Methods for Phosphorus Control Plan & Nutrient Source Identification Report Development

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Introduction

This document details the Massachusetts Department of Conservation and Recreation's methodology for the development of Phosphorus Control Plans and Nutrient Source Identification Reports, which were developed to meet the requirements of EPA's National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System Permit.

The 2016 National Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4s) in Massachusetts ("the MS4 Permit") includes requirements for MS4s that discharge to nutrient-impaired waters with total maximum daily loads (TMDLs; Appendix F) and without TMDLs (Appendix H). Specifically, MS4s that discharge to select waterbodies with phosphorus TMDLs such as the Charles River and several lakes and ponds, are required to prepare Phosphorus Control Plans (PCPs). In addition, MS4s that discharge to in-state phosphorus or nitrogen impaired waterbodies without TMDLs or out-of-state waterbodies with nitrogen or phosphorus TMDLs are required to prepare Phosphorus or Nitrogen Source Identification Reports, collectively referred to here as Nutrient Source Identification Reports (NSIRs).

PCP required:

- Charles River
- Select lakes and ponds with phosphorus TMDLs

NSIR required:

- In-state waterbodies impaired for Nitrogen (N) or Phosphorus (P) without TMDLs
- Out-of-state waterbodies with N and P TMDLs

The Massachusetts Department of Conservation and Recreation (DCR) owns properties across Massachusetts that discharge stormwater directly or indirectly to the Charles River, to the select lakes and ponds with phosphorus TMDLs, and to other nutrient-impaired waterbodies. As such, to comply with the MS4 Permit, DCR must develop several PCPs and NSIRs.

This document details DCR's methodology for PCP and NSIR development and is supplemental to DCR's PCPs and NSIRs. Data sources and analyses are similar for PCPs and NSIRs, which is why

methodology for both types of reports are presented in a common document. This document discusses permit interpretation, data sources, and analysis methodology, whereas watershed-specific data and results are included within each PCP and NSIR.

This document includes the following chapters:

- **Chapter 2.** Scoping – Discusses the methods used to determine the geographical scope of DCR's PCPs and NSIRs.
- **Chapter 3.** Pollutant Load and Required Reduction Analysis – Discusses the approaches used to perform the catchment delineation and load and target analysis for regulated DCR facilities within watersheds of waterbodies requiring PCPs and NSIRs.
- **Chapter 4.** BMP Pollutant Removal Crediting – Discusses the approaches used to perform the pollutant reduction crediting for BMPs within PCP and NSIR watersheds.
- **Chapter 5.** BMP Planning – Discusses the approaches used to identify potential sites for additional stormwater treatment.
- **Chapter 6.** Reporting – Discusses the structure of PCP and NSIR reports.

2

Scoping

This chapter discusses the methods used to determine the implementation area of the PCPs and NSIRs.

For the purposes of this document, scoping the PCP and NSIR means identifying the implementation area for the respective plans. The implementation area is defined as the DCR MS4 regulated area that discharges to a waterbody requiring a PCP or NSIR. This section first discusses the determination of watershed areas used to identify DCR facilities that may discharge to a waterbody requiring a PCP or NSIR. The section then describes the methods used to determine if facilities within those watersheds are generating regulated discharges. Further calculations to identify PCP baseline loads and targets are discussed in the next chapter.

2.1 Watershed Evaluation

To determine which DCR facilities should be included in a PCP or NSIR, we first needed to identify the watersheds of the waterbody segments requiring PCPs and NSIRs. While MassDEP provides GIS layers containing waterbody segments and their impairments (based on the MassDEP 303(d) list), they do not currently provide a shapefile with the corresponding watersheds of the segments. Therefore, we created a watershed boundary layer using the methodology discussed below.

2.1.1 Determination of Relevant Waterbodies

PCPs: Appendix F of the MS4 Permit indicates that PCPs are required for the Charles River and a select list of lakes and ponds listed in Table F-6. Since Table F-6 does not provide MassDEP Integrated List of Waters (Integrated List) Waterbody IDs, VHB used the 2016 Integrated List to identify the appropriate segments for the Charles River and the Lakes and Ponds TMDLs.[1] Table 1 lists the waterbody names and their respective Integrated List Waterbody ID. Since DCR only has

1 MassDEP. Massachusetts Year 2016 Integrated List of Waters: Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. December 2019. https://www.mass.gov/doc/final-massachusetts-year-2016-integrated-list-of-waters/download

MS4 regulated property within some of the watersheds, the table below only shows the waterbodies for which DCR is required to develop a PCP (See Section 2.2.2 for more information about determining regulation status). Grouped waterbodies are within the same overall watershed.

Table 1 MS4 Permit Appendix F PCP-Requiring Waterbodies for DCR and Corresponding Integrated List Waterbody IDs

Waterbody Name	Assessment Unit ID
Charles River	MA72-01
	MA72-03
	MA72-04
	MA72-05
	MA72-06
	MA72-07
	MA72-33
	MA72-36
	MA72-38
Lake Quinsigamond	MA51125
Flint Pond	MA51188
Leesville Pond	MA51087
Auburn Pond	MA51004
Bents Pond	MA35007
Ramsdell Pond	MA35062

NSIRs: Waterbodies requiring NSIRs are covered in Section B.I. and B.II of the MS4 Permit's Appendix F (out of state nitrogen and phosphorus TMDL waters) and Section I and II of the MS4 Permit's Appendix H (in-state nitrogen and phosphorus impaired waters without TMDLs). The list of segments covered by each NSIR is listed within the respective DCR NSIR documents.

The out-of-state nutrient TMDL waterbodies include the Long Island Sound with a nitrogen TMDL and eight Rhode Island waterbodies with phosphorus TMDLs which are listed with their Rhode Island Integrated List Waterbody ID in Appendix F Table F-12:

- Upper Ten Mile River
- Lower Ten Mile River
- Central Pond
- Omega Pond
- Turner Reservoir
- Upper Kickemuit River
- Kickemuit River
- Kickemuit Reservoir

In-state nutrient and phosphorus impaired waters without TMDLs were identified by reviewing the Final 2016 Integrated List of Waters (303(d) list) for waterbodies with impairments for "total nitrogen" or "total phosphorus" and did not include other "nutrient-related" impairments, based on clarification in EPA's MS4 Permit's Response to Comments #204 and #1099.[2] These waterbodies are shown in the DCR NSIR & PSIR Web Application.[3]

Note that in February 2022, the 2018/2020 303(d) list was finalized[4] and in May 2023 the 2022 303(d) list was finalized.[5] Appendix H Sections I.2 and II.2 state the following for nitrogen and phosphorus impaired waters, indicating that the requirement deadlines discussed in this document for Permit Years 4 and 5 will not be required for newly listed waterbodies until 4 and 5 years after the Stormwater Management Plan (SWMP) includes these newly listed waterbodies.

> "Upon EPA or MassDEP notification that the permittee is discharging to a waterbody that is water quality limited due to nitrogen [or phosphorus], the permittee shall update their SWMP within 90 days to incorporate the requirements of Appendix H part I.1 and document the date of SWMP update. When notification occurs beyond the effective date of the permit, deadlines in Appendix H part I.1 shall be extended based on the date of the required SWMP update rather than the permit effective date."

2.1.2 Defining Watersheds

To define watershed boundaries for the waterbody segments that require PCPs or NSIRs, we were required to consider discharges to the waterbody itself "or its tributaries" as cited in the MS4 Permit Section 2.2.1. EPA clarified in Response to Comment #209 that all upstream tributaries are included within the NSIR scope because "discharges of nutrients in stormwater not only affect the point at which the discharge enters the receiving waterbody, but also affect downstream waterbodies." In addition, PCP requirements apply to permittee MS4 discharges "that discharge to the identified impaired waters or their tributaries" according to the MS4 Permit Appendix F.

2.1.2.1 Watershed Boundary Delineations

There is no current publicly available watershed layer that provides watershed boundaries which match the Integrated List waterbody segment boundaries for Massachusetts. Therefore, DCR developed geospatial watershed boundaries for all PCP and NSIR-requiring waterbody segments in order to identify DCR facilities discharging to these waterbodies.

Delineations were based on the following data sources for the initial delineation and then adjusted based on desktop review, as necessary, to align with the Integrated List segments. Data sources are listed below in the order in which they were considered. The U.S. Geological Service Data Series 451

2 EPA Response to Comments on: National Pollutant Discharge Elimination System (NPDES) General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts, April 2016 https://www3.epa.gov/region1/npdes/stormwater/ma/2016fpd/rtc-2016-ma-sms4-gp.pdf

3 https://vhb.maps.arcgis.com/apps/dashboards/4cfdc963fe0442aba6e91c69c05064ac#mode=view

4 MassDEP. "Final 2018/2020 Integrated List of Waters." February 2, 2022. https://www.mass.gov/lists/integrated-lists-of-waters-related-reports

5 MassDEP. "Final 2022 Integrated List of Waters." May 2023. https://www.mass.gov/doc/final-massachusetts-integrated-list-of-waters-for-the-clean-water-act-2022-reporting-cycle/download

provides HUC12 identifiers as well as subbasins. Subbasins were delineated on a finer scale than HUC12 boundaries. This dataset was used as the basis of watershed delineation while additional sources were utilized to further refine watershed boundaries for impaired waters.

- USGS Data Series 451[6]
- USGS NHDPlus Dataset[7]
- USGS Watershed Boundary Dataset[8]
- USGS StreamStats[9]
- MassDEP Division of Watershed Management[10]
- MassDEP Massachusetts Estuary Project[11]

For watersheds of waterbodies with TMDLs, delineated watershed boundaries were cross-checked with figures presented within the respective TMDL reports.

2.1.2.2 Nested Watersheds

As mentioned, the watersheds of the waterbodies requiring PCPs and NSIRs include all upstream tributaries. Due to the nature of the stream networks and the impairments of lakes and streams, there are many cases where segments which are hydraulically connected each require PCPs and/or NSIRs. In this case, the downstream segment's PCP or NSIR would already need to include the upstream segment, since these reports are required for the waterbody of concern and its tributaries. Therefore, we developed a system that took these nested watersheds into account.

To simplify the evaluation of areas that need multiple PCPs and/or NSIRs, we identified the watershed of the most downstream applicable segment as the "parent" segment and identified all segments within that cumulative watershed as "child" watersheds of that parent. In this way we could work with the parent watershed polygons to avoid double counting overlapping areas or use the child watersheds to perform analysis for each individual segment when needed. PCP and NSIR parent and child watersheds are shown with the respective report deliverables.

6 USGS. "Local and Cumulative Impervious Cover of Massachusetts Stream Basins." Data Series 451. (2009). https://pubs.er.usgs.gov/publication/ds451

7 USGS. "NHDPlus High Resolution." https://www.usgs.gov/national-hydrography/nhdplus-high-resolution

8 USGS, USDA, & NRCS. "Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD) (4 ed.): Techniques and Methods. 11-A3." (2013). https://pubs.er.usgs.gov/publication/tm11A34

9 USGS. "StreamStats: Streamflow Statistics and Spatial Analysis Tools for Water-Resources Applications." (v. 4) https://www.usgs.gov/publications/streamstats-version-4

10 MassDEP & MassGIS. "MassDEP 2016 Integrated List of Waters (305(b)/303(d))." Commonwealth of Massachusetts. (December 2020). https://www.mass.gov/info-details/massgis-data-massdep-2016-integrated-list-of-waters-305b303d

11 MassDEP. "The Massachusetts Estuaries Project and Reports." Commonwealth of Massachusetts. https://www.mass.gov/guides/the-massachusetts-estuaries-project-and-reports

2.2 DCR Regulated Facilities

2.2.1 Facilities Layer Development

In 2019 DCR developed a geospatial data layer that contains facilities currently owned or maintained by DCR. The purpose of this layer was to provide DCR with a spatial representation of these facilities, along with associated information to help with planning, inspections, and other MS4 Permit requirements. This layer was compiled using a variety of sources from multiple institutions. A list of these sources is shown below:

- Protected and Recreational Open Space[12]
- Statewide parcel data, excluding Boston[13]
- Boston parcel data[14]
- MassDOT roads[15]
- Newly acquired DCR properties (provided by DCR)
- Snow parkways (provided by DCR)

This facility layer and the boundaries were not field surveyed or confirmed with property deeds. This layer is dynamic and is updated as new information is obtained or as property transfers are made.

2.2.2 Determining Facility Regulation Status

Although DCR owns property throughout the Commonwealth, only some is considered regulated by the MS4 Permit. As part of MS4 compliance and planning, DCR determined which areas met the MS4 regulated definition. A facility or portion of facility was deemed not regulated if it met any of the following criteria:

- Is not within an urbanized area
- Does not discharge stormwater from a point source (i.e., no channelized flow of stormwater to a waterbody)
- Discharges to combined sewers covered by a separate NPDES permit

Non-regulated facilities were excluded from further analysis for the PCPs and NSIRs.

A desktop review of each DCR facility within a PCP or NSIR watershed was conducted to determine the facility's MS4 regulation status. Since a DCR facility may include many distinct parcels, for this task a DCR facility was defined as a DCR property that shares a common name and/or operational

12 MassGIS. "Protected and Recreational OpenSpace." Commonwealth of Massachusetts. (2019). https://www.mass.gov/info-details/massgis-data-protected-and-recreational-openspace

13 MassGIS. "Property Tax Records." Commonwealth of Massachusetts. (Nov. 2018) https://www.mass.gov/info-details/massgis-data-property-tax-parcels

14 Boston Maps. "Boston Parcels 2018." Analyze Boston. (Jan. 2019). https://data.boston.gov/dataset/boston-parcels-20182

15 MassDOT Office of Transportation Planning & MassGIS. "Massachusetts Department of Transportation (MassDOT) Roads." Commonwealth of Massachusetts. (Jan. 2019). https://www.mass.gov/info-details/massgis-data-massachusetts-department-of-transportation-massdot-roads

purpose. Examples include Blue Hills State Park and Storrow Drive. Under the evaluation, an entire facility or a portion of a facility was deemed regulated or not regulated.

2.2.2.1 Urbanized Area Review

Each DCR facility's MS4 regulated status was first reviewed by assessing whether a facility was in an urbanized area. This analysis was performed using spatial coverages of the urbanized area and DCR facility boundaries. Spatial coverage of urbanized area was determined using a combination of both 2000 and 2010 Urbanized Areas as defined by the U.S. Census Bureau.[16,17] Facilities that were determined to be outside the urbanized area were tagged as "not regulated" within the DCR facilities layer.

2.2.2.2 Point Source Discharge Review

EPA's MS4 Permit covers regulated "discharges" from "point sources" as defined in the permit's Appendix A:

> Discharge of a pollutant - any addition of any "pollutant" or combination of pollutants to "waters of the United States" from any "point source," or any addition of any pollutant or combination of pollutants to the waters of the "contiguous zone" or the ocean from any point source other than a vessel or other floating craft which is being used as a means of transportation. This includes additions of pollutants into waters of the United States from surface runoff which is collected or channeled by man; or discharges through pipes, sewers, or other conveyances, leading into privately owned treatment works.
>
> Point source - any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural stormwater runoff.

Based on these definitions and the MS4 Permit Response to Comments (#944 and #953), runoff that is not channelized and conveyed to a waterbody is not regulated as a point source discharge.

To determine if facilities generated point source discharges, urbanized portions of facilities were inspected in a desktop setting to determine if elements of an MS4 (e.g. pipes, drainage swales, catch basins, BMPs) or other elements that concentrate flow were present. The following datasets were used within ArcGIS to make these determinations:

- DCR drainage infrastructure
- MassGIS 3-meter topographic data[18]

16 U.S. Census Bureau. "Urbanized Area and Urban Cluster Central Places for Census 2000." Revised October 8, 2021. https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural/2000-urbanized-areas.html

17 U.S. Census Bureau. "2010 Census Urban and Rural Classification and Urban Area Criteria." Revised October 8, 2021. https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural/2010-urban-rural.html

18 MassGIS. "Elevation Contours (1:5,000)." Commonwealth of Massachusetts. (June 2003). https://www.mass.gov/info-details/massgis-data-elevation-contours-15000

- MassGIS 1-meter impervious cover data[19]
- MassGIS 15-cm aerial imagery[20]
- Google Street View imagery[21]

Facilities without point source discharges were tagged as "not regulated" within the DCR facilities layer.

19 MassGIS. "Impervious Surfaces 2005." Commonwealth of Massachusetts. (February 2007). https://www.mass.gov/info-details/massgis-data-impervious-surface-2005

20 MassGIS. "2019 Aerial Imagery." Commonwealth of Massachusetts. (Spring 2019). https://www.mass.gov/info-details/massgis-data-2019-aerial-imagery

21 Google. "Streetview." Digital images. Google Maps. https://www.google.com/maps

3

Pollutant Load and Required Reduction Analysis

This chapter discusses the approaches used to analyze regulated DCR facilities within watersheds of waterbodies requiring PCP and NSIRs to delineate catchments, analyze land cover, calculate pollutant loading, and calculate pollutant reduction targets for PCPs.

The MS4 Permit Appendix F requires that permittees determine baseline phosphorus loading and treatment targets for permittee property in PCP watersheds. Appendix H of the permit requires the determination of total MS4 discharging areas, delineation of catchments, and identification of catchments with higher nutrient sources and catchment impervious and directly connected impervious area (DCIA) for each NSIR receiving water segment.

To address these permit requirements for both PCP and NSIR areas, we delineated catchments and performed land cover analysis and loading calculations for those catchments. For PCP watersheds we used those values to further develop pollutant reduction targets. The following sections describe these approaches.

3.1 Catchment Delineations and Treatment Status Categories

MS4 regulated facilities were subdivided to create catchments based on their gross drainage patterns (e.g. to which impaired water segment they discharge) and their potential for treatment. This approach creates catchments suited to identify pollutant loading hot-spots and prioritizing areas for future treatment. Note that these methods created catchments that do not necessarily align with the catchments used for illicit discharge detection and elimination (IDDE) analysis. The IDDE catchments are focused on specific drainage infrastructure networks to identified outfalls, whereas these

catchments include areas that are better suited for analyzing and prioritizing pollutant loading and identifying treatment potential.

Each catchment was assigned a treatment status based on whether the catchment was a "non-discharge" or discharging catchment. A catchment was assigned a "non-discharge" designation using the same criteria that was used to determine if an entire facility was not regulated, as described in Section 2.2.2. If a catchment was deemed discharging, the treatment status was assigned based on a cursory assessment of the catchment's potential for implementing stormwater treatment. This cursory review for potential treatment was performed to assist with steps in subsequent PCP and NSIR requirements. Each catchment was assigned one of the following treatment statuses:

- Unregulated: Catchment within a DCR facility that is not regulated. See Section 2.2.2.
- Non-Discharge: Catchment that does not include any channelized discharge and is therefore not considered regulated.
- Discharge to CSO: Catchment discharging to a known combined sewer.
- Existing: Catchment drains to an existing BMP identified in DCR's drainage infrastructure database.
- Existing - Not Creditable: Catchment drains to an existing BMP identified in DCR's drainage infrastructure database that does not receive pollutant removal credit according to the MS4 Permit's Appendix F Attachment 3.
- High Potential: Catchment does not currently drain to a BMP but, after an initial desktop review, it appears there is potential to collect and treat runoff (with focus on impervious cover runoff) with a retrofit BMP sited on DCR property.
- High Potential - Impervious Cover Disconnection: Catchment contains an existing or potential impervious cover (IC) disconnection opportunity based on desktop review. The catchment includes both the impervious area generating runoff and the pervious area receiving runoff. These scenarios, if already existing, could be transferred to a treatment status of "existing" once field verified.
- Low Potential: Catchment does not currently drain to a BMP and after an initial desktop review, the catchment could possibly be treated by a retrofit BMP, but site constraints indicate that BMP construction would likely require significant design and construction effort and/or the catchment is not a significant source of pollutant loading.
- Not Feasible: Catchment that does not appear feasible to retrofit with structural stormwater treatment measures after desktop review. Constraints for these areas were noted within the database. These areas may be revisited with subsequent review.

The following datasets were used within ArcGIS to delineate and evaluate catchments within a desktop setting:

- DCR drainage infrastructure
- MassGIS 3-meter topographic data[22]

22 MassGIS. "Elevation Contours (1:5,000)." Commonwealth of Massachusetts. (June 2003). https://www.mass.gov/info-details/massgis-data-elevation-contours-15000

- MassGIS 1-meter impervious cover data[23]
- MassGIS 15-cm aerial imagery[24]
- Google Street View imagery[25]

3.2 Pollutant Load Estimates

Pollutant loading estimates were generated for each regulated catchment to:

- Determine PCP baseline loads (phosphorus),
- Identify pollutant loading hot spots, and
- Develop catchment prioritization for NSIRs (phosphorus/ nitrogen)

3.2.1 Approach

Table 2 summarizes the MS4 Permit guidance and DCR's approach for load calculations for the various watersheds.

Table 2 Nutrient Loading Calculation Approach

Watershed Category	Permit Guidance	DCR Approach
Charles River PCP	Use loading totals calculated by EPA presented in Appendix F, Table F-2	Recalculated baseline loads using DCR regulated areas and EPA's methodology[26], which uses loading rates from Appendix F, Attachment 1, Table 1-2 and estimates of DCIA.
Lake and Ponds PCPs	Use Appendix F, Attachment 1, Table 1-1 composite loading rates based on land use	Used Appendix F, Attachment 1, Table 1-1
NSIRs	Prioritize catchments with high nutrient loading	Calculated catchment loading using Appendix F, Table 1-2 for phosphorus and Appendix F, Attachment 3, Table 3-2 for nitrogen and estimates of DCIA. Used loading estimates to support catchment prioritization.

23 MassGIS. "Impervious Surfaces 2005." Commonwealth of Massachusetts. (February 2007). https://www.mass.gov/info-details/massgis-data-impervious-surface-2005

24 MassGIS. "2019 Aerial Imagery." Commonwealth of Massachusetts. (Spring 2019). https://www.mass.gov/info-details/massgis-data-2019-aerial-imagery

25 Google. "Streetview." Digital images. Google Maps. https://www.google.com/maps

26 USEPA. Charles River Basin Nutrient (Phosphorus) TMDLs, Phosphorus Load Export Rates and BMP Performance. Attachment 1 – Fact Sheet Massachusetts Small MS4. 2014. https://www3.epa.gov/region1/npdes/stormwater/ma/2014FactSheet-Attachment1.pdf

Note that the assignment of the Sutherland equations to the various land use categories presented in this fact sheet differs from the assignment of the equations to land use categories presented in other EPA documentation. See Section 3.3 for more details on DCIA calculations used for the purposes of the NSIRs.

3.2.2 Spatial Datasets

The spatial datasets used for these pollutant loading calculations include:

- MassGIS 1-meter impervious cover data[27]
- MassGIS 0.5-meter land use data (2005)[28]
- United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) soils data, hydrologic soil group[29]
- MassGIS 15-cm aerial imagery[30]
- Google Street View imagery[31]

The impervious cover and land use spatial datasets were checked by comparing them to the aerial imagery and adjusting as necessary. For the Charles River Watershed, if discrepancies were identified using aerial imagery, Google Earth historic imagery from 2005 was referenced to evaluate whether the discrepancy was due to changes in land use or impervious cover since 2005. Documentation of layer adjustments were noted within DCR's database.

For all watersheds, the 2005 MassGIS land use data was used in lieu of a more recently released 2016 land use / land cover dataset.[32] Although the 2016 data is more recent, the land use categories included in the 2016 layer do not readily align with the loading categories included in the MS4 Permit, and at the time of the calculations, no crosswalk table with the 2016 data was available (compared to the MS4-provided crosswalk in Appendix F, Attachment, Table 1-3). The 2016 data provides both land use and land cover information that creates the need for a much more complex crosswalk to align with the loading rate categories. In addition, DCR properties' land use and cover vary widely and required more detailed vetting for accurate representation within both land use and land cover categories.

The soils data used for pollutant loading calculations consists of NRCS certified soils data for Massachusetts downloaded from MassGIS in 2020. Hydrologic soil group B was assumed for all areas where there was not a hydrologic soil group assigned because this is the dominant soil group when reviewing soils state-wide. DCR subsequently learned that the MS4 Permit requires assumption of C soils when HSG is not known; therefore this will be corrected in calculations in future permit years.

27 MassGIS. "Impervious Surfaces 2005." Commonwealth of Massachusetts. (February 2007). https://www.mass.gov/info-details/massgis-data-impervious-surface-2005

28 MassGIS. "Land Use (2005)." Commonwealth of Massachusetts. (June 2009). https://www.mass.gov/info-details/massgis-data-land-use-2005

29 MassGIS. "Soils SSURGO-Certified NRCS." Commonwealth of Massachusetts. (Accessed August 20, 2020). https://www.mass.gov/info-details/massgis-data-soils-ssurgo-certified-nrcs

30 MassGIS. "2019 Aerial Imagery." Commonwealth of Massachusetts. (Spring 2019). https://www.mass.gov/info-details/massgis-data-2019-aerial-imagery

31 Google. "Streetview." Digital images. Google Maps. https://www.google.com/maps

32 MassGIS. "2016 Land Cover/Land Use." Commonwealth of Massachusetts. (May 2019). https://www.mass.gov/info-details/massgis-data-2016-land-coverland-use

3.2.3 Pollutant Loading Calculations

For the Lakes and Ponds PCP catchments, catchment boundaries were intersected with the land use layer, impervious cover layer, and hydrologic soil group (HSG) layer, and then each intersected area was assigned a loading rate, based on methodology outlined in Appendix F Attachment 1. Total loads were then summed at the catchment and watershed levels.

For the Charles River PCP, even though the MS4 Permit provides baseline load, DCR recalculated the baseline load so that load was calculated only for DCR areas determined to be regulated (see Sections 2.2 and 3.1 for more information on which areas were considered regulated). Baseline load was estimated following EPA's methodology outlined in EPA's 2014 MS4 Fact Sheet, Attachment 1.[33] This methodology uses the loading rates from MS4 Permit Appendix F, Attachment 1, Table 1-2 and land use crosswalk in Table 1-3, along with an estimates of DCIA for various land uses based on the Sutherland Equations. The Sutherland Equations empirically estimate DCIA area based on total impervious area and land use, as presented in EPA's 2014 MS4 Fact Sheet, Attachment 1, Table 6. The total impervious area for the Charles River watershed was used in the Sutherland Equations.

For the Charles PCP and NSIR catchments, spatial data layers for land use, impervious cover, and HSG were overlayed with the regulated catchment boundaries to develop polygons with unique values. Impervious areas were further divided between DCIA and areas that are not directly connected and therefore use the pervious loading rate. All areas were then assigned loading rates based on EPA's nitrogen and phosphorus load export rates categories using the land use crosswalk provided in Appendix F, Attachment, Table 1-3. Loads were then summed at the catchment and watershed level.

3.2.4 Charles River Loading Changes Since 2005

The MS4 Permit requires for the Charles River Watershed a Performance Evaluation starting in Permit Year 6 that includes an estimate of the increase in phosphorus load due to development since 2005. This load change is then combined with the baseline load.

Through desktop review, DCR identified areas where impervious cover has changed since 2005 and developed spatial polygons representing either added or removed impervious cover for calculation of resulting loading changes. Those areas along with their respective land use was used along with the Pollutant Load Export Rates (PLERs) presented in Appendix F, Attachment 1, Table 1-2 to estimate the phosphorus load change due to development. Note that as of Permit Year 5 these values have not been calculated and will be presented in the PY 6 Annual Report as required by the MS4 Permit.

3.3 DCIA Estimates for NSIRs

The MS4 Permit Appendix H requires the estimation of DCIA within NSIR watersheds. DCR used the Sutherland Equations, which empirically estimate directly connected impervious area based on total

33 USEPA. Charles River Basin Nutrient (Phosphorus) TMDLs, Phosphorus Load Export Rates and BMP Performance. Attachment 1 – Fact Sheet Massachusetts Small MS4. 2014. https://www3.epa.gov/region1/npdes/stormwater/ma/2014FactSheet-Attachment1.pdf

Note that the assignment of the Sutherland equations to the various land use categories presented in this fact sheet differs from the assignment of the equations to land use categories presented in other EPA documentation. See Section 3.3 for more details on DCIA calculations used for the purposes of the NSIRs.

impervious area and land use, as presented in 2014 EPA documentation.[34] The "highway" land use was not included in this documentation and was therefore assigned the "Average" Sutherland equation described as "Mostly storm sewered with curb & gutter, no dry wells or infiltration, residential rooftops not directly connected." DCIA was calculated at the catchment level using the total impervious area value of the catchment and the appropriate DCIA equation based on land use. Totals of DCIA were summed at the catchment and then watershed level. These DCIA areas were used in the pollutant loading calculation described in Section 3.2.3.

3.4 Target Calculations for PCPs

Permittees must calculate load reduction targets in the form of mass per year for the Lakes and Ponds PCP areas. In addition, because DCR recalculated baseline loads for the Charles River PCP area, we recalculated load reduction targets for the Charles River watershed from those presented by EPA in Appendix F Table F-2. Impaired waters segments requiring NSIRs do not have numeric treatment targets and therefore do not require target calculations.

3.4.1 Lakes and Ponds

The MS4 Permit Appendix F, Table F-6 provides the TMDL phosphorus load reductions for each waterbody as a percentage. Permittees are required to estimate the load reduction as mass based on their calculated baseline load.

The baseline loading values calculated for the Lakes and Ponds PCP areas (see Section 3.2) were used along with the load reduction percentages for each respective lake or pond as presented in Appendix F, Table F-6. Percent reductions were multiplied by the estimated load to generate a load reduction as mass per year.

3.4.2 Charles River

DCR recalculated the Charles River mass load reduction required using the refined baseline loading values calculated for the Charles River PCP areas (see Section 3.2) and the waste load allocation (WLA) reduction percentages for the Charles River as presented in EPA's April 22, 2014 Memorandum recreated as Table 3.[35] Load reductions for the Charles River PCP are based on the TMDL percent reductions that vary between the Upper/Middle and the Lower Charles River subbasins and vary by land use. Therefore, DCR tracked loading by land use and subbasin and then assigned percent reductions according to their respective category. To mimic EPA's approach, load reductions were then summed at the entire Charles River watershed level to get an estimate of total load reduction in mass per year. This mass load reduction was then compared to the baseline load estimate to calculate the overall percent reduction.

34 USEPA. Estimating Change in Impervious Area (IA) and Directly Connected Impervious Area (DCIA) for Massachusetts Small MS4 Permit. April 2014. https://www3.epa.gov/region1/npdes/stormwater/ma/MADCIA.pdf

35 EPA Memorandum to Permit File for Draft Small Massachusetts MS4 General Permit from Mark Voorhees, Office of Ecosystem Protection with Subject "Overview of Methodology to Calculate Baseline Stormwater Phosphorus Loads and Phosphorus Load Reduction Requirements for Charles River Watershed – Draft MA MS4 Permit" – obtained by EPA to present methods used by EPA to calculate TMDL target load reductions.

Table 3 TMDL Waste Load Allocation (WLA) P Load Reduction Rates Applied to Land Use Groups in Upper and Lower Charles River Watersheds

Land Use Group	Upper TMDL WLA % Reduction Rate	Lower TMDL WLA % Reduction Rate
Commercial	65%	62%
Industrial	65%	62%
High Density Residential	65%	62%
Medium Density Residential	65%	62%
Low Density Residential	45%	62%
Highway	65%	62%
Open Space	35%	62%
Agriculture	35%	62%
Forest	0%	0%

3.5 NSIR Catchment Prioritization

Appendix H requires the prioritization of NSIR catchments with higher potential nutrient load. Catchments were prioritized for nutrient load mitigation based on their calculated pollutant loading as described in Section 3.2 (nitrogen or phosphorus depending on the NSIR subject pollutant). In order to equitably prioritize among catchments of different sizes and land uses, we used the metric of nutrient load per unit area to compare catchments. The catchments were then prioritized based on their loading rate (Table 4).

Prioritization categories were developed by approximating composite loading rates for 10% DCIA (cut off between low and medium priorities) and 50% DCIA (cut off between medium and high priorities) using the Commercial/Industrial and Developed Pervious HSG B land use loading rate categories. We track each catchment's calculated total nutrient load as part of the DCR database, which is used for catchment prioritization and evaluation as potential BMPs are identified and evaluated for retrofit potential. Prioritization may change as catchments and potential BMPs are reviewed in more detail in Permit Year 5.

Table 4 NSIR Load Prioritization Categories

Priority	Phosphorus (lb/ac/yr)	Nitrogen (lb/ac/yr)
High	>1.0	>8.1
Medium	0.3 – 1.0	2.6 – 8.1
Low	<0.3	<2.6

4

BMP Pollutant Removal Crediting

This chapter discusses DCR's approach to accounting for each BMP's pollutant removal credit.

4.1 Non-structural Control Measure Crediting

A requirement of the PCP is to describe the non-structural stormwater control measures necessary to support achievement of the phosphorus export milestones. This description shall include the annual phosphorus reductions that are expected to result from the implementation of these measures. Street sweeping was the only non-structural control DCR credited for pollutant removal in the Charles River and Lakes and Ponds PCPs, as DCR does not currently have enough data on the implementation of other non-structural control measures to calculate phosphorus reduction per the methodology in Appendix F Attachment 2 of the MS4 Permit.

In order to estimate phosphorus load reduction from DCR's street sweeping efforts in PCP watersheds, DCR first needed to understand the areas that were part of the street sweeping program. For roads swept, DCR used an already-created polyline layer identifying all road segments that were part of DCR's street sweeping program and clipped this layer to the PCP watershed boundaries. This road layer's attributes contained each road's annual sweeping frequency. This information, along with attributes such as road widths and shoulder widths taken from the Department of Transportation's roads data-layer[36], were used to calculate swept road area. DCR also manually delineated polygons representing swept parking lots and then entered sweeping frequency and calculated the area of these polygons. Once the swept impervious areas were determined, these areas were intersected with a land use layer[37] to create many road and parking lot fragments, each with their own land use designations. Knowing the land use of each swept area allowed DCR to apply a phosphorus load

[36] MassGIS. Massachusetts Department of Transportation (MassDOT) Roads https://www.mass.gov/info-details/massgis-data-massachusetts-department-of-transportation-massdot-roads

[37] MassGIS. "Land Use (2005)." Commonwealth of Massachusetts. (June 2009). https://www.mass.gov/info-details/massgis-data-land-use-2005

export rate to each fragment's area (MS4 Permit Appendix F Attachment 2 Table 2-1) to calculate the estimated annual load for each fragment.

Each fragment's annual sweeping frequency was used to calculate its specific phosphorus reduction factor (PRF). The PRF used for each fragment was taken from Appendix F Attachment 2 Table 2-3, which provides PRFs for different sweeper technologies and frequencies. PRF for monthly sweeping with a high-efficiency regenerative air-vacuum sweeper (0.08) was used because DCR sweeps with a mechanical broom sweeper followed by a vacuum sweeper. This factor was then adjusted proportionally based on the number of months that the roadway was swept (what the MS4 calls the Annual Frequency (AF) of sweeping), per MS4 Permit guidance. The phosphorus load of a fragment was then multiplied by the adjusted PRF to calculate the load reduction. Once phosphorus load reduction by street sweeping was calculated for all fragments, load reduction was summed for each watershed to get total load reduction by street sweeping.

4.2 Structural Control Measure Crediting

A requirement of PCPs and NSIRs is to describe the structural stormwater control measures necessary to support achievement of the phosphorus and/or nitrogen loading goals, including the annual load reductions that are expected to result from these measures. Therefore, DCR estimated phosphorus and/or nitrogen load reduction for DCR's existing structural BMPs in PCP and NSIR watersheds, as long as they were eligible for MS4 credit. (DCR did not apply load reduction credit to BMP types that are not listed in the MS4 Permit, such as proprietary separators.) In addition, for simplicity, DCR did not apply load reduction credit to more than one BMP in a series. For BMPs in series, the BMP that appeared to have the largest load reduction was chosen to be credited. BMPs that were either owned or maintained by DCR but not both were evaluated on a case-by-case basis for crediting eligibility. Generally, these BMPs were credited unless it was obvious that another MS4 permittee was taking credit for the same BMP.

DCR used methodology in the MS4 Permit's Appendix F Attachment 3 to apply pollutant removal credits to each existing BMP. This methodology uses EPA's BMP performance curves, which provide percent pollutant reduction of a given BMP based on several inputs. The first input is pollutant load delivered to the BMP. To calculate this delivered load to the BMP, DCR delineated each BMP's catchment. DCR relied on the following data sources to delineate catchments:

- Google Street View imagery[38]
- Nearmap MapBrowser imagery[39]
- MassGIS 15-cm aerial imagery[40]
- MassGIS 3-meter topographic data[41]
- DCR drainage infrastructure database

38 Google. "Streetview." Digital images. Google Maps. https://www.google.com/maps

39 Nearmap. "MapBrowser." Digital images. https://apps.nearmap.com/maps/

40 MassGIS. "2019 Aerial Imagery." Commonwealth of Massachusetts. (Spring 2019). https://www.mass.gov/info-details/massgis-data-2019-aerial-imagery

41 MassGIS. "Elevation Contours (1:5,000)." Commonwealth of Massachusetts. (June 2003). https://www.mass.gov/info-details/massgis-data-elevation-contours-15000

- Inspection photos
- DCR staff knowledge of the site/ site visits
- Plan sets (as-built plans if possible)

For existing BMPs in PCP watersheds, DCR used all of the above data sources to delineate catchments. For BMPs in NSIR watersheds, at this time, catchment delineations were not confirmed with design plans or site visits. Instead, catchments were delineated primarily using imagery and drainage infrastructure data. For both PCPs and NSIRs, catchments were delineated to include only DCR property. In the future, DCR may delineate off-property catchments that are treated by DCR BMPs and may receive additional pollutant reduction credit. Once catchments were delineated, load of the catchment was calculated based on guidance in the MS4 Permit's Appendix F Attachment 3 Table 3-1, which uses land cover, land use and hydrologic soil group information to assume empirically derived phosphorus load export rates. The following data sources were used in this methodology:

- MassGIS 1-meter impervious cover data[42]
- MassGIS 0.5-meter land use data (2005)[43]
- USDA NRCS hydrologic soil group (HSG)[44]

Because the USDA NRCS HSG data layer has some gaps, HSG C was assumed if there was a data gap within the BMP's catchment. If there were multiple HSG polygons within a BMP's catchment, the predominant (greatest by area) HSG was used. Note that at this time, this approach is slightly different from the approach used to calculate Baseline Load, in which a geospatial intersect of the land cover, land use and soils layer was performed. In future permit years, a geospatial intersect will be used, but at this time, the available tool is not set up for this. DCR does not believe this simplification will have much effect on BMP load reduction credits, as most BMP catchments only have one land use and one HSG within their boundaries.

The correct EPA performance curve was selected using BMP type and BMP estimated hydraulic conductivity. BMP type was taken from DCR's drainage infrastructure database, and was confirmed for BMPs in PCP watersheds with design plans, site visits, etc. Each BMP type in DCR's database was assigned a BMP type listed in the MS4 permit. These assignments are shown in Table 5. For infiltration BMPs, the BMP's hydraulic conductivity was estimated based on the USDA NRCS hydrologic soil group data, which was used to select the correct performance curve. If a BMP's footprint spanned multiple designated hydrologic soil groups, DCR referenced the predominant HSG within the BMP's boundary and then assumed the most conservative infiltration rate for each HSG based on Rawls et al. 1983[45], as summarized in the New England Stormwater Retrofit Manual Appendix G[46].

42 MassGIS. "Impervious Surfaces 2005." Commonwealth of Massachusetts. (February 2007). https://www.mass.gov/info-details/massgis-data-impervious-surface-2005

43 MassGIS. "Land Use (2005)." Commonwealth of Massachusetts. (June 2009). https://www.mass.gov/info-details/massgis-data-land-use-2005

44 MassGIS. "Soils SSURGO-Certified NRCS." Commonwealth of Massachusetts. (Accessed August 20, 2020). https://www.mass.gov/info-details/massgis-data-soils-ssurgo-certified-nrcs

45 Rawls, W.J. et al., (1983). Green-Ampt Infiltration Parameters from Soil Data. J. Hyd. Engr., 109:1316.

46 New England Stormwater Retrofit Manual. VHB & Southeast New England Program. October 2022.

Table 5 BMP Type Crosswalk Table to Relate DCR Database to MS4 Permit

BMP Type— DCR Database	BMP Type— MS4 Permit
Vegetated Filter Strip	Impervious Area Disconnection
Bioretention with Underdrain Basin/Swale	Biofiltration
Bioretention Infiltration Basin/Swale	Infiltration Basin
Infiltration Basin/Swale	Infiltration Basin
Infiltration Trench	Infiltration Trench
Water Quality Swale	Grass Swale
Dry Detention Basin	N/A
Extended Dry Detention Basin/Swale	Dry Pond
Wet Basin/Swale	Wet Pond
Porous Pavement with Underdrain	Porous Pavement
Porous Pavement with Infiltration	Infiltration Trench
Gravel Wetland	Gravel Wetland
Constructed Stormwater Wetland	Gravel Wetland
Sand & Organic Filter	Sand Filter
Oil/Grit Separator	N/A
Proprietary Separator	N/A
Deep-Sump Catch Basin	N/A
Leaching Catch Basin	Infiltration Trench
Leaching Basin	Infiltration Trench
Leaching Galley	Infiltration Trench
Leaching Chamber	Infiltration Trench
Leaching Line (Perforated Pipe)	Infiltration Trench
Other	N/A
Impervious Area Disconnection	Impervious Area Disconnection
Rain Barrel or Cistern	Impervious Area Disconnection through Storage

Note: MS4 Permit BMP types that are listed as "N/A" are not listed in the MS4 Permit for individual credit and were therefore not credited.

Once the appropriate BMP performance curve was selected, the X-axis value was identified. For most BMPs' curves, the X-axis is the BMP's design storage volume divided by impervious cover (also called treatment depth), and a treatment depth of 0.5 inches was conservatively assumed. In the future, some BMPs may be credited with more accurate treatment depths if design storage volume is known. For the porous pavement curve, which uses filter depth instead of treatment depth, a filter depth of 12 inches (the minimum creditable filter depth) was assumed for all porous pavement where filter depth was not known. For the impervious cover disconnection curve, which uses an impervious to pervious ratio on the X-axis, this ratio was calculated by delineating the entire impervious and pervious catchment, intersecting this catchment with the impervious cover layer (referenced above) to calculate impervious and pervious areas, and dividing impervious by pervious

area to determine the ratio of the two areas. The predominant HSG of the pervious area was used to select the correct impervious cover disconnection performance curve.

Using EPA's performance curves, DCR determined percent pollutant reduction for each BMP. This percent reduction was then applied to the pollutant load delivered to each BMP to determine the load reduction of each BMP.

5

BMP Planning

This chapter discusses DCR's approach to planning and prioritizing retrofits of DCR properties to include additional structural BMPs.

Both PCP and NSIR requirements set forth in the MS4 Permit require planning for installation of retrofit BMPs. DCR took the same general approach to BMP planning for PCPs and NSIRs, though PCPs have numeric load reduction targets while NSIRs do not. This chapter outlines DCR's general approach to BMP planning and then delves into specific planning methodology for each PCPs and NSIRs.

5.1 DCR's General Approach

DCR's opportunities for structural best management practices (BMPs) fall into two main categories: stand-alone stormwater retrofit projects and incorporation of BMPs into planned site development, redevelopment, or maintenance projects.

DCR recognizes that high load catchments are areas where implementing stormwater treatment could result in the largest impact. Therefore, particularly for stand-alone retrofits, DCR targets these high load (or high priority) catchments when identifying locations for additional treatment. Within these catchments, DCR's best retrofit opportunities occur under the following conditions:

- Impervious area can be removed
- Impervious area can be disconnected
- Impervious area is already disconnected but can be established formally as a BMP (to establish credit and include the BMP in a maintenance program)
- Existing BMP can receive more impervious runoff or be altered to increase treatment performance
- Significant amount of impervious surface can be collected and processed through a new BMP

- Available space exists for an above-ground BMP (easier to construct and maintain than a below-ground BMP)
- Location is easy to access for construction, inspection, and maintenance activities

Although the above conditions represent the most ideal scenarios for retrofit opportunities, DCR is open to creative designs, underground measures, and small-scale controls as well.

DCR also takes an opportunistic approach to stormwater retrofits, understanding that incorporating BMPs into already-planned projects is usually more cost-effective than stand-alone projects. As such, DCR has developed the DCR Stormwater Handbook, which encourages designers to incorporate BMPs during all projects, even those that do not trigger the MS4 Permit's post-construction requirement threshold of one acre disturbed.

5.2 PCP Approach

DCR's Lakes and Pond PCP documents DCR's plan to achieve the required phosphorus load reductions set forth in the MS4 Permit's PCP requirements. (DCR's Charles River Watershed Phase 1 PCP does not document the same type of plan because Phase 1 load reduction targets have already been achieved in this watershed.) One aspect of this plan is retrofitting certain properties to incorporate stormwater treatment. For each Lakes and Ponds PCP watershed where a project to meet targets was not already underway, DCR completed a priority ranking of catchment areas for the addition of phosphorus control practices based on a detailed assessment of site suitability factors. These factors included phosphorus load evaluation, which set its priority (a categorization scheme that corresponds to magnitude of load per area), presence of existing treatment, ability to collect drainage for treatment, available space for treatment, and hydrologic soil group (HSG). Each factor is listed below with descriptions of each assigned status.

- Phosphorus Load Priority

  "High" catchments were considered the most suitable for retrofit, followed by "Medium" and then "Low."

  - Low: Phosphorus load <0.3 lb/ac/yr
  - Medium: Phosphorus load 0.3 – 1.0 lb/ac/yr
  - High: Phosphorus load >1.0 lb/ac/yr
- Existing Treatment

  "No" catchments were considered more suitable for retrofit.

  - Yes: The catchment or a portion thereof is already being treated by an existing BMP
  - No: There is no existing treatment for the catchment
- Ability to Collect Drainage for Treatment

  "High" catchments were considered the most suitable for retrofit, followed by "Medium," and then "Low."

  - Low: There is limited closed drainage or impervious area available for treatment

    - Medium: There is some closed drainage or impervious area available for treatment
    - High: Most or all of the site's impervious area is being conveyed via closed drainage available for treatment
- Available Space

  "Sufficient" catchments were considered the most suitable for retrofit, followed by "Moderate" and then "Limited."

    - Limited: There is limited space on site available for installation of a BMP
    - Moderate: There is some space available on site for installation of a BMP
    - Sufficient: There is sufficient space available on site for installation of a BMP
- Soil Type (HSG)[47]

  "A" catchments were considered the most suitable for retrofit, followed by "B," then "C," then "C/D," then "D."

    - HSG A: low runoff potential when thoroughly wet; water is transmitted freely through the soil
    - HSG B: moderately low runoff potential when thoroughly wet; water transmission through soil is unimpeded
    - HSG C: moderately high runoff potential when thoroughly wet; water transmission through soil is somewhat restricted
    - HSG D: high runoff potential when thoroughly wet; water movement through soil is restricted or very restricted
    - HSG C/D: water table is present within 2 feet, therefore acts as D soil when saturated, but acts as C soil when drained (see definitions of C and D soils above)
    - No Data: Referenced soil data layer did not include the catchment in its survey area

The above site suitability factors were assessed for each PCP catchment using the following data sources, which provided information on a catchment's land use, land cover, topography, drainage infrastructure, soils, etc.:

- USDA NRCS hydrologic soil group[48]
- MassGIS 1-meter impervious cover data[49]
- MassGIS 0.5-meter land use data (2005)[50]

47 Definitions of each HSG come from the United States Department of Agriculture's Natural Resources Conservation Service's National Engineering Handbook- Part 630 Hydrology (210–VI–NEH, May 2007).

48 MassGIS. "Soils SSURGO-Certified NRCS." Commonwealth of Massachusetts. (Accessed August 20, 2020). https://www.mass.gov/info-details/massgis-data-soils-ssurgo-certified-nrcs

49 MassGIS. "Impervious Surfaces 2005." Commonwealth of Massachusetts. (February 2007). https://www.mass.gov/info-details/massgis-data-impervious-surface-2005

50 MassGIS. "Land Use (2005)." Commonwealth of Massachusetts. (June 2009). https://www.mass.gov/info-details/massgis-data-land-use-2005

- MassGIS 1:5,000 topographic data[51]
- MassGIS 15-cm aerial imagery[52]
- Google Street View imagery[53]
- Nearmap MapBrowser imagery[54]
- DCR drainage infrastructure

Site suitability factors were considered in conjunction with engineering judgment and knowledge of planned projects at the site to generate a priority ranking of catchments to be retrofitted for treatment. In each prioritized catchment, treatment opportunities were evaluated using DCR's general approach documented above in Section 5.1. In general, catchments with higher loads that were not being treated with existing BMPs and did not pose any physical constraints to a retrofit BMP were prioritized higher. If a viable treatment opportunity existed, a proposed BMP type was noted in Tables 6 and 7 of the Lakes and Ponds PCP. However, not all catchments were determined to have viable treatment opportunities. Such catchments were given a designation of "limited" in the treatment opportunity column of these tables.

5.3 NSIR Approach

In order to meet the MS4 Permit's NSIR requirements, DCR was required to provide a listing of planned structural BMPs within NSIR watersheds. DCR was also required to plan and install a minimum of one structural BMP as a demonstration project within six years of the permit effective date. The sections below outline DCR's process for meeting these requirements.

5.3.1 Site Selection and Evaluation

For each of the 9 NSIR parent watersheds, potential sites for BMPs were selected first by isolating all high load catchments (refer to Table 4 for load prioritization category cutoffs) that also had a treatment status of High Potential or High Potential—Impervious Cover Disconnection (this status was assigned in Permit Year 4, refer to Section 3.1 for more on treatment status). This pool of catchments was then reviewed for several site suitability factors, which were referred to here as "catchment considerations." As each catchment was reviewed, a related Catchment Considerations record was populated in GIS, which included the following attributes:

- Outstanding Resource Waters:
  - "Yes" was populated if the catchment was within an area with Outstanding Resource Waters protection under the Massachusetts Surface Water Quality Standards. "No" was populated if not.

51 MassGIS. "Elevation Contours (1:5,000)." Commonwealth of Massachusetts. (April 2003). https://www.mass.gov/info-details/massgis-data-elevation-contours-15000

52 MassGIS. "2019 Aerial Imagery." Commonwealth of Massachusetts. (Spring 2019). https://www.mass.gov/info-details/massgis-data-2019-aerial-imagery

53 Google. "Streetview." Digital images. Google Maps. https://www.google.com/maps

54 Nearmap. "MapBrowser." Digital images. https://apps.nearmap.com/maps/

- MassGIS Outstanding Resource Waters data[55] was referenced.

› Surface Water Protection Areas:

- "A," "B," or "C," was populated if the catchment was within an area that contributes to drinking water supply reservoirs serving public water systems (A, B, or C indicating which zone the catchment was in). "None" was populated if not.
- MassGIS Surface Water Supply Protection Areas (ZONE A, B, C) data[56] was referenced.

› Freshwater Wetlands:

- "Yes" was populated if the catchment was within an area delineated as a Massachusetts Department of Environmental Protection (MassDEP) wetland or within approximately 100 ft. of a MassDEP wetland. "No" was populated if not.
- MassGIS MassDEP Wetlands (2005)[57] data was referenced.

› Limited Drainage:

- "Yes" was checked if catchment topography and drainage infrastructure indicated it would be difficult to route significant water to an optimal BMP location. "No" was populated if not.
- MassGIS 1:5,000 topographic data[58] and the DCR drainage infrastructure database was referenced.

› Hydrologic Soil Group (HSG):

- "A," "B," "C," "C/D," or "D" was populated based on the predominant (greatest area) HSG of the catchment. "No data" was populated if the survey area of the reference data did not cover the catchment.
- USDA NRCS hydrologic soil group data[59] was referenced.

› Tree Clearing:

- "Yes" was populated if site imagery indicated significant tree clearing (>0.25 ac) would be required to construct and/or access a new BMP. "No" was populated if not.

55 MassGIS. "Outstanding Resource Waters." Commonwealth of Massachusetts. (March 2010). https://www.mass.gov/info-details/massgis-data-outstanding-resource-waters

56 MassGIS. "Surface Water Supply Protection Areas (ZONE A, B, C)." Commonwealth of Massachusetts. (May 2023). https://www.mass.gov/info-details/massgis-data-surface-water-supply-protection-areas-zone-a-b-c

57 MassGIS. "MassDEP Wetlands (2005)." Commonwealth of Massachusetts. (December 2017). https://www.mass.gov/info-details/massgis-data-massdep-wetlands-2005

58 MassGIS. "Elevation Contours (1:5,000)." Commonwealth of Massachusetts. (April 2003). https://www.mass.gov/info-details/massgis-data-elevation-contours-15000

59 MassGIS. "Soils SSURGO-Certified NRCS." Commonwealth of Massachusetts. (Accessed August 20, 2020). https://www.mass.gov/info-details/massgis-data-soils-ssurgo-certified-nrcs

- Aerial and Google Street View imagery[60, 61, 62] was referenced.

› Utilities:

- "Yes" was populated if site imagery showed aboveground utilities or indicated the possible presence of underground utilities that could interfere with construction of a BMP; "No" was populated if utilities at the site were unlikely.
- Aerial and Google Street View imagery[60, 61, 62] was referenced.

› Other Uses:

- "Yes" was populated if site imagery, information on DCR's website or any other context clues indicated that other uses for the area might constrain BMP installation. "No" was populated if not. If "Yes" was populated, the "other use" was specified in the Notes field.
- Aerial and Google Street View imagery[60, 61, 62] was referenced in addition to DCR's website[63].

› Other:

- "Yes" was populated if any other notable constraints or considerations were present (e.g,. steep slopes). "No" was populated if not.

› Environmental Justice Area:

- "Yes" was populated if the catchment was in the same census block as an Environmental Justice (EJ) population, or within approximately one mile of the EJ population census block. "No" was populated if not.
- MassGIS 2020 Environmental Justice Populations data[64] was referenced.

› Upcoming Projects:

- "Yes" was populated if the catchment was located in a DCR facility with a known upcoming construction project. "No" was populated if not.
- DCR maintains an internal "upcoming projects" data layer that was referenced.

› Notes:

- Notes about any of the above considerations were included here.

Once a Catchment Considerations record was populated, the considerations were reviewed holistically to help determine if the catchment should continue to have a status of High Potential or High Potential—Impervious Cover Disconnection. In general, the more attribute fields populated with "Yes," the more constrained the site was considered, except for "Environmental Justice Area" and

60 MassGIS. "2019 Aerial Imagery." Commonwealth of Massachusetts. (Spring 2019). https://www.mass.gov/info-details/massgis-data-2019-aerial-imagery

61 Google. "Streetview." Digital images. Google Maps. https://www.google.com/maps

62 Nearmap. "MapBrowser." Digital images. https://apps.nearmap.com/maps/

63 Department of Conservation and Recreation Website. https://www.mass.gov/orgs/department-of-conservation-recreation

64 MassGIS. "2020 Environmental Justice Populations." Commonwealth of Massachusetts. (November 2022.) https://www.mass.gov/info-details/massgis-data-2020-environmental-justice-populations

"Upcoming Projects." A "Yes" in either of these fields was viewed favorably when it came to confirming status. If a catchment appeared to have too many constraints after reviewing each consideration, treatment status was changed to Low Potential. In some instances, treatment status was also changed to Existing if a BMP had been mapped in the catchment after the catchment was assigned a treatment status. Catchments with High Potential or High Potential—Impervious Cover Disconnection treatment status were included as "Planned BMPs" in the NSIRs.

5.3.2 Selection of Demonstration BMPs

According to the MS4 Permit, DCR is required to plan and install a minimum of one structural BMP as a demonstration project within six years of the permit effective date. This demonstration project must target a catchment with high nitrogen or phosphorus load, depending on the pollutant of concern. For each parent watershed, DCR ensured at least one demonstration project was planned if a BMP had not already been constructed within the permit term (since July 1, 2018). DCR did not plan a demonstration BMP for each child watershed per clarification in EPA's MS4 Permit Response to Comments[65] (comments #157 and #158), which states that permittees that encounter overlaps may eliminate duplication whenever possible and streamline requirements" (p. 76).

65 EPA Response to Comments on: National Pollutant Discharge Elimination System (NPDES) General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts. April 4, 2016. https://www3.epa.gov/region1/npdes/stormwater/ma/2016fpd/rtc-2016-ma-sms4-gp.pdf

6

Reporting

This chapter discusses the approach used to generate the PCP and NSIR reporting documents.

6.1 Report Scope

6.1.1 PCPs

DCR was required to develop PCPs for six watersheds which were combined into two documents: the PCP for Lakes and Ponds Watersheds, which covers five PCP watersheds, and the Phase 1 PCP for the Charles River Watershed, which covers the sixth PCP watershed. These PCPs were due in Permit Year 5 and reference the methodology included within this document.

A document entitled "Phosphorus Control Plan – Permit Year 4" was submitted with the Permit Year 4 Annual Report because certain elements of the PCP were due in Permit Year 4. However, this Permit Year 4 document is obsolete now that the Permit Year 5 documents have been submitted.

6.1.2 NSIRs

To avoid redundancy, NSIR reports were organized to include all nested nutrient impaired waterbody segments tributary to and including a most downstream parent nutrient impaired waterbody segment. See Section 2.1.2.2 for more information on nested watersheds. For each system, the most downstream waterbody segment subject to the NSIR requirements was used as the primary waterbody identified in the report. Each report is focused to provide DCR and EPA with the most relevant data for the water bodies included in each report and fulfills the relevant MS4 Appendix submission requirements.

NSIRs were due in Permit Year 4 and submitted to EPA then. However, additional elements of the NSIR were required to be submitted in Permit Year 5. Therefore, new versions of the NSIRs were developed for Permit Year 5 and submitted to EPA and the Permit Year 4 versions are now obsolete.

6.2 Report Approach

The overall approach to PCP and NSIR reporting includes the following components:

- PCP reports provide the waterbody specific information and results of the PCP calculations
- NSIR reports provide the waterbody specific information and results of the NSIR calculations
- Methods document (this document) describes the means and methods for the analysis required for the PCPs and NSIRs
- Web-based mapping applications display custom views of DCR's databases to provide EPA with both spatial and tabular data in lieu of generating multiple static figures and tables.

DCR's mapping and treatment data is constantly being updated and is recorded within DCR's working databases that are stored privately. The information represented in the reports and associated mapping applications represent a copy of this information and data at the time of the submittal of the particular deliverable.