Memorandum

To: DCR Stormwater Section
10 Park Plaza
Boston, MA 02116

Date: 6/26/2024

Project #: 15722.00

From: Sarah Nalven
Kelly Siry, PE

Re: Charles River and Lake & Pond Phosphorus Control Plan Annual Performance Review – Permit Year 6

VHB has completed a performance evaluation of DCR's Phosphorus Control Plans for the Charles River Watershed (Charles River PCP) and Lake and Pond Watersheds (Lake & Pond PCPs), as required annually by the 2016 National Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts (MS4 Permit) beginning in Permit Year (PY) 6.

Introduction

DCR has developed a Charles River PCP and three Lake & Pond PCPs in accordance with the MS4 Permit. DCR submitted these PCPs to the Environmental Protection Agency (EPA) in June 2023 or PY5. Requirements for these reports are included in the MS4 Permit's Appendix F, Section A.I, entitled "Charles River Watershed Phosphorus TMDL Requirements" and Appendix F, Section A.II, entitled "Lake and Pond Phosphorus TMDL Requirements." Requirements include planning for and implementing stormwater best management practices (BMPs) to achieve numeric phosphorus reduction requirements.

The MS4 Permit Appendix F requires permittees to complete an annual performance evaluation of their PCPs beginning in PY6, i.e. this year. The performance evaluation "shall evaluate the effectiveness of the PCP by tracking the phosphorus reductions achieved through implementation of structural and non-structural BMPs and tracking increases resulting from development." The results of the performance evaluation must be reported in the permittee's annual report each year.

Over the last permit year, DCR completed requirements of the PCP performance evaluation, including tracking phosphorus load changes due to development and calculating phosphorus treatment credit from newly mapped BMPs. The following sections provide the results of these efforts and DCR's current progress toward meeting the PCP load reduction requirements for the Charles River and Lake & Pond PCPs.

PY6 Baseline Phosphorus Load Update

As required by the MS4 Permit in PY6, VHB reviewed DCR's properties within the Charles River and Lake & Pond PCP Watersheds and calculated the change to DCR's baseline load since 2005. Baseline load calculations submitted in the PCPs were based on impervious cover and land use data from 2005. Beginning in PY6, DCR is required to calculate changes to baseline load due to development as part of the annual PCP performance evaluation.

Methods for Determining Baseline Phosphorus Load Change

VHB considered various approaches to calculating DCR's phosphorus load change due to development. The MS4 Permit requires load change to be evaluated annually, so in selecting a process for PY6 calculations, VHB considered repeatability, as well as accuracy, cost, and efficiency.

Memorandum

Approaches Considered

VHB considered using the Charles River Watershed Association's (CRWA) updated land use and impervious cover data layer that was developed in 2023.[1] The purpose of developing this layer was to allow communities in the Charles River Watershed to "assess their current phosphorus loads due to land use" to meet the MS4 Permit requirements. VHB was concerned that since this data layer was grant funded, if this layer were used for the analysis, the same type of data creation may not be funded in the future for annual reviews of impervious cover, thereby limiting the repeatability of this method. Additionally, this data layer was developed for only the Charles River Watershed and VHB would have to use a different method for the Lake & Pond PCP Watersheds.

VHB also explored the approach of purchasing updated impervious cover data from NearMap and comparing that data to the 2005 impervious cover data to identify areas that had changed due to development. This approach would provide the most accurate impervious cover data and would be repeatable each year. NearMap typically provides impervious cover data on a per parcel basis and because DCR needs this data statewide, this method was determined to be cost prohibitive.

Selected Approach

Ultimately, VHB opted for a manual approach to reviewing impervious cover and land use changes to calculate baseline load updates. In 2020, VHB had performed a manual review of changes, so the PY6 review only had to account for about four years of changes. This approach also maximizes accuracy, is more cost effective than the NearMap option, and unlike the CRWA layer approach, is repeatable for future PCP performance reviews.

To calculate baseline load updates due to development, VHB reviewed 2023 aerial imagery within each of the MS4-regulated DCR properties in PCP watersheds and identified changes to impervious cover and land use since the 2020 review. VHB created two GIS layers to track addition and removal of impervious areas and changes to land use. VHB then calculated current-day baseline load using the same methodology used to calculate the original 2005 load. This methodology is detailed in Chapter 3 of the "Methods for Phosphorus Control Plan and Nutrient Source Identification Report Development"[2] (Methods for PCP & NSIR Development), which is an attachment to the PCPs. Once current-day load was calculated, this load could be compared to 2005 load to calculate the change in baseline load due to development.

Updated Baseline Load due to Development

Once review approach was selected, VHB calculated changes to baseline load due to development for each of the PCPs. While performing these calculations, VHB identified a misalignment of VHB's and EPA's implementation of the Sutherland Equations that impacted the original 2005 baseline loads and thus phosphorus reduction requirements for the Lake & Pond PCPs. Values are updated in the "Lake & Pond PCPs" section below. The original Charles River PCP baseline load and reduction requirement values relied on values dictated by the MS4 Permit, unless alternative values were approved by EPA, and therefore the approach misalignment did not impact original Charles River PCP values. DCR will continue to utilize EPA's values to implement the Charles River PCP.

[1] Curbing Stormwater Pollution — Charles River Watershed Association (crwa.org)
https://drive.google.com/drive/folders/1lmIjkQqOScQHuL7frcQdq8PpioknQ_KH?usp=drive_link

[2] Methods for Phosphorus Control Plan and Nutrient Source Identification Report Development. DCR Stormwater Management | Mass.gov

Memorandum

Lake & Pond PCPs

In Lake & Pond PCP Watersheds, DCR has not created or removed any impervious cover since 2005 according to VHB's review. Therefore, there are no changes to any of the watersheds' baseline loads as a result of development. Table 1 presents current baseline loads for each Lake & Pond PCP Watershed and phosphorus reduction requirements.

Table 1. Lake & Pond PCP Baseline Phosphorus Load and Required Phosphorus Reduction Summary

Watershed	Baseline Load (lb/yr)*	Percent Reduction Required (per Appendix F)	Total Required Reduction (lb/yr)	Total Allowable Load (lb/yr)
Auburn Pond / Leesville Pond[3]	4.5	31%	1.4	3.1
Bents Pond / Ramsdall Pond[4]	1.7	52%	0.9	0.8
Lake Quinsigamond & Flint Pond	18.5	49%	9.1	9.4

* No changes to baseline load due to development were found in PY6; therefore only one baseline load value is shown.

Charles River PCP

Unlike for the Lake & Pond PCPs, Charles River PCP baseline load did change as a result of development since 2005. Through manual comparison of 2023 aerial imagery to 2005 imagery, impervious cover data and land use data, VHB identified changes to impervious cover and/or land use since 2005 that accounted for 3.1 lb/yr of additional baseline load (Table 2).

Table 2. Charles River PCP Baseline Phosphorus Load and Required Phosphorus Reduction Summary

Watershed	Removed Impervious Cover (ac)	Additional Impervious Cover (ac)	Load due to Development (lb/yr)	PY5 Baseline Load (Appendix F) (lb/yr)	PY6 Updated Baseline Load (lb/yr)	Percent Reduction Required (per Appendix F)	Updated Total Required Reduction (lb/yr)
Charles River	10	11	3.1	873	876	22%	193

[3] The Leesville Pond Watershed's phosphorus reduction requirement is included in this table and used for calculations because it is higher than Auburn Pond's and therefore used as the governing target.

[4] The Bents Pond Watershed's phosphorus reduction requirement is included in this table and used for calculations because it is higher than Ramsdall Pond's and therefore used as the governing target.

Memorandum

PY6 Phosphorus Load Reduction Update

As required by the MS4 Permit in PY6, VHB reviewed DCR's properties within the Charles River and Lake & Pond PCP Watersheds and calculated phosphorus load reduction from newly constructed or newly mapped BMPs. DCR began fulfilling this requirement in PY5 as part of the PCPs and will continue to do so annually.

Methods for Determining Additional Load Reduction

In PY5, VHB reviewed each of DCR's mapped BMPs within PCP watersheds and calculated existing phosphorus reduction credit. Since this evaluation, new BMPs have been mapped in DCR's GIS database, either because they were recently constructed or because they were recently identified through field visits or design plan set review. DCR and VHB also partnered during PY6 to review linear features in DCR's geodatabase that were tagged as swales within the Charles River Watershed. Previously, VHB's credit calculations had only been performed on features included in the surface and subsurface BMP layers, so none of these swales were credited. In PY6, when appropriate, these features were moved from the linear feature layer to the surface BMP layer and designated as either water quality swales or infiltration swales, depending on the findings of a field evaluation. This effort generated 22 new BMPs credited in PY6.

During PY6, VHB reviewed and credited BMPs that had been mapped between January 10, 2023, and January 31, 2024. The credit from the new BMPs was added to the totals from PY5 to provide an updated pollutant load reduction for the PCP watersheds. The methodology used for crediting is described in Chapter 4 of the document, Methods for PCP & NSIR Development.

The PY6 crediting differed from the methodology used in PY5 and described in Methods for PCP & NSIR in two ways. First, the National Resource Conservation Service (NRCS) Hydrologic Soil Group (HSG) data5 used for crediting has areas where soils are shown as unknown HSG type. In PY5, HSG B was assumed for these gaps. In PY6, VHB noticed that the MS4 Permit's Appendix F Attachment 3 recommends assuming HSG C for unknown soil types, so PY6 calculations assume HSG C for unknown soil types instead. Second, in PY5 if a BMP's catchment included more than one HSG or land use type, the predominant (i.e. largest by area) HSG type or land use was used to calculate the BMP catchment load. In PY6, to increase precision and alignment with how baseline load is calculated, VHB updated the approach to calculate BMP catchment load by summing the load from each combination of HSG and land use in the BMP's catchment area. While this approach was only completed for BMPs credited in PY6, as the MS4 Permit only requires crediting of new BMPs each permit year, VHB will apply the updated methods to all credited BMPs in PY7 to provide consistent crediting methodology.

Note that by crediting each BMP, DCR assumes the BMP is functioning as designed. If BMPs are not properly maintained, their effectiveness in reducing phosphorus load decreases. VHB is working to support improvement of DCR's BMP inspection and maintenance procedures to ensure that each BMP functions as designed and calculated treatment is accurate.

[5] MassGIS. "Soils SSURGO-Certified NRCS." Commonwealth of Massachusetts. https://www.mass.gov/info-details/massgis-data-soils-ssurgo-certified-nrcs

Memorandum

Updated Phosphorus Load Reduction Credit

Lake & Pond PCPs

In Lake & Pond PCP Watersheds, VHB found that no newly mapped, creditable BMPs were mapped during the PY6 review timeframe. Therefore, the BMP credit information reported last year in the Lake & Pond PCPs is still current (Table 3).

Table 3. Existing versus Required Phosphorus Load Reduction in Lake & Ponds Watersheds

Watershed	Existing P Load Reduction (lb/yr)			Required P Load Reduction (lb/yr)				Remaining Required P Load Reduction (lb/yr)
	Sweeping*	Structural BMPs	Total	PY8	PY10	PY13	PY15 (Final)	
Auburn Pond / Leesville Pond	0.01	0.0	**0.0**	0.3	0.6	1.0	**1.4**	**1.4**
Bents Pond / Ramsdall Pond	0.00	0.5	**0.5**	0.2	0.4	0.6	**0.9**	**0.4**
Lake Quinsigamond & Flint Pond	0.03	4.5	**4.5**	1.8	3.6	6.4	**9.1**	**4.6**

*Street sweeping phosphorus load reduction values are rounded to the nearest hundredth rather than tenth due to their small magnitude.

Green cells indicate permit milestones have been met

Red cells indicate permit milestones have yet to be met

Charles River PCP

In the Charles River Watershed, VHB identified 29 newly mapped BMPs to credit in PY6, for which phosphorus reduction credit totaled 7.6 lb/yr (Table 4). Of these 29 credited BMPs, 24 were surface BMPs and 5 were subsurface BMPs. Most of the newly mapped surface BMPs (22) were swales that had been mapped in DCR's geodatabase as linear features during PY5 but were reviewed in more detail and properly credited as BMP features in PY6. These swales accounted for 3.1 lb/yr of phosphorus reduction credit. This PY6 effort addressed each of the known locations of swale BMPs mapped as linear features, so VHB does not expect to complete this data review in future years. However, other large data reviews may be completed in the future at the watershed scale to ensure that creditable BMPs are accounted for, such as a comprehensive review to identify existing impervious cover disconnection. DCR will likely also review the 67 BMPs that are mapped in the Charles River watershed but considered not creditable under the MS4 Permit to evaluate whether they can be converted into creditable BMP types.

Table 4. Phosphorus Reduction from BMPs Credited in PY6 BMPs in the Charles River Watershed

	Count	Total P Reduction (lb/yr)	Average P Reduction (lb/yr)	Average P Reduction (%)
Surface BMPs				
Bioretention Infiltration Basin/Swale	1	2.0	2.1	77
Impervious Area Disconnection	1	1.7	1.7	50
Infiltration Basin/Swale	2	0.6	0.3	77
Water Quality Swale	20	2.5	0.1	11
Subsurface BMPs				
Leaching Galley	5	0.8	0.2	65
Total	**29**	**7.6**	**0.3**	**29**

In the Charles River PCP submitted in PY5, DCR reported 65.1 lb/yr of total phosphorus reduction credit, which was 34% of the way to the final PY20 phosphorus reduction requirement and met interim milestones up to PY10. With PY6 BMP crediting complete, DCR is now accounting for 72.7 lb/yr of phosphorus load reduction. DCR is now 38% to its final PY20 reduction target and has met interim PCP milestones up to PY13 (Table 5). In the next 14 years, DCR will have to work to implement BMPs that remove 120.3 lb/yr of phosphorus from its stormwater load. Note that 102 BMPs mapped in the Charles were not credited.

Table 5. Existing and Remaining Phosphorus Load Reduction in the Charles River Watershed

Sweeping Reduction (lb/yr)	PY5 Structural BMP Reduction (lb/yr)	PY6 Structural BMP Reduction (lb/yr)	Total Reduction (lb/yr)	Required PY 13 Reduction (lb/yr)	Required PY 20 (Final) Reduction (lb/yr)	Remaining Required Reduction (lb/yr)	Progress to PY20 Reduction
31.0	34.1	7.6	72.7	68	193	120.3	38%

Summary

In accordance with the MS4 Permit, DCR has completed a PY6 performance evaluation for the effectiveness of the Charles River and Lake & Pond PCPs. As part of this evaluation, VHB reviewed DCR properties in the PCP watersheds and calculated the change in phosphorus load due to development since 2005, using a manual approach based on comparison of aerial imagery to impervious cover and land use data. Additionally, DCR credited new BMPs that were mapped in the last year using the methodology described in the Methods for PCP and NSIR Development with minor updates. In PY7 and subsequent permit years, DCR and VHB will continue to map and credit new BMPs and evaluate baseline load changes due to development.