Massachusetts
Nonpoint Source Pollution
319 GRANT GUIDEBOOK

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Commonwealth of Massachusetts
Department of Environmental Protection

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Contents

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GRANT GUIDEBOOK

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Section 1

Introduction to Section 319 Grants

Welcome to the Massachusetts Nonpoint Source Pollution Grant Guidebook!

You've come to the right place if you are looking for:

- Information about **funding options** to restore or protect a lake, river, or coastal water body.
- Information about the **Section 319 (319) Nonpoint Source Grant Program**, including program goals, eligibility, project types, the application process, etc.
- Information on how to **develop a Watershed-Based Plan** and develop a **successful 319 grant application**, including:
  - identifying water quality problems and key pollutants
  - setting water quality goals
  - identifying pollutant sources and how they reach a water body
  - selecting the most effective measures to restore water quality
  - how to plan and budget for technical aspects of water pollution prevention projects, including engineering/design, project costing, monitoring, etc.

What is Section 319?

- Section 319 of the federal **Clean Water Act** created a national program to control **nonpoint source (NPS) water pollution**.
- This program **provides grants** distributed by the Massachusetts Department of Environmental Protection (MassDEP).

A quick reference guide to the Massachusetts Nonpoint Source Grant Program - and this Guidebook - is provided on the next page.

The Massachusetts Nonpoint Source Grant Program – Quick Reference Guide

319 Grant Program Overview

PROGRAM PURPOSE	• **Restore** waters impaired by nonpoint source (NPS) pollution *(most projects)*. Impaired waters are in Categories 4 and 5 of the 303(d) List within the Massachusetts Integrated List of Waters. • **Protect** high-quality unimpaired waters.	
ELIGIBILITY	• ***Who can apply?*** Any public or private organization, including municipalities, non-profit organizations, and regional planning commissions. • Projects must include a minimum of **40% non-federal match** (cash or in-kind services).	*See Section 1*
PROJECT TYPES	• Projects to address **control of major NPS pollution sources in a watershed** (nutrients, sediment, and bacteria), including structural improvements, regulatory tools, public education, etc. • ***Does not*** include work required by other permits, such as stormwater work required by the Final 2016 Massachusetts Small MS4 General Permit (including 2020 Modifications).	

Key Requirements for 319 Grant Applications

WATERSHED-BASED PLAN	• A Watershed-Based Plan includes the "**9-elements**" **required** for 319 grant projects. • The Massachusetts Watershed-Based Plan Tool helps users develop Watershed-Based Plans in support of 319 grant applications.	*See Section 2*
IDENTIFY PRIORITY PROJECTS	• Projects seeking 319 funding should be prioritized based on the **highest reduction in target pollutants per dollar spent**. This requires understanding the target pollutant(s), locations of pollutant sources and how they reach the water body, and the most effective practices (structural or non-structural) to reduce pollutant loads and reach a water quality goal. • **Conceptual design** is required for structural practices seeking funding, with sufficient detail to support estimates of pollutant load reduction and project cost.	*See Section 3* *See Section 4.1*
OTHER	• 319 grant projects must include a **public information and education** component to enhance public understanding of the project and its water quality benefits. • Other requirements described in this Guidebook include documentation of **project progress and success.**	*See Section 7* *See Section 8*

After 319 Grant Award

FINAL DESIGN	Final designs are often developed by a **professional civil engineer** as part of a 319-funded grant project. See Section 4.2 for more information on what this includes and how to estimate design costs.	*See Section 4.2*
PERMITTING / CONSTRUCTION	Permitting and construction are typically funded through 319 grants. It is important to understand the process and **include realistic schedules and cost estimates** for these tasks in your grant application.	*See Sections 5 and 6*

1.1 The Section 319 Nonpoint Source Grant Program

MassDEP, in partnership with the U.S. Environmental Protection Agency (EPA), provides annual 319 grant funds to control NPS pollution. These grants can be used for projects to help ***restore*** impaired waterbodies and to ***protect*** high-quality waterbodies.

What is NPS Pollution?

NPS pollution comes from rain or melting snow moving over and through the ground. As runoff moves, it picks up and carries natural and human-made pollutants and eventually deposits them into lakes, rivers, wetlands, coastal waters, and ground waters. These pollutants may come from:

- Fertilizers and herbicides
- Oil, grease, and toxic chemicals from urban runoff
- Construction sediment
- Streambank erosion
- Irrigation runoff
- Bacteria and nutrients from animal livestock, pet wastes, and faulty septic systems
- Atmospheric deposition, commonly called "acid rain"

1.2 NPS Grant Program Goals

The primary goal of the Massachusetts 319 Nonpoint Source Competitive Grant Program is to **restore waterbodies impaired due to NPS pollution.** The Massachusetts Surface Water Quality Standards specify the baseline quality that all surface waters in the state must meet.

Every two years, Massachusetts prepares an Integrated List of Waters to document the condition of waterbodies, including identification of waterbodies that are impaired and require the establishment of Total Maximum Daily Loads (TMDLs). Click here to learn more about TMDLs

Impairments most frequently associated with NPS pollution are those related to **nutrients** such as phosphorus and nitrogen (e.g., excess algal growth, low dissolved oxygen) and **pathogens** (e.g., bacteria such as *E. coli* leading to swimming beach closures). Waterbodies are categorized as listed below based on their water quality status. **Categories 4 and 5 are considered "impaired"** and are eligible for 319 funding (with the exception of Category 4B waters).

Waterbody Assessment Unit Categories

Category 1: Unimpaired and not threatened for all designated uses

Category 2: Unimpaired for some uses and not assessed for others

Category 3: Insufficient information to make assessments for any uses

Category 4: Impaired or threatened for one or more uses, but not requiring calculation of a TMDL.

- **Category 4A:** TMDL is completed
- **Category 4B:** Expected to attain all designated uses in the near future
- **Category 4C:** Impairment is not caused by a pollutant

Category 5: Impaired or threatened for one or more uses; requires a TMDL

1.3 Project Eligibility and Match

Implementation work that addresses water quality impairments listed in **Categories 4a, 4c, and 5** of the Massachusetts 2016 Integrated List of Waters are the ***highest priority*** to receive 319 grant funds. The 319 program is open to any Massachusetts public or private organization that meets the following eligibility criteria for projects:

- Implement measures that address the prevention, control, and abatement of NPS pollution
- Target the major source(s) of nonpoint source pollution within a watershed/subwatershed
- Include an appropriate method for estimating pollutant removal numbers
- Include a minimum of **40% non-federal match** (s*ee next page for more information on match)*
- Address watersheds with completed Watershed-Based Plans (for implementation projects). *See Section 2 of this Guidebook for more information on developing a Watershed-Based Plan.*
- Address activities identified in the Massachusetts Nonpoint Source Management Program Plan

In addition to implementation projects directly addressing water quality impairments, other eligible projects include:

- Protection of high quality and unimpaired waters. These Healthy Watersheds projects are allowed under EPA 319 program guidelines. Projects that implement climate adaptation, stream stabilization, and pollutant removal best management practices (BMPs) can be also funded.
- Outreach and education work addressing statewide NPS topics.
- Projects to address goals of the Massachusetts Nonpoint Source Management Program Plan***.***

Guide to Non-federal Match

What is match? Match is a resource commitment, either in the form of cash or in-kind services, made by the grantee or other project partners to help implement a 319-grant project. Eligible match must be non-federal. **Your grant application should document the match that will be provided**, including letters from all organizations that will provide match. The letters should specify the amount and type of match that has been committed, should be on organization letterhead, and must be signed by an authorized signatory.

What are in-kind services? In-kind services include contributions to 319 project implementation in the form of services or goods, with dollar value specified. Examples include, but are not limited to:

- project management labor by a municipal official
- project construction assistance by municipal staff in the form of labor, materials, and/or equipment use
- volunteer labor from a local watershed organization
- contributions of labor, materials, and/or equipment from a privately-owned business
- non-federal grants and funding sources, such as the Massachusetts Environmental Trust Fund, Sustainable Watershed Management Initiative, State Revolving Fund, Chapter 90 funds, Community Preservation Act, and Municipal Vulnerability Preparedness grants
- direct state or town appropriations

In-kind services must be:

- **Verifiable**: In-kind match commitments must be tracked and documented to MassDEP during the course of the project.
- **Directly necessary** for proper and efficient accomplishments of project objectives.
- **From non-federal sources**. Local (e.g., municipal), state, and private funding sources are all allowable, as long as no part of these funding sources includes federal funds.
- **Allowable/eligible:** Match must meet the same eligibility guidelines as grant-funded work, be related to the project or located in the project watershed, and within a specified, relevant time period.

Calculating Match Ratio: Match for 319 projects is calculated using the following formula:

$$\frac{Dollar\ value\ of\ match}{Total\ project\ cost} = Match\ ratio$$

Total project cost is the sum of non-federal match plus 319 grant funds. For example, if a project requests $75,000 in 319 funds, $50,000 in match is needed to meet the 40% match requirement:

$$\frac{\$50{,}000\ (match)}{\$50{,}000\ (match) + \$75{,}000\ (319\ funds)} = 0.4\ (40\%\ match\ ratio)$$

1.3.1 Ineligible Projects

Section 319 Grants may only be used for work that is not required by National Pollutant Discharge Elimination System (NPDES) stormwater permits, including municipal separate storm sewer system (MS4) permits consent orders, and Residual Designation Authority (RDA) permits. In areas regulated by these permits, ***319 funds cannot be used for work that is required in the permits***. The regulated discharges are defined as "point sources" that are no longer eligible for nonpoint source funding.

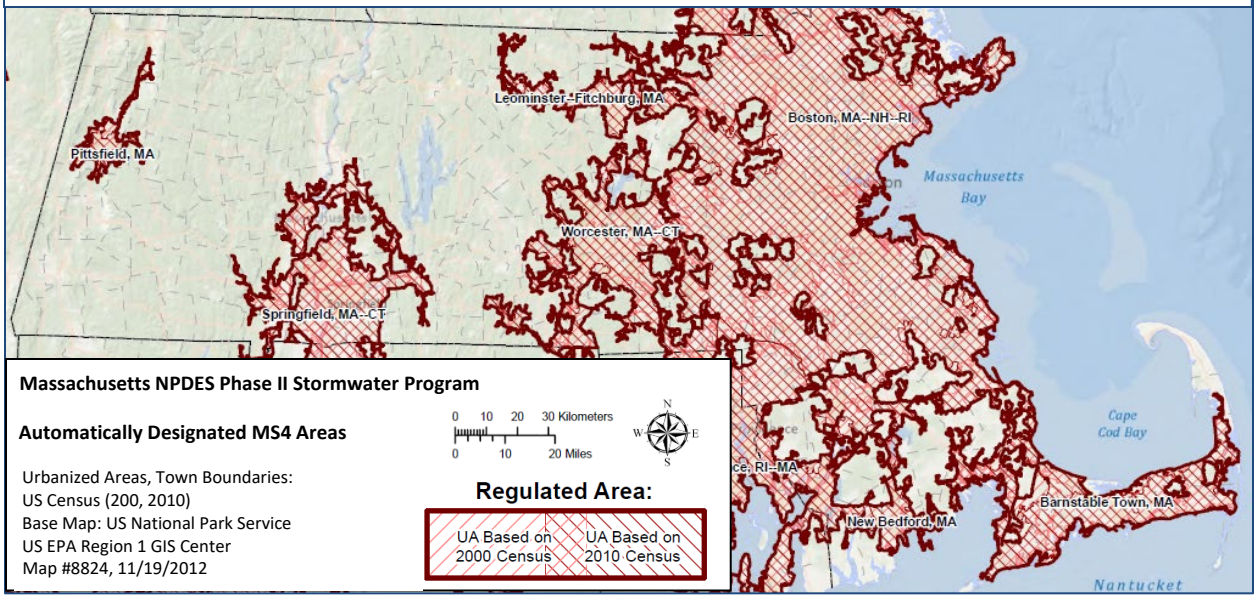
What is a point source?	The Clean Water Act defines a point source a conveyance, including but not limited to "*any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged".*" This term does not include agricultural stormwater and return flows from irrigated agriculture.	

Determining the areas regulated by NPDES stormwater permits, and what work will be allowed, is important to consider when applying for 319 funding. A few simple guidelines:

- In MS4 regulated areas, stormwater work that is **not** required by the Final 2016 Massachusetts Small MS4 General Permit can be funded with 319 dollars.
- Areas **outside the regulated areas** are fully eligible for 319 funds.
- A municipality that contains both regulated and unregulated areas is eligible for 319 funds for work in the **unregulated area and in the regulated area if not required by MS4 permit**.

To determine the permit status of your project area, go to the EPA web site for Regulated Communities in Massachusetts. Scroll down to the town you are interested in and click on the "Regulated Area Map". Note that these maps only depict regulated areas within municipalities. Some large stand-alone entities, such as MassDOT and public universities, have individual NPDES permits that must be followed.

As shown in this USEPA map, 37% of Massachusetts is classified as urbanized area (UA) which is regulated as a MS4 area under the NPDES Phase II Stormwater Program.



1.4 Additional Resources for Developing 319 Proposals

As summarized below, there are several other resources available to assist applicants with completing a successful 319 grant application and subsequent project.

- **To review previous projects**: Section 319 Project Summaries provide examples of successful past projects completed using 319 grant funds.
- **To determine possible solutions:** The Massachusetts Clean Water Toolkit is a guide to control of NPS pollution. The Toolkit provides information on NPS pollution sources including urban stormwater runoff, agriculture, boating and marinas, erosion/sediment control, forestry, wastewater, natural resources extraction, roads, and stream corridor and shoreline protection. An interactive platform allows for the user to determine appropriate best management practices (BMPs) for their site, including practices for agriculture, construction, residential, shorelines, roads, and urban environments.
- **Especially for coastal watersheds:** Coastal Stormwater Management Through Green Infrastructure, A Handbook for Municipalities was developed by EPA with the Massachusetts Bays National Estuary Partnership. The handbook includes guidance for watershed assessment, and describes options for stormwater treatment that are suitable for coastal watersheds.

- **To estimate preliminary costs:** The Community Stormwater Solutions - BMPs Cost Catalog developed by the Massachusetts Watershed Coalition was created for municipalities to provide practical guidance for selecting BMPs that can remove more pollutants for less cost. The Cost Catalog provides a starting point for generating estimates for BMP costs per acre of impervious area treated and BMP pollutant removal costs per pound of Total Suspended Solids (TSS).

- **For more information about the NPS Program:** The 2020-2024 Massachusetts Nonpoint Source Management Program Plan is a planning framework developed by the state to address NPS pollution. The plan identifies a strategy and specific, measurable actions to reduce the impacts of NPS pollution and improve water quality in Massachusetts. It is not necessary for a grantee to read this plan to submit a competitive proposal.

- **A variety of resources to guide grant writing and proposal development for clean water projects can be found at**: https://www.mass.gov/service-details/massbays-technical-transfer-resources. These resources were developed through a collaboration between MassDEP and the Massachusetts Bays National Estuary Program.

Other Related Grant Programs: See Appendix A for information on other grant programs that provide funding for water quality assessments and related investigations that can provide the basis for future 319 grant projects.

Section 2

Watershed-Based Plans

2.1 What is a Watershed-Based Plan (WBP)?

2.1.1 Purpose and Need

The purpose of a Watershed-Based Plan (WBP) is to organize information about watersheds, and present it in a format that will enhance the development and implementation of projects to restore water quality and beneficial uses in the Commonwealth. The WBP follows EPA's recommended format for "nine-element" WBPs, as described below.

All states are required to develop WBPs, but not all states have taken the same approach. Many states have chosen to develop WBPs only for selected watersheds. MassDEP's approach has been to develop a tool to support statewide development of WBPs, so that good projects in all areas of the state may be eligible for federal watershed implementation grant funds under Section 319 of the Clean Water Act.

2.1.2 Background

EPA guidelines promote the use of Section 319 funding for developing and implementing Watershed-Based Plans (WBPs). WBPs are **required for all implementation projects completed with 319 funding**, and are recommended for all watershed projects, whether they are designed to protect unimpaired waters, restore impaired waters, or both. A WBP is currently not required when submitting a 319 grant proposal but would increase a proposal's competitiveness. A WBP is required prior to commencement of implementation project.

Development of a WBP will help you to identify known and likely causes and sources of NPS pollution in your watershed. It will also help you to prioritize the NPS problems, identify appropriate best management practices (BMPs) and watershed-based strategies for addressing the problems, and develop competitive proposals to fund the work using 319 grant funds or similar programs.

To support the development of WBP's for 319 grant applications and other watershed planning efforts, MassDEP has developed the Massachusetts Watershed-Based Plans tool.

Why use the Massachusetts WBP tool?

- ☑ The MassDEP WBP tool provides **instant access to watershed data, maps, pollutant load modeling**, and other information.
- ☑ Using the WBP tool will **increase your competitiveness for state/federal grants** for watershed improvements.
- ☑ The WBP tool provides a **building block**, allowing you to focus resources on more detailed investigations and implementation.

The nine elements of a Watershed-Based Plan as required by EPA are summarized below:

a. **Identify the causes and pollutant sources** (or groups of similar sources) that will need to be controlled to achieve the pollutant load reductions estimated in the Watershed-Based Plan (and to achieve any other watershed goals identified in the plan), as discussed in item (b) below.

b. **Estimate the pollutant load reductions** expected for the management measures described under paragraph (c) below (recognizing the natural variability and difficulty in precisely predicting the performance of management measures over time).

c. **Describe the NPS management measures** that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in the Watershed-Based Plan), and identify (using a map or a description) the critical areas in which those measures will be needed to implement the plan. *See Section 3 of this Guidebook for more detailed information on selecting BMP sites and BMP types.*

d. **Estimate the technical and financial assistance needed**, associated costs, and/or the sources and authorities that will be relied upon, to implement the plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

e. An **information/education component** that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented. *See Section 7 of this Guidebook for more information and resources for public education and outreach.*

f. A **schedule for implementing the NPS management measures** identified in the plan that is reasonably expeditious. *See Section 8 of this Guidebook for more information on establishing a schedule.*

g. Describe **interim, measurable milestones** for determining whether NPS management measures or other control actions are being implemented. *See Section 8 of this Guidebook for more information on establishing milestones.*

h. A **set of criteria** to determine if loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether the Watershed-Based Plan or TMDL needs to be revised. *See Section 8 of this Guidebook for more information on evaluation criteria.*

i. A **monitoring component** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above. *See Section 8 of this Guidebook for more information on monitoring.*

2.2 Key WBP Information Sources

Links to key resources related to WBP development and information provided by the Massachusetts WBP tool are provided below. For some watersheds, a great deal of additional information is available but is not directly cited in the WBP tool, because the information has also been incorporated into the key resource documents listed below (click links for more information).

- Water Quality Assessments**:** MassDEP conducts monitoring and assessment activities and reports its findings to the EPA and the public as required by the Clean Water Act. Water quality assessments are conducted to evaluate the ecological and recreational ("fishable/swimmable") condition of Massachusetts's surface waters.
- Technical Memoranda: MassDEP water quality monitoring efforts are reflected in these technical memoranda.
- Water Quality Monitoring Data**:** Quality-assured water quality monitoring data.
- Total Maximum Daily Loads (TMDLs): TMDLs are a calculation of the highest amount of a pollutant that a water body can receive and still meet water quality standards. The Clean Water Act requires states to identify waterbodies not meeting these standards and develop TMDLs for them. This link provides information about TMDLs and access to completed TMDL reports.
- Integrated List of Waters: *See Section 1.2 of this Guidebook for more information.*

2.3 How to Fund a Watershed-Based Plan

Grant funding is currently available to develop a Watershed-Based Plan through the MassDEP 604b Grant Program for Water Quality Management Planning. This grant program supports development of a WBP for local watershed planning and to support future 319 grant projects. Development of many WBPs could be also funded locally through municipal and/or watershed association budgets. Currently 319 programs funds can also help develop watershed-based plans for successful grant applicants

2.4 MassDEP Review and Example Watershed-Based Plans

MassDEP reviews and accepts completed WBPs that are submitted through the WBP web application. The submittal process is easy, simply requiring the user to click a button that converts the WBP to a MS-Word document, which is then uploaded for review by MassDEP staff. ***MassDEP acceptance of a Watershed-Based Plan is required prior to the start of any 319 funded implementation project.***

As examples, links to accepted WBPs from recent 319 grant projects are below.

Watershed-Based Plan for Lake Mansfield, Great Barrington

Watershed-Based Plan for Abbey Brook and Lower Chicopee River Watershed, Chicopee

2.5 MassDEP WBP Review

MassDEP reviews WBPs that accompany 319 applications for consistency and completeness. The review includes the following:

- Review for Provisional WBP Acceptance to confirm that all EPA elements are included in the plan
- Review and Rating of "Provisionally Accepted" WBPs for Acceptance of WBP

For more information or assistance with the Massachusetts WBP Tool, contact:

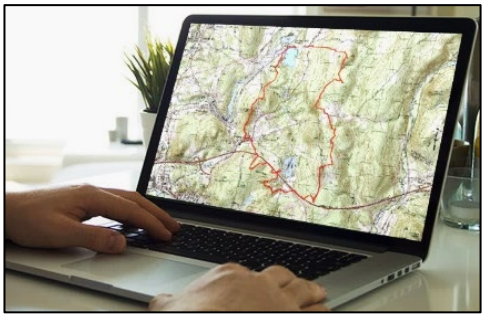
Malcolm Harper, MassDEP Nonpoint Source Program Grants Manager
malcolm.harper@mass.gov; 617-418-9732
8 New Bond Street, Worcester, MA 01606

Section 3

How to Identify a NPS Grant Project

An important part of developing a Watershed-Based Plan is to identify areas where effective actions can be taken to reduce NPS pollution to a waterbody. This process should include both **preliminary watershed data collection** and a **watershed field assessment**.

3.1 Preliminary Watershed Data Collection



Preliminary data collection can help to **identify and prioritize potential pollutant sites and locations to hopefully maximize the removal of the targeted pollutants.** A thorough preliminary investigation will make your field investigation more effective.

3.1.1. Desktop Analysis

A desktop analysis can provide important information about a watershed that will guide a field assessment. The **review of existing maps** can help identify priority areas in the watershed and how suitable some of these areas are for best management practices (BMPs) to reduce NPS pollution. Maps for your watershed that can be created using the Massachusetts Watershed-Based Plans tool include:

- **Watershed Boundary/Topographic Map**: This map includes your watershed boundary and shows a variety of other key information such as topography, roads, tributaries, etc.
- **Land Use**: This map shows where specific types of land uses are located in the watershed and can help focus efforts on areas with higher expected pollutant loads. For instance, knowing the location of agricultural areas can help identify potential sites for agricultural BMPs.
- **Impervious Cover:** This map shows where impervious surfaces such as roads and parking lots are located in the watershed. Concentrated areas of impervious surfaces may be good candidates for stormwater BMPs.

Other maps that are commonly used for watershed planning, and which may be available from your municipality or regional planning agency, include the following:

- **Soils**: Soil maps will show you which areas of the watershed have soil types that are appropriate for certain types of BMPs. *See Section 4.1.7 for more information on soils maps.*
- **Sewer/septic systems**: Understanding the type of wastewater management in specific areas of the watershed can help you identify the appropriate BMP to recommend (e.g., areas for public education on proper septic system maintenance).
- **Vegetated buffers**: Vegetated buffers to waterbodies protect water quality. Areas with minimal vegetated buffers may be good candidates for buffer plantings or other BMPs.

- **Sensitive habitats or special areas**: These areas include Designated Shellfish Growing Areas (DSGAs), Areas of Critical Environmental Concern (ACECs), Outstanding Resource Waters (ORWs), mapped Natural Heritage and Endangered Species Program (NHESP) areas, etc.
- **Property Ownership**: Identifying parcel boundaries and ownership can be important when determining an appropriate location for a BMP and feasibility of construction and maintenance.

The Watershed-Based Plan tool can be used to conduct a parcel level analysis of potential BMP locations. For more information see Appendix B (*MassDEP Guidance on Structural BMP Selection, Siting, and Sizing for the Massachusetts Watershed-Based Planning Tool*). It is important to note this analysis and any desktop analysis should be the starting point for further BMP site identification and prioritization.

Your watershed may have been studied before! Take some time to **review any existing water quality and watershed-specific reports**, such as studies conducted by or on behalf of municipal, state, and federal agencies, and studies by local lake and watershed organizations.

3.1.2. Stakeholder Input

People that live and work in your watershed know it best! **Reach out to local stakeholders** such as the Department of Public Works, Conservation Commission, or local watershed groups for information on potential pollution sources, such as:

- Areas of suspected septic system failure.
- Areas prone to flooding and any associated areas of erosion.
- Developed areas either lacking adequate stormwater management or with good potential for improvements (e.g., infiltration techniques in areas with well-draining soils).
- Agricultural activities within or close to waterbodies and poorly drained or somewhat poorly drained soils.
- Evaluation of nutrient management practices including manure management.
- Evaluation of manure management practices on horse farms and other facilities with livestock.
- Municipal, commercial, residential practices for maintaining sport fields, lawns, golf courses, etc.
- Municipal and commercial housekeeping practices such as street sweeping, leaf disposal, etc.
- Public areas near waterbodies that are popular for dog walking where proper disposal of pet waste may be a concern.
- Grassy areas adjacent to waterbodies (e.g., concerns related to use of lawn fertilizers, limited shoreline buffers, waterfowl activity, etc.).
- Eroding streambank and riparian areas.

3.2 Prepare a Site Visit List

Based on information from your preliminary data collection, the next step is to **compile a list of sites to visit** during a watershed field assessment. The list should include:

- Site number
- Site name
- Location (street address; coordinates)
- Property ownership
- Site description (*e.g., parking lot adjacent to stream with little vegetated buffer)*

The initial list should include all sites identified during preliminary data collection and then be prioritized for field investigation. It will also be helpful to **mark your site visit locations on a map**. Once your site visit list and map are complete, share it with your stakeholders and start planning your field assessment!

3.3 Watershed Field Assessment

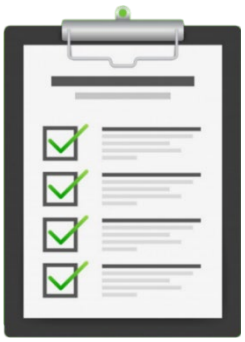
The three main goals of the watershed field assessment are:

1. Identify/confirm potential **BMP locations**.
2. Select **potential BMP types** for the site.
3. Assess **feasibility** and **site constraints**.

Field assessments are often conducted by two-person teams and require some technical understanding of pollution sites, drainage, and BMP design criteria. *A more detailed discussion on BMP selection and sizing is provided in Section 4 of this Guidebook.* If you do not feel qualified to conduct a watershed field assessment, consider seeking technical assistance from a civil engineer or other qualified professional.

3.3.1 Field Assessment Checklist

In preparation for your field day, ensure you have the correct equipment:



- ✓ Site Visit List in the order you plan to visit them
- ✓ Field maps showing field sites to visit with directions to each site
- ✓ Watershed Assessment Field Data Form (*see example at the end of this Section)*
- ✓ Measuring wheel or large measuring tape

- ✓ Camera
- ✓ Handheld GPS or camera with GPS capability
- ✓ Field notebook, clip board, and writing utensils
- ✓ Rain gear if necessary. Rain can help identify the direction of stormwater flow – don't be afraid to get a little wet!

When you arrive at each site:

- ✓ Refer to the Site Visit List to get a better understanding of the site.
- ✓ Fill out the top portion of the Watershed Assessment Field Data Form before walking the site.
- ✓ Take a photo of the Field Data Form to identify the site you are visiting. It can be hard to keep track of photos of multiple sites!
- ✓ Take time to walk the site thoroughly before making specific recommendations.
- ✓ Describe potential pollutant sources on the Field Data Form and measure the approximate area.
- ✓ Describe potential BMPs on the Field Data Form (*see Section 4 for more on BMP Selection*).
- ✓ Sketch the site with the location of potential BMPs on the Field Data form.
- ✓ Identify potential site constraints on the Field Data form (*see Section 3.3.2 for more on this*).
- ✓ Take plenty of site photos – the more the better!

It's a good idea to scan your field data forms and upload your pictures to a computer **as soon as possible after completing each field assessment**. This will keep your data organized and ready for the next steps – selecting the most effective BMP type for each location (*see Section 4.1 for more on this*).

3.3.2 BMP Siting Constraints

Some of the potential project sites that you have identified may have design constraints that will make them difficult to work on and/or result in significantly increased costs. In some cases, these constraints may make the site either **infeasible for BMP construction** or make the site a **lower priority for implementation**. Site constraints may be identified during preliminary data collection efforts, but are more often discovered during field assessments.

Potential BMP Siting Constraints

- **Land Ownership:** Who owns the land? Would the BMP be crossing property lines? For 319 grant projects, land owners will be required to sign a letter allowing the proposed construction and maintenance of the BMP.
- **Limited space**: Is enough space available to install a BMP large enough to treat runoff from the site? ***See Section 4 for guidance on BMP sizing.***
- **Utilities**: Location of both underground and above-ground utilities may limit the space available to install a BMP or the depth of excavation that is feasible. For information on the location of underground utilities, contact Dig Safe (dial 811).
- **Permitting:** How close is the site to a waterbody, its tributaries and wetlands? Would BMP construction require permits? Although permits are not uncommon for 319 grant projects, some environmental permits (e.g., Massachusetts Wetlands Protection Act) may limit or prohibit BMPs in regulated areas, or could require mitigation measures that would increase project costs. ***See Section 5 for guidance on permitting.***
- **Access**: Is the ideal location for a BMP difficult to access? This could create challenges and cost issues for both installation and long-term maintenance of the BMP.
- **Interference with other practices**: Would the location of a BMP at this site interfere with other practices such as habitat restoration efforts, snow plowing, or parking?

Example Watershed Assessment Field Data Form (page 1)

Watershed / Subwatershed Name: _____ Field Crew: _____

Site # _____ Date: _____ Site Ownership (if known): _____

Weather Conditions: _____ Rain in last 48 hours (approx. total) _____

Location (*town, road name, house#, intersection)* _____

GPS Coordinates: _____ Photos Taken? _____

General Site Description:

Land Use/Activity: *circle one*

State Road	*Driveway*	*Boat Access*
Municipal Road	*Residential*	*Agriculture*
Private Road	*Commercial*	*Construction Site*
Trail/Path	*Municipal/Public*	*Other: _____*

Description of Problems/Improvement Opportunities: *circle ALL that apply*

Problem Type	**Description (circle)**	**Notes/ Description of Problem**	**Approx. Size** (length x width)
Surface Erosion	*Slight* *Moderate* *Severe*		
Road Shoulder Erosion	*Slight* *Moderate* *Severe*		
Soil	*Bare* *Uncovered Pile* *Winter Sand*		
Culvert	*Unstable Inlet/Outlet* *Clogged* *Crushed/Broken* *Undersized*		
Ditch	*Slight Erosion* *Moderate Erosion* *Severe Erosion* *Bank Failure* *Undersized*		
Parking Lot	*Drains Directly to Waterbody* *Evidence of Concentrated Flow*		
Shoreline	*Undercut* *Lack of Shoreline Vegetation* *Erosion* *Unstable Access*		
Agriculture	*Livestock Access to Waterbody* *Tilled Eroding Fields* *Manure Washing Off-Site* *Inadequate Buffer*		
Other (e.g., area to improve stormwater treatment)			

Example Watershed Assessment Field Data Form (page 2)

Recommended BMP(s): *circle ALL that apply*

Vegetated Filter Strip
Bioretention/Rain Garden
Permeable Pavement
Green Roof
Detention Basin
Retention Basin
Infiltration Basin
Infiltration Trench
Gravel Wetland
Sand Filter
Other: _____

Vegetated Swale
Subsurface Structure
Deep Sump Catch Basin
Leaching Catch Basin
Hydrodynamic Separator
Establish Vegetated Buffer
Enhance Vegetated Buffer
Stabilize Surface with Stone (or other material)
Bank Armoring

Bank Stabilization
Divert Runoff
Armor Inlet/Outlet (Culvert)
Replace Culvert
Enlarge Culvert
Plunge Pool
Conservation Tillage
Crop Nutrient Management
Livestock Access Limitation
Pet Waste Station

Description of Recommendation(s):

Potential Site Constraints: *circle ALL that apply*

Limited Space
Utilities
Private Property
Other: _____

Crosses Property Lines
Permitting Issues (e.g., wetlands)
Steep Slope

Difficult Access
May Interfere with Snow Plowing
Sensitive area (ACEC, NHESP, ORW, DSGA)

Sketch of Site / Potential BMP(s):

Section 4

Project Design

4.1 Conceptual Design

4.1.1 BMP Selection and Sizing

Once you have identified potential areas for BMPs, it's time to select the most effective BMPs for each location. You will also need to choose the approximate size for each BMP, since size will affect BMP pollutant removal performance and costs for materials and construction. Some key resources for BMP selection and siting include:

- **BMP Selector Tool**: Element C of the Massachusetts Watershed-Based Plans includes a ***BMP Selector Tool*** and other resources for BMP selection and estimation of costs and pollutant load reductions.
- The Massachusetts Stormwater Handbook includes a section on BMP Selection in Volume 2. Section 319 grants require an **Operation and Maintenance (O&M) Plan** for each structural BMP. The O&M Plan should be developed in accordance with Standard 9 of the Stormwater Handbook, and must be effective and implemented for the life of the BMP.
- EPA-approved **BMP pollutant removal performance information** is included in Appendix F (Attachments 2 and 3) of the Massachusetts Small Municipal Separate Storm Sewer Systems (MS4) General Permit.
- The Community Stormwater Solutions - BMPs Cost Catalog provides **estimates of BMP installation and maintenance costs** per acre of impervious area treated and per pound of Total Suspended Solids removed.
- Coastal BMPs: EPA guidance, Coastal Stormwater Management Through Green Infrastructure: A Handbook for Municipalities. Section 5 of the Handbook includes a **BMP Selection Matrix**.
- **Nature-based Solutions:** Nature-based solutions use natural systems, mimic natural processes, or work in tandem with traditional approaches to address natural hazards like flooding, erosion, drought, and heat islands. This includes approaches such as open space preservation, restoration of vegetated buffers, and Low Impact Development stormwater management techniques. Nature-based solutions can often **both reduce NPS pollutants and improve climate resiliency**, and should be considered where feasible as part of your 319 grant project.

Selecting BMPs and determining BMP size can be complicated and is often performed by a professional civil engineer that specializes in stormwater management. If you do not feel qualified to do this, consider seeking technical assistance from an engineer or other qualified professional to complete these tasks.

4.1.2 *Guide to Using the WBP BMP Selector Tool*

The BMP Selector Tool allows you to select BMPs and calculates pollutant load reductions and capital costs for those measures.[1] When using the Selector Tool to choose BMPs, keep the following in mind:

1. **Pollutant removal efficiency:** Different BMPs provide different levels of pollutant load removal for various pollutants. Make sure to focus on the **primary pollutant of concern** for your waterbody (*see more on this in Section 4.2.3, Estimating Pollutant Load Reductions*). 319 projects should aim to **reduce the target pollutant load as much as possible per dollar spent**.

2. **Operation and Maintenance (O&M) Costs:** The cost estimates provided by the BMP Selector Tool are capital costs, and do not include the important ongoing costs associated with long-term O&M of the BMP. Proper O&M is critical to BMP performance, and all 319 projects should consider **how O&M will be paid for and conducted over the lifespan of the BMP**. Approximate O&M costs are estimated in the Community Stormwater Solutions - BMPs Cost Catalog.

The BMP Selector Tool includes a group of commonly used **structural BMPs** that have undergone sufficient study to allow for estimation of pollutant load removal for several key NPS pollutants: phosphorus, nitrogen, and total suspended solids. These BMPs are listed below, with links to fact sheets from the Massachusetts Clean Water Toolkit.

Structural BMPs *(click title to view fact sheet)*			
Bioretention Areas / Rain Gardens	Grassed Channel /Water Quality Swale	Oil/Grit Separator	Wet Basin
Deep Sump Catch Basin	Constructed Stormwater Wetlands	Porous Pavement	Subsurface Structure
Dry Well	Infiltration-Recharge Basin	Sand Filter	Infiltration Trench
Extended Dry Detention Basin	Leaching Catch Basin	Vegetated Filter Strip	

BMP Selector Tool Inputs: After selecting a BMP type, in order to calculate estimated pollutant removal and capital costs the user must provide BMP size/storm depth, drainage area, and land use/cover type estimates. These three items are described below.

BMP Size/Storm Depth

BMPs sized to handle larger storms will treat more rainfall events effectively and therefore have a higher pollutant removal efficiency. Some BMPs (e.g., bioretention, wet basins) can be sized to treat runoff from a specified storm event (e.g., 0.5 inches of rain, 1 inch of rain, etc.). The larger the design storm, the larger the BMP needs to be to treat the runoff produced by the event.

Other BMPs (e.g., deep sump catch basin, oil/grit separator) tend to have standardized sizing and do not require sizing information. The manufacturer of the device should be consulted to determine

[1] The pollutant load reductions provided by this tool are based on BMP performance information included in ***Appendix F*** (Attachment 3) of the Massachusetts Small MS4 General Permit.

which model(s) are most appropriate for your site and upstream drainage area. *See Section 4.2.3 for more detailed information on BMP sizing.*

If you are unsure about which design storm depth to select, don't worry!

The BMP Selector Tool has a default setting for a **1-inch storm**. You should adjust this default to a smaller storm size if the BMP footprint (in square feet) estimated by the Selector Tool is bigger than the space available.

Keep in mind:

- At some sites where space is limited, the most practical approach is to use the available space to treat stormwater up to the largest storm size feasible. *This will often still allow for treatment of the smaller storms that contribute most of the stormwater runoff and pollutants over the course of a year*.
- In other cases, where the function and longevity of BMPs may be compromised by larger flood flows (e.g., BMPs including culverts, pipes, headwalls, etc.), these BMPs **should be sized to accommodate the larger storms that are predicted to occur with greater frequency due to climate change** (*see more on this in Section 4.1.6*). In these cases, more competitive grant proposals will be designed for larger storms (1-inch or larger) to ensure that they will function well into the future.

Drainage Area

Estimating the drainage area that will flow into the proposed BMP can be tricky, especially in flat areas! If possible, it is helpful to observe the area during rain to confirm drainage patterns.

Drainage Area = Length x Width of *all* contributing land

When estimating BMP drainage area, include all developed land (e.g., roofs, lawns, roads) *and* undeveloped land (e.g., forest) that will drain towards the BMP. It is often helpful to use a topographic map as a starting point. An interactive topographic mapping tool can be viewed at: https://viewer.nationalmap.gov/advanced-viewer/.

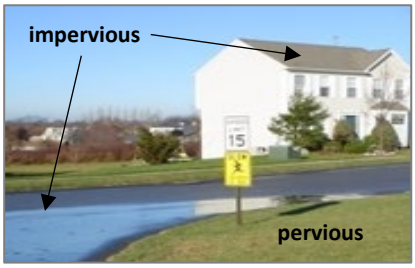
Although a topographic map can provide a starting point, it's a good idea to refine the drainage area based on observed features: *Does a nearby roof drain towards or away from the BMP? Is the adjacent road crowned in the center and splitting runoff down both road shoulders?* These kinds of details can make a big difference is getting an accurate estimate of drainage area.

Land Use/Cover Type

You will need to specify the land use type(s) within the drainage area. **Land use information is key to understanding pollutant loads, since different land uses are known to contribute (export) NPS pollutants at different rates.** For example, forested land has a lower phosphorus export rate than residential land. The estimated export rate for each land use type is by the BMP Selector Tool to calculate the pollutant load that will be treated by the selected BMP.

As a starting point, general land use types can be identified by using land use maps or aerial imagery (e.g., Google Earth). **This information should always be confirmed with a site visit** to allow for a more detailed breakdown of land uses within the BMP drainage area.

For each land use that you select (e.g., medium-density residential), you will also be asked by the BMP Selector Tool to estimate how much of that land is **pervious** (land that allows water to readily infiltrate to the soil) and **impervious** (areas that do not readily infiltrate, such as paved surfaces, roofs, etc.). Options for selecting land use and land cover are provided from a drop-down menu in the Selector Tool.



4.1.3 Other Methods for Estimating Pollutant Load Reduction

The BMP Selector Tool includes pollutant load reduction estimates for a subset of commonly used structural BMPs that were approved by USEPA Region 1 and MassDEP. The table below describes additional methods and resources that are commonly used to estimate pollutant load reductions. This table may be helpful if you are considering BMPs for your site that are not supported by the BMP Selector Tool, or would simply like to compare different calculation methodologies.

Alternative Methods for Estimating Pollutant Load Reduction *(click links on left to access)*	
MassDEP Stormwater Handbook	Includes guidance on methods to estimate pollutant loading and potential BMP pollutant removal efficiencies.
BMP Accounting and Tracking Tool (BATT)	This link includes an MS-Excel workbook, User's Guide, and Technical Support Document for an EPA-Region 1 tool that facilitates estimation and reporting for nutrient load reduction requirements in the Massachusetts Small MS4 permit.
US EPA Region 1 Nomographs	Includes structural BMP pollutant removal performance curves (i.e., removal efficiency vs. treated depth) and associated pollutant export rates by land use. *See pages 41-75 of link and example on page 35 of this Guidebook.*
NHDES Simple Method Spreadsheet	Spreadsheet-based tool to calculate pre- and post-development pollutant loads using the Simple Method (also includes a Fertilizer Reduction Calculator). This method is often used to calculate pollutant removal numbers for 319 grant projects, and is simple to use. Users must input BMP pollutant removal efficiency from Appendix E of the New Hampshire Department of Environmental Services Stormwater Manual.
USEPA Region 1 Opti-Tool	Spreadsheet-based tool that determines the best potential mix of Structural BMPs on a watershed scale to achieve the highest load reductions at the lowest cost.
USEPA Region 5 Model for Estimating Load Reductions	Includes easy to use calculation spreadsheets to estimate potential load reductions resulting from Gully Stabilization, Bank Stabilization, Agricultural Field Filter Strips, and other BMPs.
International Stormwater BMP Database	Includes over 700 BMP studies and performance results, including annual summary reports depicting BMP summary statistics for various pollutant types.

Note: There are many other available resources for estimating pollutant loads and resulting reductions from BMPs. Some additional resources include US EPA Region 5 STEPL Model and WINSLAMM.

MassDEP has prepared detailed guidance on how to use the BMP Selector Tool in a document titled Guidance on Structural BMP Selection, Siting, and Sizing for the Massachusetts Watershed-Based Planning Tool .

This technical reference includes guidance on selecting the Tool inputs (BMP size/design storm depth, drainage area, land use type), explains how the Tool outputs (pollutant removal, BMP cost) are calculated, and provides a step-by-step example of how the Tool is used for a hypothetical site.

4.1.4 Non-structural BMPs

As you select management measures for your watershed, consider how **non-structural measures** can be implemented to help meet your water quality goals. Unlike structural BMPs, non-structural measures do not involve construction of site-specific facilities and generally focus on reducing pollutants at the source through changing behavior and land use patterns, institutional practices, regulatory tools, public education, and economic tools. **Non-structural BMPs can often be very effective at reducing target pollutant loads per dollar spent – in some cases even more effective than structural BMPs.** However, pollutant load reductions associated with non-structural measures are more difficult to estimate than those for structural BMPs, and typically must be estimated on a case-by-case basis with appropriate technical expertise.

Examples of non-structural measures and links to fact sheets from the Massachusetts Clean Water Toolkit are provided below.

Non-structural BMPs *(click title to view fact sheet)*			
Alternate Livestock Water Supply	Conservation Tillage	Lawn/Landscaping Education	Road Salt Management
Bilge Water Handling	Crop Nutrient Management	Laws and Regulations	Snow Disposal
Boat Engine Maintenance	Fish Waste Management	Low Impact Development Design	Soil Amendments
Boat Fueling	Hazardous Materials Storage	No Discharge Zones	Spill Prevention and Control Plan
Car Washing	Horsekeeping: Manure Management	Pet Waste Management	Storm Drain Marking
Catch Basin[2] Maintenance	Integrated Pest Management	Municipal DPW Pollution Prevention	Street Sweeping[2]

[2] For more information on pollutant load reduction credits for selected non-structural BMPs included in the Massachusetts Small Municipal Separate Storm Sewer Systems (MS4) General Permit, see Attachment 2 of Appendix F of the General Permit.

4.1.5 Estimating Project Costs

Estimating project costs is a critical component of a successful Section 319 grant application. To be competitive, your application should include a realistic and well thought out cost estimate that accounts for potential unanticipated issues. Begin the process by creating a sequential list of all potential steps of the project from planning to construction. Keep in mind that successful 319 grant applications typically have completed most of the technical and planning work necessary before a 319 grant application is submitted.

Next, determine which steps will require financial assistance and which steps can be covered internally by your organization. For example, an applicant may have in-house engineering capabilities, but may request financial assistance for construction activities. Section 319 grant projects costs and activities can generally be split into two categories: 1) capital costs for construction and 2) technical assistance.

Capital Costs for Construction

For the purposes of this document, capital costs refer to material and construction costs. The Massachusetts Watershed-Based Plans BMP Selector Tool provides planning-level BMP capital costs based on the anticipated size of your selected BMP(s). Refer to the Element C Guide of the WBP Tool for cost references used by the tool. The following alternative methods can also be used to calculate capital costs, or as a point of comparison.

Alternative Resources for Estimating Conceptual BMP Costs *(Click Links on Left to Access)*	
Community Stormwater Solutions - BMPs Cost Catalog	Provides a starting point for generating estimates for BMP costs per acre of impervious area treated and BMP pollutant removal costs per pound of Total Suspended Solids (TSS).
RS Means	Construction cost estimation software (requires purchase), including a database of unit pricing for specific tasks (e.g., sawcut pavement). This is most suitable for larger projects and therefore may lead to underestimation of potential costs.
EPA National Stormwater Calculator	This software application estimates the annual amount of rainwater and frequency of runoff from a specific site using green infrastructure stormwater controls, and also gives planning-level estimates for BMP installation costs.
Civil Engineer	Ask qualified civil engineering firms for a cost estimate. Engineering firms often maintain a library of past similar construction projects.
Construction Firm or Landscaper	Ask qualified construction contractors for a cost estimate. Ask for their estimated mobilization costs, day rates, and overall construction timeline estimate.

Be sure to adjust your cost estimate for inflation. Inflation adjustments can be performed using the regional Consumer Price Index (CPI) or the regional Engineering News Record Construction Cost Index (ENR CCI). The ENR CCI provides a better construction-specific inflation estimate than the CPI, but requires a paid subscription.

Regardless of which cost estimation method(s) you decide to implement for your project, remember that the cost estimate that is included in the Section 319 grant application is for a conceptual BMP design that might change during the design process. It is important to build a construction contingency into your estimate to account for potential unknowns.

Finally, remember to consider ancillary construction costs such as police traffic details for sites located on or adjacent to a roadway.

Technical Assistance

Technical assistance refers to any potential help that is needed outside of your organization to execute the project. Potential tasks may include, but aren't limited to:

- Project planning activities
- Site survey and soil samples
- Civil engineering/design
- Landscape design/planting plans
- Wetland delineation/environmental permitting
- Legal counsel (e.g., easements, etc.)
- Public participation and outreach
- Post-construction monitoring (e.g., water quality monitoring, lab sampling fees)

Although some of the technical services and planning-level investigations listed above may be eligible for 319 funding, **the most competitive proposals will have completed most of the required technical and planning work before a 319 grant application is submitted**. The 604b grant program is a good source of funding to do technical and planning work necessary for a successful 319 grant application.

The best way to obtain reasonable estimates for technical assistance is to obtain price quotes from service providers. As a general rule of thumb, technical assistance costs will generally range from 20-40% of estimated capital costs, but can be significantly higher depending on project complexity.

Also remember to consider post-construction operations and maintenance (O&M) activities that must be performed for the life of the installed BMP(s). O&M costs can vary widely depending on BMP type. ***Note: O&M costs are not covered by Section 319 grant funds.***

4.1.6 Designing for Climate Change Resiliency

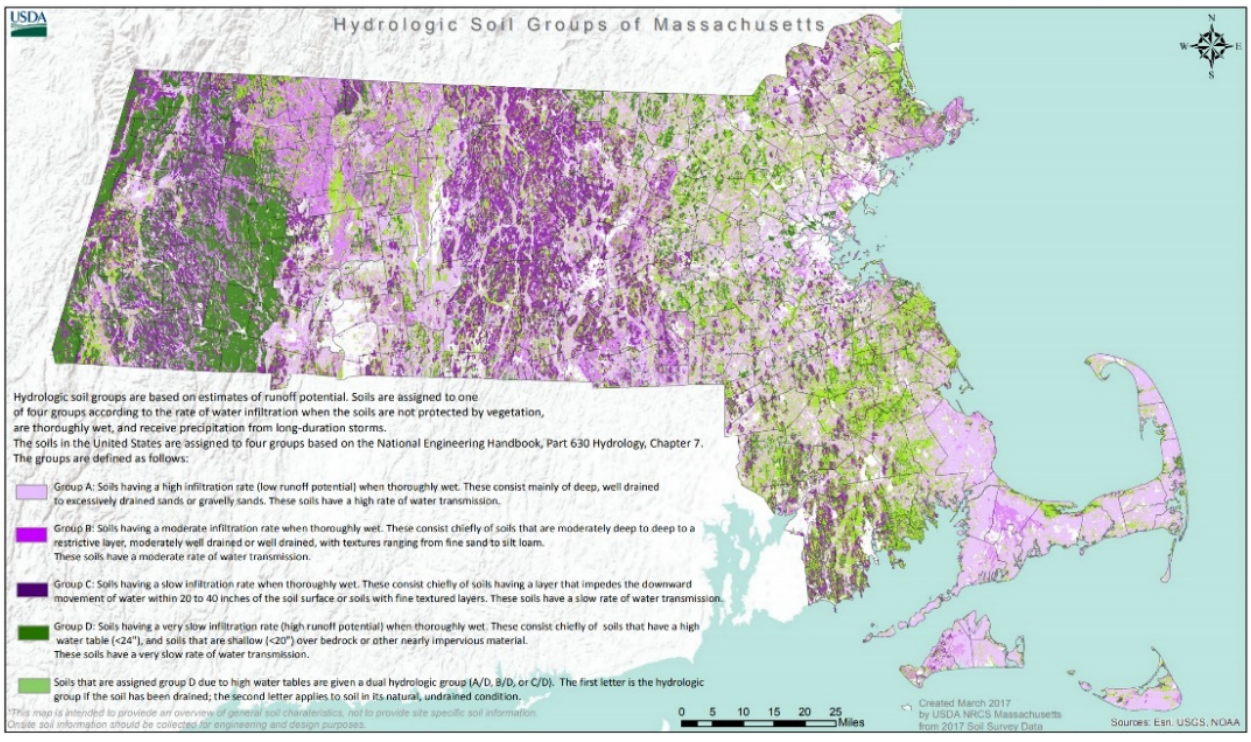
Projects designed to improve water quality should also be designed with a goal of **improving the resiliency of the Commonwealth to climate change**, consistent with 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan. Section 319 grant proposal designs that are developed to accommodate changing precipitation and groundwater elevations will be most competitive. Information on climate change projections for Massachusetts can be found at www.resilientma.org.

Nature-based Solutions (e.g., open space preservation, restoration of vegetated buffers, and Low Impact Development stormwater management techniques) can often **both reduce NPS pollutants and improve climate resiliency**, and should be considered where feasible as part of your 319 grant project.

4.1.7 Soils Information

Proposals for infiltration BMPs must provide **soils data** to support BMP feasibility. Sites with soils in Hydrologic Soil Group A or B are generally suitable for infiltration BMPs. Sites with more poorly drained soils (Groups C and D) may require an underdrain, soil amendments, or other engineering measures to make infiltration BMPs feasible. Resources for soil information are listed below. *Keep in mind that these maps represent general conditions - actual site conditions may vary significantly.*

- A soils mapping tool from the U.S. Natural Resources Conservation Service (NRCS) can be found at: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.
- An NRCS map of the **hydrologic soils groups** in Massachusetts can be found at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ma/soils/?cid=nrcseprd383021.



NRCS map of the hydrologic soils groups in Massachusetts

4.1.8 Developing Conceptual Plans

Conceptual designs submitted as part of a Section 319 grant funding proposal must be of **sufficient detail, and include sufficient site assessment**, to allow the proposal review committee to evaluate the viability of the proposal. The conceptual designs do not need to be prepared by a Professional Engineer (PE) and do not necessarily need to include detailed site work.

- Information on how to conduct a site assessment and associated desktop analyses in support of conceptual designs can be found in **Section 3** of this Guidebook.
- The level detail provided in conceptual designs can vary, but often includes the following elements:
  - Site photograph(s)
  - Narrative description of existing and proposed site conditions (e.g., describe land uses/land cover, describe existing issues and anticipated improvements, describe potential site constraints such as tree roots or nearby utilities, property ownership, how site access is obtained, nearby septic systems or drinking water wells, etc.)
  - Map or aerial photo showing the approximate proposed BMP location(s)
  - Estimated BMP sizing (e.g., 200 square foot bioretention area, 50 linear feet of vegetated swale, etc.)
  - Estimated pollutant removal quantities for target pollutant(s)
  - Schematic /drawing of typical BMP design features (e.g., plan view and/or cross section)
  - Soils information (*for infiltration BMPs, see Section 4.1.7*)
  - Anticipated permits required and potential permitting issues, such as proximity to wetlands, Outstanding Resource Waters (ORWs), Areas of Critical Environmental Concern (ACECs), rare species habitat, etc. (*see discussion on permitting in Section 5*)

*The following pages provide an **example of a BMP conceptual design** that is suitable for inclusion as part of a Section 319 grant application.*

Example Conceptual BMP Design (Page 1 of 2)

Site 1: Town Boat Launch

Location: 123 Lake Street
Source Type: Boat Launch/Parking Lot
Owner: Town of Townington
Pollutant of Concern: Phosphorus

Site Description

The Boat Launch and parking lot are located on Lake Street. The parking lot is relatively flat and unpaved, with an approximate 0.8-acre area draining as surface runoff down the boat launch into the Lake. The Boat Ramp is cracked and is in poor condition. There are no known underground utilities or site access constraints at this site. Underlying soils are Sandy Loam (Hydrologic Soil Group B) and are expected to provide effective infiltration.

Existing Boat Launch Parking Area.

Existing Boat Launch

Proposed Improvements

1. Install appx. 60’ by 30’ bioretention cell in existing grassed area to east of boat ramp with curb inlet to capture sediment / debris from upgradient gravel parking lot. Install grassed swale to discharge to the lake.
2. Replace paved boat ramp with articulated block ramp (appx. 30’ wide by 30’ long). Install trench drain at the top of boat launch ramp (approximately 46‘ wide) and direct flow to east of ramp to bioretention cell.

See **figures below** for an overview of proposed improvements, including a typical design detail for a bioretention cell. Treatment area for the proposed improvements is approximately 0.8 acres.

Estimated Capital Costs: $78,000 - $117,000

Estimated Annual Operations and Maintenance Costs: $2,200/yr

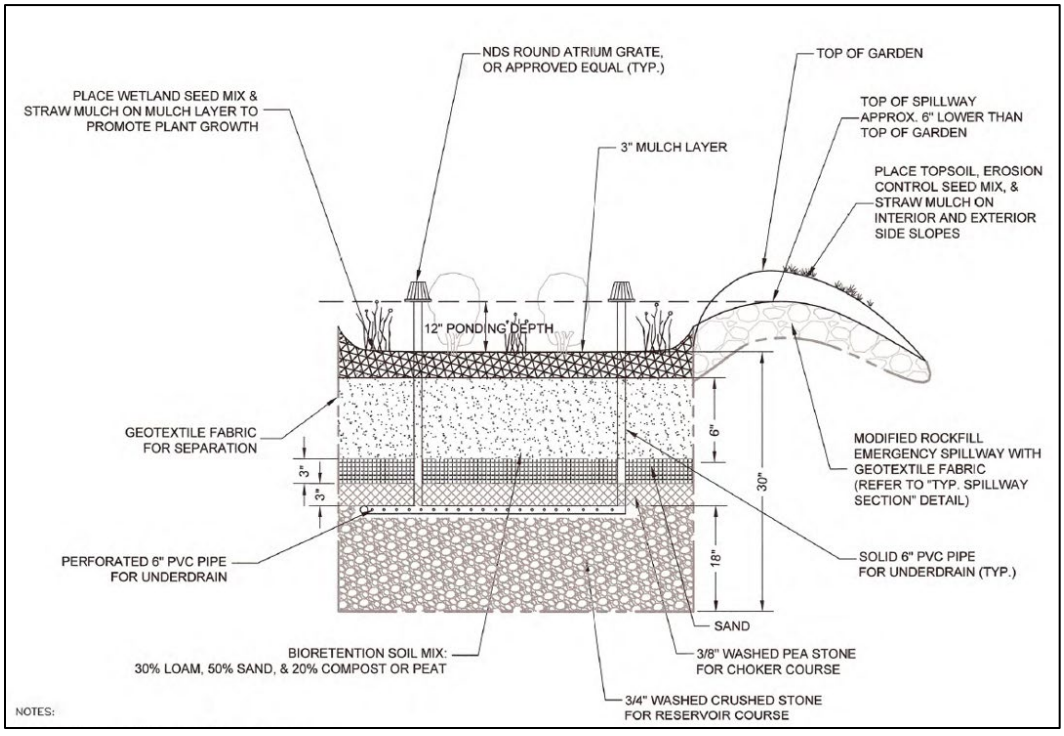
Estimated Nutrient Load Reduction:

- Total Phosphorus (pollutant of concern): 2.1 lb/yr
- Total Nitrogen: 2.2 lb/yr
- Total Suspended Solids: 0.4 ton/yr

Anticipated Permits: MA Wetlands Protection Act (Notice of Intent); 401 Water Quality Certification

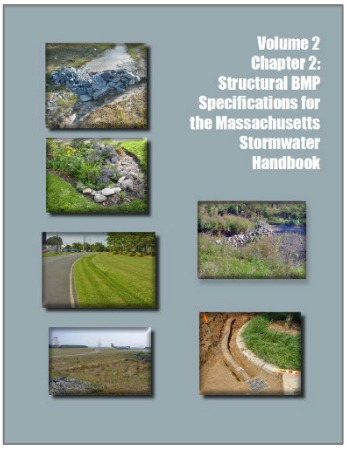
Example Conceptual BMP Design (Page 2 of 2)

Proposed Parking Lot and Boat Launch Improvements.



Typical Bioretention Cell Cross Section with Underdrain and Overflow

4.2 Final Design



Once you have been awarded a Section 319 grant, it will be time to commence final design. Design for most structural BMPs must be prepared by a qualified Professional Engineer licensed in Massachusetts. Design components for a Section 319 grant can vary widely. This section is intended to provide an overview of typical milestones, including tips and tricks to effectively navigate through the process. Refer to the Massachusetts Stormwater Handbook for detailed design information, including BMP specific design criteria.

4.2.1 Soil Testing

The first step of the design process is to perform soil testing to inform design. Soil testing is generally used to verify soil types, potential infiltration rates, depth of seasonal high groundwater, and depth to bedrock. It can also be used to identify any other unexpected items such as urban fill. Before performing soil testing, be sure to "pre-mark" your site with the locations of potential borings and/or soil test pits, then call DigSafe at 811 to identify potential utility conflicts.

DigSafe notifies participating utility companies of your plans to dig. In turn, these utilities respond to mark out the location of their underground facilities. Pre-marking means to mark out the area on the ground where the work will take place using white stakes, paint or flags. Massachusetts state law requires that you give DigSafe at least 72 hours of notice prior to digging, not including weekends and legal holidays. **See www.digsafe.com for more information.**

This process is most critical for **infiltrating BMPs**[3] such as infiltration basins and bioretention cells, but is still recommended for other BMP types to avoid surprises. For example, soil testing for an extended dry detention basin may reveal that a shallow bedrock outcrop will impede excavation or that the seasonal high groundwater table is too high.

Soil testing should be performed at the location(s) of each proposed BMP and will include drilling borings or digging test pits. ***Note: Borings are most suitable for deep BMPs such as a large infiltration basin while test pits may be acceptable for shallower BMPs such as a raingarden.*** It is generally recommended that soil testing be performed, at minimum, at the soil layer where infiltration is proposed.

Once borings are complete and/or test pits are dug, a soils professional should evaluate the soils to verify the soil type, identify depth to seasonal high groundwater, and infiltration rate (if applicable). Sites with poorly drained soils (Groups C and D) may require an underdrain, soil amendments, or other engineering measures to make infiltration BMPs feasible. If soils are poorly drained, an *in-situ* permeability test may be performed to verify infiltration rates. Testing can be performed using a variety of methods such as a double ring infiltrometer or falling head permeameter. While simple to conduct,

[3] The Underground Injection Regulations (310 CMR 27.00) require the registration of certain infiltrating BMPs such as dry wells, infiltration trenches, subsurface structures, and leaching catch basins.

percolation tests are generally not considered reliable as they may overestimate potential infiltration rates. Finally, the Massachusetts Stormwater Handbook specifies that the bottom of any infiltrating BMP (including the media layer) should be located **at least two feet above the depth to seasonal high groundwater**. The depth of seasonal high groundwater can be evaluated based on visual observations of soil mottles, direct observation when groundwater levels are likely to be highest in April or May, or other means such as the Frimpter method. Refer to the Massachusetts Stormwater Handbook, Volume 3, Chapter 1 for detailed information on soil evaluations.

4.2.2 Site Survey

The next step of the design process is to perform a detailed site survey. It is recommended that a Professional Land Surveyor be engaged to perform the site survey. Before engaging a Professional Land Surveyor, be sure to "pre-mark" your site, then call DigSafe at 811 to identify potential utilities. Site survey can be performed concurrently with soil testing such that DigSafe will only need to come to the site once. See Section 4.2.1 for more information on DigSafe.

Potential BMP sites and the resulting survey requirements can vary widely. The goal of a site survey is to provide the designer with a detailed snapshot of the site that informs decisions such as delineation of drainage areas and drainage patterns, BMP sizing, and avoidance of critical features such as septic systems and drinking water wells. The following tables lists typical site survey features (as applicable).

Survey Feature Category	Example Survey Features
Boundaries	• Property boundaries • Road right-of-way • Wetland (*e.g., 100-ft, 200-ft River Area, 100-year floodplain*) • Local setback requirements • Wellhead protection zones
Elevation Information	• Topographic contours • Spot elevations of key features (*e.g., manhole rim, mean high water*)
Structures and Roads	• Buildings, Fences, Retaining Walls • Roads, Driveways and Walkways
Utilities	• Stormwater Drainage • Electrical • Water • Sewer • Gas • Telecommunications • Fiber optic
Hydrologic Features	• Wetland resource areas • Water features (*e.g., ponds, streams, ditches, swales*)
Vegetation	• Trees • Shrubs
Misc.	• Boring and test pit locations • Parks, trails, open space, etc.

An accurate topographic survey provides a critical basis of BMP design that can make or break the success of your BMP.

Very subtle differences in elevation can determine the flow path of stormwater. If survey information is inaccurate (in some cases even by less than an inch!) this could result in a design that has stormwater flowing around – instead of into – the BMP. The same is true during construction, when it is critical to confirm that the BMP is built precisely to the intended grades.

Dye test showing stormwater bypassing the intended flow path to a catch basin.

4.2.3 BMP Design Criteria and Sizing

Before initiating final design, be sure to check if your site is subject to any federal, state, or local regulations or design standards. For example, activities located within the 100-foot Wetland Resource Area buffer zone are subject to review under the Massachusetts Wetlands Protection Act (and any related local bylaws) and must be designed in accordance with the Massachusetts Stormwater Handbook. Also note that the Underground Injection Regulations (310 CMR 27.00) require the registration of certain infiltrating BMPs such as dry wells, infiltration trenches, subsurface structures, and leaching catch basins. Refer to Section 5 for more information on project permitting and regulatory considerations. Site specific regulations and design criteria can vary widely. Refer to the Massachusetts Stormwater Handbook for BMP-specific design criteria.

Final BMP Selection

Before initiating final BMP layout and sizing, it is important to review your conceptual design relative to soil testing and site survey results and make adjustments accordingly. For example:

- *Did testing reveal that soil types had slower infiltration rates than previously anticipated?* Consider design modifications or a different BMP based on updated site knowledge. Soil amendments or an underdrain system may also be considered ensure proper functionality.
- *Was the groundwater table higher than anticipated?* Consider alternate upgradient site locations or a shallower BMP design.
- *Did soil testing reveal a shallow bedrock outcropping that would impede infiltration?* Consider an alternative site location, alternative BMP type that doesn't rely on infiltration, or implementation of an underdrain system.

Pretreatment

All BMPs should be designed with a pretreatment facility at their inlet such as a deep sump catch basin or sediment forebay. Pretreatment provides energy dissipation and promotes sedimentation which minimizes clogging and performance issues of downgradient BMPs. Pretreatment facilities should be easily accessible and maintainable. For example, the bottom of a sediment forebay may be stabilized with concrete pavers or other means to facilitate the removal of sediment via vacuum truck or shovel.

BMP Sizing

BMPs are commonly sized in accordance with the Massachusetts Stormwater Standards to provide a balance between pollutant removal, groundwater recharge, and peak discharge reduction. The following is a description of some key technical terms used in the Standards with regard to BMP size:

- Water Quality Volume (WQv): WQv is the site's runoff volume requiring **treatment** and is calculated as the target runoff depth times contributing impervious area. The target runoff depth is established based on site-specific pollutant removal goals. See below discussion on estimation of pollutant removal rates.
- Recharge Volume (Rv): Rv is the site's runoff volume requiring **infiltration** and is calculated as the target runoff depth times contributing impervious area. According to the Massachusetts Stormwater Handbook, the following BMPs can be used for recharge: *Dry well, infiltration basin, infiltration trench, subsurface infiltration structures, leaching catch basin, exfiltrating bioretention area, and porous pavement*.
- Peak discharge: BMPs are typically designed such that post-installation **peak discharge** rates do not exceed pre-installation peak discharge rates for specified storm events. Sizing BMPs to control peak is best accomplished using hydrologic and hydraulic computer modeling software. Typical steps include: 1) delineate upstream catchment area(s) and assign input parameters; 2) build a representative hydraulic routing network (e.g., pipes, channels, BMPs) and assign input parameters; 3) run model simulations based on specified storm events; and 4) evaluate outputs. Refer to the Hydrology Handbook for Conservation Commissioners for detailed modeling methodologies to evaluate peak discharge. According to the Massachusetts Stormwater Handbook, the following BMPs can be used to reduce peak discharge: *vegetated filter strip, constructed stormwater wetlands, extended dry detention basin, gravel wetlands, retention basins, water quality swale, dry wells/infiltration trenches, infiltration basins, porous pavement, and cisterns.* Other BMP types such as bioretention areas are discouraged for peak discharge reduction as larger storms can wash away the media used to treat and remove pollutants.

An iterative sizing process that maximizes these three factors relative to site constraints generally results in well-rounded BMPs capable of meeting a variety of conditions.

Drawdown Timing

Infiltration BMPs must be sized to infiltrate their design Water Quality Volume and/or Recharge Volume within 72 hours. A persistent slow draining BMP may be ineffective at handling back-to-back storm events and can present safety concerns from standing water. *Refer to Volume 3, Chapter 1 of the Massachusetts Stormwater Handbook for recommendations on how to calculate drawdown timing.*

Designing for Climate Change Resiliency

As discussed in Section 4.1.6, Section 319 grant proposal designs that are developed to accommodate changing precipitation and groundwater elevations will be most competitive. The Massachusetts Stormwater Standards currently base evaluation of peak discharge on the NRCS TR55 method which relies on design storm depths and intensity distributions from a U.S. Weather Bureau Technical Paper (TP 40) which was published in 1961.

Design storm depths and intensity distributions have since been updated based on analysis of current precipitation data by the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14. For example, the median design storm depth for the 24 hour 100-year rainfall event in Middlesex County is 7.9 inches for NOAA Atlas 14 vs. 6.5 inches for TP 40. NOAA Atlas 14 design storm depths are presented as a range based on a 90 percent confidence interval. One simple method to approximate potential impacts of future climate change is to use the upper 90th percent confidence interval of the estimated range. The resulting 100-year 24-hour depth for Middlesex County would be a 10.8-inch storm. This design storm depth can be applied to a dimensionless distribution to represent intensity as published by the Natural Resources Conservation Services (NRCS) National Engineering Field Handbook.

To maximize climate change resiliency, BMPs should be designed to reduce peak discharge from the 100-year 24-hour NOAA Atlas 14 upper 90th percentile confidence interval event as feasible.

Outflow Configuration

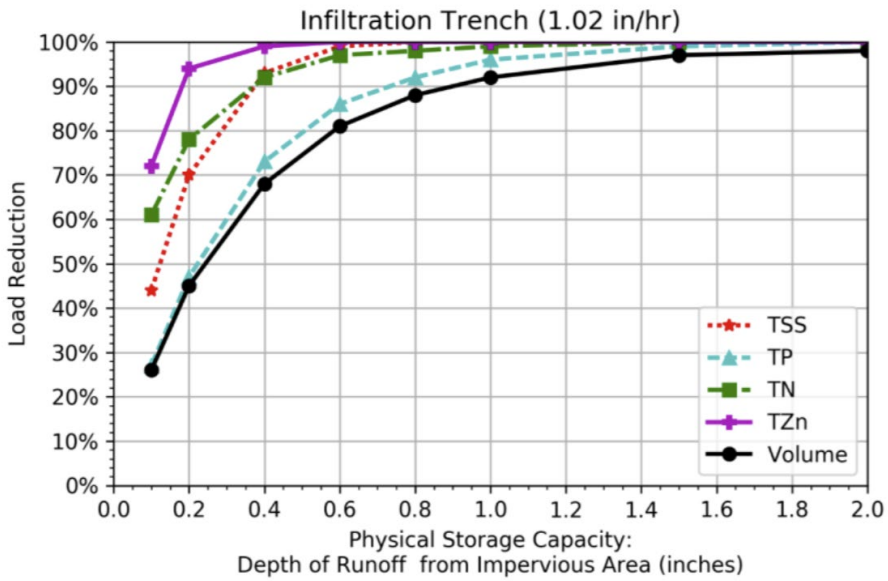
BMP outflows must be carefully configured to meet sizing and drawdown requirements. BMPs are typically designed as "online" or "offline" facilities. An online facility is designed to receive, treat, and infiltrate runoff from the entire contributing watershed. Online facilities are commonly configured with a multi-functional outlet control structure. For example, an infiltration basin may be configured with a riser-style outlet control structure with multiple discharge points. Low level orifices are installed just above the target WQv or Rv to enable drawdown within 72 hours, while a higher level overflow weir (or grate) is included for peak control of larger storms. Conversely, an offline facility is designed to receive only a portion of the runoff from the contributing watershed such as the target WQv or Rv. The remaining runoff bypasses the BMP via a diversion structure such as flow splitter. Bypassed runoff typically discharges to a downstream facility for peak control such as an extended detention basin.

Finally, the outlet of a BMP must be designed with proper energy dissipation measures to avoid downstream impacts such as erosion or scour. Energy dissipation measures may include a stabilized outlet with riprap apron, a level spreader to encourage sheet flow, check dams, or a combination of these measures.

Estimating Pollutant Load Reductions

The goal of any BMP designed under the Section 319 program should be to select and size BMPs that maximize the removal of target pollutant(s), as feasible, based on site limitations and cost constraints. Pollutant load reductions from BMPs can be estimated by updating the BMP Selector Tool as described in Section 4.1.2 or other methods as described in Section 4.1.3. One simple approach is to use the EPA Region 1 Nomographs (*see pages 41-75 of link*), which were developed for the 2016 Small Municipal Separate Storm Sewer System (MS4) Permit.

The EPA Region 1 nomographs provide tables of pollutant export rates by land use types and performance curves (see example below) with estimated BMP pollutant efficiencies based on treated impervious surface runoff depth. The nomographs use the same export rates and removal efficiency values that are built into the WBP BMP Selector Tool.



As shown in this example performance curve for an infiltration trench, the EPA nomographs estimate BMP performance for multiple pollutants based on the BMP's design WQv. Pollutant removal performance is different for each of the four pollutants shown. As the performance curves indicate, there is a point at which increasing BMP storage will begin to yield diminishing returns for pollutant load reduction. ***The goal for 319 grant projects should be to select and size BMPs to yield the maximum reduction in the target pollutant per dollar spent.***

Keep in mind that BMPs will typically reduce pollutant loads for multiple pollutants. Your BMP should be selected to **target reduction in the primary pollutant of concern,** especially if the receiving water has a TMDL which sets a water quality target for that pollutant.

Miscellaneous Design Considerations

- ***Safety***: BMPs are often located in public places or near roads and can have standing water, particularly if they get clogged. Consider implementation of fencing, outlet grates, shallower depth, grading to avoid steep slopes, or other methods to reduce risk.
- ***Aesthetics***: BMPs are often located in prominent public areas such as community boat launches and public parks. Consider implementing features to promote aesthetics and public reception such as educational signage and appealing vegetation.
- ***Maintenance***: Routine maintenance and financial resources to maintain the BMP over its lifespan are critical for long-term BMP effectiveness. The design process should include an ongoing dialogue with the end-user who will be responsible for maintenance to ensure that expected maintenance efforts are compatible with their available resources (e.g., required equipment) and expertise. The BMP should also be designed with ease of access in mind. For example, if heavy equipment will be required to remove accumulated sediment, ensure that adequate and easy access is included in the design.

Section 319 grants require an **Operation and Maintenance (O&M) Plan** for each structural BMP. The O&M Plan should be developed in accordance with Standard 9 of the Massachusetts Stormwater Handbook. The O&M Plan must be effective and implemented for the life of the BMP.

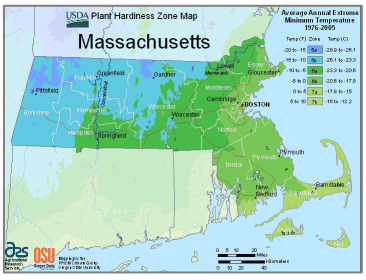
For more information on O&M for stormwater BMPs, see the **Coastal Pollutant Remediation Program Stormwater BMP Operation, Maintenance, and Performance Evaluation** . This report provides a summary of findings from field inspections of grant-funded stormwater BMPs, and includes recommendations for improving maintenance, construction, and design.

- ***Cold climate considerations***: BMP sites in Massachusetts are subject to harsh winter conditions that can negatively impact BMP performance, and should be designed for a cold climate. Some tips include:

  - Designate a space for on-site snow storage away from the BMP.
  - Install critical components below the frost line.
  - Specify native vegetation that is appropriate for the regional climate.
  - Consider the effects of winter management activities such as plowing, snow storage, and the application of sand, salt, and other de-icing products.
- ***Coastal site considerations:*** See the Report on Climate Change Impacts to Coastal Stormwater Treatment Systems, prepared by the Massachusetts Office of Coastal Zone Management (CZM), in partnership with MassDEP.

4.2.4 *Planting Guidance*

For BMPs that include plantings (e.g., raingardens, bioretention, buffer zones, etc.), it is important to select species that are well-suited to the expected hydrology of the site. For example, species planted in center of a rain garden should be able to withstand periodic inundation, while those planted on the upper margins of a rain garden should be drought-tolerant. Other general planting considerations include:



- To **select native species** that are appropriate for the regional climate, check the USDA Plant Hardiness Zone Map to see what planting zone you are in. The hardiness zones in Massachusetts range from 5a in the Berkshire mountains to 7a on Cape Cod. Non-native species should not be used.
- Consider using a **mix of species** with varied height, texture, and color to add visual interest.
- What is the desired **plant size at maturity**? Although some shrub and small tree species can be easily pruned to maintain a desired size, consider how frequently such maintenance will be performed, or if there are other aesthetic considerations (such as maintaining views).
- **Wildlife considerations**: In addition to their BMP function, plantings can benefit wildlife by providing food sources and habitat. However, it is also important to select species that will not be destroyed by wildlife and require replacement. For example, if deer are common in your area, select deer-resistant species. For shoreline plantings in areas where beavers are present, avoid woody species that are preferred by beavers, such as birch, aspen, alder, and willows.
- To help **ensure plant survival**, water immediately after planting, and then water weekly (if there is no significant rainfall) or as needed based on weather conditions during the first growing season. More frequent watering may be needed during hot weather.
- For sites where a **low level of maintenance** for plantings is desired and/or practical, consider a planting plan using grasses and other native herbaceous plants which require relatively infrequent mowing. This approach is less expensive and can often provide similar water quality performance as more elaborate planting plans.

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Links to resources with planting lists and other guidance on plantings are provided below:

Rain Gardens: A Way to Improve Water Quality (UMass Extension)
Massachusetts Vegetated Buffer Manual (Berkshire Regional Planning Commission)
Native Plants for New England Rain Gardens (New Hampshire Soak Up the Rain Program)
What is Green Infrastructure? (USEPA)
StormSmart Coasts - Coastal Landscaping in Massachusetts (MA CZM)

4.2.5 Site Plans, Details, and Specifications

Once BMPs are sized, it is time to put the design to paper. The level of detail provided by site plans, details, and specifications will be highly dependent on the overall design complexity. For example, if the design will be publicly bid, detailed specifications and construction documents need to be prepared. Conversely, if the design is to be constructed by the local Department of Public Works, detailed design plans with applicable technical specifications may be sufficient.

Regardless of who will be performing construction, the site plans and specifications must be easily interpretable to avoid confusion. **Don't re-invent the wheel!** Use standard details and designs which have already been successfully implemented, then modify them for your site-specific design.

- Standard details can be obtained from BMP design manuals such as the Massachusetts Stormwater Handbook.
- For examples of designs for construction-phase erosion and sediment control, see the Massachusetts Runoff, Erosion & Sediment Control Field Guide, a publication of the Massachusetts Association of Conservation Commissions.
- For agricultural BMPs, the USDA-NRCS offers engineered BMP designs that meet both their goals and the goals of the MassDEP Nonpoint Source Program.
- Many manufacturers of proprietary devices such as tree box filters (a type a biofiltration BMP) provide standard details and specifications.
- Professional engineers with past experience designing BMPs will typically maintain an in-house library of specifications and details.

A typical plan set will include some variation of the following design sheets:

- Cover page
- Existing conditions
- Proposed conditions
- Erosion and Sedimentation Control Details
- Design and planting details

One often overlooked portion of the design process is development of effective Erosion and Sediment Control (ESC) measures to minimize the potential for off-site discharge of sediment during construction. A Construction Period Pollution Prevention and Erosion and Sedimentation Plan is required for sites that subject to the Massachusetts Stormwater Standards. Disturbance of more than one acre of land will require authorization under the 2017 Construction General Permit and Stormwater Pollution Prevention Plan (SWPPP). Refer to EPA's guide to Developing Your Stormwater Pollution Prevention Plan for tips and tricks to develop an effective SWPPP and ESC measures.

4.2.6 Final Capital Cost Estimates

Regardless of whether the project is going out to bid, it is important to update the capital cost estimate once the engineering design plans and specifications are complete. The updated cost estimate is more detailed and includes changes made during the final design process based on sizing, soil evaluations, and other site considerations. The engineer will typically prepare the final capital cost estimate based on an

internal library of past project data, publicly available data such as the Massachusetts Department of Transportation's weighted bid price database, and best professional judgement. The final cost estimate should be clear and easy to follow and should include line by line estimates of key construction items (e.g., excavation, drainage catch basins, outlet control structure, erosion and sediment controls etc.). Each item should include a **description, quantity, unit of measure, unit price, and cost estimate**.

If unforeseen circumstances are encountered during the design process, such as a high groundwater table, the engineer should revise the design so that the project is constructable within the grant budget.

Section 5

Permitting

Once your BMPs are designed, it may be necessary to obtain a **permit or other regulatory authorization** before starting construction. This section provides information about the permits most often required for 319 grant projects, permitting considerations, and how to avoid common permitting pitfalls for your project.

5.1 Common Permits for Section 319 Grant Projects

Depending on the desired location of your BMP, certain restrictions, such as a specific setback requirement from a waterbody or wetland may apply. Below is a guide to some of the permits most often required for 319 grant projects. Where available, links are provided to more information, permit forms and guidance, and other information. It is highly recommended that you reach out to relevant permitting authorities with your project ideas to determine any potential obstacles to permitting. 319 grant proposals which have considered this prior to proposal submittal and have a plan to ensure successful permitting will have a more competitive proposal.

Regulatory Program	Description	Details and Links
Massachusetts Wetlands Protection Act (WPA)	WPA permitting is required for projects that involve activities within inland and coastal wetland resource areas, within the 100-foot buffer zone to wetlands, and within the Riverfront Area to perennial rivers (typically 200-feet, but less in some cases). The municipal Conservation Commission administers the WPA.	File a Request for Determination of Applicability or Notice of Intent with the Conservation Commission Regulations Fees: See activity categories and fees listed in the WPA Form 3 Instructions Timeline: Town-specific
Local Wetland Bylaws	Over 200 Massachusetts municipalities have local zoning or non-zoning wetland bylaws or ordinances that are stricter than the state WPA. Permits for work in or near wetlands jurisdictional to state and local wetland regulations are usually processed together by the local Conservation Commission.	Check your Town's website or contact Town staff to determine if there is a local wetland bylaw or ordinance.
Chapter 91: The Public Waterfront Act	Massachusetts General Law, Chapter 91 authorization is required for structures in tidelands, rivers and streams, and Great Ponds. Structures include anything that may alter the flow and reach of a stream including: culverts, piers, wharves, floats, retaining walls, revetments, pilings, bridges, dams and some waterfront buildings. You may need a new license if proposing a change to a previously licensed structure.	File a Request for Determination of Applicability to determine if your project is in Chapter 91 jurisdiction or requires a Waterways License. If required, License forms are here. Regulations Permitting Guidance Fees

Regulatory Program	Description	Details and Links
Section 404 of the Federal Clean Water Act (CWA)	Section 404 of the CWA authorizes the U.S. Army Corp of Engineers (USACE) to regulate the discharge of dredged or fill material into waters of the U.S. (includes navigable waters and jurisdictional wetlands). Permitting categories include activities eligible for authorization under the General Permits (GPs) for Massachusetts, including activities eligible for self-verification (SV) or preconstruction notification (PCN). In some cases, an Individual Permit (IP) is required.	To determine if your project requires USACE authorization, see Section II of the GPs for Massachusetts. See Sections III and IV to determine the permit category and requirements. USACE New England District website, including GPs for Massachusetts, Self-Verification Form, etc. Regulations Permitting Guidance
Massachusetts Environmental Policy Act (MEPA)	The MEPA regulations establish review thresholds for projects that are of a nature, size, or location likely to cause damage to the environment. Details on MEPA review thresholds are in section 11.03 of the MEPA Regulations.	Based on review thresholds, filing an Environmental Notification Form (ENF) and Environmental Impact Report (EIR) with MEPA may be required. Regulations Fees Timeline
401 Water Quality Certification (WQC)	401 WQC is required for projects involving dredging, filling, or excavation in wetlands and waterbodies in Massachusetts.	File a WQC form for dredging, filling, or for excavation Regulations Fees Timeline
Underground Injection Control Regulations	The Underground Injection Control (UIC) regulations (310 CMR 27.00) protect ground water quality by regulating the disposal of fluids into the subsurface. Most UIC wells or injection wells are simple devices that allow fluids into the shallow subsurface under the force of gravity, including BMPs such as dry wells, infiltration trenches, subsurface structures, and leaching catch basins. MassDEP administers these state regulations, which includes registration of applicable infiltrating structures.	Regulations MassDEP Contact: ask.UIC@mass.gov
*For a more **comprehensive guide to permits**, see **Environmental Permitting in Coastal Massachusetts**, prepared by the Massachusetts Office of Coastal Zone Management.*		

Consider using **in-house staff** or **staff of project partners** to apply for permits for 319 grant projects. Many of these permits are required for municipal projects and the process may be familiar to some in-house staff. ***The time spent preparing permit applications may be counted as project in-kind match!***

5.2 Common Permitting Pitfalls and Other Considerations

- **Allow adequate time for approval**: The permitting process can take more time than you may expect. Permitting may include multiple public hearings over several months or require additional technical reviews. In some cases, the entire process from permit submittal to approval can take over six months. Be sure to check the expected timeline of the permit and discuss the project in advance with the permitting authority to allow adequate time for review and approval.

- **Property owner permission:** Permit forms often require property owner signatures to document that permission has been granted for all properties where an activity (such as construction) will take place. It is a good idea to get property owner permission at the beginning of the project planning phase, and get any required signatures well before your targeted permit submittal date.

- **Rare species screening:** Don't forget to check if your project is in an area requiring Massachusetts Endangered Species Act (MESA) review for potential impacts to rare species and their habitat. The MassGIS Online Mapping Tool provides an interactive map that can be used to view rare species habitats delineated by the Massachusetts Natural Heritage and Endangered Species Program (NHESP). For more information and permit forms, see the MESA website.

- **Historic and Cultural Resources:** Many historic properties and sites with archeological/cultural resources in Massachusetts are on or are eligible for listing on the National Register of Historic Places. The Massachusetts Cultural Resource Information System allows you to search the Massachusetts Historical Commission (MHC) database for information on historic properties and areas. Any project on a historic property or within a historic district requires filing a Project Notification Form with the MHC. More information can be found on the MHC website.

  Underwater resources are protected by the Board of Underwater Archaeological Resources (BUAR). Underwater archaeological resources may include shipwrecks, Native American sites, wharves, and aircraft. BUAR issues permits for reconnaissance, excavation, and special use of underwater archaeological resources. More information can be on the BUAR website.

- **Ecological Restoration Limited Projects**: Some WPA permitting projects qualify as an Ecological Restoration Limited Project (see eligibility requirements in WPA Form 3, Appendix A). If submitting a Notice of Intent for this type of project, you must first provide public notice of the project in the Massachusetts Environmental Policy Act (MEPA) / *Environmental Monitor*. Make sure that this step in included in your permitting schedule and note that Public Notices must be

received by 5 p.m. on either the 15th or last day of each month for publication in the next issue of the *Environmental Monitor.* If the 15th or last day falls on a weekend or holiday, the deadline is extended to the next business day.

- **Fisheries**: If a project has the potential to impact commercial or sport fisheries, MassDEP will contact the Division of Marine Fisheries (DMF) as part of its 401 Water Quality Certification review. DMF may recommend time-of-year restrictions to protect spawning fish or will recommend mitigation for damage to shellfish beds. DMF's recommendations are incorporated into the 401 WQC as conditions.

- **Areas of Critical Environmental Concern (ACECs) Projects:** Determine if your project area is located in an ACEC. The ACEC Program is intended to preserve, restore, and enhance environmental resources and resource areas of statewide significance. Additional reviews are required for a project proposed in an ACEC including additional MEPA, Chapter 91: Waterways, and WPA reviews.

Section 6

Time to Build!

After all of your work, it's finally **time to build!** This process can be confusing and unfamiliar to many grant recipients. This section provides a guide to the construction process for most 319 grant projects, including hiring a contractor, construction oversight, and project completion.

6.1 Hiring a Contractor

Although some 319 grant projects may be implemented by homeowners or other watershed stakeholders, **many projects will require technical expertise and specialized equipment** and may require outside help. Contractors can be very familiar with both the construction of BMPs as well as the entire installation process and can provide valuable assistance to grantees.

6.1.1 Bidding and Procurement Timeline

Hiring a contractor can be time consuming! You will need to include the process in your overall project schedule. In general, you can expect the entire process to take about **two to four months**. More detailed information about procurement process is outlined in the sections below. This process generally includes:

- **Develop the bid solicitation document**: A bid document must be prepared to solicit contractors to provide proposals to complete the work. This process can take up to a month to complete.
- **Release the solicitation document**: Generally, contractors are given about a month to prepare proposals. This time should also include a window of time to allow contractors to submit questions about the solicitation document and to send the solicitation to potential Disadvantaged Business Enterprise (DBE) project partners.
- **Review proposals**: Depending on the size and availability of the review team, this process can take anywhere from a week to two weeks.
- **Negotiate contract**: This process often requires some back-and-forth negotiation between the chosen contractor and the grantee. If needed, this may include a request for the chosen contractor to include DBEs as project partners. Expect one to two months to complete this task.

6.1.2 Contractor Selection Process

Step 1: Issue a Bid Solicitation

A first step in selecting a contractor is to issue a bid solicitation for the project work.

> ***Note: Municipalities have their own structured procurement rules. Municipal grantees should follow those rules in addition to the general guidance related to 319 projects discussed below.***

Depending on the cost of the project, you may be required to solicit bids from multiple contractors. You can determine the type of procurement required for your project based on Massachusetts's public procurement procedures. The solicitation may be issued as **a Request for Qualifications (RFQ)** or **Request for Proposals (RFP)** prepared by the grantee, and should be sent to certified DBEs to encourage bids. The solicitation generally includes:

1. A **scope of work** describing the tasks and deliverables to be completed by the contractor.
2. The **selection procedure**, including requirements for submission, criteria for evaluation, and the timeline for selecting a contractor. Submittals will generally include a technical proposal, a statement of qualifications, a list of references, resumes for project team members, and a proposed project schedule.
3. **Specific dates** for submittal of questions and the proposal package.

What's the difference between an RFQ and an RFP?

- RFQs focus on an applicant's qualifications to complete the job – such as recent experience with similar projects, project staff, and client references. RFQ's typically do not include a price proposal. **Issuing an RFQ can ensure that you hire the most qualified applicant, as cost is not included in the decision.** After selecting the most qualified applicant, you will then need to negotiate a price for the project.
- RFPs usually require the applicant to include qualification information, but also include a price proposal as an important part of the selection criteria. **Issuing an RFP will often save you the step of negotiating price, but should be written carefully to prevent selection of a less qualified contractor with a low price.**

Other important considerations when soliciting contractors include:

- **Disadvantaged Business Enterprise (DBE) Requirements:** 319 grantees are required to make good faith efforts to assure that DBEs are used when possible. Disadvantaged minority and women's business enterprises (MBE/WBE) should be given equal opportunities to participate as suppliers, contractors or subcontractors. This process of soliciting and encouraging DBE project participation should be included at the beginning of the contractor selection process and not as an afterthought. MassDEP has specific "fair share" goals for its programs to ensure that DBE firms are solicited and evaluated fairly. "Fair Share" utilization goals are currently **4.2% (MBE) and 4.5% (WBE)** of the total project dollars (the 319 grant amount plus the 40% non-federal matching funds). DBE/MBE/WBE certification is a federal designation and firms can be identified using the Directory of Certified Businesses database.

  In some cases, it is not possible to find a DBE firm to participate in the project as some work is specialized and no available or competitive DBE firm can be identified. In these cases, **waivers to the DBE requirements** may be requested from MassDEP. Waiver requests must include a detailed record of the effort made to contact, solicit, and negotiate with DBE firms.

- **Liability**: Ensure the contractor is adequately covered in case of injury or other issues that may come up during construction. The contractor should provide a certificate of liability insurance.

- **Property Access Agreements**: The location of your project may require property access agreements to be developed. These types of agreements are often required if the project is located on **private property** (e.g., residential or commercial property) and must be in place before work at the project site begins.

Step 2: Review Proposals

Once proposals have been received, grantees will review the proposals and select a contractor that **most closely satisfies the needs of the project**. The review team will rank the proposals based on the contractor's qualifications. 319 grant projects require contractors with experience specific to the project to ensure the project runs smoothly. Criteria for selecting a contractor typically includes:

- ✓ **General experience** with 319 implementation projects.
- ✓ Experience with BMP construction, including **specific experience with the proposed project type** (e.g., roadway design or small-scale homeowner BMP design).
- ✓ Knowledge of **local, state, and federal permits** and authorizations that are required for the specific project type.
- ✓ Demonstration of **successful cooperation** with local, State, and Federal agencies, project stakeholder, and the public.

STEP 3: Select Contractor

Once ranking of the proposals is complete and a top firm is selected, the highest-ranked applicant is contacted by the grantee and a **contract can be negotiated**, including efforts include DBEs on the project. Depending on the type of solicitation, a detailed budget may then need to be developed for each task by the contractor. If the cost negotiation is unsuccessful, the grantee may contact the next highest-ranked applicant to begin the negotiation process.

Occasionally, contractor costs may be higher than anticipated. This is a common problem when selecting contractors and can be addressed during contract negotiations. In some cases, funds may be **allocated from other tasks**. In cases where that cannot occur, considerations such as the timing of the project or the release date of the solicitation could be shifted to avoid high materials costs or peak seasonal demand for contractors (e.g., avoid issuing a bid solicitation in the fall when contractors are often busiest).

6.2 Construction Process

Once you've hired a contractor, it is finally…**time to build!** It is important to understand each step of the construction process to ensure your project is moving forward efficiently and that construction is completed as designed.

6.2.1 Preconstruction Meeting

Holding a meeting before construction begins will ensure that all stakeholders are on the same page and that the contractor understands the project design, schedule, and permit requirements. This meeting should include the contractor, the design engineer (when possible), representatives from the Town, and other relevant stakeholders. Depending on permit requirements, the local Conservation Commission or other permitting authority may need to be notified and invited to this meeting. Tasks to accomplish at the preconstruction meeting should include:

- **Introduce** all stakeholders.
- Review the **project design.** *(Note: The project design must be approved by MassDEP prior to construction.)*
- Review any relevant **permit conditions**.
- Determine process for approval of any **change orders** requested by the contractor.
- Review the **project schedule**.
- Outline **construction oversight** requirements.
- Review **project completion** requirements.

6.2.2 Construction Oversight

Once construction has begun, it is a good idea to conduct **routine inspections and oversight** at the project site. Construction oversight is conducted by engineers or other professionals familiar with the specific type of project to ensure that the project is being **constructed as designed** and in **compliance with permits**. Many elements of 319-project construction are specialized and benefit from routine inspections of critical elements of the project. Construction oversight professionals can also approve change orders when requested by the contractor.

6.2.3 Project Completion

Upon completion of construction, it is important to review the work to ensure it was completed correctly and that all necessary documentation has been completed. Project completion steps include the following:

- **Site walk**: A site walk should be held with all relevant stakeholders, including the project engineer, contractor, town representatives, and others. This walk through of the project site will allow for any problems to be identified and documented.

- **Development of a punch list**: From the site walk, a "punch list" of necessary fixes can be developed. The items on this list are expected to be addressed by the contactor before the project can be considered complete.
- **Final site inspection**: Once the punch list has been addressed, a final site inspection should be conducted.
- **Removal of erosion controls**: Once the project is considered complete and the site has achieved final stabilization (e.g., with established vegetation), the contractor can remove any remaining erosion controls that were in place during construction.
- **Construction Documentation:** The contractor's job is considered complete once they have submitted to following documentation:
    - **Written Certification:** BMPs constructed with 319 funds require written certification that the system has been installed in conformance with the engineering plans and design specifications. This certification can be prepared by the professional conducting oversight as a project deliverable. The certification must occur in advance of release of payment for the system. *It is necessary to conduct this certification **prior to the system being covered**, buried, or otherwise made inaccessible, and shall occur in advance of release of payment for the system.*

    - **As-Built Plans**: For some projects, contractors may need to submit full-scale "as-built" plans, certified by a Professional Engineer, for any stormwater BMPs or other structures built during construction. These plans provide detailed information on BMPs installed during the project to reflect "as-built" conditions and document that the work has been completed in accordance with the project design. As-built plans include details about grading, elevations, location of stormwater structures, utilities, etc. As-built plans are often a requirement of some environmental permits (e.g., MA Wetlands Protection Act permits). As-built plans may also be required for your 319 project if the constructed BMP is different than what submitted and approved for grant funding. Contact MassDEP 319 Program staff to determine if as-built plans are required for your project.
    - **Operations and Maintenance Plan:** A MassDEP-approved, long-term Operations and Maintenance Plan is required to ensure that the BMP functions properly long after construction has ended. These plans include important information on BMP specifics, including detailed location information (e.g., coordinates in longitude/latitude), a map of the BMP, information about maintaining the BMP, maintenance frequency, responsible parties for maintenance, equipment required, and the source of funding for maintenance. In some cases, training of municipal employees may be required for long-term maintenance of the BMP. This type of training should be outlined in the plan.

Construction and Contracting Do's and Don'ts	
DO	**DON'T**
DO - Select an engineer/contractor that is qualified and experienced.	**DON'T - Rely on low bidders who lack experience!**
DO - Coordinate early with permitting authorities and allow enough time to obtain approvals.	**DON'T - Expect quick and easy permitting approvals requiring no prior coordination.**
Do - Base payment on performance and retain some funds (e.g., 10%) until project completion.	**DON'T - Expect the contractor to get it 100% right the first time.**
DO - Require phased construction (including staging areas) appropriately to protect the infiltration capacity of soils.	**DON'T - Allow soil compaction and disturbance where it can be avoided.**
DO - Protect the natural environment, including minimization of tree clearing and soil disturbance.	**DON'T - Clear land and cut trees simply out of convenience.**
DO - Require testing and product submittals. For some projects, testing is the best way to ensure that product specifications have been met. Examples include (1) soil testing to confirm adequate organic content for establishment of plantings and (2) sieve analysis to ensure proper grain size/gradation for drainage, geotechnical stability, etc.	**DON'T - Rely solely on specifications or contract documents.**
DO - Be flexible…things change!	**DON'T - Stick to a design that won't work based on new information about site conditions.**
DO - Have inspections DURING and post-construction. Use design professionals with plenty of construction experience.	**DON'T - Rely solely on the post-construction inspections. Important design elements are often underground and should be inspected before covered.**
DO - Require a warranty/assurance…check and test your installations and make adjustments.	**DON'T - Accept a system that won't work.**
DO - Have a maintenance plan and a viable way of implementing it.	**DON'T - Expect it to be maintained because it reads that way in the plans.**

Section 7

Public Information and Education

Public information and education (I/E) is an important part of all 319 grant projects. Because many water quality problems result from individual actions and the solutions are often voluntary practices, an effective I/E program will promote adoption of management practices and encourage changes in behavior that help achieve water quality goals. 319 projects may focus primarily on I/E to reduce pollution sources, but more often include I/E as a required component of a larger implementation project.

To develop an effective I/E program, consider the steps listed below.

Step 1: Identify I/E Goals

Identify the I/E goals for your project. It's important to make your objectives, schedule, and intended results as specific as possible.

Example I/E goals:

- Promote reduced use of lawn fertilizers and chemicals.
- Provide information to watershed residents about stormwater improvements constructed with 319 funding and their water quality benefits.
- Promote improved septic system maintenance.
- Build support for zoning and regulatory tools to protect water resources, such as watershed protection bylaws.
- Improve understanding of proper disposal of pet waste and household hazardous waste.

Step 2: Identify Target Audience

Identify the audiences you need to reach with your message to meet your I/E goals.

Example target audiences:

- All watershed residents/businesses
- Watershed homeowners with septic systems
- Waterfront property owners
- Boaters/fishermen (e.g., invasive species awareness)
- Agricultural land owners (e.g., commercial farms, non-commercial hobby farms)
- K-12 education
- Special interest groups (sportsmen clubs, garden clubs, etc.)
- Watershed associations, other nonprofit organizations
- Municipalities

Step 3: Outreach Products and Distribution

After selecting your target audience, consider the types of outreach products that will engage them and help achieve your I/E goals. ***Don't reinvent the wheel!*** As listed below, there is a wide variety of copyright-free I/E materials which can be used or adapted to meet your project's needs.

Example Sources for Nonpoint Source Information/Education Materials

The USEPA's "***Nonpoint Source Outreach Toolbox***" www.epa.gov/nps/toolbox/ provides over 700 outreach materials that you can use or adapt to develop an I/E campaign for your watershed. The Toolbox focuses on **7 nonpoint source pollution topics**:

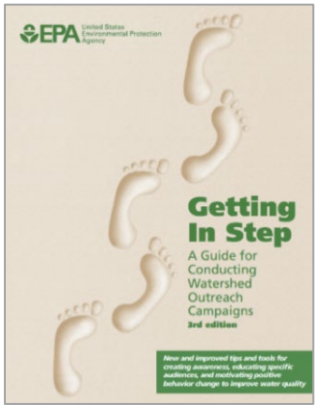
- general stormwater and stormdrain awareness
- household chemicals and waste
- lawn and garden care (includes Low Impact Development practices)
- septic system care
- pet care
- motor vehicle care
- other resource collections

Outreach products in the Toolbox include print ads, public service announcements, and materials for signs, kiosks, posters, brochures, fact sheets, and giveaways to raise awareness and promote non-polluting behaviors. Permission-to-use information is included, which makes it easy to tailor these products to your project. Evaluations of several outreach campaigns also offer real-world examples of what works best in terms of messages, communication styles, and formats.

Other helpful resources include:

- MassDEP's Clean Water Toolkit
- MassDEP's Stormwater Outreach Materials to Help Towns Comply with the MS4 Permit
- USEPA's Soak Up the Rain materials
- USEPA's Green Infrastructure Collaborative

Distribution



Distribution of your I/E message can include social media posting, direct mail, door-to-door canvassing, local newspaper stories, public events, signage, etc. Consider reaching a broader audience by using multiple distribution approaches for an outreach product. For example, an educational brochure could be distributed in hard copy by mail, door hangers, provided in electronic format on a website, and converted to poster format for viewing in a public space. **See USEPA's Getting in Step Outreach Series and database of example media campaigns.**

Step 4: Evaluate I/E Program

Develop a simple method to document and evaluate your I/E program. Building an evaluation component into the plan from the beginning will ensure that feedback on I/E program effectiveness is generated. The strongest I/E programs will measure engagement and changes in behavior.

Example evaluation methods include:

- Number of unique views of project-specific information on a website or social media site
- Number of shares and comments on project-specific social media pages
- Number of surveys distributed and returned
- Percentage of watershed properties that were directly contacted (e.g., distribution of door hangers with project information)
- Attendance at public presentations/workshops (plus views of recorded presentations via YouTube, etc.)

Other I/E Considerations

Building and Maintaining Structural BMPs as an Educational Tool

When stormwater improvement BMPs are built in publicly accessible locations such as parks, schools, and municipal properties (e.g., town hall), they can often serve to **both improve water quality and help promote public education**. If your proposed BMPs are in a highly visible location, consider how to best use the location for educational purposes. Examples include:

- Integration of BMPs on or near school grounds with **K-12 education**, including school programs which teach the fundamentals of NPS pollution, how BMPs protect water quality, and how these and similar techniques (e.g., rain gardens) can be used on residential properties. For more information, see the EPA's Storm Smart Schools.

- **Adopt-a-Raingarden** programs engage citizens to assist with long-term raingarden maintenance. Typical volunteer activities include visiting the raingarden several times per year for pruning and weeding, replacement of plantings as needed, and removal of accumulated sediment at the inlet. For more information and example materials, see the Adopt-a-Raingarden information from the Washington Conservation District in Minnesota.

Opportunities for I/E Partnerships

319 projects can be a great opportunity for partnerships with other organizations, especially when it comes to public outreach and education. Partnerships can help extend the reach of your I/E efforts to different audiences, provide staff resources to implement your program, and in some cases can provide a source of local **in-kind matching funds** for your project (*see Section 1.3 for more on in-kind match*). Potential partnering opportunities include:

- **Non-Governmental Organizations (NGOs):** Local NGOs such as river and lake watershed associations may have water quality protection and I/E goals that are compatible with 319 grant projects. In addition to potential volunteer labor, these organizations may be able to support your I/E program through links on their website, outreach opportunities at group meetings, and access to targeted mail/email lists of members. Depending on your project type, you should also consider reaching out to special interest groups such as sportsmen clubs, garden clubs, etc.
- **Schools:** As discussed above, K-12 schools can offer opportunities to incorporate 319 project-related education into their curriculum. Some stormwater BMPs on school grounds may also be good candidates for an educational kiosk or signage which explains how the BMP works to protect water quality.
- **Businesses:** Local businesses may be willing to partner funds or labor for the construction and maintenance of BMPs. Signage in visible areas can be used to both promote public awareness of the 319 project and to "advertise" the contribution of business project partners.
- **Municipalities:** Municipal governments can help to promote your I/E message though distribution of educational materials at Town Hall, links on the municipal website or social media pages, broadcasting recorded meetings on local access cable (and associated YouTube stations), etc.

Section 8

Project Evaluation

Each 319 grant application is required to describe **how the project's progress and accomplishments will be evaluated**.

One size does not fit all when it comes to project evaluation! *It is important to choose an evaluation method that fits your project.*

8.1 Project Schedule and Milestones

Schedule: Present a schedule for implementing your 319 grant project. Your schedule can be organized into the activity categories listed below.

- **Structural BMPs**, including all BMPs that will be installed or constructed to control pollution
- **Nonstructural BMPs**, including procedures such modified landscaping practices, land conservation, regulatory tools, and other measures discussed in Section 4.1.4
- **Information and Education (I/E) -** provide a schedule for the I/E activities discussed in Section 7
- **Monitoring -** if proposed (not required), provide a schedule for monitoring activities

Interim Milestones: Present interim milestones for implementation each project activity. For example, most construction projects could include interim milestones such as completion of final design plans, submittal of permit applications, construction start date, and construction completion.

The Massachusetts Watershed-Based Plans tool includes a **Schedule and Milestones Tool** (*see Elements F/G*) which allows you to build a table showing project activities and related milestones. An example schedule/milestone table from this tool is shown below.

Example Schedule/Milestones Table (adapted from Elements F/G of MA Watershed-Based Plans tool)

Structural BMPs (devices installed or constructed on a site)						
Bioretention cell – Park Street	Complete design plans	Submit permit applications	Permit approvals	Select contractor	Start construction	Complete construction
	3/1/2022	4/1/2022	5/1/2022	6/1/2022	7/1/2022	9/1/2022
Tree box filters – Main Street	Complete design plans	Submit permit applications	Permit approvals	Select contractor	Start construction	Complete construction
	3/1/2022	4/1/2022	5/1/2022	6/1/2022	7/1/2022	9/1/2022
Non-structural BMPs (e.g., modified landscaping practices, land conservation, regulatory tools, etc.)						
Street Sweeping of River Rd., Main St., and Green St.	Begin street sweeping program (2x per month)	End street sweeping program				
	4/1/2022	N/A - continuous				
Fertilizer Reduction Ordinance	Draft ordinance	Final ordinance	Introduce ordinance at City Meeting	Public hearing on ordinance	City Council vote on ordinance	
	5/1/2022	7/1/2022	9/1/2022	10/15/2022	11/15/2022	
Public Information and Education						
NPS pollution door hanger and website /social media posting	Draft door hanger	Final door hanger	Deliver door hanger to all watershed residents	Door hanger link on City website	Social media postings via City and partner organizations	
	7/15/2022	8/15/2022	9/15/2022	9/30/2022	9/30/2022	
Monitoring						
Monitoring of lake phosphorus concentrations	Develop monitoring plan/QAPP	Submit QAPP to EPA/MassDEP	Receive EPA/MassDEP comments on QAPP	Submit updated QAPP for approval	Begin monitoring	
	1/1/2022	2/1/2022	4/1/2022	5/1/2022	6/1/2022	

8.2 Progress Evaluation Criteria

In addition to a schedule and milestones, your 319-grant project should include a set of criteria used to determine if progress is being made toward attaining the intended pollutant load reductions, water quality goals or other indicators of progress.

The criteria established to track progress can be **indirect indicators** of load reduction, **project-specific indicators**, or **direct measurements**:

- **Indirect Indicators of Load Reduction:** Indirect indicators do not directly measure water quality, but can provide important evidence of water quality conditions. For example, it is useful to know the frequency and duration of bacteria-related beach closures for a water body with a

pathogen impairment. For a water body with a nutrient impairment, it may be useful to know the frequency and duration of nuisance algal blooms. Describe indirect indicators and how they will be measured and reported.

- **Project Specific Indicators:** It may be appropriate to include performance indicators associated with specific practices included in your 319 project. Project-specific indicators should **quantify an activity** and, whenever possible, **explain how that activity results in load reductions** for targeted pollutants. If it is not possible to quantify load reductions, state the target pollutant(s) that is expected to be reduced as a result of the activity. Some examples of project-specific indicators are included in the table below.

Examples of Project-Specific Indicators

Quantified Activity	How Activity Results in Load Reductions
Pounds of no-phosphorus fertilizer sold each year through a no-phosphorus fertilizer rebate program	Reduction in phosphorus applied to lawns in the watershed, compared to standard fertilizer
Number of pet waste pickup bags used annually at newly installed dispensers	Reduction in bacteria load and nutrients associated with pet waste
Number of raingardens installed as part of a raingarden pilot program and training workshop for watershed residents	Pollutant load reductions from structural BMPs can be estimated using the tools in Element C of the MA Watershed-Based Plans tool
Number of homes participating each year in a septic system revolving fund for system upgrades	Reduction in nutrient loads from upgrading sub-standard systems to Title V-approved systems
Square feet of vegetated buffer installed at lakefront or stream riparian zones	Reduction in sediment and nutrient load due to more robust vegetative cover in near-shore area
Number of road miles where road sweeping was conducted each year	Compare to "pre-project" annual road sweeping miles to estimate increase in sediment removal

Note: Examples of project-specific indicators for evaluation of I/E activities are discussed in Section 7.

- **Direct Measurements:** Water quality monitoring is **not required** for 319 grant projects. When proposed as part of a 319 project, it often makes good practical sense to conduct most monitoring activities *after* sufficient management measures have been installed to result in measurable water quality improvements. One may consider collection of baseline monitoring data to allow for comparison of "pre-project" and "post-project" water quality.

Monitoring programs conducted as part of a 319 project require an EPA- and MassDEP-approved **Quality Assurance Project Plan (QAPP)**. For more information on water quality monitoring and QAPPs, see the following resources:

- MassDEP's Water Quality Monitoring for Volunteers web page
- AquaQAPP, a web-based tool for developing QAPPs produced by the MassBays National Estuary Partnership with funding from MassDEP and EPA
- USEPA's Nonpoint Source: Volunteer Monitoring web page

If considering monitoring as part of a water quality restoration project, the 604b Water Quality Management Planning Grant Program or the MassDEP Water Quality Monitoring Grant Program may a good source of potential funding. When proposing monitoring as part of a water quality restoration project, consider the following when developing a QAPP:

How will the data be used?

- What questions are you trying to answer? How will the monitoring data answer those questions?
- What type of monitoring is feasible with proposed resources? Consider the lab cost for each parameter and focus on getting the most useful data for each dollar and labor hour.
- What accuracy and precision are needed?
- How does the monitoring program account for variations in weather and other sources of variation?

Monitoring Design Considerations: A watershed-scale monitoring program can be used to evaluate the collective effectiveness of all management measure implemented within the watershed. Site-specific monitoring for individual management measures. (e.g., pre-construction and post-construction monitoring downgradient of a new management measure) is typically not required unless that type of monitoring is particularly relevant to the project.

Be Specific: Provide a summary of the monitoring program that involves direct measurements, such as data collected with field equipment or samples sent to a lab for analysis. Include a list of parameters, sampling locations, sampling frequency, and timing (e.g., monthly from April to October each year). Describe interim targets established for each parameter.

Appendix A:
Other Related Grant Programs

Appendix A: Other Related Grant Programs

As summarized below, there are several other grant programs that provide funding for water quality assessments and related investigations that can provide the basis for future 319 grant projects.

Planning and Implementation Programs

604b Water Quality Management Planning Grant Program

Agency: Massachusetts Department of Environmental Protection (MassDEP)

The 604b grant program provides funds for water quality assessment and management planning. In cases where water body data is limited or does not exist, information collected through these grant projects (e.g., water quality monitoring) can provide the foundation to support 319 grant projects. ***No local match is required for these grants***. Link to MassDEP 604b Program

Coastal Planning and Implementation Programs

Coastal Pollution Remediation (CPR) Grant Program

Agency: Massachusetts Executive Office of Energy and Environmental Affairs (EEA) - Coastal Zone Management (CZM)

The CPR grant program provides funding to municipalities located within the Massachusetts coastal watershed to address stormwater runoff pollution and boat-waste from commercial vessels. Eligible projects include stormwater pollutant identification and assessment; BMP selection, design, permitting and construction; and commercial boat-waste pumpout projects. Projects must focus on waters that directly connect to the coast (i.e., inland ponds/lakes with no flow connection to coastal waters through day-lighted or culverted streams, or impacts to groundwater, are not eligible project areas). For a list of eligible communities, click here. Link to CPR Grant Program

Southeast New England Program (SNEP)

Agency: U.S. Environmental Protection Agency

The Southeast New England Coastal Watershed Restoration Program (SNEP) includes government and non-government organization all of whom are currently working collaboratively and innovatively to maintain and improve water quality and habitat conditions within the coastal watersheds of Massachusetts and Rhode Island. Projects have included expanding wastewater treatment plant capacity, restoring brook trout habitat, and upgrading environmental monitoring equipment. Link to SNEP Watershed Grants.

Massachusetts Bays Healthy Estuaries Grants

Agency: US EPA, Massachusetts Bays National Estuary Partnership (MassBays)

MassBays is an EPA National Estuary Program dedicated to protecting, restoring, and enhancing the estuarine resources of Ipswich Bay, Massachusetts Bay, and Cape Cod Bay. MassBays funds work that identifies causes of coastal habitat degradation, develop management plans and recommendations to address coastal water pollution, design conceptual improvements to stormwater infrastructure, and build local capacity to protect coastal resources including salt marsh, shellfish beds, and anadromous fish runs. Link to MassBays Healthy Estuaries Grants Program.

Climate Resiliency Programs

Coastal Resilience Grant Program

Agency: Massachusetts Executive Office of Energy and Environmental Affairs (EEA) - Coastal Zone Management (CZM)

The Coastal Resilience Grant Program provides financial and technical support for local efforts to increase awareness and understanding of climate impacts, assess vulnerability and risk, plan for changing conditions, redesign vulnerable public facilities and infrastructure, and implement non-structural approaches that enhance natural resources and provide storm damage protection. Grants are available for a range of coastal resilience approaches – from planning, public outreach, feasibility assessment, and analysis of shoreline vulnerability to design, permitting, construction, and monitoring. This program is open to the 78 municipalities located within the Massachusetts coastal zone and certified 501(c)(3) nonprofit organizations with vulnerable coastal property that is open and accessible to the public. Link to Coastal Resilience Grant Program

Municipal Vulnerability Preparedness (MVP) Grant Program

Agency: Massachusetts Executive Office of Energy and Environmental Affairs (EEA)

The MVP grant program provides support for cities and towns in Massachusetts to begin the process of planning for climate change resiliency and implementing priority projects. The state awards communities with funding to complete vulnerability assessments and develop action-oriented resiliency plans. Communities who complete an MVP planning grant become certified as an MVP community and are eligible for MVP Action Grant funding and other opportunities. Link to MVP Grant Program

Habitat Improvement Programs

Massachusetts Division of Ecological Restoration (DER) Grant Programs

Agency: Department of Fish and Game

- The **Culvert Replacement Municipal Assistance Grant Program** is for municipalities interested in replacing an undersized, perched, and/or degraded culvert located in an area of high ecological value. This funding is to encourage municipalities to replace aging culverts with better designed crossings that meet improved structural and environmental design standards and flood resiliency criteria. Link to DER Culvert Replacement Assistance Grant Program
- The **Restoration and Revitalization Priority Projects Program** selects projects that restore and protect Massachusetts rivers, wetlands, and watersheds for the benefit of people and the environment. The Priority Projects Program selects ecological and urban stream revitalization projects that present significant benefits to Massachusetts. Eligible applicants include restoration project site landowners, non-profit and/or non-governmental organizations, regional planning organizations, municipalities, and state and federal agencies. Current project focus is on cranberry bog wetland restoration, stream restoration, and urban stream and river revitalization. Link to DER Priority Project Program

Agricultural Programs

Climate Smart Agriculture Program (CSAP) Grants
Agency: Massachusetts Department of Agricultural Resources

MDAR offers various grants and funding programs for agricultural projects. The CSAP program links MDAR's water, energy, and climate grants together into one application. This program implements projects that help the agricultural sector adapt to climate change, mitigate climate change, reduce or prevent impacts to natural resources that may result from agricultural practices, and that improve energy efficiency and facilitate adoption of alternative clean energy technologies. Link to the CSAP Program.

Natural Resources Conservation Service (NRCS) Financial Assistance Programs
Agency: United States Department of Agriculture

- **Environmental Quality Incentives Program (EQIP)** provides financial and technical assistance to agricultural producers to address natural resources concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion, and improved wildlife habitat. Link to EQIP Program
- **Conservation Stewardship Program (CSP)** is the largest conservation program in the United States with a goal of enhancing natural resources and improving agricultural operations. The program helps agricultural operations build on existing conservation efforts while strengthening their operations. The program focuses on improving grazing conditions, increasing crop yields, developing wildlife habitat, and increasing resilience to weather extremes. Link to CSP Program

Other Programs

State Revolving Fund (SRF) Clean Water Program
Agency: Massachusetts Department of Environmental Protection (MassDEP)

- The SRF Clean Water program provides a low-cost financing method to help communities meet water quality standards. The program addresses issues such as watershed management priorities, stormwater management, and green infrastructure. SRF also supplies financial assistance to address communities with septic systems. Link to SRF Program

Summaries of other grant programs can be found at the following links:

https://www.mass.gov/service-details/available-funding-for-stormwater-projects-in-massachusetts

https://www.mass.gov/files/documents/2016/08/vg/grants-directory.pdf

Appendix B:

Guidance on Structural BMP Selection, Siting, and Sizing for the Massachusetts Watershed-Based Planning Tool

Guidance on Structural BMP Selection, Siting, and Sizing for the Massachusetts Watershed-Based Plans Tool

Purpose

The purpose of this document is to provide additional guidance and information to users of the BMP Selector Tool included in Element C of MassDEP's Watershed-Based Plans Tool. The BMP Selector Tool and this guidance document will support the user in appropriately selecting and sizing structural stormwater best management practices (BMPs).

The remainder of this document details the general sequence for BMP selection, siting and sizing; provides an overview of the BMP Selector Tool; and provides a BMP selection, siting and sizing example.

General Sequence for BMP Selection, Siting, and Sizing

BMPs should be designed and sited with cost-effectiveness in mind; with the ultimate goal of achieving the most pollutant removal for the least cost. When selecting a BMP, numerous factors should be taken into consideration. These factors include, but are not limited to, the pollutant of concern (i.e., the pollutant requiring treatment), drainage area size, drainage area cover type, available BMP footprint area, available funding, permitting requirements, and land ownership.

The following general sequence is recommended to identify and implement structural BMPs in a watershed.

A. Identify Potential BMP Implementation Locations: Perform a desktop analysis using aerial imagery and available GIS data to develop a preliminary list of potentially feasible implementation locations. Important items to consider during the desktop analysis include soil type (e.g., hydrologic soil groups (HSG) A and B would be desirable for infiltration BMPs); land ownership (i.e., public or private); proximity to receiving waters; known problem areas; potential permitting requirements; and publicly owned right of ways or easements.

It is also important to consider the land use within the drainage area of the proposed BMP. Pollutant load export rates (PLERs) vary by land use (e.g., commercial, residential, etc.) and cover type (pervious or impervious area). For a BMP to have the highest pollutant removal impact, siting a BMP in an area with high PLERs will maximize the load reduction benefits of the BMP.

Additional pollutant loading modeling may also be performed to help fine-tune BMP implementation locations; the methodology outlined in Element A – Section 6 may be applied to individual subwatersheds within the watershed to identify which areas have the highest loading rates per acre and thus would be more ideal candidates for BMP implementation.

B. Visit Potential Implementation Locations and Develop BMP Concepts: Perform field reconnaissance, preferably during a period of runoff-producing rainfall, to evaluate potential implementation locations, gauge feasibility of different BMP types, and identify potential BMP concepts. During field reconnaissance, assess identified locations for space constraints, potential accessibility issues, presence of mature vegetation that may cause conflicts (e.g., roots), potential utility conflicts, site-specific drainage patterns, and other factors that may cause issues during design, construction, or long-term maintenance.

C. Select a BMP Type and Use the BMP Selector Tool: Once potential BMP locations are conceptualized, the BMP type should be selected, and the BMP Selector Tool can be used to obtain estimates for pollutant load reductions for Total Phosphorus (TP), Total Nitrogen (TN), and Total Suspended Solids (TSS), cost, and BMP footprint area. The inputs required for the BMP Selector Tool include BMP type, estimated drainage area to the BMP; land use within the drainage area; and design storm depth that the BMP is sized for. Detailed instructions on selecting a BMP type and using the BMP Selector Tool are provided in the next section of this document.

D. Document BMP Concepts: Develop documentation on each BMP concept for inclusion in the watershed-based plan (WBP). Documentation should include a site description, a description of the proposed BMP, conceptual BMP design details, drainage area, BMP footprint areas, estimated cost and pollutant load reduction estimates (from the BMP Selector Tool output), and a discussion of potential conflicts such as property ownership, O&M requirements, and permitting constraints.

E. Rank BMP Concepts (Optional): Once the proposed BMP concepts are developed, perform a priority ranking to identify the proposed order for BMP implementation. Ranking can be based on different site-specific factors including cost; expected pollutant load reductions; implementation complexity; potential outreach opportunities and visibility to public; accessibility; and expected operation and maintenance effort.

BMP Selector Tool (Table C1)

A. Tool Overview: The BMP Selector Tool allows the user to select structural BMPs and calculates pollutant load reductions, estimated costs, and estimated BMP footprint area. The tool includes a collection of commonly used structural BMPs that have undergone sufficient study to allow for a modeled estimation of pollutant load removal for TP, TN, and TSS.

B. Tool Inputs: When selecting a BMP for water quality treatment it is important to consider the expected pollutant removal efficiency of the BMP for the pollutants of concern (POC). Different BMP types have different levels of treatment (or pollutant load reduction) for different pollutants. Also, on an average annual basis, a BMP sized for a larger design storm will treat a greater number of rainfall events and therefore have a higher pollutant removal efficiency. Figures 1 through 3 illustrate the pollutant removal efficiencies for various BMPs under a range of design storm depths provided by the BMP Selector Tool.

After selecting a BMP type, the user must input the following additional information:

1. BMP Size/Storm Depth: Some BMPs (e.g., bioretention areas and wet basins) can be sized to treat runoff from a specified storm event (e.g., 0.5 inches of rain, 1 inch of rain, etc.). Other BMPs (e.g., deep sump catch basin, oil/grit separator) tend to have standardized sizing and do not require sizing information. The larger the design storm depth, the larger the BMP needs to be to treat the runoff produced by the event; the BMP footprint is determined by the design storm selected for treatment.
2. Drainage Area: Delineate the drainage area that will flow into the proposed BMP using available topographic map(s). If possible, it is helpful to observe the area during rain to confirm drainage patterns. When estimating the BMP drainage area, include all developed land (e.g., roofs, lawns, roads) and undeveloped land (e.g., forest) that will drain into the BMP.
3. Land Use/Cover Type: Specify and measure the land use type(s) and cover type(s) included in the BMP drainage area. Land use types can be identified through a site visit; by referring to the land use map

provided in Element A of the WBP; or by using other available land use maps/aerial imagery. The two options for cover type include impervious area and pervious area and can be estimated by a site visit; by referring to the impervious cover map provided in Element A of the WBP; or by using other available aerial imagery/maps.

C. Tool Outputs: Once input information is provided, the tool will calculate planning-level estimates of BMP footprint, BMP cost and pollutant load reduction for TP, TN, and TSS.

BMP Footprint: There are often constraints on the available area for constructing a BMP (particularly in retrofit situations), so it is important to incorporate the available BMP footprint into a design. The BMP Selector Tool will provide an estimated BMP footprint area for planning purposes. The tool calculates the estimated BMP footprint area using the methodology outlined below.

1. BMP footprint area is calculated as:

$$BMP_{Area} = \frac{WQv}{D_{eff}}$$

Where BMP_{Area}= BMP footprint area (sq.ft.); WQv = the BMP water quality volume (ft^3); and D_{eff}=effective depth (ft)

2. The tool uses a typical cross-section for applicable BMP types. The effective depth is calculated as:

$$D_{eff} = (D_{Pond} + (D_{Media} x\ POR)$$

Where D_{Pond} = ponding depth (ft); D_{Media}= media depth (ft); and POR = the media porosity (a porosity of 0.4 is assumed based on guidance found in Rawls (1983)). Table 2 lists the ponding depth D_{Pond}, media depth D_{Media}, and resulting effective depth D_{eff}, for each BMP type provided in the BMP Selector Tool. The table also includes the references, assumptions and additional notes regarding how the ponding depth D_{Pond} and media depth D_{Media} were estimated.

It should be noted that BMP cross-sections can vary depending on site constraints, but the typical cross-sections used by the BMP Selector Tool are appropriate for attaining planning-level estimates of BMP footprint area. There are BMPs for which the BMP Selector Tool does not calculate a BMP footprint area (i.e., Vegetated Filter Strip (≥ 50 ft wide); grassed channel/water quality swale; porous pavement; leaching catch basin; deep sump catch basin; and oil/grit separator), because the method for sizing these BMPs is different from what is described here. Table 2 provides notes and links for guidance on how to size these BMPs.

3. The water quality volume WQv is calculated as:

$$V = WQv = C * P * DA$$

Where V = the runoff volume (cu.ft.); C = weighted runoff coefficient (dimensionless); P = design storm depth (ft); DA = the total drainage area to the BMP (sq.ft.).

The values for the variables P and DA are based on the direct inputs into the BMP Selector Tool. The tool calculates the weighted runoff coefficient C based on the percent of impervious and percent of pervious area within the drainage area. The runoff coefficient assigned to all pervious areas is 0.2 and the

estimated runoff coefficient assigned to all impervious areas is 0.95 (based on guidance from ASCE (1992)). The tool calculates the weighted runoff coefficient C is as:

$$C = \%Impervious * 0.95 + \%Pervious * 0.2$$

4. The equation becomes:

$$BMP_{Area} = \frac{C * P * DA}{D_{eff}}$$

BMP Cost: The BMP Selector Tool also provides planning-level BMP capital cost (i.e., construction costs) estimates. The following sources were referenced for estimating the capital cost of each BMP type/size: Geosyntec (2014); Geosyntec (2015); King and Hagan (2011); UMass (2004); and USBLS (2016).

The estimated costs provided by the tool do not include BMP operation and maintenance (O&M) costs or engineering design and permitting costs. Element D of the WBP requires estimates for both annual O&M costs and technical assistance costs. BMP O&M costs can vary widely depending on BMP type, complexity, and who performs the maintenance (e.g., municipality, volunteers, contractors, etc.). A typical rule of thumb estimate of BMP O&M costs is 2-6% of the BMP capital costs. Engineering and permitting costs can also vary widely. A typical rule of thumb estimate of engineering design and permitting costs is approximately 20-30% of the BMP capital costs.

Figure 4 provides the capital costs (per acre managed) for various BMPs under the different design storm depths provided in the tool. This figure, together with the Figures 1 through 3 can be used to help select a BMP for the watershed that provides the maximum BMP pollutant removal for the lowest cost.

Estimated Pollutant Load Reductions: Pollutant load reductions are calculated by the BMP Selector Tool as follows:

1. Each BMP type and BMP size (design storm depth in inches) combination has a treatment value or percent removal for TP, TN, and TSS. Most BMP type treatment values (i.e., percent removal values) were obtained from performance curves provided by the USEPA (USEPA 2016a). The Massachusetts Stormwater Handbook, Massachusetts Clean Water Toolkit, and International Stormwater BMP Database were also referenced for estimating treatment for select BMPs (i.e., leaching catch basin, deep sump catch basin, oil/grit separator and vegetated filter strip) (Leisenring, et al., 2014; MassDEP, 2016a, 2016b).
2. Each land use and cover type combination has a PLER in lbs/acre/year for TP, TN, and TSS. For the calculations in the BMP Selector tool, the pervious land cover is assumed to consist of HSG B soils for purposes of estimating the pollutant load reduction(s) achieved by the BMP. PLER values by soil type are included in Appendix A of the WBP (USEPA 2016b) and in Table 1 (at the end of this document).
3. The tool calculates the total PLER as follows:

$$\mathrm{PLER_T} = \sum \mathrm{PLER_n} * \mathrm{A_n}$$

Where $\mathrm{PLER_T}$= total PLER (lbs/acre/year); $\mathrm{PLER_n}$= PLER for land use/cover type n (lbs/acre/year); and $\mathrm{A_n}$= percent of land use/cover type n in drainage area.

4. The tool calculates the estimated pollutant load reduction for TP, TN, and TSS in lbs/year as follows:

$$BMP = \mathrm{PLER_T} * T_{BMP} * DA$$

Where BMP = the BMP Pollutant Load Reduction (lbs/year); $\mathrm{PLER_T}$= total PLER (lbs/acre/year) (calculated in step 3); T_{BMP}= BMP percent removal (from step 1); and DA = the total drainage area to the BMP (acres).

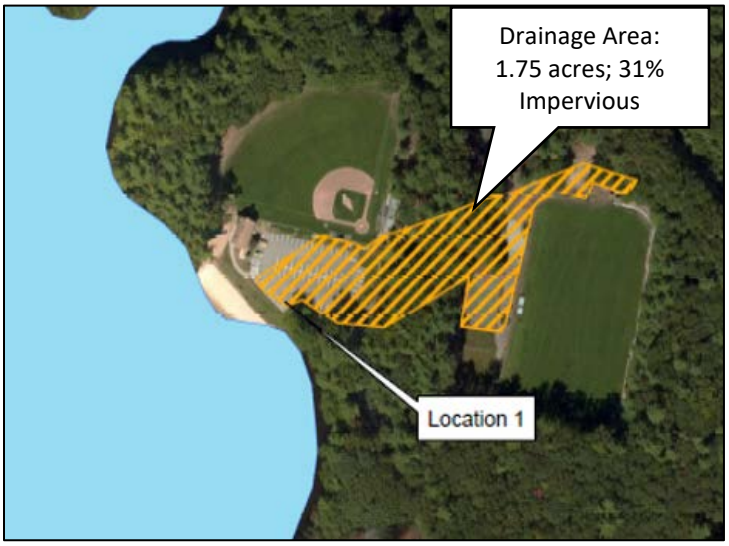
D. Checking Results: It is recommended to check that the output from the tool is feasible and realistic. Specifically, the BMP footprint area should be checked to ensure that it will fit into the desired location, and the capital cost should be divided by the BMP footprint area to see if the resulting cost/square foot is reasonable and is comparable to available references for cost.

BMP selection, siting and sizing example

An example of the BMP selection, siting and sizing process is provided below.

A. Identifying Potential BMP Implementation Location: An initial desktop analysis of aerial imagery and available GIS data revealed "Location 1" as an ideal candidate for BMP implementation. The area was identified, because it is a public recreational area directly adjacent to the waterbody. The area is comprised of a large parking lot, a community center, and a sports complex with multiple athletic fields. Available soil maps for the area indicated hydrologic soil group A, which is excellent for installation of infiltrating BMPs.

B. Visit Potential Implementation Location and Develop BMP Concept: A field investigation was conducted during a time of active precipitation to enable visualization of active flow patterns. The field investigation coupled with the desktop analysis revealed that the entire parking area drains to a single catch basin located in the southern corner of the parking lot which discharges untreated runoff through a 6-inch PVC outfall onto the southeastern side of the beach. The catch basin was at capacity during the field investigation and ponding within the southern corner of the parking lot was observed. The 6-inch outfall discharged onto an embedded concrete block that provided minimal energy dissipation. Active erosion and scouring were observed during the field investigation. A grassed area adjacent to the parking lot was identified as an ideal location for a BMP. No major spatial or access conflicts were observed that would cause issues during design, construction, or long-term maintenance. The image below shows the aerial view and drainage area of Location 1.

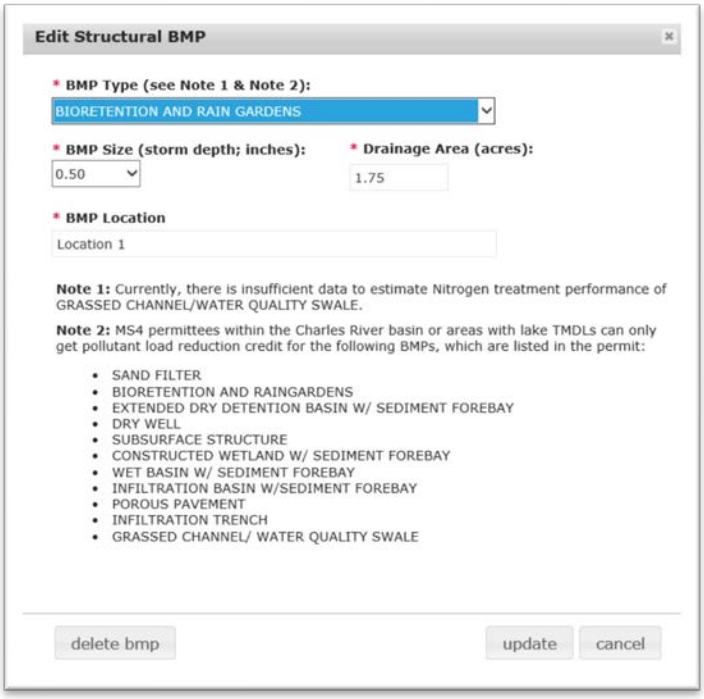


Example BMP Location and Drainage Area

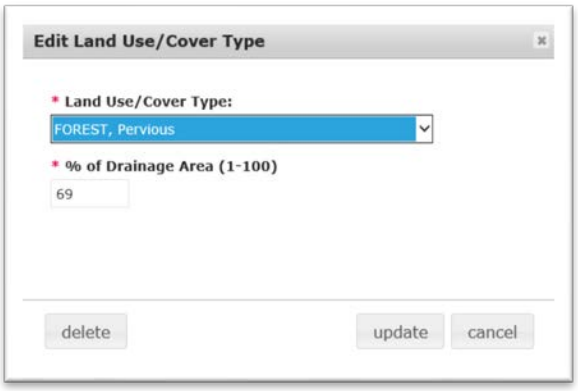
C. Select a BMP Type and Use the BMP Selector Tool: The POC for this example was TP. The design goal was to size the BMP to treat and infiltrate 0.5 inches of runoff from the drainage area of the BMP. Based on Figures 2 and 4, a bioretention cell would have an approximately 58% removal efficiency and a capital cost of approximately $19,000/acre treated. Other BMPs with higher TP removal efficiency were ruled out due to factors such as available space; cost; proximity to the waterbody (e.g., infiltration trenches should be a minimum of 100 ft from a waterbody of the Commonwealth); and/or type of runoff treated (e.g., dry wells are not suitable for treating parking lot runoff). The bioretention cell was therefore selected as the most suitable BMP for this location.

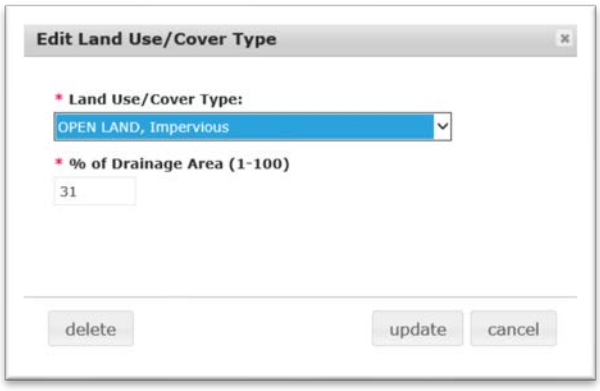
The BMP size was entered as 0.5 inches. Additional inputs included a drainage area of 1.75 acres; the bmp location; and a land use/cover type of 31% impervious (open land) and 69% pervious (forest). The screenshots below illustrate how the required information was input into the tool and the tool outputs.

1. Edit Structural BMP

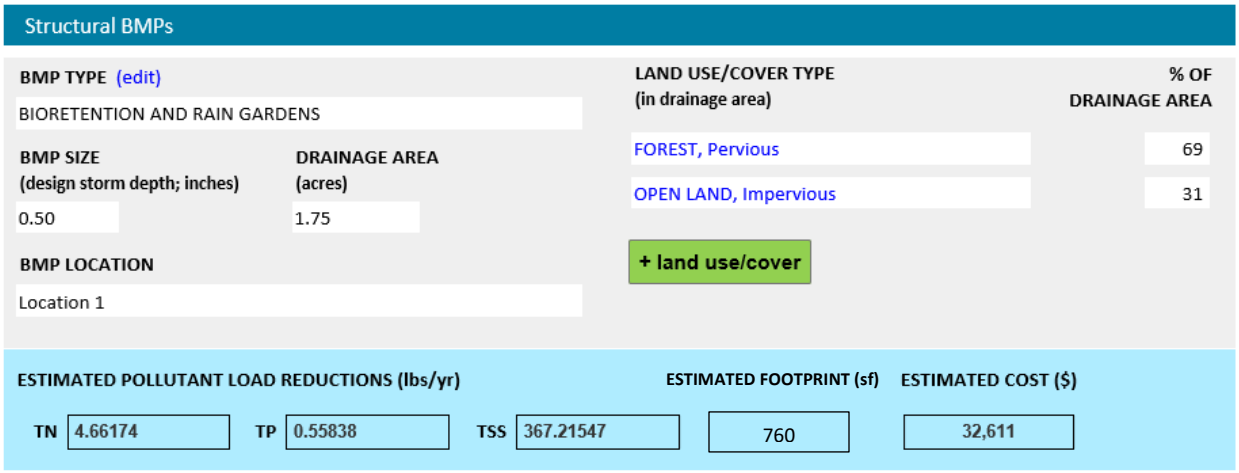


2. Edit Land Use/Cover Type





3. Tool Outputs



4. Check Results: The results were checked to confirm that they are feasible and realistic. Specifically, it was confirmed that the BMP footprint area of 760 square feet would fit into the available area at Location 1. The cost of $32,611 was also divided by the BMP footprint area of 760 square feet and the result was an estimated capital cost of $43/square foot. The Massachusetts Clean Water Toolkit provides an estimated cost of bioretention areas to be between $5—$30 per square foot. The cost provided by the tool in this example is therefore probably slightly conservative but is still realistic and acceptable for a planning-level estimate.

D. Document BMP Concepts: A one-page fact sheet was developed for the proposed bioretention area at Location 1 (see Attachment 1). The fact sheet included a site summary, a description of the proposed BMP, annotated photographs with conceptual design details, drainage area information, BMP footprint area, estimated cost, pollutant load reduction estimates, property ownership, O&M requirements and permitting constraints.

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Tables

1. Pollutant Load Export Rates (PLERs) for Hydrologic Soil Group (HSG) B Soils
2. Typical BMP Cross-section Information and Sizing Guidance

Figures

1. BMP Phosphorous Removal Efficiency by Design Storm Depth
2. BMP Nitrogen Removal Efficiency by Design Storm Depth
3. BMP Total Suspended Solids Removal Efficiency by Design Storm Depth
4. BMP Capital Cost by Design Storm Depth

Attachment

1. BMP Concept Fact Sheet

Table 1: Pollutant Load Export Rates (PLERs) for Hydrologic Soil Group (HSG) B Soils

	Pollutant Load Export Rate (lbs/acre/year)		
Land Use, Cover Type	TP	TN	TSS
AGRICULTURE, IMPERVIOUS	1.52	11.33	649.51
AGRICULTURE, PERVIOUS	0.45	2.59	29.44
COMMERCIAL, IMPERVIOUS	1.78	15.08	377.39
COMMERCIAL, PERVIOUS	0.12	1.16	29.44
INDUSTRIAL, IMPERVIOUS	1.78	15.08	377.39
INDUSTRIAL, PERVIOUS	0.12	1.16	29.44
HIGHWAY, IMPERVIOUS	1.34	10.17	1,480.13
HIGHWAY, PERVIOUS	0.12	1.16	29.44
HIGH DENSITY RESIDENTIAL, IMPERVIOUS	2.32	14.10	438.95
HIGH DENSITY RESIDENTIAL, PERVIOUS	0.12	1.16	29.44
MEDIUM DENSITY RESIDENTIAL, IMPERVIOUS	1.96	14.10	438.95
MEDIUM DENSITY RESIDENTIAL, PERVIOUS	0.12	1.16	29.44
LOW DENSITY RESIDENTIAL, IMPERVIOUS	1.52	14.10	438.95
LOW DENSITY RESIDENTIAL, PERVIOUS	0.12	1.16	29.44
FOREST, IMPERVIOUS	1.52	11.33	649.51
FOREST, PERVIOUS	0.12	1.16	29.44
OPEN LAND, IMPERVIOUS	1.52	11.33	649.51
OPEN LAND, PERVIOUS	0.12	1.16	29.44

Table 2: Typical BMP Cross-section Information and Sizing Guidance

BMP Type	Ponding Depth (ft)	Media Depth (ft)	Effective Depth (ft) D_{eff}	Sizing Notes/Assumptions/References
Bioretention and Raingardens	0.5	3.3	1.8	Used cross-section on page 24 of MassDEP (2016b) to estimate typical D_{Pond} and D_{Media}
Infiltration Basin w/ Sediment Forebay	2	0	2	Used cross-section on page 87 of MassDEP (2016b) to estimate typical D_{Pond}. Assumed typical 2.0 ft depth for storage of WQv.
Dry Well	0	6	2.4	Used cross-section on page 85 of MassDEP (2016b) to estimate typical D_{Media}. Assumed typical 6.0 ft depth for storage of
Sand Filter	0	4.3	1.7	Used cross-section included in Young et al. (1996) to estimate typical D_{Media}. Assumed typical 4.3 ft depth for storage of WQv.
Extended Dry Detention Basin w/ Sediment Forebay	5	0	5	Used cross-section on page 50 of MassDEP (2016b) to estimate typical D_{Pond}. Assumed typical 5.0 ft depth for storage of WQv.
Infiltration Trench	0	6	2.4	Used cross-section on page 95 of MassDEP (2016b) to estimate typical D_{Media}. Assumed typical 6.0 ft depth for storage of
Subsurface Structure	2.5	0	2.5	Used cross-section on page 104 of MassDEP (2016b) to estimate typical D_{Pond}. Assumed typical 2.5 ft depth for storage of WQv.
Constructed Wetland w/ Sediment Forebay	0.5	3	1.7	Used cross-section for gravel wetland included in UNHSC (2009) to estimate typical D_{Pond} and D_{Media}
Wet Basin w/ Sediment Forebay	1	0	1	Used guidance on pages 63—67 of MassDEP (2016b) and in MassDEP (2016a) to estimate typical D_{Pond}
Vegetated Filter Strip (≥ 50 ft wide)[1]	N/A	N/A	N/A	See pages 17—21 of MassDEP (2016b)for detailed guidance on sizing.
Grassed Channel/ Water Quality Swale[1]	N/A	N/A	N/A	See pages 73—82 of MassDEP (2016b) for detailed guidance on sizing.
Porous Pavement[1]	N/A	N/A	N/A	The BMP footprint area is equal to the drainage area. See pages 118—122 of MassDEP (2016b) for detailed guidance on sizing.
Leaching Catch Basin[1]	N/A	N/A	N/A	See MassDEP (2016a) for detailed guidance on sizing. See pages 100—102 of MassDEP (2016b) for detailed guidance on sizing.
Deep Sump Catch Basin[1]	N/A	N/A	N/A	See pages 2—5 of MassDEP (2016b) for detailed guidance on sizing.
Oil/grit Separator[1]	N/A	N/A	N/A	See pages 6—9 of MassDEP (2016b) for detailed guidance on sizing.

Note 1: The interactive BMP Selector Tool (Table C1) does not calculate BMP Areas for the following BMPs: Vegetated Filter Strip (≥ 50 ft wide); grassed channel / water quality swale; porous pavement; leaching catch basin; deep sump catch basin; and oil/grit separator. See notes and references on guidance for sizing these BMPs.

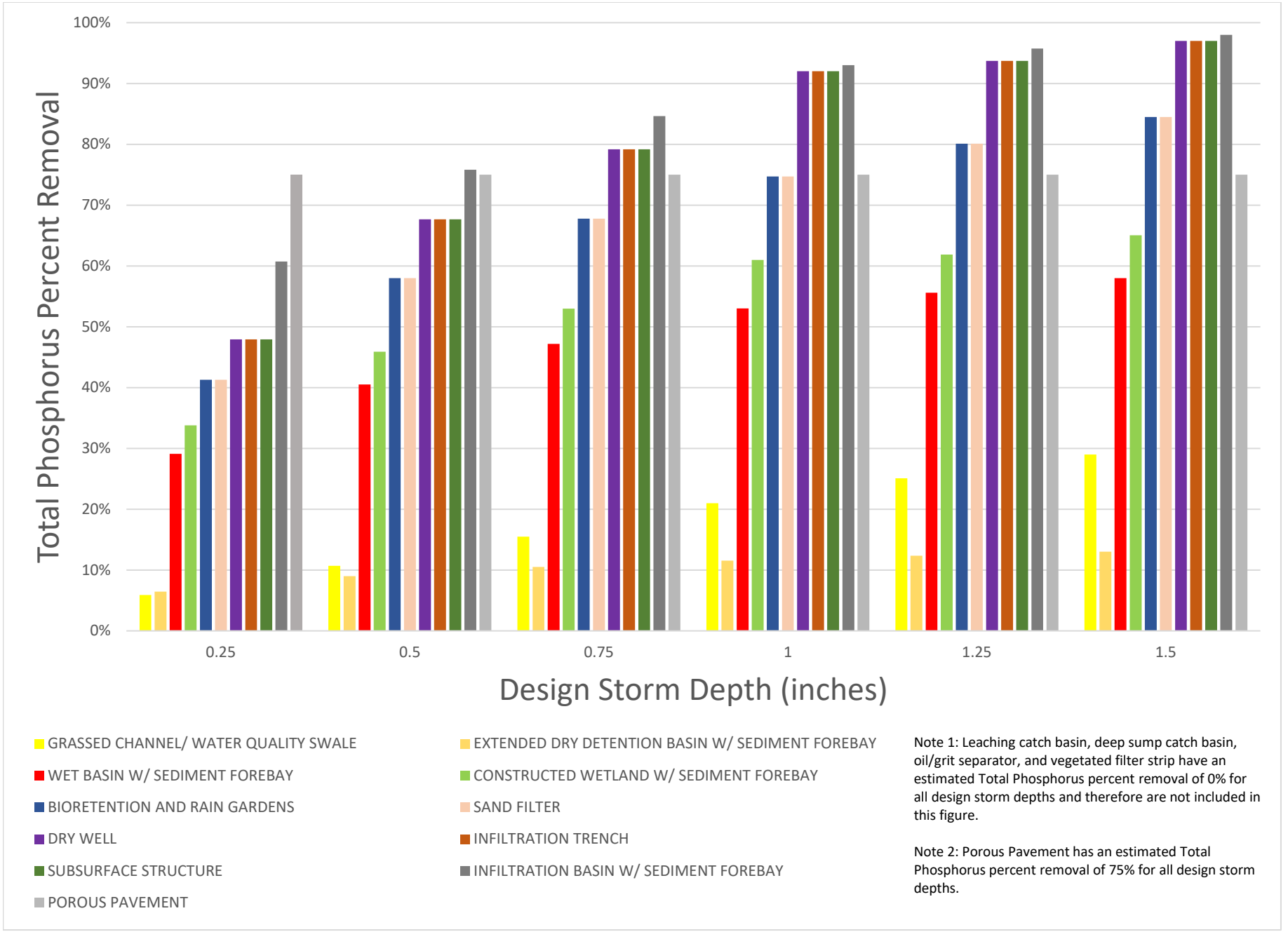


Figure 1: BMP Phosphorus Removal Efficiency by Design Storm Depth

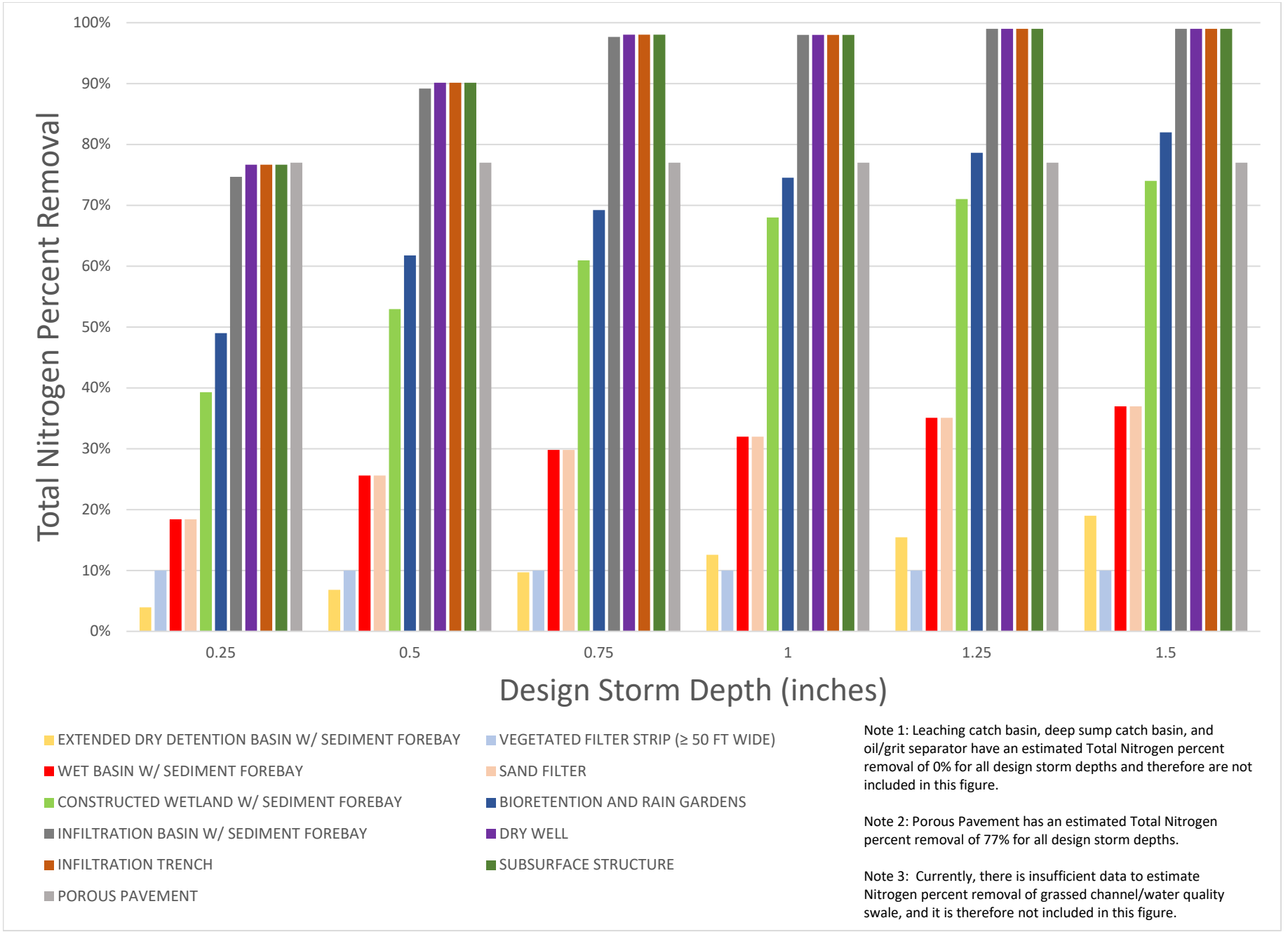


Figure 2: BMP Nitrogen Removal Efficiency by Design Storm Depth

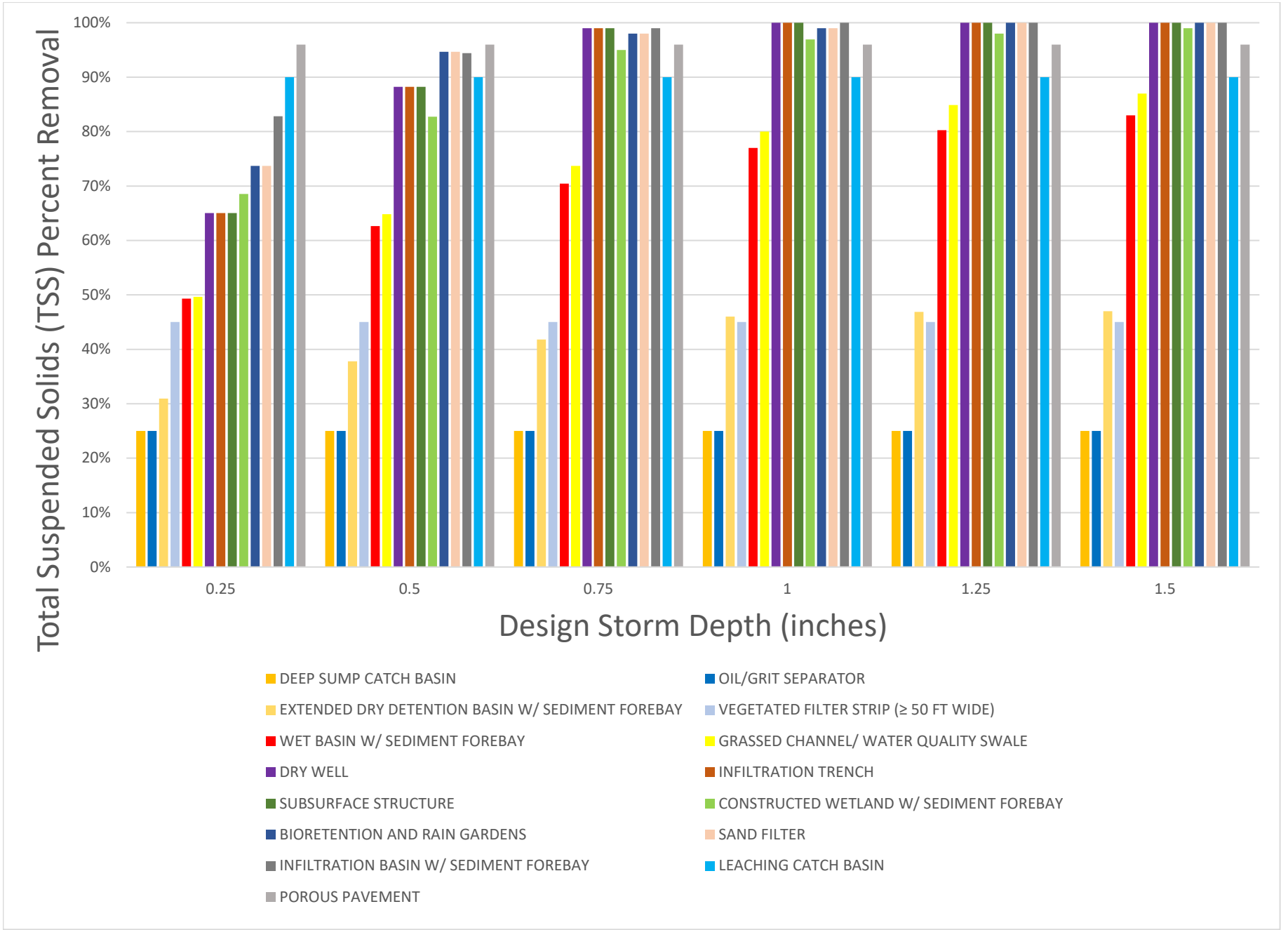


Figure 3: BMP Total Suspended Solids Removal Efficiency by Design Storm Depth

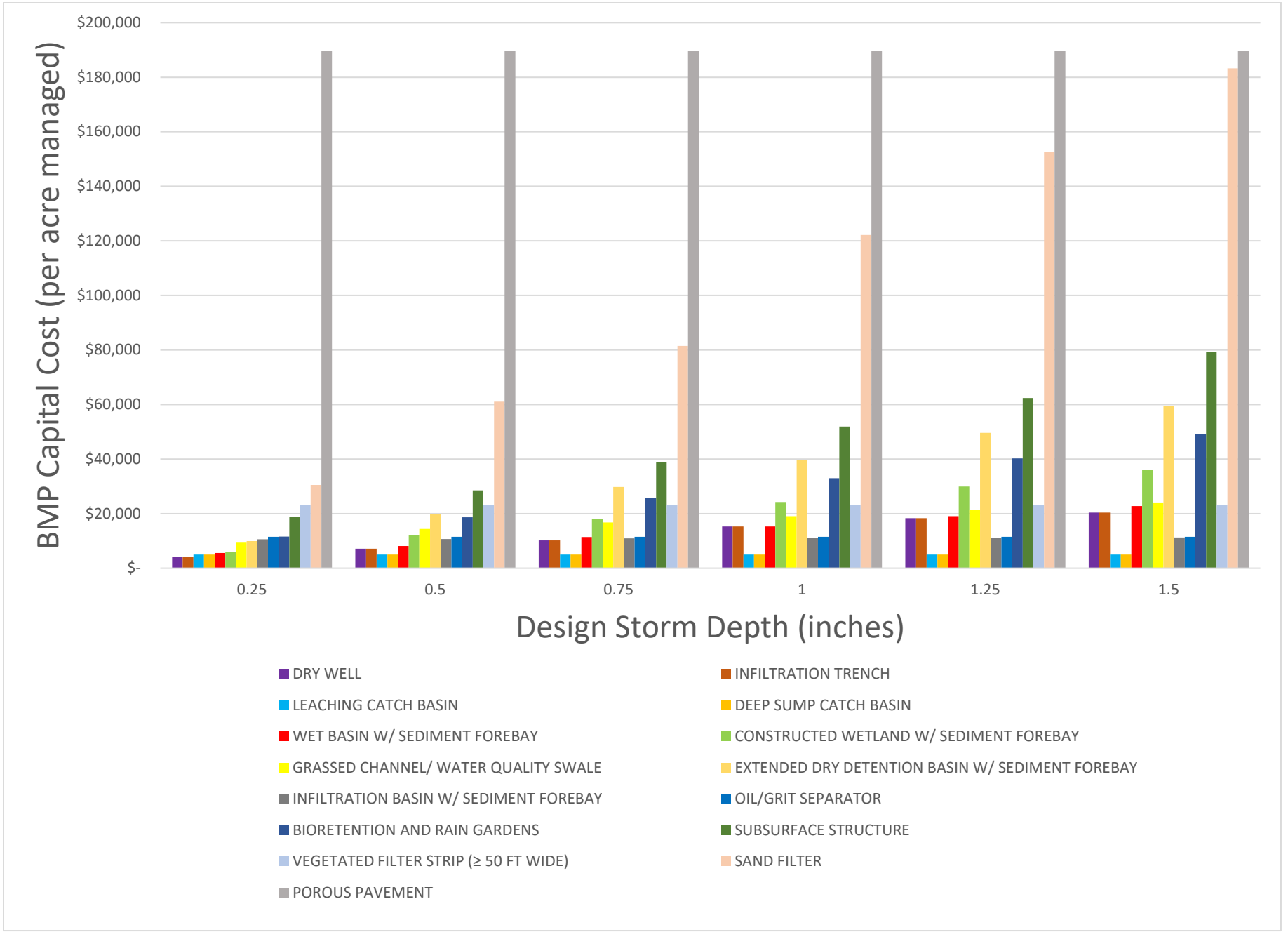


Figure 4: BMP Capital Cost by Design Storm Depth

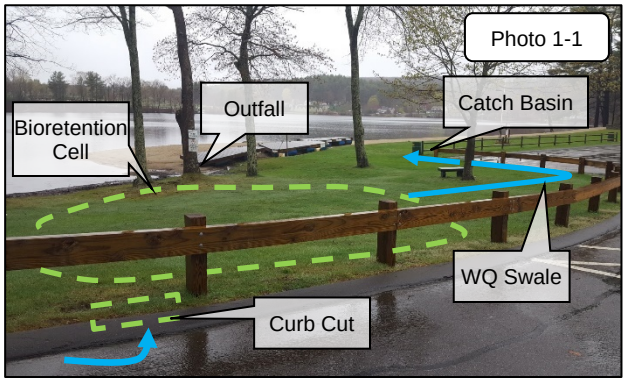
Attachment 1 – BMP Concept Fact Sheet

Location 1: Beach Road

Recreational Beach Parking Lot

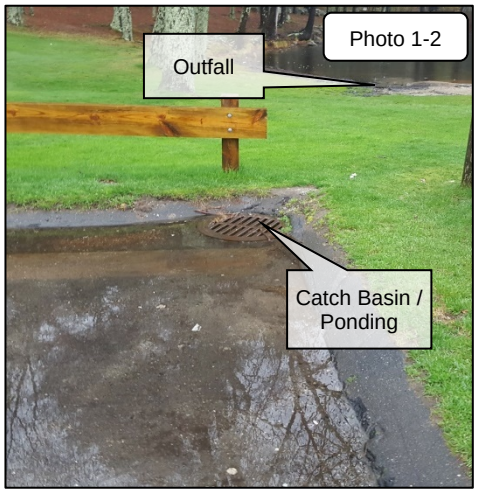
Site Summary: Photos 1-1, 1-2, 1-3

The recreational beach is located along the northeastern corner of the pond. The area is comprised of a large parking lot, a community center, and a sports complex with multiple athletic fields. The entire parking area drains to a single catch basin located in the southern corner of the parking lot which discharges untreated runoff through a 6-inch PVC outfall onto the southeastern side of the beach. The catch basin was at capacity and ponding was observed during the site investigation. Active erosion and scouring was observed on the beach at the outfall.



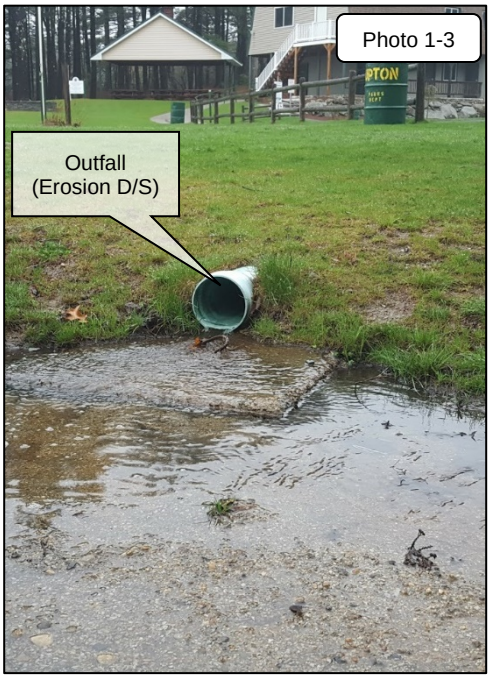
Proposed Improvement: Photo 1-1,

Install a 760-square foot bioretention cell within the grassed area adjacent to the parking lot to treat a water quality volume of 0.5 inches. Runoff from most of the parking area would be conveyed to the bioretention cell via curb cuts. During larger storm events, overflow from the bioretention area would be conveyed via a new 75-linear foot grassed swale to the existing catch basin. Install riprap outlet protection at the existing outfall to dissipate energy and minimize future erosion.



Property Ownership: Public

Expected O&M: Remove accumulated sediment from bioretention cell and energy dissipation pad annually and maintain/replace plants as needed every two years. Mow grassed swale regularly. Replant grass as needed to maintain adequate vegetative cover. Remove accumulated debris prior to mowing.



Wetland Permitting: As a project with minor buffer zone disturbances, Wetlands Protection Act (WPA) permitting is expected to require submittal of an abbreviated notice of intent (ANOI).

Sizing/BMP Characteristics	
Drainage Area (acres)	1.75
Impervious Area (%)	31
BMP Footprint (sf)	760
Estimated Load Reduction (lb/yr)	
TN (lbs/yr)	4.7
TP (lbs/yr)	0.56
TSS (lbs/yr)	367
Estimated Costs ($)	
Capital	$32,611