Attachment 5:

Pathogen Only Final Assessments

List of Impaired Water Bodies

Water Body ID	Water Body Name
MA52-06	Bungay River
MA53-03	Palmer River
MA53-05	Palmer River
MA53-16	Rocky Run
MA61-08	Kickamuit River
MA62-20	Assonet River
MA62-38	Meadow Brook
MA62-50	Broad Cove
MA62-51	Muddy Cove Brook
MA62-55	Segreganset River
MA62-56	Three Mile River
MA62-57	Three Mile River
MA71-08	Mill Creek
MA73-06	School Meadow Brook
MA73-17	Traphole Brook
MA73-24	Purgatory Brook
MA73-27	Ponkapog Brook
MA83-06	Vine Brook
MA83-07	Strong Water Brook
MA83-10	Kiln Brook
MA83-14	Spring Brook
MA91-11	Little River
MA93-32	Hawkes Brook
MA93-33	Hawkes Brook
MA93-41	Crane River
MA93-48	Bennetts Pond Brook
MA93-50	Shute Brook
MA93-52	Lynn Harbor
MA93-53	Lynn Harbor

Impaired Waters Assessment for Bungay River (MA52-06) - Final Report

Impaired Water Body

Name: Bungay River

Location: North Attleborough and Attleboro, MA

Water Body ID: MA52-06

Impairments

Bungay River (MA52-06) is listed under Category 5, "Waters Requiring a TMDL" on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Bungay River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Ten Mile River Watershed 2002 Water Quality Assessment Report* (MassDEP, 2002a), fecal coliform was detected at a sampling station located near the end of Mary-Kennedy Road, downstream from the United States Fish and Wildlife Service fish hatchery, during five sampling events. A large number of waterfowl were observed upstream from the sample location during all sampling events and the source of the fecal coliform was attributed to the presence of these waterfowl.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and

no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Bungay River (MA52-06) is a water body in North Attleborough and Attleboro, Massachusetts. It originates at the outlet of Greenwood Lake and flows south approximately 5 miles to join the Ten Mile River. As shown in Figure 1, MassDOT urban roads within the total and subwatershed include portions of Interstate 95 and a bridge on Holden Street. These roads could potentially contribute stormwater to this segment of Bungay River.

The land use within the subwatershed is primarily forest with some residential developments throughout. MassDOT owns Route 95 within the total and subwatershed, as well as a bridge on Holden Street in Attleboro. Another bridge, the Mount Vernon Road Bridge, is located at the extreme upstream extent of Bungay River (MA52-06), at Greenwood Lake Dam Crest Road immediately west of the Greenwood Lake outlet. This bridge is the only MassDOT-owned property that is directly adjacent to this segment of the Bungay River. At this location, MassDOT owns only the bridge and minimal to no property surrounding the bridge. The approach roadways are owned and operated by the municipality. No closed drainage systems exist on the bridge structures; however, the bridges are curbed. Therefore, stormwater runoff has the potential to flow off the bridge and into the nearest stormwater system.

Assessment of Pathogen Impairment under BMP 7U

MassDOT assessed the pathogen impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002b).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal

- Pet waste management

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatershed of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

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MassDEP. (2009a). Final Pathogen TMDL for the Buzzards Bay Watershed. Available at: MADEP 2009a Final Pathogens TMDL for the Buzzards Bay Watershed

MassDEP. (2009b). Final Pathogen TMDL for the Cape Cod Watershed. Available at: MassDEP 2009b Final Pathogen TMDL for the Cape Cod Watershed Area

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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.

U.S. Geological Survey (USGS). (1999). Pesticides and Bacteria in an Urban Stream – Gills Creek. USGS Fact Sheet FS-131-98. Columbia, South Carolina.

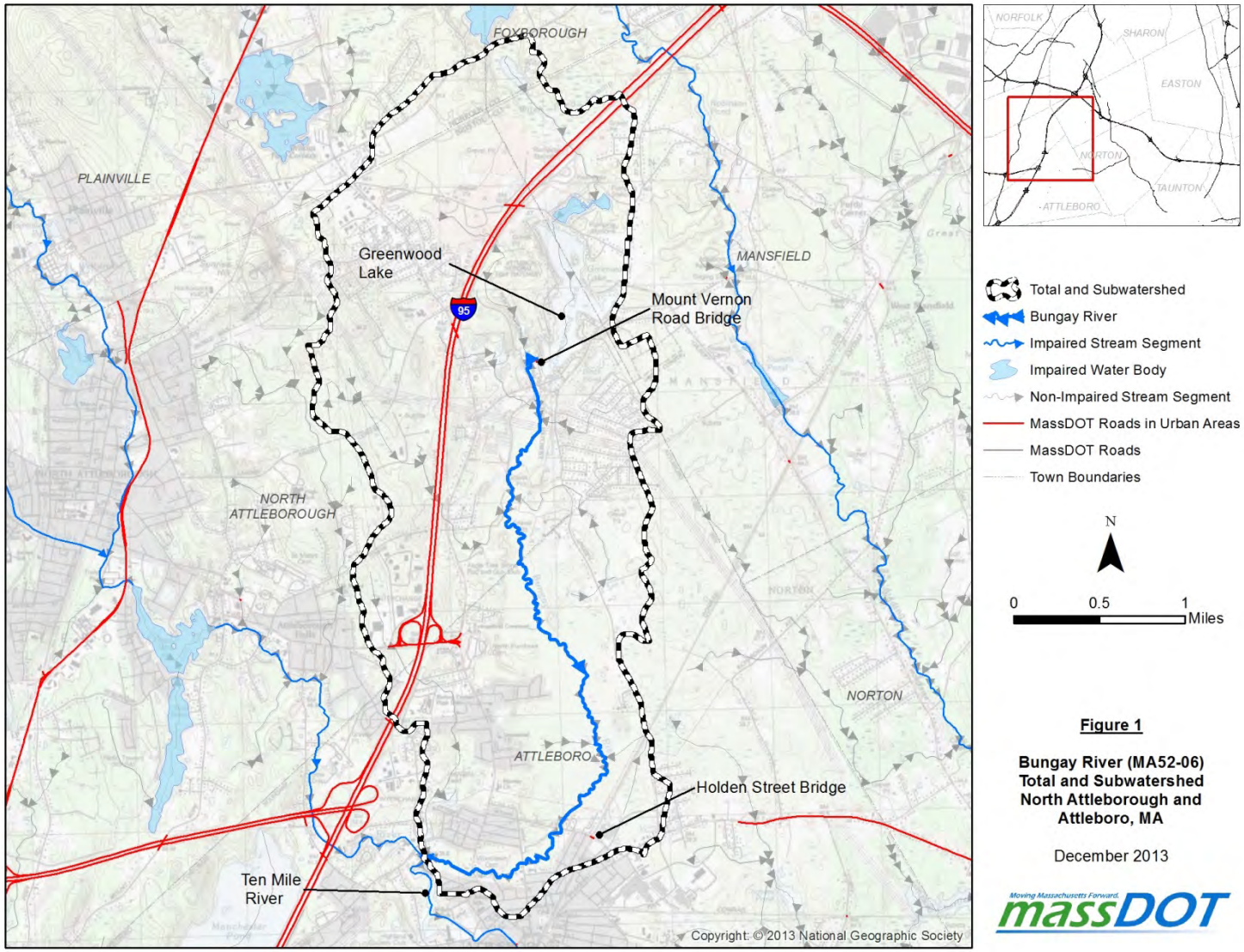

Figure 1

Bungay River (MA52-06)
Total and Subwatershed
North Attleborough and Attleboro, MA

December 2013

Impaired Waters Assessment for Palmer River (MA53-03) - Final Report

Impaired Water body

Name: Palmer River

Location: Swansea and Rehoboth, MA

Water Body ID: MA53-03

Impairments

Palmer River (MA53-03) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Palmer River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009c), Palmer River (MA53-03) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Palmer River is covered by the *Final Bacteria TMDL for the Palmer River Basin* (MassDEP, 2004).

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non-bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all of the samples taken during the most recent six

months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The Palmer River is a tributary of Narragansett Bay. The headwaters of the river feed the East and West Branches which converge into the main stem that flows through Shad Factory Pond and continues to the Massachusetts/Rhode Island border. The river then flows into Warren River which discharges to the Narragansett Bay. The main stem of the Palmer River is separated into three segments for the purposes of the final *Massachusetts Year 2012 Integrated List of Waters.* Segment MA53-04 of Palmer River begins at the confluence of the East Branch and West Branch and continues to the Shad Factory Pond dam in Rehoboth MA. Segment MA53-05 extends from the Shad Factor Pond dam to the Route 6 Bridge in Rehoboth MA. Segment MA 53-03 of the Palmer River, which is the subject of this assessment, extends from the Route 6 Bridge in Rehoboth, MA to the state line in Swansea MA/Barrington, RI. This segment is considered an estuary with an area of approximately 0.11 square miles.

The subwatershed for Segment MA53-03 of Palmer River consists of wetlands directly adjacent to the segment. The total watershed contains more urbanization including several commercial properties along Route 6. According to MassDEP's Final Pathogen TMDL for the Narragansett/Mt. Hope Bay Watershed (MassDEP, 2010), several of the businesses in the portion of the reach south of the Route 6 crossing have had known failures of on-site wastewater disposal systems. Refer to Figure 1 for the total watershed Figure 2 for the subwatershed to Segment MA53-03 of Palmer River.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA53-03 of Palmer River is comprised of portions of Route 6. Refer to Figure 2 for the location of these roadways within the subwatershed to Segment MA53-03 of Palmer River.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely on the IC method to assess pathogen impairments. Instead,

MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Bacteria Total Maximum Daily Load (TMDL) for the Palmer River Basin (CN 0182.0)* covers the Massachusetts portion of the Palmer River and its tributaries (Mass DEP, 2004).

The Palmer River watershed has no documented point sources of bacteria pollution but numerous non-point contributions are identified in the TMDL report (Mass DEP, 2004). The overwhelming bacteria source identified in the TMDL report is agricultural runoff, due to livestock contributions. The report states that the findings of water quality sampling "point strongly toward agriculture as the primary source of bacterial pollution in the Dry-weather source categories evaluated in the TMDL". Other potential dry weather sources identified included poorly performing septic systems, wildlife directly contributing fecal matter to the receiving water (versus contributions via stormwater inputs), and livestock. Stormwater runoff, including agricultural runoff, was the primary wet-weather source category evaluated in the TMDL report.

The TMDL report states the following on Page 19 (MassDEP, 2004):

> "several sub-basins in the Palmer River watershed stand out as likely priority areas to address bacteria pollution sources. These sub-basins tend to be located in the southern and western portions of the watershed, where relatively dense residential development is increasing, major roads and highways are present, intensive agriculture is practiced, golf courses and the waterfowl that frequent them are plentiful, and stream channels are less buffered by forested and otherwise vegetated zones than they are in the upper Palmer."

Segment MA53-05 of the Palmer River is located in the southern portion of the watershed.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable.

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Palmer River TMDL report (Section 8.0, page 27) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Controls for agricultural runoff, such as improved cattle fencing and feeding operations
- Stream bank, riparian wetland, and floodplain restoration in the riparian zone where residential development and roadways are predominant land uses

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

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

- Agricultural BMPs
- Septic tank controls

- Documentation of storm drain outfall locations
- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Palmer River bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the sub-watershed of this water body. At rest stops that have been identified as being within sub-watersheds of waterbodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing

construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the sub-watershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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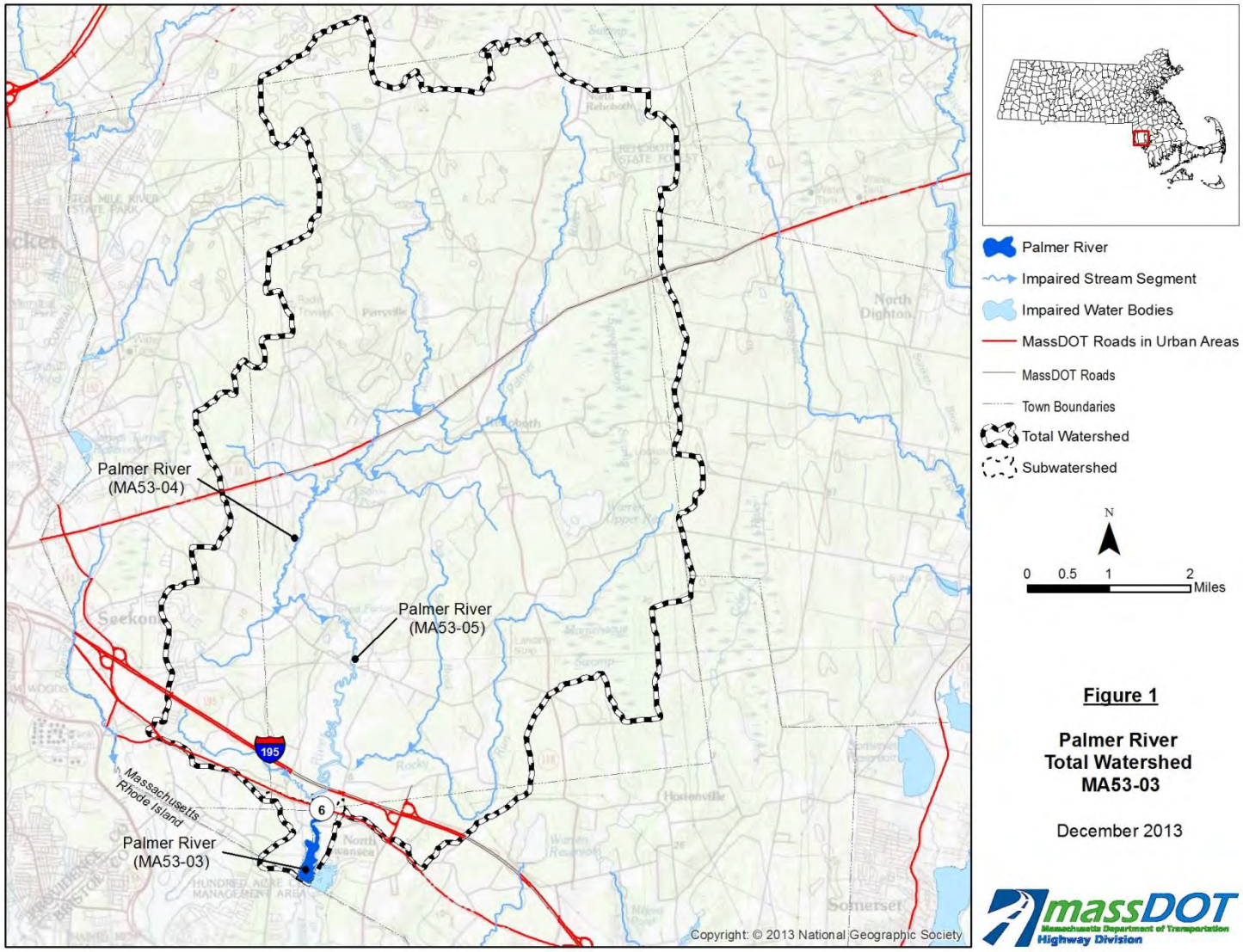

Figure 1

Palmer River
Total Watershed
MA53-03

December 2013

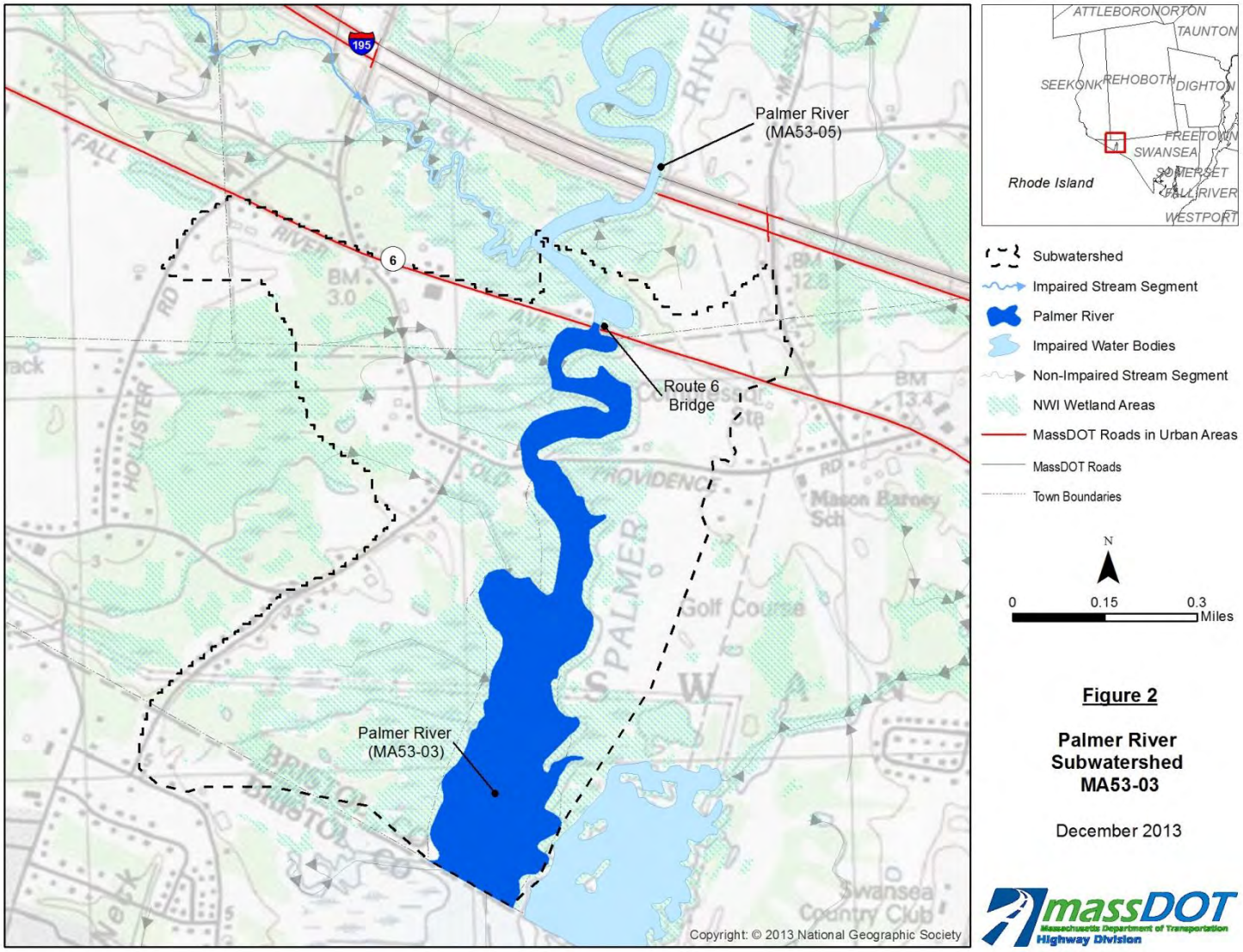

Figure 2

Palmer River Subwatershed MA53-03

December 2013

Impaired Waters Assessment for Palmer River (MA53-05) - Final Report

Impaired Water Body

Name: Palmer River

Location: Rehoboth, MA

Water Body ID: MA53-05

Impairments

Palmer River (MA53-05) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Palmer River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009), Palmer River (MA53-05) is impaired for shellfish harvesting due to total fecal coliform bacteria; however, the source is not identified. The aquatic life use has not been assessed due to limited data being available. Palmer River is covered by the *Final Bacteria TMDL for the Palmer River Basin* (MassDEP, 2004).

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non-bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all of the samples taken during the most recent six

months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The Palmer River is a tributary of Narragansett Bay. The headwaters of the river feed the East and West Branches which converge into the main stem that flows through Shad Factory Pond and continues to the Massachusetts/Rhode Island border. The river then flows into Warren River which discharges to the Narragansett Bay. The main stem of the Palmer River is separated into three segments for the purposes of the final *Massachusetts Year 2012 Integrated List of Waters.* Segment MA53-04 of Palmer River begins at the confluence of the East Branch and West Branch and continues to the Shad Factory Pond dam in Rehoboth MA. Segment MA53-05, which is the subject of this assessment, extends from the Shad Factory Pond dam to the Route 6 Bridge in Rehoboth MA. Segment MA 53-03 of the Palmer River, extends from the Route 6 Bridge in Rehoboth, MA to the state line in Swansea MA/Barrington, RI.

Segment MA53-05 has an area of approximately 0.9 square miles. The total and subwatershed contain a mix of land uses including agricultural, commercial and residential. The Palmer River is considered an important resource for agricultural land uses and aesthetic values for the residential community of Rehoboth MA. Refer to Figure 1 for the total watershed Figure 2 for the subwatershed to Segment MA53-05 of Palmer River.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA53-05 of Palmer River is comprised of portions of Interstate 195 and possibly Route 6. Refer to Figure 2 for the location of these roadways within the subwatershed to Segment MA53-05 of Palmer River.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Bacteria Total Maximum Daily Load (TMDL) for the Palmer River Basin (CN 0182.0)* covers the Massachusetts portion of the Palmer River and its tributaries (Mass DEP, 2004).

The Palmer River watershed has no documented point sources of bacteria pollution but numerous non-point contributions are identified in the TMDL report (Mass DEP, 2004). The overwhelming bacteria source identified in the TMDL report is agricultural runoff, due to livestock contributions. The report states that the findings of water quality sampling "point strongly toward agriculture as the primary source of bacterial pollution in the dry-weather source categories evaluated in the TMDL". Other potential Dry weather sources identified included poorly performing septic systems, wildlife directly contributing fecal matter to the receiving water (versus contributions via stormwater inputs), and livestock. Stormwater runoff, including agricultural runoff, was the primary wet-weather source category evaluated in the TMDL report.

The TMDL report states the following on Page 19 (MassDEP, 2004):

> "several sub-basins in the Palmer River watershed stand out as likely priority areas to address bacteria pollution sources. These sub-basins tend to be located in the southern and western portions of the watershed, where relatively dense residential development is increasing, major roads and highways are present, intensive agriculture is practiced, golf courses and the waterfowl that frequent them are plentiful, and stream channels are less buffered by forested and otherwise vegetated zones than they are in the upper Palmer."

Segment MA53-05 is located within the southern portion of the watershed.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that

> BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable.

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Palmer River TMDL report (Section 8.0, page 27) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Controls for agricultural runoff, such as improved cattle fencing and feeding operations
- Stream bank, riparian wetland, and floodplain restoration in the riparian zone where residential development and roadways are predominant land uses

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

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

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Palmer River bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

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

no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs.

As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways be a contributing source it is unlikely to warrant action relative to other sources of pathogens in the watershed.

References

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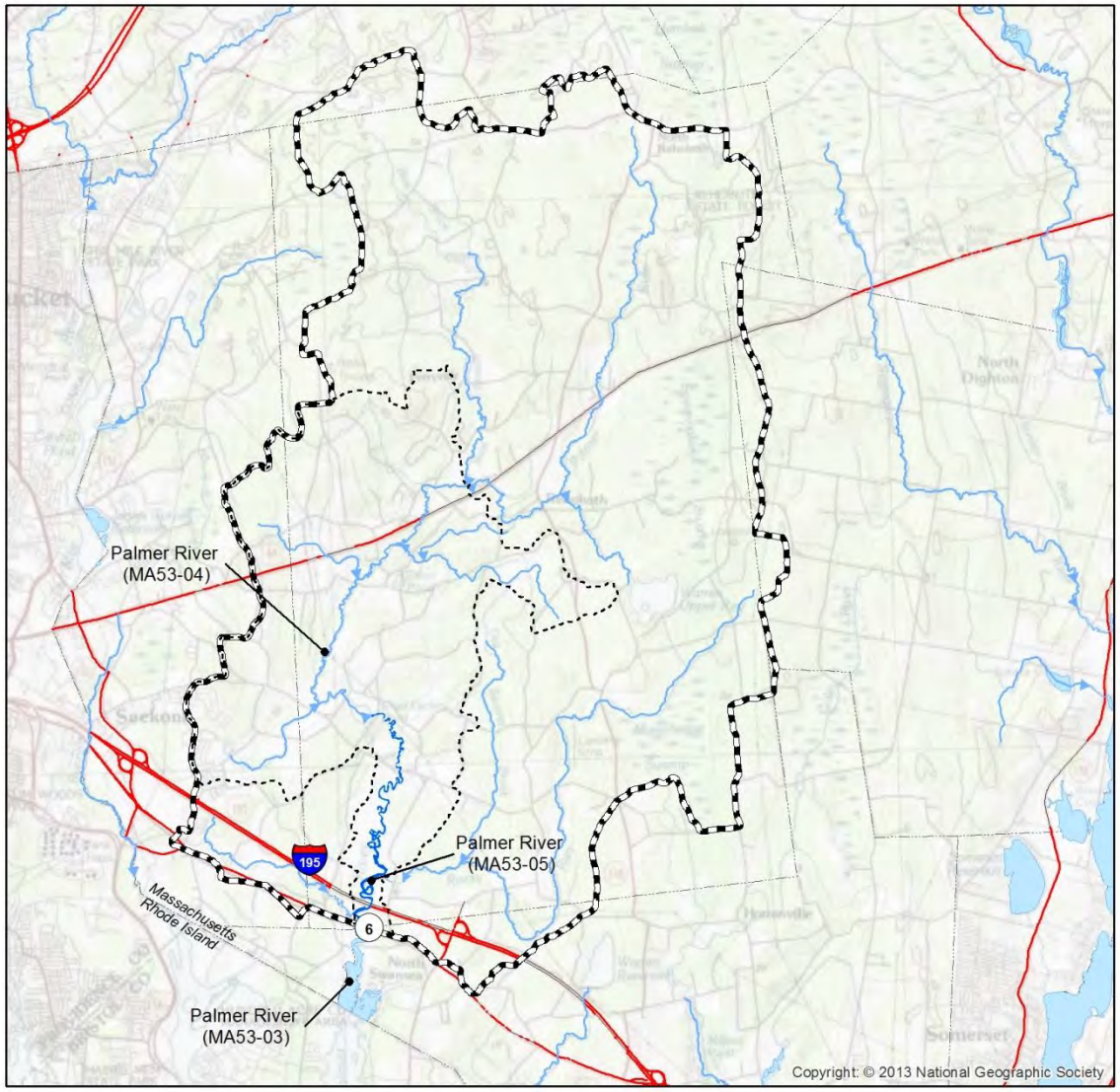
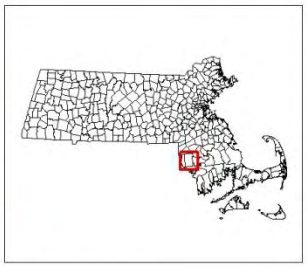




Subwatershed
Total Watershed
Palmer River
Impaired Stream Segment
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

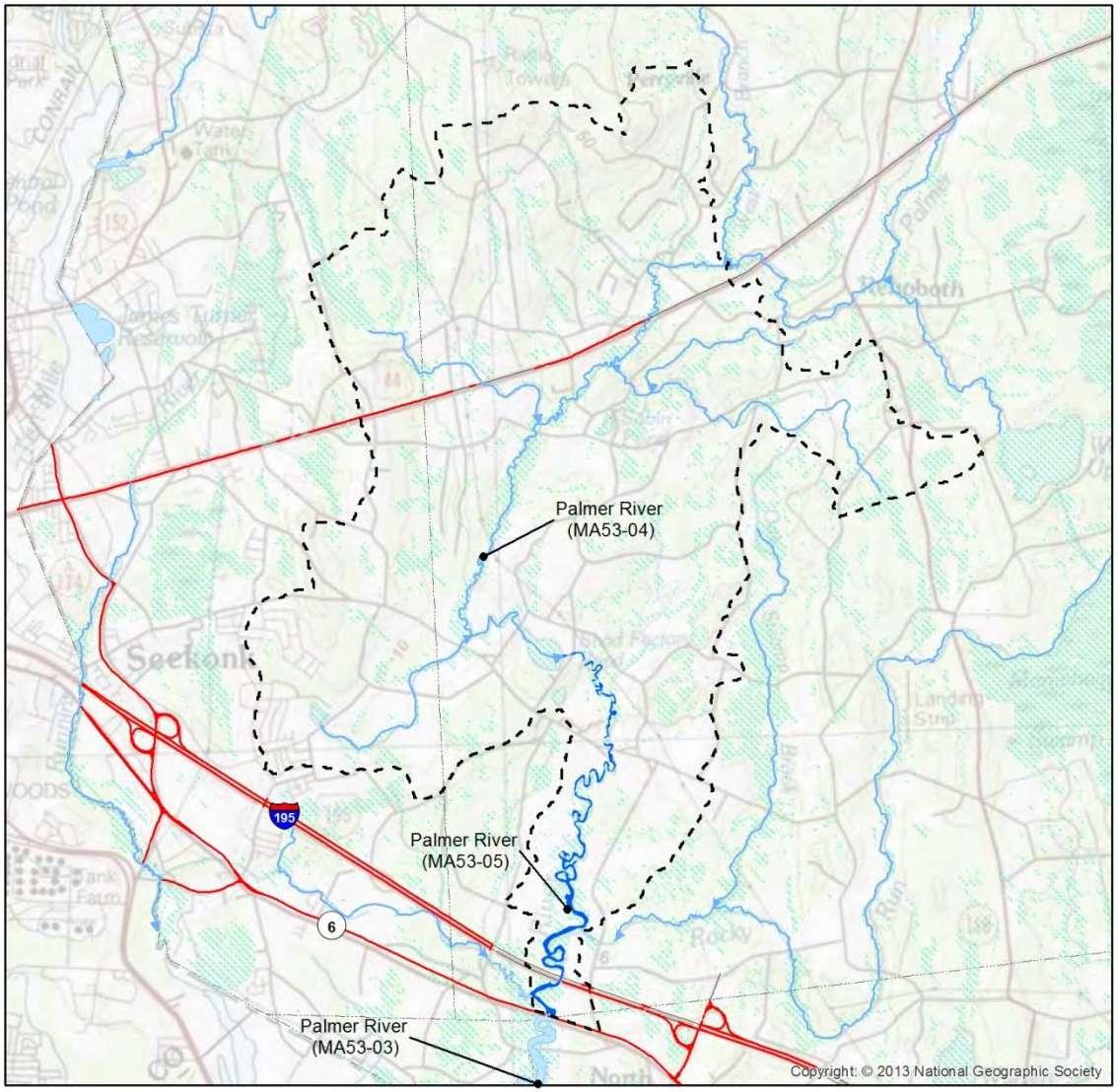
N

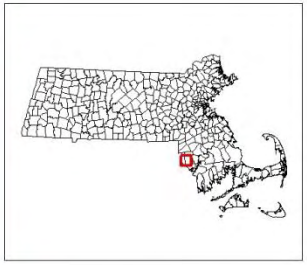
0 0.5 1 2 Miles

Figure 1

Palmer River
Total Watershed
MA53-05

December 2013





Subwatershed
Impaired Stream Segment
Palmer River
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.5 1 Miles

Figure 2

Palmer River Subwatershed MA53-05

December 2013

Impaired Waters Assessment for Rocky Run (MA53-16) - Final Report

Impaired Water Body

Name: Rocky Run

Location: Rehoboth, MA

Water Body ID: MA53-16

Impairments

Rocky Run (MA53-16) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Palmer River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009c), Rocky Run (MA53-16) was not assessed for any designated uses. River Herring and rainbow smelt have been observed within this segment of Rocky Run; however, no significant spawning area exists for either species. The aquatic life use has not been assessed due to limited data being available. Rocky Run is covered by the *Final Bacteria TMDL for the Palmer River Basin* (MassDEP, 2004).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric

mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Rocky Run (MA53-16) is an 8.6 mile long water body extending from its headwaters in a wetland located east of Simmonds Street to approximately 0.1 mile east of Mason Street in Rehoboth MA. Rocky run is located within the Palmer River Basin.

The total and subwatershed for Rocky Run (MA53-16) is primarily open space wetlands and forest with some agricultural fields and small residential developments. Refer to Figure 1 for the total and subwatershed area.

The nearest MassDOT's owned property to Rocky Run (MA53-16) is a portion of Interstate 195 located south of Rocky Run.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been

reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Bacteria Total Maximum Daily Load (TMDL) for the Palmer River Basin (CN 0182.0)* covers the Massachusetts portion of the Palmer River and its tributaries (Mass DEP, 2004).

The Palmer River watershed has no documented point sources of bacteria pollution but numerous non-point contributions are identified in the TMDL report (Mass DEP, 2004). The overwhelming bacteria source identified in the TMDL report is agricultural runoff, due to livestock contributions. The report states that the findings of water quality sampling "point strongly toward agriculture as the primary source of bacterial pollution in the dry-weather source categories evaluated in the TMDL". Other potential dry weather sources identified included poorly performing septic systems, wildlife directly contributing fecal matter to the receiving water (versus contributions via stormwater inputs), and livestock. Stormwater runoff, including agricultural runoff, was the primary wet-weather source category evaluated in the TMDL report

The TMDL report states the following on Page 19 (MassDEP, 2004):

> "several sub-basins in the Palmer River watershed stand out as likely priority areas to address bacteria pollution sources. These sub-basins tend to be located in the southern and western portions of the watershed, where relatively dense residential development is increasing, major roads and highways are present, intensive agriculture is practiced, golf courses and the waterfowl that frequent them are plentiful, and stream channels are less buffered by forested and otherwise vegetated zones than they are in the upper Palmer."

Segment MA53-16 is located within the southern portion of the Palmer River watershed.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Palmer River TMDL report (Section 8.0, page 27) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Controls for agricultural runoff, such as improved cattle fencing and feeding operations
- Stream bank, riparian wetland, and floodplain restoration in the riparian zone where residential development and roadways are predominant land uses

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

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

- Agricultural BMPs
- Septic tank controls

- Documentation of storm drain outfall locations
- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Palmer River bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing

construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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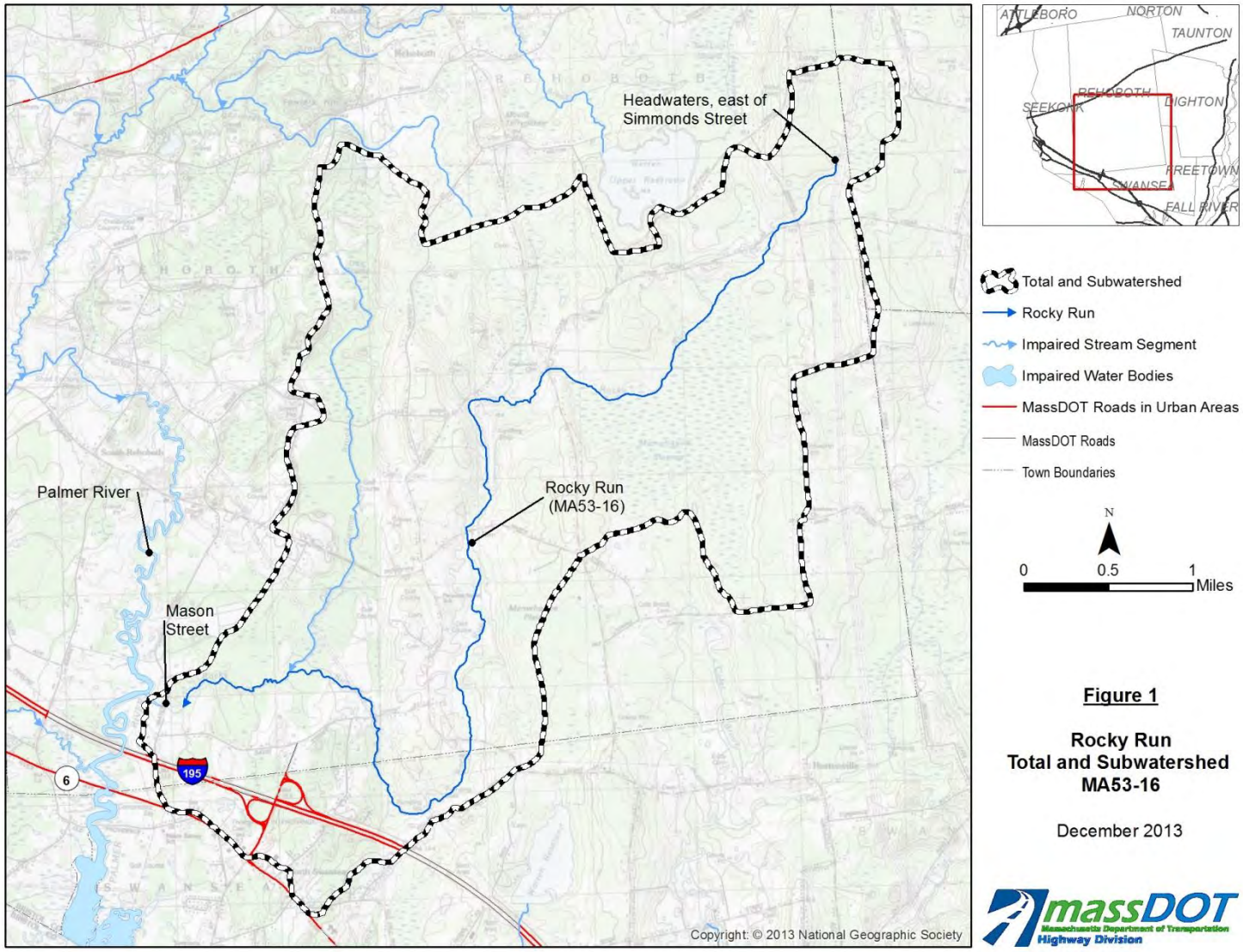

Figure 1

Rocky Run
Total and Subwatershed
MA53-16

December 2013

Impaired Waters Assessment for Kickamuit River (MA61-08) - Final Report

Impaired Water Body

Name: Kickamuit River (also referred to as Kickemuit)

Location: Swansea, MA

Water Body ID: MA61-08

Impairments

Kickamuit River (MA61-08) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Kickamuit River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Narragansett and Mount Hope Bay Watersheds 2004-2008 Water Quality Assessment Report* (MassDEP, 2009c), Kickamuit River (MA61-08) has not been assessed for its designated uses; however, there is an alert status issued for aquatic life. The aquatic life use is not assessed because there is too little data; however, the report states that the alert status is based on impediments to fish caused by the Warren Reservoir Dam. The dam impedes fish passage into Warren reservoir and there is no outflow other than seepage through the dam. The Kickamuit River is covered by the Fecal coliform TMDL described in the report titled the *Fecal Coliform and Total Phosphorus TMDLs for Kickemuit Reservoir, Rhode Island (RI0007034L-01), Upper Kickemuit River (RI 0007037R-01) and Kickemuit River (MA61-08_2004) (RIDEM 2006)*.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b.for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010:

the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Kickamuit River (MA61-08) extends approximately 2.8 miles from the Outlet of Warren Reservoir to the Massachusetts/Rhode Island state border in Swansea, Massachusetts. The Kickamuit (or Kickemuit) River continues to flow into Rhode Island and includes the Lower Kickemuit Reservoir and a tributary referred to in this document as the Upper Kickemuit River or western tributary, in the Town of Warren.

The watershed for the entire stretch of the Kickemuit River (including areas within Rhode Island) is comprised principally of forest (42.4% of its area), with significant areas of residential (16.0% medium to medium high density and 6.6% medium to low density) and agricultural (16.5%) use. Approximately 80 percent of the local watershed is located in Swansea and Rehoboth, Massachusetts, and 20 percent is located in Warren, Rhode Island. The total and subwatershed for Segment MA61-08 of the Kickamuit River is shown in Figure 1.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA61-08 of Kickamuit River is comprised of portions of Interstate 195 and Route 6. Refer to Figure 1 for the location of these roadways within the subwatershed to Segment MA61-08 of Kickamuit River.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The Fecal Coliform and Total Phosphorus TMDLs for Kickemuit Reservoir, Rhode Island (RI0007034L-01), Upper Kickemuit River (RI 0007037R-01) and Kickemuit River (MA61-08_2004) report prepared by the Rhode Island Department of Environmental Management (RIDEM) identifies the fecal coliform TMDL for the Massachusetts portion of the Kickamuit River and its tributaries (RIDEM, 2006).

The TMDL report states the following on Page 18 (RIDEM, 2006):

> "The Kickemuit Reservoir, the Kickemuit River and the numerous tributaries are affected by a variety of pollution sources. Non-point and point sources of pollution include stormwater runoff from disturbed or eroding watersheds that carry sediments, phosphorus and bacteria from developed and agricultural lands within the watershed. Residential and commercial areas contribute bacteria, phosphorus, and sediment loads to the river through overland flow during and after rainstorms. The loads originate from septic systems, particularly failing systems that break out onto the surface, lawn fertilizers, pet waste, and wildlife. Failing septic systems in residential and commercial areas may also contribute bacteria and phosphorus to the river and tributaries through groundwater"

Monitoring conducted along the segment of Kickamuit River (MA61-08) was split into two reaches. One reach was determined to have sources of both bacteria and phosphorus from wildlife that inhabit the open and wetland areas that border this reach of the river, and stormwater runoff from adjacent roadways. The other reach received bacteria and phosphorous from stormwater runoff, failing septic systems, wildlife, and agricultural land use activities in close proximity to the stream where adequate riparian buffers are lacking. This segment (MA61-08) of the Kickemuit River is directly adjacent to a large un-sewered residential development that has a history of septic system problems and failures.

In addition, the TMDL indicates that "The primary sources of fecal coliform in the Kickemuit watershed are nonpoint in nature and because nonpoint source loadings, especially bacteria loadings, are inherently difficult to quantify with any certainty . . ."implicit assumptions for the bacteria margin of safety were used (RIDEM 2006).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, this TMDL establishes bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts as well as the Kickamuit TMDL recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable.

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the TMDL report (Section 5.0, page 40) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Upgrading failing septic systems upon land transfer
- Controls for agricultural runoff, such as proper control and disposal of manure, restrict livestock access to streams, streambank stabilization and establishment of vegetated buffers along stream banks

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

The following implementation recommendations are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Kickamuit River:

- Stormwater Management, including development of a SWMP identifying the six minimum control measures mandated in the Phase II stormwater program and the measurable goals that may be used to gauge the success of the program.
- Future Development and redevelopment
- Proper Wastewater Treatment
- Agricultural BMPs
- Educational Programs on Pollution Prevention and good Housekeeping Practices
- Water Quality Enhancement

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations in regard to pathogens. In accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Kickamuit bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, MassDOT has a comprehensive Stormwater Management Plan (SWMP) which outlines BMPs that MassDOT has or will implement to comply with the six Minimum Control Measures (MCMs),and includes measurable milestones as well as an implementation schedule. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be

installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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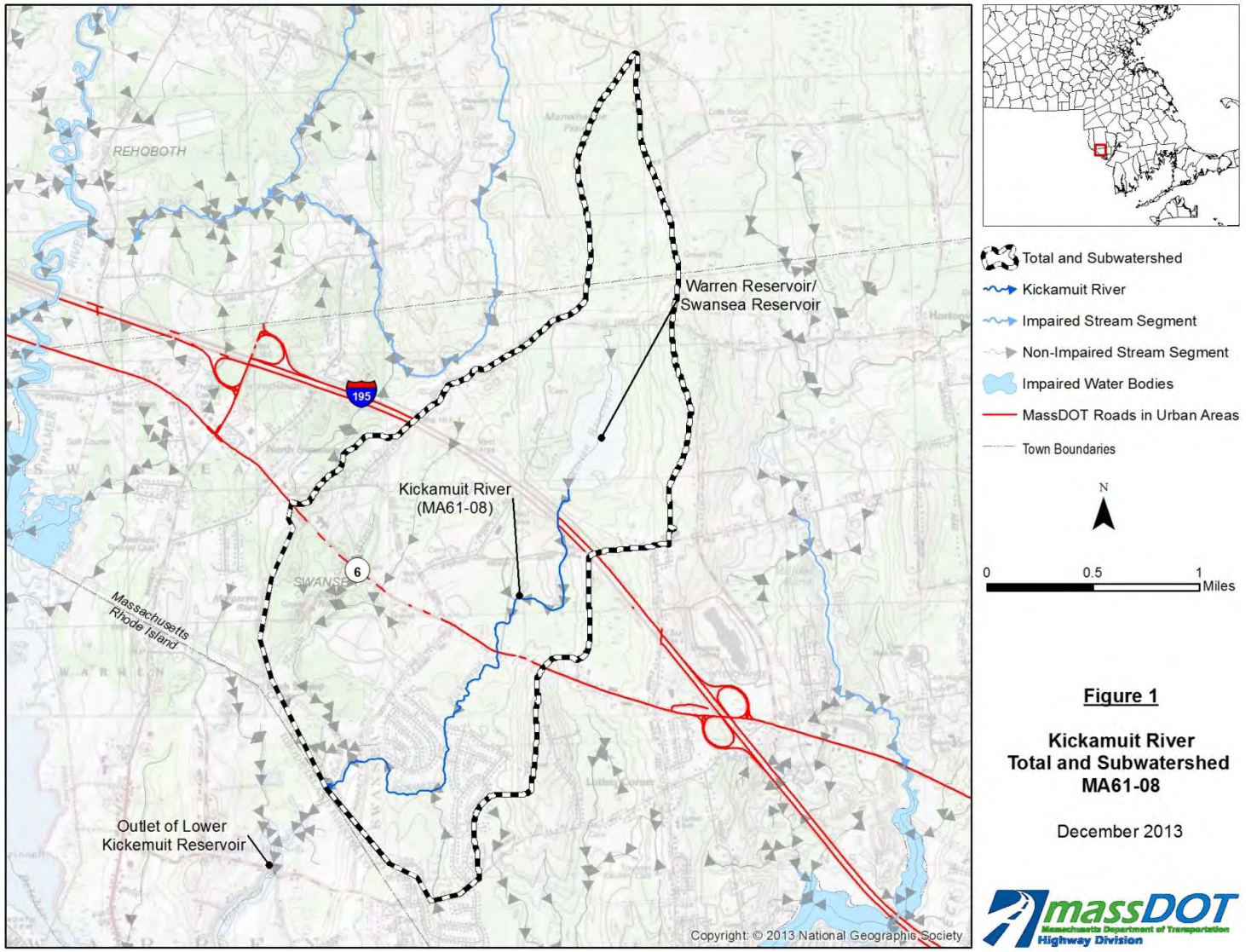

Total and Subwatershed
Kickamuit River
Impaired Stream Segment
Non-Impaired Stream Segment
Impaired Water Bodies
MassDOT Roads in Urban Areas
Town Boundaries

N

0 0.5 1 Miles

Figure 1

Kickamuit River
Total and Subwatershed
MA61-08

December 2013

Impaired Waters Assessment for Assonet River (MA62-20) - Final Report

Impaired Water Body

Name: Assonet River

Location: Freetown, MA

Water Body ID: MA62-20

Impairments

Assonet River (MA62-20) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Assonet River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2001), Assonet River (MA62-20) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Assonet River is covered by the *Final Pathogen TMDL for the Taunton River Watershed* (MassDEP, 2011).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 314 CMR 4.05 (4)(a) 4 Bacteria.
  - a. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed a geometric mean of 35 enterococci colonies per 100 ml. In non-bathing beach waters and bathing beach waters during the non-bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all samples taken within the most

recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The Assonet River subwatershed is part of the Taunton River Watershed and is comprised of several segments leading into the Taunton River main stem. The Cedar Swamp River originates in Cedar Swamp in, Lakeville and flows through an extensive wetland area. After it is joined by an unnamed tributary that also originates in Cedar Swamp, Cedar Swamp River flows west, becoming the inlet to Forge Pond, at which point the waterway becomes the Assonet River. The freshwater portion of the Assonet River flows though Lakeville and Freetown. The lower Assonet forms a broad estuarine finger of the Taunton River. The Assonet River is the last major tributary to empty into the Taunton Estuary.

The subject of this assessment is Assonet River Segment MA62-20. This 0.82 square mile class SA segment extends from the Tisdale Dam (north of Route 79/Elm Street Intersection) in Freetown to the confluence with the Taunton River in Freetown. In the 2001 WQA report this segment was listed as impaired for Shellfish Harvesting Use based on the DMF prohibited classification. This portion of the Assonet River has been placed on the Massachusetts Year 2002 Integrated List of Waters – Category 5 as not meeting Water Quality Standards for pathogens. The DMF Shellfish Status Report of 2003 indicates that shellfish harvesting is prohibited in all growing areas of the lower Assonet River (Segment MA62-20).

The land use is dominated by forest with over 70% in that category. Residential land use is less than 15% followed by open space. Approximately 413 acres of land which are classified in the Land-Use theme as cranberry bogs are present in the Assonet River Subwatershed, and it is estimated that water use for this area is 3.6 MGD. Impervious area is less than 10% indicating there is a low potential for adverse water quality impacts from impervious surface water runoff. The Town Line Farm is the only facility authorized under the WMA for a surface water withdrawal of 0.03 MGD. There are no NPDES permitted discharges in this subwatershed. The communities of Lakeville, Freetown, Berkley, and Fall River are Phase II stormwater communities and each community was granted coverage under the stormwater general permit for Massachusetts from EPA and MassDEP in 2003/2004; therefore these communities are authorized to discharge stormwater from their municipal drainage systems.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA62-20 of Assonet River is comprised of portions of Route 24. Refer to Figure 2 for the location of these roadways within the subwatershed to Segment MA62-20 of Assonet River.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on

this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the Taunton River Watershed (CN 0256.0)* applies to the 20 pathogen impaired segments of the Taunton River watershed that are currently listed on the CWA 303(d) Integrated List of impaired waters.

Numerous point and non-point sources of fecal contamination have been identified in the Taunton River Watershed. Sources of indicator bacteria in the Taunton River watershed were found to be many and varied. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational activities, wildlife including birds, and inadequately treated boat wastes. Wet weather sources include wildlife and domesticated animals, stormwater runoff including municipal separate storm sewer systems (MS4), combined sewer overflows (CSOs), and sanitary sewer overflows (SSOs). Most of the bacteria sources are believed to be stormwater related.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

The TMDL states on page 17 that 100% of the total estuary area assessed is impaired. Several of the Taunton River Segments are prioritized and will require additional bacterial source tracking work and implementation of structural and non-structural Best Management Practices (BMP's). In total, there are 20 pathogen impaired segments (12 river and 8 estuary), that contain indicator bacteria concentrations in excess of the Massachusetts water quality standards. The majority of the priority areas are located near downtown Taunton, MA where there are relatively dense residential developments and nearby major roads and highways including Route 44 and Route 24.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)

- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In

- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Pathogen TMDL for this impaired water body segment, that the BMPs outlined in the stormwater management are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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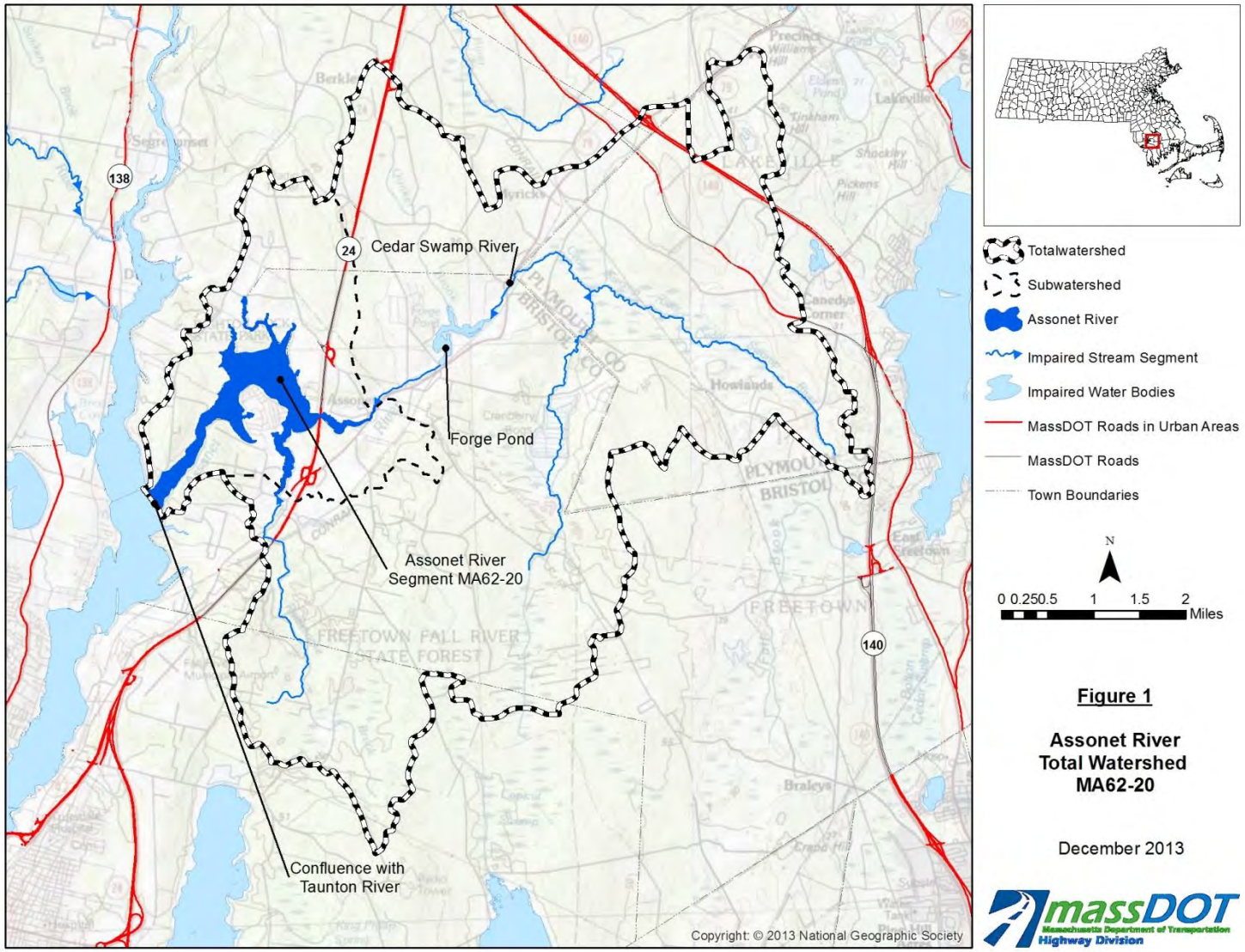

Figure 1

Assonet River
Total Watershed
MA62-20

December 2013

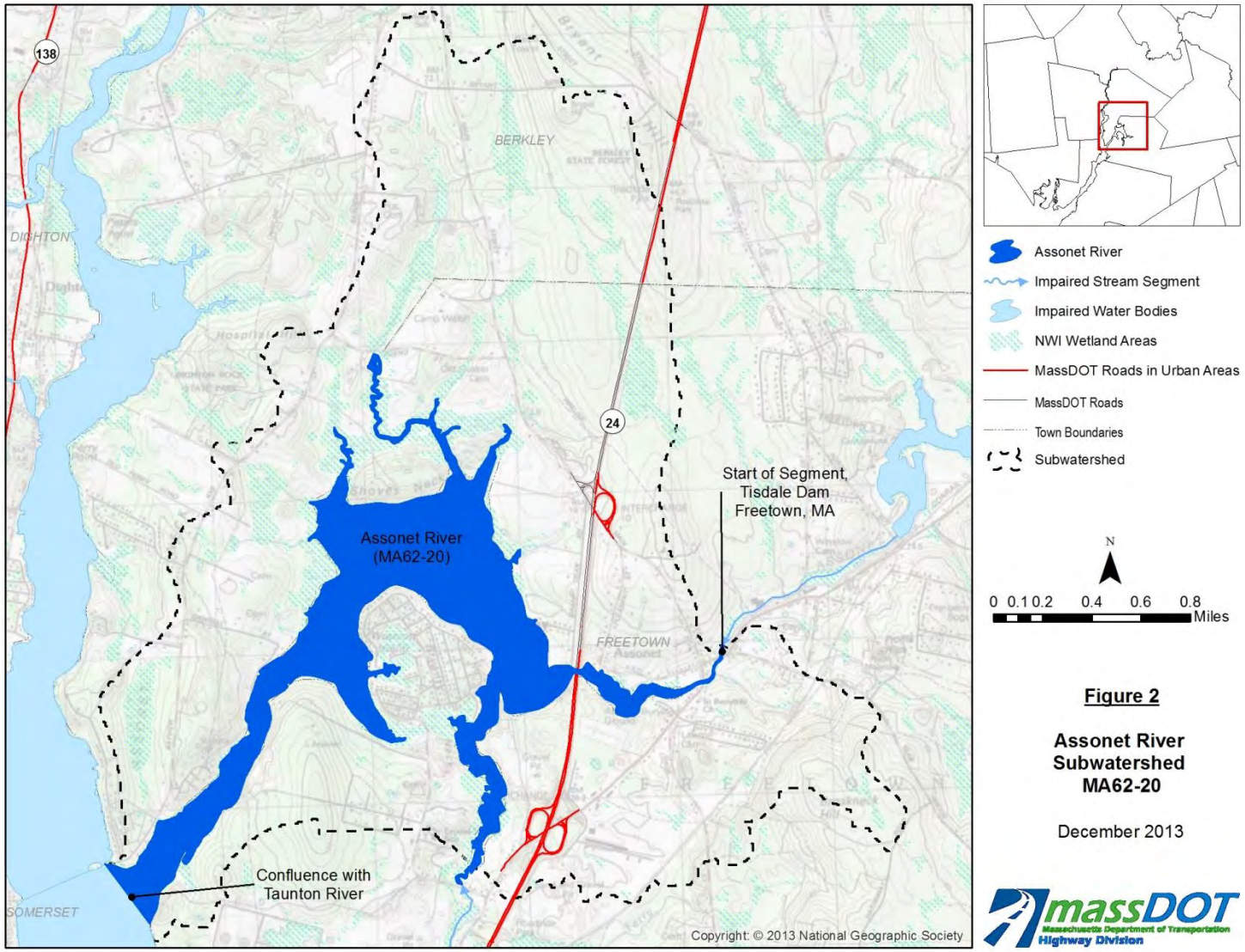

Figure 2

Assonet River Subwatershed MA62-20

December 2013

Impaired Waters Assessment for Meadow Brook (MA62-38) - Final Report

Impaired Water Body

Name: Meadow Brook

Location: Whitman and East Bridgewater, MA

Water Body ID: MA62-38

Impairments

Meadow Brook (MA62-38) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Meadow Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2001), Meadow Brook (MA62-38) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Meadow Brook is covered by the *Final Pathogen TMDL for the Taunton River Watershed* (MassDEP, 2011).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3) (b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. For other waters and, during the non-bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not

exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Meadow Brook (Segment MA62-38) is part of the Matfield River Subwatershed which is part of the Taunton River Watershed. The Matfield River and its tributaries drain 77 square miles of the northeast portion of the Taunton River Watershed. This subwatershed contains some of the most densely developed areas of the state (MassDEP, 2001).

This 6.0 mile class B river segment extends from the headwaters north of Pine Street in Whitman through Forge Pond (see Figure 2) and East Bridgewater to the confluence with the Matfield River in East Bridgewater. Meadow brook has a drainage area of about 7.5 square miles. Land use is mostly forest with over 45% in that category. Residential use is second most common land use, representing over 32% of the drainage area. The impervious cover area for this subwatershed is 11.5% (MassDEP, 2001). Equity Industrial GHEB Limited Partnership (MA004103) was authorized to discharge process wastewater and treated sanitary waste to this segment, but since March of 1999, waste is collected in an 18,000-gallon tank and treated offsite. The permit was terminated by EPA 5/17/2006. The communities of East Bridgewater (MAR041109) and Whitman (MAR04071) have general permit coverage under the U.S. EPA/DEP MS4 permit. There are eleven facilities permitted under the WMA authorized to withdraw a total of 10.56 MGD surface and groundwater; seven of these are municipal water supply sources. Water use for the 1008 acres of cranberry bog in this subwatershed is estimated at 17.74 MGD (MassDEP, 2001).

MassDOT's property with the potential to directly contribute stormwater runoff to Meadow Brook Segment MA62-38 is comprised of portions of Route 18 and Route 27. Route 123 is also located within the subwatershed, although it is over a half mile from the impaired segment. Refer to Figure 2 for the location of these roadways within the Matfield River Subwatershed.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead,

MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the Taunton River Watershed (CN 0256.0)* applies to the 20 pathogen impaired segments of the Taunton River watershed that are currently listed on the CWA 303(d) Integrated List of impaired waters.

Numerous point and non-point sources of fecal contamination have been identified in the Taunton River Watershed. Sources of indicator bacteria in the Taunton River watershed were found to be many and varied. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational activities, wildlife including birds, and inadequately treated boat wastes. Wet weather sources include wildlife and domesticated animals, stormwater runoff including municipal separate storm sewer systems (MS4), combined sewer overflows (CSOs), and sanitary sewer overflows (SSOs). Most of the bacteria sources are believed to be stormwater related.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

The TMDL states on page 17 that 100% of the total estuary area assessed is impaired. Several of the Taunton River Segments are prioritized and will require additional bacterial source tracking work and implementation of structural and non-structural Best Management Practices (BMP's). In total, there are 20 pathogen impaired segments (12 river and 8 estuary), that contain indicator bacteria concentrations in excess of the Massachusetts water quality standards. The majority of the priority areas are located near downtown Taunton, MA where there are relatively dense residential developments and nearby major roads and highways including Route 44 and Route 24.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not

> include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the sub-watershed of this water body. At rest stops that have been identified as being within sub-watersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the sub-watershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Pathogen TMDL for this impaired water body segment, that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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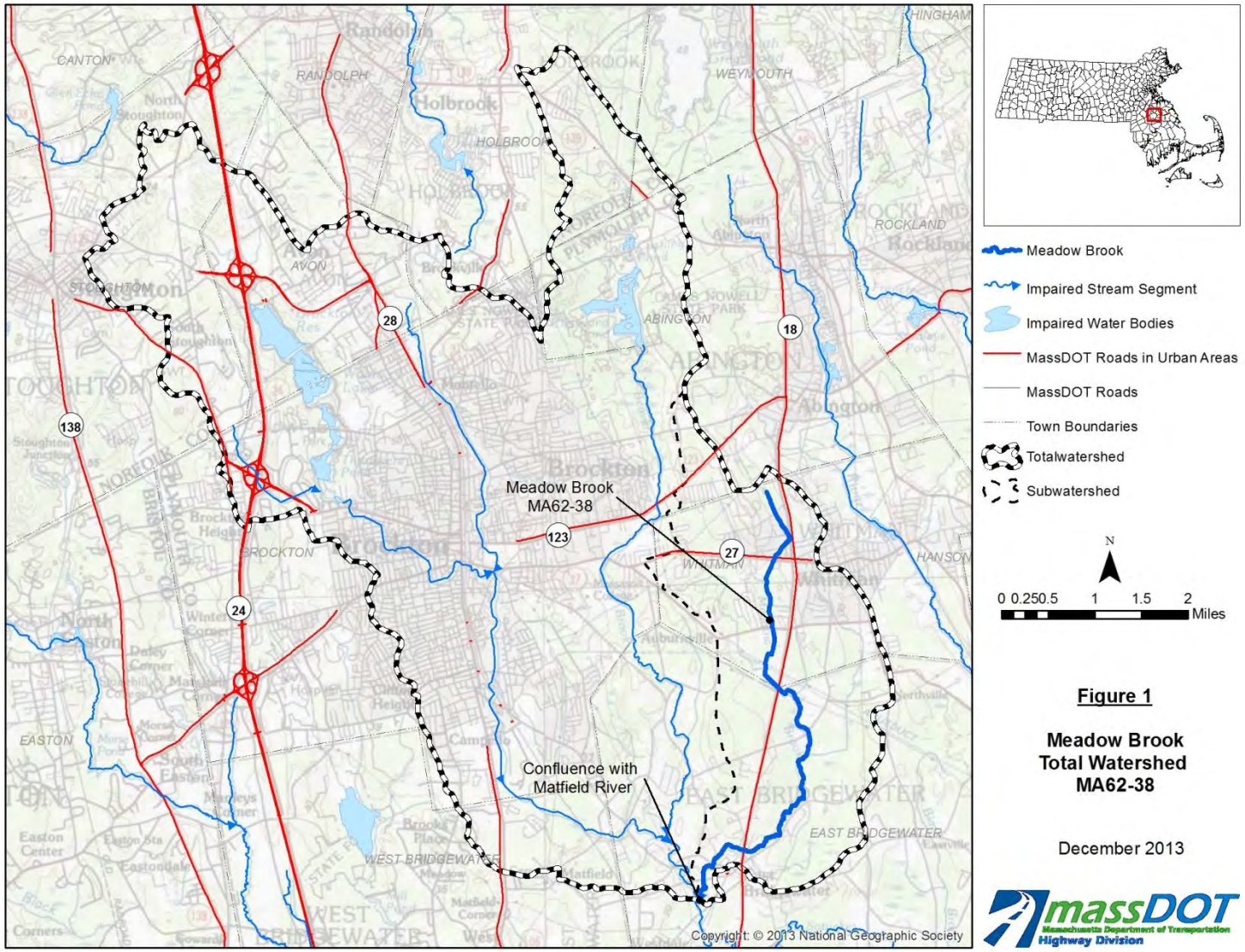
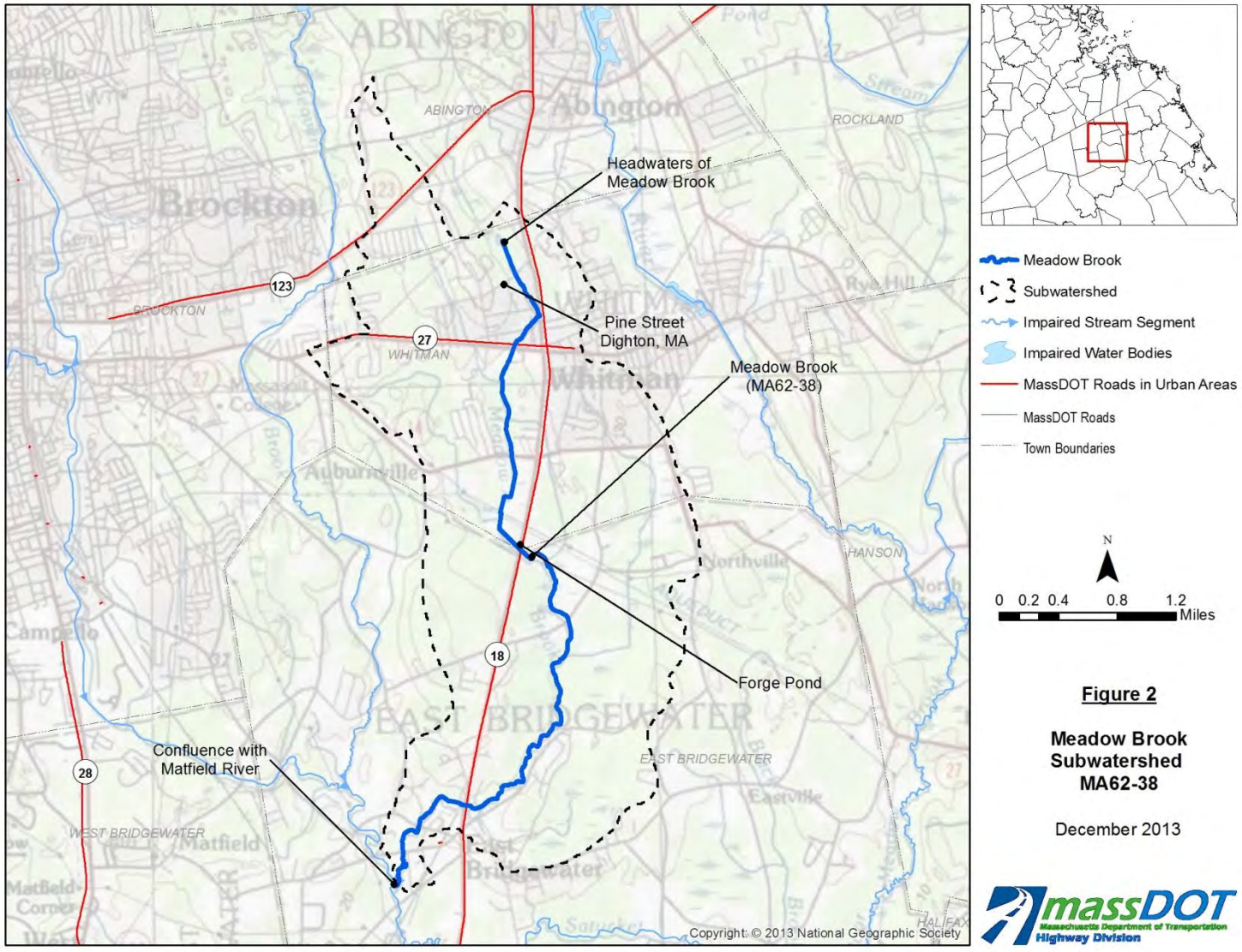


Figure 1

Meadow Brook
Total Watershed
MA62-38

December 2013



Meadow Brook
Subwatershed
Impaired Stream Segment
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.2 0.4 0.8 1.2
Miles

Figure 2

Meadow Brook Subwatershed MA62-38

December 2013

Impaired Waters Assessment for Broad Cove (MA62-50) - Final Report

Impaired Water Body

Name: Broad Cove

Location: Dighton and Somerset, MA

Water Body ID: MA62-50

Impairments

Broad Cove (MA62-50) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Broad Cove is impaired for the following:

- Fecal Coliform

According to MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2001), Broad Cove (MA62-50) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Broad Cove is covered by the *Final Pathogen TMDL for the Taunton River Watershed* (MassDEP, 2011).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 314 CMR 4.05 (4) (a) 4 Bacteria.
  - a. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed a geometric mean of 35 enterococci colonies per 100 ml. In non-bathing beach waters and bathing beach waters during the non-bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all samples taken within the most

recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Broad Cove Segment MA62-50 of the Taunton River Watershed is a small body of water located in Dighton and Somerset that feeds directly into the Taunton River northeast of the Somerset Reservoir and near Pleasant Street in Dighton, MA. This 0.13 square mile Class SA segment has a drainage area of approximately 1.1 square miles. Some of the highest amounts of agricultural land in the Taunton River Watershed are found in the Broad Cove drainage area. Land use for drainage area associated with this segment is estimated at just under 40% Forest with more than 18% agriculture and approximately 17% residential. The impervious cover area for this subwatershed is less than 10%, meaning there is a low potential for adverse water quality impacts from direct surface runoff (MassDEP, 2001).

The community of Somerset has general permit coverage under U.S. EPA/Mass DEP MS4 permit. Because of elevated fecal coliform concentrations in Broad Cove, the DMF shellfish growing area classification as of September 2009 was prohibited, and thus the shellfish use is assessed as impaired. This segment is considered to be a high priority bacteria impaired segment due to its proximity to a sensitive use segment. Broad Cove was formerly reported as Segment MA62022.

MassDOT's properties with the potential to directly contribute stormwater runoff to Broad Cove Segment MA62-50 include portions of Route 138. Refer to Figure 1 for the location of roadways within the Broad Cove Subwatershed.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the Taunton River Watershed (CN 0256.0)* applies to the 20 pathogen impaired segments of the Taunton River watershed that are currently listed on the CWA 303(d) Integrated List of impaired waters.

Numerous point and non-point sources of fecal contamination have been identified in the Taunton River Watershed. Sources of indicator bacteria in the Taunton River watershed were found to be many and varied. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational activities, wildlife including birds, and inadequately treated boat wastes. Wet weather sources include wildlife and domesticated animals, stormwater runoff including municipal separate storm sewer systems (MS4), combined sewer overflows (CSOs), and sanitary sewer overflows (SSOs). Most of the bacteria sources are believed to be stormwater related.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

The TMDL states on page 17 that 100% of the total estuary area assessed were impaired. Several of the Taunton River Segments are prioritized and will require additional bacterial source tracking work and implementation of structural and non-structural Best Management Practices (BMP's). In total, there are 20 pathogen impaired segments (12 river and 8 estuary), that contain indicator bacteria concentrations in excess of the Massachusetts water quality standards. The majority of the priority areas are located near downtown Taunton, MA where there are relatively dense residential developments and nearby major roads and highways including Route 44 and Route 24.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not

> include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Pathogen TMDL for this impaired water body segment, that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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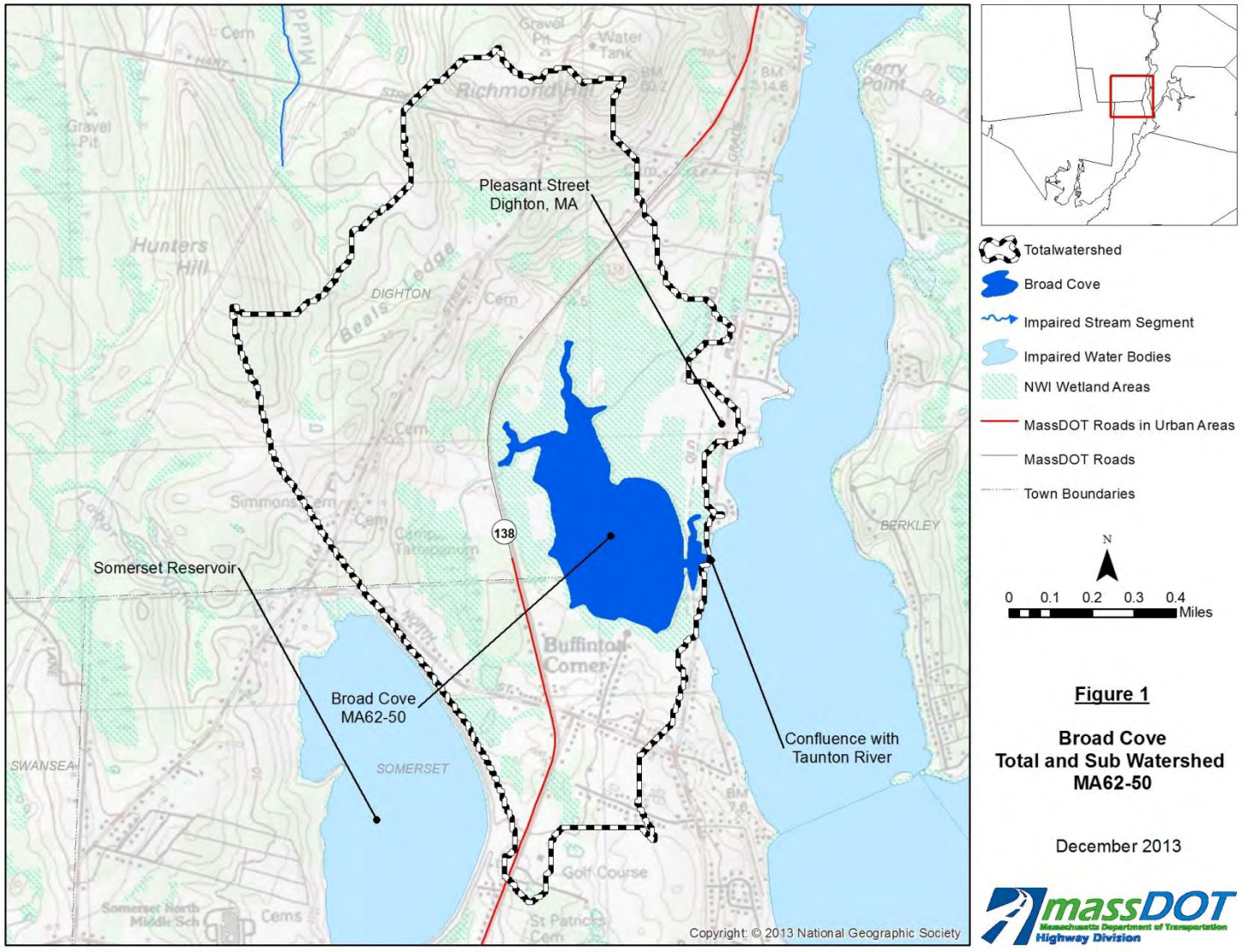

Figure 1

Broad Cove
Total and Sub Watershed
MA62-50

December 2013

Impaired Waters Assessment for Muddy Brook Cove (MA62-51) - Final Report

Impaired Water Body

Name: Muddy Brook Cove

Location: Dighton, MA

Water Body ID: MA62-51

Impairments

Muddy Brook Cove (MA62-51) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Muddy Brook Cove is impaired for the following:

- Fecal Coliform

According to MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2001), Muddy Brook Cove (MA62-51) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Muddy Brook Cove is covered by the *Final Pathogen TMDL for the Taunton River Watershed* (MassDEP, 2011).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 314 CMR 4.05 (4) (a) 4 Bacteria.
  - a. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed a geometric mean of 35 enterococci colonies per 100 ml. In non-bathing beach waters and bathing beach waters during the non-bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all samples taken within the most

recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Muddy Cove Brook is part of the Taunton River Watershed. This tributary to the Taunton River consists of two segments. Segment MA62-52 starts near Main Street in Dighton and flows east to Muddy Cove Pond. Muddy Cove Brook then continues to the east to its confluence with the Taunton River near pleasant street in Dighton. Segment MA62-51 begins at the outfall of Muddy Cove Pond, and is the subject of this assessment.

This 0.01 square mile Class SA segment MA62-51 extends from the outlet of a small impoundment behind 333 Main Street, Dighton, to the confluence of the Taunton River in Dighton. Zeneca, Inc., a facility that manufactured textile dyestuff, historically discharged treated wastewater to this segment of Muddy Cove Brook under a multi-sector general stormwater permit, but in 1992 the discharge was moved to the Taunton River Segment MA62-03, and subsequently ceased altogether due to the decommissioning of the facility in 1995 (MassDEP, 2001). The community of Dighton has general permit coverage under the U.S. EPA/Mass DEP MS4 permit for stormwater discharges. The DMF shellfish harvesting classification is prohibited in this water body. In the 2001 WQA report this segment was listed as impaired for Shellfish Harvesting Use based on the DMF prohibited classification. DMF staff indicates that the prohibition was due to elevated bacteria counts (MassDEP, 2011).

Land use in the subwatershed is primarily forest, with almost 70% coverage, followed by 12.5% agriculture and less than 9% residential. The impervious cover area for this subwatershed is less than 10%, meaning there is a low potential for adverse water quality impacts from direct surface runoff.

MassDOT's properties with the potential to directly contribute stormwater runoff to Muddy Brook Cove Segment MA62-51 include portions of Route 138. Refer to Figure 1 for the location of these roadways within the Muddy Brook Cove Total and Subwatersheds.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban

areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent

on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the Taunton River Watershed (CN 0256.0)* applies to the 20 pathogen impaired segments of the Taunton River watershed that are currently listed on the CWA 303(d) Integrated List of impaired waters.

Numerous point and non-point sources of fecal contamination have been identified in the Taunton River Watershed. Sources of indicator bacteria in the Taunton River watershed were found to be many and varied. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational activities, wildlife including birds, and inadequately treated boat wastes. Wet weather sources include wildlife and domesticated animals, stormwater runoff including municipal separate storm sewer systems (MS4), combined sewer overflows (CSOs), and sanitary sewer overflows (SSOs). Most of the bacteria sources are believed to be stormwater related.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

The TMDL states on page 17 that 100% of the total estuary area assessed is impaired. Several of the Taunton River Segments are prioritized and will require additional bacterial source tracking work and implementation of structural and non-structural Best Management Practices (BMP's). In total, there are 20 pathogen impaired segments (12 river and 8 estuary), that contain indicator bacteria concentrations in excess of the Massachusetts water quality standards. The majority of the priority areas are located near downtown Taunton, MA where there are relatively dense residential developments and nearby major roads and highways including Route 44 and Route 24.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program

- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Pathogen TMDL for this impaired water body segment, that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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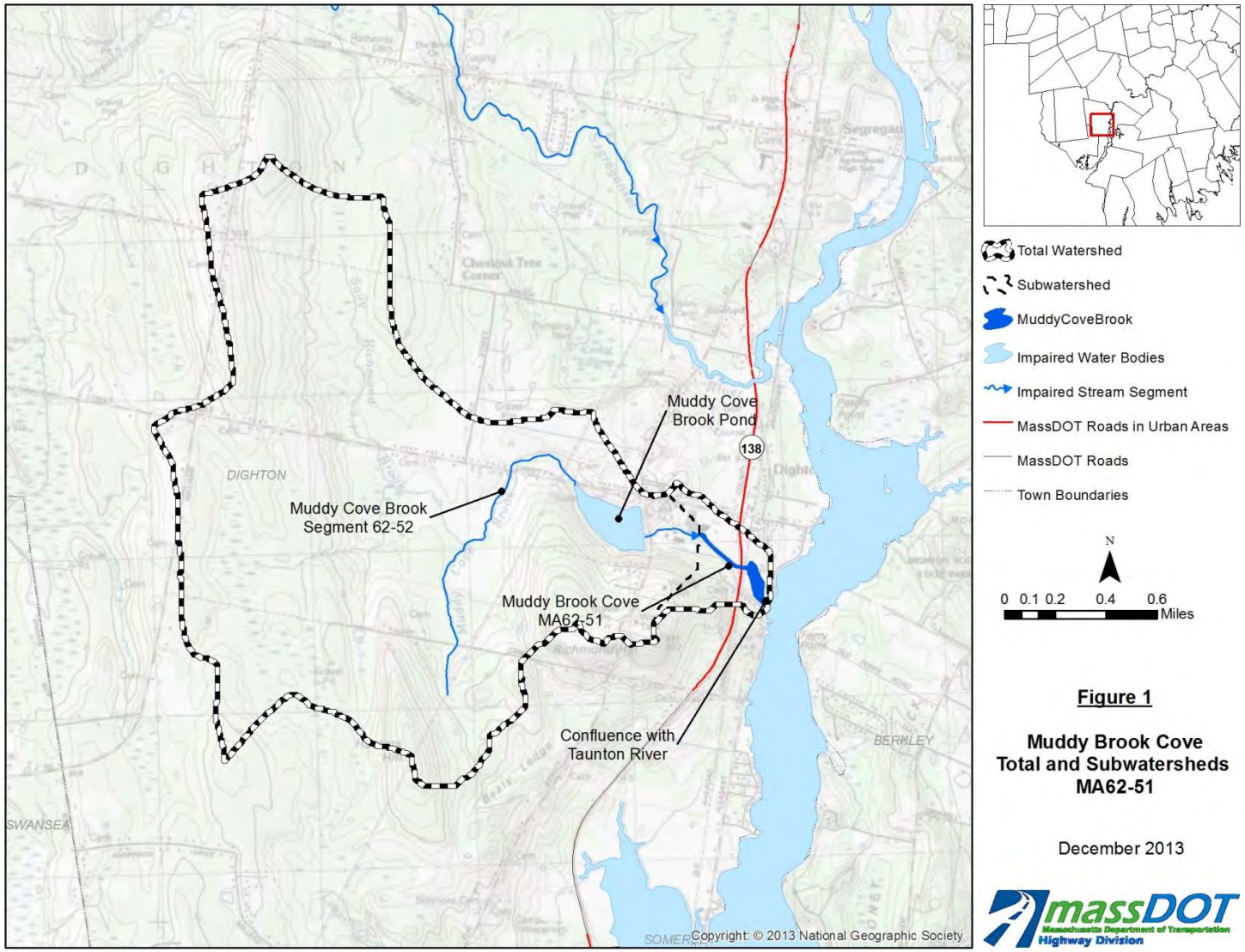

Figure 1

Muddy Brook Cove Total and Subwatersheds MA62-51

December 2013

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Segreganset River (MA62-55) - Final Report

Impaired Water Body

Name: Segreganset River

Location: Dighton, MA

Water Body ID: MA62-55

Impairments

Segreganset River (MA62-55) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Segreganset River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2001), Segreganset River (MA62-55) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Segreganset River is covered by the *Final Pathogen TMDL for the Taunton River Watershed* (MassDEP, 2011).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 314 CMR 4.05 (4) (a) 4 Bacteria.
  - a. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed a geometric mean of 35 enterococci colonies per 100 ml. In non-bathing beach waters and bathing beach waters during the non-bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all samples taken within the most

recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The Segreganset River is part of the Taunton River Watershed and is comprised of three segments. Segment MA62-53 starts in the wetland north of Glebe Street in Taunton, and continues through the Segreganset River Ponds to the Segreganset River Dam in Dighton. Segment MA62-54 starts at the Segreganset River Dam and continues 0.4 miles until approximately 250 north of Brook Street in Dighton. The subject of this assessment is Segreganset River segment MA62-55. This 0.02 square mile Class SA segment extends from approximately 250 feet north of Brook Street in Dighton to the confluence with the Taunton River in Dighton.

The drainage area of this segment is approximately 14.8 square miles. The Land use in the watershed is mostly forest at over 70%. Residential is the second largest land use at almost 14% and agriculture is third with under 7%. The impervious cover area for this subwatershed is less than 10%, meaning there is a low potential for adverse water quality impacts from direct surface runoff (MassDEP, 2001).

There are no NPDES discharges along this segment of the Segreganset River; however, the community of Dighton has general permit coverage under the U.S EPA/Mass DEP MS4 permit. DMF shellfish growing area classification as of September 2009 is prohibited. In the 2001 WQA report this segment was listed as impaired for Shellfish Harvesting Use based on the DMF prohibited classification due to elevated bacteria counts. Segment MA62-55 is considered a high priority segment due to its proximity to sensitive use segment (MassDEP, 2011).

MassDOT's properties with the potential to directly contribute stormwater runoff to Segreganset River Segment MA62-55 include portions of Route 138. Refer to Figure 2 for the location of these roadways within the Segreganset River Subwatershed.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead,

MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the Taunton River Watershed (CN 0256.0)* applies to the 20 pathogen impaired segments of the Taunton River watershed that are currently listed on the CWA 303(d) Integrated List of impaired waters.

Numerous point and non-point sources of fecal contamination have been identified in the Taunton River Watershed. Sources of indicator bacteria in the Taunton River watershed were found to be many and varied. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational activities, wildlife including birds, and inadequately treated boat wastes. Wet weather sources include wildlife and domesticated animals, stormwater runoff including municipal separate storm sewer systems (MS4), combined sewer overflows (CSOs), and sanitary sewer overflows (SSOs). Most of the bacteria sources are believed to be stormwater related.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

The TMDL states on page 17 that 100% of the total estuary area assessed is impaired. Several of the Taunton River Segments are prioritized and will require additional bacterial source tracking work and implementation of structural and non-structural Best Management Practices (BMP's). In total, there are 20 pathogen impaired segments (12 river and 8 estuary), that contain indicator bacteria concentrations in excess of the Massachusetts water quality standards. The majority of the priority areas are located near downtown Taunton, MA where there are relatively dense residential developments and nearby major roads and highways including Route 44 and Route 24.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The

MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System

- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Pathogen TMDL for this impaired water body segment, that the BMPs outlined in the stormwater management plan and those under consideration for reducing effective IC from MassDOT areas are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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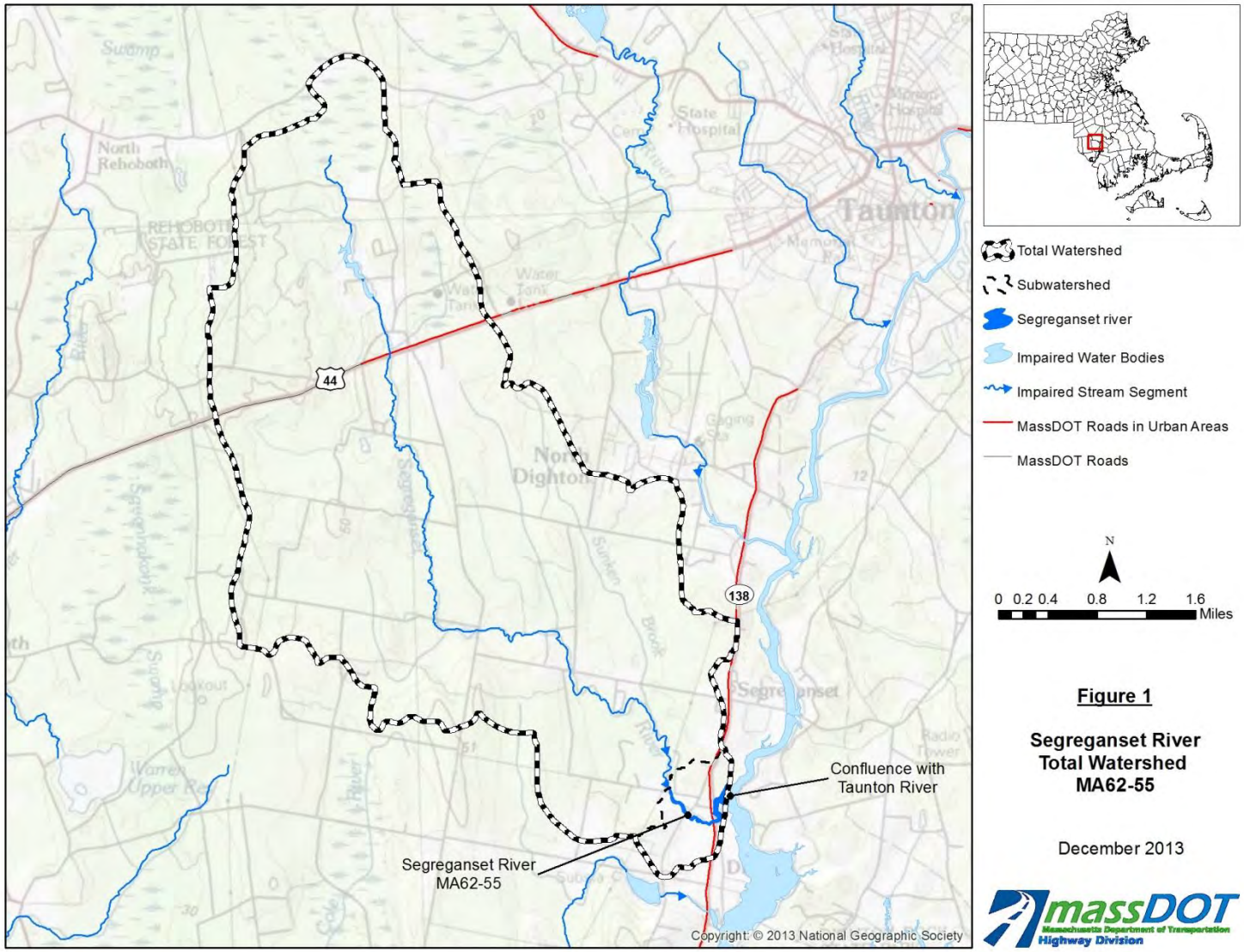
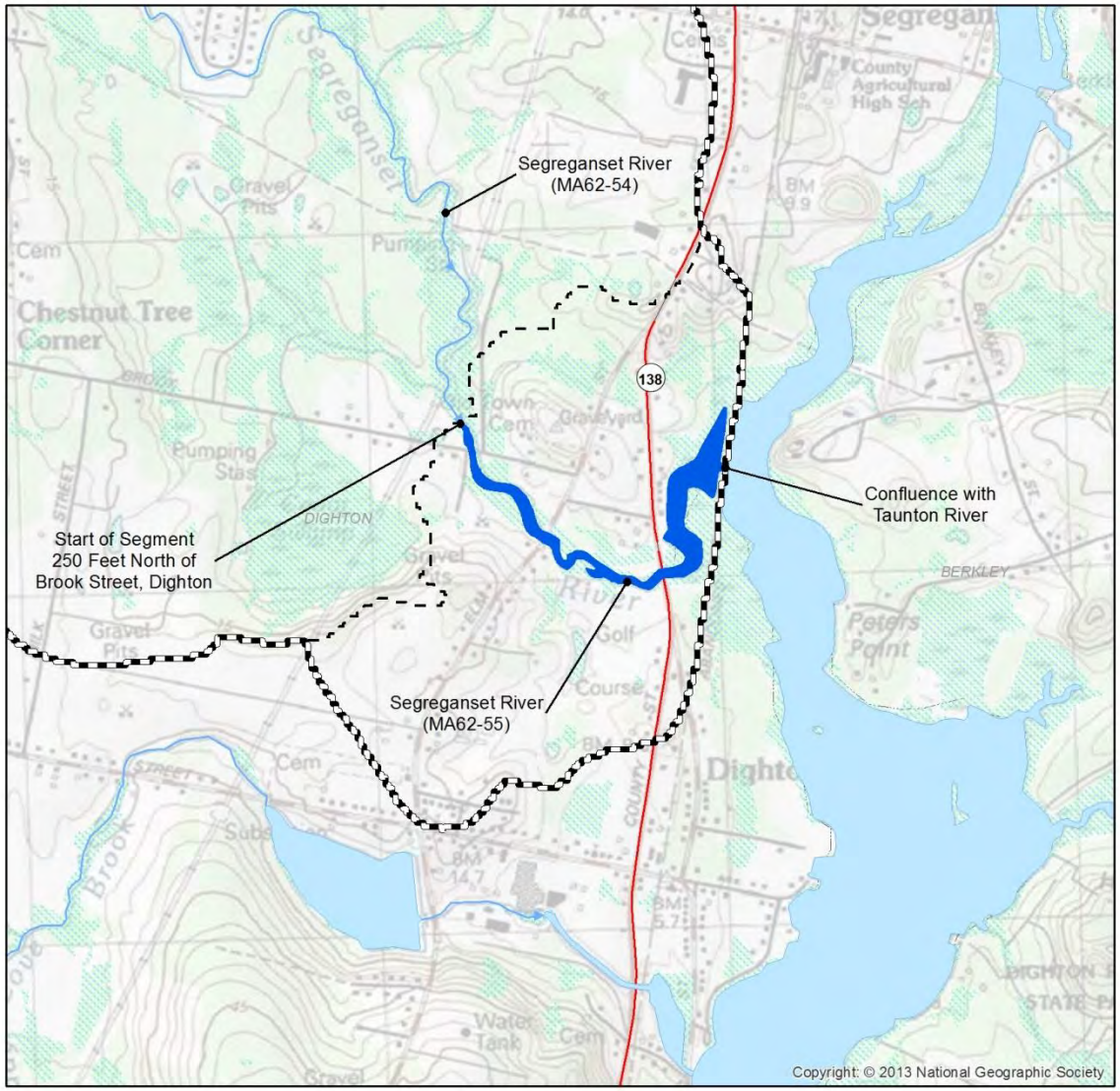
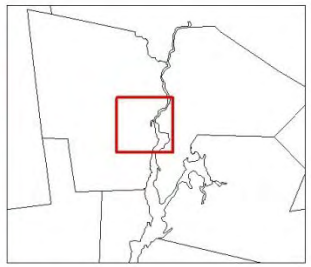


Figure 1

Segreganset River Total Watershed MA62-55

December 2013





Total Watershed
subwatershed
Segreganset_River
Impaired Water Bodies
Impaired Stream Segment
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.050.1 0.2 0.3 0.4 Miles

Figure 2

Segreganset River Subwatershed MA62-55

December 2013

Impaired Waters Assessment for Threemile River (MA62-56) - Final Report

Impaired Water Body

Name: Threemile River

Location: Dighton, MA

Water Body ID: MA62-56

Impairments

Threemile River (MA62-56) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Threemile River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2001), Threemile River (MA62-56) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Threemile River is covered by the *Final Pathogen TMDL for the Taunton River Watershed* (MassDEP, 2011).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non-bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not

exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Threemile River is a tributary to the Taunton River and is located in the Taunton River Watershed. Threemile River segment MA62-56, which is the subject of this assessment, begins at the confluence of Wading and Rumford rivers in Norton, and ends 12.8 miles downstream at the Harodite Industries facility near 66 South Street in Taunton. Segment MA62-57 of Threemile River continues from the outfall at Harodite Industries to the confluence with Taunton River Segment MA62-02. Both of these Threemile River segments were formerly part of Segment MA62-16 (see Figure 1).

This 12.8 mile class B warm water fishery extends from the confluence of the Wading and Rumford rivers, Norton to the impoundment spillway behind 66 South Street (Harodite Finishing) in Taunton (MassDEP, 2011). Approximately 100 acres of cranberry bogs are farmed in this subwatershed. There are three individual NPDES permitted discharges to this segment. In addition, the communities of Norton and Taunton have general permit coverage under U.S.EPA/Mass DEP MS4 permit. In 2003, the town of Dighton received funding from the Clean Water SRF to identify areas of the community where existing on-site sewage disposal systems are inadequate for wastewater disposal, and to develop recommendations for wastewater management to protect groundwater and surface waters including the Threemile River (MassDEP, 2001).

The drainage area of this segment is approximately 84.4 square miles. The Land use in the watershed is mostly forest at over 53%. There is significant residential land, and it is the second largest land use at over 24%. There is also more than 7% of open land in the subwatershed. The impervious cover area for this subwatershed is 10.5% (MassDEP, 2001).

MassDOT's properties with the potential to directly contribute stormwater runoff to Threemile River Segment MA62-56 include portions of Route 44 and Route 140. Refer to Figure 2 for the location of these roadways within the Threemile River Subwatershed.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban

areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent

on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the Taunton River Watershed (CN 0256.0)* applies to the 20 pathogen impaired segments of the Taunton River watershed that are currently listed on the CWA 303(d) Integrated List of impaired waters.

Numerous point and non-point sources of fecal contamination have been identified in the Taunton River Watershed. Sources of indicator bacteria in the Taunton River watershed were found to be many and varied. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational activities, wildlife including birds, and inadequately treated boat wastes. Wet weather sources include wildlife and domesticated animals, stormwater runoff including municipal separate storm sewer systems (MS4), combined sewer overflows (CSOs), and sanitary sewer overflows (SSOs). Most of the bacteria sources are believed to be stormwater related.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

The TMDL states on page 17 that 100% of the total estuary area assessed is impaired. Several of the Taunton River Segments are prioritized and will require additional bacterial source tracking work and implementation of structural and non-structural Best Management Practices (BMP's). In total, there are 20 pathogen impaired segments (12 river and 8 estuary), that contain indicator bacteria concentrations in excess of the Massachusetts water quality standards. The majority of the priority areas are located near downtown Taunton, MA where there are relatively dense residential developments and nearby major roads and highways including Route 44 and Route 24.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The

MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System

- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Pathogen TMDL for this impaired water body segment, that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

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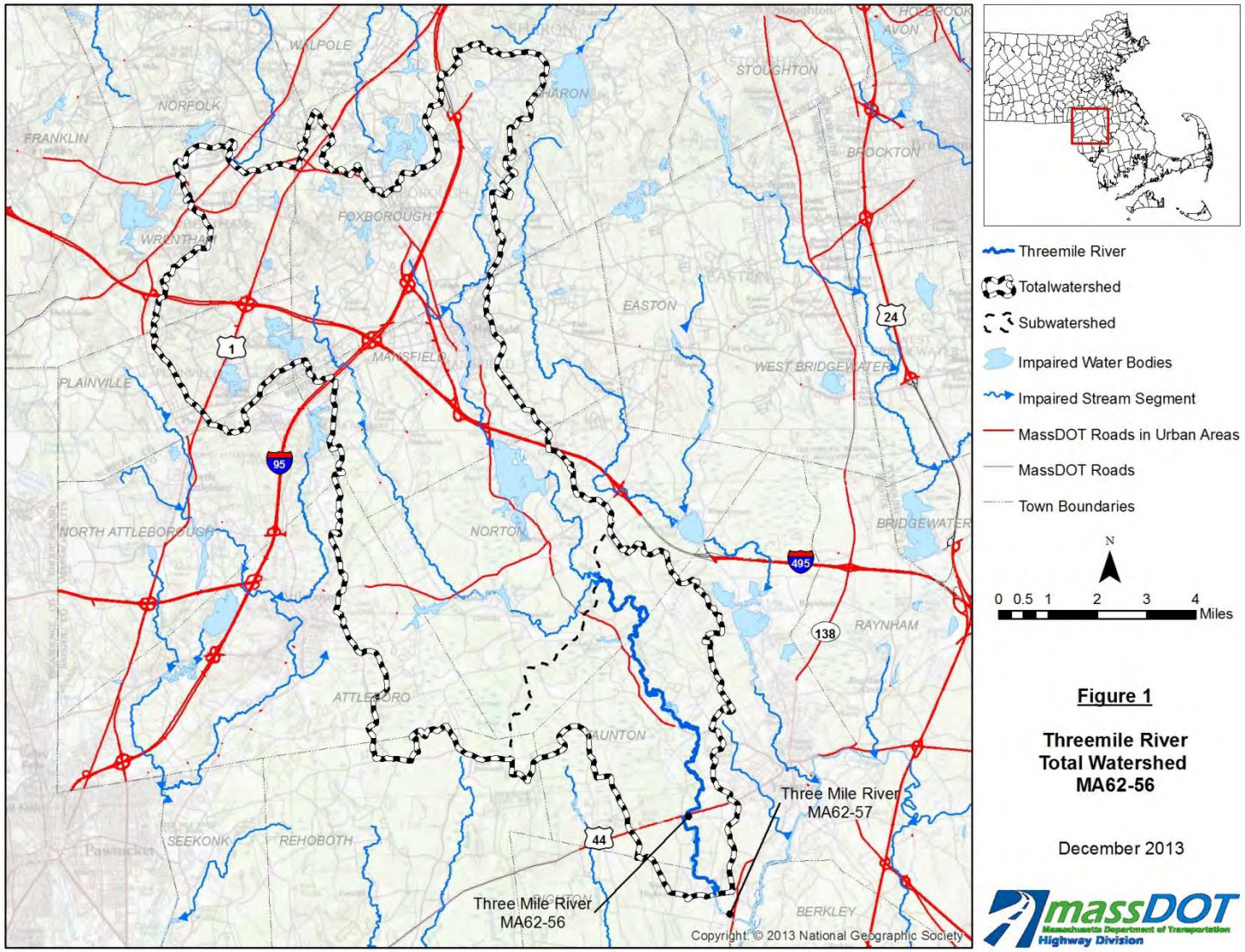


Threemile River
Totalwatershed
Subwatershed
Impaired Water Bodies
Impaired Stream Segment
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

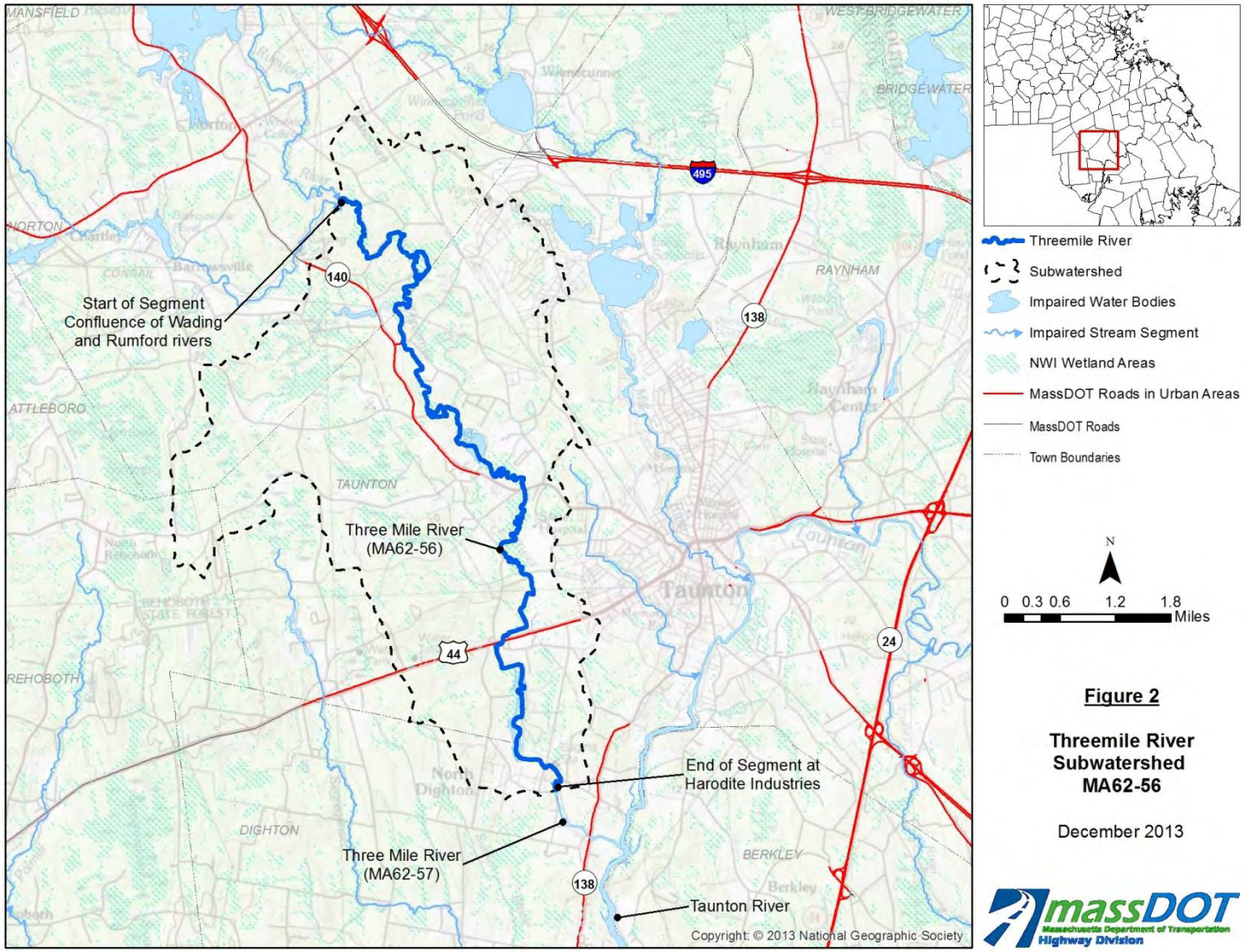
0 0.5 1 2 3 4 Miles

Figure 1

Threemile River Total Watershed MA62-56

December 2013

massDOT Massachusetts Department of Transportation Highway Division



Threemile River
Subwatershed
Impaired Water Bodies
Impaired Stream Segment
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.3 0.6 1.2 1.8 Miles

Figure 2

Threemile River Subwatershed MA62-56

December 2013

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Threemile River (MA62-57) - Final Report

Impaired Water Body

Name: Threemile River

Location: Dighton, MA

Water Body ID: MA62-57

Impairments

Threemile River (MA62-57) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Threemile River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2001), Threemile River (MA62-57) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Threemile River is covered by the *Final Pathogen TMDL for the Taunton River Watershed* (MassDEP, 2011).

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non-bathing beach waters and bathing beach waters during the non-bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all of the samples taken during the most recent six

months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Threemile River is a tributary to the Taunton River and is located in the Taunton River Watershed. Threemile River segment MA62-56 begins at the confluence of Wading and Rumford rivers in Norton, and ends 12.8 miles downstream at the Harodite Industries facility near 66 South Street in Taunton. Segment MA62-57 of Threemile River, which is the subject of this assessment, continues from the outfall at Harodite Industries to the confluence with Taunton River Segment MA62-02.

This 0.02 square mile Class SB segment extends from the impoundment spillway behind 66 South Street in Taunton to the confluence with Taunton River. This section of the river was previously part of segment MA62-16. Approximately 100 acres of cranberry bog are located entirely within the subwatershed for this segment. The communities of Norton and Taunton have general permit coverage under U.S. EPA/MassDEP MS4 permit. DMF shellfish growing areas status as of September 30, 2009 is prohibited (MassDEP, 2011).

The drainage area of this segment is approximately 85.1 square miles. The Land use in the watershed is mostly forest at over 53% forest. There is significant residential land and it is the second largest land use at over 24%. There is also more than 7% of open land in the subwatershed. The impervious cover area for this subwatershed is less than 10%, meaning there is a low potential for adverse water quality impacts from direct surface runoff.

MassDOT's properties with the potential to directly contribute stormwater runoff to Threemile River Segment MA62-57 include portions of Route 138. Refer to Figure 2 for the location of these roadways within the Threemile River Subwatershed.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
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The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

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TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
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- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not

> include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
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- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Pathogen TMDL for this impaired water body segment, that the BMPs outlined in the stormwater management plan and those under consideration for reducing effective IC from MassDOT areas are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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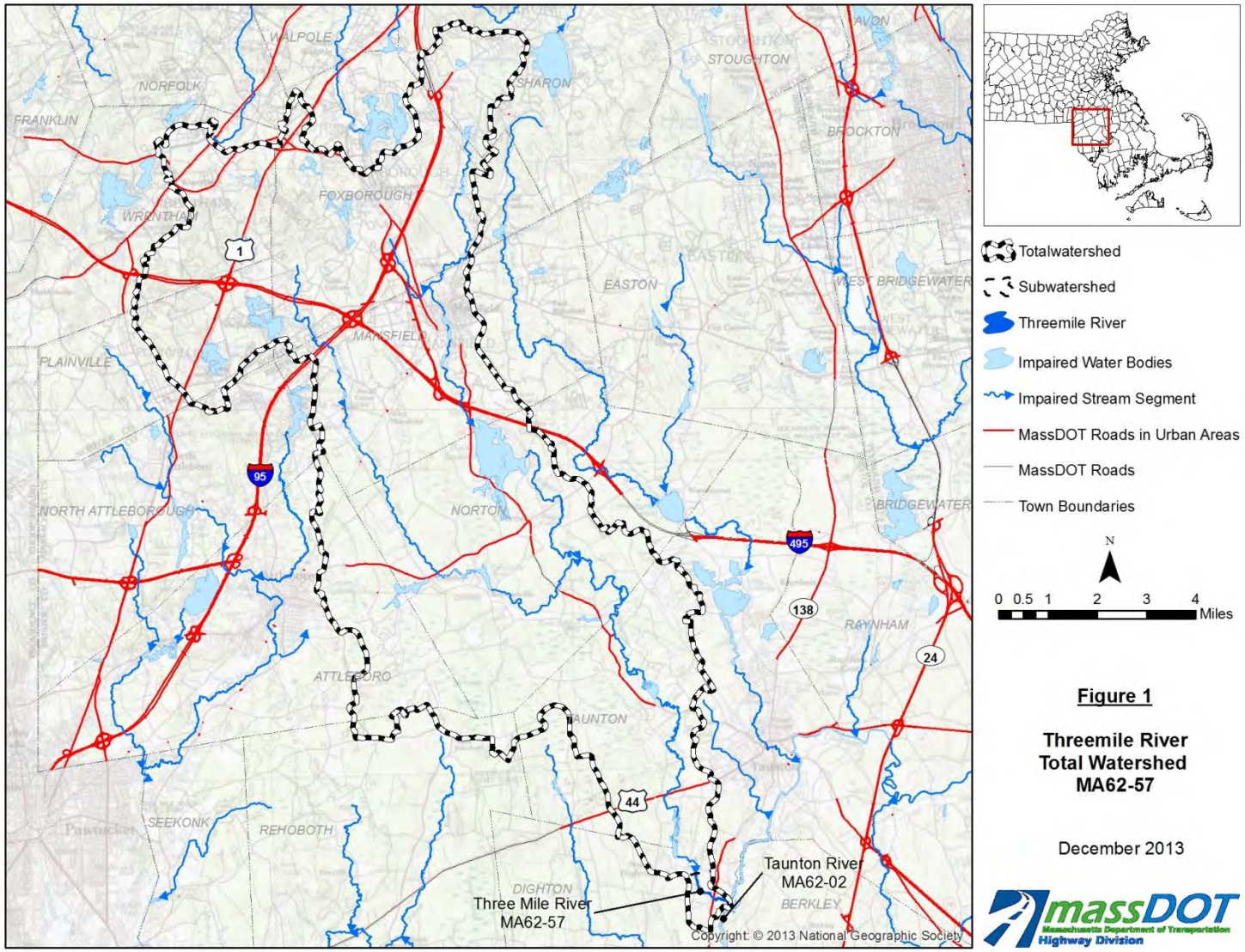

Totalwatershed
Subwatershed
Threemile River
Impaired Water Bodies
Impaired Stream Segment
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.5 1 2 3 4 Miles

Figure 1

Threemile River Total Watershed MA62-57

December 2013

massDOT Massachusetts Department of Transportation Highway Division

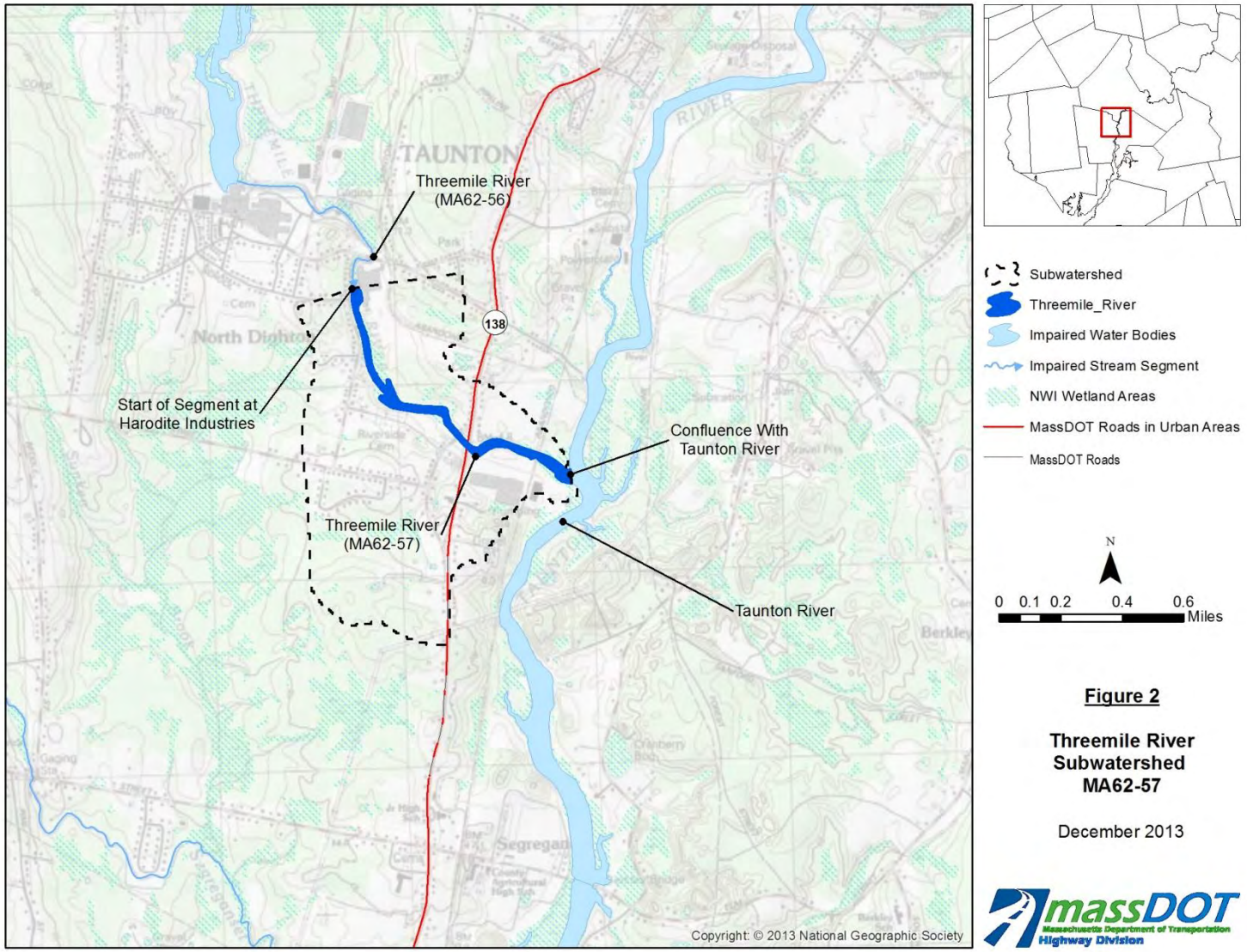

Figure 2

Threemile River Subwatershed MA62-57

December 2013

Impaired Waters Assessment for Mill Creek (MA71-08) – Final Report

Impaired Water Body

Name: Mill Creek

Location: Chelsea and Revere, MA

Water Body ID: MA71-08

Impairments

Mill Creek (MA71-08) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). The causes for the Mill Creek impairments are listed as:

- Fecal Coliform

According to MassDEP's *Mystic River Watershed and Coastal Drainage Area 2004-2008 Water Quality Assessment Report* (MassDEP, 2010), Mill Creek is impaired for the following designated uses: fish consumption, shellfishing, primary contact recreation, and secondary contact recreation. Aquatic life use and aesthetics have not been assessed.

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 314 CMR 4.05 (4)(a) 4 Bacteria.

  a. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));

  b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed a geometric mean of 35 enterococci colonies per 100 ml. In non-bathing beach waters and bathing beach waters during the non-bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all samples taken within the most recent six months typically

based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Mill Creek (MA71-08) is the headwater tributary to Chelsea River (MA71-06) and flows from Route 1 east-southeast to a railroad bridge on the Chelsea/Revere boundary (Figure 1). This water body is approximately 0.02 square miles and is situated in a highly urbanized and industrialized area.

The Mill Creek (MA71-08) watershed is approximately 920 acres and includes densely developed residential and industrial land uses. The city of Chelsea has approximately eight stormwater outfalls that discharge to Mill Creek, according to their existing sewer system map (Weston & Sampson, no date).

MassDOT's property with the potential to contribute stormwater runoff to Mill Creek (MA71-08) is comprised of approximately a 1.8 mile segment of Route 1 and a 0.4 mile segment of Route 1A (Figure 1).

Assessment of Impairments under BMP 7U

MassDOT assessed the pathogen impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been

reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water

quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)

- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review

- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the sub-watershed of this water body. At rest stops that have been identified as being within sub-watersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the sub-watershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable, and although there is potential for stormwater runoff from DOT roadways to be a contributing source, it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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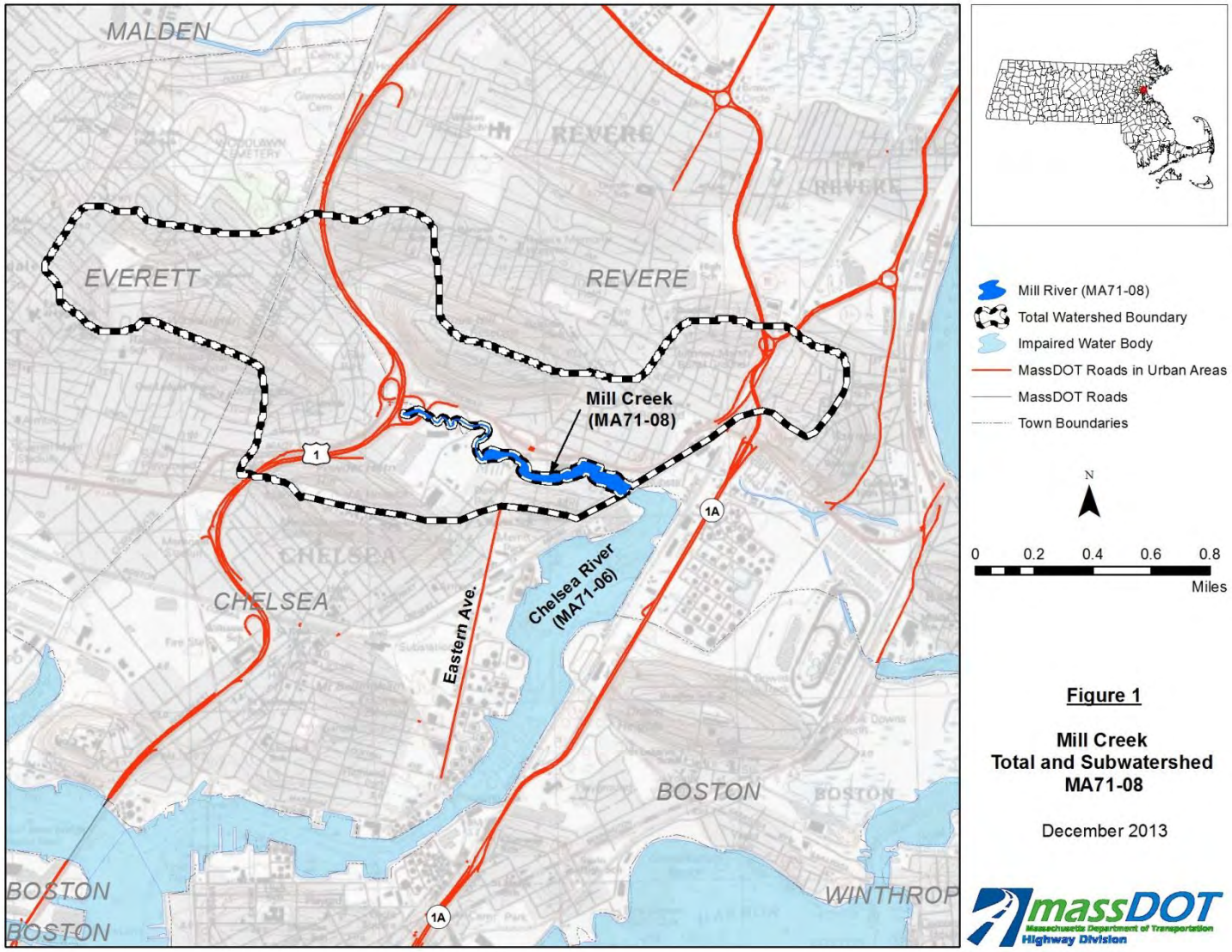

Figure 1

Mill Creek
Total and Subwatershed
MA71-08

December 2013

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for School Meadow Brook (MA73-06) - Final Report

Impaired Water Body

Name: School Meadow Brook

Location: Walpole, MA

Water Body ID: MA73-06

Impairments

School Meadow Brook (MA73-06) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). School Meadow Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *Final Total Maximum Daily Loads of Bacteria for Neponset River Basin* (MassDEP, 2002), water quality monitoring conducted on School Meadow Brook (MA73-06) indicates fecal coliform data in violation of water quality standards. School Meadow Brook is covered by the aforementioned TMDL of the Neponset River Basin.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no

single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

School Meadow Brook is a tributary of the Neponset River. School Meadow Brook is the outlet of Ganawatte Farm Pond (MA73037) and flows approximately 1.9 miles to its confluence with the Neponset River (MA73-01) in Walpole. The total and subwatershed of School Meadow Brook are the same, with a total drainage area of 3.16 square miles, as shown on Figure 1.

According to the *Neponset River Watershed 1994 Resource Assessment Report,* there was a minor NPDES discharge into a tributary of School Meadow Brook. This discharge contained cooling and process wastewater from an electroplating operation located in Sharon (MassDEP, 1995)

MassDOT's property with the potential to directly contribute stormwater runoff to School Meadow Brook occurs where Route 1 crosses School Meadow Brook. Interstate 95 does not directly cross School Meadow Brook, but is located within its watershed and could potentially also contribute stormwater runoff to the brook.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been

reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Total Maximum Daily Loads of Bacteria for Neponset River Basin (CN 121.0)* covers School Meadow Brook and its tributaries. According to the TMDL, known or suspected sources of fecal coliform contamination include leaking sewer pipes, illicit sewer connections, sanitary sewer overflows, and failing septic systems.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

According to the TMDL, the fecal coliform bacteria water quality standards for Class B waters, such as School Meadow Brook, require the geometric mean of a representative set of samples not exceed 200 cfu per 100 ml and that 10% of the samples not exceed 400 cfu per 100 ml. Based on water quality monitoring summarized in the TMDL, School Meadow Brook has exceeded the water quality standards for fecal coliform. In a 1997 study, 16.7% of the water samples collected violated the 400 cfu per 100 ml water quality standard for fecal coliform at the Washington Street sampling location. Another sampling location on School Meadow Brook (also part of the 1997 study), located at Pine Street near the outlet from Ganawatte Farm Pond, had a geometric mean of 5 cfu per 100 ml with no samples violating the 400 cfu per 100 ml water quality standard for fecal coliform. Based on sampling conducted in 1999, none of the samples collected at the Washington Street location violated the 400 cfu per 100 ml water quality standard for fecal coliform and the geometric mean of all samples was less than the 200 cfu per 100 ml limit (MassDEP, 2002).

According to the TMDL, it is difficult to accurately quantify the fecal coliform contributions of the various sources located within the Neponset River Basin as the sources are difficult to monitor and model due to their intermittency. The Neponset River Basin fecal coliform data has been linked to the stream base flow, where low base flows result in higher bacteria concentrations. Leaking sewers, sanitary sewer overflows, and failing septic systems are known to contribute to elevated bacteria concentrations in the receiving waters within the Neponset River Basin. The TMDL proposes a basin-wide strategy to improve water quality within the Neponset River Basin, including a mandatory program for implementing stormwater BMPs and eliminating illicit sources.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- “given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP’s expectation is that for stormwater an iterative approach is needed…” (MassDEP, 2009a)
- “The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.”(MassDEP, 2009b)
- “Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs.” (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable.

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states “For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA.” Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Neponset River TMDL report (pages 38-39) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Increased frequency of street sweeping and catch basin cleaning
- Public education programs
- Adoption of pet waste pick up laws
- Diversion of runoff to pervious areas for infiltration where possible

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

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

- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the

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

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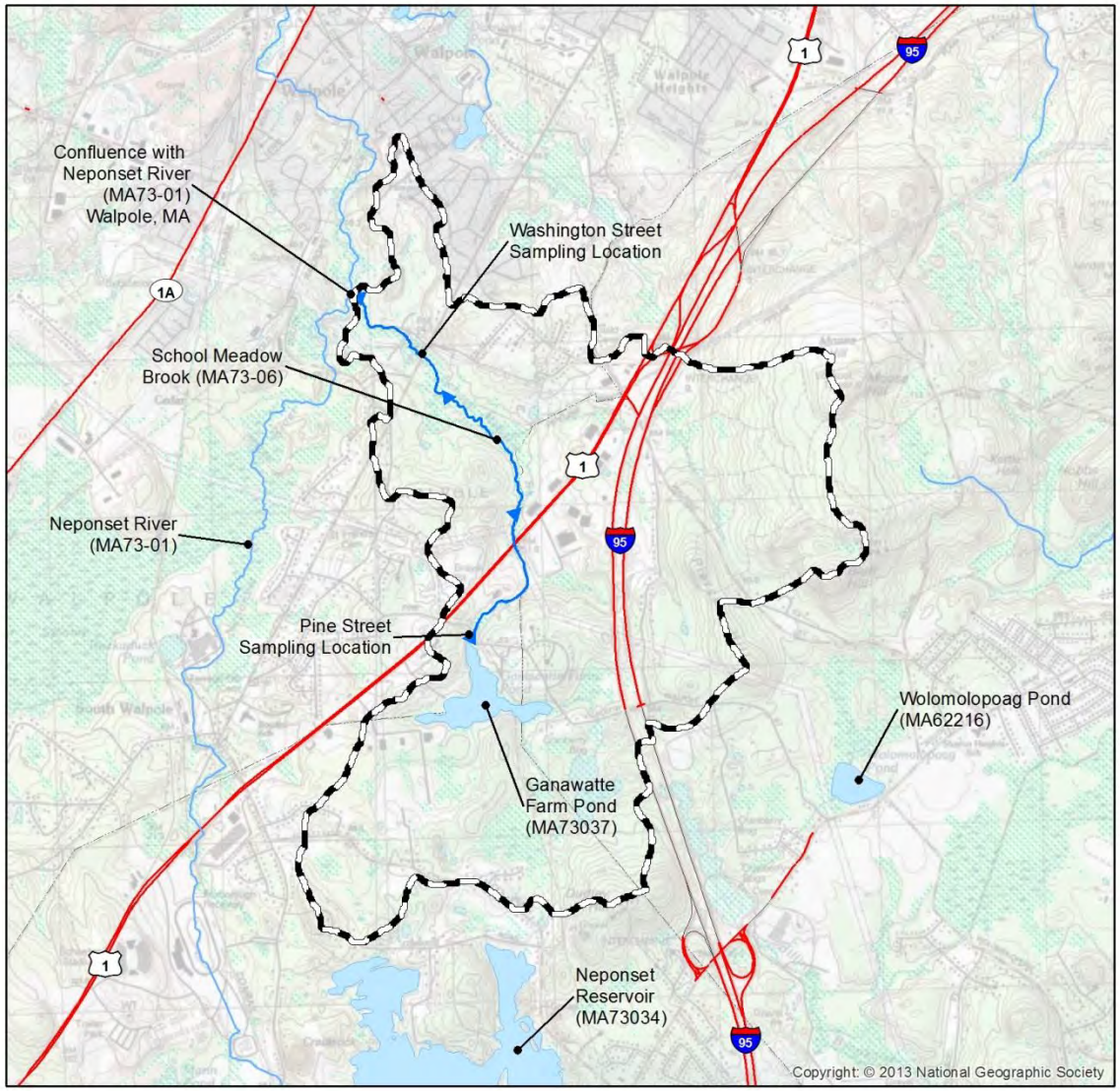

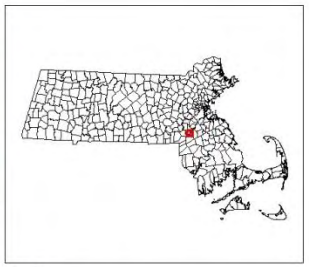

Total and subwatershed
School Meadow Brook
Impaired Stream Segment
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.25 0.5 1 Miles

Figure 1

School Meadow Brook
Total Watershed
MA73-06

December 2013

Impaired Waters Assessment for Traphole Brook (MA73-17) - Final Report

Impaired Water Body

Name: Traphole Brook

Location: Sharon, MA

Water Body ID: MA73-17

Impairments

Traphole Brook (MA73-17) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Traphole Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *Final Total Maximum Daily Loads of Bacteria for Neponset River Basin* (MassDEP, 2002), water quality monitoring conducted on Traphole Brook (MA73-17) indicates fecal coliform data in violation of water quality standards in multiple sampling locations. Traphole Brook is covered by the aforementioned TMDL of the Neponset River Basin.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no

single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Traphole Brook is a tributary of the Neponset River. The headwaters of Traphole Brook originate west of Everett Street in Sharon and flow approximately 3.9 miles to its confluence with the Neponset River (MA73-01) in Sharon. The total and subwatershed of Traphole Brook is shown on Figure 1 and has a total drainage area of 4.65 square miles.

According to the *Neponset River Watershed 1994 Resource Assessment Report,* the Traphole Brook watershed contains easily erodible soils which limit habitat quality. There were also water quality observations indicative of septic system failures due to high levels of chloride and occasional elevated fecal coliform levels (MassDEP, 1995).

MassDOT's property with the potential to directly contribute stormwater runoff to Traphole Brook occurs where Route 1 and Interstate 95 cross the waterway, as shown on Figure 1. Route 1 intersects Traphole Brook in two locations and Interstate 95 crosses the brook once (Figure 1).

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been

reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Total Maximum Daily Loads of Bacteria for Neponset River Basin (CN 121.0)* covers Traphole Brook and its tributaries. According to the TMDL, the known and suspected sources of fecal coliform contamination in Traphole Brook are illicit sewer connections, stormwater runoff, and failing septic systems.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

According to the TMDL, the fecal coliform bacteria water quality standards for Class B waters, such as Traphole Brook, require the geometric mean of a representative set of samples not exceed 200 cfu per 100 ml and that 10% of the samples not exceed 400 cfu per 100 ml. Based on water quality monitoring summarized in the TMDL, Traphole Brook has exceeded the water quality standards for fecal coliform at multiple locations during a 1997 study. Three sampling locations along Traphole Brook had greater than 10% of their samples with more than 400 cfu per 100 ml. These locations are shown on Figure 1 and are located at High Plain Street in Sharon, Coney Street in Walpole, and Sumner Street in Norwood (MassDEP, 2002).

According to the TMDL, it is difficult to accurately quantify the fecal coliform contributions of the various sources located within the Neponset River Basin as the sources are difficult to monitor and model due to their intermittency. The Neponset River Basin fecal coliform data has been linked to the stream base flow, where low base flows result in higher bacteria concentrations. Leaking sewers, sanitary sewer overflows, and failing septic systems are known to contribute to elevated bacteria concentrations in the receiving waters within the Neponset River Basin. The TMDL proposes a basin-wide strategy to improve water quality within the Neponset River Basin, including a mandatory program for implementing stormwater BMPs and eliminating illicit sources.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- “given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP’s expectation is that for stormwater an iterative approach is needed…” (MassDEP, 2009a)
- “The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.”(MassDEP, 2009b)
- “Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs.” (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of

stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states “For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA.” Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Neponset River TMDL report (pages 38-39) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Increased frequency of street sweeping and catch basin cleaning
- Public education programs
- Adoption of pet waste pick up laws
- Diversion of runoff to pervious areas for infiltration where possible

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

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

- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure

- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing

stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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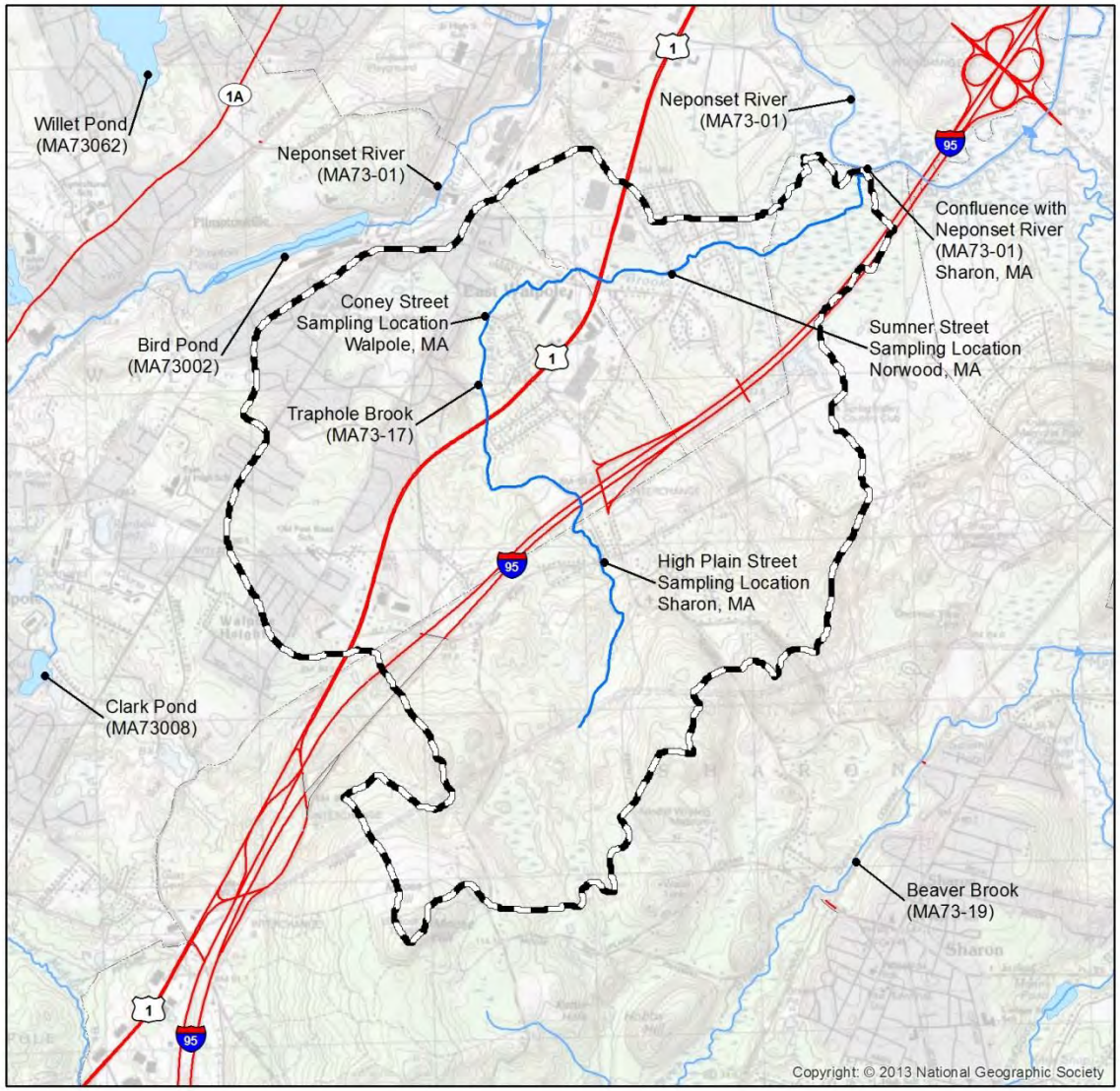

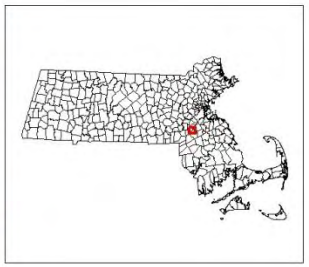

Total and Subwatershed
Traphole Brook (MA73-17)
Impaired Stream Segment
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.25 0.5 1
Miles

Figure 1

Traphole Brook
Total and Subwatershed
MA73-17

December 2013

Impaired Waters Assessment for Purgatory Brook (MA73-24) - Final Report

Impaired Water Body

Name: Purgatory Brook

Location: Westwood and Norwood, MA

Water Body ID: MA73-24

Impairments

Purgatory Brook (MA73-24) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Purgatory Brook is impaired for the following:

- Escherichia Coli
- Fecal Coliform

According to MassDEP's *Final Total Maximum Daily Loads of Bacteria for Neponset River Basin* (MassDEP, 2002), water quality monitoring conducted on Purgatory Brook (MA73-24) indicates fecal coliform data in violation of water quality standards. Purgatory Brook is covered by the aforementioned TMDL of the Neponset River Basin.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not

exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Purgatory Brook is a tributary of the Neponset River. The headwaters of the brook originate in Westwood, east of Farm Lane, and flow approximately 4.5 miles to its confluence with the Neponset River (MA73-02) in Norwood. The total and subwatershed of Purgatory Brook are shown on Figure 1 and have a total drainage area of 5.99 square miles.

Plantingfield Brook (MA73-23) is a tributary of Purgatory Brook and is listed under Category 4C, "Impairment not caused by pollutant – TMDL not required", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013).

MassDOT's property with the potential to directly contribute stormwater runoff to Purgatory Brook occurs where Route 1 crosses Purgatory Brook. Route 1 also crosses Plantingfield Brook, a tributary of Purgatory Brook. Route 1A (Upland Road) also crosses Plantingfield Brook, approximately 650 feet upstream of the Route 1 crossing.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from

other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Total Maximum Daily Loads of Bacteria for Neponset River Basin (CN 121.0)* covers Purgatory Brook and its tributaries. According to the TMDL, known and suspected sources of fecal coliform contamination in Purgatory Brook consist of illicit sewer connections, sanitary sewer overflows, stormwater runoff and failing septic systems.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

According to the TMDL, the fecal coliform bacteria water quality standards for Class B waters, such as Purgatory Brook, require the geometric mean of a representative set of samples not exceed 200 cfu per 100 ml and that 10% of the samples not exceed 400 cfu per 100 ml. Based on water quality monitoring summarized in the TMDL, Purgatory Brook has exceeded the water quality standards for fecal coliform on multiple occasions. In a 1994 study, 33% of the water samples collected violated the 400 cfu per 100 ml water quality standard for fecal coliform (MassDEP, 1995). Based on sampling conducted in 1999, 25% of the water samples collected violated the 400 cfu per 100 ml water quality standard for fecal coliform and the geometric mean of all samples exceeded the 200 cfu per 100 ml limit.

According to the TMDL, it is difficult to accurately quantify the fecal coliform contributions of the various sources located within the Neponset River Basin as the sources are difficult to monitor and model due to their intermittency. The Neponset River Basin fecal coliform data has been linked to the stream base flow, where low base flows result in higher bacteria concentrations. Leaking sewers, sanitary sewer overflows, and failing septic systems are known to contribute to elevated bacteria concentrations in the receiving waters within the Neponset River Basin. The TMDL proposes a basin-wide strategy to improve water quality within the Neponset River Basin, including a mandatory program for implementing stormwater BMPs and eliminating illicit sources.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- “given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP’s expectation is that for stormwater an iterative approach is needed…” (MassDEP, 2009a)
- “The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.”(MassDEP, 2009b)
- “Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs.” (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of

stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states “For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA.” Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Neponset River TMDL report (pages 38-39) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Increased frequency of street sweeping and catch basin cleaning
- Public education programs
- Adoption of pet waste pick up laws
- Diversion of runoff to pervious areas for infiltration where possible

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

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

- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure

- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing

stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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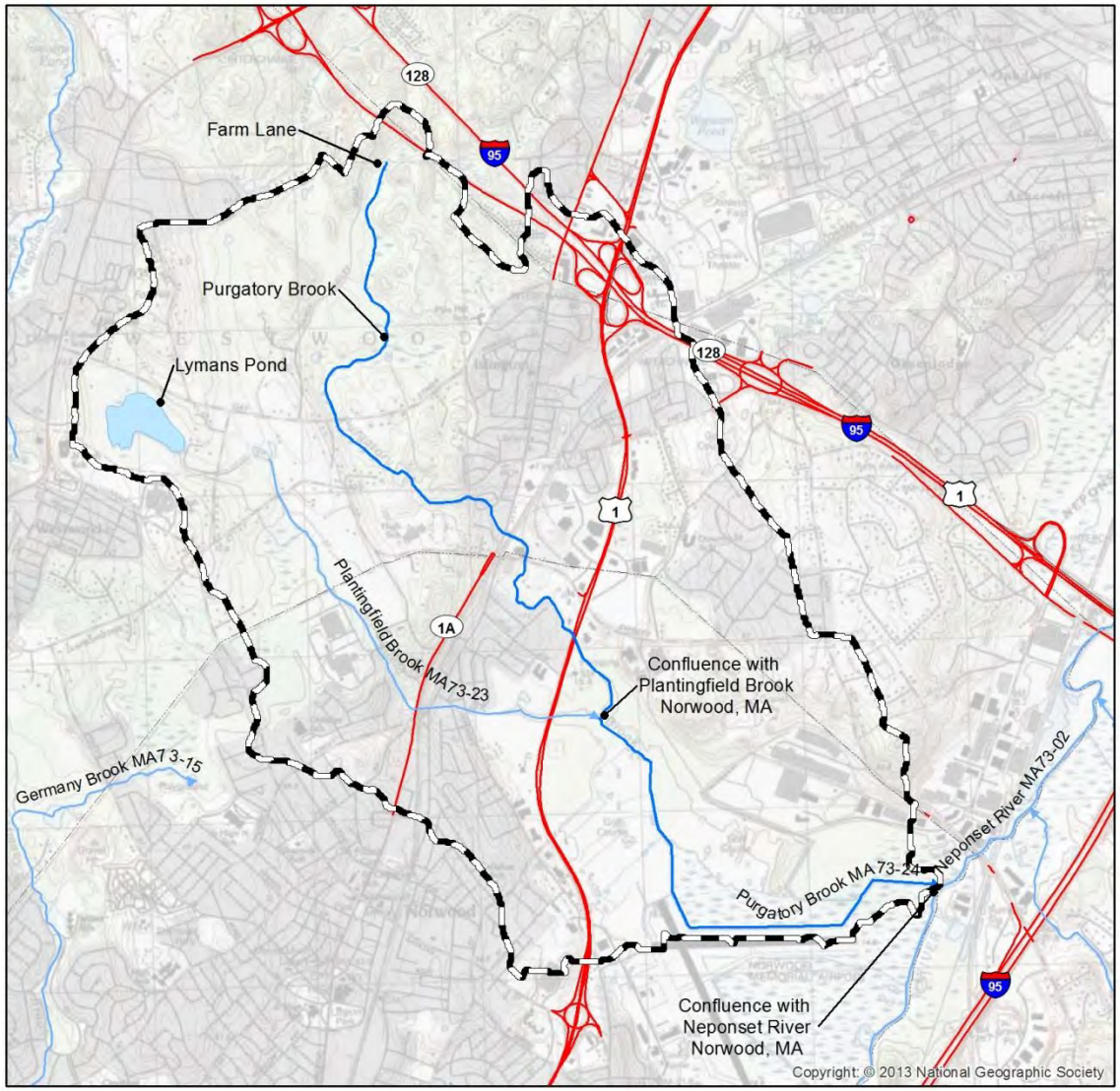

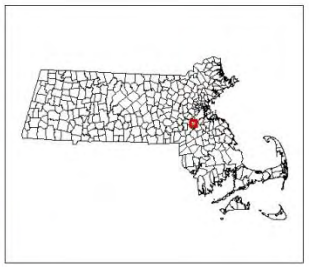

Total and Subwatershed
Purgatory Brook (MA73-24)
Impaired Stream Segment
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.25 0.5 1
Miles

Figure 1

Purgatory Brook
Total and Subwatershed
MA73-24

December 2013

Impaired Waters Assessment for Ponkapoag Brook (MA73-27) - Final Report

Impaired Water Body

Name: Ponkapoag Brook

Location: Canton, MA

Water Body ID: MA73-27

Impairments

Ponkapoag Brook (MA73-27) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Ponkapoag Brook is impaired for the following:

- Escherichia Coli
- Fecal Coliform

According to MassDEP's *Final Total Maximum Daily Loads of Bacteria for Neponset River Basin* (MassDEP, 2002), water quality monitoring conducted on Ponkapoag Brook (MA73-27) indicates fecal coliform data in violation of water quality standards. Ponkapoag Brook is covered by the aforementioned TMDL of the Neponset River Basin.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not

exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Ponkapoag Brook is a tributary of the Neponset River. The brook originates at Ponkapoag Pond (MA73043) and flows approximately 3 miles to its confluence with the Neponset River (MA73-02) in Canton. The total and subwatershed of Ponkapoag Brook are shown on Figure 1 and have a total drainage area of 4.27 square miles.

Ponkapoag Pond (MA73043) is a 214 acre pond at the head of Ponkapoag Brook and is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013).

MassDOT's property with the potential to directly contribute stormwater runoff to Ponkapoag Brook occurs where Route 138 (Washington Street) and Interstate 95 cross Ponkapoag Brook as shown on Figure 1.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been

reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Total Maximum Daily Loads of Bacteria for Neponset River Basin (CN 121.0)* covers Ponkapoag Brook and its tributaries. According to the TMDL, known and suspected sources of fecal coliform contamination in Ponkapoag Brook consist of illicit sewer connections, stormwater runoff and failing septic systems.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

According to the TMDL, the fecal coliform bacteria water quality standards for Class B waters, such as Ponkapoag Brook, require the geometric mean of a representative set of samples not exceed 200 cfu per 100 ml and that 10% of the samples not exceed 400 cfu per 100 ml. In a 1994 study, 33% of the water samples collected from Ponkapoag Brook at Elm Street in Canton violated the 400 cfu per 100 ml water quality standard for fecal coliform (MassDEP, 1995). However, samples collected from Ponkapoag Brook at Washington Street in Canton met the water quality standards for fecal coliform during conducted in 1994 and 1999 (MassDEP, 2002).

According to the TMDL, it is difficult to accurately quantify the fecal coliform contributions of the various sources located within the Neponset River Basin as the sources are difficult to monitor and model due to their intermittency. The Neponset River Basin fecal coliform data has been linked to the stream base flow, where low base flows result in higher bacteria concentrations. Leaking sewers, sanitary sewer overflows, and failing septic systems are known to contribute to elevated bacteria concentrations in the receiving waters within the Neponset River Basin. The TMDL proposes a basin-wide strategy to improve water quality within the Neponset River Basin, including a mandatory program for implementing stormwater BMPs and eliminating illicit sources.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- “given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP’s expectation is that for stormwater an iterative approach is needed…” (MassDEP, 2009a)
- “The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.”(MassDEP, 2009b)
- “Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs.” (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states “For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA.” Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Neponset River TMDL report (pages 38-39) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Increased frequency of street sweeping and catch basin cleaning
- Public education programs
- Adoption of pet waste pick up laws
- Diversion of runoff to pervious areas for infiltration where possible

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

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

- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition

- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a

contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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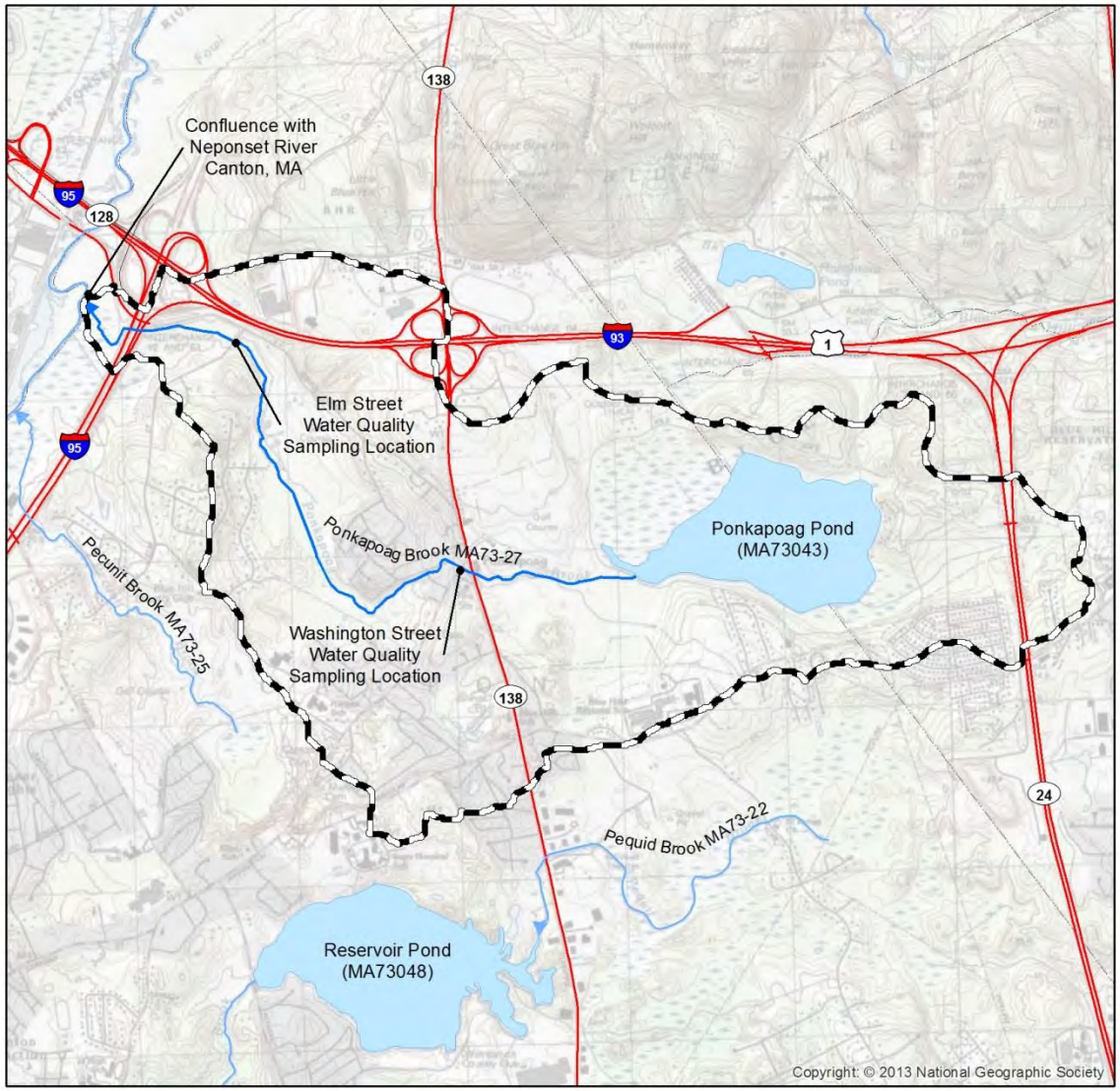

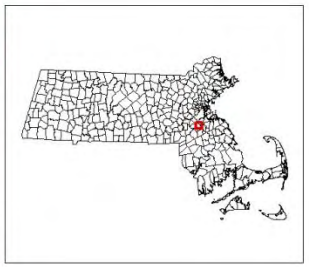

Total and Subwatershed
Ponkapoag Brook (MA73-27)
Impaired Stream Segment
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.25 0.5 1
Miles

Figure 1

Ponkapoag Brook
Total and Subwatershed
MA73-27

December 2013

Impaired Waters Assessment for Vine Brook (MA83-06) - Final Report

Impaired Water Body

Name: Vine Brook

Location: Lexington, Burlington, and Bedford, MA

Water Body ID: MA83-06

Impairments

Vine Brook (MA83-06) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Vine Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *Shawsheen River Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), there is one discharge to Vine Brook covered by an NPDES permit: E.H. Perkins Construction, Burlington (MA0004081). Two previous NPDES permits have been terminated: Burlington Groundwater Treatment Plant, Burlington (MA0102911) and MITRE Corporation, Bedford (MA0027197). Vine Brook is covered by the *Bacteria TMDL for the Shawsheen River Basin* (MassDEP, 2002a).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of

all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Vine Brook (MA83-06) is a water body in Lexington, Burlington, and Bedford, Massachusetts. The water body extends from headwaters near Grant Street, Lexington and flows north approximately 6.8 miles to confluence with the Shawsheen River in Bedford (See Figure 1).

There are two locations where MassDOT's property has the potential to directly contribute stormwater runoff to MA83-06. I-95/Route 128 crosses Vine Brook in Burlington, and Vine Brook flows under Routes 62 and 3 at the Route 3/62 interchange in Bedford. Other portions of Routes I-95/Route 128 and Routes 62 and 3 also have the potential to contribute stormwater, but are located farther from the receiving waters. Refer to Figure 1 for the location of the total watershed and subwatershed to Segment MA83-06 of Vine Brook. The total watershed and subwatershed are the same for Vine Brook.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been

reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

According to the *Bacteria TMDL for the Shawsheen River Basin* report (MassDEP, 2002a), sources of indicator bacteria in the Shawsheen River watershed are believed to be primarily from illicit sewer connections and sewer line leaks during dry weather, low flow conditions; urban runoff was determined to be the source component of greatest significance during high flow conditions. Known and suspected sources specific to Vine Brook are cited as Burlington sewer overflow (documented wet weather overflows), manure piles near stream, possible sewer leaks, and stormwater runoff.

The report contains fecal coliform data collected by the MassDEP and the Merrimack River Watershed Council (MRWC) during the period 1989 – 1998. Violations of the bacteria standard were regularly observed in Vine Brook, with exceedingly high (>5,000 cfu/100ml) concentrations measured in 1995, 1997, and 1998.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002b).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G

references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Shawsheen River TMDL report (Section 8.0, page 56) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Correction of failing septic systems
- Management and control of urban runoff

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

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

- Control of point sources
- Septic tank controls
- Management and control of urban runoff
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains towards meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

Massachusetts Department of Environmental Protection (MassDEP). (2003). Shawsheen River Watershed 2000 Water Quality Assessment Report. Retrieved from: MADEP 2003 Shawsheen River Watershed 2000 Water Quality Assessment Report

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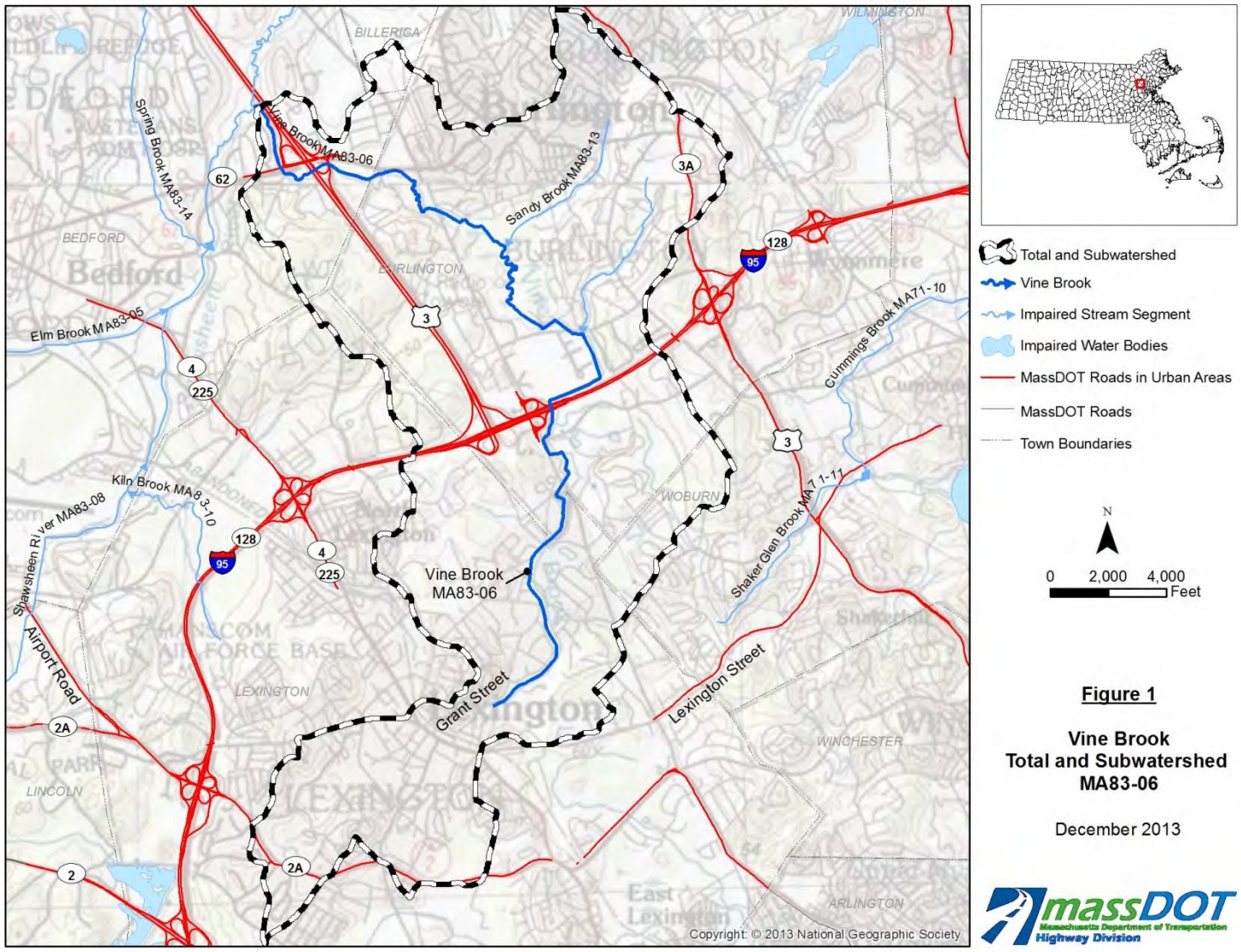

Total and Subwatershed
Vine Brook
Impaired Stream Segment
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 2,000 4,000 Feet

Figure 1

Vine Brook
Total and Subwatershed
MA83-06

December 2013

Impaired Waters Assessment for Strong Water Brook (MA83-07) - Final Report

Impaired Water Body

Name: Strong Water Brook

Location: Tewksbury, MA

Water Body ID: MA83-07

Impairments

Strong Water Brook (MA83-07) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Strong Water Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *Shawsheen River Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), there were three discharges to Vine Brook previously covered by an NPDES permit: Getty Petroleum Corp, Tewksbury (MA0036846, terminated 2001), Tewksbury Hospital, Tewksbury (MA0030040, terminated 2001) and Raytheon Company, Tewksbury (MAR05C203, terminated 2005). Strong Water Brook is covered by the *Bacteria TMDL for the Shawsheen River Basin* (MassDEP, 2002a).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of

all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Strong Water Brook (MA83-07) is a water body in Tewksbury, Massachusetts. The water body extends from headwaters northeast of Long Pond, Tewksbury, and flows east/southeast approximately 4.8 miles to confluence with the Shawsheen River. The total watershed is shown in Figure 1; the subwatershed is shown in Figure 2.

There is one location where MassDOT's property has the potential to directly contribute stormwater runoff to MA83-06, where Route 38 crosses Strong Water Brook.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

According to the *Bacteria TMDL for the Shawsheen River Basin* report (MassDEP, 2002a), sources of indicator bacteria in the Shawsheen River watershed are believed to be primarily from illicit sewer connections and sewer line leaks during dry weather, low flow conditions; urban runoff was determined to be the source component of greatest significance during high flow conditions. There are no known or suspected sources specific to Strong Water Brook cited in the TMDL.

The report contains fecal coliform data collected by the MassDEP and the Merrimack River Watershed Council (MRWC) during the period 1989 – 1998. Violations of the bacteria standard were regularly observed in Strong Water Brook, with exceedingly high (>5,000 cfu/100ml) concentrations measured in 1996.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources

include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
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- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002b).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program

- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Shawsheen River TMDL report (Section 8.0, page 56) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Correction of failing septic systems
- Management and control of urban runoff

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

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

- Control of point sources
- Septic tank controls
- Management and control of urban runoff
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
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- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies

impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains towards meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

Massachusetts Department of Environmental Protection (MassDEP). (2003). Shawsheen River Watershed 2000 Water Quality Assessment Report. Retrieved from: MADEP 2003 Shawsheen River Watershed 2000 Water Quality Assessment Report

Massachusetts Department of Environmental Protection (MassDEP). (2002a). Bacteria TMDL for the Shawsheen River Basin. Retrieved from: MADEP 2002a Bacteria TMDL for the Shawsheen River Basin

MassDEP. (2002b). Final Total Maximum Daily Loads of Bacteria for Neponset River Basin. Available at: MADEP 2002b Final Bacteria TMDL for Neponset River Basin

MassDEP. (2009a). Final Pathogen TMDL for the Buzzards Bay Watershed. Available at: MADEP 2009a Final Pathogens TMDL for the Buzzards Bay Watershed

MassDEP. (2009b). Final Pathogen TMDL for the Cape Cod Watershed. Available at: MassDEP 2009b Final Pathogen TMDL for the Cape Cod Watershed Area

MassDEP. (2013). Massachusetts Year 2012 Integrated List of Waters - Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Retrieved from: MassDEP 2013 MA Year 2012 Integrated List of Waters

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.

U.S. Geological Survey (USGS). (1999). Pesticides and Bacteria in an Urban Stream – Gills Creek. USGS Fact Sheet FS-131-98. Columbia, South Carolina.

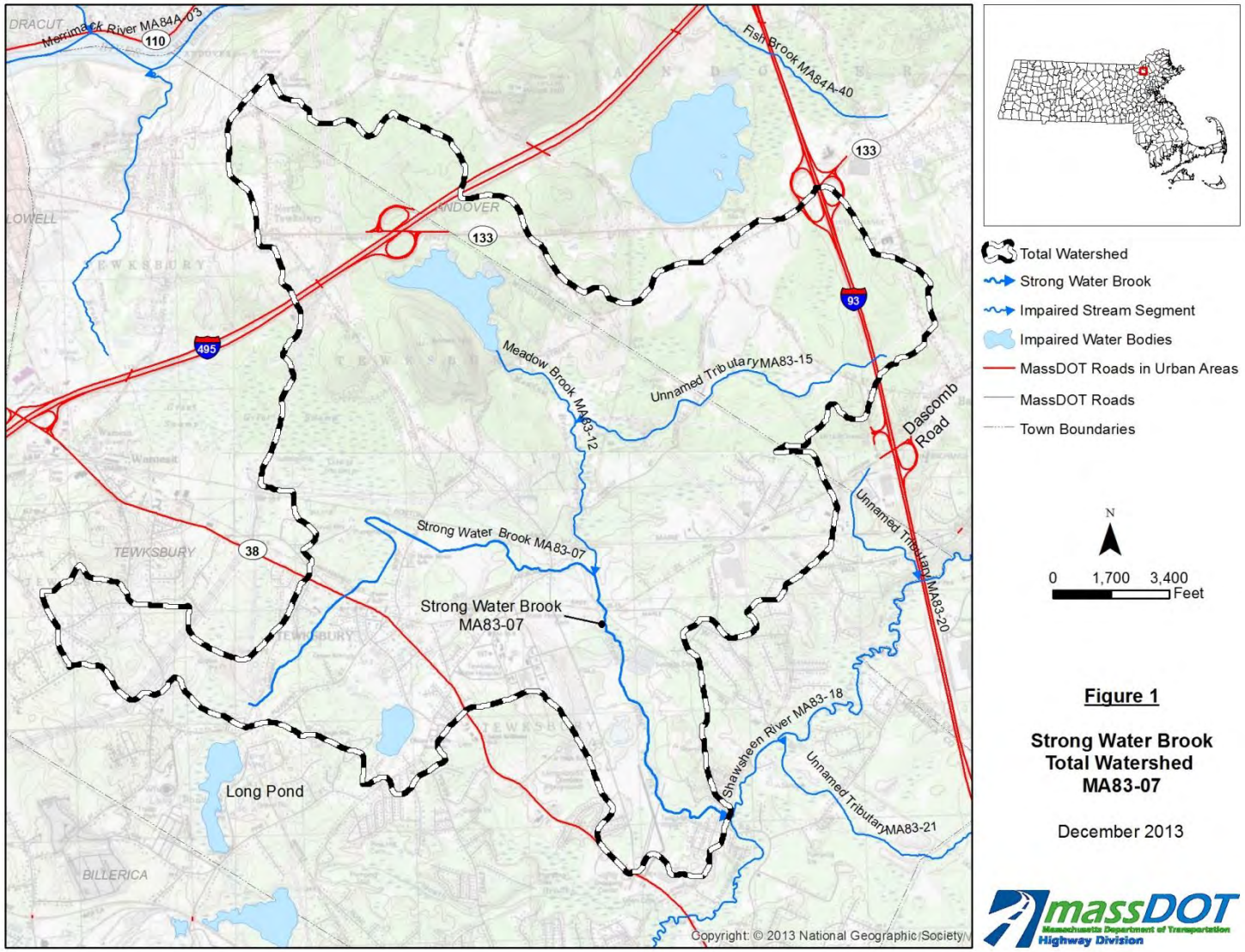
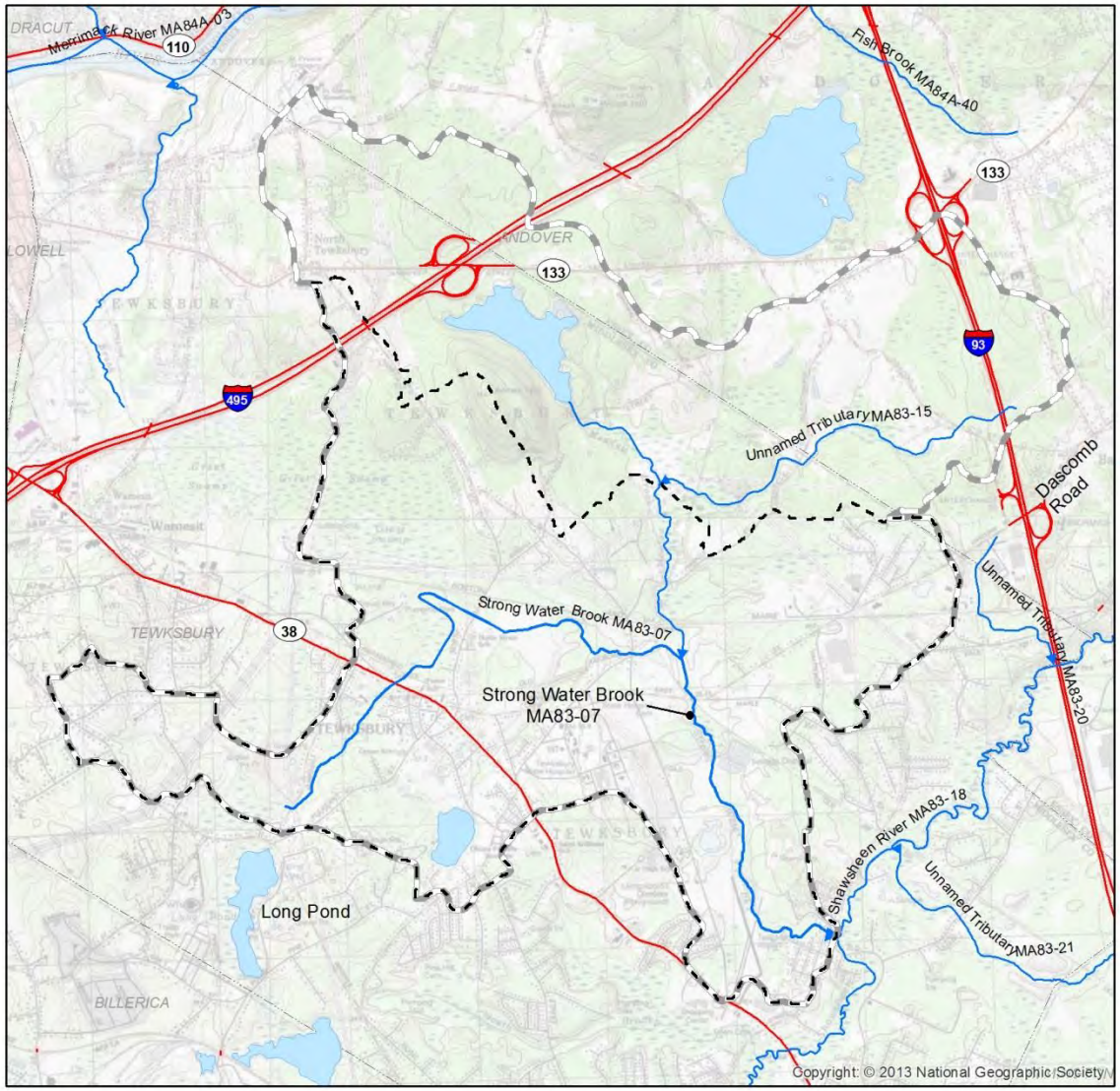
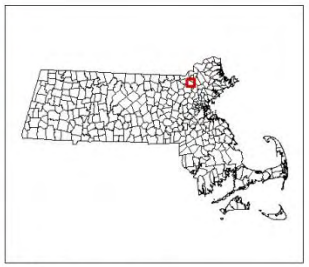


Figure 1

Strong Water Brook
Total Watershed
MA83-07

December 2013





Subwatershed
Total Watershed
Strong Water Brook
Impaired Stream Segment
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 1,700 3,400
Feet

Figure 2

Strong Water Brook Subwatershed MA83-07

December 2013

Impaired Waters Assessment for Kiln Brook (MA83-10) - Final Report

Impaired Water Body

Name: Kiln Brook

Location: Lexington and Bedford, MA

Water Body ID: MA83-10

Impairments

Kiln Brook (MA83-10) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Kiln Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *Shawsheen River Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), there are no discharges to Kiln Brook covered by an NPDES permit. Kiln Brook is covered by the *Bacteria TMDL for the Shawsheen River Basin* (MassDEP, 2002a).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample

shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Kiln Brook (MA83-10) is located in Lexington and Bedford, Massachusetts. The brook extends from the outlet of an unnamed pond located in the Pine Meadows Country Club, Lexington, and flows north/northwest approximately 1.5 miles to its confluence with the Shawsheen River in Bedford.

There is one location where MassDOT's property has the potential to directly contribute stormwater runoff to MA83-06, where Route 128 (I-95) crosses Kiln Brook. Routes 4 and 224 are also owned by MassDOT and located within the subwatershed, but are more than a half mile away from the receiving waters. Refer to Figure 1 for the location of the total watershed and subwatershed to Segment MA83-10 of Kiln Brook. The total watershed and subwatershed are the same for Kiln Brook.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

According to the *Bacteria TMDL for the Shawsheen River Basin* report (MassDEP, 2002a), sources of indicator bacteria in the Shawsheen River watershed are believed to be primarily from illicit sewer connections and sewer line leaks during dry weather, low flow conditions; urban runoff was determined to be the source component of greatest significance during high flow conditions. There are no known or suspected sources specific to Kiln Brook cited in the TMDL.

The report contains fecal coliform data collected by the MassDEP and the Merrimack River Watershed Council (MRWC) during the period 1989 – 1998. Violations of the bacteria standard were regularly observed in Kiln Brook, with exceedingly high (>5,000 cfu/100ml) concentrations measured in 1998.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources

include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002b).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program

- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Shawsheen River TMDL report (Section 8.0, page 56) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Correction of failing septic systems
- Management and control of urban runoff

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

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

- Control of point sources
- Septic tank controls
- Management and control of urban runoff
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies

impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains towards meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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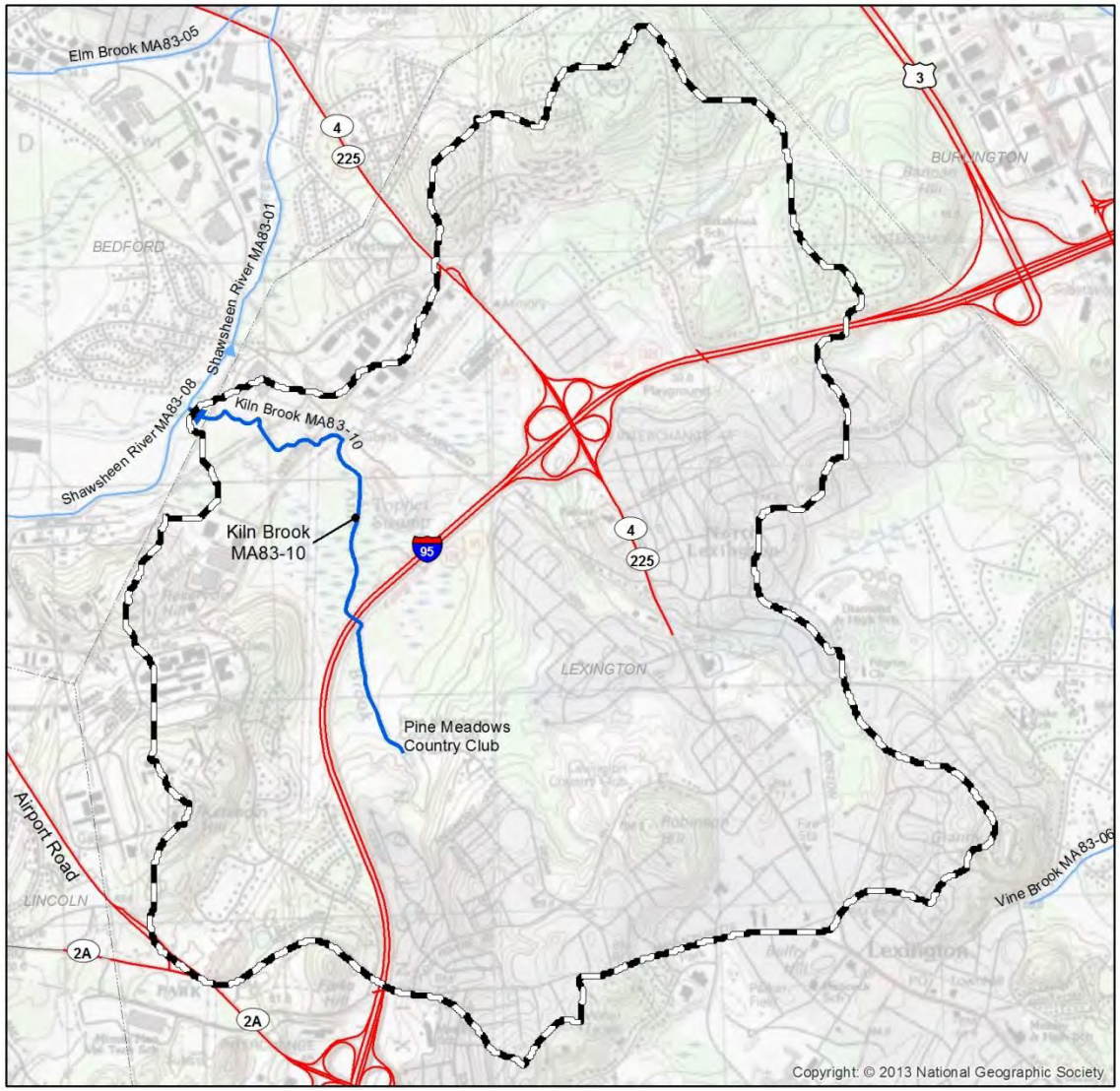

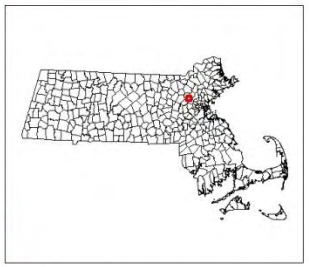

Total and Subwatershed
Kiln Brook
Impaired Stream Segment
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 1,000 2,000
Feet

Figure 1

Kiln Brook
Total and Subwatershed
MA83-10

December 2013

Impaired Waters Assessment for Spring Brook (MA83-14) - Final Report

Impaired Water Body

Name: Spring Brook

Location: Billerica and Bedford, MA

Water Body ID: MA83-14

Impairments

Spring Brook (MA83-14) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Spring Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *Shawsheen River Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), there are no discharges to Spring Brook covered by an NPDES permit. Spring Brook is covered by the *Bacteria TMDL for the Shawsheen River Basin* (MassDEP, 2002a).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample

shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Spring Brook (MA83-14) is a water body located in Bedford and Billerica, Massachusetts. The brook extends from wetlands northeast of Route 3 in Billerica and flows south approximately 2.5 miles to confluence with the Shawsheen River in Bedford.

There is one location where MassDOT's property has the potential to directly contribute stormwater runoff to MA83-14, where Route 3 crosses Spring Brook. Refer to Figure 1 for the location of the total watershed and subwatershed to Segment MA83-14 of Spring Brook. The total watershed and subwatershed are the same for Spring Brook.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

According to the *Bacteria TMDL for the Shawsheen River Basin* report (MassDEP, 2002a), sources of indicator bacteria in the Shawsheen River watershed are believed to be primarily from illicit sewer connections and sewer line leaks during dry weather, low flow conditions; urban runoff was determined to be the source component of greatest significance during high flow conditions. There are no known or suspected sources specific to Spring Brook cited in the TMDL.

The report contains fecal coliform data collected by the MassDEP and the Merrimack River Watershed Council (MRWC) during the period 1989 – 1998. Violations of the bacteria standard were regularly observed in Spring Brook.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their

consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002b).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Shawsheen River TMDL report (Section 8.0, page 56) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Correction of failing septic systems
- Management and control of urban runoff

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

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

- Control of point sources
- Septic tank controls
- Management and control of urban runoff
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains towards meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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MassDEP. (2009b). Final Pathogen TMDL for the Cape Cod Watershed. Available at: MassDEP 2009b Final Pathogen TMDL for the Cape Cod Watershed Area

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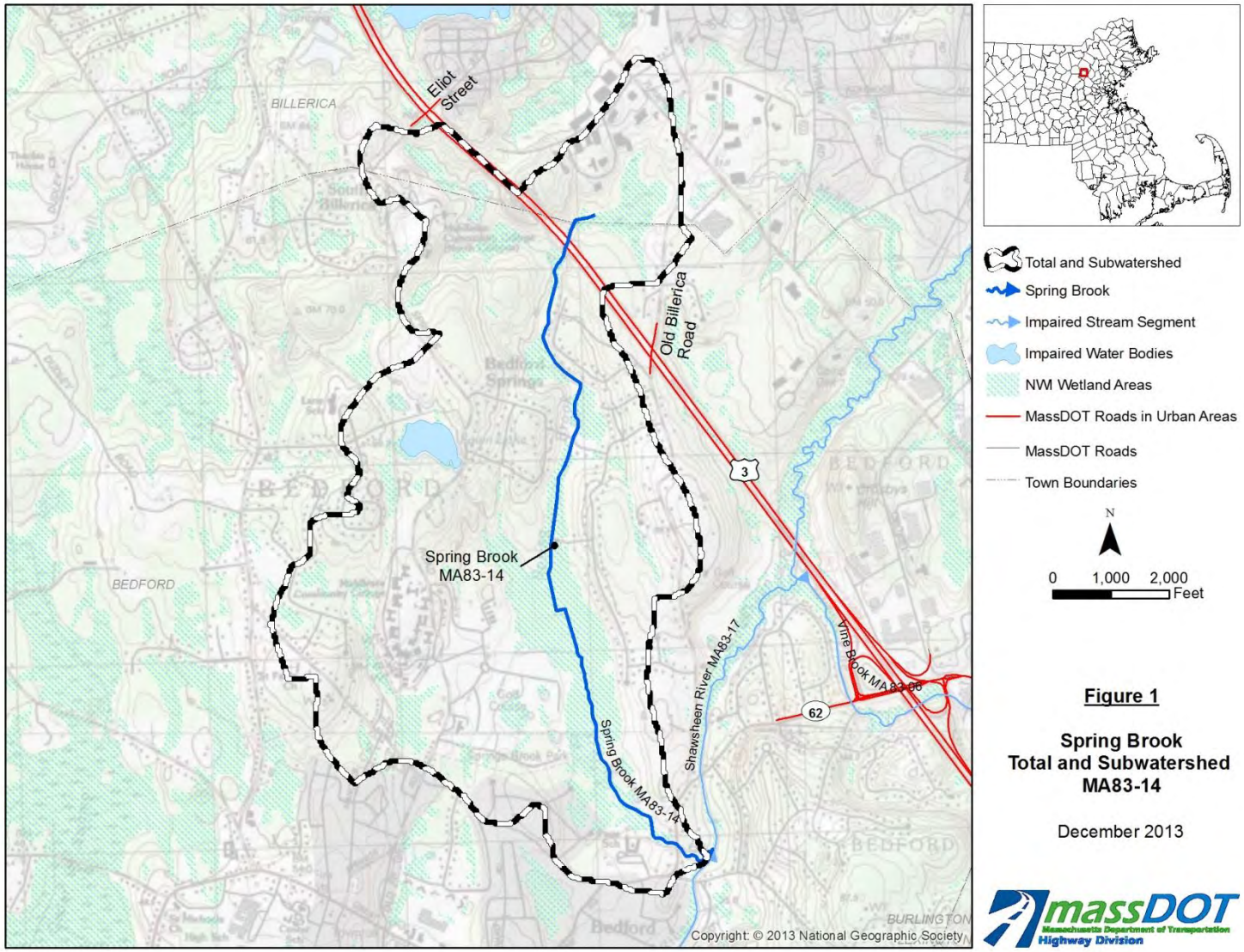

Figure 1

Spring Brook
Total and Subwatershed
MA83-14

December 2013

Impaired Waters Assessment for Little River (MA91-11) - Final Report

Impaired Water body

Name: Little River

Location: Newbury and Newburyport, MA

Water Body ID: MA91-11

Impairments

Little River (MA91-11) is listed under Category 5, "Waters requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Little River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Parker River Watershed and Coastal Drainage Area 2004-2008 Water Quality Assessment Report* (MassDEP, 2010), Little River (MA91-11) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Little River is included in the watershed area described in the *Draft Pathogen TMDL for the Parker River Watershed* (MassDEP, 2004).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed a geometric mean of 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104

colonies per 100 ml and the geometric mean of all samples taken within the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Little River Segment MA91-11 is a 0.09 square mile class SA estuary between Parker Street, Newbury/Newburyport and the confluence with the Parker River, Newbury. Land use estimates for this subwatershed is approximately 31% forest, a large portion of this being the Martin H. burns Wildlife Management area on the western edge of the subwatershed. Residential is listed at 17% of land use with the majority of this area at the north end of the watershed in Newburyport. Agriculture is listed at 17% land use. The 2001 WQA report noted a large beaver dam constricting flow of the Little River at the upstream end of the segment.

The MADEP WQA lists no water withdrawals for this segment. The Hero Coatings, Inc. Newburyport facility had a multi-sector storm water permit to discharge to a tributary of the Little River, but has not reapplied for the new general permit since their permit expired. Seven facilities have coverage under multi-sector storm water permits for discharge to the Little River: Newbury Auto, JRM Hauling and Recycling Services, Newburyport Layover, GI Plastek Limited Partnership, Bixby International Corp (two permits), and MBTA. The draft TMDL mentions non-point source pollution from the Newbury Industrial Park as a potential source of pathogen impairment.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA91-11 of Little River is comprised of portions of Route 1 and route 95. Refer to Figure 1 for the location of these roadways within the total watershed and subwatershed to Segment MA91-11 of Little River.

Assessment of Pathogen Impairment under BMP 7U

MassDOT assessed the pathogen impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Draft Pathogen Total Maximum Daily Load (TMDL) for the Parker River Watershed* covers the Parker River and its tributaries. The Parker River Watershed covers 82 square miles and encompasses all or parts of nine towns. The watershed includes 37 named streams approximately 76 miles in length, seventeen ponds/impoundments totaling 322.6 acres and approximately 14.3 square miles of estuarine waters.

According to the Draft TMDL report, the Parker River Watershed has no documented point sources of bacteria pollution; however several tributaries of the Parker River have been impacted by nonpoint sources of pollution as evidenced by one or more of the following: low dissolved oxygen concentrations, elevated nutrient levels and relatively high fecal coliform counts. These tributaries include the Little River.

Sources of indicator bacteria in the Parker River Watershed are many and varied. Dry weather sources include animal feeding operations, animal grazing in riparian zones, stormwater drainage systems (illicit connections), failing septic systems, recreational activities, wildlife including birds, and illicit boat discharges. Wet weather sources include wildlife and domesticated animals and storm water runoff including municipal separate storm sewer systems (MS4; MassDEP 2004).

The draft TMDL suggests that higher priority should be placed on areas with increasing residential development and increased impervious surface area. Approximately 22.4% of the Parker River Watershed is classified as Urban Areas by the United States Census Bureau and is therefore subject to the Stormwater Phase II Final Rule that requires the development and implementation of an illicit discharge detection and elimination plan. Page 28 of the TMDL emphasizes that failed or non-conforming septic systems are a major contributor of fecal coliform to the Parker River Watershed. A preliminary analysis in Rowley, Georgetown and Newbury indicates that at least 5% of the inspected septic systems have failed in the last ten years. Potential sources of bacteria to the Little River specifically are identified in the draft TMDL report as agricultural land use, stormwater in general, and stormwater from the Newbury Industrial Park in particular.

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water Body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water Body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- “given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP’s expectation is that for stormwater an iterative approach is needed…” (MassDEP, 2009a)

- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable.

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Draft Palmer River TMDL report (Section 8.0, page 27) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems and leaking sewer pipes
- Elimination of sewer connections to drainage pipes and elimination of sanitary sewer overflows
- Implementation of non-structural BMPs to reduce pathogen contributions to stormwater runoff

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

The following BMPs are identified in the draft TMDL report as being ongoing and/or planned in order to reduce bacteria contributions to the Palmer River:

- Agricultural BMPs
- Study and rehabilitation of closed coastal shellfish beds
- Correction of failing septic systems
- Elimination of illicit sewer connections, and repair of failing infrastructure
- Compliance with MS4 general permit requirements, including identification of Minimum Control Measures for stormwater management
- Improved management of recreational waters

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, MassDOT has a comprehensive Stormwater Management Plan (SWMP) which outlines BMPs that MassDOT has or will implement to comply with the six Minimum Control Measures (MCMs), and includes measurable milestones as well as an implementation schedule. As part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the sub-watershed of this water Body. At rest stops that have been identified as being within sub-watersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water Body, and pet waste removal bags and disposal cans will be provided.

The TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen

concentrations in highway runoff, and the low probability of achieving substantial gains towards meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicioFus connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the sub-watershed of this water Body that could be contributing pathogens to the impaired water Body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters, that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable, and although there is potential for stormwater runoff from DOT roadways to be a contributing source, it is unlikely to warrant action relative to other sources of pathogens in the watershed.

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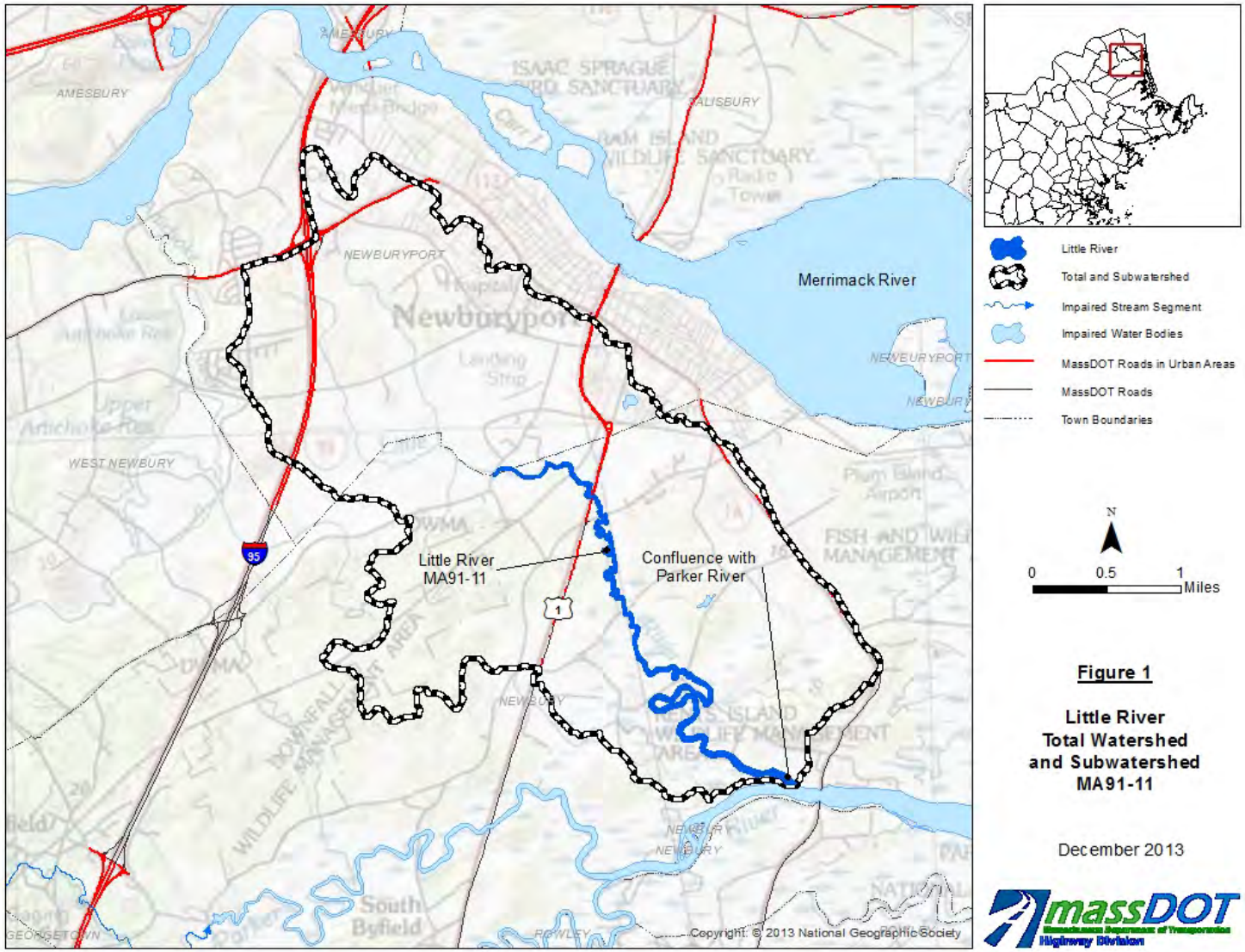

Figure 1

Little River
Total Watershed
and Subwatershed
MA91-11

December 2013

Impaired Waters Assessment for Hawkes Brook (MA93-32) - Final Report

Impaired Water Body

Name: Hawkes Brook

Location: Lynnfield, MA

Water Body ID: MA93-32

Impairments

Hawkes Brook (MA93-32) is listed under Category 5, "Impaired and requires one or more TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013), but also is covered by the Final Pathogen TMDL for the North Coastal Watershed (MassDEP, 2012). Hawkes Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *North Shore Coastal Watersheds 2002 Water Quality Assessment Report* (MassDEP, 2007), Hawkes Brook (MA93-32) has not been assessed for any designated uses due to limited data being available. Quality samples obtained in 2007 showed elevated total fecal coliform bacteria concentrations during dry-weather conditions (MassDEP, 2012).

Relevant Water Quality Standards

Water Body Classification: Class A, Public Water Supply, Outstanding Resource Water (ORW)

Applicable State Regulations:

- 314 CMR 4.05 (3)(a) 4 Bacteria.
  - a. At water supply intakes in unfiltered public water supplies: either fecal coliform shall not exceed 20 fecal coliform organisms per 100 ml in all samples taken in any six month period, or total coliform shall not exceed 100 organisms per 100 ml in 90% of the samples taken in any six month period, If both fecal coliform and total coliform are measured, then only the fecal coliform criterion must be met. More stringent regulations may apply under the Massachusetts Drinking Water regulations, 310 CMR 22.00 (see 314 CMR 4.06(1)(d)1.);
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same

bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;

- c. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples, and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Hawkes Brook flows from its headwaters near the Lynn/Lynnfield border to the inlet of Hawkes Pond in Lynnfield. The segment is 2.6 miles long (MassDEP, 2007).

The watershed for Segment MA93-32 Hawkes Brook is in a primarily residential area, with some commercial buildings. The brook crosses Route1/Route 129 from south to north. The brook then crosses Interstate 95 (I-95)/Route 128 from south to north and again from north to south, prior to its discharge into Hawkes Pond. Refer to Figure 1 for both the total watershed and subwatershed to Segment MA93-32 of Hawkes Brook.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA93-32 of Hawkes Brook is comprised of portions of I-95/Route 128 and Route 1/Route 129. Refer to Figure 1 for the location of these roadways within the total watershed and subwatershed to Segment MA93-32 of Hawkes Brook.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the North Coastal Watershed (CN: 155.0)* covers the lakes, ponds, rivers, and estuary areas of the North Coastal Watershed (MassDEP, 2012).

Suspected and known dry-weather sources of bacteria reported in the TMDL report include leaking sewer pipes, illicit connections, failing septic systems, recreational activities, wildlife, and discharge of boat waste. Wet-weather sources of bacteria, both suspected and known, include wildlife, stormwater runoff including Municipal Separate Sewer Systems (MS4), combined sewer overflows, and sanitary sewer overflows (MassDEP, 2012).

In an effort to eliminate bacteria sources, segments of the North Coastal Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, OWRs, public water supply intake, and proximity to swimming beaches. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2012).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- “given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP’s expectation is that for stormwater an iterative approach is needed…” (MassDEP, 2009a)
- “The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.”(MassDEP, 2009b)
- “Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs.” (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of

stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states “For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA.” Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the North Coastal Watershed TMDL report (Section 8.0, page 97-112) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Stormwater runoff management, such as street sweeping and/or managerial strategies with local controls
- Periodic monitoring

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

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

- Study and Rehabilitation of Closed Coastal Shellfishing Beds
- Identification and elimination of illicit sources
- Stormwater runoff management
- Septic tank controls
- Wastewater Treatment Plants
- Recreational waters use management
- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

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

no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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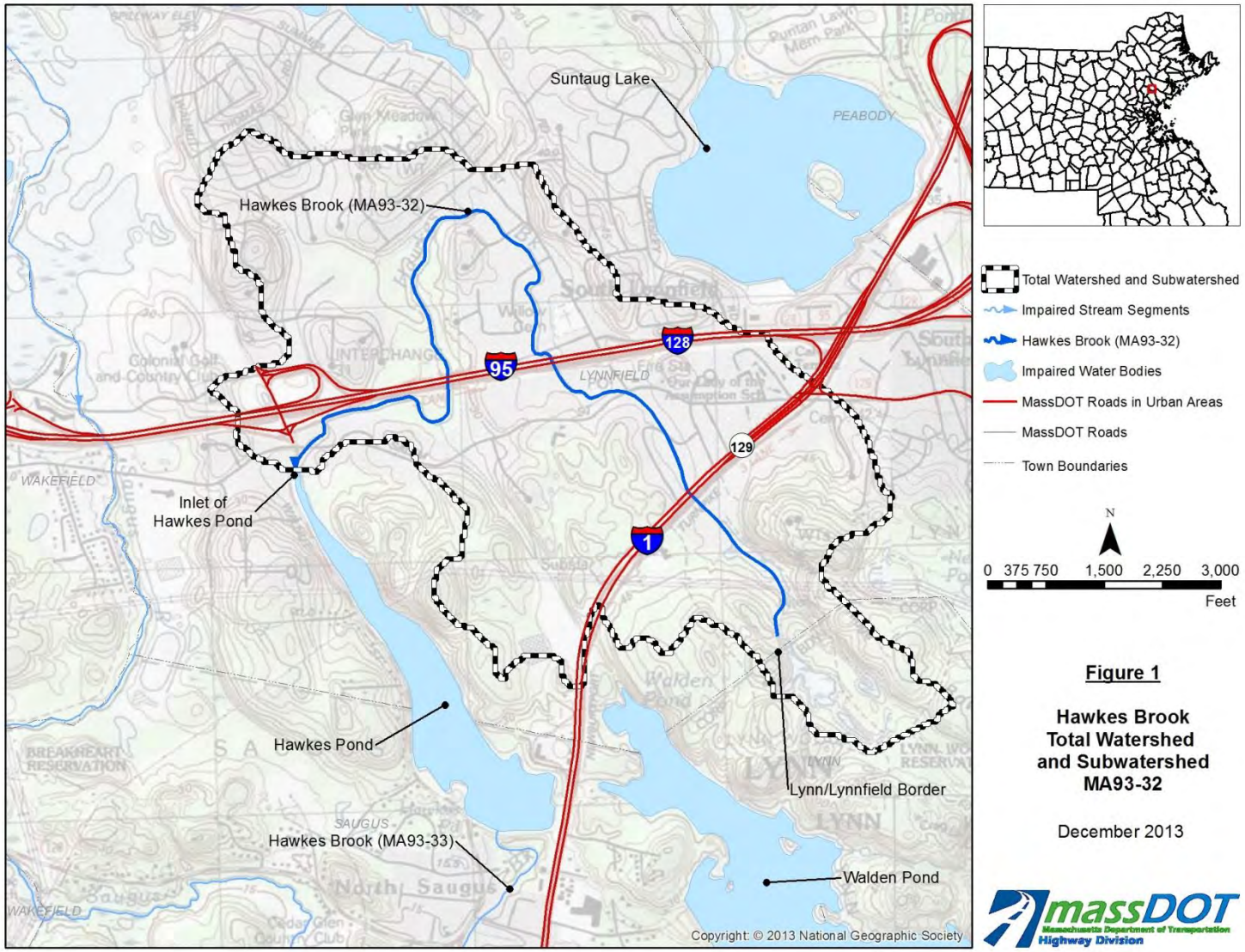

Figure 1

Hawkes Brook
Total Watershed
and Subwatershed
MA93-32

December 2013

Impaired Waters Assessment for Hawkes Brook (MA93-33) - Final Report

Impaired Water Body

Name: Hawkes Brook

Location: Saugus, MA

Water Body ID: MA93-33

Impairments

Hawkes Brook (MA93-33) is listed under Category 5, "Impaired and requires one or more TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013), but also is covered by the Final Pathogen TMDL for the North Coastal Watershed (MassDEP, 2012). Hawkes Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *North Shore Coastal Watersheds 2002 Water Quality Assessment Report* (MassDEP, 2007), Hawkes Brook (MA93-33) has not been assessed for any designated uses due to limited data being available. Quality samples obtained in 2007 showed elevated total fecal coliform bacteria concentrations during dry-weather conditions (MassDEP, 2012).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(a) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not

exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Hawkes Brook flows from the outlet of Hawkes Pond in Saugus to confluence with the Saugus River. The segment is 1.1 miles long (MassDEP, 2007).

The watershed for Segment MA93-33 Hawkes Brook is in a primarily residential area, with some commercial buildings. The brook runs parallel to portions of Route1 and Route 129, within 500 feet. The brook then discharges into the Saugus River. Refer to Figure 1 for the total watershed and to Figure 2 for the subwatershed to Segment MA93-33 of Hawkes Brook.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA93-33 of Hawkes Brook is comprised of portions of Route 1 and Route 129. Refer to Figure 2 for the location of this roadway within the subwatershed to Segment MA93-33 of Hawkes Brook.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been

reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the North Coastal Watershed (CN: 155.0)* covers the lakes, ponds, rivers, and estuary areas of the North Coastal Watershed (MassDEP, 2012).

Suspected and known dry-weather sources of bacteria reported in the TMDL report include leaking sewer pipes, illicit connections, failing septic systems, recreational activities, wildlife, and discharge of boat waste. Wet-weather sources of bacteria, both suspected and known, include wildlife, stormwater runoff including Municipal Separate Sewer Systems (MS4), combined sewer overflows, and sanitary sewer overflows (MassDEP, 2012).

In an effort to eliminate bacteria sources, segments of the North Coastal Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform

concentration in receiving water, OWRs, public water supply intake, and proximity to swimming beaches. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2012).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any

discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the North Coastal Watershed TMDL report (Section 8.0, page 97-112) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Stormwater runoff management, such as street sweeping and/or managerial strategies with local controls
- Periodic monitoring

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

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

- Study and Rehabilitation of Closed Coastal Shellfishing Beds
- Identification and elimination of illicit sources
- Stormwater runoff management
- Septic tank controls
- Wastewater Treatment Plants
- Recreational waters use management
- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review

- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings

are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

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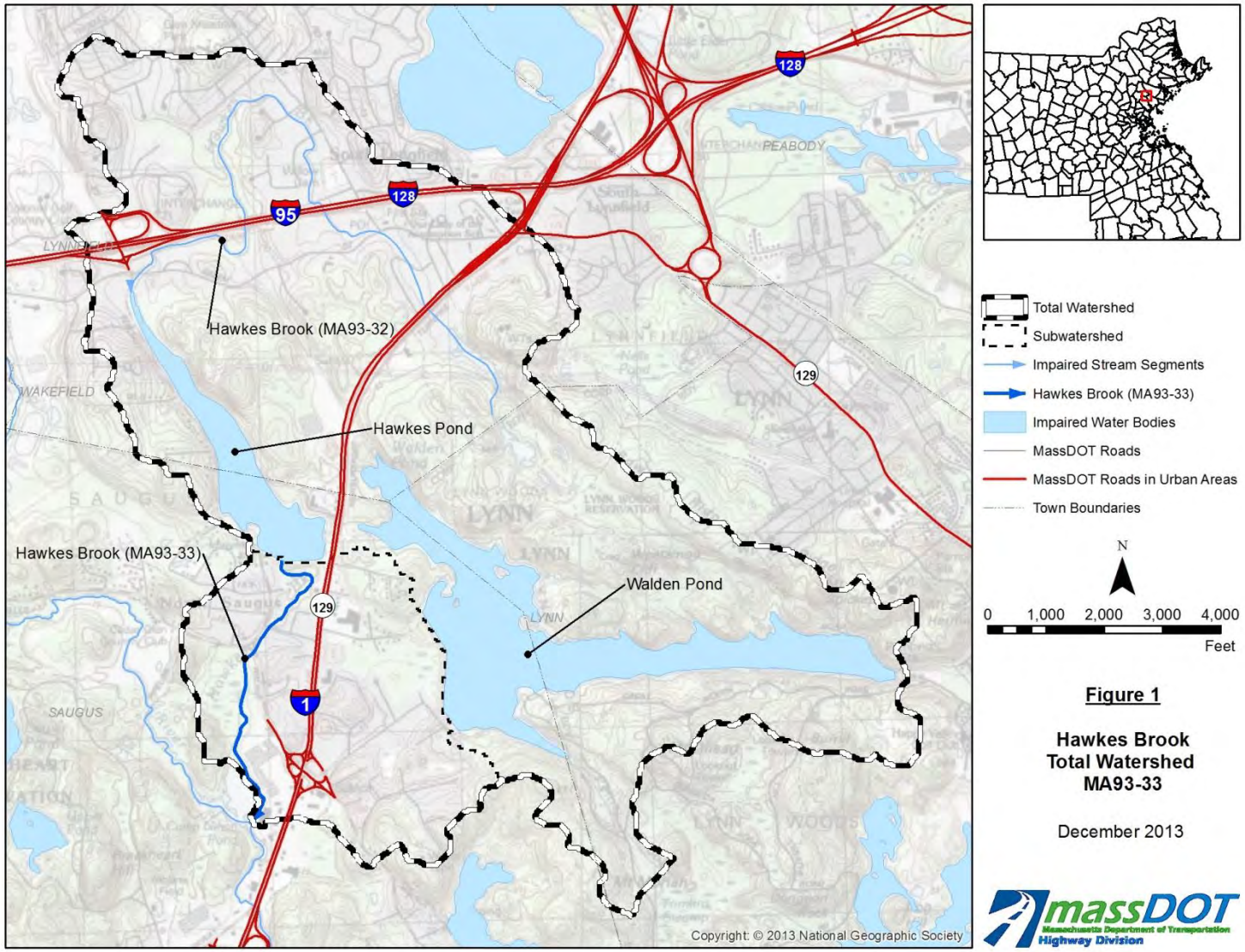

Figure 1

Hawkes Brook
Total Watershed
MA93-33

December 2013

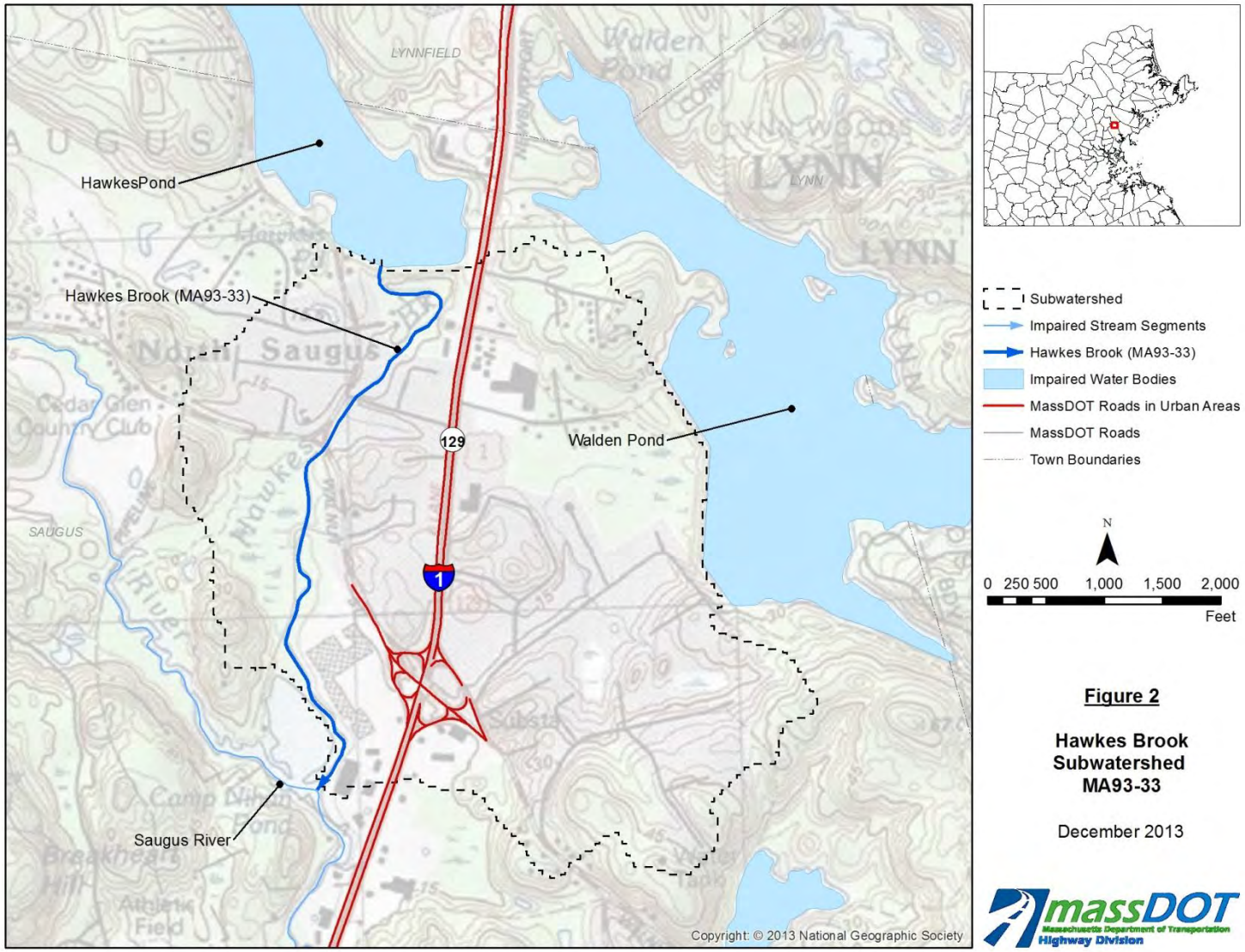

Figure 2

Hawkes Brook Subwatershed MA93-33

December 2013

Impaired Waters Assessment for Crane River (MA93-41) - Final Report

Impaired Water Body

Name: Crane River

Location: Saugus, MA

Water Body ID: MA93-41

Impairments

Crane River (MA93-41) is listed under Category 5, "Impaired and requires one or more TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013), but also is covered by the Final Pathogen TMDL for the North Coastal Watershed (MassDEP, 2012). Crane River is impaired for the following:

- Fecal Coliform

According to MassDEP's *North Shore Coastal Watersheds 2002 Water Quality Assessment Report* (MassDEP, 2007), Crane River (MA93-41) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. Crane River's specific suspected sources include Municipal Separate Storm Sewer Systems (MS4), boating pump-out releases, and boating sanitary on-vessel discharges. No other designated uses have been assessed due to limited data being available. Prior to 1975, Crane River received wastewater discharged by the former Creese & Cook Co., a tannery that operated until 1984 adjacent to the south bank of the river. Soil samples have indicated elevated levels of arsenic and remediation efforts are on-going, however, the lagoons on the former tannery site could pose a threat to the Crane River (MassDEP, 2007).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 314 CMR 4.05 (4)(a) 4 Bacteria.
  - a. Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 per 100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall

exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed a geometric mean of 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all samples taken within the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Crane River flows from the outlet of a pump house sluiceway on Purchase Street in Danvers to confluence with the Danvers River. The segment is 0.07 square miles (MassDEP, 2007).

The watershed for Segment MA93-41 Crane River is in both a residential and a commercial area, with multiple commercial buildings within 1,000 feet of the river. The river crosses under both Route 128 and Route 35, prior to confluence with the Danvers River. Route 35 is not MassDOT property. Refer to Figure 1 for the total watershed and subwatershed to Segment MA93-41 of Crane River.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA93-41 of Crane River is comprised of portions of Route 1, Route 95, Route 114, and Route 128. Route 128 is the only MassDOT property within 5,000 feet of the river. Refer to Figure 1 for the location of these roadways within the subwatershed to Segment MA93-41 of Crane River.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the North Coastal Watershed (CN: 155.0)* covers the lakes, ponds, rivers, and estuary areas of the North Coastal Watershed (MassDEP, 2012).

Suspected and known dry-weather sources of bacteria reported in the TMDL report include leaking sewer pipes, illicit connections, failing septic systems, recreational activities, wildlife, and discharge of boat waste. Wet-weather sources of bacteria, both suspected and known, include wildlife, stormwater runoff including Municipal Separate Sewer Systems (MS4), combined sewer overflows, and sanitary sewer overflows (MassDEP, 2012).

In an effort to eliminate bacteria sources, segments of the North Coastal Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, OWRs, public water supply intake, and proximity to swimming beaches. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2012).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- “given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP’s expectation is that for stormwater an iterative approach is needed…” (MassDEP, 2009a)
- “The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.”(MassDEP, 2009b)
- “Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs.” (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of

stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states “For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA.” Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the North Coastal Watershed TMDL report (Section 8.0, page 97-112) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Stormwater runoff management, such as street sweeping and/or managerial strategies with local controls
- Periodic monitoring

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

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

- Study and Rehabilitation of Closed Coastal Shellfishing Beds
- Identification and elimination of illicit sources
- Stormwater runoff management
- Septic tank controls
- Wastewater Treatment Plants
- Recreational waters use management
- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

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

no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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MassDEP. (2009b). Final Pathogen TMDL for the Cape Cod Watershed. Available at: MassDEP 2009b Final Pathogen TMDL for the Cape Cod Watershed Area

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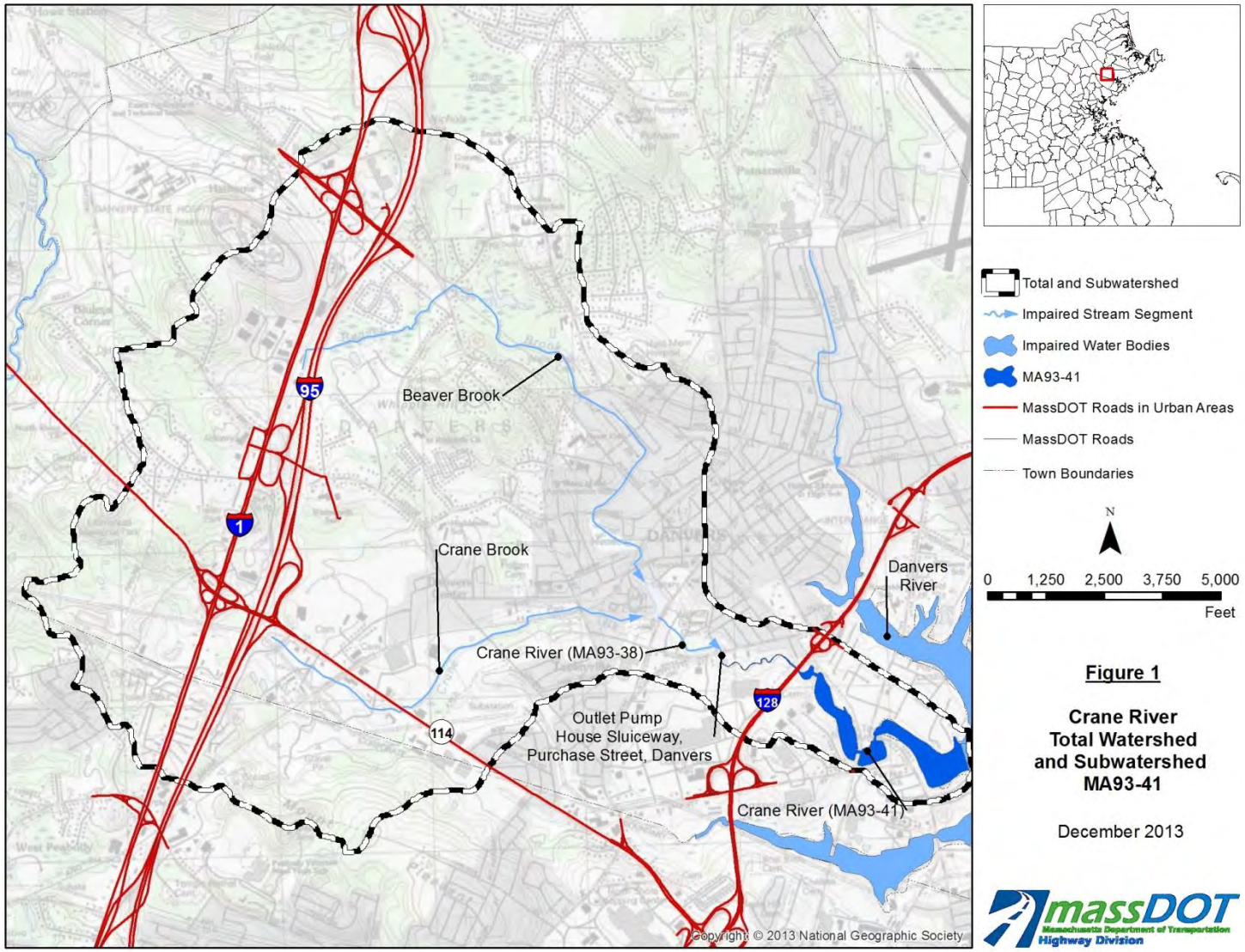

Figure 1

Crane River Total Watershed and Subwatershed MA93-41

December 2013

Impaired Waters Assessment for Bennetts Pond Brook (MA93-48) - Final Report

Impaired Water Body

Name: Bennetts Pond Brook

Location: Melrose and Saugus, MA

Water Body ID: MA93-48

Impairments

Bennetts Pond Brook (MA93-48) is listed under Category 5, "Impaired and requires one or more TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013), but also is covered by the Final Pathogen TMDL for the North Coastal Watershed (MassDEP, 2012). Bennetts Pond Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *North Shore Coastal Watersheds 2002 Water Quality Assessment Report* (MassDEP, 2007), Bennetts Pond Brook (MA93-48) is supported for aquatic life, with an alert status to identify the elevated concentrations of total phosphorus. Aesthetic uses were also assessed as supported because no objectionable conditions were observed. Both primary and secondary contact recreation are impaired due to the elevated fecal coliform bacteria. Suspected sources include discharge from Municipal Separate Storm Sewer Systems (MS4) and highway and road runoff. Fish consumption was not assessed (MassDEP, 2007).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(a) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall

not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Bennetts Pond Brook headwaters are located east of Lynn Fells Parkway (in Bellevue Golf Course) in Melrose, and the brook flows to its confluence with the Saugus River in Saugus. The segment is 2.4 miles long (MassDEP, 2007).

The watershed for Segment MA93-48 Bennetts Pond Brook is in a primarily residential area, with some commercial buildings. The brook runs along Lynn Fells Parkway and crosses Route 1 prior to its confluence with the Saugus River. Refer to Figure 1 for the total watershed and subwatershed to Segment MA93-48 of Bennetts Pond Brook.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA93-48 of Bennetts Pond Brook is comprised of portions of Route 1. Refer to Figure 1 for the location of these roadways within the subwatershed to Segment MA93-48 of Bennetts Pond Brook.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen

concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the North Coastal Watershed (CN: 155.0)* covers the lakes, ponds, rivers, and estuary areas of the North Coastal Watershed (MassDEP, 2012).

Suspected and known dry-weather sources of bacteria reported in the TMDL report include leaking sewer pipes, illicit connections, failing septic systems, recreational activities, wildlife, and discharge of boat waste. Wet-weather sources of bacteria, both suspected and known, include wildlife, stormwater runoff including Municipal Separate Sewer Systems (MS4), combined sewer overflows, and sanitary sewer overflows (MassDEP, 2012).

In an effort to eliminate bacteria sources, segments of the North Coastal Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, OWRs, public water supply intake, and proximity to swimming beaches. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2012).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they

represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states “For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA.” Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the North Coastal Watershed TMDL report (Section 8.0, page 97-112) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Stormwater runoff management, such as street sweeping and/or managerial strategies with local controls
- Periodic monitoring

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

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

- Study and Rehabilitation of Closed Coastal Shellfishing Beds
- Identification and elimination of illicit sources
- Stormwater runoff management
- Septic tank controls
- Wastewater Treatment Plants
- Recreational waters use management
- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure

- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing

stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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MassDEP. (2009b). Final Pathogen TMDL for the Cape Cod Watershed. Available at: MassDEP 2009b Final Pathogen TMDL for the Cape Cod Watershed Area

MassDEP. (2012). Final Pathogen TMDL for the North Coastal Watershed. Available at: MassDEP 2012 Final Pathogen TMDL for the North Coastal Watershed Area

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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.

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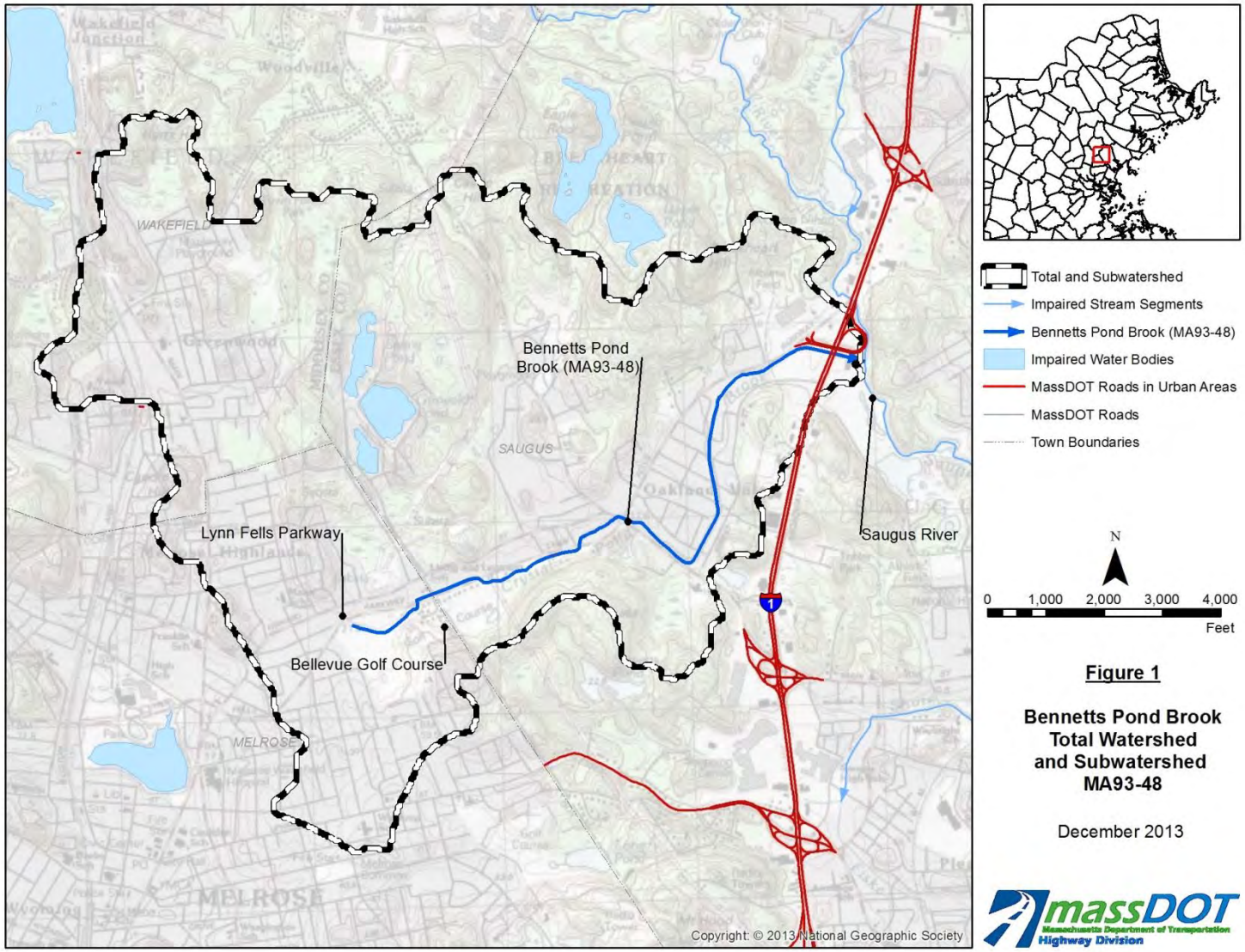

Figure 1

Bennetts Pond Brook Total Watershed and Subwatershed MA93-48

December 2013

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Shute Brook (MA93-50) – Final Report

Impaired Water Body

Name: Shute Brook

Location: Saugus, MA

Water Body ID: MA93-50

Impairments

Shute Brook (MA93-50) is listed under Category 5, "Impaired and requires one or more TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013), but also is covered by the Final Pathogen TMDL for the North Coastal Watershed (MassDEP, 2012). Shute Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *North Shore Coastal Watersheds 2002 Water Quality Assessment Report* (MassDEP, 2007), Shute Brook (MA93-50) is supported for aquatic life, with an alert status to identify the elevated concentrations of total phosphorus and the excessive periphyton growth. Aesthetic uses were also assessed as supported because no objectionable conditions were observed. Both primary and secondary contact recreation are impaired due to the elevated fecal coliform bacteria. Suspected sources include discharge from Municipal Separate Storm Sewer Systems (MS4), highway and road runoff, and illicit sewer connections. Fish consumption was not assessed (MassDEP, 2007).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(a) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010:

the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Shute Brook flows from the confluence of Fiske Brook to approximately 350 feet downstream from Central Street in Saugus. The segment is 0.9 miles long (MassDEP, 2007).

The watershed for Segment MA93-50 Shute Brook is in a primarily residential area. Portions of the brook runs within 1,000 feet of Route 1. Refer to Figure 1 for the total watershed and the subwatershed to Segment MA93-50 of Shute Brook.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA93-50 of Shute Brook is comprised of portions of Route 1. Refer to Figure 1 for the location of these roadways within the subwatershed to Segment MA93-50 of Shute Brook.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's

specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen Total Maximum Daily Load (TMDL) for the North Coastal Watershed (CN: 155.0)* covers the lakes, ponds, rivers, and estuary areas of the North Coastal Watershed (MassDEP, 2012).

Suspected and known dry-weather sources of bacteria reported in the TMDL report include leaking sewer pipes, illicit connections, failing septic systems, recreational activities, wildlife, and discharge of boat waste. Wet-weather sources of bacteria, both suspected and known, include wildlife, stormwater runoff including Municipal Separate Sewer Systems (MS4), combined sewer overflows, and sanitary sewer overflows (MassDEP, 2012).

In an effort to eliminate bacteria sources, segments of the North Coastal Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, OWRs, public water supply intake, and proximity to swimming beaches. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2012).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they

represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states “For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA.” Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the North Coastal Watershed TMDL report (Section 8.0, page 97-112) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Stormwater runoff management, such as street sweeping and/or managerial strategies with local controls
- Periodic monitoring

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

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

- Study and Rehabilitation of Closed Coastal Shellfishing Beds
- Identification and elimination of illicit sources
- Stormwater runoff management
- Septic tank controls
- Wastewater Treatment Plants
- Recreational waters use management
- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure

- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

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

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff is trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing

stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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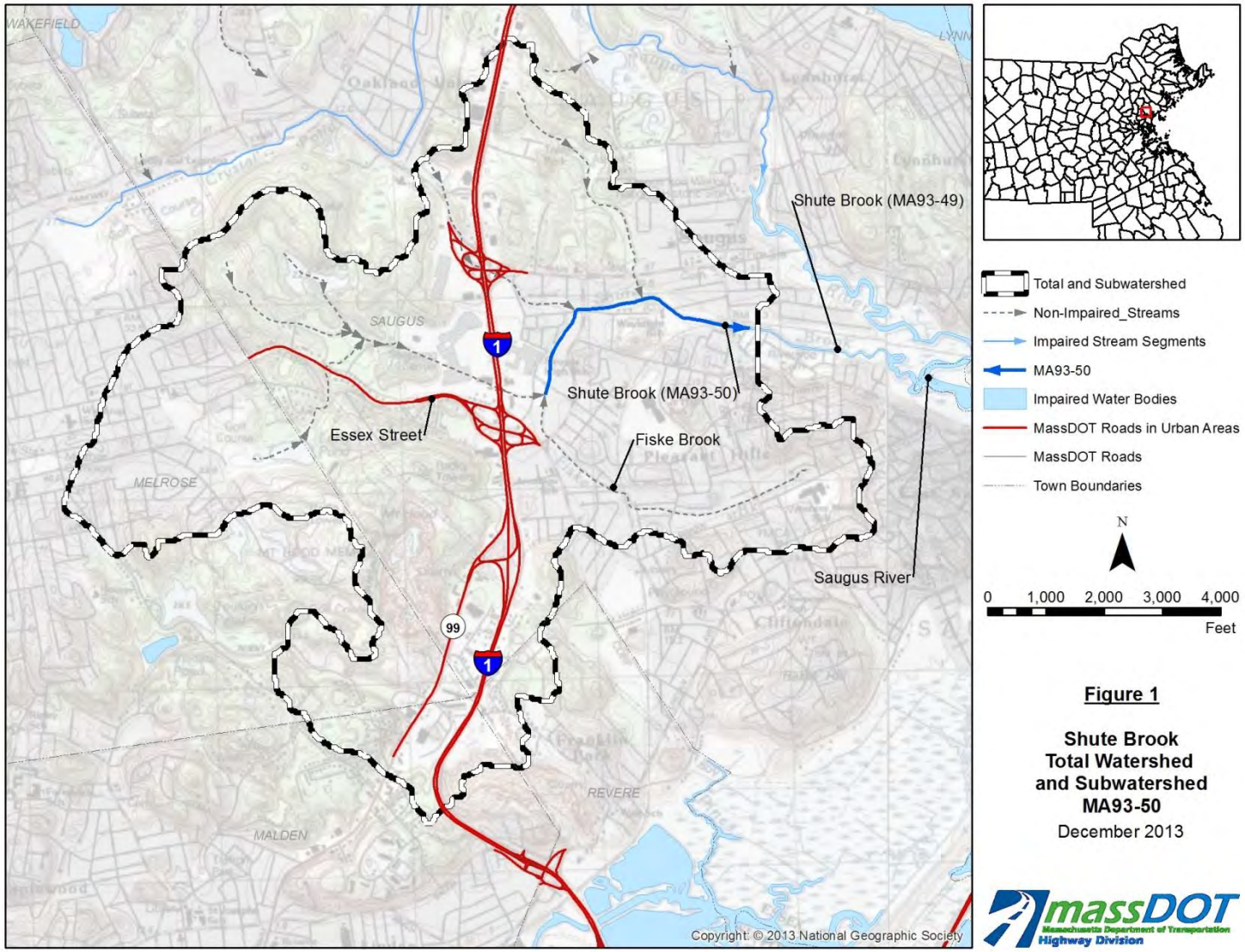

Figure 1

Shute Brook
Total Watershed
and Subwatershed
MA93-50
December 2013

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Lynn Harbor (MA93-52) – Final Report

Impaired Water Body

Name: Lynn Harbor

Location: Lynn, Nahant and Revere, MA

Water Body ID: MA93-52

Impairments

Lynn Harbor (MA93-52) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013), but also is covered by the Final Pathogen TMDL for the North Coastal Watershed (MassDEP, 2012). Lynn Harbor (MA93-52) is impaired for the following:

- Fecal Coliform

According to MassDEP's *Final Pathogen TMDL for the North Coastal Watershed* (MassDEP, 2012), combined sewer overflows (CSOs) have been a historical problem in the Lynn Harbor and the Saugus River System, which drains to Lynn Harbor. Lynn Harbor is covered by the aforementioned TMDL of the North Coastal Watershed.

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100

ml and the geometric mean of all of the samples taken during the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The segment of Lynn Harbor (MA93-52) is defined as the 1.62 square mile estuary making up the inner portion of Lynn Harbor, bounded by the Saugus River (MA93-44) segment and the outer Lynn Harbor (MA93-53) segment (MassDEP, 2013). Lynn Harbor is located at the downstream end of the Saugus River System. The two major tributaries to Lynn Harbor are the Pines River (MA93-15) and the Saugus River (MA93-44) (MassDEP, 2007).

The Lynn Water and Sewer Commission (LWSC) has an authorized NPDES discharge into Lynn Harbor (MA0100552, issued in May 2000). LWSC is authorized to discharge via outfalls #002, #004 and #005 to Lynn Harbor (MassDEP, 2007). The LWSC is currently undergoing CSO abatement actions to reduce the amount of CSO volume discharged into Lynn Harbor (MassDEP, 2012).

The following communities within the Saugus River System have MS4 coverage as part of the NPDES program: Saugus (MAR041059), Revere (MAR041057), Wakefield (MAR041065), Lynn (MAR041044), Melrose (MAR041050), and Malden (MAR041046) (MassDEP, 2012).

MassDOT's property with the potential to directly contribute stormwater runoff to Lynn Harbor (MA93-52) occurs along Carroll Parkway in Lynn. Refer to Figure 1 for the total watershed and Figure 2 for the subwatershed to Segment MA93-52 of Lynn Harbor.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen TMDL for the North Coastal Watershed (CN 155.0)* covers Lynn Harbor and its tributaries. According to the TMDL, the main potential source of fecal coliform contamination in Lynn

Harbor is due to CSOs. Sanitary sewer overflows and discharges from MS4 systems are also suspected sources of fecal coliform contamination (MassDEP, 2007).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

The TMDL prioritized the North Coastal Watershed impaired segments based on a simple approach due to limited source information and data within each segment. Lynn Harbor was classified as a high priority segment since its measured fecal coliform concentrations were equal to or greater than 10,000 cfu/100 mL in past water quality monitoring studies.

For a surface water classification of SB, such as Lynn Harbor, the TMDL applies the following waste load allocation or load allocation (depending on pathogen source): fecal coliform less than or equal to median or geometric mean, MPN, of 88 organisms per 100 mL nor shall 10% of the samples be greater than or equal to 260 organisms per 100 mL.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- “given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP’s expectation is that for stormwater an iterative approach is needed…” (MassDEP, 2009a)
- “The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.”(MassDEP, 2009b)
- “Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs.” (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen

TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states “For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA.” Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the North Coastal Watershed TMDL report (Section 8.0, page 97-112) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Stormwater runoff management, such as street sweeping and/or managerial strategies with local controls
- Periodic monitoring

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

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

- Study and Rehabilitation of Closed Coastal Shellfishing Beds
- Identification and elimination of illicit sources
- Stormwater runoff management
- Septic tank controls
- Wastewater Treatment Plants
- Recreational waters use management
- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains towards meeting the TMDL with solely implementing IC reductions and controls.

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

no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

References

Center for Watershed Protection (CWP). (2003). Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicott City, MD.

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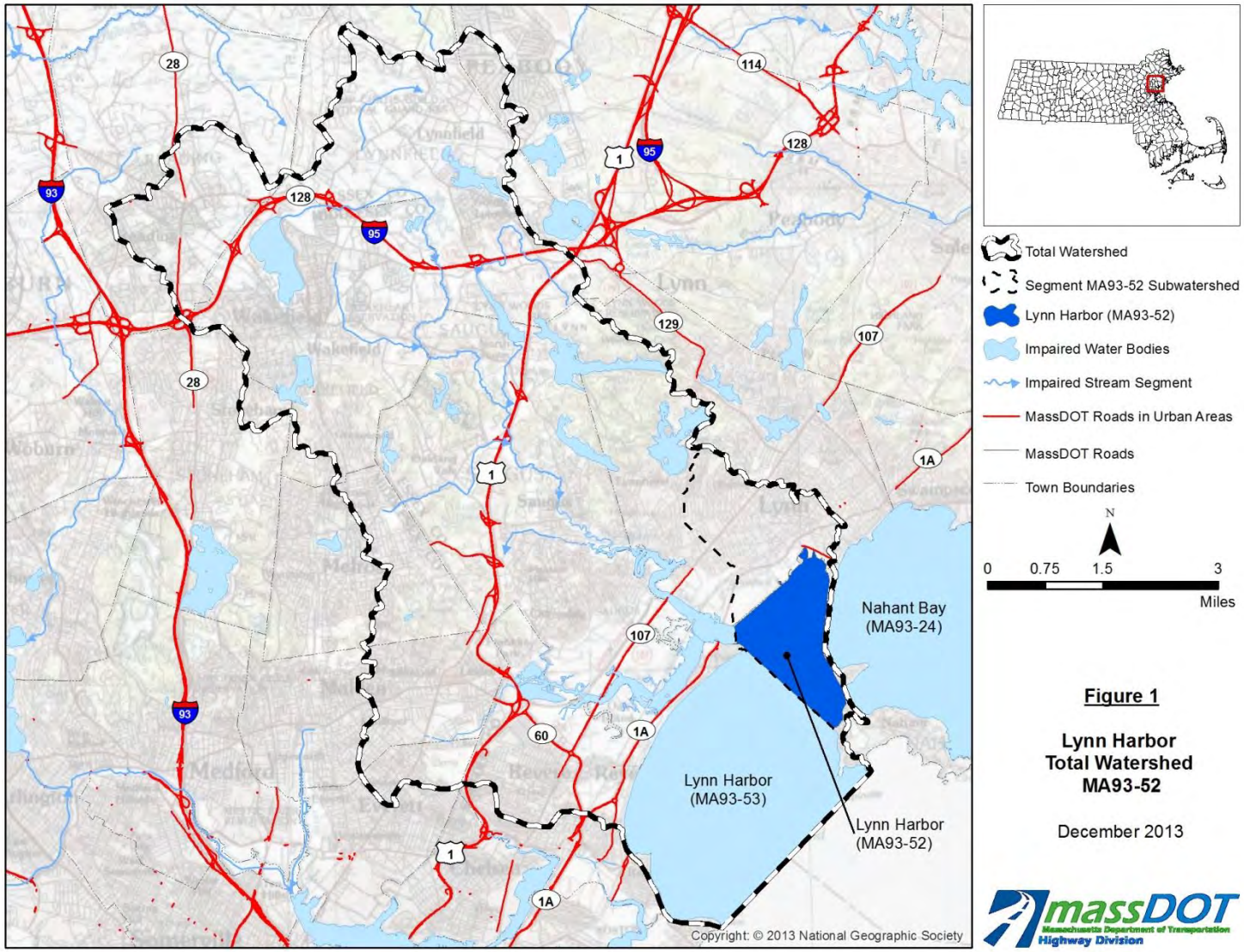

Figure 1

Lynn Harbor
Total Watershed
MA93-52

December 2013

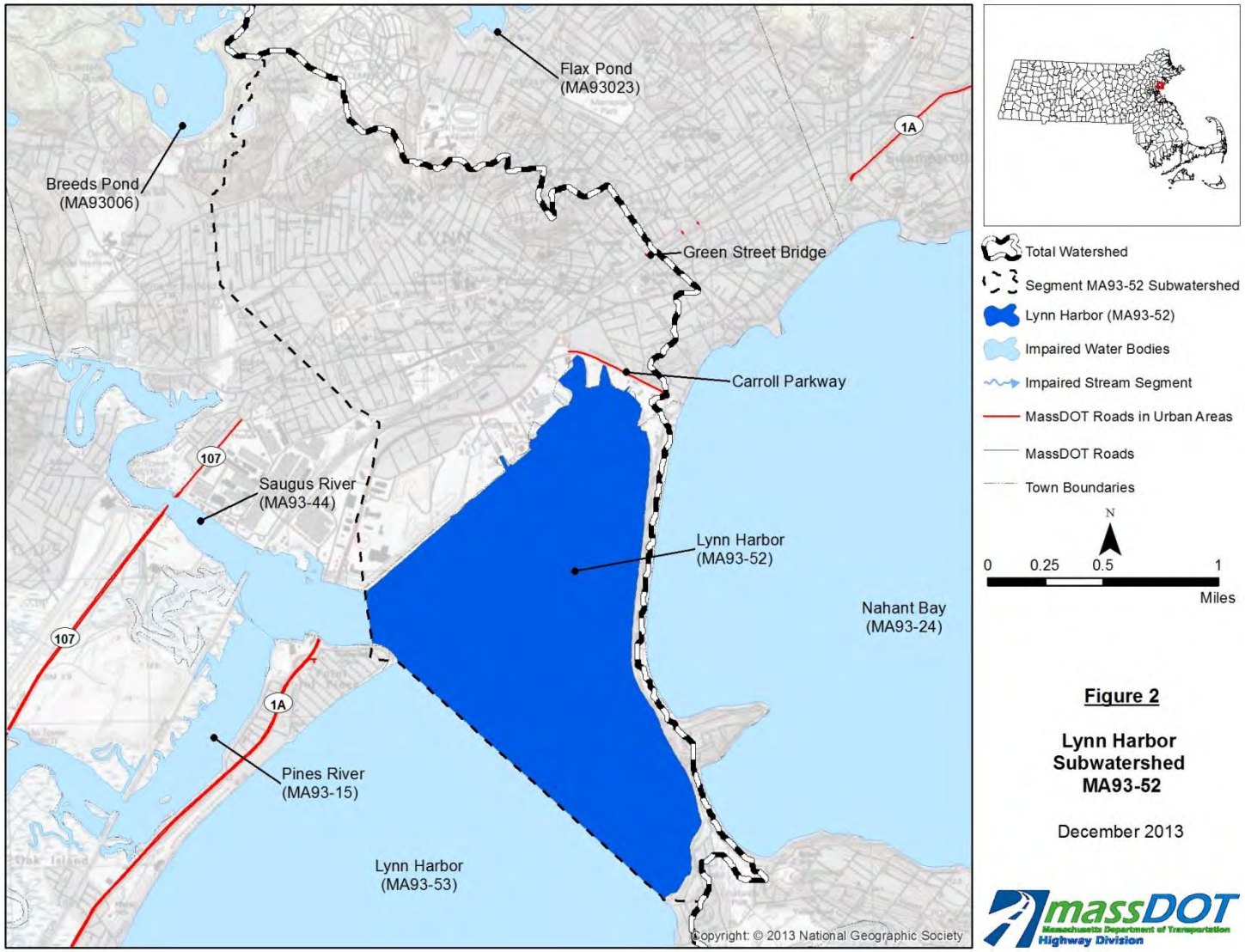

Figure 2

Lynn Harbor Subwatershed MA93-52

December 2013

Impaired Waters Assessment for Lynn Harbor (MA93-53) - Final Report

Impaired Water Body

Name: Lynn Harbor

Location: Nahant, Revere and Winthrop, MA

Water Body ID: MA93-53

Impairments

Lynn Harbor (MA93-53) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013), but also is covered by the Final Pathogen TMDL for the North Coastal Watershed (MassDEP, 2012). Lynn Harbor (MA93-53) is impaired for the following:

- Fecal Coliform

According to MassDEP's *Final Pathogen TMDL for the North Coastal Watershed* (MassDEP, 2012), combined sewer overflows (CSOs) have been a historical problem in the Lynn Harbor and the Saugus River System, which drains to Lynn Harbor. Lynn Harbor is covered by the aforementioned TMDL of the North Coastal Watershed.

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100

ml and the geometric mean of all of the samples taken during the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The segment of Lynn Harbor (MA93-53) is defined as the 6.56 square mile estuary making up the outer portion of Lynn Harbor, bounded by the inner Lynn Harbor (MA93-52) segment (MassDEP, 2013). Lynn Harbor is located at the downstream end of the Saugus River System. The two major tributaries to Lynn Harbor are the Pines River (MA93-15) and the Saugus River (MA93-44) (MassDEP, 2007).

The Lynn Water and Sewer Commission (LWSC) has an authorized NPDES discharge into Lynn Harbor (MA0100552, issued in May 2000). LWSC is authorized to discharge via outfalls #002, #004 and #005 to Lynn Harbor (MassDEP, 2007). The LWSC is currently undergoing CSO abatement actions to reduce the amount of CSO volume discharged into Lynn Harbor (MassDEP, 2012).

The following communities within the Saugus River System have MS4 coverage as part of the NPDES program: Saugus (MAR041059), Revere (MAR041057), Wakefield (MAR041065), Lynn (MAR041044), Melrose (MAR041050), and Malden (MAR041046) (MassDEP, 2012).

MassDOT's property with the potential to directly contribute stormwater runoff to Lynn Harbor (MA93-53) occurs along Route 1A, North Shore Road and State Road, all located in Revere. Refer to Figure 1 for the total watershed and Figure 2 for the subwatershed to Segment MA93-53 of Lynn Harbor.

Assessment of Pathogen Impairment under BMP 7R

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (TMDL Watershed Review), which applies to impairments that have been assigned to a water body covered by a final TMDL. 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 (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment

The *Final Pathogen TMDL for the North Coastal Watershed (CN 155.0)* covers Lynn Harbor and its tributaries. According to the TMDL, the main potential source of fecal coliform contamination in Lynn

Harbor is due to CSOs. Sanitary sewer overflows and discharges from MS4 systems are also suspected sources of fecal coliform contamination (MassDEP, 2007).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

The TMDL prioritized the North Coastal Watershed impaired segments based on a simple approach due to limited source information and data within each segment. Lynn Harbor was classified as a high priority segment since its measured fecal coliform concentrations were equal to or greater than 10,000 cfu/100 mL in past water quality monitoring studies.

For a surface water classification of SB, such as Lynn Harbor, the TMDL applies the following waste load allocation or load allocation (depending on pathogen source): fecal coliform less than or equal to median or geometric mean, MPN, of 88 organisms per 100 mL nor shall 10% of the samples be greater than or equal to 260 organisms per 100 mL.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- “given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP’s expectation is that for stormwater an iterative approach is needed…” (MassDEP, 2009a)
- “The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.”(MassDEP, 2009b)
- “Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs.” (MassDEP, 2002).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen

TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states “For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA.” Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the North Coastal Watershed TMDL report (Section 8.0, page 97-112) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Identification and elimination of illicit sources
- Stormwater runoff management, such as street sweeping and/or managerial strategies with local controls
- Periodic monitoring

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

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

- Study and Rehabilitation of Closed Coastal Shellfishing Beds
- Identification and elimination of illicit sources
- Stormwater runoff management
- Septic tank controls
- Wastewater Treatment Plants
- Recreational waters use management
- Watershed resident education
- Additional monitoring

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains towards meeting the TMDL with solely implementing IC reductions and controls.

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

no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, and the Final Bacteria TMDL for this impaired water body segment that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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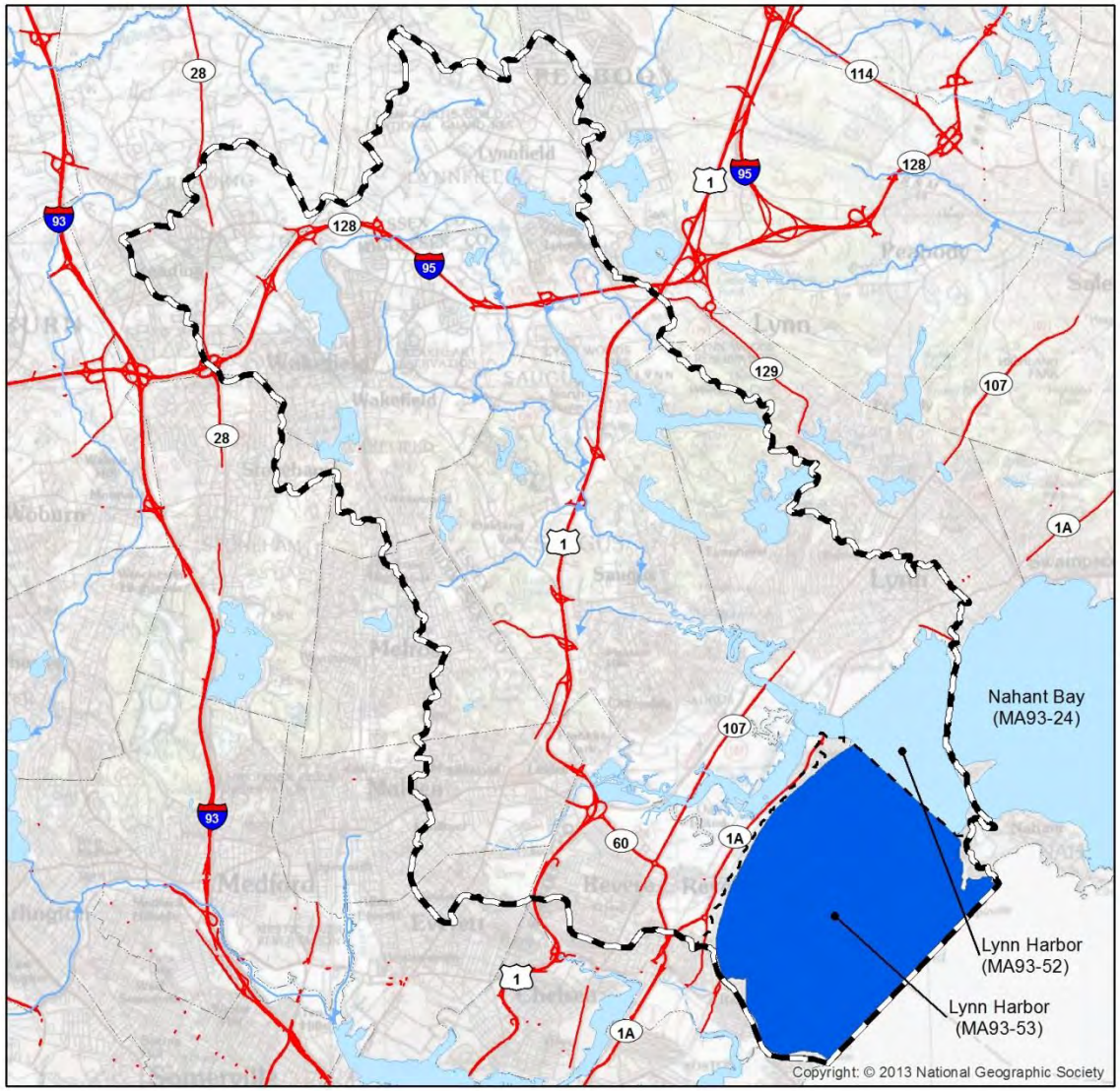
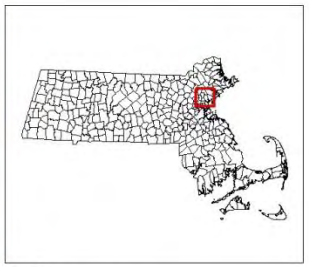




Total Watershed
Segment MA93-53 Subwatershed
Lynn Harbor (MA93-53)
Impaired Water Bodies
Impaired Stream Segment
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

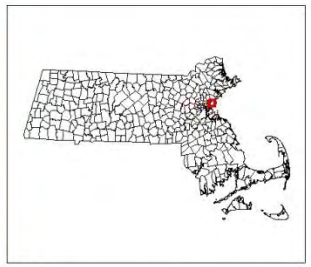
N

0 0.75 1.5 3
Miles

Figure 1

Lynn Harbor
Total Watershed
MA93-53

December 2013



Total Watershed
Segment MA93-53 Subwatershed
Lynn Harbor (MA93-53)
Impaired Water Bodies
Impaired Stream Segment
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.25 0.5 1
Miles

Figure 2

Lynn Harbor Subwatershed MA93-53

December 2013