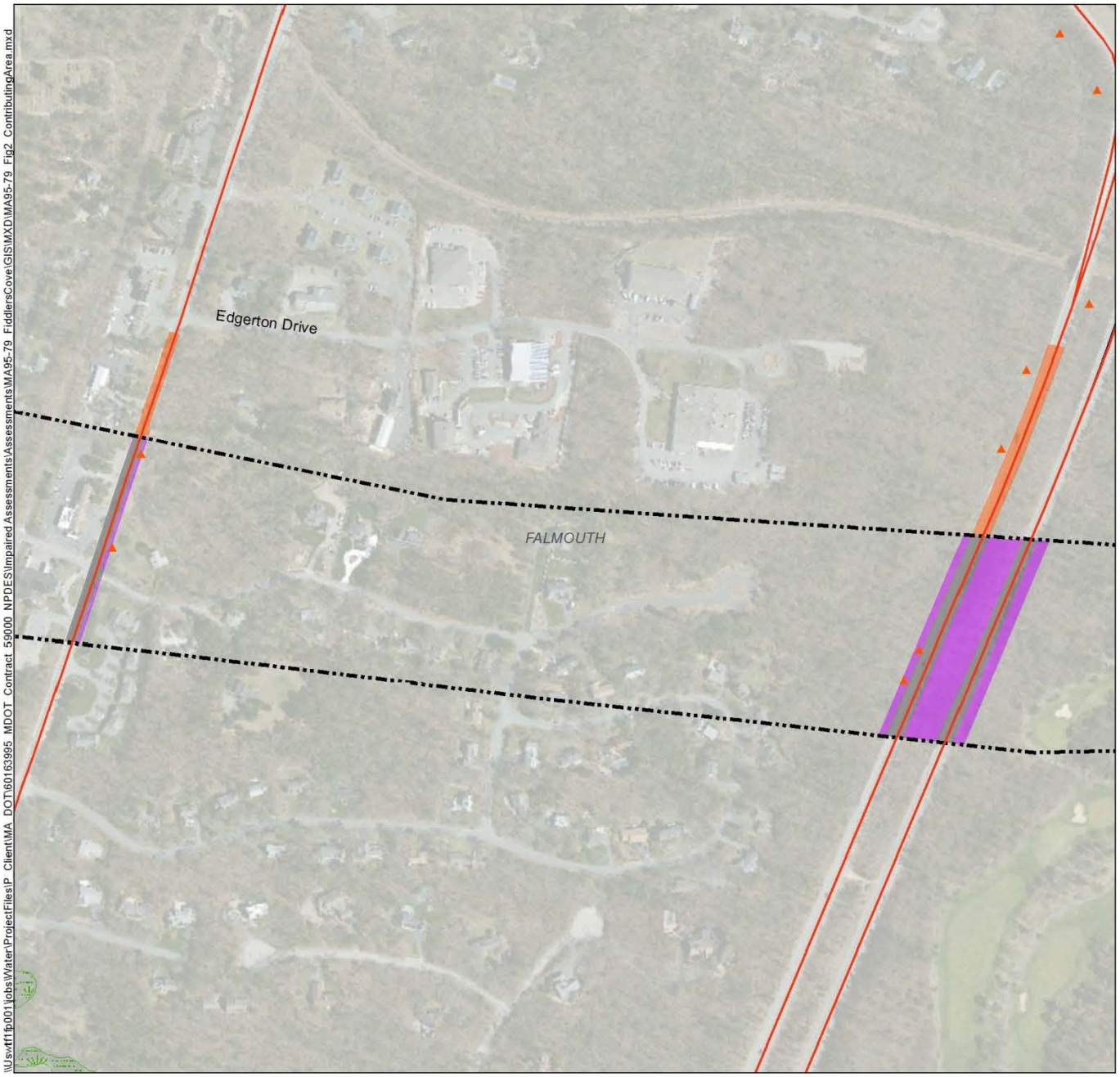

Figure 2

Fiddlers Cove (MA95-79)
MassDOT Contributing Area

December 2014

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12/08/2014

Impaired Waters Assessment for Oyster Pond (MA95927)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments; Dissolved Oxygen*
	Category:	*4A (TMDL is completed)*
	Final TMDLs:	*West Falmouth Harbor Embayment System Total Maximum Daily Loads for Total Nitrogen (EPA TMDL # 34284)*[2]
	WQ Assessment:	*None*
Location	Towns:	*Falmouth*
	MassDOT Roads:	*Route 28, Route 28A*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☐
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*46.8 lbs/yr*
	Existing Load to Water Body:	*1,159 lbs/yr*
	MassDOT Contribution to Existing Load	*4.06 %*

Site Description

Oyster Pond (MA95927) is a 0.01-square mile water body located west of Route 28A in Falmouth, Massachusetts. Figure 1 illustrates the groundwatershed for Oyster Pond (MA95927). The groundwatershed for this impaired segment is based on technical reports[3] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total

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

[2] Mass DEP. 2007. Final West Falmouth Harbor Embayment System Total Maximum Daily Loads for Total Nitrogen, Massachusetts (CN 243.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/falmouth.pdf

[3] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Oyster Pond, Falmouth, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/Oyster_Pond/OysterPond_FINAL_Report.pdf

Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. The Oyster Pond groundwatershed is located in Falmouth and includes residential areas, woods, wetlands, ponds and MassDOT roads (Routes 28 and 28A).

Oyster Pond receives inflows from tidal sources, wetlands, and MassDOT roadways. Nutrients from Oyster Pond are discharged during ebb tidal flow into Harbor Head (MA95-46), which ultimately discharges to Inner West Falmouth Harbor (MA95-22). Oyster Pond has not been included in a water quality assessment to date. During the development of the *West Falmouth Harbor Embayment System Total Maximum Daily Loads for Total Nitrogen*, it was determined that Oyster Pond was impaired for nutrients.[4] In addition, the MEP technical report[5] identifies the total nitrogen loading from the watershed for this water body, and identifies that estuarine degradation is a result of excess nitrogen loading to the groundwatershed.

Figure 2 illustrates the two MassDOT-owned roadways contributing runoff to the groundwatershed. Contributing MassDOT property to the groundwatershed includes approximately 1,000 feet of Route 28 southbound, 1,100 feet of Route 28 northbound, 400 feet of the southbound exit ramp to Brick Kiln Road and 500 feet of the northbound entrance ramp from Brick Kiln Road. Existing storm drain systems in this area collect and convey runoff to outfalls located within the groundwatershed along the shoulders and within the median. MassDOT-owned pervious area within the limits of the median, shoulders and additional property within the MassDOT-owned right-of-way also contribute runoff to the groundwatershed.

Oyster Pond also receives flows from stormwater outfalls located along Route 28A (West Falmouth Highway). An existing stormwater outfall located along the west curb at the end of Frazar Road discharges to Oyster Pond. This outfall collects runoff from approximately 800 feet of Route 28A between Katelyn Hills Drive and the culvert crossing discussed below. A second outfall is located approximately 250 feet north of the Frazar Road outfall. This outfall is the discharge location of an existing 24-inch reinforced concrete culvert. This culvert conveys flow from an existing drainage ditch through a wetland. This drainage ditch receives inflow from approximately 1,200 feet of Route 28A beyond the groundwatershed boundary and is considered "Supplemental DOT Contributing Area" (Figure 2). Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". The concrete culvert also receives flow from an existing drainage system that collects runoff from Seabreeze Lane to a point approximately 400 feet south of the location of the culvert crossing.

Based on field visit, runoff from approximately 270 feet of the eastbound travel lane and runoff from 200 feet of the westbound travel lane of Route 28 are collected in a storm drain system outside of the groundwatershed and flows back into the groundwatershed via an existing storm drain and is considered "Supplemental" (Figure 2).

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[4] Mass DEP. 2007. Final West Falmouth Harbor Embayment System Total Maximum Daily Loads for Total Nitrogen, Massachusetts (CN 243.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/falmouth.pdf

[5] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Oyster Pond, Falmouth, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/Oyster_Pond/OysterPond_FINAL_Report.pdf

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Oyster Pond (MA95927) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[8] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Oyster Pond is not proposed to change.

BMP 7R for Nitrogen TMDL (CN 243.0)

The *West Falmouth Harbor Embayment System Total Maximum Daily Loads for Total Nitrogen* (CN 243.0)[10] identifies the total existing groundwatershed nitrogen load for this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Oyster Pond (MA95927) to be linked to elevated nitrogen: estuarine bioassessments and dissolved oxygen. MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7R[6] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL, and MassDOT's application of BMP 7R to nitrogen in groundwater-controlled watersheds.[11]

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[12] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from

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[6] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

[10] Mass DEP. 2007. Final West Falmouth Harbor Embayment System Total Maximum Daily Loads for Total Nitrogen, Massachusetts (CN 243.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/falmouth.pdf

[11] MassDOT, December 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[12] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

pervious areas as 2.5 lbs/acre/yr.[13] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 3.6 acres
- MassDOT Pervious Area: 9.8 acres
- Estimated Existing MassDOT Load: 46.8 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 1,159 lbs/yr (from TMDL)
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 4.06%

No BMPs currently exist to treat stormwater from MassDOT's property directly discharging to this segment of Oyster Pond. Under existing conditions, MassDOT's estimated contributing annual nitrogen load exceeds the MassDOT existing load as a percentage of total groundwatershed nitrogen load threshold of 3.5%, and is therefore not negligible. Under existing conditions, MassDOT's estimated nitrogen load exceeds the TMDL target.

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

Proposed Mitigation Plan

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

Due to the heavily wooded areas that would require clear cutting for installation of BMPs along Route 28 and limited MassDOT property along Route 28A, it was determined that site limitations prevent the installation of BMPs within the groundwatershed.

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Oyster Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[14] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either

[13] MassDOT, December 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[14] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

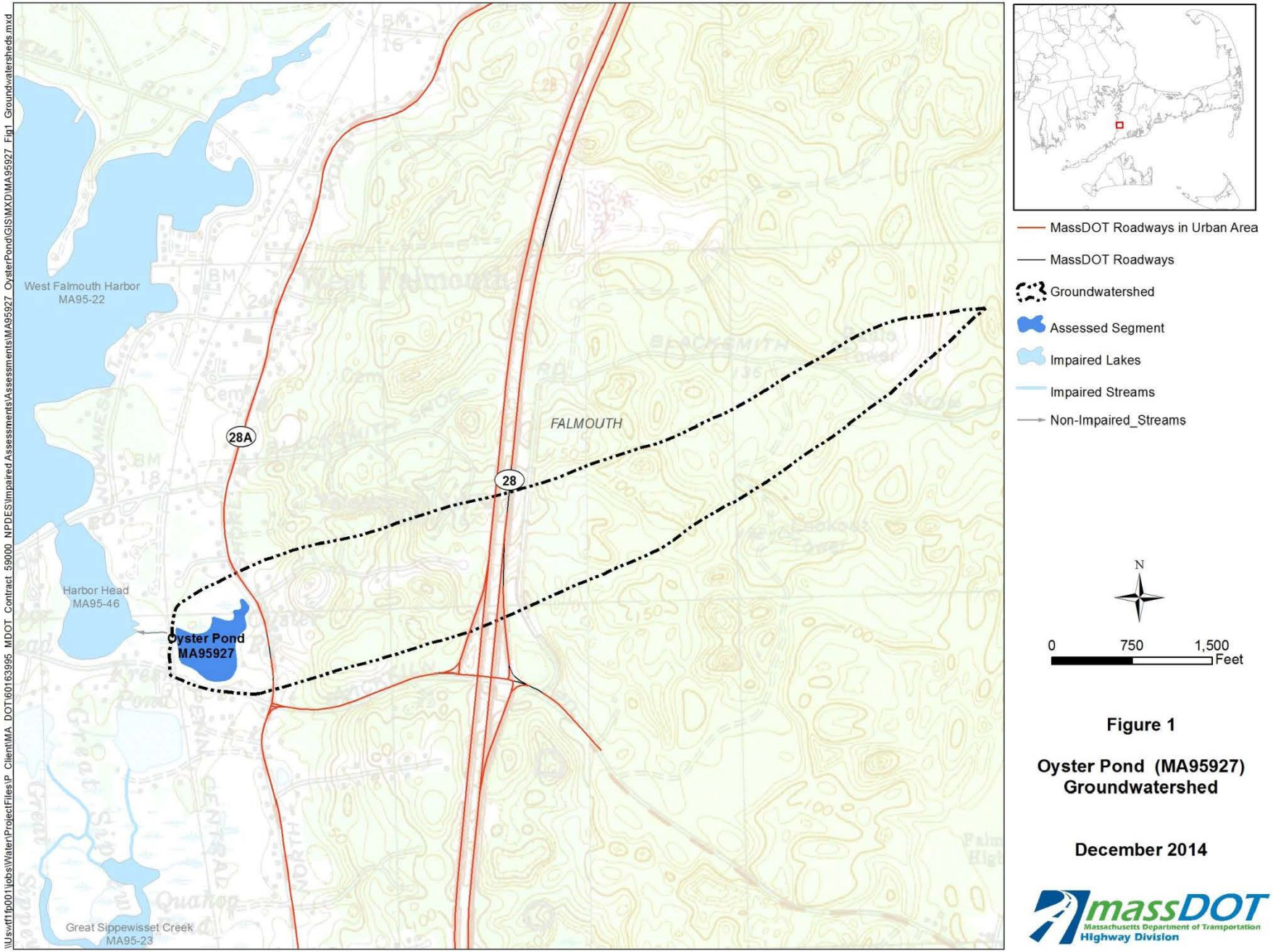

Figure 1

Oyster Pond (MA95927) Groundwatershed

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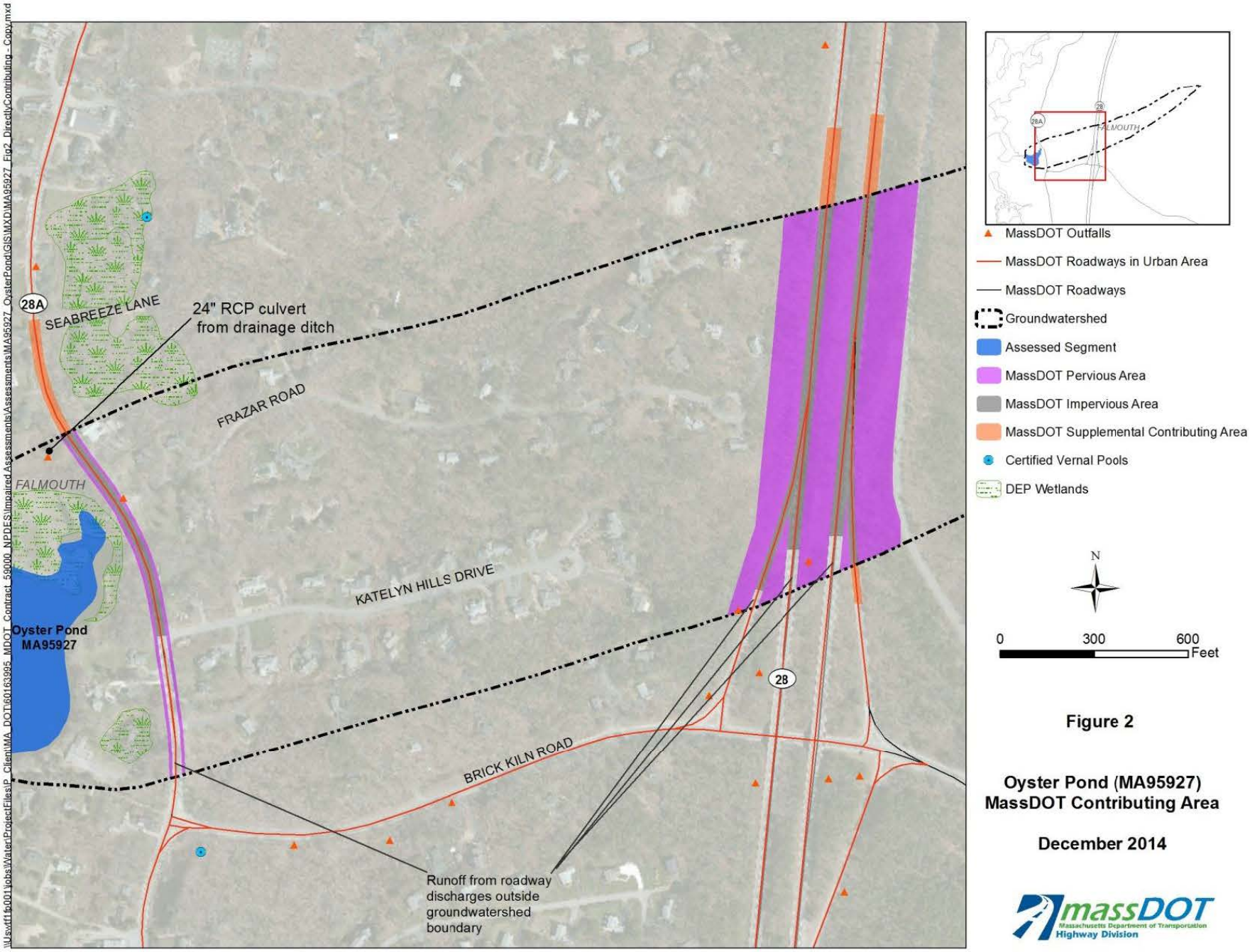

Figure 2

Oyster Pond (MA95927)
MassDOT Contributing Area

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Impaired Waters Assessment for Bass River (MA96-12)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments; Fecal Coliform*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the Cape Cod Watershed (CN 252.0)*[2]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location	Towns:	*Dennis and Yarmouth*
	MassDOT Roads:	*Route 28, Route 6, Route 134, Route 6A, West Yarmouth Road, Union Street, Station Avenue, Old Bass River Road and North Dennis Road*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*1,283 lbs/yr*
	Existing Load to Water Body:	*271,972 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.47 %*

Site Description

Bass River (MA96-12) extends from the Route 6 bridge on the Dennis/Yarmouth town line to its outlet at Nantucket Sound. Figure 1 illustrates the location of this water body and its

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

[2] MassDEP, 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

[3] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

groundwatershed. The groundwatershed for this impaired segment is based on technical reports[4] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the watershed area is considered in this assessment as contributing to Bass River (MA96-12).

MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[5] identifies the Aquatic Life Use as "impaired" for Bass River (MA96-12). The Shellfish Harvesting Use was identified as "impaired" because the entire segment is listed by Massachusetts Division of Marine Fisheries (DMF) as either "prohibited" or "conditionally approved" for harvesting. The "impaired" Aquatic Life Use is reported to be caused by loss of eelgrass habitat (estuarine bioassessment) from unknown sources. The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from marina/boating pump-out releases, waterfowl, waste from pets, septic systems, and discharges from municipal separate storm sewer systems. Primary and Secondary Contact Uses were identified as "support." The other uses were not assessed. In addition, the MEP technical report[4] identifies the total nitrogen loading from the watershed for this water body, and identifies that estuarine degradation is a result of excess nitrogen loading to the watershed.

Figures 2a through 2f illustrate the MassDOT-owned roadway within the groundwatershed that contributes runoff to the water body. Approximately 335.2 acres of MassDOT-owned urban roadway drains to the groundwatershed via overland flow, infiltration or catch basins and pipes; therefore, these sections of roadway are considered discharging to Bass River (MA96-12).

Figures 2a and 2b show the area where Route 28 contributes runoff to the Bass River (MA96-12) groundwatershed. Runoff is collected with localized catch basins or the flows discharge to pervious areas adjacent to the road, either by infiltration, catch basins or via pipe network to outfalls. Figure 2a shows the western section of Route 28 within the groundwatershed where outfalls discharge to the pervious areas adjacent to the roadway with the exception of the area east of Old Main Street in Yarmouth where outfalls discharge into Bass River. Figure 2b shows the area of Route 28 west of the assessed water body. The outfalls in this section drain to pervious areas adjacent to the road or to wetlands near the road. Four of these outfalls drain to wetlands near the roadway, the area drained by these outfalls comprises the majority of the contributing roadway west of Bass River.

Route 6 in the Bass River groundwatershed is a four-lane highway with a median which crosses the center of the Bass River watershed in an east-west direction. The majority of the Route 6 roadway is collected in local catch basin collection systems discharging along the pervious areas adjacent to the roadway. As shown in Figure 2c, the contributing portion of Route 6 starts on the west side of the groundwatershed in Yarmouth. The intersection between Union Street, Station Avenue, and Route 6, the associated on- and off-ramps, and a segment of North Dennis Road (Figure2d) are also included in the MassDOT contributing area. Route 6 extends eastward as shown in Figure 2d

[4] University of Massachusetts Dartmouth and MassDEP, 2011. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Bass River Embayment System, Towns of Yarmouth and Dennis, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/BassRiver/BassRiver_MEP_FINAL13MB.pdf

[5] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

and exits the groundwatershed in Figure 2e east of Bass River and east of Route 134. As shown in figure 2b, Route 134, all associated on- and off-ramps, and a small section of Old Bass River Road that overlaps with the Route 6 property are included as MassDOT contributing areas. On Figure2c, a portion of Route 6 is located outside of the groundwatershed and is considered "Supplemental Contributing Area". Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental".

Figure 2f shows where Route 6A traverses through the northwest portion of the groundwatershed. A portion of impervious roadway (approximately 240 linear feet) from the western boundary of the Bass River watershed drains into the adjacent groundwatershed. The remainder of the roadway in the groundwatershed is collected by catch basins or travels by sheet flow to pervious areas adjacent to the road. Figure 2f shows approximately 1,500 linear feet of roadway, located outside the groundwatershed boundary, where runoff enters a drainage system that discharges within the boundary of the Bass River groundwatershed. This section of roadway is also considered "Supplemental Contributing Area".

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Bass River (MA96-12) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[8] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Bass River (MA96-12) is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[6] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been

[6] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[10] The MEP technical report[11] identifies the total existing groundwatershed nitrogen load for the water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Bass River (MA96-12) to be linked to elevated nitrogen: estuarine bioassessments.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[12] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[13] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 120.3 acres
- MassDOT Pervious Area: 214.9 acres
- Estimated Existing MassDOT Load: 1,283 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 271,972 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.47%

The MassDOT existing load compared to the total watershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[13] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). Bass River (MA96-12) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[14]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit

[10] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[11] University of Massachusetts Dartmouth and MassDEP, 2011. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Bass River Embayment System, Towns of Yarmouth and Dennis, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/BassRiver/BassRiver_MEP_FINAL13MB.pdf

[12] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[13] MassDOT, 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[14] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[15]

According to the Final TMDL, sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and best management practices to mitigate stormwater runoff volume.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Bass River (MA96-12) is listed as a medium priority based on dry weather event sampling and a high priority based on wet weather event sampling. Both designations also consider the resource value associated with Bass River being a Class SA water, as well as its uses for public swimming and shellfishing. [16]

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report[16] (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls

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

[16] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters
- Repair illicit discharge outlets
- Annual street sweeping and priority catch basin cleaning

Proposed Mitigation Plan

As described above, MassDOT’s nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

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

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

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

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

MassDOT has concluded that the BMPs outlined in the SWMP are consistent with its existing permit requirements for Bass River. These measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit. As stated previously, pathogen loadings are highly variable and although there

is potential for stormwater runoff from MassDOT roadways to be a contributing source it is unlikely to warrant action relative to other sources of pathogens in the watershed.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Bass River, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[17] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reduction

[17] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

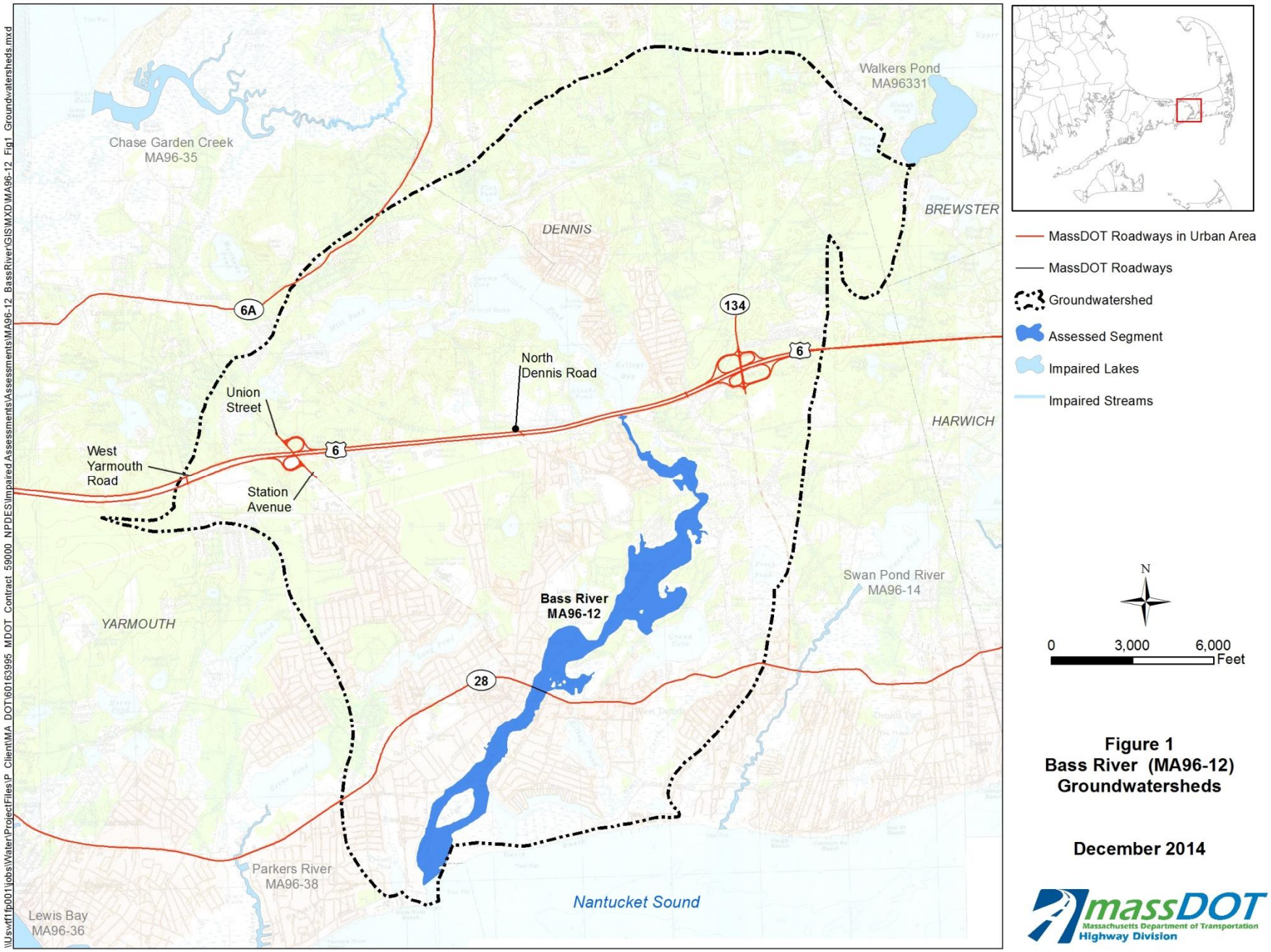


Figure 1
Bass River (MA96-12)
Groundwatersheds

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

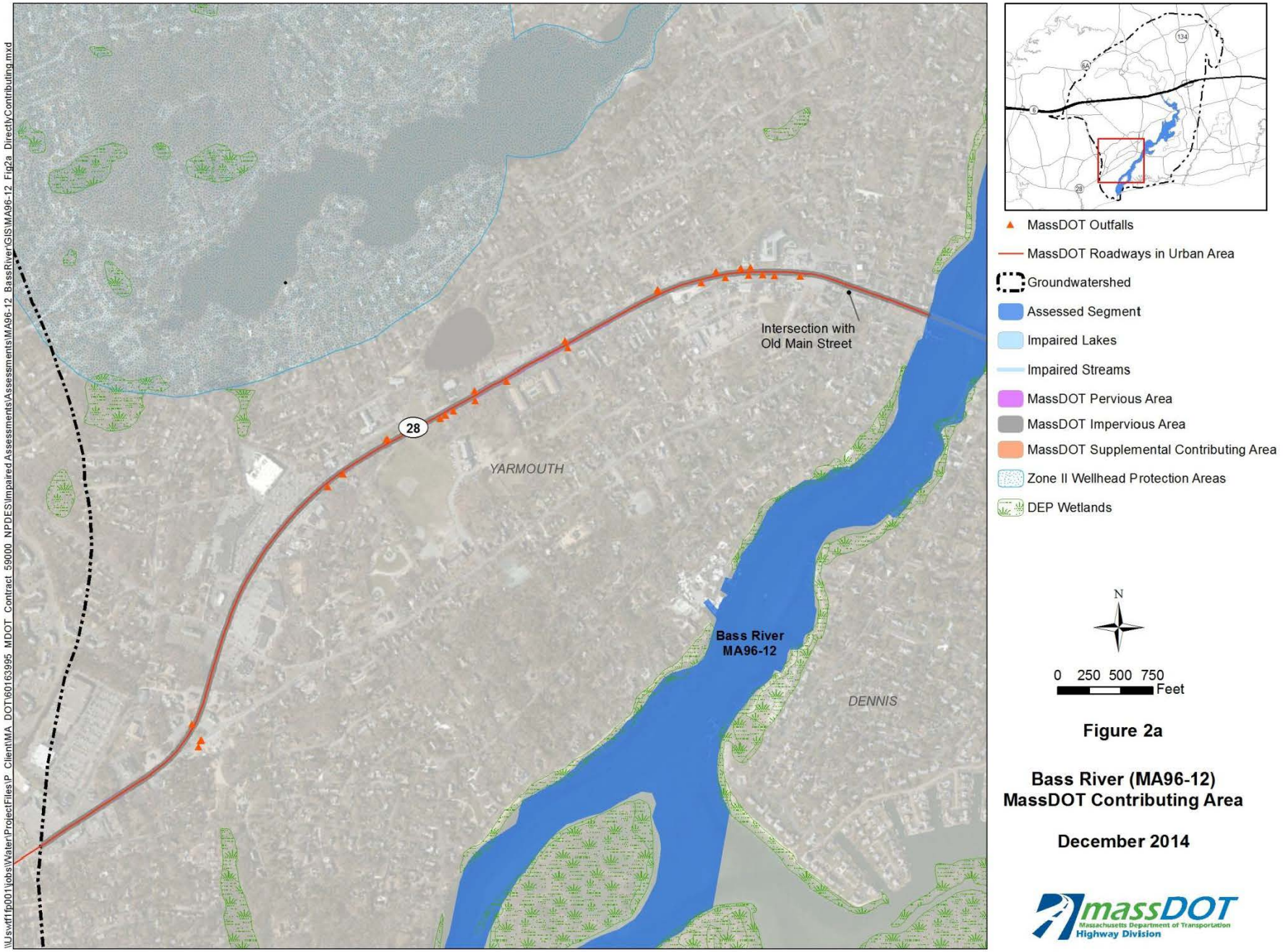
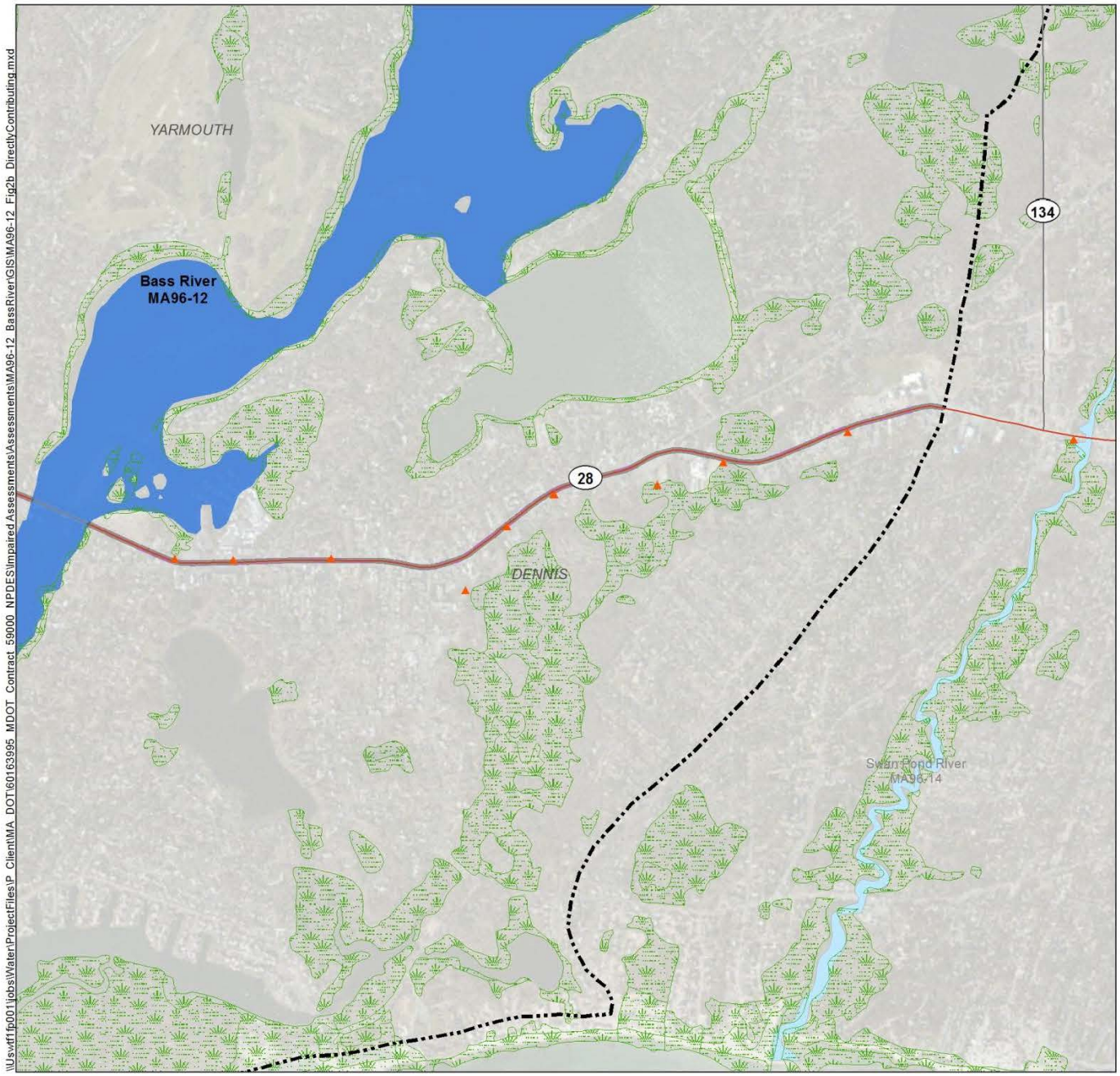
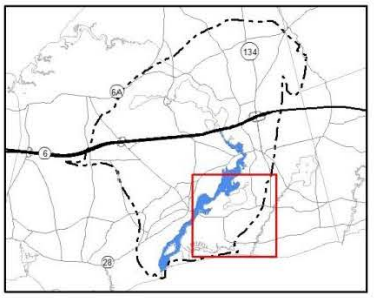


Figure 2a

Bass River (MA96-12)
MassDOT Contributing Area

December 2014





MassDOT Outfalls

MassDOT Roadways in Urban Area

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

MassDOT Pervious Area

MassDOT Impervious Area

MassDOT Supplemental Contributing Area

DEP Wetlands

N

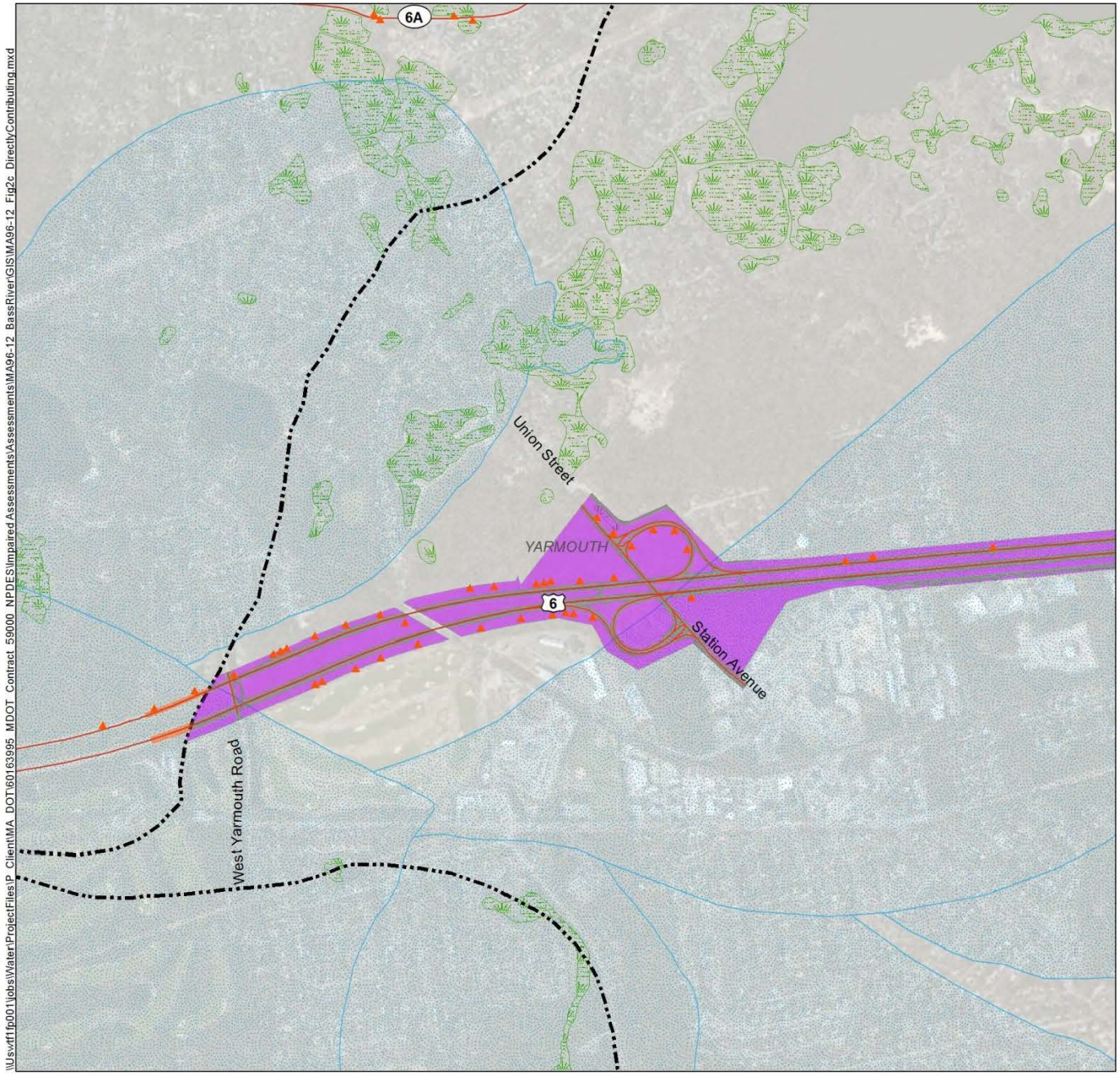
0 500 1,000 1,500 Feet

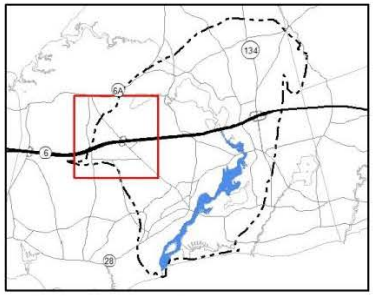
Figure 2b

Bass River (MA96-12)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- MassDOT Pervious Area
- MassDOT Impervious Area
- MassDOT Supplemental Contributing Area
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

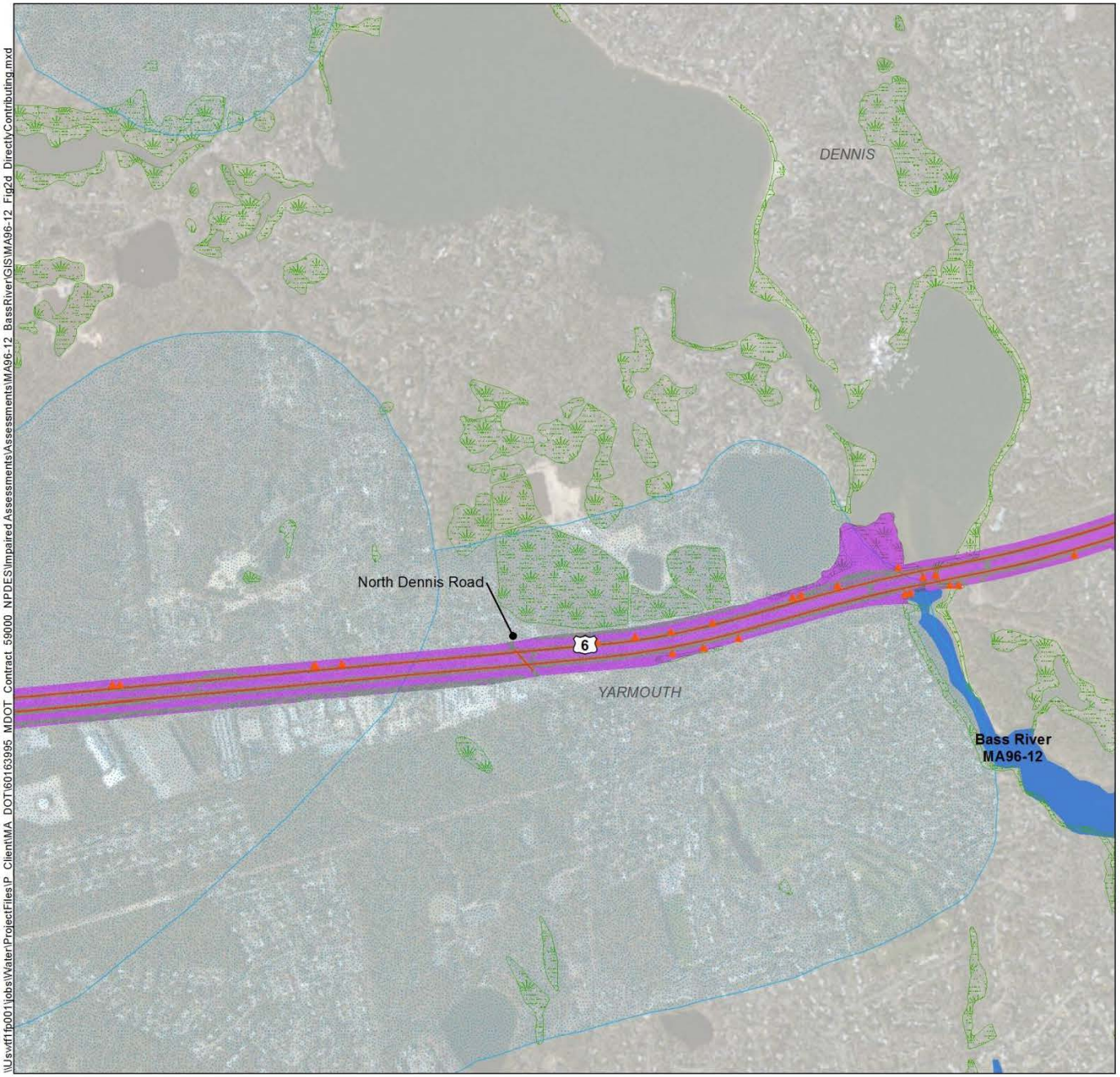
0 500 1,000 1,500 Feet

Figure 2c

Bass River (MA96-12)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division



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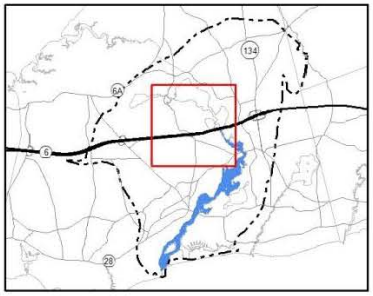


- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- MassDOT Pervious Area
- MassDOT Impervious Area
- MassDOT Supplemental Contributing Area
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

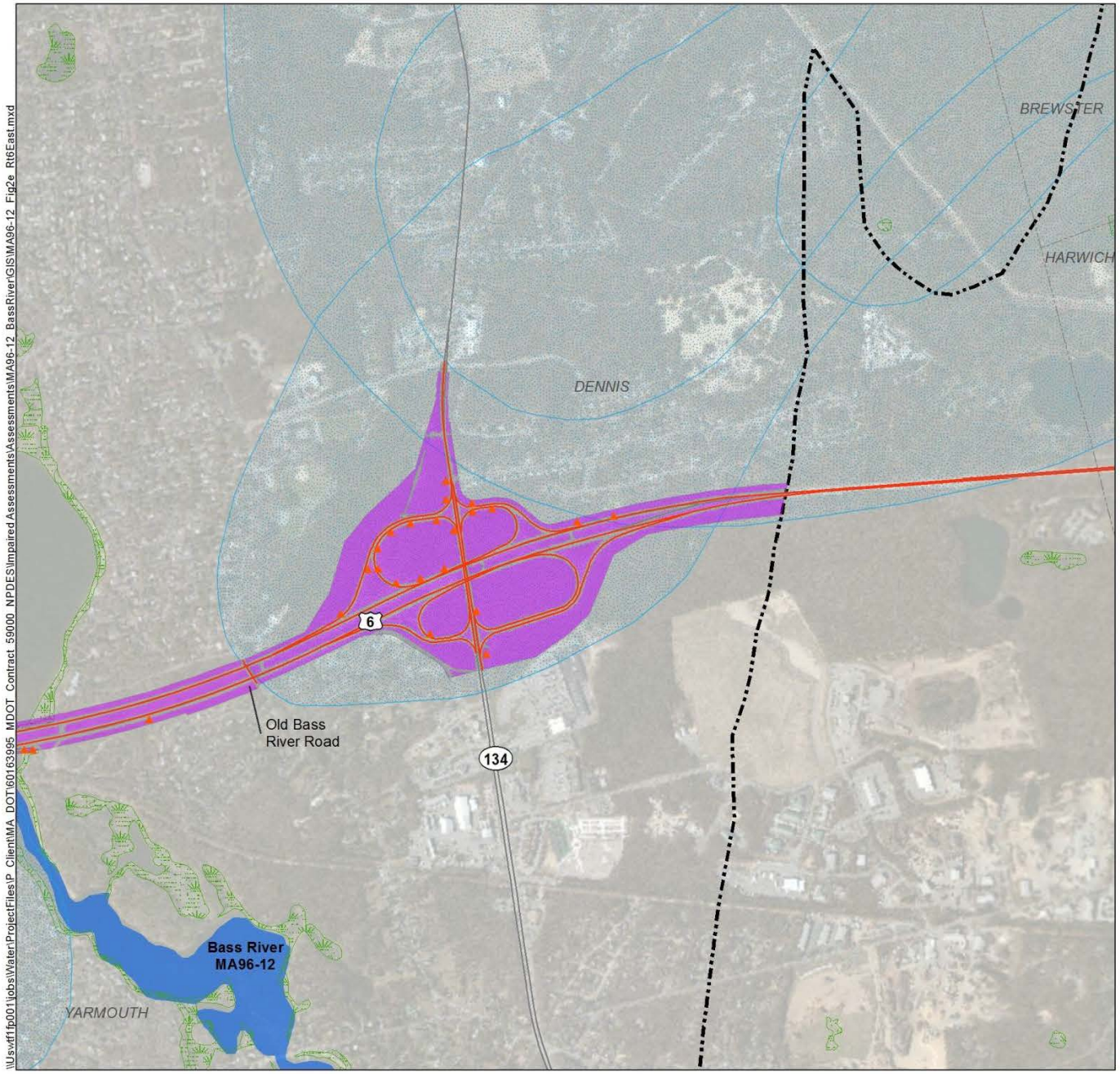
0 500 1,000 1,500 Feet

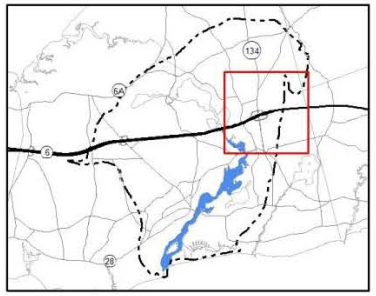
Figure 2d

Bass River (MA96-12)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- MassDOT Pervious Area
- MassDOT Impervious Area
- MassDOT Supplemental Contributing Area
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

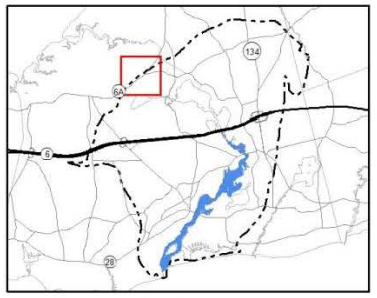
0 500 1,000 1,500 Feet

Figure 2e

Bass River (MA96-12)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division



MassDOT Outfalls

MassDOT Roadways in Urban Area

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

MassDOT Pervious Area

MassDOT Impervious Area

MassDOT Supplemental Contributing Area

Zone II Wellhead Protection Areas

DEP Wetlands

N

0 250 500 Feet

Figure 2f

Bass River (MA96-12)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Swan Pond River (MA96-14)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments; Fecal Coliform*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the Cape Cod Watershed*[2]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location	Towns:	*Dennis*
	MassDOT Roads:	*Route 6 and Route 28*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*39.5 lbs/yr*
	Existing Load to Water Body:	*33,262 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.12 %*

Site Description

Swan Pond River (MA96-14) is a water body in Dennis, Massachusetts that covers approximately 0.04 square miles. The water body extends from its source at the outlet to Swan Pond and flows southwest to Nantucket Sound. Figure 1 illustrates the groundwatershed for Swan Pond River (MA96-14).

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

[2] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

[3] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

The groundwatershed for this impaired segment is based on technical reports[4] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Swan Pond River (MA96-14).

Land use in the Swan Pond River groundwatershed is primarily high density residential in the vicinity of the coast, commercial in the vicinity of Route 28, wetlands in the vicinity of Swan Pond River, and medium density residential and forest north of Route 28. The Town of Dennis has a NPDES permit to discharge to Swan Pond River (MAR041103).[5]

MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[5] identifies the Aquatic Life Use and Shellfishing Harvesting Use as "impaired" for Swan Pond River (MA96-14). The other uses, including Fish Consumption, Primary and Secondary Contact Recreational, and Aesthetics, were "not assessed". The Aquatic Life Use is reported to be caused by loss of eelgrass habitat (estuarine bioassessment) and the source is unknown. The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from waterfowl, waste from pets, on-site septic system discharges and discharges from municipal separate storm sewer systems. The Massachusetts Division of Marine Fisheries (DMF) indicates that all of Segment MA96-14 is "conditionally approved" for shellfishing. The MEP technical report[4] identifies the total nitrogen loading from the groundwatershed for this water body, and identifies that estuarine degradation is a result of excess nitrogen loading to the groundwatershed.

Figures 2a and 2b illustrate the MassDOT-owned roads within the groundwatershed that contribute runoff to the water body. Route 6 traverses the groundwatershed boundary north of Swan Pond River and Route 28 crosses over Swan Pond River in the southern portion of the groundwatershed.

The portion of Route 6 located within the groundwatershed drains via overland flow and infiltration, or catchbasins and pipes; therefore, this section of roadway is considered discharging to Swan Pond River (MA96-14). Catchbasins along Route 6 drain locally; there is no trunk line and no curbing along this roadway.

The section of Route 28 located within the groundwatershed also discharges to Swan Pond River (MA96-14). Route 28 drains to the groundwatershed via overland flow and infiltration or catchbasins and pipes. The outfalls are either small, localized systems with one or two catchbasins or an outfall with a curb cut. The shoulder in this portion of roadway is wide and paved.

Existing BMPs

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

[4] University of Massachusetts Dartmouth and MassDEP, 2012. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Swan Pond River Embayment System, Town of Dennis, Massachusetts. Unpublished Report

[5] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Swan Pond River (MA96-14) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[8] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Swan Pond River is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[7] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[10] The MEP technical report[11] identifies the total existing groundwatershed nitrogen load for this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Swan Pond River (MA96-14) to be linked to elevated nitrogen: estuarine bioassessments.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[12] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[10] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 5.2 acres
- MassDOT Pervious Area: 2.9 acres

[6] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

[10] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[11] University of Massachusetts Dartmouth and MassDEP, 2012. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Swan Pond River Embayment System, Town of Dennis, Massachusetts.

[12] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

- Estimated Existing MassDOT Load: 39.5 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 33,262 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.12%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[13] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). Swan Pond River (MA96-14) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[14]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[15]

According to the Final TMDL, sources of indicator bacteria in the Cape Cod Watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and BMPs to mitigate stormwater runoff volume.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod Watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters (ORWs) or designated uses that require higher water quality standards than Class B. Swan Pond River (MA96-14) is listed as a medium priority due to its designation as a Class SA, as well as its uses for shellfishing.[14]

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report[14] (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

[13] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[14] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

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

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catchbasin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters
- Street sweeping and catchbasin cleaning

Proposed Mitigation Plan

As described above, MassDOT’s nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT’s BMP 7R Pathogen Methodology,[16] MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Pathogen TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the groundwatershed of this water body. MassDOT will be installing signs at rest stops within the groundwatershed of impaired water bodies. The signs will inform the public of the need to remove pet waste, which can minimize

[16] MassDOT. December 2014. Description of MassDOT’s Application of BMP 7R for Pathogen Related Impairments.

contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

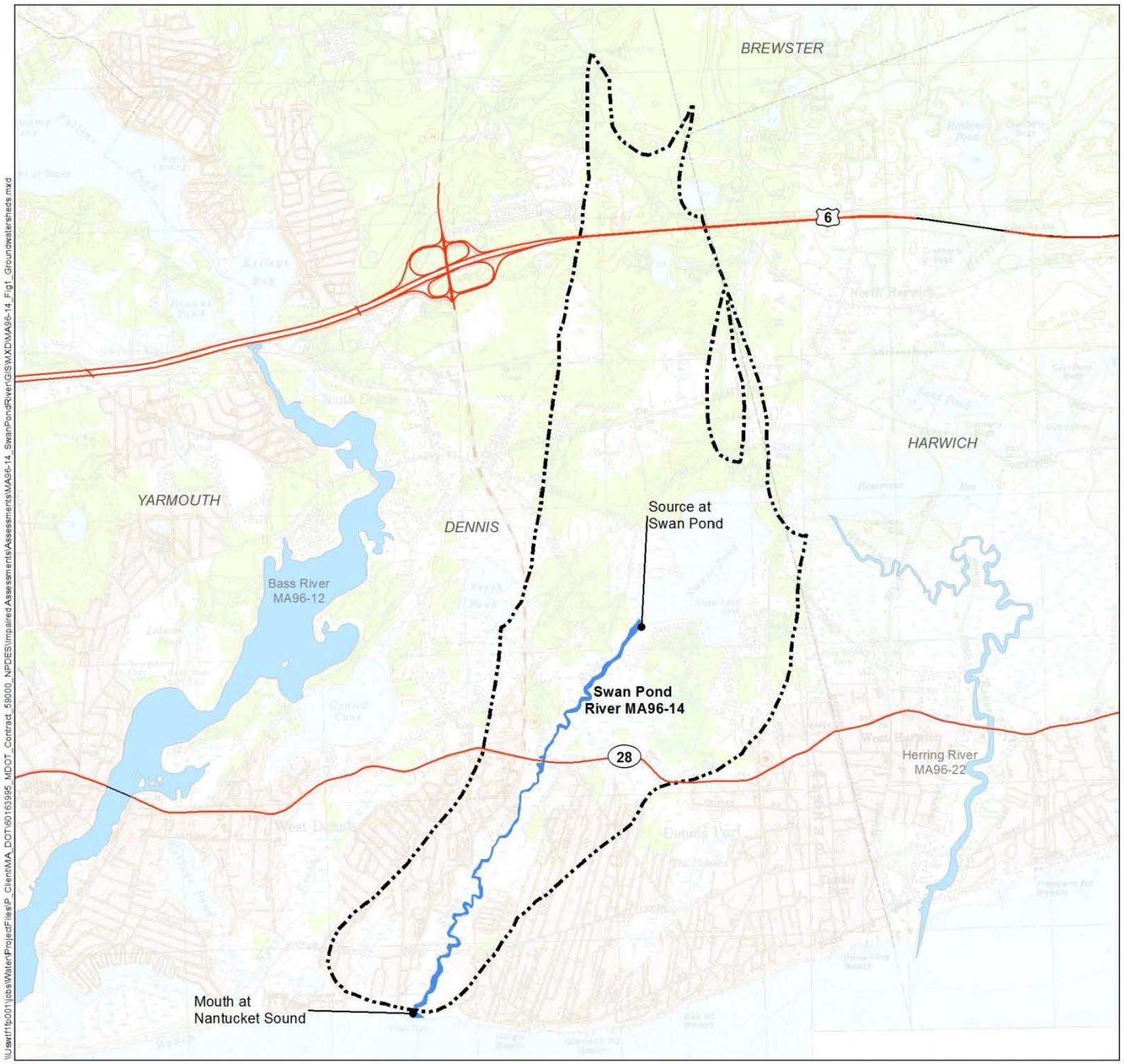
Although the TMDL report also identifies the benefits of structural BMPs to address pathogens in runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these BMPs in advance of other ongoing BMP efforts identified in the groundwatershed, given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

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Swan Pond River, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[17] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[17] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf



MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

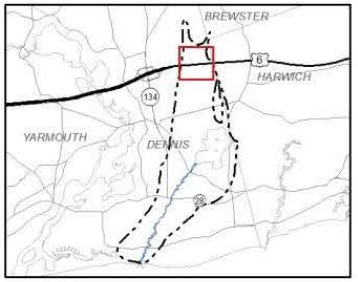
N

0 2,000 4,000 Feet

Figure 1
Swan Pond River (MA96-14)
Groundwatershed

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- MassDOT Impervious Area
- MassDOT Pervious Area
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

0 300 600 Feet

Figure 2a

Swan Pond River (MA96-14)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

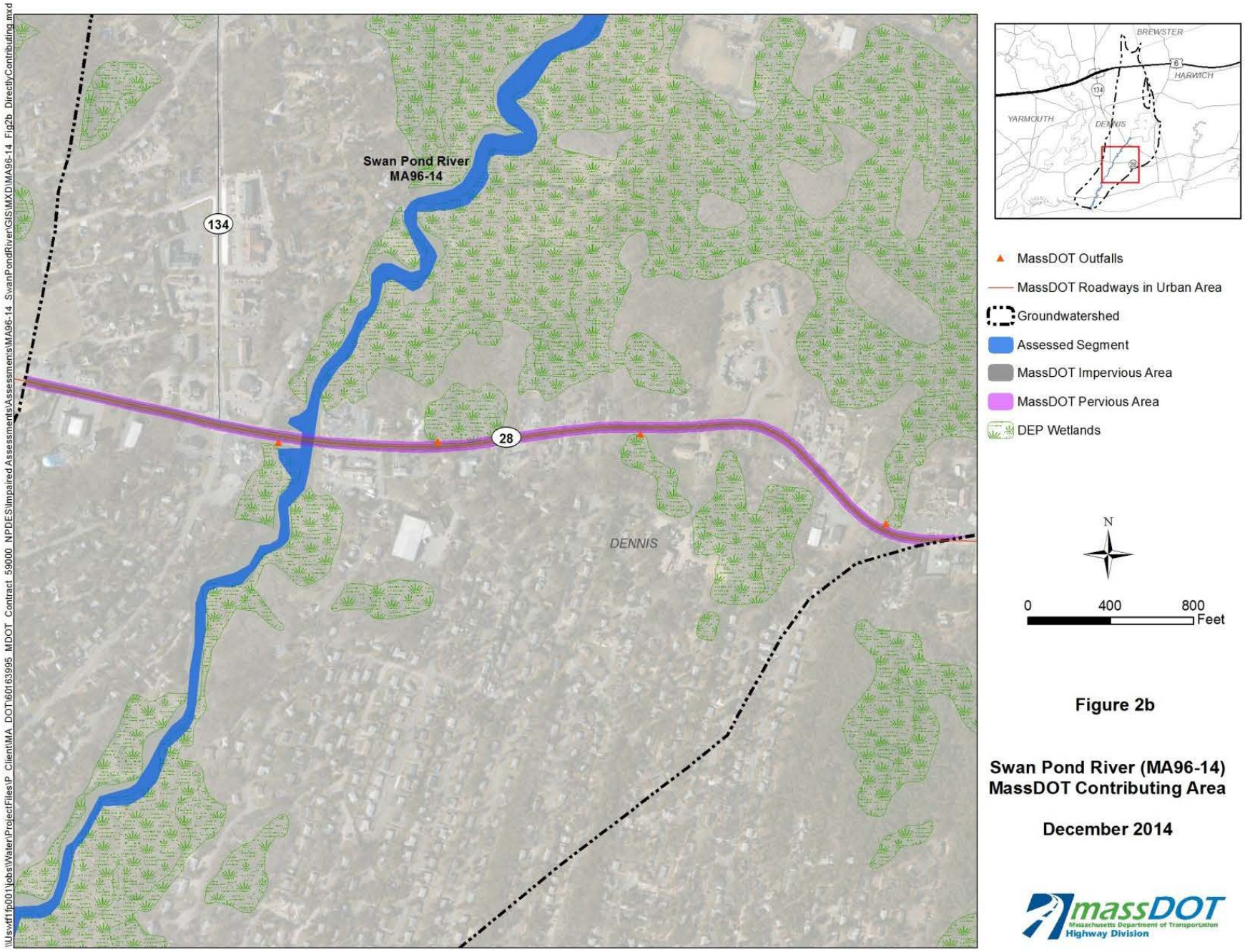


Figure 2b

Swan Pond River (MA96-14)
MassDOT Contributing Area

December 2014

Impaired Waters Assessment for Quashnet River (MA96-20)

Summary

Impaired Water[1]	Stormwater Impairments:	*Total Nitrogen, Dissolved Oxygen, and Fecal Coliform*
	Category:	*4A (TMDL is completed)*
	Final TMDLs:	*Final Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen* [2]
		Final Pathogen TMDL for the Cape Cod Watershed [3]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004-2008 Surface Water Quality Assessment Report*[4]
Location	Towns:	*Falmouth*
	MassDOT Roads:	*Route 28*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☐
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*30.5 lbs/yr*
	Existing Load to Water body:	*36,750 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.08 %*

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

2 Mass DEP. 2007. Final Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen, Massachusetts (CN 218.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/quastmdl.pdf

3 MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

4 MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Site Description

Quashnet River (MA96-20) is a 0.07-square mile water body located south of Route 28 and north of Waquoit Bay (MA96-21) in Falmouth, Massachusetts. Figure 1 illustrates the groundwatershed for Quashnet River (MA96-20). The groundwatershed for this impaired segment is based on technical reports[5] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. The Quashnet River groundwatershed is located in Falmouth and Masphee and includes residential areas, woods, wetlands, ponds and MassDOT-owned roads (Route 28).

The Quashnet River receives inflows from John's Pond (MA96157) and Acushnet Pond (MA96157) and non-impaired tributaries, surface runoff and groundwater flow. Quashnet River discharges to Waquoit Bay. MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[6] identified the Aquatic Life Use as "impaired" due to total nitrogen and low dissolved oxygen. The report identified the Shellfish Harvesting Use as "support" for 0.002 square miles, as it is "approved" for shellfish harvesting. This use was also assessed as "impaired" for 0.068 square miles as shellfish harvesting is "prohibited", likely due to elevated fecal coliform bacteria counts associated with waterfowl and/or stormwater discharges from the municipal stormwater systems. Two private Wastewater Treatment Facilities (WWTF) with individual subsurface disposal systems, are located in the upper groundwatershed of the Quashnet River: Southport and Mashpee High School. Both are reportedly providing nitrogen removal from the wastewater streams.

Quashnet River receives discharges within the groundwatershed. Figure 2 illustrates the MassDOT contributing area to the groundwatershed. Contributing MassDOT-owned property to the groundwatershed along Route 28 includes approximately 2,600 feet of impervious area from Collins Road to the Mashpee town line located approximately 200 feet to the north of Cash's trail as shown on Figure 2. Multiple outfalls are located along this stretch and discharge along the shoulder within the limits of the groundwatershed as shown on Figure 2. MassDOT contributing area along this stretch also includes the pervious area located along the shoulders of the road within the limits of the state highway layout.

Based on a field visit, approximately 430 feet of the total contributing area on Route 28 in the vicinity of Collins Road and the western boundary of the groundwatershed flows into the groundwatershed via gutter flow and is considered "Supplemental DOT Contributing Area" (Figure 2). Any impervious area located outside the groundwatershed boundary that flows into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental".

[5] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Quashnet River, Hamblin Pond, and Jehu Pond, in the Waquoit Bay System of the Towns of Mashpee and Falmouth, MA. Available at: http://www.oceanscience.net/estuaries/Quashnet.htm

[6] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[7] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[8] MassDOT assessed Quashnet River (MA96-20) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act[9]. MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[10] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Quashnet River (MA96-20) is not proposed to change.

BMP 7R for Nitrogen TMDL (CN 218.0)

The *Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen* (CN 218.0)[11] identifies the total existing groundwatershed nitrogen load for this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Quashnet River (MA96-20) to be linked to excess nitrogen: total nitrogen and dissolved oxygen. MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7R[7] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL, and MassDOT's application of BMP 7R to nitrogen in groundwater-controlled watersheds.[12]

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[13] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using

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

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

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

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

[11] Mass DEP. 2007. Final Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen, Massachusetts (CN 218.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/quastmdl.pdf

[12] MassDOT, March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf.

[13] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. [14] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 3.8 acres
- MassDOT Pervious Area: 2.8 acres
- Estimated Existing MassDOT Load: 30.5 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 36,750 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.08%

The MassDOT existing load compared to the total watershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[14] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP).[15] Quashnet River (MA96-20) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[16]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[17]

According to the Final TMDL, sources of indicator bacteria in the Cape Cod Watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and best management practices to mitigate stormwater runoff volume.

[14] MassDOT, March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[15] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[16] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

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

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Quashnet River (MA96-20) is listed as a medium priority due to its designation as Class SA, as well as its use for shellfishing.[18]

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report[18] (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters
- Street sweeping and catch basin cleaning

Proposed Mitigation Plan

As described above, MassDOT’s nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed

[18] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

in MassDOT's BMP 7R Pathogen Methodology, MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

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

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

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

Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Quashnet River, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[19] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout

[19] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

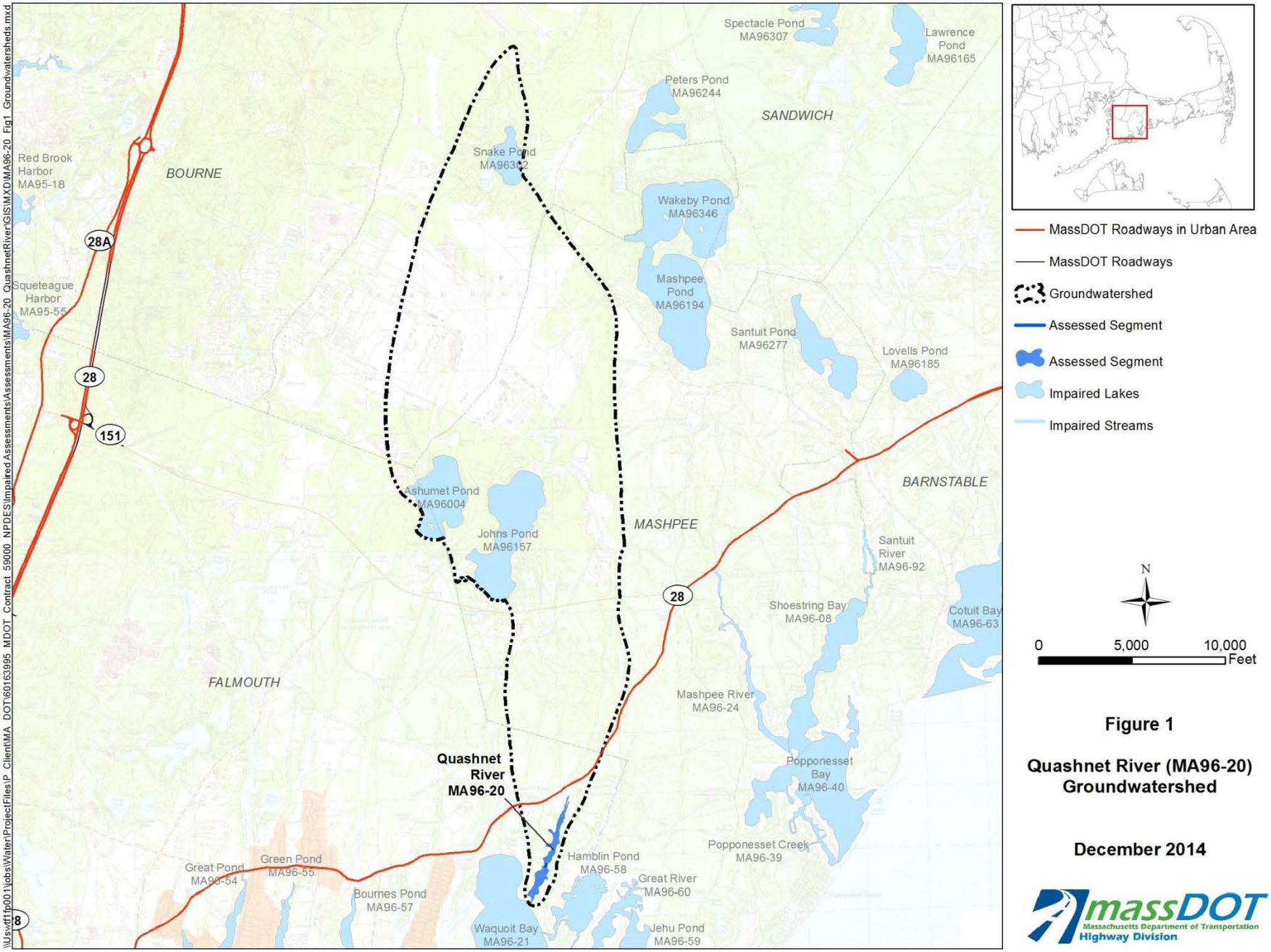
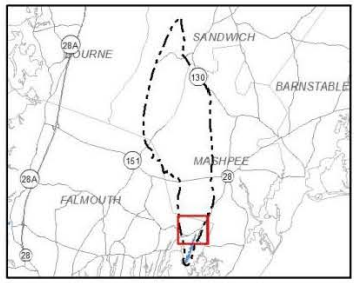


Figure 1

Quashnet River (MA96-20) Groundwatershed

December 2014



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- MassDOT Pervious Area
- MassDOT Impervious Area
- MassDOT Supplemental Contributing Area
- Zone II Wellhead Protection Areas
- DEP Wetlands
- Non-Impaired Streams

N

0 500 1,000 Feet

Figure 2

Quashnet River (MA96-20)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

massDOT Massachusetts Department of Transportation Highway Division

12/08/2014

Impaired Waters Assessment for Waquoit Bay (MA96-21)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments; Dissolved Oxygen*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*None*
	WQ Assessment:	*Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report*[2]
Location	Towns:	Falmouth, Mashpee
	MassDOT Roads:	*Route 28*
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*73.4 lbs/yr*
	Existing Load to Water Body:	*109,803 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.07 %*

Site Description

Waquoit Bay (MA96-21) is a 1.4-square mile water body which extends from the mouths of the Seapit River (non-impaired), Quashnet River (MA96-20) and Great River (MA96-60) to the confluence with Vineyard Sound (non-impaired) in Falmouth/Mashpee, Massachusetts. Figure 1 illustrates the groundwatershed for Waquoit Bay (MA96-21). The groundwatershed for this

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

[2] MassDEP, 2011. Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

impaired segment is based on technical reports[3] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of TMDLs. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Waquoit Bay (MA96-21).

Several upstream water bodies are within the Waquoit Bay groundwatershed including Great River (MA96-60), Jehu Pond (MA96-59), Hamblin Pond (MA96-58), Quashnet River (MA96-20), Ashumet Pond (MA96004), Johns Pond (MA96157) and Snake Pond (MA96302). MassDOT has assessed these water bodies in separate assessments as part of the Impaired Waters Program. The Waquoit Bay groundwatershed is comprised of residential land uses, wetlands and water resources, and forest. There are several water bodies within the groundwatershed near Route 28 that are designated as Areas of Critical Environmental Concern (ACEC) associated with Waquoit Bay (Figure 2A, 2B and 2C).

MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report*[4] identifies the Aquatic Life Use as "impaired" based on a loss of eelgrass bed habitat. The source is stated to be subsurface wastewater disposal (septic) systems, stormwater runoff (unspecified urban stormwater and discharges from municipal separate storm sewer systems) and fertilizers (yard maintenance, agriculture and golf courses). Shellfish Harvesting, Primary Contact and Secondary Contact Uses are designated as "support". Fish Consumption and Aesthetics Uses were "not assessed". In addition, the MEP report[5] states that the primary ecological threat to the estuarine resources of Waquoit Bay and its subembayments is degradation resulting from nitrogen enrichment stemming from the nitrogen loading to the groundwatershed.

Figure 2A through 2C illustrates the MassDOT-owned road that contributes runoff to the groundwatershed. Route 28 traverses the groundwatershed north of Waquoit Bay. Approximately 9.3 acres of roadway within the limits of the groundwatershed drains via overland flow, infiltration or catch basins and pipes; therefore, the section of roadway is considered contributing to Waquoit Bay (MA96-21). The roadway runoff that is directed to the shoulders of roadways and other pervious areas within the MassDOT right-of-way are also considered contributing area to the water body as the runoff infiltrates into the groundwatershed. The pervious area shown on Figures 2A to 2C is approximately 4.6 acres.

Based on a filed visit, an additional 0.73 acres of impervious area on Route 28 extending beyond the boundary of the groundwatershed to the east and the west but drains to the groundwatershed catchbasins and pipes is considered "Supplemental Contributing Area". Any impervious area

[3] University of Massachusetts Dartmouth and MassDEP, 2013. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Waquoit Bay and Eel Pond Embayment System Towns of Falmouth and Mashpee, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/Waquoit/Waquoit_MEP_FINAL-12MB.pdf

[4] MassDEP, 2011. Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

[5] University of Massachusetts Dartmouth and MassDEP, 2013. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Waquoit Bay and Eel Pond Embayment System Towns of Falmouth and Mashpee, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/Waquoit/Waquoit_MEP_FINAL-12MB.pdf

located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". These portions of roadway are shown in Figure 2A and 2C.

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Waquoit Bay (MA96-21) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[8] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Waquoit Bay is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[7] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to impairments related to elevated nitrogen in groundwater-controlled watersheds.[10] The MEP technical report[11] identifies the total existing groundwatershed nitrogen load for this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to Waquoit Bay (MA96-21) to be linked to excess nitrogen: estuarine Bioassessments and dissolved oxygen.

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[6] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

[10] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[11] University of Massachusetts Dartmouth and MassDEP, 2013. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Waquoit Bay and Eel Pond Embayment System Towns of Falmouth and Mashpee, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/Waquoit/Waquoit_MEP_FINAL-12MB.pdf

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[12] to estimate annual pollutant loads from its property and treatment through existing BMPs, if present. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[13] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 10.0 acres
- MassDOT Pervious Area: 4.6 acres
- Estimated Existing MassDOT Load: 73.4 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 109,803 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.07%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen Non-TMDL Groundwater Method because it is less than 3.5% of the total nitrogen groundwatershed load.[13] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs as part of the Retrofit Program because of their minimal impact on the overall groundwatershed load.

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Waquoit Bay, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[14] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[12] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[13] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[14] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

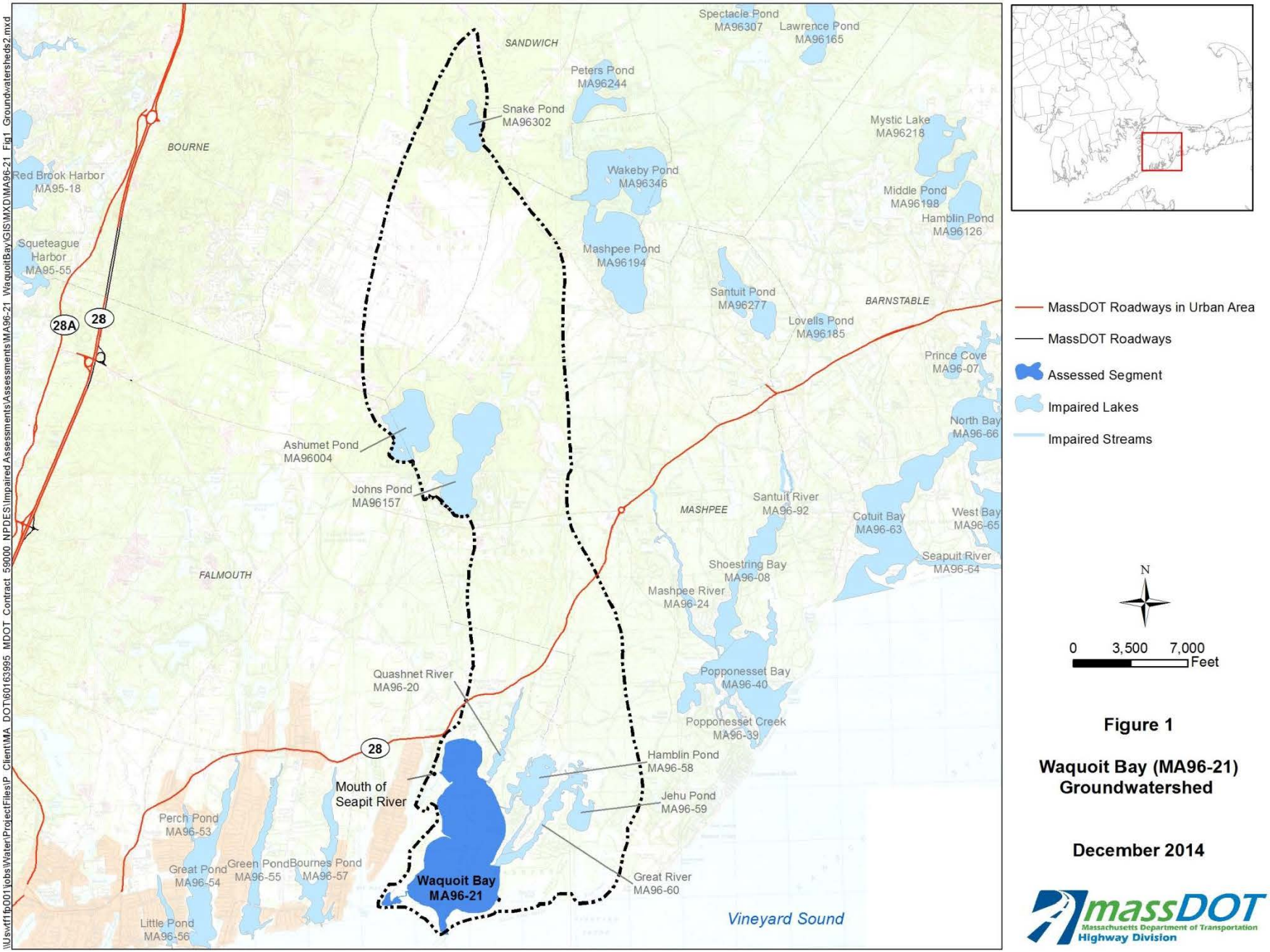
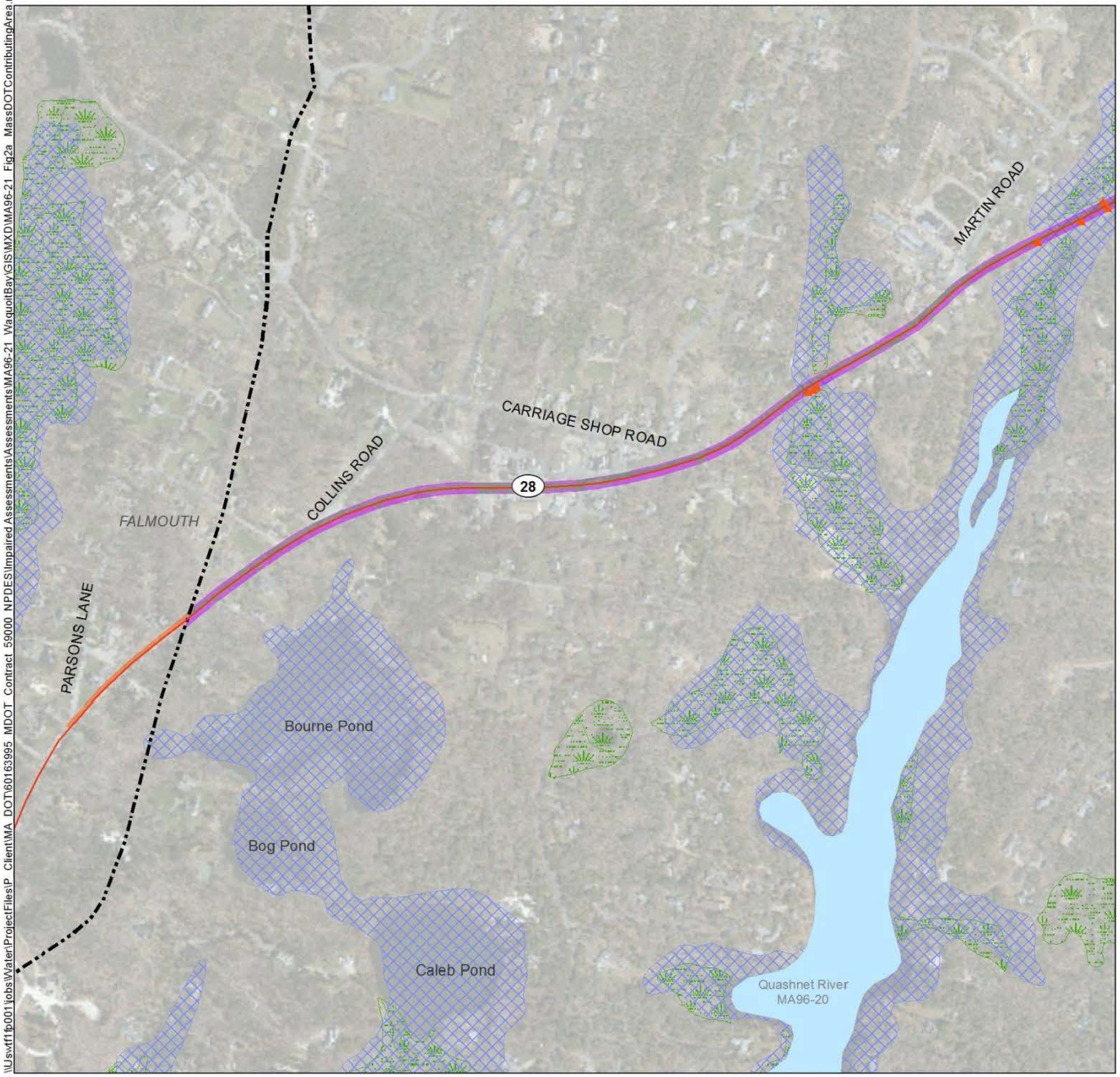


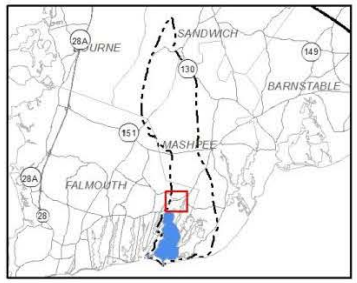
Figure 1

Waquoit Bay (MA96-21) Groundwatershed

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- MassDOT Impervious Area
- MassDOT Pervious Area
- MassDOT Supplemental Contributing Area
- Certified Vernal Pools
- Areas of Critical Environmental Concern
- DEP Wetlands

N

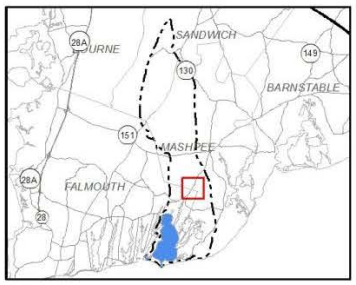
0 300 600 Feet

Figure 2A

Waquoit Bay (MA96-21)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- MassDOT Impervious Area
- MassDOT Pervious Area
- MassDOT Supplemental Contributing Area
- Certified Vernal Pools
- Areas of Critical Environmental Concern
- DEP Wetlands

N

0 300 600 Feet

Figure 2B

Waquoit Bay (MA96-21)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

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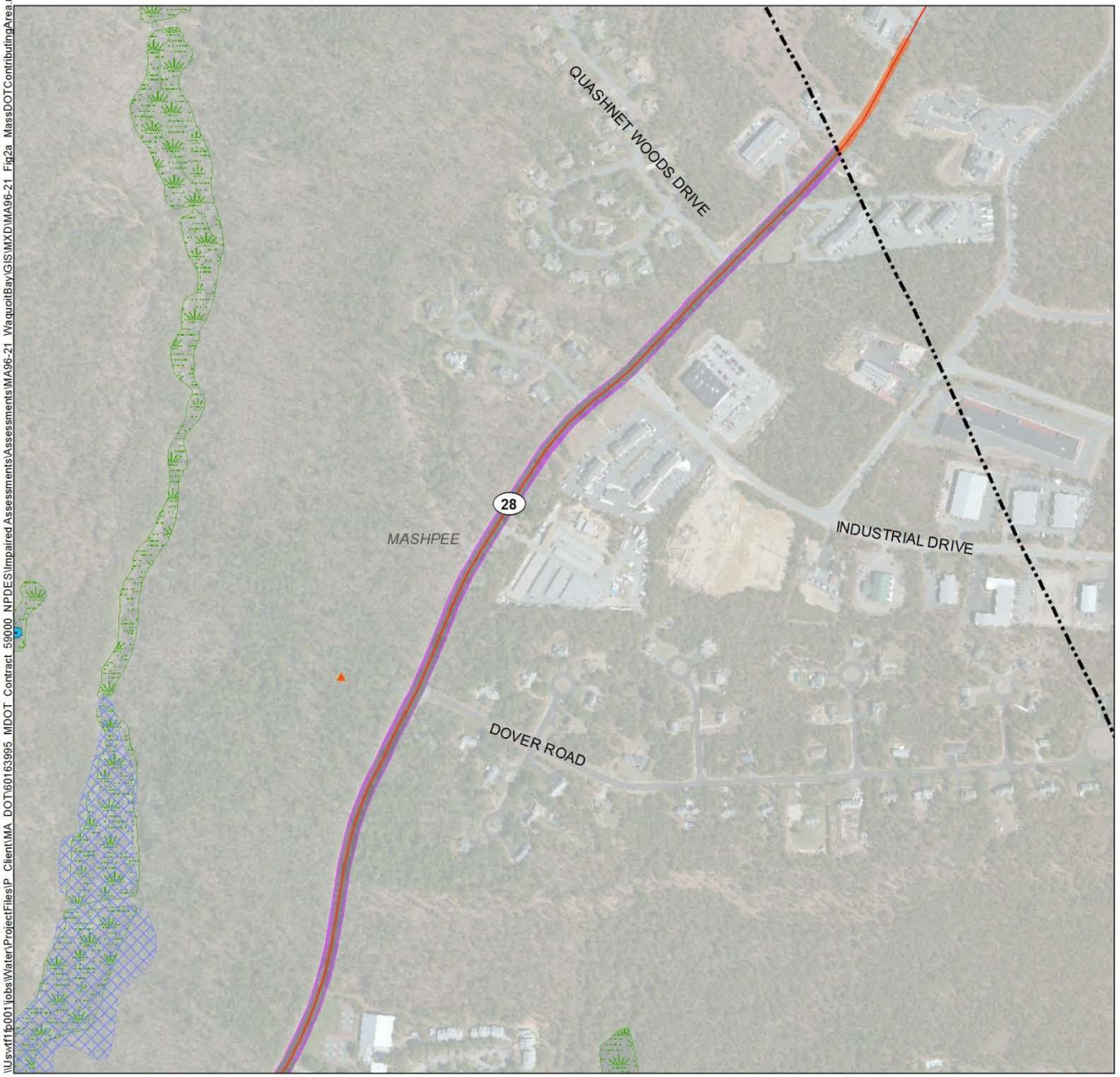

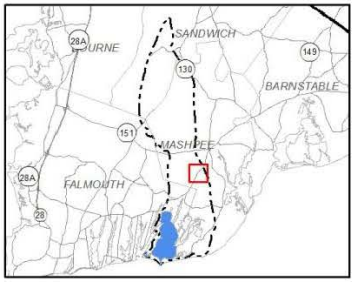

- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- MassDOT Impervious Area
- MassDOT Pervious Area
- MassDOT Supplemental Contributing Area
- Certified Vernal Pools
- Areas of Critical Environmental Concern
- DEP Wetlands

N

0 300 600 Feet

Figure 2C

Waquoit Bay (MA96-21)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

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Impaired Waters Assessment for Lewis Bay (MA96-36)

Summary

Impaired Water[1]	Stormwater Impairments:	*Nitrogen (Total); Fecal Coliform*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the Cape Cod Watershed*[2]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location	Towns:	*Barnstable, Yarmouth*
	MassDOT Roads:	*Route 28*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	None
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*258.7 lbs/yr*
	Existing Load to Water Body:	*56,625 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.46 %*

Site Description

Lewis Bay (MA96-36) is a 1.8-square mile water body located south of Route 28 and adjacent to Hyannis Harbor (MA96-05) in Barnstable and Yarmouth, Massachusetts. Figure 1 illustrates the groundwatershed for Lewis Bay (MA96-36). The groundwatershed for this impaired segment is

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

[2] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

[3] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

based on technical reports[4] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Lewis Bay (MA96-36).

MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[5] identifies the Aquatic Life Use as "impaired" for Lewis Bay (MA96-36). The Shellfish Harvesting Use was identified as "impaired" for 0.03 square miles and "support" for 1.77 square miles. The "impaired" Aquatic Life Use is reported to be caused by loss of eelgrass habitat (estuarine bioassessment) from subsurface wastewater disposal (septic) systems, stormwater runoff (unspecified urban stormwater and discharges from municipal separate storm sewer systems), and fertilizers. The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from marina/boating pumpout releases, waterfowl, waste from pets, and discharges from municipal separate storm sewer systems. Primary and Secondary Contact Uses were identified as "support". The other uses were not assessed.

Figures 2a through 2e illustrate the MassDOT-owned roadway within the groundwatershed that contributes runoff to the water body. Approximately 28.8 acres of urban roadway drains to the groundwatershed via overland flow, infiltration or catch basins and pipes; therefore, these sections of roadway are considered discharging to Lewis Bay (MA96-36).

Approximately 7.5 acres of urban roadway at intersection of Route 6 with Willow Street contributes runoff to Lewis Bay groundwatershed. Runoff is collected mainly with localized catch basins which discharge to the pervious area adjacent to the road and travels to Lewis Bay via groundwater flow (Figure 2a). Route 28 traverses the groundwatershed boundary north of Lewis Bay. Runoff from Route 28 from the west boundary of the groundwatershed in the vicinity of Bearses Way to Quaker Road is collected by a catch basins and pipes network and discharges to Fresh Pond within the Lewis Bay groundwatershed. Runoff from Route 28 from Quaker Road to Nightingale Lane sheet flows off the road and discharges to Fresh Pond (Figure 2b).

Runoff from Nightingale Lane to an area the west of the rotary sheet flows off the road and infiltrates into the pervious area adjacent to the road. Runoff from Route 28 from the rotary to Simpkins Way is collected with a network of catch basins and pipes, and discharges to an unnamed water body North of Simpkins Way (Figure 2c).

Figure 2d shows that the roadway runoff from Route 28 between Simpkins Way and a high point in the vicinity of Town Brook Road travels sheet flows off the road and discharges to the north section of Mill Pond, or infiltrates in the pervious area adjacent to Route 28. Stormwater runoff from Route 28 between Town Brook Road and the eastern groundwatershed boundary at Traders Lane is collected by the drainage network and discharges to a channel that connects Mill Pond to Mill Creek. Runoff from approximately 0.6 acres of roadway from Main Street between Bayview Street

[4] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Lewis Bay Embayment System, Barnstable/Yarmouth, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/Lewis_Bay/Lewis_Bay_MEP_Final.pdf

[5] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

and Route 28 sheet flows off the road and infiltrates so it is considered to be discharging within the groundwatershed (Figure 2d).

On the east side of the groundwatershed, runoff from Route 28 between Traders Lane and Springer Lane sheet flows off the road and infiltrates into the pervious surface adjacent to the road or is collected with catch basins discharging at an unidentified location within Lewis Bay groundwatershed. Runoff from a portion of the roadway located outside of the groundwatershed boundary edge is directed inside the boundaries and discharged within the groundwatershed via sheet flow, catch basins or pipes and is considered "Supplemental Contributing Area" (Figure 2e). Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". Based on aerial images, the land use within the watershed is mostly commercial and urban.

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Lewis Bay (MA96-36) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act[8]. MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Lewis Bay is not proposed to change.

BMP 7U for Nitrogen

The *draft Total Maximum Daily Load (TMDL) for Total Nitrogen in the Lewis Bay System, Massachusetts (CN 314)*[10] identifies the total existing groundwatershed nitrogen load for this water body. MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body

[6] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

[10] MassDEP. 2010. Draft - Lewis Bay System and Halls Creek Total Maximum Daily loads for Total Nitrogen Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/lewisbay.pdf

using the approach described in BMP 7U[11] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a Final TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds. [12]

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[13] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[12] which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[12] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 28.8 acres
- MassDOT Pervious Area: 32.0 acres
- Estimated Existing MassDOT Load: 258.7 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 56,625 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.46 %

The MassDOT existing load compared to the total watershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[12]In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). Lewis Bay (MA96-36) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[14]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[15]

According to the Final TMDL, sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It

[11] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[12] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[13] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[14] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

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

should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and best management practices to mitigate stormwater runoff volume.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod Watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Lewis Bay (MA96-36) is listed as a medium priority due to its designation as a Class SA, as well as its uses for public swimming and shellfishing.[16]

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report[16] (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters
- Annual street sweeping and catch basin cleaning

[16] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

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

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

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

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Lewis Bay, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[17] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is

[17] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

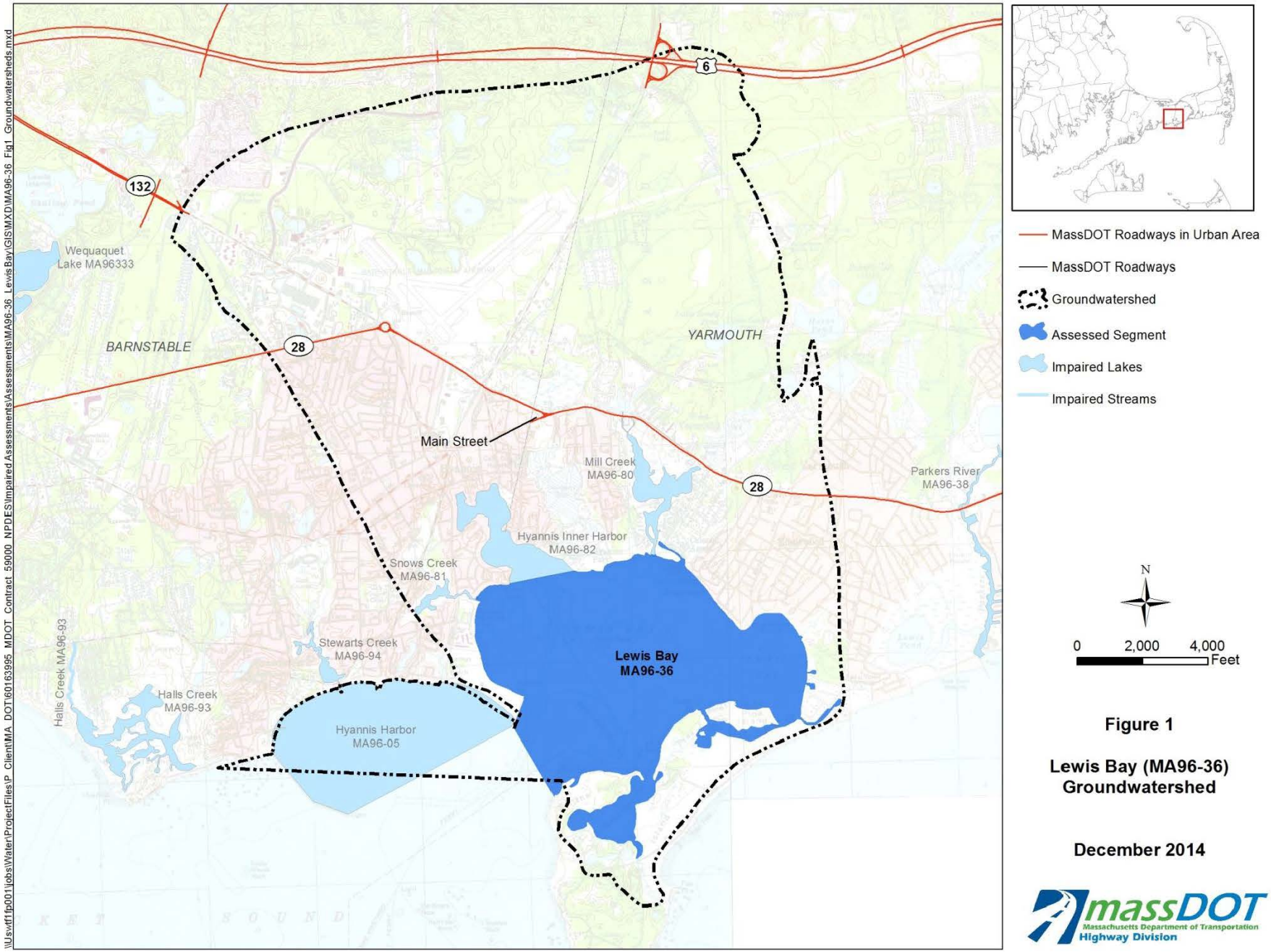
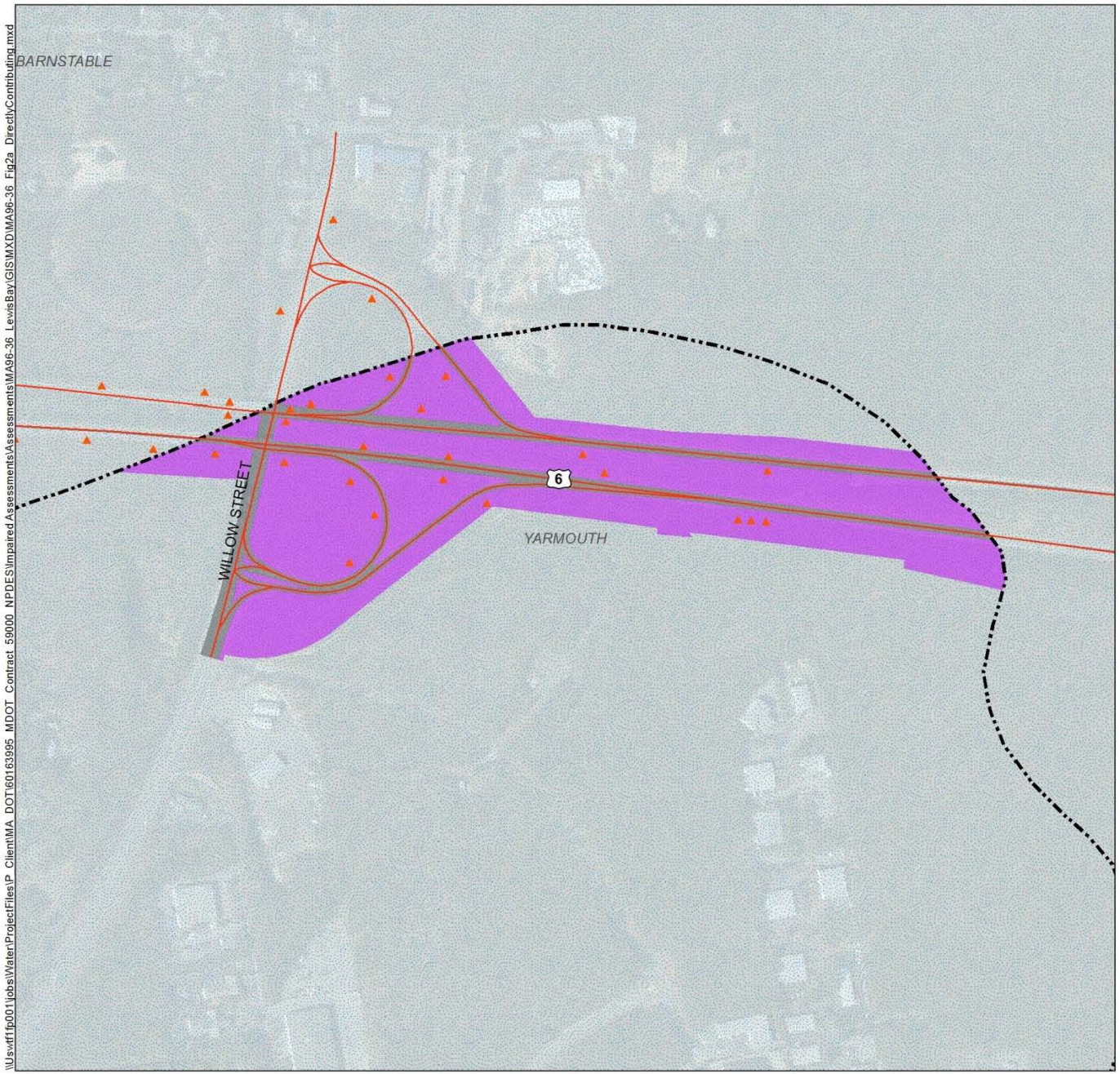
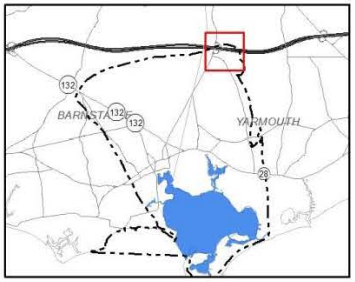


Figure 1

Lewis Bay (MA96-36) Groundwatershed

December 2014





MassDOT Outfalls

MassDOT Roadways in Urban Area

Groundwatershed

Assessed Segment

MassDOT Impervious

MassDOT Pervious

Zone II Wellhead Protection Areas

N

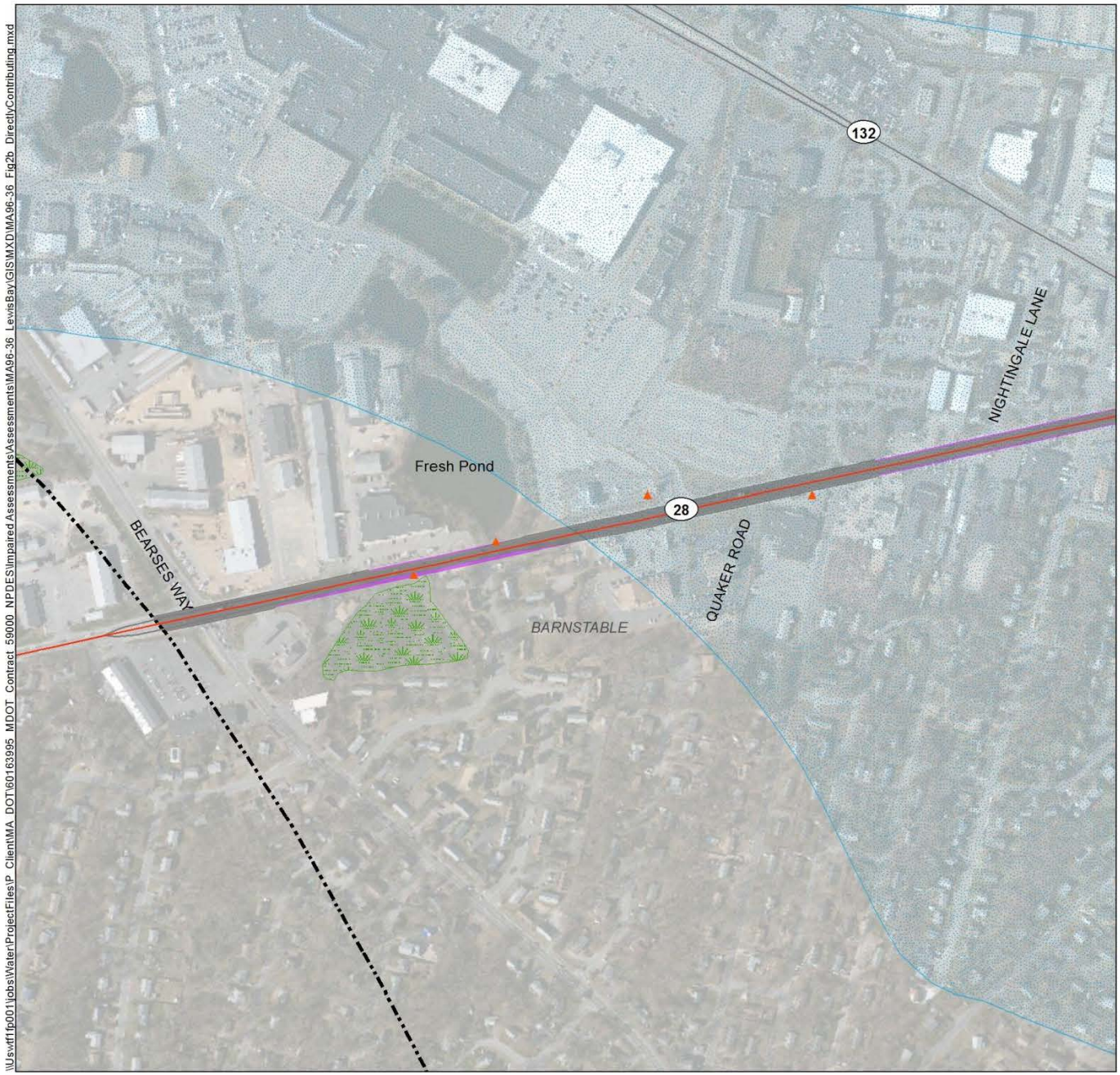
0 400 800 Feet

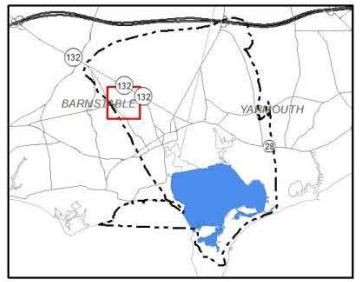
Figure 2a

Lewis Bay (MA96-36)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Impervious
- MassDOT Pervious
- MassDOT Supplemental Contributing Area
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

0 300 600 Feet

Figure 2b

Lewis Bay (MA96-36)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

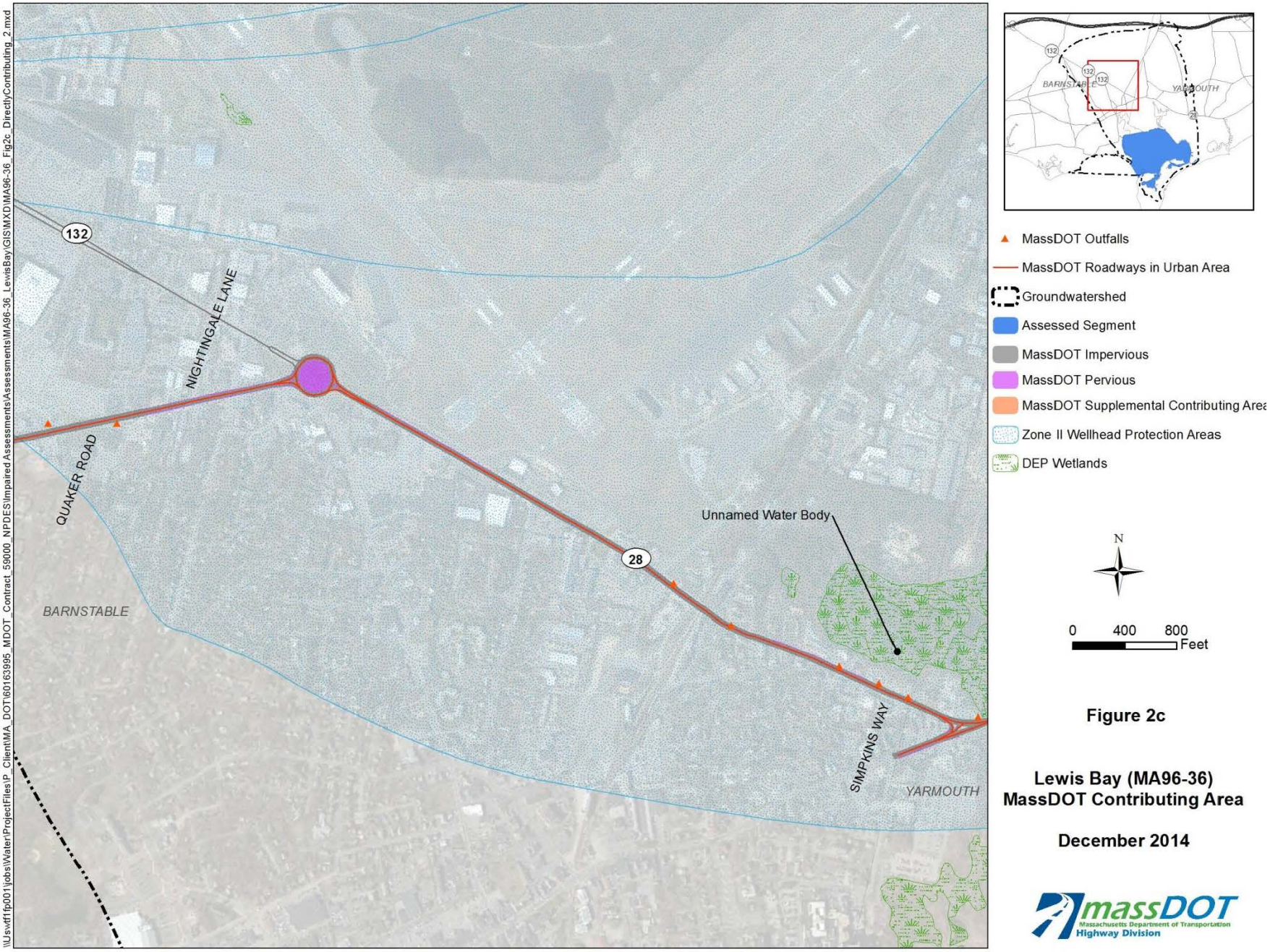


Figure 2c

Lewis Bay (MA96-36)
MassDOT Contributing Area

December 2014

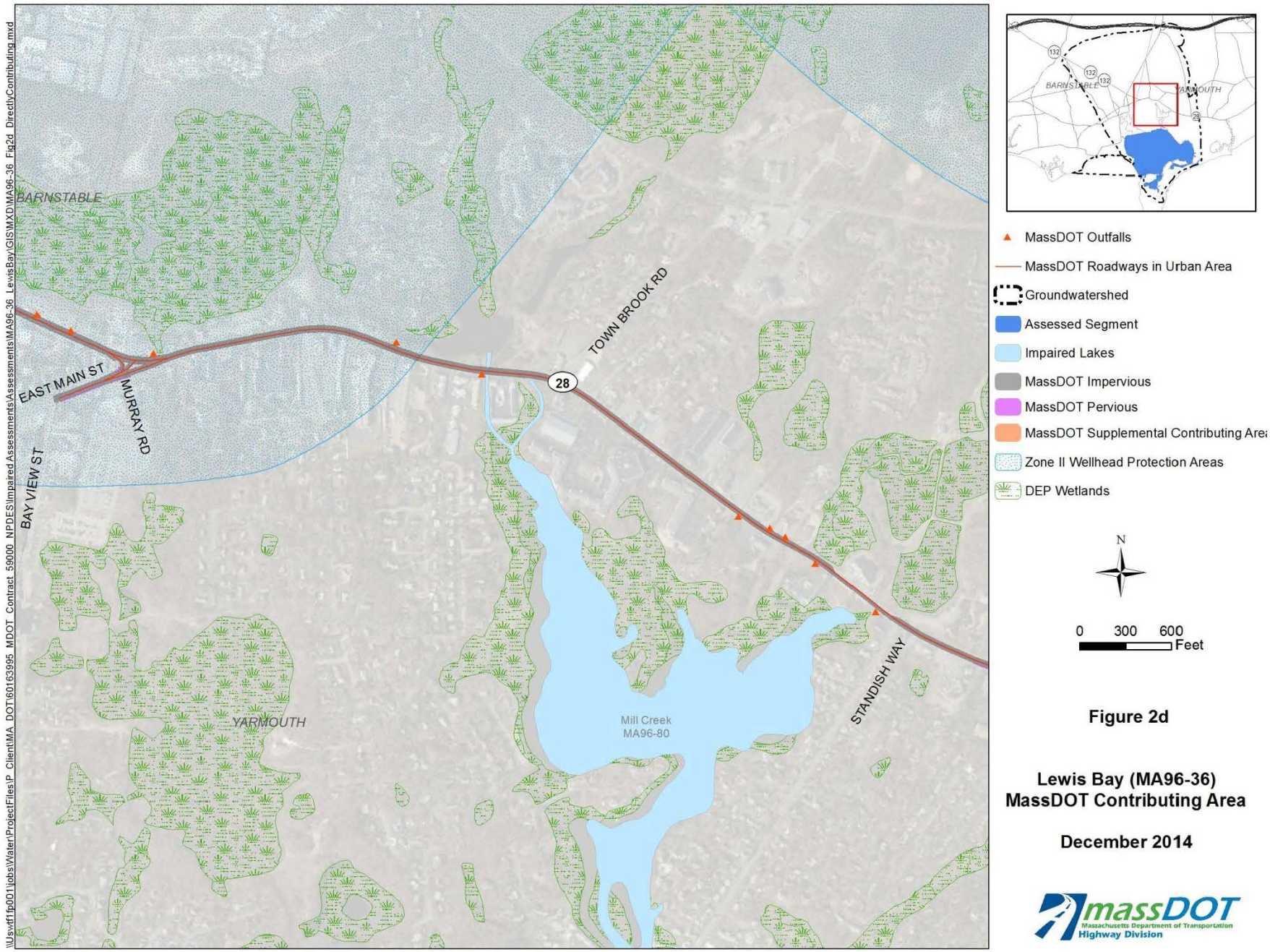
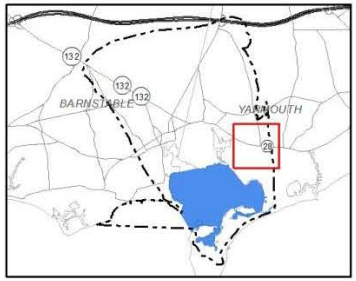


Figure 2d

Lewis Bay (MA96-36)
MassDOT Contributing Area

December 2014



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- MassDOT Impervious
- MassDOT Pervious
- MassDOT Supplemental Contributing Area
- DEP Wetlands

N

0 500 1,000 Feet

Figure 2e

Lewis Bay (MA96-36)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

massDOT Massachusetts Department of Transportation Highway Division

12/08/2014

Impaired Waters Assessment for Oyster Pond (MA96-62)

Summary

Impaired Water[1]	Stormwater Impairments:	*Nitrogen (Total); Fecal Coliform*
	Category:	*4A (TMDL is completed)*
	Final TMDLs:	*Final Oyster Pond Embayment System Total Maximum Daily Loads for Total Nitrogen (Report # 96-TMDL-7 Control#245)* [2] *Final Pathogen TMDL for the Cape Cod Watershed*[3]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]
Location	Towns:	*Falmouth*
	MassDOT Roads:	*Woods Hole Road*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☐
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*11.0 lbs/yr*
	Existing Load to Water Body:	*5,159 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.21 %*

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

[2] Mass DEP.2008. Final Oyster Pond Embayment System Total Maximum Daily Load for Total Nitrogen, Massachusetts (CN 245). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/oyster.pdf

[3] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

[4] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Site Description

Oyster Pond (MA96-62) is a 0.1-square mile water body located south of Woods Hole Road in Falmouth, Massachusetts. Figure 1 illustrates the groundwatershed for Oyster Pond (MA96-62). The groundwatershed for this impaired segment is based on technical reports[5] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Oyster Pond (MA96-62). The Oyster Pond groundwatershed has seen rapid and extensive development of single family homes and the conversion of seasonal to full-time residences which has transformed forest to suburban use and increased on-site wastewater treatment systems.

MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[6] identifies the Aquatic Life Use and Shellfishing Harvesting Use as "impaired" for Oyster Pond (MA96-62). The "impaired" status for the Aquatic Life Use is reported to be caused by estuarine bioassessment and low dissolved oxygen from subsurface wastewater disposal (septic) systems, stormwater runoff (unspecified urban stormwater and discharges from municipal separate storm sewer systems) and fertilizers. The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from waterfowl, waste from pets, on-site septic system discharges and discharges from municipal separate storm sewer systems. The other uses were not assessed.

Figure 2 illustrates the MassDOT-owned road within the groundwatershed that contributes runoff to the water body. Woods Hole Road traverses the groundwatershed boundary north of Oyster Pond. Approximately 1.5 acres of roadway drains to the groundwatershed via overland flow, infiltration or catch basins and pipes; therefore, the section of roadway is considered discharging to Oyster Pond (MA96-62). Most outfalls are either small, localized systems with one or two catch basins and an outfall or curb cuts at a low point in the roadway where sheet flow is allowed to drain overland to the shoulder of the roadway. High points in the roadway limit the section of roadway that is considered draining to the groundwatershed. The sections of roadway within the groundwatershed on the east and west boundaries that are not shown as contributing to the Oyster Pond groundwatershed as runoff flows outside of the Oyster Pond groundwatershed boundary via piped drainage systems.

Existing BMPs

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

[5] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Oyster Pond System, Falmouth, Massachusetts. Available at: http://www.oceanscience.net/estuaries/OysterPond.htm

[6] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[7] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[8] MassDOT assessed Oyster Pond (MA96-62) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. [9] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[10] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Oyster Pond is not proposed to change.

BMP 7R for Nitrogen TMDL (CN 245)

The *Total Maximum Daily Load (TMDL) for Total Nitrogen in the Oyster Pond Embayment System, Massachusetts (CN 245*)[11] addresses the total nitrogen impairment for this water body. MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7R[7] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL, and MassDOT's application of BMP 7R to nitrogen in groundwater-controlled watersheds. [12]

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[13] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[12] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 1.5 acres
- MassDOT Pervious Area: 0.7 acres

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

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

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

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

[11] Mass DEP.2008. Final Oyster Pond Embayment System Total Maximum Daily Load for Total Nitrogen, Massachusetts (CN 245). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/oyster.pdf

[12] MassDOT, March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[13] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

- Estimated Existing MassDOT Load: 11.0 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 5,159 lbs/yr (from TMDL)
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.21%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[14] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). Oyster Pond (MA96-62) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[15]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[16]

According to the Final TMDL, sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and best management practices to mitigate stormwater runoff volume.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod Watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters (ORWs) or designated uses that require higher water quality standards than Class B. Oyster Pond (MA96-62) as a priority is not listed due to insufficient data, but the water body is classified as Class SA, and is used for public swimming and shellfishing.[17]

[14] MassDOT, March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[15] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

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

[17] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report[18] (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters
- Street Sweeping and catch basin cleaning

Proposed Mitigation Plan

As described above, MassDOT’s nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT’s BMP 7R Pathogen Methodology,[19] MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

[18] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

[19] MassDOT. December 2014. Description of MassDOT’s Application of BMP 7R for Pathogen Related Impairments.

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

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

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Oyster Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[20] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[20] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

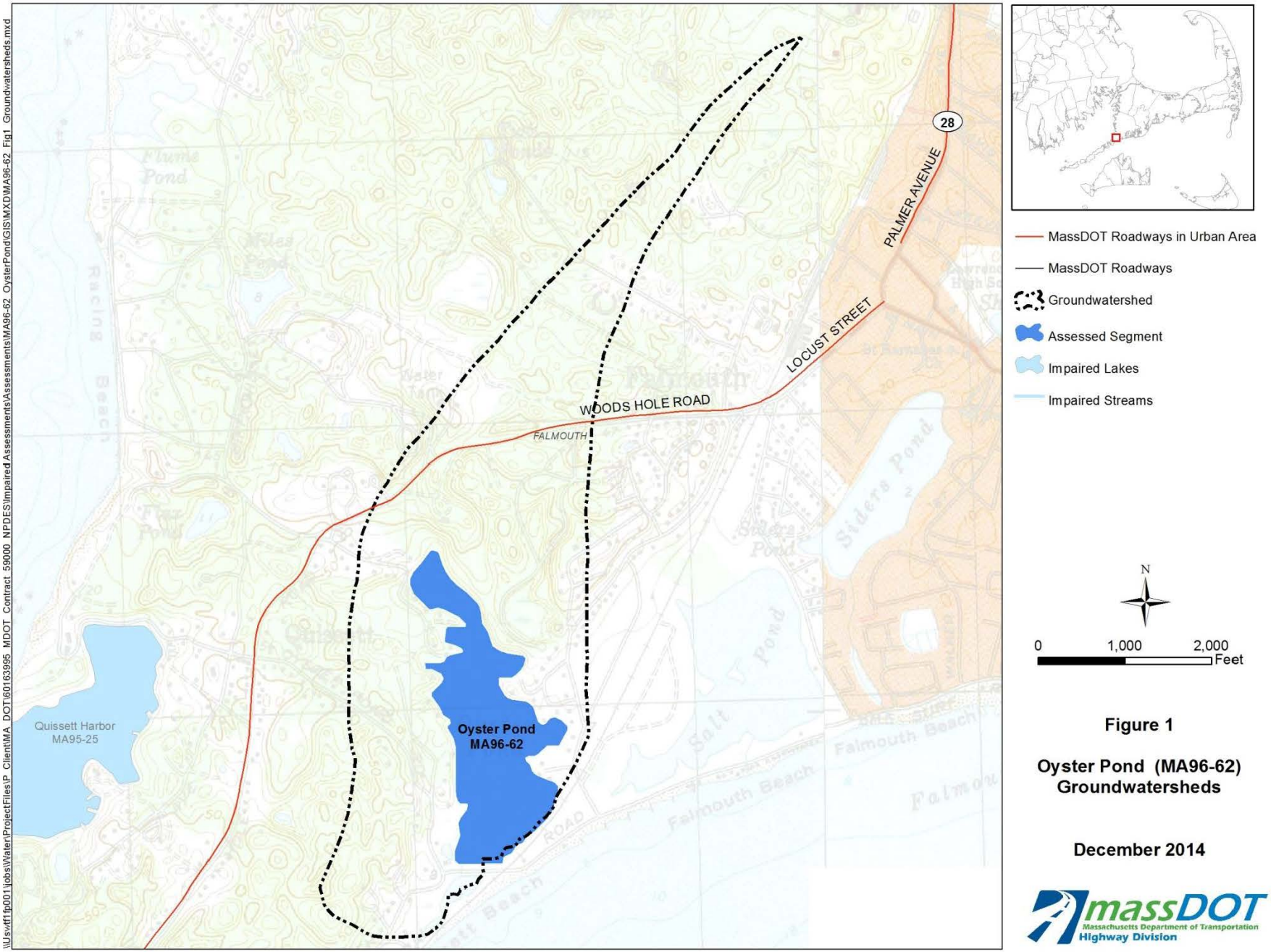

Figure 1

Oyster Pond (MA96-62) Groundwatersheds

December 2014

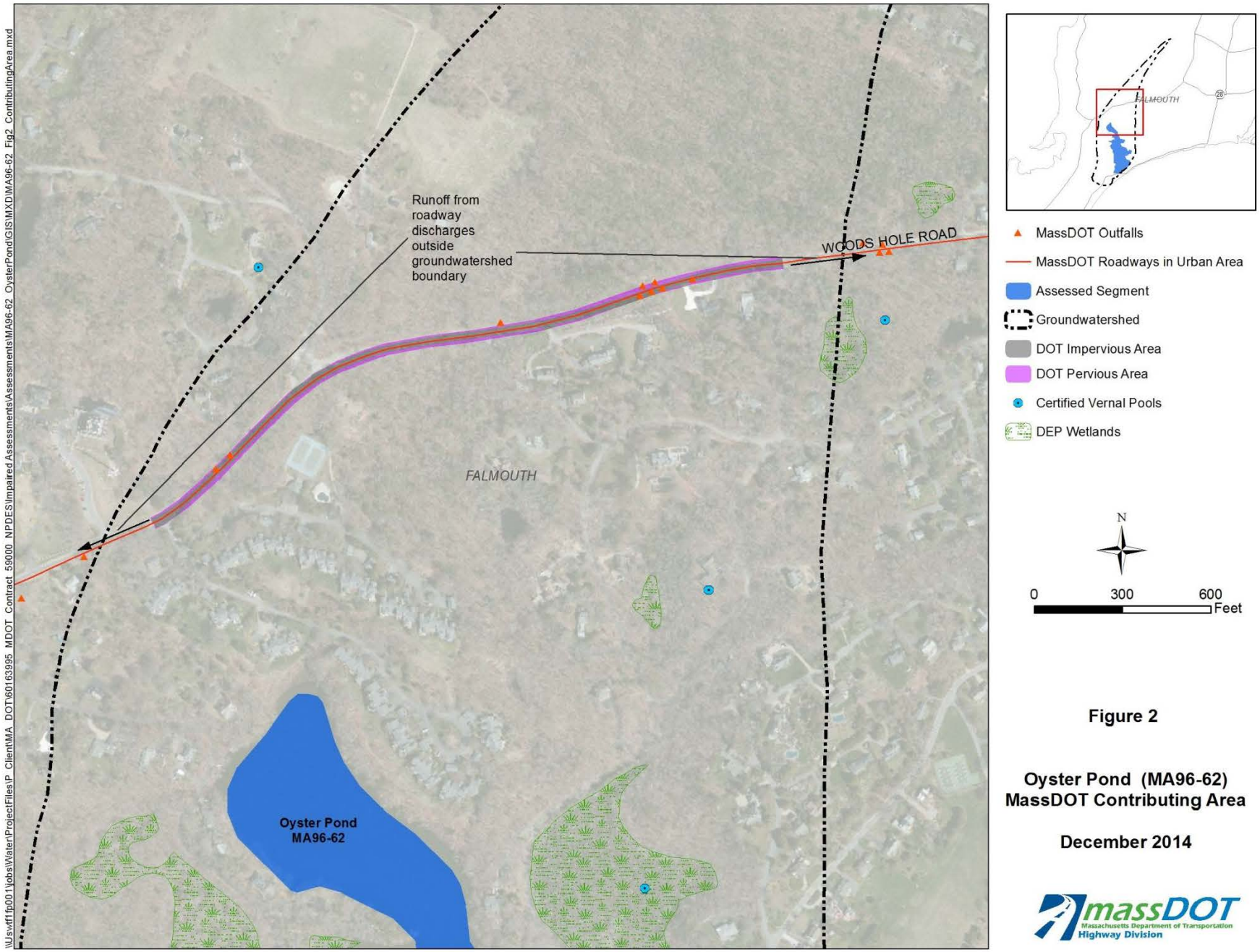

Figure 2

Oyster Pond (MA96-62)
MassDOT Contributing Area

December 2014

Impaired Waters Assessment for Cotuit Bay (MA96-63)

Summary

Impaired Water[1]	Stormwater Impairments:	*Nitrogen (Total); Fecal Coliform*
	Category:	*4A (TMDL is completed)*
		Final Three Bays System
	Final TMDLs:	*Total Maximum Daily Loads for Total Nitrogen (EPA TMDL #33988)* [2]
		Final Pathogen TMDL for Three Bays Watershed, Barnstable, MA (CN309.0)[3]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]
Location	Towns:	*Barnstable*
	MassDOT Roads:	*Route 28*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☐
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*16.9 lbs/yr*
	Existing Load to Water Body:	*25,372 lbs/yr*
	MassDOT Contribution to Existing Load	*0.07 %*

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

[2] Mass DEP.2007. Final Three Bays System, Total Maximum Daily Load for Total Nitrogen, Massachusetts (CN 242.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/threebay.pdf

[3] Mass DEP.2009. Final Pathogen TMDL for Three Bays Watershed, Barnstable, MA (CN 309.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/3baapp/3bays.pdf

[4] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Site Description

Cotuit Bay (MA96-63) is a 0.85-square mile water body located south of Route 28 in Barnstable Massachusetts. Figure 1 illustrates the groundwatershed for Cotuit Bay (MA96-63). The groundwatershed for this impaired segment is based on technical reports[5] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration to these areas is considered contributing to Cotuit Bay (MA96-63). The Cotuit Bay groundwatershed is located in Barnstable and includes residential areas, wetlands, ponds, and a MassDOT road (Route 28).

The Cotuit Bay groundwatershed represents the inflow from and non-impaired stream, Little River, and groundwater flow. Cotuit Bay discharges to Nantucket Sound. MassDEP's Water Quality Assessment Report[6] identifies that the Aquatic Life Use as "impaired" for Cotuit Bay due to total nitrogen from septic systems, stormwater runoff, and fertilizers. The report identified that Cotuit Bay "supports" the Shellfish Harvesting Use in a 0.79 square mile area, Primary Contact and Secondary Contact Uses, though some beach closings in 2003, 2004 and 2007 have been documented. The Aesthetics and Fish Consumption Uses were not assessed.

Figure 2 illustrates the MassDOT-owned roads within the groundwatershed that contribute runoff to Cotuit Bay. Runoff from a segment of Route 28 that extends from Anchor Lane to approximately 380 feet east of the entrance to the Content Lane neighborhood is considered MassDOT contributing area. Approximately 2.5 acres of this section of road is impervious and drains via catch basins that direct flow to three outfalls along the southern side of Route 28 near the Little River. This portion of Route 28 is two lanes and has a 50 foot wide right-of-way. This area approximately 0.6 acres within the right-of-way that is pervious contributes by infiltration.

The other sections of Route 28 on Figure 2 within the groundwatershed do not contribute to the Cotuit Bay groundwatershed because they drain to areas outside of the groundwatershed boundary. Runoff from the section of Route 28 west of Anchor Lane is collected via catchbasins and piped to a discharge location west of the groundwatershed boundary. Runoff from Route 28, east of Content Lane, drains to a system that pipes stormwater flow to the east and outside of the Cotuit Bay groundwatershed.

Existing BMPs

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

[5] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Three Bays, Barnstable, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/3Bays/3Bays_MEP_Final.pdf

[6] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[7] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[8] MassDOT assessed Cotuit Bay (MA96-63) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. [9] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[10] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Cotuit Bay is not proposed to change.

BMP 7R for Nitrogen TMDL (CN 242.0)

The *Total Maximum Daily Load (TMDL) for Total Nitrogen in the Three Bays System, Massachusetts (CN 242.0)*[11] addresses the total nitrogen impairment for this water body. MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7R[8] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL, and MassDOT's application of BMP 7R to nitrogen in groundwater-controlled watersheds.[12]

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[13] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[13] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 2.5 acres
- MassDOT Pervious Area: 0.6 acres

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

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

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

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

[11] Mass DEP.2007. Final Three Bays System, Total Maximum Daily Load for Total Nitrogen, Massachusetts (CN 242.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/threebay.pdf

[12] MassDOT, March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[13] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

- Estimated Existing MassDOT Load: 16.9 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 25,372 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.07%

The MassDOT existing load compared to the total watershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[14] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 309.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP)[15] which applies to impairments that have been assigned to a water body covered by a final TMDL. Cotuit Bay (MA96-66) is covered by the *Final Pathogen TMDL for the Three Bays Watershed.*[16]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[17]

According to the Final TMDLs, sources of indicator bacteria in the Three Bays groundwatersheds are believed to be primarily from boat discharges, waterfowl/wildlife, transport of fecal coliform via the Marston Mills River via tidal exchange and stormwater inflows from paved areas. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Additionally, the Three Bays TMDL states that the first priority should be given to all sources that result in water quality standards violations during dry weather conditions, such as illicit sewer connections, failed Title 5 systems and/or sanitary sources. Recommended TMDL implementation measures include identification and elimination of these sources.

The Three Bays TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. Prince Cove (MA96-07) is included as a priority ranking as a component of the Massachusetts Estuary Project.[16] The Three Bays TMDL states that the two predominant types of land use in the Three Bays watershed are forestland and residential.

[14] MassDOT, March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[15] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[16] Mass DEP.2009. Final Pathogen TMDL for Three Bays Watershed, Barnstable, MA (CN 309.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/3baapp/3bays.pdf

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

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Three Bays Watershed TMDL report (Section 6.0)[19] recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume
- Enforcement of the "No Discharge Zone" which makes direct discharge of wastewater from boats illegal

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT's BMP 7R Pathogen Methodology,[18] MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Pathogen TMDL and the Three Bays Watershed TMDL reports, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the groundwatershed of this water body. MassDOT will be installing signs at rest stops within the groundwatershed of impaired water bodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

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

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

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Cotuit Bay, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[19] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional turf establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[19] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004.

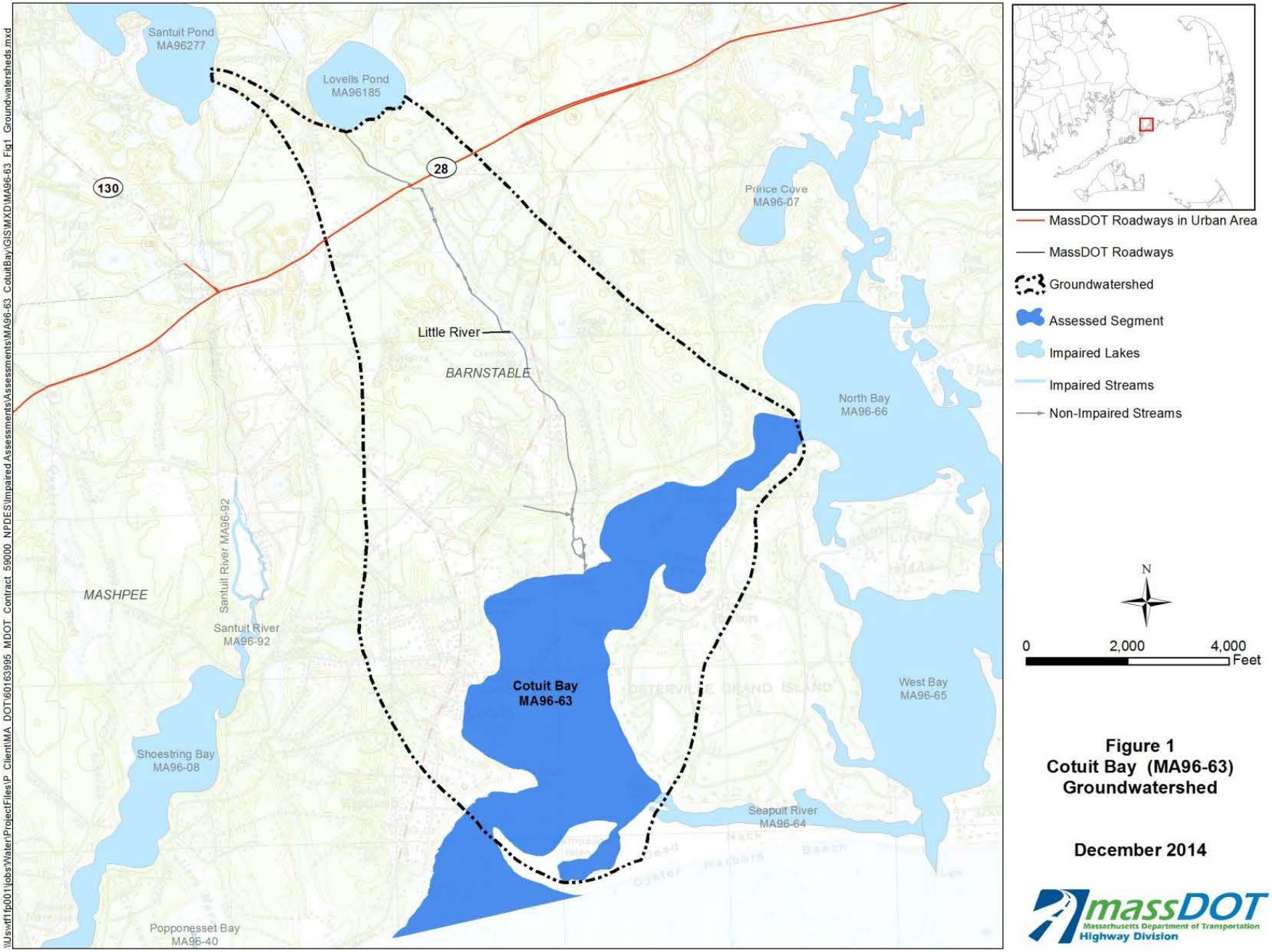
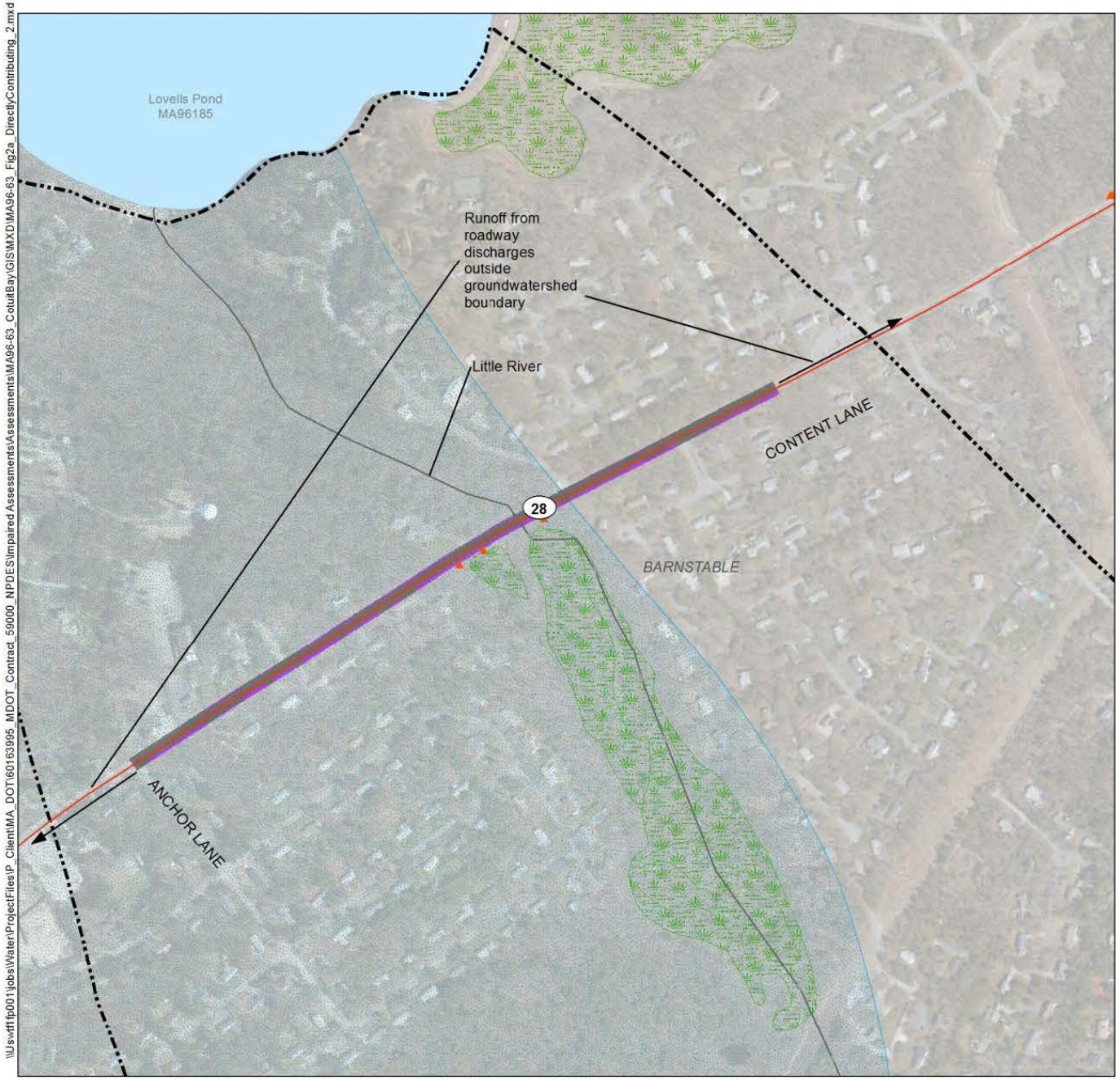
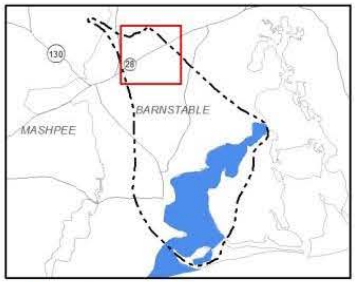


Figure 1
Cotuit Bay (MA96-63)
Groundwatershed

December 2014





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- Non-Impaired Streams
- MassDOT Pervious Area
- MassDOT Impervious Area
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

0 300 600 Feet

Figure 2

Cotuit Bay (MA96-63)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for West Bay (MA96-65)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments*
	Category:	*4A (TMDL is completed)*
	Final TMDLs:	*Three Bays System Total Maximum Daily Loads for Total Nitrogen (CN 242.0)* [2]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location	Towns:	*Barnstable*
	MassDOT Roads:	*Route 28*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☐
BMPs	Existing:	*Infiltration Basin*
MassDOT Area and Targets		Nitrogen
	Directly Contributing Load:	*100.2 lbs/yr*
	Existing Load to Water Body:	*139,153 lbs/yr*
	Reduction provided by Existing BMPs:	*5.5 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.07 %*

Site Description

West Bay (MA96-65) is a 0.52-square mile water body located south of Route 28 and downstream of North Bay (MA96-66) in Barnstable, Massachusetts. Figure 1 illustrates the groundwatershed for

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

[2] Mass DEP, 2007. Final Three Bays System, Total Maximum Daily Load for Total Nitrogen, Massachusetts (CN 242.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/threebay.pdf

[3] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

West Bay (MA96-65). The groundwatershed for this segment is based on technical reports[4] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to West Bay.

As indicated in Figure1, West Bay receives inflow from the following upgradient water bodies: North Bay (MA96-66), Prince Cove (MA96-07) and Marston Mills River (a non-impaired stream segment). As a result, all MassDOT property that contributes runoff or infiltration to these upstream water bodies is also described below as contributing to West Bay (MA96-65). West Bay also receives flow from groundwater. It should be noted that North Bay (MA96-66) and Prince Cove (MA96-07) are also assessed independently in separate assessments. The West Bay groundwatershed is located in Barnstable and includes residential areas, wetlands, ponds, and segments of a MassDOT road (Route 28).

MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[5] identifies the Aquatic Life Use as "impaired" for West Bay due to the loss of eelgrass bed habitat as a result of total nitrogen loading from septic systems, stormwater runoff, and fertilizers. The report identifies the Shellfish Harvesting, Primary Contact, and Secondary Contact Uses as "support". The Aesthetics and Fish Consumption Uses were not assessed.

Figures 2a through 2c illustrate the MassDOT-owned roads within the groundwatershed that contribute runoff to the water body. In the western side of the groundwatershed, runoff from Route 28 from the high area near Content Lane east to Geraldine Road drains via catch basins to two adjacent outfalls on the north side of Route 28 near Geraldine Lane (Figure 2a). This area consists of approximately 4 acres of impervious surface and approximately 0.2 acres of pervious surface in the right-of-way that contributes to the West Bay groundwatershed. A portion of this area extends approximately 380 feet west of the western boundary of the groundwatershed, so it is considered "Supplemental Contributing Area". Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental".

Figure 2b illustrates the MassDOT-owned roads within the groundwatershed that contribute runoff to Prince Cove which drains to North Bay. A total of approximately 10 acres of impervious area and 1.4 acres of pervious area within the right-of-way of Route 28 contributes runoff to Prince Cove either by catch basin and pipe systems or runoff and infiltration to groundwater. The center portion of Route 28, beginning from approximately 350 feet west of Staysail Circle and extending 2,150 feet east of Staysail Circle (2,500 linear feet total) flows via catch basins and pipes to a subsurface leaching bed located at a low point adjacent to Marston Mills River. The ground surface at the bypass outfall for the leaching bed has become a deeply eroded channel that directs stormwater to the adjacent low-lying area that flows directly to Marston Mills River. On the east and west ends of

[4] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Three Bays, Barnstable, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/3Bays/3Bays_MEP_Final.pdf

[5] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

this section of roadway directing runoff to the leaching bed, runoff from the other sections of Route 28 is directed to catch basins and pipes that drain through outfalls shown on Figure 2b or by sheet flow to adjacent pervious areas. The additional sections include the roadway from approximately 250 feet west of Putnam Avenue to 350 feet west of Staysail Circle and the area 1,500 feet west of County Road to approximately 150 feet east of the intersection of Route 28 and Osterville West Barnstable Road. The drainage from these sections infiltrates into the ground and is considered contributing through groundwater.

Approximately 2,500 feet of Route 28 between Moniz Circle and Captain Aldens Lane is situated within the West Bay groundwatershed (Figure 2c). Runoff from approximately 0.7 acres of Route 28 in this area drains to pervious surfaces adjacent to the road. Runoff from approximately 2 acres of this road segment drains through catch basins and drain pipes and discharges into a recently constructed infiltration basin located at the Tanglewood Drive intersection.

Existing BMPs

MassDOT estimated the pollutant load reduction provided by existing BMPs by applying treatment reductions to existing BMPs based on their size, function and contributing watershed. BMP performances were derived different sources depending on the BMP and engineering judgment as described in the *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[6]

MassDOT identified two existing BMPs in place with the potential to treat roadway runoff from the discharging area before reaching the impaired water segment; a subsurface leaching bed located at a low point adjacent to Marston Mills River, and an infiltration basin located at the Tanglewood Drive intersection (Figure 2c).

MassDOT estimated the pollutant load reduction provided by existing BMPs by applying treatment reductions to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's BMP performance analysis report[7] and engineering judgment. Per the methodology, the subsurface leaching bed does not provide storage or advanced water quality treatment, and therefore does not receive a nitrogen removal credit. The table below shows nitrogen removal, the MassDOT drainage areas and the pollutant load reductions for the existing infiltration basin.

Table 1 Annual MassDOT Groundwatershed Nitrogen Loading under Existing Conditions

Groundwatershed/ BMP ID	Contributing Groundwatershed Size (acres)	Pre-BMP Annual Load (lbs/yr)	BMP Pollutant Load Reduction (lbs/yr)	Post-BMP Annual Load (lbs/yr)	Estimated Annual Removal Efficiency
Existing BMP 1	2.0	12.5	5.5	7.0	44%

[6] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[7] United States Environmental Protection Agency (USEPA), March 2010. Stormwater Best Management Practices (BMP) Performance Analysis. Available at: http://www.epa.gov/region1/npdes/stormwater/assets/pdfs/BMP-Performance-Analysis-Report.pdf

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[8] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[9] MassDOT assessed West Bay (MA96-65) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[10] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[11] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of West Bay (MA96-65) is not proposed to change.

BMP 7R for Nitrogen TMDL (CN 242.0)

The *Three Bays System Total Maximum Daily Loads for Total Nitrogen* (EPA TMDL #33988)[12] identifies the total existing groundwatershed nitrogen load for this water body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to West Bay (MA96-55) to be linked to elevated nitrogen: estuarine bioassessments. MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7R[8] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL, and MassDOT's application of BMP 7R to nitrogen in groundwater-controlled watersheds.[13]

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[14] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from

[8] MassDOT, July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[9] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

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

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[12] Mass DEP, 2007. Final Three Bays System, Total Maximum Daily Load for Total Nitrogen, Massachusetts (CN 242.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/threebay.pdf

[13] MassDOT. March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[14] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

pervious areas as 2.5 lbs/acre/yr.[15] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 16.3 acres
- MassDOT Pervious Area: 1.8 acres
- Estimated Existing MassDOT Load: 105.7 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 139,153 lbs/yr
- Reduction Provided by Existing BMPs: 5.5 lbs/yr
- Total MassDOT Load: 100.2 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.07 %

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[15] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of West Bay, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[16] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[15] MassDOT. March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[16] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

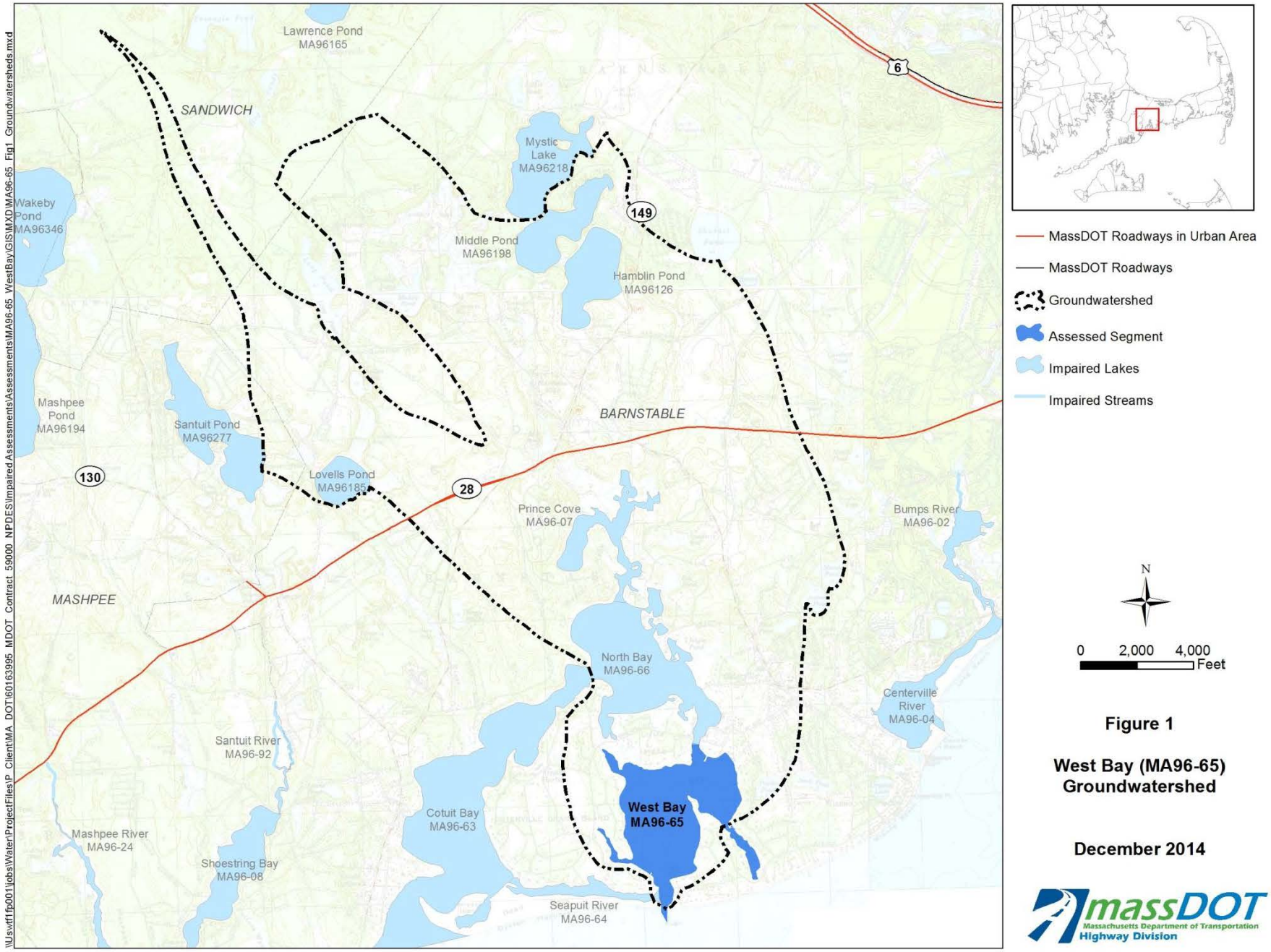

Figure 1

West Bay (MA96-65) Groundwatershed

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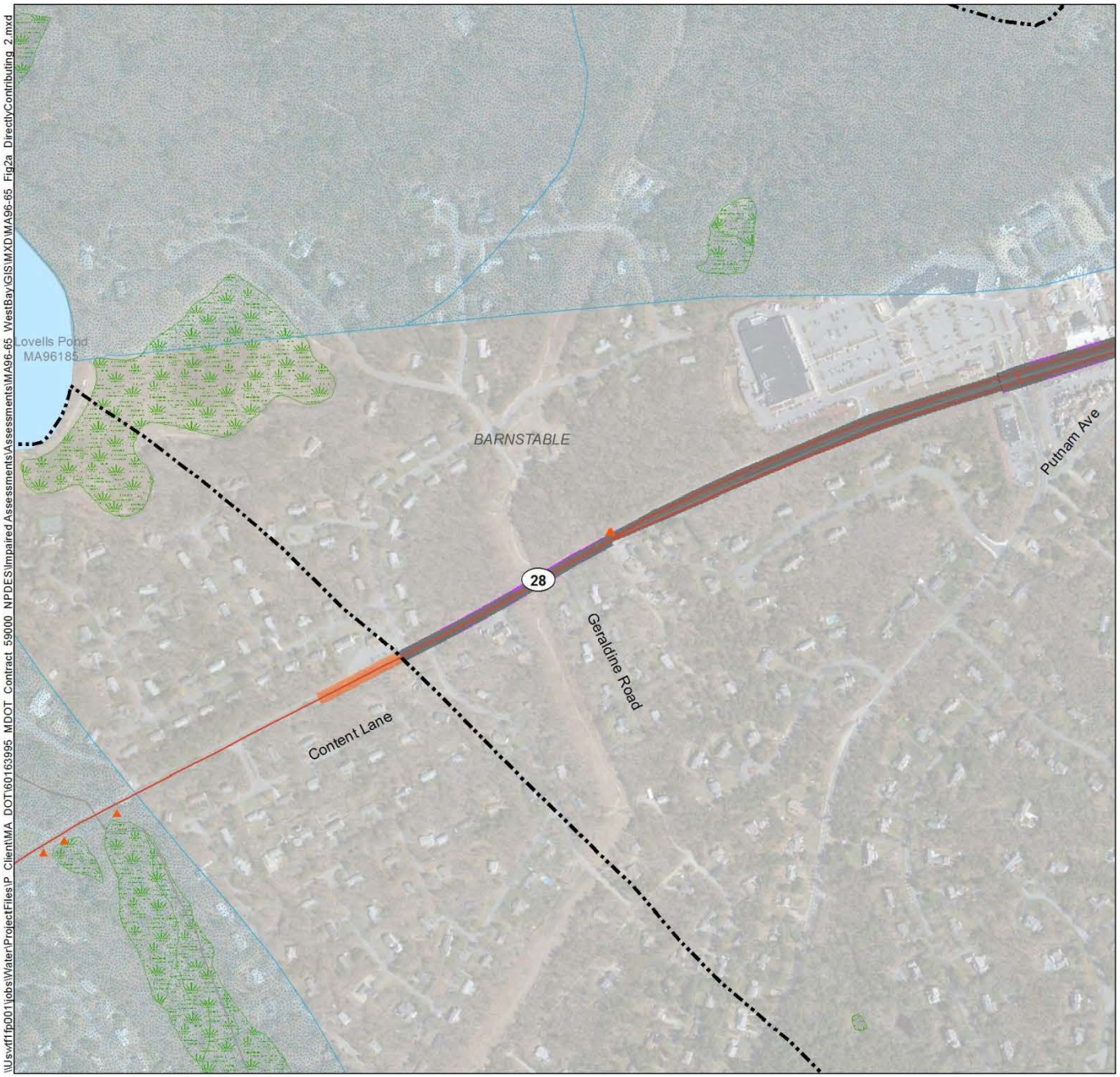

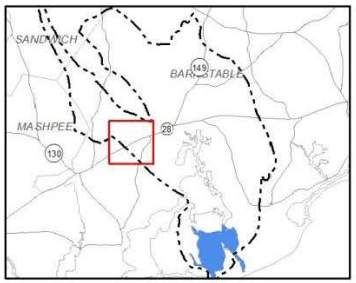

- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- MassDOT Pervious Area
- MassDOT Impervious Area
- MassDOT Supplemental Contributing Area
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

0 300 600 Feet

Figure 2a

West Bay (MA96-65)
MassDOT Contributing Area

December 2014

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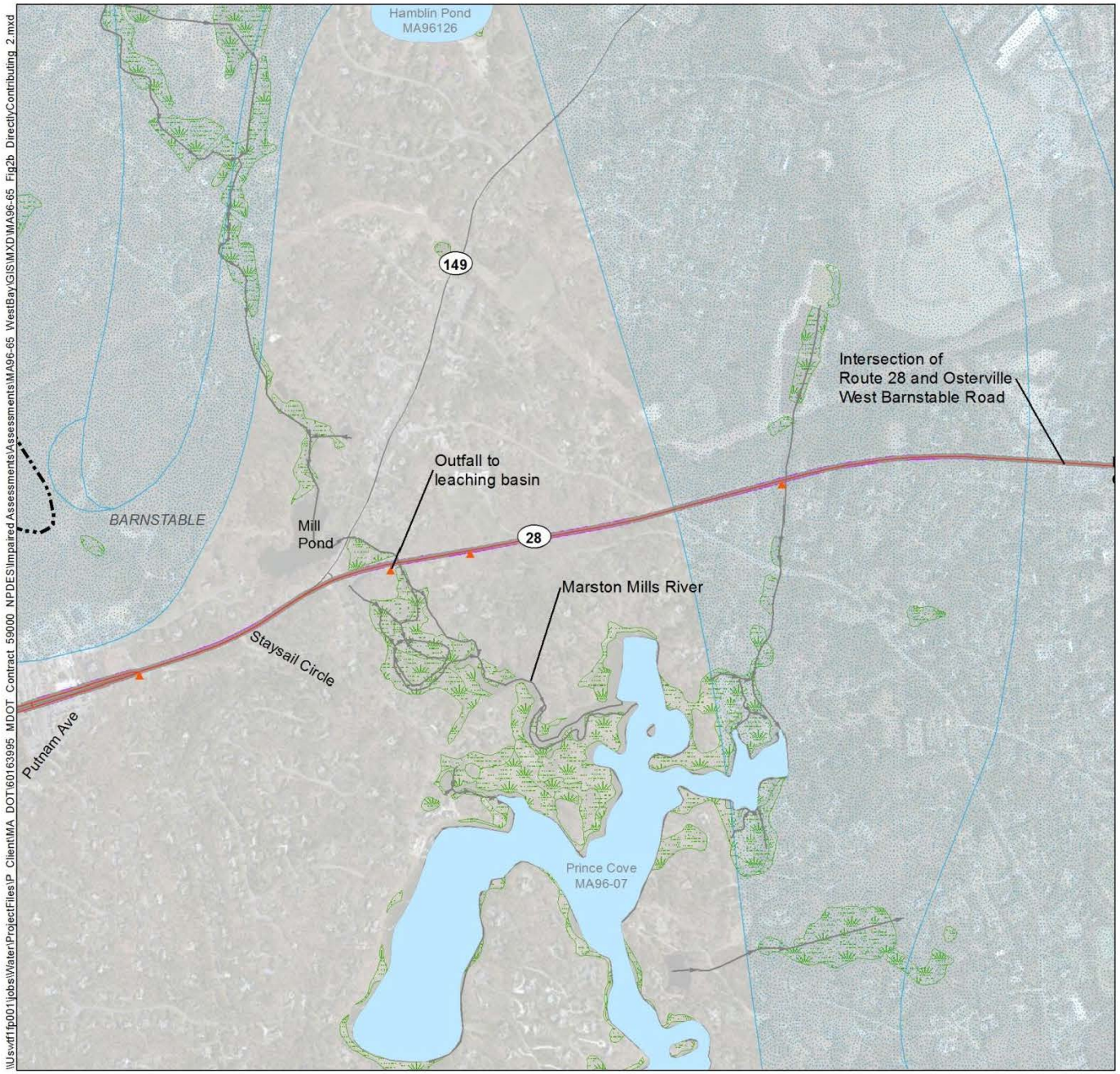
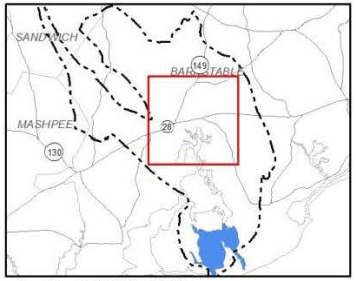
Massachusetts Department of Transportation
Highway Division





MassDOT Outfalls

MassDOT Roadways in Urban Area

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

MassDOT Pervious Area

MassDOT Impervious Area

Zone II Wellhead Protection Areas

DEP Wetlands

Non-Impaired Streams

N

0 600 1,200
Feet

Figure 2b

West Bay (MA96-65)
MassDOT Contributing Area

December 2014

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Massachusetts Department of Transportation
Highway Division

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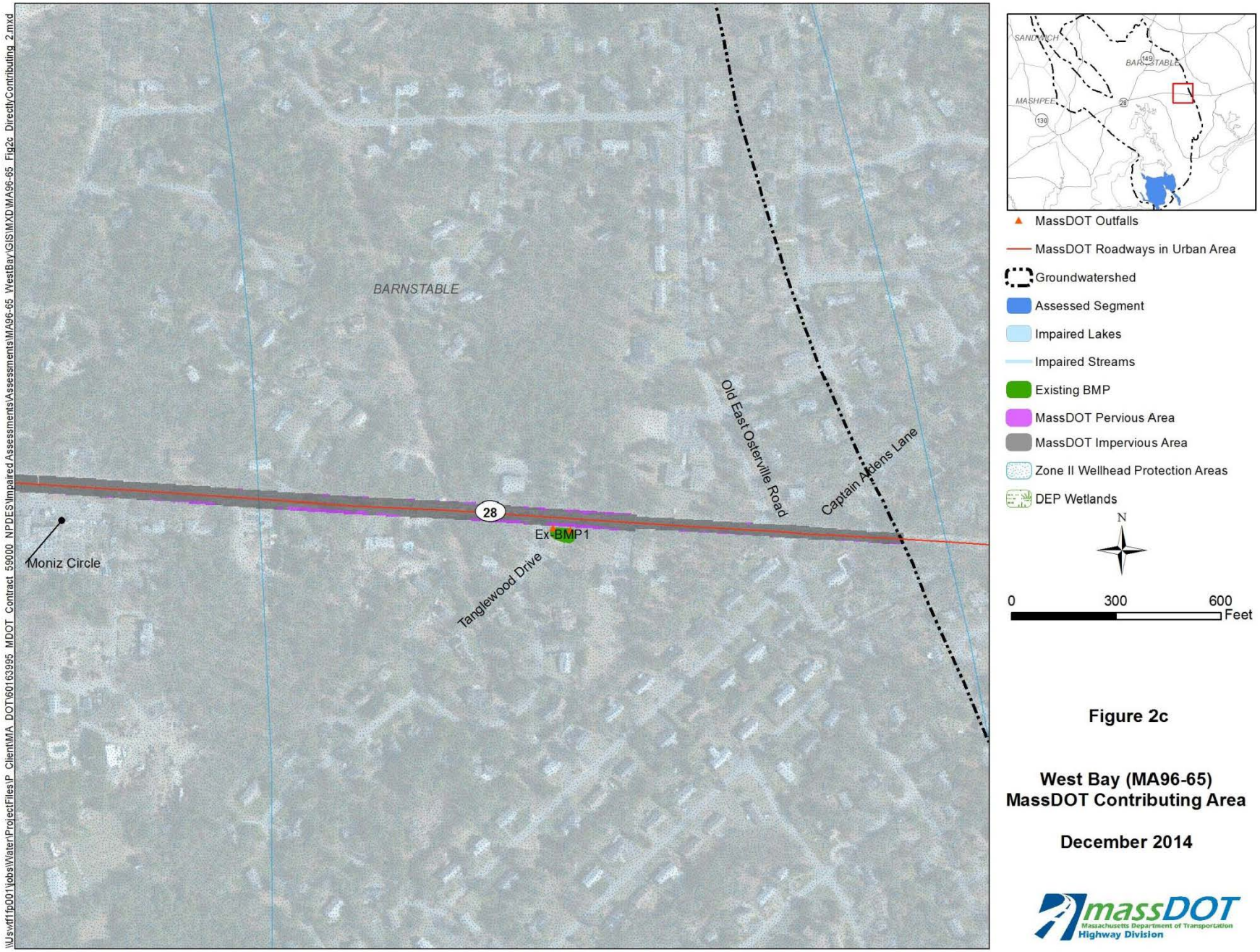


Figure 2c

West Bay (MA96-65)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for North Bay (MA96-66)

Summary

Impaired Water[1]	Impairments:	Stormwater:	*Nitrogen (Total); Fecal Coliform*
	Category:		*4A (TMDL is completed)*
	Final TMDLs:		*Three Bays System Total Maximum Daily Loads for Total Nitrogen (242.0)* [2]
			Final Pathogen TMDL for Three Bays Watershed, Barnstable, MA (CN309.0)[3]
	WQ Assessment:		*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]
Location	Towns:		*Barnstable*
	MassDOT Roads:		*Route 28*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☐	
BMPs	Existing:		*Infiltration Basin*
MassDOT Area and Targets			Nitrogen
	Estimated MassDOT Load:		*100.2 lbs/yr*
	Existing Load to Water Body:		*110,989 lbs/yr*
	Reduction provided by Existing BMPs:		*5.5 lbs/yr*
	MassDOT Contribution to Existing Load		*0.10 %*

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

[2] Mass DEP, 2007. Final Three Bays System, Total Maximum Daily Load for Total Nitrogen, Massachusetts (CN 242.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/threebay.pdf

[3] Mass DEP, 2009. Final Pathogen TMDL for Three Bays Watershed, Barnstable, MA (CN 309.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/3baapp/3bays.pdf

[4] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Site Description

North Bay (MA96-66) is a 0.47-square mile water body south of Route 28 in Barnstable, Massachusetts. Figure 1 illustrates the groundwatershed for North Bay (MA96-66). The groundwatershed for this impaired segment is based on technical reports[5] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration to these areas is considered contributing to North Bay (MA96-66). The North Bay groundwatershed is located in Barnstable and includes residential areas, wetlands, ponds, and a MassDOT road (Route 28).

North Bay receives flow from Prince Cove (MA96-07) and discharges to West Bay (MA96-65). These water bodies and their water quality conditions are discussed and in separate assessments. MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[6] identifies the Aquatic Life Use as "impaired" for North Bay due to the loss of eelgrass bed habitat as a result of total nitrogen loading from septic systems, stormwater runoff, and fertilizers. The report identified the Shellfish Harvesting Use as "impaired" due to fecal coliform bacteria. The report identifies Primary Contact, and Secondary Contact as "support". The Aesthetics and Fish Consumption Uses were not assessed.

Figures 2a, 2b and 2c illustrate the MassDOT-owned roads within the groundwatershed that contribute runoff to the water body. In the western side of the groundwatershed, runoff from Route 28 from the high point near Content Lane east to Geraldine Road drains via catch basins to two adjacent outfalls on the north side of Route 28 near Geraldine Road (Figure 2a). A portion of the contributing area extends approximately 380 feet west of the western boundary of the groundwatershed. Any impervious area located outside the watershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental Contributing Area". Figure 2a encompasses approximately 4 acres of impervious surface and approximately 0.2 acres of pervious surface in the right-of-way that contributes to the North Bay groundwatershed by infiltration.

Figure 2b illustrates the MassDOT-owned roads within the groundwatershed that contribute runoff to Prince Cove which drains to North Bay. A total of approximately 10 acres of impervious area and 1.4 acres of pervious area within the right-of-way of Route 28 contributes runoff to Prince Cove either by catch basin and pipe systems or runoff and infiltration to groundwater. The center portion of Route 28, beginning from approximately 350 feet west of Staysail Circle and extending 2,150 feet east of Staysail Circle (2,500 linear feet total) flows via catch basins and pipes to a subsurface leaching bed located at a low point adjacent to Marston Mills River. The ground surface at the bypass outfall for the leaching bed has become a deeply eroded channel that directs stormwater to the adjacent low-lying area that flows directly to Marston Mills River. On the east and west ends of this section of roadway directing runoff to the leaching bed, runoff from the other sections of Route

[5] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Three Bays, Barnstable, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/3Bays/3Bays_MEP_Final.pdf

[6] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

28 is directed to catch basins and pipes that drain through outfalls shown on Figure 2b or by sheet flow to adjacent pervious areas. The additional sections include the roadway from approximately 250 west of Putnam Ave to 350 feet west of Staysail Circle and the area 1,500 feet west of S. County Road to approximately 150 feet east of the intersection of Route 28 and Osterville West Barnstable Road. The drainage from these sections infiltrates into the ground and is considered contributing through groundwater.

Approximately 2,500 feet of Route 28 between Moniz Circle and Captain Aldens Lane is situated within the West Bay groundwatershed (Figure 2c). Runoff from approximately 0.7 acres of Route 28 in this area drains to pervious surfaces adjacent to the road. Runoff from approximately 2 acres of this road segment drains through catch basins and drain pipes and discharges into a recently constructed infiltration basin located at the Tanglewood Drive intersection. The impervious surface that drains to this BMP includes approximately 670 feet of Route 28 beyond the eastern boundary of the groundwatershed. This area flows back into the groundwatershed via drainage pipes and is considered "Supplemental Contributing Area". Any impervious area located outside the watershed boundary that flows back into the watershed via sheet flow, drainage pipes, or other means is considered "Supplemental".

Existing BMPs

MassDOT estimated the pollutant load reduction provided by existing BMPs by applying treatment reductions to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from different sources depending on the BMP and engineering judgment as described in the *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[7]

MassDOT identified two existing BMPs in place with the potential to treat roadway runoff from the discharging area before reaching the impaired water segment; a subsurface leaching bed located at a low point adjacent to Marston Mills River, and an infiltration basin located at the Tanglewood Drive intersection.

MassDOT estimated the pollutant load reduction provided by existing BMPs by applying treatment reductions to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's BMP performance analysis report[8] and engineering judgment. Per the methodology, the subsurface leaching bed does not provide storage or advanced water quality treatment, and therefore does not receive a nitrogen removal credit. The table below shows nitrogen removal, the MassDOT drainage areas and the pollutant load reductions for the existing infiltration basin.

Table 1 Annual MassDOT Groundwatershed Nitrogen Loading under Existing Conditions

Groundwatershed/ BMP ID	Contributing Groundwatershed Size (acres)	Pre-BMP Annual Load (lbs/yr)	BMP Pollutant Load Reduction (lbs/yr)	Post-BMP Annual Load (lbs/yr)	Estimated Annual Removal Efficiency
Existing BMP 1	2.0	12.5	5.5	7.0	44%

[7] Massachusetts Department of Transportation (MassDOT), March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[8] United States Environmental Protection Agency (USEPA), March 2010. Stormwater Best Management Practices (BMP) Performance Analysis. Available at: http://www.epa.gov/region1/npdes/stormwater/assets/pdfs/BMP-Performance-Analysis-Report.pdf

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[9] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[10] MassDOT assessed North Bay (MA96-66) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act[11]. MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[12] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of North Bay (MA96-66) is not proposed to change.

BMP 7R for Nitrogen TMDL (CN 242.0)

The *Total Maximum Daily Load (TMDL) for Total Nitrogen in the Three Bays System, Massachusetts (CN 242.0)*[13] addresses the total nitrogen impairment for this water body. MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7R[9] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL, and MassDOT's application of BMP 7R to nitrogen in groundwater-controlled watersheds.[14]

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[15] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[14] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 16.3 acres

[9] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[10] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

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

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

[13] Mass DEP.2007. Final Three Bays System, Total Maximum Daily Load for Total Nitrogen, Massachusetts (CN 242.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/threebay.pdf

[14] MassDOT. March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[15] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

- MassDOT Pervious Area: 1.8 acres
- Estimated Existing MassDOT Load: 105.7 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 110,989 lbs/yr
- Reduction Provided by Existing BMPs: 5.5 lbs/yr
- Total MassDOT Load: 100.2 lbs/yr
- MassDOT Existing Load as a percentage of Total Groundwatershed Nitrogen Load: 0.07%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[16] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 309.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP).[17] North Bay (MA96-66) is covered by the *Final Pathogen TMDL for the Three Bays Watershed*.[18]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[19]

According to the Final TMDLs, sources of indicator bacteria in the Three Bays groundwatersheds are believed to be primarily from boat discharges, waterfowl/wildlife, transport of fecal coliform via the Marston Mills River via tidal exchange and stormwater inflows from paved areas. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Additionally, the Three Bays TMDL states that the first priority should be given to all sources that result in water quality standards violations during dry weather conditions, such as illicit sewer connections, failed Title 5 systems and/or sanitary sources. Recommended TMDL implementation measures include identification and elimination of these sources.

The Three Bays TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. North Bay (MA96-66) is included as a priority ranking as a

[16] MassDOT. March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[17] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[18] Mass DEP.2009. Final Pathogen TMDL for Three Bays Watershed, Barnstable, MA (CN 309.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/3baapp/3bays.pdf

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

component of the Massachusetts Estuary Project.[17] The Three Bays TMDL states that the two predominant types of land use in the Three Bays watershed are forestland and residential.[17]

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Three Bays Watershed TMDL report (Section 6.0) [20] recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume
- Enforcement of the "No Discharge Zone" which makes direct discharge of wastewater from boats illegal

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT's BMP 7R Pathogen Methodology, [21] MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Three Bays Watershed TMDL reports, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT determined that no MassDOT targeted rest stops are located within the groundwatershed of this water body. MassDOT will be installing signs at rest stops within the groundwatershed of impaired water bodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.

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

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

[20] Mass DEP.2009. Final Pathogen TMDL for Three Bays Watershed, Barnstable, MA (CN 309.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/3baapp/3bays.pdf

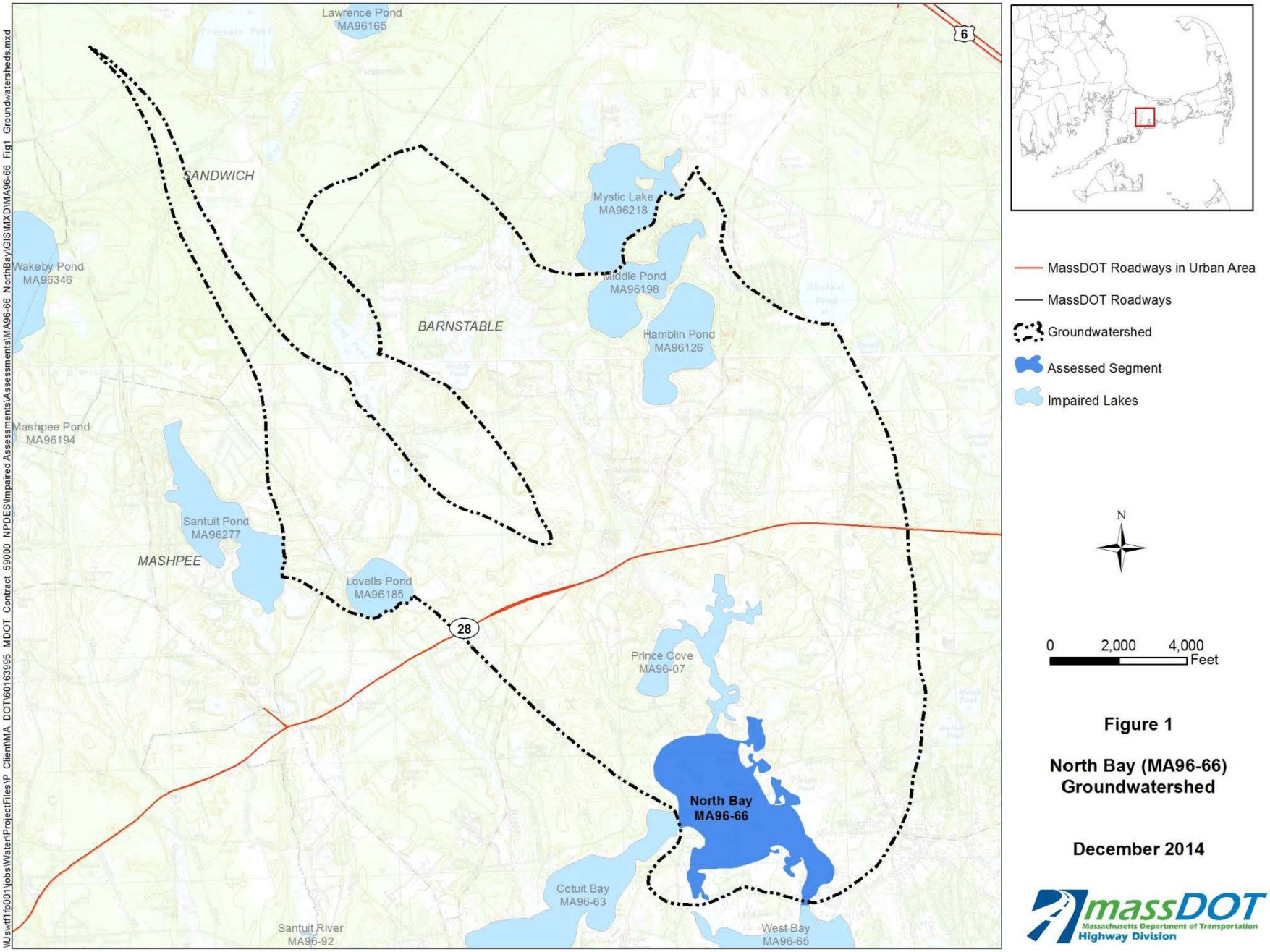
[21] MassDOT. December 2014. Description of MassDOT's Application of BMP 7R for Pathogen Related Impairments.

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of North Bay, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[22] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[22] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf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Lawrence Pond
MA96165
6
SANDWICH
Mystic Lake
MA96218
Wakeby Pond
MA96346
Middle Pond
MA96198
BARNSTABLE
Hamblin Pond
MA96126
Mashpee Pond
MA96194
Santuit Pond
MA96277
MASHPEE
Lovells Pond
MA96185
28
Prince Cove
MA96-07
North Bay
MA96-66
Cotuit Bay
MA96-63
Santuit River
MA96-92
West Bay
MA96-65
MassDOT Roadways in Urban Area
MassDOT Roadways
Groundwatershed
Assessed Segment
Impaired Lakes
N
0
2,000
4,000
Feet
Figure 1
North Bay (MA96-66)
Groundwatershed
December 2014
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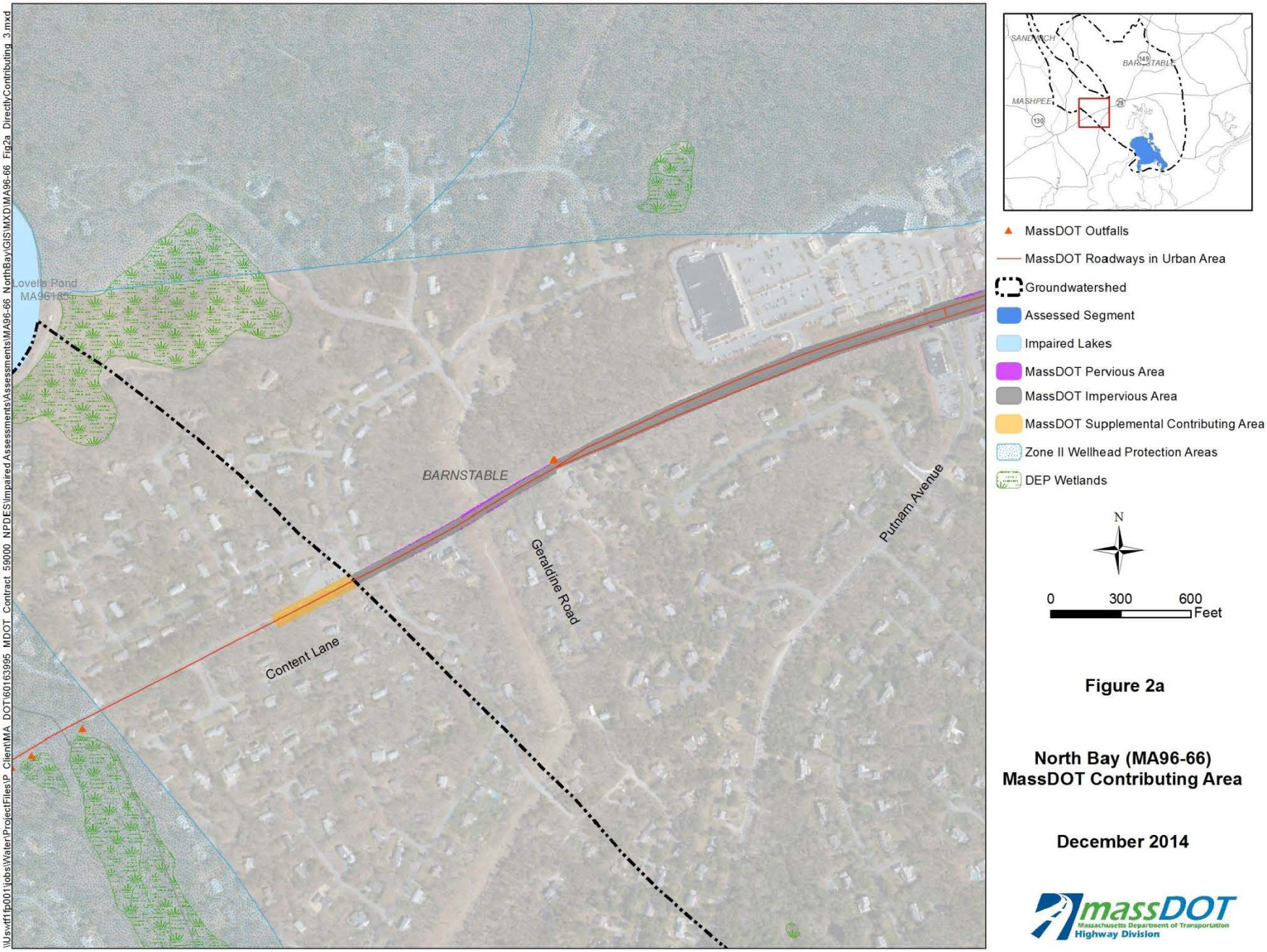
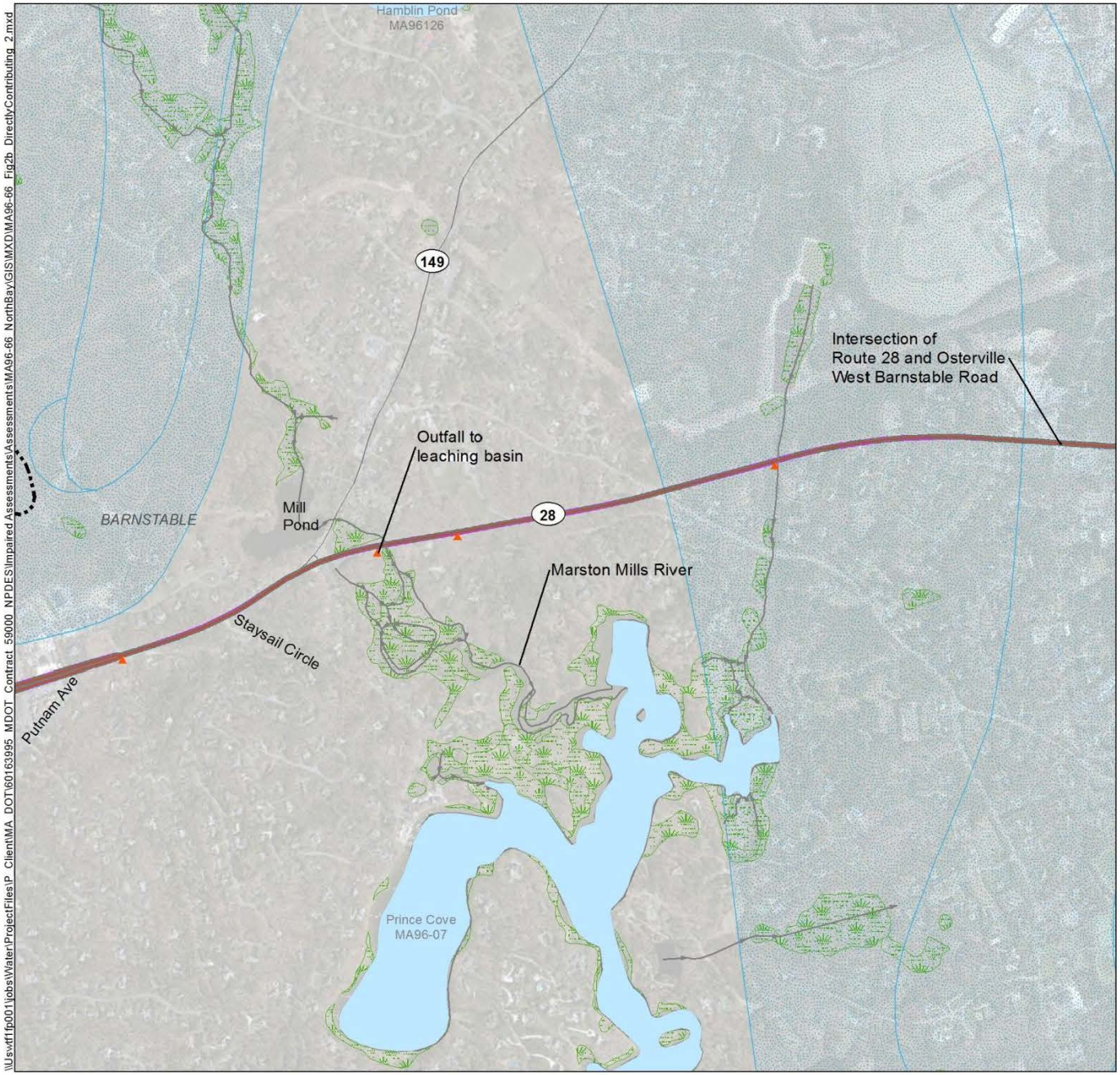
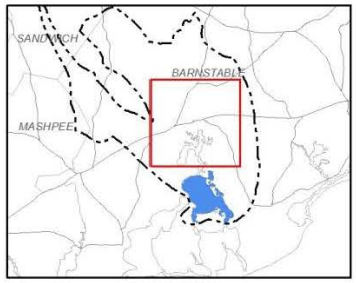


Figure 2a

North Bay (MA96-66)
MassDOT Contributing Area

December 2014





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- MassDOT Pervious Area
- MassDOT Impervious Area
- Zone II Wellhead Protection Areas
- DEP Wetlands
- Non-Impaired Streams

N

0 600 1,200 Feet

Figure 2b

North Bay (MA96-66)
MassDOT Contributing Area

December 2014

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Figure 2c

North Bay (MA96-66)
MassDOT Contributing Area

December 2014

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Impaired Waters Assessment for Town Cove (MA96-68)

Summary

Impaired Water[1]	Stormwater Impairments:	*Nitrogen (Total); Fecal Coliform*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the Cape Cod Watershed*[2]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location	Towns:	*Orleans, Eastham*
	MassDOT Roads:	*Route 28, Route 6, and Route 6A*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*186.9 lbs/yr*
	Existing Load to Water Body:	*25,428 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.73 %*

Site Description

Town Cove (MA96-68) is an embayment that extends along the border between Orleans and Eastham, Massachusetts. It includes Rachel Cove and Woods Cove and extends to the outlet to Nauset Harbor. Figure 1 illustrates the groundwatershed and the location of this 0.8-square mile water body. The groundwatershed for this impaired segment is based on technical reports[4]

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

[2] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

[3] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

[4] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Nauset Harbor Embayment System, Orleans and Eastham, Massachusetts. Unpublished Report.

developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Town Cove (MA96-68). Based on aerial images, the land use within the groundwatershed is mostly residential with a lesser amount of commercial area as well.

MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[5] identifies the Aquatic Life Use as "impaired" for Town Cove (MA96-68). The Shellfish Harvesting Use was identified as "impaired" for 0.003 square miles and "support" for 0.787 square miles. The "impaired" status for the Aquatic Life Use is reported to be caused by loss of eelgrass habitat (estuarine bioassessment) from unknown sources. The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from waterfowl, and discharges from municipal separate storm sewer systems. Primary and Secondary Contact Uses were identified as "support". The other uses were not assessed. As seen on Figure 2c, an Area of Critical Environmental Concern (ACEC) related to Boat Meadow River (MA96-15) is partially located within the groundwatershed of Town Cove (MA96-68).

Figures 2a through 2e illustrate the MassDOT-owned roadway within the groundwatershed that contributes runoff to the water body. Approximately 25.9 acres of urban roadway drains to the watershed via overland flow, infiltration or catch basins and pipes; therefore, these sections of roadway are considered discharging to Town Cove (MA96-68).

Figure 2a shows the southern extent of the urban roadways within the Town Cove groundwatershed. The entire area of Route 6 within this section of the groundwatershed contributes runoff to the groundwatershed. Runoff is collected mainly with localized catch basins which discharge to the pervious area adjacent to the road, where the stormwater infiltrates into the ground. The urban roadway area on Route 6 extending south from the Route 6A east-bound ramp to the north boundary of the groundwatershed is considered "Supplemental Contributing Area" as the runoff from this section of roadway is collected and discharged within the groundwatershed boundary. Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental".

Route 28 is located in the southern portion of the groundwatershed and contributes runoff to the groundwatershed. This section of roadway continues north to the intersection with Route 6A and continues on Figure 2b. Runoff is collected mainly with localized catch basins which discharge to the pervious area adjacent to the road. Route 6A is located in the western portion of the groundwatershed, its entry point into the groundwatershed is shown in Figure 2b. Runoff from the supplemental contributing areas outside of the groundwatershed on Route 6A flows into the groundwatershed via storm drains. From a high point at 1st Choice Cleaners southwest to Orleans Lobster Pound, the impervious area contributes runoff as supplemental area and flows northeast along Route 6A and into the groundwatershed. Runoff is collected in catch basins and discharges to an outfall behind a retail building at 139 Old Kings Highway. This outfall discharges to a wetland

[5] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

that is within the groundwatershed boundary. Approximately 180 linear feet of roadway outside of the groundwatershed contributes supplemental runoff from its impervious area (Figure 2b).

The majority of the runoff from Route 6A within the groundwatershed is collected by catch basins and routed to areas off of the roadway to two outfalls near the shore of Town Cove (Figure 2c). Route 6 re-enters the Town Cove groundwatershed at the Route 6/6A traffic circle. Runoff from the impervious areas of the traffic circle and the area just northwest of the circle extending to a high point on Route 6 flows to points outside of the groundwatershed and is not considered contributing to Town Cove (MA96-68).

The MassDOT contributing area of Route 6 continues in a northern direction in Figures 2d and 2e. The majority of the runoff from Route 6 within the groundwatershed is collected by catch basins and leached into the ground on site or routed to pervious areas off of the roadway.

Existing BMPs

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

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Town Cove (MA96-68) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[8] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Town Cove is not proposed to change.

BMP 7U for Nitrogen

MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[7] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have not been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-

[6] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

controlled watersheds.[10] The MEP technical report[11] identifies the total existing groundwatershed nitrogen load for this water body to address the total nitrogen impairment.

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[12] to estimate annual pollutant loads from its property and treatment through existing BMPs, if present. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[10] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 26.6 acres
- MassDOT Pervious Area: 8.8 acres
- Estimated Existing MassDOT Load: 186.9 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 25,428 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.73%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[10] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). Town Cove (MA96-68) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[13]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[14]

According to the Final TMDL, sources of indicator bacteria in the Cape Cod Watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals.

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[10] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[11] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Nauset Harbor Embayment System, Orleans and Eastham, Massachusetts. Unpublished Report.

[12] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[13] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

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

Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and best management practices to mitigate stormwater runoff volume.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod Watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Town Cove (MA96-68) is not prioritized due to insufficient data, however, the water body is designated Class SA and includes a designated use for shellfishing which indicate there is a high resource value associated with Town Cove. [15]

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report[16] (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters
- Repair illicit discharge outlets
- Biannual or annual street sweeping and catch basin cleaning

[15] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT's BMP 7R Pathogen Methodology,[16] MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

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

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

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Town Cove, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[17] MassDOT does not use nitrogen based fertilizers as part of normal

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

[17] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

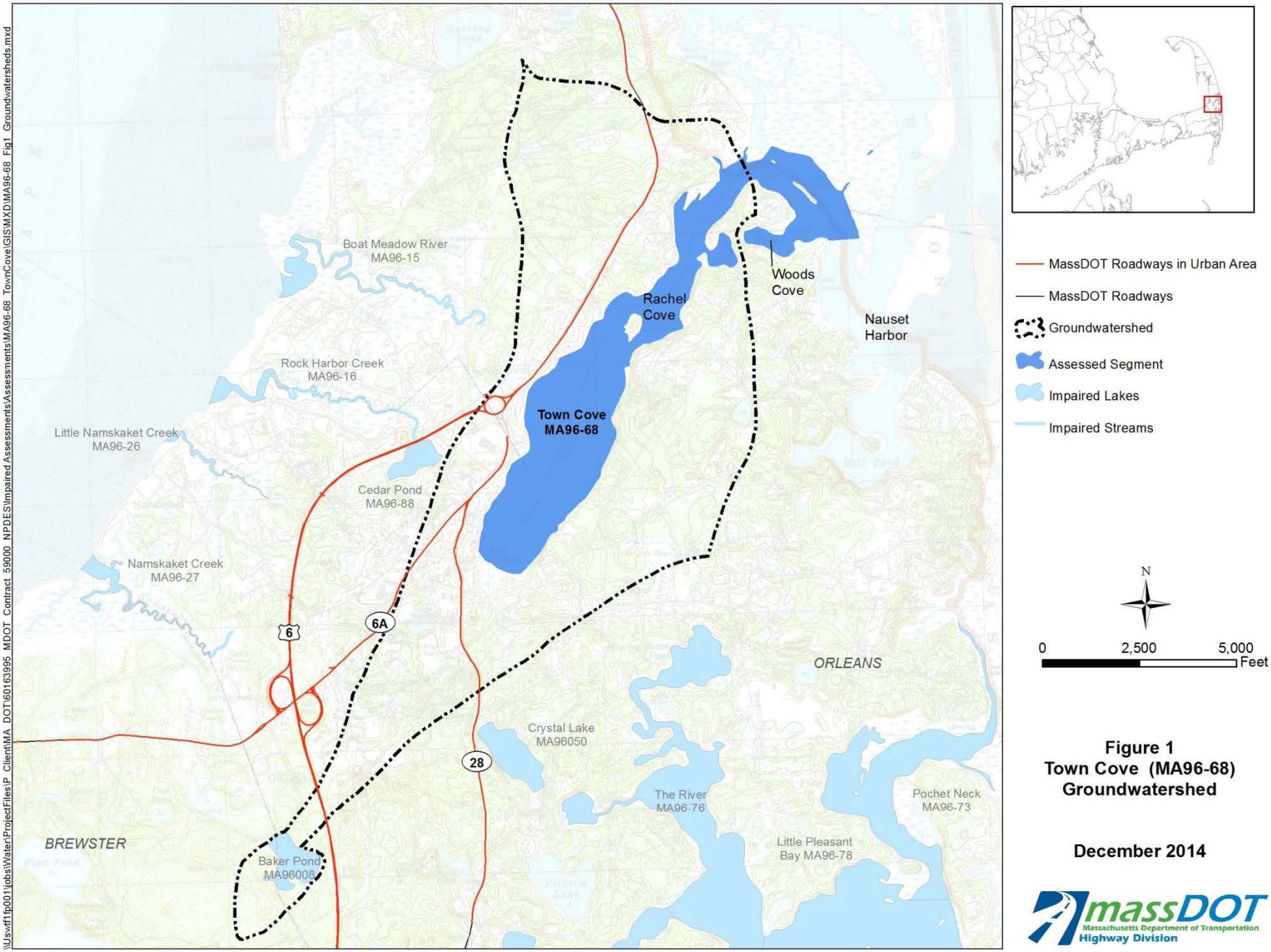

Figure 1
Town Cove (MA96-68)
Groundwatershed

December 2014

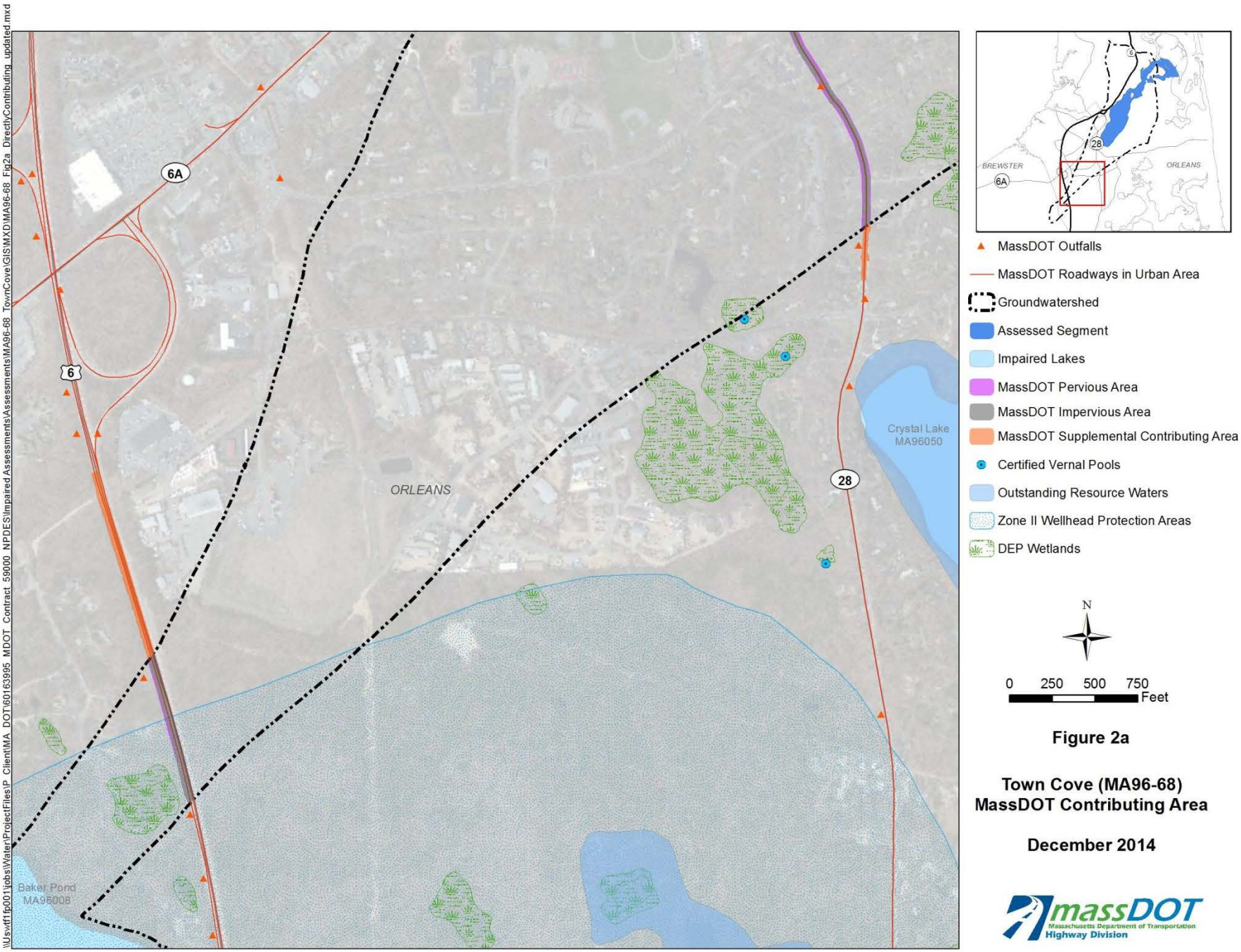

Figure 2a

Town Cove (MA96-68)
MassDOT Contributing Area

December 2014

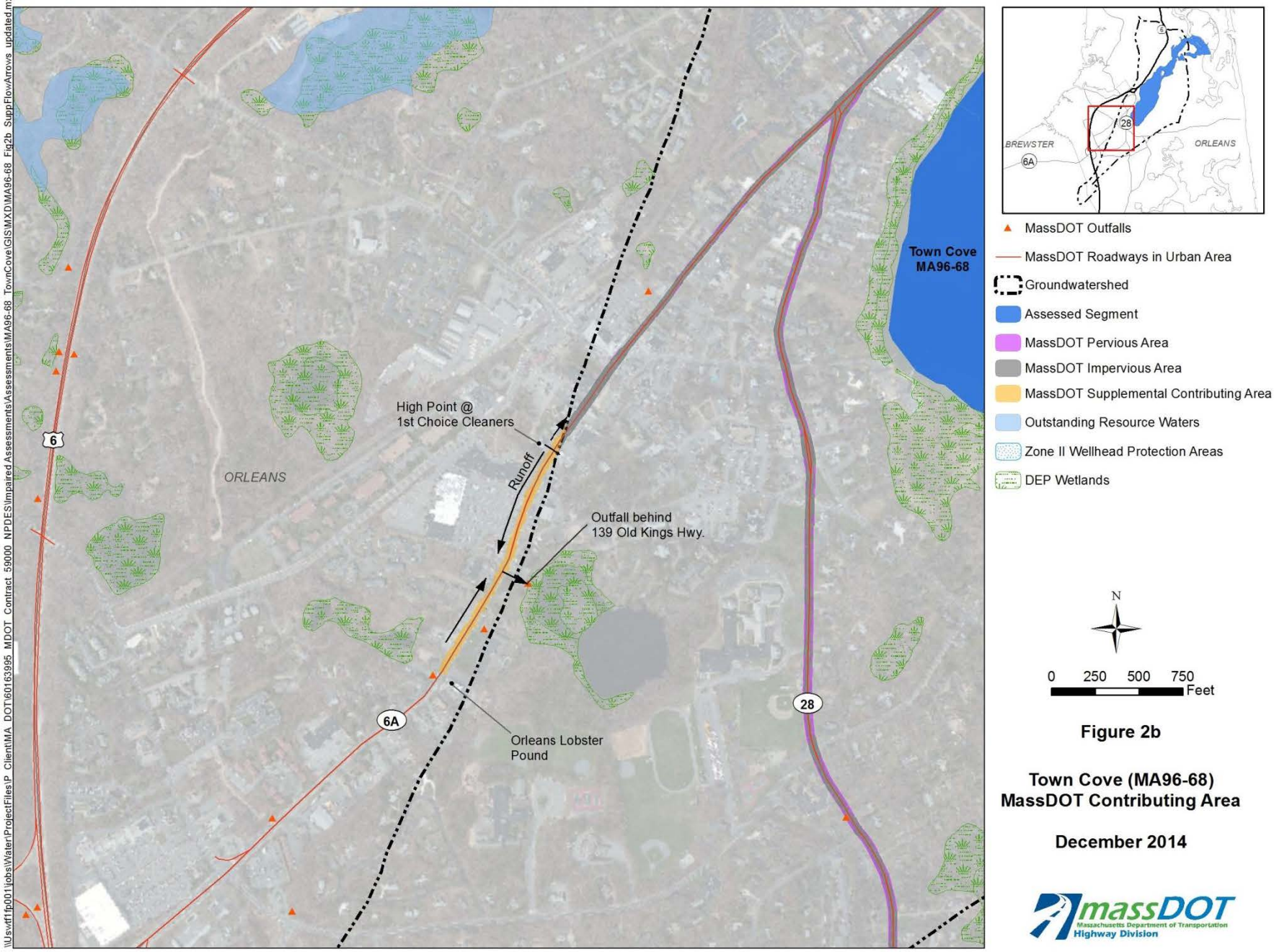

Figure 2b

Town Cove (MA96-68)
MassDOT Contributing Area

December 2014

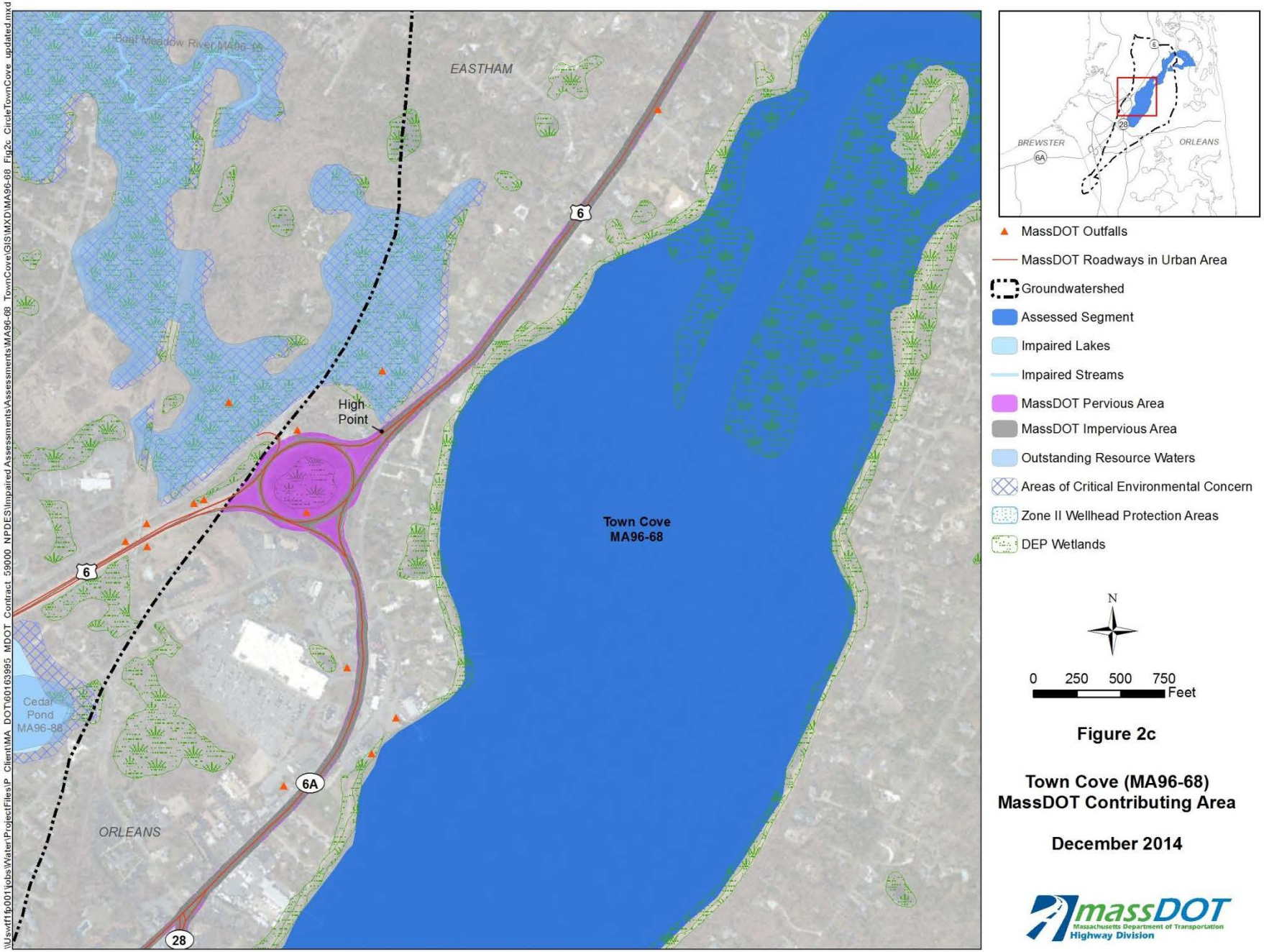

Figure 2c

Town Cove (MA96-68)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

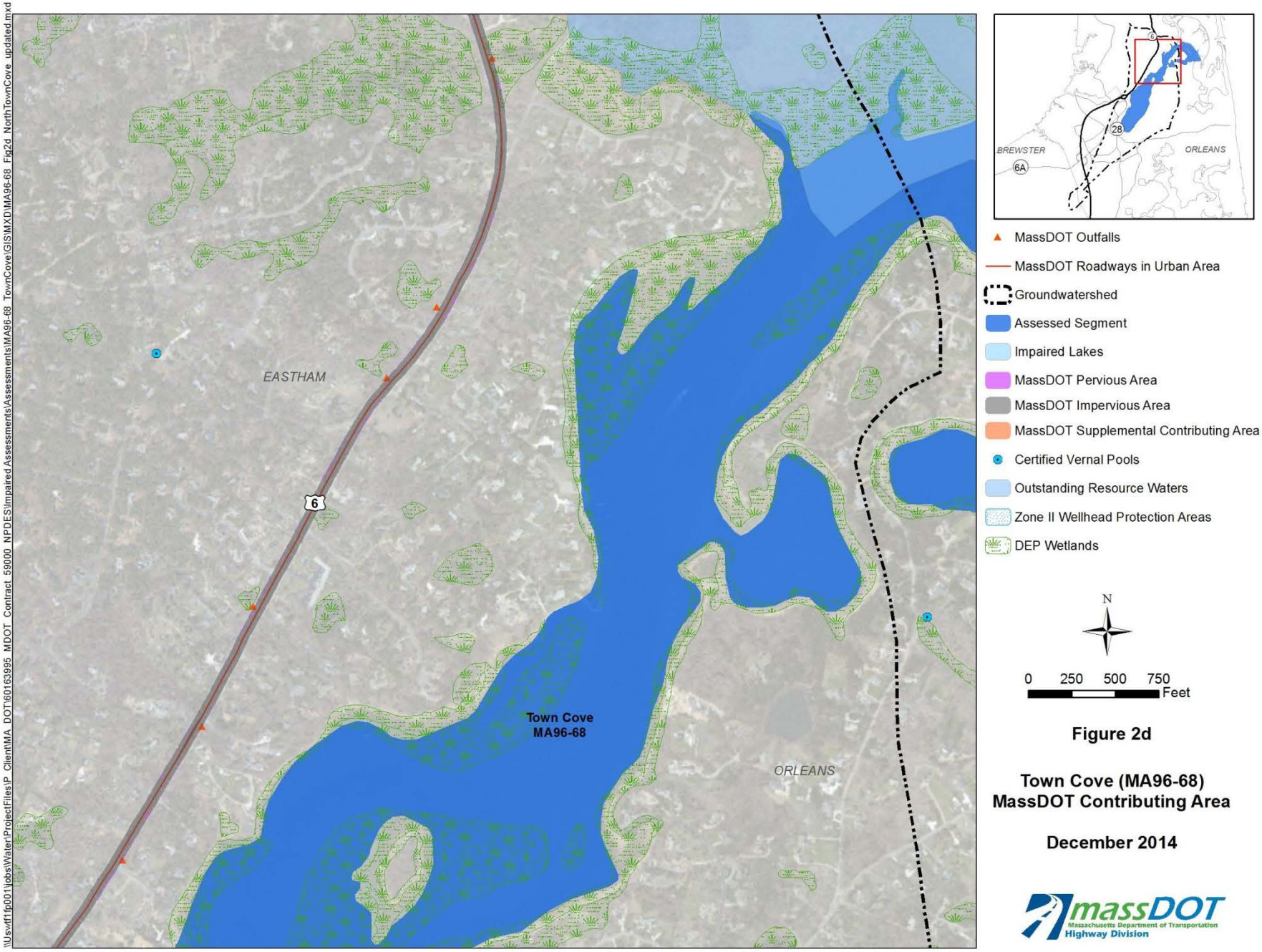

Figure 2d

Town Cove (MA96-68)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

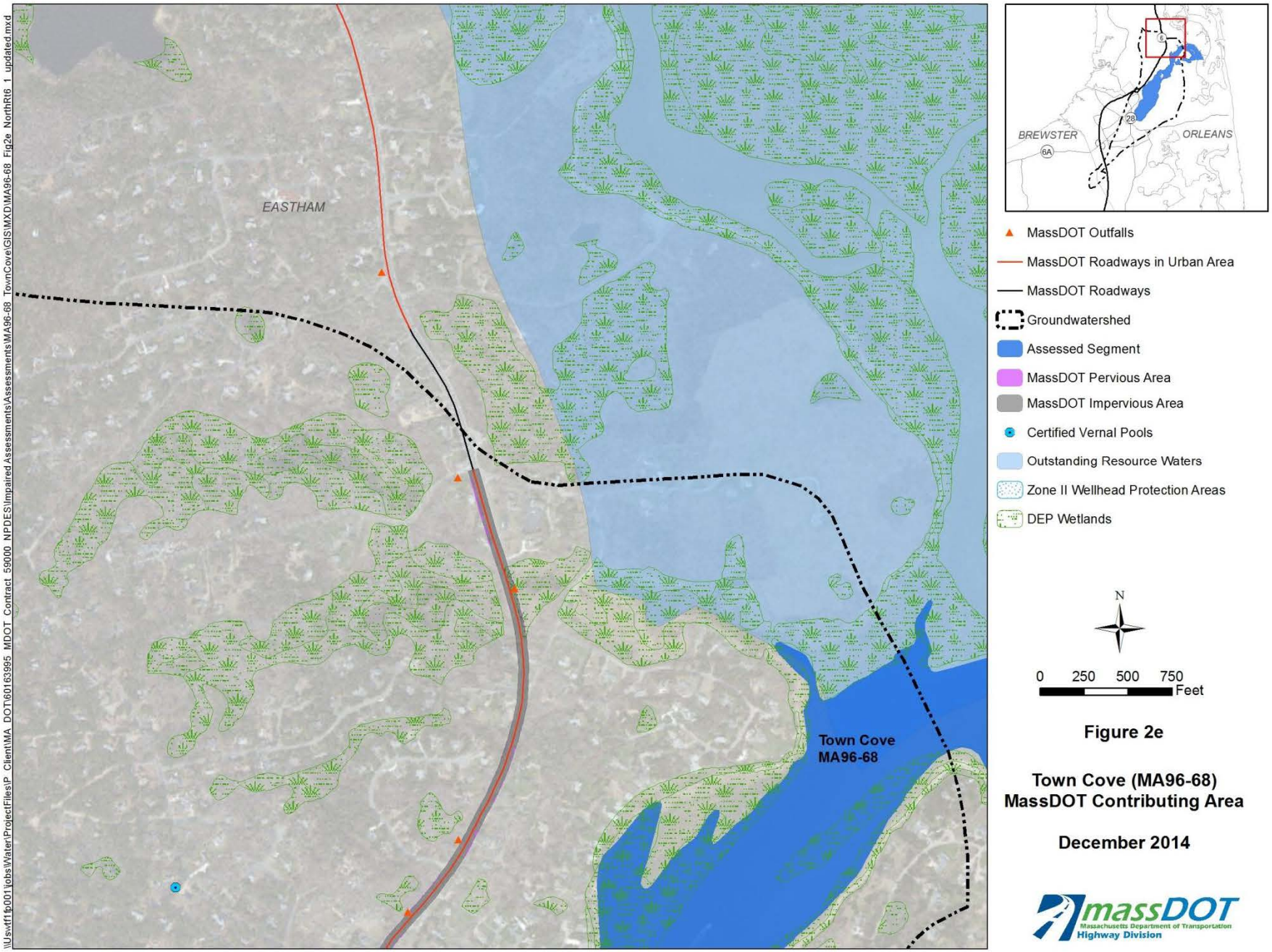

Figure 2e

Town Cove (MA96-68)
MassDOT Contributing Area

December 2014

massDOT Massachusetts Department of Transportation Highway Division

12/08/2014

Impaired Waters Assessment for The River (MA96-76)

Summary

Impaired Water[1]	Stormwater Impairments:	*Estuarine Bioassessments, Fecal Coliform, Nitrogen (Total)*
	Category:	*4A (TMDL is completed)*
	Final TMDLs:	*Addendum: Final Pathogen TMDL for the Cape Cod Watershed*[2] *Final Pleasant Bay System TMDL for Total Nitrogen*[3]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]
Location	Towns:	*Brewster, Orleans*
	MassDOT Roads:	*Route 6, Route 28*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☐
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*76.4 lbs/yr*
	Existing Load to Water Body:	*20,861 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.37 %*

Site Description

The River (MA96-76) is a 0.42-square mile water body located in Orleans, Massachusetts. Figure 1 illustrates the groundwatershed for The River (MA96-76). The groundwatershed for this impaired

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

[2] MassDEP. 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

[3] MassDEP. 2007. Final Pleasant Bay System TMDL for Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/pbtmdl.pdf

[4] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

segment is based on technical reports[5] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment.

As indicated in Figure 1, The River, which includes Meeting House Pond and Kescayo Gansett Pond, receives inflow from the following upgradient water bodies and their delineated groundwatersheds: Areys Pond (MA96-70), Namequoit River (MA96-71), Crystal Lake (MA96050), Pilgrim Lake (MA96246), Baker Pond (MA96008), Little Cliff Pond and Higgins Pond. Some of these water bodies and their water quality conditions are discussed in separate assessments. The River (MA96-76) discharges to Little Pleasant Bay (MA 96-78). MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to The River (MA96-76). The River groundwatershed is located in Orleans and Brewster and includes residential areas, wetlands, ponds, state park land, and MassDOT roads (Route 6 and Route 28). The majority of the groundwatershed is wooded. There is also an Area of Critical Environmental Concern within The River groundwatershed.

MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[6] identifies the Aquatic Life Use as "impaired" and 0.002 square miles as "impaired" for the Shellfishing Harvesting Use. The "impaired" status for the Aquatic Life Use is reported to be caused by loss of eelgrass bed habitat (estuarine bioassessment) and total nitrogen from subsurface wastewater disposal (septic) systems, stormwater runoff (unspecified urban stormwater and discharges from municipal separate storm sewer systems] and fertilizers [yard maintenance, agriculture). The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from marina or boating pump-out releases, waterfowl, and discharges from municipal separate storm sewer systems. The Primary and Secondary Contact Uses are reported as "supported". The other uses were not assessed.

Figures 2a through 2c illustrate the MassDOT roads within the groundwatershed that contribute runoff to the water body. It should be noted that only a portion of the MassDOT-owned roads inside the groundwatershed boundary are within an MS4-regulated urban area. Portions of the MassDOT roads are outside of the designated urban area; therefore, discharges from these sections of roadway are not identified as contributing to the impaired segment. Approximately 9.3 acres of impervious roadway area and 7.5 acres of pervious within the Route 28 and Route 6 rights-of-way within the urban area drain to the groundwatershed.

Route 6 crosses the groundwatershed west of and mainly parallel to Route 28. Route 6, a two-lane highway, has surrounding land uses of conservation land, state park, and residential. Runoff from Route 6 within the groundwatershed includes a section of roadway from the northern groundwatershed limits extending to approximately the Orleans town limits (Figure 2a). Roadway runoff is collected by catch basins that direct flow through drain pipes to adjacent wooded areas. Additionally, a 300-foot segment of Route 6 which extends outside of the groundwatershed border

[5] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Pleasant Bay System, Orleans, Chatham, Brewster and Harwich, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/Pleasant_Bay/PleasantBay_MEP_Final.pdf

[6] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

is considered "Supplemental Contributing Area". Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". Stormwater from this area flows along the roadway south where it is collected in catchbasins and discharges to a subsurface leaching basin west of Route 6 (Figure2a).

Route 28 crosses the groundwatershed boundary west of Crystal Lake, Pilgrim Lake, and Areys Pond. Route 28 has one lane in each direction and a narrow shoulder within a 50 feet wide right-of-way. As mentioned in the Namequoit River assessment, Route 28 has two urbanized sections contributing runoff. The northern section starts at The River's northern groundwatershed boundary and extends south to Areys Lane (Figure 2b). The southern section starts at The River's southern groundwatershed boundary and extends north to Namequoit Road (Figure 2c). A 265-foot segment of Route 28 south of the groundwatershed border is a supplemental contributing area. Flow from this area is collected in catchbasins and pipes discharging at an outfall between Namequoit Road and John Kenrick Road (Figure 2c).

Existing BMPs

MassDOT identified an existing leaching basin west of Route 6 (Figure 2a). Per the methodology, the subsurface leaching bed does not provide storage or advanced water quality treatment, and therefore does not receive a nitrogen removal credit.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[7] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[8] MassDOT assessed The River (MA96-76) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[9] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[10] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of The River (MA96-76) is not proposed to change.

BMP 7R for Nitrogen TMDL (CN 244.0)

The *Total Maximum Daily Load (TMDL) for Total Nitrogen in the Pleasant Bay System, Massachusetts (CN 244.0)* [11] identifies the total existing groundwater nitrogen load for this water

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

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

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

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

[11] MassDEP. 2007. Final Pleasant Bay System TMDL for Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/pbtmdl.pdf

body and attributes estuarine degradation to excess nitrogen loading from the groundwatershed. Therefore, MassDOT considers the following impairments to The River (MA96-76) to be linked to excess nitrogen: estuarine bioassessments and total nitrogen. MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7R[7] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL, and MassDOT's application of BMP 7R to nitrogen in groundwater-controlled watersheds.[12]

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[13] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[12] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 9.3 acres
- MassDOT Pervious Area: 7.5 acres
- Estimated Existing MassDOT Load: 76.4 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 20,861 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.37%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[12] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 252.2)

MassDOT assessed the indicator bacteria impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP).[14] The River (MA96-76) is covered by the Addendum to the *Final Pathogen TMDL for the Cape Cod Watershed*,[15] which is an *Addendum to the 2009 Final Pathogen TMDL for the Cape Cod Watershed*.[16]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead

[12] MassDOT, March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[13] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[14] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[15] MassDEP. 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

[16] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[17]

According to the 2009 Cape Cod Pathogen TMDL, sources of indicator bacteria throughout the watershed were found to be many and varied. Most of the bacteria sources are believed to be failing septic systems, combined sewer overflows (CSO), sanitary sewer overflows (SSO), sewer pipes connected to storm drains, certain recreational activities, wildlife including birds along with domestic pets and animals and direct overland stormwater runoff. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and best management practices to mitigate stormwater runoff volume.[18]

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters (ORWs) or designated uses that require higher water quality standards than Class B. The River (MA96-76) is not prioritized due to a lack of data; however, the water body is classified as a Class SA ORW and includes a shellfishing use.[19]

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

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

[18] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

[19] MassDEP. 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of "No Discharge" areas in high priority coastal waters
- Annual street sweeping and catch basin cleaning

Proposed Mitigation Plan

As described above, MassDOT's nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT's BMP 7R Pathogen Methodology,[20] MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

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

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

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

MassDOT has concluded that the BMPs outlined in the SWMP are consistent with its existing permit requirements for The River. These measures achieve pathogen reductions (including fecal

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

coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from MassDOT roadways to be a contributing source it is unlikely to warrant action relative to other sources of pathogens in the groundwatershed.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of The River, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[21] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[21] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

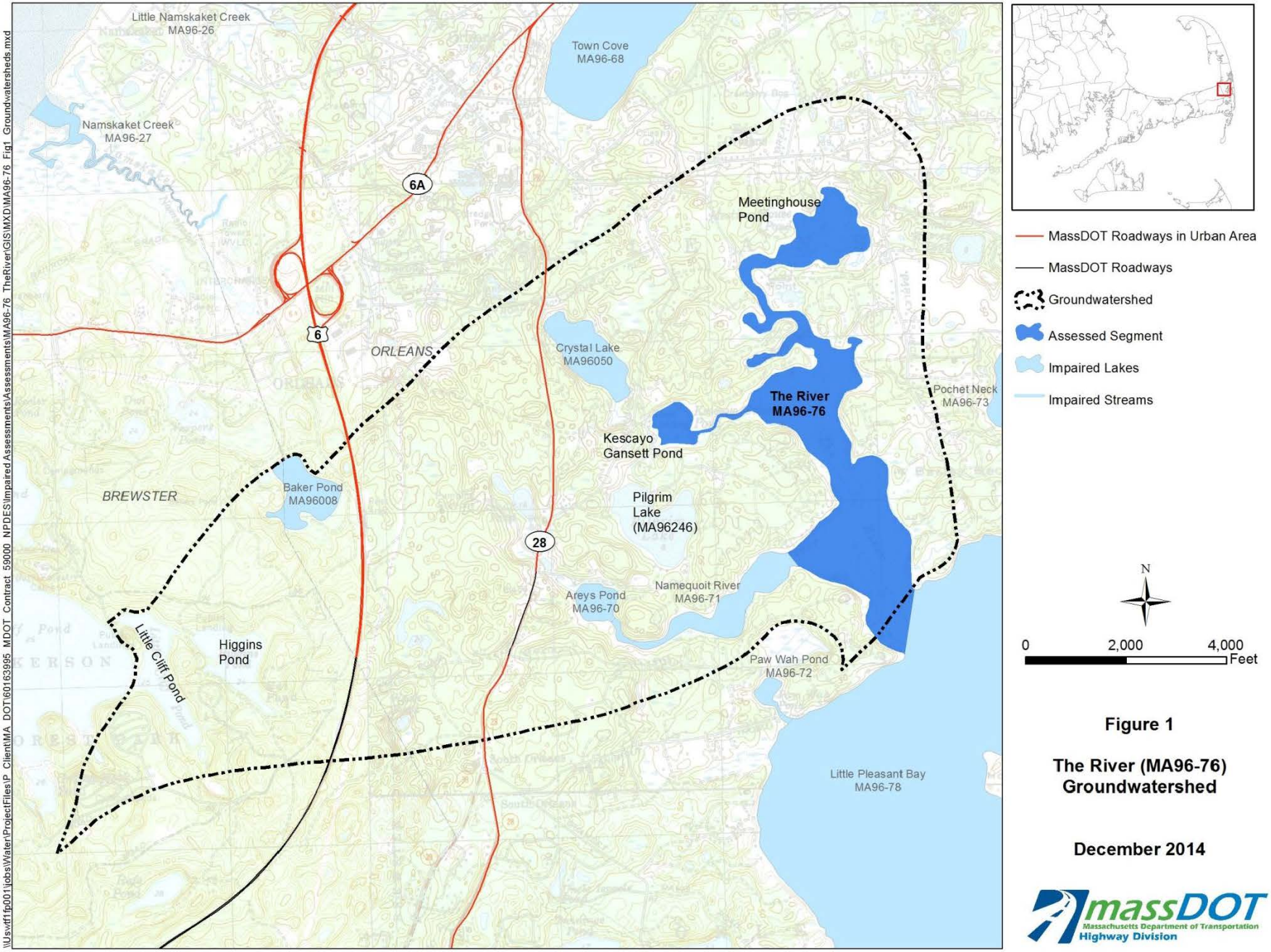

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Figure 1

The River (MA96-76) Groundwatershed

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

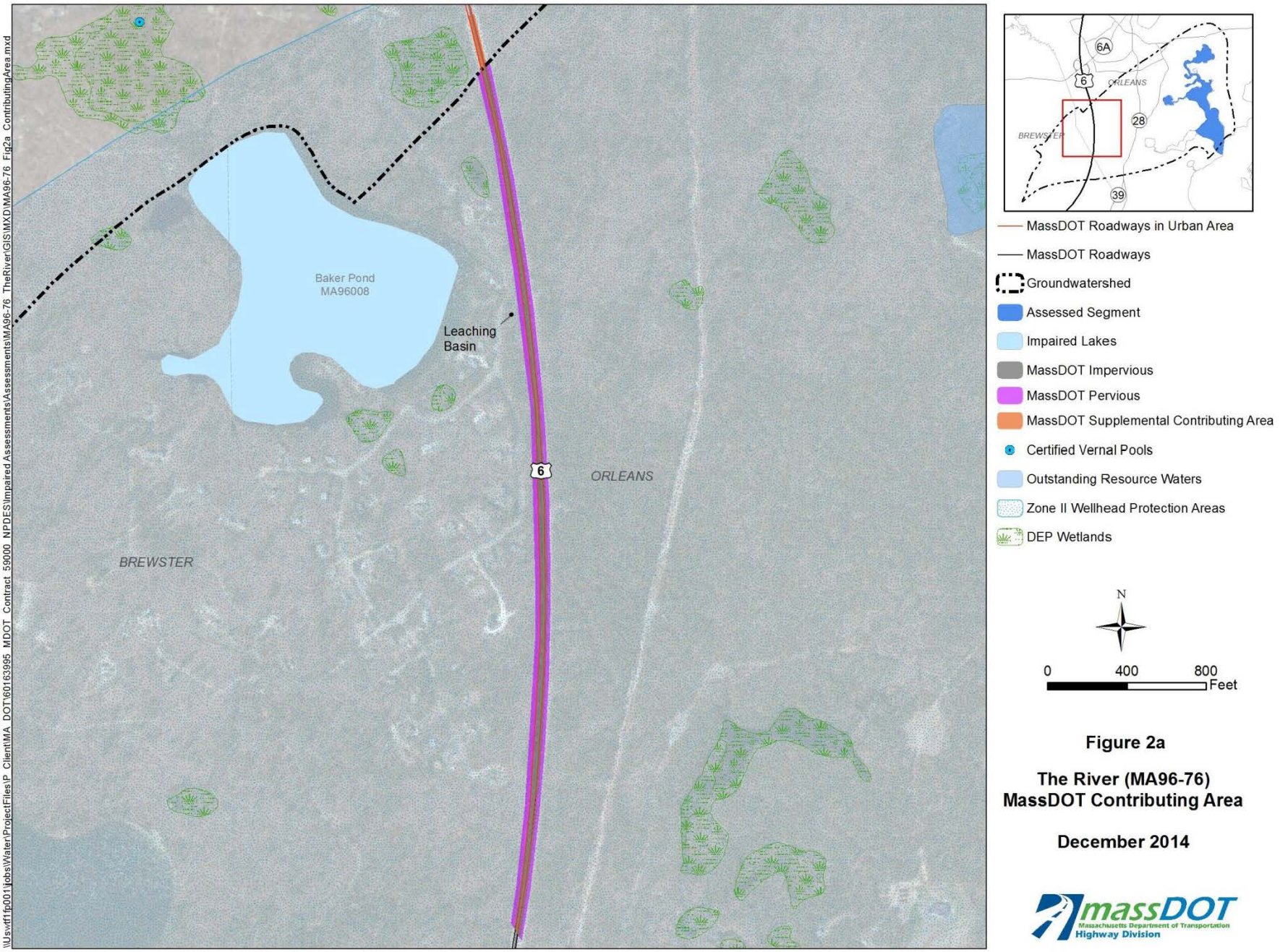

Figure 2a

The River (MA96-76)
MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

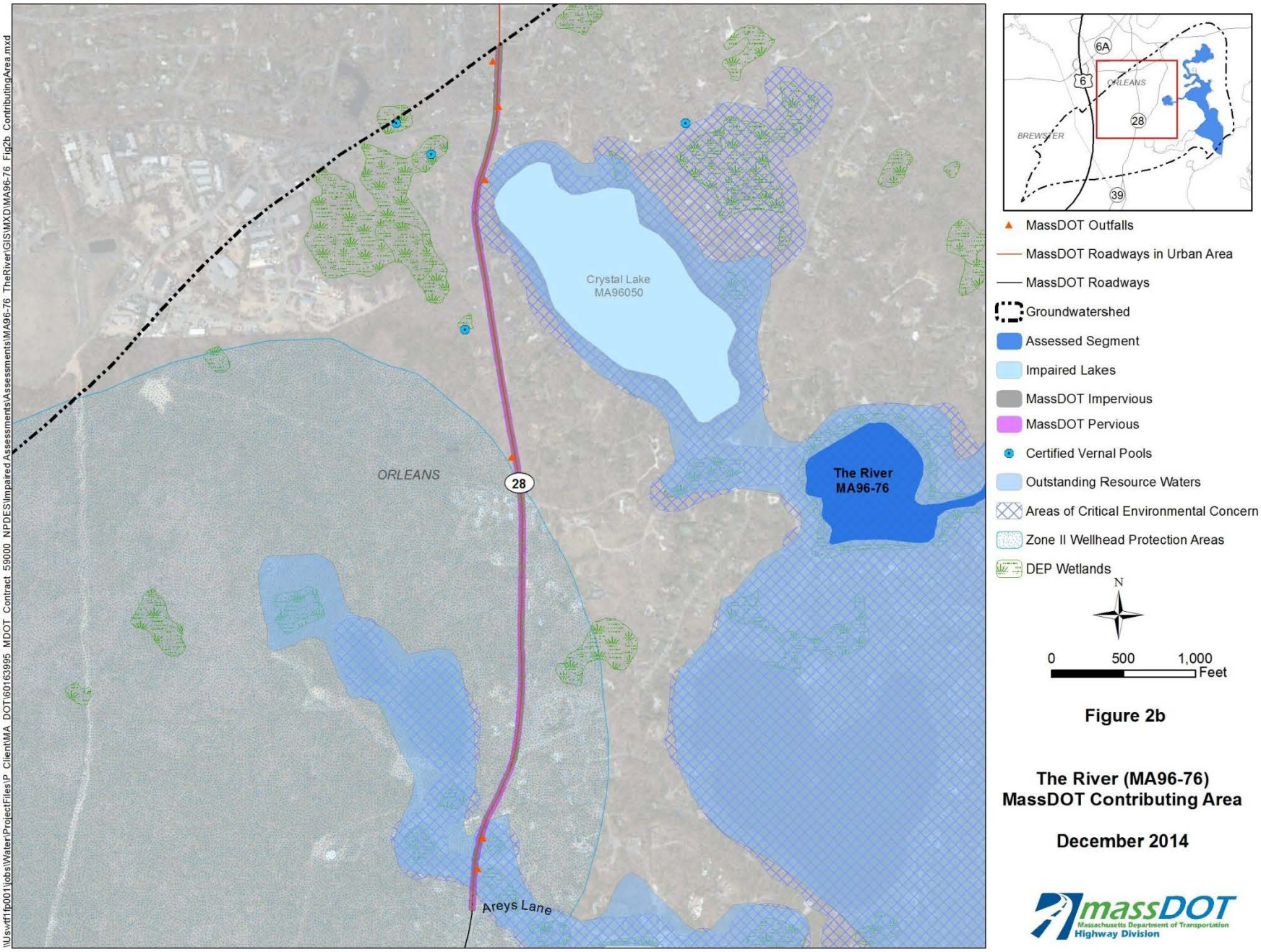

Figure 2b

The River (MA96-76)
MassDOT Contributing Area

December 2014

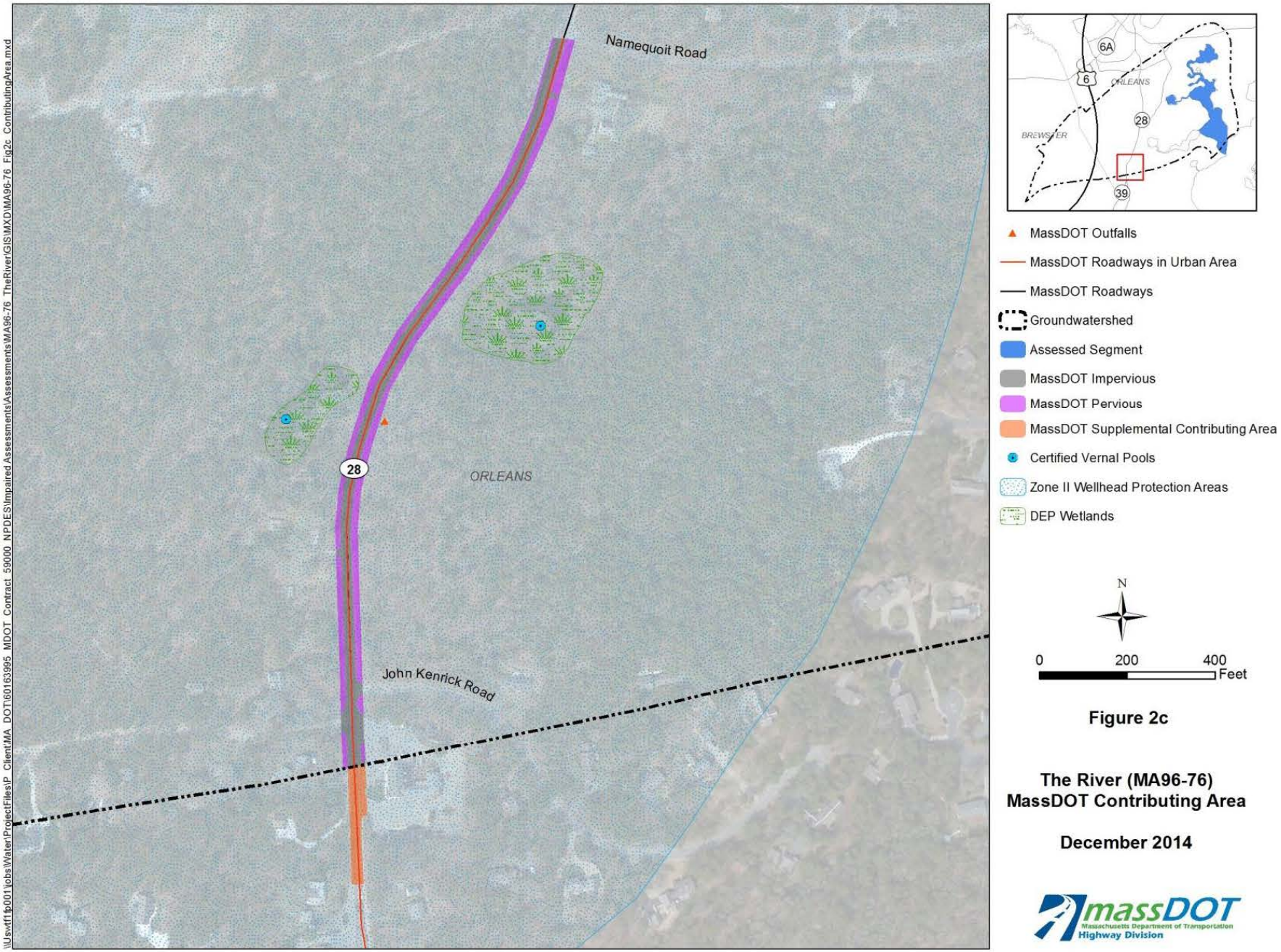

Figure 2c

The River (MA96-76)
MassDOT Contributing Area

December 2014

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Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78)

Summary

Impaired Water[1]	**Pleasant Bay (MA96-77)**:	Stormwater Impairments:	*Nitrogen (Total)*
		Category:	*4A (TMDL is completed)*
		Final TMDLs:	*Final Pleasant Bay System TMDL for Total Nitrogen*[2]
		WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
	Little Pleasant Bay (MA96-78):	Stormwater Impairments	*Fecal Coliform, Nitrogen (Total)*
		Category:	*4A (TMDL is completed)*
		Final TMDLs:	*Addendum: Final Pathogen TMDL for the Cape Cod Watershed*[4] *Final Pleasant Bay System TMDL for Total Nitrogen*[2]
		WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location		Towns:	*Brewster, Chatham, Harwich, Orleans*
		MassDOT Roads:	*Route 6, Route 28, Route 137*
Assessment Method(s)	7R (TMDL Method) ☒		7U (Non-TMDL Method) ☐
BMPs		Existing:	*None*
MassDOT Area and Targets			Nitrogen
		Estimated MassDOT Load:	*312.6 lbs/yr*
		Existing Load to Water Body:	*358,002 lbs/yr*
		MassDOT Contribution to Existing Load:	*0.09 %*

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

[2] MassDEP. 2007. Final Pleasant Bay System TMDL for Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/pbtmdl.pdf

[3] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

[4] MassDEP. 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

Site Description

Pleasant Bay (MA96-77), a 2.88 square mile water body, and Little Pleasant Bay (MA96-78), a 3.3 square mile water body, are located adjacent to Chatham Harbor in Brewster, Harwich, Orleans, and Chatham, Massachusetts. Figure 1 illustrates the groundwatershed for the entire Pleasant Bay system, including both Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78). The groundwatersheds are based on technical reports[5] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). The Pleasant Bay and Little Pleasant Bay systems were assessed within the overall Pleasant Bay watershed since the groundwatershed for Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) were combined within the MEP report. For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment.

As indicated in Figure 1, Pleasant Bay and Little Pleasant Bay are two parts of a larger Pleasant Bay system including Chatham Harbor (MA 96-10) which ultimately drains to the Atlantic Ocean. Chatham Harbor is not being assessed as part of the Impaired Waters Program because it is designated a category 2 water on the Massachusetts 303(d) list; [6] however, the Pleasant Bay system groundwatershed includes a number of upgradient impaired water bodies and their delineated groundwatersheds: Frost Fish Creek (MA 96-49), Ryder Cove (MA 96-50), Muddy Creek (MA 96-51), Areys Pond (MA96-70), Namequoit River (MA96-71), Paw Wah Pond (MA 96-72), Pochet Neck (MA 96-73), Quanset Pond (MA 96-74), Round Cove (MA 96-75), The River (MA 96-76), Baker Pond (MA96008), Crystal Lake (MA96050), Lovers Lake (MA96186), and Stillwater Pond (MA96309). These water bodies and their water quality conditions are discussed in separate assessments. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78).

For Pleasant Bay (MA96-77), MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3] identifies the Aquatic Life Use as "impaired". The Aquatic Life Use is reported to be caused by total nitrogen from subsurface wastewater disposal (septic) systems, stormwater runoff (unspecified urban stormwater and discharges from municipal separate storm sewer systems) and fertilizers (yard maintenance, agriculture, golf courses). Shellfish Harvesting, Primary Contact and Secondary Contact Uses are reported as "supported". The other uses were not assessed.

For Little Pleasant Bay (MA96-78), MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[3] identifies the Aquatic Life Use as "impaired" and 0.001 square miles as "impaired" for the Shellfishing Harvesting Use. The Aquatic Life Use is reported to be caused by total nitrogen from subsurface wastewater

[5] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Pleasant Bay System, Orleans, Chatham, Brewster and Harwich, Massachusetts. Available at: http://www.oceanscience.net/estuaries/report/Pleasant_Bay/PleasantBay_MEP_Final.pdf

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

disposal (septic) systems, stormwater runoff (unspecified urban stormwater and discharges from municipal separate storm sewer systems) and fertilizers (yard maintenance). The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from marina or boating pumpout releases, waterfowl, and discharges from waterfowl and upstream sources. The Primary and Secondary Contact Uses are reported as "supported". The other uses were not assessed.

Figures 2A through 2I illustrate the MassDOT-owned roads in the urban area within the groundwatershed that contribute runoff to the water bodies. It should be noted that only a portion of the MassDOT-owned roads inside the groundwatershed boundary are within an MS4-regulated urban area. Portions of the MassDOT roads are outside of the designated urban area; therefore, discharges from these roadways are not identified as contributing to the impaired segment.
Route 6 crosses through the groundwatershed west of Route 28, from the east side of Baker Pond running just south of Long Pond. Route 6, a two-lane highway, has two urbanized sections contributing runoff (Figures 2A and 2B). As described in The River (MA96-76) assessment, the northern section has surrounding land uses of conservation land, state park, and residential land uses. This section of contributing roadway starts at the northern groundwatershed limits extending south to approximately the Orleans town limits. Roadway runoff is collected by catch basins that direct flow through drain pipes to adjacent wooded areas. A 300-foot segment of Route 6 north of the groundwatershed border is located outside of the groundwatershed boundary and is considered "Supplemental Contributing Area" (Figure 2A). Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental". Stormwater from this area flows along the roadway south where it is collected in catchbasins which discharge to a leaching basin west of Route 6 within the groundwatershed.

The southern section of Route 6 includes the area described in the Muddy Creek assessment, as well as additional ramp areas at the intersection between Route 137 and Route 6 (Figure 2B). At the Route 137/ Route 6 interchange a small section of Route 137 and the ramp connecting Route 137 northbound to Route 6 eastbound contributes runoff within the Muddy Creek groundwatershed via overland flow, infiltration or catchbasins and pipes. MassDOT roadway includes Route 6 areas from the intersection with Route 137 to a high point approximately 325 feet north of the southern groundwatershed boundary close to Hawksnest Pond; the roadway south of this is collected in pipes and conveyed south where the runoff discharges outside of the groundwatershed. Approximately 11.4 acres of impervious roadway area and 6.3 acres of pervious within the Route 6 or Route 137 rights-of-way drains to the groundwatershed.

Route 28 crosses the groundwatershed boundary just west of Crystal Lake and wraps around Pleasant Bay (Figures 2C-2I). The MassDOT urban right-of-way contributing to Pleasant Bay and Little Pleasant Bay includes the entire length of the Route 28 roadway within the groundwatershed except for a 2,000-foot stretch of impervious roadway, from north of Barcliffe Avenue to the southern groundwatershed border, which drains south outside the groundwatershed via catch basins and pipes. Additional area on Route 28 that is not included in this assessment is a non-urban stretch of road within The River groundwatershed between Areys Lane and Namequoit Road (Figures 2Cand 2D). The remainder of Route 28 runoff drains to the watershed via overland flow, infiltration or catchbasins and pipes. A section of Route 28 that is also discussed in the Round Cove (MA96-75) assessment drains to the groundwatershed via overland flow and infiltrates or by catchbasins and pipes that discharge to subsurface leaching beds located on the west side of Route 28 (Figure 2F). Approximately 25.1 acres of impervious roadway area and 16.1 acres of pervious within the Route 28 right-of-way drains to the groundwatershed.

Existing BMPs

MassDOT estimated the pollutant load reduction provided by existing BMPs by applying treatment reductions to existing BMPs based on their size, function and contributing watershed. BMP performances were derived different sources depending on the BMP and engineering judgment as described in the *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[7]

MassDOT identified seven existing BMPs in place with the potential to treat roadway runoff from the discharging area before reaching the impaired water segment. All BMPs are subsurface leaching beds within the Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) groundwatersheds; of these, one is also within the Muddy Creek (MA96-51) groundwatershed shown on Figure 2A, one is located in The River (MA96-76) groundwatershed shown on Figure 2B and five are also within the Round Cove (MA96-75) groundwatershed (Figure2F). The southernmost subsurface leaching bed is located west of Route 28 south of Misty Meadow Lane and approximately 670 feet north of Stoney Hill Road to the ramp connecting Route 137 northbound to Route 6 westbound. The subsurface leaching bed within the Muddy Creek groundwatershed is located adjacent to the ramp connecting Route 137 northbound to Route 6 westbound. The five subsurface leaching beds within the Round Cove groundwatershed are located on the west side of Route 28 between Cove Landing Road and Mariner Drive. However, none of these BMP's account for reduction credit for nitrogen removal from this system, per the methodology.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[8] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[9] MassDOT assessed Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. [10] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[11] which has been reviewed for any proposed changes to the condition of the water bodies. The conditions of Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) are not proposed to change.

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[7] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

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

[9] MassDOT, 6 April, 2011. Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method). http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[10] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

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

BMP 7R for Nitrogen TMDL (CN 244.0)

The *Total Maximum Daily Load (TMDL) for Total Nitrogen in the Pleasant Bay System, Massachusetts (CN 244.0)*[12] addresses the total nitrogen impairments for these water bodies. MassDOT assessed the contribution of nitrogen from MassDOT properties to these water bodies using the approach described in BMP 7R[13] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL, and MassDOT's application of BMP 7R to nitrogen in groundwater-controlled watersheds.[14]

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[15] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[14] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 36.5 acres
- MassDOT Pervious Area: 34.5 acres
- Estimated Existing MassDOT Load: 312.6 lbs/yr
- Total Existing Groundwatershed Nitrogen Load: 358,002 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.09%

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[14] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 252.2)

MassDOT assessed the indicator bacteria impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). [16] Little Pleasant Bay (MA96-78) is covered

[12] MassDEP. 2007. Final Pleasant Bay System TMDL for Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/pbtmdl.pdf

[13] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[14] MassDOT, March 7, 2014. Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year4/Attachment_5.pdf

[15] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

[16] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

by the *Final Pathogen TMDL for the Cape Cod Watershed*,[17] which is an *Addendum to the 2009 Final Pathogen TMDL for the Cape Cod Watershed.*[18]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[19]

According to the 2009 Cape Cod Pathogen TMDL, sources of indicator bacteria throughout the watershed were found to be many and varied. Most of the bacteria sources are believed to be failing septic systems, combined sewer overflows (CSO), sanitary sewer overflows (SSO), sewer pipes connected to storm drains, certain recreational activities, wildlife including birds along with domestic pets and animals and direct overland stormwater runoff. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and best management practices to mitigate stormwater runoff volume.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters (ORWs) or designated uses that require higher water quality standards than Class B. Little Pleasant Bay (MA96-78) is not prioritized due to inefficient data; however the water body is designated as a Class SA ORW and has value based on its shellfishing use.[20]

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report[21] (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume

[17] MassDEP. 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

[18] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

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

[20] MassDEP. 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

[21] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters

Proposed Mitigation Plan

As described above, MassDOT’s nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment for Little Pleasant Bay (MA96-78), MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT’s BMP 7R Pathogen Methodology, MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Pathogen TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT targeted rest stops are located within the groundwatershed of this water body. MassDOT will be installing signs at rest stops within the groundwatershed of impaired water bodies. The signs will inform the public of the need to remove pet waste, which can minimize contributions of pathogens to stormwater runoff. Pet waste removal bags and disposal cans will be provided.”

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

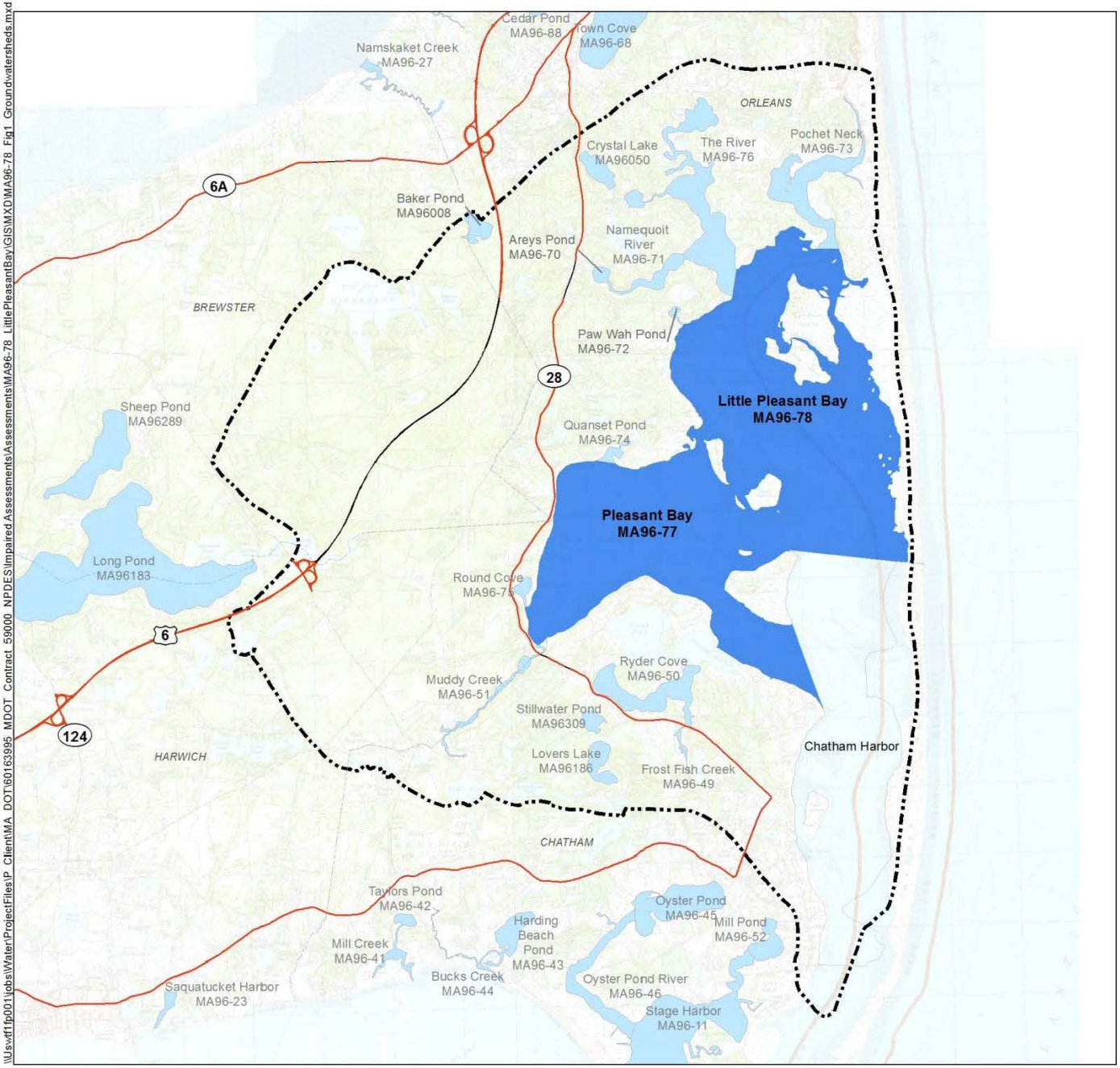
Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT’s stormwater management system. MassDOT

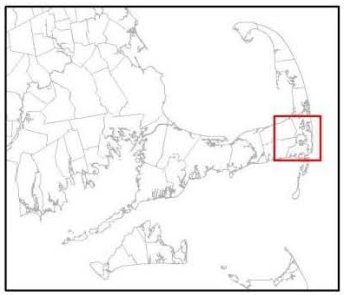
investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the groundwatershed of this water body that could be contributing pathogens to the impaired water body.

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[22] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[22] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf





MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

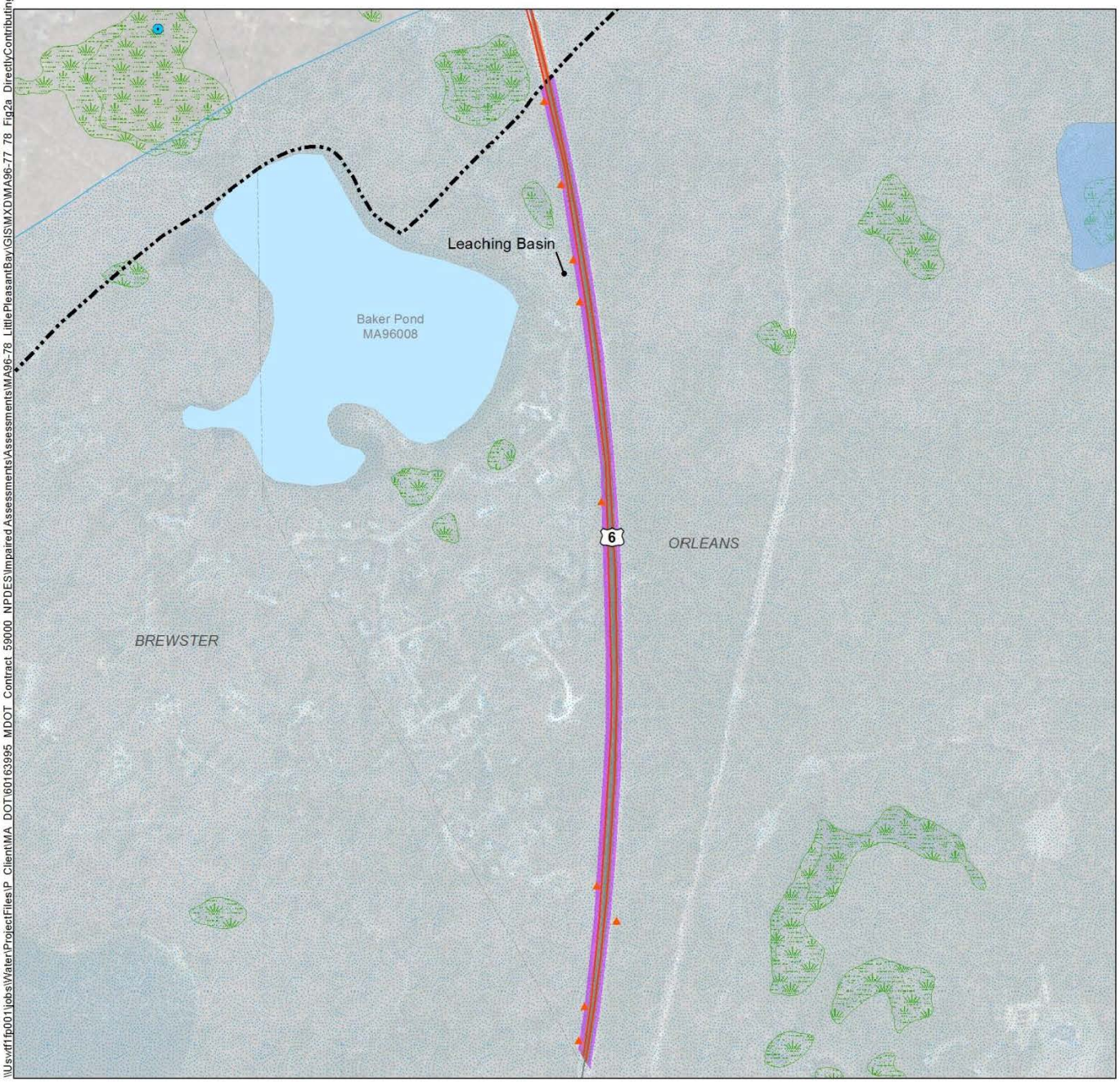
0 0.75 1.5 Miles

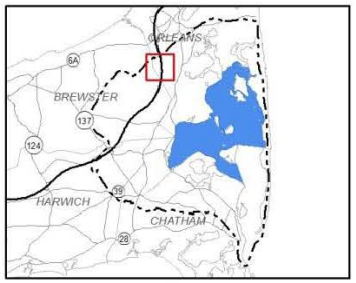
Figure 1

Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) Groundwatershed

December 2014

massDOT Massachusetts Department of Transportation Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- Impaired Streams
- MassDOT Supplemental Contributing Area
- MassDOT Impervious Area
- MassDOT Pervious Area
- Certified Vernal Pools
- Outstanding Resource Waters
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

0 300 600 Feet

Figure 2A

Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) MassDOT Contributing Area

December 2014

massDOT Massachusetts Department of Transportation Highway Division

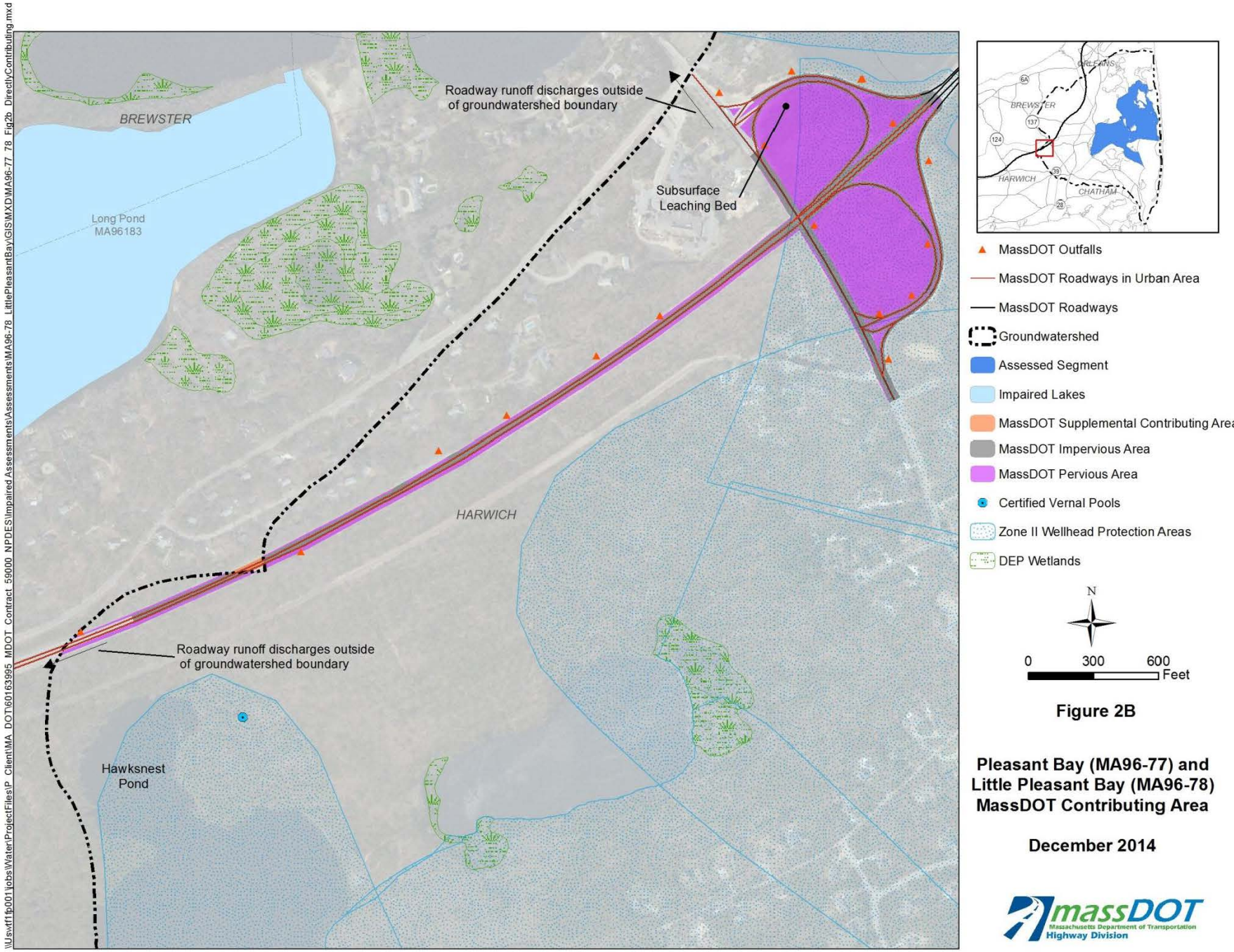
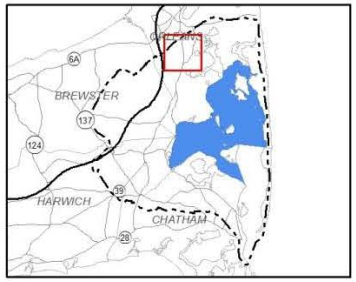


Figure 2B

Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) MassDOT Contributing Area

December 2014



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- MassDOT Supplemental Contributing Area
- MassDOT Impervious Area
- MassDOT Pervious Area
- Certified Vernal Pools
- Outstanding Resource Waters
- Areas of Critical Environmental Concern
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

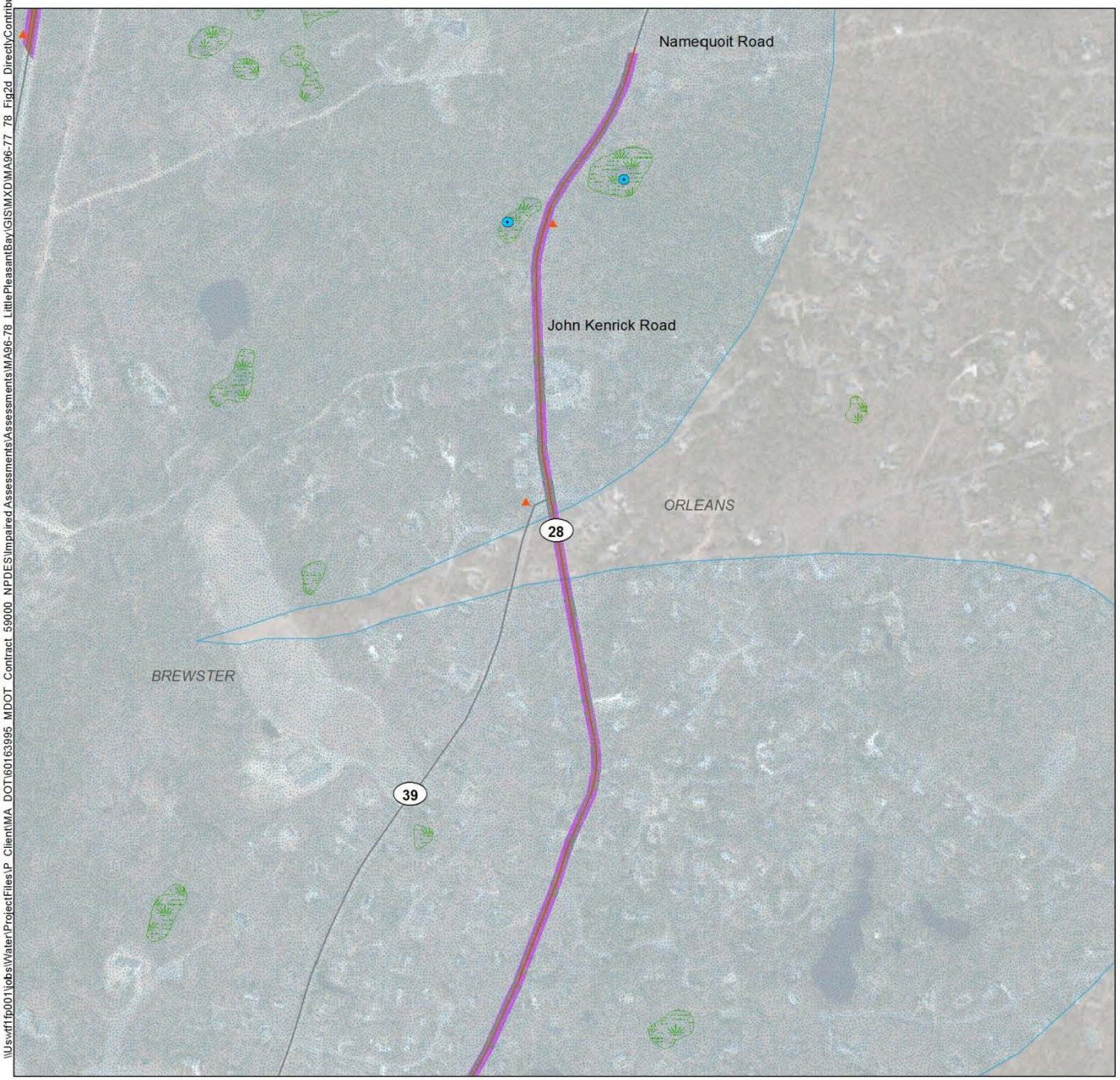
0 300 600 Feet

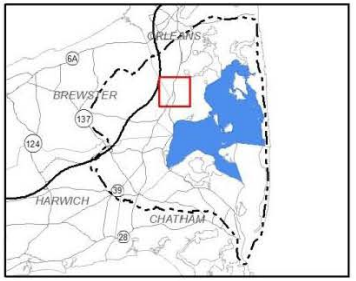
Figure 2C

Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) MassDOT Contributing Area

December 2014

massDOT Massachusetts Department of Transportation Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- MassDOT Impervious Area
- MassDOT Pervious Area
- Certified Vernal Pools
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

0 300 600 Feet

Figure 2D

Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) MassDOT Contributing Area

December 2014

massDOT Massachusetts Department of Transportation Highway Division

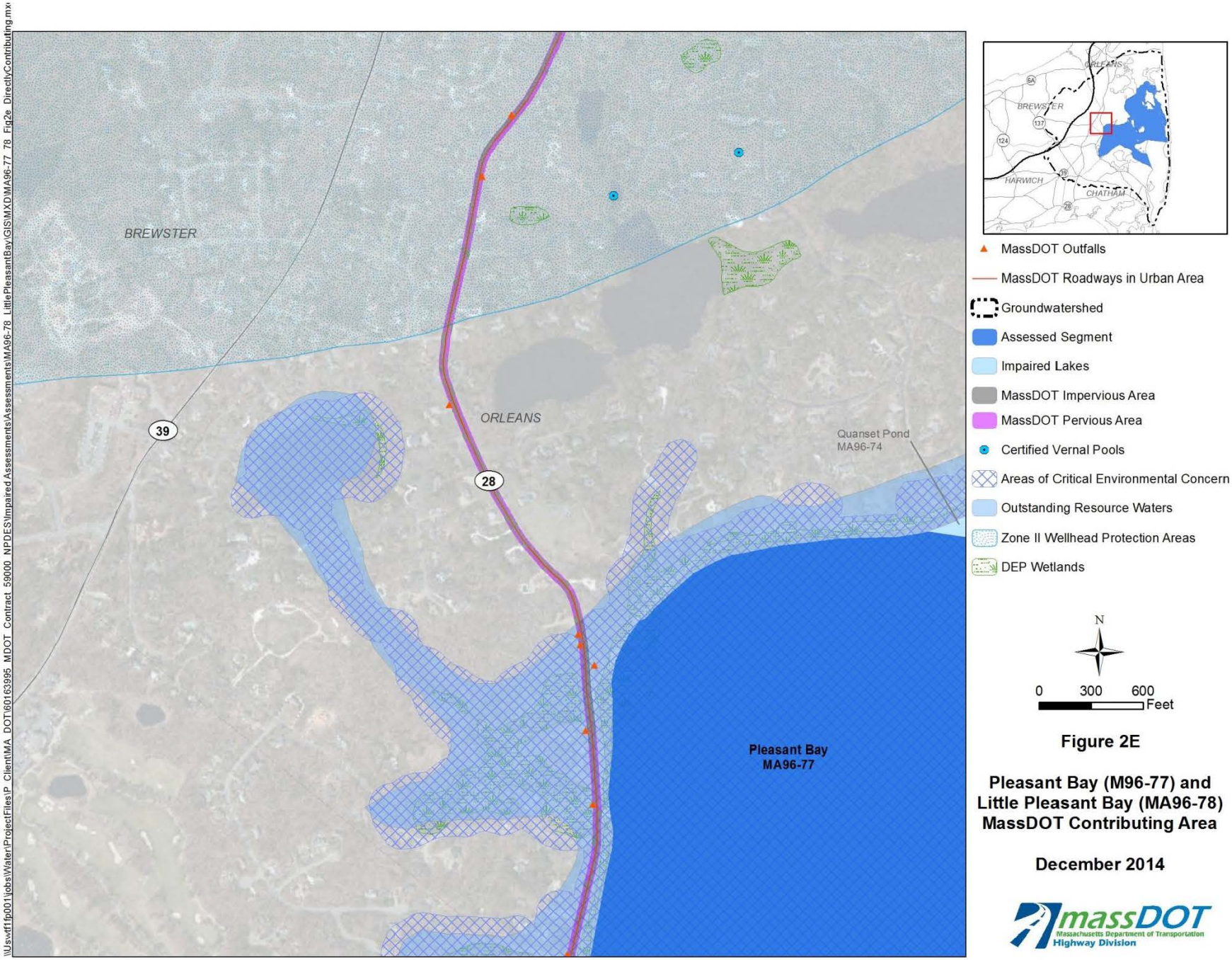


Figure 2E

Pleasant Bay (M96-77) and Little Pleasant Bay (MA96-78) MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

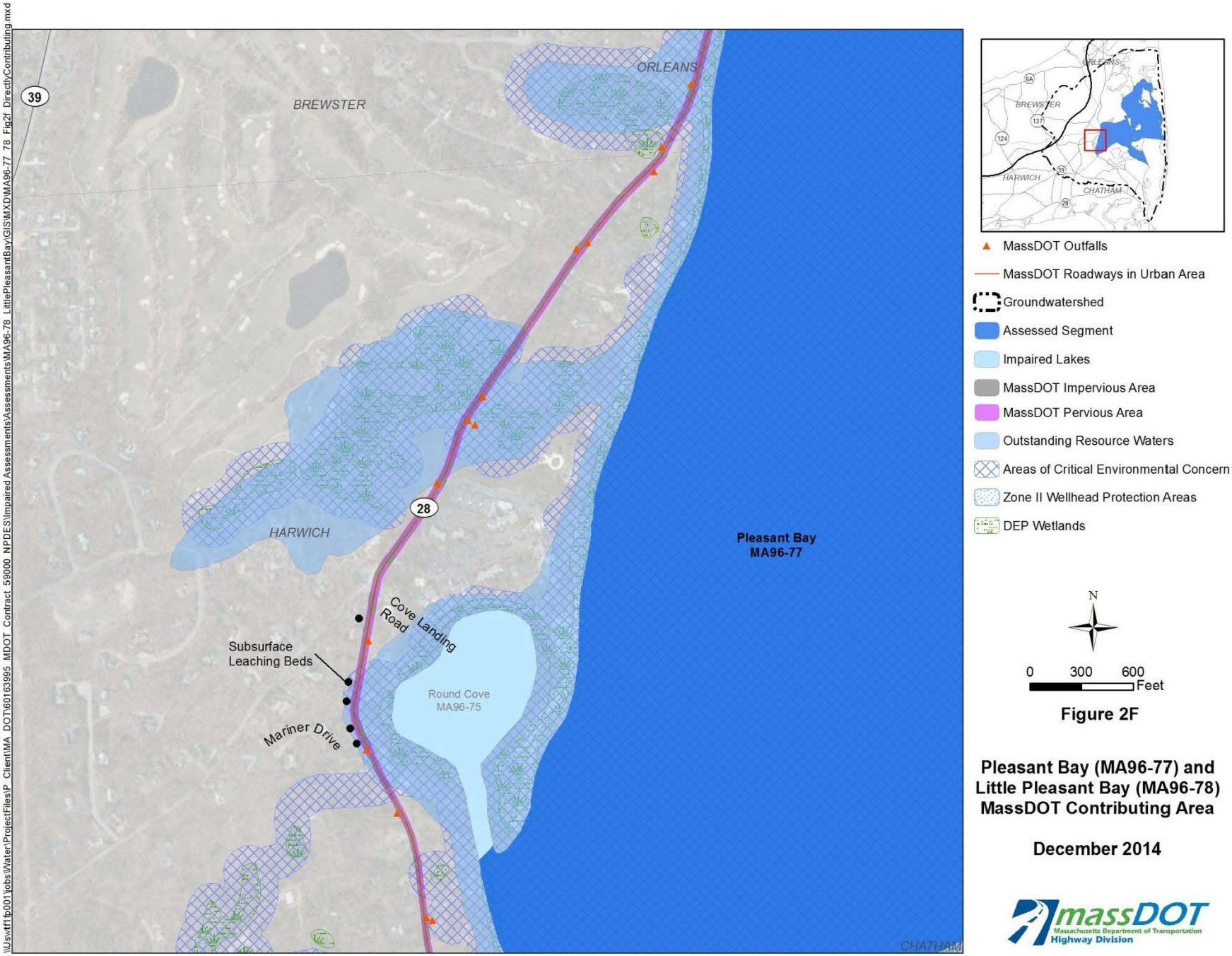


Figure 2F

Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) MassDOT Contributing Area

December 2014

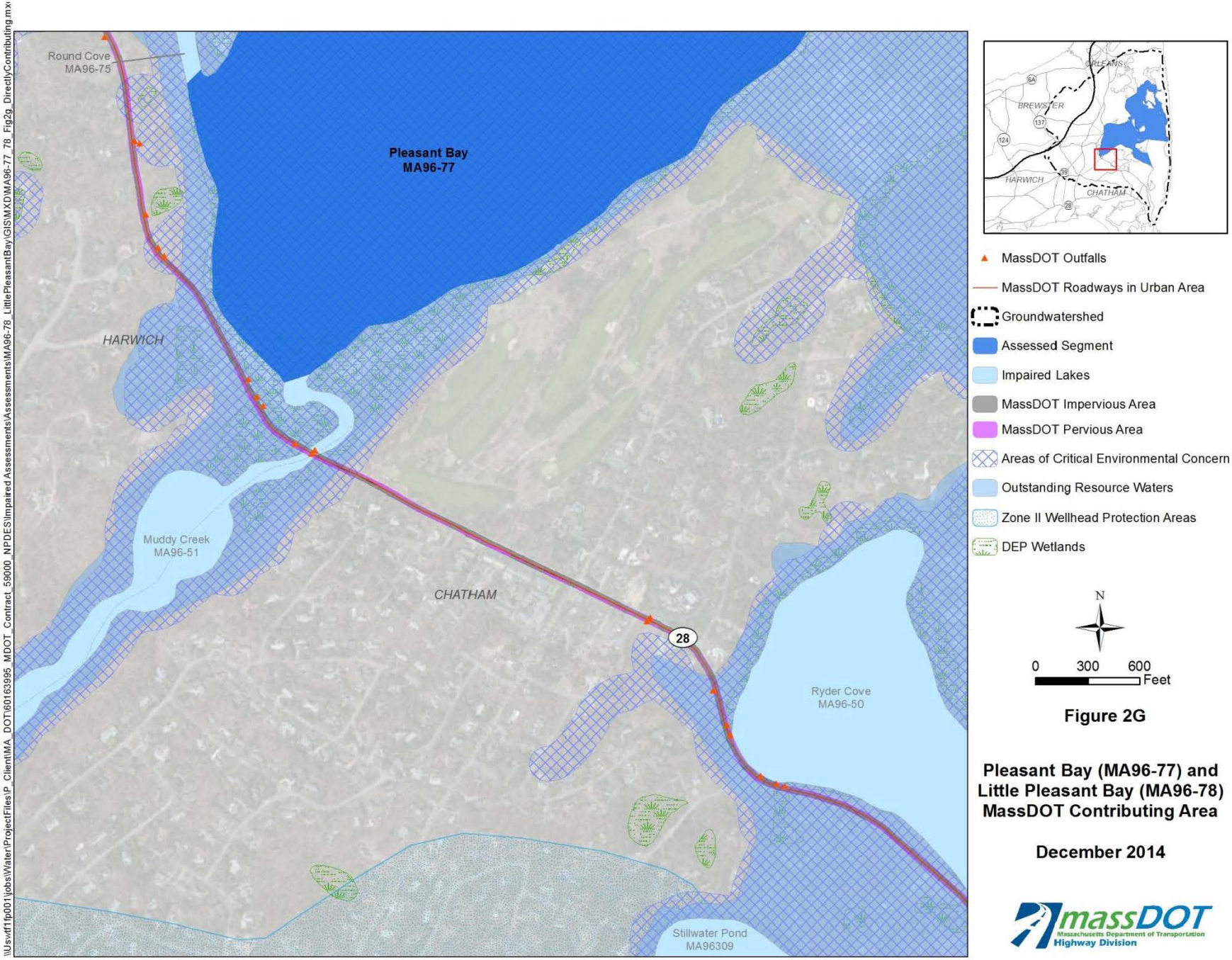
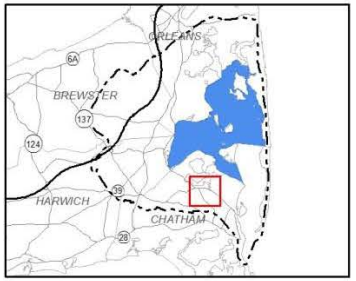


Figure 2G

Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) MassDOT Contributing Area

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division



- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Impaired Lakes
- MassDOT Impervious Area
- MassDOT Pervious Area
- Certified Vernal Pools
- Outstanding Resource Waters
- Areas of Critical Environmental Concern
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

0 300 600 Feet

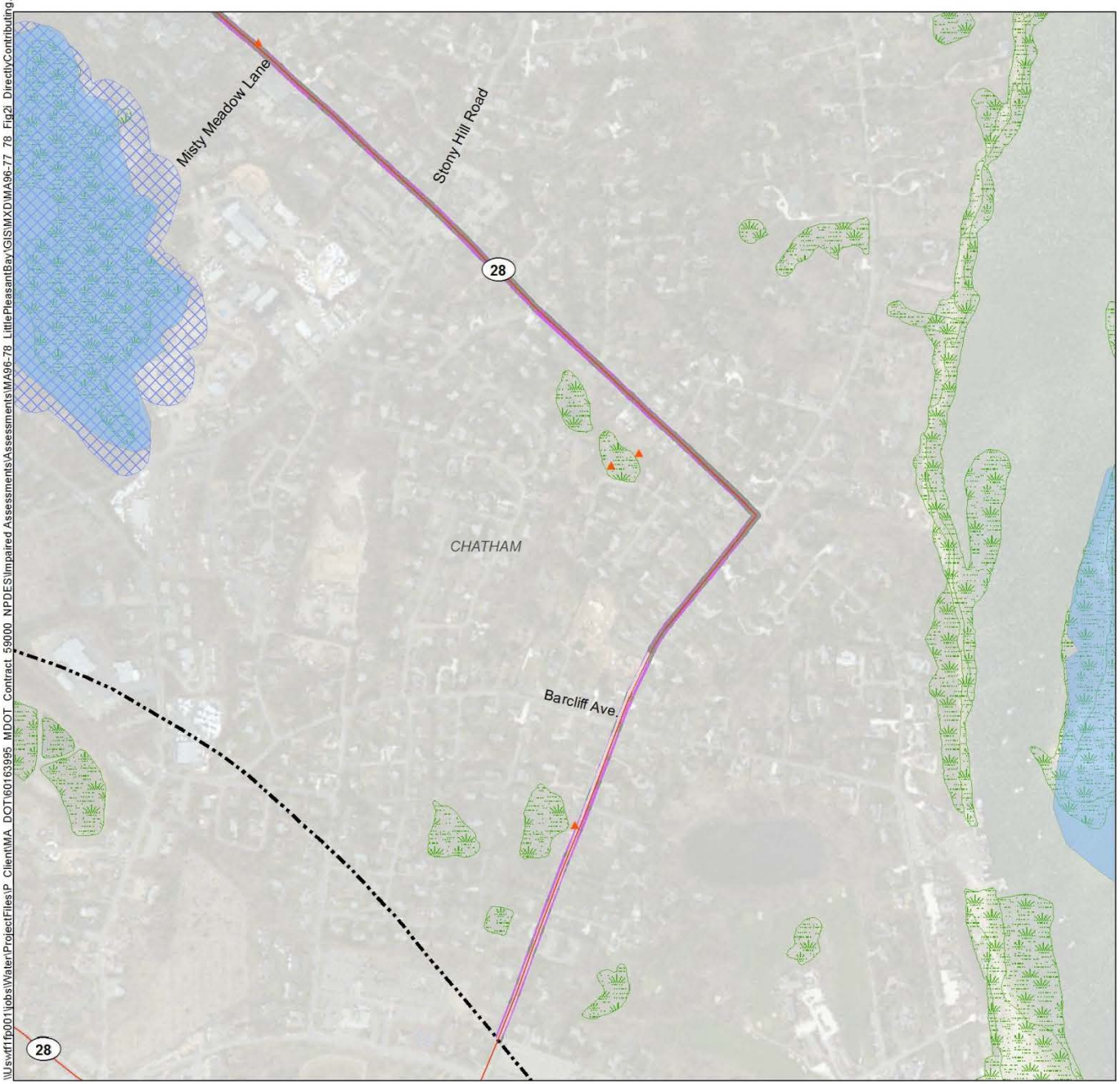
Figure 2H

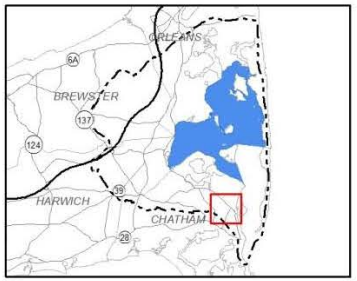
Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) MassDOT Contributing Area

December 2014

massDOT Massachusetts Department of Transportation Highway Division

\\Jswtf1fp001\jobs\Water\ProjectFiles\P_Client\MA_DOT\60163995_MDOT_Contract_59000_NPDES\ImpairedAssessments\Assessments\MA96-78_LittlePleasantBay\GIS\MXD\MA96-77_78_Fig2h_DirectlyContributing.mxd





- MassDOT Outfalls
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- Groundwatershed
- Assessed Segment
- Impaired Lakes
- MassDOT Impervious Area
- MassDOT Pervious Area
- Outstanding Resource Waters
- Areas of Critical Environmental Concern
- Zone II Wellhead Protection Areas
- DEP Wetlands

N

0 300 600 Feet

Figure 2I

Pleasant Bay (MA96-77) and Little Pleasant Bay (MA96-78) MassDOT Contributing Area

December 2014

massDOT Massachusetts Department of Transportation Highway Division

massDOT Massachusetts Department of Transportation Highway Division

12/08/2014

Impaired Waters Assessment for Mill Creek (MA96-80)

Summary

Impaired Water[1]	Stormwater Impairments:	*Nitrogen (Total); Fecal Coliform*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Addendum: Final Pathogen TMDL for the Cape Cod Watershed*[2]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location	Towns:	*Yarmouth*
	MassDOT Roads:	*Route 28*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*42.7 lbs/yr*
	Existing Load to Water Body:	*13,358 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.32 %*

Site Description

Mill Creek (MA96-80) is a 0.07-square mile water body located south of Route 28 and north of Lewis Bay (MA96-36) in Yarmouth, Massachusetts. Figure 1 illustrates the groundwatershed for Mill

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

[2] MassDEP, 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

[3] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Creek (MA96-80). The groundwatershed for this impaired segment is based on technical reports[4] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Mill Creek (MA96-80). The Mill Creek groundwatershed has seen rapid and extensive development of single family homes and the conversion of seasonal to full-time residences which has transformed forest to suburban use and increased on-site wastewater treatment systems.[4] Based on aerial images, the land use in the watershed is mainly commercial and low density residential.

MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[5] identifies the Aquatic Life Use and Shellfish Harvesting Use as "impaired" for Mill Creek (MA96-80). The "impaired" status for the Aquatic Life Use is reported to be caused by total nitrogen from subsurface wastewater disposal (septic) systems, stormwater runoff (unspecified urban stormwater and discharges from municipal separate storm sewer systems), and fertilizers. The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from marina/boating pump-out releases, waterfowl, waste from pets, on-site septic system discharges, and discharges from municipal separate storm sewer systems. The other uses were not assessed.

Figure 2 illustrates the MassDOT-owned road within the groundwatershed that contributes runoff to the water body. Route 28 traverses the groundwatershed north of Mill Creek. Roadway runoff from Route 28 between Simpkins Way and a high point in the vicinity of Town Brook Road travels via sheet flow and discharges to the north section of Mill Creek or infiltrates in the pervious area adjacent to Route 28. Stormwater runoff from Route 28 between Town Brook Road and the eastern groundwatershed boundary at Traders Lane is collected with a catch basin network discharging to a channel that connects Mill Pond to Mill Creek. Runoff from approximately 0.6 acres of roadway between Bayview Street and Route 28 discharges within the boundaries of the Mill Creek groundwatershed via sheet flow and is considered "Supplemental Contributing Area". Any impervious area located outside the groundwatershed boundary that flows back into the groundwatershed via sheet flow, drainage pipes, or other means is considered "Supplemental" (Figure 2). High points in the roadway limit the section of roadway that is considered draining to the groundwatershed.

Existing BMPs

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

[4] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Lewis Bay Embayment System, Barnstable/Yarmouth, MA. Available at: http://www.oceanscience.net/estuaries/report/Lewis_Bay/Lewis_Bay_MEP_Final.pdf

[5] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Mill Creek (MA96-80) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[8] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Mill Creek is not proposed to change.

BMP 7U for Nitrogen TMDL

The *Draft Total Maximum Daily Load (TMDL) for Total Nitrogen in the Lewis Bay System, Massachusetts (CN 314)*[10] addresses the total nitrogen for this water body. MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[6] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[11]

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[12] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[11] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 6.9 acres
- MassDOT Pervious Area: 0.06 acres
- Estimated Existing MassDOT Load: 42.7 lbs/yr

[6] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

[10] MassDEP. 2010. Draft - Lewis Bay System and Halls Creek Total Maximum Daily loads for Total Nitrogen Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/lewisbay.pdf

[11] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[12] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

- Total Existing Groundwatershed Nitrogen Load: 13,358 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.32 %

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[13] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). Mill Creek (MA96-80) is covered by the *Addendum to the Final Pathogen TMDL for the Cape Cod Watershed*,[14] which is an addendum to the *2009 Final Pathogen TMDL for the Cape Cod Watershed*.[15]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[16]

According to the Final TMDL, sources of indicator bacteria in the Cape Cod Watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and best management practices to mitigate stormwater runoff volume.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters (ORWs) or designated uses that require higher water quality standards than Class B. Mill Creek (MA96-80) has not been prioritized but the

[13] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[14] MassDEP. 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

[15] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

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

water body is classified as Class SA and includes a Shellfish Harvesting Use that provide value to the water body.[17]

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report[18] (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters
- Annual Street Sweeping and priority catch basin cleaning

Proposed Mitigation Plan

As described above, MassDOT’s nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed

[17] MassDEP. 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

[18] MassDEP, 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

in MassDOT's BMP 7R Pathogen Methodology,[19] MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

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

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

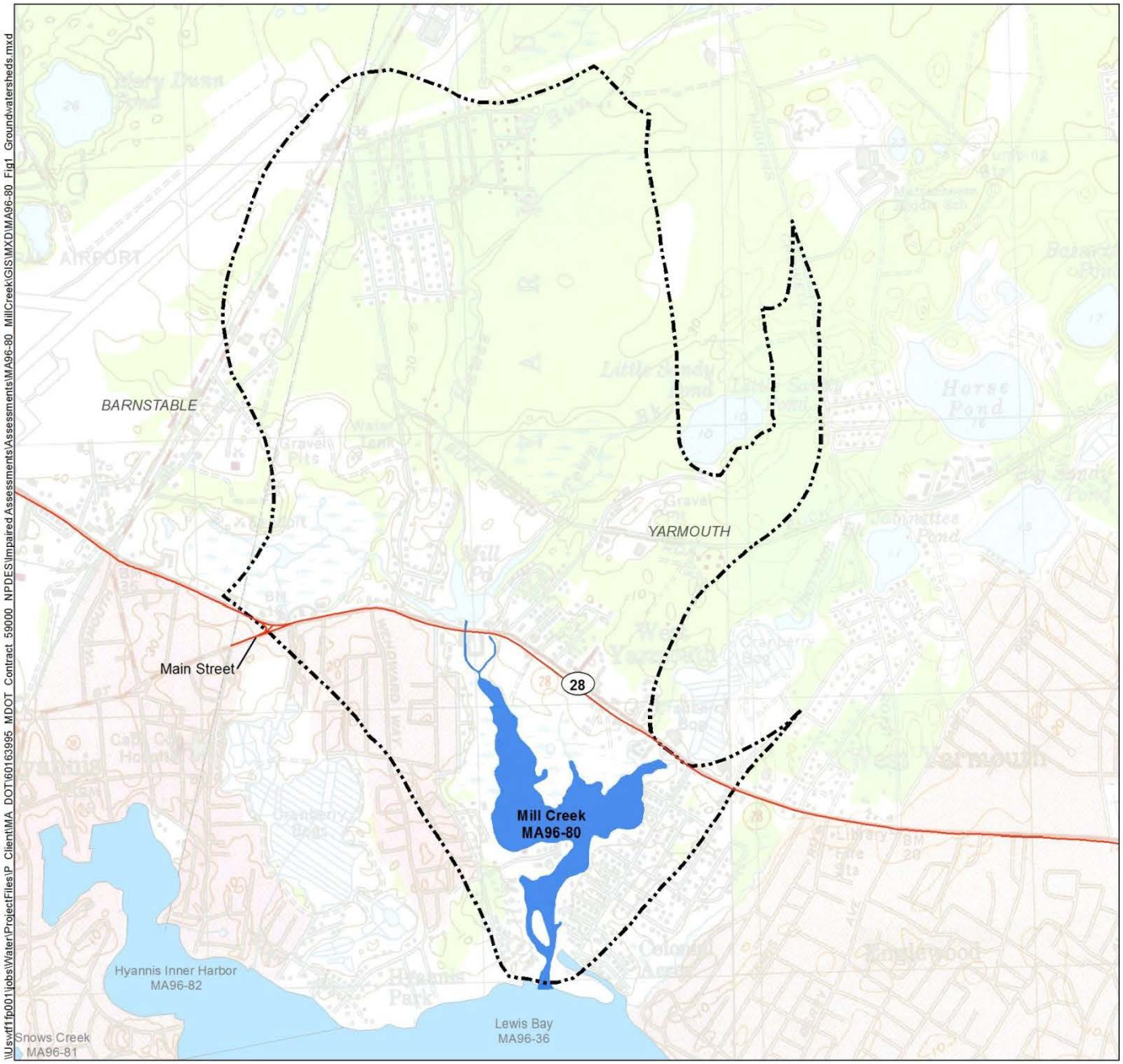
Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and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

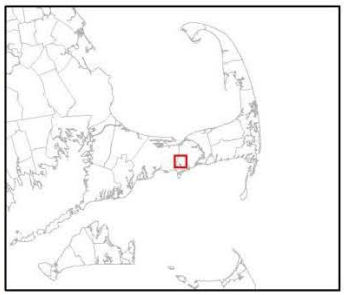
MassDOT has concluded that the BMPs outlined in the SWMP are consistent with its existing permit requirements for Mill Creek. These measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit. As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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Mill Creek, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[20] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

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

[20] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf





MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 1,000 2,000 Feet

Figure 1

Mill Creek (MA96-80) Groundwatershed

December 2014

massDOT
Massachusetts Department of Transportation
Highway Division

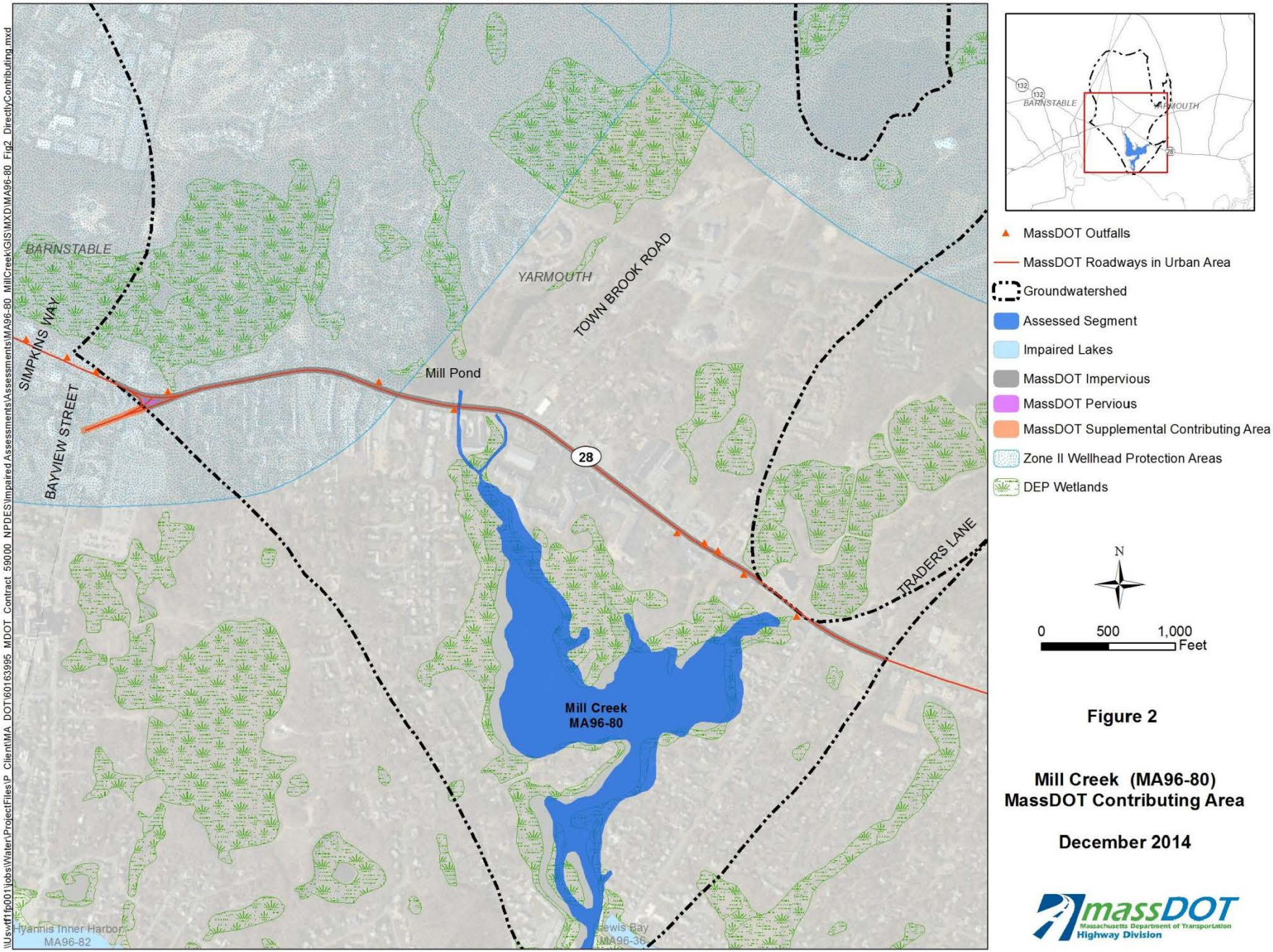


Figure 2

Mill Creek (MA96-80)
MassDOT Contributing Area

December 2014

MassDOT
Massachusetts Department of Transportation
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Impaired Waters Assessment for Hyannis Inner Harbor (MA96-82)

Summary

Impaired Water[1]	Stormwater Impairments:	*Nitrogen (Total); Fecal Coliform*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*Final Pathogen TMDL for the Cape Cod Watershed*[2]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location	Towns:	*Barnstable*
	MassDOT Roads:	*Route 28*
Assessment Method(s)	7R (TMDL Method) ☒	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*
MassDOT Area and Targets		Nitrogen
	Estimated MassDOT Load:	*47.8 lbs/yr*
	Existing Load to Water Body:	*25,307 lbs/yr*
	MassDOT Contribution to Existing Load:	*0.19 %*

Site Description

Hyannis Inner Harbor (MA96-82) is a 0.13-square mile water body located south or Route 28 and north of Lewis Bay (MA96-36) in Barnstable, Massachusetts. Figure 1 illustrates the groundwatershed for Hyannis Inner Harbor (MA96-82). The groundwatershed for this impaired

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

[2] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

[3] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

segment is based on technical reports[4] developed by the Massachusetts Estuaries Project (MEP) which serve as the basis for the development of Total Maximum Daily Loads. The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST). For groundwatershed assessments, if a discharge occurs inside the groundwatershed boundary, it is considered to be a discharge that contributes to the impaired segment. If the discharge point is outside of the groundwatershed boundary, it is not considered to contribute to the impaired segment. MassDOT property that contributes runoff or infiltration within the groundwatershed area is considered in this assessment as contributing to Hyannis Inner Harbor (MA96-82). The Hyannis Inner Harbor groundwatershed has seen rapid and extensive development of single family homes and the conversion of seasonal to full-time residences which has transformed forest to suburban use and increased on-site wastewater treatment systems. Based on aerial images, the land use within the groundwatershed is mainly commercial and low density urban.

MassDEP's Water Quality Assessment Report titled *Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[5] identifies the Aquatic Life Use as "impaired" for Hyannis Inner Harbor (MA96-82). The Shellfish Harvesting Use was identified as "impaired" for 0.11 square miles and "support" for 0.02 square miles. The "impaired" status for the Aquatic Life Use is reported to be caused by total nitrogen from subsurface wastewater disposal (septic) systems, stormwater runoff (unspecified urban stormwater and discharges from municipal separate storm sewer systems), and fertilizers. The Shellfish Harvesting Use is reported to be "impaired" due to elevated fecal coliform bacteria from marina/boating pump-out releases, waterfowl, waste from pets, on-site septic system discharges, and discharges from municipal separate storm sewer systems. Primary and Secondary Contact Uses were identified as "support". The other uses were not assessed.

Figure 2 illustrates the MassDOT-owned road within the groundwatershed that contributes runoff to the water body. Route 28 traverses the groundwatershed boundary north of Hyannis Inner Harbor. Approximately 8.7 acres of MassDOT-owned urban roadway drains to the groundwatershed via overland flow, infiltration, or piped systems, thus contributing to Hyannis Inner Harbor. Runoff from Nightingale Lane to an area west of the rotary travels through sheet flow and infiltrates into the pervious area adjacent to the road. Runoff from Route 28 from the east of the rotary to Simpkins Way is collected with a network of catch basins and pipes, and discharges to an unnamed water body within the Hyannis Inner Harbor watershed. Runoff from Route 28 between Nightingale Lane to the eastern boundary of the groundwatershed in the vicinity of Simpkins Way sheet flows and discharges outside of the Hyannis Inner Harbor watershed.

Existing BMPs

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

[4] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Lewis Bay Embayment System in Barnstable/Yarmouth, MA. Available at: http://www.oceanscience.net/estuaries/report/Lewis_Bay/Lewis_Bay_MEP_Final.pdf

[5] MassDEP, 2011. Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Hyannis Inner Harbor (MA96-82) using the methodologies described below.

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[8] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[9] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Hyannis Inner Harbor is not proposed to change.

BMP 7U for Nitrogen

The *Draft Total Maximum Daily Load (TMDL) for Total Nitrogen in the Lewis Bay System, Massachusetts (CN 314)*[10] addresses the total nitrogen impairment for this water body. MassDOT assessed the contribution of nitrogen from MassDOT properties to this water body using the approach described in BMP 7U[7] of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been addressed by a TMDL, and MassDOT's application of BMP 7U to nitrogen in groundwater-controlled watersheds.[11]

For the nitrogen assessment under BMP 7U, MassDOT used USGS modeling[12] to estimate annual pollutant loads from its property. Based on the USGS SELDM model, which was run using precipitation data from the Hyannis site and an average of water quality data from Harwich and Marion, MassDOT estimates the nitrogen loading from impervious areas as 6.2 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr.[11] The nitrogen loading for MassDOT property in the contributing area is summarized below:

- MassDOT Impervious Area: 7.0 acres
- MassDOT Pervious Area: 1.7 acres
- Estimated Existing MassDOT Load: 47.8 lbs/yr

[6] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

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

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

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

[10] MassDEP, 2010. Draft - Lewis Bay System and Halls Creek Total Maximum Daily loads for Total Nitrogen Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/lewisbay.pdf

[11] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[12] Granato, G.E., 2013, Stochastic empirical loading and dilution model (SELDM) version 1.0.0: U.S. Geological Survey Techniques and Methods, book 4, chap. C3, 112 p. Available at: http://pubs.usgs.gov/tm/04/c03

- Total Existing Groundwatershed Nitrogen Load: 25,307 lbs/yr
- MassDOT Existing Load as a Percentage of Total Groundwatershed Nitrogen Load: 0.19 %

The MassDOT existing load compared to the total groundwatershed nitrogen load is very small and considered negligible based on MassDOT's Nitrogen TMDL Method because it is less than 3.5% of the total nitrogen groundwatershed load.[13] In general, in areas where the MassDOT load is determined to be negligible, MassDOT does not implement BMPs because of their minimal impact on the overall groundwatershed load.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP). Hyannis Inner Harbor (MA96-82) is covered *Addendum to the Final Pathogen TMDL for the Cape Cod Watershed*,[14] which is an addendum to the *2009 Final Pathogen TMDL for the Cape Cod Watershed*.[15]

Pathogen concentrations in stormwater vary widely and concentrations can vary by an order of magnitude within a given storm event at a single location making it difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT generally will not conduct site specific assessments of pathogen loading for each water body impaired for pathogens but instead developed an iterative adaptive management approach to address impaired waters and permit condition requirements and an approach to stormwater management. Greater detail of the assessment methodology is provided in MassDOT's BMP 7R Pathogen Methodology.[16]

According to the Final TMDL, sources of indicator bacteria in the Cape Cod Watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and best management practices to mitigate stormwater runoff volume.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod Watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Hyannis Inner Harbor (MA96-82) was not prioritized, but the water

[13] MassDOT, December 2014. Application of BMP 7U to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.

[14] MassDEP. 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

[15] MassDEP. 2009. Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capecod1.pdf

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

body is classified as within Class SA, and provides value due to its Shellfish Harvesting and water-based recreational uses. [17]

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate stormwater runoff volume

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized

The following BMPs are specifically identified in the TMDL as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters
- Street Sweeping and catch basin cleaning

Proposed Mitigation Plan

As described above, MassDOT’s nitrogen contribution to the receiving water is negligible. Therefore, MassDOT has no plans to implement structural BMPs to control nitrogen in stormwater runoff from their property.

With respect to the fecal coliform impairment, MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. As discussed in MassDOT’s BMP 7R Pathogen Methodology,[18] MassDOT believes that existing efforts are

[17] MassDEP, 2012. Addendum: Final Pathogen TMDL for the Cape Cod Watershed. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/capeadd.pdf

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

consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens.

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

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

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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Hyannis Inner Harbor (MA96-82), including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. As described in MassDOT's Stormwater Handbook,[19] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional vegetation establishment associated with recent ground disturbance. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards meeting target reductions.

[19] MassDOT, May 2004. The MassHighway Storm Water Handbook for Highways and Bridges. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Stormwater_Handbook.pdf

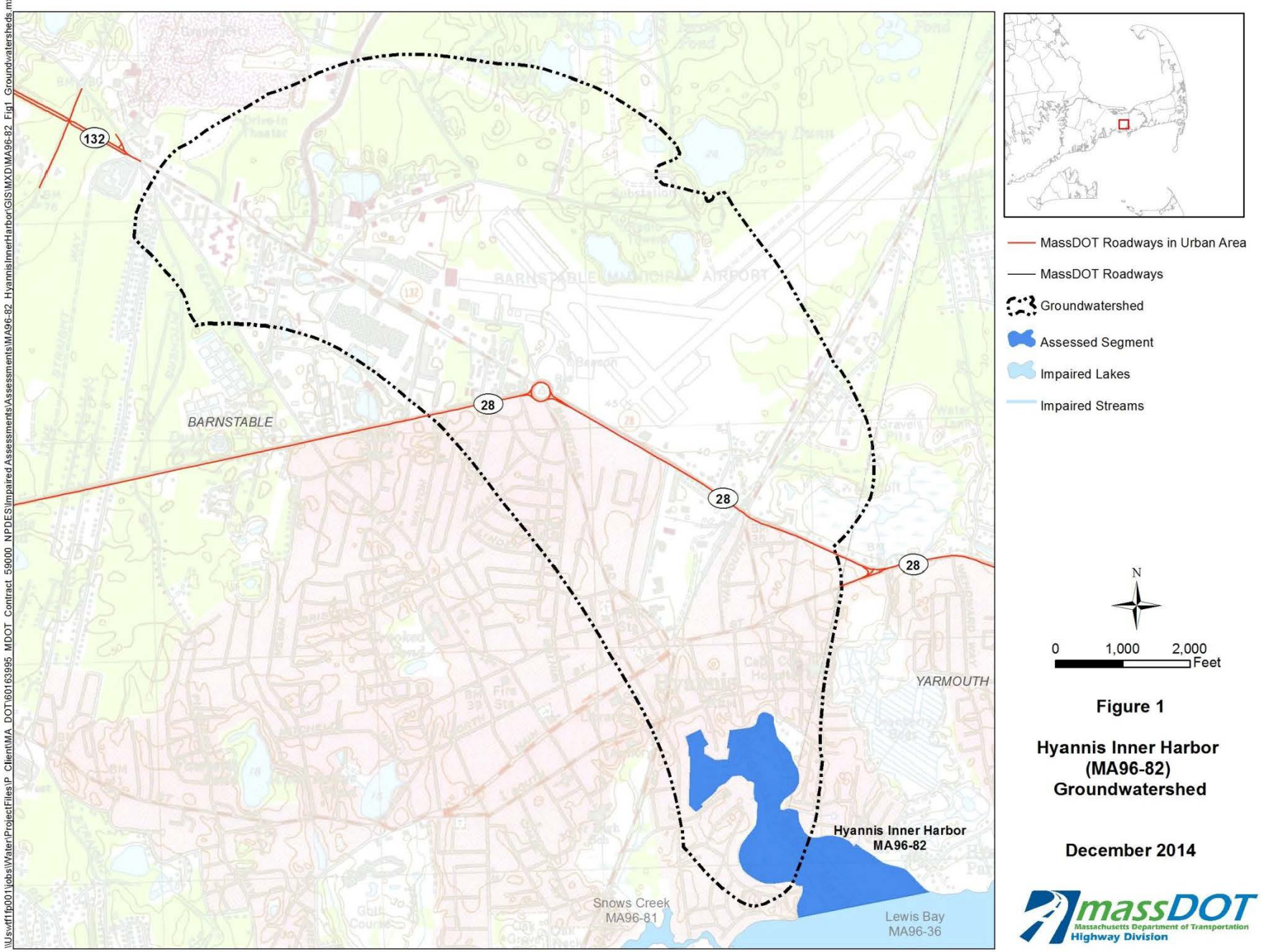

Figure 1

Hyannis Inner Harbor (MA96-82) Groundwatershed

December 2014

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Massachusetts Department of Transportation
Highway Division

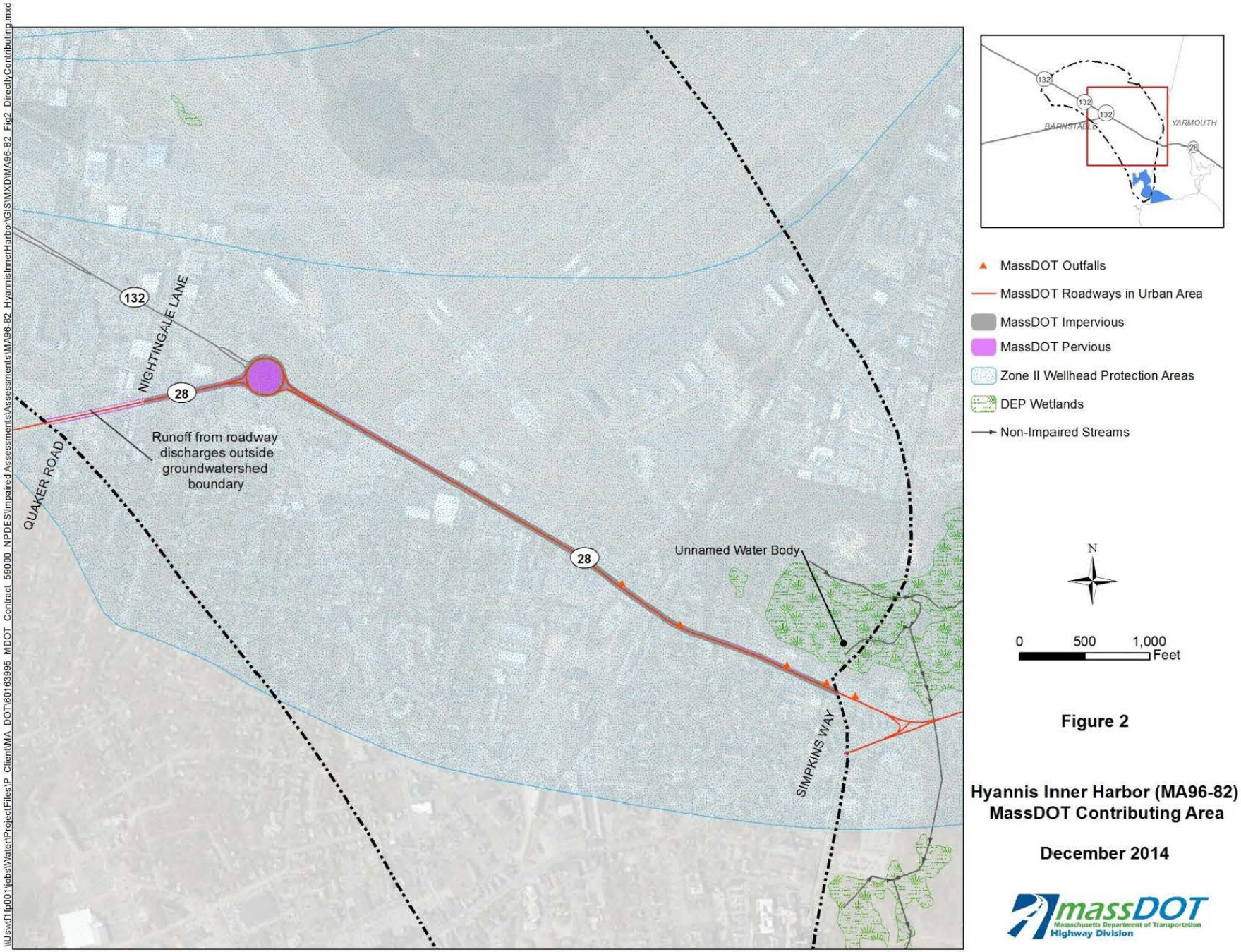

Figure 2

Hyannis Inner Harbor (MA96-82)
MassDOT Contributing Area

December 2014