City of Carlsbad
BMP Design Manual

For Permanent Site Design, Storm Water Treatment and Hydromodification Management

Effective Date: February 16, 2016

Revised: September 1, 2021

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Summary

In May 2013, the California Regional Water Quality Control Board for the San Diego Region reissued (SDRWQCB) a municipal storm water, National Pollutant Discharge Elimination System permit (Municipal Separate Storm Sewer Systems [MS4] Permit) that covered its region. The San Diego Region is comprised of San Diego, Orange, and Riverside County Copermittees. The MS4 Permit reissuance to the San Diego County Copermittees went into effect in 2013 (Order No. R9-2013-0001).

The reissued MS4 Permit updates and expands storm water requirements for new developments and redevelopments. In February 2015, the MS4 Permit was amended by Order R9-2015-0001, and again in November 2015 by Order R9-2015-0100. As required by the reissued MS4 Permit, the Copermittees have prepared this Model Best Management Practices (BMP) Design Manual (from here in referred to as the "**manual**") to replace the current Countywide Model Standard Urban Stormwater Mitigation Plan (SUSMP), dated March 25, 2011, which was based on the requirements of the 2007 MS4 Permit. The effective date of this manual was **February 16, 2016**.

Following adoption and implementation of the February 2016 Regional Model Manual, the Copermittees have prepared an updated version of the manual which was used to establish this updated City of Carlsbad BMP Design Manual. The updated Regional Model Manual incorporated additional public comments, clarifications from the SDRWQCB, and additional BMP sizing, maintenance, and design guidance. A summary of the updates incorporated into the Regional Model Manual is provided in the table "Chronology of Storm Water Regulations and San Diego Region Model Guidance Documents" at the end of this section. This updated City of Carlsbad BMP Design Manual replaces and supersedes the February 2016 manual.

What this Manual is intended to address:

This Manual addresses updated onsite post-construction storm water requirements for Standard Projects and Priority Development Projects (PDPs), and provides updated procedures for planning, preliminary design, selection, and design of permanent storm water BMPs based on the performance standards presented in the MS4 Permit.

The intended users of the City of Carlsbad BMP Design Manual (from here in refereed to as the "Manual") include project applicants, for both private and public developments, their representatives responsible for preparation of Storm Water Quality Management Plans (SWQMPs) and City of Carlsbad (from here in referred to as the "City") staff reviewing of these plans.

The following are significant updates to storm water requirements of the MS4 Permit compared to the 2007 MS4 Permit and 2011 Countywide Model SUSMP:

- PDP categories have been updated, and the minimum threshold of impervious area to qualify as a PDP has been reduced.
- Many of the low impact development (LID) requirements for site design that were applicable only to PDPs under the 2007 MS4 Permit are applicable to all projects (Standard Projects and PDPs) under the MS4 Permit.
- The standard for storm water pollutant control (formerly treatment control) is retention of the 24-hour 85th percentile storm volume, defined as the event that has a precipitation total greater than or equal to 85 percent of all daily storm events larger than 0.01 inches over a given

period of record in a specific area or location.

- For situations where onsite retention of the 85th percentile storm volume is technically not feasible, biofiltration must be provided to satisfy specific "biofiltration standards". These standards consist of a set of siting, selection, sizing, design and operation and maintenance (O&M) criteria that must be met for a BMP to be considered a "biofiltration BMP" – see Section 2.2.1 and Appendix F.
- Exemptions from hydromodification management are reduced, and certain categories of exemptions that are not identified in the MS4 Permit must be identified in a Watershed Management Area Analysis (WMAA).
- The flow control performance standard for hydromodification management is based on controlling flow to pre-development condition (natural) rather than pre-project condition.
- The flow control performance standard is updated. Requirement to compare flow frequency curves is removed. Performance standard for comparing pre-development and post-project flow duration curves is revised.
- Hydromodification management requirements are expanded to include requirements to protect critical coarse sediment yield areas.
- Provide a pathway for an Alternative Compliance Program (Note: Carlsbad has not adopted an Alternative Compliance Program). If adopted in the future, alternative (offsite) compliance approaches could provide an option to satisfy pollutant control or hydromodification management performance standards. Per the MS4 Permit, if adopted, the City will have the discretion to allow the project applicants to participate in an Alternative Compliance Program.

What this manual does not address:

This manual provides guidelines for compliance with onsite post-construction storm water requirements in the MS4 Permit, which apply to both private and public projects. The MS4 Permit includes provisions for discretionary participation in an alternative compliance program and implementation of "Green Streets" design concepts. As these elements are jurisdiction-specific and in different stages of development across the San Diego region, this manual which precedes development of local implementation guidance, **does not provide guidance for participation in an alternative compliance program nor is intended to serve as a Green Streets design manual**. This manual only indicates the conditions under which project applicants, public or private, can seek to participate in alternative compliance or implement Green Streets at the discretion of local jurisdictions. Additionally, this manual addresses only post-construction storm water requirements and is not intended to serve as a guidance or criteria document for construction-phase storm water controls.

Disclaimer

Currently, some of the Copermittees are pursuing a subvention of funds from the State to pay for certain activities required by the 2007 Municipal Permit, including activities that require Copermittees to perform activities outside their jurisdictional boundaries and on a regional or watershed basis. Nothing in this manual should be viewed as a waiver of those claims or as a waiver of the rights of Copermittees to pursue a subvention of funds from the State to pay for certain activities required by the MS4 Permit, including the preparation and implementation of the BMP Design Manual. In addition, several Copermittees have filed petitions with the State Board challenging some of the requirements of Provision E of the MS4 Permit. Nothing in this manual should be viewed as a waiver of those claims. Because the State Board has not issued a stay of the 2013 Municipal Permit, Copermittees must comply with the MS4 Permit's requirements while the State Board process is pending.

This manual is organized in the following manner:

An introductory section titled **"How to Use this Manual"** provides a practical orientation to intended uses and provides examples of recommended workflows for using the manual.

Chapter 1 provides information to help the manual user determine which of the storm water management requirements are applicable to the project; source controls/site design, pollutant controls, and hydromodification management. This chapter also introduces the procedural requirements for preparation, review, and approval of project submittals. General jurisdiction requirements for processing project submittals are provided in this chapter.

Chapter 2 defines the performance standards for source control and site design BMPs, storm water pollutant control BMPs, and hydromodification management BMPs based on the MS4 Permit. These are the underlying criteria that must be met by projects, as applicable. This chapter also presents information on the underlying concepts associated with these performance standards to provide the project applicant with technical background; explains why the performance standards are important; and gives a general description of how the performance standards can be met.

Chapter 3 describes the essential steps in preparing a comprehensive storm water management design and explains the importance of starting the process early during the preliminary design phase. By following the recommended procedures in Chapter 3, project applicants can develop a design that complies with the complex and overlapping storm water requirements. This chapter is intended to be used by both Standard Projects and PDPs; however, certain steps will not apply to Standard Projects (as identified in the chapter).

Chapter 4 presents the source control and site design requirements to be met by all development projects and is therefore intended to be used by both Standard Projects and PDPs. This chapter also serves as guidance for development projects subject to Trash Capture requirements.

Chapter 5 applies to PDPs. It presents the specific process for determining which category of onsite pollutant control BMP, or combination of BMPs, is most appropriate for the PDP site and how to design the BMP to meet the storm water pollutant control performance standard. The prioritization order of onsite pollutant control BMPs begins with retention, then biofiltration, and finally flow-thru treatment control (in combination with offsite alternative compliance*). Chapter 5 does not apply to Standard Projects.

Chapter 6 applies to PDPs that are subject to hydromodification management requirements. This chapter provides guidance for meeting the performance standards for the two components of hydromodification management: protection of critical coarse sediment yield areas and flow control for post-project runoff from the project site. Chapter 6 incorporates applicable requirements of the "Final Hydromodification Management Plan (HMP) Prepared for County of San Diego, California," dated March 2011, with modifications based on updated requirements in the MS4 Permit. Chapter 6 does not apply to Standard Projects or to PDPs with only pollutant control requirements.

Chapter 7 addresses the long term O&M requirements of structural BMPs presented in this manual, and mechanisms to ensure O&M in perpetuity. Chapter 7 applies to PDPs only and is not required for Standard Projects; however Standard Projects may use this chapter as a reference.

Chapter 8 describes the specific requirements for the content of project submittals to facilitate

* Flow-thru Treatment Control BMPs are not an option as a structural BMP. Carlsbad has not adopted an Alternative Compliance Program.

preparation and city review of project plans for compliance with applicable requirements of the manual and the MS4 Permit. This chapter is applicable to Standard Projects and PDPs. This chapter pertains specifically to the content of project submittals, and is intended to complement the requirements for processing of project submittals that are included in Chapter 1.

Appendices to this manual provide detailed guidance for BMP design, calculation procedures, worksheets, maps and other figures to be referenced for BMP design. These Appendices are not intended to be used independently from the overall manual – rather they are intended to be used only as referenced in the main body of the manual.

This manual is organized based on project category. Requirements that are applicable to both Standard Projects and PDPs are presented in Chapter 4. Additional requirements applicable only to PDPs are presented in Chapters 5 through 7. While source control and site design BMPs are required for all projects inclusive of Standard Projects and PDPs, structural BMPs are only required for PDPs. Throughout this manual, the term "structural BMP" is a general term that encompasses the pollutant control BMPs and hydromodification management BMPs required for PDPs under the MS4 Permit. A structural BMP may be a pollutant control BMP, a hydromodification management BMP, or an integrated pollutant control and hydromodification management BMP. Hydromodification management BMPs are also referred to as flow control BMPs in this manual.

Chronology of Storm Water Regulations and San Diego Region Model Guidance Documents

Date	Document	Notes
July 16, 1990	MS4 Permit	The SDRWQCB issued general storm water requirements to all jurisdictions within the County of San Diego via the MS4 Permit
February 21, 2001	MS4 Permit	Land Development SUSMP requirements were written into the MS4 Permit during permit reissuance
February 14, 2002	Model SUSMP	Countywide model guidance document was issued for implementation of the 2001 MS4 Permit requirements
January 24, 2007	MS4 Permit	LID and HMP requirements were written into the MS4 Permit during reissuance
July 24, 2008	Model SUSMP	Countywide model guidance document for implementation of the 2007 MS4 Permit requirements, including interim HMP criteria, was prepared
March 2011	Final HMP	Final HMP addresses HMP requirements of the 2007 MS4 Permit
March 25, 2011	Model SUSMP	Countywide model guidance document for implementation of the 2007 MS4 Permit requirements, including final HMP, was completed
May 8, 2013	MS4 Permit	Storm water retention requirements and requirements for protection of critical coarse sediment yield were written into the MS4 Permit during reissuance
February 11, 2015	MS4 Permit	Amends 2013 MS4 permit and provides clarification on water quality equivalency and provides other technical revisions.
June 27, 2015	Model BMP Design Manual	Countywide model guidance document for implementation of the MS4 Permit requirements "Model BMP Design Manual" updates former "Model SUSMP"
February 16, 2016	Carlsbad BMP Design Manual	Updates to June 27, 2015 version include updated PDP definitions and definition of redevelopment, updates to storm water requirements applicability timeline, and updates to hydromodification management performance criteria and procedures.
September 1, 2021	Carlsbad BMP Design Manual	Updates to incorporate May 30, 2018 Model BMP Design Manual including: Hydromodification Sizing Factors, geotechnical feasibility, Biofiltration BMP sizing, and Operations and Maintenance Requirements. Updates to Appendices include the addition of Source Control Fact Sheets and Bioretention Soil Media (BSM) specifications, maintenance fact sheets, baseline and significant site design and source control BMPs, adopting San Diego County sizing methodology, and trash capture BMP requirements.

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List of Acronyms

303(d)	Refers to Clean Water Act Section 303(d) list of impaired and threatened waters
ASTM	American Society for Testing and Materials
BF	Biofiltration (BMP Category)
BMPs	Best Management Practices
BSM	Biofiltration Soil Media
CC&Rs	Conditions, Covenants, and Restrictions
CEQA	California Environmental Quality Act
CMC	Carlsbad Municipal Code
DCV	Design Capture Volume
DMA	Drainage Management Area
EIR	Environmental Impact Report
ESA	Environmentally Sensitive Area
FT	Flow-thru Treatment Control BMP (BMP Category)
GLUs	Geomorphic Landscape Units
GR	General Requirements
HMP	Hydromodification Management Plan
HOA	Home Owners Association
HSPF	Hydrologic Simulation Program-FORTRAN
HU	Harvest and Use
INF	Infiltration (BMP Category)
LID	Low Impact Development
MEP	Maximum Extent Practicable
MS4	Municipal Separate Storm Sewer System
NRCS	Natural Resource Conservation Service
O&M	Operation and Maintenance
PCBMP	Post-Construction BMP Exhibit
PDPs	Priority Development Projects
POC	Point of Compliance
PR	Partial Retention (BMP Category)
RRV	Required Retention Volume
SC	Source Control
SCCWRP	Southern California Coastal Water Research Project
SD	Site Design
SDHM	San Diego Hydrology Model
SDRWQCB	San Diego Regional Water Quality Control Board
SIC	Standard Industrial Classification
SSD-BMP	Significant Site Design BMP
SUSMP	Standard Urban Stormwater Mitigation Plan
SWMM	Storm Water Management Model
SWMP	Storm Water Management Plan

SWQMP	Storm Water Quality Management Plan
TN	Total Nitrogen
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WMAA	Watershed Management Area Analysis
WQIP	Water Quality Improvement Plan

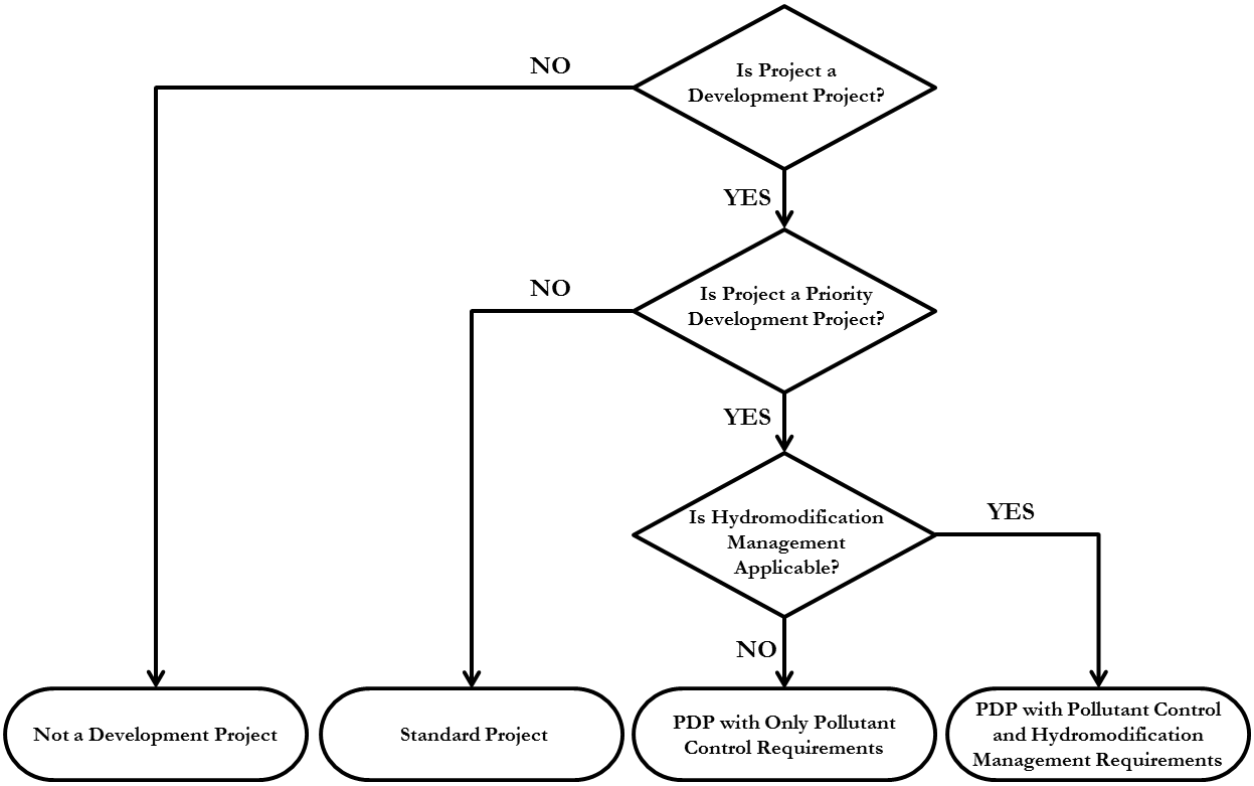
How to Use this Manual

This manual is intended to help a project applicant, in coordination with City staff, develop a SWQMP for a development project (public or private) that complies with City and MS4 Permit requirements. Most applicants will require the assistance of a qualified civil engineer, geotechnical engineer, architect, and/or landscape architect to prepare a SWQMP. The applicant should begin by checking specific requirements with City's storm water program staff, because every project is different.

Beginning Steps for All Projects: What requirements apply?

To use this manual, start by reviewing **Chapter 1** to determine whether your project is a "Standard Project" or a "PDP" and which storm water quality requirements apply to your project.

Not all of the requirements and processes described in this manual apply to all projects. Therefore, it is important to begin with a careful analysis of which requirements apply and the city requirements. Chapter 1 also provides an overview of the process of planning, design, construction, operation, and maintenance, with associated city review and approval steps, leading to compliance. A flow chart that shows how to categorize a project in terms of applicable post-construction storm water requirements is included below. The flow chart is followed by a table that lists the applicable section of this manual for each project type.



Project Type	Applicable Requirements		
	Source Control and Site Design (Chapter 4)	Storm Water Pollutant Control BMPs (Chapter 5)	Hydromodification Management BMPs (Chapter 6)
Not a Development Project (without impact to storm water quality or quantity – e.g. interior remodels, routine maintenance; Refer to Section 1.3)	Requirements in this manual do not apply		
Standard Projects	X		
PDPs with only Pollutant Control Requirements	X	X	
PDPs with Pollutant Control and Hydromodification Management Requirements	X	X	X

Once an applicant has determined which requirements apply, **Chapter 2** describes the specific performance standards associated with each requirement. For example, an applicant may learn from Chapter 1 that the project must meet storm water pollutant control requirements. Chapter 2 describes what these requirements entail. This chapter also provides background on key storm water concepts to help understand why these requirements are in place and how they can be met. Refer to the list of acronyms and glossary as guidance to understanding the meaning of key terms within the context of this manual.

Next Steps for All Projects: How should an applicant approach a project storm water management design?

Most projects will then proceed to **Chapter 3** to follow the step-by-step guidance to prepare a storm water project submittal for the site. This chapter does not specify any regulatory criteria beyond those already specified in Chapter 1 and 2 – rather it is intended to serve as a resource for project applicants to help navigate the task of developing a compliant storm water project submittal. Note that the first steps in Chapter 3 apply to both Standard Projects and PDPs; while other steps in Chapter 3 only apply to PDPs.

The use of a step-by-step approach is highly recommended because it helps ensure that the right information is collected, analyzed, and incorporated in to project plans and submittal at the appropriate time in the city review process. It also helps facilitate a common framework for discussion between the applicant and the reviewer. However, each project is different and it may be appropriate to use a different approach as long as the applicant demonstrates compliance with the MS4 Permit requirements that apply to the project.

Final Steps in Using This Manual: How should an applicant design BMPs and prepare documents for compliance?

Standard Projects	PDPs
Standard Projects will proceed to **Chapter 4** for guidance on implementing source control and site design requirements. After Chapter 4, Standard Projects will proceed to **Chapter 8** for project submittal requirements.	PDPs will also proceed to **Chapter 4** for guidance on implementing source control and site design requirements. PDPs will use **Chapters 5 through 7** and associated Appendices to implement pollutant control requirements, and hydromodification management requirements for the project site, as applicable. These projects will proceed to **Chapter 8** for project submittal requirements.

Plan Ahead to Avoid Common Mistakes

The following list identifies some common errors made by applicants that delay or compromise development approvals with respect to storm water compliance.

- Not planning for compliance early enough. The strategy for storm water quality compliance should be considered before completing a conceptual site design or sketching a layout of project site or subdivision lots (see Chapter 3). Planning early is crucial under current requirements compared to previous requirements; for example, LID/Site Design is required for all development projects and onsite retention of storm water runoff is required for PDPs. Additionally, collection of necessary information early in the planning process (e.g. geotechnical conditions, groundwater conditions) can help avoid delays resulting from redesign.

- Assuming proprietary storm water treatment facilities will be adequate for compliance and/or relying on strategies acceptable under previous MS4 Permits may not be sufficient to meet compliance. Under the MS4 Permit, the standard for pollutant control for PDPs is **retention of the 85th percentile storm volume** (see Chapter 5). Flow-thru treatment cannot be used to satisfy permit requirements unless the project also participates in an alternative compliance program*. Under some conditions, certain proprietary BMPs may be classified as "biofiltration" according to Appendix F of this manual and can be used for primary compliance with storm water pollutant treatment requirements (i.e. without alternative compliance).

- Not planning for on-going inspections and maintenance of PDP structural BMPs in perpetuity. It is essential to secure a mechanism for funding of long term O&M of structural

* Flow-thru Treatment Control BMPs are not an option as a structural BMP. Carlsbad has not adopted an Alternative Compliance Program.

BMPs, select structural BMPs that can be effectively operated and maintained by the ultimate property owner, and include design measures to ensure access for maintenance and to control maintenance costs (see Chapter 7).

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Chapter 1

Policies and Procedural Requirements

This chapter introduces storm water management policies and is intended to help categorize a project and determine the applicable storm water management requirements as well as options for compliance. This chapter also introduces the procedural requirements for preparation, review, and approval of project submittals.

1.1 Introduction to Storm Water Management Policies

MS4 Permit Provision E.3.a-c; E.3.d.(1)

Storm water management requirements for development projects are derived from the MS4 Permit and implemented by local jurisdictions.

On May 8, 2013, the California Regional Water Quality Control Board San Diego Region (referred to as "San Diego Water Board") reissued a municipal storm water permit titled "National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges from the MS4s draining the watersheds within the San Diego Region" (Order No. R9-2013-0001; referred to as MS4 Permit) to the municipal Copermittees. The MS4 Permit was amended in February 2015 by Order R9-2015-0001, and again in November 2015 by Order R9-2015-0100. The MS4 Permit was issued by the San Diego Water Board pursuant to section 402 of the federal Clean Water Act and implementing regulations (Code of Federal Regulations Title 40, Part 122) adopted by the United States Environmental Protection Agency, and Chapter 5.5, Division 7 of the California Water Code. The MS4 Permit, in part, requires each Copermittee to use its land use and planning authority to implement a development planning program to control and reduce the discharge of pollutants in storm water from new development and significant redevelopment to the maximum extent practicable (MEP). MEP is defined in the MS4 Permit.

Different requirements apply to different project types.

The MS4 Permit requires all development projects to implement source control and site design practices that will minimize the generation of pollutants. While all development projects are required to implement source control and site design/LID practices, the MS4 Permit has additional requirements for development projects that exceed size thresholds and/or fit under specific use

categories. These projects, referred to as PDPs, are required to incorporate structural BMPs into the project plan to reduce the discharge of pollutants, and address potential hydromodification impacts from changes in flow and sediment supply.

1.2 Purpose and Use of the Manual

This manual presents a "unified BMP design approach."

To assist the land development community, streamline project reviews, and maximize cost-effective environmental benefits, the regional Copermittees have developed a unified BMP design approach[1] that meets the performance standards specified in the MS4 Permit. By following the process outlined in this manual, project applicants (for both private and public developments) can develop a single integrated design that complies with the complex and overlapping MS4 Permit source control and site design requirements, storm water pollutant control requirements (i.e. water quality), and hydromodification management (flow-control and sediment supply) requirements. Figure 1-1 below presents a flow chart of the decision process that the manual user should use to:

1. Categorize a project;
2. Determine storm water requirements; and
3. Understand how to submit projects for review and verification.

This figure also indicates where specific procedural steps associated with this process are addressed in Chapter 1.

Alternative BMP design approaches that meet applicable performance standards may also be acceptable.

Applicants may choose not to use the unified BMP design approach present in this manual, in which case they will need to demonstrate to the satisfaction of the City, in their submittal, compliance with applicable performance standards. These performance standards are described in **Chapter 2** and in Section E.3.c of the MS4 Permit.

[1] The term "unified BMP design approach" refers to the standardized process for site and watershed investigation, BMP selection, BMP sizing, and BMP design that is outlined and described in this manual with associated appendices and templates. This approach is considered to be "unified" because it represents a pathway for compliance with the MS4 Permit requirements that is anticipated to be reasonably consistent across the local jurisdictions in San Diego County. In contrast, applicants may choose to take an alternative approach where they demonstrate to the satisfaction of the Copermittee, in their submittal, compliance with applicable performance standards without necessarily following the process identified in this manual.

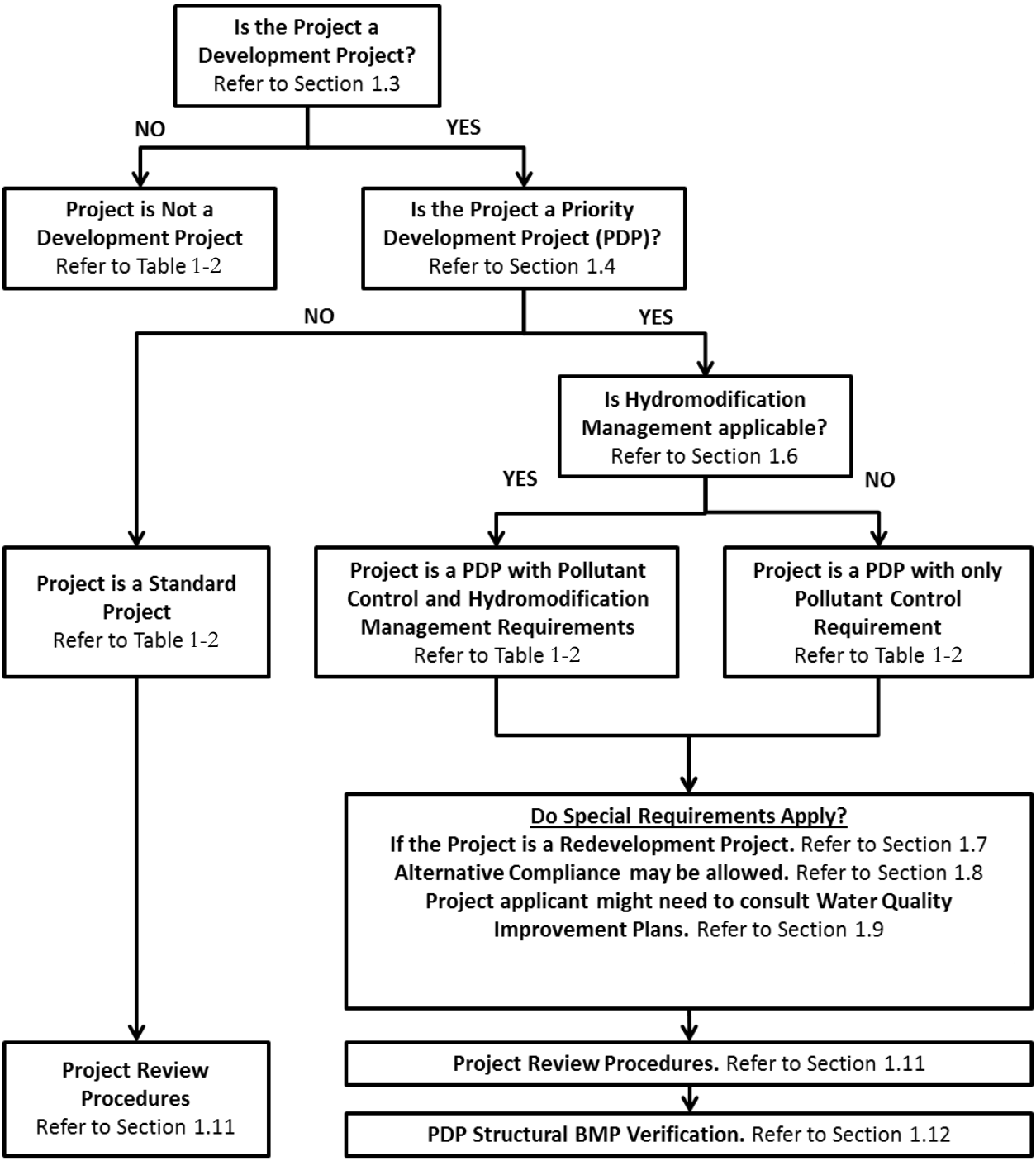


FIGURE 1-1. Procedural Requirements for a Project to Identify Storm Water Requirements

1.2.1 Determine Applicability of Construction BMP Requirements

All projects, or phases of projects, even if exempted from meeting some or all of the Permanent BMP Requirements, are required to implement temporary erosion, sediment, good housekeeping and pollution prevention BMPs to mitigate storm water pollutants during the construction phase. See City of Carlsbad Engineering Standards, Volume 4 for detailed information on these requirements.

1.3 Defining a Project

Not all site improvements are considered "development projects" under the MS4 Permit.

This manual is intended for new development and redevelopment projects, inclusive of both private- and public funded projects. Development projects are defined by the MS4 Permit as "construction, rehabilitation, redevelopment, or reconstruction of any public or private projects". Development projects are issued by local permits to allow construction activities. To further clarify, this manual applies only to development or redevelopment activities that have the potential to contact storm water and contribute an anthropogenic source of pollutants, or reduce the natural absorption and infiltration abilities of the land.

A project must be defined consistent with the California Environmental Quality Act (CEQA) definitions of "project."

CEQA defines a project as: a discretionary action being undertaken by a public agency that would have a direct or reasonably foreseeable indirect impact on the physical environment. This includes actions by the agency, financing and grants, and permits, licenses, plans, regulations or other entitlements granted by the agency. CEQA requires that the project include "the whole of the action" before the agency. This requirement precludes "piecemealing," which is the improper (and often artificial) separation of a project into smaller parts in order to avoid preparing EIR-level documentation.

In the context of this manual, the "project" is the "whole of the action" which has the potential for adding or replacing or resulting in the addition or replacement of, roofs, pavement, or other impervious surfaces and thereby resulting in increased flows and storm water pollutants. "Whole of the action" means the project may not be segmented or phased into small parts either onsite or offsite if the effect is to reduce the quantity of impervious area and fall below thresholds for applicability of storm water requirements.

When defining the project, the following questions are considered:

- What are the project activities?
- Do they occur onsite or offsite?
- What are the limits of the project (project boundary)?
- What is the whole of the action associated with the project (i.e. what is the total amount of new or replaced impervious area considering all of the collective project components through all phases of the project)?
- Are any facilities or agreements to build facilities offsite in conjunction with providing service to the project (street widening, utilities)?

Table 1-2 is used to determine whether storm water management requirements defined in the MS4 Permit and presented in this manual apply to the project.

If a project meets one of the exemptions in Table 1-2 then permanent BMP requirements do not apply to the project i.e. requirements in this manual are not applicable. If permanent BMP requirements apply to a project, Sections 1.4 to 1.7 will further define the extent of the applicable requirements based on the MS4 Permit. The MS4 Permit contains standard requirements that are applicable to all

projects (Standard Projects and PDPs), and more specific requirements for projects that are classified as PDPs.

TABLE 1-1. Applicability of Permanent, Post-Construction Storm Water Requirements

Do permanent storm water requirements apply to your project?
Requirements DO NOT apply to:
Replacement of impervious surfaces that are part of a routine maintenance activity, such as: • Replacing roof material on an existing building • Restoring pavement or other surface materials affected by trenches from utility work • Resurfacing existing roads and parking lots, including slurry, overlay and restriping • Routine replacement of damaged pavement, if the sole purpose is to repair the damaged pavement • Resurfacing existing roadways, sidewalks, pedestrian ramps or bike lanes on existing roads • Restoring a historic building to its original historic design • Installation of ground mounted solar arrays over existing impermeable surface. **Note**: Work that creates impervious surface outside of the existing impervious footprint is not considered routine maintenance. Repair or improvements to an existing building or structure that do not alter the size: • Plumbing, electrical and HVAC work • Interior alterations including major interior remodels and tenant build-out within an existing commercial building • Exterior alterations that do not increase existing impervious surface footprint and do not expose underlying soil during construction (e.g. roof replacement).

1.4 Is the Project a PDP?

MS4 Permit Provision E.3.b.(1)

PDP categories are defined by the MS4 Permit, but the PDP categories can be expanded by local jurisdictions, and local jurisdictions can offer specific exemptions from PDP categories.

Section 1.4.1 presents the PDP categories defined in the MS4 Permit. Section 1.4.2 presents specific local exemptions.

1.4.1 PDP Categories

In the MS4 Permit, PDP categories are defined based on project size, type and design features.

Projects shall be classified as PDPs if they are in one or more of the PDP categories presented in the latest version of the MS4 Permit. A PDP applicability checklist for these categories is also provided in the City's Storm Water Standard Questionnaire Form E-34. If any of the categories match the project, the entire project is a PDP. For example, if a project feature such as a parking lot falls into a PDP category, then the entire development footprint including project components that otherwise would not have been designated a PDP on their own (such as other impervious components that did not meet PDP size thresholds, and/or landscaped areas), shall be subject to PDP requirements. Note that size thresholds for impervious surface created or replaced vary based on land use, land characteristics, and whether the project is a new development or redevelopment project. Therefore, all definitions must be reviewed carefully. Also, note that categories are defined by the total quantity of "added or replaced" impervious surface, not the **net change** in impervious surface.

For example, consider a redevelopment project that adds 7,500 square feet of new impervious surface and removes 4,000 square feet of existing impervious surface. The project has a net increase of 3,500 square feet of impervious surface. However, the project is still classified as a PDP because the total added or replaced impervious surface is 7,500 square feet, which is greater than 5,000 square feet.

"**Collectively**" for the purposes of the manual means that all contiguous and non-contiguous parts of the project that represent the whole of the action must be summed up. For example, consider a residential development project that will include the following impervious components:

- 3,600 square feet of roadway
- 350 square feet of sidewalk
- 4,800 square feet of roofs
- 1,200 square feet of driveways
- 500 square feet of walkways/porches

The collective impervious area is 10,450 square feet.

1.4.2 Local PDP Exemptions

The MS4 Permit provides each Copermittee the discretion to exempt certain projects from being defined as PDPs. For a list of Local PDP Exemptions (other than ground mounted solar arrays described below), see the City's Storm Water Standard Questionnaire, Form E-34.

Ground Mounted Solar Arrays may be exempted from PDP requirements provided that LID features are incorporated so the 24-hour, 85th percentile storm event is reintroduced to the underling soil. Applicant shall demonstrate compliance on development plans and supporting calculations subject to the City Engineer approval.

Note that the source control and site design storm water requirements that are applicable to all projects will still apply even if a project is exempt from PDP requirements (i.e. a project that has been exempted from PDP requirements will be a Standard Project subject to Standard Project requirements).

1.5 Determining Applicable Storm Water Management Requirements

MS4 Permit Provision E.3.c.(1)

Depending on project type and receiving water, different storm water management requirements apply.

New development or redevelopment projects that are subject to this manual requirement pursuant to Section 1.3, but are not classified as PDPs based on Section 1.4, are called "Standard Projects." Source control and site design requirements apply to all projects including Standard Projects and PDPs. Additional structural BMP requirements (i.e. pollutant control and hydromodification management) apply only to PDPs. Storm water management requirements for a project, and the applicable sections of this manual, are summarized in Table 1-2.

TABLE 1-2. Applicability of Manual Sections for Different Project Types

Project Type	Project Development Process (Chapter 3 and 8)	Source Control and Site Design (Section 2.1 and Chapter 4)	Structural Pollutant Control (Section 2.2 and Chapter 5 and 7)	Structural Hydromodification Management (Section 2.3, 2.4 and Chapter 6 and 7)
Not a Development Project	The requirements of this manual do not apply			
Standard Project (including Trash Capture)	☑	☑	NA	NA
PDP with only Pollutant Control Requirements	☑	☑	☑	NA
PDPs with Pollutant Control and Hydromodification Management Requirements	☑	☑	☑	☑

1.6 Applicability of Hydromodification Management Requirements

MS4 Permit Provision E.3.c.(2)

Hydromodification management requirements apply to PDPs only.

If the project is a Standard Project, hydromodification management requirements do not apply. Hydromodification management requirements apply to PDPs (both new and re-development) unless the project meets specific exemptions discussed below.

PDP exemptions from hydromodification management requirements are based on the receiving water system.

The City has the discretion to exempt a PDP from hydromodification management requirements where the project discharges storm water runoff to:

(i) Existing underground storm drains discharging directly to water storage reservoirs, lakes, enclosed embayments (i.e. lagoon), or the Pacific Ocean;

(ii) Conveyance channels whose bed and bank are concrete lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments (i.e. lagoon), or the Pacific Ocean; or

(iii) An area identified by the Copermittees as appropriate for an exemption by the optional WMAA incorporated into the Water Quality Improvement Plan (WQIP) pursuant to Provision B.3.b.(4) of the MS4 permit. Carlsbad commissioned an Hydromodification exemption study for areas draining to existing lagoons in Carlsbad. This study is entitled *Hydromodification Exemption Analyses for Select Carlsbad Watersheds*, prepared by Chang Consultants, dated September 17, 2015. The study is included in the WQIP for Carlsbad watershed. To find out if this study affects your project, please contact the land development engineering staff.

Additional hydromodification management exemptions would need to be approved by the RWQCB through the WQIP Annual Update process (Regional MS4 Permit Section F.1.2.c.) prior to the project being exempt from hydromodification management exemptions. Applicants electing to perform an exemption analysis to exempt a project from hydromodification management requirements shall use the methodology for hydromodification management exemption presented in Carlsbad Watershed Management Area Analysis.

Refer to Figure 1-2 and the associated criteria describing nodes in Figure 1-2 to determine applicability of hydromodification management requirements. The criteria reflect the latest list of exemptions that are allowed under the 2013 MS4 Permit, and therefore supersede criteria found in earlier publications.

- Figure 1-2, Node 1 – Hydromodification management control measures are only required if the proposed project is a PDP.
- Figure 1-2, Node 2 – As allowed by the MS4 Permit, projects discharging directly to the Pacific Ocean, by either existing underground storm drain systems or conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to the Pacific Ocean, are exempt.

- This exemption is subject to the following additional criteria defined by this manual:
    a) The outfall must be located on the beach (not within or on top of a bluff),
    b) A properly sized energy dissipation system must be provided to mitigate outlet discharge velocity from the direct discharge to the ocean for the ultimate condition peak design flow of the direct discharge,
    c) The invert elevation of the direct discharge conveyance system (at the point of discharge to the ocean) should be equal to or below the mean high tide water surface elevation at the point of discharge, unless the outfall discharges to quay or other non-erodible shore protection.

- Figure 1-2, Node 3 – As allowed by the MS4 Permit, projects discharging directly to enclosed embayments (e.g., San Diego Bay or Mission Bay), by either existing underground storm drain systems or conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to the enclosed embayment, are exempt.
    - This exemption is subject to the following additional criteria defined by this manual:
        a) The outfall must not be located within a wildlife refuge or reserve area (e.g., Kendall-Frost Mission Bay Marsh Reserve, San Diego Bay National Wildlife Refuge, San Diego National Wildlife Refuge),
        b) A properly sized energy dissipation system must be provided to mitigate outlet discharge velocity from the direct discharge to the enclosed embayment for the ultimate condition peak design flow of the direct discharge,
        c) The invert elevation of the direct discharge conveyance system (at the point of discharge to the enclosed embayment) should be equal to or below the mean high tide water surface elevation at the point of discharge, unless the outfall discharges to a quay or other non-erodible shore protection.
            - For cases in which the direct discharge conveyance system outlet invert elevation is above the mean high tide water surface elevation but below the 100-year water surface elevation, additional analysis is required to determine if energy dissipation should be extended between the conveyance system outlet and the elevation associated with the mean high tide water surface level.
            - No exemption may be granted for conveyance system outlet invert elevations located above the 100-year floodplain elevation.

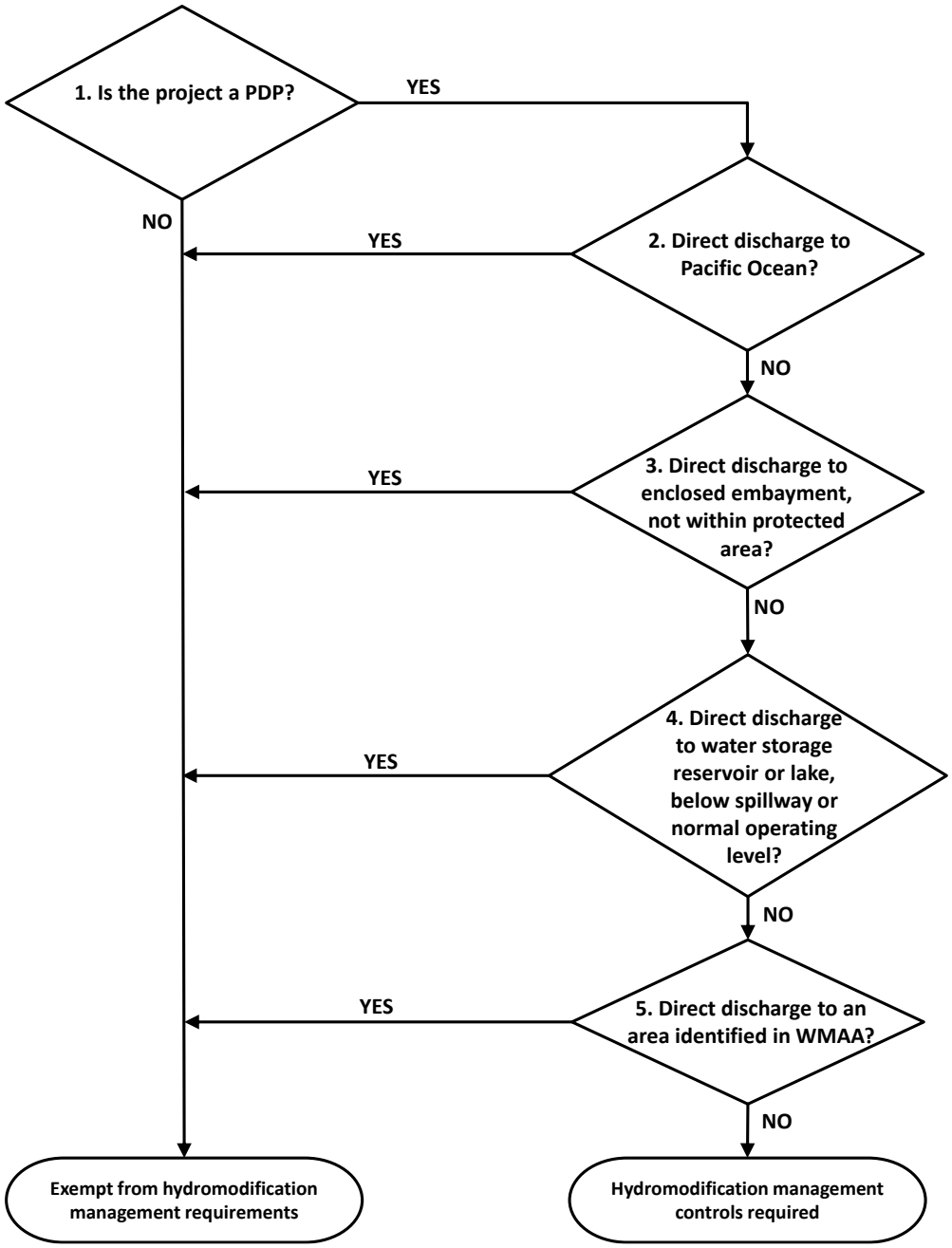
- Figure 1-2, Node 4 – As allowed by the MS4 Permit, projects discharging directly to a water storage reservoir or lake, by either existing underground storm drain systems or conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to the water storage reservoir or lake, are exempt.
    - This exemption is subject to the following additional criteria defined by this manual:
        a) A properly sized energy dissipation system must be provided in accordance with city design standards to mitigate outlet discharge velocity from the direct discharge to the water storage reservoir or lake for the ultimate condition peak design flow of the direct discharge,
        b) The invert elevation of the direct discharge conveyance system (at the point of discharge to the water storage reservoir or lake) should be equal to or below the lowest normal operating water surface elevation at the point of discharge, unless the outfall discharges to a quay or other non-erodible shore protection. Normal operating water

surface elevation may vary by season; contact the reservoir operator to determine the elevation. For cases in which the direct discharge conveyance system outlet invert elevation is above the lowest normal operating water surface elevation but below the reservoir spillway elevation, additional analysis is required to determine if energy dissipation should be extended between the conveyance system outlet and the elevation associated with the lowest normal operating water surface level.

c) No exemption may be granted for conveyance system outlet invert elevations located above the reservoir spillway elevation.

- Figure 1-2, Node 5 – As allowed by the MS4 Permit, projects discharging directly to an area identified as appropriate for an exemption in the WMAA[2] for the watershed in which the project resides, by either existing underground storm drain systems or conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to the designated area, are exempt. Consult the WMAA within the WQIP for the watershed in which the project resides to determine areas identified as appropriate for an exemption. Exemption is subject to any criteria defined within the WMAA, and criteria defined below by this manual:
  - To qualify as a direct discharge to an exempt river reach:
    a) A properly sized energy dissipation system must be provided to mitigate outlet discharge velocity from the direct discharge to the exempt river reach for the ultimate condition peak design flow of the direct discharge,
    b) The invert elevation of the direct discharge conveyance system (at the point of discharge to the exempt river reach) should be equal to or below the 10-year floodplain elevation. Exceptions may be made at the discretion of the City Engineer, but shall never exceed the 100-year floodplain elevation. The City Engineer may require additional analysis of the potential for erosion between the outfall and the 10-year floodplain elevation.
    c) No exemption may be granted for conveyance system outlet invert elevations located above the 100-year floodplain elevation.

[2]Refer to *Hydromodification Exemption Analysis for Select Carlsbad Watersheds,* by Chang Consultants, dated September 17, 2015 included in the Carlsbad WQIP



*Direct discharge refers to an uninterrupted hardened conveyance system; Note to be used in conjunction with Node Descriptions.

FIGURE 1-2. Applicability of Hydromodification Management BMP Requirements

1.7 Special Considerations for Redevelopment Projects (50% Rule)

MS4 Permit Provision E.3.b.(2)

Redevelopment PDPs (PDPs on previously developed sites) may need to meet storm water management requirements for ALL impervious areas (collectively) within the ENTIRE project site.

If the project is a redevelopment project, the structural BMP performance requirements and hydromodification management requirements apply to redevelopment PDPs as follows:

(a) Where redevelopment results in the creation or replacement of impervious surface in an amount of less than fifty percent of the surface area of the previously existing development, then the structural BMP performance requirements of Provision E.3.c of the MS4 Permit apply only to the creation or replacement of impervious surface, and not the entire development; or

(b) Where redevelopment results in the creation or replacement of impervious surface in an amount of more than fifty percent of the surface area of the previously existing development, then the structural BMP performance requirements of Provision E.3.c of the MS4 Permit apply to the entire development.

These requirements for managing storm water on an entire redevelopment project site are commonly referred to as the "50% rule". For the purpose of calculating the ratio, the surface area of the previously existing development shall be the area of impervious surface within the previously existing development. The following steps shall be followed to estimate the area that requires treatment to satisfy the MS4 Permit requirements:

1. How much total impervious area currently exists on the site?
2. How much existing impervious area will be replaced with new impervious area?
3. How much new impervious area will be created in areas that are pervious in the existing condition?
4. Total created and/or replaced impervious surface = Step 2 + Step 3.
5. **50% rule test**: Is step 4 more than 50% of Step 1? If yes, treat all impervious surface on the site. If no, then treat only Step 4 impervious surface and any area that comingles with created and/or replaced impervious surface area.

Note: Step 2 and Step 3 must not overlap as it is fundamentally not possible for a given area to be both "replaced" and "created" at the same time. Also activities that occur as routine maintenance shall not be included in Step 2 and Step 3 calculation.

For example, a 10,000 sq. ft development proposes replacement of 4,000 sq. ft of impervious area. The treated area is less than 50% of the total development area and only the 4,000 sq. ft area is required to be treated.

1.8 Alternative Compliance Program (not in effect)*

MS4 Permit Provision E.3.c.(1).(b); E.3.c.(2).(c); E.3.c.(3)

PDPs are currently not allowed to participate in an alternative compliance program.

Carlsbad does not have an Alternative Compliance Program. The City has discretion to independently develop an alternative compliance program for our jurisdiction. The San Diego County Copermittees are currently developing criteria and methods to establish BMP values and credits in order to outline a framework for a potential credit (or in-lieu) program. These methods and framework require updates to the Carlsbad WQIP and are subject to SDRWQCB approval.

1.9 Relationship between this Manual and WQIPs

This manual is connected to other permit-specified planning efforts.

The MS4 Permit requires each Watershed Management Area within the San Diego Region to develop a **WQIP** that identifies priority and highest priority water quality conditions and strategies that will be implemented with associated goals to demonstrate progress towards addressing the conditions in the watershed. The MS4 Permit also provides an option to perform a **WMAA** as part of the WQIP to develop watershed specific requirements for structural BMP implementation in the watershed management area. PDPs should expect to consult either of these separate planning efforts as appropriate when using this manual as follows:

1. For PDPs, flow-thru treatment BMPs cannot be implemented. Refer to Section 1.8.

2. There may be watershed management area specific BMPs or strategies that are identified in WQIPs, for which PDPs should consult and incorporate as appropriate.

3. As part of the hydromodification management obligations that PDPs must comply with, PDPs shall consult the mapping of potential critical coarse sediment yield areas provided in the WMAA attachment to the WQIPs and design the project according to the procedures outlined in this manual if these sediments will be impacted by the project.

4. PDPs may be exempt from implementing hydromodification management BMPs (Chapter 6) based on the exemptions indicated in Section 1.6, and potentially from additional exemptions recommended in the WMAA attachment to the WQIPs. PDPs should consult the Carlsbad WMAA for recommended hydromodification management exemptions to determine if the project is eligible[3].

5. PDPs may have the option of participating in an alternative compliance program. Refer to

* Flow-thru treatment control is not an option as a structural BMP. Carlsbad has not adopted an Alternative Compliance Program.

[3] Refer to *Hydromodification Exemption Analysis for Select Carlsbad Watersheds,* by Chang Consultants, dated September 17, 2015 included in the Carlsbad WQIP.

Section 1.8.

These relationships between this manual and WQIPs are presented in Figure 1-3.

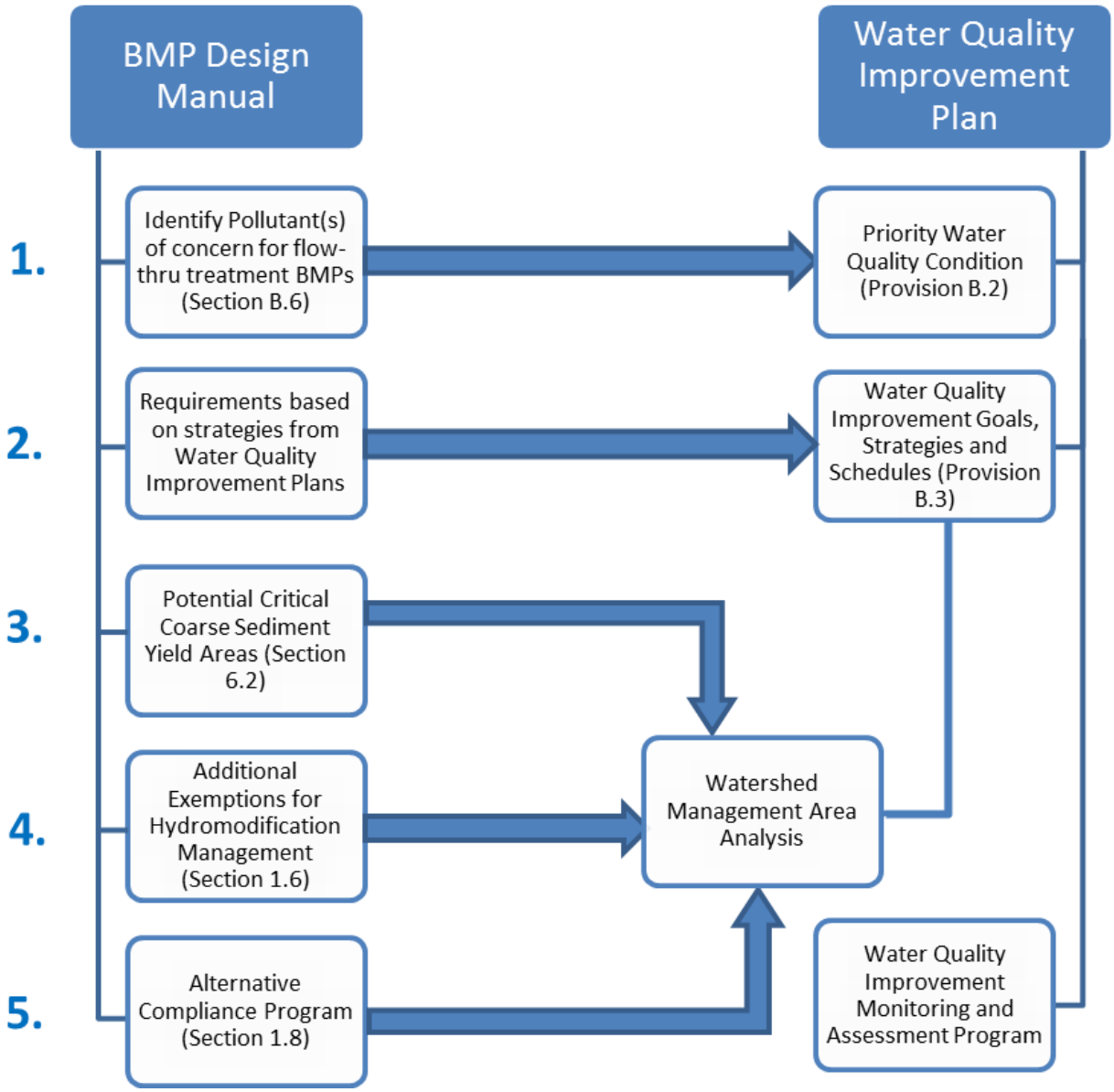


FIGURE 1-3. Relationship between this Manual and WQIP

1.10 Storm Water Requirement Applicability Timeline

Any new complete application of a grading and/or improvement plan review submitted to the City after September 1, 2021 will be required to comply with the requirements in this manual. For projects that do not require a grading plan and/or improvement plan, any new complete application for building plan review submitted to the city after September 1, 2021 will be required to comply with the requirements in this manual.

1.11 Project Review Procedures

City review project plans for compliance with applicable requirements of this manual and the MS4 Permit.

Specific submittal requirements for documentation of permanent, post-construction storm water BMPs may vary by project type; however, in all cases the project applicant must provide sufficient documentation to demonstrate that applicable requirements of the BMP Design manual and the MS4 Permit will be met.

For Standard Projects, this typically means using forms, checklist or other equivalent documents approved by the City to document that the following general requirements of the MS4 Permit are met, and showing applicable features such as onsite grading, building, improvement and landscaping plans:

- BMP Requirements for All Development Projects, which includes general requirements, source control BMP requirements, and narrative (i.e. not numerically-sized) site design requirements (MS4 Permit Provision E.3.a).

For PDPs, this means preparing a SWQMP to document that the following general requirements of the MS4 Permit are met, and showing applicable features such as onsite grading and landscaping plans:

- BMP Requirements for All Development Projects, which includes general requirements for siting of permanent, post-construction BMPs, source control BMP requirements, and narrative (i.e. not numerically-sized) site design requirements (MS4 Permit Provision E.3.a);
- Storm Water Pollutant Control BMP Requirements, for numerically sized onsite structural BMPs to control pollutants in storm water (MS4 Permit Provision E.3.c.(1)); and
- Hydromodification Management BMP Requirements, which includes protection of critical sediment yield areas and numerically sized onsite BMPs to manage hydromodification that may be caused by storm water runoff discharged from a project (MS4 Permit Provision E.3.c.(2)).

Detailed submittal requirements are provided in Chapter 8 of this manual. Documentation of the permanent, post-construction storm water BMPs at the discretion of the City Engineer must be provided with the first submittal of a project or another preliminary planning stage defined by the city. Storm water requirements will directly affect the layout of the project. Therefore, storm water requirements must be considered from the initial project planning phases, and will be reviewed with each submittal, beginning with the first submittal.

1.12 PDP Structural BMP Verification

MS4 Permit Provision E.3.e.(1)

Structural BMPs must be verified by the City prior to project occupancy.

Pursuant to MS4 Permit Provision E.3.e.(1), each Copermittee must require and confirm the following with respect to PDPs constructed within their jurisdiction:

(a) Each Copermittee must require and confirm that appropriate easements and ownerships are properly recorded in public records and the information is conveyed to all appropriate parties when there is a change in project or site ownership.

(b) Each Copermittee must require and confirm that prior to occupancy and/or intended use of any portion of the PDP, each structural BMP is inspected to verify that it has been constructed and is operating in compliance with all of its specifications, plans, permits, ordinances, and the requirements of the MS4 Permit.

For PDPs, this means that after structural BMPs have been constructed, the City requires the engineer of record to provide a certification that the site improvements for the project have been constructed in conformance with the approved storm water management documents and drawings. The engineer of record shall provide documentation to support the certification of the structural BMP to the satisfaction of the City.

For large or phased projects, the City may require inspection of the structural BMPs at each significant construction stage and at completion. Following construction, the City may require an addendum to the SWQMP and As-Builts to address any changes to the structural BMPs that occurred during construction. To ensure the long-term maintenance of structural BMPs, the City requires the property owner to sign and notarize a Permanent Storm Water Quality BMP Maintenance Agreement that will be recorded for the property prior to the issuance of a construction permit. A maintenance agreement that is recorded carries with the land (on property title) in perpetuity so that future owners are held responsible to own, maintain and report on the structural BMPs.

Chapter

2

Performance Standards and Concepts

Projects must meet four separate performance standards, as applicable.

Performance standards are specific design objectives to be achieved through the implementation of BMPs. The MS4 Permit establishes separate performance standards for source control and site design practices; storm water pollutant control BMPs; and hydromodification management BMPs. Each development project must be designed to satisfy any of several potentially applicable performance standards. Four types of standards are addressed in this manual; the first applies to all development projects, while the remaining three apply only to PDPs. The specific applicability of all standards may vary depending on specific site conditions and design choices. Table 2-1 provides an overview of these standards and their potential applicability.

1. Baseline BMP Implementation (Sections 2.1.1.2 and 2.1.1.3)

Baseline Source Control and Site Design BMPs must be implemented for all development projects wherever it is applicable and feasible to do so. These BMPs help to prevent the onsite generation of pollutants and flows and to keep them from leaving the site. For example, covering trash storage areas prevents wastes from being washed into the MS4. Likewise, directing runoff from an impervious surface (e.g., a rooftop) to a pervious dispersion area (landscaping, etc.) provides infiltration of pollutants and flows into the soil.

Baseline BMP requirements are qualitative in that strict compliance with BMP sizing and/or specific design criteria is not required. Their selection and design should be guided by the feasibility of implementing them at all applicable locations. They include each of the BMPs described in Sections 4.2 and 4.3. Both the Standard Projects and PDPs require consideration of specific Baseline BMPs for each of the following categories:

- Existing Natural Site Features. This category addresses water bodies, drainage corridors, and other natural features with the following BMPs: Conserve Natural Features (SD-G), and Provide Buffers Around Waterbodies (SD-H)
- Outdoor Impervious Areas. This category addresses streets, sidewalks, driveways, and other common outdoor impervious features with the following BMPs: Direct runoff to pervious areas (SD-B), Construct Surfaces From Permeable Materials (SD-I), and Minimize the Size of Impervious Areas.

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TABLE 2-1. Applicability of Performance Standards for Different Project Types

	1. Baseline BMP Implementation		2. DCV Reduction through Enhanced Site Design BMPs	3. Compliance with Structural Performance Standards		4. Avoidance & Bypass of Critical Coarse Sediment
	a. Source Control BMPs	b. Site Design BMPs		a. Pollutant Control	b. Hydromod. Management	
	Sections 2.1.1.2 & 4.2	Sections 2.1.1.3 & 4.3	Sections 2.1.1.4, 2.2.2.2 & Appendices B.1 & I.1	Sections 2.2 & 5	Sections 2.3, 2.4 & 6	Sections 2.3.3, 6.2 & Appendix H
Standard Projects	**Required where applicable and feasible**		**NA**	**NA**	**NA**	**NA**
PDP-exempted Projects						
• New or retrofit paved sidewalks, bicycle lanes, or trails (Section 1.4.3)			**NA**	**NA**	**NA**	**NA**
• Retrofitting or redevelopment of paved alleys, streets or roads (Section 1.4.3)			**NA**	**Required**	**NA**	**NA**
PDPs						
• Without HMP Exemption (Section 1.4)			**Optional**	**Required**	**Required**	**Required**
• With HMP Exemption (Section 6.1)			**Optional**	**Required**	**NA**	**NA**

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- Rooftop Areas. This category addresses permanent impervious coverings on buildings and/or other structures such as patios or decks with the following BMPs: Direct Runoff to Pervious Areas (SD-B), Install Green Roofs (SD-C), Install Rain Barrels (SD-E)
- Landscaped Areas. This category addresses planting areas, turf areas (artificial or natural), and water features in a landscape design with the following BMP: Use Sustainable Landscaping (SD-K)
- Work and Storage Areas: This category addresses trash storage, materials and equipment storage, loading and unloading, fueling, maintenance and repair, vehicle and equipment cleaning, and other areas that have the potential to generate pollutants with the following BMPs: Overhead Covering (SC-A), Berms and Grade Breaks (SC-B), and Wind Protection (SC-C)
- Management of Stormwater Discharges: This category addresses management of discharges from outdoor work areas and where runoff may be routed to with the following BMPs: Sanitary Sewer (SC-D), Containment Areas (S-D), Stormwater S-BMP or SSD-BMP
- Management of Non-Stormwater Discharges: This category addresses non-stormwater discharges to prevent illicit discharges from entering the storm drain system with the following BMPs: Storm Drain Signage (SC-F), Educational BMP Signage (SC-G), and practices for interior work surfaces, floor drains and sumps, drain lines, and fire sprinkler test water

2. DCV Reduction through Enhanced Site Design BMPs (Sections 2.1.1.4, 2.2.2.2, & Appendix B.1)

An Enhanced Site Design BMP is any site design BMP used specifically to reduce the Design Capture Volume (DCV) within a Drainage Management Area (DMA). This can be achieved either by adjusting the impervious runoff factor of one or more surfaces (Table B.1-1) or by implementing BMPs that receive and mitigate a portion of the DCV (Appendix B.1.4). Since DCV reduction is not required, this performance standard is optional. However, implementation of Enhanced Site Design BMPs is strongly encouraged for all PDPs as a means of reducing or eliminating the need for other, more complex or costly BMPs needed to satisfy Structural Performance Standards for the remaining DCV (see below).

Examples of BMPs that can be used as Enhanced Site Design BMPs include Tree Wells (Fact Sheet SD-A), Impervious Area Dispersion (Fact Sheet SD-B), Green Roofs (Fact Sheet SD-C), Permeable Pavement (Fact Sheet SD-D) and Rain Barrels (Fact Sheet SD-E). These BMPS must be sized and constructed in accordance with applicable guidance provided in their respective Fact Sheets or as otherwise specified. DCV reductions may be determined using the DCV Worksheet B.1.1 in Appendix B or any other methodology acceptable to the City.

3. Compliance with Structural Performance Standards (Sections 2.2, 2.3, 2.4, 5; Chapters 5 and 6)

Structural Performance Standards are numeric design standards for reducing or eliminating stormwater flows and pollutant loads from Priority Development Project sites. They specifically address the remaining volume of runoff within a DMA (either the DCV or a greater volume) after the application of all other site design and source control BMPs described above.

Projects that are exempt from hydromodification management requirements must only satisfy the

Pollutant Control Structural Performance Standard. All other projects must satisfy both the Pollutant Control Structural Performance Standard and the Hydromodification Management Structural Performance Standard. The latter must mitigate an adjusted volume greater than the DCV.

Subject to all applicable design requirements, either standard may be fully satisfied through a variety of design approaches, including Structural BMPs (S-BMPs) and Significant Site Design BMPs (SSD-BMPs). SSD-BMPs are site design BMPs designed to fully retain the DCV for the DMA (Section 5.2.3). Tree Wells (Fact Sheet SD-A), Impervious Area Dispersion (Fact Sheet SD-B), or any other SSD-BMP acceptable to the City may be used.

4. Avoidance and Bypass of Critical Coarse Sediment (Sections 2.3.1, 6.2, & Appendix H)

For many Priority Development Project sites, additional BMPs may be needed to preserve the supply of critical coarse sediment to water bodies. Any PDP that is not exempt from hydromodification management requirements must either comply with critical coarse sediment requirements or demonstrate that they do not apply. Documentation of applicability and compliance options is required in SWQMP and corresponding attachments. See Section 6.2 and Appendix H for additional description of these requirements.

Performance standards can be met through an integrated approach.

While three separate performance standards are defined by this manual, an overlapping set of design features can be used as part of demonstrating conformance to each standard. Further discussion of the relationship between performance standards is provided in Section 2.4.

2.1 Source Control and Site Design Requirements for All Development Projects (Standard & PDP)

2.1.1 Performance Standards

MS4 Permit Provision E.3.a

This section defines performance standards for source control and site design practices that are applicable to all projects (regardless of project type or size; both Standard Projects and PDPs) when local permits are issued, including unpaved roads and flood management projects.

2.1.1.1 General Requirements

All projects shall meet the following general requirements:

(a) Onsite BMPs must be located so as to remove pollutants from runoff prior to its discharge to any receiving waters, and as close to the source as possible;

(b) Structural BMPs must not be constructed within waters of the United States (U.S.); and

(c) Onsite BMPs must be designed and implemented with measures to avoid the creation of nuisance or pollution associated with vectors (e.g. mosquitos, rodents, or flies).

2.1.1.2 Baseline Source Control Requirements

Pollutant source control BMPs are features that must be implemented to address specific sources of pollutants.

The following source control BMPs must be implemented at all development projects where applicable and technically feasible:

(a) Prevention of illicit discharges into the MS4;

(b) Storm drain system stenciling or signage;

(c) Protection of outdoor material storage areas from rainfall, run-on, runoff, and wind dispersal;

(d) Protection of materials stored in outdoor work areas from rainfall, run-on, runoff, and wind dispersal;

(e) Protection of trash storage areas from rainfall, run-on, runoff, and wind dispersal; and

(f) Use of any additional BMPs determined to be necessary by the City Engineer to minimize pollutant generation at each project.

Further guidance is provided in Section 2.1.2 and Chapter 4.

2.1.1.3 Baseline Site Design Requirements

Baseline site design requirements are qualitative requirements that apply to the layout and design of ALL development project sites (Standard Projects and PDPs).

Site design performance standards define minimum requirements for how a site must incorporate LID BMPs, including the location of BMPs and the use of integrated site design practices. The following site design practices must be implemented at all development projects, where applicable and technically feasible:

(a) Maintenance or restoration of natural storage reservoirs and drainage corridors (including topographic depressions, areas of permeable soils, natural swales, and ephemeral and intermittent streams)[4];

(b) Buffer zones for natural water bodies (where buffer zones are technically infeasible, require project applicant to include other buffers such as trees, access restrictions, etc.);

(c) Conservation of natural areas within the project footprint including existing trees, other vegetation, and soils;

(d) Construction of streets, sidewalks, or parking lot aisles to the minimum widths necessary, provided public safety is not compromised;

(e) Minimization of the impervious footprint of the project;

(f) Minimization of soil compaction to landscaped areas;

[4] Development projects proposing to dredge or fill materials in waters of the U.S. must obtain a Clean Water Act Section 401 Water Quality Certification. Projects proposing to dredge or fill waters of the state must obtain waste discharge requirements.

(g) Disconnection of impervious surfaces through distributed pervious areas;

(h) Landscaped or other pervious areas designed and constructed to effectively receive and infiltrate, retain and/or treat runoff from impervious areas, prior to discharging to the MS4;

(i) Small collection strategies located at, or as close as possible to, the source (i.e. the point where storm water initially meets the ground) to minimize the transport of runoff and pollutants to the MS4 and receiving waters;

(j) Use of permeable materials for projects with low traffic areas and appropriate soil conditions;

(k) Landscaping with native or drought tolerant species; and

(l) Harvesting and using precipitation.

A key aspect of this performance standard is that these design features must be used where applicable and feasible. Responsible implementation of this performance standard depends on evaluating applicability and feasibility. Further guidance is provided in Section 2.1.2 and Chapter 4.

Additional site design requirements may apply to PDPs.

Site design decisions may influence the ability of a PDP to meet applicable performance standards for pollutant control and hydromodification management BMPs (as defined in Section 2.2 and 2.3). For example, the layout of the site drainage and reservation of areas for BMPs relative to areas of infiltrative soils may influence the feasibility of capturing and managing storm water to meet storm water pollutant control and/or hydromodification management requirements. As such, the City may require additional site design practices, beyond those listed above, to be considered and documented as part of demonstrating conformance to storm water pollutant control and hydromodification management requirements.

2.1.1.4 DCV Reduction through Enhanced Site Design BMPs (Sections 2.2.2.2 & Appendix B.1)

Enhanced site design BMPs reduce or eliminate the DCV within a DMA. Using them can decrease the number or size of other, more complex or costly BMPs needed to satisfy Structural Performance Standards.

Examples of Enhanced Site Design BMPs include Tree Wells (Fact Sheet SD-A), Impervious Area Dispersion (Fact Sheet SD-B), Green Roofs (Fact Sheet SD-C), Permeable Pavement (Fact Sheet SD-D), and Rain Barrels (Fact Sheet SD-E). Each BMP must be sized and constructed in accordance with applicable guidance provided in its respective Fact Sheet or as otherwise specified. DCV reductions are typically determined for larger projects using the DCV Worksheet B.1.1 in Appendix B and Worksheet I.1.1 in Appendix I. However, other worksheets, tables, calculators, or methods acceptable to the City may also be used. See section 2.2.2.2 for additional guidance on DCV calculation, and Appendices B.1 and I.1. for specific options and methodologies for achieving DCV reductions.

2.1.2 Concepts and References

Land development tends to increase the amount of pollutants in storm water runoff.

Land development generally alters the natural conditions of the land by removing vegetative cover, compacting soil, and/or placement of concrete, asphalt, or other impervious surfaces. These

impervious surfaces facilitate entrainment of urban pollutants in storm water runoff (such as pesticides, petroleum hydrocarbons, heavy metals, and pathogens) that are otherwise not generally found in high concentrations in the runoff from the natural environment. Pollutants that accumulate on impervious surfaces and actively landscaped pervious surfaces may contribute to elevated levels of pollutants in runoff relative to the natural condition.

Land development also impacts site hydrology.

Impervious surfaces greatly affect the natural hydrology of the land because they do not allow natural infiltration, retention, evapotranspiration and treatment of storm water runoff to take place. Instead, storm water runoff from impervious surfaces is typically and has traditionally been directed through pipes, curbs, gutters, and other hardscape into receiving waters, with little treatment, at significantly increased volumes and accelerated flow rates over what would occur naturally. The increased pollutant loads, storm water volume, discharge rates and velocities, and discharge durations from the MS4 adversely impact stream habitat by causing accelerated, unnatural erosion and scouring within creek beds and banks. Compaction of pervious areas can have a similar effect to impervious surfaces on natural hydrology.

Site Design LID involves attempting to maintain or restore the predevelopment hydrologic regime.

LID is a comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. LID designs seeks to control storm water at the source, using small-scale integrated site design and management practices to mimic the natural hydrology of a site, retain storm water runoff by minimizing soil compaction and impervious surfaces, and disconnecting storm water runoff from conveyances to the storm drain system. Site Design LID BMPs may utilize interception, storage, evaporation, evapotranspiration, infiltration, and filtration processes to retain and/or treat pollutants in storm water before it is discharged from a site. Examples of Site Design LID BMPs include using permeable pavements, rain gardens, rain barrels, grassy swales, soil amendments, and native plants.

Site design must be considered early in the design process.

Site designs tend to be more flexible in the early stages of project planning than later on when plans become more detailed. Because of the importance of the location of BMPs, site design shall be considered as early as the planning/tentative design stage (check with City requirements). Site design is critical for feasibility of storm water pollutant control BMPs (Section 2.2) as well as coarse sediment supply considerations associated with hydromodification management (introduced in Section 2.3).

Source control and site design (LID) requirements help avoid impacts by controlling pollutant sources and changes in hydrology.

Source control and site design practices prescribed by the MS4 Permit are the minimum management practices, control techniques and system, design and engineering methods to be included in the planning procedures to reduce the discharge of pollutants from development projects, regardless of size or purpose of the development. In contrast to storm water pollutant control BMPs and hydromodification control BMPs which are intended to mitigate impacts, source control and site design BMPs are intended to avoid or minimize these impacts by managing site hydrology, providing treatment features integrated within the site, and reducing or preventing the introduction of pollutants from specific sources. Implementation of site design BMPs will result in reduction in storm water

runoff generated by the site. Methods to estimate effective runoff coefficients and the storm water runoff produced by the site after site design BMPs are implemented are presented in Appendix B.1. This methodology is applicable for PDPs that are required to estimate runoff produced from the site with site design BMPs implemented so that they can appropriately size storm water pollutant control BMPs and hydromodification control BMPs.

The location of BMPs matters.

The site design BMPs listed in the performance standard include practices that either prevent runoff from occurring or manage runoff as close to the source as possible. This helps create a more hydrologically effective site and reduces the requirements that pollutant control and hydromodification control BMPs must meet, where required. Additionally, because sites may have spatially-variable conditions, the locations reserved for structural BMPs within the site can influence whether these BMPs can feasibly retain, treat, and/or detain storm water to comply with structural pollutant control and hydromodification control requirements, where applicable. For planned projects, common or shared structural BMPs are preferred. Finally, the performance standard specifies that onsite BMPs must remove pollutants from runoff prior to discharge to any receiving waters or the MS4, be located/constructed as close to the pollutant generating source as possible and must not be constructed within waters of the U.S.

The selection of BMPs also matters.

The lists of source control and site design BMPs specified in the performance standard must be used "where applicable and feasible." This is an important concept – BMPs should be selected to meet the R9-2013-0001 permit requirements and are feasible with consideration of site conditions and project type. By using BMPs that are applicable and feasible, the project can achieve benefits of these practices, while not incurring unnecessary expenses (associated with using practices that do not apply or would not be effective) or creating undesirable conditions (for example, infiltration-related issues, vector concerns including mosquito breeding, etc.).

Methods to select and design BMPs and demonstrate compliance with source control and site design requirements are presented in Chapter 4 of this manual. Source control and site design fact sheets are also provided in Appendix C and E.

2.2 Storm Water Pollutant Control Requirements for PDPs

2.2.1 Storm Water Pollutant Control Performance Standard

MS4 Permit Provision E.3.c.(1)

Storm Water Pollutant Control BMPs for PDPs shall meet the following performance standards:

(a) Each PDP shall implement BMPs that are designed to retain (i.e. intercept, store, infiltrate, evaporate, and evapotranspire) onsite the pollutants contained in the volume of storm water runoff produced from a 24-hour, 85th percentile storm event (Design Capture Volume (DCV)). The 24-hour, 85th percentile storm event shall be based on Figure B.1-1 in Appendix B. An alternative site-specific rainfall analysis may be considered, subject to city review and

approval.

(i) If it is not technically feasible to implement retention BMPs for the full DCV onsite for a PDP, then the PDP shall utilize biofiltration BMPs for the remaining volume not reliably retained. Biofiltration BMPs must be designed as described in Appendix F to have an appropriate hydraulic loading rate to maximize storm water retention and pollutant removal, as well as to prevent erosion, scour, and channeling within the BMP, and must be sized to:

[a]. Treat 1.5 times the DCV not reliably retained onsite, OR

[b]. Treat the DCV not reliably retained onsite with a flow-thru design that has a total volume, including pore spaces and pre-filter detention volume, sized to hold at least 0.75 times the portion of the DCV not reliably retained onsite.

(b) Carlsbad does not have an Alternative Compliance Program. Therefore, an applicant of a PDP may not participate in an alternative compliance program in lieu of fully complying with the performance standards for storm water pollutant control BMPs onsite.

Demonstrations of feasibility findings and calculations to justify BMP selection and design shall be provided by the project applicant in the SWQMP to the satisfaction of the City Engineer. Methodology to demonstrate compliance with the performance standards, described above, applicable to storm water pollutant control BMPs for PDPs is detailed in Chapter 5.

2.2.2 Concepts and References

Retention BMPs are the most effective type of BMPs to reduce pollutants discharging to MS4s when they are sited and designed appropriately.

Retention of the required DCV will achieve 100 percent pollutant removal efficiency (i.e. prevent pollutants from discharging directly to the MS4). Thus, retention of as much storm water onsite as technically feasible is the most effective way to reduce pollutants in storm water discharges to, and consequently from the MS4, and remove pollutants in storm water discharges from a site to the MEP.

However, in order to accrue these benefits, retention BMPs must be technically feasible and suitable for the project. Retention BMPs that fail prematurely, under-perform, or result in unintended consequences as a result of improper selection or siting may achieve performance that is inferior to other BMP types while posing other issues for property owners and copermittees. Therefore, this manual provides criteria for evaluating feasibility and provides options for other types of BMPs to be used if retention is not technically feasible.

Biofiltration BMPs can be sized to achieve approximately the same pollutant removal as retention BMPs.

In the case, where the entire DCV cannot be retained onsite because it is not technically feasible PDPs are required to use biofiltration BMPs with specific sizing and design criteria listed in Appendix B.5 and Appendix F. These sizing and design criteria are intended to provide a level of long term pollutant removal that is reasonably equivalent to retention of the DCV.

Flow-thru treatment BMPs is not an option to treat the pollutant loads in the DCV not retained or biofiltered onsite to the MEP.

Flow-thru treatment BMPs cannot be implemented to address onsite storm water pollutant control requirements since Carlsbad has not adopted an Alternative Compliance Program at this time.

Offsite Alternative Compliance Program not currently available.

Although the MS4 Permit allows the City to grant PDPs permission to utilize an alternative compliance program for meeting the pollutant control performance standard, Carlsbad has not adopted an Alternative Compliance Program at this time (Refer to Section 1.8).

Methods to design and demonstrate compliance with storm water pollutant control BMPs are presented in Chapter 5 of this manual. Definitions and concepts that should be understood when sizing storm water pollutant control BMPs to be in compliance with the performance standards are explained below:

2.2.2.1 Best Management Practices

To minimize confusion, this manual considers all references to "facilities," "features," or "controls" to be incorporated into development projects as BMPs.

2.2.2.2 DCV

The MS4 Permit requires pollutants be addressed for the runoff from the 24-hour 85th percentile storm event ("DCV") as the design standard to which PDPs must comply.

The 85th percentile, 24-hour storm event is the event that has a precipitation total greater than or equal to 85 percent of all storm events over a given period of record in a specific area or location. For example, to determine what the 85th percentile storm event is in a specific location, the following steps would be followed:

- Obtain representative precipitation data, preferably no less than 30-years period if possible.
- Divide the recorded precipitation into 24-hour precipitation totals.
- Filter out events with no measurable precipitation (less than 0.01 inches of precipitation).
- Of the remaining events, calculate the 85th percentile value (i.e. 15 percent of the storms would be greater than the number determined to be the 85th percentile, 24-hour storm).

The 85th percentile, 24-hour storm event depth is then used in hydrologic calculations to calculate the DCV for sizing storm water pollutant control BMPs. An exhibit showing the 85th percentile, 24-hour storm depth across San Diego County and the methodology used to develop this exhibit is included in Appendix B.1.1 Guidance to estimate the DCV is presented in Appendix B.1.

2.2.2.3 Implementation of Storm Water Pollutant Control BMPs

The MS4 Permit requires that the PDP applicants proposing to meet the performance standards onsite implement storm water pollutant control BMPs in the order listed below. That is, the PDP applicant first needs to implement **all** feasible onsite retention BMPs needed to meet the storm water pollutant control BMP requirements prior to installing onsite biofiltration BMPs.

Retention BMPs: Structural measures that provide retention (i.e. intercept, store, infiltrate, evaporate and evapotranspire) of storm water as part of pollutant control strategy. Examples include infiltration

BMPs and cisterns (INF-1 & INF-2), bioretention BMPs (INF-3) and biofiltration with partial retention BMPs (PR-1).

Biofiltration BMPs: Structural measures that provide biofiltration of storm water as part of the pollutant control strategy (BF-1 & BF-2).

Proprietary Biofiltration BMPs: Structural measures that provide biofiltration of storm water as part of the pollutant control strategy (BF-3)

Flow-thru treatment control BMPs* Examples include vegetated swales and media filters.

2.2.2.4 Technical Feasibility

MS4 Permit Requirement E.3.c.(5)

Analysis of technical feasibility is necessary to select the appropriate BMPs for a site.

PDPs are required to implement pollutant control BMPs in the order of priority in Section 2.2.2.3 based on determinations of technical feasibility. In order to assist the project applicant in selecting BMPs, this manual includes a defined process for evaluating feasibility. Conceptually, the feasibility criteria contained in this manual are intended to:

- Promote reliable and effective long term operations of BMPs by providing a BMP selection process that eliminates the use of BMPs that are not suitable for site conditions, project type or other factors;
- Minimize significant risks to property, human health, and/or environmental degradation (e.g. geotechnical stability, groundwater quality) as a result of selection of BMPs that are undesirable for a given site; and
- Describe circumstances under which regional and watershed-based strategies, as part of the Carlsbad WMAA may be selected.

Steps for performing technical feasibility analyses are described in detail in Chapter 5. More specific guidance related to geotechnical investigation guidelines for feasibility of storm water infiltration and groundwater quality and water balance factors is provided in Appendix D.

2.2.2.5 Biofiltration BMPs

The MS4 Permit (provision E.3.c.(1).(a).(i)) requires Biofiltration BMPs be designed to have an appropriate hydraulic loading rate to maximize storm water retention and pollutant removal, as well as to prevent erosion, scour, and channeling within the BMP. Appendix F of this manual has guidance for hydraulic loading rates and other biofiltration design criteria to meet these required goals. Appendix F also has a checklist that will need to be completed by the project SWQMP preparer. Guidance for sizing Biofiltration BMPs is included in Chapter 5 and Appendices B and F.

* Flow-thru Treatment Control BMPs is not an option as a structural BMP. Carlsbad has not adopted an Alternative Compliance Program.

2.2.2.6 Flow-thru Treatment Control BMPs (for use with Alternative Compliance)

MS4 Permit Requirement E.3.d.2-3

Since Carlsbad does not have an Alternative Compliance Program at this time, flow-thru treatment control BMP cannot be selected by the PDP applicant.

2.3 Hydromodification Management Requirements for PDPs

2.3.1 Hydromodification Management Concepts and References

2.3.1.1 What is Hydromodification?

The MS4 Permit defines hydromodification as the change in the natural watershed hydrologic processes and runoff characteristics (i.e. interception, infiltration, overland flow, and groundwater flow) caused by urbanization or other land use changes that result in increased stream flows and sediment transport. In addition, alteration of stream and river channels, such as stream channelization, concrete lining, installation of dams and water impoundments, and excessive streambank and shoreline erosion are also considered hydromodification, due to their disruption of natural watershed hydrologic processes.

Typical impacts to natural watershed hydrologic processes and runoff characteristics resulting from new development and redevelopment include:

- Decreased interception and infiltration of rainfall at the project site due to removal of native vegetation, compaction of pervious area soils, and the addition of impervious area;
- Increased connectivity and efficiency of drainage systems serving the project site, including concentration of project-site runoff to discrete outfalls;
- Increased runoff volume, flow rate, and duration from the project site due to addition of impervious area, removal of native vegetation, and compaction of pervious area soils;
- Reduction of critical coarse sediment supply from the project site to downstream natural systems (e.g. streams) due to stabilization of developed areas, stabilization of streams, and addition of basins that trap sediment (either by design as a permanent desilting basin or storm water quality treatment basin that settles sediment, or incidentally as a peak flow management basin); and
- Interruption of critical coarse sediment transport in streams due to stream crossings such as culverts or ford crossings that incidentally slow stream flow and allow coarse sediment to settle upstream of the crossing.

Any of these changes can result in increased potential for erosion, or degraded instream habitat downstream of PDPs. The changes to delivery of runoff to streams typically modify the timing, frequency, magnitude, and duration of both storm flows and baseflow. Changes to delivery of coarse sediment and transport of coarse sediment result in increased transport capacity and the potential for adverse channel erosion.

Note that this manual is intended for design of permanent, post-construction BMPs, therefore this discussion is focused on the permanent, post-construction effects of development. The process of construction also has impacts, such as a temporary increase in sediment load produced from surfaces exposed by vegetation removal and grading, which is often deposited within stream channels, initiating aggradation and/or channel widening. Temporary construction BMPs to mitigate the sediment delivery are outside the purview of this manual.

Channel erosion resulting from PDP storm water discharge can begin at the point where runoff is discharged to natural systems, regardless of the distance from the PDP to the natural system. It could also begin some distance downstream from the actual discharge point if the stream condition is stable at the discharge point but more susceptible to erosion at a downstream location. The March 2011 HMP defines a domain of analysis for evaluation of stream susceptibility to erosion from PDP storm water discharge.

2.3.1.2 How Can Hydromodification be Controlled?

In the big picture, watershed-scale solutions are necessary to address hydromodification. Factors causing hydromodification are watershed-wide, and all of San Diego's major watersheds include some degree of legacy hydromodification effects from existing development and existing channel modifications, which cannot be reversed by onsite measures implemented at new development and redevelopment projects alone. As recommended by SCCWRP in Technical Report 667, "Hydromodification Assessment and Management in California," dated April 2012, "management strategies should be tailored to meet the objectives, desired future conditions, and constraints of the specific channel reach being addressed," and "potential objectives for specific stream reaches may include: protect, restore, or manage as a new channel form."

Development of such management strategies and objectives for San Diego watersheds will evolve over successive MS4 Permit cycles. The current MS4 Permit requires the Copermittees to prepare WQIPs for all Watershed Management Areas within the San Diego Region. The WQIPs may include WMAAs which would assess watershed-wide hydrologic processes. These documents may be used to develop watershed-specific requirements for structural BMP implementation, including watershed-scale hydromodification management strategies.

This manual addresses development and redevelopment project-level hydromodification management measures currently required for PDPs by the MS4 Permit. Until optional watershed-specific performance recommendations or alternative compliance programs* are developed, hydromodification management strategies for new development and redevelopment projects will consist of onsite measures designed to meet the performance requirements of Provisions E.3.c.(2).(a) and (b) of the MS4 Permit shown in Section 2.3.1. While development project-level measures alone will not reverse hydromodification of major streams, onsite measures are a necessary component of a watershed-wide solution, particularly while watershed-wide management strategies are still being developed. Also, development project-level measures are necessary to protect a project's specific storm water discharge points, which are typically discharging in smaller tributaries not studied in detail in larger watershed studies. Typical measures for development projects include:

- Protecting critical sediment yield areas by designing the project to avoid them or implementing

* Carlsbad has not developed an Alternative Compliance Program

measures that would allow coarse sediment to be discharged to receiving waters, such that the natural sediment supply is unaffected by the project;

- Using site design/LID measures to minimize impervious areas onsite and reduce post-project runoff; and
- Providing structural BMPs designed using continuous simulation hydrologic modeling to provide flow control of post-project runoff (e.g. BMPs that store post-project runoff and infiltrate, evaporate, harvest and use, or discharge excess runoff at a rate below the critical flow rate).

Structural BMPs for hydromodification management provide volume to control a range of flows from a fraction of Q2 to Q10. The volume determined for hydromodification management is different from the DCV for pollutant control. Methodology to demonstrate compliance with hydromodification management requirements are presented in Chapter 6 of this BMP Design manual. See Section 2.4 regarding the relationship between pollutant control and hydromodification management performance standards.

2.3.2 Hydromodification Management Performance Standards

MS4 Permit Provision E.3.c.(2)

This section defines performance standards for hydromodification management, including flow control of post-project storm water runoff and protection of critical sediment yield areas, that shall be met by all PDPs unless exempt from hydromodification management requirements per Section 1.6 of this manual. Each PDP shall implement onsite BMPs to manage hydromodification that may be caused by storm water runoff discharged from a project as follows:

(a) Post-project runoff conditions (flow rates and durations) must not exceed pre-development runoff conditions by more than 10 percent (for the range of flows that result in increased potential for erosion, or degraded instream habitat downstream of PDPs).

  (i) In evaluating the range of flows that results in increased potential for erosion of natural (non-hardened) channels, the lower boundary must correspond with the critical channel flow that produces the critical shear stress that initiates channel bed movement or that erodes the toe of channel banks.

  (ii) The Copermittees may use monitoring results collected pursuant to Provision D.1.a.(2) of the MS4 Permit to re-define the range of flows resulting in increased potential for erosion, or degraded instream habitat conditions, as warranted by the data.

(b) Each PDP must avoid critical sediment yield areas known to the City or identified by the WMAA pursuant to Provision B.3.b.(4) of the MS4 Permit, or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no net impact to the receiving water.

(c) A PDP may be allowed to utilize alternative compliance under Provision E.3.c.(3) of the MS4 Permit in lieu of complying with the performance requirements of Provision E.3.c.(2)(a), however, Carlsbad does not have an Alternative Compliance Program at this time. The PDP must mitigate for the post-project runoff conditions not fully managed onsite if Provision E.3.c.(3) is utilized.

Hydromodification management requirements apply to both new development and redevelopment PDPs, except those that are exempt based on discharging to downstream channels or water bodies that are not subject to erosion, as defined in either the MS4 Permit (Provision E.3.c.(2).(d)) or the Carlsbad WMAA. Exemptions from hydromodification management requirements are described in Section 1.6 of this manual.

For undisturbed sites, the existing condition shall be taken to be the pre-development runoff condition. For redevelopment PDPs or sites that have been previously disturbed, pre-development runoff conditions shall be approximated by applying the parameters of a pervious area rather than an impervious area to the existing site, using the existing onsite grade and assuming the infiltration characteristics of the underlying soil.

For San Diego area watersheds, the range of flows that result in increased potential for erosion or degraded instream habitat downstream of PDPs and the critical channel flow shall be based on the "Final Hydromodification Management Plan Prepared for County of San Diego, California March 2011" (herein, "March 2011 Final HMP"). For PDPs subject to hydromodification management requirements, the range of flows to control depends on the erosion susceptibility of the receiving stream and shall be:

- 0.1Q2 to Q10 for streams with high susceptibility to erosion (this is the default range of flows to control when a stream susceptibility study has not been prepared);
- 0.3Q2 to Q10 for streams with medium susceptibility to erosion and which has a stream susceptibility study prepared and approved by the City Engineer; or
- 0.5Q2 to Q10 for streams with low susceptibility to erosion and which has a stream susceptibility study prepared and approved by the City Engineer.

Tools for assessing stream susceptibility to erosion have been developed by Southern California Coastal Water Research Project (SCCWRP). The tools are presented in the March 2011 Final HMP and also available through SCCWRP's website. If a PDP intends to select the 0.3Q2 or 0.5Q2 threshold, the SCCWRP screening tool must be completed and submitted with other project documentation.

The March 2011 Final HMP does not provide criteria for protection of critical sediment yield areas. The standard as presented in the MS4 Permit and shown above is: avoid critical sediment yield areas or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no net impact to the receiving water.

Methods to demonstrate compliance with hydromodification management requirements, including protection of critical coarse sediment yield areas and flow control for post-project runoff from the project site, are presented in Chapter 6 of this manual. Hydromodification management concepts, theories, and references are described below.

2.4 Relationship between Performance Standards

An integrated approach can provide significant cost savings by utilizing design features that meet multiple standards.

Site design/LID, storm water pollutant control, and hydromodification management are separate requirements to be addressed in development project design. Each has its own purpose and each has separate performance standards that must be met. However, effective project planning involves understanding the ways in which these standards are related and how single suites of design features can meet more than one standard.

Site design features (aka LID) can be effective at reducing the runoff to downstream BMPs.

Site design BMPs serve the purpose of minimizing impervious areas and therefore reducing post-project runoff, and reducing the potential transport of pollutants offsite and reducing the potential for downstream erosion caused by increased flow rates and durations. By reducing post-project runoff through, site design BMPs, the amount of runoff that must be managed for pollutant control and hydromodification flow control can be reduced.

Single structural BMPs, particularly retention BMPs, can meet or contribute to both pollutant control and hydromodification management objectives.

The objective of structural BMPs for pollutant control is to reduce offsite transport of pollutants, and the objective of structural BMPs for hydromodification management is to control flow rates and durations for control of downstream erosion. In either case, the most effective structural BMP to meet the objective are BMPs that are based on retention of storm water runoff where feasible. Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMP(s). However, demonstrating that the separate performance requirements for pollutant control and hydromodification management are met must be shown separately.

The design process should start with an assessment of the feasibility to retain or partially retain the DCV for pollutant control, then determine what kind of BMPs will be used for pollutant control and hydromodification management.

A typical design process for a single structural BMP to meet two separate performance standards at once involves (1) initiating the structural BMP design based on the performance standard that is expected to require the largest volume of storm water to be retained, (2) checking whether the initial design incidentally meets the second performance standard, and (3) adjusting the design as necessary until it can be demonstrated that both performance standards are met.

Chapter

3

Development Project Planning and Design

Compliance with source control/site design, pollutant control, and hydromodification management BMPs, as applicable, requires coordination of site, landscape, and project storm water plans. It also involves provisions for O&M of structural BMPs. In order to effectively comply with applicable requirements, a step-wise approach is recommended. This chapter outlines a step-wise, systematic approach (Figure 3-1) to preparing a comprehensive storm water management design for Standard Projects and PDPs.

STEP 1: **Coordinate Between Disciplines** Refer to Section 3.1	*Purpose:* Engage and coordinate with owner and other project disciplines (e.g. architect, engineer) early in the design and throughout the design process to support appropriate project decisions.
⇓	
STEP 2: **Gather Project Site Information** Refer to Section 3.2	*Purpose:* Gather information necessary to inform overall storm water planning process and specific aspects of BMP selection; determine the applicable storm water requirements for the project.
⇓	
STEP 3: **Develop Conceptual Site Layout and Storm Water Control Strategies** Refer to Section 3.3	*Purpose:* Use the information obtained in Step 2 to inform the preliminary site design and storm water management strategy. The scope of this step varies depending on whether the project is a Standard Project or a PDP.
⇓	
STEP 4: **Develop Complete Storm Water Management Design** Refer to Section 3.4	*Purpose:* Develop the complete storm water management design by incorporating the site design and storm water management strategies identified in Step 3 and conducting design level analyses. Integrate the storm water design with the site plan and other infrastructure plans.

FIGURE 3-1. Approach for Developing a Comprehensive Storm Water Management Design

A step-wise approach is not mandatory, and adaptation of this step-wise approach to better fit with unique project features is encouraged. However, taking a step-wise, systematic approach of some sort for planning and design has a number of advantages. First, it helps ensure that applicable requirements and design goals are identified early in the process. Secondly, it helps ensure that key data about the site, watershed, and project are collected at the appropriate time in the project development process, and the analyses are suited to the decisions that need to be made at each phase. Third, taking a

systematic approach helps identify opportunities for retention of storm water that may not be identified in a less systematic process. Finally, a systematic approach helps ensure that constraints and unintended consequences are considered and used to inform BMP selection and design, and related project decisions.

3.1 Coordination Between Disciplines

Storm water management design requires close coordination between multiple disciplines, as storm water management design will affect the site layout and should therefore be coordinated among the project team as necessary from the start. The following list describes entities/disciplines that are frequently involved with storm water management design and potential roles that these entities/disciplines may plan.

Owner:

- Engage the appropriate disciplines needed for the project and facilitate exchange of information between disciplines.
- Identify who will be responsible for long term O&M of storm water management features, and initiate maintenance agreements when applicable.
- Ensure that whole lifecycle costs are considered in the selection and design of storm water management features and a source of funding is provided for long term maintenance.
- Identify the party responsible to inspect structural BMPs at each significant construction stage and at completion in order to provide certification of structural BMPs following construction.

Planner:

- Communicate overall project planning criteria to the team, such as planned development density, parking requirements, project-specific planning conditions, conditions of approval from prior entitlement actions (e.g. CEQA, 401 certifications), locations of open space and conservation easements and environmentally sensitive areas that are protected from disturbance, etc.
- Consider location of storm water facilities early in the conceptual site layout process.
- Assist in developing the site plan.

Architect:

- Participate in siting and design (architectural elements) of storm water BMPs.

Civil Engineer:

- Determine storm water requirements applicable to the site (e.g. Standard Project vs. PDP).
- Obtain site-specific information (e.g. watershed information, infiltration rates) and develop viable storm water management options that meet project requirements.
- Reconcile storm water management requirements with other site requirements (e.g. fire access, Americans with Disabilities Act accessibility, parking, open space).
- Develop site layout and site design including preliminary and final design documents or plans.
- Select and design BMPs; conduct and document associated analyses; prepare BMP design sheets, details, and specifications.

- Prepare project SWQMP submittals.

Landscape Architect and/or Horticulturist/Agronomist:

- Select appropriate plants for vegetated storm water features, BMPs and prepare planting plans.
- Develop specifications for planting, vegetation establishment, and maintenance.
- Assist in developing irrigation plans/rates to minimize water application and non-storm water runoff from the project site.

Geotechnical Engineer

- Assist in preliminary infiltration feasibility screening of the site to help inform project layout and initial BMP selection, including characterizing soil, groundwater, geotechnical hazards, utilities, and any other factors, as applicable for the site.
- Conduct detailed analyses at proposed infiltration BMP locations to confirm or revise feasibility findings and provide design infiltration rates.
- Provide recommendations and perform infiltration testing that must be conducted during the construction phase, if needed to confirm pre-construction infiltration estimates.

Geomorphologist and/or Geologist

- Provide specialized services, as needed, related to sediment source assessment and/or channel stability or sensitivity assessment.

3.2 Gathering Project Site Information

In order to make decisions related to selection and design of storm water management BMPs, it is necessary to gather relevant project site information. This could include physical site information, proposed uses of the site, level of storm water management requirements (i.e. is it a Standard Project or a PDP?), proposed storm water discharge locations, potential/anticipated storm water pollutants based on the proposed uses of the site, receiving water sensitivity to pollutants and susceptibility to erosion, hydromodification management requirements, and other site requirements and constraints.

The amount and type of information that should be collected depends on the project type (i.e. is it a Standard Project, a PDP with all requirements or with only pollutant control requirements?). Refer to Figure 1-1 in Chapter 1 to identify the project type.

Information should only be gathered to the extent necessary to inform the storm water management design. In some cases, it is not necessary to conduct site specific analyses to precisely characterize conditions.

Checklists (in Appendix K), submittal templates (in Appendix A) and city forms are provided to facilitate gathering information about the project site for BMP selection and design. As part of planning for site investigation, it is helpful to review the subsequent steps (Section 3.3 and 3.4) to gain familiarity with how the site information will be used in making decisions about site layout and storm water BMP selection and design. This can help prioritize the data that are collected.

3.3 Developing Conceptual Site Layout and Storm Water Control Strategies

Once preliminary site information has been obtained, the site can be assessed for storm water management opportunities and constraints that will inform the overall site layout. Considering the project site data discussed above, it is essential to identify potential locations for storm water management features at a conceptual level during the site planning phase. Storm water management requirements must be considered as a key factor in laying out the overall site. Preliminary design of permanent storm water BMPs is partially influenced by whether the project is a Standard Project or a PDP. Table 3-1 presents the applicability of different subsections in this manual based on project type and must be used to determine which requirements apply to a given project.

TABLE 3-1. Applicability of Section 3.3 Sub-sections for Different Project Types

Project Type	Section 3.3.1	Section 3.3.2	Section 3.3.3	Section 3.3.4
Standard Project	☑	NA	NA	NA
PDP with only Pollutant Control Requirements	☑	NA	☑	☑
PDP with Pollutant and Hydromodification Management Requirements	☑	☑	☑	☑

3.3.1 Preliminary Design Steps for All Development Projects

All projects must incorporate source control and site design BMPs. The following systematic approach outlines these site planning considerations for all development projects:

1. Review Chapter 4 of this manual to become familiar with the menu of source control and site design practices that are required.
2. Review the preliminary site information gathered in Section 3.2, specifically related to:
    a. Natural hydrologic features that can be preserved and/or protected;
    b. Soil information;
    c. General drainage patterns (i.e. general topography, points of connection to the storm drain or receiving water); and
    d. Pollutant sources that require source controls.
3. Create opportunities for source control and site design BMPs by developing an overall conceptual site layout that allocates space for site design BMPs and promotes drainage patterns that are effective for hydrologic control and pollutant source control. For example:
    a. Locate pervious areas down gradient from buildings where possible to allow for dispersion.

b. Identify parts of the project that could be drained via overland vegetated conveyance rather than piped connections.

c. Develop traffic circulation patterns that are compatible with minimizing street widths.

4 As part of Section 3.4, refine the selection and placement of source control and site design BMPs and incorporate them into project plans. Compliance with site design and source control requirements shall be documented as described in Chapter 4.

3.3.2 Evaluation of Critical Coarse Sediment Yield Areas

For PDPs that are required to meet hydromodification management requirements, evaluate whether critical coarse sediment yield areas exist within or upstream of the project site. Identification of critical coarse sediment yield areas is discussed in Chapter 6 of this manual, additional guidance on identification and protection of critical coarse sediment yield areas is provided in Appendix H. Conceptual layout of the project site must consider the following items:

a. Have critical coarse sediment areas been identified within the project site? Does the proposed project impact these onsite critical coarse sediment areas? What measures are necessary to avoid impacts to these areas? What measures are necessary to convey critical coarse sediment from these areas through the site?

b. Have critical coarse sediment areas been identified upstream of the project site? Does the proposed project impact upstream critical coarse sediment areas? What measures are necessary to avoid impacts to these areas or convey critical coarse sediment from these areas through the site?

c. If impacts to onsite and offsite critical course sediment areas are not avoided, what mitigation practices will be implemented to ensure no net impact to the receiving water?

3.3.3 Drainage Management Areas

Drainage management areas (DMAs) provide an important framework for feasibility screening, BMP prioritization, and storm water management system configuration. BMP selection, sizing, and feasibility determinations must be made at the DMA level; therefore delineation of DMAs is highly recommended at the conceptual site planning phase and is mandatory for completing the project design and meeting submittal requirements. This section provides guidance on delineating DMAs that is intended to be used as part of Section 3.3 and 3.4.

DMAs are defined based on the proposed drainage patterns of the site and the BMPs to which they drain. During the early phases of the project, DMAs shall be delineated based onsite drainage patterns and possible BMP locations identified in the site planning process. DMAs should not overlap and should be similar with respect to BMP opportunities and feasibility constraints. More than one DMA can drain to the same BMP. However, because the BMP sizes are determined by the runoff from the DMA, a single DMA may not drain to more than one BMP. See Figure 3-2.

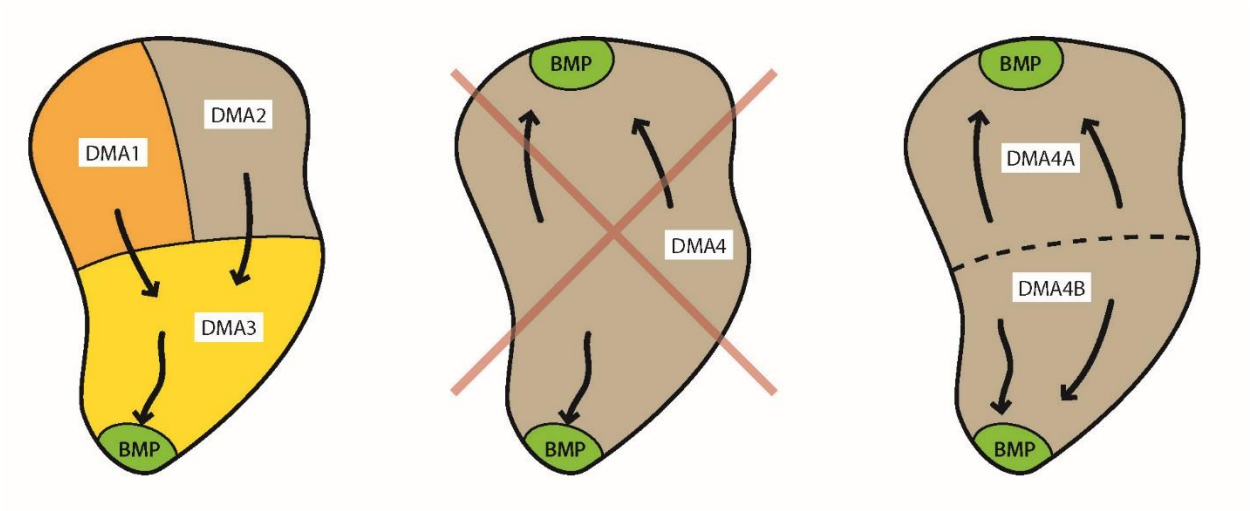

FIGURE 3-2. DMA Delineation

In some cases, in early planning phases, it may be appropriate to generalize the proposed treatment plan by simply assigning a certain BMP type to an entire planning area (e.g. Parking lot X will be treated with bioretention) and calculating the total sizing requirement without identifying the specific BMP locations at that time. This planning area would be later subdivided for design-level calculations. Section 5.2 provides additional guidance on DMA delineation. A runoff factor (similar to a "C" factor used in the rational method) should be used to estimate the runoff draining to the BMP. Appendix B.1 provides guidance in estimating the runoff factor for the drainage area draining to a BMP.

BMPs must be sized to treat the DCV from the total area draining to the BMP, including any offsite or onsite areas that comingle with project runoff and drains to the BMP. To minimize offsite flows treated by project BMPs, consider diverting upgradient flows subject to local drainage and flood control regulation. An example is shown in Figure 3-3.

DMAs must be established for all areas within the disturbed footprint of the project site. Land use within each DMA should be delineated consistent with the CEQA definition of a "project" to include the "whole of the action" and include all impervious areas in the ultimate build out of the project.

If the ultimate buildout of the project is unknown, the applicant may assign a runoff coefficient to a DMA based upon an assumed percentage of impervious surface. If a future project applicant (e.g., for a building permit) exceeds the impervious area proposed in the original SWQMP an amendment may be required to show that all BMPs are sized to meet all applicable MS4 Permit requirements.

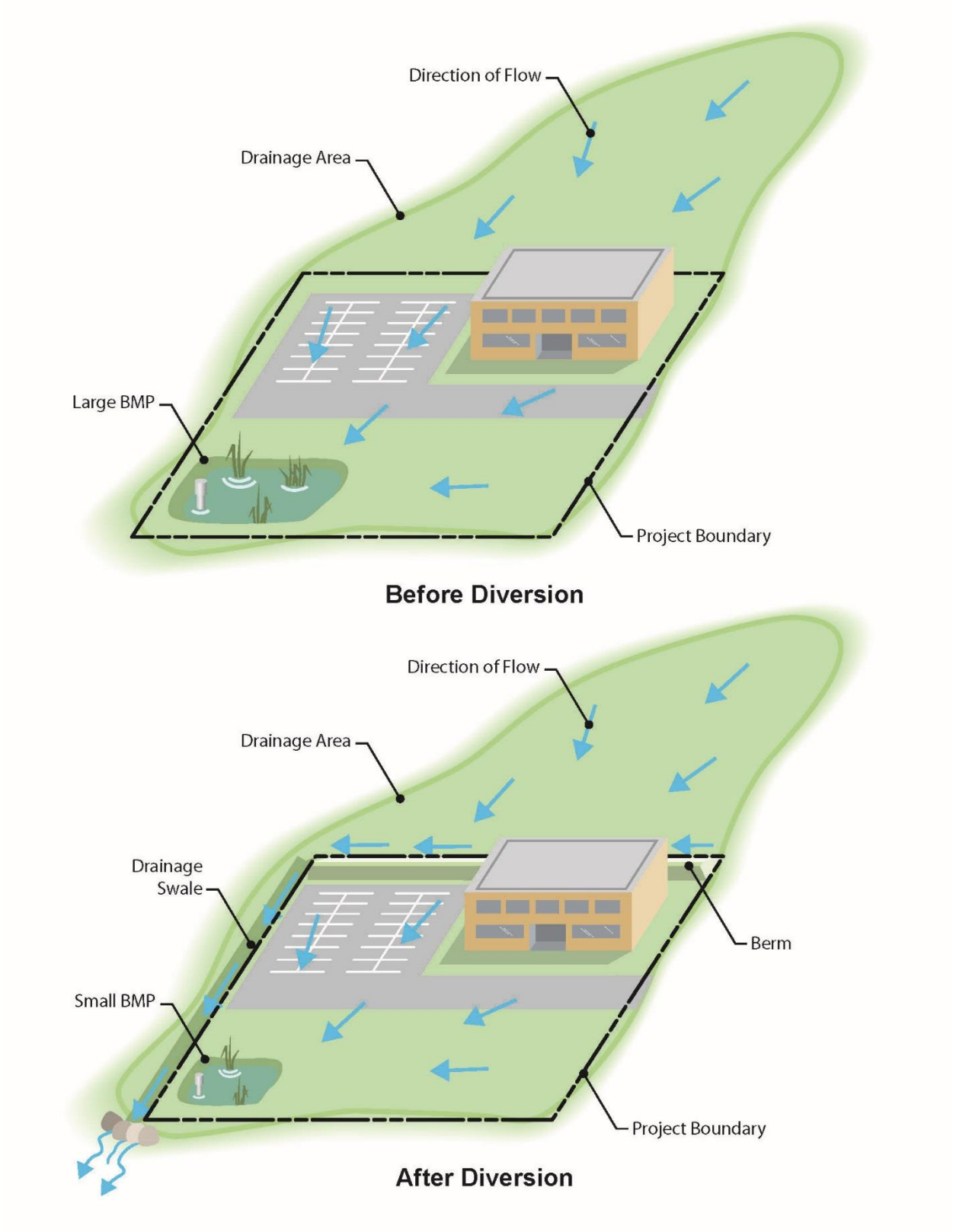

FIGURE 3-3. Tributary Area for BMP Sizing

3.3.4 Developing Conceptual Storm Water Control Strategies

This step applies to PDPs only. The goal of this step is to develop conceptual storm water control strategies that are compatible with the site conditions, including siting and preliminary selection of structural BMPs. At this phase of project planning, it is typically still possible for storm water considerations to influence the site layout to better accommodate storm water design requirements. The end product of this step should be a general, but concrete understanding of the storm water management parameters for each DMA, the compatibility of this approach with the site design, and preliminary estimates of BMP selection. For simpler sites, this step could be abbreviated in favor of skipping forward to design-level analyses in Section 3.4. However, for larger and/or more complex sites, this section can provide considerable value and help allow evaluation of storm water management requirements on common ground with other site planning considerations.

The following systematic approach is recommended:

1. Review the preliminary site information gathered in Section 3.2, specifically related to information gathered and summarized in the Site Information Checklist for PDPs (see city SWQMP template).
2. Identify self-mitigating, de minimis areas, and/or potential self-retaining DMAs that can be isolated from the remainder of the site (See Section 5.2).
3. Estimate DCV for each remaining DMAs (See Appendix B.1).
4. Determine if there is a potential opportunity for harvest and use of storm water from the project site. See Section 5.4.1 for harvest and use feasibility screening, which is based on water demand at the project site. For most sites, there is limited opportunity; therefore evaluating this factor early can help simplify later decisions.
5. Estimate potential runoff reduction and the DCV that could be achieved with site design BMPs (See Section 5.3 and Appendix B.1.4) and harvest and use BMPs (See Appendix B.4).
6. Based on the remaining runoff after accounting for steps 2 to 5, estimate BMP space requirements. Identify applicable structural BMP requirements (i.e. storm water pollutant control versus hydromodification management) and conduct approximate sizing calculations to determine the overall amount of storage volume and/or footprint area required for BMPs. Use worksheets presented in Appendix B to estimate sizing requirements for different types of BMPs.
7. Conduct preliminary screening of infiltration feasibility conditions. A preliminary screening of infiltration feasibility should be conducted as part of site planning to identify areas that are more or less conducive to infiltration. Recommended factors to consider include:
    a. Soil types (determined from available geotechnical testing data, soil maps, site observations, and/or other data sources)
    b. Approximate infiltration rates at various points on the site, obtained via approximate methods (e.g. simple pit test), if practicable
    c. Groundwater elevations
    d. Proposed depths of fill
    e. New or existing utilities that will remain with development
    f. Soil or groundwater contamination issues within the site or in the vicinity of the site

g. Slopes and other potential geotechnical hazards that are unavoidable as part of site development
h. Safety and accessibility considerations

This assessment is not intended to be final or account for all potential factors. Rather, it is intended to help in identifying site opportunities and constraints as they relate to site planning. After potential BMP locations are established, a more detailed feasibility analysis is necessary (see Section 3.4 and 5.3.2). Additionally, Appendix D provide methods for geotechnical and groundwater assessment applicable for screening at the planning level and design-level requirements. The City may allow alternate assessment methods with appropriate documentation at the discretion of the City Engineer.

8. Identify tentative BMP locations based on preliminary feasibility screening, natural opportunities for BMPs (e.g. low areas of the site, areas near storm drain or stream connections), and other BMP sites that can potentially be created through effective site design (e.g. oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers which can double as locations for bioretention or biofiltration facilities).

9. Determine tentative BMP feasibility categories for infiltration for each DMA or specific BMP location. Based on the results of feasibility screening and tentative BMP locations, determine the general feasibility categories that would apply to BMPs in these locations. Categories are described in Section 5.3.2 and include:
   a. Full infiltration condition;
   b. Partial infiltration condition; and
   c. No infiltration condition.

   Adapt the site layout to attempt to achieve infiltration to the greatest extent feasible.

10. Consider how storm water management BMPs will be accessed for inspection and maintenance and provide necessary site planning allowances (access roads, inspection openings, setbacks, etc.) and coordinate with the City's Public Works Departments for additional design requirements or allowed BMPs if required for BMPs in public easements or are part of a community facilities district maintained by the City. In addition consider the use of the site. Some BMPs may not be suitable for maintenance by individual home owners.

11. Document site planning and opportunity assessment activities as a record of the decisions that led to the development of the final storm water quality management plan. The SWQMP primarily shows the complete design rather than the preliminary steps in the process. However, to comply with the requirements of this manual, the applicant is required to describe how storm water management objectives have been considered as early as possible in the site planning process and how opportunities to incorporate BMPs have been identified.

3.4 Developing Complete Storm Water Management Design

The complete storm water management design consists of all of the elements describing the BMPs to be implemented, as well as integration of the BMPs with the site design and other infrastructure. The storm water management design shall be developed by taking into consideration the opportunities and/or constraints identified during the site planning phase of the project and then performing the final design level analysis. The scope of this step varies depending on whether the project is a Standard Project, PDP with only pollutant control BMP requirements or PDP with pollutant control and hydromodification management requirements. The following systematic approach is recommended to develop a final site layout and storm water management design. Table 3-2 presents the applicability of different subsections based on project type and must be used to determine which requirements apply to a given project.

TABLE 3-2. Applicability of Section 3.4 Sub-sections for Different Project Types

Project Type	Section 3.4.1	Section 3.4.2	Section 3.4.3
Standard Project	☑	NA	NA
PDP with only Pollutant Control Requirements	☑	☑	NA
PDP with Pollutant Control and Hydromodification Management Requirements	☑	NA	☑

3.4.1 Steps for All Development Projects

Standard Projects need to only satisfy the source control and site design requirements of Chapter 4 of this manual, and then proceed to Chapter 8 of this manual to determine submittal requirements.

1. Select, identify and detail specific source control BMPs. See Section 4.2.
2. Select, identify and detail specific site design BMPs. See Section 4.3.
3. Document that all applicable source control and site design BMPs have been used. See Chapter 8.

3.4.2 Steps for PDPs with only Pollutant Control Requirements

The steps below primarily consist of refinements to the conceptual steps completed as part of Section 3.3, accompanied by design-level detail and calculations. More detailed instructions for selection and design of storm water pollutant treatment BMPs are provided in Chapter 5.

1. Select locations for storm water pollutant control BMPs, and delineate and characterize DMAs using information gathered during the site planning phase.
2. Conduct feasibility analysis for harvest and use BMPs. See Section 5.3.1.

3. Conduct feasibility analysis for infiltration to determine the infiltration condition. See Section 5.4.2.
4. Based on the results of steps 2 and 3, select the BMP category that is most appropriate for the site. See Section 5.4.
5. Calculate required BMP sizes and footprints. See Appendix B (sizing methods) and Appendix E (design criteria).
6. Evaluate if the required BMP footprints will fit within the site considering the site constraints; if not, then document infeasibility and move to the next step.
7. If using biofiltration BMPs, document conformance with the criteria for biofiltration BMPs found in Appendix F, including Appendix F.1, as applicable.
8. Prepare SWQMP documenting site planning and opportunity assessment activities, final site layout, storm water management design and O&M requirements. See Chapter 7 and 8.
9. Execute Permanent Storm Water Quality BMP Maintenance Agreement (city will provide). See Chapters 7 and 8.

3.4.3 Steps for Projects with Pollutant Control and Hydromodification Management Requirements

The steps below primarily consist of refinements to the conceptual steps completed as part of Section 3.3, accompanied by design-level detail and calculations. More detailed instruction for selection and design of storm water pollutant treatment and hydromodification control BMPs are provided in Chapter 5 and 6, respectively.

1. If critical coarse sediment yield areas were determined to exist within or upstream of the project site (Section 3.3.2) incorporate mitigation measures when applicable (Section 6.2).
2. Select locations for storm water pollutant control and hydromodification management BMPs and delineate and characterize DMAs using information gathered during the site planning phase.
3. Conduct feasibility analysis for harvest and use BMPs. See Section 5.3.1.
4. Conduct feasibility analysis for infiltration to determine the infiltration condition. See Section 5.4.2.
5. Based on the results of steps 3 and 4, select the BMP category for pollutant treatment BMPs that is most appropriate for the site. See Section 5.4.
6. Develop the design approach for integrating storm water pollutant treatment and hydromodification control. The same location(s) can serve both functions (e.g. a biofiltration area that provides both pollutant control and flow control), or separate pollutant control and flow control locations may be identified (e.g. several dispersed retention areas for pollutant control, with overflow directed to a single location of additional storage for flow control).
7. Calculate BMP sizing requirements for pollutant control and flow control. See Appendix B (sizing methods) and Appendix E (design criteria).

   a. When the same BMP will serve both functions, Section 6.3.6 of this manual provides recommendations for assessing the controlling design factor and initiating the design process.

8. Evaluate if the required BMP footprints will fit within the site considering the site constraints:
   a. If they fit within the site, design BMPs to meet applicable sizing and design criteria. Document sizing and design separately for pollutant control and hydromodification management even when the same BMP is serving both functions.
   b. If they do not fit the site then document infeasibility and move to the next step.
9. Prepare a SWQMP documenting site planning and opportunity assessment activities, final site layout, storm water pollutant control design, hydromodification management design and O&M requirements. See Chapter 8.
10. Execute Permanent Storm Water Quality BMP Maintenance Agreement (city will provide). See Chapters 7 and 8.

3.5 Carlsbad Specific Project Planning and Design Requirements

The PDP SWQMP shall clearly identify how final land ownership mapping relates to ownership and location of storm water pollutant treatment and hydromodification control BMPs and their corresponding DMAs. The City reserves the right to reject any proposed PDP SWQMP that is likely to create future conflicts in enforcing the maintenance and effectiveness of BMPs once legally defined land parcels are sold to separate owners. DMAs of a subdivision shall drain to a common pollutant control BMP to be maintained by the property owners in an equitable manner via CC&Rs, an agreement recorded on property title or other acceptable means. Installing individual pollutant control BMPs on each lot (i.e. single family residential lot) of the subdivision to be maintained solely by each individual property owner is **not** allowed unless otherwise approved by the City Engineer.

The term "offsite improvements" refers to improvements constructed offsite from the project area such as access roads, sidewalks, utility lines, and sewers that are within the scope of the project as a whole. Offsite improvements constructed to support a project must be considered part of the whole of the action of the project (see Section 1.3). This includes new offsite impervious areas such as intersection improvements or road widening related to the project. The new offsite impervious areas must be included as part of the collective impervious area of the project even when not contiguous with the project if they are part of the whole of the action of the project. Offsite improvements that generate pollutants and excess runoff must be addressed with storm water management features, including structural BMPs when the collective project as a whole is a PDP, even when the individual offsite improvement on its own does not meet PDP thresholds.

Interim improvements are those which are built to serve the project on an interim basis until they are later replaced with permanent or ultimate improvements. Interim improvements that generate pollutants and excess runoff must, like permanent improvements, be addressed with storm water management features, including structural BMPs for the life of the interim improvement. Temporary access roads during construction are not considered interim improvements if they are part of the construction site, and are removed at the termination of construction of the project. Generally, these roads would only be in place on an interim basis of less than one year.

Swapping DMAs and Equivalency

If a project DMA cannot be treated or routed to a project BMP due to certain site constraints, an equivalent existing impervious area may be treated in lieu of said project DMA. The said equivalent existing impervious area must be located within the project boundary, currently untreated and with equal or greater DCV as said DMA. The project boundary may include the adjacent streets. Any swapping of DMAs and equivalency is subject to city engineer's approval.

Per city's Permanent Stormwater Maintenance BMP Agreement, the city has authorization to enter private property to inspect permanent pollutant control BMPs. Therefore, permanent pollutant control BMPs shall be located in common areas accessible to city staff.

3.6 Phased Projects

Phased projects typically require a conceptual or master PDP SWQMP followed by more detailed submittals.

Phased projects typically require a conceptual or master SWQMP followed by more detailed submittals. As part of an application for approval of a phased development project, a conceptual or master SWQMP shall be submitted; which describes and illustrates, in broad outline, how the drainage for the project will comply with the storm water performance standards. The level of detail in the conceptual or master SWQMP should be consistent with the scope and level of detail of the development approval being considered. The conceptual or master SWQMP should specify that a more detailed SWQMP for each later phase or portion of the project will be submitted with subsequent applications for discretionary approvals. If the overall project is determined to be a PDP, applicants that phase work must still satisfy PDP and other applicable storm water requirements. Applicants cannot phase work to bypass PDP requirements. The project details outlined in the SWQMP will be reviewed cumulatively to determine site specific storm water requirements. The City will also take into account permits issuance within the last five years to determine applicable storm water requirements. For redevelopment projects, the permit issuance date will also determine whether the "50% rule" applies or not.

For complex projects the submittal of a Preliminary Review with the City may be helpful to determine submittal requirements for phased projects.

If a tentative map approval would potentially entitle future owners of individual parcels to construct new or replaced impervious area which, in aggregate, could exceed the thresholds in Section 1.4, then the applicant must either address storm water management requirements for individual parcels or take steps to ensure storm water management requirements can and will be implemented as the phased development project (eg. subdivision) is built out.

If the tentative map application does not include plans for site improvements, the applicant should nevertheless identify the type, size, location, and final ownership of pollutant control and flow control facilities adequate to serve new roadways and any common areas, and to also manage runoff from an expected reasonable estimate of the square footage of future roofs, driveways, and other impervious surfaces on each individual lot. The City Engineer may condition approval of the map on implementation of BMPs in compliance with storm water management requirements when construction occurs on the individual lots. This condition may be enforced by a development improvement agreement.

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Chapter 4

Source Control, Site Design, and Trash Capture Requirements for All Development Projects

This chapter presents the source control and site design requirements to be met by all projects, inclusive of Standard Projects and PDPs. The City's Standard Project Requirement Checklist, Form E-36 (see city website) for source control and for site design can be used by both Standard Projects and PDPs to document conformance with the requirements. This chapter also includes trash capture requirements for Standard Projects within a Priority Land Use area (PLUs) and all PDPs. The City's Trash Capture SWQMP, Form E-35A (see city website) can be used for Standard Projects subject to trash capture requirements.

4.1 General Requirements (GR)

4.1.1: Onsite BMPs must be located so as to remove pollutants from runoff prior to its discharge to any receiving waters, and as close to the source as possible.

The location of the BMP affects the ability of the BMP to retain, and/or treat, the pollutants from the contributing drainage area. BMPs must remove pollutants from runoff and should be placed as close to the pollutant source as possible.

> **How to comply**: Projects shall comply with this requirement by implementing source control (Section 4.2) and site design BMPs (Section 4.3) that are applicable to their project and site conditions. If the project is subject to trash capture BMPs, see Section 4.4.

4.1.2: Structural BMPs must not be constructed within the Waters of the U.S.

Construction, operation, and maintenance of a structural BMP in a water body can negatively impact the physical, chemical, and biological integrity, as well as the beneficial uses, of the water body. However, alternative compliance opportunities involving restoration of areas within Waters of the U.S. may be identified by local jurisdictions.

> **How to comply**: Projects shall comply with this requirement by preparing project plans that illustrate

the location of all storm water BMPs demonstrate compliance with this requirement by showing the location of BMPs on project plans and describing or depicting the location of receiving waters.

4.1.3: Onsite BMPs must be designed and implemented with measures to avoid the creation of nuisances or pollutions associated with vectors (e.g. mosquitos, rodents, or flies).

According to the California Department of Health, structural BMPs that retain standing water for over 96 hours are particularly concerning for facilitating mosquito breeding. Certain site design features that hold standing water may similarly produce mosquitoes.

How to comply: Projects shall comply with this requirement by incorporating design, construction, and maintenance principles to drain retained water within **96 hours** and minimize standing water. Design calculations shall be provided to demonstrate the potential for standing water ponding at surface level and accessible to mosquitos has been addressed. For water retained in biofiltration facilities that are not accessible to mosquitoes this criteria is not applicable (i.e. water ponding in the gravel layer, water retained in the amended soil, etc.).

4.2 Source Control (SC) BMP Requirements

Source control BMPs avoid and reduce pollutants in storm water runoff. Everyday activities, such as recycling, trash disposal and irrigation, generate pollutants that have the potential to drain to the storm water conveyance system. Source control BMPs are defined as an activity that reduces the potential for storm water runoff to come into contact with pollutants. An activity could include an administrative action, design of a structural facility, usage of alternative materials, and operation, maintenance and inspection of an area. Where applicable and feasible, all development projects are required to implement source control BMPs. Source control BMPs (4.2.1 through 4.2.6) are discussed below.

How to comply: Projects shall comply with this requirement by implementing source control BMPs listed in this section that are applicable to their project. Applicability shall be determined through consideration of the development project's features and anticipated pollutant sources. Appendix C provides guidance for identifying source control BMPs applicable to a project. The City's Standard Project Requirement Checklist, Form E-36 shall be used to document compliance with source control BMP requirements.

4.2.1 Prevent illicit discharges into the MS4

An illicit discharge is any discharge to the MS4 that is not composed entirely of storm water except discharges pursuant to a National Pollutant Discharge Elimination System permit and discharges resulting from firefighting activities. Projects must effectively eliminate discharges of non-storm water into the MS4. This may involve a suite of housekeeping BMPs which could include effective irrigation, dispersion of non-storm water discharges into landscaping for infiltration, and controlling wash water from vehicle washing.

For outdoor areas, exposure reduction generally requires work areas and storage areas to be covered to prevent rain exposure; graded to prevent stormwater run-on and run-off; and protected from the wind so that materials are not dispersed. See Fact Sheet BL-5 (Work and Storage Areas) in Appendix C. If there are storm water discharges from outdoor areas work areas or storage areas, Fact Sheet BL-6 (Management of Stormwater Discharges) in Appendix C provides practices to prevent discharge of materials from these areas. For interior work surfaces, floor drains and sumps (including underground

parking or garages), drain lines, and fire sprinkler test water, exposure reduction generally requires directing the discharge to the sanitary sewer. See Fact Sheet BL-7 (Management of Non-Stormwater Discharges) in Appendix C. Fact Sheet BL-7 also discusses education for prevention of illicit discharges, which is discussed in more detail below in Section 4.2.2.

4.2.2 Identify the storm drain system using stenciling or signage

Storm drain signs and stencils are visible source controls typically placed adjacent to the inlets. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Stenciling shall be provided for all storm water conveyance system inlets and catch basins within the project area. Inlet stenciling may include concrete stamping, concrete painting, placards, or other methods approved by the City. In addition to storm drain stenciling, projects are encouraged to post signs and prohibitive language (with graphical icons) which prohibit illegal dumping at trailheads, parks, building entrances and public access points along channels and creeks within the project area.

A stenciling template used by the City is attached in the "Storm Drain Signage" section of Fact Sheet BL-7 in Appendix C.

Storm drain signage in section of Fact Sheet BL-7 requires applicants to post temporary BMP signage to alert contractors during construction that a permanent BMP has been completed and to ensure it does not get disturbed during subsequent grading and building construction activities. Private developments projects with permanent pollutant control BMPs require permanent BMP signage.

For PDPs with Retention and/or Biofiltration Basins signage shall be installed to the satisfaction of the City Engineer. For more details, refer to the City's standard Single Sheet BMP Plan and Fact Sheet BL-7 in Appendix C.

4.2.3 Protect *outdoor material storage areas* from rainfall, run-on, runoff, and wind dispersal

Materials with the potential to pollute storm water runoff shall be stored in a manner that prevents contact with rainfall and storm water runoff. Contaminated runoff shall be managed for treatment and disposal (e.g. secondary containment directed to sanitary sewer). All development projects shall incorporate the following structural or pollutant control BMPs for outdoor material storage areas, as applicable and feasible:

- Materials with the potential to contaminate storm water shall be:
    - Placed in an enclosure such as, but not limited to, a cabinet, or similar structure, or under a roof or awning that prevents contact with rainfall runoff or spillage to the storm water conveyance system; or
    - Protected by secondary containment structures such as berms, dikes, or curbs.
- The storage areas shall be paved and sufficiently impervious to contain leaks and spills, where necessary.
- The storage area shall be sloped towards a sump or another equivalent measure that is effective to contain spills.
- Runoff from downspouts/roofs shall be directed away from storage areas.

- The storage area shall have a roof or awning that extends beyond the storage area to minimize collection of storm water within the secondary containment area. A manufactured storage shed may be used for small containers.

See Fact Sheet BL-5 (Work and Storage Areas) in Appendix C for more information

4.2.4 Protect *materials stored in outdoor work areas* from rainfall, run-on, runoff, and wind dispersal

Outdoor work areas have an elevated potential for pollutant loading and spills. All development projects shall include the following structural or pollutant control BMPs for any outdoor work areas with potential for pollutant generation, as applicable and feasible:

- Create an impermeable surface such as concrete or asphalt, or a prefabricated metal drip pan, depending on the size needed to protect the materials.
- Cover the area with a roof or other acceptable cover.
- Berm the perimeter of the area to prevent water from adjacent areas from flowing on to the surface of the work area.
- Directly connect runoff to sanitary sewer or other specialized containment system(s), as needed and where feasible. This allows the more highly concentrated pollutants from these areas to receive special treatment that removes particular constituents. Approval for this connection must be obtained from the appropriate sanitary sewer agency.
- Locate the work area away from storm drains or catch basins.
- See Fact Sheets BL-5 (Work and Storage Areas) and BL-6 (Management of Stormwater Discharges) in Appendix C for more information.

4.2.5 Protect *trash storage areas* from rainfall, run-on, runoff, and wind dispersal

Storm water runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. All development projects shall include the following structural or pollutant control BMPs, as applicable:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This can include berming or grading the waste handling area to prevent run-on of storm water.
- Ensure trash container areas are screened or walled to prevent offsite transport of trash.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Locate storm drains away from immediate vicinity of the trash storage area and vice versa.
- Post signs on all dumpsters informing users that hazardous material are not to be disposed.

- See Fact Sheets BL-5 (Work and Storage Areas) and BL-6 (Management of Stormwater Discharges) in Appendix C for more information

4.2.6 Use any additional BMPs determined to be necessary by the City Engineer to minimize pollutant generation at each project site

At its discretion, the City may determine that additional on-site controls are necessary to minimize pollutant generation. These determinations will be made on a project-specific basis. Appendix C provides guidance on permanent controls that are applicable at a project site based on potential sources of runoff pollutants at the project site. Applicants must implement all applicable and feasible source control BMPs listed in Appendix C.

4.3 Site Design (SD) BMP Requirements

Site design BMPs (also referred to as LID BMPs) are intended to reduce the rate and volume of storm water runoff and associated pollutant loads by minimizing surface soil compaction, reducing impervious surfaces, and/or providing flow pathways that are "disconnected" from the storm drain system, such as by routing flow over pervious surfaces. Site design BMPs may incorporate interception, storage, evaporation, evapotranspiration, infiltration, and/or filtration processes to retain and/or treat pollutants in storm water before it is discharged from a site.

Appendix C also provides the following fact sheets to assist project applicants with designing BMPs to meet Site Design requirements:

- BL-1 – Existing Natural Site Features
- BL-2 – Outdoor Impervious Areas
- BL-3 – Rooftop Areas
- BL-4 – Landscaped Areas

In addition, Appendix E also provides the following fact sheets to assist applicants in Design Capture Volume (DCV) reduction using Enhanced Site Design BMPs:

- SD-A – Tree Wells
- SD-B – Impervious Area Dispersion
- SD-C – Green Roofs
- SD-D – Permeable Pavement (Site Design BMP)
- SD-E – Rain Barrels; and
- SD-F – Amended Soil

The City strongly encourages applicants to utilize these resources to inform the design and construction of low impact design and sustainable infrastructure features for their projects. In addition to generally being environmentally preferable, incorporation of these features can be significantly less expensive than traditional structural approaches, both for construction and ongoing maintenance. Incorporating many of these features may also reduce the sizing requirements for Structural BMPs.

Implementation of Enhanced Site Design BMPs may result in quantifiable reductions in the site's DCV (refer to Appendix B.1); however, failure to meet the minimum thresholds for DCV reductions does not eliminate requirements to implement applicable Site Design BMPs. All applicable and feasible Site Design BMPs must be implemented to the maximum extent practicable. Additionally,

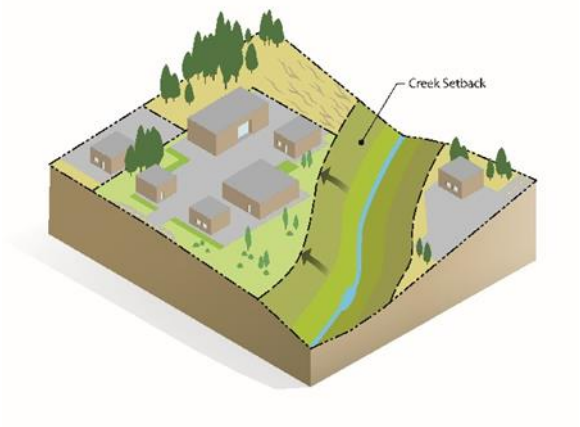
implementation of Significant Site Design BMPs (SSD-BMPs) such as Tree Wells and Impervious Area Dispersion when designed to meet flow control per Fact Sheets SD-A and SD-B, respectfully may result in quantifiable hydromodification flow control benefits; refer to Section 6.1 and Appendix I.1.

Per MS4 Permit Provision E.3.a.(3), s*ite design BMPs listed below in 4.3.1 to 4.3.8 must be applied to all development projects as applicable and feasible for the project site and project conditions.*

How to comply: Projects must comply with this requirement by using all of the site design BMPs listed in this section that are applicable and practicable to their project type and site conditions. Applicability of a given site design BMP should be determined based on project type, soil conditions, presence of natural features (e.g. streams), and presence of site features (e.g. parking areas). Applicants must provide an explanation for any site design BMP they do not consider to be applicable and feasible. Site plans must identify site design BMPs and provide adequate supporting detail to ensure their effective implementation. Table 1 "Baseline BMPs for Existing and Proposed Site Features" which is part of both the Standard Project Requirement Checklist and SWQMP listed in Appendix A, should be used to document compliance with site design BMP requirements. Table 1 applies to all development projects.

4.3.1 Maintain natural drainage pathways and hydrologic features

- Maintain or restore natural storage reservoirs and drainage corridors (including topographic depressions, areas of permeable soils, natural swales, and ephemeral and intermittent streams)
- Buffer zones for natural water bodies (where buffer zones are technically infeasible, require project applicant to include other buffers such as trees, access restrictions, etc.)



During the site assessment, natural drainages must be identified along with their connection to creeks and/or streams, if any. Natural drainages offer a benefit to storm water management as the soils and habitat already function as a natural filtering/infiltrating swale. When determining the development footprint of the site, altering natural drainages should be avoided. By providing a development envelope set back from natural drainages, the drainage can retain some water quality benefits to the watershed. In some situations, site constraints, regulations, economics, or other factors may not allow avoidance of drainages and sensitive areas. Projects proposing to dredge or fill materials in Waters of the U.S. must obtain Clean Water Act Section 401 Water Quality Certification. Projects proposing to dredge or fill waters of the State must obtain waste discharge requirements. Both the 401 Certification and the Waste Discharge Requirements are administered by the San Diego Water Board. The project applicant shall consult the Planning and Land Development Engineering Departments for other specific requirements.

For specific requirements on buffer zones and setbacks for natural water bodies, see CMC 21.203.040.

Projects can incorporate 4.3.1 into a project by implementing the following planning and design phase

techniques as applicable and practicable:

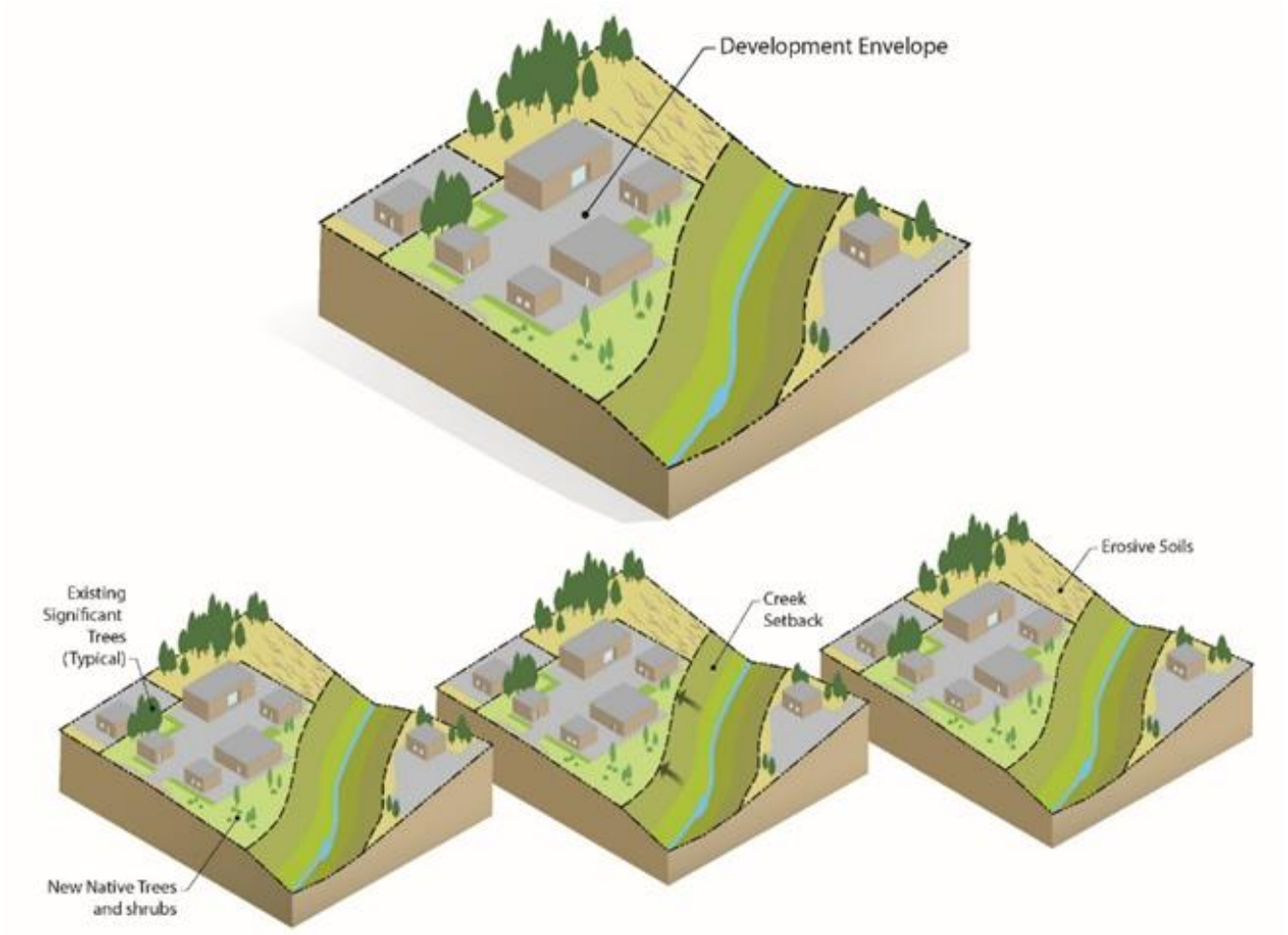
- Evaluate surface drainage and topography in considering selection of Site Design BMPs that will be most beneficial for a given project site. Where feasible, maintain topographic depressions for infiltration.
- Optimize the site layout and reduce the need for grading. Where possible, conform the site layout along natural landforms, avoid grading and disturbance of vegetation and soils, and replicate the site's natural drainage patterns. Integrating existing drainage patterns into the site plan will help maintain the site's predevelopment hydrologic function.
- Preserve existing drainage paths and depressions, where feasible and applicable, to help maintain the time of concentration and infiltration rates of runoff, and decrease peak flow.
- Structural BMPs cannot be located in buffer zones if a State and/or Federal resource agency (e.g. SDRWQCB, California Department of Fish and Wildlife; U.S. Army Corps of Engineers, etc.) prohibits maintenance or activity in the area.

See Fact Sheet BL-1 (Existing Natural Site Features) in Appendix C for more information.

4.3.2 Conserve natural areas, soils and vegetation

- Conserve natural areas within the project footprint including existing trees, other vegetation, and soils

To enhance a site's ability to support source control and reduce runoff, the conservation and restoration of natural areas must be considered in the site design process. By conserving or restoring the natural drainage features, natural processes are able to intercept storm water, thereby reducing the amount of runoff.

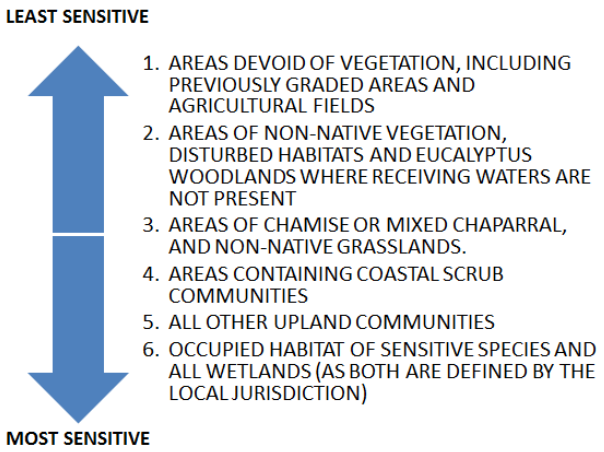


The upper soil layers of a natural area contain organic material, soil biota, vegetation, and a configuration favorable for storing and slowly conveying storm water and establishing or restoring vegetation to stabilize the site after construction. The canopy of existing native trees and shrubs also provide a water conservation benefit by intercepting rain water before it hits the ground. By minimizing disturbances in these areas, natural processes are able to intercept storm water, providing a water quality benefit. By keeping the development concentrated to the least environmentally sensitive areas of the site and set back from natural areas, storm water runoff is reduced, water quality can be improved, environmental impacts can be decreased, and many of the site's most attractive native landscape features can be retained. In some situations, site constraints, regulations, economics, and/or other factors may not allow avoidance of all sensitive areas on a project site. Project applicant shall consult the Planning Department for jurisdictional specific requirements for mitigation of removal of sensitive areas.

See CMC 21.210 regarding habitat preservation and management requirement.

Projects can incorporate BMPs SD-G (Conservative Natural Features) and SD-H (Buffers) in Fact Sheet BL-1 in Appendix C by implementing the following planning and design phase techniques as applicable and practicable:

- Identify areas most suitable for development and areas that should be left undisturbed. Additionally, reduced disturbance can be accomplished by increasing building density and increasing height, if possible.



- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Avoid areas with thick, undisturbed vegetation. Soils in these areas have a much higher capacity to store and infiltrate runoff than disturbed soils, and reestablishment of a mature vegetative community can take decades. Vegetative cover can also provide additional volume storage of rainfall by retaining water on the surfaces of leaves, branches, and trunks of trees during and after storm events.

- Preserve trees, especially native trees and shrubs, and identify locations for planting additional native or drought tolerant trees and large shrubs. Refer to Appendix E.1 for additional guidance on implementing SD-A Tree Wells as a Site Design BMP.

- In areas of disturbance, topsoil should be removed before construction and replaced after the project is completed. When handled carefully, such an approach limits the disturbance to native soils and reduces the need for additional (purchased) topsoil during later phases.

- Avoid sensitive areas, such as wetlands, biological open space areas, biological mitigation sites, streams, floodplains, or particular vegetation communities, such as coastal sage scrub and intact forest. Also, avoid areas that are habitat for sensitive plants and animals, particularly those, State or federally listed as endangered, threatened or rare. Development in these areas is often restricted by federal, state and local laws.

See Fact Sheet BL-1 (Existing Natural Site Features) in Appendix C for more information.

4.3.3 Minimize impervious area

- Construct streets, sidewalks or parking lots aisles to the minimum widths necessary, provided public safety is not compromised

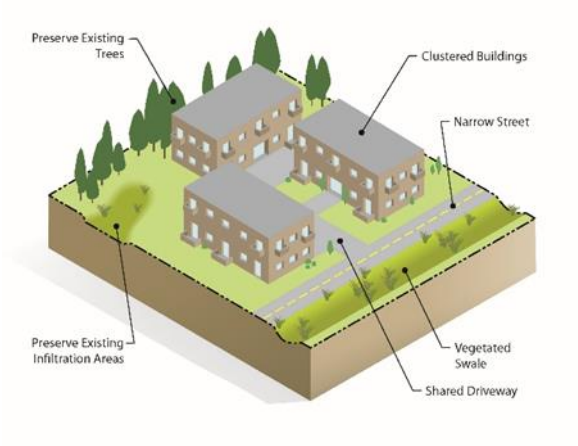
- Minimize the impervious footprint of the project

One of the principal causes of environmental impacts by development is the creation of impervious surfaces. Imperviousness links urban land development to degradation of aquatic ecosystems in two ways:

- First, the combination of paved surfaces and piped runoff efficiently collects urban pollutants

and transports them, in suspended or dissolved form, to surface waters. These pollutants may originate as airborne dust, be washed from the atmosphere during rains, or may be generated by automobiles and outdoor work activities.

- Second, increased peak flows and runoff durations typically cause erosion of stream banks and beds, transport of fine sediments, and disruption of aquatic habitat. Measures taken to control stream erosion, such as hardening banks with riprap or concrete, may permanently eliminate habitat.



Impervious cover can be minimized through identification of the smallest possible land area that can be practically impacted or disturbed during site development. Reducing impervious surfaces retains the permeability of the project site, allowing natural processes to filter and reduce sources of pollution.

Projects can incorporate 4.3.3 by implementing the following planning and design phase techniques as applicable and practicable:

- Decrease building footprint through the design of compact and taller structures when allowed by city zoning and design standards and provided public safety is not compromised.
- Construct walkways, trails, patios, overflow parking lots, alleys and other low-traffic areas with permeable surfaces. Refer to Appendix E.4 for additional guidance on implementing SD-D Permeable Pavement as a Site Design BMP.
- Construct streets, sidewalks and parking lot aisles to the minimum widths necessary, provided that public safety and alternative transportation (e.g. pedestrians, bikes) are not compromised.
- Consider the implementation of shared parking lots and driveways where possible.
- Landscaped area in the center of a cul-de-sac can reduce impervious area depending on configuration. Design of a landscaped cul-de-sac must be coordinated with fire department personnel to accommodate turning radii and other operational needs.
- Design smaller parking lots with fewer stalls, smaller stalls, more efficient lanes.
- Design indoor or underground parking.
- Minimize the use of impervious surfaces in the landscape design.

See Fact Sheets BL-2 (Outdoor Impervious Area), BL-3 (Rooftop Areas), and BL-4 (Landscaped Areas) in Appendix C for more information.

In addition, the following fact sheets provided in Appendix E describe ways to reduce impervious areas:

- SD-B – Impervious Area Dispersion;
- SD-C – Green Roofs; and

- SD-D – Permeable Pavement (Site Design).

4.3.4 Minimize soil compaction

- Minimize soil compaction in landscaped areas

The upper soil layers contain organic material, soil biota, and a configuration favorable for storing and slowly conveying storm water down gradient. By protecting native soils and vegetation in appropriate areas during the clearing and grading phase of development the site can retain some of its existing beneficial hydrologic function. Soil compaction resulting from the movement of heavy construction equipment can reduce soil infiltration rates. It is important to recognize that areas adjacent to and under building foundations, roads and manufactured slopes must be compacted with minimum soil density requirements in compliance with city building and grading ordinances.

Projects can incorporate BMP SD-G (Conserve Natural Areas) and SD-K (Sustainable Landscaping) in Fact Sheets BL-1 and BL-4, respectively, in Appendix C by implementing the following planning and design phase techniques as applicable and practicable:

- Avoid disturbance in planned green space and proposed landscaped areas where feasible. These areas that are planned for retaining their beneficial hydrological function should be protected during the grading/construction phase so that vehicles and construction equipment do not intrude and inadvertently compact the area.
- In areas planned for landscaping where compaction could not be avoided, re-till the soil surface to allow for better infiltration capacity. Soil amendments are recommended and may be necessary to increase permeability and organic content. Soil stability, density requirements, and other geotechnical considerations associated with soil compaction must be reviewed by a qualified landscape architect or licensed geotechnical, civil or other professional engineer. Refer to SD-F fact sheet in Appendix E for additional guidance on implementing amended soils within the project footprint.

See Fact Sheets BL-1 (Existing Natural Site Features) and BL-4 (Landscaped Areas) in Appendix C for more information.

4.3.5 Disperse Runoff from Impervious Areas

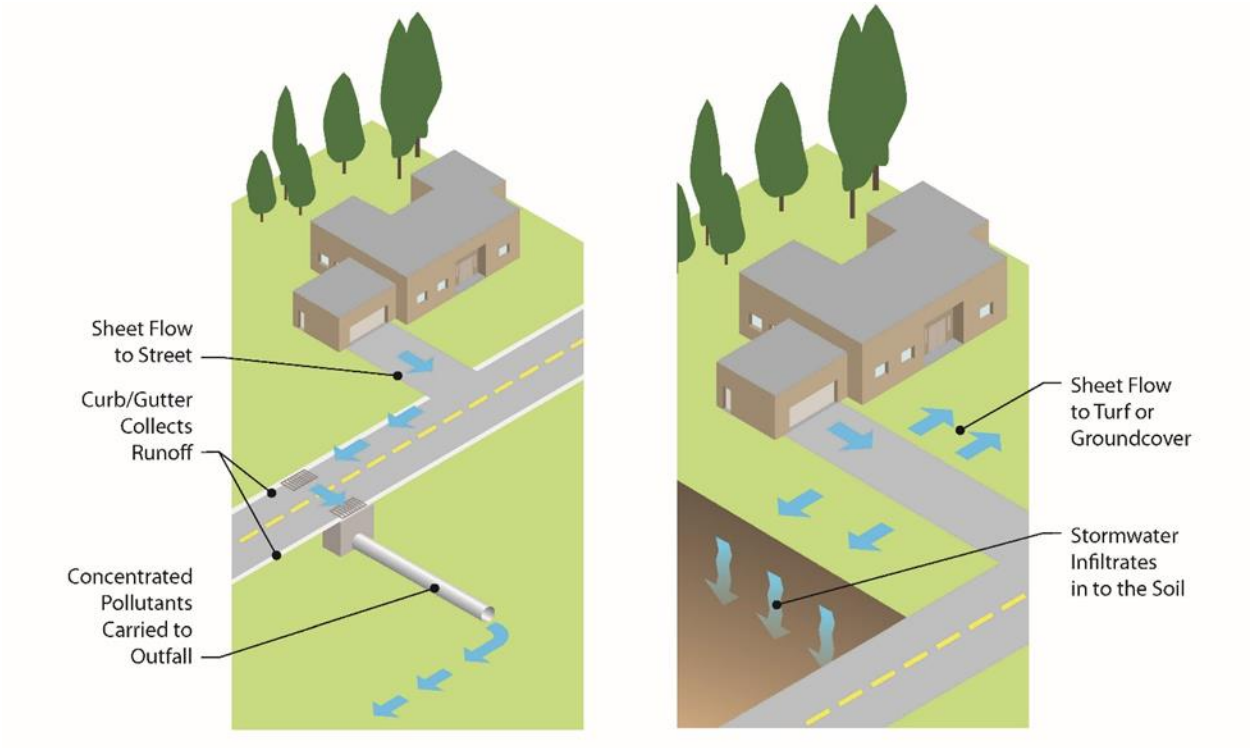
- Disconnect impervious surfaces through disturbed pervious areas
- Design and construct landscaped or other pervious areas to effectively receive and infiltrate, retain and/or treat runoff from impervious areas prior to discharging to the MS4

Disperse runoff from impervious area (dispersion) refers to the practice of essentially disconnecting impervious areas from directly draining to the storm drain system by routing runoff from impervious areas such as rooftops, walkways, and driveways onto the surface of adjacent pervious areas. The intent is to slow runoff discharges, and reduce volumes while achieving incidental treatment. Volume reduction from dispersion is dependent on the infiltration characteristics of the pervious area and the amount of impervious area draining to the pervious area. Treatment is achieved through filtration, shallow sedimentation, sorption, infiltration, evapotranspiration, biochemical processes and plant uptake.

The effects of imperviousness can be mitigated by disconnecting impervious areas from the drainage

system and by encouraging detention and retention of runoff near the point where it is generated. Detention and retention of runoff reduces peak flows and volumes and allows pollutants to settle out or adhere to soils before they can be transported downstream. Disconnection practices may be applied in almost any location, but impervious surfaces must discharge into a suitable receiving area for the practices to be effective. Information gathered during the site assessment will help determine appropriate receiving areas.

Project designs should direct runoff from impervious areas to adjacent landscaping areas that have higher potential for infiltration and surface water storage. This will limit the amount of runoff generated, and therefore the size of the mitigation BMPs downstream. The design, including consideration of slopes and soils, must reflect a reasonable expectation that runoff will soak into the soil and produce no runoff of the DCV. On hillside sites, drainage from upper areas may be collected in conventional catch basins and piped to landscaped areas that have higher potential for infiltration. Or use low retaining walls to create terraces that can accommodate BMPs.



Projects can incorporate 4.3.5 by implementing the following planning and design phase techniques as applicable and practicable:

- Implement design criteria and considerations listed in disperse runoff from impervious areas fact sheet (SD-B) presented in Appendix E.
- Drain rooftops into adjacent landscape areas.
- Drain impervious parking lots, sidewalks, walkways, trails, and patios into adjacent landscape areas.
- Reduce or eliminate curb and gutters from roadway sections, thus allowing roadway runoff to drain to adjacent pervious areas.

- Replace curbs and gutters with roadside vegetated swales and direct runoff from the paved street or parking areas to adjacent LID facilities. Such an approach for alternative design can reduce the overall capital cost of the site development while improving the storm water quantity and quality issues and the site's aesthetics.
- Plan site layout and grading to allow for runoff from impervious surfaces to be directed into distributed permeable areas such as turf, landscaped or permeable recreational areas, medians, parking islands, planter boxes, etc.
- Detain and retain runoff throughout the site. On flatter sites, landscaped areas can be interspersed among the buildings and pavement areas. On hillside sites, drainage from upper areas may be collected in conventional catch basins and conveyed to landscaped areas in lower areas of the site.
- Pervious area that receives run on from impervious surfaces should have a minimum width of 10 feet and a maximum slope of 5%.

See Fact Sheets BL-2 (Outdoor Impervious Areas), BL-3 (Rooftop Areas) and BL-4 (Landscaped Areas) in Appendix C for more information.

In addition, the following fact sheet in Appendix E describes ways to reduce the impact of runoff from impervious areas:

- SD-B- Impervious area dispersion

4.3.6 Collect runoff

- Use small collection strategies located at, or as close to as possible to the sources (i.e. the point where storm water initially meets the ground) to minimize the transport of runoff and pollutants to the MS4 and receiving waters
- Use permeable material for projects with low traffic areas and appropriate soil conditions. Refer to Appendix E.4 for additional guidance on implementing SD-D Permeable Pavement as a Site Design BMP.

Distributed control of storm water runoff from the site can be accomplished by applying small collection techniques (e.g. SD-C Green Roofs in Appendix E), or integrated management practices, on small sub-catchments or on residential lots. Small collection techniques foster opportunities to maintain the natural hydrology provide a much greater range of control practices. Integration of storm water management into landscape design and natural features of the site, reduce site development and long-term maintenance costs, and provide redundancy if one technique fails. On flatter sites, it typically works best to intersperse landscaped areas and integrate small scale retention practices among the buildings and paving.

Permeable pavements contain small voids that allow water to pass through to a gravel base. They come in a variety of forms; they may be a modular paving system (concrete pavers, grass-pave, or gravel-pave) or poured in place pavement (porous concrete, permeable asphalt). Project applicants should identify locations where permeable pavements could be substituted for impervious concrete or asphalt paving. The O&M of the site must ensure that permeable pavements will not be sealed in the future. In areas where infiltration is not appropriate, permeable paving systems can be fitted with an under drain to allow filtration, storage, and evaporation, prior to drainage into the storm drain

system.

Photograph Courtesy of Arid Solutions, Inc.

Projects can incorporate 4.3.6 by implementing the following planning and design phase techniques as applicable and practicable:

- Implementing distributed small collection techniques to collect and retain runoff
- Installing permeable pavements (see SD-D in Appendix E.4)

See Fact Sheets BL-2 (Outdoor Impervious Areas) and BL-3 (Rooftop Areas) in Appendix C for more information.

4.3.7 Landscape with native or drought tolerant species

All development projects are required to select a landscape design and plant palette that minimizes required resources (irrigation, fertilizers and pesticides) and pollutants generated from landscape areas. Native plants require less fertilizers and pesticides because they are already adapted to the rainfall patterns and soils conditions. Plants should be selected to be drought tolerant and not require watering after establishment (2 to 3 years). Watering should only be required during prolonged dry periods after plants are established. Final selection of plant material needs to be made by a landscape architect experienced with LID techniques. Microclimates vary significantly throughout the region and consulting local municipal resources will help to select plant material suitable for a specific geographic location.

See Fact Sheet BL-4 (Landscaped Areas) in Appendix C for more information. Recommended plant list is included in Appendix E (Fact Sheet PL).

4.3.8 Harvest and use precipitation

Harvest and use BMPs capture and stores storm water runoff for later use. This harvest and use technique has been successful in reducing runoff discharged to the storm drain system conserving potable water and recharging groundwater.

Rain barrels are above ground storage vessels that capture runoff from roof downspouts during rain events and detain that runoff for later reuse for irrigating landscaped areas. The temporary storage of roof runoff reduces the runoff volume from a property and may reduce the peak runoff velocity for small, frequently occurring storms. In addition, by reducing the amount of storm water runoff that flows overland into a storm water conveyance system (storm drain inlets and drain pipes), less pollutants are transported through the conveyance system into local creeks and the ocean. The reuse of the detained water for irrigation purposes leads to the conservation of potable water and the recharge of groundwater. SD-E fact sheet in Appendix E provides additional detail for designing Harvest and Use BMPs. Projects can incorporate 4.3.8 by installing rain barrels or cisterns, as applicable.

4.4 Trash Capture BMPs

4.4.1 Introduction

The California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) issued Order No. R9-2017-0077 (San Diego Water Board 2017) to owners and operators of Phase 1 municipal separate storm sewer systems (MS4s) in the City. The order requires MS4 permittees to submit reports pertaining to the control of trash in discharges to ocean waters, inland surface waters, enclosed bays and estuaries in the City.

City of Carlsbad has selected the Track 2 Implementation Plan which uses an approach that prioritizes existing controls and implementation of Full Capture Systems (FCS), multi-benefit projects, other treatment controls, and/or institutional controls within city jurisdiction based on need and analysis of ongoing programs. The City's Track 2 Implementation Plan can be found on the city's website.

4.4.2 Requirements

All areas within the project's property boundary are subject trash capture including DMAs excluded from DCV calculations as discussed in Section 5.2. If the city's right-of-way adjacent to a self-mitigating area, as demonstrated in Figure 5-3, contains sufficient BMPs for trash capture per the city's Trash Capture Program, the self-mitigating area may be excluded from trash capture requirements subject to discretion of the City Engineer. For specific design requirements and documentation, see Appendix J.

4.4.2.1 Applicable Projects

The Trash Capture MS4 permit amendments provide the framework for implementation of Priority Land Use (PLU) based compliance approaches into NPDES storm water discharge permits, waste discharge requirements, and waivers of waste discharge requirements for the City. The PLU-based approach is designed to target areas with high trash generation rates.

All development projects within a PLU is subject to the Trash Capture requirements. PLUs include land areas designated as high density residential, industrial, commercial, mixed urban, and public transportation stations. Table 4-1 categorizes the City's land use designations that are subject to the Trash Capture requirements. To determine whether the project is located in a PLU and is subject to Trash Capture BMPs, see the city's Planning division webpage for the city's Land Use Map.

Table 4-1 City of Carlsbad Trash Capture Land Use Categories

Land Use Categories	Priority Land Use Categories
R-23 (15-23 du/ac) R-30 (23-30 du/ac)	High Density Residential
PI (Planned Industrial)	Industrial
CF (Community Facilities) GC (General Commercial) L (Local Shopping Center) R (Regional Commercial) V-B (Village-Barrio) VC (Visitor Commercial) O (Office) VC/OS (Visitor Commercial/Open Space)	Commercial
PI/O (Planned Industrial/Office)	Mixed Urban
All transit stops part of development projects and major transit centers such as NCTD transit center at Shoppes of Carlsbad, and Coaster Stations at Carlsbad Village and Poinsettia. It does not include roadways or transportation corridors (TC).	Public Transportation Stations

All PDPs are required to implement Trash Capture BMPs.

4.4.2.2 Trash Capture Sizing Criteria

Development projects subject to the Trash Amendment requirements must capture all trash greater than 5 millimeters in size and at a minimum size the Trash Capture BMPs for a 1-year 1-hour storm event, or same size of the storm drain system.

4.4.3 Types of Trash Capture BMPs

For an approved list of Trash Capture devices and BMPs, see the California Water Board website for the Certified Full Capture System List of Trash Treatment Control Devices and Certified Trash Full Capture Systems List of Multi-Benefit Treatment Systems.

Visit:
https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html

Chapter

5

Storm Water Pollutant Control Requirements for PDPs

In addition to the site design and source control BMPs discussed in Chapter 4, PDPs are required to implement storm water pollutant control BMPs to reduce the quantity of pollutants in storm water discharges. Storm water pollutant control BMPs are engineered facilities that are designed to retain (i.e. intercept, store, infiltrate, evaporate and evapotranspire), biofilter or provide flow-thru treatment of storm water runoff generated on the project site.

This chapter describes the specific process for determining which category of pollutant control BMP, or combination of BMPs, is most appropriate for the PDP site and how to design the BMP to meet the storm water pollutant control performance standard (per Section 2.2).

This chapter by itself is not a complete design guide for project development. It is intended to provide guidance for selecting and designing storm water pollutant control BMPs. Specifically:

- This chapter should be followed after having conducted site planning that maximizes opportunities for storm water retention and biofiltration as discussed in Chapter 3.
- The steps in this chapter pertain specifically to storm water pollutant control BMPs. These criteria must be met regardless of whether or not hydromodification management applies, however the overall sequencing of project development may be different if hydromodification management applies. For guidance on how to integrate both hydromodification management and pollutant control BMPs (in cases where both requirements apply), see Sections 3.4.3, 5.6 and Chapter 6.

5.1 Steps for Selecting and Designing Storm Water Pollutant Control BMPs

Step 1. Determine DCV per Appendix B.1

A. Determine rainfall depth per Appendix B.1.1.

B. Delineate tributary areas per Appendix B.1.2.

C. Determine runoff factors per Appendix B.1.3.

D. Determine site design volume reductions per Appendix B.1.4

Step 2. Determine Retention Requirements Appendix B.2

A. Determine if capture and use analysis is required per Appendix B.2.1
B. Evaluate infiltration restrictions per Appendix B.2.2
C. Determine design infiltration rate per Appendix B.2.3
D. Determine retention requirements per Appendix B.2.4

Step 3. Determine BMP Performance per Appendix B.

A. Identify proposed BMP characteristics per Appendix B.3.1.
B. Calculate retention processes per Appendix B.3.2
C. Calculate biofiltration processes per Appendix B.3.3
D. Satisfaction of pollutant control requirements per Appendix B.3.4
E. Satisfaction of minimum retention requirements per Appendix B.3.5

Prepare a SWQMP documenting site planning and opportunity assessment activities, final site layout, storm water management design and O&M requirement. See Chapters 7 and Chapter 8.

Step 4. Execute Permanent Storm Water Quality BMP Maintenance Agreement (city will provide). See Chapters 7 and Chapter 8.

5.2 DMAs Excluded from DCV Calculation

This manual provides project applicants the option to exclude DMAs from DCV calculations if they meet the criteria specified below. These DMAs must implement source control and site design BMPs from Chapter 4 as applicable and feasible. These exclusions will be evaluated on a case-by-case basis and approvals of these exclusions are at the discretion of the City Engineer.

5.2.1 Self-mitigating DMAs

Self-mitigating DMAs consist of natural or landscaped areas that drain directly offsite or to the public storm drain system. Self-mitigating DMAs must meet **ALL** the following characteristics to be eligible for exclusion:

- Vegetation in the natural or landscaped area is native and/or non-native/non-invasive drought tolerant species that do not require regular application of fertilizers and pesticides.
- Soils are undisturbed native topsoil, or disturbed soils that have been amended and aerated to promote water retention characteristics equivalent to undisturbed native topsoil.
- The incidental impervious areas are less than 5 percent of the self-mitigating area.
- Impervious area within the self-mitigated area should not be hydraulically connected to other impervious areas unless it is a storm water conveyance system (such as brow ditches).
- The self-mitigating area is hydraulically separate from DMAs that contain permanent storm water pollutant control BMPs.

Figure 5.3 illustrates the concept of self-mitigating DMAs.

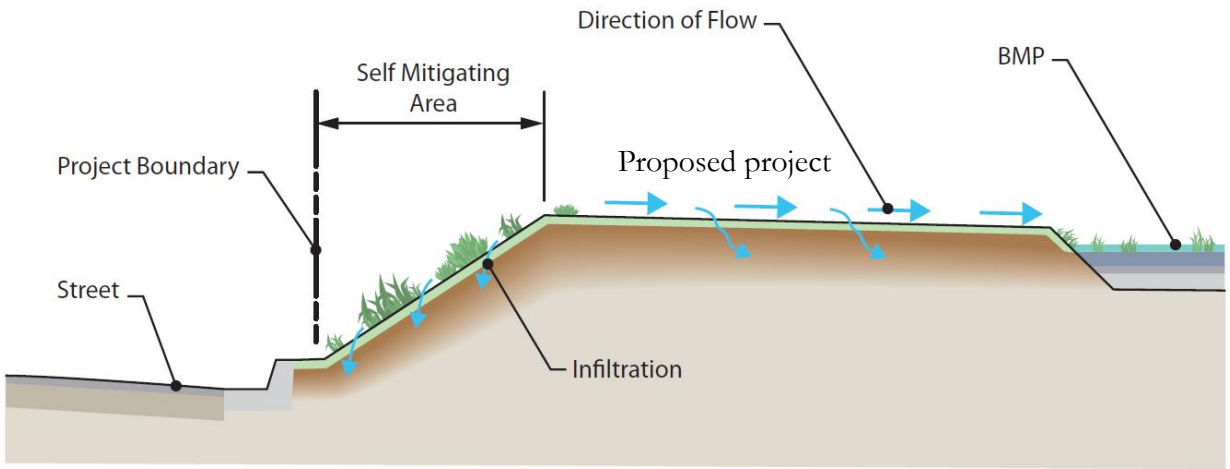


FIGURE 5-1. Self Mitigating Area

5.2.2 De Minimis DMAs

De minimis DMAs consist of areas that are very small, and therefore are not considered to be significant contributors of pollutants, and are considered by the owner and the City Engineer not practicable to drain to a BMP. It is anticipated that only a small subset of projects will qualify for de minimis DMA exclusion. Examples include driveway aprons connecting to existing streets, portions of sidewalks, retaining walls at the external boundaries of a project, and similar features. De minimis DMAs must include **ALL** of the following characteristics to be eligible for exclusion:

- Areas abut the perimeter of the development site.
- Topography and land ownership constraints make BMP construction to reasonably capture runoff technically infeasible.
- The portion of the site falling into this category is minimized through effective site design
- Each DMA should be less than 250 square feet and the sum of all de minimis DMAs should represent less than 2 percent of the total added or replaced impervious surface of the project. Except for projects where 2 percent of the total added or replaced impervious surface of the project is less than 250 square feet, a de minimis DMA of 250 square feet or less is allowed.
- Multiple de minimis DMAs cannot be adjacent to each other and hydraulically connected.
- The SWQMP must document the reason that each de minimis area could not be addressed otherwise.

5.2.3 Self-retaining DMAs via Qualifying Site Design BMPs

Self-retaining DMAs are areas that are designed with site design BMPs to retain runoff to a level determined to constitute full retention of, at a minimum, the entire DCV. Figure 5-2 illustrates the concept of self-retaining DMAs.

To satisfy pollutant control requirements only, self-retaining means retention of the entire DCV.

However, under some circumstances, a DMA may also satisfy hydromodification management requirements by implementing BMPs that retain a greater volume of runoff. BMPs used to satisfy either standard within a DMA are classified as Significant Site Design BMPs, or SSD-BMPs. Sizing requirements for SSD-BMPs both for pollutant control and hydromodification management are addressed in their respective BMP Fact Sheets as applicable.

Two types of site design BMPs may currently be used in the design of self-retaining DMAs. Basic performance criteria are summarized below.

1. Tree Wells (SD-A in Appendix E.1),

A DMA can be designed using tree wells to satisfy both pollutant control and hydromodification management performance standards.

- For pollutant control only, the DMA must retain the entire DCV.
- For hydromodification management, the DMA must retain the required retention volume (RRV), where RRV is DCV increased by a DCV multiplier provided in SD-A.

Appendix I provides additional information for design of tree wells as SSD-BMPs. 2. Impervious Area Dispersion (SD-B in Appendix E.2)

The following apply if the dispersion area is native soil (SD-B in Appendix E.2):

- For pollutant control only, the DMA is considered self-retaining if the impervious to pervious ratio is:
    - 2:1 when the pervious area is composed of Hydrologic Soil Group A
    - 1:1 when the pervious area is composed of Hydrologic Soil Group B

The following applies if the dispersion area includes amended soil (SD-B in Appendix E.2):

- DMAs using impervious area dispersion can be considered to meet both pollutant control and hydromodification flow control requirements if the impervious to pervious area ratio is 1:1 or less and all other design requirements of SD-B are satisfied, including 11 inches of amended soil.

Appendix I provides additional information for design of native soil or amended soil dispersion areas as SSD-BMPs.

Permeable pavement may also be used as dispersion area to satisfy pollutant control requirements only. The following apply if the dispersion area is permeable pavement (SD-D in Appendix E.4):

- For pollutant control only, a DMA is considered self-retaining if the ratio of total drainage area (including permeable pavement) to area of permeable pavement is 1.5:1 or less, and all other design requirements of SD-D are satisfied.
- Hydromodification management performance standards can be satisfied using permeable pavement only if constructed to Structural BMP specifications. In this case, the permeable pavement must be sized and constructed in accordance with the requirements of INF-3.

All of the criteria described above are conservatively developed to anticipate potential changes in DMA characteristics with time. Each BMP must de designed in accordance with the requirements and limitations described in its applicable BMP Fact Sheet (Appendix E). The City may accept or reject a proposed self-retaining DMA meeting these criteria at its discretion. Examples of rationales for rejection may include the potential for negative impacts (such as infiltration or vector issues), potential for significant future alteration of this feature, or inability to visually inspect and confirm the feature. A project may use more than one type of SSD-BMP across the project to satisfy requirements. However, the SSD-BMPs must be sized individually by DMA because their sizing factors cannot be combined. Each DMA's requirements must be fully satisfied by either the proposed dispersion area or the proposed tree well(s). Dispersion areas meeting the SSD-BMP criteria do not need an additional downstream BMP. Dispersion areas not meeting the SSD-BMP criteria can be used as regular site design BMPs to reduce the DCV draining to a downstream BMP such as a tree well sized as an SSD-BMP or a structural BMP. Tree wells meeting the SSD-BMP criteria do not need an additional downstream BMP. Tree wells not meeting the SSD-BMP criteria can be used as regular site design BMPs to reduce the DCV draining to a downstream structural BMP. See Appendix I for additional information about sizing dispersion areas and/or tree wells as SSD-BMPs. See Appendix B for additional information about using dispersion areas and/or tree wells to reduce DCV draining to a downstream structural BMP.

Site design BMPs used as part of a self-retaining DMA or as part of reducing DCV draining to a downstream BMP must be clearly called out on project plans and in the SWQMP.

For PDPs subject to hydromodification requirements and using structural BMPs to satisfy hydromodification flow control requirements, please note that Self-retaining DMAs not designed as SSD-BMPs must be included in the hydromodification analysis. When a project uses a combination of SSD-BMPs and structural BMPs to meet hydromodification requirements, the SSD-BMPs need not be included in the hydromodification analysis if the DMAs served by the SSD-BMPs are hydraulically separate from, not draining through, the structural BMPs.

Other site design BMPs can be considered self-retaining for meeting storm water pollutant control obligations if the long-term annual runoff volume (estimated using continuous simulation following guidelines listed in Appendix G) from the DMA is reduced to a level equivalent to pervious land and the applicant provides supporting analysis and rationale for the reduction in long term runoff volume.

Analysis of proposals for satisfying applicable hydromodification management requirements may also be considered if supported by continuous simulation analysis. Approval of other self-retaining areas is at the discretion of the City.

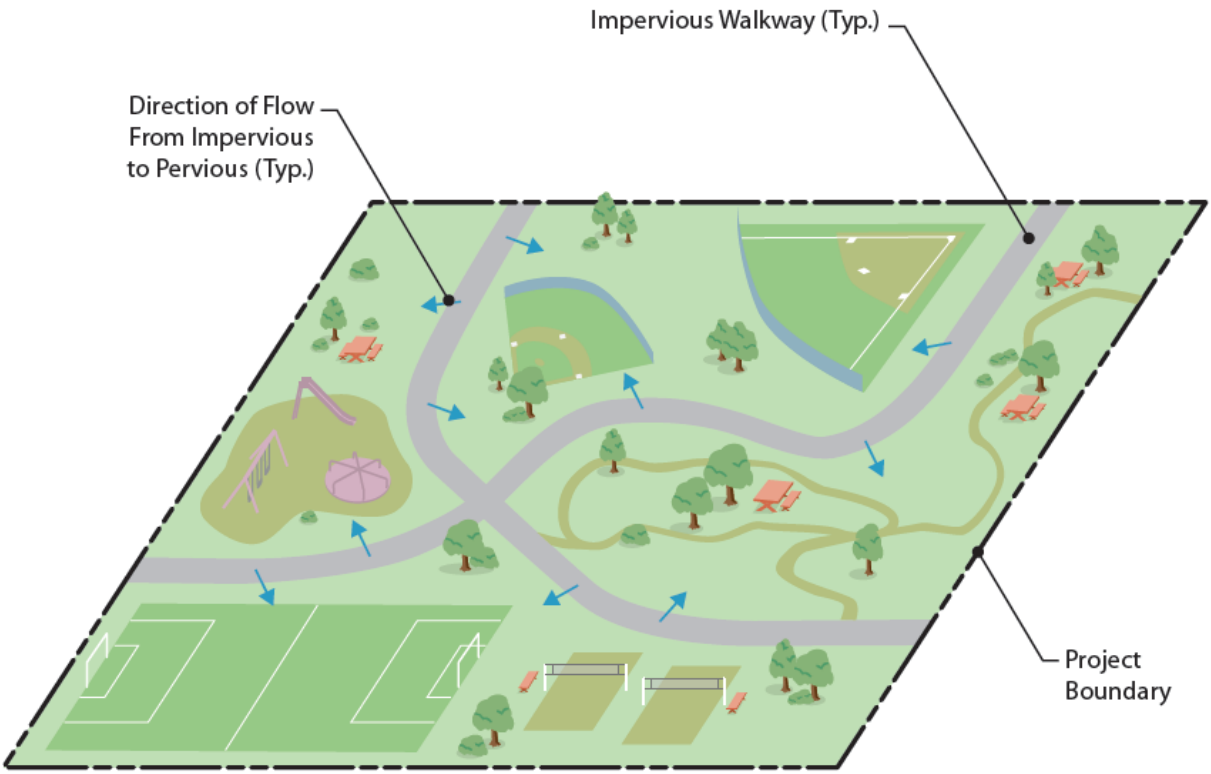


FIGURE 5-2. Self-retaining Site

5.3 Evaluating Feasibility of Storm Water Pollutant Control BMP Options

This section provides the fundamental process to establish which category, or combination of categories, of pollutant control BMP is feasible and to determine the volume of onsite retention that is feasible, either through harvest and use, or infiltration of the DCV. The feasibility screening process presented below establishes the volume of retention that can be achieved to fully or partially meet the pollutant control performance standards.

5.3.1 Feasibility Screening for Harvest and Use Category BMPs

Harvest and use is a BMP that captures and stores storm water runoff for later use. The primary question to be evaluated is:

- Is there a demand for harvested water within the project or project vicinity that can be met or partially met with rainwater harvesting in a practical manner?

Appendix B.4.2 provides guidance for determining the feasibility for using harvested storm water based on onsite demand. Step 2 from Section 5.1 describes how the feasibility results need to be considered in the pollutant control BMP selection process.

5.3.2 Feasibility Screening for Infiltration Category BMPs

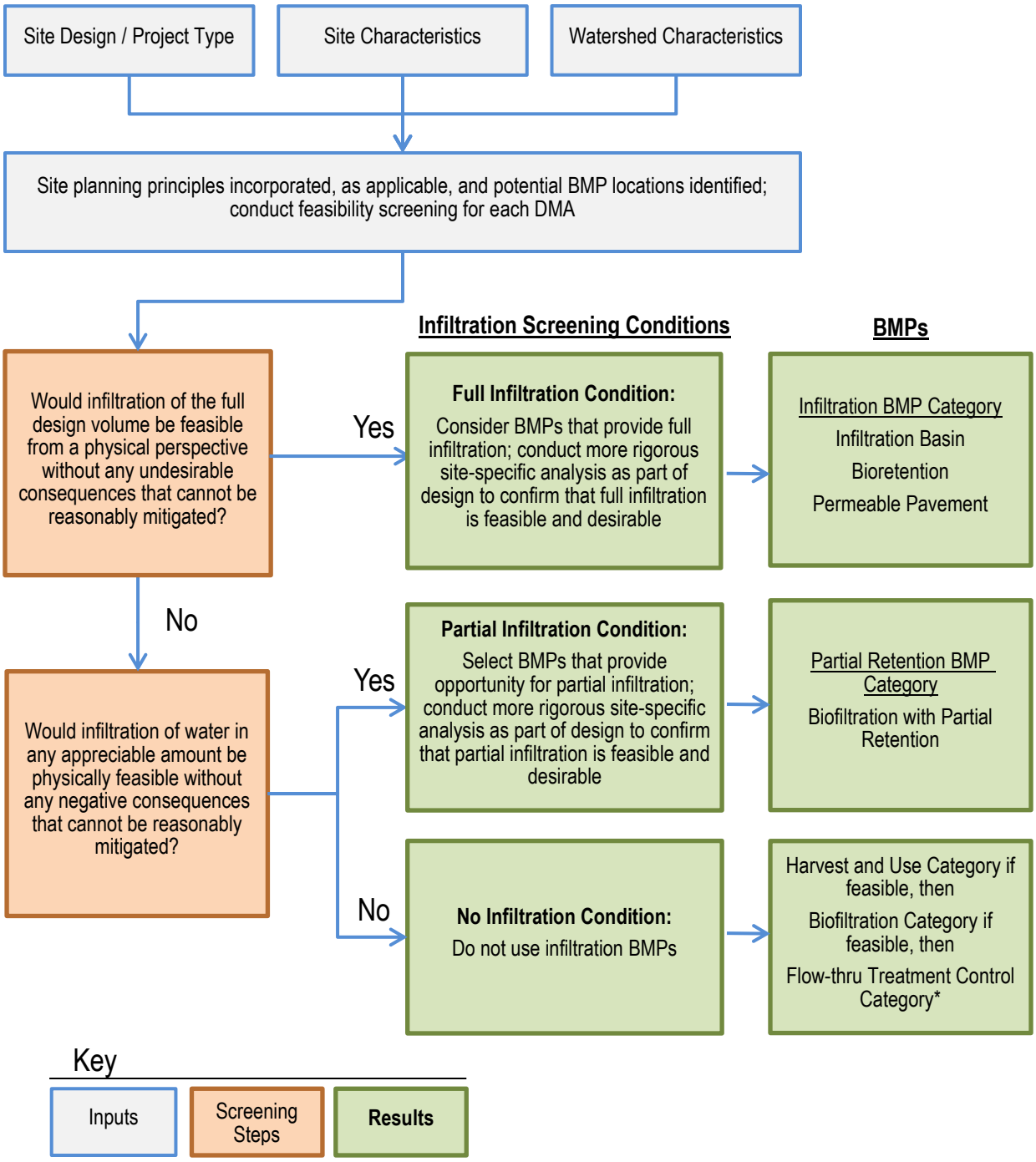
After accounting for any potential onsite use of storm water, the next step is to evaluate how much storm water can be retained onsite primarily through infiltration of the DCV. Infiltration of storm water is dependent on many important factors that must be evaluated as part of infiltration feasibility screening. The key questions to determining the degree of infiltration that can be accomplished onsite are:

- Is infiltration potentially feasible and desirable?
- If so, what quantity of infiltration is potentially feasible and desirable?

These questions must be addressed in a systematic fashion to determine if full infiltration of the DCV is potentially feasible. If when answering these questions it is determined that full infiltration is not feasible, then the portion of the DCV that could be infiltrated must be quantified, or a determination that infiltration in any appreciable quantity is infeasible or must be avoided. **This process is illustrated in Figure 5-3.** As a result of this process, conditions can be characterized as one of the three categories listed and defined below.

- **Full Infiltration Condition**: Infiltration of the full DCV is potentially feasible and desirable. More rigorous design-level analyses should be used to confirm this classification and establish specific design parameters such as infiltration rate and factor of safety. BMPs in this category may include bioretention and infiltration basins. See Section 5.4.1.2.
- **Partial Infiltration Condition**: Infiltration of a significant portion of the DCV may be possible, but site factors may indicate that infiltration of the full DCV is either infeasible or not desirable. Select BMPs that provide opportunity for partial infiltration, e.g. biofiltration with partial retention. See Section 5.4.2.
- **No Infiltration Condition**: Infiltration of any appreciable volume should be avoided. Some incidental volume losses may still be possible, but any appreciable quantity of infiltration would introduce undesirable conditions. Biofiltration BMPs should be considered. See Section 5.4.3.

All PDPs are required to document the findings of the infiltration feasibility assessment which must be supported by all associated information used in the feasibility findings. Appendix D in this manual provides additional guidance and criteria for performing and documentation of the feasibility analysis for infiltration. At the site planning phase, preliminary screening can help guide the design process by influencing project layout and selection of infiltration BMPs, and identifying whether more detailed studies are needed. At the design and final report submittal phase, planning level categorizations related to infiltration must be confirmed or revised and rigorously documented and supported based on design-level investigations and analyses, as needed. A Geological Investigation Report must be prepared for PDPs implementing onsite structural BMPs. This report should be attached to the SWQMP. Geotechnical and groundwater investigation report requirements are listed in Appendix D.



*** Flow-thru Treatment Control BMPs is not an option as a structural BMP. Carlsbad has not adopted an Alternative Compliance Program.**

FIGURE 5-3. Infiltration Feasibility and Desirability Screening Flow Chart

5.4 BMP Selection and Design

BMP selection shall be based on steps listed in Section 5.1 and the feasibility screening process described in Section 5.3. When selecting BMPs designated for placement within the City, such as easements or rights-of-way, it is important to contact the City to inquire about additional design requirements that must be met. Selected BMPs must be designed based on accepted design standards. The BMP designs described in the BMP Fact Sheets (Appendix E) shall constitute the allowable storm water pollutant control BMPs for the purpose of meeting storm water management requirements. Other BMP types and variations on these designs may be approved at the discretion of the City Engineer if documentation is provided demonstrating that the BMP is functionally equivalent or better than those described in this manual.

This section provides an introduction to each category of BMP and provides links to fact sheets that contain recommended criteria for the design and implementation of BMPs. Table 5-1 maps the BMP category to the fact sheets provided in Appendix E. Criteria specifically described in these fact sheets override guidance contained in outside referenced source documents. Where criteria are not specified, the applicant and the project review staff should use best professional judgment based on the recommendations of the referenced guidance material or other published and generally accepted sources. When an outside source is used, the preparer must document the source in the SWQMP.

TABLE 5-1. Permanent Structural BMPs for PDPs

MS4 Permit Category	Manual Category	BMPs
Retention	Harvest and Use (HU)	HU-1: Cistern
Retention	Infiltration (INF)	INF-1: Infiltration basin INF-2: Bioretention INF-3: Permeable pavement INF-4: Dry Wells
NA	Partial Retention (PR)	PR-1: Biofiltration with partial retention
Biofiltration	Biofiltration (BF)	BF-1: Biofiltration BF-2: Nutrient Sensitive Media Design BF-3: Proprietary Biofiltration
Flow-thru treatment control*	Flow-thru treatment control with Alternative Compliance (FT)	FT-1: Vegetated swales FT-2: Media filters FT-3: Sand filters FT-4: Dry extended detention basins FT-5: Proprietary flow-thru treatment control

5.4.1 Retention Category

5.4.1.1 Harvest and Use BMP Category

Harvest and use (typically referred to as rainwater harvesting) BMPs capture and store storm water runoff for later use. These BMPs are engineered to store a specified volume of water and have no design surface discharge until this volume is exceeded. Uses of captured water shall not result in runoff to storm drains or receiving waters. Potential uses of captured water may include irrigation demand, indoor non-potable demand, industrial process water demand, or other demands.

Selection: Harvest and use BMPs shall be selected after performing a feasibility analysis per Section 5.3.1. Based on findings from Section 5.4 if both harvest and use and full infiltration of the DCV is feasible onsite the project applicant has an option to implement either harvest and use BMPs and/or infiltration BMPs to meet the storm water requirements.

Design: A worksheet for sizing harvest and use BMPs is presented on Form K-7 in Appendix K and

* Flow-thru Treatment Control BMPs is not an option as a structural BMP. Carlsbad has not adopted an Alternative Compliance Program.

the fact sheet for sizing and designing the harvest and use BMP is presented in Appendix E.7 Figure 5-4 shows a schematic of a harvest and use BMP.

BMP option under this category:

- HU-1: Cistern

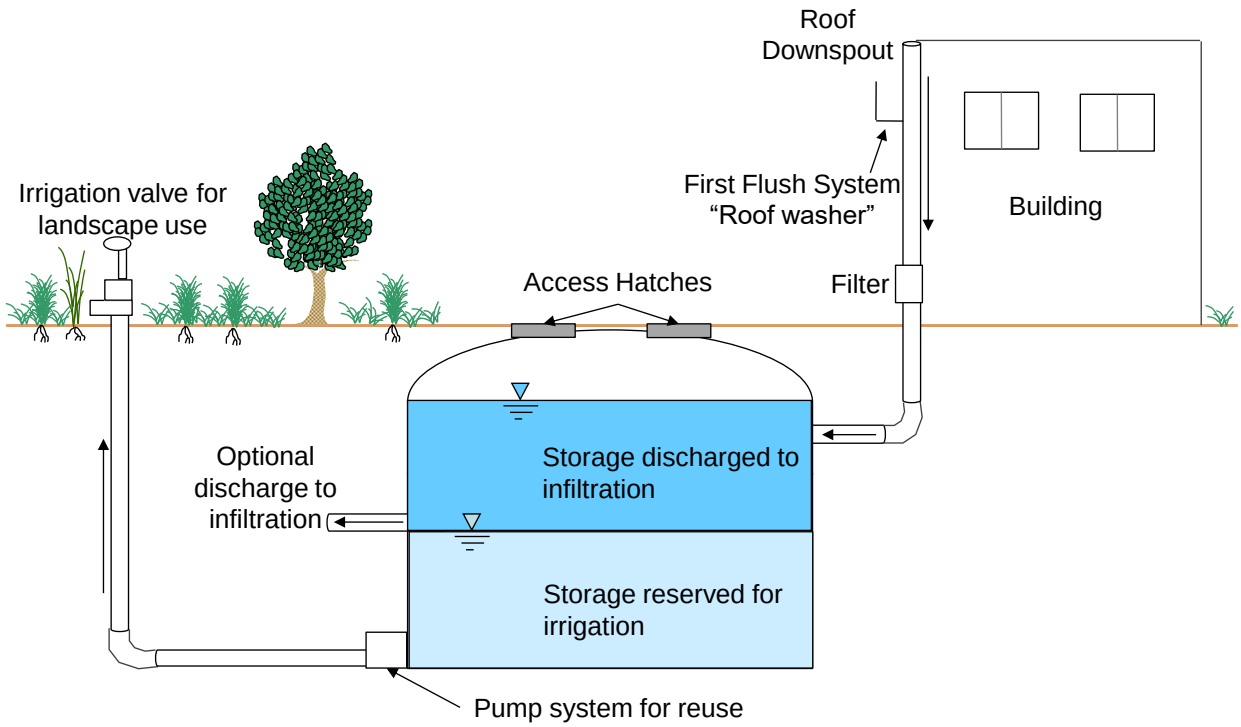


FIGURE 5-4. Schematic of a Typical Cistern

5.4.1.2 Infiltration BMP Category

Infiltration BMPs are structural measures that capture, store and infiltrate storm water runoff. These BMPs are engineered to store a specified volume of water and have no design surface discharge (underdrain or outlet structure) until this volume is exceeded. These types of BMPs may also support evapotranspiration processes, but are characterized by having their most dominant volume losses due to infiltration. Pollution prevention and source control BMPs shall be implemented at a level appropriate to protect groundwater quality for areas draining to infiltration BMPs and runoff must undergo pretreatment such as sedimentation or filtration prior to infiltration.

Selection: Selection of this BMP category shall be based on analysis according to Sections 5.1 and 5.4.2. Dry wells are considered Class V injection wells and are subject to underground injection control (UIC) regulations. Dry wells are only allowed when registered with the US EPA.

Design: Appendix B.4 has a worksheet for sizing infiltration BMPs, Appendix D and Form K-9 in Appendix K has guidance for estimating infiltration rates for use in design the BMP and Appendix E provides fact sheets to design the infiltration BMPs. Figure 5-5 shows a schematic of an infiltration basin.

BMP options under this category:

- INF-1: Infiltration basins
- INF-2: Bioretention
- INF-3: Permeable pavement.
- INF-4: Dry Wells

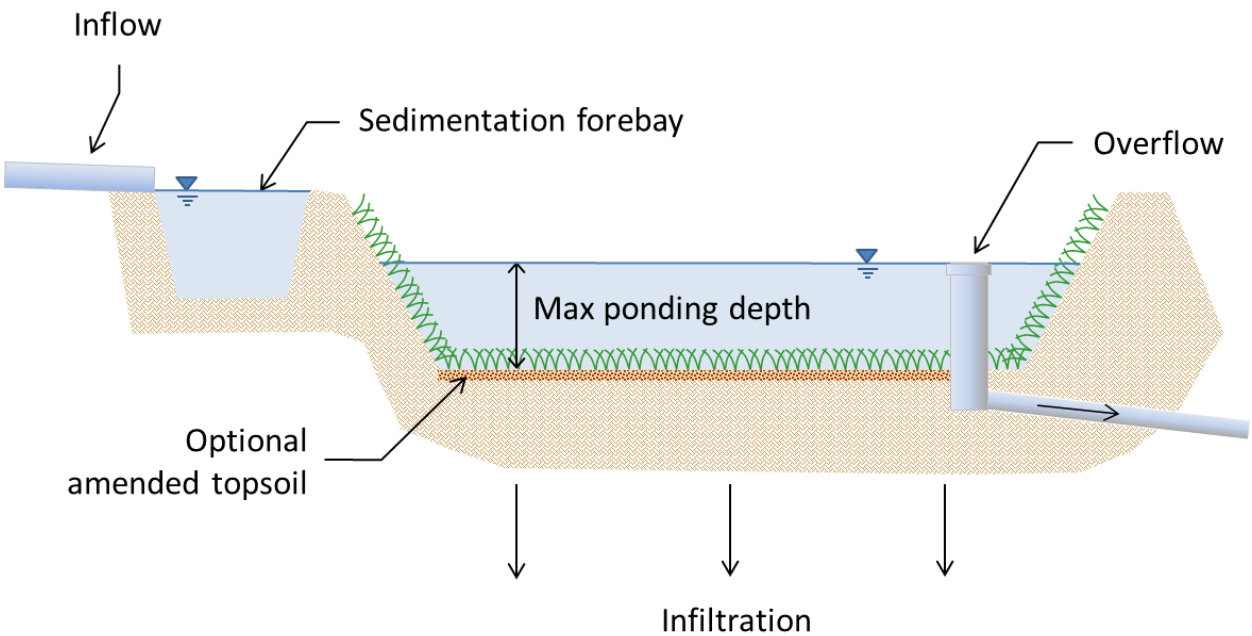


FIGURE 5-5. Schematic of a Typical Infiltration Basin

5.4.2 Partial Retention BMP Category

Partial retention category is defined by structural measures that incorporate both infiltration (in the lower treatment zone) and biofiltration (in the upper treatment zone). Example includes biofiltration with partial retention BMP.

5.4.2.1 Biofiltration with Partial Retention BMP

Biofiltration with partial retention BMPs are shallow basins filled with treatment media and drainage rock that manage storm water runoff through infiltration, evapotranspiration, and biofiltration. These BMPs are characterized by a subsurface stone infiltration storage zone in the bottom of the BMP below the elevation of the discharge from the underdrains. The discharge of biofiltered water from the underdrain occurs when the water level in the infiltration storage zone exceeds the elevation of the underdrain outlet. The storage volume can be controlled by the elevation of the underdrain outlet (shown in Figure 5-6), or other configurations. Other typical biofiltration with partial retention components include a media layer and associated filtration rates, drainage layer with associated in-situ soil infiltration rates, and vegetation.

Selection: Biofiltration with partial retention BMP shall be selected if the project site feasibility analysis performed according to Section 5.4.2 determines a partial infiltration feasibility condition.

Design: Appendix B.3 provides guidance for sizing biofiltration with partial retention BMP and

Appendix E.12 provides a fact sheet to design biofiltration with partial retention BMP.

BMP option under this category:

- PR-1: Biofiltration with partial retention

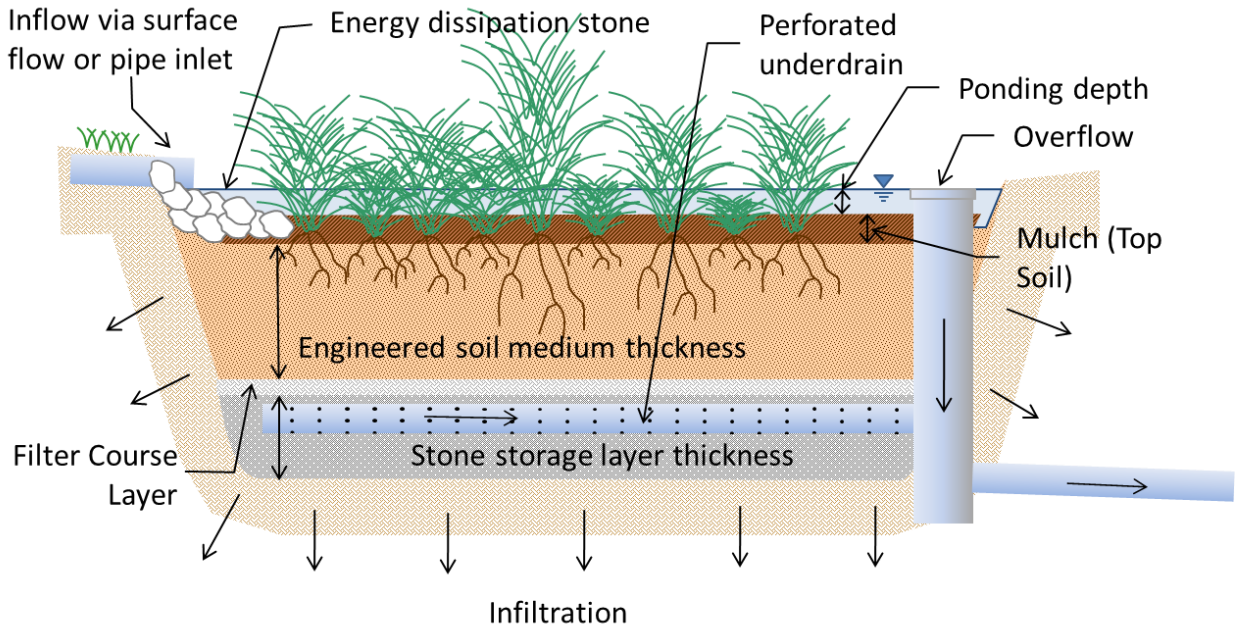


FIGURE 5-6. Schematic of a Typical Biofiltration with Partial Retention BMP

5.4.3 Biofiltration BMP Category

Biofiltration BMPs are shallow basins filled with treatment media and drainage rock that treat storm water runoff by capturing and detaining inflows prior to controlled release through minimal incidental infiltration, evapotranspiration, or discharge via underdrain or surface outlet structure. Treatment is achieved through filtration, sedimentation, sorption, biochemical processes and/or vegetative uptake. Biofiltration BMPs can be designed with or without vegetation, provided that biological treatment processes are present throughout the life of the BMP via maintenance of plants, media base flow, or other biota-supporting elements. BMP BF-1 shall include vegetation. Typical biofiltration components include a media layer with associated filtration rates, drainage layer with associated in-situ soil infiltration rates, underdrain, inflow and outflow control structures, and vegetation, with an optional impermeable liner installed on an as needed basis due to site constraints.

Selection: Biofiltration BMPs shall be selected if the project site feasibility analysis performed according to Section 5.3.2 determines a No Infiltration Feasibility Condition.

Design: Appendix B has a worksheet for sizing biofiltration BMPs and Appendix E provides fact sheets to design the biofiltration BMP. Figure 5-7 shows the schematic of a biofiltration Basin.

BMP option under this category:

- BF-1: Biofiltration

- BF-2: Nutrient Sensitive Media Design
- BF-3: Proprietary Biofiltration

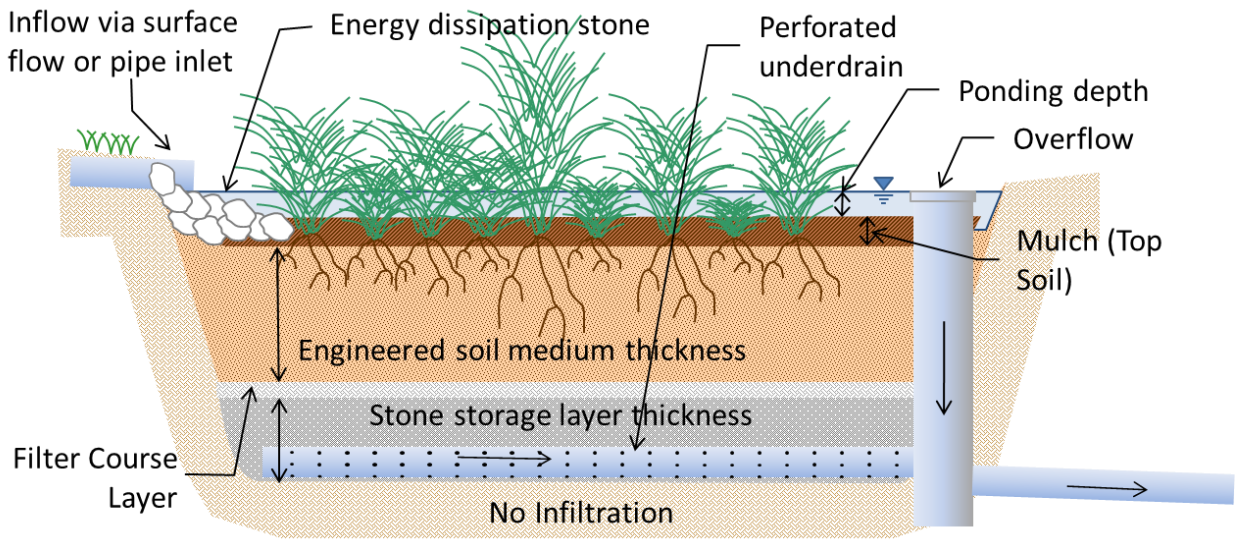


FIGURE 5-7. Schematic of a Typical Biofiltration Basin

Alternative Biofiltration Options: Other BMPs, including proprietary BMPs (See fact sheet BF-3) may be classified as biofiltration BMPs if they (1) meet the minimum design criteria listed in Appendix F, including the pollutant treatment performance standard in Appendix F.1, (2) are designed and maintained in a manner consistent with their performance certifications, if applicable, and (3) are acceptable at the discretion of the City Engineer. The applicant may be required to provide additional studies and/or required to meet additional design criteria beyond the scope of this document in order to demonstrate that these criteria are met. Additionally, proprietary biofiltration is only acceptable if infiltration is infeasible and where site-specific documentation demonstrates that the use of larger footprint biofiltration BMPs (BF-1) would be infeasible. Proprietary biofiltration BMPs are not allowed in city's right-of-way. In determining the acceptability of an alternative biofiltration BMP, the City Engineer should consider, as applicable, (a) the data submitted; (b) representativeness of the data submitted; (c) consistency of the BMP performance claims with pollutant control objectives; certainty of the BMP performance claims; and (d) other relevant factors.

5.4.4 Flow-thru Treatment Control BMPs (for use with Alternative Compliance) Category

Flow-thru treatment control BMPs are not options as structural BMPs since Carlsbad has not adopted an Alternative Compliance Program. However, Flow-thru treatment control BMPs can be used for pretreatment and/or site design BMPs.

5.5 Documenting Storm Water Pollutant Control BMP Compliance when Hydromodification Management Applies

The steps and guidance presented in Chapter 5 apply to all PDPs for demonstrating conformance to storm water pollutant control requirements regardless of whether hydromodification management applies. However, when hydromodification management applies, the approach for project design may be different. The following process can be used to document compliance with storm water pollutant control BMPs in cases when hydromodification management also applies:

1. Develop a combined BMP or treatment train (BMPs constructed in series) based on both storm water pollutant control and hydromodification management requirements. Appendix E provides specific examples of how storm water pollutant control BMPs can be configured to also address hydromodification management.
2. Dedicate a portion of the combined BMP or treatment train as the portion that is intended to comply with storm water pollutant control requirements.
3. Follow all of the steps in this chapter related to demonstrating that the dedicated portion of the BMP or treatment train meets the applicable storm water pollutant control criteria.
4. Check BMP design criteria in Appendix E and F to ensure that the hydromodification management design features (additional footprint, additional depth, modified outlet structure, lower discharge rates, etc.) do not compromise the treatment function of the BMP.
5. On project plans and in the O&M section of the SWQMP, clearly denote the portion of the BMP that serves the storm water pollutant control function.

Alternative approaches that meet both the storm water pollutant control and hydromodification management requirements may be acceptable at the discretion of the City Engineer and shall be documented in the SWQMP. Also refer to Section 6.3.6 for additional guidance.

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Chapter

6

Hydromodification Management Requirements for PDPs

The purpose of hydromodification management requirements for PDPs is to minimize the potential of storm water discharges from the MS4 from causing altered flow regimes and excessive downstream erosion in receiving waters. Hydromodification management implementation for PDPs includes two components: protection of critical coarse sediment yield areas and flow control for post-project runoff from the project site. For PDPs subject to hydromodification management requirements, this Chapter provides guidance to meet the performance standards for the two components of hydromodification management.

The civil engineer preparing the hydromodification management study for a project will find within this Chapter and Appendix G of this manual, along with watershed-specific information in the Carlsbad WMAA, all necessary information to meet the MS4 Permit standards. Should unique project circumstances require an understanding beyond what is provided in this manual, then consult the March 2011 Final HMP, which documents the historical development of the hydromodification management requirements.

Guidance for flow control of post-project runoff is based on the March 2011 Final HMP, with modifications in this manual based on updated requirements in the MS4 Permit. The March 2011 Final HMP was prepared based on the 2007 MS4 Permit, not the MS4 Permit that drives this manual. In instances where there are changes to hydromodification management criteria or procedures based on the MS4 Permit, the criteria and procedures presented in this manual supersede the March 2011 Final HMP.

Protection of critical coarse sediment yield areas is a new requirement of the MS4 Permit and is not covered in the March 2011 Final HMP. The standards and management practices for protection of critical coarse sediment yield areas are presented here in this manual.

6.1 Hydromodification Management Applicability and Exemptions

A project may be exempt from hydromodification management requirements. Refer to Section 1.6 for exemption criteria. If your project is exempt from hydromodification requirements, Chapter 6 does not apply.

Applicants electing to perform an exemption analysis to exempt a project from hydromodification management requirements shall use the methodology for hydromodification management exemption presented in Attachment E of the Regional Watershed Management Area Analysis. However, any future proposed hydromodification management exemptions would need to be approved by the RWQCB through the WQIP Annual Update process (Regional MS4 Permit Section F.1.2.c.) prior to the project being exempt from hydromodification management exemptions.

DMAs Excluded from Hydromodification Management Flow Control Requirements

When hydromodification management requirements apply to a project, protection of critical coarse sediment yield areas applies to all of the project area (all DMAs); however, certain DMAs may be excluded from the hydromodification management flow control analysis, pursuant to the criteria below.

Self-mitigating DMAs (defined in Section 5.2.1) must be evaluated on a case by case basis. Even when self-mitigating DMAs do not add impervious area, increased flow rates and durations can occur if the project's drainage layout increases the total area draining to a natural system, or if the project creates a new concentrated discharge point in natural terrain in a location where runoff is not concentrated in the pre-development condition (e.g., a new outfall located on a hillside without defined natural channels). Additionally, if the self-mitigating area is contributing runoff to a flow control point of compliance, POC, (see Section 6.3.1 for guidelines to identify POCs), then it must be included in the sizing factor analysis or project-specific continuous simulation model. This is necessary to ensure accurate accounting of area draining to the POC and calculation of total flow rates and durations at the POC. Self-mitigating DMAs may only be excluded from flow control analyses if the following conditions are met:

- The self-mitigating area does not contribute runoff to a flow control POC.
- The self-mitigating DMA does not concentrate runoff in a new location where runoff is not concentrated in the pre-development condition.
- The self-mitigating DMA does not increase the total area draining to the same discharge point compared to the pre-development condition.

De minimis DMAs meeting the restrictions defined in Section 5.2.2 may always be excluded from the flow control analysis. Subtract the de minimis area from both the pre-development and post-project footprint when conducting sizing factor calculations (Section 6.3.5.1) or project-specific continuous simulation modeling (Section 6.3.5.2).

Self-retaining DMAs via qualifying site design BMPs (defined in Section 5.2.3) must be included in the hydromodification management analysis. Reductions in DCV realized through site design BMPs are applicable to pollutant control only and do not relax hydromodification management requirements. The self-retaining area geometry may be included in a project-specific continuous

simulation model as it may provide some flow control benefit that would reduce the size of flow control structural BMP(s). Sizing factor calculations do not consider self-retaining area geometry; therefore, any flow control benefit from the self-retaining area will not be realized in the sizing factor results. The exception to this rule is for DMAs that are self-retaining through the use of impervious area dispersion when the ratio of impervious to pervious area is 1:1 or less and the DMA meets all the requirements of fact sheet SD-B: Impervious Area Dispersion (Appendix E.7). These DMAs are considered to meet both the pollutant control and hydromodification flow-duration control performance standard and shall be subtracted from both the pre-development and post-project area when performing hydromodification sizing calculations.

6.2 Protection of Critical Coarse Sediment Yield Areas

When hydromodification management requirements are applicable, the applicant must determine if the project will impact any areas that are determined to be critical coarse sediment yield areas (CCSYAs). A CCSYA is an area that has been identified as an active or potential source of coarse sediment to downstream channel reaches. The process for demonstrating that the PDP does not impact CCSYAs is illustrated in Figure 6-1 below, and supplemented with detailed methodologies presented in Appendix H of this manual.

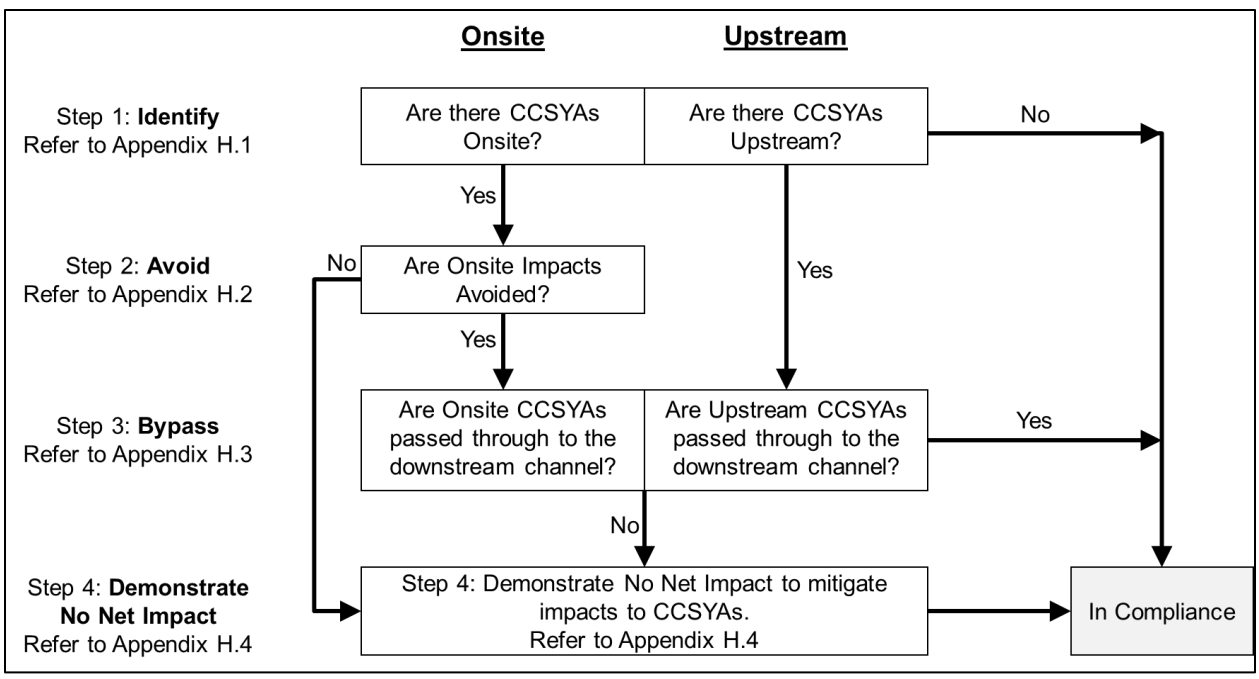


FIGURE 6-1. Pathways to meet CCSYA requirements

Description of Steps:

Step 1. Applicants must identify CCSYAs located onsite and/or upstream of the project's property boundary per the guidance presented in Appendix H.1. If no CCSYAs are identified in this step, no further consideration of critical coarse sediment supply is necessary.

Step 2. Applicants should avoid impacts to onsite CCSYAs through effective site design techniques discussed in Appendix H.2.

Step 3. Applicants should bypass bed sediment from onsite and/or upstream CCSYAs to downstream receiving waters per guidance presented in Appendix H.3.

Step 4. When impacts to CCSYAs are not avoided or bypassed through the site, the applicant must demonstrate that the project generates no net impact to the receiving water per guidance presented in Appendix H.4

6.3 Flow Control for Hydromodification Management

PDPs subject to hydromodification management requirements must provide flow control for post-project runoff to meet the flow control performance standard.

This is typically accomplished using structural BMPs that may include any combination of infiltration basins; bioretention, biofiltration with partial retention, or biofiltration basins; or detention basins. This Section will discuss design of flow control measures for hydromodification management. This Section is intended to be used following the source control and site design processes described in Chapter 4 and the storm water pollutant control design process described in Chapter 5.

The flow control performance standard is as follows:

1 For flow rates ranging from 10 percent, 30 percent or 50 percent of the pre-development 2-year runoff event ($0.1Q_2$, $0.3Q_2$, or $0.5Q_2$) to the pre-development 10-year runoff event (Q_{10}), the post-project discharge rates and durations must not exceed the pre-development rates and durations by more than 10 percent over and more than 10 percent. The specific lower flow threshold will depend on the erosion susceptibility of the receiving stream for the project site (see Section 6.3.4).

In this context, Q_2 and Q_{10} refer to flow rates determined based on either continuous simulation hydrologic modeling or the following approved regression equation:

$$Q_2 = 3.60 \times A^{0.672} \times P^{0.753}$$

$$Q_{10} = 6.56 \times A^{0.783} \times P^{1.07}$$

where:

Q_2	=	2-year recurrence interval discharge in cubic feet per second
Q_{10}	=	10-year recurrence interval discharge in cubic feet per second
A	=	Drainage area in square miles
P	=	Mean annual precipitation in inches (Refer to Table 6-1)

When determining Q_2 and Q_{10} the same methodology must be applied to determination of both flow rates (i.e. cannot mix and match methods at a POC), and be consistent across all POCs for the project (i.e. cannot mix and match methods between multiple POCs).

TABLE 6-1. Mean Annual Precipitation

Gage	Latitude	Longitude	Mean Annual Precipitation (inches)
Oceanside	33.2105556	-117.353333	12.29
Encinitas	33.044567	-117.277213	10.73

The range from a fraction of Q_2 to Q_{10} represents the range of geomorphically significant flows for hydromodification management in San Diego. The upper bound of the range of flows to control is pre-development Q_{10} for all projects. The lower bound of the range of flows to control, or "lower flow threshold" is a fraction of pre-development Q_2 that is based on the erosion susceptibility of the stream and depends on the specific natural system (stream) that a project will discharge to. Tools have been developed in the March 2011 Final HMP for assessing the erosion susceptibility of the stream (see Section 6.3.4 below for further discussion of the lower flow threshold).

When selecting the type of structural BMP to be used for flow control, consider the types of structural BMPs that will be utilized onsite for pollutant control.

Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMPs. For example, a full infiltration BMP that infiltrates the DCV for pollutant control could include additional storage volume above or below ground to provide either additional infiltration of storm water or control of outflow for hydromodification management. If possible, the structural BMPs for pollutant control should be modified to meet flow control performance standards in addition to the pollutant control performance standards. See Section 6.3.6 for further discussion of integrating structural BMPs for pollutant control and flow control.

6.3.1 Point(s) of Compliance

For PDPs subject to hydromodification management requirements, the flow control performance standard must be met for each natural or un-lined channel that will receive runoff from the project.

This may require multiple structural BMPs within the project site if the project site discharges to multiple discrete outfalls. When runoff is discharged to multiple natural or un-lined channels within a project site, each natural or un-lined channel must be considered separately and points of compliance (POCs) for flow control must be provided for each natural or un-lined channel, including situations where the channels will confluence before leaving the project boundary. When runoff from the project site does not meet a natural or un-lined channel onsite, instead traveling some distance downstream of the project in storm drain systems or lined channels prior to discharge to natural or un-lined channels, the POC(s) for flow control analysis shall be placed at the project boundary (i.e., comparing the pre-development and post-project flows from the project area only, not analyzing the total watershed draining to the offsite POC), unless the project is draining to and accommodated by an approved master planned or regional flow control BMP.

For projects with multiple POCs, care should be taken to avoid the diversion of flow from one POC to another. In addition to water balance issues, flow diversion between points of compliance increases the size of the required flow control measures because the post-project drainage area is larger than the pre-development area. Consider the effect of grading changes and conveyances on potential diversions.

For individual projects draining to approved master planned or regional flow control BMPs, the POC for flow control analysis may be offsite of the specific project application.

In these instances, the individual project draining to a master planned or regional flow control BMP shall reference the approved design documents for the BMP, and shall demonstrate that either (a) the individual project design is consistent with assumptions made for imperviousness and features of the project area when the master planned or regional BMP was designed, or (b) the master planned or regional BMP still meets performance standards when the actual proposed imperviousness and features of the project area are considered.

Guidelines for Drainage Layout for Effective Hydromodification Management

The following guidelines for drainage layout will assist PDPs in effectively managing site runoff for more efficient hydromodification flow control management. By following these guidelines, the total number and size of structural BMPs necessary for flow control can be minimized.

- Identify existing (pre-development) drainage concentration points and use the existing concentration points for storm water discharge in the proposed design.
- Avoid creating new concentrated discharge points (storm drain outfalls) on hillsides or other locations where drainage is not naturally concentrated.
- Avoid diversion. Diversion means changing the discharge location of storm water runoff from a given land area from one concentration point to another (i.e., change in POC drainage area between pre-development and post-project condition). In the context of hydromodification management, diversion is measured with respect to each natural drainage system that is subject to erosion (i.e., at each POC), rather than at a property boundary. A diversion area is created when area that originally drains to one discharge location (e.g., "POC A") is changed to discharge to a different location (e.g., "POC B") as a result of grading and land development. Note that when the proposed project design will create a diversion area, the project must provide mitigation to match the pre-development runoff from the existing (pre-development) area. This means that if the proposed project will discharge runoff from 5 acres to a location that had a pre-development drainage area of 4 acres, the proposed project must provide mitigation to match the pre-development runoff flow rates and durations from the pre-development drainage area of 4 acres. When there is a diversion area, project-specific continuous simulation modeling is required to demonstrate that the flow control performance standard is met (Section 6.3.5.2). Sizing factor calculations (Section 6.3.5.2) are not applicable when there is a diversion area.

6.3.2 Offsite Area Restrictions

Runoff from offsite undeveloped areas should be routed around structural BMPs for flow control whenever feasible.

Methods to route flows around structural BMPs include designing the site to avoid natural drainage courses, or using parallel storm drain systems. If geometric constraints prohibit the rerouting of flows from undeveloped areas around a structural BMP, a detailed description of the constraints must be submitted to the City Engineer.

Structural BMPs for flow control must be designed to avoid trapping sediment from natural

areas regardless of whether the natural areas are critical coarse sediment yield areas or not.

Reduction in coarse sediment supply contributes to downstream channel instability. Capture and removal of natural sediment from the downstream watercourse can create "hungry water" conditions and the increased potential for downstream erosion. Additionally, coarse or fine sediment from natural areas can quickly fill the available storage volume in the structural BMP and/or clog a small flow control outlet, which can cause the structural BMP to overflow during events that should have been controlled, and will require frequent maintenance. Failure to prevent clogging of the principal control orifice defeats the purpose of a flow control BMP, since basin inflows would simply overtop the control structure and flow unattenuated downstream, potentially worsening downstream erosion.

6.3.3 Requirement to Control to Pre-Development (Not Pre-Project) Condition

The MS4 Permit requires that post-project runoff must be controlled to match pre-development runoff conditions, not pre-project conditions, for the range of flow rates to be controlled.

Pre-development runoff conditions are defined in the MS4 Permit as "approximate flow rates and durations that exist or existed onsite before land development occurs."

- **Redevelopment PDPs:** Use available maps or development plans that depict the topography of the site prior to development, otherwise use existing onsite grades if historic topography is not available. Assume the infiltration characteristics of the underlying soil. Use available information pertaining to existing underlying soil type such as soil maps published by the Natural Resource Conservation Service (NRCS). Do not use runoff parameters for concrete or asphalt to estimate pre-development runoff conditions. If compacted soils condition exists, however, infiltration characteristics (refer to Appendix G, Table G.1-4 for allowable adjustments) for that runoff condition may be assumed.
- **New development PDPs:** The pre-development condition typically equates to runoff conditions immediately before project construction. However if there is existing impervious area onsite, as with redevelopment, the new development project must not use runoff parameters for concrete or asphalt to estimate pre-development runoff conditions. If compacted soils condition exists, however, infiltration characteristics (refer to Appendix G, Table G.1-4 for allowable adjustments) for that runoff condition may be assumed.

When it is necessary for runoff from offsite impervious area (not a part of the project) to co-mingle with project site runoff and be conveyed through a project's structural flow control BMP, the offsite impervious area may be modeled as impervious in both the pre- and post- condition models. A project is not required to provide flow control for storm water from offsite. This also means that for redevelopment projects not subject to the 50% rule (i.e., redevelopment projects that result in the creation or replacement of impervious surface in an amount of less than 50% of the area of impervious surface of the previously existing development), comingled runoff from undisturbed portions of the previously existing development (i.e., areas that are not a part of the project) will not require flow control. Flow control facilities for comingled offsite and onsite runoff would be designed to process the total volume of the comingled runoff through the facility, but would provide mitigation for the excess runoff (difference of developed to pre-developed condition) based on onsite impervious areas only. The project applicant must clearly explain why it was not feasible or practical to provide a bypass system for storm water from offsite. The City Engineer may request that the project applicant provide a supplemental analysis of onsite runoff only (i.e., supplemental model of the project area only).

6.3.4 Determining the Low Flow Threshold for Hydromodification Flow Control

The range of flows to control for hydromodification management depends on the erosion susceptibility of the receiving stream.

The range of flows to control is either:

- $0.1Q_2$ to Q_{10} for projects discharging to streams with high susceptibility to erosion (and this is the default range of flows to control when a stream susceptibility study has not been prepared),
- $0.3Q_2$ to Q_{10} for projects discharging to streams with medium susceptibility to erosion as determined by a stream susceptibility study approved by the City Engineer, or
- $0.5Q_2$ to Q_{10} for projects discharging to streams with low susceptibility to erosion as determined by a stream susceptibility study approved by the City Engineer.

The project applicant may opt to design to the default low flow threshold of 0.1Q2, or provide assessment of the receiving stream ("channel screening" a.k.a. "geomorphic assessment"), which may result in a higher low flow threshold of 0.3Q2 or 0.5Q2 for project hydromodification management.

Use of a higher low flow threshold of 0.3Q2 or 0.5Q2 must be supported by a channel screening report. Channel screening is based on a tool developed by the Southern California Coastal Water Research Project (SCCWRP), documented in SCCWRP's Technical Report 606 dated March 2010, "Hydromodification Screening Tools: Field Manual for Assessing Channel Susceptibility." The SCCWRP channel screening tool considers channel conditions including channel braiding, mass wasting, and proximity to the erosion threshold. SCCWRP's Technical Report 606 is included in Appendix B of the March 2011 Final HMP, and can also be accessed through SCCWRP's website. The result of applying the channel screening tool will be classification of high, medium, or low susceptibility to erosion, corresponding to low flow thresholds of 0.1Q2, 0.3Q2, and 0.5Q2, respectively, for the receiving stream. Note that the City Engineer may require that the channel screening study has been completed within a specific time frame prior to their review, and/or may apply a sunset date to their approval of a channel screening study.

The receiving stream is the location where runoff from the project is discharged to natural or un-lined channels.

The receiving stream may be onsite or offsite. The POC for channel screening is the point where runoff initially meets an un-lined or natural channel, regardless of whether the POC for flow control facility sizing is at or within the project boundary or is offsite. A project may have a different POC for channel screening versus POC for flow control facility sizing if runoff from the project site is conveyed in hardened systems from the project site to the un-lined or natural channel. The erosion susceptibility of the receiving stream must be evaluated at the POC for channel screening, and for an additional distance known as the domain of analysis, defined in SCCWRP's Technical Report 606.

6.3.5 Designing a Flow Control Facility

Flow control facilities for hydromodification management must be designed based on continuous simulation hydrologic modeling.

Continuous simulation hydrologic modeling uses an extended time series of recorded precipitation

data and evapotranspiration data as input and generates hydrologic output, such as surface runoff, groundwater recharge, and evapotranspiration, for each model time step. Using the continuous flow output, peak flow frequency and duration statistics can be generated for the pre-development and post-project conditions for the purpose of matching pre-development hydrologic conditions in the range of geomorphically significant flow rates. Peak flow frequency statistics estimate how often flow rates will exceed a given threshold. Flow duration statistics determine how often a particular flow rate is exceeded. To determine if a flow control facility meets hydromodification management performance standards, peak flow frequency and flow duration curves must be generated and compared for pre-development and post-project conditions.

Flow control facilities may be designed using either sizing factors presented in Appendix B of this manual, or using project-specific continuous simulation modeling. The sizing factors were developed based on unit-area continuous simulation models. This means the continuous simulation hydrologic modeling has already been done and the project applicant needs only to apply the sizing factors to the project's effective impervious area to size a facility that meets flow control performance standards. The sizing factor method is intended for simple studies that do not include diversion, do not include significant offsite area draining through the project from upstream, and do not include offsite area downstream of the project area. Use of the sizing factors is limited to the specific structural BMPs for which sizing factors were prepared. Project-specific continuous simulation modeling offers the most flexibility in the design, but requires the project applicant to prepare and submit a complete continuous simulation hydrologic model for review.

6.3.5.1 Sizing Factor Method

A project applicant may use sizing factors that were created to facilitate sizing of certain specific BMPs for hydromodification management.

The sizing factors included in G.2 have been updated based on the requirements in the 2013 MS4 permit and are different than the sizing factors presented in previous manuals. These updated values replace the previous sizing factors which shall no longer be used for sizing of hydromodification flow control BMPs. A discussion of the rational for the update is included in Appendix G.2.

The sizing factor method is intended for simple studies that do not include diversion, do not include significant offsite area draining through the project from upstream, and do not include offsite area downstream of the project area. Use of the sizing factors is limited to the specific structural BMPs described in Appendix G.2.

6.3.5.2 Project-Specific Continuous Simulation Modeling

A project applicant may prepare a project-specific continuous simulation model to demonstrate compliance with hydromodification management performance standards.

This option offers the most flexibility in the design. In this case, the project applicant shall prepare continuous simulation hydrologic models for pre-development and post-project conditions, and compare the pre-development and post-project (with hydromodification flow control BMPs) runoff rates and durations until compliance with the flow control performance standards is demonstrated. The project applicant will be required to quantify the long term pre-development and post-project runoff response from the site and establish runoff routing and stage-storage-discharge relationships for the planned flow control BMPs. There are several available hydrologic models that can perform continuous simulation analyses. Refer to Appendix G.1 of this manual for guidance for continuous

simulation hydrologic modeling.

6.3.6 Integrating HMP Flow Control Measures with Pollutant Control BMPs

Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMP(s) or by a series of structural BMP(s).

The design process should start with an assessment of the controlling design factor, then the typical design process for an integrated structural BMP or series of BMPs to meet two separate performance standards at once involves (1) initiating the design based on the performance standard that is expected to require the largest volume of storm water to be retained, (2) checking whether the initial design incidentally meets the second performance standard, and (3) adjusting the design as necessary until it can be demonstrated that both performance standards are met. The following are recommendations for initiating the design process:

- **Full infiltration condition:** retention for pollutant control performance standard is the controlling design factor. For a system that is based on full retention for storm water pollutant control, first design an initial retention area to meet storm water pollutant control standards for retention, then check whether the facility meets flow control performance standards. If the initial retention facility does not meet flow control performance standards: increase the volume of the facility, increasing retention if feasible or employing outflow control for runoff to be discharged from the facility; as needed to meet the flow control performance standards.
- **Partial infiltration condition:** retention for pollutant control performance standard is the controlling design factor. For a system that is based on partial retention for storm water pollutant control, first design the retention area to maximize retention as feasible. Then design an additional runoff storage area with outflow control for runoff to be discharged from the facility; as needed to meet the flow control performance standards. Then address pollutant control needs for the portion of the storm water pollutant control DCV that could not be retained onsite.
- **No infiltration condition:** flow control for hydromodification management standard is the controlling design factor. For a system that is based on biofiltration with no infiltration for storm water pollutant control, first design the facility to meet flow control performance standards, then check whether the facility meets biofiltration design standards for storm water pollutant control. If the flow control biofiltration facility does not meet performance standards for storm water pollutant control by biofiltration, increase the volume of the biofiltration facility as needed to meet pollutant control performance standards, or identify other methods to address pollutant control needs for the portion of the storm water pollutant control DCV that could not be processed with biofiltration onsite.

When an integrated structural BMP or series of BMPs is used for both storm water pollutant control and flow control for hydromodification management, separate calculations are required to demonstrate that pollutant control performance standards and hydromodification management standards are met.

When an integrated structural BMP or series of BMPs is proposed to meet the storm water pollutant control and flow control for hydromodification management obligations, the applicant shall either:

- Perform separate calculations to show that both hydromodification management and pollutant control performance standards are met independently by using guidance from Appendices B

and G. Calculations performed shall be documented in the SQWMP. **or**

- Develop an integrated design that meets the separate performance standards presented in Chapter 2 for both hydromodification management and pollutant control. In this option the BMP requirements to meet the pollutant control performance standard are optimized to account for the BMP storage provided for flow control, and vice versa. Calculations performed to develop an integrated design shall be documented in the SQWMP. Project approval when this option is selected is at the discretion of the City Engineer.

Appendix B.5.2 provides a methodology to optimize the footprint of the downstream biofiltration BMP that is required to meet the pollutant control performance standard, when there is an upstream hydromodification flow control BMP (e.g. cistern, vault, etc.)

6.3.7 Drawdown Time

The maximum recommended drawdown time for hydromodification management facilities is 96 hours based on Section 6.4.6 of the March 2011 Final HMP.

This is based on instruction from the County of San Diego Department of Environmental Health for mitigation of potential vector breeding issues and the subsequent risk to human health. This standard applies to, but is not limited to, detention basins, underground storage vaults, and the above-ground storage portion of LID facilities. When this standard cannot be met due to large stored runoff volumes with limited maximum release rates, a vector management plan may be an acceptable solution if approved by the governing municipality.

In cases where a Vector Management Plan is necessary, it shall be incorporated into the SWQMP as an attachment. A Vector Management Plan will only be accepted after the applicant has proven infeasibility of meeting the required drawdown time using any and all allowable BMPs. The information included in the plan will vary based on the nature, extent and variety of potential vector sources. It is recommended that preparers consult with the Department of Environmental Health Vector Control Program for technical guidance. Plans should include the following information at a minimum:

- Project identification information;
- A description of the project, purpose of the report, and existing environmental conditions;
- A description of the management practices that will be employed to minimize vector breeding sources and any associated employee education required to run facilities and operations;
- A discussion of long term maintenance requirements;
- A summary of mitigation measures;
- References; and
- A list of persons and organizations contacted (project proponents are expected to obtain review and concurrence of proposed management practices from Department of Environmental Health Vector control program staff prior to submission).

The property owner and applicant must include and sign the following statement: "The measures identified herein are considered part of the proposed project design and will be carried out as part of project implementation. I understand the breeding of mosquitoes in unlawful under the State of California Health and Safety Code Section 2060-2067. I will permit the Vector Surveillance and Control program to place adult mosquito monitors and to enforce this document as needed."

Refer to the sources below for additional guidance:

https://www.sandiegocounty.gov/content/dam/sdc/pds/docs/vector_report_formats.pdf

Department of Environmental Health Vector Control Program Department of Environmental Health - http://www.sandiegocounty.gov/deh/pests/vector_disease.html

It should be noted that other design factors may influence the required drawdown when hydromodification management BMPs are integrated with storm water pollutant control BMPs. Since hydromodification flow control BMPs are designed based on continuous simulation modeling, which is based on a continuous rainfall record and analyzes a continuous inflow and outflow of the BMPs, inter-event drawdown time and availability of the BMP for subsequent event inflow has been accounted for in the sizing. Therefore, drawdown recommendations for hydromodification management are based on public safety, not availability of the BMP for the next inflow event. Storm water pollutant control BMPs are designed on a single-event basis for a DCV (the 85th percentile storm event). Some of the design standards presented in Chapter 5 or Appendix B require that the pollutant control portion of the BMP drain within a specific time frame to ensure the pollutant control portion of the BMP is available for subsequent storm events. When hydromodification management BMPs are integrated with storm water pollutant control BMPs, the designer must evaluate drawdown time based on both standards.

6.4 In-Stream Rehabilitation

An alternative to onsite flow control for post-project runoff may be in-stream rehabilitation.

Carlsbad has not adopted an Alternative Compliance Program. Therefore, the project applicant may not be allowed to participate in an in-stream rehabilitation project in lieu of implementing onsite flow control BMPs. Refer to section 1.8.

Chapter

7

Long Term Operation & Maintenance

Permanent structural and trash capture BMPs require on-going inspection and maintenance into perpetuity to preserve the intended pollution control and/or flow control performance.

This Chapter addresses procedural requirements for implementation of long-term O&M and the typical maintenance requirements of structural and trash capture BMPs presented in the manual. Specific requirements for O&M Plan reports will be discussed in Chapter 8 with the Submittal Requirements.

7.1 Need for Permanent Inspection and Maintenance

7.1.1 MS4 Permit Requirements

The MS4 Permit requires that each Copermittee implement a program that requires and confirms structural and trash capture devices on all PDPs and projects subject to the Trash Amendment are designed, constructed, and maintained to remove pollutants in storm water to the MEP.

To ensure this effort, the City performs reviews at each design stage (concept, design, construction, and as-built). At concept stage (discretionary review) staff reviews site plans and/or tentative maps to evaluate applicability of storm water standards using the City's E-34 form discussed in Chapter 2. Also at discretionary review, city staff reviews preliminary SWQMPs to determine if the project satisfies applicable storm water requirements.

During final design, staff reviews construction drawings and evaluates and confirms applicability of storm water standards using the City's E-34 form. As part of staff review and plan check, design drawings are required to show locations of structural BMPs along with completing structural (treatment control) BMP tables on each sheet that builds a structural BMP. The SWQMP is also reviewed for consistency with this manual and the MS4 Permit. As with the review of any other technical document, the BMP selection and sizing is compared from the SWQMP to the construction drawings to ensure consistency. Plan check cycles continues until the construction plans and SWQMP are completed and approved.

During as-built and/or project completion but prior to occupancy, city inspection staff require the Engineer-of-Work to submit certification ensuring the structural BMP was installed per plan and SWQMP and is operational. During the pre-construction meeting and after project completion on an annual basis, the developer and project applicant are provided with a city memorandum notifying them of these requirements. As discussed earlier, the BMP tables on the plans are used by city staff to add the BMPs to the City's GIS inventory. The City maintains an inventory of all structural BMPs installed since 2002. The inventory is used track, inspect, and notify property owners of their responsibility to maintain the BMPs. Although it is not required by the MS4 Permit, source control and site design BMPs are also added to the City's GIS inventory.

Routine inspection and maintenance of BMPs will preserve the design and MS4 Permit objective to remove pollutants in storm water to the MEP. The MS4 Permit requirement specifically applies to PDP structural BMPs. However, source control BMPs and site design / LID BMPs within a PDP are components in the storm water management scheme that determine the amount of runoff to be treated by structural BMPs; and when source control, site design, or LID BMPs are not maintained, this can lead to clogging or failure of structural BMPs due to greater delivery of runoff and pollutants than intended. Therefore, the City Engineer may also require confirmation of maintenance of source control BMPs and site design / LID BMPs as part of their PDP structural BMP maintenance documentation requirements (see Section 7.4).

7.1.2 Practical Considerations

Why do permanent structural and trash capture BMPs require on-going inspection and maintenance into perpetuity?

By design, structural BMPs will trap pollutants transported by storm water. Structural BMPs are subject to deposition of solids such as sediment, trash, and other debris. Some structural BMPs are also subject to growth of vegetation, either by design (e.g. biofiltration) or incidentally. The pollutants and any overgrown vegetation must be removed on a periodic basis for the life of the BMP to maintain the capacity of the structural BMP to process storm water and capture pollutants from every storm event. Structural BMP components are also subject to clogging from trapped pollutants and growth of vegetation. Clogged BMPs can result in flooding, standing water and mosquito breeding habitat. Maintenance is critical to ensure the ongoing drainage of the facility. All components of the BMP must be maintained, including both the surface (e.g. vegetation, ground cover, mulch, energy dissipation, irrigation, etc.) and any sub-surface components (e.g. engineered soil, gravel layer, sub-drain, orifice control, storm drain, etc.).

Vegetated structural BMPs, including vegetated infiltration or partial infiltration BMPs, and above-ground detention basins, also require routine maintenance so that they do not inadvertently become wetlands, waters of the state, or sensitive species habitat under the jurisdiction of the United States Army Corps of Engineers, SDRWQCB, California Department of Fish and Wildlife, or the United States Fish and Wildlife Service. A structural BMP that is constructed in the vicinity of, or connected to, an existing jurisdictional water or wetland, without proper maintenance, could inadvertently result in creation of expanded waters or wetlands. As such, vegetated structural BMPs have the potential to come under the jurisdiction of one or more of the above-mentioned resource agencies. This could result in the need for specific resource agency permits and costly mitigation to perform maintenance of the structural BMP. Along with proper placement of a structural BMP, routine maintenance is key to preventing this scenario.

7.2 Summary of Steps to Maintenance Agreement

Ownership and maintenance responsibility for structural BMPs (including trash capture devices) should be discussed at the *beginning of project planning*, typically during discretionary review or Preliminary Review with the City.

During development and/or permitting of a PDP and projects subject to the Trash Amendment, an owner-executed Permanent Storm Water Quality BMP Maintenance Agreement is recorded against the property. There are several objectives of this agreement:

1. Notification to existing and future property owners of permanent onsite BMPs;
2. BMPs treat runoff from owner's development;
3. City and State regulations;
4. Owner's responsibility to maintain BMPs;
5. Reference to the construction plan that built the BMPs;
6. Reference technical study (SWMP/SWQMP) on file with the City summarizing location and maintenance requirements of the BMPs; and
7. City enforcement.

Provisions to finance and implement maintenance of BMPs can be a stumbling block to project approval, particularly for ***small residential subdivisions***. Subdivisions (with planned HOA) will require provisions for long-term maintenance of structural BMPs. The language outlining HOA or property owner responsibility must be included with the draft CC&Rs. The draft CC&Rs are reviewed by the City prior to approval of construction plans. Project owners must be aware of their storm water BMP maintenance responsibilities and the contents of the O&M section of the project SWQMP. Chapter 8 provides the guidelines for preparation of a site specific O&M section. Below are typical steps and schedule for establishing a plan and mechanism to ensure on-going maintenance of structural BMPs.

TABLE 7-1. Schedule for Developing O&M Section and Permanent Storm Water Quality BMP Maintenance Agreement

Item	Description	Time Frame
1	Determine structural BMP ownership, party responsible for permanent O&M, and maintenance funding	Prior to first submittal of a project application – include draft framework in preliminary SWQMP
2	Identify expected maintenance actions	First submittal of a project application – identify in SWQMP
3	Document structural BMP locations on drawings	During final design, fill in structural BMP tables on construction drawings using city template title sheets
4	Develop detailed O&M section (in SWQMP)	During final design, subject to approval by City Engineer, prior to issuance of construction, grading, building, or other applicable permits

Item	Description	Time Frame
5	For private maintenance execute Permanent Storm Water Quality Maintenance Agreement (legal agreement to be recorded against the property by the County Assessor)	Required by City Engineer, prior to the issuance of construction, grading, building, or other applicable permits
6	Project revisions trigger amendment to approved SWQMP to reflect constructed structural BMPs with as-built plans	Required by City Engineer, upon completion of construction of structural BMPs

7.3 Maintenance Responsibility

Who is responsible for the maintenance of the permanent structural and trash capture BMPs into perpetuity?

The MS4 Permit requires "the project applicant to submit proof of the mechanism under which ongoing long-term maintenance of all structural BMPs will be conducted." When structural BMPs are constructed, inspected, and found to be operating properly, they require long term maintenance to ensure continued functionality.

Whether public or private, the property owner is responsible to ensure inspection and O&M of permanent structural BMPs on their property. At times, the responsibility may be formally transferred to an agency, community facilities district, homeowners association, property owners association, or other special district. When property ownership changes (i.e. the property is sold or otherwise transferred to a new owner), maintenance responsibility also transfers to the new owner. The Permanent Storm Water Quality BMP Maintenance Agreement recorded against the property carries with the land in perpetuity. For structural BMPs that will be transferred to an agency, community facilities district, homeowners association, property owners association, or other special district, there may be an interim period during which the property owner is responsible until maintenance responsibility is formally transferred. The Permanent Storm Water Quality BMP Maintenance Agreement states that, if the property owner fails to maintain the storm water facilities, the City may enter the property, restore the storm water facilities to operable condition, and obtain reimbursement, including administrative costs, from the property owner.

7.4 Long-Term Maintenance Documentation

As part of on-going structural and trash capture BMPs maintenance into perpetuity, property owners are required to provide documentation of maintenance for the structural BMPs on their property to support the City's reporting requirements to the SDRWQCB.

The MS4 Permit requires each Copermittee to verify that structural BMPs on each PDP "are adequately maintained, and continue to operate effectively to remove pollutants in storm water to the MEP through inspections, self-certifications, surveys, or other equally effective approaches." Each Copermittee must also identify the party responsible for structural BMP maintenance for the PDP and report the dates and findings of structural BMP maintenance verifications, and corrective actions and/or resolutions when applicable, in their PDP inventory. The findings of maintenance verifications and City inspections must be reported to the SDRWQCB annually. Based on these MS4 Permit requirements, the City requires property owners to provide annual verification of maintenance reports

that include the results of inspections, maintenance activities, and updates to the contact information for the responsible party. In addition, the City performs compliance inspections to verify the accuracy of the verification of maintenance reports for the responsible parties. The results of these inspections are reported to the SDRWQCB annually.

7.5 Inspection and Maintenance Frequency

How often is a property owner required to inspect and maintain permanent structural BMPs (including trash capture BMPs) on their property?

The minimum inspection and maintenance frequency is annual and must be reported annually. However, actual maintenance requirements are site and structure specific, and maintenance may be needed more frequently than annually. The need for maintenance depends on the amount and quality of runoff delivered to the structural BMP. Maintenance must be performed whenever needed, based on maintenance indicators presented in Section 7.7 and in the SWQMP. The optimum maintenance frequency is each time the maintenance threshold for removal of materials (sediment, trash, debris or overgrown vegetation) is met. If this maintenance threshold has been exceeded by the time the structural BMP is inspected, the BMP has been operating at reduced capacity. This would mean it is necessary to inspect and maintain the structural BMP more frequently. Routine maintenance will also help avoid more costly rehabilitative maintenance to repair damages that may occur when BMPs have not been adequately maintained on a routine basis.

During the first year of normal operation of a structural BMP, inspection by the responsible party is recommended at least once between May 1 and September 30 and then monthly from October 1 through April 30. Inspection prior to and after a storm event is also recommended to help determine if the structural BMP is functioning properly. After the initial period of frequent inspections, the minimum inspection and maintenance frequency can be determined based on the results of the first year inspections. For trash capture devices, the maintenance frequency is determined by the California Water Board's approved list of Trash Capture devices and BMPs fact sheets.

7.6 Measures to Control Maintenance Costs

Because structural and trash capture BMPs must be maintained into perpetuity, it is essential to include measures to control maintenance costs.

The most effective way to reduce maintenance of structural BMPs is to prevent or reduce pollutants generated onsite and delivered to the structural BMP by implementation of source control and site design BMPs onsite, as required and described in Chapter 4 of this manual. Second, vegetated BMPs should be placed properly to reduce the potential to come under the jurisdiction of one or more resource agencies that could require permits and costly mitigation to perform maintenance of the structural BMP. Third, the structural BMP should include design features to facilitate maintenance, as listed below.

Considerations for placement of vegetated BMPs:

- Locate structural BMPs outside of floodway, floodplain, and other jurisdictional areas.
- Avoid direct connection to a natural surface water body.

- Discuss the location of the structural BMP with a wetland biologist to avoid placing a structural BMP in a location where it could become jurisdictional or be connected to a jurisdictional area. If unavoidable, identify enhanced/elevated maintenance frequencies to ensure BMP is properly maintained.

Measures to facilitate collection of the trapped pollutants:

- Design a forebay to trap gross pollutants in a contained area that is readily accessible for maintenance. A forebay may be a dedicated area at the inlet entrance to an infiltration BMP, biofiltration BMP, or detention basin, or may be a gross pollutant separator installed in the storm drain system that drains to the primary structural BMP.

Measures to access the structural and trash capture BMPs:

- The BMP must be accessible to equipment needed for maintenance. Access requirements for maintenance will vary with the type of facility selected.
- Infiltration BMPs, biofiltration BMPs and most above-ground detention basins and sand filters will typically require routine landscape maintenance using the same equipment that is used for general landscape maintenance. At times these BMPs may require excavation of clogged media (e.g. bioretention soil media, or sand for the sand filter), and should be accessible to appropriate equipment for excavation and removal/replacement of media.
- Above-ground detention basins should include access ramps for trucks to enter the basin to bring equipment and to remove materials.
- Underground BMPs such as detention vaults, media filters, or gross pollutant separators used as forebays to other BMPs, typically require access for a vactor truck to remove materials. Proprietary BMPs[*] such as media filters or gross pollutant separators may require access by a forklift or other truck for delivery and removal of media cartridges or other internal components. Access requirements must be verified with the manufacturer of proprietary BMPs and incorporated in final design.
- Vactor trucks are large, heavy, and difficult to maneuver. Structural BMPs that are maintained by vactor truck must include a level pad adjacent to the structural BMP, preferably with no vegetation or irrigation system (otherwise vegetation or irrigation system may be destroyed by the vactor truck).
- The sump area of a structural BMP should not exceed 20 feet in depth due to the loss of efficiency of a vactor truck. The water removal rate is three to four times longer when the depth is greater than 20 feet. Deep structures may require additional equipment (stronger vactor trucks, ladders, more vactor pipe segments).

Measures to facilitate inspection of the structural and trash capture BMPs

- Structural BMPs shall include inspection ports for observing/accessing all underground components that require inspection and maintenance.
- For BMPs subject to siltation or heavy trash, silt level posts or other markings shall be included in all BMP components that will trap and store sediment, trash, and/or debris, so that the

[*] Media filters, sand filters, detention vaults and proprietary BMPs in regards to flow-thru treatment control BMPs are not options as structural BMPs since Carlsbad has not adopted an Alternative Compliance Program. However, Flow-Thru Treatment Control BMPs can be used for pretreatment and/or site design BMPs.

inspector may determine how full the BMP is, and the maintenance personnel may determine where the bottom of the BMP is. If required, posts or other markings shall be indicated and described on structural BMP plans.

- Vegetation requirements including plant type, coverage, and minimum height when applicable shall be provided on the structural BMP and/or landscaping plans as appropriate or as required by the City Engineer and/or City Planner.
- Signage indicating the location and boundary of the structural BMPs such as Retention and/or Biofiltration Basin is required.

When designing a structural BMP, the engineer should review the typical structural BMP maintenance actions listed in Section 7.7 to determine the potential maintenance equipment and access needs.

When selecting permanent structural BMPs for a project, the engineer of work and project owner should consider the long term cost of maintenance and what type of maintenance contracts a future property owner, homeowners association or property owners association will need to manage. The types of materials used (e.g. proprietary vs. non-proprietary parts), equipment used (e.g. landscape equipment vs. vactor truck), actions/labor expected in the maintenance process and required qualifications of maintenance personnel (e.g. confined space entry) affect the cost of long term O&M of the structural BMPs presented in this manual.

7.7 Maintenance Indicators and Actions for Structural and Trash Capture BMPs

This Section presents typical maintenance indicators and expected maintenance actions (routine and corrective) for typical structural and trash capture BMPs.

There are many different variations of structural BMPs, and structural BMPs may include multiple components. For the purpose of maintenance, the structural BMPs have been grouped into five categories based on common maintenance requirements:

- Vegetated infiltration or filtration BMPs
- Non-vegetated infiltration BMPs
- Non-vegetated filtration BMPs*
- Detention BMPs
- Trash capture BMPs

The project civil engineer is responsible for determining which categories are applicable based on the components of the structural BMP, and identifying the applicable maintenance indicators from within the category. Maintenance indicators and actions shall be included in the project-specific O&M section of the SWQMP.
During inspection, the inspector checks the maintenance indicators. If one or more thresholds are

* Non-vegetated filtration BMPs in regards to flow-thru treatment control BMPs are not options as structural BMPs. Carlsbad has not adopted an Alternative Compliance Program.

met or exceeded, maintenance must be performed to ensure the structural BMP will function as designed during the next storm event. **Error! Reference source not found.** to

TABLE 7-56 present general maintenance actions for the four BMP categories. Additional guidance is provided in the Appendix E Fact Sheets for each specific BMP.

7.7.1 Maintenance of Vegetated Infiltration or Filtration BMPs

"Vegetated infiltration or filtration BMPs" are BMPs that include vegetation as a component of the BMP. Applicable Fact Sheets may include INF-2 (bioretention in Appendix E.9), PR-1 (biofiltration with partial retention in Appendix E.12), BF-1 (biofiltration) or FT-1 (vegetated swale in Appendix E.16)*. The vegetated BMP may or may not include amended soils, subsurface gravel layer, underdrain, and/or impermeable liner. The project civil engineer is responsible for determining which maintenance indicators and actions shown below are applicable based on the components of the structural BMP.

* Vegetated swales and flow-through planter boxes in regards to flow-thru treatment control BMPs are not options as structural BMPs. Carlsbad has not adopted an Alternative Compliance Program.

TABLE 7-2. Maintenance Indicators and Actions for Vegetated BMPs

Typical Maintenance Indicator(s) for Vegetated BMPs	Maintenance Actions
Accumulation of sediment, litter, or debris	Remove and properly dispose of accumulated materials, without damage to the vegetation.
Poor vegetation establishment	Re-seed, re-plant, or re-establish vegetation per original plans.
Overgrown vegetation	Mow or trim as appropriate, but not less than the design height of the vegetation per original plans when applicable (e.g. a vegetated swale may require a minimum vegetation height).
Erosion due to concentrated irrigation flow	Repair/re-seed/re-plant eroded areas and adjust the irrigation system.
Erosion due to concentrated storm water runoff flow	Repair/re-seed/re-plant eroded areas, and make appropriate corrective measures such as adding erosion control blankets, adding stone at flow entry points, or minor re-grading to restore proper drainage according to the original plan. If the issue is not corrected by restoring the BMP to the original plan and grade, the City Engineer shall be contacted prior to any additional repairs or reconstruction.
Standing water in vegetated swales used for pretreatment and/or site design BMPs	Make appropriate corrective measures such as adjusting irrigation system, removing obstructions of debris or invasive vegetation, loosening or replacing top soil to allow for better infiltration, or minor re-grading for proper drainage. If the issue is not corrected by restoring the BMP to the original plan and grade, the City Engineer shall be contacted prior to any additional repairs or reconstruction.
Standing water in bioretention, biofiltration with partial retention, or biofiltration areas, or flow-through planter boxes* for longer than 96 hours following a storm event**	Make appropriate corrective measures such as inspecting/unclogging orifice opening, adjusting irrigation system, removing obstructions of debris or invasive vegetation, clearing underdrains (where applicable), or repairing/replacing clogged or compacted soils.
Obstructed inlet or outlet structure	Clear obstructions.
Damage to structural components such as weirs, inlet or outlet structures	Repair or replace as applicable.
*Vegetated swales and flow-through planter boxes in regards to flow-thru treatment control BMPs are not options as structural BMPs. Carlsbad has not adopted an Alternative Compliance Program. **These BMPs typically include a surface ponding layer as part of their function which may take 96 hours to drain following a storm event.	

7.7.2 Maintenance of Non-Vegetated Infiltration BMPs

"Non-vegetated infiltration BMPs" are BMPs that store storm water runoff until it infiltrates into the ground, and do not include vegetation as a component of the BMP (refer to the "vegetated BMPs" category for infiltration BMPs that include vegetation). Non-vegetated infiltration BMPs generally

include non-vegetated infiltration trenches and infiltration basins, dry wells, underground infiltration galleries, and permeable pavement with underground infiltration gallery. Applicable Fact Sheets may include INF-1 (infiltration basin in Appendix E.8) or INF-3 (permeable pavement in Appendix E.10). The non-vegetated infiltration BMP may or may not include a pre-treatment device, and may or may not include above-ground storage of runoff. The project civil engineer is responsible for determining which maintenance indicators and actions shown below are applicable based on the components of the structural BMP.

TABLE 7-3. Maintenance Indicators and Actions for Non-Vegetated Infiltration BMPs

Typical Maintenance Indicator(s) for Non-Vegetated Infiltration BMPs	Maintenance Actions
Accumulation of sediment, litter, or debris in infiltration basin, pre-treatment device, or on permeable pavement surface	Remove and properly dispose accumulated materials.
Standing water in infiltration basin without subsurface infiltration gallery for longer than 96 hours following a storm event	Remove and replace clogged surface soils.
Standing water in subsurface infiltration gallery for longer than 96 hours following a storm event	This condition requires investigation of why infiltration is not occurring. If feasible, corrective action shall be taken to restore infiltration (e.g. flush fine sediment or remove and replace clogged soils). BMP may require retrofit if infiltration cannot be restored. If retrofit is necessary, the City Engineer shall be contacted prior to any repairs or reconstruction.
Standing water in permeable paving area	Flush fine sediment from paving and subsurface gravel. Provide routine vacuuming of permeable paving areas to prevent clogging.
Damage to permeable paving surface	Repair or replace damaged surface as appropriate.
Note: When inspection or maintenance indicates sediment is accumulating in an infiltration BMP, the DMA draining to the infiltration BMP should be examined to determine the source of the sediment, and corrective measures should be made as applicable to minimize the sediment supply.	

7.7.3 Maintenance of Non-Vegetated Filtration BMPs*

"Non-vegetated filtration BMPs" include media filters (FT-2 in Appendix E.17) and sand filters (FT-3 in Appendix E.18). These BMPs function by passing runoff through the media to remove pollutants. The project civil engineer is responsible for determining which maintenance indicators and actions shown below are applicable based on the components of the structural BMP.

* Media filters and san filters in regards to flow-thru treatment control BMPs are not options as structural BMPs. Carlsbad has not adopted an Alternative Compliance Program.

TABLE 7-4. Maintenance Indicators and Actions for Filtration BMPs

Typical Maintenance Indicator(s) for Filtration BMPs	Maintenance Actions
Accumulation of sediment, litter, or debris	Remove and properly dispose accumulated materials.
Obstructed inlet or outlet structure	Clear obstructions.
Clogged filter media	Remove and properly dispose filter media, and replace with fresh media.
Damage to components of the filtration system	Repair or replace as applicable.
Note: For proprietary media filters, refer to the manufacturer's maintenance guide.	

7.7.4 Maintenance of Detention BMPs

"Detention BMPs" includes basins, cisterns, vaults, and underground galleries that are primarily designed to store runoff for controlled release to downstream systems. For the purpose of the maintenance discussion, this category does not include an infiltration component (refer to "vegetated infiltration or filtration BMPs" or "non-vegetated infiltration BMPs" above). Applicable Fact Sheets may include HU-1 (cistern in Appendix E.7) or FT-4 (extended detention basin in Appendix E.19)*. There are many possible configurations of above ground and underground detention BMPs, including both proprietary and non-proprietary systems. The project civil engineer is responsible for determining which maintenance indicators and actions shown below are applicable based on the components of the structural BMP.

* Extended detention basin in regards to flow-thru treatment control BMPs is not an option as a structural BMP. Carlsbad has not adopted an Alternative Compliance Program.

TABLE 7-5. Maintenance Indicators and Actions for Detention BMPs

Typical Maintenance Indicator(s) for Detention Basins	Maintenance Actions
Poor vegetation establishment	Re-seed, re-establish vegetation.
Overgrown vegetation	Mow or trim as appropriate.
Erosion due to concentrated irrigation flow	Repair/re-seed/re-plant eroded areas and adjust the irrigation system.
Erosion due to concentrated storm water runoff flow	Repair/re-seed/re-plant eroded areas and make appropriate corrective measures such as adding erosion control blankets, adding stone at flow entry points, or re-grading where necessary.
Accumulation of sediment, litter, or debris	Remove and properly dispose of accumulated materials.
Standing water	Make appropriate corrective measures such as adjusting irrigation system, removing obstructions of debris or invasive vegetation, or minor re-grading for proper drainage.
Obstructed inlet or outlet structure	Clear obstructions.
Damage to structural components such as weirs, inlet or outlet structures	Repair or replace as applicable.

7.7.5 Maintenance of Trash Capture Devices

Trash capture devices include any device listed in the California Water Board's certified list of Trash Capture Devices and BMPs. The project civil engineer should refer to the manufacturer's guide for maintenance indicators and actions.

TABLE 7-6. Maintenance Indicators and Actions for Trash Captures BMPs

Typical Maintenance Indicator(s) for Trash Captures BMPs	Maintenance Actions
Accumulation of sediment, litter, or debris	Remove and properly dispose accumulated materials.
Obstructed inlet or outlet structure	Clear obstructions.
Clogged filter media	Remove and properly dispose filter media, and replace with fresh media.
Damage to components of the filtration system	Repair or replace as applicable.
Note: For trash capture BMPs, refer to the manufacturer's maintenance guide.	

Chapter

8

Submittal Requirements

It is necessary for the City Engineer to review project plans for compliance with applicable requirements of this manual and the MS4 Permit.

The review process must verify that storm water management objectives were considered in the project planning process and that opportunities to incorporate BMPs have been identified. The review process must confirm the site plan, landscape plan, and project storm water documents are congruent. Therefore, every jurisdiction in San Diego County requires a submittal documenting the storm water management design for every project that is subject to the requirements of this manual. Herein the submittal for PDPs is called a "SWQMP." A complete and thorough project submittal will facilitate and expedite the review and approval, and may result in fewer submittals by the applicant. The Sections below discuss submittal requirements. The project applicant must provide sufficient documentation to demonstrate that applicable requirements of this manual and the MS4 Permit will be met.

8.1 Submittal Requirement for Standard Projects

8.1.1 Standard Project Storm Water Checklist

For submittal requirements on Standard Projects, please refer to City's Standard Project Requirement Checklist, Form E-36 (see city website). The E-36 Form shall be completed by the applicant and submitted to the City as part of the development permit review process. Submittal Requirements for Standard Projects with Trash Capture

For Standard Projects within a Priority Land Use (PLU), the project submittal shall include a Trash Capture SWQMP.

For submittal requirements for a Trash Capture SWQMP, please refer to City's Trash Capture Template, Form E-35A (see city website). The E-35A form shall be prepared by the Engineer, reviewed and signed by the applicant and submitted to the City as part of the development permit process review.

The Trash Capture SWQMP shall document that all permanent source control and site design BMPs have been considered for the project and implemented where feasible; document the planning process and the decisions that led to the selection of trash capture BMPs; provide the calculations for design of trash capture BMPs to demonstrate that applicable performance standards are met by the trash

capture BMP design; identify O&M requirements of the selected structural BMPs; and identify the maintenance mechanism (see Sections 7.2 and 7.3) for long term O&M of trash capture BMPs. The Trash Capture SWQMP shall consist of several items including but not limited to site information, Standard Project requirements, Trash Capture BMP requirements, Trash Capture BMP sizing calculations, DMA exhibits, SSBMP showing site design, source control, and Trash Capture BMPs, and Trash Capture BMP maintenance requirements.

A Trash Capture SWQMP must be provided with the first submittal of a project application.

Storm water requirements will directly affect the layout of the project. Storm water requirements must be considered from the initial project planning or in project concept stage, and will be reviewed upon each submittal, beginning with the first submittal. The process from initial project application through approval of the project plans often includes design changes to the site layout and features. Changes may be driven by storm water management requirements or other site requirements. Each time the site layout is adjusted, whether the adjustment is directly due to storm water management requirements identified during the City Engineer's review of the storm water submittal, or is driven by other site requirements, the storm water management design must be revisited to ensure the revised project layout and features meet the requirements of this manual and the MS4 Permit. An updated Trash Capture SWQMP must be provided with each submittal of revised project plans. The updated Trash Capture SWQMP should include documentation of changes to the site layout and features, and reasons for the changes.

For Requirements on Construction Plans, see Section 8.2.2.

8.2 Submittal Requirements for PDPs

8.2.1 PDP SWQMP

For PDPs, the project submittal shall include a "PDP SWQMP."

For submittal requirements for a SWQMP, please refer to City's SWQMP Template, Form E-35 (see city website). The E-35 form shall be prepared by the Engineer, reviewed and signed by the applicant and submitted to the City as part of the development permit process review.

The SWQMP shall document that all permanent source control and site design BMPs have been considered for the project and implemented where feasible; document the planning process and the decisions that led to the selection of structural BMPs; provide the calculations for design of structural BMPs to demonstrate that applicable performance standards are met by the structural BMP design; identify O&M requirements of the selected structural BMPs; and identify the maintenance mechanism (see Sections 7.2 and 7.3) for long term O&M of structural BMPs. PDPs shall use the City's SWQMP Template provided on the city website, which will include forms and/or checklists included in Appendix I of this manual as well as checklists for documentation of pollutant control and hydromodification management structural BMP design. The SWQMP shall consist of several items including but not limited to site information, pollutants-of-concern, impaired water bodies, Standard Project requirements, Trash Capture BMP requirements, Structural BMP selection, BMP sizing calculations, DMA exhibits, Hydromodification Exhibits (if applicable), SSBMP showing site design, source control, and structural BMPs, and structural BMP maintenance requirements.

A SWQMP must be provided with the first submittal of a project application.

Storm water requirements will directly affect the layout of the project. Storm water requirements must be considered from the initial project planning or in project concept stage, and will be reviewed upon each submittal, beginning with the first submittal. The process from initial project application through approval of the project plans often includes design changes to the site layout and features. Changes may be driven by storm water management requirements or other site requirements. Each time the site layout is adjusted, whether the adjustment is directly due to storm water management requirements identified during the City Engineer's review of the storm water submittal, or is driven by other site requirements, the storm water management design must be revisited to ensure the revised project layout and features meet the requirements of this manual and the MS4 Permit. An updated SWQMP must be provided with each submittal of revised project plans. The updated SWQMP should include documentation of changes to the site layout and features, and reasons for the changes.

8.2.2 Requirements for Construction Plans

8.2.2.1 BMP Identification and Display on Construction Plans

Plans for construction of the project (grading plans, improvement plans, building plans, and landscaping plans, as applicable) must show all permanent site design, source control, trash capture BMPs, and structural BMPs, and must be congruent with the SWQMP.

For PDPs, structural BMP tables shall be included as a part of the grading and/or improvement plans. The City's standard Grading Plan Title Sheet and Improvement Plan Title Sheet are available on the city website. The following is a sample structural BMP table that is included on the title sheet of the grading and/or improvement plans.

STRUCTURAL (POST-CONSTRUCTION) BMP TABLE					
STORMWATER REQUIREMENTS THAT APPLY:			EXEMPT FROM TRASH CAPTURE?	EXEMPT FROM HYDROMODIFICATION?	
☐ STANDARD STORMWATER REQUIREMENTS ☐ PRIORITY PROJECT REQUIREMENTS			☐ YES ☐ NO	☐ YES ☐ NO	
TYPE	DESCRIPTION	OWNERSHIP	MAINTENANCE AGREEMENT	SHEET NO.	MAINTENANCE FREQUENCY

This table assist both reviewers, inspectors, contractors, and property owners to identify the type, size, and location of structural BMPs constructed as part of the project. Throughout the plans, any sheet constructing a structural BMP shall also include a BMP table summarizing the BMP type, ownership and size (square feet, cubic feet, model no., etc.). The following is an example.

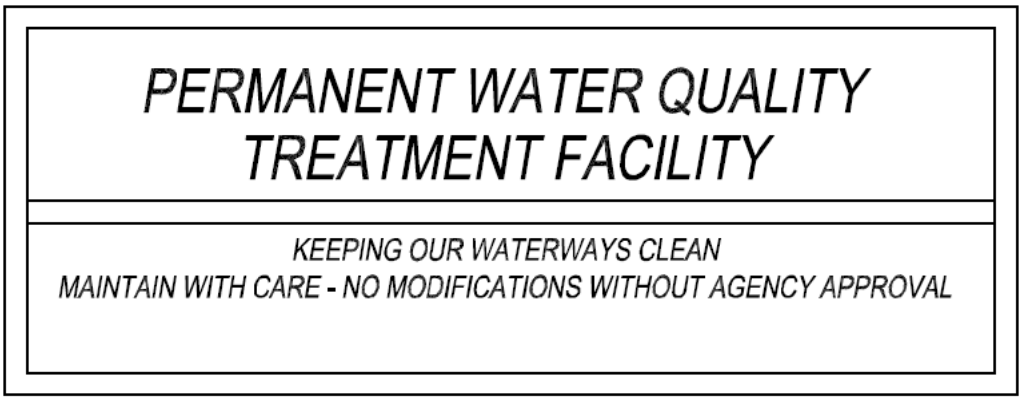
TYPE	SIZE	OWNERSHIP

As PDP projects are constructed, these BMP tables are used by the City when updating the City's structural BMP inventory in the City's GIS database. This facilitates the City's reporting requirements

as part of the MS4 permit.

As part of PDPs, the City also requires a comprehensive SSBMP exhibit to be prepared and submitted which provides a summary plan of the project and the location(s) of structural, site design, LID, trash capture, and source control BMP. The SSBMP exhibit is required attachment to the SWQMP per the SWQMP template (City Form E-35). When preparing a submittal to the City, please refer to the City's current template SSBMP exhibit available on the city's website.

All BMP signage shall be installed for each structural BMP basin (INF-1, INF-2, PR-1, and BF-1). Signage size shall be no smaller than 18" by 12" (landscape orientation), constructed of durable materials, permanently mounted and in a visible location.



8.2.2.2 Structural BMP Maintenance Information on Construction Plans

Plans for construction of the project must provide sufficient information to describe maintenance requirements (thresholds and actions) for structural BMPs. This helps identify the structural BMPs and identify the required maintenance actions based on the plans.

For the purpose of long term O&M, the project plans must identify the following:

- How to access the structural BMP to inspect and perform maintenance;
- Features that are provided to facilitate inspection (e.g. observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds);
- Manufacturer and part number for proprietary parts.

8.2.3 Design Changes during Construction and Project Closeout Procedures

8.2.3.1 Design Changes during Construction

Prior to occupancy and/or intended use of any portion of a PDP, the site must be in compliance with the requirements of this manual and the MS4 Permit.

Therefore during construction, any changes that affect the design of storm water management features must be reviewed and approved by the City Engineer. Approved documents and additional design

may be required prior to implementation of design changes during construction. This might include changes to drainage patterns that occurred based on actual site grading and construction of storm water conveyance structures, or substitutions to storm water management features. Similar to the design stage, when there are changes to the site layout and features, the storm water management design must be revisited to ensure the revised project layout and features meet the requirements of this manual and the MS4 Permit. To ensure storm water quality standards are met, any design changes affecting structural BMPs during construction are required to submit a Construction Change Submittal to the City and an amendment to the approved SWQMP must also be submitted to the City.

8.2.3.2 Certification of Constructed BMPs

As part of the "Structural BMP Approval and Verification Process" required by the MS4 Permit, each structural BMP must be inspected to verify that it has been constructed and is operating in compliance with all of its specifications, plans, permits, ordinances, and the requirements of the MS4 Permit.

Since some structural BMPs will not be visible after completion of construction (e.g. subsurface layers), the City requires inspections during construction, and/or other Engineer certification that the BMP has been constructed in conformance with the approved plans and SWQMP. The City may require forms or other documentation be submitted prior to the inspection in order to facilitate the structural BMP inspection.

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