

City of Omaha

**Post Construction Stormwater
Management Planning**

Guidance



August 2015

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is to provide guidance on the development and submittal of a Post-Construction Stormwater Management Plan (PCSMP). The City adopted ordinances requiring post construction stormwater management to comply with the requirement in their Municipal Separate Storm Sewer System (MS4) permit to establish such a program (Chapter 32, Article V). The intent of the program is to mandate the incorporation of stormwater best management practices (BMPs) in new developments and re-developments for *water quality* control of stormwater runoff.

It is important to note that a PCSMP is only one component of the City's current stormwater management program. In addition to the MS4 permit, the City must also meet the criteria set forth in their Combined Sewer Outfall (CSO) permit. Post construction stormwater management evolved as a program requirement in the MS4, but it applies throughout Omaha's corporate limits plus a 3 mile extra territorial jurisdiction (ETJ), i.e., it applies to areas covered by both the MS4 AND the CSO permit.

While this document focuses on the development and submittal of a Post Construction Stormwater Management Plan, it includes a summary of the basic stormwater management criteria that are part of the City's overall stormwater management program.

1.2 Applicability

A Post Construction Stormwater Management Plan applies to land development and significant redevelopment projects with the potential to add pollutants to stormwater or to affect the flow rate or velocity of stormwater runoff after construction is completed. New land development includes areas not previously built to urban uses (including but not limited to farmland, pasture, woodland, and green space). Significant redevelopment includes areas that are currently built to urban and suburban land uses, and are being revitalized with rehabilitation of existing structures, or demolition of existing structures and construction of new ones. Table 1 describes how the requirements are applied to different developments. In all cases where control of the first 0.5 inch of runoff cannot be achieved, the management plan should provide BMPs that maximize control and provide a calculation of amount of control that can be practicably attained.

In addition to applicable post construction stormwater management requirements, new development or re-development, projects discharging into the Municipal Separate Storm Sewer System (MS4 - generally west of 72nd Street) must maintain a "No Adverse Impact" condition. Similarly, projects discharging to the Combined Sewer system (generally those east of 72nd Street) must control runoff such that there is no net increase in runoff from pre-development conditions as they existed in October 2002 for 2-, 10- and 100- year storm events. In addition, the City of Omaha may require stormwater detention in areas where there is not adequate downstream sewer capacity. The applicant should meet with the City of Omaha Public Works Department to verify these requirements for each individual development.

Two summary sheets are provided in the following pages for your information: the "Stormwater Management Guidance Summary" and "Table 1: Post-Construction Stormwater Management Plan (PCSMP) Applicability".

Stormwater Management Guidance Summary

Stormwater Management Requirements in CSO Permit area (refer to attached figure ES-2)

- PCSMP (control first ½” of runoff)
 - Reference: Chapter 32, Article V of the Omaha Municipal Code.
 - Refer to Table 1 for specific requirements
 - The PCSMP requirement exists in the CSO areas because once the sewers are separated; the area will then fall under the MS4 permit.
- Maintain pre-project conditions (as they existed in 2002) for 2-, 10- and 100-yr events.
 - This is a result of the requirement in the CSO Permit. One of the 9 minimum controls is “no increase in the magnitude, duration, or frequency of overflows”. By maintaining pre-project runoff conditions, this provides engineers and the City a quantifiable means to ensure this requirement is met.

Stormwater Management Requirements MS4 Permit area (areas outside CSO service area)

- PCSMP (control first ½” of runoff and maintain pre-project 2-yr runoff conditions.)
 - The PCSMP program is a result of the requirement in the City’s MS4 permit to establish a Post Construction Stormwater Management Program.
 - Reference: Chapter 32, Article V of the Omaha Municipal Code.
 - Refer to Table 1 for specific requirements.
- Maintain “No Adverse Impact” condition
 - This policy is outlined in the Land Use element in the City of Omaha Master Plan. <http://www.cityofomaha.org/planning/comprehensive-plan> (Land Use Element, p 10 and 63). The policy is based on the NRD’s recommended practice for the Papillion Creek Watershed.
 - The No Adverse Impact approach “assures that the action of one property owner or a community does not adversely impact the properties and rights of other property owners, as measured by increased flood peaks, flood stage, flood velocity, erosion, sedimentation and costs now and costs in the future.”
 - Reference: Chapter 32, Article VII of the Omaha Municipal Code.

FIGURE ES-2
CSO Outfalls as of 2009

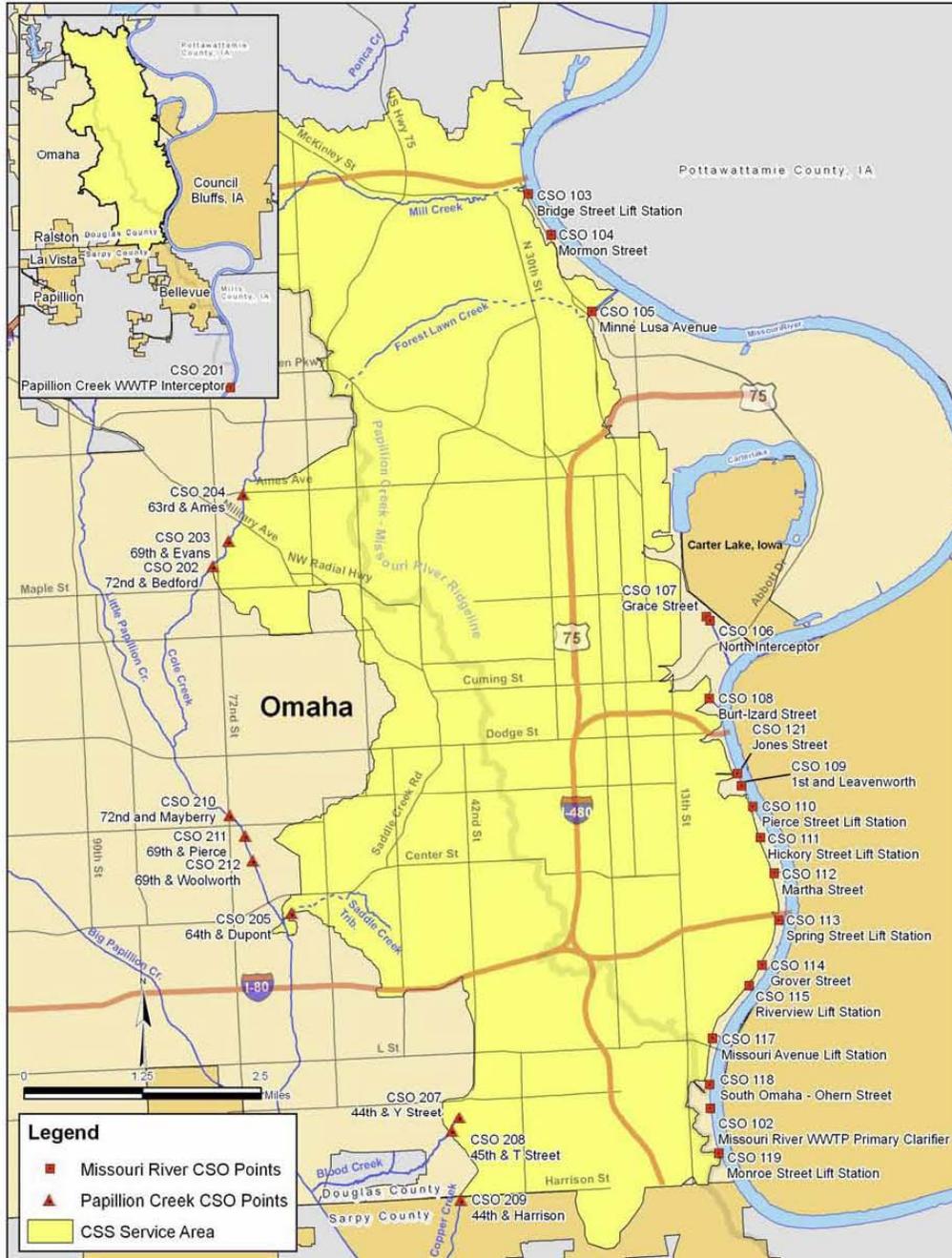


Table 1: Post-Construction Stormwater Management Plan (PCSMP) Applicability

Development	Requirement
<p>(1) For all developments with a preliminary plat approved by City Council on or after July 1, 2008</p> <p>(2) For any replat in a preliminarily platted subdivision approved by City Council before July 1, 2008 that significantly increases the amount of impervious area (if required by the Planning Director)</p>	<p>PCSMP that includes BMPs.</p> <p>Provide water quality control of the first ½” of runoff from the site.</p> <p>Maintain pre-project 2-yr runoff.</p> <p>No Adverse Impact Downstream</p>
<p>(1) For all developments with a Preliminary Plat approved by City Council before July 1, 2008</p> <p>(2) For all development or significant redevelopment that disturbs 1 acre or more and does not require preliminary platting</p>	<p>PCSMP that includes BMPs.</p> <p>Where reasonably practical, provide water quality control of the first ½” of runoff from the site.</p> <p>Maintain pre-project 2-yr runoff.</p> <p>No Adverse Impact Downstream</p>
<p>Significant redevelopment that adds or replaces less than 1 acre but more than 5,000 SF of surface area ^{1,2,3}</p> <p>Includes:</p> <ul style="list-style-type: none"> (1) The expansion of a building footprint (2) Addition or replacement of a structure (3) Replacement of impervious surface that is not part of a routine maintenance activity (4) Land disturbing activities related to structural or impervious surface 	<p>PCSMP that includes BMPs.</p> <p>Maintain pre-project 2-yr runoff.</p> <p>No Adverse Impact Downstream</p>
<p>Significant redevelopment involving an outlot parcel that is part of existing development</p>	<p>PCSMP with BMP’s.</p> <p>Water quality control of the first ½” of runoff for <i>impervious area</i>.</p> <p>Maintain pre-project 2-yr runoff conditions.</p> <p>No Adverse Impact Downstream</p>

¹Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of facility or emergency redevelopment activity required to protect public health and safety.

²Control of the first ½” of runoff in these cases is not required, however, the applicant must demonstrate that best management practices are included.

³Projects that disturb more that 5000 sq ft, but result in less impervious area are addressed on a case by case basis as far as whether a PCSMP is required

2.0 POST-CONSTRUCTION STORMWATER MANAGEMENT PLAN SUBMITTAL REQUIREMENTS

Approval of a PCSMP will require the submittal of a Conceptual Post-Construction Stormwater Management Plan and/or Final Post-Construction Stormwater Management Plan depending on the type of development proposed. This criterion is defined in the following paragraphs along with more detailed information on the elements that make up a Post-Construction Stormwater Management Plan submittal.

Post-Construction Stormwater Management Plans shall be prepared by or under the supervision of a licensed professional civil engineer registered in the State of Nebraska or other professional approved by the City of Omaha Public Works Department. The responsible professional shall be listed as the Designer on the Application and will be required to provide a seal on PCSMP sheets and calculations.

2.0.1 Project Numbers

As of November 16, 2010, project numbers are generated automatically through the Papio Watershed Partnership's Permix site. If logging in for the first time, applicants will first need to set up an account and password.

<http://www.omahapermix.com/>



The image shows a screenshot of the City of Omaha Permix Portal. At the top, there is a banner with the text "CITY OF Omaha" and a logo for "permix OMAHA". Below the banner, the main content area is white with a light blue border. It features a welcome message: "Welcome to the City of Omaha Permix Portal. Omaha Permix improves the process of applying for project permits. Login to Omaha Permix or create a new account." Below this is a green notification box: "August 18: All enhancements and upgrades are complete and Permix is up and running." The main login area has a pink header: "Please enter your user name and password." To the right of this header is a button labeled "Public Access to Grading Permits". Below the header are two input fields: "Username:" and "Password:". Below the input fields are three buttons: "Log In", "Create Account" (with a link "New to Permix?..." above it), and "Forgot Password" (with a link "Forgot your password? Click this button..." above it). At the bottom of the page, there is a copyright notice: "© 2015 City of Omaha. All Rights Reserved."

After setting up an account, the PCSMP process basically involves 3 steps:

1. Submission and approval of your application. (A number will be generated at this time).
2. Submission and approval of your supporting documentation. This results in "Conditional Approval" which will allow construction to move forward.
3. Submission and approval of the BMP certification and As-Built drawings. This will generate "Final Approval" and a complete PCSMP

The OMA number assigned for the PCSMP submittal is required on plan sheets. If the applicant is submitting the PCSMP with a Preliminary Plat Application, the OMA Project No. will need to be obtained before submitting the Preliminary Plat Application.

2.0.2 Conceptual PCSMP

A Conceptual PCSMP will be required with the submittal of a Preliminary Plat Application.

The Conceptual Post-Construction Stormwater Management Plan shall include the following elements:

- a. Conceptual Post-Construction Stormwater Management Plan Application
- b. Conceptual Post-Construction Stormwater Management Plan Sheets
- c. Preliminary BMP Calculations
- d. Preliminary Drainage Study

2.0.3 Final PCSMP

A Final PCSMP will be required with the submittal of (1) storm sewer construction plans for subdivisions that have an approved preliminary plat, (2) a Grading Permit Application for projects that do not require a preliminary plat and disturb 1 acre or more of the site or (3) submittal of a Building Permit Application for projects that add or replace less than 1 acre but more than 5,000 SF of impervious surface area.

A building permit may be issued while the final PCSMP is prepared. This is handled with a letter submitted to the City requesting a Hold on the Certificate of Occupancy (CO) until such time as the final PCSMP is approved. An example of a CO Hold letter is provided in Appendix B.

The Final Post-Construction Stormwater Management Plan shall include the following elements:

- a. Final Post-Construction Stormwater Management Plan Application
- b. Final Post-Construction Stormwater Management Plan Sheets
- c. Final BMP Calculations
- d. Drainage Study
- e. BMP Maintenance Requirements
- f. Maintenance Agreement (Maintenance Agreement will be required before Final Plat or Certificate of Occupancy is approved)

2.0.4 BMP Certification

Upon construction completion, all stormwater BMPs that are part of the Final Post-Construction Stormwater Management Plan shall be certified by a licensed professional civil engineer registered in the State of Nebraska or other professional approved by the City of Omaha Public Works Department, the Designer.

For BMP Certification, the Designer shall submit the following elements to the City of Omaha Public Works Department (Attn: Joan Green)

- a. Record Drawings of the Final Post-Construction Stormwater Management Plan Sheets
- b. BMP Certification Document

The BMP Certification document can be found at www.omahastormwater.org. This document also provides space for indicating the inspector and inspection report holder as part of the annual monitoring requirements for the BMPs.

2.1 Post-Construction Stormwater Management Plan Application

The PCSMP application provides the reviewer with critical information about the new development that demonstrates responsibility for the site and an understanding of site conditions that will affect post construction stormwater management. Instructions are provided on the Application (Conceptual and/or Final depending on the project). Clear and concise presentation of this information will result in quicker review and fewer questions. Important information in the application will include:

- Project Information
 - Name & Location
 - Project Description
 - Site Data
- Submittal Instructions
- Supplementary Information
 - Required Submittals
 - Project Specific Submittals
 - Submittal Instructions
- Site Conditions
 - Floodplain
 - Name of Receiving Waters
 - TMDLs & Impaired Waters
 - Construction Activities
 - Public BMPs
 - Private BMPs
 - Additional Comments
- City of Omaha Agreement Information
- General Requirements
- Plan Review
- Applicants Certification

2.2 Conceptual Post-Construction Stormwater Management Plan Sheets

At a minimum, the Conceptual PCSMP plan set must include:

1. A Site Resources Plan of the development site at scale showing existing natural and aquatic resources as noted above along with a description of area or length including, but not limited to:
 - Existing topography (2' minimum contour interval)
 - Wetlands
 - Open waterways with 50 acres of drainage or a defined bed and bank
 - Ponds or lakes
 - Green space corridors

- General types of vegetation on site, excluding crops (e.g. tree canopy, turf grass, native grasses or other buffer, wetlands, etc)
 - Floodplain and floodway
 - Steep slopes (greater than 17%)
 - Utility lines, easements, water supply wells, and sewage treatment systems
2. A Preliminary Drainage and Stormwater BMP Plan of the development site at scale showing:
- Existing topography (2' minimum contour interval)
 - Proposed topography (5' minimum contour interval)
 - Proposed drainage basins for each stormwater BMP labeled with an identifier, runoff coefficient and drainage basin area (acres)
 - Proposed land uses/zoning in each drainage basin
 - Location of proposed stormwater conveyance systems such as storm sewer, storm drains, grass channels, vegetated swales, and flow paths
 - Proposed areas of fill placement and limits of construction
 - Proposed BMPs with an identifier that matches their drainage basin
 - Proposed utility lines, easements, water supply wells, and sewage treatment systems

Depending on the size and complexity of the project, the designer may elect to combine the components of the various plans so long as all of the components are represented and clearly identified.

2.3 Final Post-Construction Stormwater Management Plan Sheets

At a minimum, the Final PCSMP plan set must include:

1. A Site Resources Plan of the development site at scale showing existing natural and aquatic resources including, but not limited to:
 - a. Existing topography (2' minimum contour interval)
 - b. Wetlands
 - c. Open waterways with 50 acres of drainage or a defined bed and bank
 - d. Ponds or lakes
 - e. Green space corridors
 - f. General types of vegetation on site, excluding crops (e.g. tree canopy, turf grass, native grasses or other buffer, wetlands, etc)
 - g. Floodplain and Floodway
 - h. Steep slopes (greater than 17%)
 - i. Utility lines, easements, water supply wells, and sewage treatment systems
2. A Final Drainage and Stormwater BMP Plan of the development site at scale showing
 - a. Existing topography (2' minimum contour intervals)
 - b. Proposed topography (2' minimum contour intervals)
 - c. Proposed drainage basins labeled with an identifier, runoff coefficient and drainage basin area (acres)
 - d. Proposed land uses/zoning in each drainage basin
 - e. Location of proposed stormwater conveyance systems such as storm sewer, storm drains, grass channels, vegetated swales, and flow paths
 - f. Proposed areas of fill placement and limits of construction
 - g. Proposed BMPs with an identifier that matches their drainage basin
 - h. Proposed utility lines, easements, water supply wells, and sewage treatment systems

3. Final Construction Plans
 - a. Vicinity map
 - b. Existing utilities and infrastructure
 - c. Proposed stormwater BMPs including structural components
 - d. Proposed storm sewer and stormwater conveyance systems
 - e. Other proposed infrastructure as it relates to the construction of the stormwater BMPs
 - f. Construction notes
 - g. Design water surface elevations
 - h. Structural details of outlet structures, embankments, spillways, stilling basins, grade control structures, conveyance channels, etc.
 - i. Plan and profile sheets (if applicable)
 - j. Reference to the project geotechnical report

Depending on the size and complexity of the project, the designer may elect to combine the components of the various plans so long as all of the components are represented and clearly identified.

2.4 BMP Calculations

This section of the PCSMP provides data and calculations supporting the selection and sizing of stormwater management structures.

1. Final sizing calculations for all stormwater BMPs. Calculating the volume of selected BMPs is simply based on the first one-half inch (0.5") of stormwater runoff. The drainage area to the BMP or series of BMPs is multiplied by 0.5" to determine the volume needed to be treated, referred to as the water quality control volume (WQCV). The following factors can be used to approximate the WQCV.

The first 0.5 inch of runoff will generate

- **1,815** cubic feet of water for 1 acre of area
- **42** cubic feet of water for every 1,000 square feet of area

2. For stormwater BMPs that provide treatment based on a flow rate, the Designer may submit calculations that demonstrate water quality flow rates that are equivalent to treating the first one-half inch (0.5") of stormwater runoff. On sites where the Rational Method is suitable and the time of concentration is 10 minutes or less, designers may use a 1.5 cfs/acre value to size flow based systems (Appendix 8-D, Omaha Regional Stormwater Design Manual). Designers may also use WinTR-55 to estimate flow rate, however, the model must show a correlation to a 0.5" runoff depth in the output report. Proprietary stormwater BMPs shall be pre-approved for use by the City of Omaha Public Works Department.

- Final sizing calculations for structural stormwater management practices include contributing drainage area, storage or equivalent treatment flow rate, and outlet configurations as applicable. At a minimum, the following information should be provided for each BMP:

BMP Identification Number	Type	Drainage Area (ac)	WQCV (cf) or Equivalent Treatment Flow Rate (cfs)	Design Volume (cf) or Equivalent Treatment Flow Rate (cfs)

- For projects that discharge into a combined sewer, the design must include the water quality volume or equivalent treatment flow rate plus any storage necessary to control runoff such that there is no net increase in peak runoff from pre-development conditions as they existed in October 2002 for the 2-, 10- and 100-year storm events. Documentation to support the final design volume and structural components shall be included in the submittal.
- For projects that discharge into the municipal separate storm sewer system, designers must verify that the system has appropriate capacity, and follow the “No Adverse Impact” approach (defined in the Omaha Master Plan and adopted in Chapter 32, Article VII of the Omaha Municipal Code.) Documentation to support the final design volume and structural components shall be included in the submittal.

2.5 BMP Maintenance Requirements

Section 32-124 of the City of Omaha Municipal Code states, “The owners and occupants of lands on which post-construction BMPs have been installed to meet the requirements of this chapter shall ensure the maintenance of these BMPs and shall themselves maintain those BMPs if other persons or entities who are also obliged to maintained those BMPs (by contract or covenant, or pursuant to this chapter) fail to do so. BMPs shall be inspected or reviewed as appropriate at least annually, and a written record of inspection results and any maintenance work shall be maintained and available for review by the City.”

Annual review and inspection of BMPs shall be done by a professional qualified in stormwater BMP function and maintenance. Information on the Inspector that will provide annual review and inspection of BMPs and the holder of the annual inspection report shall be provided on the BMP Certification Form.

To assure compliance with the municipal code, maintenance requirements for post construction stormwater BMPs must be documented as an exhibit to the Maintenance Agreement to ensure that the system will function properly.

The following elements are required:

- Site information.
- BMP information.
- Description and schedule of maintenance and repair tasks for each BMP type.

A template is provided in Appendix A that can be modified into a site specific maintenance plan.

2.6 Maintenance Agreement and Easement

Section 32-124 of the City of Omaha Municipal Code states, “the applicant or owner is required to execute an inspection and maintenance agreement, to be filed on record, binding on all subsequent owners of land served by a private stormwater management facility. Such agreements shall provide for access to the facility, at reasonable times, for inspections by the City or its authorized representative to ensure that the facility is maintained in proper working condition to meet design standards.”

Such agreements shall document the responsibilities of the owner, the Home Owner’s Association or other responsible party (for Sanitary Improvement Districts), and the City of Omaha. The maintenance agreement shall be approved by the Public Works Department as part of the Final PCSMP and recorded with the Register of Deeds. A sample copy of the Maintenance Agreement can be downloaded at www.omahastormwater.org.

Maintenance Agreement exhibits shall include the following:

- Exhibit A – Real Property Depiction – Provide lot certificate or platted subdivision with legal description, or PCSMP plan sheet if that information is contained on the sheet already (11”x17”)
- Exhibit B – BMP Maintenance Requirements as described in Section 2.5 of this document (See Appendix A also)

3.0 POST-CONSTRUCTION STORMWATER MANAGEMENT PLAN DEVELOPMENT

3.1 Site Evaluation

In developing a PCSMP it is important to characterize and evaluate the site. Information obtained during the site assessment enables the applicant and their consultant to assess site conditions that will contribute to an effective post construction stormwater management plan. A complete evaluation shall include consideration of limitations and advantages of each individual site. This process will enable the selection, sizing and siting of practices that address the unique circumstances of a site.

The development of the Post Construction Stormwater Management Plan must be initiated in the early stages of site planning and design. However, before a stormwater management plan can be developed, defining site conditions must be completed by conducting a site assessment. The data collected during the site assessment will be used for describing site conditions, including vegetation, soils and drainage patterns. When this information is obtained, appropriate stormwater BMPs can be selected, located, sized, and designed.

The following data should be collected, to the extent practical, during the development of the PCSMP:

Natural Resources: The development site's natural resources, including vegetative communities, soils and geology, and aquatic resources need to be determined to assist in stormwater management plan development and is part of the permit application. Important data includes wetlands, riparian (stream) corridors, native prairie and/or woodland. Natural resources should be assessed by trained professionals.

Site topography: Topography dictates how and where water will drain from a site. On steeper sites, stormwater will runoff more rapidly, with less infiltration and greater volume. Stormwater management requirements are substantially different than for more gently rolling or flat sites.

Soils: Soil information is important for development of the stormwater management plan, and for optimal planning of the new community. Soil depth, texture (sand, silt, and clay content), and structure are important factors that will provide understanding of infiltration capacity (permeability), ability to support vegetation, and erodability. Engineering qualities and limitations of the soil are important for determining where structures can be placed, how stormwater runoff can be managed, and possible limitations for underground utilities. If hydric soils are present, it is important to understand limitations of building in these areas. Much of the information can be obtained from a USDA County Soil Survey, but an on-site soil assessment is recommended.

Aquatic Resources: The identification of streams, ponds, and lakes as receiving waters and as an integral part of the stormwater management plan is critical. Understanding the function of these water bodies, their current condition, and potential impacts from proposed development may influence your choice of stormwater BMPs. The identification of these resources may also be necessary to comply with local, State and Federal regulations.

3.2 BMP Selection

Chapter 8 of the Omaha Regional Stormwater Design Manual provides information about BMPs most often used for control and treatment of stormwater, including minimum control requirements, site design feasibility, conveyances issues, pre-treatment requirements, and other design criteria for stormwater quality. Allowable practices are not limited to what is included Chapter 8 of the Omaha Regional Stormwater Design Manual and can be selected from other acceptable design manuals.

The stormwater BMPs listed in Chapter 8 emulate natural systems by integrating a variety of dispersed treatments at multiple scales, from backyard rain gardens to district-level bioretention basins (Table 2). They are widely applicable in both urban and rural environments. These treatments can be designed into new developments or retrofit into existing community open spaces, parks, road rights-of-way, side and rear areas of homes and commercial buildings, rooftops of structurally adequate buildings, below parking lots and in many other settings. All aspects of stormwater management can be integrated to contribute to positive community aesthetics and economics.

Stormwater BMPs include a variety of methods that are simple and practical in design, yet provide effective stormwater management as well as aesthetic enhancements for urban, suburban, and rural landscapes. These methods can be cost effective to build while providing long-term sustainability for City infrastructure and conservation of Omaha's water resources.

Typical BMP's and recommended design guidelines are:

- Infiltration (rain gardens, bioretention gardens, swales, green space)
 - Sod on fill not considered infiltration area.
 - If using green space, test the permeability of the soil.
 - Recommended infiltration rate: ~0.5 inches/hour.
- Water Quality Detention (wet and dry detention)
 - 24-40 hour drawdown
 - Forebay recommended
 - Floatable capture recommended if feasible
- Green Roof
- Pervious Pavement/Permeable Pavers
- Hydrodynamic Separators
 - 80% TSS removal efficiency
- Subsurface Storage
 - Analyze as detention basin
- Inlet Filters, Roof Drain Filters
 - 80% TSS removal efficiency

Table 2: Suitability of BMP applications at multiple planning and management scales

BMP	Development Density				
	Parcel		Block	Neighborhood	Transportation Corridor
	Residential	Commercial/ Governmental			
Bioretention Area		X	X	X	X
Wet Detention (Ponds and Lakes)		X	X	X	X
Dry Detention Basin		X	X	X	X
Filter Strip	X	X	X	X	X
Grassed Swale	X	X	X	X	X
Green Roof	X	X			
Infiltration Trench	X	X	X		X
Pervious Pavement	X	X	X	X	X
Rain Garden	X	X	X		
Subsurface Storage		X			X
Vegetated Bioswale	X	X	X	X	X
Hydrodynamic Separators		X			X
Roof Drain Filters ¹		X			

¹Use of in line roof drain filters must be approved by the Permits and Inspection Department.

4.0 ADDITIONAL RESOURCES

There are numerous additional resources to provide guidance and assistance in implementing stormwater BMPs for new development or redevelopment sites. Some of these resources are listed below.

Omaha Regional Stormwater Design Manual. April 2006. Fundamental requirements for stormwater management in the Omaha region are provided in this document. Chapters 2 and 8 are specifically cited as relevant to Post-Construction Stormwater Management. The document can be downloaded at <http://www.pcwperosioncontrol.org/downloads/files/StormwaterManual.pdf>.

Bioretention Gardens, A Manual for Contractors in the Omaha Region to Design and Install Bioretention Gardens. 2009. Hartsig and Rodie. The City of Omaha produced this manual to provide technical design guidelines for bioretention gardens and is written specifically for the Omaha region. These manuals are available at the Douglas County Extension Office.

Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices. December 2007. EPA 841-F-07-006. United States Environmental Protection Agency, Nonpoint Source Control Branch (4503T), 1200 Pennsylvania Ave., NW, Washington, DC 20460

The Stormwater Manager's Resource Center. <http://www.stormwatercenter.net/>. This site provides a wide variety of resources for stormwater management planning and implementation.

American Public Works Association 5600 Stormwater BMP Guidance. This document provides detailed information about stormwater management planning and design, including determining the best approach for attaining stormwater discharge requirements. The document can be downloaded at <http://www.marc.org/environment/Water/bmps.htm>.

Urban Design Tools - Low Impact Development. <http://www.lid-stormwater.net/>. This site provides watershed managers with a new set of tools and techniques that can be used to meet regulatory and receiving water protection program goals for urban retrofits, re-development projects, and new development sites.

Low Impact Development Center. <http://www.lowimpactdevelopment.org/index.html>. This site provides several resources and links to aid in the planning and design of stormwater quality BMPs.

Better Site Design: A Handbook for Changing Development Rules in Your Community. 1998. Center for Watershed Protection

Papillion Creek Watershed Management Plan. <http://www.papiopartnership.org>. This site provides resources that provide additional resources, watershed policy considerations and documents.

Stormwater BMPs – Selection, Maintenance, & Monitoring. England, Gordon and Stewart Stein, 2007, Forester Press, Santa Barbara, California. This book describes stormwater pollutants, pollutant removal mechanisms, BMP selection criteria, types of BMPs, maintenance of BMPs and monitoring.

Appendix A

BMP Maintenance Requirements

The project designer shall include the following information as part of Exhibit B of the Maintenance Agreement.

Name & Location

Project Name: _____

Address: _____

PCWP Project #: _____

PCWP Grading Permit #: _____

Site Data

Total Site Area: _____

Total Disturbed Area: _____

Total Undisturbed Area: _____

Impervious Area Before Construction: _____

Impervious Area After Construction: _____

BMP Information

The designer shall provide, on the PCSMP plan set, the following information on post-construction stormwater BMPs:

BMP ID	TYPE OF BMP	State Plane Coordinates (N/E)	Longitude/Latitude

Note: Use the same naming convention for the BMPs that are used on the accepted plans and add rows if needed. Use either state plane coordinates or longitude/latitude.

Routine Maintenance and Tasks Schedule

The following tables outline recommended maintenance tasks and **suggested** frequencies for example BMPs. Detailed owner inspection forms are available for download at <http://www.omahastormwater.org/resources/forms-publications/#>, enter "Evaluation form" in the search box at the upper right corner of the page.

Inspection Reports should be completed and kept on file with the Inspector or Owner.

**Papillion Creek Watershed Partnership (PCWP)
Permanent Stormwater Management BMP Annual Inspection Form**

Inspection Date: _____ Inspection Time: _____

Project Name: _____ Project Number: _____

Site Address: _____ City: _____ Postal Code: _____

Owner Name: _____ Owner Phone Number: _____

Owner Address: _____ City: _____ Postal Code: _____

Designer Name: _____ Designer Company: _____

Are maintenance records being kept?: Yes No

Date of previous inspection: _____

Was previous inspection reviewed prior to conducting this inspection? Yes No N/A

Are there any outstanding corrective actions? Yes No N/A

If yes, explain: _____

Site Contact Name: _____ Site Contact Phone Number: _____

Site Contact E-mail: _____

Inspector: _____ Inspector Phone Number: _____

Inspector E-mail: _____ Inspector Company/Firm: _____

Inspector Qualifications/Certifications/Official Training: _____

BMP TypeNumber of BMP's per Site (use a checklist for EACH BMP)
Bioretention System	
Dry Detention Basin	
Bioswale	
Level Spreader	
Underground Detention	
Hydrodynamic Separator	
Permeable Pavers / Pervious Pavement	
Other: _____	

Days since last rain: _____ Amount of rain: _____

I certify that this information is true and accurate to the best of my knowledge.

Signature: _____ Date: _____

**PCWP
Underground Detention
Annual Inspection Form**

This is a general inspection form - depending on the model, there may be a more in depth inspection form from the manufacturer.

BMP Identification: _____ Inspection Date: _____

Every response that is a 'yes' requires a corrective action, to whom the action is assigned, and the expected completion date of the assignment.

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Inflow Points

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Obstruction (vegetation/debris/sediment)				
Comments				

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Underground Vault

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Sediment/debris accumulation				
Access manhole(s) in poor condition				
Vault in poor structural condition				
Baffles and/or weir in poor condition				
Access ladder/steps in poor condition				
Oil accumulation				
Blocked, damaged, or plugged air vents				
Improper drainage				
Other (describe)				

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Outlet Device

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Obstruction (vegetation/debris/sediment)				
Joint failure/Loss of joint material				
Control valve not operating properly				
Emergency by-pass in poor condition				
Comments				

**PCWP
Underground Detention
Annual Inspection Form**

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Miscellaneous

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Access restricted (ex.fence, vegetation, etc.)				
Fumes/odors present				
Evidence of routine maintenance not being performed				
Issues with additional features (ex. walkways, fences, etc.)				
Is site modified from approved plan				
Comments				

Photographs:

Attach photographs of the site and BMP features using the photo log template attached. Include captions describing each photograph.

Additional Comments:

**PCWP
Other BMP Type
Annual Inspection Form**

BMP Type: _____

BMP Identification: _____ Inspection Date: _____

Every response that is a 'yes' requires a corrective action, whom the action is assigned to, and the expected completion date of the assignment.

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Features

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Miscellaneous

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Access restricted (ex.fence, vegetation, etc.)				
Fumes/odors present				
Evidence of routine maintenance not being performed				
Issues with additional features (ex. walkways, fences, etc.)				
Is site modified from approved plan				
Comments				

Photographs:
Attach photographs of the site and BMP features using the photo log template attached. Include captions describing each photograph.

Additional Comments:

PCWP
Permeable Pavers / Pervious
Pavement Annual Inspection Form

BMP Identification: _____ Inspection Date: _____

Every response that is a 'yes' requires a corrective action, to whom the action is assigned, and the expected completion date of the assignment.

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Pavement Area				
Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Evidence of clogging or debris accumulation				
Structural Issues (signs of spalling, cracks, vegetation, etc.)				
Erosion/undercutting (evidence of eroding material into/from pavement area)				
Outlets obstructed				
Comments				

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Miscellaneous				
Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Access restricted (ex.fence, vegetation, etc.)				
Evidence of routine maintenance not being performed				
Issues with additional features (ex. walkways, fences, etc.)				
Is site modified from approved plan				
Comments				

Photographs:
 Attach photographs of the site and BMP features using the photo log template attached. Include captions describing each photograph.

Additional Comments:

**PCWP
Level Spreader
Annual Inspection Form**

BMP Identification: _____ Inspection Date: _____

Every response that is a 'yes' requires a corrective action, to whom the action is assigned, and the expected completion date of the assignment.

				Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
Inlet/Flow Splitter Device					
Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion	
Obstruction (vegetation/debris/sediment)					
Erosion/Undercutting					
Displacement/sedimentation of fabric/rip-rap/ proprietary matting					
Comments					

				Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
Pooling Area and Level Lip					
Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion	
Sediment/debris accumulation					
Level lip cracked, settled, undercut, or eroded					
Stormwater bypassing level spreader					
Unwanted vegetation growth in pooling area or on level lip					
Vegetation inadequately maintained					
Comments					

				Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
Bypass Channel					
Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion	
Erosion/Bare soil					
Displacement/sedimentation of fabric/rip-rap/ proprietary matting					
Comments					

**PCWP
Level Spreader
Annual Inspection Form**

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Filter Strip

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Unhealthy/Sparse vegetation				
Erosion present				
Sediment accumulation				
Unwanted vegetation				
Comments				

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Miscellaneous

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Access restricted (ex. fence, vegetation, etc.)				
Evidence of routine maintenance not being performed				
Issues with additional features (ex. walkways, fences, etc.)				
Is site modified from approved plan				
Comments				

Photographs:

Attach photographs of the site and BMP features using the photo log template attached. Include captions describing each photograph.

Additional Comments:

**PCWP
Hydrodynamic Separator (Proprietary Device)
Annual Inspection Form**

This is a general inspection form - depending on the model, there may be a more in depth inspection form from the manufacturer.

BMP @ _____ : _____ @ _____ Date: _____

Every response that is a 'yes' requires a corrective action, to whom the action is assigned, and the expected completion date of the assignment.

Inflow Points

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Obstruction (vegetation/debris/sediment)				
Filter in poor condition				
Comments				

Separator Body

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Sediment/debris accumulation				
Access manhole(s) in poor condition				
Access ladder/steps unsafe condition				
Oil accumulation/sheen				
Standing water				
Comments				

Outlet Device

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Obstruction (vegetation/debris/sediment)				
Joint failure/loss of joint material				
Emergency by-pass in poor condition				
Comments				

**PCWP
Hydrodynamic Separator (Proprietary Device)
Annual Inspection Form**

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Miscellaneous

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Access restricted (ex.fence, vegetation, etc.)				
Fumes/odors present				
Evidence of routine maintenance not being performed				
Issues with additional features (ex. walkways, fences, etc.)				
Is site modified from approved plan				
Comments				

Photographs:

Attach photographs of the site and BMP features using the photo log template attached. Include captions describing each photograph.

Additional Comments:

PCWP
Dry Detention Basin
Annual Inspection Form

BMP Identification: _____ Inspection Date: _____

Every response that is a 'yes' requires a corrective action, to whom the action is assigned, and the expected completion date of the assignment.

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Inflow Points (Curb Cut, Daylight Pipe, Overland Flow, Etc.)

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Obstruction (vegetation/debris/sediment)				
Erosion/Undercutting				
Displacement/sedimentation of fabric/rip-rap/ proprietary matting				
Energy dissipation structural issues				
Comments				

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Pre-Treatment Area (Forebay, Grass Swales, Etc.) *As Applicable*

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Sediment/debris accumulation				
Erosion/Undercutting				
Unwanted vegetation				
Flow is by-passing pretreatment				
Comments				

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Embankment

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Erosion/Bare soil/Loss of dam material				
Unwanted vegetation present				
Animal burrows present				
Sparse/Unhealthy vegetative cover				
Signs of seepage on downstream face				
Comments				

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Main Treatment Area

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Standing water (>3 days after storm)				
Sediment/debris accumulation				
Erosion/Undercutting				
Vegetation inadequately maintained				
Comments				

PCWP
Dry Detention Basin
Annual Inspection Form

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Outflow Structure

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Obstructed pipe/trash rack/draw down orifice				
Erosion present				
Joint failure/loss of joint material/soil piping				
Point of discharge not stabilized				
Displacement/sedimentation of fabric/rip-rap/ proprietary matting				
Comments				

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Spillway

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Eroded/Bare areas in spillway				
Unwanted vegetation				
Spillway obstructed				
Comments				

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Miscellaneous

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Access restricted (ex.fence, vegetation, etc.)				
Evidence of routine maintenance not being performed				
Issues with additional features (ex. walkways, fences, etc.)				
Is site modified from approved plan				
Comments				

Photographs:

Attach photographs of the site and BMP features using the photo log template attached. Include captions describing each photograph.

Additional Comments:

**PCWP
Bioswale
Annual Inspection Form**

BMP Identification: _____ Inspection Date: _____

Every response that is a 'yes' requires a corrective action, to whom the action is assigned, and the expected completion date of the assignment.

	Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable		
Inflow Points (Curb Cut, Daylight Pipe, Overland Flow, Etc.)				
Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Obstruction (vegetation/debris/sediment)				
Erosion/Undercutting				
Displacement/sedimentation of fabric/rip-rap/ proprietary matting				
Comments				

	Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable		
Entire Length of Swale				
Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Trash/Debris present				
Erosion (side slope/channel)				
Sediment accumulation				
Vegetation sparse/unhealthy				
Unwanted vegetation				
Comments				

	Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable		
Outlet Point				
Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Obstruction (vegetation/debris/sediment)				
Erosion/Undercutting				
Displacement/sedimentation of fabric/rip-rap/ proprietary matting				
Comments				

**PCWP
Bioswale
Annual Inspection Form**

Condition:	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Miscellaneous

Assessment	Yes/No	Corrective Actions	Assigned To	Expected Completion
Access restricted (ex.fence, vegetation, etc.)				
Evidence of routine maintenance not being performed				
Issues with additional features (ex. walkways, fences, etc.)				
Is site modified from approved plan				
Comments				

Photographs:

Attach photographs of the site and BMP features using the photo log template attached. Include captions describing each photograph.

Additional Comments:

**PCWP
Bioretention System
Annual Inspection Form**

BMP Identification: _____ Inspection Date: _____

Every response that is a 'yes' requires a corrective action, to whom the action is assigned, and the expected completion date of the assignment.

Condition	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Inflow Points (Curb Cut, Daylight Pipe, Overland Flow, Etc.)

Assessment	'	V	Corrective Actions	Assigned To	Expected Completion
Obstruction (vegetation/debris/sediment)					
Erosion/Undercutting					
Displacement/sedimentation of fabric/rip-rap/ proprietary matting					
Comments					

Condition	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Pre-Treatment Area (Forebay, Grass Swales, Etc.)

Assessment	'	V	Corrective Actions	Assigned To	Expected Completion
Sediment/debris accumulation					
Erosion/Undercutting					
Unwanted vegetation					
Flow is by-passing pretreatment					
Comments					

Condition	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Perimeter/Side Slopes/Embankment

Assessment	'	V	Corrective Actions	Assigned To	Expected Completion
Sediment/debris accumulation					
Erosion/Undercutting					
Unwanted vegetation					
Adjacent landscape not well maintained					
Comments					

Condition	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Bottom of System

Assessment	'	V	Corrective Actions	Assigned To	Expected Completion
Unwanted vegetation					
Plants are dead, diseased, or dying					
Mulch/Ground cover issues					
Soils/Mulch clogged with sediment					
Evidence of lack of proper drainage					
Bare/Eroded areas in vegetated cells					
Comments					

**PCWP
Bioretention System
Annual Inspection Form**

Condition	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Outlet Device

Assessment	V	Corrective Actions	Assigned To	Expected Completion
Obstruction (vegetation/debris/sediment)				
Erosion/Undercutting				
Sediment/Debris in pipe				
Joint failure/loss of joint material/ soil piping				
Displacement of stabilization measures				
Comments				

Condition	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Overflows

Assessment	V	Corrective Actions	Assigned To	Expected Completion
Bare or eroded areas in overflow				
Unwanted vegetation				
Overflow obstructed				
Comments				

Condition	Outstanding (No Maintenance Needed) Satisfactory (Minor Maintenance Needed) Needs Improvement (Maintenance Needed) Not Applicable
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Miscellaneous

Assessment	V	Corrective Actions	Assigned To	Expected Completion
Access restricted (ex.fence, vegetation, etc.)				
Issues with additional features (walkways, fences, etc.)				
Evidence of routine maintenance not being performed				
Is site modified from approved plan				
Comments				

Photographs:

Attach photographs of the site and BMP features using the photo log template attached. Include captions describing each photograph.

Additional Comments: