Attachment 6:

Groundwater and Nitrogen TMDL Assessments

List of Impaired Water Bodies

Waterbody ID	Waterbody Name
MA95-15	Phinneys Harbor
MA95-46	Harbor Head
MA96-07	Prince Cove
MA96-08	Shoestring Bay
MA96-24	Mashpee River
MA96-42	Taylors Pond
MA96-43	Harding Beach Pond
MA96-44	Bucks Creek
MA96-45	Oyster Pond
MA96-46	Oyster Pond River
MA96-53	Perch Pond
MA96-54	Great Pond
MA96-55	Green Pond
MA96-56	Little Pond
MA96-57	Bournes Pond
MA96-70	Areys Pond

Impaired Waters Assessment for Phinneys Harbor (MA95-15)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Phinneys Harbor Embayment System Total Maximum Daily Loads for Total Nitrogen* (EPA TMDL # 35069)[2] *Final Pathogen TMDL for the Buzzards Bay Watershed* (EPA TMDL # 36172)[3]
	WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[4]
Location	**Towns:**	Bourne, Sandwich
	MassDOT Roads:	Route 28
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None

MassDOT Area and Targets	**Nitrogen**
Directly Contributing Load	83.3 lbs/yr
Contributing Watershed Area Load	28,542 lbs/yr
DOT Contribution to Existing Load	0.29 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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 Total Maximum Daily Load (TMDL) for Total Nitrogen in the Phinneys Harbor Embayment System, Massachusetts (CN 247.0) Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/phinharb.pdf

[3] 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

[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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Phinneys Harbor (MA95-15). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Phinneys Harbor watershed is located in Bourne and Sandwich and includes residential areas, woods, wetlands, ponds and a MassDOT roadway (Route 28).

Phinneys Harbor receives inflows from pathogen impaired waterbodies Eel Pond (MA95-48) and Back River (MA95-47). Surface runoff and groundwater flow also contribute to Phinneys Harbor and discharge to Buzzards Bay . MassDEP's Water Quality Assessment Report titled "Buzzards Bay Watershed 2000 Surface Water Quality Assessment Report"[7] recommended the continued monitoring of bacteria within Phinneys Harbor as it pertains to shellfish and pollutant loading.

Figure 2 illustrates the MassDOT roads that are directly contributing to the water body. Contributing DOT property to Phinneys Harbor includes the pervious area within the median and along the shoulders and impervious roadway surface of Route 28. An additional 1,080 feet of Route 28 beyond the northern boundary of the watershed flows back into the watershed via a storm drain and is considered "Supplemental DOT 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". There is also a portion of Route 28 that is outside the groundwatershed, but bordered by the groundwatershed on either side. The southbound side of Route 28 is served by a storm drain system outside of the watershed which collects and discharges the drainage within the limits of the groundwatershed. The northbound side of Route 28 does not have a drainage system, and therefore, the area located outside of the groundwatershed does not drain into the groundwatershed of Phinneys Harbor. Supplemental area is illustrated on 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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[8] MassDOT assessed Phinneys Harbor (MA95-15) using the methodologies described below.

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[5] 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

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

[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

[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.

BMP 7R for Nitrogen TMDL (CN 243.0)

The *Total Maximum Daily Load (TMDL) for Total Nitrogen in the Phinneys Harbor Embayment System, Massachusetts* (CN 247.0)[9] 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 7R[10] 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] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described below.

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,[12] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The Nitrogen Loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 7.8 acres
- DOT Pervious Area: 6.8 acres
- Estimated Existing MassDOT Load: 83.3 lb/yr
- Total Existing Watershed Nitrogen Load: 28,542 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.29%

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.[13] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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.

[9] Mass DEP. 2007. Final Total Maximum Daily Load (TMDL) for Total Nitrogen in the Phinneys Harbor Embayment System, Massachusetts (CN 247.0) Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/phinharb.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[11] MassDOT. March 7, 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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

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

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] Phinneys Harbor (MA95-15) is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed*.[15] According to the Final TMDL, sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from failing septic systems; 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[15] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's South East Expressway study measured bacterial concentration in stormwater runoff[16] and data indicated that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g. illicit discharges, sewer utilities, pet waste and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicate that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommend implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review and source control.

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

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 watershed 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,[17] MassDOT does not use nitrogen based fertilizers as part of

[14] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[15] 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

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

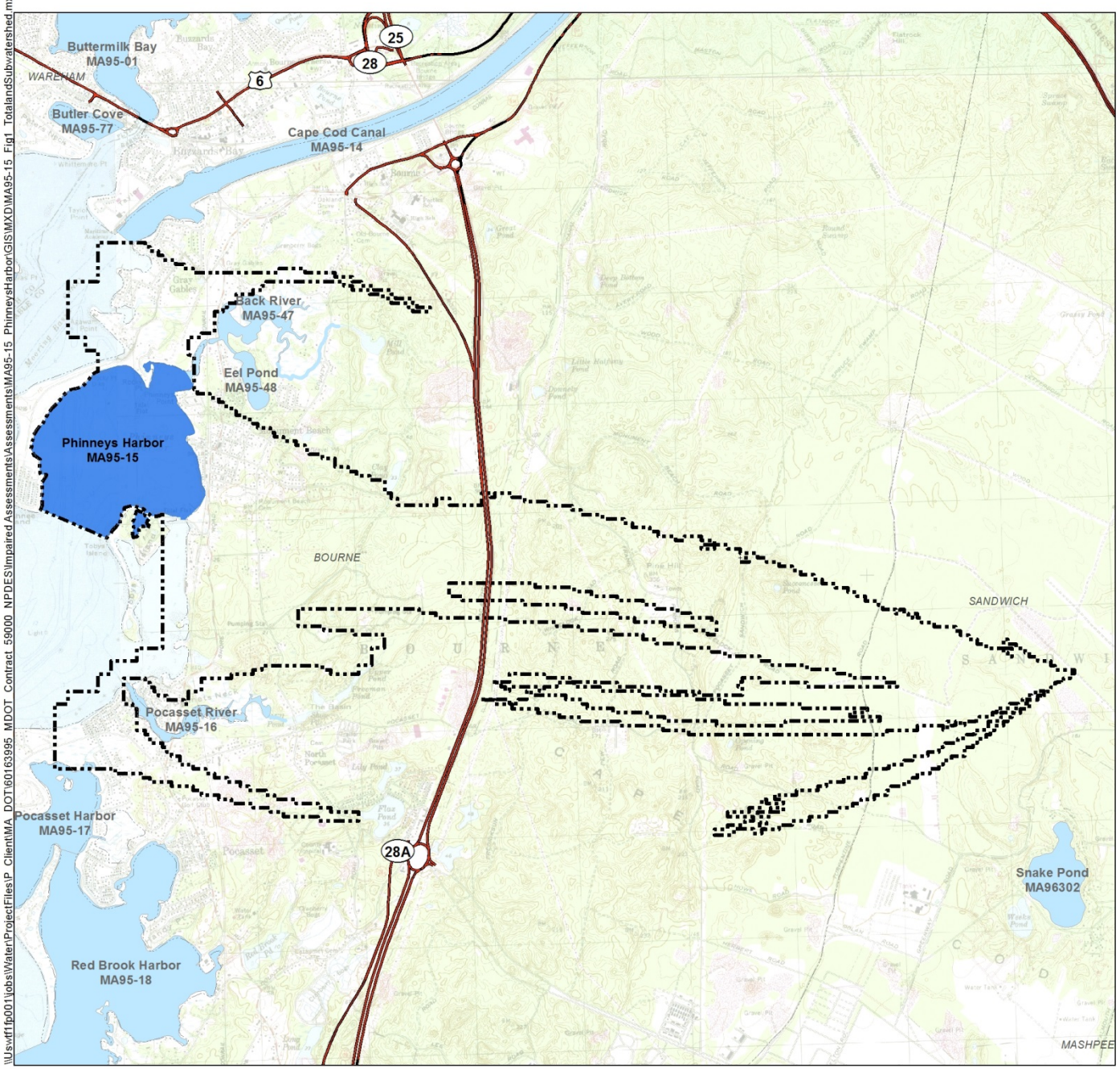
[17] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004.

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.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Phinneys Harbor, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.



MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 2,500 5,000 Feet

Figure 1

Phinneys Harbor (MA95-15) Groundwatershed

June 2014

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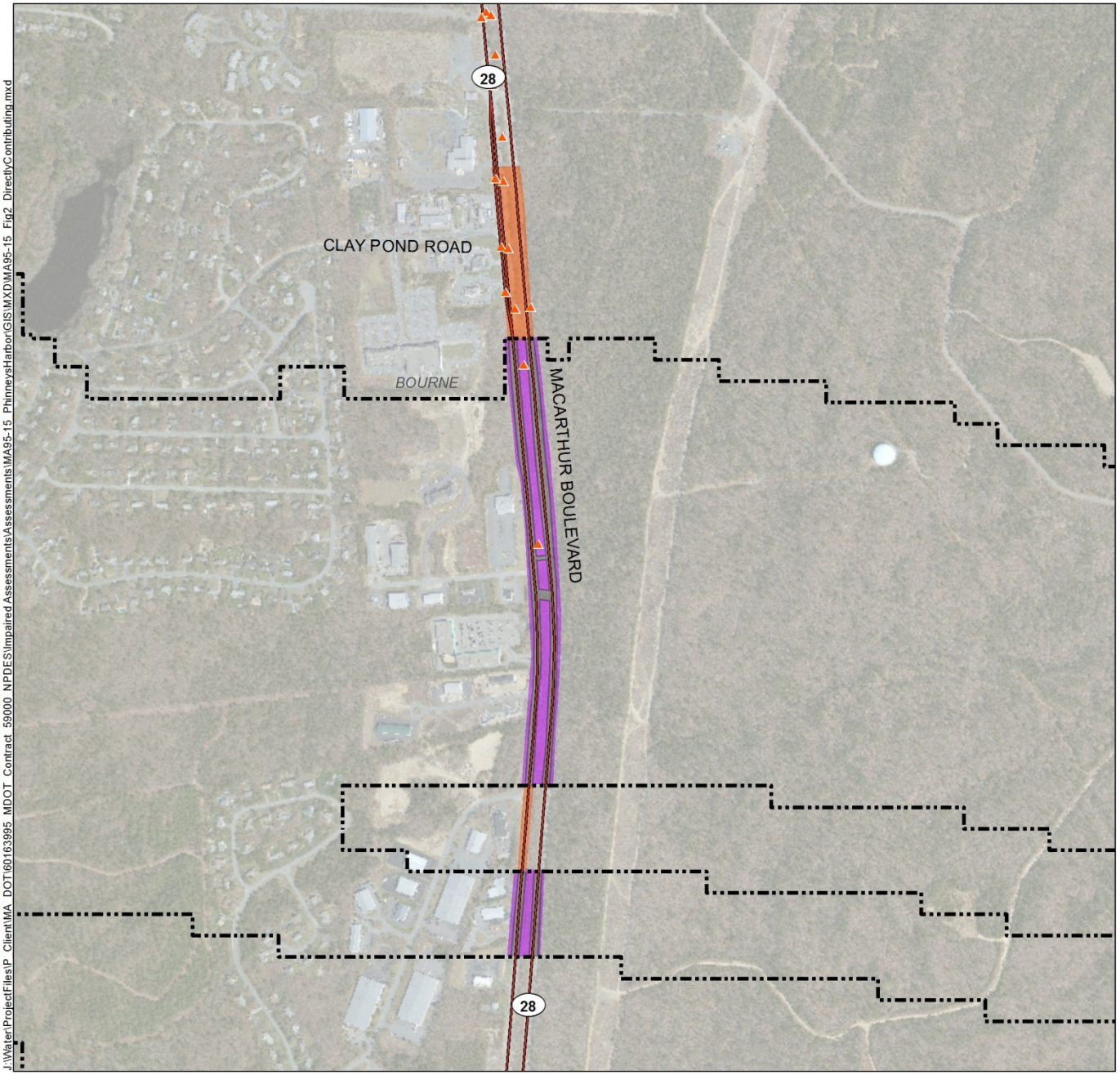
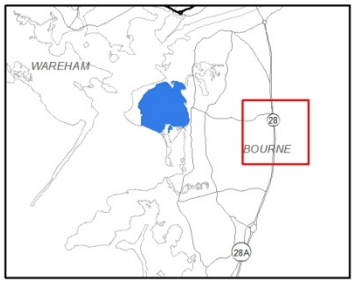
Highway Division





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

N

0 500 1,000 Feet

Figure 2

Phinneys Harbor (MA95-15)
MassDOT Contributing Area

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Impaired Waters Assessment for Harbor Head (MA95-46)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen, Estuarine Bioassessments, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*West Falmouth Harbor Embayment System Total Maximum Daily Loads for Total Nitrogen* (EPA TMDL # 34284)[2] *Final Pathogen TMDL for the Buzzards Bay Watershed* (EPA TMDL # 36172)[3]
	WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[4]
Location	**Towns:**	Falmouth
	MassDOT Roads:	Route 28 and Route 28A
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None

	Nitrogen
MassDOT Area and Targets	
Directly Contributing Load	18.3 lbs/yr
Contributing Watershed Area Load	998 lbs/yr
DOT Contribution to Existing Load	1.83 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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] 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

[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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Harbor Head (MA95-46). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Harbor Head watershed is located in Falmouth and includes residential areas, woods, wetlands, ponds and MassDOT roads (Routes 28 and 28A).

Harbor Head receives inflows from an unnamed stream, surface runoff and groundwater flow and discharges to West Falmouth Harbor. MassDEP's Water Quality Assessment Report titled "Buzzards Bay Watershed 2000 Surface Water Quality Assessment Report"[7] identified the shellfish harvesting as impaired due to fecal coliform bacteria. All other uses were not assessed. It is noted that the water quality assessment report recommended the development of a nutrient TMDL for the West Falmouth Harbor system in accordance with the Massachusetts Estuaries Project.

Figures 2a and 2b illustrates the MassDOT roads that are contributing to the water body. Two MassDOT roadways are located within the groundwatershed. Contributing DOT property to Harbor Head along Route 28 is limited to the pervious area within the median and along the shoulders as shown on Figure 2a. An existing drainage system collects runoff from the paved area and discharges outside of the groundwatershed.

Route 28A (West Falmouth Highway) also contributes runoff to the watershed. An existing drainage ditch is located behind properties along the east side of the road. Runoff from DOT property discharges to an existing drain outfall that is located within the groundwatershed at the upstream end of the ditch. Approximately 300 feet of roadway between the outfall and Seabreeze Lane also contributes runoff to the watershed. An existing drainage system also runs approximately 910 feet north of the outfall to a terminal set of catch basins in front of 572 West Falmouth Highway as shown on Figure 2b. This drainage system collects runoff from roadway past the northern boundary of the watershed and directs flow back into the the watershed. 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". The "Supplemental DOT Contributing Area" is illustrated on Figures 2a and 2b. To the south of Seabreeze Lane, a separate drainage system collects stormwater from the road and discharges to a different receiving water (Oyster Pond (MA95927)).

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] 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

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

[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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.[8] MassDOT assessed Harbor Head (MA95-46) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 243.0)

The *Total Maximum Daily Load (TMDL) for Nutrients in the West Falmouth Harbor Watershed, Massachusetts* (CN 243.0)[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described in section below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[11] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The Nitrogen Loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 1.0 acres
- DOT Pervious Area: 3.9 acres
- Estimated Existing MassDOT Load: 18.3 lb/yr
- Total Existing Watershed Nitrogen Load: 998 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 1.83%

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.[8] The cut-off value of 3.5% is based on loading values determined

[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.

[9] 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

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

to be negligible in the Cape Cod TMDLs. 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).[12] Harbor Head (MA95-46) is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed*.[13] 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[13] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's South East Expressway study measured bacterial concentration in stormwater runoff[14] and data indicated that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g. illicit discharges, sewer utilities, pet waste and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicate that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommend implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review and source control.

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

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.

[12] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[13] 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

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

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed 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,[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 turf establishment associated with recent ground disturbance.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Harbor Head, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.

[15] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004.

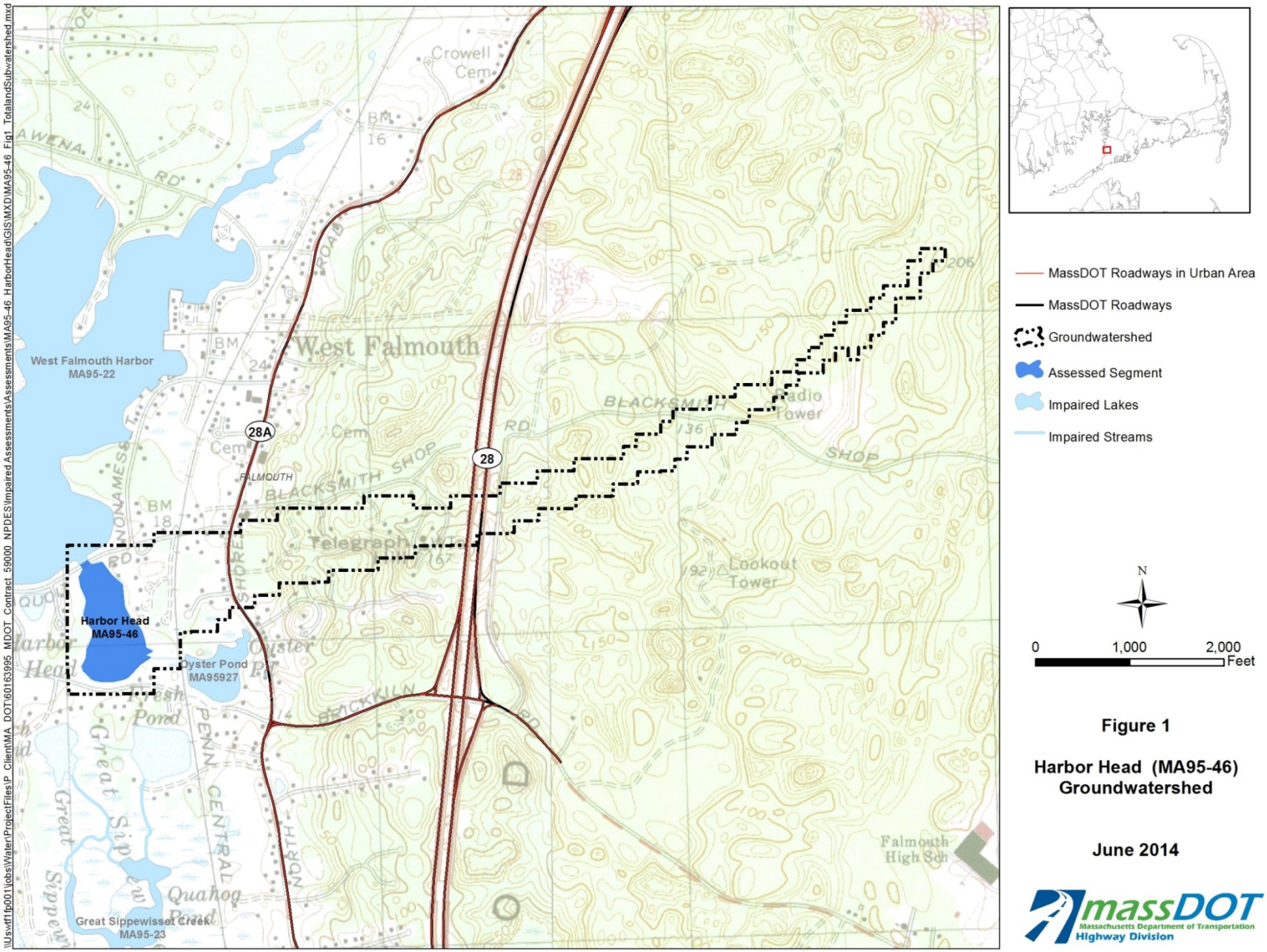
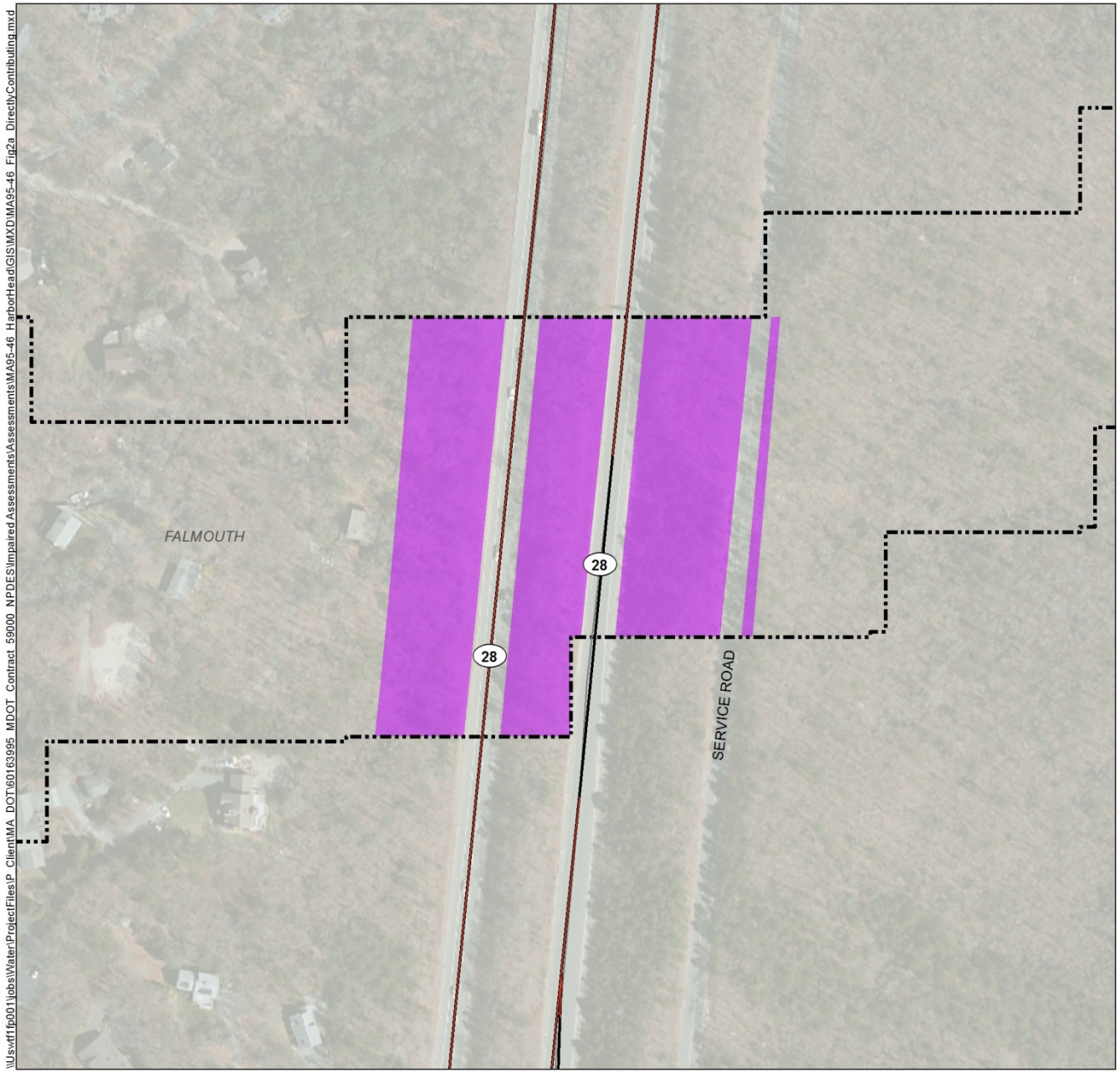


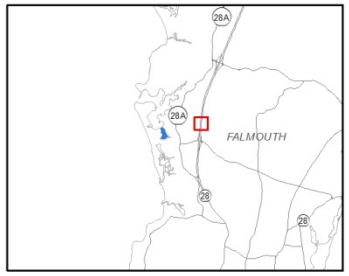
Figure 1

Harbor Head (MA95-46) Groundwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division





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

N

0 100 200 Feet

Figure 2a

Harbor Head (MA95-46)
MassDOT Contributing Area

June 2014

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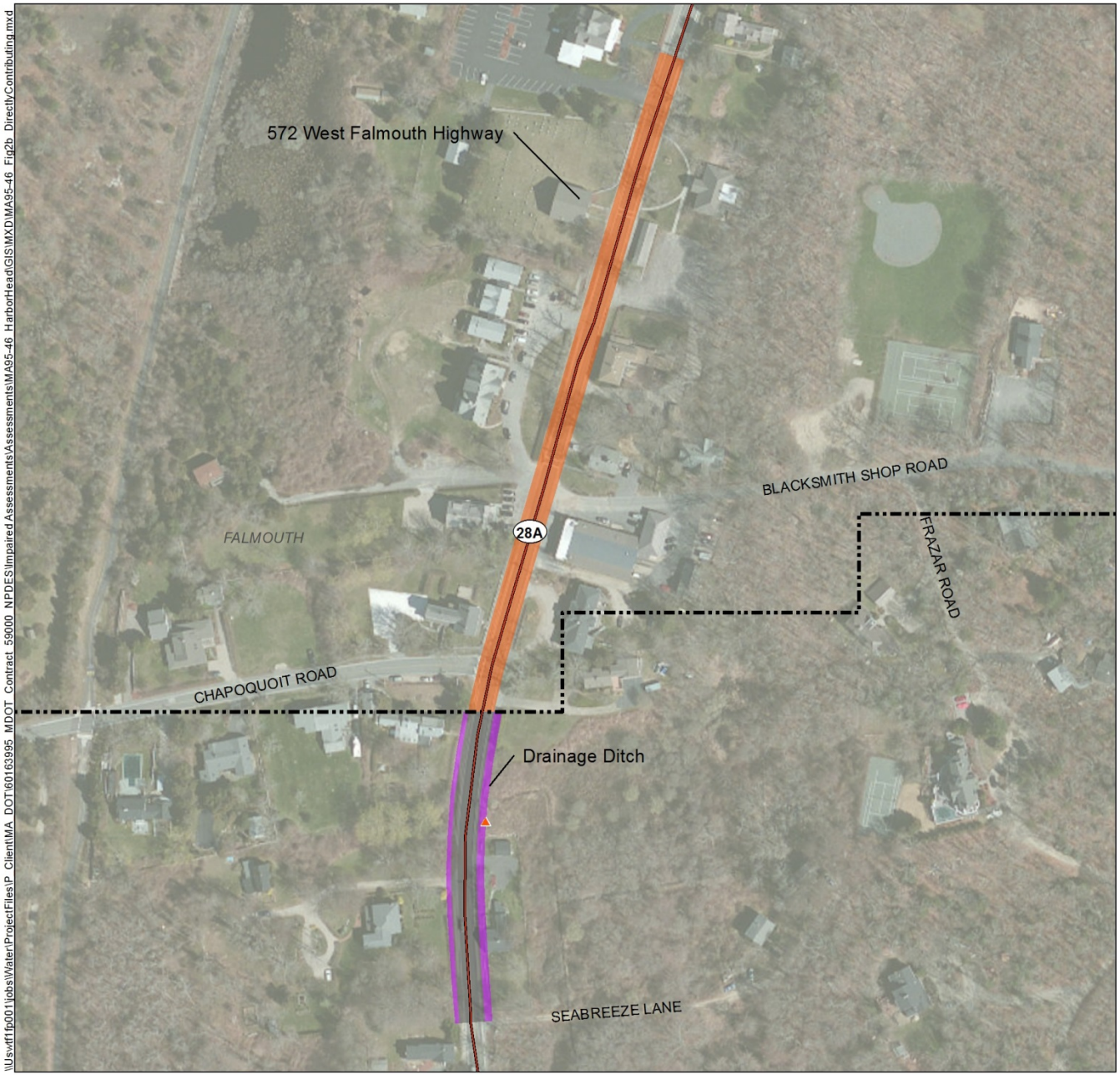

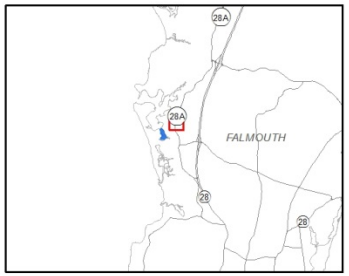

- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Groundwatershed
- Assessed Segment
- Impaired Streams
- Impaired Lakes
- DOT Supplemental Contributing Area
- DOT Pervious Area
- DOT Impervious Area

N

0 100 200 Feet

Figure 2b

Harbor Head (MA95-46)
MassDOT Contributing Area

June 2014

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Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Prince Cove (MA96-07)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Estuarine Bioassessments, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Three Bays System Total Maximum Daily Loads for Total Nitrogen* (CN 242.0)[2] *Final Pathogen TMDL for the Buzzards Bay Watershed* (CN 251.1)[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 (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None

MassDOT Area and Targets	**Nitrogen**
Directly Contributing Load	19.0 lbs/yr
Contributing Watershed Area Load	29,781 lbs/yr
DOT Contribution to Existing Load	0.06 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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. 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

[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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Prince Cove (MA96-07). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Prince Cove watershed is located in Barnstable along the Marstons Mills River and includes residential areas, wetlands, ponds, and a MassDOT road (Route 28).

Prince Cove receives inflow from Marston Mills River, an unnamed tributary and groundwater flow. The Marston Mills River flows from Middle Pond south through Mill Pond into Prince Cove. Prince Cove discharges to North Bay (MA96-66). MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identifies the Aquatic Life Use as "Impaired" for Prince Cove due to the loss of eelgrass bed habitat caused by total nitrogen loading from septic systems and fertilizers. The report identified shellfish harvesting as "Impaired" due to fecal coliform bacteria. The report identifies primary contact and secondary contact as "Support". Aesthetics and fish consumption were not assessed.

Figure 2 illustrates the MassDOT roads within the watershed that contribute runoff to the water body. Runoff from a 2,500 foot segment of Route 28 drains via catch basins and pipes to a subsurface leaching bed located at a low point adjacent to Marstons Mills River. This portion of Route 28 begins approximately 350 feet west of Staysail Circle and extends 2,500 feet to the east. 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 Marstons Mills River. The Route 28 segment that contributes to this outfall is approximately 2.2 acres of impervious surface and less than 0.1 acre of pervious surface in the Right of Way (ROW) allows for infiltration of runoff in this watershed.

An additional 2,000 feet of Route 28 beyond the eastern and western boundary of the watershed flows back into the watershed and is considered "Supplemental DOT 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". The supplemental area is illustrated on Figure 2.

Existing BMPs

MassDOT identified one existing BMPs in place with the potential to treat roadway runoff from the discharging area before reaching the impaired water segment. This existing BMP is a subsurface leaching bed located at a low point adjacent to Marstons Mills River. However, this BMP does not account for reduction credit for nitrogen removal from this system, per the methodology.

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[5] 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

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

[7] 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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.[8] MassDOT assessed Prince Cove (MA96-07) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 242.0)

The *Three Bays System Total Maximum Daily Loads for Total Nitrogen* (CN 242.0)[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described in section below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[11] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The Nitrogen Loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 2.2 acres
- DOT Pervious Area: 0.1 acres
- Estimated Existing MassDOT Load: 19.0 lb/yr
- Total Existing Watershed Nitrogen Load: 29,781 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.06%

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.[8] The cut-off value of 3.5% is based on loading values determined

[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*

[9] 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

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

to be negligible in the Cape Cod TMDLs. 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).[12] Harbor Head (MA95-46) is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed*.[13] 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[13] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's Southeast Expressway study measured bacterial concentration in stormwater runoff[14] and data indicated that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g., illicit discharges, sewer utilities, pet waste and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicate that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommend implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review and source control.

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

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 watershed of the water body, including regular roadway and drainage system maintenance, erosion

[12] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[13] 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

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

and sedimentation control, street sweeping, 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 turf establishment associated with recent ground disturbance.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Prince Cove, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Form.

[15] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004. Available at: http://www.mhd.state.ma.us/downloads/projdev/2009/mhd_stormwater_handbook.pdf

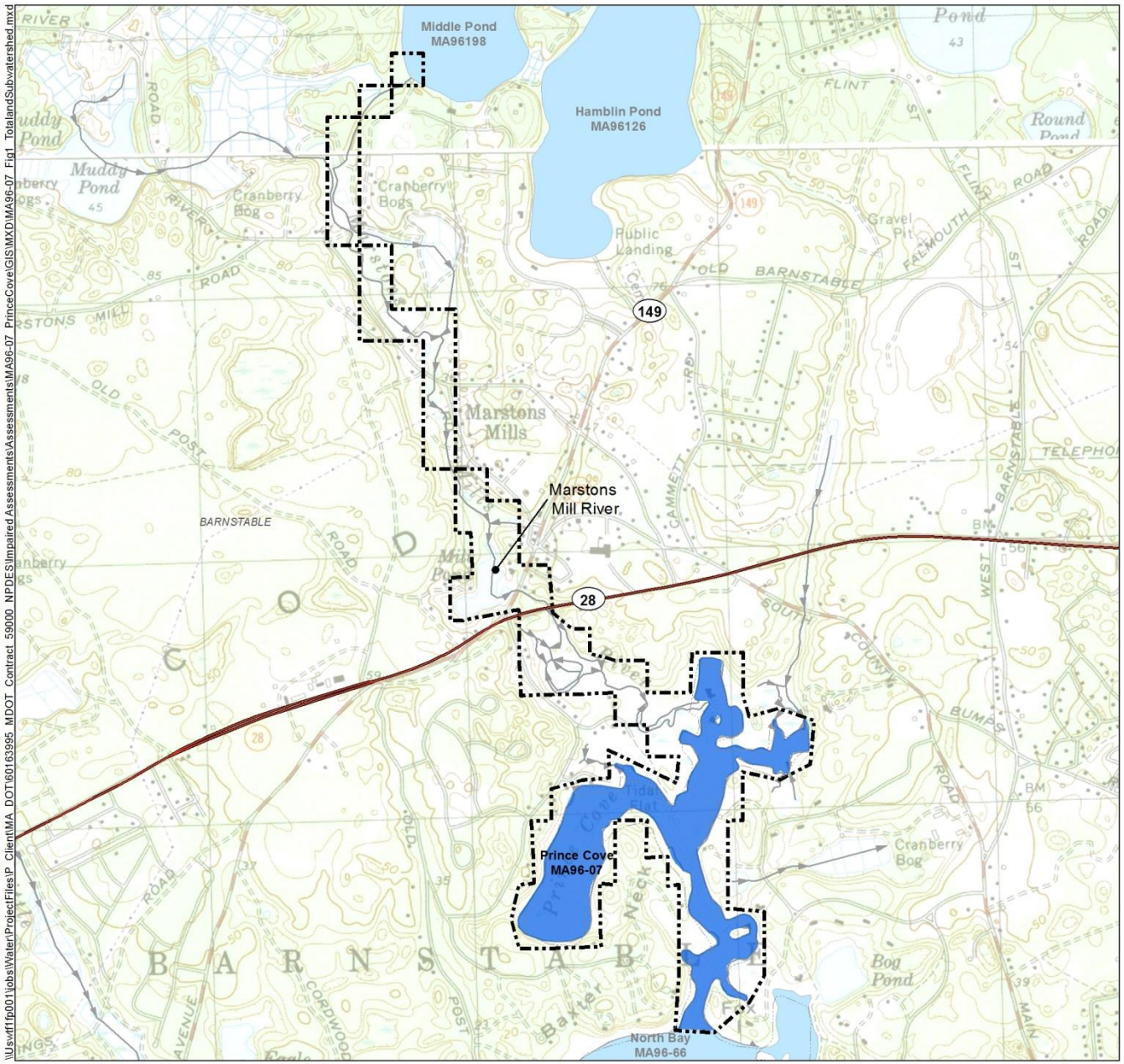

Figure 1

Prince Cove (MA96-07) Groundwatershed

June 2014

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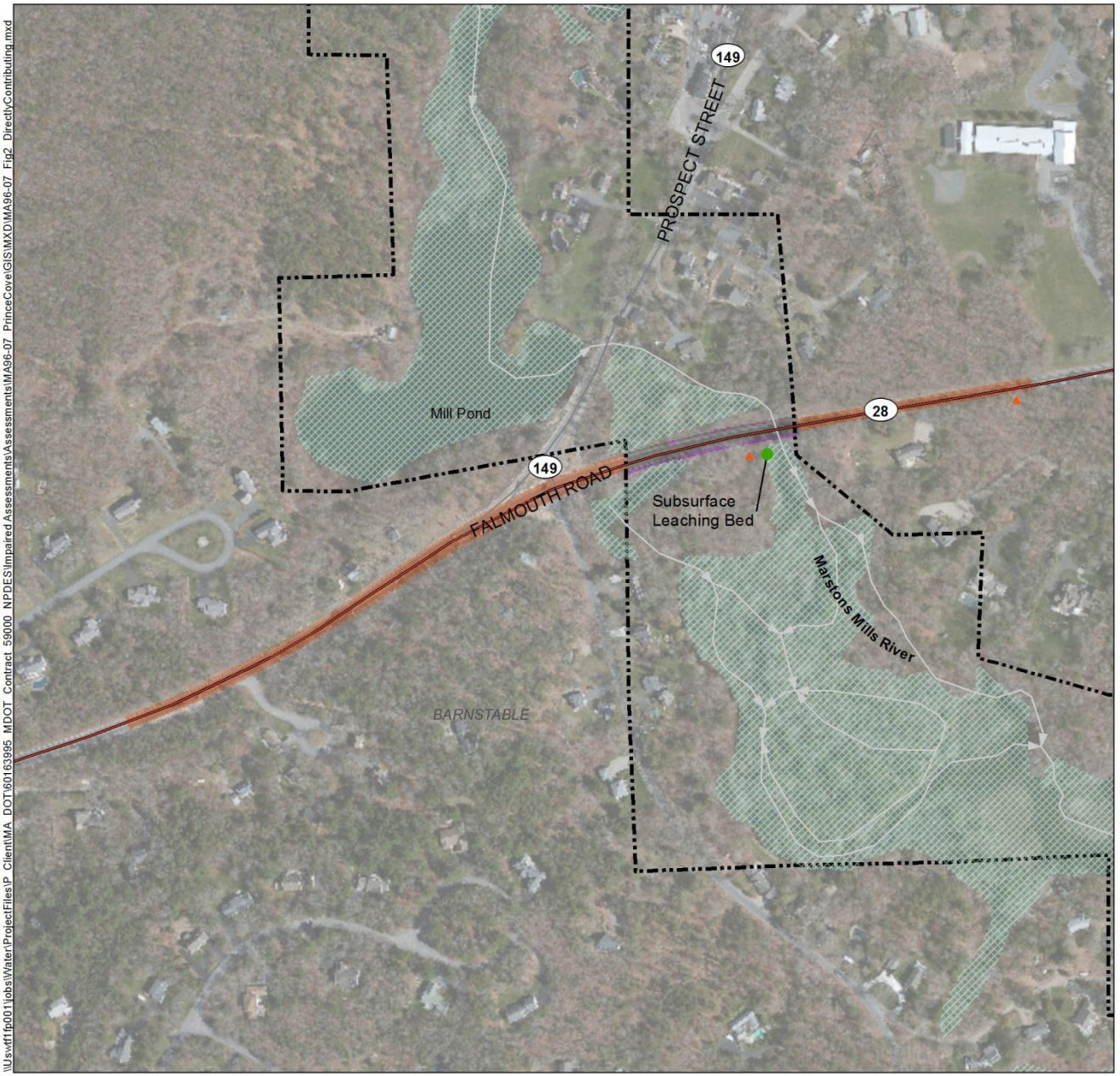

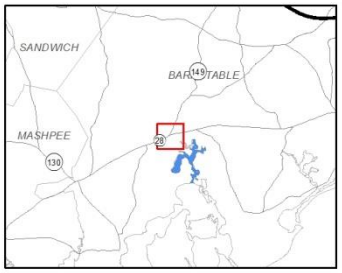

- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- NWI Wetland Areas
- Groundwatershed
- Assessed Segment
- DOT Supplemental Contributing Area
- DOT Pervious Area
- DOT Contributing Impervious Area
- Existing BMPs
- Non-Impaired Streams

N

0 200 400 Feet

Figure 2

Prince Cove (MA96-07)
MassDOT Contributing Area

June 2014

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Highway Division

Impaired Waters Assessment for Shoestring Bay (MA96-08)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Estuarine Bioassessments, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Popponesset BayTotal Maximum Daily Loads for Total Nitrogen* (EPA TMDL #33965)[2] *Final Pathogen TMDL for the Cape Cod Watershed* (EPA TMDL # 36771)[3]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]
Location	**Towns:**	Barnstable, Mashpee
	MassDOT Roads:	Route 28
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None

MassDOT Area and Targets	**Nitrogen**
Directly Contributing Load	29.5 lbs/yr
Contributing Watershed Area Load	19,047 lbs/yr
DOT Contribution to Existing Load	0.15 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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. 2006. Final Popponessett Bay Total Maximum Daily Load for Total Nitrogen (CN 217.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/popptmdl.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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Shoestring Bay (MA96-08). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Shoestring Bay watershed is located in Barnstable/Mashpee and includes residential areas, forest, cranberry bogs, and MassDOT roads (Route 28). The majority of the watershed is forest, closely followed by residential use.

Shoestring Bay receives inflows from Santuit River (MA96-92), surface runoff and groundwater flow. Shoestring Bay discharges to Popponesset Bay. MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identified shellfish harvesting as "Non-Support". The report identified primary and secondary contact as "Support" because of low bacteria counts registered during a sampling study. All other uses were not assessed.

Figure 2 illustrates the MassDOT roads that are directly contributing to the water body. Route 28 in Mashpee contributes runoff to Shoestring Bay. Contributing roadway to Shoestring Bay begins at a high point in the vicinity of 72 Falmouth Road (Route 28) in Mashpee, northeast of Bowdoin Road and continues to the southwest to a high point located near Sea Oaks in Mashpee. The outfall in the Shoestring Bay watershed discharges directly into Quaker Run which flows south into Shoestring Bay.

The western portion of the Route 28 contributing area is within the USGS delineated watershed area, but the eastern portion is outside of the watershed and is considered "Supplemental DOT 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" and is considered to be a source of impairment to the watershed. Stormwater in the supplemental DOT contributing area is conveyed via catch basins and storm drains to the outfall located between Noisy Hole Road and Old Mill 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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled

[5] 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

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

[7] 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

Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.[8] MassDOT assessed Shoestring Bay (MA96-08) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 217.0)

The *Popponesset Bay Total Maximum Daily Load (TMDL) for Total Nitrogen* (CN 217.0)[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described in section below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[11] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The nitrogen loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 3.0 acres
- DOT Pervious Area: 1.6 acres
- Estimated Existing MassDOT Load: 29.5 lb/yr
- Total Existing Watershed Nitrogen Load: 19,047 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.15%

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.[8] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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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[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*

[9] Mass DEP. 2006. Final Popponessett Bay Total Maximum Daily Load for Total Nitrogen (CN 217.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/popptmdl.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

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).[12] Shoestring Bay (MA96-08) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[13] 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[13] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's South East Expressway study measured bacterial concentration in stormwater runoff[14] and data indicated that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g. illicit discharges, sewer utilities, pet waste and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicate that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommend implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review and source control.

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

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 watershed 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,[15] MassDOT does not use nitrogen based fertilizers as part of

[12] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

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

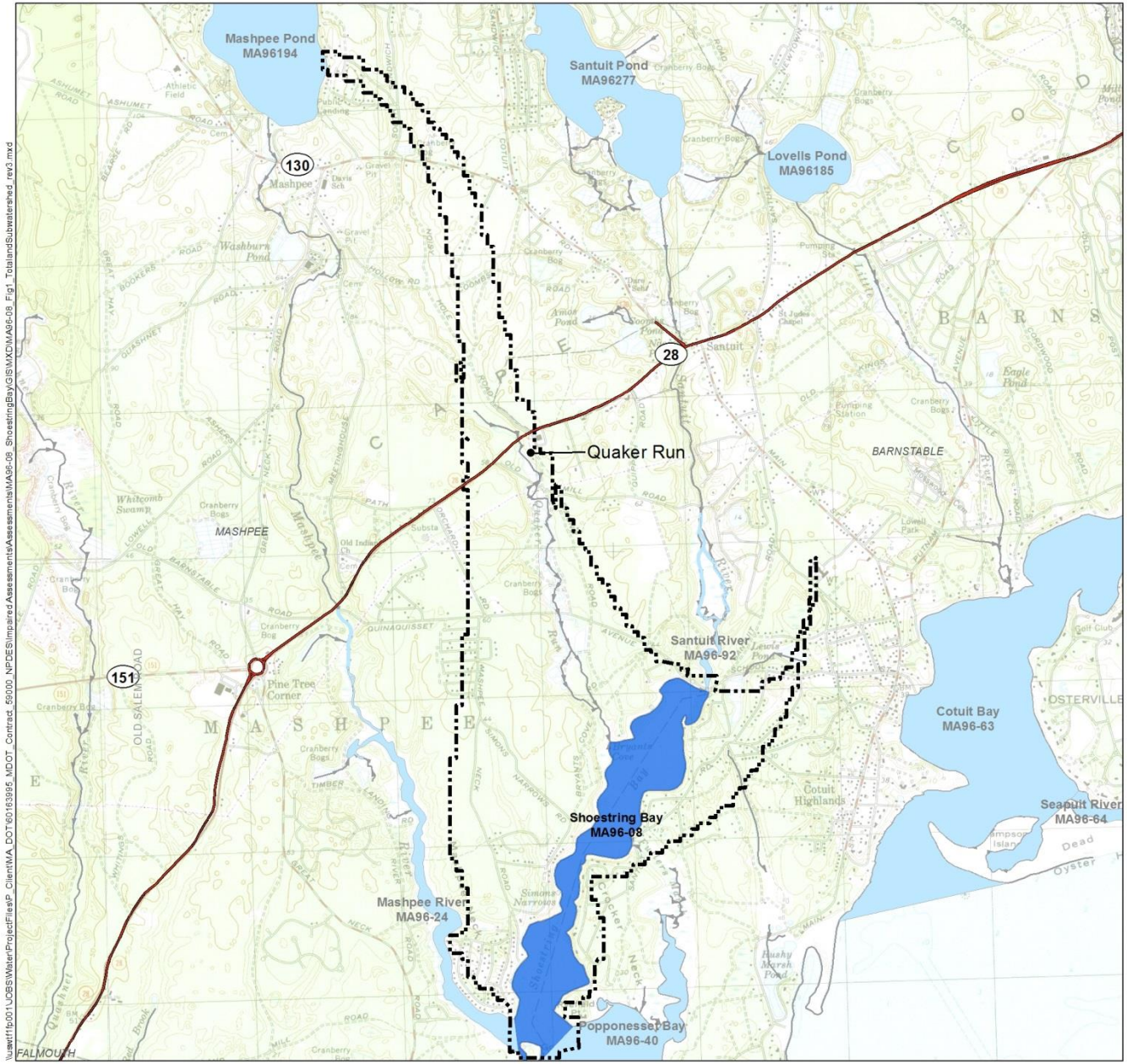
[15] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004.

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.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Shoestring Bay, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.



MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

Non-Impaired Streams

N

0 2,000 4,000 Feet

Figure 1

Shoestring Bay (MA96-08) Groundwatershed

June 2014

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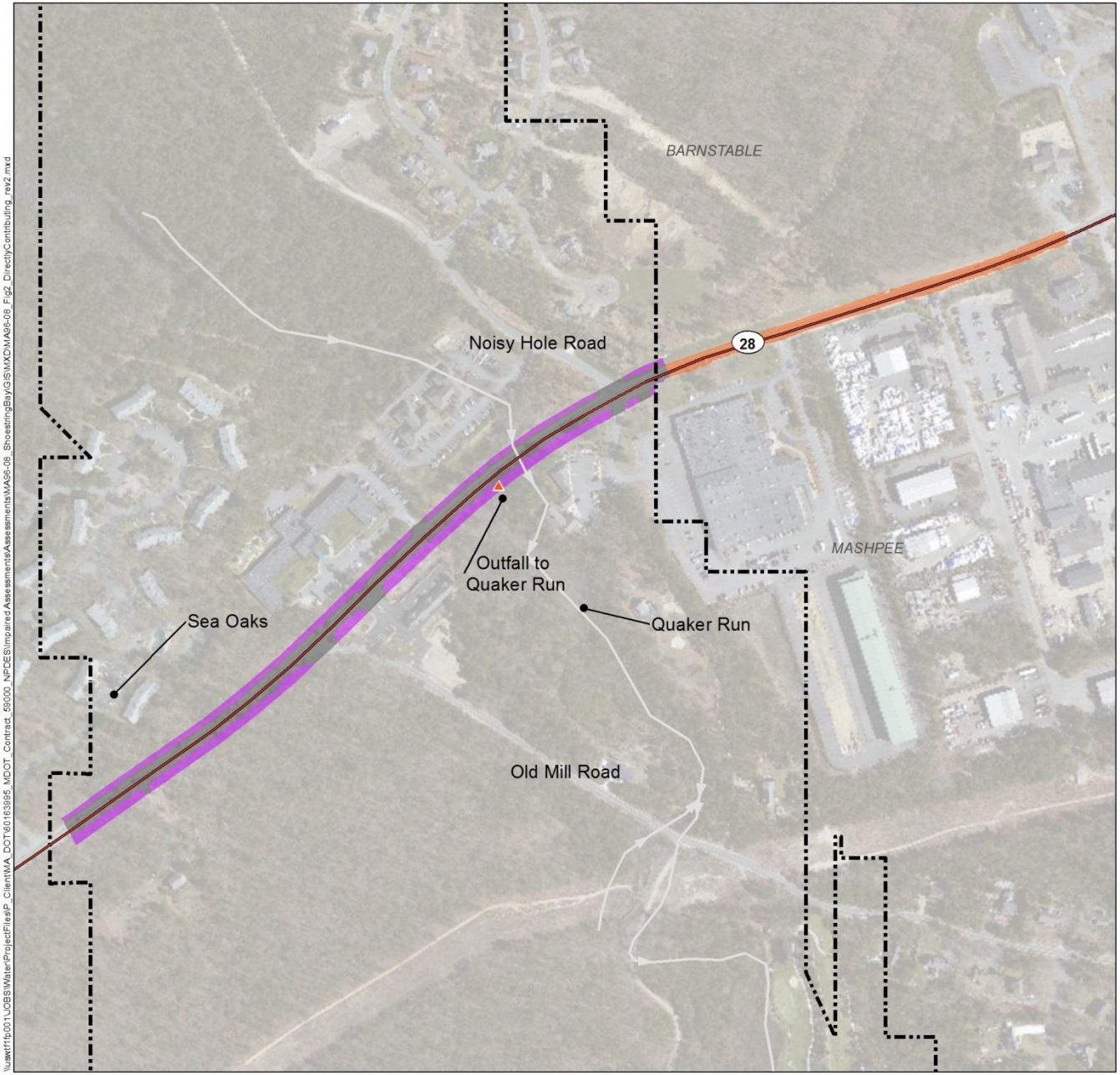

MassDOT Outfalls
MassDOT Roadways in Urban Area
MassDOT Roadways
Groundwatershed
Assessed Segment
Impaired Streams
Impaired Lakes
Non-Impaired Streams
DOT Supplemental Contributing Area
DOT Pervious Area
DOT Impervious Area

N

0 200 400 Feet

Figure 2

Shoestring Bay (MA96-08)
MassDOT Contributing Area

June 2014

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Highway Division

Impaired Waters Assessment for Mashpee River (MA96-24)

Summary

Impaired Waters[1]	**Impairments:**	Estuarine Bioassessments, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Popponesset BayTotal Maximum Daily Loads for Total Nitrogen* (EPA TMDL #33965)[2] *Final Pathogen TMDL for the Cape Cod Watershed* (EPA TMDL # 36771)[3]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]
Location	**Towns:**	Mashpee
	MassDOT Roads:	Route 28
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None

MassDOT Area and Targets	**Nitrogen**
Directly Contributing Load	121.7 lbs/yr
Contributing Watershed Area Load	45,070 lbs/yr
DOT Contribution to Existing Load	0.27 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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. 2006. Final Popponessett Bay Total Maximum Daily Load for Total Nitrogen (CN 217.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/popptmdl.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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Mashpee River (MA96-24). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Mashpee River watershed is located in Mashpee and includes residential areas, forest, cranberry bogs, and MassDOT roads (Route 28). The majority of the watershed is forest, followed by residential use.

Mashpee River receives inflows from an unnamed stream, surface runoff and groundwater flow. Mashpee River discharges to Shoestring Bay. MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identified shellfish harvesting as "Partital Support" in 0.04 mi^2 and "Non-Support" in 0.06 mi^2. The report identified primary and secondary contact as "Support" because of low bacteria counts during a sampling period. All other uses were not assessed.

Figures 2a, 2b, 2c, and 2d illustrate the MassDOT roads that are directly contributing to the water body. Route 28 in Mashpee contributes runoff to Mashpee River. The Mashpee River receives runoff from two MassDOT owned outfalls located within the watershed. The outfall in the western portion of the MA96-24 watershed receives drainage from approximately 3,300 feet of contributing DOT road that is conveyed north through a storm drain that starts near Dover Road (Figure 2a). Approximately 250 feet of this segment is located within the watershed. The remaining segment that located beyond the watershed flows back into the watershed and is considered "Supplemental DOT 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". This outfall also receives drainage from 3,100 feet of Route 28 that is conveyed through a storm drain from a high point approximately 200 feet south of the Mashpee Circle (Figure 2b). This segment of Route 28 is located within the watershed. The outfall discharges into a low-lying area that does not appear to have an established outlet.

Stormwater from the Route 28 segment that crosses the Mashpee River is conveyed through storm drains from the east and west to an outlet into the river (Figures 2c and 2d). Approximately 400 feet of Route 28 is located within the watershed. An additional 1,500 feet west and 3,200 feet east along Route 28 beyond the watershed flows back into the watershed and is considered "Supplemental DOT Contributing Area". The outfall from this road segment discharges into the river.

Stormwater in the eastern section of the watershed is only from sheet flow runoff from approximately 300 feet of Route 28 onto the adjacent land area that is within the delineated watershed near Sea Oaks Road (Figure 2d).

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[5] 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

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

[7] 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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[8] MassDOT assessed Mashpee River (MA96-24) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 217.0)

The *Final Popponessett Bay Total Maximum Daily Load (TMDL) for Nitrogen (CN 217.0)*[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described in section below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[11] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The Nitrogen Loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 12.9 acres
- DOT Pervious Area: 4.8 acres
- Estimated Existing MassDOT Load: 121.7 lb/yr
- Total Existing Watershed Nitrogen Load: 45,070 lb/yr (from TMDL)

[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.

[9] Mass DEP. 2006. Final Popponessett Bay Total Maximum Daily Load for Total Nitrogen (CN 217.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/popptmdl.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.27%

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.[12] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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 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).[13] Mashpee River (MA96-24) is covered by the Final Pathogen TMDL for the Cape Cod Watershed.[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. 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[14] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's South East Expressway study measured bacterial concentration in stormwater runoff[15] and data indicated that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g. illicit discharges, sewer utilities, pet waste and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicate that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommend implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review and source control.

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

[13] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/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] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

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

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 watershed 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,[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 turf establishment associated with recent ground disturbance.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Mashpee River, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.

[16] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004.

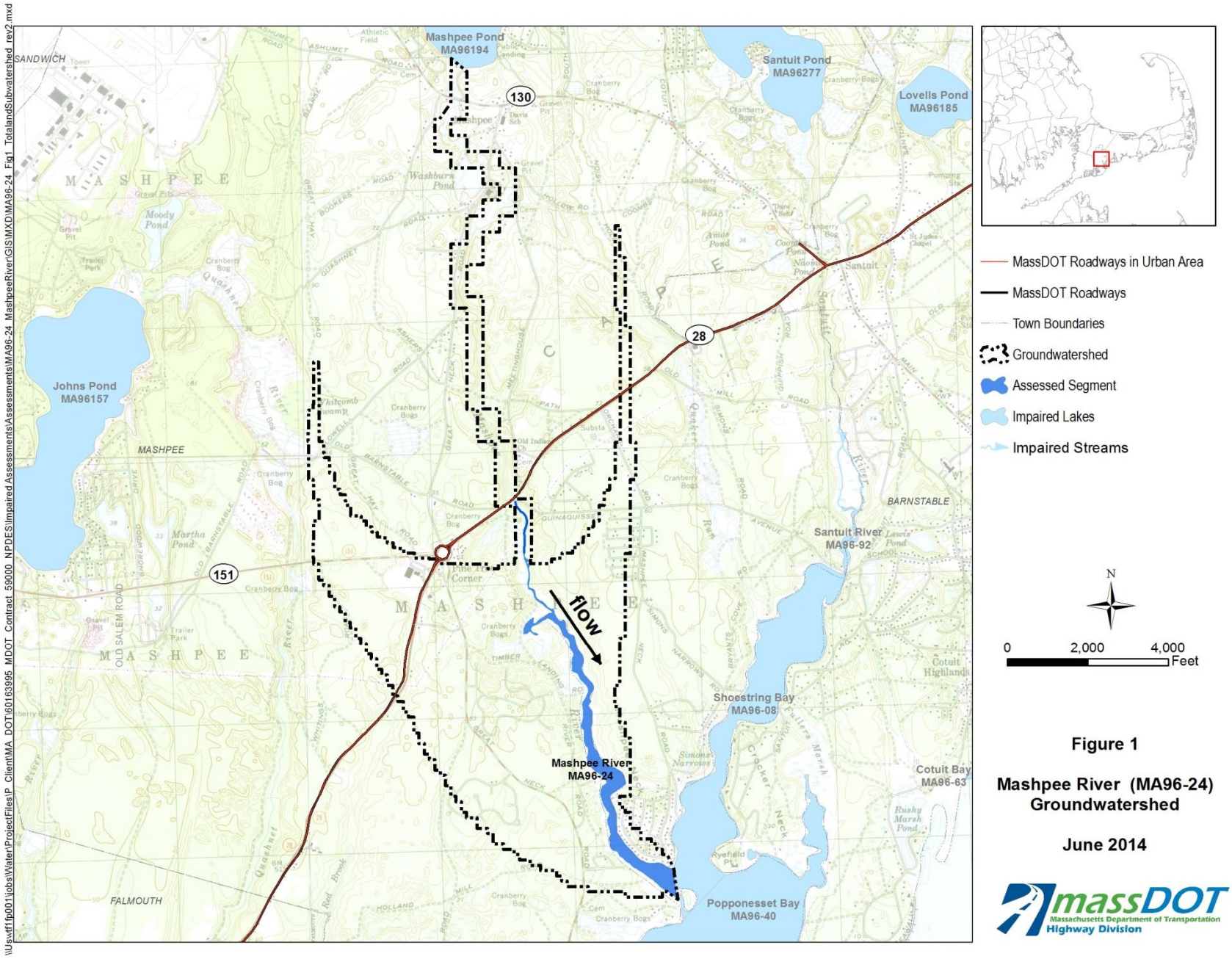
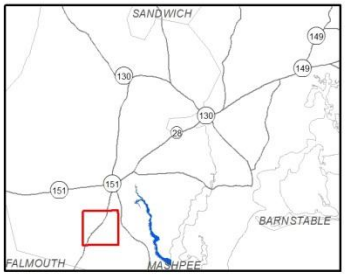


Figure 1

Mashpee River (MA96-24) Groundwatershed

June 2014



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

N

0 300 600 Feet

Figure 2a

Mashpee River (MA96-24)
MassDOT Contributing Area

June 2014

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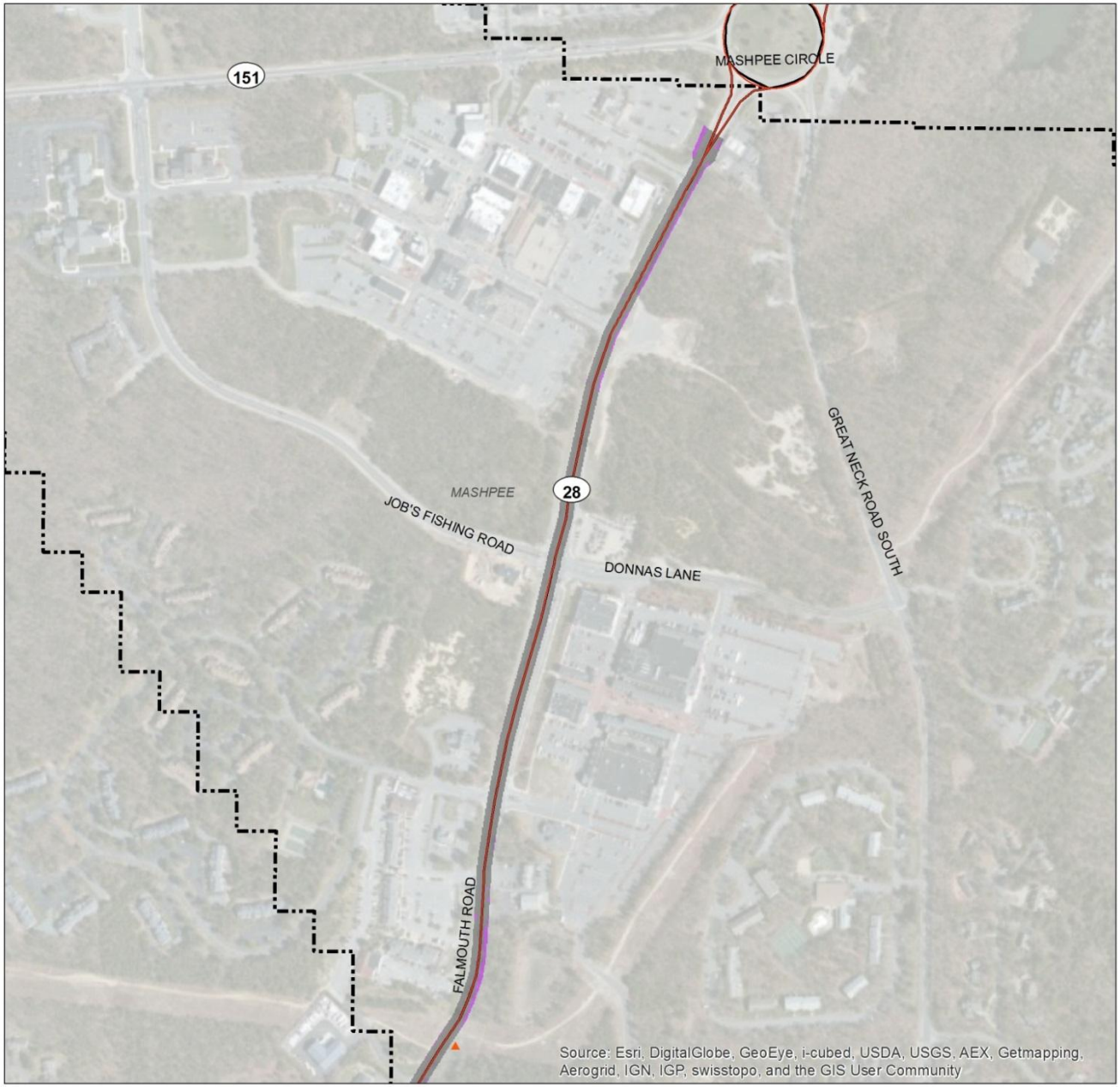
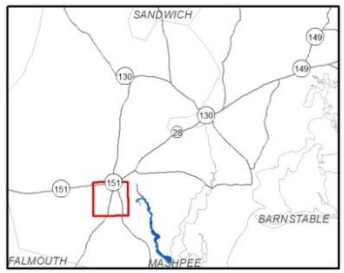
Highway Division





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

N

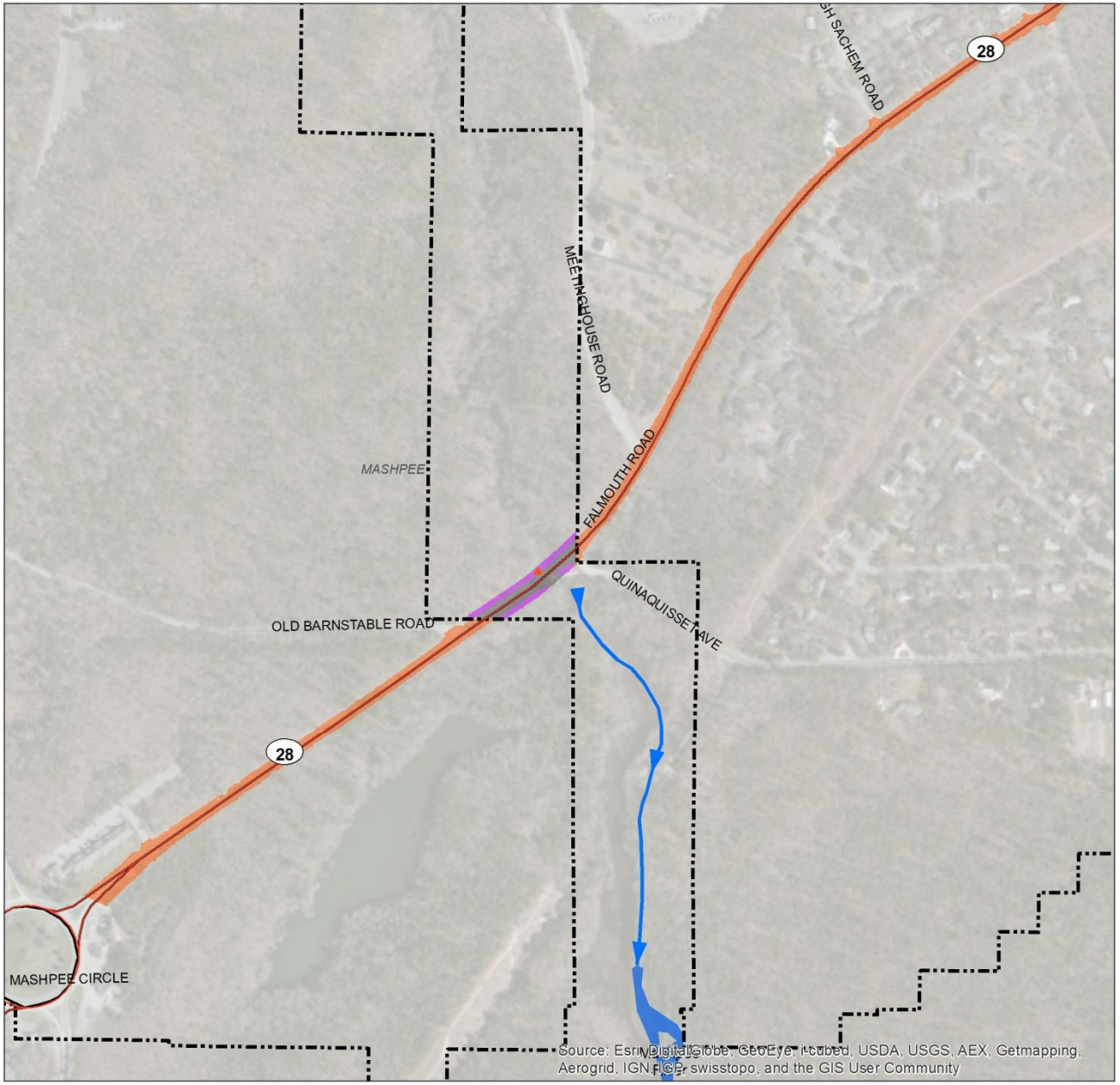
0 300 600
Feet

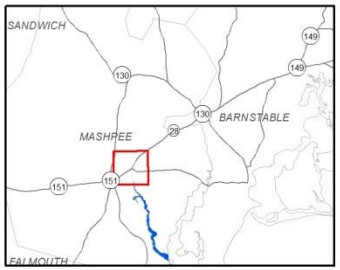
Figure 2b

Mashpee River (MA96-24)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division





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

N

0 300 600 Feet

Figure 2c

Mashpee River (MA96-24)
MassDOT Contributing Area

June 2014

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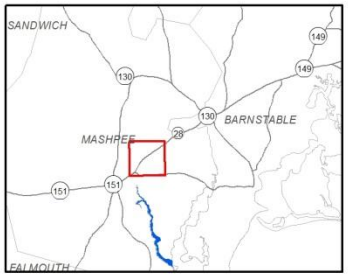
Massachusetts Department of Transportation
Highway Division



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

N

0 300 600 Feet

Figure 2d

Mashpee River (MA96-24)
MassDOT Contributing Area

June 2014

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Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Taylors Pond (MA96-42)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Stage Harbor/Oyster Pond, Sulphur Springs/Bucks Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations for Total Nitrogen* (CN 206.1)[2] *Final Pathogen TMDL for the Cape Cod Watershed* (CN 252.0)[3]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]
Location	**Towns:**	Chatham
	MassDOT Roads:	Route 28
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None
		Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**	18.0 lbs/yr
	Contributing Watershed Area Load	6,276 lbs/yr
	DOT Contribution to Existing Load	0.29 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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. Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/chatham.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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Taylors Pond (MA96-42). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Taylors Pond watershed is located in Chatham, MA and includes residential areas, wetlands, a pond (Duane Pond), state park land (Sylvan Parcel), a state road (Route137) and a MassDOT road (Route 28). The majority of the watershed is developed.

Taylors Pond does not receive inflow from any surface waters. It is fed by groundwater and tidal water through Mill Creek which discharges into Cockle Cove. MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identified the Aquatic Life Use as "Impaired" for Taylors Pond due to total nitrogen from subsurface waste water disposal (septic systems), stormwater runoff, and fertilizers. The Shellfish Harvesting Use is also "Impaired" for Taylors Pond due to elevated fecal coliform bacteria from marina/boating pumpout releases, waterfowl, waste from pets, on-site (septic) systems, and discharges from municipal separate storm sewer systems. Shellfish harvesting is conditionally approved for Taylors Pond. All other uses were not assessed.

Figure 2 illustrates the MassDOT roads that are directly contributing to the water body. In the contributing area, Route 28 has one lane in each direction and a sidewalk within a 40 feet wide Right of Way (ROW). Runoff from approximately 150 feet of Route 28 from the Waterview Circle to the western watershed boundary is transferred to the adjacent watershed via surface flow, and therefore does not contribute to Taylors Pond. The contributing roadway to Taylors Pond begins at a high point in the vicinity of Waterview Circle and continues approximately 2,500 feet east to a high point located on the eastern watershed boundary, in the vicinity of Beacon Hill. Runoff from Route 28 from the high point near Waterview Circle travels through sheet flow to a low point located in the vicinity of Deepwater Road, where it is collected by two catch basins, and then is infiltrated into the groundwater. The runoff from the portion of Route 28 from Deepwater Road to the eastern watershed boundary runs off the side of the roadway and ultimately discharges to side ditches, infiltrating into the groundwater. Surrounding land uses are commercial and residential.

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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with

[5] 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

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

[7] 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

an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[8] MassDOT assessed Taylors Pond (MA 96-42) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 206.1)

The *Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen* (CN 206.1)[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described in section below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[11] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The Nitrogen Loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 2.0 acres
- DOT Pervious Area: 0.4 acres
- Estimated Existing MassDOT Load: 18.0 lb/yr
- Total Existing Watershed Nitrogen Load: 6,276 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.29%

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.[12] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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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[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*

[9] Mass DEP. 2007. Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/chatham.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[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. March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.

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).[13] Taylors Pond (MA96-42) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed.*[14] According to the TMDL, sources of indicator bacteria in the Taylors Pond watershed are believed to be primarily from illicit marina/boating pumpout releases; waterfowl; pet waste; failing septic systems; 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[14] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's South East Expressway study measured bacterial concentration in stormwater runoff[15] and data indicate that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g. illicit discharges, sewer utilities, pet waste, and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

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

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

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 watershed of the water body, including regular roadway and drainage system maintenance, erosion and sedimentation control, street sweeping, and outreach and education. As described in

[13] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/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] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

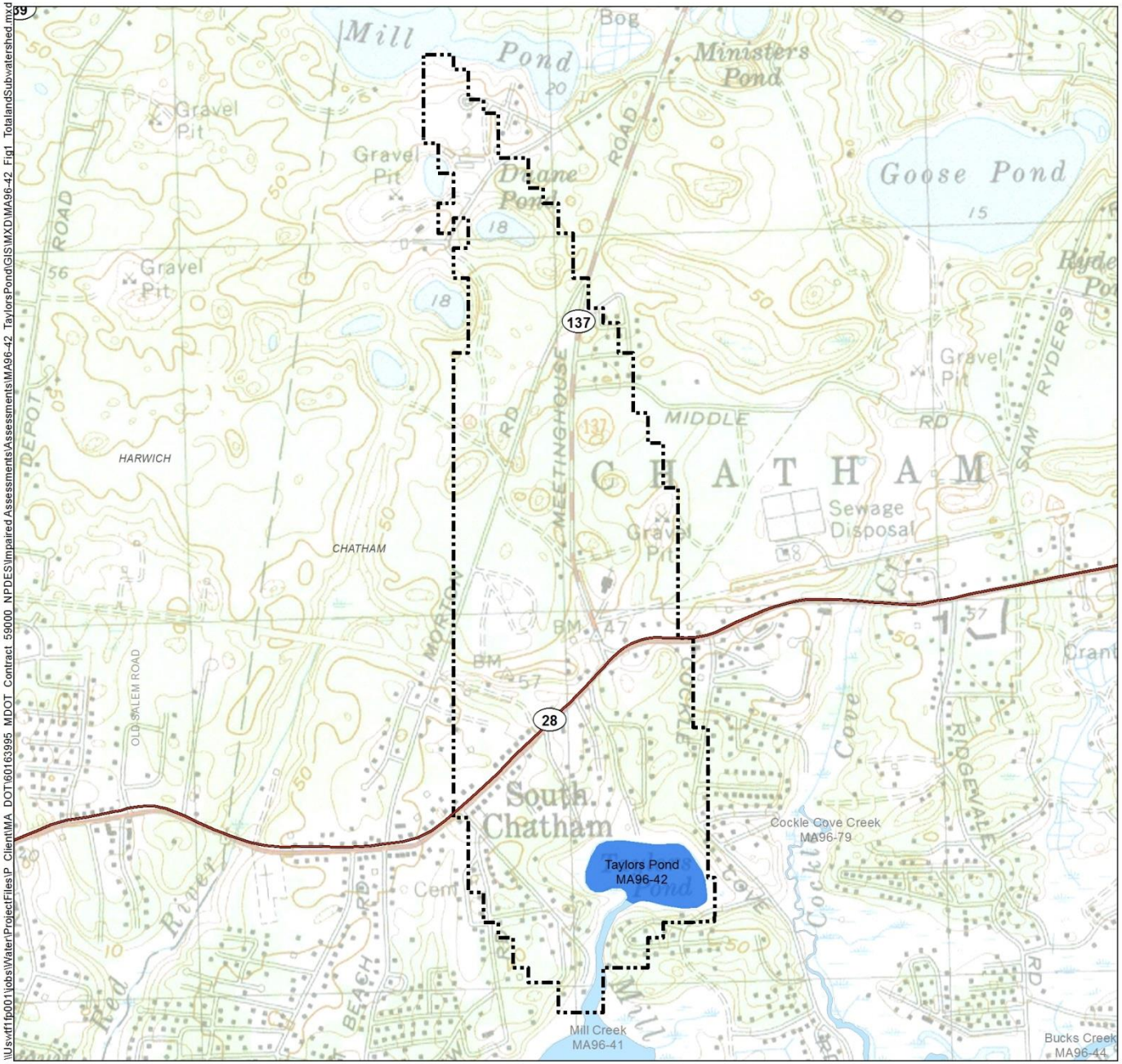
MassDOT's Stormwater Handbook,[16] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional turf establishment associated with recent ground disturbance.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Taylors Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.

[16] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004.



MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

0 750 1,500 Feet

Figure 1

Taylors Pond (MA96-42) Groundwatershed

June 2014

massDOT
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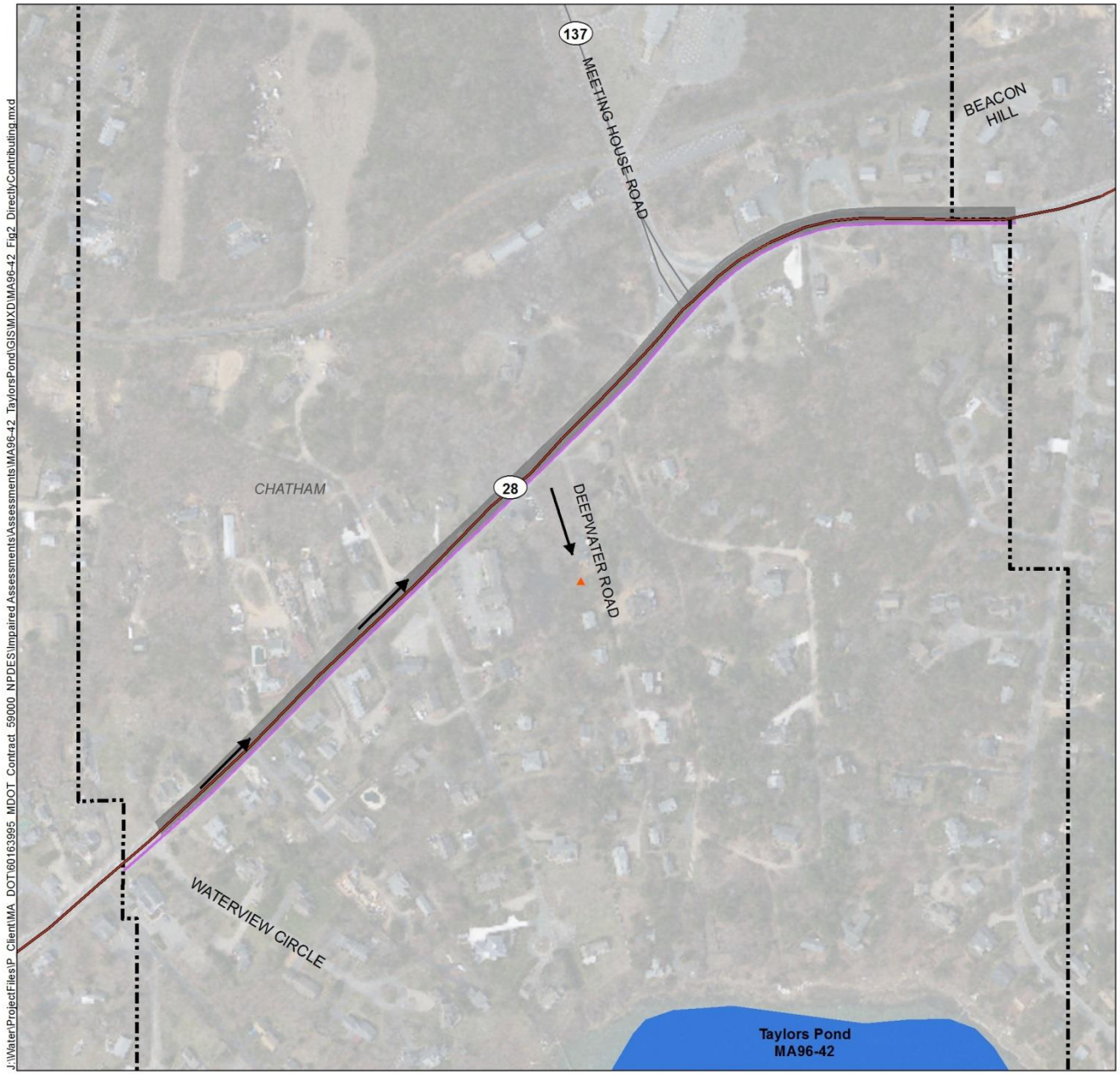
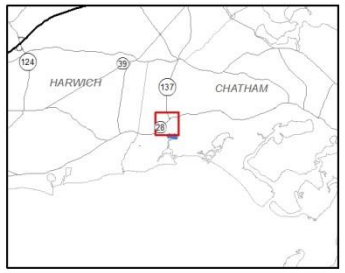
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Groundwatershed
- Assessed Segment
- Impaired Streams
- Impaired Lakes
- DOT Pervious Area
- DOT Impervious Area
- Flow Direction

N

0 200 400 Feet

Figure 2

Taylors Pond (MA96-42)
MassDOT Contributing Area

June 2014

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Massachusetts Department of Transportation
Highway Division

J:\Water\ProjectFiles\P_Client\MA_DOT\60163995_MDOT_Contract_59000_NPDES\Impaired Assessments\Assessments\MA96-42_TaylorsPond\GIS\MXD\MA96-42_Fig2_DirectlyContributing.mxd

Impaired Waters Assessment for Harding Beach Pond (MA96-43)

Summary

		Stormwater	
Impaired Waters[1]	**Impairments:**	Nitrogen, Fecal Coliform	
	Category:	4A (TMDL is completed)	
	Final TMDLs:	*Stage Harbor/Oyster Pond, Sulphur Springs/Bucks Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations for Total Nitrogen* (CN 206.1)[2] *Final Pathogen TMDL for the Cape Cod Watershed* (CN 252.0)[3]	
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]	
Location	**Towns:**	Chatham	
	MassDOT Roads:	Route 28	
Assessment Method(s)	**7R (TMDL Method)**	☒	
	7U (IC Method)	☐	
	Load Negligible	☒	
BMPs	**Existing:**	None	
	Proposed:	None	
			Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**		37.2 lbs/yr
	Contributing Watershed Area Load		8,047 lbs/yr
	DOT Contribution to Existing Load		0.46 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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. Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/chatham.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

Harding Beach Pond is also known as the Bucks Creek Marshes or Sulphur Springs (as referred to in the *Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen* report). Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Harding Beach Pond (MA 96-43). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Harding Beach Pond watershed is located in Chatham, MA and includes residential areas, marshlands and wetlands, municipal roads and an airstrip (Chatham Municipal Airport), and a MassDOT road (Route 28). The majority of the watershed is developed.

Harding Beach Pond receives inflow from three unnamed streams and groundwater. It discharges to Bucks Creek and ultimately into Cockle Cove. MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identified the Aquatic Life Use as "Impaired" for Harding Beach Pond due to total nitrogen load from subsurface waste water disposal (septic systems), stormwater runoff, and fertilizers. The Shellfish Harvesting Use is also "Impaired" for Harding Beach Pond due to elevated fecal coliform bacteria from waterfowl, waste from pets, on-site (septic) systems, and discharges form municipal separate storm sewer systems. The Shellfish Harvesting Use is Conditionally Approved for Harding Beach Pond. Primary and secondary contact Uses and all other uses were not assessed.

Figure 2 illustrates the MassDOT roads that are directly contributing to the water body. Approximately 3,300 feet of Route 28 in Chatham between Sam Ryders Road and Whelden Way contributes runoff and groundwater infiltration to the watershed area. Along the contributing area, Route 28 has one lane in each direction and a sidewalk within a 40 feet wide Right of Way (ROW) between the Sam Ryders Road and George Ryder Road. Route 28 has three lanes between George Ryder Road and Barn Hill Road and a sidewalk within a 60 feet wide ROW, and narrows down to two lanes and a sidewalk from Barn Hill Road to the eastern boundary of the watershed, about 200 feet east of Whelden Way. In the western part of the watershed, runoff travels through sheet flow and concentrated flow along the side of the road and then is discharged into ditches adjacent to the road through two paved spillways. The spillways are located in the vicinity of Shady Acre Drive and Baileys Path. Runoff from the eastern side of the watershed is discharged mainly through direct sheet-flow to the areas adjacent to Route 28 and infiltrated into the groundwater. Several independent catch basins located in the vicinity of Whelden Way discharge into ditches and wetlands adjacent to Route 28 within the watershed boundaries. The MassDOT property within this watershed contributes to Harding Beach Pond through groundwater flow. Surrounding land uses are commercial and residential.

In addition, 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". Runoff

[5] 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

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

[7] 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

from a supplemental area of approximately 300 feet of roadway from Sam Ryders Road to the western boundary of the groundwatershed contributes runoff to Harding Beach Pond. Runoff from the supplemental area sheet flows on the roadway, and then discharged to ditches alongside the road within the Harding Beach Pond 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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.[8] MassDOT assessed Harding Beach Pond (MA 96-43) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 206.1)

The *Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen* (CN 206.1)[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described in section below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property and treatment through existing BMPs, if present. Based on the USGS SELDM model,[11] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The Nitrogen Loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 4.2 acres

[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*

[9] Mass DEP. 2007. Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/chatham.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

- DOT Pervious Area: 0.6 acres
- Estimated Existing MassDOT Load: 37.2 lb/yr
- Total Existing Watershed Nitrogen Load: 8,047 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed 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 watershed load.[12] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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 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).[13] Harding Beach Pond (MA96-43) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[14] According to the TMDL, sources of indicator bacteria in the Harding Beach Pond watershed are believed to be primarily from waterfowl; pet waste; failing septic systems; 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[14] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's South East Expressway study measured bacterial concentration in stormwater runoff[15] and data indicate that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g. illicit discharges, sewer utilities, pet waste, and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

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

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

[13] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/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] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review, and source control.

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

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 watershed 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,[16] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. Fertilizers are only used for initial vegetative establishment associated with new construction.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Harding Beach Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of

[16] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004.

BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.

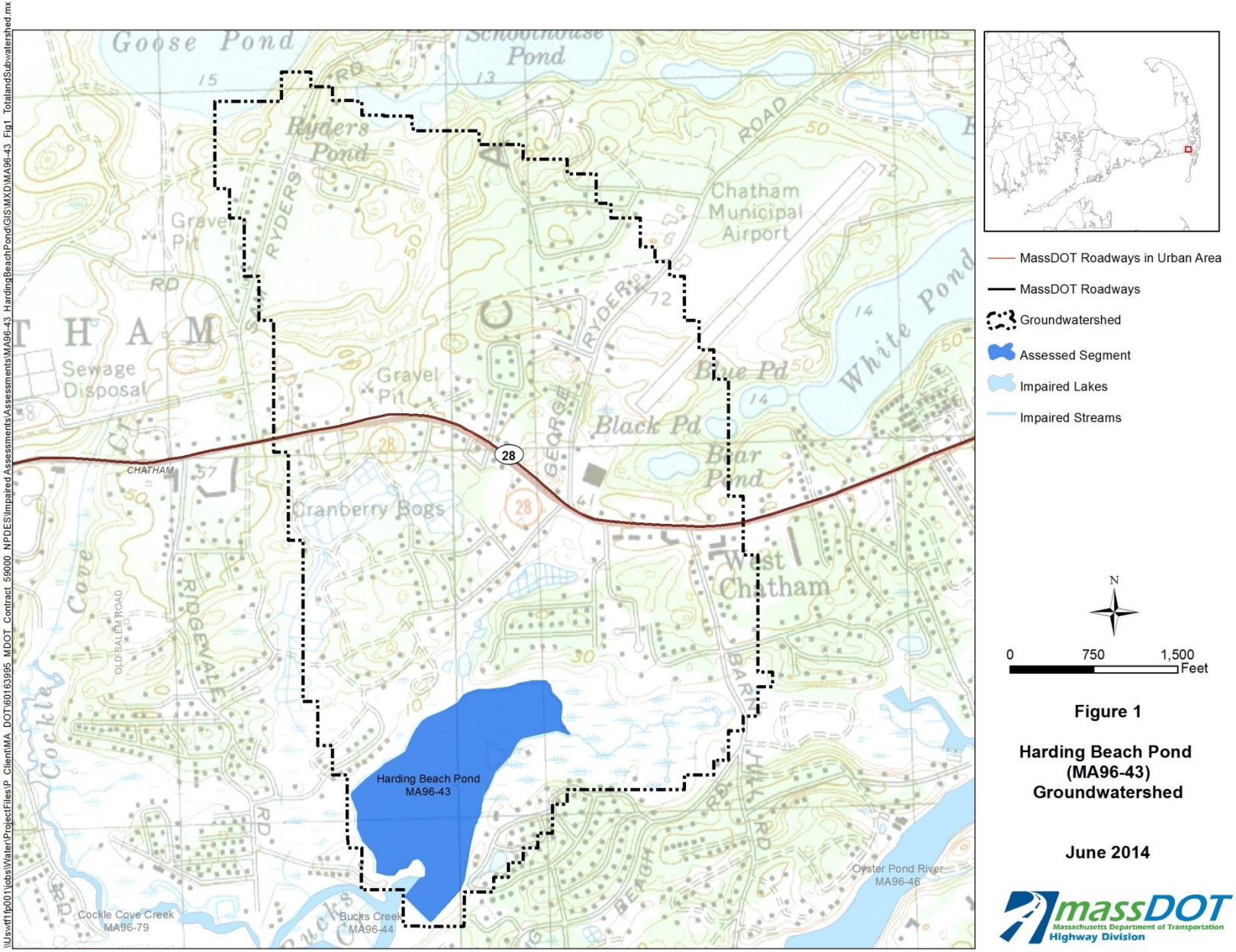
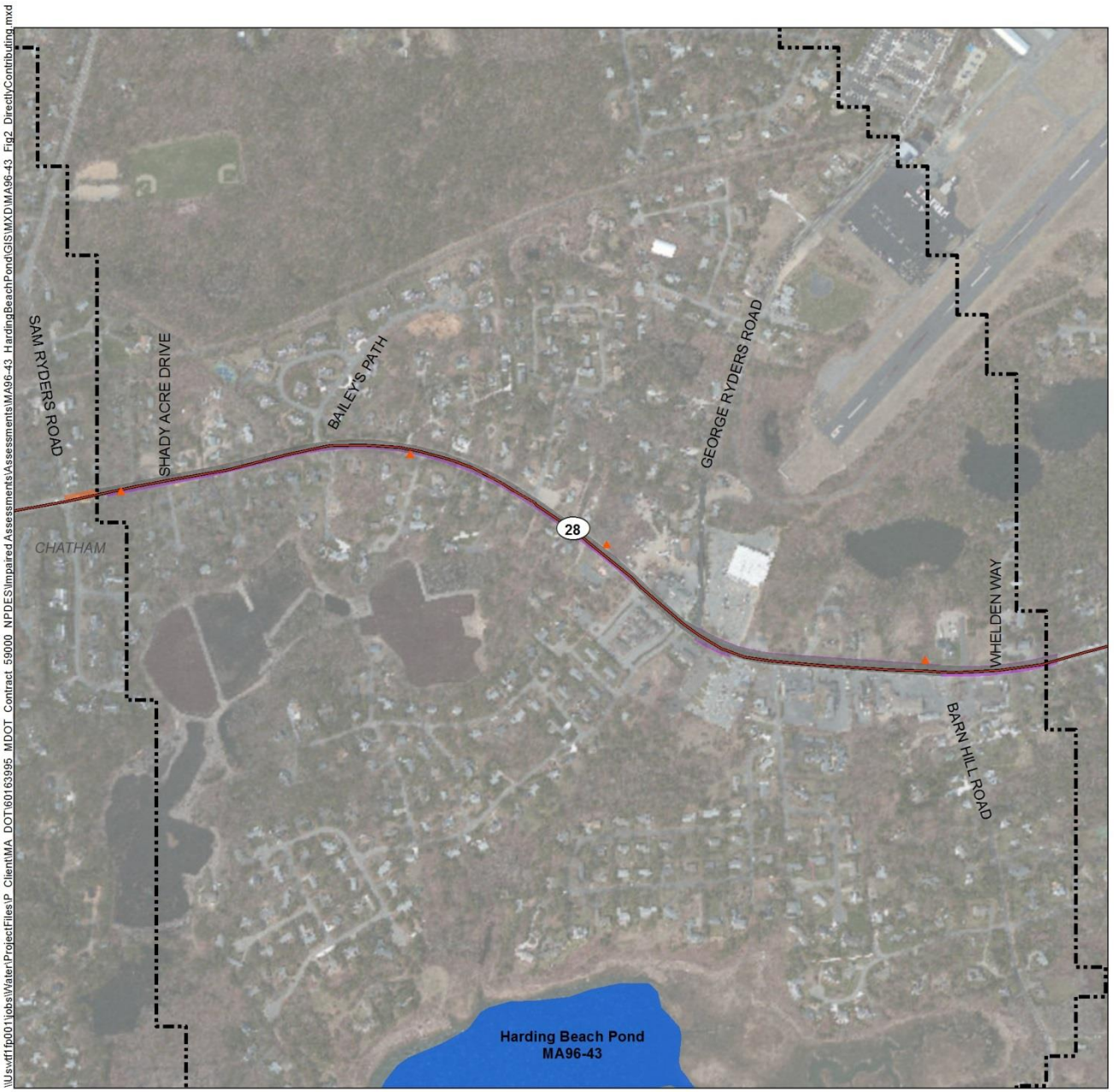
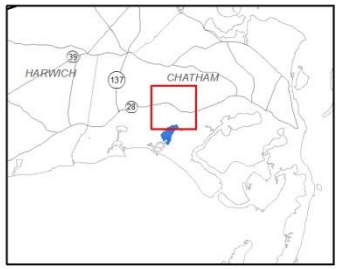


Figure 1

Harding Beach Pond (MA96-43) Groundwatershed

June 2014





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

N

0 400 800 Feet

Figure 2

Harding Beach Pond
(MA96-43)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Bucks Creek (MA96-44)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen, Fecal Coliform, Enterococcus
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Stage Harbor/Oyster Pond, Sulphur Springs/Bucks Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations for Total Nitrogen* (CN 206.1)[2] *Final Pathogen TMDL for the Cape Cod Watershed* (CN 252.0)[3]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]
Location	**Towns:**	Chatham
	MassDOT Roads:	Route 28
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None

		Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**	0.3 lbs/yr
	Contributing Watershed Area Load	5,150 lbs/yr
	DOT Contribution to Existing Load	0.01 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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. Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/chatham.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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Bucks Creek (MA 96-44). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Bucks Creek watershed is located in Chatham, MA and includes residential areas, wetlands, ponds, and MassDOT roads (Route 28). The majority of the watershed is developed.

The impaired water is the lower section of Bucks Creek which is an impoundment receiving water from Bucks Creek and Harding Beach Pond. Bucks Creek discharges ultimately into Cockle Cove. MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identified the Aquatic Life Use as "Impaired" for Bucks Creek due to total nitrogen from subsurface wastewater disposal (septic systems), stormwater runoff, and fertilizers. The Shellfish Harvesting Use is also "Impaired" for Bucks Creek due to elevated fecal coliform bacteria from waterfowl, waste from pets, on-site (septic) systems, and discharges from municipal separate storm sewer systems. The report identified the primary contact recreational use as impaired, based on the frequency of beach closures due to elevated Enterococcus bacteria from an unknown upstream source. All other uses were not assessed.

Figure 2 illustrates the MassDOT roads that are contributing to the water body. This section of approximately 700 feet of Route 28 in Chatham has one lane in each direction and a sidewalk within a 40 feet wide Right of Way (ROW). The impervious area of this section of MassDOT property, approximately 400 feet of Route 28 from a high point in the vicinity of Sam Ryders Road to the western watershed boundary, does not contribute runoff to the Bucks Creek watershed but instead discharges outside the watershed. Runoff from this section of road travels through sheet flow on the surface of the pavement and infiltrates into the surrounding pervious area outside of the Bucks Creek watershed boundaries. Runoff from approximately 300 feet from the high point to the eastern watershed boundary, travels through sheet flow on the pavement surface and through concentrated flow alongside the road, and ultimately discharges to side ditches within the boundaries of the Harding Beach Pond watershed. Runoff from the pervious portion of the MassDOT property within the boundaries infiltrates into the ground and therefore discharges to Bucks Creek through groundwater flow. Surrounding land use in this watershed is residential.

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.

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[5] 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

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

[7] 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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.[8] MassDOT assessed Bucks Creek (MA 96-44) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 206.1)

The *Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen* (CN 206.1)[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described in section below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[11] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The Nitrogen Loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 0.0 acres
- DOT Pervious Area: 0.1 acres
- Estimated Existing MassDOT Load: 0.3 lb/yr
- Total Existing Watershed Nitrogen Load: 5,150 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.01 %

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.[12] The cut-off value of 3.5% is based on loading values

[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.

[9] Mass DEP. 2007. Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/chatham.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[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] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.

determined to be negligible in the Cape Cod TMDLs. 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 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).[13] Bucks Creek (MA96-44) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[14] According to the TMDL, sources of indicator bacteria in the Bucks Creek watershed are believed to be primarily waterfowl; pet waste; failing septic systems; 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[15] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's South East Expressway study measured bacterial concentration in stormwater runoff[16] and data indicate that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g. illicit discharges, sewer utilities, pet waste, and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

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

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

[13] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

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

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

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 watershed 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,[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 turf establishment associated with recent ground disturbance. MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. Fertilizers are only used for initial vegetative establishment associated with new construction.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Bucks Creek, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.

[17] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004.

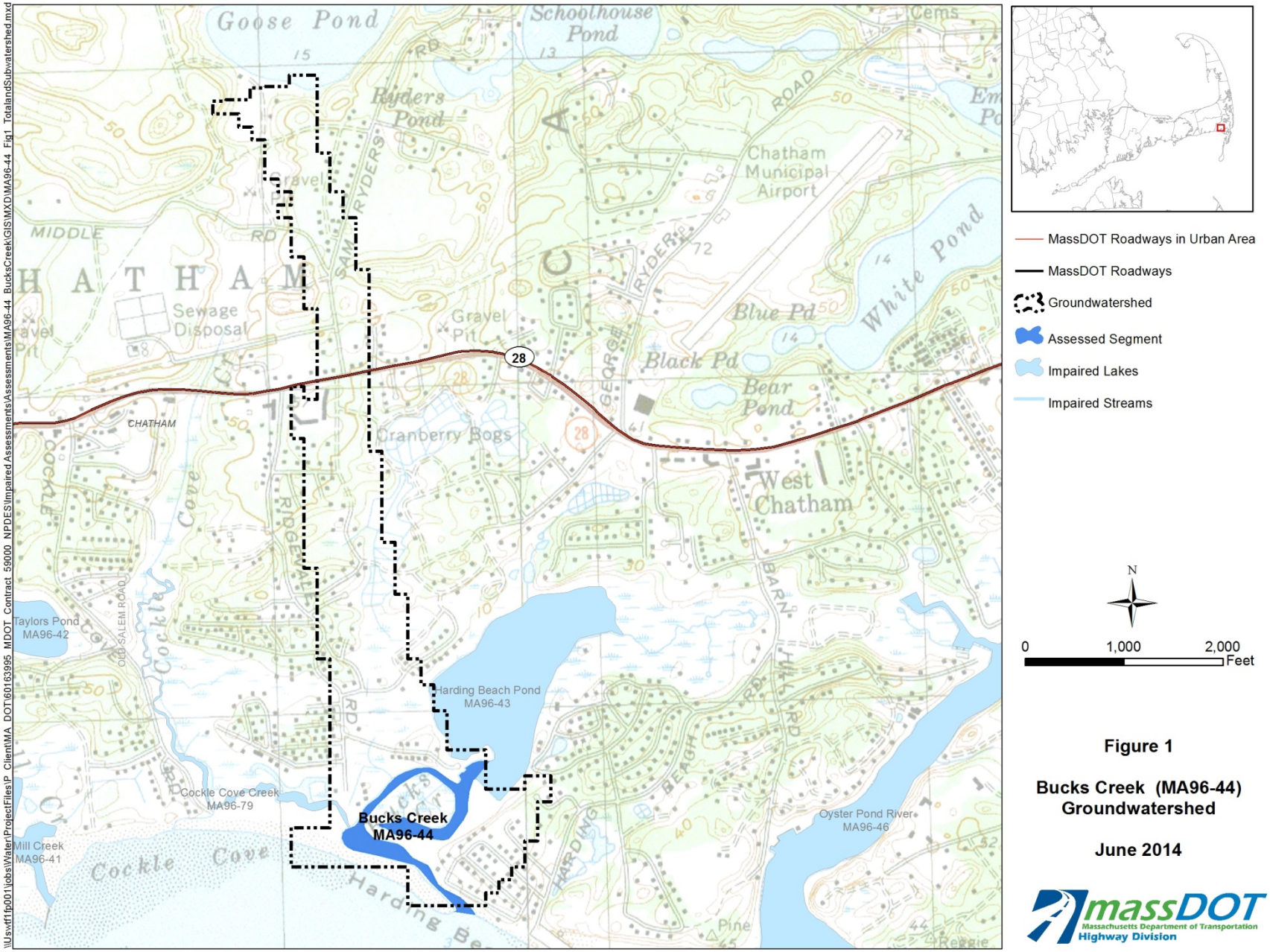
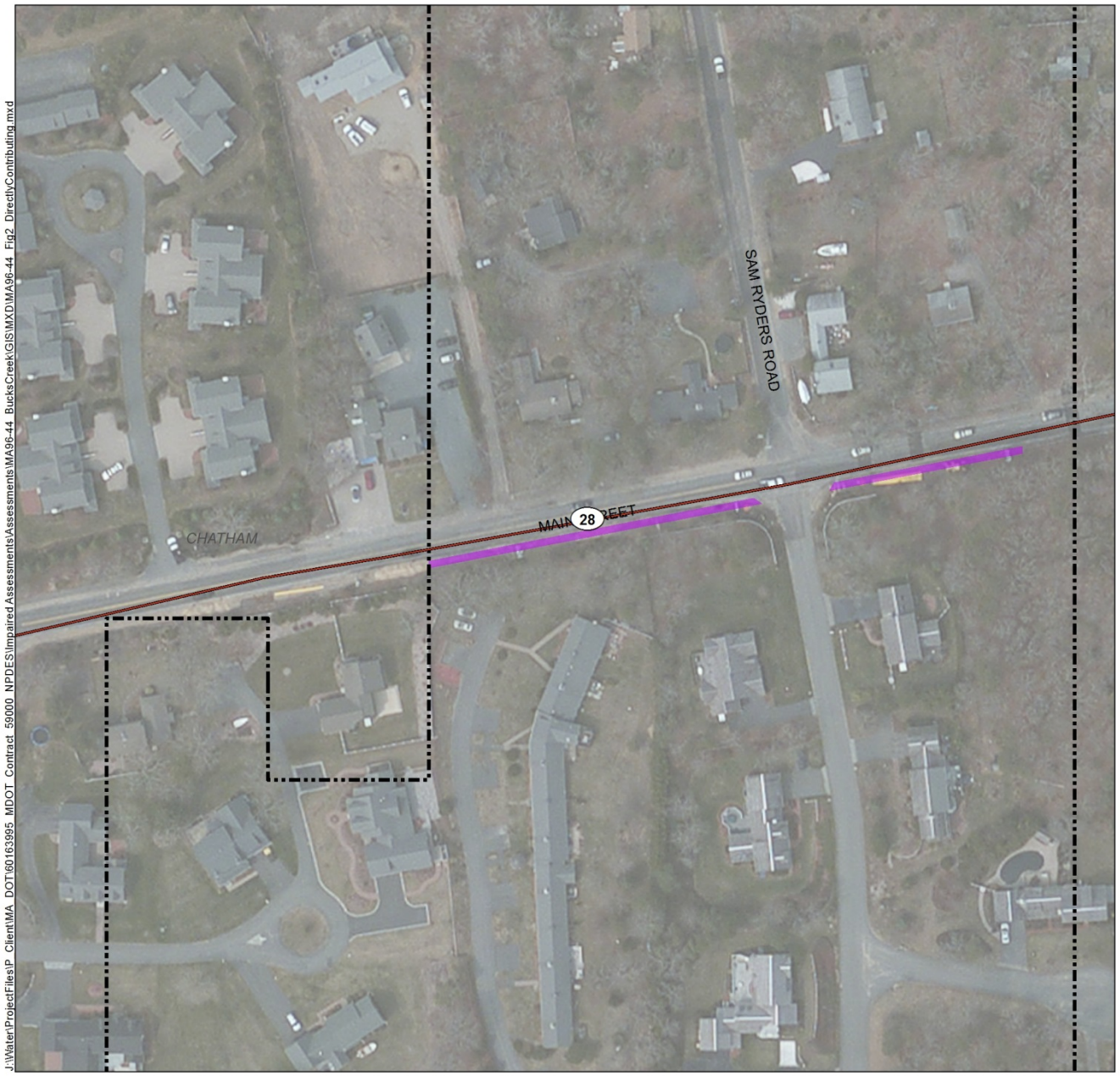
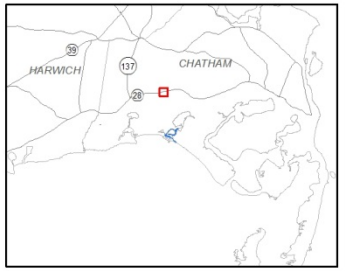


Figure 1

Bucks Creek (MA96-44) Groundwatershed

June 2014





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Assessed Segment
- Impaired Streams
- Impaired Lakes
- DOT Pervious Area
- DOT Impervious Area

N

0 100 200 Feet

Figure 2

Bucks Creek (MA96-44)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Oyster Pond (MA96-45)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen, Estuarine Bioassessments, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Stage Harbor/Oyster Pond, Sulphur Springs/Bucks Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations for Total Nitrogen* (CN 206.1)[2] *Final Pathogen TMDL for the Cape Cod Watershed* (CN 252.0)[3]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]
Location	**Towns:**	Chatham
	MassDOT Roads:	Route 28
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None
		Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**	96.1 lbs/yr
	Contributing Watershed Area Load	27,681 lbs/yr
	DOT Contribution to Existing Load	0.35 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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. Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/chatham.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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Oyster Pond (MA 96-45). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Oyster Pond watershed is located in Chatham, MA and includes residential areas, wetlands and ponds, municipal roads and a MassDOT road (Route 28). The majority of the watershed is developed.

Oyster Pond receives inflow from three unnamed streams and groundwater. It discharges into Oyster Pond River and ultimately into Stage Harbor. MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identified the Aquatic Life Use as "Impaired" for Oyster Pond for loss of eelgrass bed habitat and total nitrogen. The identified sources of nitrogen are subsurface waste water disposal (septic systems), stormwater runoff, and fertilizers. The Shellfish Harvesting Use is "Impaired" for 0.18 square miles of the Oyster Pond as it is assesses as "Prohibited" or "Conditional", and it is assessed as "Support" for the remaining 0.03 square miles. The impairment is due to elevated fecal coliform bacteria from marina/boating pumpout releases, waterfowl, waste from pets, and discharges form municipal separate storm sewer systems. Primary and secondary uses were assessed as "Support", and all other uses were not assessed.

Figures 2a and 2b illustrate the MassDOT roads that are directly contributing to the water body. A total of approximately 8,700 feet of Route 28 in Chatham from 100 feet west of Village Landing to 150 feet south of Barcliff Avenue contributes runoff and groundwater infiltration to the watershed area. In the contributing area, Route 28 has one lane in each direction and a sidewalk within a 45 feet wide Right of Way (ROW) from Village Landing to the roundabout (the intersection of Route 28 with Stage Harbor Road and Queen Anne Road). Route 28 has one lane in each direction and a sidewalk from the roundabout to 150 feet south of Barcliff Avenue, within a 40 feet wide ROW.

Roadway runoff from the contributing area is collected with catch basins that discharge into adjacent wetland areas and infiltrated into the ground, or are connected to municipal storm sewer lines that ultimately discharge into Oyster Pond. Runoff from the western end of the contributing area to a high point approximately 300 feet east of Old Main Street is collected by a catch basin which discharges to a wetland area next to Uncle Alberts Way (Figure 2a). The following section of Route 28 to a high point located approximately 500 east of Heritage Lane, discharges to an unnamed pond at Linden Tree Lane (Figure 2a). This pond discharges to an unnamed creek, which ultimately discharges into Oyster Pond. Runoff from the following section of Route 28 to a high point in the vicinity of Adams Lane is collected by three catch basins networks that discharge into a municipal drain pipe, which ultimately discharges into Oyster Pond (municipal discharge CHA-10) through a network of ditches and culverts (Figure 2b). Runoff from Route 28 from the vicinity of Adams Lane to the northern boundary of the watershed, and from a supplemental contributing area extending from the northern boundary to Barcliff Avenue is collected by a catch basin network

[5] 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

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

[7] 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

(Figure 2b). This network is connected to a municipal drain pipe that discharges directly into Oyster Pond (municipal discharge CHA-11).

Approximately 600 feet of Route 28 from Village Landing Road to the western boundary of the watershed discharges through sheet flow to the Oyster Pond River watershed and therefore is considered non-contributing area to the Oyster River Pond.

Supplemental contributing area runoff from approximately 2080 feet of Route 28 from the northern boundary of the watershed to 150 feet south of Barcliff Avenue discharges within the Oyster Pond watershed (Figure 2b). 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". Surrounding land uses are commercial and residential.

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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.[8] MassDOT assessed Oyster Pond (MA 96-45) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 206.1)

The *Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen* (CN 206.1)[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described below.

[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*

[9] Mass DEP. 2007. Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/chatham.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[12] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The Nitrogen Loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 10.8 acres
- DOT Pervious Area: 1.7 acres
- Estimated Existing MassDOT Load: 96.1 lb/yr
- Total Existing Watershed Nitrogen Load: 27,681 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.35%

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.[13] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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 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).[14] Oyster Pond (MA96-45) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[15] According to the TMDL, sources of indicator bacteria in the Oyster Pond watershed are believed to be primarily from illicit marina/ boating pumpout releases; waterfowl; pet waste; 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[15] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's Southeast

[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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

[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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

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

[14] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.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

Expressway study measured bacterial concentration in stormwater runoff[16] and data indicate that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g., illicit discharges, sewer utilities, pet waste, and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

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

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

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 watershed 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,[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 turf establishment associated with recent ground disturbance.

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

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

[17] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004.

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Oyster Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.

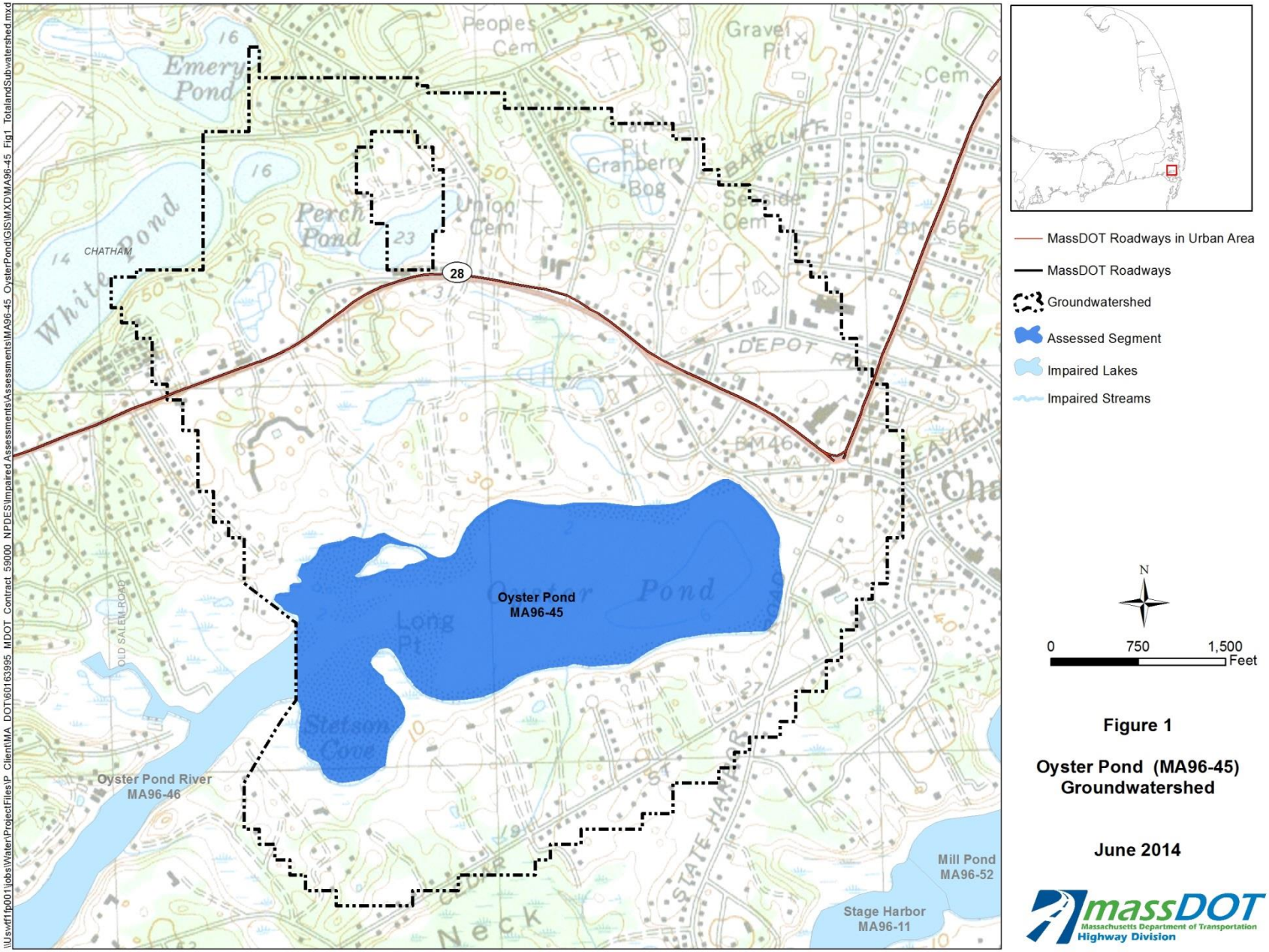
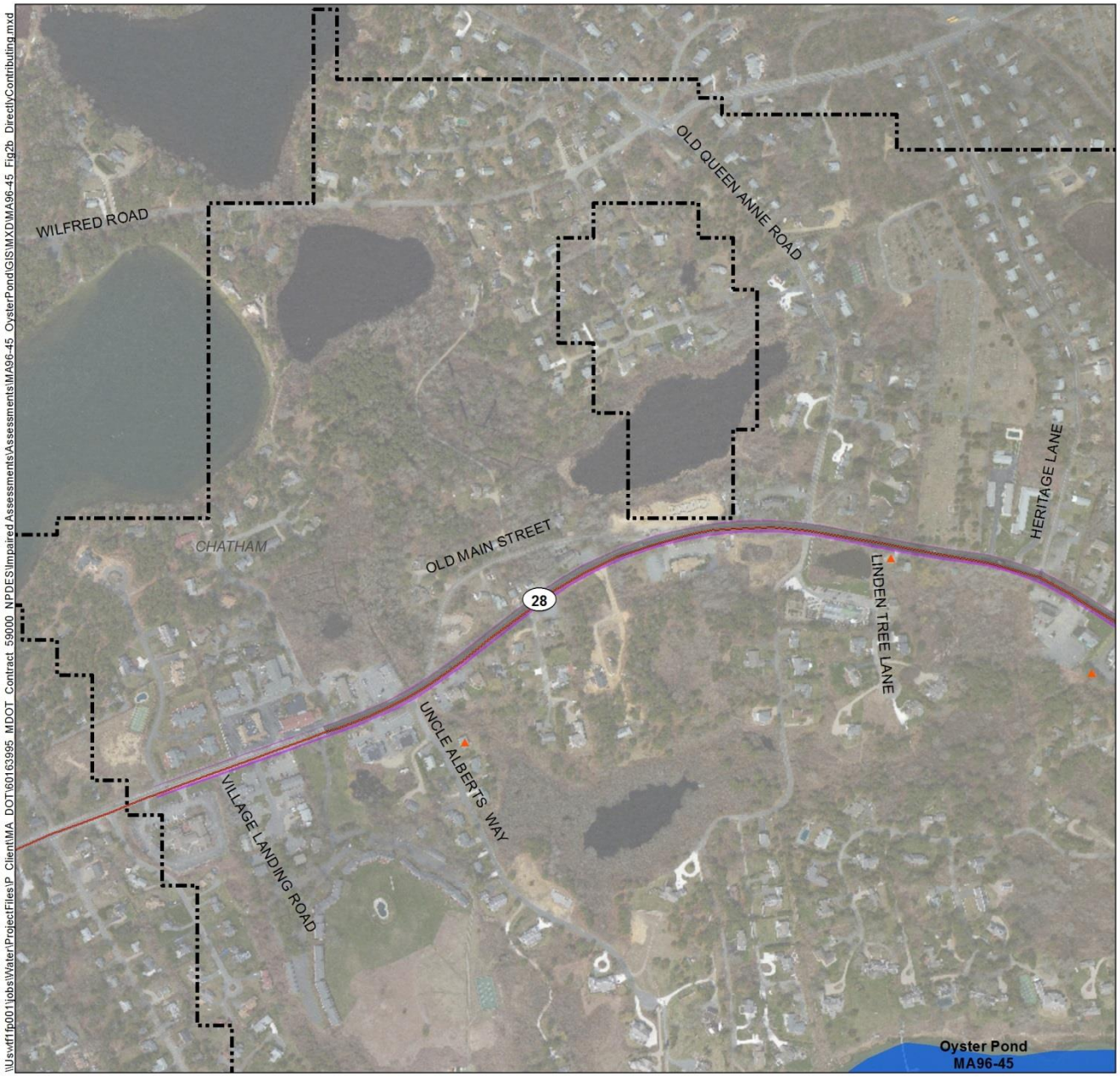
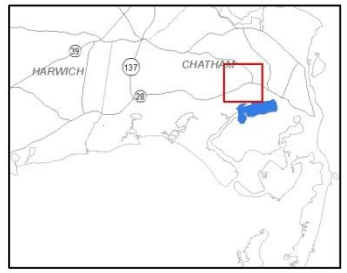


Figure 1

Oyster Pond (MA96-45) Groundwatershed

June 2014





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

N

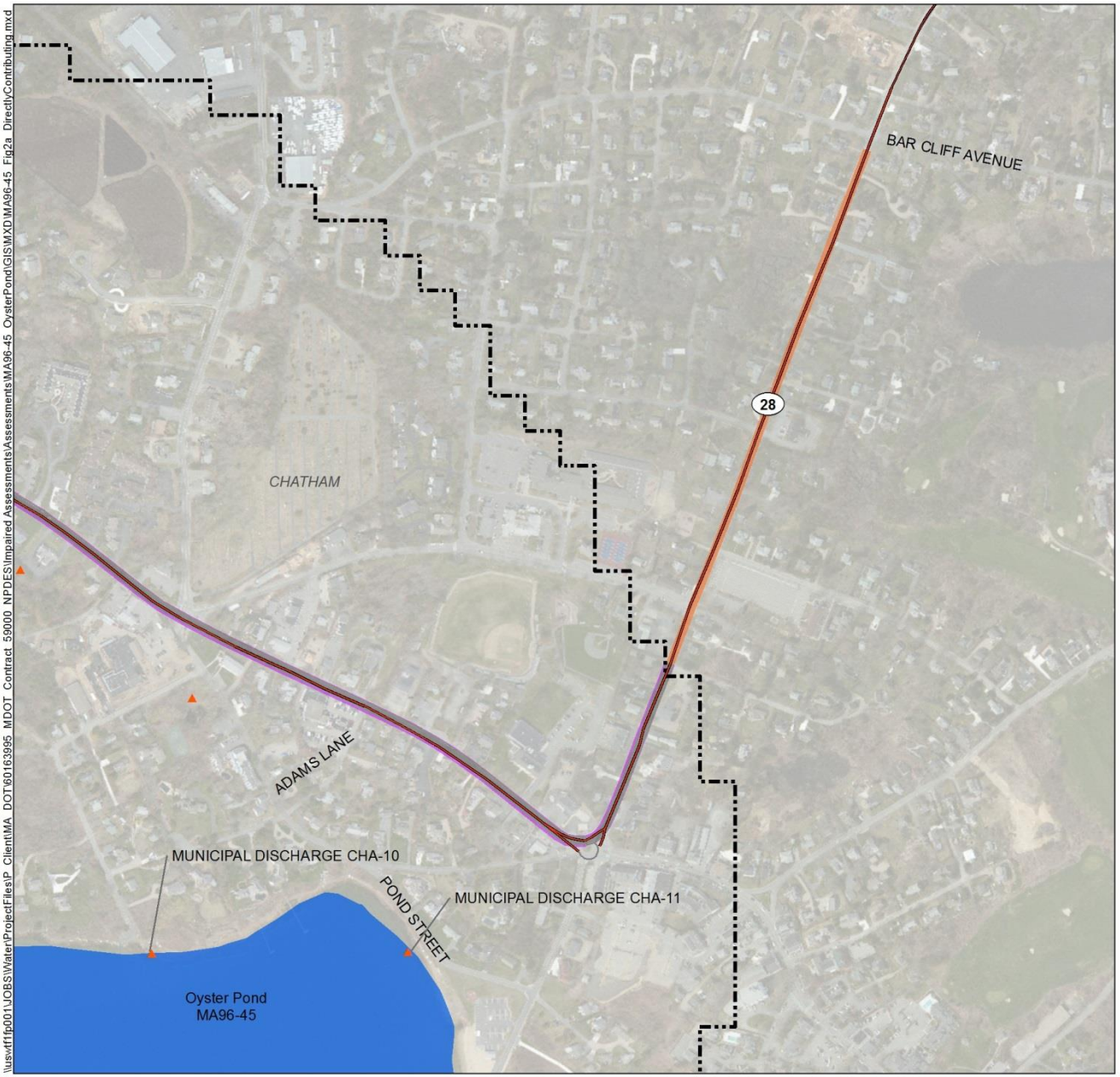
0 250 500 Feet

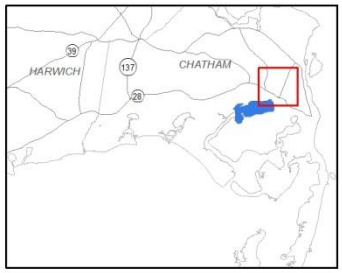
Figure 2a

Oyster Pond (MA96-45)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division





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

N

0 250 500 Feet

Figure 2b

Oyster Pond (MA96-45)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Progress Report Assessment for Oyster Pond River (MA96-46)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen, Estuarine Bioassessments, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Stage Harbor/Oyster Pond, Sulphur Springs/Bucks Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations for Total Nitrogen* (CN 206.1)[2] *Final Pathogen TMDL for the Cape Cod Watershed* (CN 252.0)[3]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[4]
Location	**Towns:**	Chatham
	MassDOT Roads:	Route 28
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None
		Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**	20.2 lbs/yr
	Contributing Watershed Area Load	9,254 lbs/yr
	DOT Contribution to Existing Load	0.22 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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. Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/chatham.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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Oyster Pond River (MA 96-46). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Oyster Pond River watershed is located in Chatham, MA and includes residential areas, wetlands and ponds, an airstrip (Chatham Municipal Airport), and a MassDOT road (Route 28). The majority of the watershed is developed.

Oyster Pond River receives inflow from three unnamed streams, Oyster Pond and groundwater. It discharges into Stage Harbor. MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identified the Aquatic Life Use as "Impaired" for Oyster Pond River for loss of eelgrass bed habitat and total nitrogen. The identified sources of nitrogen are subsurface waste water disposal (septic systems), and fertilizers. The shellfish harvesting use is "impaired" for Oyster Pond River for two small sections adjacent to the marina (0.003 square miles), due to elevated fecal coliform bacteria from marina/boating pumpout releases. The shellfish harvesting use is assessed as "support" for the remaining section (0.137 square miles). The shellfish harvesting use is approved for 98% of the Oyster Pond River. The primary and secondary contact uses were assessed as "support", and all other uses were not assessed.

Figure 2 illustrates the MassDOT roads that are directly contributing to the water body. Approximately 2,720 feet of Route 28 in Chatham from 300 feet east of Whelden Way to 100 feet west of the Village Landing contributes runoff and groundwater infiltration to the watershed area. The Oyster Pond River watershed receives supplemental runoff from approximately 600 feet of Route 28 extending into the Oyster Pond watershed. Runoff from the supplemental area is collected by catch basins located within the watershed boundaries, and is ultimately discharged and infiltrated within the groundwatershed area of Oyster Pond River. 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".

In the contributing area, Route 28 has one lane in each direction and a sidewalk within a 45 feet wide Right of Way (ROW). Roadway runoff from a high point in the vicinity of Waveland Avenue to the western boundary of the watershed is collected with two independent catch basins which discharge adjacent to the road, within the ROW. Runoff from the high point to the western boundary of the watershed is discharged mainly through direct sheet-flow to the adjacent areas and infiltrated into the groundwater. Four catch basins were located in this section of Route 28, at the intersection with the Cornfield and Vineyard Avenue. These catch basins are connected to a municipal drain pipe, which ultimately discharges into Oyster Pond River. Surrounding land uses are commercial and residential.

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[5] 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

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

[7] 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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[8] MassDOT assessed Oyster Pond River (MA 96-46) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 206.1)

The *Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen* (CN 206.1)[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[11] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The Nitrogen Loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 2.2 acres
- DOT Pervious Area: 0.6 acres
- Estimated Existing MassDOT Load: 20.2 lb/yr
- Total Existing Watershed Nitrogen Load: 9,254 lb/yr (from TMDL)

[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*

[9] Mass DEP. 2007. Stage Harbor/Oyster Pond, Sulphur Springs/Bucks,Creek, Taylors Pond/Mill Creek Total Maximum Daily Load Re-Evaluations For Total Nitrogen. Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/chatham.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[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

- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.22%

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.[12] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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 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).[13] Oyster Pond River (MA 96-46) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[14] According to the TMDL, sources of indicator bacteria in the Oyster Pond River watershed are believed to be primarily from illicit marina/boating pumpout releases. 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[14] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's Southeast Expressway study measured bacterial concentration in stormwater runoff[15] and data indicate that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g., illicit discharges, sewer utilities, pet waste, and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

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

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

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

[13] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/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] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

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 watershed 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,[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 turf establishment associated with recent ground disturbance.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Oyster Pond River, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.

[16] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004

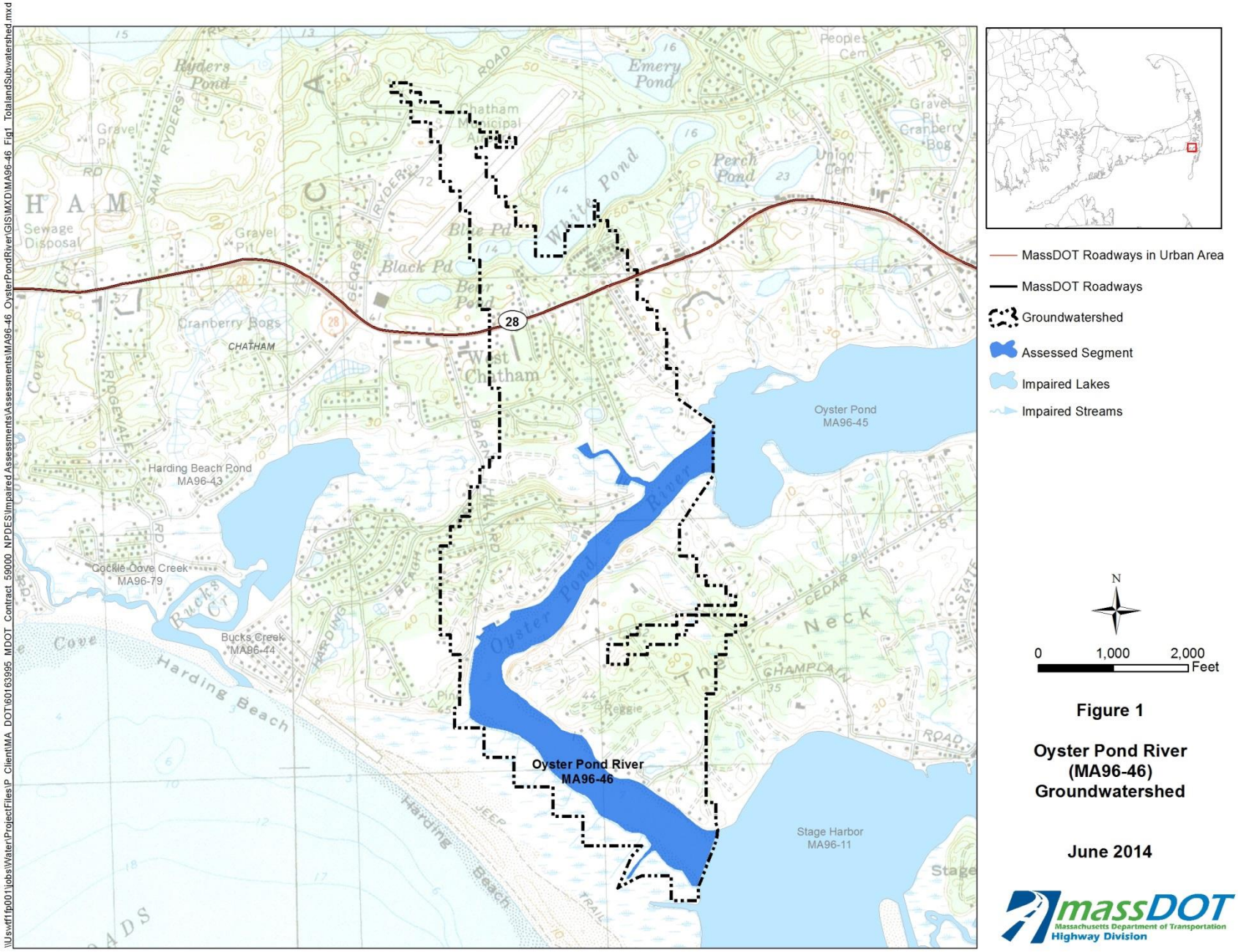

Figure 1

Oyster Pond River (MA96-46) Groundwatershed

June 2014

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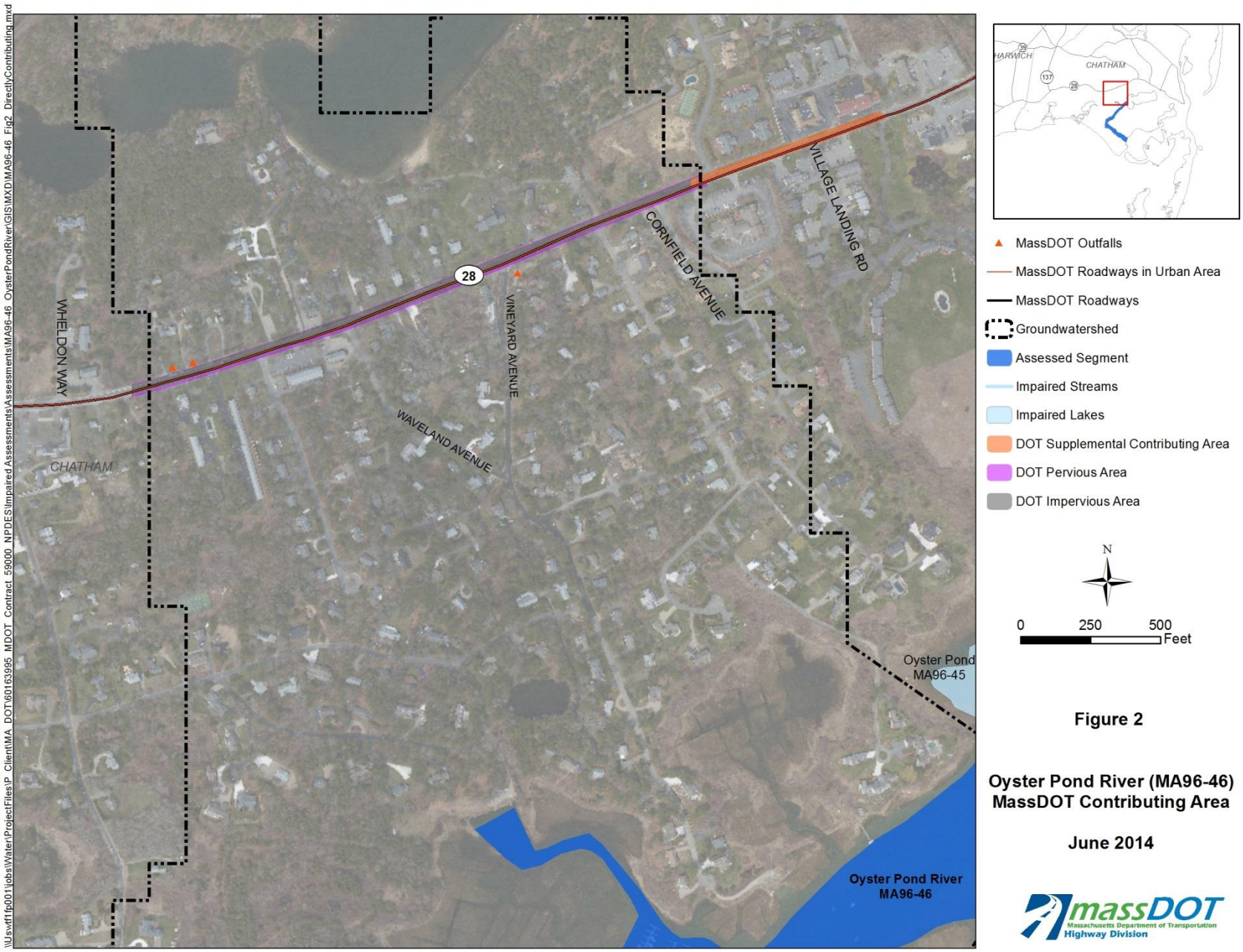

Figure 2

Oyster Pond River (MA96-46)
MassDOT Contributing Area

June 2014

Impaired Waters Assessment for Perch Pond (MA96-53)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Great, Green and Bournes Pond Embayment Systems Total Maximum Daily Loads for Total Nitrogen* (CN 181.0)[2]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location	**Towns:**	Falmouth
	MassDOT Roads:	Route 28
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None
		Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**	19.2 lbs/yr
	Contributing Watershed Area Load	3,613 lbs/yr
	DOT Contribution to Existing Load	0.5 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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 Total Maximum Daily Load for Total Nitrogen in the Great, Green and Bournes Pond Embayment Systems, Massachusetts (CN 181.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/ggbtmdl.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

Site Description

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Perch Pond (MA96-53). The watersheds and subwatersheds for Cape Cod were 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 data.[4,5] The Perch Pond watershed is located in Falmouth and includes residential areas, wetlands, ponds, and MassDOT roads (Route 28). Perch Pond is a relatively deep kettle basin that includes a shallow tidally influenced inlet connecting to Great Pond. The majority of the watershed is urban and contains both commercial and residential properties.

Perch Pond receives inflows from an unnamed stream, surface runoff and groundwater flow. Perch Pond discharges to Great Pond. 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" for Perch Pond due to total nitrogen from septic systems, stormwater runoff, and fertilizers. The report identified shellfish harvesting, primary contact and secondary contact as "Support" because Perch Pond is approved for shellfish harvesting. All other uses were not assessed.

Figure 2 illustrates the MassDOT roads that are contributing to the water body. Route 28 in Falmouth contributes runoff to Perch Pond. The Perch Pond watershed is situated between two lobes of the Great Pond watershed. Roadway tributary to the Perch Pond watershed begins at the high point located at the rear entrance to the Falmouth High School parking lot and continues approximately 2,000 feet to the east to another high point located 400 feet past Norris Path. No drainage systems exist in this stretch of road and runoff runs along the gutter to a low point located in the vicinity of Teaticket Path. Runoff is collected by two catch basins (one on each curb) and is directed into wooded areas to the north and south of the roadway. Approximatley 385 feet of Route 28 beyond the eastern and western boundary of the watershed flows along the gutter back into the watershed and is considered "Supplemental DOT 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 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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled

[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, 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

Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.[7] MassDOT assessed Perch Pond (MA96-53) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 181.0)

The *Great, Green and Bournes Pond Embayment Systems Total Maximum Daily Load (TMDL) for Total Nitrogen* (CN 181.0)[8] 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 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.[7] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[10] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[10] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The nitrogen loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 2.2 acres
- DOT Pervious Area: 0.2 acres
- Estimated Existing MassDOT Load: 19.2 lb/yr
- Total Existing Watershed Nitrogen Load: 3,613 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.5%

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.[7] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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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[7] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*

[8] Mass DEP. 2007. Final Total Maximum Daily Load for Total Nitrogen in the Great, Green and Bournes Pond Embayment Systems, Massachusetts (CN 181.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/ggbtmdl.pdf

[9] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[10] 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. Avaialble 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 watershed 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,[11] 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.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Perch Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Form.

[11] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004. Available at: http://www.mhd.state.ma.us/downloads/projdev/2009/mhd_stormwater_handbook.pdf

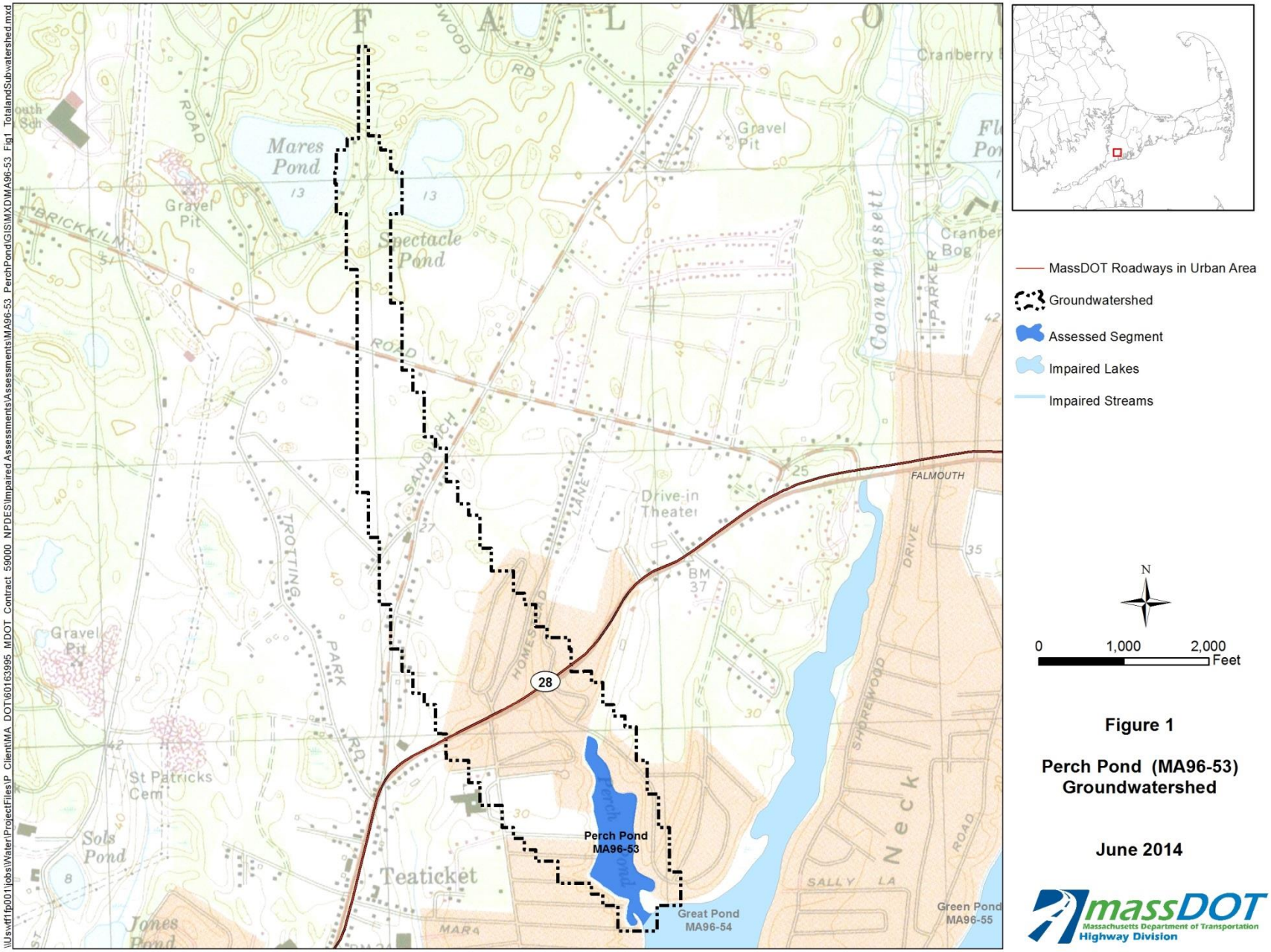

Figure 1

Perch Pond (MA96-53) Groundwatershed

June 2014

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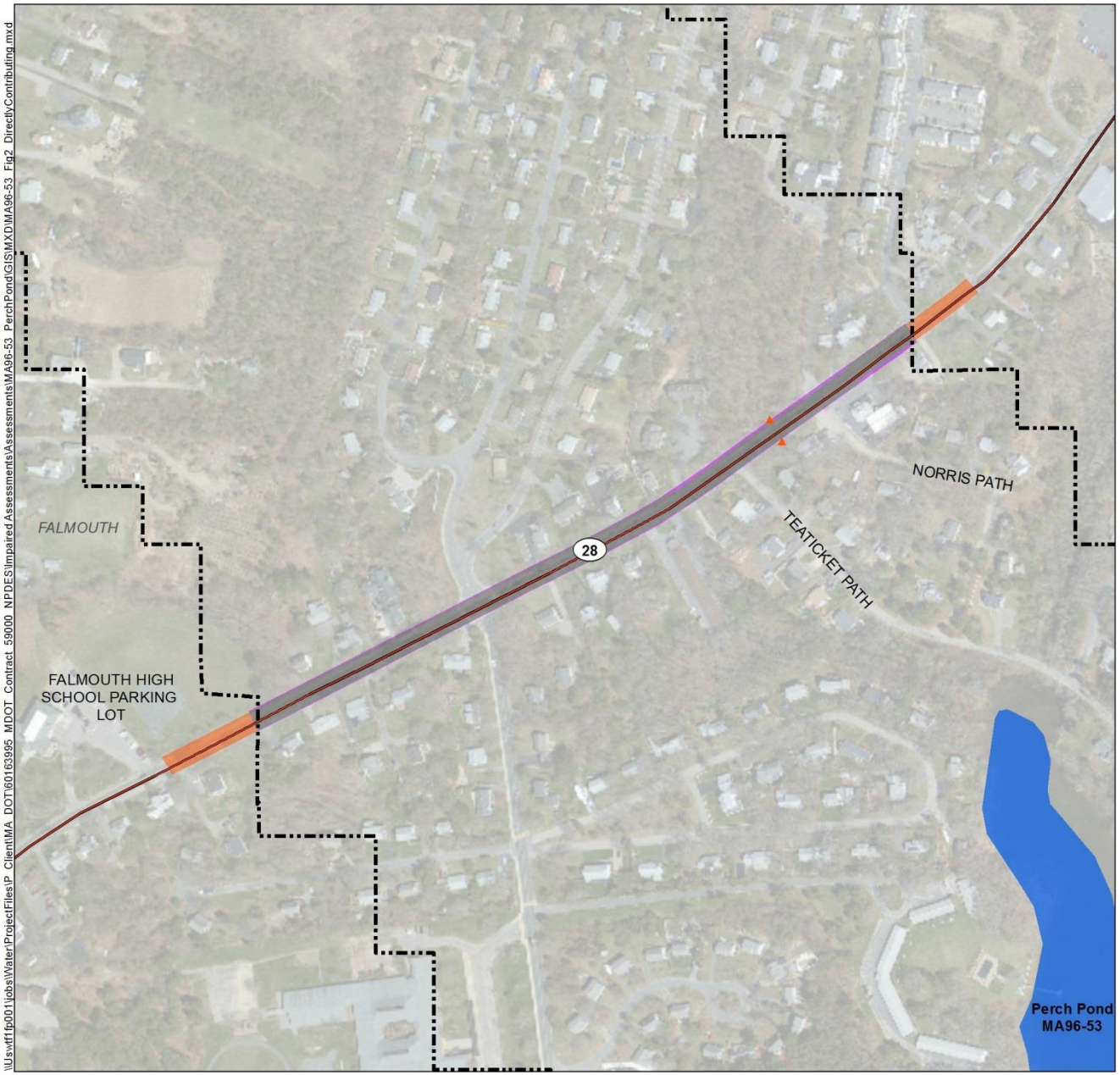
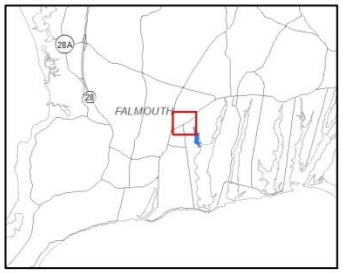
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- DOT Supplemental Contributing Area
- DOT Pervious Area
- DOT Contributing Impervious Area

N

0 200 400 Feet

Figure 2

Perch Pond (MA96-53)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Great Pond (MA96-54)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen, Estuarine Bioassessments
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Great, Green and Bournes Pond Embayment Systems Total Maximum Daily Loads for Total Nitrogen* (CN 181.0)[2]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location	**Towns:**	Falmouth
	MassDOT Roads:	Route 28
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None
		Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**	76.8 lbs/yr
	Contributing Watershed Area Load	52,481 lbs/yr
	DOT Contribution to Existing Load	0.15 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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 Total Maximum Daily Load for Total Nitrogen in the Great, Green and Bournes Pond Embayment Systems, Massachusetts (CN 181.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/ggbtmdl.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

Site Description

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Great Pond (MA96-54). The watersheds and subwatersheds for Cape Cod were 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 data.[4,5] The USGS data indicate that multiple upstream groundwatersheds contribute flow to the Perch Pond (MA96-53) groundwatershed. As indicated in Figure 1, Great Pond (MA96-54) may receive some inflow from the upgradient Perch Pond water body and its USGS delineation groundwatersheds. As a result, all MassDOT property that contributes runoff or infiltrates to the Perch Pond (MA96-53) is also described below as contributing to Great Pond (MA96-54). It should be noted that Perch Pond (MA96-53) is also assessed independently in a separate assessment.The Great Pond watershed is located in Falmouth and includes residential areas, wetlands, ponds and MassDOT roads (Route 28). The majority of the watershed is urban and contains both commercial and residential properties.

Great Pond receives inflows from the Coonamesset River, Perch Pond and groundwater flow. Great Pond discharges to Vineyard Sound. 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" for Great Pond due to loss of eelgrass habitat (estuarine bioassessment), total nitrogen from septic systems, stormwater runoff, and fertilizers. The report identified shellfish harvesting, primary contact and secondary contact as "Support". All other uses were not assessed.

Figures 2a, 2b, 2c and 2d illustrate the MassDOT roads that are contributing to the water body. Route 28 in Falmouth contributes runoff to Great Pond watershed from three separate drainage areas. The watershed for Great Pond begins at Maravista Avenue and continues northeast approximately 2,000 feet along Route 28 to a high point located in the vicinity of the rear parking lot entrance to Falmouth High School at the intersection of Sandwich Road as shown on Figure 2a. Runoff from this area is discharged through a 15-inch RCP storm drain outfall located at the end of Alphonse Street behind Seven Eleven. This high point marks the starting point of the area tributary to the Perch Pond watershed (MA96-53).

As described in the Perch Pond (MA96-53) Assessment, roadway tributary to the Perch Pond watershed begins at the high point located at the rear entrance to the Falmouth High School parking lot and continues approximately 2,000 feet to the east to another high point located 400 feet past Norris Path as shown on Figure 2b. No drainage systems exist in this stretch of road and runoff runs along the gutter to a low point located in the vicinity of Teaticket Path. Runoff is collected by two catch basins (one on each curb) and is directed into wooded areas to the north and south of the roadway.

Roadway tributary to the Great Pond watershed resumes approximately 400 feet past Norris Path at a high point and continues approximately 2,100 feet to the east to another high point located in the vicinity of Cedar Meadows Drive as shown on Figure 2c. There is no drainage system located in

[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, 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 stretch of road. Water runs along the gutter to a low point located in the vicinity of Village Common Drive. Two leaching catch basins are located at this low point. The first is located in the entrance of Aubuchon Hardware (643 Teaticket Highway). The second is located within the limits of Village Common Drive.

The third area tributary to the Great Pond watershed discharges stormwater runoff to the headwaters of Great Pond just upstream of the watershed boundary. This area begins at the high point at Cedar Meadows Drive as shown on Figure 2b and continues approximately 3,400 feet east to the intersection of Acapesket Road as shown on Figure 2d. A storm drain system collects runoff from the roadway and discharges along the south edge of the roadway into the headwaters of Great Pond. Approximately 2,400 feet of roadway beginning at the western intersection of Oxbow Road and Route 28 is located outside of the watershed boundary and is therefore considered "Supplemental DOT Contributing Area". While this discharge occurs outside of the limits of the watershed boundary, the runoff is discharged to the water body via catchbasins, and is thereforefore considered supplemental contributing area.

Existing BMPs

MassDOT identified two existing BMPs in place with the potential to treat roadway runoff from the discharging area before reaching the impaired water segment. These two existing BMPs are two leaching catch basins located at a low point located in the vicinity of Village Common Drive. However, these BMPs do not account for reduction credit for nitrogen removal from this system, per the methodology.

Assessment

In cases where a TMDL has been approved, MassDOT assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[7] MassDOT assessed Great Pond (MA96-54) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 181.0)

The *Great, Green and Bournes Pond Embayment Systems Total Maximum Daily Load (TMDL) for Total Nitrogen* (CN 181.0)[8] 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 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.[7] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen

[7] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.

[8] Mass DEP. 2007. Final Total Maximum Daily Load for Total Nitrogen in the Great, Green and Bournes Pond Embayment Systems, Massachusetts (CN 181.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/ggbtmdl.pdf

[9] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[10] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[10] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The nitrogen loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 8.8 acres
- DOT Pervious Area: 0.8 acres
- Estimated MassDOT Load: 76.8 lb/yr
- Total Existing Watershed Nitrogen Load: 52,481 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.15%

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.[11] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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.

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 watershed 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,[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 turf establishment associated with recent ground disturbance.

MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute nitrogen to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff note signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, Resident Engineers overseeing construction

[10] 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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

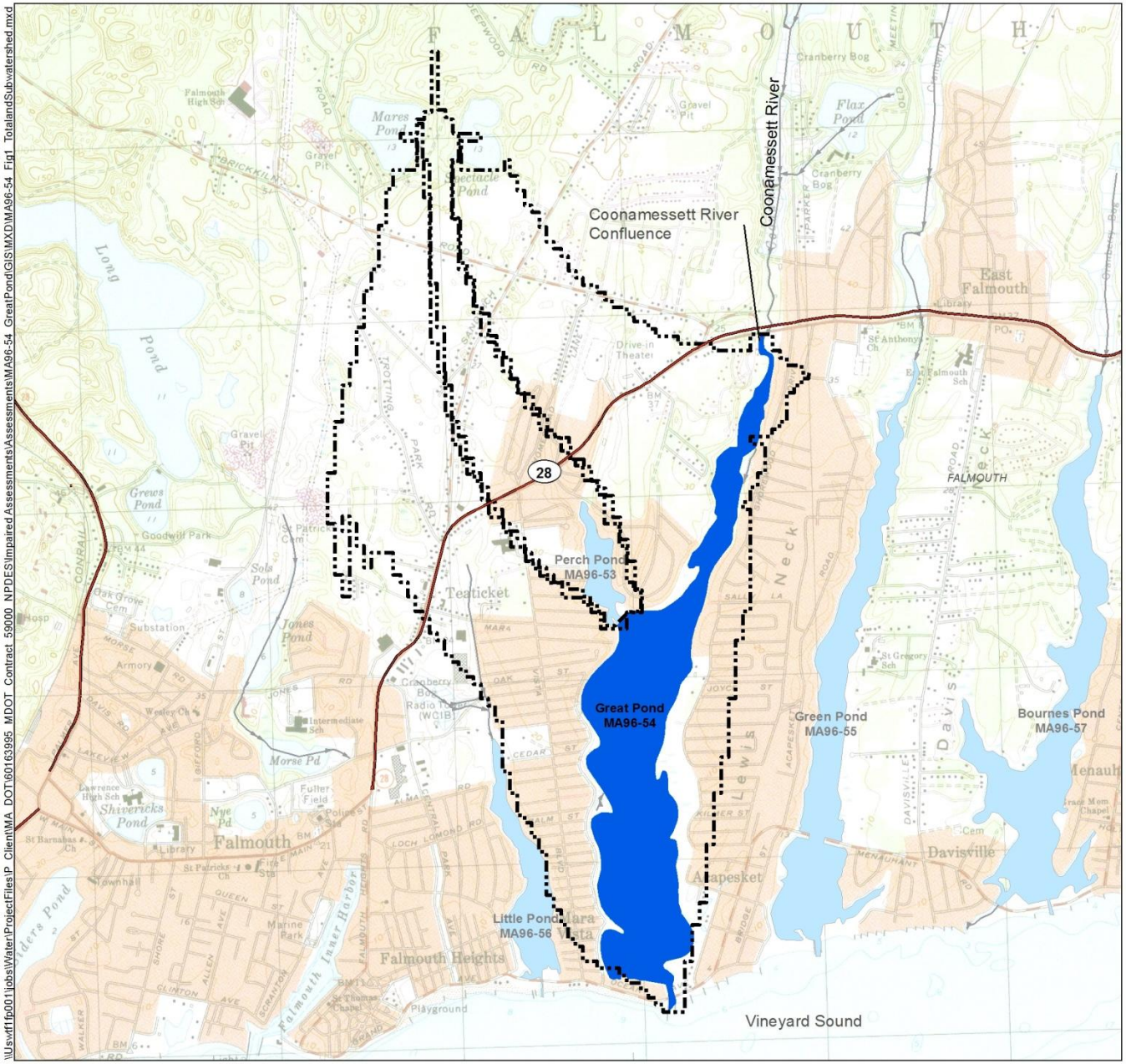
[11] MassDOT. March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.

[12] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004. Available at: http://www.mhd.state.ma.us/downloads/projdev/2009/mhd_stormwater_handbook.pdf

projects also receive instruction regarding the need to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this IDDE training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and proceeds to work with owners of confirmed illicit discharges to remove these flows, and thereby minimize pathogen contributions to receiving waters.

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Great Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Form.



MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

Non-Impaired Streams

N

0 1,500 3,000 Feet

Figure 1

Great Pond (MA96-54) Groundwatershed

June 2014

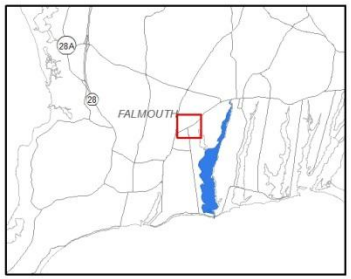
massDOT Massachusetts Department of Transportation Highway Division

Figure 2a

Great Pond (MA96-54)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division



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

N

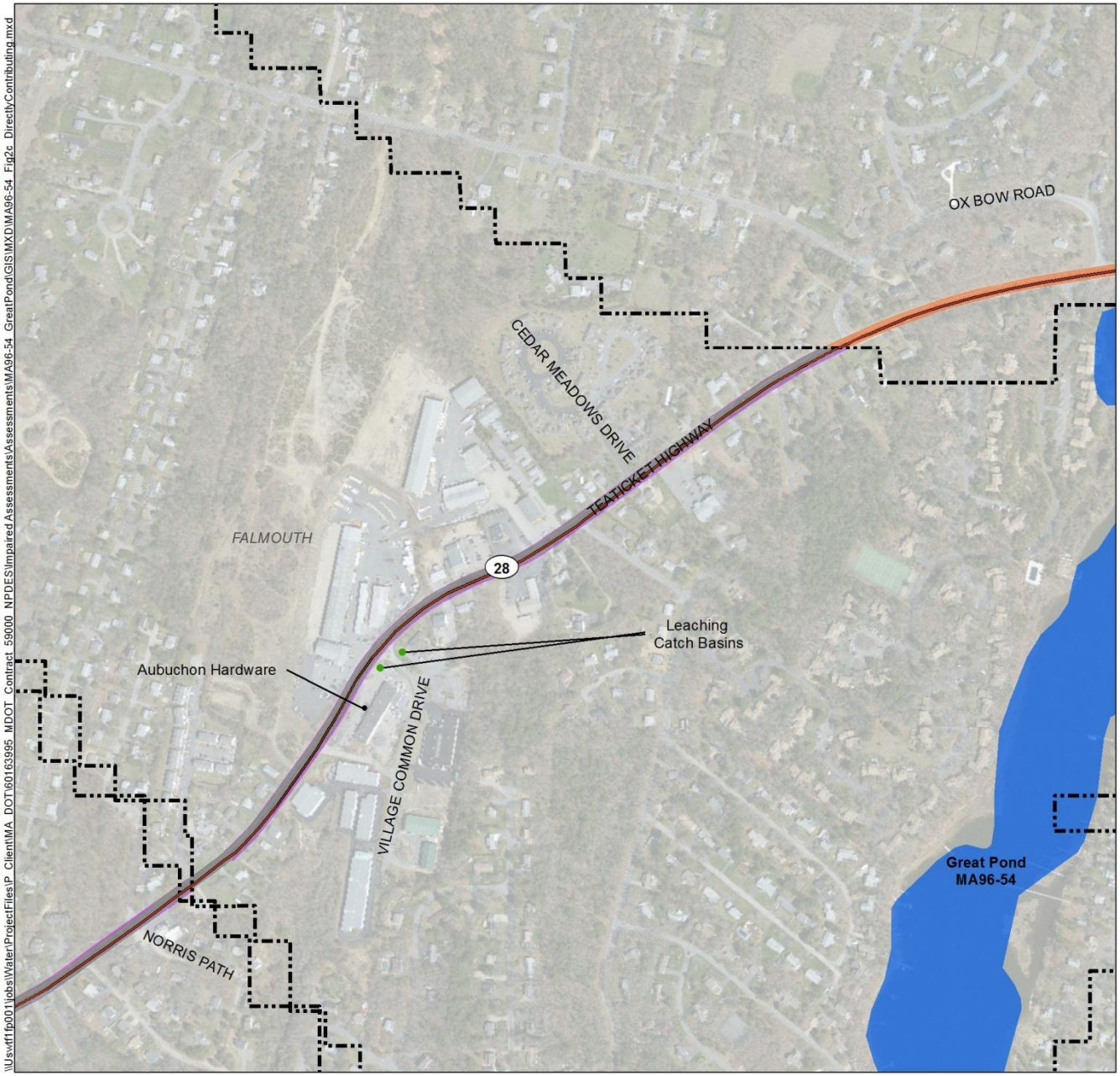
0 200 400 Feet

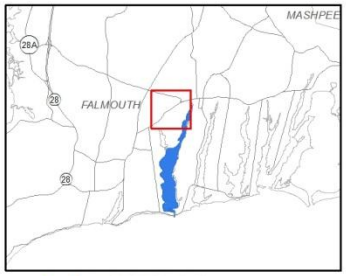
Figure 2b

Great Pond (MA96-54)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Groundwatershed
- Assessed Segment
- Impaired Streams
- Impaired Lakes
- DOT Supplemental Contributing Area
- DOT Pervious Area
- DOT Impervious Area
- Existing BMPs

N

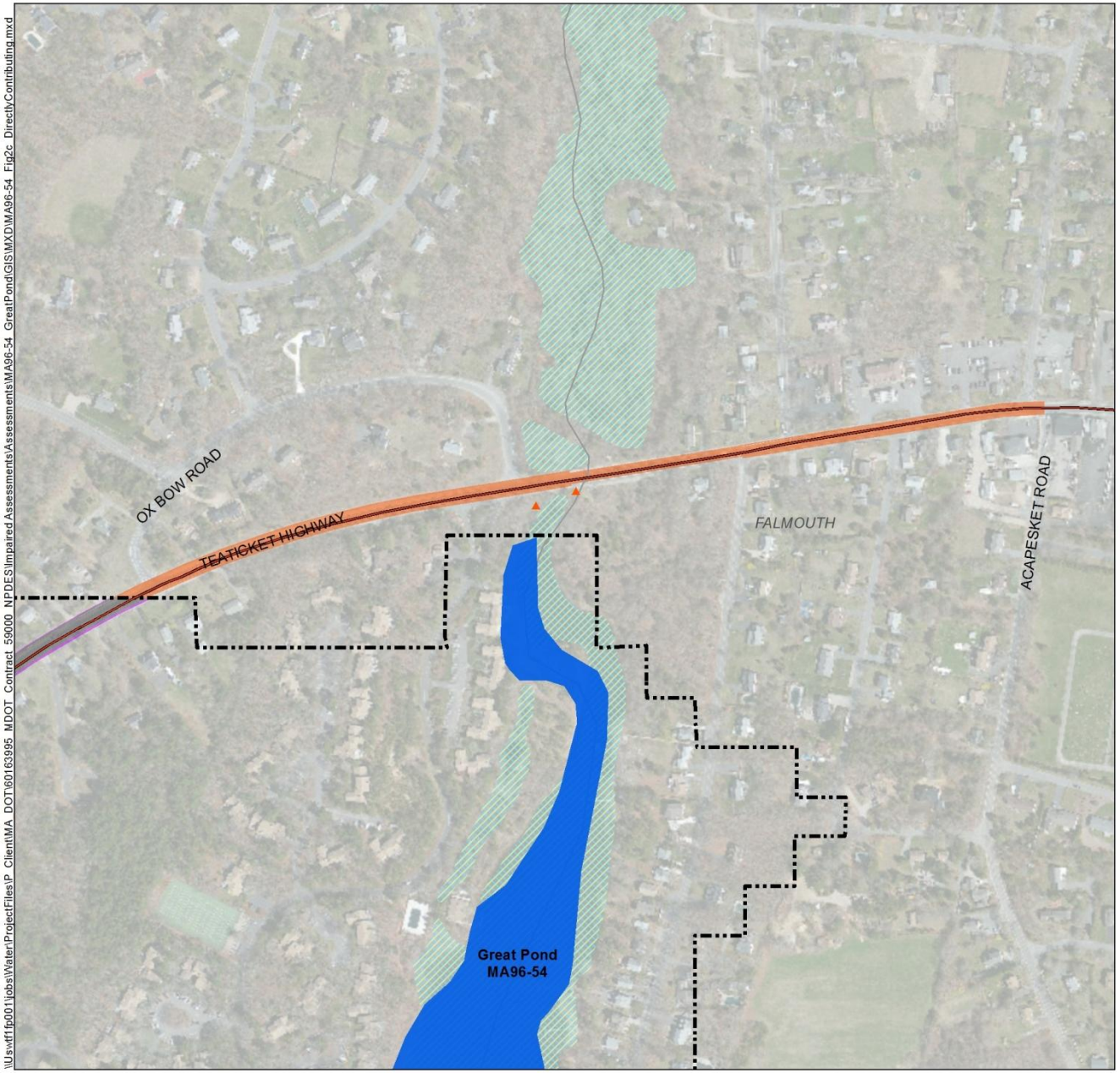
0 200 400 Feet

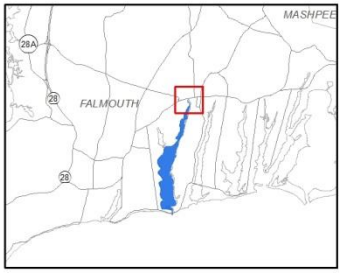
Figure 2c

Great Pond (MA96-54)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- Groundwatershed
- Assessed Segment
- Non-Impaired Streams
- NWI Wetland Areas
- DOT Supplemental Contributing Area
- DOT Pervious Area
- DOT Impervious Area

N

0 200 400 Feet

Figure 2d

Great Pond (MA96-54)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Green Pond (MA96-55)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen, Estuarine Bioassessments, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Great, Green and Bournes Pond Embayment Systems Total Maximum Daily Loads for Total Nitrogen* (CN 181.0)[2] *Final Pathogen TMDL for the Cape Cod Watershed* (CN 252.0)[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 (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None
		Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**	16.6 lbs/yr
	Contributing Watershed Area Load	66,877 lbs/yr
	DOT Contribution to Existing Load	0.02 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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 Total Maximum Daily Load for Total Nitrogen in the Great, Green and Bournes Pond Embayment Systems, Massachusetts (CN 181.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/ggbtmdl.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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Green Pond (MA96-55). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Green Pond watershed is located in Falmouth and includes residential areas, wetlands, ponds and MassDOT roads (Route 28). The majority of the watershed is urban and contains both commercial and residential properties.

Green Pond receives inflows from an unnamed stream, surface runoff and groundwater flow. Green Pond discharges to Vineyard Sound. MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identified the Aquatic Life Use as "Impaired" for Green Pond due to loss of eelgrass habitat (estuarine bioassessment), total nitrogen from septic systems, stormwater runoff, and fertilizers and fecal coliform. The report identified shellfish harvesting as "Support" because Green Pond is conditionally approved for shellfish harvesting. All other uses were not assessed.

Figure 2 illustrates the MassDOT roads that are contributing to the water body. Route 28 in Falmouth contributes runoff to Green Pond. The contributing roadway to Green Pond begins at the high point located in the vicinity of Acapesket Road and continues approximately 2,300 feet east to a high point in the vicinity of the Dunkin Donuts located at 363 East Falmouth Highway. At least one drainage outfall is located at the low point at the Green Pond crossing. Catch basins along the southern curb of the road collect runoff from the roadway and discharge it to Green Pond. Runoff from the eastern end of the watershed is collected by two catch basins and is directed to a drainage ditch located in front of the Pura Vida Spa and Salon at 289 East Falmouth Highway. The drainage ditch continues along the road and discharges into the wooded area to the east of Green Pond.

Approximately 300 feet of Route 28 between Acapesket Road and the the western boundary of the watershed flows back into the watershed via gutter flow and is considered "Supplemental DOT Contributing Area" (Figure 2). 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 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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled

[5] 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

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

[7] 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

Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.[8] MassDOT assessed Green Pond (MA96-55) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 181.0)

The *Great, Green and Bournes Pond Embayment Systems Total Maximum Daily Load (TMDL) for Total Nitrogen* (CN 181.0)[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT property is assumed to be in the controllable land use load allocation category because there is not a specific transportation category in the TMDL.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[11] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The nitrogen loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 1.8 acres
- DOT Pervious Area: 0.5 acres
- Estimated Existing MassDOT Load: 16.6 lb/yr
- Total Existing Watershed Nitrogen Load: 66,877 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.02 %

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.[12] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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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[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds*.

[9] Mass DEP. 2007. Final Total Maximum Daily Load for Total Nitrogen in the Great, Green and Bournes Pond Embayment Systems, Massachusetts (CN 181.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/ggbtmdl.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

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

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).[13] Green Pond (MA96-55) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[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. 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[14] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's Southeast Expressway study measured bacterial concentration in stormwater runoff[15] and data indicated that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g., illicit discharges, sewer utilities, pet waste and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicate that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommend implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review and source control.

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

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 watershed of the water body, including regular roadway and drainage system maintenance, erosion and sedimentation control,street sweeping, and outreach and education. As described in

[13] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/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] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

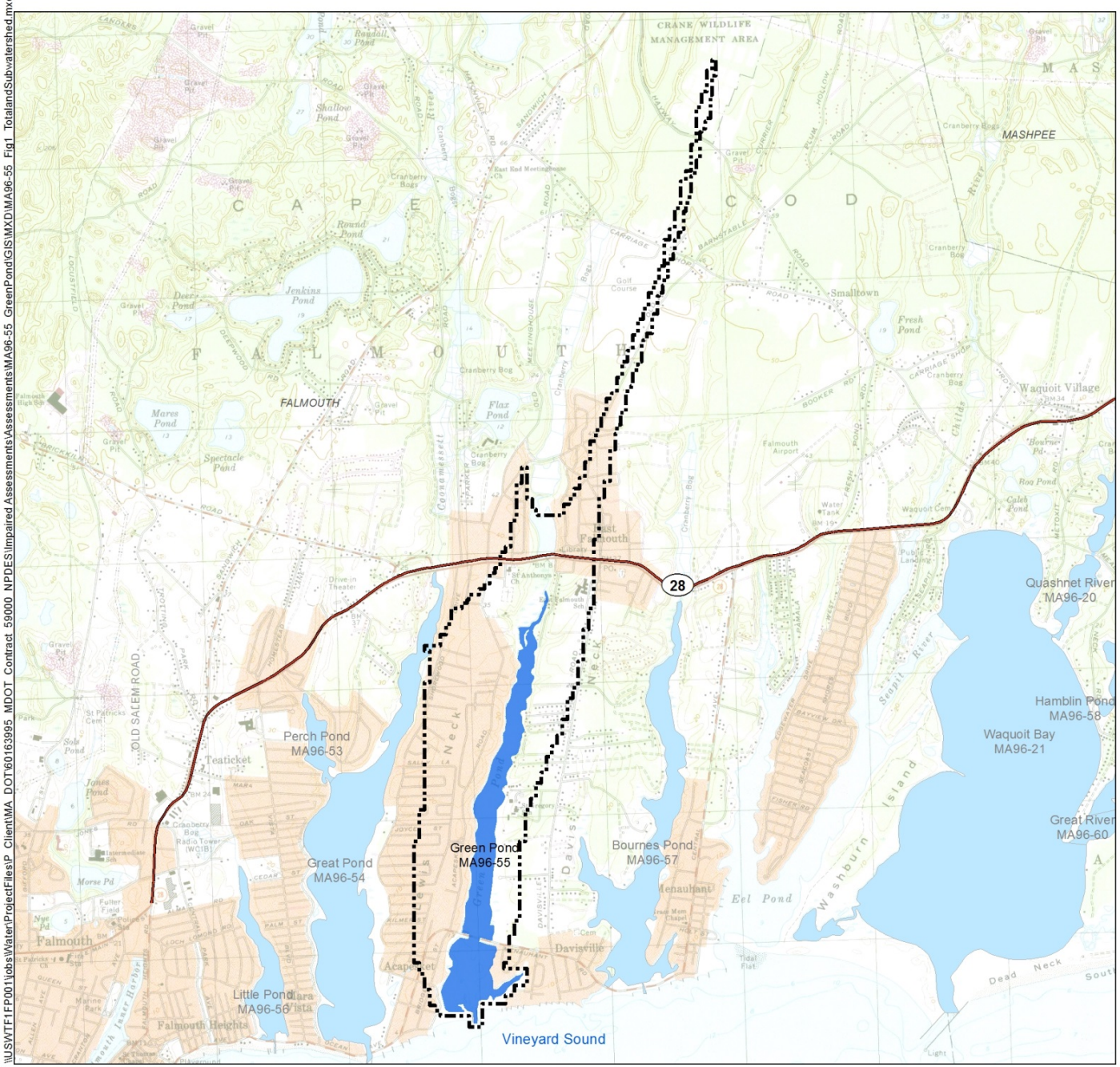
MassDOT's Stormwater Handbook,[16] MassDOT does not use nitrogen based fertilizers as part of normal operations and maintenance procedures. In the rare circumstance where fertilizers are used, it is for the occasional turf establishment associated with recent ground disturbance.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Green Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Form.

[16] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004. Available at: http://www.mhd.state.ma.us/downloads/projdev/2009/mhd_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

Green Pond (MA96-55) Groundwatershed

June 2014

massDOT Massachusetts Department of Transportation Highway Division

\\USWTF1FP001\Jobs\Water\ProjectFiles\P Client\MA DOT\60163995 MDOT Contract 59000 NPDES\Impaired Assessments\Assessments\MA96-55 GreenPond\GIS\MXD\MA96-55 Fig1 TotalandSubwatershed.mxd

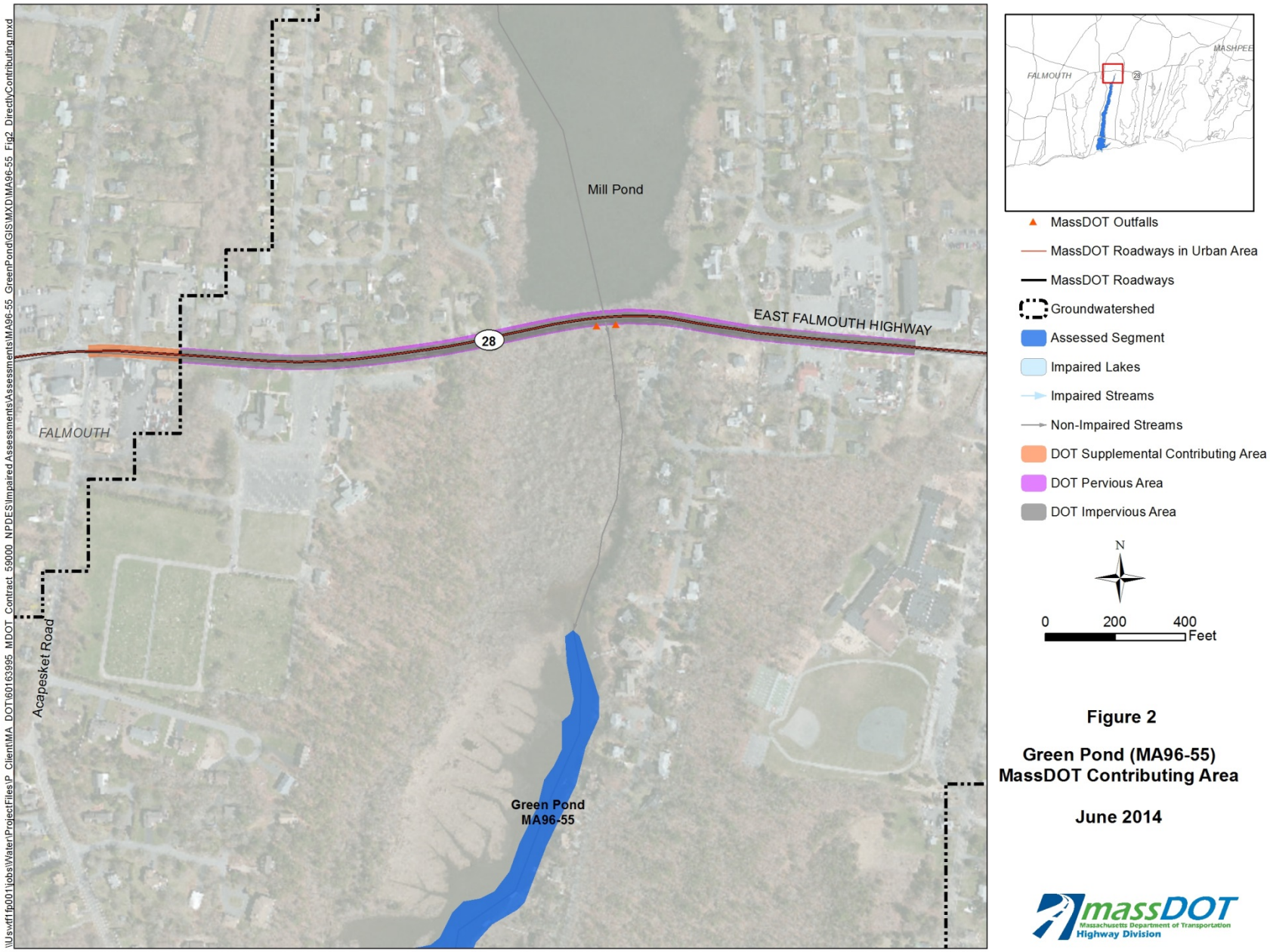


Figure 2

Green Pond (MA96-55)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Little Pond (MA96-56)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Estuarine Bioassessments, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Little Pond Embayment System Total Maximum Daily Loads for Total Nitrogen* (CN 246.0)[2] *Addendum: Final Pathogen TMDL for the Cape Cod Watershed* (CN 252.5)[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 (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None
		Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**	16.0 lbs/yr
	Contributing Watershed Area Load	18,314 lbs/yr
	DOT Contribution to Existing Load	0.09 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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 Total Maximum Daily Loads for Total Nitrogen in the Little Pond Embayment System (CN 246.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/little.pdf

[3] 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

[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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Little Pond (MA96-56). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Little Pond watershed is located in Falmouth and includes residential, commercial and forested areas and MassDOT roads (Route 28). The majority of the watershed is urban and contains both commercial and residential properties.

Little Pond receives inflows from Little Pond Brook and groundwater flow. Little Pond discharges to Vineyard Sound. MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identified the Aquatic Life Use and Shellfish Harvesting Use as "Impaired" for Little Pond based on loss of eelgrass habitat and because all of the segment area is prohibited for shellfish harvesting, respectively. The impairments are presumed to be due to septic systems, stormwater runoff, and fertilizers. All other uses were not assessed.

Figure 2 illustrates the MassDOT roads that are contributing to the water body. Route 28 in Falmouth contributes runoff to Little Pond. The contributing roadway to Little Pond begins at the high point located in the vicinity of Jones Road and continues approximately 1,600 feet northeast to a high point in the vicinity of Maravista Avenue. At least one drainage outfall is located at the low point approximately half way between Jones Road and Maravista Avenue. This outfall discharges into a wooded area to the northwest of Little Pond. The portion of Route 28 from the high point in the vicinity of Jones Road to the southern watershed boundary discharges outside of the watershed of Little Pond.

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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[8] MassDOT assessed Little Pond (MA96-56) using the methodologies described below.

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[5] 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

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

[7] 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

[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*

BMP 7R for Nitrogen TMDL (CN 246.0)

The *Little Pond Embayment System Total Maximum Daily Loads (TMDL) for Total Nitrogen* (CN 246.0)[9] 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 7R[10] 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] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described below.

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,[12] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The nitrogen loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 1.7 acres
- DOT Pervious Area: 0.6 acres
- Estimated Existing MassDOT Load: 16.0 lb/yr
- Total Existing Watershed Nitrogen Load: 18,314 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.09 %

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.[11] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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 252.5)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP).[10] Little Pond (MA96-56) is

[9] Mass DEP. 2008. Final Total Maximum Daily Loads for Total Nitrogen in the Little Pond Embayment System (CN 246.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/little.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[11] MassDOT. March 7, 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

covered by the *Addendum to the Final Pathogen TMDL for the Cape Cod Watershed*.[13] Little Pond (MA96-56) was identified as impaired due to pathogens after the *Final Pathogen TMDL for the Cape Cod Watershed*[14] was finalized in 2009, but it is assumed that Little Pond is impacted by the same types of pathogen sources included in the Final TMDL, including waterfowl, pet waste, septic systems, 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 Addendum to the Final 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[14] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's Southeast Expressway study measured bacterial concentration in stormwater runoff[15] and data indicated that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g., illicit discharges, sewer utilities, pet waste and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicate that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommend implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review and source control.

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

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 watershed 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,[16] MassDOT does not use nitrogen based fertilizers as part of

[13] 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

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

[16] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004. Available at: http://www.mhd.state.ma.us/downloads/projdev/2009/mhd_stormwater_handbook.pdf

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.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Little Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.

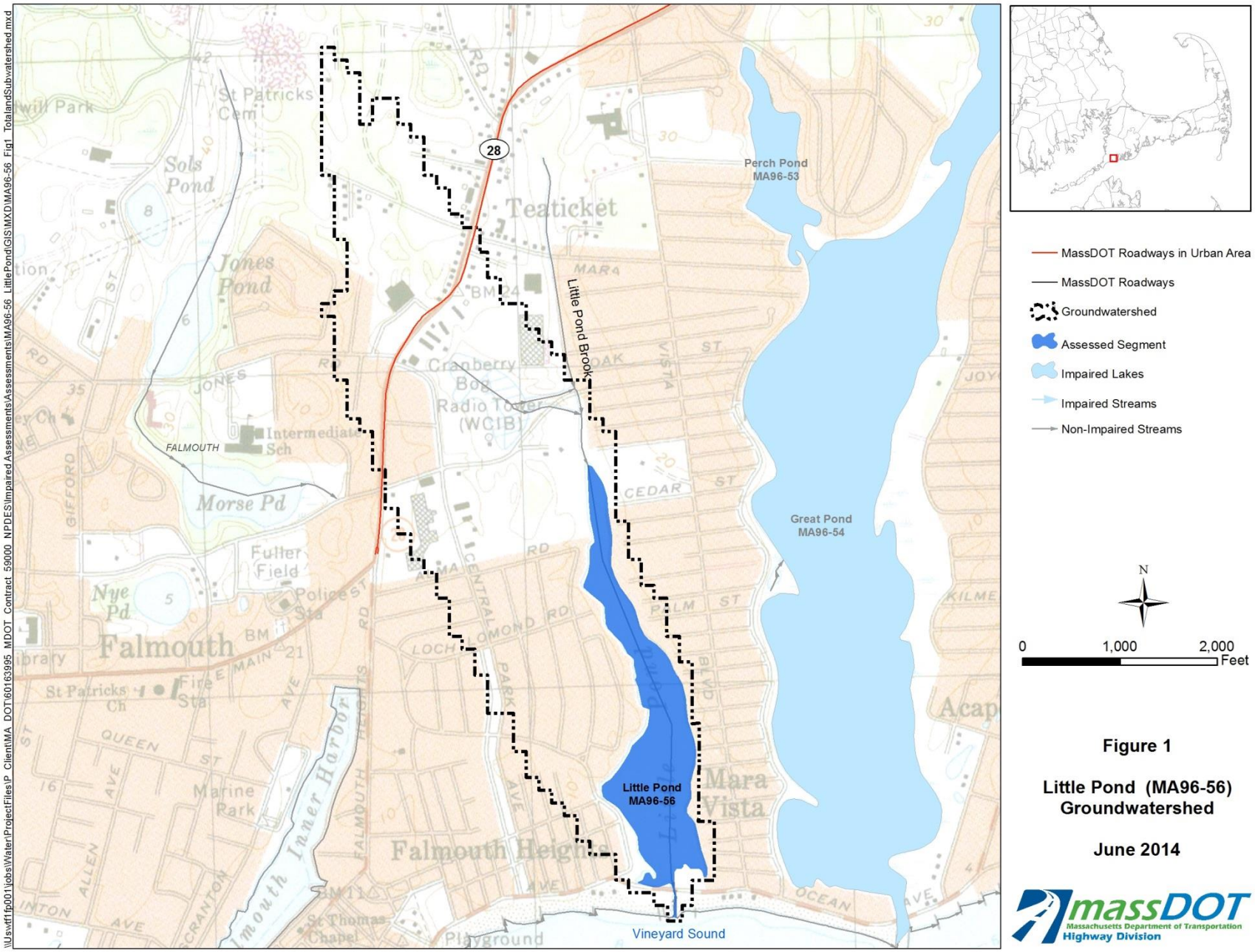
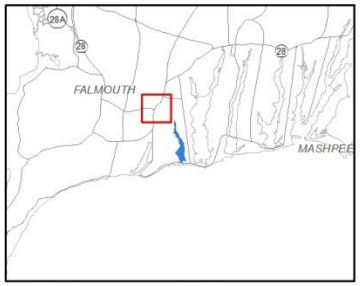


Figure 1

Little Pond (MA96-56)
Groundwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division



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

N

0 175 350
Feet

Figure 2

Little Pond (MA96-56)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

\\Usvdf1p001\jobs\Water\ProjectFiles\P Client\MA DOT\60163995 MDOT Contract 59000 NPDES\Impaired Assessments\Assessments\MA96-56 LittlePond\GIS\MXD\MA96-56 Fig2 DirectlyContributing.mxd

Impaired Waters Progress Report Assessment for Bournes Pond (MA96-57)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen, Estuarine Bioassessments, Fecal Coliform
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Great, Green and Bournes Pond Embayment Systems Total Maximum Daily Loads for Total Nitrogen* (CN 181.0)[2] *Final Pathogen TMDL for the Cape Cod Watershed* (CN 252.0)[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 (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None
		Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**	24.9 lbs/yr
	Contributing Watershed Area Load	35,768 lbs/yr
	DOT Contribution to Existing Load	0.07 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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 Total Maximum Daily Load for Total Nitrogen in the Great, Green and Bournes Pond Embayment Systems, Massachusetts (CN 181.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/ggbtmdl.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

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Bourne's Pond (MA96-57). The watersheds and subwatersheds for Cape Cod were 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 data.[5,6] The Bourne's Pond watershed is located in Falmouth and includes residential areas, wetlands, ponds and MassDOT roads (Route 28). The majority of the watershed is urban and contains both commercial and residential properties.

Bourne's Pond receives inflows from an unnamed stream, surface runoff and groundwater flow. Bourne's Pond discharges to Vineyard Sound. MassDEP's Water Quality Assessment Report titled "Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report"[7] identified the Aquatic Life Use as "Impaired" for Bournes Pond due to loss of eelgrass habitat (estuarine bioassessment), total nitrogen from septic systems, stormwater runoff, and fertilizers and fecal coliform. The report identified shellfish harvesting as "Support" because Bournes Pond is approved for shellfish harvesting along 0.18 square miles (approximately 74% of segment area) and conditionally approved for 0.06 square miles (approximately 24% of segment area). All other uses were not assessed.

Figures 2a and 2b illustrate the MassDOT roads that are contributing to the water body. Route 28 (East Falmouth Highway) in Falmouth contributes runoff to Bourne's Pond. Contributing roadway to Bourne's Pond begins at a high point in the vicinity of Dunkin Donuts at 363 East Falmouth Highway and continues approximately 4,000 feet to the east to a high point located at Central Avenue. Runoff is collected by catch basins and conveyed via a storm drain along this stretch of road and directed to a recently rebuilt culvert. Leaching basins are located at 15 of the catch basins along this stretch of road. When the capacity of the leaching basins is reached, water spills over into the storm drain and flows downstream to the outfalls at the culvert. Two outfalls connect to the culvert and discharge to the headwaters of Bourne's Pond immediately upstream of the impaired water body, as shown on Figures 2a and 2b. The portion of Route 28 from the high point near Central Avenue toward the eastern watershed boundary is served by a separate storm drain system that discharges outside of the watershed of Bournes Pond. Therefore, this portion of Route 28 is not considered a DOT contributing area, as illustrated on Figure 2a.

Approximately3,800 feet of Route 28 described above is located beyond the boundaries of the watershed flows back into the watershed via the existing drainage system and is considered "Supplemental DOT 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 identified 15 existing BMPs in place with the potential to treat roadway runoff from the discharging area before reaching the impaired water segment. These 15 existing BMPs are leaching basins located along the recently constructed storm drain as shown on Figures 2a and 2b.

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[5] 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

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

[7] 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

However, these BMPs do not account for reduction credit for nitrogen removal from this system, per the methodology.

Assessment

In cases where a TMDL has been approved, MassDOT assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[8] MassDOT assessed Bournes Pond (MA96-57) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 181.0)

The *Great, Green and Bournes Pond Embayment Systems Total Maximum Daily Loads for Total Nitrogen* (CN 181.0)[9] 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 7R[10] 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.[8] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[11] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[11] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The nitrogen loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 2.9 acres
- DOT Pervious Area: 0.1 acres
- Estimated Existing MassDOT Load: 24.9 lb/yr
- Total Existing Watershed Nitrogen Load: 35,768 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.07%

[8] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*

[9] Mass DEP. 2007. Final Total Maximum Daily Load for Total Nitrogen in the Great, Green and Bournes Pond Embayment Systems, Massachusetts (CN 181.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/ggbtmdl.pdf

[10] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[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. Avaialble at: http://pubs.usgs.gov/tm/04/c03

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.[12] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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 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).[13] Bournes Pond (MA96-57) is covered by the *Final Pathogen TMDL for the Cape Cod Watershed*.[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. 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 storm water runoff volume.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[14] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's Southeast Expressway study measured bacterial concentration in stormwater runoff[15] and data indicated that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g., illicit discharges, sewer utilities, pet waste and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicate that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommend implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review and source control.

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

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

[13] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/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] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

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 watershed 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,[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 turf establishment associated with recent ground disturbance.

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

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen or nitrogen impaired water body. As part of its pet waste management program, MassDOT has determined that there are no targeted rest areas located within the watershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens or nitrogen, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens or nitrogen to the impaired water body and pet waste removal bags and disposal cans will be provided.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Bournes Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design, plans for construction of BMPs, and nitrogen load reduction provided. MassDOT will continue to track projects under design in watersheds of impaired waters through the ongoing use of Water Quality Data Forms.

[16] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004. Available at: http://www.mhd.state.ma.us/downloads/projdev/2009/mhd_stormwater_handbook.pdf

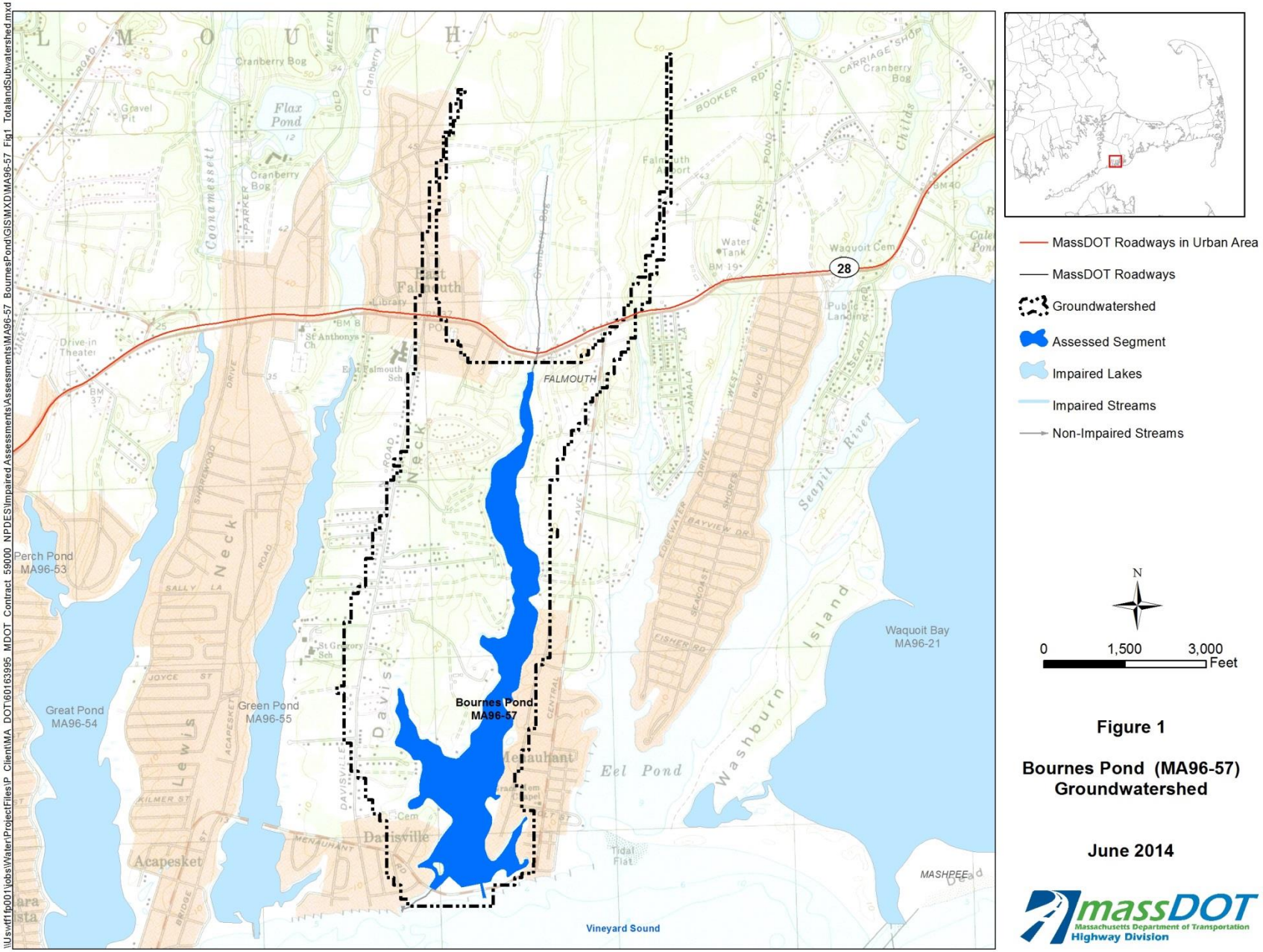
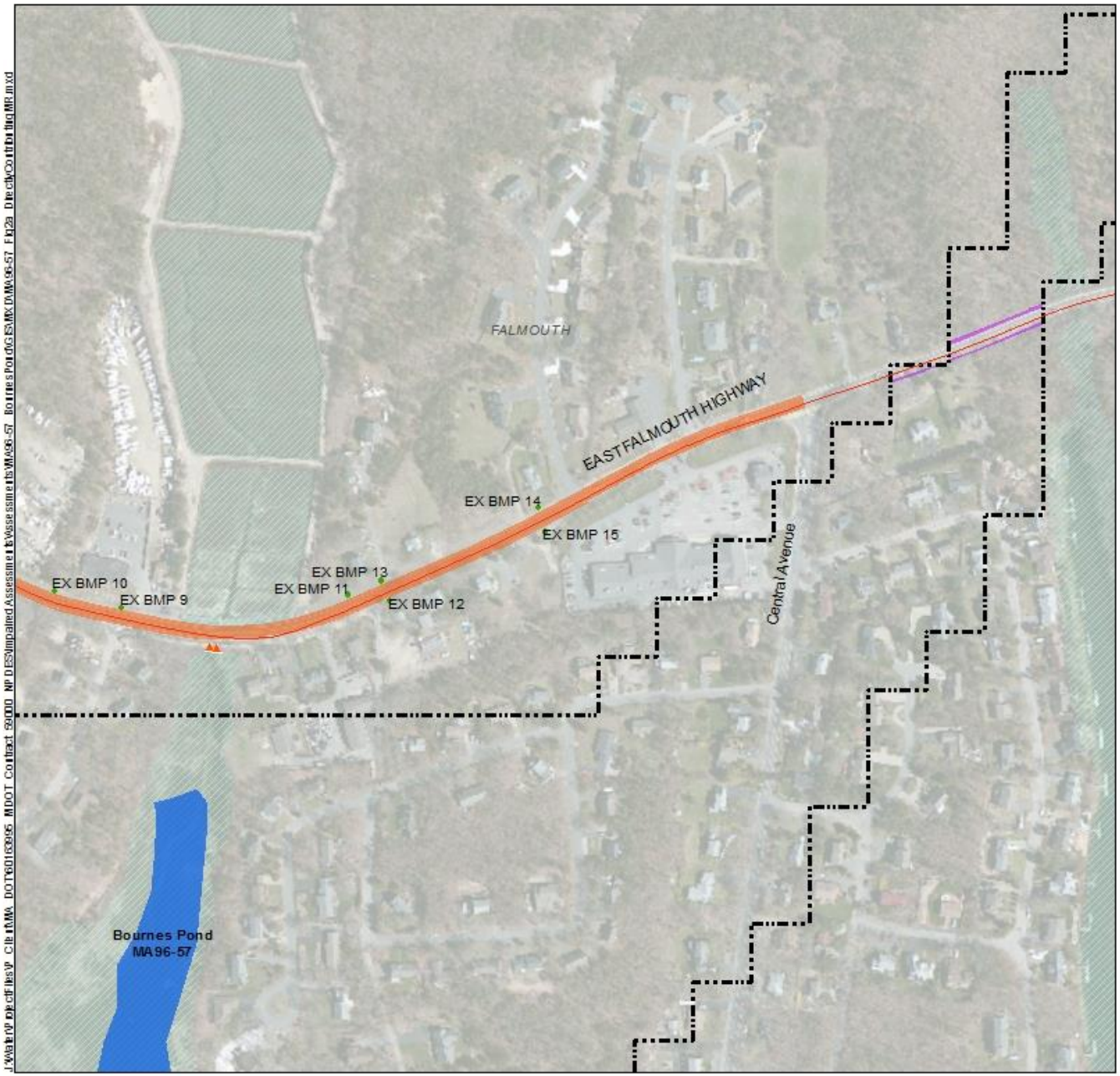
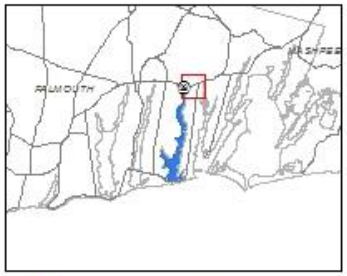


Figure 1

Bournes Pond (MA96-57) Groundwatershed

June 2014





MassDOT Outfalls
MassDOT Roadways in Urban Area
MassDOT Roadways
Groundwatershed
Assessed Segment
Impaired Streams
Impaired Lakes
DOT Supplemental Contributing Area
DOT Impervious Area
DOT Pervious Area
NWI Wetland Areas
Existing BMPs

N

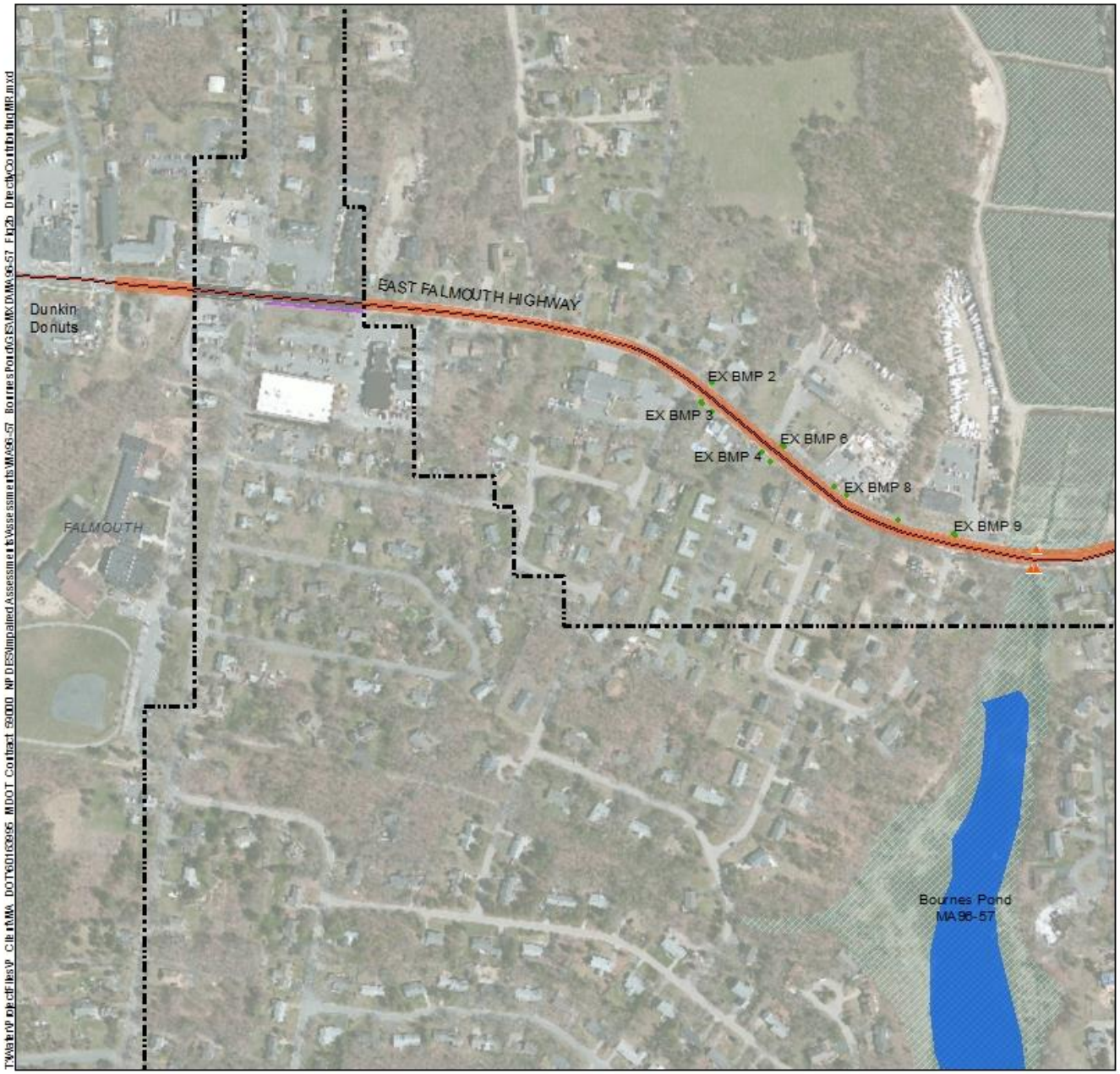
0 150 300
Feet

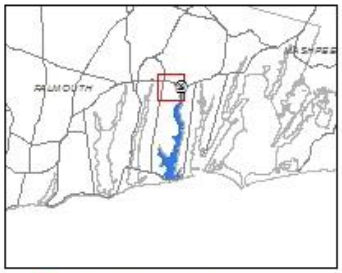
Figure 2a

Bournes Pond (MA96-57)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division





MassDOT Outfalls
MassDOT Roadways in Urban Area
MassDOT Roadways
Groundwatershed
Assessed Segment
Impaired Streams
Impaired Lakes
DOT Supplemental Contributing Area
DOT Pervious Area
DOT Impervious Area
NWI Wetland Areas
Existing BMPs

N

0 175 350
Feet

Figure 2b

Bournes Pond (MA96-57)
MassDOT Contributing Area

June 2014

Impaired Waters Progress Report Assessment for Areys Pond (MA96-70)

Summary

		Stormwater
Impaired Waters[1]	**Impairments:**	Nitrogen, Estuarine Bioassessments
	Category:	4A (TMDL is completed)
	Final TMDLs:	*Pleasant Bay System Total Maximum Daily Loads for Total Nitrogen* (CN 244.0)[2]
	WQ Assessment:	*Cape Cod Coastal Drainage Areas, 2004 – 2008 Surface Water Quality Assessment Report*[3]
Location	**Towns:**	Orleans
	MassDOT Roads:	Route 6 and Route 28
Assessment Method(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☐
	Load Negligible	☒
BMPs	**Existing:**	None
	Proposed:	None
		Nitrogen
MassDOT Area and Targets	**Directly Contributing Load**	10.9 lbs/yr
	Contributing Watershed Area Load	6,028 lbs/yr
	DOT Contribution to Existing Load	0.18 %

[1] Massachusetts Department of Environmental Protection (Mass DEP). 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 Total Maximum Daily Load for Total Nitrogen in the Pleasant Bay System, Massachusetts (CN 244.0). 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

Site Description

Figure 1 illustrates the groundwatershed (herein referred to as watershed) for Areys Pond (MA96-70). The watersheds and subwatersheds for Cape Cod were 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 data.[4,5] The Areys Pond watershed 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 watershed is wooded.

Areys Pond receives inflows from several unnamed streams and groundwater flow. Areys Pond discharges to the Namequoit River which feeds into The River and ultimately Little Pleasant 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" for Areys Pond due to total nitrogen from septic systems, stormwater runoff, and fertilizers. The report identified shellfish harvesting, primary contact, and secondary contact as "Support" because Areys Pond is approved for shellfish harvesting. All other uses were not assessed.

Figures 2a and 2b illustrate the MassDOT roads within the watershed that contribute runoff to the water body. Approximately 800 feet of Route 6 in Orleans in the vicinity of Shorewood Drive contributes runoff and groundwater infiltration within the watershed area. Route 6 has one lane in each direction within a 100 feet wide Right of Way (ROW). Roadway runoff from impervious areas is collected by catch basins that route flow through drain pipes to adjacent wooded areas. Runoff from pervious areas within the ROW infiltrates directly to the groundwater. The northern limit of the DOT contributing area along Route 6 is defined by the watershed limit, whereas the southern limit is defined by the termination of the DOT urban roadway. Surrounding land uses are conservation land, state park, and residential.

Approximately 190 feet of Route 28 in Orleans between Lisa's Way and Areys Lane contributes runoff within the watershed area. An additional 240 feet of Route 28 beyond the northern boundary of the watershed flows back into the watershed and is considered "Supplemental DOT 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". Supplemental area is illustrated on Figures 2a and 2b. Route 28 in this area is also called Orleans-Chatham Road. Route 28 has one lane in each direction and a narrow shoulder within a 50 feet wide ROW. The roadway runoff is collected by roadside gutters and catch basins that direct flow to an unnamed stream connecting to Areys Pond.

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.

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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. 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 assessed the water body for the impairments covered by the TMDL under the BMP 7R methodology. Nitrogen impaired waters with an approved TMDL are assessed using the methodology outlined in MassDOT's document entitled *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*[7] MassDOT assessed Areys Pond (MA96-70) using the methodologies described below.

BMP 7R for Nitrogen TMDL (CN 244.0)

The *Pleasant Bay System Total Maximum Daily Load (TMDL) for Total Nitrogen* (CN 244.0)[8] 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 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.[7] Specific parameters of the TMDL are as follows:

- Pollutant of Concern: Nitrogen
- MassDOT Load Allocation (LA): The MassDOT Load Allocation was not calculated for this watershed because the existing MassDOT Load is less than 3.5% of the total watershed load, as described below.

For the nitrogen assessment under BMP 7R, MassDOT used USGS modeling[10] to estimate annual pollutant loads from its property. Based on the USGS SELDM model,[10] which was run using precipitation and other relevant datasets specific to the Cape Cod area, MassDOT estimates the nitrogen loading from impervious areas as 8.5 lbs/acre/yr and from pervious areas as 2.5 lbs/acre/yr. The Nitrogen Loading for MassDOT property in the contributing area is summarized below:

- DOT Impervious Area: 0.9 acres
- DOT Pervious Area: 1.3 acres
- Estimated Existing MassDOT Load: 10.9 lb/yr
- Total Existing Watershed Nitrogen Load: 6,028 lb/yr (from TMDL)
- MassDOT Existing Load as a percentage of Total Watershed Nitrogen Load: 0.18%

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

[7] Massachusetts Department of Transportation (MassDOT), March 7, 2014. *Application of BMP 7R to Nitrogen in Groundwater-Controlled Massachusetts Watersheds.*

[8] Mass DEP. 2007. Final Total Maximum Daily Load for Total Nitrogen in the Pleasant Bay System, Massachusetts (CN 244.0). Available at: http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/pbtmdl.pdf

[9] MassDOT. July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[10] 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

the total nitrogen watershed load.[11] The cut-off value of 3.5% is based on loading values determined to be negligible in the Cape Cod TMDLs. 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.

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 watershed 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,[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 turf establishment associated with recent ground disturbance.

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

[12] The MassHighway Storm Water Handbook for Highways and Bridges. May 2004. Available at: http://www.mhd.state.ma.us/downloads/projdev/2009/mhd_stormwater_handbook.pdf

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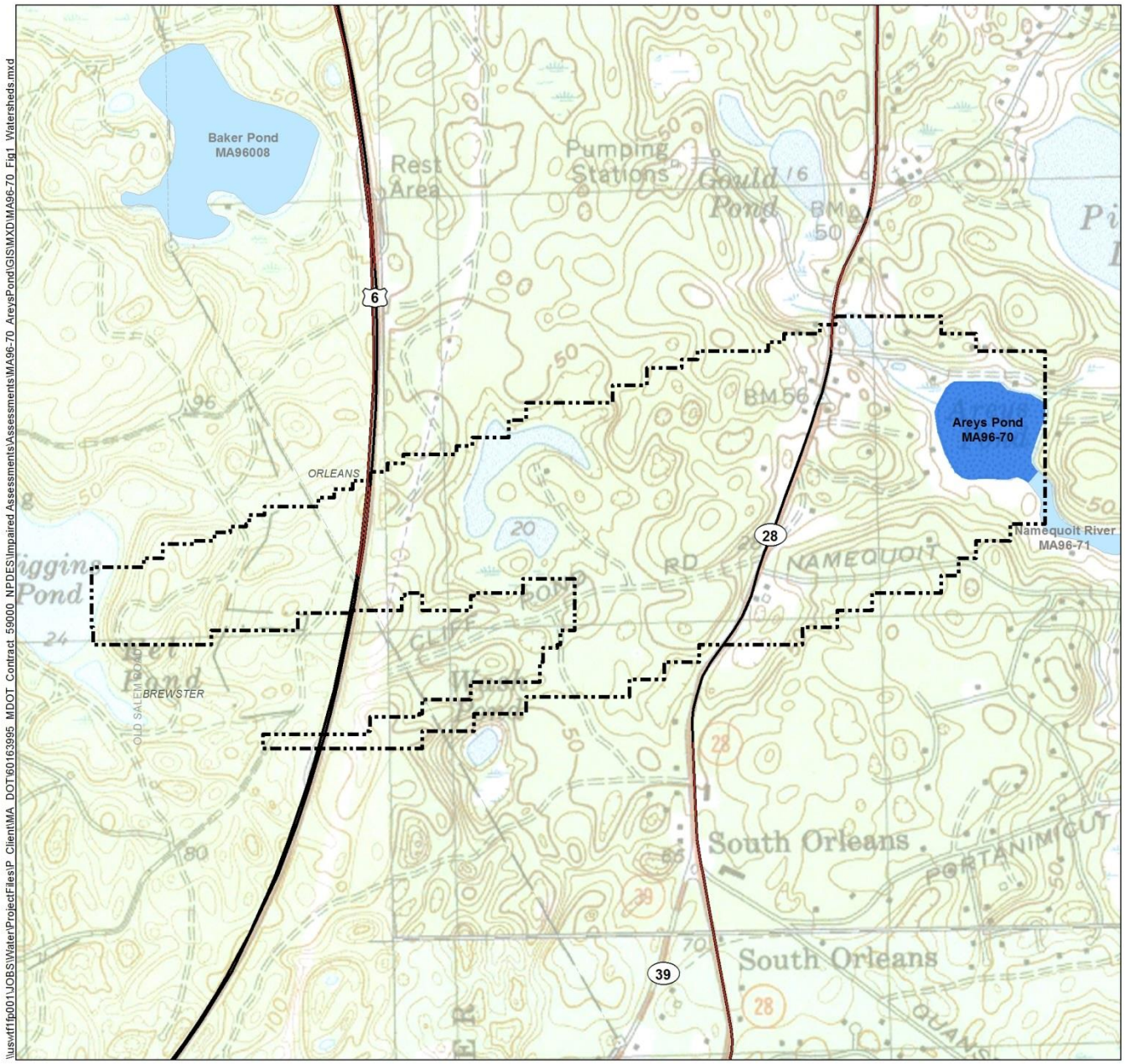


MassDOT Roadways in Urban Area

MassDOT Roadways

Groundwatershed

Assessed Segment

Impaired Lakes

Impaired Streams

N

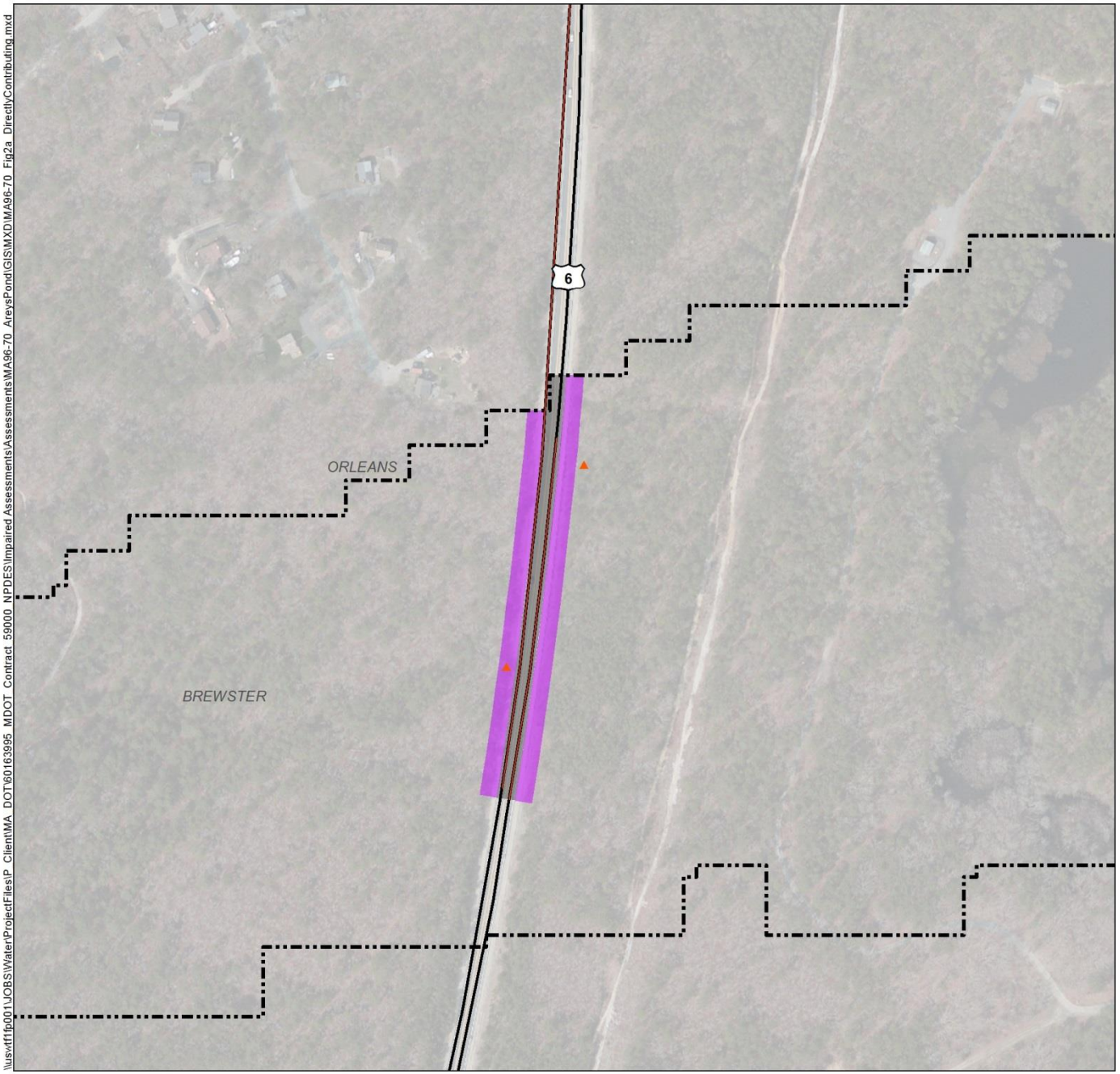
0 500 1,000 Feet

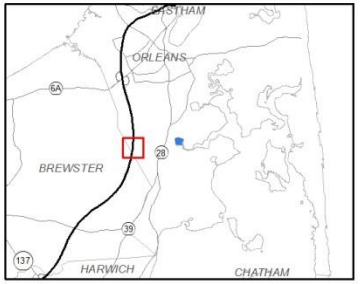
Figure 1

Areys Pond (MA96-70) Groundwatershed

June 2014

MassDOT Massachusetts Department of Transportation Highway Division





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

N

0 200 400 Feet

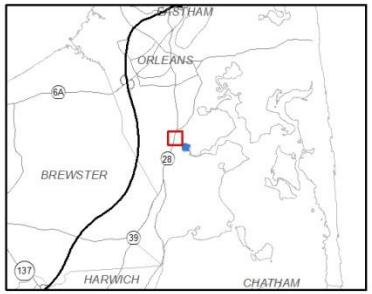
Figure 2A

Areys Pond (MA96-70)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

\\uswff1fp001\JOBS\Water\ProjectFiles\P Client\MA DOT\60163995 MDOT Contract 59000 NPDES\Impaired Assessments\Assessments\MA96-70 AreysPond\GIS\MXD\MA96-70 Fig2a DirectlyContributing.mxd



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- DOT Impervious Area

N

0 100 200 Feet

Figure 2B

Areys Pond (MA96-70)
MassDOT Contributing Area

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division