DCR Stormwater Design Handbook

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Introduction

The Massachusetts Department of Conservation and Recreation (DCR) has developed this Handbook to provide guidance on the stormwater design requirements for projects on DCR properties. DCR staff will use this Handbook during the project development and project submittal review processes, and for internal designs. External designers will also use the Handbook for their designs. This Handbook focuses on stormwater management measures and requirements. Construction erosion and sediment controls, programmatic measures, and operation and maintenance are addressed through other DCR guidance.

DCR projects are subject to federal Environmental Protection Agency (EPA) municipal separate storm sewer system (MS4) General Permit requirements, Massachusetts Department of Environmental Protection (MassDEP) Wetlands Protection Act (WPA)/401 water quality certification (WQC) regulations, and local stormwater regulations that each include specific stormwater design requirements. A project may be subject to just one set of regulations, all of them, or none of them, depending on the resource areas on the site and the type of project proposed.

In general, the federal and state regulations generally mirror or reference each other, with the exception of water quality treatment. **This Handbook focuses on the different water quality treatment requirements to address the MS4 General Permit Minimum Control Measure (MCM) 5 for Post-Construction Stormwater Management and to assist in meeting the MS4 General Permit impaired waters requirements.** DCR must mitigate potential impacts to water quality and meet certain water quality treatment standards during projects. Therefore, DCR will use the MS4 water quality treatment criteria as a program-wide standard for most projects.

This Handbook provides a step-by-step guide to determining applicable regulations related to a project, developing stormwater design, and meeting water quality treatment requirements. The Handbook explains the requirements and then guides the designer through decision points and calculations. This process is outlined in Figure 1.

The chapters in this Handbook include:

» Providing the big picture—review of DCR stormwater objectives (Chapter 2)

» Determining applicable regulatory jurisdictions (Chapter 3)

» Determining project type and if exemptions are applicable (Chapter 4)

» Designing to include low impact development (LID) practices (Chapter 5)

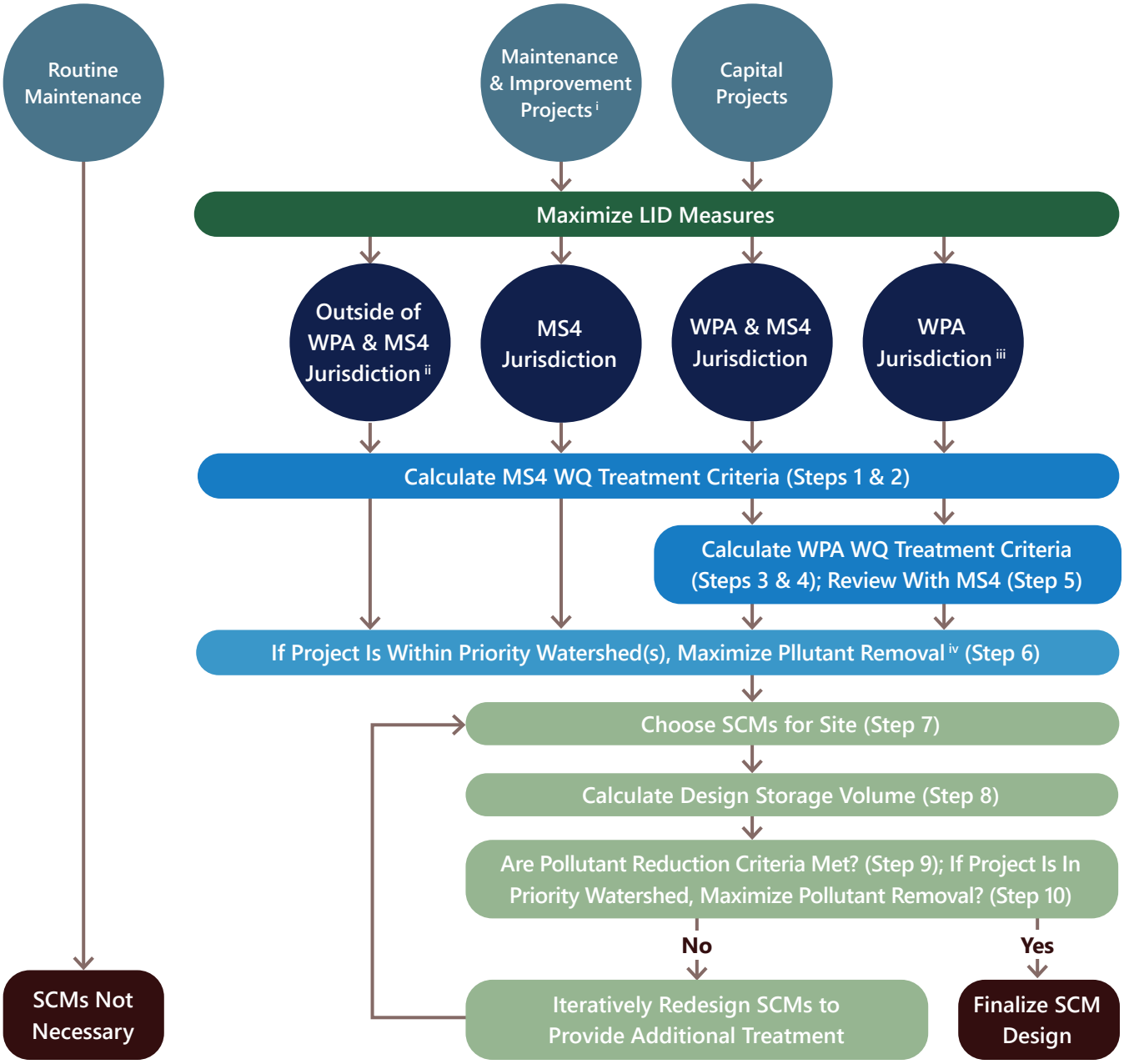
» Determining water quality treatment requirements (Chapter 6)

» Determining which stormwater control measures (SCMs) are best for the site and to meet the water quality treatment requirements (Chapter 7)

» Calculating water quality treatment provided by the chosen SCM (Chapter 8)

» Identifying specific design guidance for the controls (Chapter 9)

Figure 1: DCR Stormwater Treatment Flow Chart



[i] Regulations allow for meeting water quality criteria to the maximum extent practicable (see Chapter 4). DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown, whenever possible.

[ii] Since project is outside regulated areas there are no required water quality treatment criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown.

[iii] Projects are subject to WPA water quality criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet both of the requirements.

[iv] Including additional treatment is not explicitly required by either the MS4 permit or the WPA but is needed to continue progress towards meeting impaired waters pollutant removal requirements in the MS4 permit; therefore, DCR is encouraging maximizing pollutant removal in projects in these watersheds.

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DCR Stormwater Objectives

Maintaining the important recreational, historical, and natural resources available to the people of Massachusetts at our parks, reservations, forests, beaches, rinks, pools, and parkways is DCR's commitment. DCR understands the importance of water quality and the impact of stormwater to these facilities, including the threat of pollution from stormwater and erosion. DCR strives to improve the quality of the Commonwealth's water resources and meet the agency's green infrastructure and climate resilience goals by controlling the sources of pollution from facilities and roads and incorporating stormwater control measures (SCMs) into projects, while meeting relevant stormwater regulations. DCR's Division of Design and Engineering encourages designers to choose SCMs that address impairments to the receiving waterbody and complement the mission of the DCR facility. It is important to DCR that low impact development (LID) practices are incorporated into each design to maximize the use of the natural practices to treat stormwater and mimic the existing hydrology. The following chapters discuss DCR's objectives for stormwater designs.

2.1 Stewardship

While each property is unique, DCR strives to include the following stewardship objectives in all designs, including the stormwater activities:

» Make parks more resilient to climate change
  - Reduce the urban heat island effect

» Support native species plantings and improved local ecology
  - Improve pollinator habitat and connect habitat corridors
  - Contain and prevent the spread of invasive plant species
  - Plant only native plants and seed mixes to reduce the need for irrigation, fertilization, etc., and improve ecosystem function
  - Preserve and grow native tree canopy

» Improve water quality statewide
  - Educate the public about stormwater management and water quality
  - Increase infiltration/groundwater recharge
  - Minimize impervious cover in roadway, pathway, and parking lot designs

» Improve public access to open space, recreational areas, and water resources
  - Provide pedestrian- and bike-friendly transportation alternatives
  - Enhance sense of place (i.e., placemaking)

» Improve landscape aesthetics (e.g., along highways, in neighborhoods, etc.)

2.2 Stakeholders

The designer should include stakeholders in the design process and receive and review input that will inform the design. Project stakeholders are groups or individuals that are involved in, have an interest in, or are affected by a proposed project. Identifying and engaging with stakeholders early in the project can help the design team better understand the project context and objectives and improve the chance of support and timely approvals during design, permitting, and construction.

2.3 Context of the Watershed/Site

The designer should consider the context of the watershed and site, including how it will impact the recommended type of stormwater controls for the site. The watershed and water body context often drive the applicable regulatory requirements that will determine specific water quality objectives. Different context considerations are discussed in the chapters below.

2.3.1 Watershed Context

Understanding the watershed context involves understanding the relationship between the project's drainage area and the encompassing watershed, including receiving water bodies and their water quality status. The designer should review the land use and land cover of the project site and watershed to determine potential pollutant sources. Watersheds should also be reviewed for the presence of wetland, ecological, and cultural resource areas regulated by federal and state policies and rules. Resources that should be reviewed through desktop analysis and site investigations include:

» Land Uses with Higher Potential Pollutant Loads (LUHPPLs)

» Wetland resource areas

» Federal Emergency Management Agency (FEMA) flood zones

» Public water supply protection zones (Zone I, Zone II, Interim Wellhead Protection Area [IWPA], Zone A)

» Bathing beaches, cold-water fisheries, shellfish growing areas

» Outstanding Resource Waters (ORWs)

» Special Resource Waters

» Wildlife habitat

» Stream crossings

» Cultural resources

» Watersheds with Impaired waters/Total Maximum Daily Load (TMDL) reports

DCR has identified Priority Watersheds, discussed more in Chapter 6.3, where either regulations or DCR priorities drive a focus on maximizing stormwater controls in these watersheds. The watershed context will inform the type of stormwater control measures appropriate for the site. Specific types of SCMs to address specific resource areas are discussed more in later chapters of this Handbook.

2.3.2 Site Conditions

A project site's physical conditions will also help determine the strategies and opportunities for stormwater treatment. The designer should complete a desktop review and site investigation to understand the site's characteristics, including the following, and if they trigger regulatory requirements:

» Hazardous materials

» Utilities

» Rights-of-way, property boundaries, easements

» Topography

» Existing site drainage conditions

» Preservation of mature native canopy trees

» Soil, groundwater, bedrock

2.3.3 Facility Use

Siting and design approaches may differ depending on the intended use of the DCR facility. The designer should consider contextual elements that may affect design and construction. For example, the appropriate stormwater controls for a roadway may be very different than those for a park or forest. Urban facilities may have different design objectives than those in a rural area. The amount of public access to a facility will also have an impact on the design. Siting and design considerations that may change based on facility type include:

» Minimizing impervious area

» Addressing space constraints and accessibility

» Minimizing utility conflicts

» Addressing community preferences

» Minimizing high-maintenance measures

» Considering vegetation, signage, access

» Preserving mature native canopy trees

2.4 Operation

DCR prioritizes stormwater management controls that minimize the source of pollution, including:

» Public education

» Anti-litter signage

- Reduction of de-icing salt or sand on roadways
- Quick response and incident management of fuel spills
- Pet waste management
- Proper waste handling practices at storage areas
- Stabilization of slopes and shoulders
- Protection of soil resources and prevention of soil compaction by vehicular loading or construction staging

Additional information on source controls can be found in DCR's Operation and Maintenance Plan[1] and in the Municipal Separate Storm Sewer System (MS4) Stormwater Management Plan (SWMP).[2]

Designers should keep maintenance requirements in mind when planning stormwater controls. While DCR has a statewide inspection and maintenance program for its drainage infrastructure, it is important to weigh the chosen treatment with the necessary maintenance requirements and avoid specialized, labor-intensive, or equipment-intensive activities to maintain the control measures. Sometimes more maintenance will be necessary, especially to encourage green infrastructure controls that are the right fit for the project, but these activities should be weighed as part of the design planning.

The design should also make sure measures requiring inspection are safely accessible. This may require pull-off locations, gaps or gates in fencing, and access roads.

[1] See "Operation and Maintenance (O+M Plan)" at https://www.mass.gov/service-details/dcr-stormwater-management

[2] See "Stormwater Management Plan" at https://www.mass.gov/service-details/dcr-stormwater-management

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Regulatory Compliance

Federal, state, and local regulations provide protection of our water resources, including wetland resource areas and receiving waters. Massachusetts stormwater discharges are regulated under one or more of the multiple applicable regulations, including:

» Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) General Permit

» Massachusetts Department of Environmental Protection (MassDEP) Wetlands Protection Act (WPA)/401 water quality certification (WQC) regulations

» Local municipal ordinances

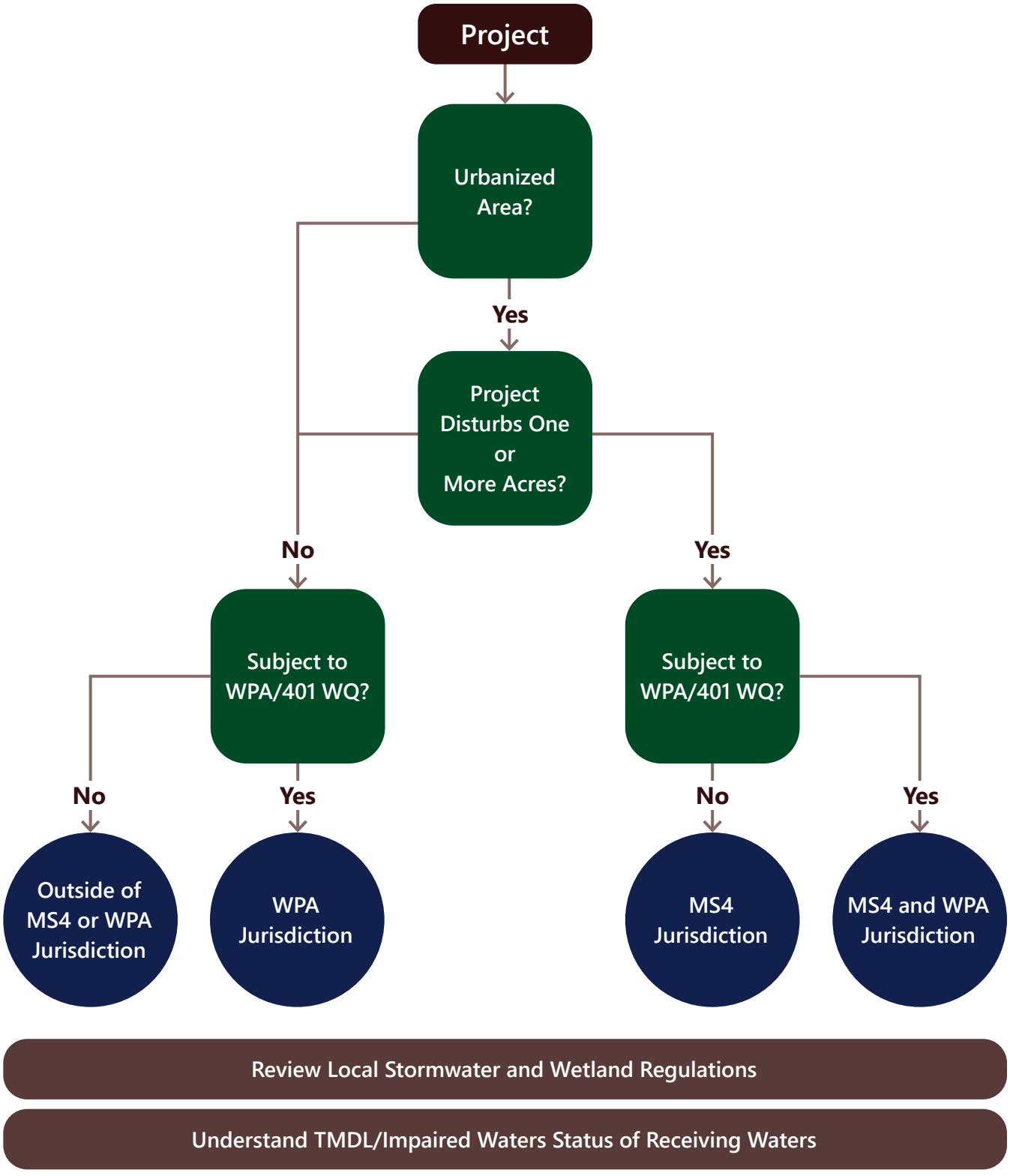
This Handbook is not intended to serve as the sole resource for determining a project's compliance with stormwater regulatory programs. It should be used in conjunction with, and as a supplement to, federal, state, and local regulations. The designer is responsible for reviewing the most current regulatory requirements and design criteria.

The EPA MS4, the MassDEP WPA, and local regulations cover unique resource areas and have different stormwater design requirements. The designer's first task is to determine the relevant regulations for a project and design the stormwater treatment to meet the most stringent requirements.

Once the designer determines the applicable regulations (see the steps presented in this chapter), the next chapter will guide the designer in determining if the regulations provide flexibility regarding stormwater controls based on the type of project being proposed. Figure 2 on the following page provides an overview of the decision points that will aid the designer in determining the regulations that will govern the stormwater design criteria. The DCR Stewardship Map[3] includes layers to assist in determining if the project is within an urbanized area.

[3] See the DCR Stewardship Map at Stewardship Map (arcgis.com)

Figure 2: Regulatory Flow Chart



Note: Designer should use the DCR Stewardship Map[4] to identify if the facility is within an urbanized area.

[4] See the DCR Stewardship Map at Stewardship Map (arcgis.com)

3.1 Massachusetts Stormwater Regulations

In Massachusetts, multiple regulations apply to stormwater discharges. DCR is regulated by EPA's MS4 program as an overall agency and the regulation includes specific stormwater water quality treatment criteria for projects. Also, Massachusetts has developed various environmental permitting programs that include a set of stormwater standards, including the Wetlands Protection Act and the Water Quality Certification processes as described below. Whereas the WPA and WQC processes only capture projects that are located within or adjacent to wetlands or waters of the United States, the EPA MS4 General Permit regulates a broader range of projects at DCR facilities within urbanized areas.

3.1.1 EPA Municipal Separate Storm Sewer System (MS4) Permit (Non-Traditional Permittee)

The Clean Water Act (CWA) authorizes EPA to address water pollution by regulating discharges to waters of the United States and to address stormwater runoff as a source of pollution to receiving waters. To meet the CWA requirements, EPA promulgated rules under the NPDES program. EPA and MassDEP issued the General Permit for Stormwater Discharges From Small MS4s in Massachusetts[5] to provide permit coverage of stormwater discharges in the urbanized areas of Massachusetts. DCR is authorized to discharge stormwater under this permit. Because traditional regulated facilities are cities and towns, not state properties, DCR is considered a non-traditional regulated entity.

The MS4 General Permit requires implementation of the following six minimum control measures (MCMs):

1. Public education and outreach
2. Public involvement and participation
3. Illicit Discharge Detection and Elimination (IDDE) Program
4. Construction site stormwater runoff control
5. Stormwater management in new development and redevelopment (post-construction stormwater management)
6. Good housekeeping and pollution prevention from permittee-owned operations

In addition to these six measures, the MS4 permit requires DCR to address stormwater discharges to impaired waters and provides associated guidance (see Chapter 3.2 of this Handbook).

The DCR Stormwater Management Plan[6] outlines DCR programs that address each of the six MCMs and the MS4 permit's impaired waters requirements. The SWMP describes DCR's planned actions for meeting the measures, provides measurable goals for each action, and sets a schedule for implementing new measures.

To determine if a project is subject to the MS4 permit, the designer should follow the flow chart shown in Figure 2 and check if the facility is within an urbanized area on the DCR Stewardship Map. If the project is within an urbanized area and will disturb one or more acres of land, it is subject to the MS4 post-construction MCM 5 jurisdiction. Next, the designer should check if the project is also subject to Wetlands Protection Act jurisdiction.

[5] See the Massachusetts MS4 General Permit at https://www.epa.gov/npdes-permits/massachusetts-small-ms4-general-permit

[6] See "Stormwater Management Plan" at https://www.mass.gov/service-details/dcr-stormwater-management

The DCR SWMP addresses DCR's activities on a programmatic level, whereas this Handbook is focused on project-specific stormwater design and management.

This Handbook's focus is to address the MS4 General Permit's MCM 5 for Post-Construction Stormwater Management and to assist in meeting the permit's impaired waters requirements when implementing stormwater control measures (SCMs) to mitigate potential impacts to water quality and to meet certain water quality treatment standards.

3.1.2 Massachusetts Wetlands Protection Act Regulations

MassDEP regulates the discharge of stormwater through the Massachusetts Wetlands Protection Act[7] (MGL Chapter 131, Section 40) and its regulations[8] (310 CMR 10.00) for all activities within designated Resource Areas and associated Buffer Zones, such as:

» Any wetland, water body, Land Under Water Bodies and Waterways, Land Subject to Tidal Action, or land within the 100-foot buffer zone of a resource area

» The area within 200 feet from any perennial stream (200-foot Riverfront Area)

» The 100-year floodplain (Bordering Land Subject to Flooding/Land Subject to Coastal Storm Flowage)

Projects within these resource areas and/or their buffers must comply with the WPA (including the 10 Stormwater Standards) to receive approval from the issuing authority (e.g., local conservation commissions or MassDEP). A project must file either a Request for Determination of Applicability (RDA) or Notice of Intent (NOI). Designers of DCR projects must be familiar with the WPA and its regulations to determine project-specific permit applicability and requirements.

3.1.3 Massachusetts 401 Water Quality Certification (WQC) Regulations

Under Section 401 of the federal CWA, activities proposing discharges to waters of the United States require a Water Quality Certificate. MassDEP must certify that projects requiring federal permits will not violate the State Water Quality Standards (314 CMR 4.00). MassDEP has coordinated the Section 401 WQC Program with the state's WPA program. Therefore, most projects approved by local conservation commissions or MassDEP under the WPA are not subject to further review under the 401 WQC Program (314 CMR 9.03 and 9.04).

Some projects, including but not limited to those that have proposed large wetland impacts (i.e., greater than 5,000 square feet [sf] of impacts to waters of the U.S. [314 CMR 9.03(1) through (8)]) or those that discharge to an Outstanding Resource Water, require an individual 401 WQC. For these projects, the Section 401 WQC regulations (CMR 314 9.06) include specific provisions for stormwater discharges. The Section 401 WQC regulations provide criteria that define a project's jurisdictional applicability.

[7] See the Massachusetts Wetlands Protection Act at https://www.mass.gov/doc/310-cmr-1000-the-wetlands-protection-act/download

[8] Refer to the Code of Massachusetts Regulations (CMR) at https://www.mass.gov/code-of-massachusetts-regulations-cmr for the Massachusetts legislation mentioned in this Handbook.

Further general information about the applicability of the Stormwater Standards under the Section 401 WQC regulations may be found in the Massachusetts Stormwater Handbook (Vol. 1, Ch. 2).[9]

3.1.4 Massachusetts Stormwater Management Standards

MassDEP has developed Stormwater Management Standards that are incorporated into both the WPA and 401 WQC regulations. MassDEP's Massachusetts Stormwater Handbook,[10] published in 2008, describes how the Stormwater Standards apply to various types of projects. The designer should consult MassDEP's website[11] for updates to the Stormwater Standards, applicable regulations, and current policies and procedures.

This DCR Stormwater Handbook only focuses on how to meet the water quality treatment standard (Stormwater Standard 4) of the WPA Stormwater Management Standards, since the remainder of the standards are not impacted by the MS4 requirement and thus further guidance was not needed.

The designer should follow the Massachusetts Stormwater Handbook for compliance with all other standards.

Table 1: MassDEP Stormwater Management Standards[12]

1	No new stormwater conveyances (e.g., outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.
2	Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed predevelopment peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.
3	Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from predevelopment conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.
4	Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when: a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained. b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook. c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

[9] See Volume 1, Chapter 2 of the Massachusetts Stormwater Handbook at v1c2.doc (live.com)

[10] See the Massachusetts Stormwater Handbook at https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards

[11] See the Massachusetts Stormwater Handbook at https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards

[12] See Volume 1, Chapter 1, pp. 1–2 of the Massachusetts Stormwater Handbook at v1c1.doc (live.com)

Table 1: MassDEP Stormwater Management Standards *(continued)*

5	For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.
6	Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.
7	A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.
8	A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.
9	A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.
10	All illicit discharges to the stormwater management system are prohibited.

These Stormwater Management Standards are reviewed in Stormwater Management Reports developed for a project. The reports can be in any of the following formats:

a. **Within the NOI Write-Up**—Often used for projects that do not require stormwater controls. The stormwater write-up is generally in paragraph form and briefly describes the existing conditions, noting that the project does not propose any change and therefore meets the standards.

b. **Stormwater Memo Attached to the NOI**—Typically used for projects that are minimally impacting stormwater and/or for projects that only need to meet the standards to the maximum extent practicable as described in Standard 7. Existing conditions and proposed conditions are described in a moderate amount of detail before individually discussing impacts/compliance with the standards. Attachments are generally limited.

c. **Stormwater Report Attached to the NOI**—Used for projects that have a large impact and make significant changes to the existing stormwater conditions. This is generally a more robust and thorough report about existing and proposed conditions. The 10 standards are individually discussed in detail and many attachments are required.

3.1.5 Local Regulations

Many municipalities have bylaws, ordinances, and/or regulations that pertain to stormwater discharges. Designers should review local permitting requirements and determine if they apply to DCR projects. Some local regulations may be stricter than the criteria outlined in this Handbook and their applicability should be discussed with the DCR Stormwater Group during initial designs. In general, DCR strives to keep its stormwater systems separate from municipal systems, but sometimes DCR's systems are interconnected or receive flows from other municipal systems.

3.1.5.1 Municipal By-Laws, Ordinances, and Regulations

The MS4 permit requires regulated municipalities to adopt by-laws or ordinances to address post-construction stormwater runoff from all new development and redevelopment sites that disturb one or more acres and discharge to the municipalities' drainage systems. Since DCR is subject to this same requirement, as fulfilled by this Handbook, the post-construction requirements will be met by this Handbook's water quality sizing criteria. Municipalities can set stricter water quality treatment criteria or thresholds. Designers should review the applicable local by-laws and ordinances to determine if DCR projects require permitting with municipalities and if the local regulations include more stringent design standards.

3.1.5.2 Stormwater Utilities/Enterprise Fund

Many municipalities have developed stormwater utility/enterprise funds to provide dedicated funding sources for stormwater maintenance and improvements. Designers should determine if DCR facilities are within municipalities with local stormwater utilities. They should discuss if design objectives should include measures to make sure DCR facilities do not discharge to municipal systems, both for simplicity but also to potentially reduce fees. Designers should also review the utility documentation to understand if credits are available for non-structural and structural stormwater control measures implemented as part of projects.

3.1.5.3 Wetland Ordinance and Bylaws

Many municipalities have adopted wetland protection bylaws that extend the jurisdictional areas and buffers beyond those in the WPA and may require adherence to the Storm Water Standards. Designers should determine if DCR projects are subject to local wetland ordinances or bylaws.

3.2 Impaired Waters

MassDEP assesses the state's water bodies for conformance with Massachusetts State Water Quality Standards based on the water bodies' assigned use. The agency develops a list of water bodies, known as the Integrated List of Waters, as part of the requirements of Section 303(d) of the federal CWA.[13] If a water body does not meet the Water Quality Standards for its assigned use, MassDEP designates it as "impaired."

[13] See the most recent Integrated List of Waters at https://www.mass.gov/lists/integrated-lists-of-waters-related-reports

MassDEP is required to develop a Total Maximum Daily Load (TMDL) for an impaired water body or watershed. TMDLs identify known sources of pollutants that contribute to the impairments and determine reduction targets for the pollutant(s) of concern. MassDEP has prepared and is continuing to develop TMDLs[14] for watersheds in Massachusetts.

The MS4 General Permit includes additional requirements for discharges to waters subject to TMDLs and/or discharges to certain water quality limited waters.

3.2.1 Impaired Water Bodies

MassDEP has placed every water body segment on the Section 303(d) list in one of the following categories:

» **Category 1**: Water bodies attaining all designated uses[15]

» **Category 2**: Water bodies attaining some uses; other uses not assessed

» **Category 3**: Water bodies with no uses assessed

» **Category 4A**: Water bodies with a final TMDL actively under implementation that covers all uses

» **Category 4B**: Water bodies where the impairment is controlled by an alternative pollution control requirement and therefore a TMDL is not required

» **Category 4C**: Water bodies that are impaired by a non-pollutant (e.g., invasive aquatic plants) and therefore a TMDL is not required

» **Category 5**: Water bodies that require one or more TMDLs

» **Category 5A**: Water bodies for which Alternative Restoration Plans have been completed

Surface waters that have never been assessed do not appear in the impaired waters lists and are considered Category 3 waters by default. MassDEP reviews the impaired waters list every two years and issues a draft for public comment. Once the public comment period is closed, the final list is issued. The designer should use that most recent list to determine the category and impairments for a project's receiving water bodies. This information will then be used in guiding the design, as discussed in more detail in Chapter 6.

3.2.2 TMDLs

Total Maximum Daily Loads are determined based on study of the contributing area to an impaired water body. They represent a calculation of the maximum amount of a pollutant(s) a waterbody can receive and continue to meet the state water quality standards for public health and healthy ecosystems. The federal Clean Water Act requires that all states develop TMDLs for those water bodies identified as Category 5. A TMDL report establishes waste load allocations (WLAs) for contributing point sources (including certain stormwater sources) and load allocations (LAs) for other non-regulated sources of pollution (including non-point sources).

[14] See lists of TMDLs at https://www.mass.gov/lists/total-maximum-daily-loads-by-watershed

[15] There are no Category 1 waters in Massachusetts due to a statewide advisory by the Massachusetts Department of Public Health that prohibits consumption of finfish due to the risk of elevated mercury to sensitive populations. This means that no waters can be classified as in full support of the fish consumption use.

A TMDL is the maximum pollutant load that a water body can receive and still meet the assigned water quality standards.

DCR must incrementally make progress towards reducing pollutants from regulated facilities to meet WLA targets in certain watersheds as set by the MS4 permit. In order to provide these reductions, DCR is maximizing stormwater treatment in projects in these watersheds. See Chapter 6 for additional detail.

3.3 Other Regulatory Programs

In addition to the stormwater provisions addressed in this Handbook, projects must comply with other applicable regulatory requirements with objectives that include:

- Complying with MassDEP Stormwater Standards 1–3 and 5–11 (this Handbook focuses on Standard 4)
- Complying with EPA MS4 MCMs 1–4 and 6 (this Handbook focuses on MCM 5 [Post Construction])
- Maintaining stream continuity and habitat at stream crossings
- Preventing impacts to habitat of threatened and endangered species
- Preventing direct discharges to Class A public water supplies
- Preventing incremental flooding and loss of floodplain
- Preserving historical and cultural resources
- Addressing coastal and riverine impacts

The designer is responsible for evaluating whether additional permitting requirements are applicable to a project and communicating with the DCR project manager on the approach to addressing them.

4

Project Type and Stormwater Design Impacts

Once the designer determines a project's governing regulatory jurisdiction(s), the next step (shown in Figure 3) is to determine the project type. Project types are paraphrased here, and discussed in further detail below, because the stormwater requirements in the various regulations differ based on the project type:

- **Routine Maintenance**: general daily operation activities that address minor safety and facility improvements, typically involves less than 1 acre of disturbance[16]
- **Maintenance and Improvement Projects**: projects that address safety improvements or maintenance needs but may include some design and permitting, typically involve less than 1 acre of disturbance[17]
- **Capital Projects**: projects that provide significant improvements at a site and usually include full design and permitting, typically involve more than 1 acre of disturbance[18]

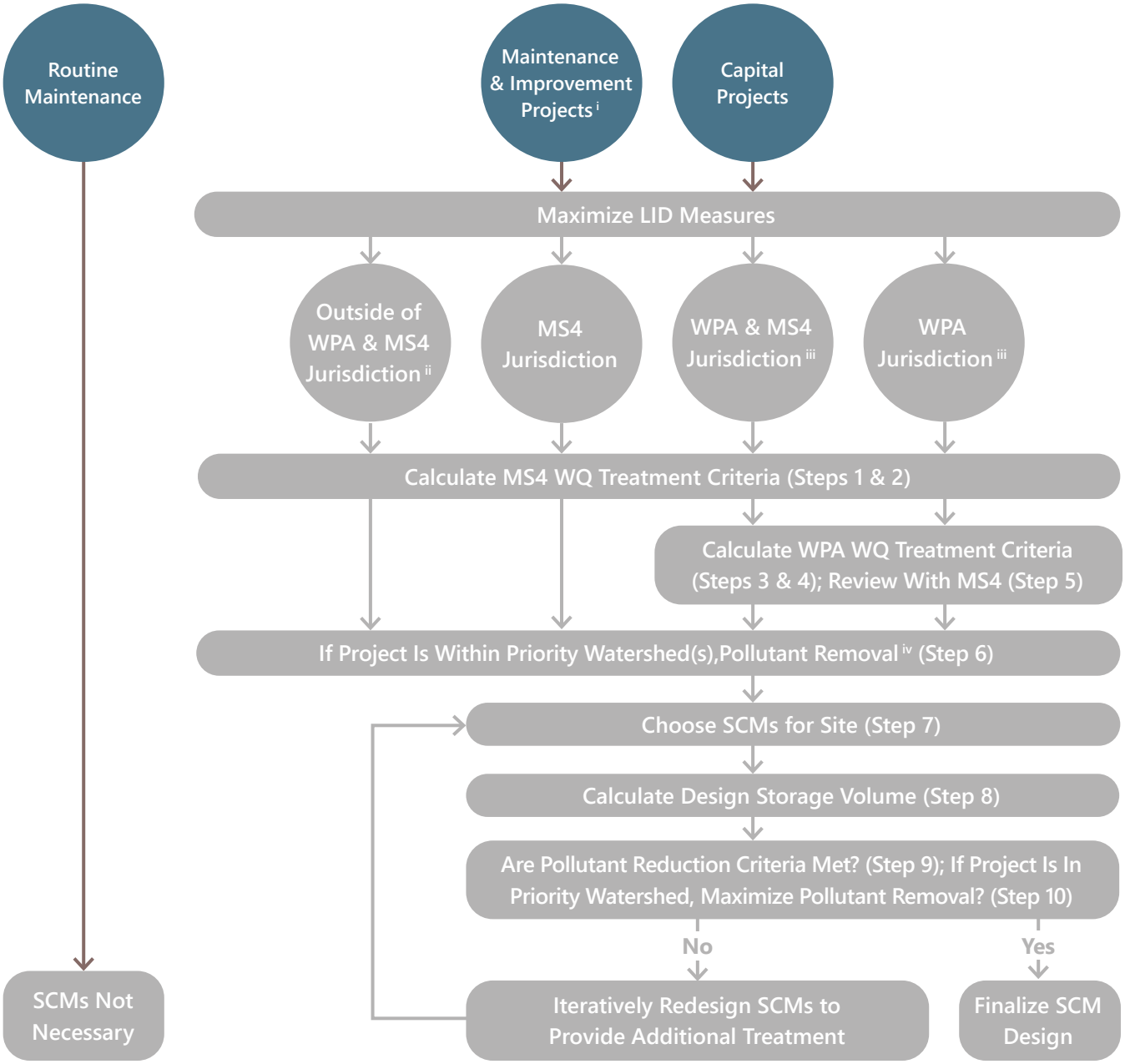
This chapter discusses the definition/criteria used by each regulatory program to define project types. The majority of DCR projects are maintenance and improvement projects. Despite regulations for this type of project allowing leeway with regards to implementing stormwater improvements, DCR will strive to fully meet the stormwater requirements, as discussed in Chapter 6, for these projects.

[16] The one-acre threshold is used for determining eligibility for coverage under the NPDES Construction General Permit as well as the MS4 Construction Site Stormwater Runoff Control Minimum Control Measure, and to give a sense of general scale of the projects. See further description in this chapter.

[17] Ibid.

[18] Ibid.

Figure 3: Water Quality Treatment Flow Chart—Project Types



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[ii] Since project is outside regulated areas there are no required water quality treatment criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown.

[iii] Projects are subject to WPA water quality criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet both of the requirements.

[iv] Including additional treatment is not explicitly required by either the MS4 permit or the WPA but is needed to continue progress towards meeting impaired waters pollutant removal requirements in the MS4 permit; therefore, DCR is encouraging maximizing pollutant removal in projects in these watersheds.

4.1 Routine Maintenance

Many of DCR's activities are considered routine maintenance. The regulatory agencies have included thresholds (discussed in the next two subsections) for disturbance and types of activities that routine maintenance will not meet in order to encourage regular maintenance without needing designs and permitting approval. If a project does not exceed the thresholds, it does not need to implement new structural stormwater control measures.

Routine maintenance projects do not need to construct structural stormwater control measures (SCMs) since the Municipal Separate Storm Sewer System (MS4) permit and the Wetlands Protection Act (WPA) do not require providing stormwater treatment for maintenance activities. **The designer should document that a project is considered routine maintenance based on the project site's regulatory jurisdiction(s), and that no further stormwater structural controls are required.**

4.1.1 MS4 Routine Maintenance

The MS4 permit does not require post-construction control measures unless the project disturbs one or more acres within an urbanized area. Most routine maintenance will not meet this threshold and therefore will not need to meet MS4 post-construction water quality treatment standards.

4.1.2 WPA Routine Maintenance

The WPA includes multiple sections, discussed in the following subsection, that provide guidance for encouraging routine maintenance for projects within WPA jurisdiction. The WPA allows this work to be performed without a Request for Determination of Applicability (RDA) or Notice of Intent (NOI) filing, and projects undergoing routine maintenance do not need to meet WPA Stormwater Standards. If there are questions about regulatory applicability, proposed work should be coordinated with the local conservation commission or an RDA may be submitted to avoid a potential violation. Erosion and sediment (E&S) controls may be required for some minor activities and routine roadway maintenance, depending on the site.

4.1.2.1 Stormwater Management System Maintenance

Stormwater management systems (including structural controls) must be maintained to continue to perform as designed. Stormwater management systems installed in compliance with an Order of Conditions (OOC) subsequent to April 1, 1983, may be maintained without requiring the filing of an RDA or NOI, provided the following are true:

- The system was constructed in accordance with all applicable provisions of 310 CMR 10.00.
- Work is limited to maintenance of the stormwater management system.
- Work uses best practical measures to avoid and minimize impacts to wetland resources areas outside the footprint of the stormwater management system (310 CMR 10.02(3)).

Allowable maintenance generally includes mowing, clearing of woody vegetation, or removing accumulated sediment (but not altering the system). Maintenance of a stormwater management system is defined as work to keep a stormwater management system functional and in good repair

so that it may continue to operate as originally designed (310 CMR 10.04). It does not include work that reduces capacity, increases discharge volume, adds more stormwater to the system, or reduces use of above-ground SCMs.

4.1.2.2 Stormwater Control Measure Maintenance

SCMs that were constructed on or after November 18, 1996, and were built to comply with WPA regulations and the Stormwater Standards are not considered jurisdictional wetland resources. This rule promotes, without prohibitions, the use of low impact development (LID) practices and above-ground SCMs that incorporate wetland-type features.

Constructed stormwater treatment wetlands are not considered jurisdictional wetlands and they do not have Buffer Zones (310 CMR 10.02(2)(c)). They are stormwater treatment SCMs and are subject to ongoing maintenance in accordance with their approved Operations and Maintenance (O&M) Plan.

Maintenance can be performed on SCMs with constructed wetland features, or SCMs that have developed such natural wetland features over time, without filing an RDA or NOI, as long as the work meets the definition of stormwater management system maintenance as described in the previous chapter. These SCMs may include vegetated basins, conventional drainage ditches, depressions, or other structures or features that convey, control, or treat roadway runoff.

4.1.2.3 Beach Maintenance

DCR has worked with many of the state's coastal municipalities to develop standing OOCs for routine beach maintenance at applicable DCR beach facilities. The OOCs allow DCR to use certain equipment and contractors/vendors to perform some or all the routine beach maintenance related to:

» Protection of shorebird nesting

» Debris removal

» Removal and disposal of marine life mortality

» Mechanical beach cleaning

» Maintenance of lifeguard stations and disabled access

» Cleanup due to coastal storm surges, flooding, and reclamation of sand and cobble

» Snow removal

» Infrastructure repairs and maintenance

» Minor regular maintenance activities that include maintenance of storm water and flood control infrastructure

Designers should check with the DCR Stormwater Program Team to determine if project activities are covered by these standing OOCs and therefore do not require submitting a WPA filing. Some activities may still require filing of an RDA to determine applicability, depending upon the OOC conditions.

4.1.2.4 Golf Course Maintenance

While DCR has OOCs with communities where DCR golf courses are located that cover routine golf course maintenance such as mowing, it does not have OOCs for maintenance and repair projects like those performed at DCR beach facilities. Most golf course projects will still require a WPA filing for maintenance activities.

4.1.2.5 Minor Activities Including Routine Roadway Maintenance

Certain minor activities are not subject to the Wetlands Protection Act, provided the work is performed solely within the Buffer Zone to the Resource Area or within the Riverfront Area and the project implements stabilization measures for disturbed areas to minimize adverse impacts to the Resource Area during and after construction. Table 2 provides an excerpt of the list of qualified minor activities from the wetland regulations, including certain utility work, vegetation clearing, sign installation, and pavement repair/resurfacing, which cover the DCR Parkway Maintenance Program activities (those most often performed by DCR are **bolded** in the table). Routine roadway maintenance does not include the installation of drainage system infrastructure. The activities covered in Table 2 are not subject to the Wetlands Protection Act.

Table 2: Minor Activities Within Buffer Zone to Resource Areas and Within Riverfront Area Not Subject to WPA[19]

a	**Unpaved pedestrian walkways less than 30 inches wide for private use and less than three feet wide for public access on conservation property**
b	**Fencing, provided it will not constitute a barrier to wildlife movement; stonewalls; stacks of cordwood**
c	**Vista pruning provided the activity is located more than 50 feet from the mean annual high-water line within a Riverfront Area or from Bordering Vegetated Wetland, whichever is farther. (Pruning of landscaped areas is not subject to jurisdiction under 310 CMR 10.00.)**
d	**Plantings of native species of trees, shrubs, or groundcover, but excluding turf lawns**
e	The conversion of lawn to uses accessory to residential structures such as decks, sheds, patios, pools, replacement of a basement bulkhead and the installation of a ramp for compliance with accessibility requirements, provided the activity, including material staging and stockpiling is located more than 50 feet from the mean annual high-water line within the Riverfront Area, Bank or from Bordering Vegetated Wetland, whichever is farther, and erosion and sedimentation controls are implemented during construction. The conversion of such use's accessory to existing single family houses to lawn is also allowed. (Mowing of lawns is not subject to jurisdiction under 310 CMR 10.00.)
f	**The conversion of impervious to vegetated surfaces, provided erosion and sedimentation controls are implemented during construction**
g	**Activities that are temporary in nature, have negligible impacts, and are necessary for planning and design purposes (e.g., installation of monitoring wells, exploratory borings, sediment sampling and surveying and percolation tests for septic systems provided that resource areas are not crossed for site access)**

[19] Information excerpted from 310 CMR 10.02(2)(b)2. The Designer should refer to 310 CMR 10.02(2)(a) and (b) for the latest regulatory language defining these activities.

Table 2: Minor Activities Within Buffer Zone to Resource Areas and Within Riverfront Area Not Subject to WPA *(continued)*

h	Installation of directly embedded utility poles and associated anchors, push braces or grounding mats/rods along existing paved or unpaved roadways and private roadways/driveways, and their existing maintained shoulders, or within existing railroad rights-of-way, provided that all work is conducted within ten feet of the road or driveway shoulder and is a minimum of ten feet from the edge of the Bank or Bordering Vegetated Wetland and as far away from resource areas as practicable, with no additional tree clearing or substantial grading within the buffer zone, and provided that all vehicles and machinery are located within the roadway surface during work
i	**Installation of underground utilities (e.g., electric, gas, water) within existing paved or unpaved roadways and private roadways/driveways, provided that all work is conducted within the roadway or driveway and that all trenches are closed at the completion of each workday**
j	Installation and repair of underground sewer lines within existing paved or unpaved roadways and private roadways/driveways, provided that all work is conducted within the roadway or driveway and that all trenches are closed at the end of completion of each workday
k	Installation of new equipment within existing or approved electric or gas facilities when such equipment is contained entirely within the developed/disturbed existing fenced yard
l	**Installation of access road gates at public or private road entrances to existing utility right-of-way access roads, provided that all vehicles and machinery are located within the roadway surface during work**
m	Removal of existing utility equipment (poles, anchors, lines) along existing or approved roadways or within existing or approved electric, water or gas facilities, provided that all vehicles and machinery are located within the roadway surface during work
n	**Vegetation cutting for road safety maintenance, limited to the following**: i Removal of diseased or damaged trees or branches that pose an immediate and substantial threat to driver safety from falling into the roadway ii Removal of shrubbery or branches to maintain clear guardrails; such removal shall extend no further than six feet from the rear of the guardrail iii Removal of shrubbery or branches to maintain sight distances at existing intersections; such removal shall be no farther than five feet beyond the "sight triangles" established according to practices set forth in American Association of State Highway and Transportation Officials (AASHTO) A Policy on Geometric Design of Highways and Streets, 2011, 6th edition, and such removal is a minimum of ten feet from a resource area, other than Riverfront Area iv **Removal of shrubbery, branches, or other vegetation required to maintain the visibility of road signs and signals** v **Cuttings of shrubs and branches from mature trees will be performed with suitable horticultural equipment and methods that do not further damage the trees. To prevent the possible export of invasive plants, cut vegetation should be chipped and evenly spread on site, provided the chips are spread outside the buffer zone, and raked to a depth not to exceed three inches, clear of all drainage ways. Alternatively, all cuttings and slash shall be removed from the site and properly disposed.**
o	**Installation, repair, replacement or removal of signs, signals, sign and signal posts and associated supports, braces, anchors, and foundations along existing paved roadways and their shoulders, provided that work is conducted as far from resource areas as practicable, and is located a minimum of 10 feet from a resource area, any excess soil is removed from the project location, and any disturbed soils are stabilized as appropriate**

Table 2: Minor Activities Within Buffer Zone to Resource Areas and Within Riverfront Area Not Subject to WPA *(continued)*

p	**Pavement repair, resurfacing, and reclamation of existing roadways within the right-of-way configuration provided that the roadway and shoulders are not widened, no staging or stockpiling of materials, all disturbed road shoulders are stabilized within 72 hours of completion of the resurfacing or reclamation, and no work on the drainage system is performed, other than adjustments and/or repairs to respective structures within the roadway**
q	The repair or replacement of an existing and lawfully located driveway servicing not more than two dwelling units provided that all work remains within the existing limits of the driveway and all surfaces are permanently stabilized within 14 days of final grade

4.1.3 WPA Emergency Repairs

Public projects that address emergencies generally cannot be delayed for design, review, and permitting of stormwater management features. Examples of emergency repairs include, but are not limited to:

» Stormwater pipe replacement in a roadway after a failure

» Removal of an obstruction in a roadway

» Repair of pavement failures

The WPA requires authorization for emergency work that is required for the protection of public health and safety be obtained through the local Conservation Commission and MassDEP. The designer should consult with the DCR Stormwater Program Team to discuss when an Emergency Certification (310 CMR 10.06: Emergencies) from the appropriate issuing authorities is required.

Emergency Certifications typically include:

» Photographic evidence

» A site visit

» A written justification for emergency action

Permitting after the issuance of an Emergency Certification is not required by WPA or Section 401 WQC regulations. However, the designer should check with the local conservation commission to see if it requires filing of a NOI after the work is complete, as some commissions may want to issue an OOC to document the emergency work. Only those aspects of the work that are necessary to protect health and safety are allowable under the emergency certification process. Other work that may be required could require a formal permitting process with the commission under an NOI or and RDA.

The WPA regulations (310 CMR 10.05(6)(l)) and the Section 401 WQC regulations (314 CMR 9.06(6)(b)) state that the MassDEP Stormwater Standards do not apply to emergency repairs to roads or their drainage systems. However, E&S controls are required.

Under the Section 401 WQC regulations, repairs may take place without a certification in the event that immediate action is essential to avoid or eliminate a serious and immediate threat to the public health or safety or to the environment, provided authorization is issued under the WPA as described above. Most commonly, this applies to repairs following severe storms that have caused regional or statewide damage. In these instances, MassDEP may issue and publicize area-specific, emergency regulations that allow for repair to damaged property without local approval.

4.2 Maintenance and Improvement Projects

Maintenance and improvement projects include projects that are more than the routine maintenance activities described in the previous chapter, but are somewhat limited in impact and are often driven by safety and drainage improvement needs. MassDEP and EPA recognize that these types of projects have limited potential to impact receiving waters and wetlands. Therefore, regulatory agencies require that these projects improve existing conditions, but they do not have to fully meet stormwater requirements, as outlined in the chapter below. **Nevertheless, DCR is committed to including stormwater improvements whenever possible since large capital projects are relatively rare and DCR must continue to make water quality improvements both for the health of receiving waters and for compliance with DCR's stormwater discharge permit.**

DCR encourages designers to first maximize green infrastructure (GI)/low impact development (LID) (see Chapter 5) measures in their designs. Designers should then include stormwater controls in maintenance and improvement project designs to the maximum extent practicable, regardless of the exact regulatory requirement, to improve treatment provided before discharging to receiving waters. DCR is especially focused on projects within DCR-identified Priority Watersheds (see Chapter 6.3) to assist in meeting DCR program-wide stormwater goals.

Each of the maintenance and improvement project activity types are discussed in greater detail below, and designers should always reference the specific applicable chapters of the federal and state regulations. Designers must also always check local regulations to determine if local ordinances or by-laws include stricter criteria for projects that are included in the maintenance and improvement categories described below. Chapter 6 discusses specific stormwater sizing and pollutant removal requirements.

4.2.1 MS4 Maintenance and Improvement Projects

If a project is within the MS4 jurisdiction and will disturb one or more acres, the MS4 permit defines maintenance and improvement projects as projects limited to maintenance and improvement of existing roadways that only include:

» Widening less than a single lane

» Adding shoulders

» Correcting substandard intersections

» Improving existing drainage systems

» Full depth repaving projects

If the project meets this MS4 definition, then the design only needs to improve existing conditions and does not need to meet the redevelopment MS4 water quality treatment standards.

The MS4 permit does not have a specific provision for new footpaths, bike paths, or other paths for pedestrian or non-motorized vehicle access (whereas the WPA regulations discussed in the next chapter do specifically address them). This is because the drainage patterns from these paths often only include sheet flow to adjacent areas and not concentrated flow. **In order to be defined as a regulated MS4 discharge point, the stormwater flow must be a concentrated point source discharge.** Designers should review these situations (e.g., an impervious walkway in an urban park near a waterbody) with the DCR Stormwater Program Team since understanding the potential for providing a path for a pollutant(s) to reach the receiving waters must also be taken into account when deciding if the discharge is regulated.

DCR encourages designers to meet the MS4 redevelopment water quality treatment requirements to the maximum extent practicable. The MS4 redevelopment stormwater standard is discussed further in Chapter 6.

4.2.2 WPA Maintenance and Improvement Projects

Projects defined under the WPA as "limited projects" and "maintenance and improvement projects" typically meet the MassDEP definition of redevelopment. This allows a project to demonstrate that its design meets Stormwater Standards 2 and 3, and meets the pretreatment and structural best management practice requirements of Standards 4, 5, and 6 to the maximum extent practicable. This chapter describes each category in more detail.

4.2.2.1 Limited Projects

Many DCR maintenance and minor improvement projects meet the WPA Limited Projects definition for which some regulatory thresholds do not apply (310 CMR 10.24(7)(a-c)). These project types include:

- Maintenance and improvement of existing public roadways, but limited to widening less than a single lane, adding shoulders, correcting substandard intersections, and improving drainage systems
- Maintenance, repair, and improvement (but not substantial enlargement except when necessary to reduce or eliminate a tidal restriction) of structures, including buildings, piers, towers, headwalls, bridges, and culverts that existed on November 1, 1987
- Routine maintenance and repair of road drainage structures, including culverts and catch basins, drainage easements, ditches, watercourses, and artificial water conveyances to ensure flow capacities that existed on November 1, 1987
- Ecological Restoration Limited Projects as defined in 310 CMR 10.53(4)

Limited projects are not exempt from WPA regulations, but get relief from strict compliance with the Resource Area performance standards. As appropriate, NOIs or RDAs must be prepared and submitted for Limited Projects and must include an alternatives analysis describing the reason for selecting the proposed design and how it avoids and minimizes wetland impacts. Limited Projects requiring a NOI need to meet the WPA Stormwater Standards, but are classified by MassDEP as redevelopment, which provides some relief from compliance with the Resource Area performance standards. The redevelopment standard is discussed further in Chapter 5.

4.2.2.2 WPA New Footpaths, Bike Paths, and Other Paths for Pedestrian and/or Non Motorized Vehicle Access

The WPA provides relief from full compliance with its Stormwater Standards for the following types of projects:

» Sidewalks

» Footpaths

» Bike travel lanes and paths

» Similar access ways for pedestrian and/or nonmotorized vehicles (310 CMR 10.02)

These types of projects must comply with the WPA Stormwater Standards to the maximum extent practicable.

4.2.3 Projects Outside of MS4 or WPA Jurisdiction

DCR encourages those responsible for designs of maintenance and improvement projects located outside of regulated areas, or those that do not meet the MS4 one-acre disturbance threshold, to maximize water quality treatment. At a minimum, DCR will require maximizing use of open drainage conveyance and dispersing flows to allow for recharge and infiltration. The designer will need to demonstrate that the use of impervious cover disconnection has been maximized. In areas where drainage systems are needed to capture and convey the flow, offline leaching catch basins or similar infiltration structures will need to be used whenever possible to continue to allow for infiltration of smaller storms.

4.3 Capital Projects

Projects that do not meet the routine maintenance or maintenance and improvement category thresholds discussed in the previous chapters are considered capital projects in this Handbook. For these projects, the designer must follow the guidance to fully incorporate required treatment into the stormwater design as discussed in the following chapters. The designer will first need to incorporate low impact development practices into the design before moving on to designing other controls.

Capital projects within the MS4 or WPA regulatory areas (see Chapter 3.1) must meet the relevant stormwater criteria and be designed for the most stringent water quality treatment requirements to meet the regulations. Capital projects located outside of regulatory jurisdiction, or within MS4 jurisdiction but not disturbing one acre or more, are expected to implement stormwater controls to meet the MS4 post-construction treatment requirements (as outlined in Chapter 6) to continue to provide healthy environments and capitalize on including water-quality improvements during projects.

Capital projects must fully meet the relevant stormwater criteria for the regulatory jurisdiction of the project site. Designers must first maximize LID measures (see Chapter 5) for the site. They must then identify the required stormwater treatment (see Chapter 6) and prioritize constructed controls with infiltration before considering other SCMs for the site (see Chapter 7). Projects within DCR's Priority Watersheds should maximize stormwater treatment and pollutant removal to assist in meeting **DCR program-wide stormwater goals**, which may exceed the regulatory-driven requirements for a project site.

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5

Low Impact Development Practices

Low impact development (LID) is a growing approach to site design that minimizes disturbance, mimics natural hydrologic processes, and infiltrates stormwater runoff close to its source instead of deploying historical centralized end-of-pipe stormwater management practices. LID prioritizes site design techniques that focus on conservation of natural hydrologic functions to prevent runoff before implementing smaller dispersed constructed green infrastructure (GI) stormwater controls across the site. LID principles include:

» Minimizing site disturbance

» Working with site hydrology

» Minimizing and disconnecting impervious surfaces

» Applying small-scale controls at the source

DCR has created Figure 4 to assist designers with stepping through the design while following the DCR water quality treatment criteria, starting with maximizing GI/LID measures. LID practices should be discussed during project planning, incorporated into conceptual designs, and re-evaluated as the project progresses through preliminary and final design. DCR encourages:

» Preservation and enhancement of native vegetation

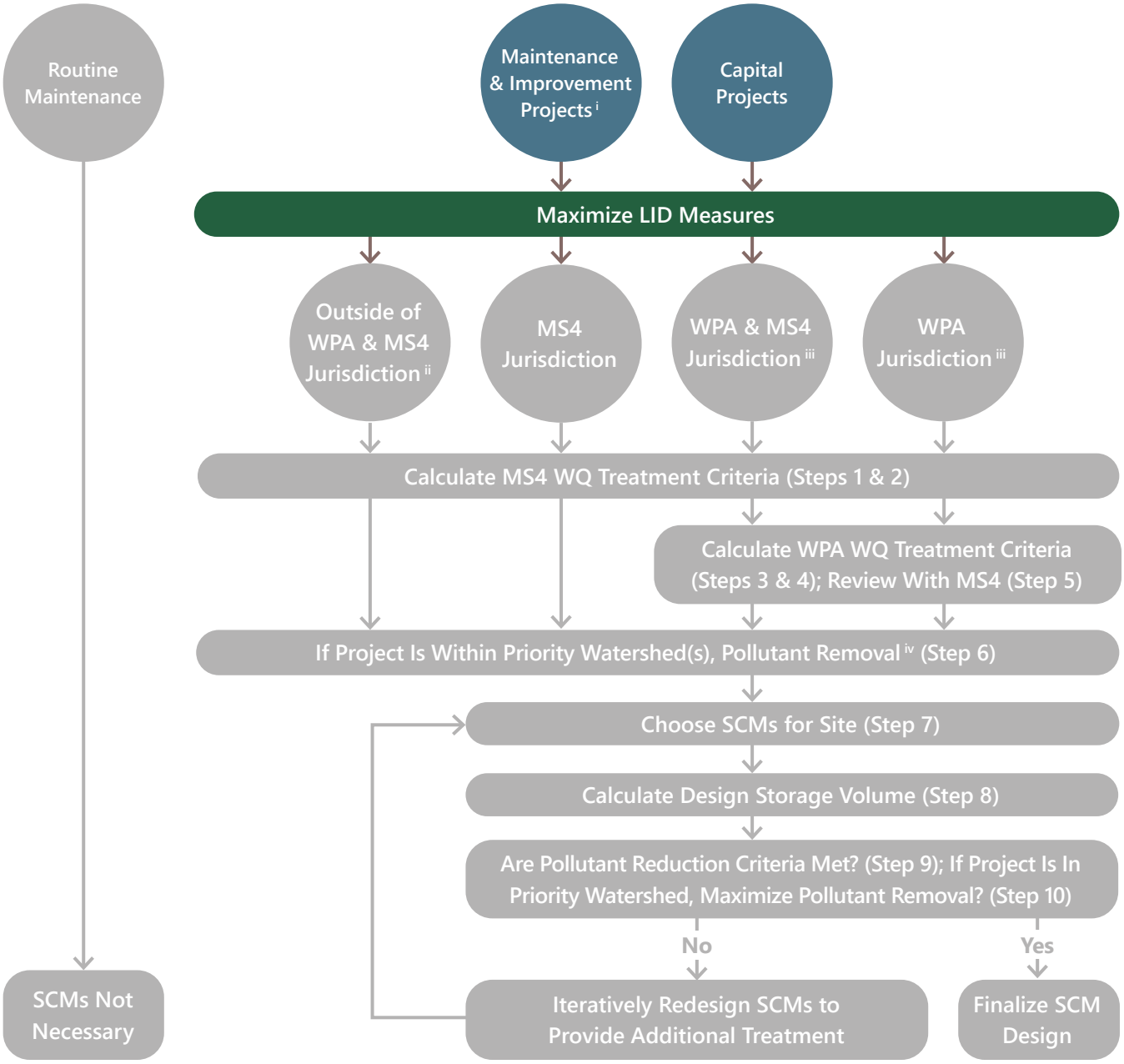
» Reduction of impervious cover

» Disconnection of pavement

» Maintenance of predevelopment drainage patterns

This chapter discusses each of these measures in detail.

Figure 4: Water Quality Treatment Flow Chart—Low Impact Development Practices



[i] Regulations allow for meeting water quality criteria to the maximum extent practicable (see Chapter 4). DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown, whenever possible.

[ii] Since project is outside regulated areas there are no required water quality treatment criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown.

[iii] Projects are subject to WPA water quality criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet both of the requirements.

[iv] Including additional treatment is not explicitly required by either the MS4 permit or the WPA but is needed to continue progress towards meeting impaired waters pollutant removal requirements in the MS4 permit; therefore, DCR is encouraging maximizing pollutant removal in projects in these watersheds.

5.1 Preserve and Enhance Vegetation

Vegetation performs many functions and plays a critical support role in stormwater management, including the reduction of runoff volume, soil erosion, and pollutant transport. To maximize stormwater treatment benefits, designers should include the following measures into their designs:

» Preserve existing vegetation, particularly canopy trees

» Stabilize and establish vegetation along roadway embankments, shorelines, causeways, and other natural resource areas (e.g., vegetated riprap)

» Increase vegetation along the runoff flow path to provide shading and erosion control

» Encourage native species and pollinators

5.2 Reduce Impervious Cover

Reducing impervious cover increases opportunities for recharge and infiltration. Ensuring there is less impervious cover on site also decreases runoff volume and peak flow rates. Designers should include the following measures into their designs whenever possible/practicable:

» Remove existing pavement

» Minimize proposed pavement

» Use grass islands or other natural groundcover instead of paved islands

» Use permeable materials for slope stabilization

» Use porous pavement, gravel, mulch, or other options, when suitable

5.3 Disconnect Impervious Areas

Impervious areas disconnection is a stormwater management measure that diverts stormwater runoff from impervious surfaces to vegetated areas (natural or constructed) where treatment and recharge will occur. This is a cost-effective and low-maintenance measure that designers can use to reduce the effects of impervious cover. Impervious areas disconnection receives water quality treatment credit under the regulatory programs, as discussed more in Chapter 7.2. Vegetated filter strips as a stormwater control measure (SCM) are discussed in more detail in Chapter 7.2.

Impervious areas disconnection is a cost-effective and low-maintenance measure that receives structural control pollutant removal credit as Qualifying Pervious Area (QPA), as detailed in the Massachusetts Stormwater Handbook (Vol. 3, Ch. 1), and Vegetated Filter Strip (VFS), as detailed in the Massachusetts Stormwater Handbook (Vol. 2, Ch. 2).

5.4 Maintain Predevelopment Drainage Patterns

Designs should accommodate and maintain existing drainage patterns while integrating stormwater management measures to the maximum extent practicable. Maintaining existing drainage patterns reduces a project's potential to alter the site's stormwater travel paths, resulting in increased runoff velocities and volumes, while supporting groundwater recharge.

Designers should include measures to:

» Preserve natural depressions that act as natural detention/infiltration

» Preserve natural drainage divides to keep flow paths dispersed to the maximum extent practicable

» Minimize the use of curbs and closed drainage systems

» Grade to encourage sheet flow and lengthen flow paths

» Incorporate design features to slow runoff velocities and increase time of concentration

» Minimize disturbance of natural channel surfaces

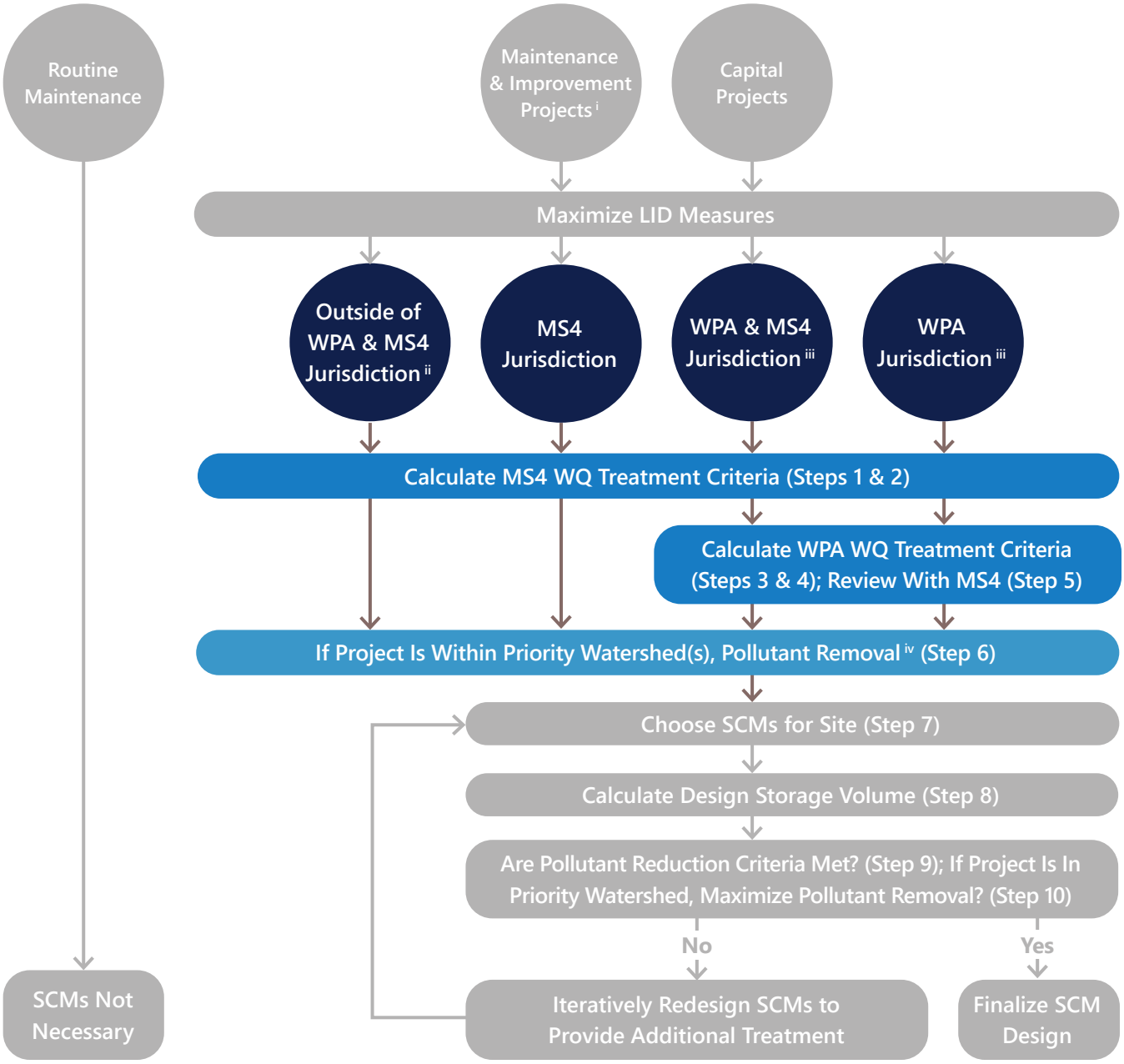
» Prevent soil compaction during construction

6

Water Quality Treatment Requirement

Once low impact development (LID) measures have been maximized, the next step (shown in Figure 5) is to calculate the required water quality treatment. DCR uses the Municipal Separate Storm Sewer System (MS4) water quality treatment standard as the baseline for DCR project designs. The designer should then check if the project is subject to the Wetlands Protection Act (WPA) water quality treatment criteria, and if those criteria require additional treatment. Finally, the designer should check if the project is within a Priority Watershed where additional controls are necessary to meet watershed wide treatment goals. The most stringent criteria will govern when designing the stormwater treatment system for the site. This chapter outlines how the designer walks through the steps in shown in the Water Quality Treatment flow chart (see Figure 5) to develop the water quality treatment standard requirement.

Figure 5: Water Quality Treatment Flow Chart—Water Quality Treatment Criteria



[i] Regulations allow for meeting water quality criteria to the maximum extent practicable (see Chapter 4). DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown, whenever possible.

[ii] Since project is outside regulated areas there are no required water quality treatment criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown.

[iii] Projects are subject to WPA water quality criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet both of the requirements.

[iv] Including additional treatment is not explicitly required by either the MS4 permit or the WPA but is needed to continue progress towards meeting impaired waters pollutant removal requirements in the MS4 permit; therefore, DCR is encouraging maximizing pollutant removal in projects in these watersheds.

6.1 Calculate MS4 Water Quality Treatment Criteria

The designer must first calculate the water quality requirement to meet the Minimum Control Measure (MCM) 5 Post-Construction measure of the MS4 General Permit. In general, this MCM references the MassDEP Stormwater Standards for addressing stormwater. However, the MS4 permit sets different water quality treatment requirements for new projects versus redevelopment projects, including sizing and pollutant removal requirements, which are distinct from MassDEP's Stormwater Standard 4.

The MS4 pollutant removal criteria require meeting a certain removal percentage of total suspended solids (TSS) and total phosphorus (TP) for a site. This removal percentage can be demonstrated through the use of the EPA Pollutant Removal Curves (see Chapter 8.2) for the specified stormwater control measures (SCMs) (also referred to as best management practices [BMPs] by EPA in its BMP Accounting and Tracking Tool [BATT]), or through retaining the specified volume from the contributing impervious area. As a final option, the water quality treatment can be provided in the same United States Geologic Service Hydrologic Unit Code 12 (USGS HUC12)[20] watershed but outside of the project area. DCR uses the MS4 water quality treatment standard as the baseline for DCR project designs.

As shown in the Water Quality Treatment flow chart above, the designer should progress through the following steps to determine the water quality treatment requirement is met.

Step 1 Determine if Project Site Is Categorized as New or Redevelopment per MS4 Definitions: EPA's MS4 MCM 5 for Post-Construction Runoff Control defines entire projects as either new development or redevelopment. If a project disturbs less than an acre, the project will not meet either of the MS4 definitions below, but DCR is using the MS4 water quality treatment standard as the program-wide goal and a project that disturbs less than an acre should use the redevelopment standard.

MS4 New Development Definition: "any construction activities or land alteration resulting in total earth disturbances equal to or greater than 1 acre (or activities that are part of a larger common plan of development disturbing greater than 1 acre) on an area that has not previously been developed to include impervious cover." Examples of DCR projects include new roads, new facilities, and new parking lots.

MS4 Redevelopment Definition: "any construction, land alteration, or improvement of impervious surfaces resulting in total earth disturbances equal to or greater than 1 acre (or activities that are part of a larger common plan of development disturbing greater than 1 acre) that does not meet the definition of new development." Examples of DCR projects include widening roadways and expanding parking lots. DCR is including projects that disturb less than an acre in this definition for this Handbook's calculations.

Under EPA's definitions, an entire project site is categorized as either new development or redevelopment and must meet the appropriate requirements.

[20] See USGS HUC12 data available at National Watershed Boundary Dataset (WBD)

Step 2 Identify Water Quality Treatment Requirements: Determine the water quality treatment requirement based on the new or redevelopment criteria summarized below. The designer should review the SCM design options that are available to meet or exceed the treatment requirement as discussed in the next chapters.

MS4 New Development Water Quality Treatment Requirement: For a project that includes no existing impervious area (IA) and proposes to add IA:

» Provide 90 percent TSS and 60 percent TP reduction; Achieve said pollutant removal by one of the following methods:
  - Design/install BMPs that together meet site TSS and TP pollutant removal requirements based on the guidance in the MS4 permit
  - Retain 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
  - Provide a combination of retention and treatment
  - Utilize offsite mitigation that meets the above standards within the same USGS HUC12 as the project site. (DCR will use this option only as a last resort and after consultation.)

MS4 Redevelopment Water Quality Treatment Requirement: For a project that includes existing IA:

» Provide 80 percent TSS and 50 percent TP reduction; Achieve said pollutant removal by one of the following methods:
  - Design/install BMPs that together meet site TSS and TP pollutant removal requirements based on the guidance in the MS4 permit
  - Retain the volume of runoff equivalent to, or greater than, 0.8 inches multiplied by the total post-construction impervious surface area on the redevelopment site
  - Provide a combination of retention and treatment
  - Utilize offsite mitigation that meets the above standards within the same USGS HUC12 as the project site. (DCR will use this option only as a last resort and after consultation.)

6.2 Calculate WPA Water Quality Treatment Criteria

For a project that is subject to the WPA regulations, the designer must next calculate the water quality treatment criteria based on WPA Stormwater Standard 4 and compare them with the MS4 treatment values. While this Handbook focuses on Stormwater Standard 4, the MassDEP Stormwater Standards 2 (peak rate control) and 3 (recharge) are also critical to the design of stormwater systems and should be carefully reviewed when designing a system. The designer should follow the MassDEP guidance provided in the Massachusetts Stormwater Handbook for the other Stormwater Standards not addressed in this Handbook.

DCR performs source control and pollution prevention through programmatic operation and maintenance plans implemented across the state for its facilities. The designer will need to summarize a stormwater system's source control and pollution prevention measures in a long-term pollution prevention plan (LTPPP) for the DEP stormwater management report.

Continue with the following steps to determine the WPA water quality treatment criteria, including pretreatment.

Step 3 Determine Portions of Project to Be Categorized as New Development or Redevelopment per WPA Definitions: Determine which portion(s) of a project will be considered new development and which portion(s) will be considered redevelopment according to the definitions below. Note that unlike the MS4 categorization of an entire site as either new development or redevelopment, per the WPA a project site may have areas that meet each definition.

WPA New and Redevelopment Definitions

MassDEP New Development: The portions of project sites that involve the addition of impervious cover on previously undeveloped areas. New development includes these examples:

- New roads
- New intersections/interchanges
- Major realignments
- New parking lots
- New maintenance depots or buildings

MassDEP Redevelopment: MassDEP details its definition and provisions for redevelopment projects in Stormwater Standard 7 (redevelopment). For the purpose of the WPA Stormwater Standards, as provided in 310 CMR 10.05(6)(k) through (q), redevelopment is defined to include the following projects

- Maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems, and repaving
- Development, rehabilitation, expansion, and phased projects on previously developed sites provided the redevelopment results in no net increase in impervious area
- Remedial projects specifically designed to provide improved stormwater management such as projects to separate storm drains and sanitary sewers and stormwater retrofit projects

Under MassDEP's definitions, portions of a project site may be categorized as new development while other portions are categorized as redevelopment. New Development portions of site must fully meet Standard 4 Water Quality Volume (see Step 4) where Redevelopment portions must meet the volume to the maximum extent practicable.

Step 4 Calculate Required Water Quality Volume (WQV): Using the Massachusetts Stormwater Handbook, choose SCMs to provide an 80 percent TSS reduction from New Development IA by sizing control measures to treat a WQV equal to 0.5 inches times the total post-development impervious area. The designer must reference the MassDEP TSS removal efficiencies table (see Table 4 in Chapter 8.2.2) for the removal credits given for different SCMs. If the project site (or a portion of the site) includes any of the situations below, the SCM(s) should be sized using a WQV equal to 1.0 inch times the IA of the post-development condition for that portion of the project:

- Land use with a higher potential pollutant load (LUHPPLS) (see MassDEP Stormwater Standard 5 for more detail)
- Soils with rapid infiltration rates (i.e., saturated hydraulic conductivity > 2.4 in/hr.)

» Within a Zone II or Interim Wellhead Protection Area (see MassDEP Stormwater Standard 6 for more detail)

» Near or discharging to the following Critical Areas (see MassDEP Stormwater Standard 6 for more detail):

- Outstanding resource waters (ORW)
- Special resource waters
- Bathing beaches
- Shellfish growing areas
- Cold-water fisheries

While the WPA allows flexibility in Redevelopment portions of the site in meeting the WQV by allowing projects to demonstrate the volume has been provided to the maximum extent practicable, the designer should define both volume criteria to understand the goal of the stormwater design.

Step 5 Review WPA and MS4 WQV Requirements: The designer should review the WPA water quality treatment required (acre-feet) including the total value if the site includes a mixture of new and redevelopment with the MS4 water quality treatment percentage needed for the overall site. Since the MS4 requirements can be met either by calculating the removal efficiency of the specific SCMs or be calculating the required infiltration volume these two values may be hard to compare to determine which is most stringent.

Once the designer chooses the SCMs (see Chapter 7) for the site and perform water quality treatment calculations (see Chapter 8), it will be clearer if the WPA or the MS4 WQV requirement will drive the stormwater design.

6.3 Priority Watershed Treatment

Step 6 Determine if Project Site is in Priority Watershed; If so, Maximize Treatment: The final step in calculating the required water quality treatment is to determine if a project is located within a DCR Priority Impaired Waterbody Watershed ("Priority Watershed") by referencing the DCR Stewardship Map.[21] If a project discharges to a receiving water within a Priority Watershed, the designer will be required to fully maximize pollutant removal on the site through expanding stormwater controls, providing additional water quality volume, and taking measures to maximize infiltration. This treatment may be in excess of what is required from the steps above.

Maximizing the treatment is necessary if a watershed has a Total Maximum Daily Load (TMDL) with a numeric pollutant removal target, because DCR is required to construct SCMs and implement other measures to progress towards meeting the target pollutant reductions. If DCR's pollutant reduction target for a watershed has not been fully met, that watershed is included as a Priority Watershed on the DCR Stewardship Map to help DCR meet the watershed targets. The designer should maximize the construction of SCMs on a property located within a Priority Watershed, potentially beyond those necessary to meet the regulatory criteria.

[21] See the DCR Stewardship Map at Stewardship Map (arcgis.com)

The designer should select the DCR Priority Watershed within which the project is located using the DCR Stewardship Map. The associated pop-up will include the Pollutant(s) of Concern for that watershed. The designer should maximize pollutant removal for the Priority Watershed's specific pollutant of concern.

Other watersheds may be added to the DCR Stewardship Map as Priority Watersheds to meet DCR's water quality goals.

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7

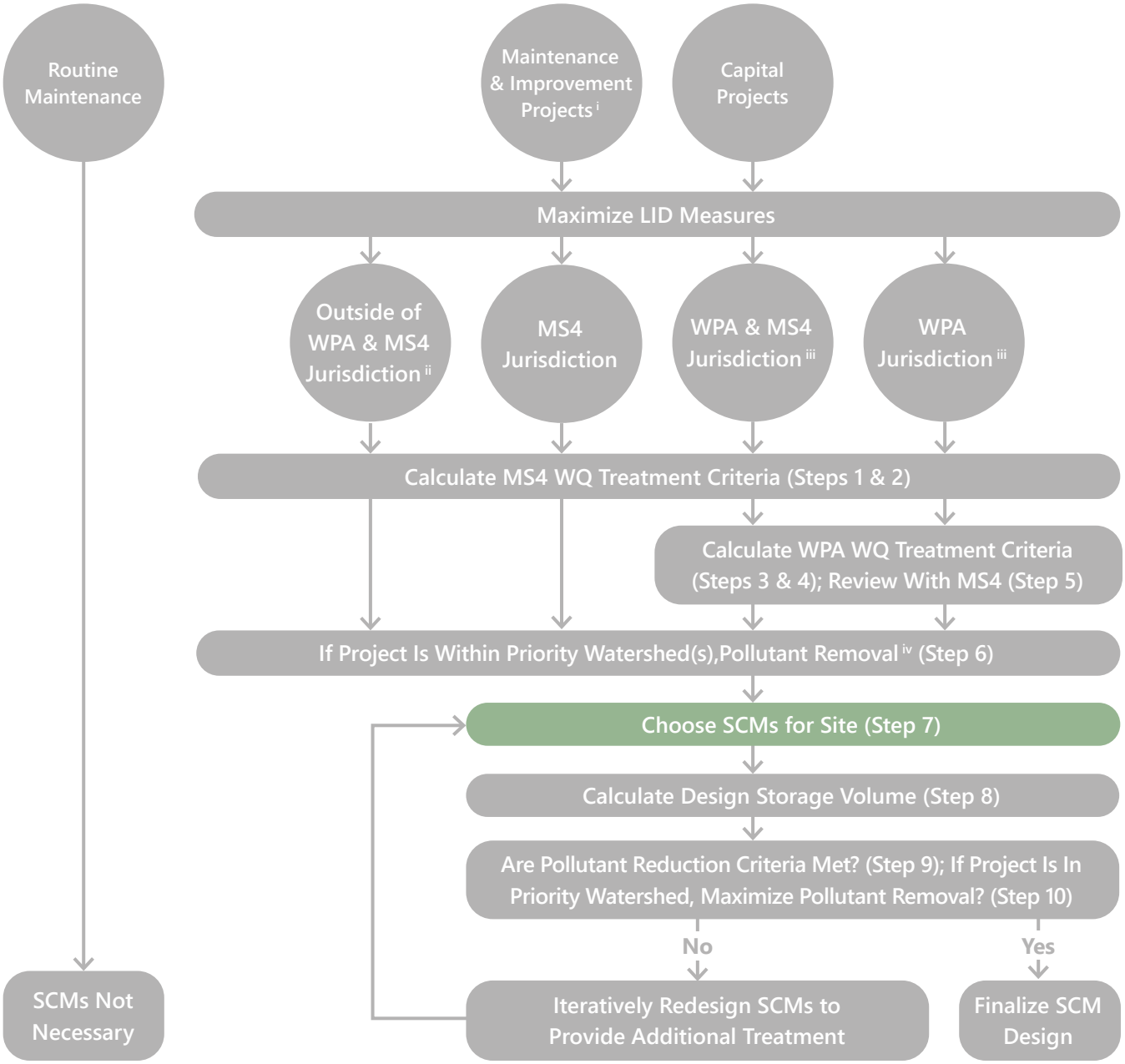
Constructed Stormwater Control Measures

Once the designer has identified the required water quality treatment and pollutant removal to meet the applicable regulations (see Steps 1–6 in the previous chapter), in **Step 7 the Designer Chooses Constructed Controls** for the site (as outlined in this chapter). In future steps, the designer will calculate the water quality treatment provided (see Chapter 8) and, if the treatment requirement is met, complete the design.

The designer should first prioritize green infrastructure (GI) controls, including those labeled as infiltration and treatment in the Massachusetts Stormwater Handbook,[22] and their associated pretreatment. Once GI controls have been maximized on-site, the designer should then consider subsurface SCMs. The designer should keep the pollutants of concern for receiving waters in mind when deciding on the appropriate SCMs. If additional treatment is needed, the designer should return to this chapter and identify if a different combination of SCMs can be proposed on the site.

[22] See the Massachusetts Stormwater Handbook at https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards

Figure 6: Water Quality Treatment Flow Chart—Choosing the SCM Type(s)



[i] Regulations allow for meeting water quality criteria to the maximum extent practicable (see Chapter 4). DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown, whenever possible.

[ii] Since project is outside regulated areas there are no required water quality treatment criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown.

[iii] Projects are subject to WPA water quality criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet both of the requirements.

[iv] Including additional treatment is not explicitly required by either the MS4 permit or the WPA but is needed to continue progress towards meeting impaired waters pollutant removal requirements in the MS4 permit; therefore, DCR is encouraging maximizing pollutant removal in projects in these watersheds.

Constructed control measures positively impact a project site by providing:

» Pretreatment measures: reduce sediment loads in runoff prior to reaching the larger SCM

» Treatment measures: remove pollutants from stormwater through diverse mechanisms, including settling, filtration, adsorption, vegetative uptake, etc.

» Detention measures: reduce flow velocities (and resultant erosion), allow settling, and reduce the peak rate of runoff discharging to receiving waters

» Infiltration measures: reduce the volume of surface runoff, replenish groundwater, remove pollutants via filtration, and reduce thermal impacts to receiving waters

The SCM guidance in this Handbook is meant to expand upon the SCMs found in the Massachusetts Stormwater Handbook (Vol. 2, Ch. 2)[23] and discuss the SCMs that work best for DCR. The designer should review the design criteria for each SCM in the Massachusetts Stormwater Handbook.

DCR has chosen to list infiltration SCMs first, and then treatment SCMs, to reflect DCR's desire to prioritize infiltration SCMs and their associated pretreatment. The designer should proceed through the list of SCM types in the order in which they are presented in this Handbook and narrow down the options for treatment based upon site constraints. This ordering of SCMs differs from that in the Massachusetts Stormwater Handbook. Similar SCM grouping and naming conventions have been retained in this Handbook, and the MassDEP names for SCMs are referenced.

The designer should consult the DCR Stormwater Program Team during the SCM selection process if considering a novel SCM treatment that is not included in this Handbook. Treatment credit for alternative SCMs may require discussion with regulators.

7.1 Pretreatment SCMs

Pretreatment captures materials that may impact an SCM's treatment capabilities and provides a concentrated location for removing accumulated sediment during maintenance activities. The following pretreatment measures can receive up to 25 percent of MassDEP's WPA total suspended solids (TSS) removal credit when used in combination with other SCMs. The Municipal Separate Storm Sewer System (MS4) regulations assume that pretreatment is part of the design and included in the pollutant removal estimates of the SCM. The recommended pretreatment SCMs include:

» Street sweeping (nonstructural) (as detailed in Massachusetts Stormwater Handbook (Vol. 3, Ch. 1)

» Deep sump catch basins

» Oil/Grit separators

» Proprietary separators

» Sediment forebays

» Vegetated filter strip

[23] See Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook at https://www.mass.gov/doc/massachusetts-stormwater-handbook-vol-2-ch-2-stormwater-best-management-practices/download

DCR requires deep sump catch basins on all projects where new catch basins are proposed. Designers should also note that, due to their inaccessibility for inspection, ongoing cleaning needs, and limited treatment performance, proprietary separators should be used only when all other pretreatment has been determined to be impracticable and capture of trash and coarse particles is needed.

A **vegetated filter strip** (VFS) is a uniformly graded vegetated surface that receives runoff from adjacent impervious area. The vegetated surface slows the runoff, traps sediment, and promotes infiltration. The VFS can be used as pretreatment for another SCM or as a standalone practice (see the next chapter) if the required width of land is available.

7.2 Infiltration SCMs

Infiltration SCMs capture stormwater runoff and allow it to percolate through the soil into the groundwater system. By taking advantage of native soil characteristics and their ability to infiltrate and filter runoff, infiltration SCMs reduce stormwater volumes and remove pollutants from stormwater.

Green infrastructure measures, including infiltration measures, are DCR's preferred SCMs and should be used wherever possible, including in retrofit situations where available space may be limited.

Recommended infiltration SCMs (with the corresponding Massachusetts Stormwater Handbook SCM name called out for ease of reference) include:

» Impervious area disconnection (MassDEP: Vegetated filter strip)
  - Qualifying pervious area (QPA)
  - Vegetated filter strip (VFS)
  - Other instances of disconnection that may not meet QPA or VFS details definition but still receive credit per MS4 crediting curves

» Infiltration basins/swales (MassDEP: Infiltration basins/swales)

» Infiltration trenches (MassDEP: Infiltration trenches)

» Bioretention infiltration basins/swales (MassDEP: Bioretention areas & rain gardens [with exfiltration])
  - Rain gardens

» Leaching basins/leaching catch basins (MassDEP: Leaching catch basins)

» Leaching chambers, galleys, perforated pipes, and pre-cast concrete or plastic pits (MassDEP: Subsurface structures)

» Porous pavement with infiltration (MassDEP: Porous pavement)

Impervious area disconnection can be achieved through simple techniques such as:

» Grading to direct stormwater, in the form of sheet flow, to QPAs or VFSs

» Adding curb cuts to direct stormwater to pervious areas

» Not adding curbing where curbing is not required so flow is not concentrated

» Installing drainage inlets within pervious medians, shoulders, or beyond the right-of-way

» Providing disconnection through storage in the form of a rain barrel or cistern

Impervious area disconnection is considered a low impact development measure as discussed in Chapter 5.3. When a vegetated area meets MassDEP's definition of a **qualifying pervious area**, as detailed in the Massachusetts Stormwater Handbook (Vol. 3, Ch. 1 Low Impact Development Site Design Credits section), it is considered an infiltration SCM. The contributing impervious cover can be deducted from the area subject to groundwater recharge (Standard 3) and water quality treatment (Standard 4) requirements. If treatment cannot meet the QPA criteria, but sufficient land is available to provide the width requirements in the Massachusetts Stormwater Handbook (Vol. 2, Ch. 2), then a **vegetated filter strip** can be considered a standalone SCM. In cases where treatment cannot meet either QPA or VFS criteria, but it is still providing disconnection, the crediting curves in the MS4 permit can be used to calculate pollutant reduction for MS4 compliance.

Designers should propose green infrastructure for surface SCMs, such as **infiltration basins/swales or infiltration trenches**, whenever possible, since it can provide high pollutant removal for TSS, phosphorus, nitrogen, metals, and pathogens. **Infiltration swales** are linear infiltration basins with check dams and/or outlet control to force retention and infiltration. Infiltration SCMs are most effective when suitable soils and adequate depth to groundwater (to ensure the intended treatment occurs and minimize the effects of groundwater mounding) are present. Keep in mind that other physical constraints (e.g., shallow depth to bedrock) may preclude the use of or limit the performance of infiltration SCMs. When site constraints or limited extents of a project lead to retrofitting stormwater controls for an existing site, the use of infiltration measures may be best even if the infiltration rates and depth to groundwater or bedrock do not fully meet the MassDEP requirements, since they will still maximize the treatment provided.

Bioretention with infiltration basins/swales, called bioretention areas in the Massachusetts Stormwater Handbook, including infiltrating **rain gardens**, provide stormwater treatment by filtering runoff through vegetation and an engineered soil media and infiltrate stormwater, allowing for groundwater recharge. For roadway applications, the vegetation component of bioretention may be designed with roadway standard maintenance practices in mind. For urban or park applications, bioretention may be smaller in scale (e.g., rain gardens) and include a vegetative component designed for aesthetics.

If green infrastructure cannot be installed due to site constraints, the designer should review the applicability of subsurface infiltration features, such as **leaching catch basins (or leaching basins without catchbasin grate), leaching pit/basin, leaching lines (perforated pipes), leaching chambers, or leaching galleys.** Leaching structures should be installed as off-line structures and installed without grates to reduce resuspension whenever possible.

Porous pavement with infiltration and paving materials can be a good solution for providing treatment, especially in densely populated urban environments where space constraints reduce the options for treatment. DCR recommends porous paving SCMs for parking lots, sidewalks, and paved pathways/trails when site conditions allow.

7.3 Treatment SCMs

Once infiltration SCMs are ruled out as not appropriate for a certain location, the designer should review using treatment SCMs, including:

» Constructed stormwater wetlands (MassDEP: Constructed stormwater wetlands)
  • Gravel wetlands (MassDEP: Constructed stormwater wetlands)

» Bioretention with underdrains basins/swales (MassDEP: Bioretention areas & rain gardens) [no exfiltration])
  • Rain gardens (filtration with underdrains)

» Sand & organic filters (MassDEP: Sand & organic filters)
  • Tree box filters

» Porous pavement with underdrains

Each of these treatment SCM types are described in more detail in the following chapters.

In rare circumstances, the following treatment SCMs may be appropriate, although only when the previous SCMs have been ruled out, as the treatment provided by these SCMs in minimal when compared with other mechanisms:

» Wet basins/swales

» Extended dry detention basins/swales

Constructed stormwater wetlands are stormwater treatment features designed to simulate the hydrologic and biological conditions that occur in a natural wetland. Stormwater wetlands have high pollutant removal rates via vegetative uptake, biological processes, and filtration, and can be designed with additional storage to attenuate peak flows. These features also remove nitrogen, phosphorus, pathogens, metals, and oil and grease from stormwater and can be used even when groundwater elevations are relatively high and/or soils are poorly drained. Constructed stormwater wetlands must have the right hydrologic conditions to allow for wetland conditions. **Gravel wetlands** are stormwater wetlands designed with a subsurface gravel reservoir to enhance water quality treatment. They are often used to capture large volumes of runoff from roadways.

Bioretention (with underdrain) basins/swales, including filtering **rain gardens**, provide stormwater treatment by filtering runoff through vegetation and engineered soil media. DCR recommends that designers use bioretention where groundwater levels are too deep to support stormwater wetlands. The vegetation specified for the SCMs should account for DCR's roadway standard maintenance practices. For urban or park applications, bioretention may be smaller in scale (e.g., rain gardens) and the vegetative component may include a greater focus on aesthetics, as well as ease of maintenance.

Sand and organic filters provide stormwater treatment by filtering runoff through sand or organics that capture solids in the stormwater. The features sometimes include biological uptake for treatment. These filters can include **tree box filters**.

Porous pavement with underdrain is often applied in densely populated urban environments due to space constraints, and DCR recommends porous pavement SCMs for parking lot areas if site conditions allow. When soils or groundwater levels do not allow for infiltration to provide full treatment, the pavement can be installed with an underdrain to allow for discharge of the water.

While MassDEP includes **wet basins/swales, extended detention basins**, and **dry detention basins** in its list of possible treatment SCMs, these practices only rely on settling by holding stormwater for extended periods of time to remove solids in the stormwater. These measures receive lower pollutant removal credit (or no credit for dry detention) as they do not have the biological uptake and filtration provided by the other SCMs described in this chapter. Therefore, DCR encourages constructing infiltration or bioretention measures as discussed above instead.

MassDEP also includes **proprietary media filters** as a treatment option. DCR has not encouraged the installation of these filters due to the complexity of the installation and maintenance of these systems. These filters do not receive pollutant removal credit under the MS4 permit criteria.

7.4 Conveyance SCMs

MassDEP includes **drainage channels**, **grassed channels**, and **water quality swales** as conveyance SCMs in its Massachusetts Stormwater Handbook. Swales/channels are typically proposed along long, narrow project areas, such as roadways, and are vegetated open channels designed to convey drainage. **Drainage channels** do not receive pollutant removal credit and are just part of the conveyance system to downstream treatment. **Grassed channels** must provide a longer hydraulic residence time to provide water quality treatment through settling, and must include a sediment forebay. In order to be considered **water quality swales** by MassDEP, linear practices must be designed to treat the required water quality volume, and must include sediment forebays and check dams to force retention and infiltration. While grassed channels and water quality swales receive some TSS removal credit by MassDEP, they do not receive significant pollutant removal credit in the MS4 best management practice (BMP) Removal Curves.

Whenever possible, linear treatment systems should be designed to meet the MassDEP infiltration basin or bioretention area definitions, in linear layout, to receive greater pollutant removal credit.

7.5 Other SCMs

In addition to the SCMs above, DCR recommends the following SCMs to improve water quality, control peak rates and/or improve existing conditions wherever they fit within a facility's layout and objectives:

» Green roof

» Rain barrels and cisterns

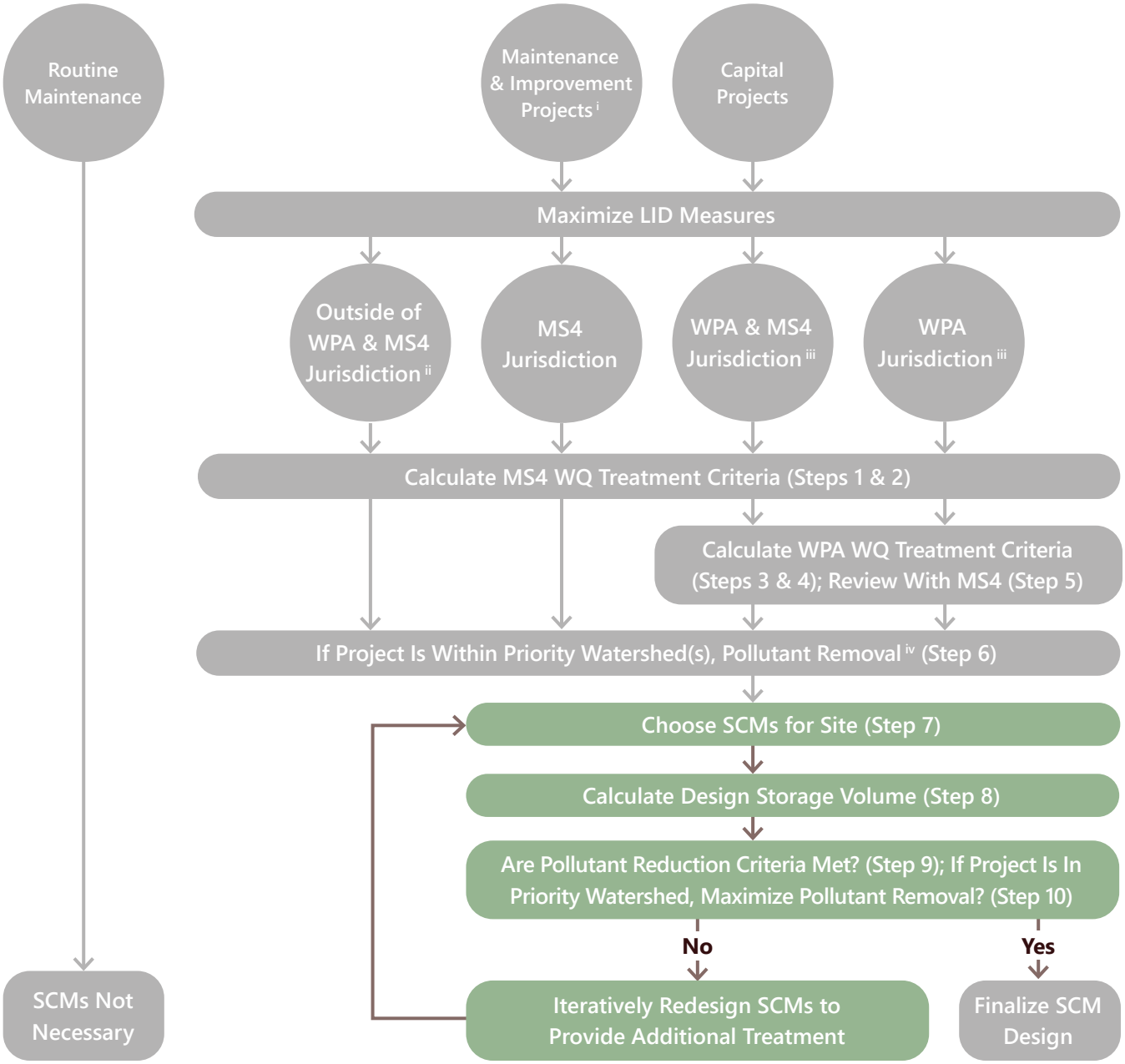
The contributing square footage of a green roof, which would otherwise be considered impervious roof area, may be able to be deducted from a project's impervious area, depending on regulated area and current pollutant crediting allowed.

8

Calculate Water Quality Treatment Provided

Once the stormwater control measure (SCM) types that will work on a site have been identified, the designer should calculate the water quality treatment provided by the proposed SCMs and determine if the design meets the water quality criteria identified in Chapter 5. As shown in Figure 7, the process will often be iterative.

Figure 7: Water Quality Treatment Flow Chart—Calculating Water Quality



[i] Regulations allow for meeting water quality criteria to the maximum extent practicable (see Chapter 4). DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown, whenever possible.

[ii] Since project is outside regulated areas there are no required water quality treatment criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown.

[iii] Projects are subject to WPA water quality criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet both of the requirements.

[iv] Including additional treatment is not explicitly required by either the MS4 permit or the WPA but is needed to continue progress towards meeting impaired waters pollutant removal requirements in the MS4 permit; therefore, DCR is encouraging maximizing pollutant removal in projects in these watersheds.

The water quality treatment can be provided through the following options:

Water Quality Treatment Options: Meeting the Municipal Separate Storm Sewer System (MS4) or Wetlands Protection Act (WPA) pollutant removal requirement can be achieved by one of the following methods:

1. Retain the volume of runoff based on the MS4 or WPA requirement; or
2. Provide a combination of retention and treatment stormwater control measures (SCMs) to meet pollutant removal reductions and (if necessary) water quality volume (WQV).

For MS4 jurisdiction, the pollutant removal requirements must be met on-site whenever possible, but after all on site options are ruled out, the designer can utilize offsite mitigation within the same United States Geologic Service Hydrologic Unit Code 12 (USGS HUC12) as the project site to meet the pollutant removal standards, after consultation with DCR. For WPA jurisdiction, the pollutant removal must be met on-site for each design point.

DCR suggests that designers start with determining the volume of runoff that should be retained comparing the water quality volume option and determining the maximum volume needed under the MS4 or the WPA, or whichever one is applicable to the project. If that volume can be retained on-site, then the water quality treatment design is complete (Option 1 above). If not, the designer can then review if the SCMs collectively meet the pollutant removal requirements using the best management practice (BMP) pollutant removal curves (see Chapter 8.2) and, if necessary, the WQV and DEP's total suspended solids (TSS) table (Option 2 above). Offsite mitigation should be used only when all other options have been expended and the project is only within MS4 regulated area, since it can be more complicated to implement, permit and track. If the designer wants to use this allowance, they should discuss the possibilities with the DCR Stormwater Program Team.

8.1 Retain Volume of Runoff

The designer should size the chosen SCM(s) to retain the treatment volume. Retention can come in the form of infiltration or other means to keep runoff on-site, including evaporation and reuse.

Step 8a Calculate Treatment Volume to Be Retained: The treatment volume will be determined by the regulated jurisdiction areas:

» For the MS4, retain the volume of runoff equivalent to, or greater than, one (1.0) inch multiplied by the total post-construction impervious surface area on a new development site or eight tenths (0.8) of an inch multiplied by the total post-construction impervious surface area on a redevelopment site.

» For the WPA, size the control measures to provide a water quality volume equal to 0.5 inches times the impervious area or 1.0 inches per IA if portions of the project meet the criteria listed for increased treatment in Chapter 5.2.

The Design Storage Volume (DSV) provided by the SCM should be equivalent to or greater than the required treatment volume.

Step 8b Calculate Design Storage Volume in SCMs: The DSV is the physical storage capacity of the SCM available for treatment before overflow or bypass, which is discussed more in Table 3 in Chapter 8.2.1. The project may include a mixture of SCMs to provide the required retention.

8.2 Meet Pollutant Removal Requirements

Step 9 Check That the Required Pollutant Removal Is Provided: While the MS4 requirements indicate that if the design provides the required retention volumes then the MS4 pollutant removal requirement is met (see callout box above), the designer should use the pollutant curves to calculate the percent of the removal credit for DCR tracking and to fine-tune the design. If the project is within the WPA jurisdiction, then the designer must calculate the pollutant removal percentage using MassDEP's TSS credit tables. Finally, the pollutant reductions must be calculated for compliance with Total Maximum Daily Load (TMDL) numeric targets (see Step 10).

8.2.1 MS4 Pollutant Removal Calculation

EPA's Best Management Practice Accounting and Tracking Tool (BATT)[24] was developed to allow MS4 permittees to keep track of post-construction pollutant load reductions. The tool includes a calculator to determine pollutant load reductions (TSS, total phosphorus [TP]), which are based on the BMP Performance Curves in the MS4 permit (Appendix F, Attachment 3). The naming convention of BMP is used by EPA for stormwater controls, whereas DCR uses SCM (stormwater control measures) as its naming convention for the same controls. While the designer can reference the MS4 permit's BMP Performance Curves directly, the designer will need the BATT tool for TSS values since those are not included in the performance curves and the tool includes the most up-to-date values from EPA.

The designer should use the BMP-BATT tool calculator to enter the "physical storage capacity, depth of runoff from impervious area" proposed to be treated by the SCM (x-axis on the MS4 permit's BMP Performance Curves) and then calculate the corresponding "cumulative nutrient and TSS load reduction." The pollutant load reduction will vary according to the SCM type chosen and the specific pollutant.

> ***Treatment Depth = (DSV/ IA*12)*** where:
>
> Treatment Depth = depth of runoff that requires treatment, inches
> DSV = design storage volume, ft^3
> IA = impervious area, ft^2

The designer should use the tool to calculate the pollutant removal provided by the proposed water quality treatment measures (structural and non-structural) for a site. If the percent reduction or DSV criteria is not met, the designer should iteratively expand the DSV of individual SCMs until the project's required pollutant removal is met.

If the design provides the required retention volumes, as described in previous chapter, then the MS4 treatment requirement is met but the designer can use the pollutant curves to reduce the size of the SCM by meeting the pollutant removal requirement instead. The MS4 permit allows for meeting either the retention volume or the pollutant removal value. The designer should check if the

[24] See "Stormwater BMP Pollutant Removal Tools and Information" at https://www.epa.gov/npdes-permits/stormwater-tools-new-england

SCMs as designed meet or exceed the required pollutant removal. The designer may be able to reduce the size of the SCM if the proposed SCMs exceed required pollutant removals or if SCMs that provide more effective pollutant treatment are used.

Since MassDEP's SCM types and naming conventions are slightly different than those used in the MS4 permit (Appendix F, Attachment 3) and the BMP-BATT tool, Table 3 below notes which of the EPA curves should be used to calculate treatment for each of the SCMs in this Handbook. This Handbook does not include the pretreatment SCMs since for MS4 compliance, the curve's pollutant removal credits assume that the SCM includes the necessary pretreatment. For some SCM types, the table lists a range of curves since the curve is based on infiltration rates of the soils at the SCM location. The table below also includes notes on how to calculate the DSV for each SCM. Additional information about design storage volumes can be found in the MS4 permit (Table 3-5, Appendix F, Attachment 3).

Table 3: DCR Stormwater Design Handbook SCM Types and Applicable EPA Performance Curves for Use in BMP-BATT Tool

DCR Stormwater Design Handbook SCM Type/Name	Massachusetts Stormwater Handbook SCM Name	EPA Water Quality Curve (Figure Number)[25]	Design Storage Volume (DSV) Calculation
Pretreatment*			
Deep Sump Catch Basins	Deep Sump Catch Basins	N/A	N/A
Sediment Forebays	Sediment Forebays	N/A	N/A
Oil/Grit Separators	Oil-Grit Separators	N/A	N/A
Proprietary Separators	Proprietary Separators	N/A	N/A
Infiltration SCMs			
Qualifying Pervious Areas**	QPA LID Credit	Impervious Area Disconnection (Fig. 3-41)	N/A
Vegetated Filter Strips**	Vegetated Filter Strips	Impervious Area Disconnection (Fig. 3-41)	N/A
Other Impervious Area Disconnection Infiltration Measures	N/A	Impervious Area Disconnection (Fig. 3-41)	N/A
Infiltration Basins/Swales	Infiltration Basins	Surface Infiltration (Fig. 3-7 through 3-12)	Water volume of storage before bypass (below lowest level outlet)
Infiltration Trenches	Infiltration Trenches	Infiltration Trench (Fig. 3-1 through 3-6)	Void space volume of washed stone and sand layers

[25] See Attachment 3 to Appendix F of the MS4 General Permit at Attachment 3 to Appendix F—Methods to Calculate Phosphorus and Nitrogen Load Reductions for Structural Stormwater Best Management Practices (epa.gov)

Table 3: DCR Stormwater Design Handbook SCM Types and Applicable EPA Performance Curves for Use in BMP-BATT Tool *(continued)*

DCR Stormwater Design Handbook SCM Type/Name	Massachusetts Stormwater Handbook SCM Name	EPA Water Quality Curve (Figure Number)[25]	Design Storage Volume (DSV) Calculation
Bioretention with Infiltration Basin/Swales	Bioretention Areas & Rain Gardens (exfiltrating)	Surface Infiltration (Fig. 3-7 through 3-12)	Ponding water storage volume (below lowest level outlet) + void space volume of the soil filter media
Rain Gardens with Infiltration	Bioretention Areas & Rain Gardens (exfiltrating)	Surface Infiltration (Fig. 3-7 through 3-12)	Ponding water storage volume (below lowest level outlet) + void space volume of the soil filter media
Dry Wells	Dry Wells	Infiltration Trench (Fig. 3-1 through 3-6)	Water storage volume of structure below inlet invert + void space volumes of washed stone
Leaching Catch Basins	Leaching Catch Basins	Infiltration Trench (Fig. 3-1 through 3-6)	Water storage volume of structure below inlet invert + void space volumes of washed stone
Leaching Chambers, Galleys, or Lines	Subsurface Structures	Infiltration Trench (Fig. 3-1 through 3-6)	Water storage volume of structure below inlet invert + void space volumes of washed stone
Porous Pavement with Infiltration	Porous Pavement (exfiltrating)	Infiltration Trench (Fig. 3-1 through 3-6)	Void space volume of stone reservoir
Treatment SCMs			
Constructed Stormwater Wetlands	Constructed Stormwater Wetlands	Gravel Wetland (Fig. 3-14)	Pretreatment volume + Permanent pool volume prior to bypass + void space volume of gravel internal storage reservoir
Gravel Wetlands	Gravel Wetlands (subset of Constructed Stormwater Wetlands)	Gravel Wetland (Fig. 3-14)	Pretreatment volume + Permanent pool volume prior to bypass + void space volume of gravel internal storage reservoir
Bioretention with Underdrain Basins/Swales	Bioretention Areas & Rain Gardens (filtering)	Bio-Filtration (with underdrain) (Fig. 3-13)	Ponding water storage volume (below lowest level outlet) + void space volume of the soil filter media

Table 3: DCR Stormwater Design Handbook SCM Types and Applicable EPA Performance Curves for Use in BMP-BATT Tool *(continued)*

DCR Stormwater Design Handbook SCM Type/Name	Massachusetts Stormwater Handbook SCM Name	EPA Water Quality Curve (Figure Number)[25]	Design Storage Volume (DSV) Calculation
Rain Gardens (filtering with underdrains)	Bioretention Areas & Rain Gardens (filtering)	Bio-Filtration (with underdrain) (Fig. 3-13)	Ponding water storage volume (below lowest level outlet) + void space volume of the soil filter media
Sand & Organic Filters	Sand & Organic Filters	Sand Filter (Fig. 3-16)	Pretreatment volume + ponding volume + void space volume of sand and washed stone layers
Porous Pavement with Underdrain	Porous Pavement (filtering with underdrain)	Porous Pavement (Fig. 3-17)	Depth of filter course
Wet Basins/Swales	Wet Basins	Wet Pond (Fig. 3-18)	Permanent pool volume prior to high flow bypass
Extended Dry Detention Basins/Swales	Extended Dry Detention Basin	Dry Pond (Fig. 3-19)	Ponding volume prior to high-flow bypass
Dry Detention Basin	Dry Detention Basin	N/A	N/A
Proprietary Media Filters	Proprietary Media Filters	N/A	N/A
Conveyance SCMs			
Drainage Channel	Drainage Channel	N/A	N/A
Grassed Channel	Grassed Channel	N/A	N/A
Detention Swales	Water Quality Swale	Water Quality Grass Swale with Detention (Fig. 3-20)	Volume of swale at full design depth
Other SCMs			
Green Roof*	Green Roofs	Impervious Area Disconnection through Storage (Fig. 3-21 through Fig. 3-41)	N/A
Rain Barrels and Cisterns*	Rain Barrels & Cisterns	Impervious Area Disconnection through Storage (Fig 3-21 through Fig 3-41)	N/A

* The pretreatment SCMs do not have an associated treatment curve because they do not get credit for water quality treatment under the MS4 permit unless combined with an infiltration, treatment, conveyance, or other SCM listed above. They do receive pretreatment credit under the WPA. The designer should reference the Massachusetts Stormwater Handbook's TSS table included in the next chapter for reference.

** These SCMs do not have a calculated design storage volume. The treatment from these SCMs is based on the contributing impervious catchment area.

8.2.2 WPA Pollutant Removal Calculation

Projects within WPA jurisdiction must use the Massachusetts Stormwater Handbook's TSS table (included below for reference) to estimate the treatment removal provided by the chosen SCMs if they are sized to the required WQV.

Table 4: WPA TSS Removal Efficiencies for SCMs[26]

Structural Control Measures (SCMs)	TSS Removal Efficiency
Non-Structural Pretreatment	
Street Sweeping	0–10%, See Volume 2, Chapter 1
Structural Pretreatment	
Deep Sump Catch Basins	25% only if used for pretreatment and only if offline
Oil Grit Separator	25% only if used for pretreatment and only if offline
Proprietary Separators	Varies—see Volume 2, Chapter 4
Sediment Forebays	25% only if used for pretreatment
Vegetated Filter Strips	10% if at least 25 feet wide, 45% if at least 50 feet wide
Treatment	
Bioretention Areas Including Rain Gardens	90% provided it is combined with adequate pretreatment
Constructed Stomwater Wetlands	80% provided it is combined with a sediment forebay
Extended Dry Detention Basins	50% provided it is combined with a sediment forebay
Gravel Wetlands	80% provided it is combined with a sediment forebay
Proprietary Media Filters	Varies—see Volume 2, Chapter 4
Sand/Organic Filters	80% provided it is combined with a sediment forebay
Treebox Filter	80% provided it is combined with adequate pretreatment
Wet Basins	80% provided it is combined with a sediment forebay
Conveyance	
Drainage Channels	For conveyance only; no TSS removal credit
Grass Channels (formerly biofilter swales)	50% if combined with sediment forebay or equivalent
Water Quality Swale—Wet and Dry	70% provided it is combined with sediment forebay or equivalent

[26] See Volume 1, Chapter 1, p. 11 of the Massachusetts Stormwater Handbook at Massachusetts Stormwater Handbook

Table 4: WPA TSS Removal Efficiencies for BMPs *(continued)*

Infiltration	
Dry Wells	80% for runoff from non-metal roots; may also be used for runoff from metal roofs, but only if metal roof if not located within Zone II, IWPA, or at an industrial site
Infiltration Basins and Infiltration Trenches	80% provided it is combined with adequate pretreatment (sediment forebay or vegetated filter strip, grass channel, water quality swale) prior to infiltration
Leaching Catch Basins	80% provided a deep sump catch basin is used for pretreatment
Subsurface Structure	80% provided they are combined with one or more pretreatment BMPs prior to infiltration
Other	
Dry Detention Basins	For peak rate attenuation only; no TSS removal credit
Green Roofs	See Volume 2, Chapter 2; may reduce required water quality volume; no TSS removal credit
Porous Pavement	80% if designed to prevent runon and with adequate storage capacity; limited to uses identified in Volume 2, Chapter 2
Rain Barrels and Cisterns	May reduce required water quality volume; no TSS removal credit

DEP's Handbook uses BMPs as the nomenclature for stormwater control measures but for consistency we have referred to them as SCMs in this table.

8.3 Priority Watershed

Step 10 Maximize Treatment if Project Site Is in Priority Watershed: The designer should check that the pollutant removal provided has been fully maximized if the project is located within a Priority Watershed. Pollutant removal should be maximized for the Priority Watershed's pollutant of concern, as identified in the DCR Stewardship Map.[27] Taking advantage of providing all available treatment in these watersheds is important to DCR to address existing impairments in the receiving waters and to make progress towards impaired waters goals required as part of DCR's statewide stormwater permit compliance. The designer should maximize installation of green infrastructure (GI) and other treatments and be able to demonstrate to the DCR Stormwater Program Team that the maximum treatment has been provided.

Upon completion of this step, the designer can move on to finalize the SCMs and project's stormwater design.

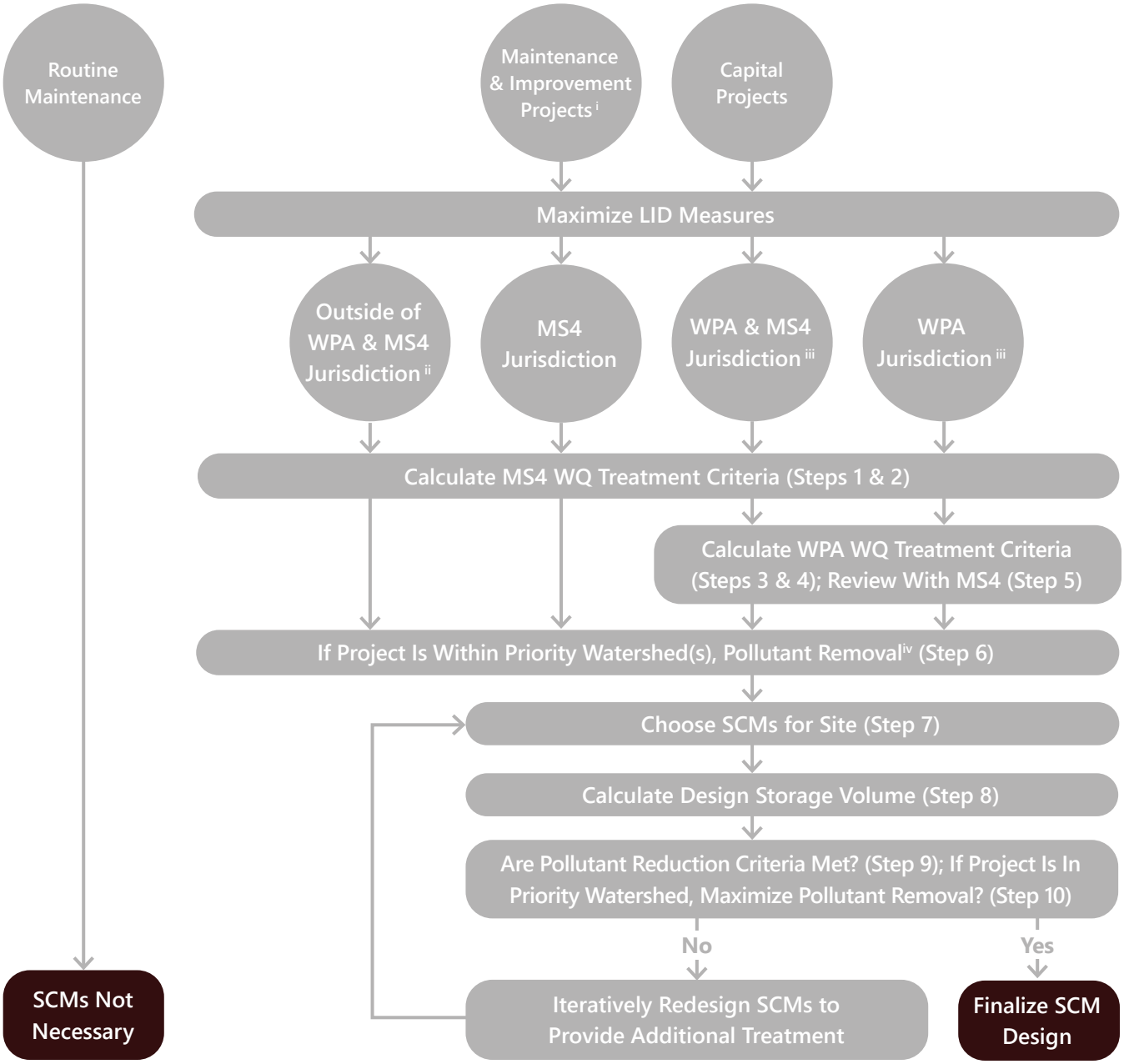
[27] See the DCR Stewardship Map at Stewardship Map (arcgis.com)

9

SCM Design Guidance

Once the stormwater control measures (SCMs) have been selected to provide the required treatment and the water quality treatment standards have been determined, the designer should apply the design guidance provided in this chapter when completing the design of SCMs. Please note that the designer should primarily refer to the Massachusetts Stormwater Handbook for guidance and design requirements for SCMs. This chapter provides additional guidance that is relevant to DCR facilities and agency goals.

Figure 8: Water Quality Treatment Flow Chart—Finalizing Design



[i] Regulations allow for meeting water quality criteria to the maximum extent practicable (see Chapter 4). DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown, whenever possible.

[ii] Since project is outside regulated areas there are no required water quality treatment criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet the requirements as shown.

[iii] Projects are subject to WPA water quality criteria, but DCR is implementing the MS4 stormwater treatment protocol statewide and encourages project teams to meet both of the requirements.

[iv] Including additional treatment is not explicitly required by either the MS4 permit or the WPA but is needed to continue progress towards meeting impaired waters pollutant removal requirements in the MS4 permit; therefore, DCR is encouraging maximizing pollutant removal in projects in these watersheds.

9.1 Isolate DCR Drainage System/ Reduce Interconnections to Other MS4s

For ease of maintenance and clear regulatory ownership, the drainage system for a DCR facility should be kept on-site and should not tie into other municipal drainage systems whenever possible. A DCR drainage system should include on-site collection and conveyance as well as treatment and control measures and the final discharge outfalls.

9.2 Resuspension

Off-line SCMs are preferred over in-line SCMs to minimize resuspension of sediment during large storms. An offline configuration can be achieved by using a bypass weir or structure. If an SCM is designed as an in-line structure, it must have sufficient hydraulic outlet capacity to safely pass water volumes in excess of design storms.

9.3 Subsurface Structures

Subsurface structures should be designed with sumped pretreatment, for easy sediment/litter removal, and cleanouts for jetting, where appropriate.

9.4 Maximize Vegetated Surfaces

In general, for surface SCMs, vegetated surfaces are preferred over crushed stone, riprap, or other hardened surfaces. Such armoring should be used only where anticipated flow concentrations and velocities will prevent establishment of vegetation.

Soils for vegetated surfaces including bioretention and constructed wetlands must be prepared for optimum establishment of vegetation and the Massachusetts Stormwater Handbook includes additional details. Soils may include select imported soils (only explicitly required and approved engineered soil or biosoil), or a blend of on-site soil with amendments.

Constructed earthen embankments designed for water impoundment should never be planted with woody vegetation (i.e., trees or shrubs) and should be maintained clear of such vegetation due to potential existing piping under root systems.

9.5 Native Species

The designer should discuss a planting list with DCR Landscape. DCR encourages use of native species in planting plans and has developed planting lists for certain facilities to provide a cohesive landscape.

9.6 Trail Design

The designer should encourage sheet flow from paved surfaces to maximize infiltration and to avoid creating point source discharges. Sheet flow should be allowed to travel into adjacent green infrastructure or vegetated buffer areas to allow for filtration and infiltration.

9.7 Setbacks

Setbacks are the minimum required distances between an SCM and a structure or resource area. Resource areas are identified in the Massachusetts Stormwater Handbook (Vol. 2, Ch. 2). These setbacks represent a minimum distance, and the designer may need to consider greater distances to provide for slope stability, protection of structures, and the satisfactory performance (e.g., access for operation and maintenance) of an SCM.

9.8 Direct Discharges to Public Water Supply

The designer should avoid or remove any direct discharges to Class A public water supplies to the maximum extent practicable. If an SCM discharges to a public water supply, designers should provide pretreatment and incorporate spill control measures for the project site.

9.9 Access and Maintenance Design

The designer should site SCMs with consideration for access and maintenance. All components of an SCM, including inlets, outlets, treatment areas, and underground features, must be accessible to facilitate inspection and cleanout. If an SCM must be in an area with constrained access, the designer may consider oversizing pretreatment practices. Designers should consider the frequency and cost of required maintenance and whether the maintenance activities can be performed by DCR staff.

To avoid maintenance issues, the drainage design of the project should only have interconnections between stormwater systems at a drainage structure and should not have blind tie-ins.

The intended access should never cross directly over a structure or spillway unless the structure or spillway has been designed to accommodate the structural loads of maintenance vehicles.

The subsurface components of SCMs must be sited so that they are accessible to the appropriate maintenance equipment.

Surface SCMs are preferred by DCR due to ease of maintenance. They should include staff gauges or other markers that indicate sediment depth to facilitate inspection and maintenance.

9.10 Fencing

Fencing around SCMs should be minimized to not impede inspection and maintenance. Fencing is not necessary at inaccessible areas. However, if an SCM has a deep permanent pool, the designer should consider fencing to prevent unauthorized access.

Physical barriers should allow for the following:

» Access for maintenance activities

» Wildlife passage

» Direct access for wildlife to reach wetlands and water bodies (fencing is prohibited within riverfront area)

SCMs with slopes no steeper than 3H:1V and standing water no more than two feet deep have a low safety risk and fencing should be avoided. Stormwater basins that include a deep-water feature, but no fencing, must include a safety bench, 10 feet wide with a slope of 10H:1V, located at or just above the normal pool elevation.

A

Handbook Acronyms

BMP	Best Management Practice
CMR	Code of Massachusetts Regulations
CWA	Clean Water Act—Federal Water Pollution Control Act, 33 U.S.C. §1251 et seq.
DCR	Department of Conservation and Recreation
DSV	Design Storage Volume
EPA	Environmental Protection Agency (see also USEPA)
E&S	Erosion & Sediment
GI	Green Infrastructure
IA	Impervious Area
IC	Impervious Cover
IDDE	Illicit Discharge Detection and Elimination
IWPA	Interim Wellhead Protection Area
LA	Load Allocations
LID	Low Impact Development
LTPPP	Long-Term Pollution Prevention Plan
LUHPPLs	Land Uses with Higher Potential Pollutant Loads
MassDEP	Massachusetts Department of Environmental Protection
MCM	Minimum Control Measure
MEP	Maximum Extent Practicable
MS4	Municipal Separate Storm Sewer System
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OOC	Order of Conditions
ORW	Outstanding Resource Water
QPA	Qualifying Pervious Area
RDA	WPA Request for Determination of Applicability
SCM	Stormwater Control Measure
SWMP	Stormwater Management Plan
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSS	Total Suspended Solids
USEPA	U.S. Environmental Protection Agency
USGS HUC	United States Geologic Service Hydrologic Unit Code
VFS	Vegetated Filter Strip
WBD	Watershed Boundary Dataset
WLA	Waste Load Allocations
WPA	Massachusetts Wetlands Protection Act
WQC	Water Quality Certification
WQV	Water Quality Volume

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