Lake Phosphorus Control Plan (LPCP) for Newton Pond

TO: Town of Boylston Stormwater Committee

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Tighe & Bond is providing this memorandum to the Town of Boylston to document requirements of the U.S. Environmental Protection Agency's (EPA's) *General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems* (MS4GP) related to discharges to Newton Pond and its tributaries (see Part 2.2 and Appendix F of the MS4GP). This memorandum presents information regarding Newton Pond within the Blackstone River watershed affected by the MS4GP as well as the phased requirements for a Lake Phosphorus Control Plan (LPCP).

1. Overview of Newton Pond's Water Quality Concerns

As you are aware, a portion of the Town of Boylston's MS4 discharges to Newton Pond. Newton Pond occupies approximately 54 acres in both Boylston and Shrewsbury. In Boylston, the pond is located south of Mill Street, east of Main Street, and west of Sewall Street. The pond is fed by Sewall Brook. The total watershed of Newton Pond is approximately 4.29 square miles.

Figure 1, below, shows the location of Newton Pond, the approximate watershed, and Boylston's MS4 urbanized areas.

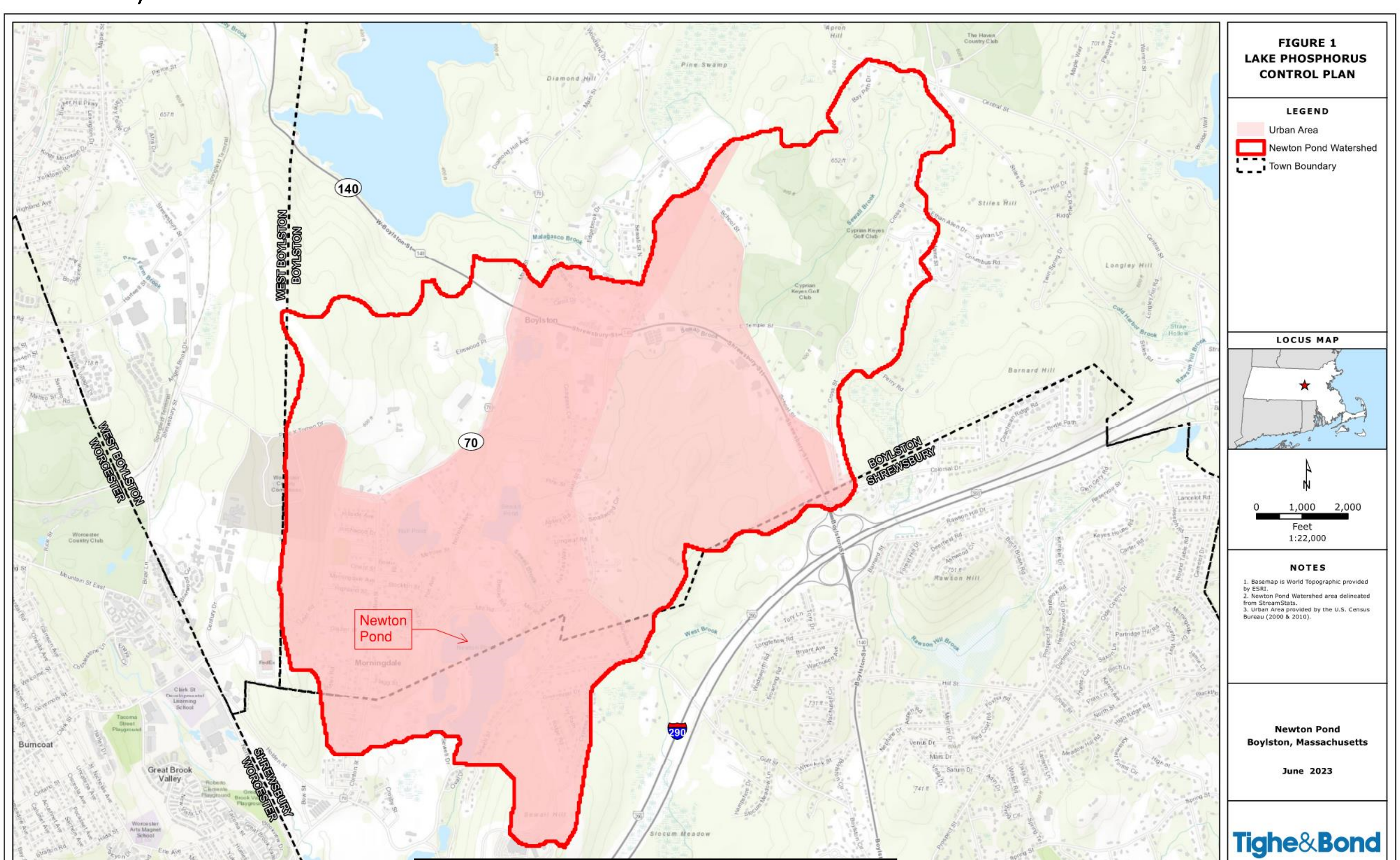

FIGURE 1: Newton Pond Watershed

The Watershed-Based Plan for Newton Pond is enclosed, which was prepared using the Massachusetts Watershed-Based Plan toolkit and provides additional background information about the watershed and water quality concerns.

A Total Maximum Daily Load (TMDL) (a.k.a. "pollution budget") for phosphorus was developed and approved in April 2002 for select waterbodies (lakes and ponds) in the Northern Blackstone River watershed, including Newton Pond[1]. Phosphorus is a nutrient that, when present at high levels in natural waterbodies, can cause overgrowth of aquatic plants, increased harmful algal blooms, decreased light in a waterbody, and decreased levels of dissolved oxygen, thereby impairing designated uses (aquatic life, fish consumption, primary and secondary contact, and aesthetics) per the Commonwealth's Surface Water Quality Standards (314 CMR 4.00). Phosphorus is a common pollutant in stormwater, with sources including leaf litter, pet waste, road salt, fertilizer, and atmospheric deposition. A variety of structural (infiltration and treatment structures) and non-structural (such as street sweeping and catch basin cleaning) Best Management Practices (BMPs) can be effective at reducing phosphorus loads from stormwater.

Per the TMDL, the lakes and ponds included "…were listed on the state "303d" list for a variety of pollutant and stressors including low dissolved oxygen, turbidity, nutrients, and over-abundance of nuisance aquatic plants. All of the pollutants and stressors are indicators of nutrient enriched systems, better known as the process of eutrophication. In freshwater systems the primary nutrient known to accelerate eutrophication is phosphorus. Therefore, in order to prevent further degradation in water quality and to ensure that each lake meets state water quality standards the TMDL establishes a phosphorus limit for each lake and outlines corrective actions to achieve that goal." There was limited data collected by the Massachusetts Department of Environmental Protection (MassDEP) in July 1994 that informed the TMDL and there was no detailed study of the nutrient sources within the watersheds conducted to develop the TMDL. Thus, nutrient sources were estimated based on land use modeling within MassDEP's NPSLAKE model.

Since approval of the TMDL in early 2002, iterations of the Integrated List of Waters have consistently listed Newton Pond as being impaired by aquatic plants (non-native) and by noxious aquatic plants (macrophytes). However, in the Massachusetts Final 2016 Integrated List of Waters, approved in January 2020, the aquatic plant (macrophytes) impairment was *removed* for Newton Pond because, as stated in the List, "applicable water quality standards [are] attained; according to new assessment method." The Massachusetts Final 2018/2020 Integrated List of Waters was approved in February 2022 and added a new impairment for Fanwort, a specific species of non-native aquatic plant. The Final 2022 Integrated List of Waters was approved in May 2023 and included no changes to the Newton Pond impairments. Excerpts from the 2014, 2016, 2018/2020, and 2022 Integrated List of Waters are enclosed.

Correspondence with permit writers at EPA indicates that an update to the Integrated List of Waters list does not supersede a TMDL and a state can only change a TMDL by updating or withdrawing it. Each community remains subject to that TMDL and the conditions of the MS4GP until the applicable TMDL is updated by the State. EPA recommended coordination with MassDEP. Following consultation with MassDEP in Permit Year 4, it was confirmed that the TMDL is not scheduled to be updated at this time because MassDEP considers the TMDL to be protective versus restorative for Newton Pond, and the Town should continue efforts toward completing the required Phosphorus Control Plan.

[1] Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes (TMDL Report Number: MA51004-2002-3), https://www.mass.gov/doc/final-tmdl-for-northern-blackstone-lakes/download

2. EPA's Lake (& Pond) Phosphorus Reduction Requirements

To address a required phosphorus reduction of 19% in Newton Pond, the MS4GP requires Boylston to develop a written LPCP and fully implement all control measures as soon as possible but no later than June 30, 2033 (15 years from effective date of MS4GP). The LPCP includes the following elements:

- Legal analysis (completed September 28, 2020 and included in this memorandum with applicable updates)
- Funding source assessment (completed in Permit Year 2 and included in this memorandum)
- Define LPCP scope/area and calculate baseline phosphorus, allowable phosphorus load, and phosphorus reduction requirement (completed in Permit Year 4 and included in this memorandum)
- Describe planned non-structural and structural controls, operation & maintenance (O&M) program, implementation schedule, costs, funding sources assessment (update), and prepare a fully written LPCP (due Permit Year 5, included in this memorandum)

The MS4GP assumes phosphorus will first be addressed with non-structural controls (street sweeping, catch basin cleaning, and enhanced leaf litter pickup), assessing performance of those controls, and then adding structural controls and assessing performance over the remaining years through 2033.

Tighe & Bond is providing this memorandum to document compliance with Part 2.2 and Appendix F, Part A.II of the MS4GP.

3. LPCP "Legal Analysis" Requirements

According to Appendix F, as part of developing and implementing a LPCP designed to reduce the amount of phosphorus in stormwater discharges from the MS4 to Newton Pond and its tributaries, Boylston must conduct an analysis of local legal authority that may be necessary to effectively implement the entire LPCP (termed by EPA as a "legal analysis"). A description of the Phase 1 PCP Legal Analysis, as stated in the MS4GP, reads as follows:

> *The permittee shall develop and implement an analysis that identifies existing regulatory mechanisms available to the MS4 such as by-laws and ordinances and describes any changes to these regulatory mechanisms that may be necessary to effectively implement the LPCP. This may include the creation or amendment of financial and regulatory authorities. The permittee shall adopt necessary regulatory changes by the end of the permit term.*

Tighe & Bond has prepared the LPCP Legal Analysis to identify existing regulatory mechanisms available to the Town such as bylaws and regulations and any changes to regulatory mechanisms that may be necessary to effectively implement the entire LPCP. The following includes an analysis of available non-structural, structural, and semi-structural phosphorus reduction actions; current legal authority of the Town to implement those actions on both public and private property; and future changes that would be required to fully implement the LPCP. This analysis also considers the potential use of a Stormwater Utility or Enterprise Fund that could include a credit system for private properties, as well as the potential for EPA taking Residual Designation Authority (RDA) over private properties.

3.1 Legal Authority to Implement the LPCP on Public Property

Current Authority

The Town of Boylston has authority to undertake all structural and non-structural controls on public property. Public property consists of Town owned or operated parcels including parking lots, as well as municipal roadways and the right of way. Boylston can complete street sweeping, catch basin cleaning, and although perhaps not desired, an enhanced Organic Waste and Leaf Litter Collection program, both now and in the future. Boylston has authority to install structural or semi-structural BMPs on Town-owned lands.

Changes Needed

There are no legal changes necessary to implement the LPCP on public property. However, requiring all public new and redevelopment projects to implement structural BMPs that improve water quality, beyond those required by current local code, requires buy-in from municipal officials and planning for these efforts in capital and operational budgets.

3.2 Legal Authority to Implement the LPCP on Private Property

Current Authority

Local Code:

- Stormwater Control By-Law and Conservation Commission Rules & Regulations for Stormwater: The Town's Stormwater Control By-Law[2] outlines the following thresholds for projects requiring a Stormwater Control Permit through the Conservation Commission:

    1. Any Subdivision requiring a Definitive Plan;

    2. Any activities that result in a land disturbance greater than one acre; and

    3. The activities that result in a land disturbance less than one acre if the project is part of a larger common plan of development which will eventually disturb greater than one acre.

  As outlined in the associated Regulations[3], stormwater management systems installed on new development and redevelopment sites must meet total phosphorus removal standards as outlined in the MS4GP. Additionally, the Regulations require applicants to implement structural and non-structural stormwater BMPs that are optimized to remove the pollutant(s) responsible for nearby waterbody impairments or TMDLs, which includes this Newton Pond phosphorus TMDL.

- Title V: Title V applies to subsurface sewage disposal systems (septic systems) of 10,000 gallons per day or less that must conform to 310 CMR 15.00. This includes private residential properties in Boylston. Implementation of the Town's Title V code and providing educational materials about proper maintenance to septic system owners can help reduce phosphorus loadings to local waters via leaching or failing systems.

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[2] The Town's Stormwater Control By-Law is Article VI, Section 9 of the General By-Laws, amended 2006.

[3] The Boylston Conservation Commission Rules & Regulations for Stormwater include additional requirements and were last amended 2022.

Non-Structural BMPs:

- Catch Basin Cleaning: Catch basin cleaning on private properties by a private entity can only be enforced under a local permit or Order of Conditions that requires catch basin cleaning through an O&M plan currently required for under jurisdiction of Wetlands, Stormwater, and/or Site Plan Review.
- Enhanced Sweeping: Boylston has no authority to physically sweep on private individual properties. Similar to catch basin cleaning, this could be required as an ongoing condition through an O&M Plan required by the Conservation Commission.
- Enhanced Organic Waste and Leaf Litter Collection Program: Boylston has no authority to require this work on private property; further, the Town has no control over the method of disposal on private individual properties. While Boylston does hold yard waste collection days each Fall, in order to meet the Organic Waste and Leaf Litter Collection program requirements in Appendix F, the Town must gather and remove all landscaping wastes, organic debris, and leaf litter from impervious roadways and parking lots at least once per week during the period of September 1 to December 1 of each year.

Semi-Structural BMPs[4]: There is limited opportunity to require semi-structural BMPs through current code.

Structural BMPs[5]: Structural BMPs on private properties can only be required through issuance of a local permit or Order of Conditions that requires structural BMPs as part of permit conditions and/or O&M plan currently required for projects under jurisdiction of Wetlands, Stormwater, and/or Site Plan Review. **Currently, it is impossible under local code for the Town to require a completed project to retrofit the drainage system to add structural BMPs.**

Changes Needed

To fully implement the LPCP on private property, there would need to be significant changes to local and/or state and federal permitting. Note that the Newton Pond watershed area covers only a portion of Boylston, as shown in **Figure 1**. Additionally, the Town's MS4 covers only a portion of the Newton Pond watershed. The requirements of the LPCP are only applicable in the area covered by both the watershed and the MS4.

Some changes to consider include:

1. Potentially reducing the threshold by which a project would be reviewed locally and obtain a stormwater control permit. Currently the Town threshold is one acre. Reducing this threshold would require new and redevelopment projects to comply with phosphorus reduction requirements.
2. Changes to roadway width, parking, and other requirements in zoning and subdivision that result in creation of impervious cover. Additional recommendations related to impervious cover provisions in local code are outlined in the *Town of Boylston – Local Code Assessment* memorandum completed in June 2022.

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[4] Semi-structural BMPs include impervious area disconnection through storage (e.g., rain barrels, cisterns, etc.), impervious area disconnection, conversion of impervious area to permeable pervious area, and soil amendments to enhance permeability of pervious areas

[5] Structural BMPs include infiltration trench, infiltration basin or other surface infiltration practice, bio-filtration practice, gravel wetland system, porous pavement, wet pond or wet detention basin, dry pond or detention basin, dry water quality swale/grass swale

3. Development of a rain barrel program.
4. Developing a Stormwater Utility or Enterprise Fund and incentivizing private sites to take their own actions through a credit system.
5. Politically, it will be very challenging if not impossible to require private properties to retrofit a site without an activity that triggers local permitting. EPA Region 1 has been petitioned to take Residual Designation Authority (RDA)[6] of various watersheds. Boylston can consider supporting a RDA petition, if desired, however, elected officials and decision makers should carefully consider balancing Town needs with the economics of private landowners.

4. LPCP Funding Source Assessment

According to Appendix F, as part of developing and implementing a LPCP designed to reduce the amount of phosphorus in stormwater discharges from the MS4 to Newton Pond and its tributaries, Boylston must conduct an assessment of possible funding sources that may be used to implement the LPCP. A description of the Phase 2 LPCP funding source assessment, as stated in the MS4GP, is as follows:

> *The permittee shall describe known and anticipated funding mechanisms (e.g. general funding, enterprise funding, stormwater utilities) that will be used to fund PCP implementation. The permittee shall describe the steps it will take to implement its funding plan. This may include but is not limited to conceptual development, outreach to affected parties, and development of legal authorities.*

Potential funding sources discussed with the Town during development of the Legal Analysis phase of the LPCP included the following:

- Property Taxes/General Fund, including the Highway Department operational budget and capital projects as needed
- Grants/Loans (e.g., MassDEP State Revolving Fund)
- Stormwater Permit/Connection Fee(s)
- Stormwater Enterprise Fund with an impervious area-based fee structure.

The Town currently funds MS4 program compliance through a mix of Conservation Commission fees, grants and loans, and the General Fund for stormwater program compliance, including sweeping, catch basin cleaning, and planning. While the true cost of implementing the LPCP was unknown when the initial funding source assessment was completed, a mix of the above funding sources was anticipated to be used to meet the requirements on public and municipal property. Through implementation of the Boylston *Conservation Commission Rules & Regulations for Stormwater*, some of the onus of phosphorus reduction and water quality improvements shifts to private developers or property owners. The Town does not intend to establish a stormwater utility at this time. Funding sources were re-evaluated in Permit Year 5

[6] EPA and the authorized states regulate stormwater discharges from regulated MS4s, industrial activities, and construction sites under section 402(p) of the Clean Water Act. These stormwater discharges require NPDES permits. In addition, EPA can use its "residual designation" authority under 40 CFR 122.26(a)(9)(i)(C) and (D) to require NPDES permits for other stormwater discharges or category of discharges on a case-by-case basis when it determines that:

- the discharges contribute to a violation of water quality standards,
- the discharges are a significant contributor of pollutant to federally protected surface waters, or
- controls are needed for the discharge based on wasteload allocations that are part of TMDLs that address the pollutant(s) of concern.

once the costs and schedule of the LPCP were better defined (see Section 11 of this memorandum).

5. LPCP Scope (LPCP Area)

Phase 3 of the LPCP requires the Town to determine the scope of implementation for the LPCP. An excerpt from the MS4GP for this phase is as follows:

> *The permittee shall indicate the area in which the permittee plans to implement the LPCP, this area is known as the "LPCP Area". The permittee must choose one of the following: 1) to implement its LPCP in the entire area within its jurisdiction discharging to the impaired waterbody (for a municipality this would be the municipal boundary) or 2) to implement its LPCP in only the urbanized area portion of its jurisdiction discharging to the impaired waterbody. If the permittee chooses to implement the LPCP in its entire jurisdiction discharging to the impaired waterbody, the permittee may demonstrate compliance with the Phosphorus Reduction Requirement and Allowable Phosphorus Load requirements applicable to it through structural and nonstructural controls on discharges that occur both inside and outside the urbanized area. If the permittee chooses to implement the LPCP in its urbanized area only discharging to the impaired waterbody, the permittee must demonstrate compliance with the Phosphorus Reduction Requirement and Allowable Phosphorus Load requirements applicable to it through structural and non-structural controls on discharges that occur within the urbanized area only.*

Approximately 2,555 acres of Boylston's total 12,600 acres are located within the Newton Pond watershed. Of those 2,555 acres, 1,588 acres are also located within Boylston's Urbanized Area (i.e., the area regulated by the MS4GP). Per discussions with Town staff, the Town will implement its LPCP only in the Urbanized Area portion of its jurisdiction within the Newton Pond watershed.

6. Phosphorus Loadings

Phase 4 of the LPCP includes determining a baseline phosphorus loading and phosphorus reduction requirement within each watershed. The methodology for this analysis is included in Attachment 1 to Appendix F of the MS4GP.[7] An excerpt from the MS4GP for this phase is as follows:

> *Permittees shall calculate their numerical Allowable Phosphorus Load and Phosphorus Reduction Requirement in mass/yr by first estimating their Baseline Phosphorus Load in mass/yr from its LPCP Area consistent with the methodology in Attachment 1 to Appendix F, the baseline shall only be estimated using land use phosphorus export coefficients in Attachment 1 to Appendix F and not account for phosphorus reductions resulting from implemented structural BMPs completed to date. Table F-6 contains the percent phosphorus reduction required from urban stormwater consistent with the TMDL of each impaired waterbody. The permittee shall apply the applicable required percent reduction in Table F-6 to the calculated Baseline Phosphorus Load to obtain the permittee specific Allowable Phosphorus Load. The Allowable Phosphorus Load shall then be subtracted from the Baseline Phosphorus Load to obtain the permittee specific Phosphorus Reduction Requirement in mass/yr.*

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[7] Attachment 1 to Appendix F of the MS4 General Permit, *Method to Calculate Baseline Phosphorus Load (Baseline), Phosphorus Reduction Requirements and Phosphorus load increases due to development (PDEVinc)*, URL: https://www3.epa.gov/region1/npdes/stormwater/ma/2016fpd/appendix-f-attach-1-2016-ma-sms4-gp-mod.pdf

The **Baseline Phosphorus Load** is a measure of the annual phosphorus load discharging in stormwater from the impervious and pervious areas within the MS4 area in each watershed subject to the LPCP. Watersheds that are more densely developed and have more impervious cover will yield a higher total pollution potential (e.g., a commercial property will have a higher phosphorus loading than forested land). The calculation uses phosphorus loading rates prescribed by EPA for each land use type (based on the MassGIS database from 2005) within the watershed. The sum of loading rates for all land use categories in the watershed is the total Baseline Phosphorus Load for the watershed.

The Phosphorus Pounds Reduction, also referred to as the **Phosphorus Reduction Requirement**, represents the required reduction in annual phosphorus load in stormwater to meet the water quality goals for the impaired watershed. This is calculated by multiplying the Baseline Phosphorus Load by the Required Percent Reduction for the watershed (19% reduction for the Newton Pond watershed). This yields the Phosphorus Pounds Reduction.

The **Allowable Phosphorus Load** is the amount of phosphorus allowed in stormwater within the impaired watershed annually. It is calculated by subtracting the Phosphorus Reduction Requirement from the Baseline Phosphorus Load.

Table 1 includes a summary of the Baseline Phosphorus, Phosphorus Reduction Requirement, and Allowable Phosphorus Load for the Newton Pond watershed.

Table 1: Required Reduction of Phosphorus from Stormwater

Waterbody	**Watershed Area in Boylston** (acres)	**Watershed Area in Town's MS4** (acres)	**Baseline Phosphorus Load** (lbs/yr)	**Phosphorus Reduction Requirement P_{RR}** (lbs/yr)	**Allowable Phosphorus Load P_{allow}** (lbs/yr)
Newton Pond	2,555	1,588	423	80	342

Notes:

- These loadings were calculated for the LPCP Area of Boylston's MS4 area within the watershed (including private and state roads and impervious cover) and may not be applicable to the entire watershed.
- The watershed area for Newton Pond was determined using StreamStats from USGS and differs slightly from the area provided in the enclosed Watershed Based Plan.
- The Baseline Phosphorus Load and thus Phosphorus Load Reduction Requirement were calculated including state roads. Those loadings should be adjusted to include only town and private roads.

7. Non-Structural Controls

Phase 5 of the LPCP requires the Town to determine what types of non-structural stormwater control measures can be implemented to achieve the phosphorus reduction requirement of 80 lbs/year within the LPCP Area. An excerpt from the MS4GP for this phase is as follows:

> *The permittee shall describe the non-structural stormwater control measures to be implemented to support the achievement of the milestones in Table F-7. The description of non-structural controls shall include the planned measures, the areas where the measures will be implemented, and the annual phosphorus reductions that are expected to result from their implementation.*

As described previously in the LPCP, non-structural controls include street sweeping, catch basin cleaning, and enhanced leaf litter pickup. The Town is currently implementing two of these non-structural BMPs (street sweeping and catch basin cleaning), which can qualify for phosphorus reduction credits.

The **street sweeping credit** is calculated using Equation 2-1 from Attachment 2 to Appendix F of the MS4GP, as follows:

$$\text{Phosphorus Credit} = IA_{swept} \times PLER_{IC\text{-}land\ use} \times PRF_{sweeping} \times AF$$

Where:
IA_{swept} = Area of impervious surface that is swept (acres)
$PLER_{IC\text{-}land\ use}$ = Phosphorus load export rate for impervious cover and specified land use (lb/acre/yr)
$PRF_{sweeping}$ = Phosphorus reduction factor for sweeping based on sweeper type and frequency
AF = Annual frequency for sweeping. Note, as stated in Attachment 2 to Appendix F, "for full credit for monthly and weekly frequency, sweeping must be conducted year round. Otherwise, the credit should be adjusted proportionally based on the duration of the sweeping season (using AF factor)." Boylston sweeps 1x per year, thus the AF factor used was (1/12).

The **catch basin cleaning credit** is calculated using Equation 2-3 from Attachment 2 to Appendix F of the MS4GP, as follows:

$$\text{Phosphorus Credit} = IA_{CB} \times PLER_{IC\text{-}land\ use} \times PRF_{CB}$$

Where:
IA_{CB} = Impervious drainage area to catch basins (acres)
$PLER_{IC\text{-}land\ use}$ = Phosphorus load export rate for impervious cover and specified land use (lb/acre/yr)
PRF_{CB} = Phosphorus reduction factor for sweeping based on sweeper type and frequency. Note, Attachment 2 to Appendix F gives the PRF_{CB} for catch basin cleaning as 0.02.

The **leaf litter program credit** is calculated using Equation 2-5 from Attachment 2 to Appendix F of the MS4GP, as follows:

$$\text{Leaf Litter Credit} = IA_{leaf\ litter} \times PLER_{IC\text{-}land\ use} \times 0.05$$

Where:
$IA_{leaf\ litter}$ = Impervious area (acres) subject to enhanced organic waste and leaf litter collection program
$PLER_{IC\text{-}land\ use}$ = Phosphorus load export rate for impervious cover and specified land use (lb/acre/yr)
$PRF_{sweeping}$ = Phosphorus reduction factor for sweeping based on sweeper type and frequency
AF = 5% nutrient reduction factor for organic waste and leaf litter collection program

The Town does not currently have a leaf litter collection program, so no credits were evaluated. If the Town were to implement the program, they would receive credit for approximately 5.5 lb/year total phosphorus removal. This assumes that all town-maintained streets within the LPCP area would be a part of the program. Note that the Town offers free yard waste drop off for reuse by the community. **Table 2** presents these phosphorus reduction credits:

Table 2: Current Non-Structural Control Summary [1]

Non-Structural BMP	Average Annual Acres Managed [2]	Average Annual Phosphorus-Reduction (lb/yr)	Implementation Level (frequency, sweeper type)
Street Sweeping	56.3	0.1	1x per year (spring), vacuum truck with broom
Catch Basin Cleaning	30.3	2.1	1x per year
Leaf Litter Program	N/A	N/A	N/A
TOTAL P_{NSred}	-	**2.2**	-

[1] Data Assumptions:

- 2016 MassGIS Land Use data layer was used.
- Street Sweeping - The nutrient reduction efficiency factor for sweeping impervious areas was assumed as the 2/year frequency with a mechanical broom, as streets are swept 1/year with vacuum assisted technology.
- Catch Basin Cleaning – Metropolitan Area Planning Council (MAPC) method for catchment delineations were used to develop catchment areas on an individual catch basin basis.

[2] The Average Annual Acres Managed noted in **Table 2** includes town-owned streets within the Newton Pond watershed and within the MS4 urbanized area (LPCP area), excluding state roads. This also excludes private roads because they are not maintained by the Town.

The financial and staffing resources to enhance non-structural controls are not available at this time. The Town will further evaluate the feasibility of increasing these efforts once additional assessment is completed in Permit Year 6 (see Table 5: changes in phosphorus loading since baseline and to exclude state and private roads, calculate private BMP phosphorus load reductions, calculate municipal BMP phosphorus load reductions, etc.).

8. Structural Controls

Phase 5 of the LPCP also requires the Town to determine what types of structural stormwater control measures can be implemented to achieve the phosphorus reduction requirement of 80 lbs/year within the LPCP Area and develop a priority ranking for locations within the LPCP Area where the controls can be implemented. An excerpt from the MS4GP for this phase is as follows:

> *The permittee shall develop a priority ranking of areas and infrastructure within the municipality for potential implementation of phosphorus control practices. The ranking shall be developed through the use of available screening and monitoring results collected during the permit term either by the permittee or another entity and the mapping required pursuant to part 2.3.4.6 of the Permit. The permittee shall also include in this prioritization a detailed assessment of site suitability for potential phosphorus control measures based on soil types and other factors. The permittee shall coordinate this activity with the requirements of part 2.3.6.8.b of the Permit. A description and the result of this priority ranking shall be included in the LPCP. The permittee shall describe the structural stormwater control measures necessary to support achievement of the milestones in Table F-7. The description of structural controls shall include the planned measures, the areas where the measures will be implemented, and the annual phosphorus reductions in units of mass/yr that are expected to result from their implementation. Structural measures to be implemented by a third party may be included in the LPCP. Annual phosphorus reduction from structural BMPs shall be calculated consistent with Attachment 3 to Appendix F.*

The following sections outline potential structural stormwater controls that can be implemented within the LPCP Area for municipal and private BMPs.

8.1 Municipal BMPs

In Permit Year 4, Boylston developed a priority ranking of areas and infrastructure within the MS4 for potential implementation of structural phosphorus controls as part of the "BMP Retrofit Inventory Assessment" dated June 30, 2022, which meets the requirements of MS4GP Section 2.3.6.d. As described in Section 2.3.6.d, this priority ranking considered "municipal properties with significant impervious cover (including parking lots, buildings, and maintenance yards)" and evaluated "factors such as access for maintenance purposes; subsurface geology; depth to water table; proximity to aquifers and subsurface infrastructure including sanitary sewers and septic systems; and opportunities for public use and education." These sites were prioritized considering site characteristics such as land use/land cover, hydrologic soil conditions, and subsurface geology. Land Use/Land Cover data was based on the MassGIS 2016 Land Use/Land Cover data layer.

The Town-owned sites identified in the Retrofit Inventory that are within Newton Pond watershed are included in **Table 3**. The assessment included descriptions of potential BMPs, as noted in the table. As part of the LPCP, an assessment was completed to determine a range of potential total phosphorus removal based on the proposed BMP type, which was estimated using EPA's BMP Accounting and Tracking Tool (BATT).

BATT uses BMP type, storage volume, catchment area, hydrologic soil group (HSG) and infiltration rate to estimate total phosphorus reduction by the BMP. The estimated ranges for each BMP included in **Table 3** were calculated with preliminary assumptions of BMP placement, size, and catchment area. The bioretention areas were assumed to have an average size of 1,000 cubic feet and any swales were assumed to have an average size of 270 cubic feet. HSGs were determined for each parcel based on Natural Resources Conservation Service (NRCS) Soils Layer, and Rawls Rate was used for the infiltration rates. Catchment areas were estimated assuming the BMP treated the parcel area. These estimated total phosphorus removals are intended to provide a high-level idea of potential removal that could be achieved at the site; they will need to be refined based on the actual design characteristics of any BMP implemented.

Table 3: Retrofit Inventory and Potential Phosphorus Load Reductions

Property	Potential BMP(s)	Range of Potential TP Removal (lb/yr)	Priority Rank
Boylston Elementary School (200 Sewall Street)	• Water quality swale(s) to capture runoff from parking lots and driveways • Bioretention area in grass area • Replace portions of existing parking areas or sidewalks with permeable pavement	1.2 – 2.7	1
Manor Playground (0 Midland Road)	• Maintain or replace existing swales to assist with flooding concerns • Install water quality units within neighboring streets and divert street drainage to the bioretention area to be treated prior to discharging to the environment	0.04 – 0.1	2

Property	Potential BMP(s)	Range of Potential TP Removal (lb/yr)	Priority Rank
Boylston Electric Light Department (16 Paul X Tivnan Drive)	• Bioretention area with sediment forebay • Install water quality unit within street and divert street drainage for treatment	0.6 – 1.4	4
Town Hall/Police Department Complex (215-221 Main Street)	• Infiltration basin with sediment forebay	1.2 – 2.7	5

Using EPA's BATT, estimated total phosphorus removal was also calculated for the existing municipal BMPs that have been installed within the LPCP Area since the MS4GP effective date, shown in **Table 4**. Available drainage plans were used to estimate BMP size. HSGs were determined from NRCS Soils Layer, and Rawls Rate was used for the infiltration rates. However, the estimated total phosphorus removal for each BMP should be further refined based on available stormwater report records that include the designed catchment areas and actual BMP storage volumes; these reports are being compiled and calculations will be refined for BMPs with readily available documentation in Permit Year 6.

Table 4: Existing BMP Estimated Phosphorus Load Reductions

Street	BMP	Range of Potential TP Removal (lb/yr)
Cross Street & School Street	Infiltration Basin 1	0.7 – 1.6
	Infiltration Basin 2	0.7 – 1.6
	Infiltration Basin 3	0.7 – 1.6
Nature's View Way	Infiltration Basin 1	0.7 – 1.6
	Infiltration Basin 2	0.7 – 1.6
Morgan Circle	Infiltration Basin	3.6 – 8.4
Smallwood Circle & Sewall Street	Infiltration Basin	2.7 – 6.4

In order to take credit for the estimated 9.8 – 22.8 lb/yr from existing municipal BMPs, the Town must certify in Annual Reports that the BMP is performing up to design specifications and is properly maintained and inspected according to manufacturer design or specifications. The MS4GP provides certification statement language as follows:

> *I certify under penalty of law that all source control and treatment Best Management Practices being claimed for phosphorus reduction credit have been inspected, maintained and repaired in accordance with manufacturer or design specification. I certify that, to the best of my knowledge, all Best Management Practices being claimed for a phosphorus reduction credit are performing as originally designed.*

8.2 Private BMPs

Phosphorus load reductions from private structural BMPs can be used to offset the phosphorus loading in the LPCP Area if O&M of the private BMPs is certified by the private owners. Private BMPs located within the LPCP Area include:

- Rand-Whitney, Unified (160 Shrewsbury Street)
- Brookside Apartments (85 Sewall Street)
- Compass Pointe Subdivision (Compass Circle)
- FedEx (100 Pine Hill Drive)
- Frito-Lay (311 Main Street)
- Phillips Precision (141 Shrewsbury Street)
- Trailside Apartments (100 Shrewsbury Street)

These existing private BMPs should be evaluated using EPA's BATT, drainage plans, and stormwater reports to estimate phosphorus load removal.

An annual O&M report is already submitted by these private entities to the Town's Conservation Commission that reports on stormwater pollution prevention efforts (facility changes, significant spills, discharges, etc.) at the sites. The report includes dates of quarterly inspections, annual trainings, non-compliance findings, corrective actions taken for non-compliance findings, and more. It is recommended an additional category be added to require confirmation that proper O&M was followed for the on-site BMP(s), including all certification components as mentioned in Section 8.1, so the Town can take credit for the phosphorus reduction in Annual Reports to EPA.

8.3 Conclusion

If all BMP retrofit opportunities presented in **Table 3** are installed, the Town could gain up to approximately 7 lb/yr of phosphorus removal. Considering the approximate phosphorus reduction removal for existing municipal BMPs (estimated in **Table 4**), and assuming proper O&M certification, the Town currently achieves approximately 10 to 23 lb/yr of phosphorus removal. These roughly calculated phosphorus reduction removals were based on assumptions and estimations, and therefore should be refined in Permit Year 6.

Assuming the private sites with BMPs complete required O&M and include a certification in the annual O&M report next year, the Town expects a substantial increase in phosphorus removal within the LPCP Area. However, this will need to be further refined in Permit Year 6 once the certification statement is required in annual reports and phosphorus reductions are estimated.

Per the MS4GP's Equation 2 in Appendix F Part A.II, Section 2, the yearly phosphorus reduction from implemented structural controls (P_{Sred}) is estimated to be 17 to 30 lb/yr.

9. Operation & Maintenance Program

Phase 6 of the LPCP requires the Town to describe the O&M Program for structural control measures being claimed for the phosphorus reduction. An excerpt from the MS4GP for this phase is as follows:

> *The permittee shall establish an Operation and Maintenance Program for all structural BMPs being claimed for phosphorus reduction credit. This includes BMPs implemented to date as well as BMPs to be implemented. The Operation and Maintenance Program shall become part of the LPCP and include: (1) inspection and maintenance schedule for each BMP according to BMP design or manufacturer specification and (2) program or department responsible for BMP maintenance.*

Municipal BMPs are inspected following the BMP Standard Operating Procedure (SOP) included in Boylston's Good Housekeeping Program, which is enclosed with this memorandum for reference. The SOP includes inspection and maintenance requirements for various BMP types.

Private BMPs must be maintained in accordance with the Town's Stormwater Regulations and the site's O&M Program. As required by the Regulations[8], each O&M Program should include a maintenance agreement with "an Inspection and Maintenance Schedule for all stormwater management facilities including routine and non-routine maintenance tasks to be performed. … All stormwater BMPs are to follow the minimum requirements for inspection and maintenance in accordance with the latest edition of the Massachusetts Stormwater Handbook." The Regulations also require submission of an annual O&M report to the Town's Conservation Commission to ensure adequate long-term operation and maintenance of stormwater management practices.

10. Implementation Schedule

Phase 7 of the LPCP requires that an initial schedule be developed for the implementation of the planned BMPs identified in this LPCP. An excerpt from the MS4GP for this phase is as follows:

> *An initial schedule for implementing the BMPs, including, as appropriate: funding, training, purchasing, construction, inspections, monitoring, O&M and other assessment and evaluation components of implementation. Implementation of planned BMPs must begin upon completion of the LPCP, and all non-structural BMPs shall be fully implemented within six years of the permit effective date. Where planned structural BMP retrofits or major drainage infrastructure projects are expected to take additional time to construct, the permittee shall within four years of the effective date of the permit have a schedule for completion of construction consistent with the reduction requirements in Table F-7. The permittee shall complete the implementation of its LPCP as soon as possible or at a minimum in accordance with the milestones set forth in Table F-7. The implementation schedule shall be updated as needed to support the achievement of the milestones in Table F-7, including an update in the updated written LPCP 10 years after the permit effective date.*

The MS4GP assumes phosphorus will first be addressed with non-structural controls, assessing performance of those controls, and then adding structural controls and assessing performance over the remaining years through 2033. The initial implementation schedule for Boylston's LPCP is summarized in **Table 5**.

---

[8] See Section 6.L) of the Stormwater Regulations for O&M Plan requirements. URL: https://www.boylston-ma.gov/sites/g/files/vyhlif4171/f/uploads/boylston_rules_regulations_for_stormwater_final_1.pdf

Note that performance evaluations are noted each year. An excerpt describing these evaluations from the MS4GP is as follows:

> *The permittee shall evaluate the effectiveness of the LPCP by tracking the phosphorus reductions achieved through implementation of structural and non-structural BMPs and tracking increases in phosphorus loading from the LPCP Area beginning six years after the effective date of the permit. Phosphorus reductions shall be calculated consistent with Attachment 2 (nonstructural BMP performance), Attachment 3 (structural BMP performance) and Attachment 1 (reductions through land use change), to Appendix F for all BMPs implemented to date. Phosphorus load increases resulting from development shall be calculated consistent with Attachment 1 to Appendix F. Phosphorus loading increases and reductions in units of mass/yr shall be added or subtracted from the calculated Baseline Phosphorus Load to estimate the yearly phosphorous export rate from the LPCP Area in mass/yr. The permittee shall also include all information required in part II.2 of this Appendix in each performance evaluation.*

Table 5: Initial Implementation Schedule

Planned Date [1]	Task
Permit Year 6 (FY2024)	• Determine changes in phosphorus loading since baseline (2005 data) using new land use and impervious area mapping; and adjust phosphorus loadings to exclude MassDOT and DCR roads and properties. • Calculate private BMP phosphorus load reductions. • Update private annual O&M report template to include BMP O&M certification. • Refine existing municipal BMP phosphorus load reductions and certify O&M. • Performance Evaluation: Evaluate level of phosphorus loading based on municipal and private BMP phosphorus reductions estimated in Permit Year 6, plan for what remains to meet the phosphorus load reduction requirement (i.e., installation of additional structural BMPs). • Based on Performance Evaluation, prepare, post for public notice, and submit to EPA and MassDEP an Alternative Schedule Request per Appendix F Part A.II, Section 4.a.
Permit Year 7 (FY2025)	• Performance Evaluation • Evaluate private BMP reporting. • Design and permitting for one priority BMP retrofit from Table 3 (*if required*).
Permit Year 8 (FY2026)	• Performance Evaluation • Demonstrate: $P_{exp} \leq P_{allow} + (P_{RR} \times 0.80)$; where P_{exp} is the current total phosphorus export rate, P_{allow} is the Allowable Phosphorus Load (342 lb/yr), P_{RR} is the Phosphorus Reduction Requirement (80 lb/yr). $P_{exp} \leq 342 + (80 \times 0.80)$; $P_{exp} \leq 406$ lb/yr • Implementation of planned structural controls (construction of one priority BMP retrofit project).
Permit Year 9 (FY2027)	• Performance Evaluation • Design and permitting for BMP retrofit (*if required*).
Permit Year 10 (FY2028)	• Performance Evaluation and update LPCP • Demonstrate: $P_{exp} \leq P_{allow} + (P_{RR} \times 0.60)$; where P_{exp} is the current total phosphorus export rate, P_{allow} is the Allowable Phosphorus Load (342 lb/yr), P_{RR} is the Phosphorus Reduction Requirement (80 lb/yr). OR demonstrate a reduction of P_{exp} by 30 kg/yr (whichever is greater, unless full P_{RR} has been met). $P_{exp} \leq 342 + (80 \times 0.60)$; $P_{exp} \leq 390$ lb/yr • Implementation of structural controls (construction of BMP retrofit project) (*if required*).

Planned Date [1]	Task
Permit Year 11/12 (FY2029/2030)	• Performance Evaluation
Permit Year 13 (FY2031)	• Performance Evaluation • Demonstrate: $P_{exp} \leq P_{allow} + (P_{RR} \times 0.30)$; where P_{exp} is the current total phosphorus export rate, P_{allow} is the Allowable Phosphorus Load (342 lb/yr), P_{RR} is the Phosphorus Reduction Requirement (80 lb/yr). $P_{exp} \leq 342 + (80 \times 0.30)$; $P_{exp} \leq 366$ lb/yr • Design and permitting for BMP retrofit (*if required*).
Permit Year 14 (FY2032)	• Performance Evaluation
Permit Year 15 (FY2033)	• Performance Evaluation • Demonstrate: $P_{exp} \leq P_{allow}$; where P_{exp} is the current total phosphorus export rate, P_{allow} is the Allowable Phosphorus Load (342 lb/yr). • Implementation of structural controls (construction of BMP retrofit project) (*if required*).

[1] Note that schedules presented herein are subject to change based on further development of the LPCP and available funding for design and construction of structural controls.

11. Cost and Funding Source Assessment Update

Phase 8 of the LPCP requires that the cost and anticipated funding for implementing the LPCP be estimated (previously described in Section 4). An excerpt from the MS4GP for this phase is as follows:

> *The permittee shall estimate the cost for implementing its LPCP and describe known and anticipated funding mechanisms. The permittee shall describe the steps it will take to implement its funding plan. This may include but is not limited to conceptual development, outreach to affected parties, and development of legal authorities.*

Based on the planned non-structural and structural controls presented herein, the following is the estimated cost for implementing the LPCP:

Table 6: Estimated LPCP Implementation Cost [1]

Number	Task	Estimated Cost [2]
1	Implement Permit Year 6 tasks from Table 5	$7,000
2	Annual performance evaluation	$3,000
3	Design, permit, and bid a BMP retrofit project [3]	$30,000
4	Construct a BMP retrofit project [3]	$15,000 - $30,000

[1] Costs presented herein exclude current operating budgets for Highway staff, equipment, etc. This should be evaluated as part of the overall LPCP implementation cost.
[2] Estimated costs are subject to change based on further development of the LPCP and during design and construction of structural controls.
[3] More than one BMP retrofit project may be required to meet the phosphorus reduction goal. The plan will be established after Task 1 has been completed and refined LPCP costs are known.

The Town anticipates funding the LPCP through a mix of Conservation Commission fees, grants and loans, and the General Fund (including Highway Department operational budget and capital projects) for work on public and municipal property. Through implementation of the Boylston *Conservation Commission Rules & Regulations for Stormwater*, some of the onus of phosphorus reduction and water quality improvements shifts to private developers or property owners. If installation of a municipal structural BMP(s) is required, the Town intends to increase the annual

Conservation Commission or Highway Department operating budget to account for the cost increase and pursue potential grant opportunities or donations. If required, a capital project could be added to the annual town budget, to be funded from the General Fund.

12. Annual Reporting

Starting in Permit Year 5, the following will be included in each annual report submitted by the Town to EPA and MassDEP, as stated in Appendix F, Part A.II.2 of the MS4GP:

a. *All non-structural control measures implemented during the reporting year along with the phosphorus reduction in mass/yr (P_{NSred}) calculated consistent with Attachment 2 to Appendix F*

b. *Structural controls implemented during the reporting year and all previous years including:*

    a. *Location information of structural BMPs (GPS coordinates or street address)*

    b. *Phosphorus reduction from all structural BMPs implemented to date in mass/yr (P_{Sred}) calculated consistent with Attachment 3 to Appendix F*

    c. *Date of last completed maintenance for each structural control*

c. *Phosphorus load increases due to development over the previous reporting period and incurred to date (P_{DEVinc}) calculated consistent with Attachment 1 to Appendix F*

d. *Estimated yearly phosphorus export rate (P_{exp}) from the LPCP Area calculated using Equation 2* [see Permit for equation]*. Equation 2 calculates the yearly phosphorus export rate by subtracting yearly phosphorus reductions through implemented nonstructural controls and structural controls to date from the Baseline Phosphorus Load and adding loading increases incurred through development to date. This equation shall be used to demonstrate compliance with applicable phosphorus reduction milestones.*

e. *Certification that all structural BMPs are being inspected and maintained according to the O&M program specified as part of the PCP. The certification statement shall be:*

    I certify under penalty of law that all source control and treatment Best Management Practices being claimed for phosphorus reduction credit have been inspected, maintained and repaired in accordance with manufacturer or design specification. I certify that, to the best of my knowledge, all Best Management Practices being claimed for a phosphorus reduction credit are performing as originally designed.

f. *Certification that all municipally owned and maintained turf grass areas are being managed in accordance with Massachusetts Regulation 331 CMR 31 pertaining to proper use of fertilizers on turf grasses (see http://www.mass.gov/courts/docs/lawlib/300-399cmr/330cmr31.pdf).*

13. Enclosures

Watershed-Based Plan - Newton Pond

Excerpts from Massachusetts Year 2014 Integrated List of Waters

Excerpts from Massachusetts Year 2016 Integrated List of Waters

Excerpts from Massachusetts Year 2018/2020 Integrated List of Waters

Excerpts from Massachusetts Year 2022 Integrated List of Waters

Excerpt from Good Housekeeping and Pollution Prevention Program for Municipal O&M: Structural BMP Inspections & Maintenance Standard Operating Procedure

MASSACHUSETTS
watershed·based plans

WATERSHED-BASED PLAN

Newton Pond

September 28, 2020

Prepared By:

Tighe&Bond
120 Front Street, Suite 7
Worcester, MA

Prepared For:

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

Contents

Element A: Identify Causes of Impairment & Pollution Sources

Element A: Identify the causes and sources or groups of similar sources that need to be controlled to achieve the necessary pollutant load reductions estimated in the watershed based plan (WBP).

1. General Watershed Information

Table A-1: General Watershed Information

Watershed Name (Assessment Unit ID):	Newton Pond (MA51110)
Major Basin:	BLACKSTONE
Watershed Area (within MA):	2749.6 (ac)
Water Body Size:	54 (ac)

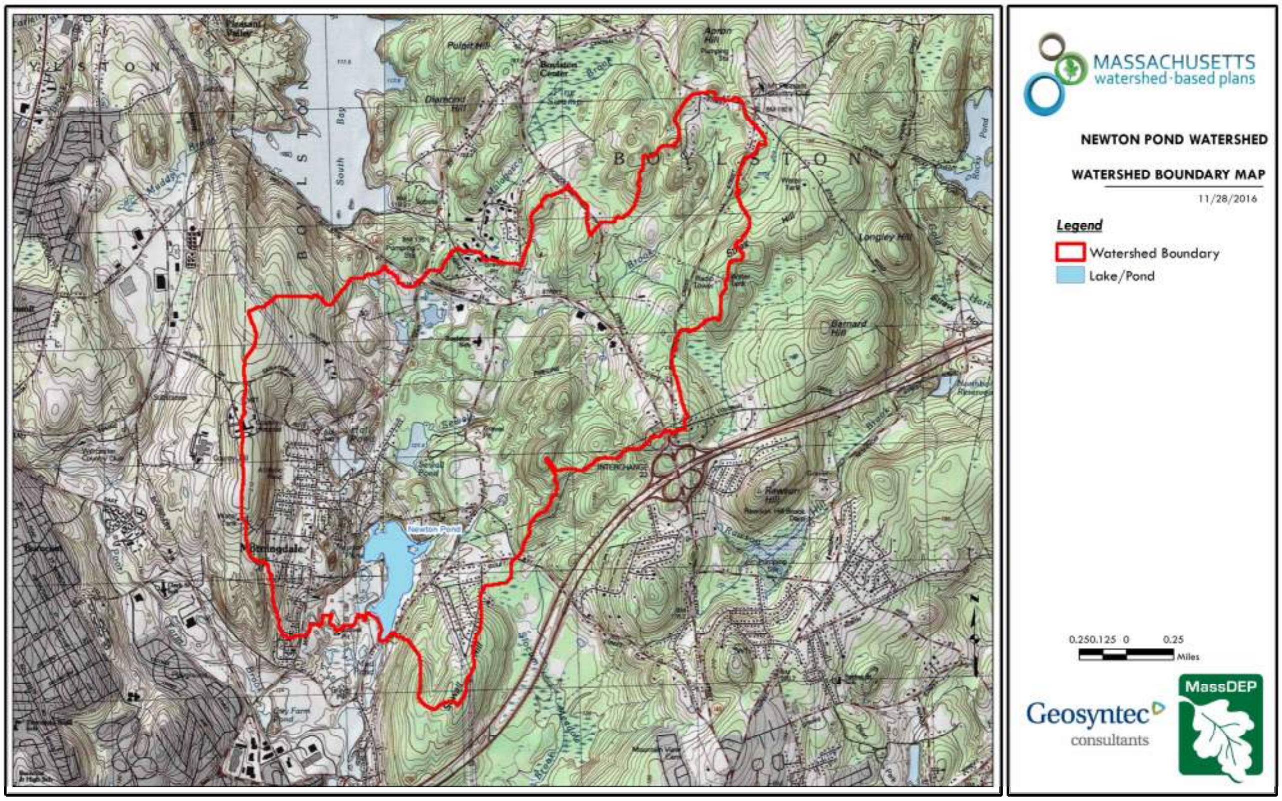

Figure A-1: Watershed Boundary Map (MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Ctrl + Click on the map to view a full sized image in your web browser.

General watershed information:

2. MassDEP Water Quality Assessment Report and TMDL Review

The following reports are available:

- Blackstone River Watershed 2003-2007 Water Quality Assessment Report
- Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes

Blackstone River Watershed 2003-2007 Water Quality Assessment Report (MA51110 - Newton Pond)
Aquatic Life Use Biology Two non-native aquatic macrophyte species (Myriophyllum heterophyllum and Cabomba caroliniana) were observed in Newton

Pond during the 1998 synoptic surveys (MassDEP 1998).

The Aquatic Life Use is assessed as impaired for Newton Pond because of the infestation with M. heterophyllum and C. caroliniana, non-native aquatic macrophytes.

Report Recommendations:
Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The watershed/canoe/kayak groups should consider seeking volunteers to provide outreach on preventing the spread of exotic invasive plants at popular access points during the busiest weekends of the summer. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson et al. 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes (MA51110 - Newton Pond)

Waterbody Descriptions and Problem Assessment
Landuse information for each watershed is based on MassGIS digital maps derived from aerial photography taken in 1985. To account for changes in landuse, population growth rates are reported for towns closest to the lake. Population (census) data and estimated growth rates are from projections provided on the internet (www.umass.edu/miser/) by the Massachusetts Institute for Social and Economic Research (MISER) at the University of Massachusetts, Amherst.

Lake Description
Newton Pond Shrewsbury is approximately 48 acres in size. The watershed is 61 percent forested and about 22 percent is in rural landuse category. About 12 percent is in urban landuse and both water and wetlands accounting for the remaining 5 percent. A large gravel pit is located just to the southwest shore of the lake that may contribute sediments and nutrients to the lake. Population in the town has been described above. The pond was assessed by DEP in the summer of 1994 and the assessment comments reported: "A 22 July 1994 synoptic survey indicates that floating leaf plants of 75% to 100% density were found in patches around shores and in coves (approximately 25% of the north part of the lake). There were no floating leaf plants at the end of the lake off Sewall street at the outlet and there were moderate submerged. The possible non-native Myriophyllum (possibly heterophyllum) was present
and threatens the secondary contact over 43 acres of the pond. No other data was available to make assessments."

Pollutant Sources and Background:
Unfortunately, no detailed study of the nutrient sources within the watersheds has been conducted to date. Thus, nutrient sources were estimated based on land use modeling within the DEP's NPSLAKE model as discussed below. The NPSLAKE model was designed to estimate watershed loading rates of phosphorus to lakes. A brief description of the NPSLAKE model and data inputs is given here. MassGIS digital maps of land use within the watershed were used to calculate areas of landuse within three major types: Forest, rural and urban landuse. This model takes the area in hectares of land use within each of three categories and applies an export coefficient to each to predict the annual external loading of phosphorus to the lake from the watershed. Because much of the landuse data is based on old (1985) aerial photographs, the current landuses within the watershed may be different today. This can be important in the development of the TMDL because different landuses can result in different phosphorus loadings to the waterbody in question. For many rural areas, landuse changes often result in conversion of open or agricultural lands to low density housing, in which case, the export coefficients of the NPSLAKE model are the same and no change in loading is predicted to occur. However, in cases where development changes forests to residential areas or rural landuses to urban landuses, phosphorus loadings are predicted to increase. In some cases, loadings are predicted to decrease if additional agricultural land is abandoned and forest regrowth occurs. To account for this uncertainty in landuse changes, a conservative target is chosen (see below). In addition, the MassGIS landuse maps are scheduled to be updated with current aerial photos and the TMDL can be modified as additional information is obtained.

Other phosphorus sources, such as septic system inputs of phosphorus, are estimated from an export coefficient multiplied by the number of homes within 100 meters of the lake. Point sources are estimated manually based on discharge information and site specific information for uptake and storage. Other sources such as atmospheric deposition to lakes was determined to be small and not significant in the NPSLAKE model, perhaps because lakes tend to be sinks rather than sources of phosphorus (Mattson and Isaac, 1999). For similar reasons wetlands were also not considered to be significant sources of phosphorus following (see discussion and references in Mattson and Isaac, 1999). Other, non-landuse sources of phosphorus such as inputs from waterfowl were not included, but can be added as additional information becomes available. If large numbers of waterfowl are using the lake the total phosphorus budget may be an underestimate, and control measures should be considered. Internal sources (recycling) of phosphorus is not included because it is not considered as a net external load to the lake, but rather a seasonal recycling of phosphorus already present in the lake. In cases where this internal source is large it may result in surface concentrations higher than predicted from landuse loading models and may contribute to water quality violations during the critical summer period. As additional monitoring data become available, these lakes will be assessed for internal contributions and possibly control of these sources by alum or other means. The major sources according to the land use analysis are shown for the lake of interest in the following table (originally part of Table 2 of "Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes" report, 2002).

Table . Newton Pond MA51110

Total Estimated Nonpoint Source Pollution loads based on GIS Landuse

Watershed Area=	1099.8 Ha (4.2 mi2)
Average Annual Water Load =	6704524.0 m3/yr (7.6 cfs)
Average Runoff=	61.0 cm/yr (24.0 in/yr)
Lake area=	19.4 Ha. (48.0ac)
Areal water loading to lake: q=	34.5 m/yr.
Homes with septic systems within 100m of lake.=	15.0
Other P inputs =	0.0 kg/yr

Estimate of annual Nonpoint Source Pollution Loads by land use

Land use	Area Ha (%)	P Load kg/yr (%)	N Load kg/yr	TSS Load kg/yr
Forest category				
Forest:	675.3 (61.4)	87.8 (26.7)	1688.3	16208.0
Rural category				
Agriculture:	34.6 (3.1)	10.4 (3.2)	304.5	10450.1
Open land:	98.9 (9.0)	29.7 (9.0)	514.3	12227.8
Residential Low:	110.0 (10.0)	33.0 (10.0)	605.1	42688.1
Urban category				
Residential High:	104.7 (9.5)	127.8 (38.9)	811.6	57702.1
Comm - Ind:	26.9 (2.4)	32.8 (10.0)	268.0	10461.7
Other Landuses				
Water:	35.8 (3.3)	0.0 (0.0)	0.0	0.0
Wetlands:	13.5 (1.2)	0.0 (0.0)	0.0	717.9
Subtotal	1099.8	321.5	4228.0	150937.9
Other P inputs:	NA	0.0 (0.0)		
15.0 Septics:	NA	7.5 (2.3)		
Total	1099.8 (100.0)	329.0(100)	4228.0	150937.9

Summary of Lake Total Phosphorus Modeling Results

Areal P loading L= 1.7 g/m2/yr.
Reckhow (1979) model predicts lake TP = L/(11.6+1.2q)*1000 = 31.9 ppb.
Predicted transparency = 1.5 meters.

If all land were forested, P export would be 136.6 kg/yr
and the forested condition lake TP would be 13.3 ppb.

The NPSLAKE model assumes land uses are accurately represented by the MassGIS digital maps and that land use has not changed appreciably since the maps were compiled in 1985. The predicted loading is based on the equation:
P Loading (kg/yr)= 0.5* septics + 0.13* forest ha + 0.3* rural ha + 14* (urban ha)^0.5
The coefficients of the model are based on a combination of values estimated with the aid of multiple regression on a Massachusetts data set and of typical values reported in previous diagnostic/feasibility studies in Massachusetts.
All coefficients fall within the range of values reported in other studies. The overall standard error of the model is approximately 172 kg/yr. If not data is available for internal loading a rough estimate of the magnitude of this sources can be estimated by substitution of the in-lake concentration for TP. The difference in predicted loadings from this approach and the landuse approach is the best estimate of internal loading.

The NPSLAKE model also generates predictions of estimated yearly average water runoff to the lake based on total watershed area and runoff maps of Massachusetts.
Because of the general nature of the landuse loading approach, natural background is included in land use based export coefficients. Natural background can be estimated based on the forest export coefficient of 0.13 kg/ha/yr multiplied by the hectares of the watershed assuming the watershed to be entirely forested. Without site specific information regarding soil phosphorus and natural erosion rates the accuracy of this estimate would be uncertain and would add little value to the analysis.
There were three NPDES point sources listed in the watersheds of some of the lakes, but further investigation revealed they are no longer official point sources, or in one case will no longer be a point source within two months. The one major industrial discharger (Worcester Spinning and Finishing) has since closed after the factory burned down and it is not expected to reopen. A small wastewater point source for Nazzareth Home for Boys is currently being tied into the sewer system of the Leicester Water District with work expected to be completed within two months. The remaining NPDES site was a general permit for Browning Ferris Industries Inc (BFI) which is now covered under an EPA Muti-Sector Permit and is not considered as a point source in this analysis but is included as industrial (urban) landuse in the model.
Reckhow, K.H. 1979. Uncertainty Analysis Applied to Vollenweider's Phosphorus Loading Criteria. J. Water Poll. Control Fed. 51(8):2123-2128
Mattson, M.D. and R.A. Isaac. 1999. Calibration of Phosphorus Export coefficients for Total Maximum Daily Loads of Massachusetts Lakes. Lake and Reservoir Man. 15(3):209-219.
Reckhow, K.H., M.N. Beaulac, J.T. Simpson. 1980. Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients. U.S.E.P.A. Washington DC. EPA 440/5-80-011.

Literature review information:

3. Water Quality Impairments

Known water quality impairments, as documented in the Massachusetts Department of Environmental Protection (MassDEP) 2012 Massachusetts Integrated List of Waters, are listed below. Impairment categories from the Integrated List are as follows:

Table A-2: 2012 MA Integrated List of Waters Categories

Integrated List Category	Description
1	Unimpaired and not threatened for all designated uses.
2	Unimpaired for some uses and not assessed for others.
3	Insufficient information to make assessments for any uses.
4	Impaired or threatened for one or more uses, but not requiring calculation of a Total Maximum Daily Load (TMDL), including: 4a: TMDL is completed 4b: Impairment controlled by alternative pollution control requirements 4c: Impairment not caused by a pollutant - TMDL not required

5	Impaired or threatened for one or more uses and requiring preparation of a TMDL.

Table A-3: Water Quality Impairments

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA51110	**Newton Pond**	**4A**	Aesthetic	Aquatic Plants (Macrophytes)	Source Unknown
MA51110	**Newton Pond**	**4A**	Fish, other Aquatic Life and Wildlife	Non-Native Aquatic Plants	Introduction of Non-native Organisms (Accidental or Intentional)
MA51110	**Newton Pond**	**4A**	Primary Contact Recreation	Aquatic Plants (Macrophytes)	Source Unknown
MA51110	**Newton Pond**	**4A**	Secondary Contact Recreation	Aquatic Plants (Macrophytes)	Source Unknown

4. Water Quality Goals

Water quality goals may be established for a variety of purposes, including the following:

a.) For **water bodies with known impairments**, a Total Maximum Daily Load (TMDL) is established by MassDEP and the United States Environmental Protection Agency (USEPA) as the maximum amount of the target pollutant that the waterbody can receive and still safely meet water quality standards. If the waterbody has a TMDL for total phosphorus (TP) or total nitrogen (TN), or total suspended solids (TSS), that information is provided below and included as a water quality goal.

b.) For **water bodies without a TMDL for total phosphorus** (TP), a default water quality goal for TP is based on target concentrations established in the Quality Criteria for Water (USEPA, 1986) (also known as the "Gold Book"). The Gold Book states that TP should not exceed 50 ug/L in any stream at the point where it enters any lake or reservoir, nor 25 ug/L within a lake or reservoir. For the purposes of developing WBPs, MassDEP has adopted 50 ug/L as the TP target for all streams at their downstream discharge point, regardless of which type of water body the stream discharges to.

c.) Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) prescribe the minimum water quality criteria required to sustain a waterbody's designated uses. Newton Pond is a Class 'B' waterbody. The water quality goal for fecal coliform bacteria is based on the Massachusetts Surface Water Quality Standards.

Table A-4: Surface Water Quality Classification by Assessment Unit ID

Assessment Unit ID	Waterbody	Class

MA51110	Newton Pond	B

d.) **Other water quality goals set by the community** (e.g., protection of high quality waters, in-lake phosphorus concentration goal to reduce recurrence of cyanobacteria blooms, etc.).

Table A-5: Water Quality Goals

<table>
<tr><th>Pollutant</th><th>Goal</th><th>Source</th></tr>
<tr><td>Total Phosphorus (TP)</td><td>
The following table (originally on page 4 of “Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes” report, 2002) lists the lakes that were evaluated, their predicted total phosphorus concentration and load using the landuse model and selected target concentration and loads necessary to achieve water quality standards. The results indicate that current phosphorus loads to these lakes need to be reduced on an average of 27% and range from a low of about 2% (Eddy Pond, Auburn, MA) to a high of 68% (Southwick Pond, Leicester, MA).
<table>
<tr><th>WBID</th><th>Lake Name</th><th>Predicted TP (ppb)</th><th>Predicted load (kg/yr)</th><th>Tar (pp</th></tr>
<tr><td>MA51004</td><td>Auburn Pond, Auburn</td><td>34</td><td>717</td><td></td></tr>
<tr><td>MA51010</td><td>Brierly Pond, Millbury</td><td>30</td><td>278</td><td></td></tr>
<tr><td>MA51032</td><td>Curtis Pond North, Worcester</td><td>26</td><td>1644</td><td></td></tr>
<tr><td>MA51033</td><td>Curtis Pond South, Worcester</td><td>27</td><td>1609</td><td></td></tr>
<tr><td>MA51039</td><td>Dorothy Pond, Millbury</td><td>26</td><td>366</td><td></td></tr>
<tr><td>MA51043</td><td>Eddy Pond, Auburn</td><td>15</td><td>123</td><td></td></tr>
<tr><td>MA51056</td><td>Green Hill Pond, Worcester</td><td>44.2</td><td>75</td><td></td></tr>
<tr><td>MA51071</td><td>Howe Reservoir, Millbury</td><td>50.9</td><td>104</td><td></td></tr>
<tr><td>MA51078</td><td>Jordan Pond, Shrewsbury</td><td>67.6</td><td>99</td><td></td></tr>
<tr><td>MA51105</td><td>Mill Pond Shrewsbury</td><td>46.5</td><td>275</td><td></td></tr>
<tr><td>MA51110</td><td>Newton Pond Shrewsbury</td><td>31.9</td><td>330</td><td></td></tr>
<tr><td>MA51120</td><td>Pondville Pond, Auburn</td><td>28.1</td><td>453</td><td></td></tr>
<tr><td>MA51156</td><td>Smiths Pond, Leicester</td><td>30</td><td>583</td><td></td></tr>
<tr><td>MA51157</td><td>Southwick Pond, Leicester</td><td>30.4</td><td>108</td><td></td></tr>
<tr><td>MA51160</td><td>Stoneville Pond, Auburn</td><td>26.7</td><td>970</td><td></td></tr>
<tr><td>MA51196</td><td>Shirley Street Pond, Shrewsbury,</td><td>37.7</td><td>670</td><td></td></tr>
</table>
</td><td>Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes</td></tr>
<tr><td>Bacteria</td><td>
<u>Class B Standards</u>
• Public Bathing Beaches: For E. coli, geometric mean of 5 most recent samples shall not exceed 126 colonies/ 100 ml and no single sample during the bathing season shall exceed 235 colonies/100 ml. For enterococci, geometric mean of 5 most recent samples shall not exceed 33 colonies/100 ml and no single sample during bathing season shall exceed 61 colonies/100 ml;
• Other Waters and Non-bathing Season at Bathing Beaches: For E. coli, geometric mean of samples from most recent 6 months shall not exceed 126 colonies/100 ml (typically based on min. 5 samples) and no single sample shall exceed 235 colonies/100 ml. For enterococci, geometric mean of samples from most recent 6
</td><td>Massachusetts Surface Water Quality Standards (314 CMR 4.00,</td></tr>
</table>

	months shall not exceed 33 colonies/100 ml, and no single sample shall exceed 61 colonies/100 ml.	2013)

Note: *There may be more than one water quality goal for bacteria due to different Massachusetts Surface Water Quality Standards Classes for different Assessment Units within the watershed.*

5. Land Use Information

A. Watershed Land Uses

Table A-6: Watershed Land Uses

Land Use	Area (acres)	% of Watershed
Agriculture	155.1	5.6
Commercial	75.3	2.7
Forest	1746.78	63.5
High Density Residential	73.2	2.7
Highway	5.16	0.2
Industrial	69.55	2.5
Low Density Residential	316.49	11.5
Medium Density Residential	93.02	3.4
Open Land	146.37	5.3
Water	68.66	2.5

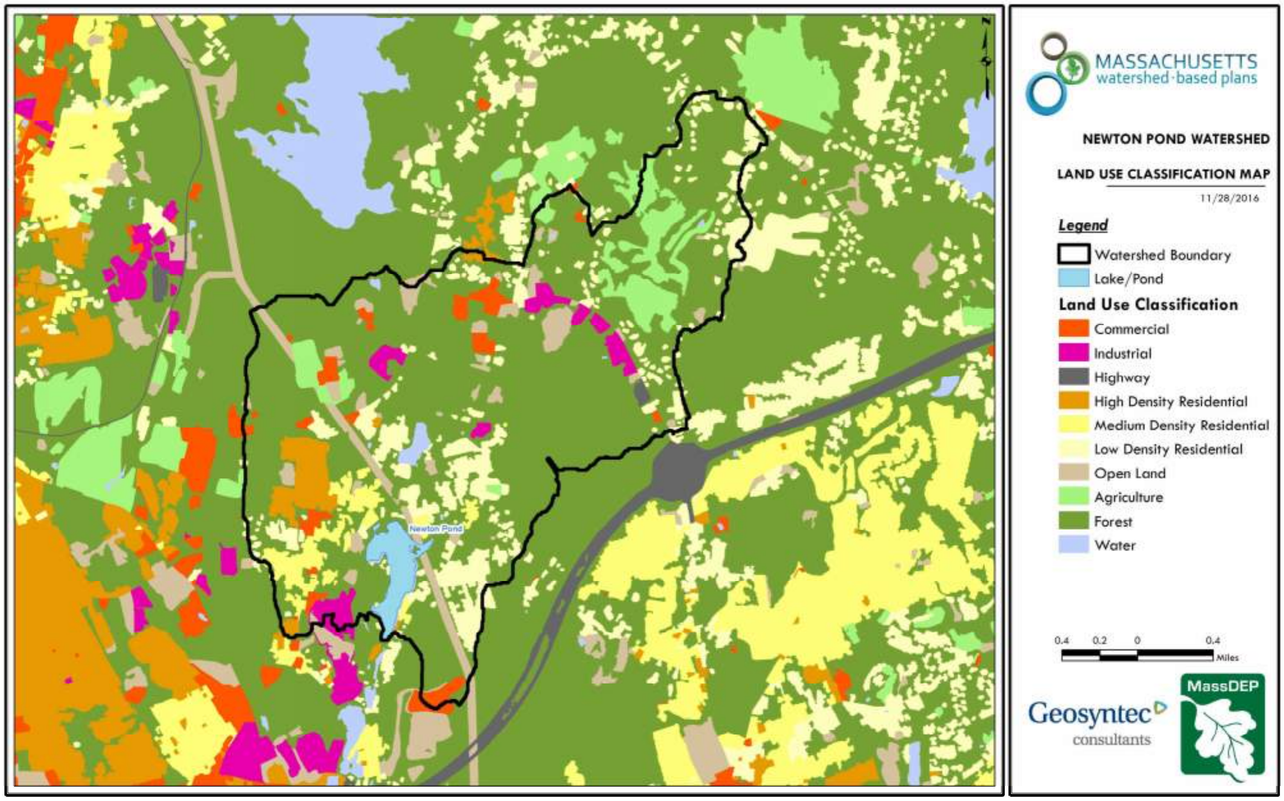

Figure A-2: Watershed Land Use Map (MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)
Ctrl + Click on the map to view a full sized image in your web browser.

B. Watershed Impervious Cover

There is a strong link between impervious land cover and stream water quality. Impervious cover includes land surfaces that prevent the infiltration of water into the ground, such as paved roads and parking lots, roofs, basketball courts, etc.

Impervious areas that are directly connected (DCIA) to receiving waters (via storm sewers, gutters, or other impervious drainage pathways) produce higher runoff volumes and transport stormwater pollutants with greater efficiency than disconnected impervious cover areas which are surrounded by vegetated, pervious land. Runoff volumes from disconnected impervious cover areas are reduced as stormwater infiltrates when it flows across adjacent pervious surfaces.

An estimate of DCIA for the watershed was calculated based on the Sutherland equations. USEPA provides guidance (USEPA, 2010) on the use of the Sutherland equations to predict relative levels of connection and disconnection based on the type of stormwater infrastructure within the **total impervious area (TIA)** of a watershed. Within each subwatershed, the total area of each land use were summed and used to calculate the percent TIA.

Estimated TIA in the watershed: 12.1 %

Estimated DCIA in the watershed: 8.9 %

The relationship between TIA and water quality can generally be categorized as follows (Schueler et al. 2009):

Table A-7: Relationship between Total Impervious Area (TIA) and water quality (Schueler et al. 2009)

% Watershed Impervious Cover	Stream Water Quality
0-10%	Typically high quality, and typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects.
11-25%	These streams show clear signs of degradation. Elevated storm flows begin to alter stream geometry, with evident erosion and channel widening. Streams banks become unstable, and physical stream habitat is degraded. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with most sensitive fish and aquatic insects disappearing from the stream.
26-60%	These streams typically no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, downcutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated and the substrate can no longer provide habitat for aquatic insects, or spawning areas for fish. Biological quality is typically poor, dominated by pollution tolerant insects and fish. Water quality is consistently rated as fair to poor, and water recreation is often no longer possible due to the presence of high bacteria levels.
>60%	These streams are typical of “urban drainage”, with most ecological functions greatly impaired or absent, and the stream channel primarily functioning as a conveyance for stormwater flows.

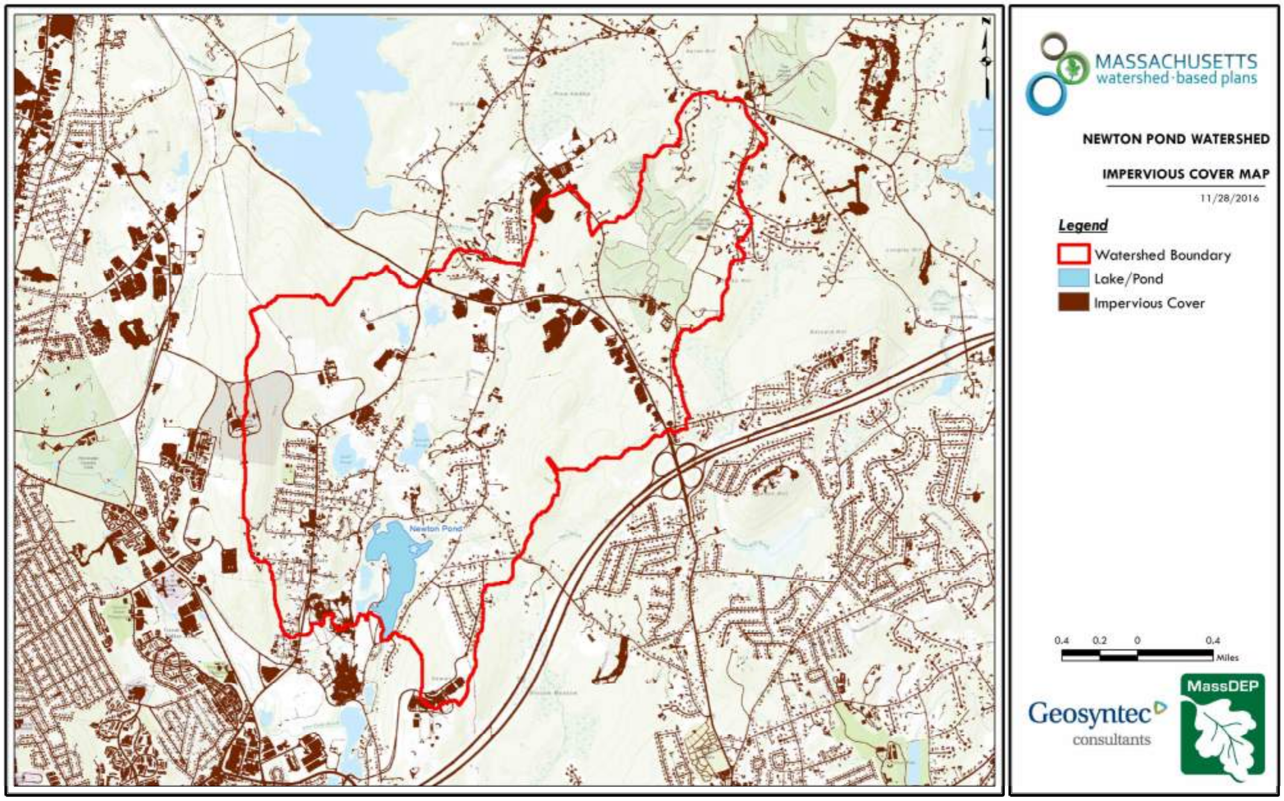

Figure A-3: Watershed Impervious Surface Map (MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Ctrl + Click on the map to view a full sized image in your web browser.

Land use information:

6. Pollutant Loading

The land use data (MassGIS, 2009b) was intersected with impervious cover data (MassGIS, 2009a) and United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soils data (USDA NRCS and MassGIS, 2012) to create a combined land use/land cover grid. The grid was used to sum the total area of each unique land use/land cover type.

The amount of DCIA was estimated using the Sutherland equations as described above and any reduction in impervious area due to disconnection (i.e., the area difference between TIA and DCIA) was assigned to the pervious D soil category for that land use to simulate that some infiltration will likely occur after runoff from disconnected impervious surfaces passes over pervious surfaces.

Pollutant loading for key nonpoint source pollutants in the watershed was estimated by multiplying each land use/cover type area by its pollutant load export rate (PLER). The PLERs are an estimate of the annual total pollutant load exported via stormwater from a given unit area of a particular land cover type. The PLER values for TN, TP and TSS were obtained from USEPA (Voorhees, 2016b) (see documentation provided in Appendix A) as follows:

$$L_n = A_n * P_n$$

Where L_n = Loading of land use/cover type n (lb/yr); A_n = area of land use/cover type n (acres); P_n = pollutant load export rate of land use/cover type n (lb/acre/yr)

Table A-8: Estimated Pollutant Loading for Key Nonpoint Source Pollutants

Land Use Type	Pollutant Loading[1]		
	Total Phosphorus (TP) (lbs/yr)	Total Nitrogen (TN) (lbs/yr)	Total Suspended Solids (TSS) (tons/yr)
Agriculture	90	569	10.05
Commercial	82	709	8.87
Forest	273	1,477	53.37
High Density Residential	49	333	4.94
Highway	5	41	2.59
Industrial	68	587	7.35
Low Density Residential	97	947	13.39
Medium Density Residential	29	236	3.38
Open Land	58	498	11.56
TOTAL	751	5,396	115.49

[1]These estimates do not consider loads from point sources or septic systems.

Pollutant loading information:

Element B: Determine Pollutant Load Reductions Needed to Achieve Water Quality Goals

Element B of your WBP should:

Determine the pollutant load reductions needed to achieve the water quality goals established in Element A. The water quality goals should incorporate Total Maximum Daily Load (TMDL) goals, when applicable. For impaired water bodies, a TMDL establishes pollutant loading limits as needed to attain water quality standards.

1. Estimated Pollutant Loads

Table 1 lists estimated pollutant loads for the following primary nonpoint source (NPS) pollutants: total phosphorus (TP), total nitrogen (TN), total suspended solids (TSS). These estimated loads are based on the pollutant loading analysis presented in Section 4 of Element A.

2. Water Quality Goals

Water quality goals for primary NPS pollutants are listed in Table 1 based on the following:

- TMDL water quality goals (if a TMDL exists for the water body);
- For all water bodies, including impaired waters that have a pathogen TMDL, the water quality goal for bacteria is based on the Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) that apply to the Water Class of the selected water body.
- If the water body does not have a TMDL for TP, a default target TP concentrations is provided which is based on guidance provided by the USEPA in Quality Criteria for Water (1986), also known as the "Gold Book". Because there are no similar default water quality goals for TN and TSS, goals for these pollutants are provided in Table 1 only if a TMDL exists or alternate goal(s) have been optionally established by the WBP author.
- According to the USEPA Gold Book, total phosphorus should not exceed 50 ug/L in any stream at the point where it enters any lake or reservoir. The water quality loading goal was estimated by multiplying this target maximum phosphorus concentration (50 ug/L) by the estimated annual watershed discharge for the selected water body. To estimate the annual watershed discharge, the mean flow was used, which was estimated based on United States Geological Survey (USGS) "Runoff Depth" estimates for Massachusetts (Cohen and Randall, 1998). Cohen and Randall (1998) provide statewide estimates of annual Precipitation (P), Evapotranspiration (ET), and Runoff (R) depths for the northeastern U.S. According to their method, Runoff Depth (R) is defined as all water reaching a discharge point (including surface and groundwater), and is calculated by:

$$P - ET = R$$

A mean Runoff Depth R was determined for the watershed by calculating the average value of R within the watershed boundary. This method includes the following assumptions/limitations:

a. For lakes and ponds, the estimate of annual TP loading is averaged across the entire watershed. However, a given lake or reservoir may have multiple tributary streams, and each stream may drain land with vastly different characteristics. For example, one tributary may drain a highly developed residential area, while a second tributary may drain primarily forested and undeveloped land. In this case, one tributary may exhibit much higher phosphorus concentrations than the average of all streams in the selected watershed.

b. The estimated existing loading value only accounts for phosphorus due to stormwater runoff. Other sources of phosphorus may be relevant, particularly phosphorus from on-site wastewater treatment (septic systems) within close proximity to receiving waters. Phosphorus does not typically travel far within an aquifer, but in watersheds that are primarily unsewered, septic systems and other similar groundwater-related sources may contribute a significant load of phosphorus that is not captured in this analysis. As such, it is important to consider the estimated TP loading as "the expected TP loading from stormwater sources."

Table B-1: Pollutant Load Reductions Needed

Pollutant	Existing Estimated Total Load	Water Quality Goal	Required Load Reduction
Total Phosphorus	See TMDL information below	See TMDL information below	See TMDL information below
Total Nitrogen	5396 lbs/yr		
Total Suspended Solids	115 ton/yr		
Bacteria	*MSWQS for bacteria are concentration standards (e.g., colonies of fecal coliform bacteria per 100 ml), which are difficult to predict based on estimated annual loading.*	Class B. **Class B Standards** • Public Bathing Beaches: For E. coli, geometric mean of 5 most recent samples shall not exceed 126 colonies/ 100 ml and no single sample during the bathing season shall exceed 235 colonies/100 ml. For enterococci, geometric mean of 5 most recent samples shall not exceed 33 colonies/100 ml and no single sample during bathing season shall exceed 61 colonies/100 ml; • Other Waters and Non-bathing Season at Bathing Beaches: For E. coli, geometric mean of samples from most recent 6 months shall not exceed 126 colonies/100 ml (typically based on min. 5 samples) and no single sample shall exceed 235 colonies/100 ml. For	

		enterococci, geometric mean of samples from most recent 6 months shall not exceed 33 colonies/100 ml, and no single sample shall exceed 61 colonies/100 ml.	

TMDL Pollutant Load Criteria

Total Phosphorus (MA51110)

Loading Capacity
Modeling Assumptions, Key Input, Calibration and Validation:
There are no numeric models available to predict the growth of rooted aquatic macrophytes as a function of nutrient loading estimates, therefore the control of nuisance aquatic plants is based on best professional judgment. However, the goal of the TMDL is to prevent future eutrophication from occurring, thus the nutrient loading still needs to be controlled. To control eutrophication, the Carlson Trophic State Index (TSI) predicts a lake should have total phosphorus concentrations of about 40 ppb to meet the 4-foot transparency requirement for swimming beaches in Massachusetts and targets are set lower than this. Due to the lack of data on mean depth and other parameters, a simple water quality model was used to link watershed phosphorus loading to in-lake total phosphorus concentration targets. Based on the NPSLAKE model phosphorus loading output and predicted water runoff volumes, an estimated in-lake total phosphorus (TP) concentration was derived based on the Reckhow (1979) model:
TP=L/(11.6+1.2*q)*1000
where
TP= the predicted average total phosphorus concentration (mg/l) in the lake.
L= Phosphorus loading in g/m2/yr (the total loading in grams divided by lake area in meters).
q= The areal water loading in m/yr from total water runoff in m3/yr divided by lake area in m2.
Similarly, by setting the TP to the target total phosphorus concentration, a target load was estimated by solving the equation above. As noted in Mattson and Isaac (1999) the Reckhow (1979) model was developed on similar, north temperate lakes and most Massachusetts lakes will fall within the range of phosphorus loading and hydrology of the calibration data set. Additional assumptions, and details of calibration and validation are given in Reckhow (1979).
Wasteload Allocations, Load Allocations and Margin of Safety:
For most lakes, point source wasteload allocation is zero. The margin of safety is set by establishing a target that is below that expected to meet the 4-foot swimming standard (about 40 ppb). Thus, the TMDL is the same as the target load allocation to nonpoint sources as indicated in the right side of the following table (originally part of Table 4 of "Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes" report, 2002). Loading allocations are based on the NPSLAKE landuse modeled phosphorus budget. Note that if lakes have surface TP concentrations that are much larger than that predicted by the NPSLAKE model, internal sources of phosphorus, such as the sediments, may also be a contributing source of phosphorus to the surface waters and should be considered for further evaluation and control.

Table . Newton Pond MA51110 TMDL Load Allocation.

Source	*Current TP Loading (kg/yr)*	*Target TP Load Allocation (kg/yr)*
Forest	88	88
Agriculture	10	7
Open Land	30	21
Residential (Low den.)	33	23
Residential (High den.)	128	90
Comm. Indust.	33	23
Septic System	8	5
Other	0	0
Total Inputs	330	257

Phosphorus loading allocations for each landuse category are shown (are rounded to the nearest kg/yr) in the above table. No reduction in forest loading is targeted, because other than logging operations, which are relatively rare and already have BMPs in place, this source is unlikely to be reduced by additional BMPs. The remaining load reductions are allocated as a proportional phosphorus loading reduction.

The TMDL is the sum of the wasteload allocations (WLA) from point sources (e.g., sewage treatment plants) plus load allocations (LA) from nonpoint sources (e.g., landuse sources) plus a margin of safety (MOS). Thus, the TMDL can be written as:

TMDL = WLA + LA + MOS

Seasonality:

As the term implies, TMDLs are often expressed as maximum daily loads. However, as specified in 40 CFR 130.2(I), TMDLs may be expressed in other terms when appropriate. For this case, the TMDL is expressed in terms of allowable annual loadings of phosphorus. Although critical conditions occur during the summer season when weed growth is more likely to interfere with uses, water quality in many lakes is generally not sensitive to daily or short term loading, but is more a function of loadings that occur over longer periods of time (e.g. annually).

Therefore, seasonal variation is taken into account with the estimation of annual loads. In addition, evaluating the effectiveness of nonpoint source controls can be more easily accomplished on an annual basis rather than a daily basis.

For most lakes, it is appropriate and justifiable to express a nutrient TMDL in terms of allowable annual loadings. The annual load should inherently account for seasonal variations by being protective of the most sensitive time of year. The most sensitive time of year in most lakes occurs during summer, when the frequency and occurrence of nuisance algal blooms and macrophyte growth are usually greatest. Therefore, because these phosphorus TMDLs were established to be protective of the most environmentally sensitive period (i.e., the summer season), it will also be protective of water quality during all other seasons. Additionally, the targeted reduction in annual phosphorus load to the ponds will result in the application of phosphorus controls that also address seasonal variation. For example, certain control practices such as stabilizing eroding drainage ways or maintaining septic systems will be in place throughout the year while others will be in effect during the times the sources are active (e.g., application of lawn fertilizer).

Reckhow, K.H. 1979. Uncertainty Analysis Applied to Vollenweider's Phosphorus Loading Criteria. J. Water Poll. Control Fed. 51(8):2123-2128

Mattson, M.D. and R.A. Isaac. 1999. Calibration of Phosphorus Export coefficients for Total Maximum Daily Loads of Massachusetts Lakes. Lake and Reservoir Man. 15(3):209-219.

Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes

Pollutant load reduction information:

Element C: Describe management measures that will be implemented to achieve water quality goals

Element C: A description of the nonpoint source management measures needed to achieve the pollutant load reductions presented in Element B, and a description of the critical areas where those measures will be needed to implement this plan.

Table C1 presents the proposed management measures as well as the estimated pollutant load reductions and costs. The planning level cost estimates and pollutant load reduction estimates and estimates of BMP footprint were based off information obtained in the following sources and were also adjusted to 2016 values using the Consumer Price Index (CPI) (United States Bureau of Labor Statistics, 2016):

- Geosyntec Consultants, Inc. (2014);
- Geosyntec Consultants, Inc. (2015);
- King and Hagen (2011);
- Leisenring, et al. (2014);
- King and Hagen (2011);
- MassDEP (2016a);
- MassDEP (2016b);
- University of Massachusetts, Amherst (2004);
- Voorhees (2015);
- Voorhees (2016a);
- Voorhees (2016b);

Table C-1: Proposed Management Measures, Estimated Pollutant Load Reductions and Costs

Structural BMPs
No Structural BMP Data Found

Additional BMPs
No Additional BMP Data Found

Element D: Identify Technical and Financial Assistance Needed to Implement Plan

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.

Table D-1 presents the funding needed to implement the management measures presented in this watershed plan. The table includes costs for structural and non-structural BMPs, operation and maintenance activities, information/education measures, and monitoring/evaluation activities.

Table D-1: Summary of Funding Needed to Implement the Watershed Plan.

Management Measures	Location	Capital Costs	Operation & Maintenance Costs	Relevant Authorities	Technical Assistance Needed	Funding Needed
Structural and Non-Structural BMPs (from Element C)						
Information/Education (see Element E)						
Monitoring and Evaluation (see Element H/I)						
					Total Funding Needed:	
Funding Sources:						

Element E: Public Information and Education

Element E: Information and Education (I/E) component of the watershed plan used to:

1. Enhance public understanding of the project; and
2. Encourage early and continued public participation in selecting, designing, and implementing the NPS management measures that will be implemented.

Step 1: Goals and Objectives

The goals and objectives for the watershed information and education program.

Step 2: Target Audience

Target audiences that need to be reached to meet the goals and objectives identified above.

Step 3: Outreach Products and Distribution

The outreach product(s) and distribution form(s) that will be used for each.

Step 4: Evaluate Information/Education Program

Information and education efforts and how they will be evaluated.

Other Information

Elements F & G: Implementation Schedule and Measurable Milestones

Element F: Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.

Element G: A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

Table FG-1: Implementation Schedule and Interim Measurable Milestones

A. Structural & Non-Structural BMPs
No Data Found

B. Public Education & Outreach
No Data Found

C. Monitoring
No Data Found

Scheduling and milestone information:

Elements H & I: Progress Evaluation Criteria and Monitoring

Element H: A set of criteria used to determine (1) if loading reductions are being achieved over time and (2) if progress is being made toward attaining water quality goals. Element H asks "**how will you know if you are making progress towards water quality goals?**" The criteria established to track progress can be direct measurements (e.g., E. coli bacteria concentrations) or indirect indicators of load reduction (e.g., number of beach closings related to bacteria).

Element I: A monitoring component to evaluate the effectiveness of implementation efforts over time, as measured against the Element H criteria. Element I asks "**how, when, and where will you conduct monitoring?**"

The water quality target concentration(s) is presented under Element A of this plan. To achieve this target concentration, the annual loading must be reduced to the amount described in Element B. Element C of this plan describes the various management measures that will be implemented to achieve this targeted load reduction. The evaluation criteria and monitoring program described below will be used to measure the effectiveness of the proposed management measures (described in Element C) in improving the water quality of Gulf Pond.

Indirect Indicators of Load Reduction

Project-Specific Indicators

TMDL Criteria

Direct Measurements

Adaptive Management

References / Appendix

References

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Water Quality Assessment Reports

"*Blackstone River Watershed 2003-2007 Water Quality Assessment Report*"

TMDL

"*Total Maximum Daily Loads of Phosphorus for Selected Northern Blackstone Lakes*"

Appendix A – Pollutant Load Export Rates (PLERs)

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
AGRICULTURE, HSG A	0.45	7.14	2.59
AGRICULTURE, HSG B	0.45	29.4	2.59
AGRICULTURE, HSG C	0.45	59.8	2.59
AGRICULTURE, HSG D	0.45	91.0	2.59
AGRICULTURE, IMPERVIOUS	1.52	650	11.3
COMMERCIAL, HSG A	0.03	7.14	0.27
COMMERCIAL, HSG B	0.12	29.4	1.16
COMMERCIAL, HSG C	0.21	59.8	2.41
COMMERCIAL, HSG D	0.37	91.0	3.66
COMMERCIAL, IMPERVIOUS	1.78	377	15.1
FOREST, HSG A	0.12	7.14	0.54
FOREST, HSG B	0.12	29.4	0.54
FOREST, HSG C	0.12	59.8	0.54
FOREST, HSG D	0.12	91.0	0.54
FOREST, HSG IMPERVIOUS	1.52	650	11.3
HIGH DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
HIGH DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
HIGH DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
HIGH DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
HIGH DENSITY RESIDENTIAL, IMPERVIOUS	2.32	439	14.1
HIGHWAY, HSG A	0.03	7.14	0.27
HIGHWAY, HSG B	0.12	29.4	1.16
HIGHWAY, HSG C	0.21	59.8	2.41
HIGHWAY, HSG D	0.37	91.0	3.66
HIGHWAY, IMPERVIOUS	1.34	1,480	10.2
INDUSTRIAL, HSG A	0.03	7.14	0.27
INDUSTRIAL, HSG B	0.12	29.4	1.16

INDUSTRIAL, HSG C	0.21	59.8	2.41
INDUSTRIAL, HSG D	0.37	91.0	3.66
INDUSTRIAL, IMPERVIOUS	1.78	377	15.1
LOW DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
LOW DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
LOW DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
LOW DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
LOW DENSITY RESIDENTIAL, IMPERVIOUS	1.52	439	14.1
MEDIUM DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
MEDIUM DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
MEDIUM DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
MEDIUM DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
MEDIUM DENSITY RESIDENTIAL, IMPERVIOUS	1.96	439	14.1
OPEN LAND, HSG A	0.12	7.14	0.27
OPEN LAND, HSG B	0.12	29.4	1.16
OPEN LAND, HSG C	0.12	59.8	2.41
OPEN LAND, HSG D	0.12	91.0	3.66
OPEN LAND, IMPERVIOUS	1.52	650	11.3
[1]HSG = Hydrologic Soil Group			

Massachusetts Year 2014 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

CN 450.1

Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
Matthew A. Beaton, Secretary
Massachusetts Department of Environmental Protection
Martin Suuberg, Commissioner
Bureau of Water Resources
Douglas E. Fine, Assistant Commissioner

Massachusetts Category 4a Waters
"TMDL is completed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	UNITS	POLLUTANTS ADDRESSED BY TMDL	EPA TMDL NUMBER
Blackstone						
Brierly Pond	MA51010	Millbury	18	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	175
Dorothy Pond	MA51039	Millbury	133	ACRES	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					(Non-Native Aquatic Plants*)	
					Turbidity	379
Eddy Pond	MA51043	Auburn	99	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	2382
Flint Pond	MA51050	[North Basin] Shrewsbury	92	ACRES	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	444
					Turbidity	444
Flint Pond	MA51188	[South Basin] Shrewsbury/Grafton/Worcester	173	ACRES	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	444
Green Hill Pond	MA51056	Worcester	29	ACRES	Turbidity	498
Howe Reservoirs	MA51071	[West Basin] Millbury	7	ACRES	Aquatic Plants (Macrophytes)	550
Indian Lake	MA51073	Worcester	186	ACRES	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					Aquatic Plants (Macrophytes)	2323
					Oxygen, Dissolved	2323
Jordan Pond	MA51078	Shrewsbury	18	ACRES	Turbidity	2385
Lake Quinsigamond	MA51125	Shrewsbury/Worcester	471	ACRES	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					(Non-Native Aquatic Plants*)	
					Excess Algal Growth	644
					Oxygen, Dissolved	644
Leesville Pond	MA51087	Auburn/Worcester	34	ACRES	(Non-Native Aquatic Plants*)	
					Oxygen, Dissolved	671
					Phosphorus (Total)	671
Mill Pond	MA51105	Shrewsbury	12	ACRES	Turbidity	804
Newton Pond	MA51110	Shrewsbury/Boylston	54	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	862

* TMDL not required (Non-pollutant)

Massachusetts Year 2016 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

CN 470.1

Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
Kathleen A. Theoharides, Secretary
Massachusetts Department of Environmental Protection
Martin Suuberg, Commissioner
Bureau of Water Resources
Kathleen Baskin, Assistant Commissioner

Category 4c waters listed alphabetically by major watershed "Impairment not caused by a pollutant – TMDL not required"

Water Body	Segment ID	Description	Size	Units	Impairment
Blackstone					
Brierly Pond	MA51010	Millbury.	18.00	Acres	(Aquatic Plants (Macrophytes)*)
					(Non-Native Aquatic Plants*)
Coes Reservoir	MA51024	Worcester.	87.00	Acres	(Eurasian Water Milfoil, Myriophyllum spicatum*)
Dark Brook Reservoir	MA51035	[South Basin] Auburn.	58.00	Acres	(Eurasian Water Milfoil, Myriophyllum spicatum*)
					(Non-Native Aquatic Plants*)
Dark Brook Reservoir	MA51036	[North Basin] Auburn.	171.00	Acres	(Eurasian Water Milfoil, Myriophyllum spicatum*)
Girard Pond	MA51053	Sutton.	2.00	Acres	(Non-Native Aquatic Plants*)
Howe Reservoirs	MA51070	[East Basin] Millbury.	2.00	Acres	(Dewatering*)
					(Non-Native Aquatic Plants*)
Ironstone Reservoir	MA51074	Uxbridge.	28.00	Acres	(Non-Native Aquatic Plants*)
Jenks Reservoir	MA51075	Bellingham.	26.00	Acres	(Non-Native Aquatic Plants*)
Mill Pond	MA51104	Upton.	10.00	Acres	(Non-Native Aquatic Plants*)
Miscoe Lake	MA51106	Wrentham (size indicates portion in Massachusetts) (entire portion in MA is from 1000 feet upstream of the state line, these interstate surface waters are public water supply in Rhode Island and designated in MA as Class A/PWS/ORW).	5.00	Acres	(Non-Native Aquatic Plants*)
Newton Pond	MA51110	Shrewsbury/Boylston.	54.00	Acres	(Non-Native Aquatic Plants*)
North Pond	MA51112	Hopkinton/Milford.	231.00	Acres	(Non-Native Aquatic Plants*)
Pratt Pond	MA51123	Upton.	40.00	Acres	(Non-Native Aquatic Plants*)
Quinsigamond River	MA51-09	Headwaters, outlet Flint Pond, Grafton to confluence with the Blackstone River in Fisherville Pond, Grafton (excluding approximately 0.5 mile through Lake Ripple segment MA51135) (segment includes all of Hovey Pond formerly segment MA51068 and a portion of Fisherville Pond formerly segment MA51048).	5.20	Miles	(Eurasian Water Milfoil, Myriophyllum spicatum*)
					(Non-Native Aquatic Plants*)
Riverlin Street Pond	MA51137	Millbury.	2.00	Acres	(Non-Native Aquatic Plants*)
Rivulet Pond	MA51138	Uxbridge.	4.00	Acres	(Non-Native Aquatic Plants*)
Sibley Reservoir	MA51148	Sutton.	25.00	Acres	(Dewatering*)
Silver Lake	MA51150	Bellingham.	42.00	Acres	(Non-Native Aquatic Plants*)
Silver Lake	MA51151	Grafton.	25.00	Acres	(Dewatering*)
Singletary Pond	MA51152	Sutton/Millbury.	341.00	Acres	(Eurasian Water Milfoil, Myriophyllum spicatum*)
					(Non-Native Aquatic Plants*)
Stevens Pond	MA51159	Sutton.	85.00	Acres	(Non-Native Aquatic Plants*)
Swans Pond	MA51164	Sutton/Northbridge.	32.00	Acres	(Non-Native Aquatic Plants*)
Taft Pond	MA51165	Upton.	11.00	Acres	(Non-Native Aquatic Plants*)

Appendix 3
Impairments *removed* from categories 4 or 5 of the integrated list in 2016
(waters listed alphabetically by major watershed)

Water Body	Segment ID	Category 2014	Category 2016	Impairment Cause	EPA TMDL No.	Explanation
Blackstone						
Beaver Brook	MA51-07	5	5	(Debris/Floatables/Trash*)		Applicable WQS attained; reason for recovery unspecified.
				Taste and Odor		Applicable WQS attained; reason for recovery unspecified.
Blackstone River	MA51-04	5	5	DDT (dichlorodiphenyltrichloroethane)		Impairment changed from "DDT" to "DDT in Fish Tissue".
Blackstone River	MA51-06	5	5	DDT (dichlorodiphenyltrichloroethane)		Impairment changed from "DDT" to "DDT in Fish Tissue".
Brierly Pond	MA51010	4A	4C	Aquatic Plants (Macrophytes)	175	Not caused by a pollutant, impairment still exists.
Dark Brook	MA51-16	5	5	Aquatic Plants (Macrophytes)	2377	Applicable WQS attained; reason for recovery unspecified.
Eddy Pond	MA51043	4A	4A	Aquatic Plants (Macrophytes)	2382	Not caused by a pollutant, impairment still exists.
				Nutrient/Eutrophication Biological Indicators	2382	New impairment, covered under existing TMDL [CN 070.1, 5/2/2002], added to this segment for 2016.
Flint Pond	MA51050	4A	4A	Aquatic Plants (Macrophytes)	444	Not caused by a pollutant, impairment still exists.
				Nutrient/Eutrophication Biological Indicators	444	New impairment, covered under existing TMDL [CN 115.0, 6/28/2002], added to this segment for 2016.
Flint Pond	MA51188	4A	4A	Aquatic Plants (Macrophytes)	444	Not caused by a pollutant, impairment still exists.
				Nutrient/Eutrophication Biological Indicators	444	New impairment, covered under existing TMDL [CN 115.0, 6/28/2002], added to this segment for 2016.
Howe Reservoirs	MA51071	4A	4A	Aquatic Plants (Macrophytes)	550	Not caused by a pollutant, impairment still exists.
				Nutrient/Eutrophication Biological Indicators	550	New impairment, covered under existing TMDL [CN 070.1, 5/2/2002], added to this segment for 2016.
Indian Lake	MA51073	4A	4A	Aquatic Plants (Macrophytes)	2323	Applicable WQS attained; according to new assessment method.
				Harmful Algal Blooms	2323	New impairment, covered under existing TMDL [CN 116.0, 6/28/2002], added to this segment for 2016.
				Nutrient/Eutrophication Biological Indicators	2323	New impairment, covered under existing TMDL [CN 116.0, 6/28/2002], added to this segment for 2016.
Jordan Pond	MA51078	4A	4A	Harmful Algal Blooms	2385	New impairment, covered under existing TMDL [CN 070.1, 5/2/2002], added to this segment for 2016.
Kettle Brook	MA51-01	5	5	(Debris/Floatables/Trash*)		Applicable WQS attained; reason for recovery unspecified.
				Aquatic Plants (Macrophytes)	2391	Applicable WQS attained; reason for recovery unspecified.
				Turbidity	2389	Applicable WQS attained; reason for recovery unspecified.
Mill River	MA51-36	5	5	Aquatic Plants (Macrophytes)		Applicable WQS attained; according to new assessment method.
Newton Pond	MA51110	4A	4C	Aquatic Plants (Macrophytes)	862	Applicable WQS attained; according to new assessment method.
Shirley Street Pond	MA51196	4A	4A	Aquatic Plants (Macrophytes)	2392	Not caused by a pollutant, impairment still exists.
				Nutrient/Eutrophication Biological Indicators	2392	New impairment, covered under existing TMDL [CN 070.1, 5/2/2002], added to this segment for 2016.
Singletary Brook	MA51-31	5	5	Aquatic Plants (Macrophytes)		Original basis for listing was incorrect.

* TMDL not required (Non-pollutant)

Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle

CN 505.1

Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
Kathleen A. Theoharides, Secretary
Massachusetts Department of Environmental Protection
Martin Suuberg, Commissioner
Bureau of Water Resources
Kathleen Baskin, Assistant Commissioner

Category 4c waters listed alphabetically by major watershed
"Impairment not caused by a pollutant – TMDL not required"

Waterbody	AU_ID	Description	Size	Units	Impairment
Blackstone					
Brierly Pond	MA51010	Millbury.	18.00	Acres	(Aquatic Plants (Macrophytes)*)
					(Non-Native Aquatic Plants*)
Coes Reservoir	MA51024	Worcester.	87.00	Acres	(Eurasian Water Milfoil, Myriophyllum Spicatum*)
					(Water Chestnut*)
Dark Brook Reservoir	MA51035	[South Basin] Auburn.	58.00	Acres	(Brittle Naiad, Najas Minor*)
					(Eurasian Water Milfoil, Myriophyllum Spicatum*)
Dark Brook Reservoir	MA51036	[North Basin] Auburn.	171.00	Acres	(Eurasian Water Milfoil, Myriophyllum Spicatum*)
Girard Pond	MA51053	Sutton.	2.00	Acres	(Fanwort*)
Howe Reservoirs	MA51070	[East Basin] Millbury.	2.00	Acres	(Dewatering*)
Ironstone Reservoir	MA51074	Uxbridge.	28.00	Acres	(Fanwort*)
Jenks Reservoir	MA51075	Bellingham.	26.00	Acres	(Non-Native Aquatic Plants*)
Mill Pond	MA51104	Upton.	10.00	Acres	(Fanwort*)
					(Non-Native Aquatic Plants*)
Miscoe Lake	MA51106	Wrentham (size indicates portion in Massachusetts) (entire portion in MA is from 1000 feet upstream of the state line, these interstate surface waters are public water supply in Rhode Island and designated in MA as Class A/PWS/ORW).	5.00	Acres	(Fanwort*)
Newton Pond	MA51110	Shrewsbury/Boylston.	54.00	Acres	(Fanwort*)
					(Non-Native Aquatic Plants*)
North Pond	MA51112	Hopkinton/Milford.	231.00	Acres	(Brittle Naiad, Najas Minor*)
					(Fanwort*)
					(Non-Native Aquatic Plants*)
Pratt Pond	MA51123	Upton.	40.00	Acres	(Fanwort*)
					(Non-Native Aquatic Plants*)
Riverlin Street Pond	MA51137	Millbury.	2.00	Acres	(Curly-leaf Pondweed*)
					(Non-Native Aquatic Plants*)
Rivulet Pond	MA51138	Uxbridge.	4.00	Acres	(Non-Native Aquatic Plants*)
Sibley Reservoir	MA51148	Sutton.	25.00	Acres	(Dewatering*)
Silver Lake	MA51150	Bellingham.	42.00	Acres	(Non-Native Aquatic Plants*)
Silver Lake	MA51151	Grafton.	25.00	Acres	(Water Chestnut*)
Singletary Pond	MA51152	Sutton/Millbury.	341.00	Acres	(Eurasian Water Milfoil, Myriophyllum Spicatum*)
Stevens Pond	MA51159	Sutton.	85.00	Acres	(Fanwort*)
Swans Pond	MA51164	Sutton/Northbridge.	32.00	Acres	(Non-Native Aquatic Plants*)

Final Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle

CN 568.1

Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
Rebecca L. Tepper, Secretary
Massachusetts Department of Environmental Protection
Bonnie Heiple, Commissioner
Bureau of Water Resources
Kathleen M. Baskin, Assistant Commissioner

MassDEP

Category 4c waters listed alphabetically by major watershed
"Impairment not caused by a pollutant – TMDL not required"

Waterbody	AU_ID	Description	Size	Units	Impairment
Blackstone					
Brierly Pond	MA51010	Millbury.	18.00	Acres	(Aquatic Plants (Macrophytes)*)
					(Non-Native Aquatic Plants*)
Coes Reservoir	MA51024	Worcester.	87.00	Acres	(Eurasian Water Milfoil, Myriophyllum Spicatum*)
					(Water Chestnut*)
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					(Eurasian Water Milfoil, Myriophyllum Spicatum*)
Dark Brook Reservoir	MA51036	[North Basin] Auburn.	171.00	Acres	(Eurasian Water Milfoil, Myriophyllum Spicatum*)
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					(Non-Native Aquatic Plants*)
Miscoe Lake	MA51106	Wrentham (size indicates portion in Massachusetts) (entire portion in MA is from 1000 feet upstream of the state line, these interstate surface waters are public water supply in Rhode Island and designated in MA as Class A/PWS/ORW).	5.00	Acres	(Fanwort*)
Newton Pond	MA51110	Shrewsbury/Boylston.	54.00	Acres	(Fanwort*)
					(Non-Native Aquatic Plants*)
North Pond	MA51112	Hopkinton/Milford.	231.00	Acres	(Brittle Naiad, Najas Minor*)
					(Fanwort*)
					(Non-Native Aquatic Plants*)
Pratt Pond	MA51123	Upton.	40.00	Acres	(Fanwort*)
					(Non-Native Aquatic Plants*)
Riverlin Street Pond	MA51137	Millbury.	2.00	Acres	(Curly-leaf Pondweed*)
					(Non-Native Aquatic Plants*)
Rivulet Pond	MA51138	Uxbridge.	4.00	Acres	(Non-Native Aquatic Plants*)
Sibley Reservoir	MA51148	Sutton.	25.00	Acres	(Dewatering*)
Silver Lake	MA51150	Bellingham.	42.00	Acres	(Non-Native Aquatic Plants*)
Silver Lake	MA51151	Grafton.	25.00	Acres	(Water Chestnut*)
Singletary Pond	MA51152	Sutton/Millbury.	341.00	Acres	(Eurasian Water Milfoil, Myriophyllum Spicatum*)
Stevens Pond	MA51159	Sutton.	85.00	Acres	(Fanwort*)
Swans Pond	MA51164	Sutton/Northbridge.	32.00	Acres	(Non-Native Aquatic Plants*)
Taft Pond	MA51165	Upton.	11.00	Acres	(Non-Native Aquatic Plants*)
Tinker Hill Pond	MA51167	Auburn.	37.00	Acres	(Brittle Naiad, Najas Minor*)
Tuckers Pond	MA51169	Sutton.	26.00	Acres	(Non-Native Aquatic Plants*)

*TMDL not required (Non-pollutant)

STANDARD OPERATING PROCEDURE

Structural Stormwater Best Management Practices Inspections & Maintenance

TARGETED POLLUTANTS

Nutrients (nitrogen, phosphorus)
Total Suspended Solids (TSS)
Metals (copper, lead, zinc)
Pathogens (*E. coli*, coliform)
Invasive species
Trash

MASSACHUSETTS STORMWATER HANDBOOK (VOLUME 2, CHAPTER 2):

https://www.mass.gov/doc/massachusetts-stormwater-handbook-vol-2-ch-2-stormwater-best-management-practices/download

Description

Procedures for inspecting and maintaining common types of constructed stormwater best management practices (BMPs). Constructed BMPs are permanent site features designed to retain, treat, and/or infiltrate stormwater before discharging it to a surface waterbody.

In accordance with Part 2.3.7.a.iii.6 of the MS4 General Permit, all municipally-owned stormwater treatment structures (excluding catch basins) shall be inspected annually, at a minimum. The description of each BMP type and the recommended activities for inspection and maintenance included in this SOP are based on the Massachusetts Stormwater Handbook (February 2008) and should be considered guidelines to follow, but the maintenance schedules presented herein are more prescriptive and stringent than the MS4 General Permit and will be followed on a case-by-case basis. **The Town will complete the required inspection annually and complete maintenance on an as-needed basis.**

This SOP is also not intended to replace a site-specific Operation and Maintenance (O&M) Plan required by the Massachusetts Wetlands Protection Act Order of Conditions or a local stormwater requirement. The 2015 *Boylston Highway Department Facility Operations and Maintenance Plan* should also be referenced for O&M procedures related to inspection and maintenance of stormwater treatment structures and swales, as well as associated record keeping.

While many of the BMP types listed in this SOP can be found in the Town, information for additional BMP types is also included in case they are constructed in the future. A general inspection form is attached.

In accordance with General Permit requirements, the Town must keep a written record (hard copy or electronic) of all maintenance activities and inspections completed and report on the status each year in the Annual Report. Maintain records for a period of at least five years.

Note: Information related to catch basins is provided in a separate SOP. Also, BMP accessories (e.g., level spreaders, check dams, outlet structures, and catch basin inserts) are not formally described in this SOP. Maintenance of BMP accessories generally includes regular inspections (especially after large rainfall events and per the manufacturer's recommendation), noting and repairing any erosion or damage as needed, removing sediment as needed, and lawfully disposing of any cleanings or used filtration media.

Structural Pretreatment BMPs

Oil and Grit Separators

Description

Oil/grit separators are underground storage tanks with three chambers designed to remove heavy particulates, floating debris and hydrocarbons from stormwater. Stormwater enters the first chamber where heavy sediments and solids drop out. The flow moves into the second chamber where oils and greases are removed and further settling of suspended solids takes place. Oil and grease are stored in this second chamber for future removal. After moving into the third outlet chamber, the clarified stormwater runoff is then discharged to a pipe and another BMP. There are other separators that may be used for spill control.

Inspection & Maintenance

Sediments and associated pollutants and trash are removed only when inlets or sumps are cleaned out, so regular maintenance is essential. Most studies have linked the failure of oil grit separators to the lack of regular maintenance. The more frequent the cleaning, the less likely sediments will be resuspended and subsequently discharged. In addition, frequent cleaning also makes more volume available for future storms and enhances overall performance. Cleaning includes removal of accumulated oil and grease and sediment using a vacuum truck or other ordinary catch basin cleaning device. In areas of high sediment loading, inspect and clean inlets after every major storm. At a minimum, inspect oil grit separators monthly, and clean them out at least twice per year. Polluted water or sediments removed from an oil grit separator should be disposed of in accordance with all applicable local, state and federal laws and regulations including M.G.L.c. 21C and 310 CMR 30.00.

Recommended Maintenance Schedule

Activity	Frequency
Inspect units	After every major storm but at least monthly
Clean units	Twice a year

Sediment Forebays

Description

A sediment forebay is a post-construction practice consisting of an excavated pit, bermed area, or cast structure combined with a weir, designed to slow incoming stormwater runoff and facilitating the gravity separation of suspended solids. This practice is different from a sediment trap used as a construction period BMP.

Inspection & Maintenance

Regular maintenance is critical for filter strips to be effective and to ensure that flow does not shortcircuit the system. Conduct semi-annual inspections during the first year (and annually thereafter). Inspect the level spreader for sediment buildup and the vegetation for signs of erosion, bare spots, and overall health. Regular, frequent mowing of the grass is required. Remove sediment from the toe of slope or level spreader, and reseed bare spots as necessary. Periodically, remove sediment that accumulates near the top of the strip to maintain the appropriate slope and prevent formation of a “berm” that could impede the distribution of runoff as sheet flow. When the filter strip is located in the buffer zone to a wetland resource area, the operation and maintenance plan must include strict measures to ensure that maintenance operations do not alter the wetland resource areas. Please note, filter strips are restricted to the outer 50 feet of the buffer zone.

Recommended Maintenance Schedule

Activity	Frequency
Inspect sediment forebays	Monthly
Clean sediment forebays	Four times per year and when sediment depth is between 3 to 6 feet.

Vegetated Filter Strips

Description

Vegetated filter strips, also known as filter strips, grass buffer strips and grass filters, are uniformly graded vegetated surfaces (i.e., grass or close-growing native vegetation) that receive runoff from adjacent impervious areas. Vegetated filter strips typically treat sheet flow or small concentrated flows that can be distributed along the width of the strip using a level spreader. Vegetated filter strips are designed to slow runoff velocities, trap sediment, and promote infiltration, thereby reducing runoff volumes.

Inspection & Maintenance

Sediments and associated pollutants are removed only when sediment forebays are actually cleaned out, so regular maintenance is essential. Frequently removing accumulated sediments will make it less likely that sediments will be resuspended. At a minimum, inspect sediment forebays monthly and clean them out at least four times per year. Stabilize the floor and sidewalls of the sediment forebay before making it operational, otherwise the practice will discharge excess amounts of suspended sediments. When mowing grasses, keep the grass height no greater than 6 inches. Set mower blades no lower than 3 to 4 inches. Check for signs of rilling and gullying and repair as needed. After removing the sediment, replace any vegetation damaged during the clean-out by either reseeding or resodding.

When reseeding, incorporate practices such as hydroseeding with a tackifier, blanket, or similar practice to ensure that no scour occurs in the forebay, while the seeds germinate and develop roots.

Recommended Maintenance Schedule

Activity	Frequency
Inspect the level spreader for sediment buildup and the vegetation for signs of erosion, bare spots, and overall health.	Every six months during the first year. Annually thereafter.
Regularly mow the grass.	As needed
Remove sediment from the toe of slope or level spreader and reseed bare spots.	As needed

Treatment BMPs

Bioretention Areas and Rain Gardens

Description

Bioretention areas and rain gardens are shallow depressions filled with sandy soil, topped with a thick layer of mulch and planted with dense native vegetation. There are two types of bioretention cells:

1. Filtering bioretention area: Areas that are designed solely as an organic filter; and
2. Exfiltration bioretention area: Areas that are configured to recharge groundwater in addition to acting as a filter.

Inspection & Maintenance

Regular inspection and maintenance are important to prevent against premature failure of bioretention areas or rain gardens. Regular inspection and maintenance of pretreatment devices and bioretention cells for sediment buildup, structural damage and standing water can extend the life of the soil media.

When failure is discovered, excavate the bioretention area, scarify the bottom and sides, replace the filter fabric and soil, replant vegetation and mulch the surface.

Never store snow within a bioretention area or rain garden. This would prevent required water quality treatment and the recharge of groundwater.

Recommended Maintenance Schedule

Activity	Time of Year	Frequency
Inspect for soil erosion and repair	Year round	Monthly
Inspect for invasive species and remove if present	Year round	Monthly
Remove trash	Year round	Monthly
Mulch Void Areas	Spring	Annually
Remove dead vegetation	Fall and Spring	Bi-Annually
Replace dead vegetation	Spring	Annually
Prune	Spring or Fall	Annually
Replace all media and vegetation	Late Spring/Early Summer	As Needed

Bioretention/Constructed Stormwater Wetlands

Description

Constructed stormwater wetlands maximize the pollutant removal from stormwater through the use of wetland vegetation uptake, retention and settling. Constructed storm water wetlands must be used in conjunction with other BMPs, such as sediment forebays.

Inspection & Maintenance

Regular inspection and maintenance are important for the health of constructed stormwater wetlands. Regular inspection and maintenance of pretreatment devices, such as forebays, should check for sediment buildup, structural damage and standing water. Inspection of the constructed wetlands should address the health of the vegetation, presence of invasive species, and identify the need to replace vegetation or media. Never store snow within a constructed stormwater wetland, as this would prevent required water quality treatment and the recharge of groundwater.

When failure is discovered, excavate the bioretention area, scarify the bottom and sides, replace the filter fabric and soil, replant vegetation and mulch the surface.

Recommended Maintenance Schedule – Years 0—3

Activity	Time of Year	Frequency
Inspect for invasive species and remove if present	Year round	Monthly
Record and Map:	Year round	Annually
Types and distribution of dominant wetland plants	Year round	Bi-Annually
Presence and distribution of planted wetland species	Spring	Annually
Presence and distribution of invasive species	Fall and Spring	Bi-Annually
Indications other species are replacing planted wetland species	Spring	Annually
Percent of standing water that is not vegetated	Spring or Fall	Annually
Replace all media and vegetation	Late Spring/Early Summer	As Needed
Stability of original depth zones and micro-topographic features	Spring and Fall	Bi-Annually
Accumulation of sediment in the forebay and micropool and survival rate of plants	Spring and Fall	Bi-Annually

Recommended Maintenance Schedule – Years 4+

Activity	Time of Year	Frequency
Inspect for invasive species and remove if present	Year round	Monthly
Clean forebays	Year round	Annually
Clean sediment in basin/wetland system	Year round	Once every 10 years
Mulch Void Areas	Spring	Annually
Remove dead vegetation	Fall and Spring	Bi-Annually
Replace dead vegetation	Spring	Annually
Prune	Spring or Fall	Annually
Replace all media and vegetation	Late Spring/Early Summer	As Needed

Extended Dry Detention Basins

Description

Extended dry detention basins are designed to control both stormwater quantity and quality. These BMPs are designed to hold stormwater for at least 24 hours, allowing solids to settle and to reduce local and downstream flooding. Pretreatment is required to reduce the potential for overflow clogging. The outflow may be designed as either fixed or adjustable. Additional nutrient removal may be achieved by a micropool or shallow marsh.

Inspection & Maintenance

Annual inspection of extended dry detention basins is required to ensure that the basins are operating properly. Potential problems include: erosion within the basin and banks, tree growth on the embankment, damage to the emergency spillway and sediment accumulation around the outlet. Should any of these problems be encountered, necessary repairs should be made immediately.

Recommended Maintenance Schedule

Activity	Time of Year	Frequency
Inspect basins	Spring and Fall	Bi-Annually, and during and after major storms
Examine outlet structure for clogging or high outflow release velocities	Spring and Fall	Bi-Annually
Mow upper stage, side slopes, embankment and emergency spillway	Spring through Fall	Bi-Annually
Remove trash and debris	Spring	Bi-Annually
Remove sediment from basin	Year round	At least once every 5 years

Sand and Organic Filters

Description

Sand and organic filters, also known as filtration basins, are intended for quality control rather than quantity control. These filters improve water quality by removing pollutants through a filtering media and settling pollutants on top of the sand bed and/or in a pretreatment basin. Pretreatment is required to prevent filter media from clogging. Runoff from the filters is typically discharged to another BMP for additional treatment.

Inspection & Maintenance

If properly maintained, sand and organic filters have a long design life. Maintenance requirements include raking the sand and removing sediment, trash and debris from the surface of the BMP. Over time, fine sediments will penetrate deep into the sand requiring replacement of several inches or the entire sand layer. Discolored sand is an indicator of the presence of fine sediments, suggesting that replacement of the sand should be completed.

Recommended Maintenance Schedule

Activity	Frequency
Inspect filters and remove debris	After every major storm for the first 3 months after construction completion. Every 6 months thereafter.

Wet Basins

Description

Wet basins are intended to treat stormwater quality through the removal of sediments and soluble pollutants. A permanent pool of water allows sediments to settle and removes the soluble pollutants, including some metals and nutrients. Additional dry storage is required to control peak discharges during large storm events, and if properly designed and maintained wet basins can add fire protection, wildlife habitat and aesthetic values to a property.

Inspection & Maintenance

To ensure proper operation, wet basin outfalls should be inspected for evidence of clogging or excessive outfall releases. Potential problems to investigate include erosion within the basin and banks, damage to the emergency spillway, tree growth on the embankment, sediment accumulation around the outlet and the emergence of invasive species. Should any of these problems be encountered, perform repairs immediately. An on-site sediment disposal area will reduce sediment removal costs.

Recommended Maintenance Schedule

Activity	Time of Year	Frequency
Inspect wet basins	Spring and/or Fall	Annually (Minimum)
Mow upper stage, side slopes, embankment and emergency spillway	Spring through Fall	Bi-Annually (Minimum)
Remove sediment, trash and debris	Spring through Fall	Bi-Annually (Minimum)
Remove sediment from basin	Year round	As required, minimum once every 10 years

Conveyance BMPs

Drainage Channels

Description

Drainage channels are traditional vegetated open channels that are designed to provide for non-erosive conveyance. They receive no infiltration or TSS removal credit (Standards 3 and 4).

Inspection & Maintenance

The maintenance and inspection schedule should take into consideration the effectiveness of the drainage channel. Regular maintenance tasks include mowing, fertilizing, liming, watering, pruning, weeding, and pest control. Keep grass height under 6 inches to maintain the design depth necessary to serve as a conveyance. Do not mow excessively, because it may increase the design flow velocity. Remove sediment and debris manually at least once per year. Re-seed periodically to maintain the dense growth of grass vegetation. Take care to protect drainage channels from snow removal procedures and off-street parking. When drainage channels are located on private residential property, the operation and maintenance plan must clearly specify the private property owner who is responsible for carrying out the required maintenance. If the operation and maintenance plan calls for maintenance of drainage channels on private properties to be performed by a public entity or an association (e.g. homeowners association), maintenance easements must be obtained.

Recommended Maintenance Schedule

Activity	Frequency
Inspect channels to make sure vegetation is adequate and for signs of rilling and gullying. Inspect for slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding, and sediment accumulation. Repair any rills or gullies. Replace dead vegetation.	The first few months after construction and twice a year thereafter.
Mow	As necessary. Grass height shall not exceed 6 inches.
Remove sediment and debris manually	At least once a year
Reseed	As necessary. Use of road salt or other deicers during the winter will necessitate yearly reseeding in the spring.

Grassed Channels

Description

Grassed Channels (formerly known as Biofilter swales) are treatment systems with a longer hydraulic residence time than drainage channels. The removal mechanisms are sedimentation and gravity separation, rather than filtration. To receive TSS credit, a sediment forebay or equivalent must be provided for pretreatment. Note that the sediment forebay does not receive a separate TSS removal credit.

Inspection & Maintenance

Maintenance access must be designed as part of the grass channel. If located adjacent to a roadway, make the maintenance access at least 15 feet wide, which can also be combined with a breakdown lane along a highway or onstreet parking along a residential street. When combined with on-street parking, post signs prohibiting parking when the swale is to be inspected and cleaned. Do not use travel lanes along highways and streets as the required maintenance access. Set mower blades no lower than 3 to 4 inches above the ground. Do not mow beneath the depth of the design flow during the storm associated with the water quality event (e.g., if the design flow is no more than 4 inches, do not cut the grass shorter than 4 inches). Mow on an as-needed basis during the growing season so that the grass height does not exceed 6 inches. Inspect semi-annually the first year, and at least once a year thereafter. Inspect the grass for growth and the side slopes for signs of erosion and formation of rills and gullies. Plant an alternative grass species if the original grass cover is not successfully established. If grass growth is impaired by winter road salt or other deicer use, re-establish the grass in the spring. Remove accumulated trash and debris prior to mowing. Check on a yearly basis and clean sediment as needed. Use hand methods (i.e., a person with a shovel) when cleaning to minimize disturbance to vegetation and underlying soils. Sediment build-up in the grass channel reduces its capacity to treat and convey the water quality event, 2-year and 10-year 24-hour storm.

Recommended Maintenance Schedule

Activity	Frequency
Remove sediment from forebay	Annually
Remove sediment from grass channel	Annually
Mow	Once a month during growing season
Repair areas of erosion and revegetate	As needed, but no less than once a year

Water Quality Swale

Description

Water quality swales are vegetated open channels designed to treat the required water quality volume and to convey runoff from the 10-year storm without causing erosion. There are two different types of water quality swales that may be used to satisfy the Stormwater Management Standards:

- Dry Swales
- Wet Swales

Unlike drainage channels which are intended to be used only for conveyance, water quality swales and grass channels are designed to treat the required water quality volume and incorporate specific features to enhance their stormwater pollutant removal effectiveness. Water quality swales have higher pollutant removal efficiencies than grass channels.

Inspection & Maintenance

Incorporate a maintenance and inspection schedule into the design to ensure the effectiveness of water quality swales. Inspect swales during the first few months after installation to make sure that the vegetation in the swales becomes adequately established. Thereafter, inspect swales twice a year. During the inspections, check the swales for slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding and sedimentation. Regular maintenance includes mowing, fertilizing, liming, watering, pruning, and weed and pest control. Mow swales at least once per year. Do not cut the grass shorter than three to four inches, otherwise the effectiveness of the vegetation in reducing flow velocity and removing pollutants may be reduced. Do not let grass height exceed 6 inches. Manually remove sediment and debris at least once per year, and periodically re-seed, if necessary, to maintain a dense growth of vegetation. Take care to protect water quality swales from snow removal and disposal practices and off-street parking. When grass water quality swales are located on private residential property, the operation and maintenance plan must clearly identify the property owner who is responsible for carrying out the required maintenance. If the operation and maintenance plan calls for maintenance of water quality swales on private properties to be accomplished by a public entity or an association (e.g. homeowners association), maintenance easements must be secured.

Recommended Maintenance Schedule

Activity	Frequency
Inspect swales to make sure vegetation is adequate and slopes are not eroding. Check for rilling and gullying. Repair eroded areas and revegetate	The first few months after construction and twice a year thereafter.
Mow dry swales. Wet swales may not need to be mowed depending on vegetation.	As needed.
Remove sediment and debris manually	At least once a year.
Reseed	As necessary.

Infiltration BMPs

Dry Wells

Description

Dry wells are used to infiltrate uncontaminated runoff. These BMPs should never be used to infiltrate stormwater or runoff that has the potential to be contaminated with sediment and other pollutants. Dry wells provide groundwater recharge and can reduce the size and cost required of downstream BMPs or storm drains. However, they are only applicable in drainage areas of less than one acre and may experience high failure rates due to clogging.

Inspection & Maintenance

Proper dry well function depends on regular inspection. Clogging has the potential to cause high failure rates. The water depth in the observation well should be measured at 24- and 48-hour intervals after a storm and the clearance rate calculated. The clearance rate is calculated by dividing the drop in water level (inches) by the time elapsed (hours).

Recommended Maintenance Schedule

Activity	Frequency
Inspect dry wells	After every major storm for the first 3 months after construction completion. Annually thereafter.

Infiltration Basins

Description

Infiltration basins are designed to contain stormwater quantity and provide groundwater recharge. Pollution prevention and pretreatment are required to ensure that contaminated stormwater is not infiltrated. Infiltration basins reduce local flooding and preserve the natural water balance of the site, however high failure rates often occur due to improper siting, inadequate pretreatment, poor design and lack of maintenance.

Inspection & Maintenance

Regular maintenance is required to prevent clogging, which results in infiltration basin failure. Clogging may be due to upland sediment erosion, excessive soil compaction or low spots.

Inspections should include:

- signs of differential settlement
- cracking
- erosion
- leakage in the embankments
- tree growth on the embankments
- rip-rap condition
- sediment accumulation
- turf health

Recommended Maintenance Schedule

Activity	Time of Year	Frequency
Preventative maintenance	Spring and Fall	Bi-Annually
Inspection	Spring and Fall	After every major storm for the first 3 months after construction completion. Bi-annually thereafter and discharges through the high outlet orifice.
Mow/rake buffer area, side slopes and basin bottom	Spring and Fall	Bi-Annually
Remove trash, debris and organic matter	Spring and Fall	Bi-Annually

Infiltration Trenches

Description

Infiltration trenches are shallow excavations filled with stone. They can be designed to capture sheet flow or piped inflow. The stone provides underground storage for stormwater runoff. The stored runoff gradually exfiltrates through the bottom and/or sides of the trench into the subsoil and eventually into the water table.

Inspection & Maintenance

Because infiltration trenches are prone to failure due to clogging, it is imperative that they be aggressively maintained on a regular schedule. Using pretreatment BMPs will significantly reduce the maintenance requirements for the trench itself. Removing accumulated sediment from a deep sump catch basin or a vegetated filter strip is considerably less difficult and less costly than rehabilitating a trench. Eventually, the infiltration trench will have to be rehabilitated, but regular maintenance will prolong its operational life and delay the day when rehabilitation is needed. With appropriate design and aggressive maintenance, rehabilitation can be delayed for a decade or more. Remove tree seedlings, before they become firmly established. Remove accumulated sediment, trash, debris, leaves and grass clippings from mowing. Check inlet and outlet pipes to determine if they are clogged. If the top of the trench is grassed, it must be mowed on a seasonal basis. Grass height must be maintained to be no more than four inches. Routinely remove grass clippings leaves and accumulated sediment from the surface of the trench. Inspect the trench 24 hours or several days after a rain event, to look for ponded water. If there is ponded water at the surface of the trench, it is likely that the trench surface is clogged. To address surface clogging, remove and replace the topsoil or first layer of stone aggregate and the filter fabric. If water is ponded inside the trench, it may indicate that the bottom of the trench has failed. To rehabilitate a failed trench, all accumulated sediment must be stripped from the bottom, the bottom of the trench must be scarified and tilled to induce infiltration, and all of the stone aggregate and filter fabric or media must be removed and replaced.

Recommended Maintenance Schedule

Activity	Frequency
Preventative maintenance	Twice a year
Inspect units and remove debris	Every 6 months and after every major storm
Remove sediment from pretreatment BMPs	Every 6 months and after every major storm
Inspect and clean pretreatment BMPs	Every 6 months and after every major storm (2 year return frequency)

Subsurface Structures

Description

Subsurface structures are underground systems that capture runoff, and gradually infiltrate it into the groundwater through rock and gravel. There are a number of underground infiltration systems that can be installed to enhance groundwater recharge. The most common types include pre-cast concrete or plastic pits, chambers (manufactured pipes), perforated pipes, and galleys.

Inspection & Maintenance
Because subsurface structures are installed underground, they are extremely difficult to maintain. Remove any debris that might clog the system. Include mosquito controls in the Operation and Maintenance Plan.

Recommended Maintenance Schedule

Activity	Frequency
Inspect inlets	Twice a year
Remove any debris that might clog the system	As needed

Proprietary BMPs

Proprietary Separators

Description
A proprietary separator is a flow-through structure with a settling or separation unit to remove sediments and other pollutants. They typically use the power of swirling or flowing water to separate floatables and coarser sediments, are typically designed and manufactured by private businesses, and come in different sizes to accommodate different design storms and flow conditions. Some rely solely on gravity separation and contain no swirl chamber. Since proprietary separators can be placed in almost any location on a site, they are particularly useful when either site constraints prevent the use of other stormwater techniques or as part of a larger treatment train. The effectiveness of proprietary separators varies greatly by size and design, so make sure that the units are sized correctly for the site's soil conditions and flow profiles, otherwise the unit will not work as designed.

Inspection & Maintenance
Inspect and clean these units in strict accordance with manufacturers' recommendations and requirements. Clean the units using the method specified by the manufacturer. Vactor trucks are typically used to clean these units. Clamshell buckets typically used for cleaning catch basins are almost never allowed by manufacturers. Sometimes it will be necessary to remove sediment manually.

Recommended Maintenance Schedule

Activity	Frequency
Inspect in accordance with manufacturer requirements, but no less than twice a year following installation, and no less than once a year thereafter.	See activity
Remove sediment and other trapped pollutants at frequency or level specified by manufacturer.	Per manufacturer's schedule

Proprietary Media Filters

Description
Media Filters are designed to reduce total suspended solids and other target pollutants, such as organics, heavy metals or nutrients, which are sorbed onto the filter media, which is contained in a concrete structure. The substrate used as filter media depends on the target pollutants, and may consist of leaf compost, pleated fabric, activated charcoal, perlite, amended sand in combination with perlite, and zeolite. Two types of Media Filters are manufactured: Dry Media Filters, which are designed to dewater within 72 hours; and Wet Media Filters, which maintain a permanent pool of water as part of the treatment system.

Inspection & Maintenance
Maintenance in accordance with the manufacturer's requirements is necessary to ensure stormwater treatment. Inspection or maintenance of the concrete structure may require OSHA confined space training. Dry Media Filters are required to dewater in 72 hours, thus preventing breeding of mosquitos and other insects. Proper maintenance is essential to prevent clogging. Wet Media Filters require tight fitting seals to keep mosquitoes and other insects from entering and breeding in the permanent pools. Required maintenance includes routine inspection and treatment.

Recommended Maintenance Schedule

Activity	Time of Year	Frequency
Inspect for standing water, trash, sediment and clogging	Per manufacturer's schedule	Bi-Annually (minimum)
Remove trash and debris	N/A	Each Inspection
Examine to determine if system drains in 72 hours	Spring, after large storm	Annually
Inspect filtering media for clogging	Per manufacturer's schedule	Per manufacturer's schedule

Other BMPs

Dry Detention Basin

Description

A dry detention basin is an impoundment or excavated basin for the short-term detention of stormwater runoff from a completed development that allows a controlled release from the structure at downstream, pre-development flow rates. Conventional dry detention basins typically control peak runoff for 2-year and 10-year 24-hour storms. They are not specifically designed to provide extended dewatering times, wet pools, or groundwater recharge. Sometimes flows can be controlled using an outlet pipe of the appropriate size but this approach typically cannot control multiple design storms.

Inspection & Maintenance

It is critical to provide access for maintenance, especially to the interior of the basin. Inspect dry detention basins at least once per year to ensure that they are operating as intended. Inspect basins during and after storms to determine if the basin is meeting the expected detention times. Inspect the outlet structure for evidence of clogging or outflow release velocities that are greater than design flow. Potential problems that should be checked include: subsidence, erosion, cracking or tree growth on the embankment; damage to the emergency spillway; sediment accumulation around the outlet; inadequacy of the inlet/outlet channel erosion control measures; changes in the condition of the pilot channel; and erosion within the basin and banks. Make any necessary repairs immediately. During inspections, note changes to the detention basin or the contributing watershed because these changes could affect basin performance. Mow the side slopes, embankment, and emergency spillway at least twice per year. Remove trash and debris at this time. Remove sediment from the basin as necessary, and at least once every 10 years or when the basin is 50% full. Provide for an on-site sediment disposal area to reduce the overall sediment removal costs.

Recommended Maintenance Schedule

Activity	Frequency
Inspect wet basins to ensure they are operating as designed	At least once a year.
Mow the upper-stage, side slopes, embankment and emergency spillway.	At least twice a year
Check the sediment forebay for accumulated sediment, trash, and debris and remove it.	At least twice a year.
Remove sediment from the basin.	As necessary, and at least once every 10 years

Porous Pavement

Description

Porous pavement is a paved surface with a higher than normal percentage of air voids to allow water to pass through it and infiltrate into the subsoil. This porous surface replaces traditional pavement, allowing parking lot, driveway, and roadway runoff to infiltrate directly into the soil and receive water quality treatment. All permeable paving systems consist of a durable, load-bearing, pervious surface overlying a stone bed that stores rainwater before it infiltrates into the underlying soil. Permeable paving techniques include porous asphalt, pervious concrete, paving stones, and manufactured “grass pavers” made of concrete or plastic. Permeable paving may be used for walkways, patios, plazas, driveways, parking stalls, and overflow parking areas.

Inspection & Maintenance

In most porous pavement designs, the pavement itself acts as pretreatment to the stone reservoir below. Consequently, frequent cleaning and maintenance of the pavement surface is critical to prevent clogging. To keep the surface clean, frequent vacuum sweeping along with jet washing of asphalt and concrete pavement is required. No winter sanding shall be conducted on the porous surface. As discussed, designs that include an "overflow edge" provide a backup in case the surface clogs. If the surface clogs, stormwater will flow over the surface and into the trench, where some infiltration and treatment will occur. For proper maintenance:

- Post signs identifying porous pavement areas.
- Minimize salt use during winter months. If drinking water sources are located nearby (see setbacks), porous pavements may not be allowed.
- No winter sanding is allowed.
- Keep landscaped areas well maintained to prevent soil from being transported onto the pavement.
- Clean the surface using vacuum sweeping machines monthly. For paving stones, periodically add joint material (sand) to replace material that has been transported.
- Regularly monitor the paving surface to make sure it drains properly after storms.
- Never reseal or repave with impermeable materials.
- Inspect the surface annually for deterioration or spalling.
- Periodically reseed grass pavers to fill in bare spots.
- Attach rollers to the bottoms of snowplows to prevent them from catching on the edges of grass pavers and some paving stones.

Recommended Maintenance Schedule

Activity	Frequency
Monitor to ensure that the paving surface drains properly after storms	As needed
For porous asphalts and concretes, clean the surface using power washer to dislodge trapped particles and then vacuum sweep the area. For paving stones, add joint material (sand) to replace material that has been transported.	As needed
Inspect the surface annually for deterioration	Annually
Assess exfiltration capability at least once a year. When exfiltration capacity is found to decline, implement measures from the Operation and Maintenance Plan to restore original exfiltration capacity.	As needed, but at least once a year
Reseed grass pavers to fill in bare spots	As needed

Attachments

- Constructed Stormwater BMP Inspection Form

CONSTRUCTED STORMWATER BMP INSPECTION FORM

Date of Inspection	
Start Time	

BMP Type/Description:

Structural Pretreatment

☐ Oil/Grit Separators
☐ Sediment Forebays
☐ Vegetated Filter Strips

Treatment

☐ Bioretention Areas/Rain Gardens
☐ Constructed Stormwater Wetlands
☐ Extended Dry Detention Basins
☐ Sand and Organic Filters
☐ Wet Basins

Conveyance

☐ Drainage Channels
☐ Grassed Channels
☐ Water Quality Swale

Infiltration

☐ Dry Wells
☐ Infiltration Basins
☐ Infiltration Trenches
☐ Subsurface Structures

Proprietary

☐ Proprietary Separators
☐ Proprietary Media Filters

Other

☐ Dry Detention Basin
☐ Porous Pavement
☐ Other:

BMP Address and Location on Site	
Inspector Name, Title, and Contact Information	

Type of Inspection:

☐ Routine ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event

Weather at time of this inspection:

☐ Clear ☐ Cloudy ☐ Rain ☐ Sleet ☐ Fog ☐ Snow ☐ High Winds
☐ Other: Temperature (F):

Photo(s) Taken: Yes ☐ No ☐ If Yes, describe:

Are there any discharges occurring at the time of inspection? Yes ☐ No ☐ If yes, are any physical indicators present in the flow? If yes, describe below:

Indicator & Description	**Relative Severity Index (1-3)**
☐ **Color present:** ☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 - Faint ☐ 2 - Clearly visible ☐ 3 - Brightly colored

CONSTRUCTED STORMWATER BMP INSPECTION FORM

Indicator & Description	**Relative Severity Index (1-3)**
☐ **Turbidity present:** ☐ Slight cloudiness ☐ Cloudy ☐ Opaque	☐ 1 - Faint ☐ 2 - Clearly visible ☐ 3 - Bright
☐ **Floatables present (does not include trash):** ☐ Sewage (toilet paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 - Few/slight ☐ 2 - Some ☐ 3 - Many/obvious
☐ **Odor present**: ☐ Sewage ☐ Sulfide ☐ Rancid/sour ☐ Petroleum/gas ☐ Other:	☐ 1 - Faint ☐ 2 - Easily detected ☐ 3 - Noticeable from a distance

Items Inspected	☐ Erosion ☐ Invasive species ☐ Dead vegetation ☐ Trash/sediment/debris ☐ Grates	☐ Filters/filter media ☐ Basins ☐ Slope integrity ☐ Cracking ☐ Clogging	☐ Standing water ☐ Deterioration ☐ Other:
Maintenance Performed	☐ Repaired erosion ☐ Removed invasive species ☐ Removed sediment/trash/debris ☐ Pruned	☐ Reseeded ☐ Mowed ☐ Replaced vegetation ☐ Replaced media ☐ Mulched	☐ Cleaned ☐ Raked ☐ Other:
Additional Maintenance Required	Yes ☐ No ☐	If yes, describe:	
Other Notes			