

# **September 2026 Supplemental Directive to:**

**City of Cambridge, Massachusetts**



**Department of Public Works**

147 Hampshire Street • Cambridge, MA 02139

**Wastewater and Stormwater Management Guidance  
May 2008 (Draft Version)**

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## Introduction

The City of Cambridge is in the process of updating the detailed written guidance presented in the **Wastewater and Stormwater Guidance Manual** (Draft Manual, May 2008). The purpose of the update is to ensure that published guidance aligns with existing regulations and ordinances that pertain to new and redevelopment activities (i.e. land disturbance) within the City. This Supplemental Directive is an interim step to inform project proponents and the public of pertinent stormwater requirements that are already in place, mainly revisions to the Land Disturbance Regulations finalized in September 2026. The document has been structured to provide streamlined information related to modifications to which activities require a Stormwater Control Permit and/or a Building Permit with Stormwater Site Plan Review by the Department of Public Works. This information will be integrated fully into the final Wastewater and Stormwater Guidance Manual when published and supersedes the previously issued June 2021 Supplemental Directive.

**If otherwise unaddressed here, the existing relevant guidance or regulations in place shall still apply.** Refer to the Draft Wastewater and Stormwater Guidance Manual and Appendix A of the Guidance Manual for stormwater control selection and design criteria.

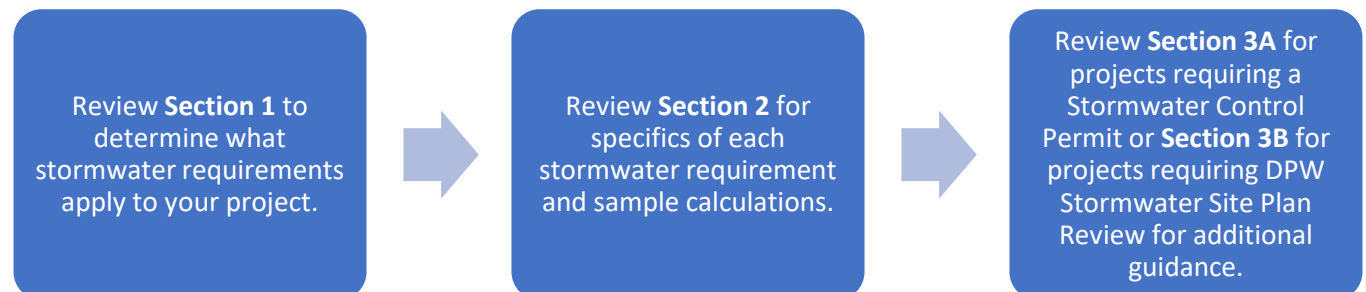
The underlying ordinances and regulations to which the Guidance Manual and this Directive refers include the following:

- Chapter 13.16 – Wastewater and Stormwater Drainage System (Cambridge, Massachusetts Code of Ordinances ([Ordinance](#)))
- City of Cambridge Department of Public Works (DPW) Wastewater and Stormwater Drainage Use Regulations ([Regulations](#), revised February 2026)
- City of Cambridge DPW Land Disturbance Regulations ([LD Regulations](#), revised September 2026)

All regulations can be found on the Stormwater website at: [www.cambridgema.gov/stormwater](http://www.cambridgema.gov/stormwater)

### How To Use This Supplemental Directive

This Supplemental Directive is intended to clarify what Stormwater Management Standards do and do not apply to development projects in Cambridge depending on size and scope, and what level of stormwater mitigation is required for Stormwater Control Permits and Building Permits with DPW Stormwater Site Plan Review.

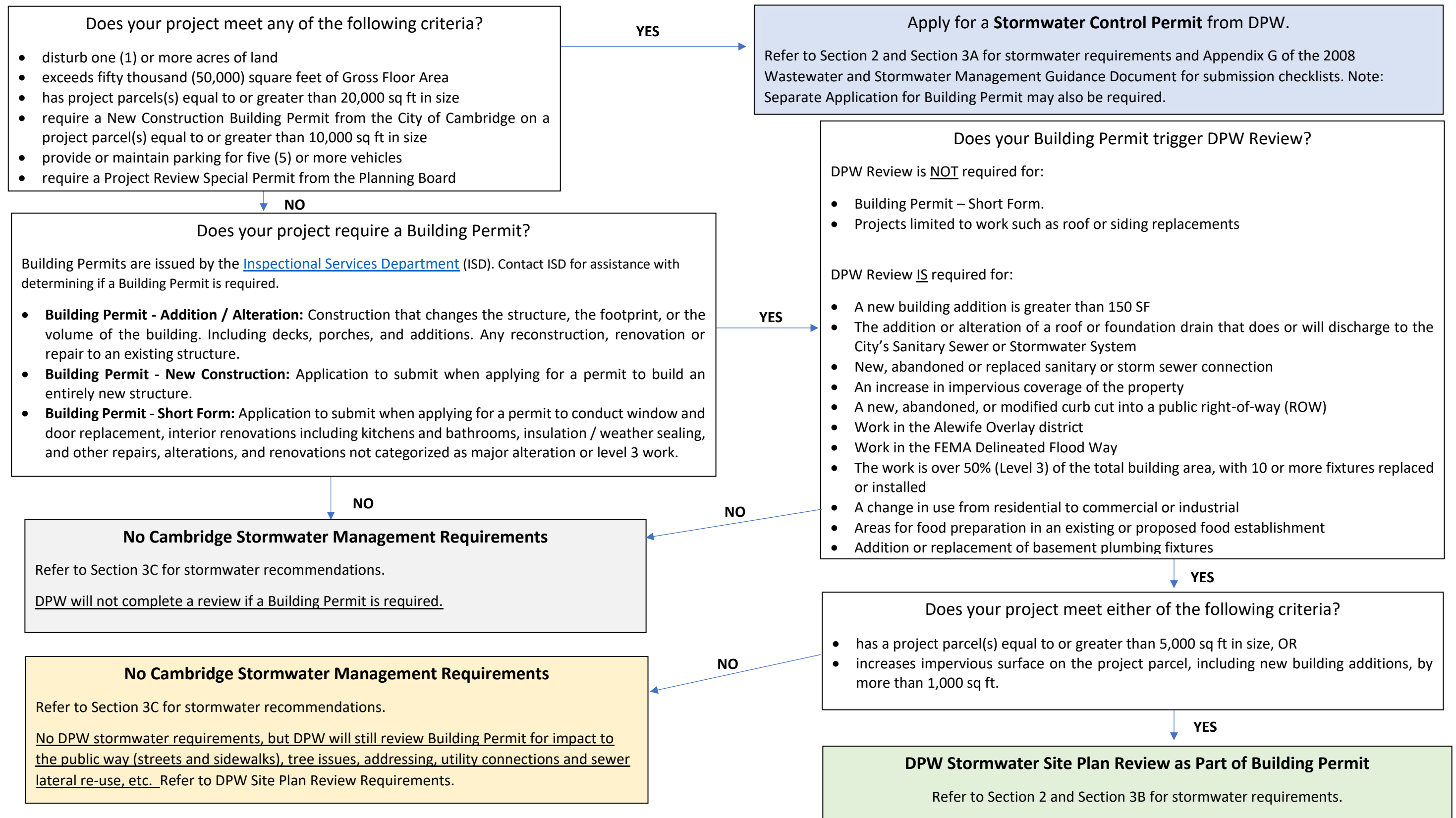


## 1. What Stormwater Requirements Apply to My Project?

Projects in Cambridge fall into one of three categories for stormwater management under Cambridge Land Disturbance Regulations. Review the following table and flow chart to determine what category is applicable to your project based on the project's scope and size.

| <b>Stormwater Control Permit</b><br>Projects in this category must apply for a Stormwater Control Permit from DPW.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| If a project meets <u>one or more</u> of the following criteria, a Stormwater Control Permit is required: <ul style="list-style-type: none"> <li>• disturb one (1) or more acres of land</li> <li>• exceeds fifty thousand (50,000) square feet of Gross Floor Area</li> <li>• has project parcels(s) equal to or greater than 20,000 sq ft in size</li> <li>• require a New Construction Building Permit from the City of Cambridge on a project parcel(s) equal to or greater than 10,000 sq ft in size</li> <li>• provide or maintain parking for five (5) or more vehicles</li> <li>• require a Project Review Special Permit from the Planning Board</li> <li>• in the opinion of the City Engineer may result in an adverse impact of the municipal Sewer, Combined Sewer, Stormwater Drainage Systems or Water Resources.</li> </ul> | <b><u>Stormwater Management Requirements:</u></b><br><br><b>Fully meet</b> Cambridge Stormwater Management Standards for water quality, recharge and peak rate as outlined in this Supplemental Directive.                |
| <b>DPW Stormwater Site Plan Review (under Building Permit)</b><br>This category is applicable to projects that require a Building Permit from the City, and based on project scope, the building permit requires DPW Review. If the following criteria are met, a Stormwater Site Plan review will be part of DPW's broader project review.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                           |
| If a project meets <u>one</u> of the following criteria, a Stormwater Site Plan Review by DPW is required as part of the Building Permit: <ul style="list-style-type: none"> <li>• has a project parcel(s) equal to or greater than 5,000 sq ft in size, OR</li> <li>• increases impervious surface on the project parcel, including new building additions, by more than 1,000 square feet.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b><u>Stormwater Management Requirements:</u></b><br>Meet Cambridge Stormwater Management Standards for water quality and peak rate as outlined in this Supplemental Directive to the <b>maximum extent practicable</b> . |
| <b>No Cambridge Stormwater Management Requirements</b><br>This category is applicable to projects that require a Building Permit from the City, and based on project scope, the building permit requires DPW Review. If the following criteria are met, a Stormwater Site Plan review is NOT part of DPW's broader project review.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                           |
| If a project meets <u>both</u> of the following criteria, no stormwater management requirements apply: <ul style="list-style-type: none"> <li>• has a project parcel(s) less than 5,000 sq ft in size, AND</li> <li>• no increase in impervious surface greater than 1,000 square feet on the project parcel, including building additions.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No <i>requirements</i> under Cambridge regulations, but <b>recommended stormwater improvements</b> include rain gardens, pervious driveways, dry wells, rain gardens etc.                                                 |

# What Cambridge Stormwater Requirements Apply to My Project?



## 2. Cambridge Stormwater Management Standards

Cambridge has stormwater management standards applicable to water quality, recharge and peak rate control. Note the Cambridge stormwater management standards are separate from the MassDEP Stormwater Management Standards. Projects under the jurisdiction of the Wetland Protection Act must also meet MassDEP's Standards following the latest regulations and guidance<sup>1</sup>.

Review the table on the next page for a summary of each standard. This Supplemental Directive includes a section on each standard with sample calculations and additional guidance on demonstrating compliance. Projects requiring Stormwater Control Permits shall meet Cambridge Stormwater Management Standards fully and projects requiring DPW Stormwater Site Plan Review shall meet Cambridge Stormwater Management Standards to the Maximum Extent Practicable (MEP).

The Cambridge Stormwater Management Standards refer to the following concepts and terms, which are defined below for clarity:

- **Bioretention:** vegetated basins that temporarily store and filter stormwater runoff through an engineered soil media.
- **Detain/detention:** Temporarily hold runoff onsite, then discharge through outlet control.
- **Retain/retention:** Permanently keep runoff onsite. Infiltration is the most common type of retention practice.
- **Store/storage:** may be retention, detention or combination of both.
- **SCMs (stormwater control measures,** formerly referred to as BMPs): permanent stormwater controls that manage post-construction stormwater quantity and quality (e.g., infiltration or detention systems, bioretention etc.). BMPs (best management practices) refer to temporary construction controls that manage erosion and sedimentation (e.g., perimeter controls, inlet protection etc.)

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<sup>1</sup> <https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards>

## Summary of Cambridge Stormwater Management Standards

| Cambridge Standard                   | Requirements for:<br><u>Stormwater Control Permits</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Requirements for:<br><u>DPW Stormwater Site Plan Review</u>                                                                                                                          | Ways To Demonstrate Compliance                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Water Quality</b><br>(TP and TSS) | All projects are required to:<br>1. Ensure no net increase in average annual Total Phosphorus (TP) or Total Suspended Solids (TSS) load compared to total pre-construction site load (baseline conditions), AND<br>2. Remove 65% of the average annual Total Phosphorus load generated from post-construction impervious area on the site, AND<br>3. Remove 90% of the average annual TSS load for new development and 80% of the average annual TSS load for redevelopment generated from post-construction impervious area on the site. | Projects shall meet Cambridge Water Quality Standard to the Maximum Extent Practicable.<br><br>At minimum: no net increase in Total Phosphorus or TSS Load from existing conditions. | For phosphorus, use methodology for loading and reduction credits following methodology in EPA MS4 Permit Appendix F.<br><br>For TSS, if meeting Phosphorus reduction, TSS reduction is met. Otherwise, use EPA Performance Curves found in Appendix B of the <a href="#">New England Stormwater Retrofit Manual</a> (performance curves for TSS are not included in the MS4 permit). |
| <b>Recharge</b>                      | All projects shall retain the volume of runoff equivalent to, or greater than, the runoff depth required to meet the Cambridge Water Quality Phosphorus Standard multiplied by the total post-construction impervious surface area.                                                                                                                                                                                                                                                                                                       | Projects shall meet the Cambridge Recharge Standard to the Maximum Extent Practicable.<br><br>No minimum recharge requirements.                                                      | Show proposed SCMs contain required recharge volume (static storage) -OR- show no overflow at required recharge depth below lowest level outlet in model                                                                                                                                                                                                                              |
| <b>Peak Rate</b>                     | All projects are required to:<br>1. Ensure that the post-project peak discharge rates do not exceed the pre-project peak discharge rates from the site, AND<br>2. Store the difference in volume between the 2-year pre-construction and 25-year post-construction conditions on site. Storage may be a combination of retention and/or detention.                                                                                                                                                                                        | Projects shall meet Cambridge Peak Rate Standard to the Maximum Extent Practicable.<br><br>At minimum: post-development peak rates shall not exceed pre-development peak rates.      | Show that the difference in volume between the 2-year pre-construction and 25-year post-construction storm is stored on site, or that the peak rate of the 25-year post-construction storm is less than the 2-year pre-construction storm.                                                                                                                                            |

## 2.1 Water Quality Standards

The Cambridge Water Quality Standard applies to both Total Phosphorus (TP) and Total Suspended Solids (TSS). Projects are required to:

1. Ensure no net increase in average annual Total Phosphorus or Total Suspended Solids (TSS) load compared to total pre-construction site load (baseline conditions), and
2. Remove 65% of the average annual Total Phosphorus load generated from post-construction impervious area on the site, and
3. Remove 90% of the average annual TSS load for new development and 80% of the average annual TSS load for redevelopment generated from post-construction impervious area on the site.

Projects requiring Stormwater Control Permits must fully meet all three components of the Cambridge Water Quality Standard. Projects requiring DPW Stormwater Site Plan Review shall strive to meet all three components of the Standard, but at a minimum must demonstrate no net increase in TP or TSS loads compared to pre-construction (baseline loads).

**All calculations for phosphorus must follow methodology outlined in [EPA's Municipal Separate Storm Sewer System \(MS4\) Permit Appendix F](#).** Pollutant removal is calculated based on average annual loading and not individual storm events. Average annual pollutant removal requirements are achieved through one of the following methods:

1. Installing SCMs that meet the pollutant removal percentages based on calculations consistent with EPA's MS4 Permit Appendix F and EPA Region 1's BMP Accounting and Tracking Tool (2016), or
2. Retaining the volume of runoff equivalent to, or greater than, one (1.0) inch multiplied by the total post-construction impervious surface area on the new development site (0.8 inch for redevelopment site); or
3. A combination of installing SCMs and retention that achieves the above standards; or
4. Utilizing offsite mitigation that meets the above standards within the same USGS HUC12 watershed<sup>2</sup> as the development site within the City of Cambridge.

SCM types eligible to meet the Water Quality Standard include:

- Reduction in impervious cover
- Change in land use
- Retention/infiltration (subsurface galleries or chambers, dry wells, unlined swales)
- Porous pavement with underdrain (minimum 12" filter course depth)
- Rainwater harvesting
- Bioretention<sup>3</sup>
- Detention<sup>3</sup>

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<sup>2</sup> Watersheds are delineated by USGS using a nationwide system based on surface hydrologic features. HUC12 refers to a local sub watershed level (Hydrologic Unit Code 12) sufficient to ensure mitigation is applied in an area proximate to the impacts associated with land disturbance within the same sub-watershed.

<sup>3</sup> Note detention and bioretention practices alone cannot achieve 65% TP reduction for a project following EPA's performance curves for these controls (refer to MS4 Permit Appendix F).

A combination of eligible SCM types may be used to demonstrate compliance for a site.

Note there are several SCM types or methodologies that are *not* approved by the City to reduce phosphorus, including:

- Jellyfish filters
- Proprietary structures
- Isolator rows (may be used for pretreatment only)
- Change in impervious land cover type (e.g., parking lot converted to roof)

#### Total Maximum Daily Loads (TMDLs)

As of the date of this document, two TMDLs have been set for the lower basin of the [Charles River Watershed](#):

- Final Phosphorus TMDL for the Lower Charles River Basin
- Final Pathogen TMDL for the Charles River Watershed

In the [Mystic River Watershed](#), as of the date of this directive, a TMDL and alternative TMDL has been developed (under the Boston Harbor Watershed). The Alewife Brook is a sub watershed of the Mystic River Watershed.

- Final Pathogen TMDL Report for the Boston Harbor, Weymouth-Weir, and Mystic Watersheds
- Mystic River Watershed Alternative TMDL Development for Phosphorus Management - Final Report

Both the Charles River and Mystic River Watersheds are also included in the [Statewide Pathogen TMDL](#).

To address TMDLs, the Massachusetts MS4 Permit requires the reduction of Total Phosphorous (TP) discharging to impaired receiving waters. In Cambridge, 62% of TP load must be reduced in discharges to the Charles River by July 2038. The TP load reduction for the Alewife Brook (Mystic River Watershed) has not yet been finalized but TP load reductions are anticipated in future MS4 Permits. The intent of the Cambridge Water Quality Standard is to support MS4 permit compliance with these TMDLs and regulatory requirements for impaired waters.

#### Other Pollutants of Concern

Both the Charles River and the Alewife Brook are impaired for additional pollutants including solids, oil and grease (hydrocarbons), bacteria, chloride and/or metals. All treatment systems capable of satisfying the above requirements are also assumed to satisfy pollutant level criteria for other “pollutants of concern” for relevant water body impairments, with the exception of industrial and commercial projects noted below.

Industrial and commercial projects that discharge through the MS4 are obligated to implement additional protective practices to address impairments for solids, oil and grease (hydrocarbons), and metals. Practices must include designs that allow for shutdown and containment, where appropriate, to isolate the system in the event of an emergency spill or other unexpected event.

In conformance with MS4 requirements under Appendix H (V)(2)(a) the City requires “all stormwater management systems designed to infiltrate stormwater on commercial or industrial sites to provide the level of pollutant removal equal to or greater than the level of pollutant removal provided through the use of biofiltration of the same volume of runoff to be infiltrated, prior to infiltration.”

#### Calculation Steps for Water Quality

All calculations for phosphorus must follow methodology outlined in [MS4 Permit Appendix F.](#)

#### Calculation Steps to Determine Project Phosphorus Requirements:

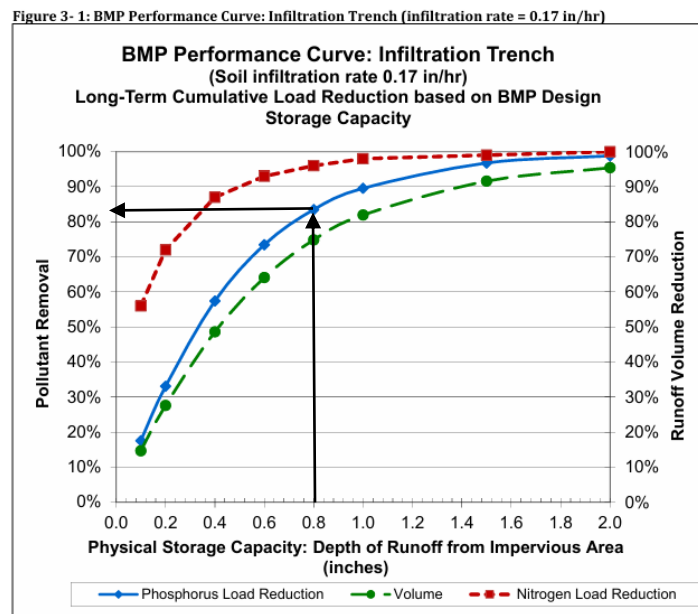
1. Calculate existing baseline phosphorus load for both impervious and pervious areas using [MS4 Appendix F Attachment 3, Table 3-1](#) (page F3-12) by land use. Results will be in pounds per year (lbs/yr).
2. Calculate post-construction phosphorus load for both impervious and pervious areas using the same Table 3-1.
3. Calculate reduction required for no net increase as: Total Site Proposed Load (lbs/yr) – Total Site Existing Load (lbs/yr)
4. Calculate reduction required for 65% phosphorus reduction as: Load from just Proposed Impervious Area (lbs/yr) \* 0.65
5. The project must meet the greater of the two load reduction requirements (i.e., meet both) to fully meet Standard.

### Calculation Steps to Determine Project TSS Requirements:

For TSS calculations, follow the same methodology as phosphorus for either 90% load reduction for new development or 80% reduction for redevelopment. TSS loading rates are not included in MS4 Permit Appendix F, but are included in [Appendix D of the New England Stormwater Retrofit Manual](#), which is consistent with EPA pollutant loading rates and methodology outlined in Appendix F.

### Calculation Steps to Determine SCM Phosphorus Treatment Credit:

1. Use Table 3-5 in the MS4 Permit Appendix F Attachment 3 to find the best fit for the proposed SCM (Stormwater Control Type column) on the description and function of the design. Note the applicable Stormwater Control Performance Curve.
2. Calculate the Design Storage Capacity (volume) using the equations listed in Table 3-5 or volume below lowest level outlet from model.
3. Convert Design Storage Capacity to treatment depth (depth of runoff from impervious area) calculated as: Design Storage Capacity / Contributing Impervious Area<sup>4</sup>. Units will be in inches. Note contributing impervious area is the upstream catchment area draining to the individual SCM.
4. Using the applicable Stormwater Control Performance Curve, find Depth of Runoff from Impervious Area on the x axis and the corresponding percent pollutant removal on the y axis. In the example below, for a 0.8-inch runoff depth, the percent phosphorus removal is 83%.



5. Multiply the percent phosphorus removal by the total phosphorus load to the SCM (calculated using land use rates in Table 3-1) to get a load reduction in lbs/yr. The load to the SCM should only be calculated for upstream catchment areas draining to the individual SCM.

<sup>4</sup> If significant pervious area contributes to the SCM, follow steps in Flow Chart 4 of MS4 Permit Appendix F Attachment 3 to determine if SCM Design Storage Capacity needs to be adjusted. If runoff volume from contributing pervious surfaces is less than 5% of total SCM storage capacity, this adjustment is not required.

6. For sites with multiple SCMs, repeat for each individual SCM to get a total phosphorus treatment credit for the entire site.

For additional example calculations, see MS4 Permit Appendix F Attachment 3 (Examples 3-1 through 3-4) and Appendix E of the New England Stormwater Retrofit Manual.

Calculation Steps to Determine SCM TSS Treatment Credit:

For TSS calculations, follow the same methodology as phosphorus for Steps 1-3. For Step 4, TSS Performance Curves are not included in MS4 Permit Appendix F, but are included in [Appendix B of the New England Stormwater Retrofit Manual](#), which is consistent with EPA pollutant loading rates and methodology outlined in Appendix F.

### Water Quality Example 1: Calculating Project Phosphorus Requirements

Redevelopment project with land use of High Density Residential and HSG B soils. Because this project parcel is 1 acre, this project will require a Stormwater Control Permit.

|                  | Existing Conditions                  |                                      |                                         | Proposed Conditions                  |                                      |                                         |
|------------------|--------------------------------------|--------------------------------------|-----------------------------------------|--------------------------------------|--------------------------------------|-----------------------------------------|
|                  | Impervious                           | Pervious                             | Total                                   | Impervious                           | Pervious                             | Total                                   |
| Area (ac)        | 0.1                                  | 0.9                                  | 1.0                                     | 0.8                                  | 0.2                                  | 1.0                                     |
| TP Load (lbs/yr) | 0.1ac * 2.32 lbs/ac/yr = 0.23 lbs/yr | 0.9ac * 0.12 lbs/ac/yr = 0.11 lbs/yr | 0.23 lbs/yr + 0.11 lbs/yr = 0.34 lbs/yr | 0.8ac * 2.32 lbs/ac/yr = 1.86 lbs/yr | 0.2ac * 0.12 lbs/ac/yr = 0.02 lbs/yr | 1.86 lbs/yr + 0.02 lbs/yr = 1.88 lbs/yr |

**Table 3-1: Average annual distinct phosphorus (P) load export rates for use in estimating P load reduction credits in the MA MS4 Permit**

| Phosphorus Source Category by Land Use                                                                                                                                                                                                              | Land Surface Cover            | P Load Export Rate, lbs/acre/year |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------------------------|
| Commercial (COM) and Industrial (IND)                                                                                                                                                                                                               | Directly connected impervious | 1.78                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Multi-Family (MFR) and High-Density Residential (HDR)                                                                                                                                                                                               | Directly connected impervious | 2.32                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Medium-Density Residential (MDR)                                                                                                                                                                                                                    | Directly connected impervious | 1.96                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Low Density Residential (LDR) - "Rural"                                                                                                                                                                                                             | Directly connected impervious | 1.52                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Highway (HWY)                                                                                                                                                                                                                                       | Directly connected impervious | 1.34                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Forest (FOR)                                                                                                                                                                                                                                        | Directly connected impervious | 1.52                              |
|                                                                                                                                                                                                                                                     | Pervious                      | 0.13                              |
| Open Land (OPEN)                                                                                                                                                                                                                                    | Directly connected impervious | 1.52                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Agriculture (AG)                                                                                                                                                                                                                                    | Directly connected impervious | 1.52                              |
|                                                                                                                                                                                                                                                     | Pervious                      | 0.45                              |
| *Developed Land Pervious (DevPERV) – HSG A                                                                                                                                                                                                          | Pervious                      | 0.03                              |
| *Developed Land Pervious (DevPERV) – HSG B                                                                                                                                                                                                          | Pervious                      | 0.12                              |
| *Developed Land Pervious (DevPERV) – HSG C                                                                                                                                                                                                          | Pervious                      | 0.21                              |
| *Developed Land Pervious (DevPERV) – HSG C/D                                                                                                                                                                                                        | Pervious                      | 0.29                              |
| *Developed Land Pervious (DevPERV) – HSG D                                                                                                                                                                                                          | Pervious                      | 0.37                              |
| Notes:                                                                                                                                                                                                                                              |                               |                                   |
| <ul style="list-style-type: none"> <li>For pervious areas, if the hydrologic soil group (HSG) is known, use the appropriate value from this table. If the HSG is not known, assume HSG C conditions for the phosphorus load export rate.</li> </ul> |                               |                                   |

| Example 1 – Project Phosphorus Requirement                   | Phosphorus Reduction Requirement (lbs/yr) |
|--------------------------------------------------------------|-------------------------------------------|
| No net increase in load compared to total existing site load | 1.88 – 0.34 = 1.54 lbs/yr                 |
| 65% reduction of load generated from post-construction IC    | 1.86 * 0.65 = 1.21 lbs/yr                 |

For this project, no net increase in phosphorus load is the most stringent requirement. SCMs on site must reduce phosphorus by at least 1.54 lbs/yr.

## Water Quality Example 2: Calculating Project Phosphorus Requirements

Redevelopment project with land use of High Density Residential and HSG B soils. Because this project parcel is 1 acre, this project will require a Stormwater Control Permit.

|                  | Existing Conditions                  |                                      |                                         | Proposed Conditions                  |                                      |                                        |
|------------------|--------------------------------------|--------------------------------------|-----------------------------------------|--------------------------------------|--------------------------------------|----------------------------------------|
|                  | Impervious                           | Pervious                             | Total                                   | Impervious                           | Pervious                             | Total                                  |
| Area (ac)        | 0.6                                  | 0.4                                  | 1.0                                     | 0.9                                  | 0.1                                  | 1.0                                    |
| TP Load (lbs/yr) | 0.6ac * 2.32 lbs/ac/yr = 1.39 lbs/yr | 0.4ac * 0.12 lbs/ac/yr = 0.05 lbs/yr | 1.39 lbs/yr + 0.05 lbs/yr = 1.44 lbs/yr | 0.9ac * 2.32 lbs/ac/yr = 2.09 lbs/yr | 0.1ac * 0.12 lbs/ac/yr = 0.01 lbs/yr | 2.09 lbs/yr + 0.01 lbs/yr = 2.1 lbs/yr |

**Table 3-1: Average annual distinct phosphorus (P) load export rates for use in estimating P load reduction credits in the MA MS4 Permit**

| Phosphorus Source Category by Land Use                                                                                                                                                                                                              | Land Surface Cover            | P Load Export Rate, lbs/acre/year |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------------------------|
| Commercial (COM) and Industrial (IND)                                                                                                                                                                                                               | Directly connected impervious | 1.78                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Multi-Family (MFR) and High-Density Residential (HDR)                                                                                                                                                                                               | Directly connected impervious | 2.32                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Medium -Density Residential (MDR)                                                                                                                                                                                                                   | Directly connected impervious | 1.96                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Low Density Residential (LDR) - "Rural"                                                                                                                                                                                                             | Directly connected impervious | 1.52                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Highway (HWY)                                                                                                                                                                                                                                       | Directly connected impervious | 1.34                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Forest (FOR)                                                                                                                                                                                                                                        | Directly connected impervious | 1.52                              |
|                                                                                                                                                                                                                                                     | Pervious                      | 0.13                              |
| Open Land (OPEN)                                                                                                                                                                                                                                    | Directly connected impervious | 1.52                              |
|                                                                                                                                                                                                                                                     | Pervious                      | See* DevPERV                      |
| Agriculture (AG)                                                                                                                                                                                                                                    | Directly connected impervious | 1.52                              |
|                                                                                                                                                                                                                                                     | Pervious                      | 0.45                              |
| *Developed Land Pervious (DevPERV) – HSG A                                                                                                                                                                                                          | Pervious                      | 0.03                              |
| *Developed Land Pervious (DevPERV) – HSG B                                                                                                                                                                                                          | Pervious                      | 0.12                              |
| *Developed Land Pervious (DevPERV) – HSG C                                                                                                                                                                                                          | Pervious                      | 0.21                              |
| *Developed Land Pervious (DevPERV) – HSG C/D                                                                                                                                                                                                        | Pervious                      | 0.29                              |
| *Developed Land Pervious (DevPERV) – HSG D                                                                                                                                                                                                          | Pervious                      | 0.37                              |
| Notes:                                                                                                                                                                                                                                              |                               |                                   |
| <ul style="list-style-type: none"> <li>For pervious areas, if the hydrologic soil group (HSG) is known, use the appropriate value from this table. If the HSG is not known, assume HSG C conditions for the phosphorus load export rate.</li> </ul> |                               |                                   |

| Example 2 – Project Phosphorus Requirement                   | Phosphorus Reduction Requirement (lbs/yr) |
|--------------------------------------------------------------|-------------------------------------------|
| No net increase in load compared to total existing site load | 2.1 – 1.44 = 0.66 lbs/yr                  |
| 65% reduction of load generated from post-construction IC    | 2.09 * 0.65 = 1.36 lbs/yr                 |

For this project, 65% reduction in post-construction impervious phosphorus load is the most stringent requirement. SCMs on site must reduce phosphorus by at least 1.36 lbs/yr.

### Water Quality Example 3: Calculating Project Phosphorus Requirements

Redevelopment project with land use of High Density Residential and HSG B soils. Because this parcel is more than 5,000 sq ft and impervious cover is increasing by 1,000 sq ft, this project will require DPW Stormwater Site Plan Review as part of the Building Permit.

|                                 | Existing Conditions                   |                                       |                                           | Proposed Conditions                   |                                        |                                            |
|---------------------------------|---------------------------------------|---------------------------------------|-------------------------------------------|---------------------------------------|----------------------------------------|--------------------------------------------|
|                                 | Impervious                            | Pervious                              | Total                                     | Impervious                            | Pervious                               | Total                                      |
| Area (sq ft)                    | 3,500                                 | 2,500                                 | 6,000                                     | 4,500                                 | 1,500                                  | 6,000                                      |
| Area (ac)                       | 0.08                                  | 0.06                                  | 0.14                                      | 0.1                                   | 0.04                                   | 0.14                                       |
| Loading Rate from MS4 Table 3-1 | 2.32 lbs/ac/yr                        | 0.12 lbs/ac/yr                        |                                           | 2.32 lbs/ac/yr                        | 0.12 lbs/ac/yr                         |                                            |
| TP Load (lbs/yr)                | 0.08ac * 2.32lbs/ac/yr = 0.186 lbs/yr | 0.06ac * 0.12 lbs/ac/yr = 0.01 lbs/yr | 0.186 lbs/yr + 0.01 lbs/yr = 0.196 lbs/yr | 0.1ac * 2.32 lbs/ac/yr = 0.232 lbs/yr | 0.04ac * 0.12 lbs/ac/yr = 0.005 lbs/yr | 0.232 lbs/yr + 0.005 lbs/yr = 0.237 lbs/yr |

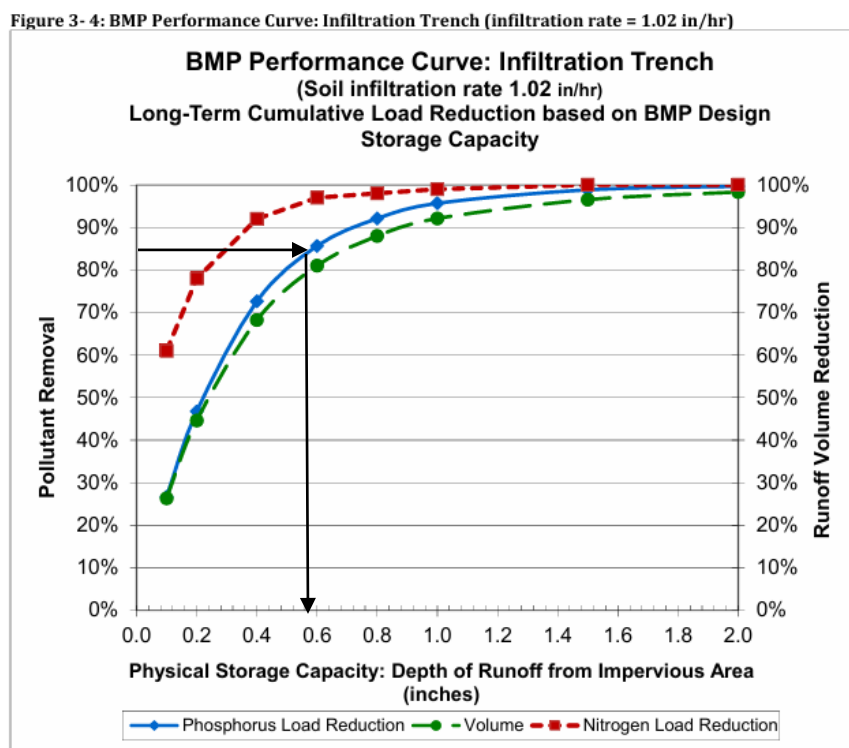
| Example 3 – Project Phosphorus Requirement                   | Phosphorus Reduction Requirement (lbs/yr) |
|--------------------------------------------------------------|-------------------------------------------|
| No net increase in load compared to total existing site load | $0.237 - 0.196 = 0.04 \text{ lbs/yr}$     |
| 65% reduction of load generated from post-construction IC    | $0.232 * 0.65 = 0.15 \text{ lbs/yr}$      |

For this project, 65% reduction in post-construction impervious phosphorus load is the most stringent requirement. This project should strive to include SCMs that reduce phosphorus by at least 0.15 lbs/yr. At minimum, the project must reduce phosphorus by 0.04 lbs/yr to ensure no increase in phosphorus loading.

#### Water Quality Example 4: Calculating SCM Treatment Credit

For Project Example 1, with a phosphorus reduction requirement of 1.54 lbs/yr, the SCM Performance Curves can be used to help inform site design and size SCMs. The designer determines infiltration rates on the site are 1.02 in/hr and plans to propose a subsurface infiltration system.

Treating 1.54 lbs/yr of the total 1.88 lbs/yr post-construction load is an 83% reduction. Using the Infiltration Trench (subsurface infiltration) curve, this corresponds to a treatment depth of approximately 0.6 inches. This information can be used when starting to size SCMs on site.



The designer determines it is feasible to direct 0.7 acres of the proposed impervious cover to a subsurface infiltration system with a design storage capacity of 2,700 ft<sup>3</sup>.

#### Calculation Steps:

1. According to Table 3-5 in the MS4 Permit Appendix F Attachment 3, a subsurface infiltration system (row 2) uses the Infiltration Trench curve.
2. The design storage capacity was calculated as 2,700 ft<sup>3</sup> using the equation in Table 3-5 (calculated static volume as the volume of galleys/chambers plus the volume of the void space of backfill materials or the volume below the lowest level outlet of the system in model).
3. Treatment Depth is calculated as: Design Storage Capacity / Contributing Impervious Area.  
$$2700 \text{ ft}^3 / (0.7 \text{ ac} * 43,560 \text{ ft}^2/\text{ac}) * 12 \text{ in/ft} = 1.06 \text{ inches}$$
4. Using the Infiltration Trench Curve with soil infiltration rate of 1.02 in/hr (also Table 3-10), the corresponding percent pollutant removal on the y axis is 96%.

Figure 3- 4: BMP Performance Curve: Infiltration Trench (infiltration rate = 1.02 in/hr)

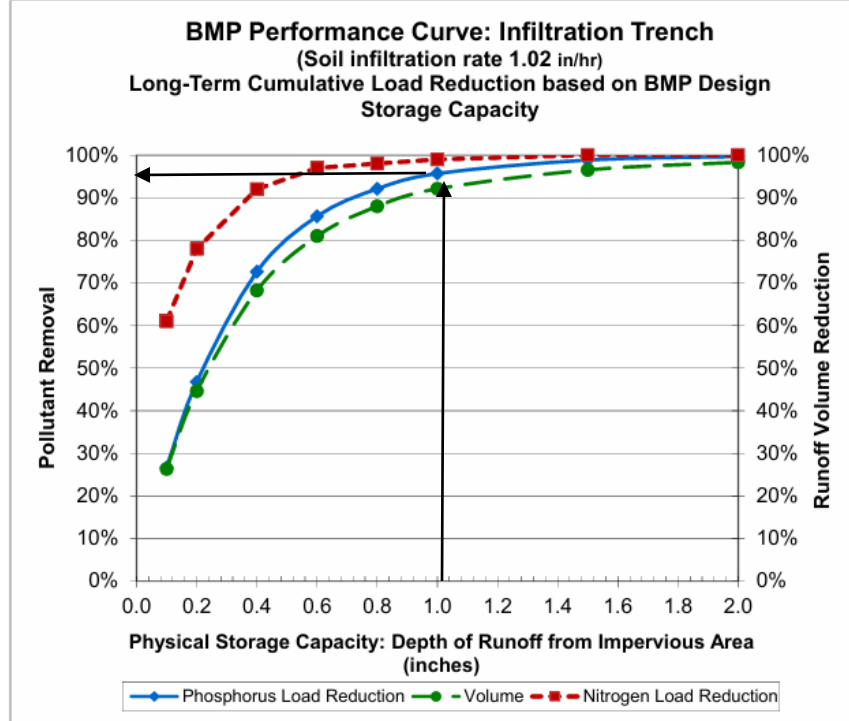


Table 3- 10: Infiltration Trench (IR = 1.02 in/hr) SCM Performance Table

| Infiltration Trench (IR = 1.02 in/hr) SCM Performance Table:<br>Long-Term Phosphorus & Nitrogen Load Reduction |       |       |       |       |       |       |       |       |
|----------------------------------------------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| SCM Capacity: Depth of Runoff from Impervious Area (inches)                                                    | 0.1   | 0.2   | 0.4   | 0.6   | 0.8   | 1.0   | 1.5   | 2.0   |
| Runoff Volume Reduction                                                                                        | 26.3% | 44.6% | 68.2% | 81.0% | 88.0% | 92.1% | 96.5% | 98.3% |
| Cumulative Phosphorus Load Reduction                                                                           | 27%   | 47%   | 73%   | 86%   | 92%   | 96%   | 99%   | 100%  |
| Cumulative Nitrogen Load Reduction                                                                             | 61%   | 78%   | 92%   | 97%   | 98%   | 99%   | 100%  | 100%  |

5. The load to the SCM is 1.62 lbs/yr (0.7 acres \* 2.32 lbs/ac/yr for high density residential impervious cover). Total phosphorus removed by the SCM is 1.56 lb/yr:

$$1.62 \text{ lbs/yr} * 0.96 = 1.56 \text{ lbs/yr}$$

This SCM treats 1.56 lbs/yr and meets the phosphorus reduction requirement for the project.

## 2.2 Recharge Standard

For the Cambridge Recharge Standard, projects are required to:

1. Retain the volume of runoff equivalent to, or greater than, the runoff depth required to meet the Cambridge Water Quality Phosphorus Standard multiplied by the total post-construction impervious surface area.

Projects requiring Stormwater Control Permits must fully meet the Cambridge Recharge Standard. Projects requiring DPW Stormwater Site Plan Review shall strive to the Standard to the Maximum Extent Practicable (refer to Section 3B). Cambridge encourages maximizing the extent to which runoff from the project site is infiltrated to groundwater, provided that soil and groundwater contamination is not exacerbated in accordance with MassDEP guidelines.

SCM types eligible to meet the Recharge Standard include:

- Infiltration practices
- Rainwater harvesting for irrigation

For purposes of meeting the Recharge Standard, retention shall be infiltration SCMs or rainwater harvesting used for irrigation. Detention or filtration practices (e.g., systems with underdrains) are not eligible to contribute toward recharge.

### Calculation Steps for Recharge

1. Determine phosphorus percent reduction required.
  - If most stringent phosphorus reduction requirement is 65%, percentage = 65%
  - If most stringent requirement is no net increase in phosphorus, calculate percent of load from post-construction IC that is reduced.
2. Use EPA Performance curve for either Surface Infiltration (Infiltration Basin) or Subsurface Infiltration (Infiltration Trench) and site soils to determine treatment depth (runoff depth).

For most projects where 65% reduction is most stringent and subsurface infiltration is proposed, required treatment depths to meet recharge standard are:

| HSG | Soil Infiltration Rate (in/yr) | Runoff Depth Required to Achieve 65% TP Reduction Using Subsurface Infiltration SCMs |
|-----|--------------------------------|--------------------------------------------------------------------------------------|
| A   | 8.27                           | 0.16                                                                                 |
| A   | 2.41                           | 0.28                                                                                 |
| B   | 1.02                           | 0.33                                                                                 |
| B   | 0.52                           | 0.37                                                                                 |
| C   | 0.27                           | 0.43                                                                                 |
| C   | 0.17                           | 0.50                                                                                 |
| D   | 0.10                           | 0.53                                                                                 |

3. Multiply required treatment depth (runoff depth) by post-construction impervious area to get recharge volume.

### Recharge Example 1: Calculating Project Requirements

Redevelopment project with land use of High Density Residential and HSG B soils. Because this project parcel is 1 acre, this project will require a Stormwater Control Permit.

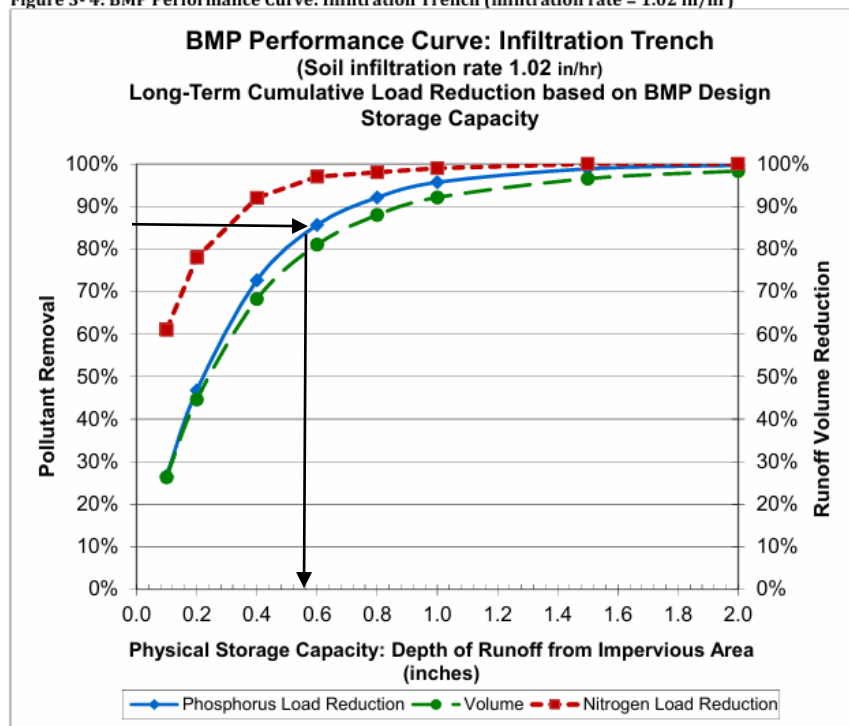
#### Calculation Steps to Determine Required Recharge Volume:

1. The most stringent phosphorus requirement for this project is no net increase in phosphorus (See Water Quality Example 1 in Section 2.1); 1.54 lbs/yr must be reduced, which is an 83% reduction:

$$1.54 \text{ lbs/yr} \div 1.86 \text{ lbs/yr} = 0.83$$

2. Since a subsurface infiltration SCM is proposed with a soil infiltration rate of 1.02 in/hr, use the Infiltration Trench Performance Curve for that soil rate to determine the treatment depth required to achieve an 83% reduction in phosphorus. This is 0.56 inches:

Figure 3- 4: BMP Performance Curve: Infiltration Trench (infiltration rate = 1.02 in/hr)



3. The required volume is This volume retained on 0.56 inches conversion) 43,560 unit = 1,626 ft<sup>3</sup>

minimum recharge 1,626 ft<sup>3</sup>. must be site.

\* (1/12 unit  
\* (0.8 ac \*  
conversion)

The storage volume of the infiltration SCM counts towards the recharge volume. The subsurface infiltration SCM with a design storage volume of 2,700 ft<sup>3</sup> (see Water Quality Example 1) meets the recharge requirement for the project site.

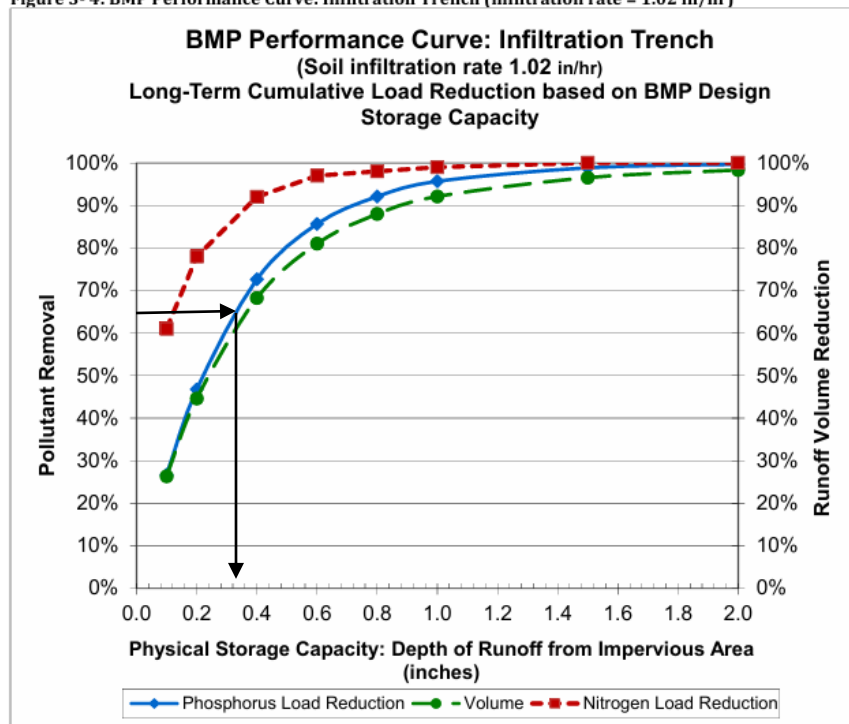
## Recharge Example 2: Calculating Project Requirements

Redevelopment project with land use of High Density Residential and HSG B soils. Because this project parcel is 1 acre, this project will require a Stormwater Control Permit.

### Calculation Steps to Determine Required Recharge Volume:

1. The most stringent phosphorus requirement for this project is 65% phosphorus reduction (See Water Quality Example 2 in Section 2.1).
2. A subsurface infiltration SCM is proposed with a soil infiltration rate of 1.02 in/hr. Use the Infiltration Trench Performance Curve for that soil rate to determine the treatment depth required to achieve an 65% reduction in phosphorus. This is 0.33 inches:

Figure 3- 4: BMP Performance Curve: Infiltration Trench (infiltration rate = 1.02 in/hr)



3. The minimum required recharge volume is 1,078 ft<sup>3</sup>. This volume must be retained on site.

$$0.33 \text{ inches} * (1/12 \text{ unit conversion}) * (0.9 \text{ ac} * 43,560 \text{ unit conversion}) = 1,078 \text{ ft}^3$$

The total volume of all infiltration SCMs proposed on site must be at least 1,078 ft<sup>3</sup>. Any detention or filtration practices (e.g., systems with underdrains) may be proposed to help achieve compliance with Water Quality or Peak Rate Standards, but do not count towards compliance with the Recharge Standard.

## 2.3 Peak Rate Standard

For the Cambridge Peak Rate Standard, projects are required to:

1. Ensure that the post-project peak discharge rates do not exceed the pre-project peak discharge rates from the site, AND
2. Store the difference in volume between the 2-year pre-construction and 25-year post-construction conditions on site. Storage may be a combination of retention and/or detention.

Projects requiring Stormwater Control Permits must fully meet both components of the Cambridge Peak Rate Standard. Projects requiring DPW Stormwater Site Plan Review shall strive to meet both components of the Standard, but at a minimum must demonstrate post-project peak rates do not exceed pre-project peak rates.

The Peak Rate Standard requires that sites store the difference between the 2-year 24-hour pre-construction runoff hydrograph from the site and the post construction 25-year 24-hour runoff hydrograph from the site utilizing the City's projected rainfall data for the 2070 storm event as shown in Table 1 and storm type NOAA 10 Type D<sup>5</sup>. Projected Cambridge 2070 storm events shall be used for calculating the required post construction runoff storage.

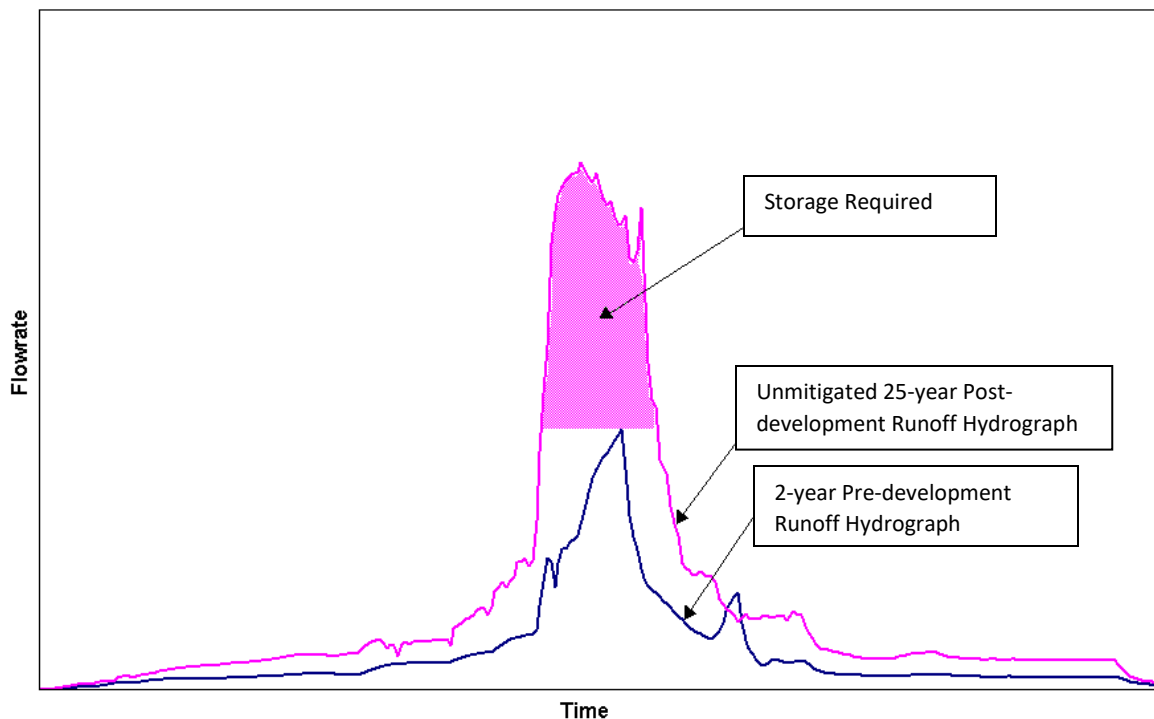
**Table 1. Projected 2070 24-Hour Design Storm Depths**

|                       | 2-Year<br>(in) | 10-Year<br>(in) | 25-Year<br>(in) | 100-Year<br>(in) |
|-----------------------|----------------|-----------------|-----------------|------------------|
| <b>Cambridge 2070</b> | 3.65           | 6.40            | 8.22            | 11.70            |

As a general rule, for properties discharging into the City of Cambridge municipal drainage system the City will provide a drainage level of service capacity to accept and transport up to the 2-year storm event. The stormwater runoff detention requirement states that the total volume of runoff generated between the pre-development 2-year 24-hour storm peak discharge and the unmitigated (i.e., prior to implementation of SCMs) post development 25-year 24-hour storm peak discharge shall be retained. Figure 3-1 illustrates this requirement with hypothetical stormwater runoff plots. The shaded area (the area between the peak 2-year runoff and the 25-year runoff) represents the quantity of stormwater retention required for achieving compliance with the City's stormwater quantity control rule.

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<sup>5</sup> This storm type is consistent with modeling efforts used to develop the Cambridge 2025 Flood Viewer.



**Figure 3-1: Onsite Storage Requirements**

Measurement of peak discharge rates must be calculated using the point of discharge or downgradient property boundary. The topography of the site may require evaluation at more than one location if flow leaves the property in more than one direction. An applicant may demonstrate that a feature beyond the property boundary (e.g. culvert) is more appropriate as a design point.

SCM Types eligible to meet the Peak Rate Standard include:

- Reduction in impervious cover
- Retention/infiltration (subsurface galleys or chambers, dry wells, unlined swales)
- Porous pavement with underdrain (minimum 12" filter course depth)
- Rainwater harvesting
- Bioretention
- Detention

For purposes of meeting peak rate control, storage volume includes infiltration SCMs, rainwater harvesting for irrigation or greywater reuse, filtering SCMs (i.e., underdrained systems) and detention practices. A combination of eligible SCM types may be used to demonstrate compliance for a site.

## 2.4 Flood Resiliency Standards

The Flood Resiliency Zoning requirements, initially adopted in February 2023, are to address the long-term impacts of increased flooding and extreme heat from climate change. The Flood Resilience Standards require that buildings address the potential for flooding that is the result of increased intensity rain events and storms. **These requirements are independent of Stormwater Control Permits or Building Permits but require DPW review under the Flood Resilience Compliance Confirmation if triggered by Cambridge Zoning Bylaws.**

Projects of all sizes should review projected flood elevations for the project parcel from [2025 Flood Viewer](#) to determine if “Long-Term Flood Elevations” (LTFEs) apply to your project per Section 22.80 of the City’s Zoning Bylaws.

To learn more about the Flood Resiliency Standards please review the following link:  
<https://www.cambridgema.gov/Services/climateresiliencezoning>.

## 3A. Submission Requirements for Stormwater Control Permits

Projects requiring stormwater control permits must fully meet the Cambridge Stormwater Standards using one or more SCM types listed in Section 2 as eligible for water quality, recharge and peak rate control.

Designers should ensure that stormwater runoff, as a result of the project, does not have a negative impact on abutting property. The Stormwater Management Plan should include a certification statement from the design engineer that the drainage design was evaluated for impacts to abutters and that there are no impacts to abutting properties. Stormwater systems designed to infiltrate must be set back minimum 5 feet from all property lines<sup>6</sup>, and a minimum of 10 feet from an existing building on an adjacent property.

Refer to the Cambridge Wastewater and Stormwater Management Guidance Document [Appendix G](#) (September 2019) for the following checklists:

- **Stormwater Control Checklist** – to be used in the preparation of and submitted along with the Stormwater Control Permit Application package.
- **Stormwater Management Plan Checklist** – to be used in the preparation of and submitted along with the Stormwater Management Plan.
- **Erosion and Sediment Control Plan** (including O&M Plan for Temporary BMPs) Checklist – to be used in the preparation of and submitted along with the Erosion and Sediment Control Plan. Per Appendix G Stormwater Control Permit Checklists of the Wastewater and Stormwater Guidance Document, the City requires the contractor to post information related to the approved Stormwater Control Permit at the entrance to the site in order that the public may have the opportunity to comment on erosion or water quality concerns and how to submit their concerns.
- **Operation and Maintenance Plan Checklist** – to be used in the preparation of and submitted along with the Operation and Maintenance Plan. This checklist can also be used to assist with periodic updates to the O&M Plan. Per City of Cambridge Land

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<sup>6</sup> A reduced setback for property lines that abut a public right-of-way may be allowable per DPW review and approval.

Disturbance Regulations Article VI – Operation and Maintenance Standards, the project owner is responsible for maintenance and shall prepare and submit to the DPW for approval an Operation and Maintenance Plan for the stormwater management measures incorporated in the Stormwater Control Permit. In addition, the owner of the property shall submit to DPW a certification annually that inspections and maintenance of the stormwater management measures have been performed according to these regulations.

Plans must be stamped by Commonwealth of MA Registered Professional Civil Engineer or Land Surveyor. The engineering design must conform to all applicable standards and good engineering practice.

After construction is completed, an as-built plan and a CAD file of the as-built plan must be submitted to DPW showing all building and utility as-built locations. The plan must be signed by the design engineer or land surveyor.

### 3B. Submission Requirements for DPW Stormwater Site Plan Review as Part of Building Permit

Projects requiring DPW Stormwater Site Plan Review should strive to fully meet the Cambridge Stormwater Standards using one or more SCM types listed in Section 2 as eligible for water quality, recharge and peak rate control. Projects in this category may demonstrate that while full compliance with the Standards is not feasible, compliance was met to the Maximum Extent Practicable, defined as:

- Applicants have illustrated that they have made all reasonable efforts to meet the applicable requirements;
- Applicants have made a complete evaluation of possible stormwater management measures which could be used on site including environmentally sensitive site design that minimizes land disturbance and impervious surfaces, LID techniques, and stormwater SCMs; and,
- If not in full compliance with the applicable requirements, applicants are implementing the highest practicable level of stormwater management.

For peak rate control, if site constraints exist, provide analysis of 2070 10-year storm or maximum extent possible. At a minimum, projects requiring DPW Stormwater Site Plan review must demonstrate no net increase in phosphorus loading and that post-development peak rates do not exceed pre-development peak rates.

Designers should ensure that stormwater runoff, as a result of the project, does not have a negative impact on an abutting property. The Stormwater Management Plan should include a certification statement from the design engineer that the drainage design was evaluated for impacts to abutters and that there are no impacts to abutting properties. Stormwater systems designed to infiltrate must be set back minimum 5 feet from all property lines, and a minimum of 10 feet from an existing building on an adjacent property.

Submission to the DPW should include, but is not limited to, a Civil Engineering Site/Utility Plan, Stormwater Management Calculations and Report, and an Operation and Maintenance Plan for Stormwater Management System. Refer to the DPW Site Plan Review Requirements

document<sup>7</sup> for guidance on site plan submission requirements. Runoff calculations, system sizing calculations, design details, and overflow configuration should be provided with the stormwater management system proposal.

Plans must be stamped by Commonwealth of MA Registered Professional Civil Engineer or Land Surveyor. The engineering design must conform to all applicable standards and good engineering practice.

After construction is completed, an as-built plan must be submitted to DPW showing all building and utility as-built locations. The plan must be signed by the design engineer or land surveyor. In addition, the owner of the property may be required to submit to DPW a certification annually that inspections and maintenance of the stormwater management measures have been performed.

### 3C. Recommendations for Small Projects

Projects on parcels less than 5,000 square feet and less than 1,000 square foot of increase in impervious cover do not have stormwater management requirements under Cambridge regulations (check if federal or state requirements are still applicable). For projects of this scope and size, the City recommends site improvements to improve stormwater management, such as:

- Disconnecting roof leaders and directing runoff towards pervious surfaces, such as rain gardens, vegetated swales, or grass filter strips.
- Connecting roof leaders to dry wells or rain barrels.
- Reducing impervious cover on site by using permeable materials for driveways, walkways and patios (e.g., porous asphalt, pervious concrete, paving stones etc.)

Helpful resources:

- [Sustainable Landscape Handbook](#). See page 15 for information on installation of rain barrels and page 38 for information on designing a rain garden.
- [Reducing Impervious Surfaces](#)
- [Pervious Walkways and Patios](#)
- Building [Rain Gardens](#)
- Installing [Dry Wells](#)
- Installing [Rain Barrels](#)

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<sup>7</sup> The DPW Site Plan Review requirements document is available online on the City's stormwater website: [Developers and Contractors - City of Cambridge, MA](#)