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THE CITY OF SALEM, VIRGINIA

Post-Construction Stormwater Management Program Manual

Programmatic Overview of the City of Salem's Post-Construction Stormwater Management Program and Process

City of Salem, Virginia

November 2020

For reporting pollution into stormwater runoff contact Chuck Van Allman, Jr. (Director, Department of Community Development) at 540-375-3032.

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EEE Consulting, Inc.

ACRONYMS

BMP	Best Management Practice
CH	Virginia BMP Clearinghouse
CPESC	Certified Professional in Erosion and Sediment Control
CWA	Clean Water Act
DEQ	Virginia Department of Environmental Quality
EPA	Environmental Protection Agency
IDDE	Illicit Discharge Detection and Elimination
MEP	Maximum Extent Practicable
MS4	Municipal Separate Storm Sewer System
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
VPDES	Virginia Pollutant Discharge Elimination System
VSMP	Virginia Stormwater Management Program

1.0 INTRODUCTION AND PURPOSE

Land development disturbs stable vegetated landscapes and increases impervious area, which in turn increases the stormwater runoff that leaves an area. Development increases pollutant concentrations in runoff, as pollution associated with development is deposited onto disturbed surfaces and carried by runoff into nearby water bodies. Such pollutants include sediment, suspended solids, nutrients, pesticides, herbicides, heavy metals, chlorides, hydrocarbons, other organics, and bacteria. To remove pollutants from stormwater runoff, structures are installed to filter, slow, and treat drainage using various processes. These stormwater structures are called Best Management Practices, commonly referred to as BMPs. They are designed to reduce flooding, remove pollutants and decrease the amount of runoff from stormwater that ultimately flows to our creeks, streams, and rivers. Ensuring that these facilities function correctly requires long-term maintenance and inspections.

This manual presents the standard protocol for Post-Construction Stormwater Management for the typical operations and facilities that relate to water quality. As a regulated small municipal separate storm sewer system (MS4), the City of Salem (City) is obligated to meet the requirements of the MS4 General Permit. The MS4 Permit is issued through Virginia's Stormwater Management Program (VSMP) regulations, which is administered at the state level by the Virginia Department of Environmental Quality (DEQ). The MS4 program is part of the Federal National Pollutant Discharge Elimination System (NPDES), which is authorized through the Clean Water Act and regulated through the US Environmental Protection Agency (EPA).

In accordance with the MS4 Permit, the City must "develop, implement, and enforce an MS4 program designed to reduce the discharge of pollutants from the small MS4 to the maximum extent practicable (MEP)." This Post-Construction Stormwater Management Manual has been developed as Minimum Control Measure 6 as described in the MS4 Permit. The Post-Construction Stormwater Management program, which is a series of written procedures in this manual, ensures adequate long-term operation and maintenance of BMPs for the City.

Salem's Post-Construction Stormwater Management Program includes three distinct components:

- **Documentation** – Procedures to document all efforts related to the Post-Construction Stormwater Management process are outlined in Section 2.0 of this manual.
- **Inspections –** A description of Post-Construction Stormwater Management facility types and a description of the components involved in the inspections process are outlined in Section 4.0 of this manual. Information and procedures for the Post-Construction Stormwater Management Facility Inspections are outlined in Section 5.0 of this manual. The stormwater facility mapping, BMP inventory, inspections forms and new facility forms can be found in the Appendices.
- **Maintenance**– A description of the typical maintenance that is performed on the facilities is outlined in Section 6.0 of this manual.

2.0 DOCUMENTATION REQUIREMENTS

Documentation of Post-Construction Stormwater Management is critical for demonstrating compliance with the MS4 permit. All documentation related to post-construction stormwater management is required to be keep for a minimum of 3 years for annual reporting and potential audits.

2.1 Inspection Forms

Inspections are a necessary and important part of the Post-Construction Stormwater Management Program. The inspection forms will provide the necessary documentation to demonstrate when and what is being inspected. This Manual includes a unique inspection form for the predominant type of stormwater facilities that currently exist within the City that include detention, retention and extended detention. Inspection forms for other types of facilities, when needed, can be found within the Virginia Stormwater Management Handbook, latest edition. For proprietary stormwater practices, the manufacturer specifications for inspection and maintenance should be utilized for inspections.

The inspections forms are intended to provide documentation that the facilities were inspected on an annual basis and that any maintenance items were noted. A follow-up inspection should be completed after every noted deficiency with the following information:

- ✓ Facility Number
- ✓ Date of initial inspection
- ✓ Date corrective maintenance performed
- ✓ Description of corrective maintenance performed

2.2 Annual Reporting to DEQ

Salem must annually report to the DEQ information pertaining to its Post-Construction Stormwater management efforts. The information is included in the overall MS4 annual report due October 1st of each year. Salem must maintain an electronic database or spreadsheet to be submitted annually that includes the following information:

1. The stormwater management facility type;
2. A general description of the facility's location, including the address or latitude and longitude;
3. The acres treated by the facility, including total acres, as well as the breakdown of pervious and impervious acres;
4. The date the facility was brought online (MM/YYYY). If the date is not known, the operator shall use June 30, 2005, as the date brought online for all previously existing stormwater management facilities;
5. The sixth order hydrologic unit code (HUC) in which the stormwater management facility is located;
6. The name of any impaired water segments within each HUC listed in the 2010 §305(b)/303(d) Water Quality Assessment Integrated Report to which the stormwater management facility discharges;
7. Whether the stormwater management facility is publically-owned or privately-owned;
8. Whether a maintenance agreement exists if the stormwater management facility is privately owned;
9. The date of the operator's most recent inspection of the stormwater management facility; and
10. Annually track and report the total number of inspections completed and, when applicable, the number of enforcement actions taken to ensure long-term maintenance.

2.3 Program Updates and Modifications

Modifications to the post-construction stormwater management program may occur as part of an iterative process to protect water quality. Updates and modifications to the Program may be made in accordance with the following procedures:

- Adding (but not eliminating or replacing) practices to the post-construction stormwater management Program outlined in this manual may be made by the City at any time. Additions shall be reported as part of the annual report.
- Updates and modifications to the post-construction stormwater management Program described in this manual are permitted provided that the updates and modifications are done in a manner that:
  - Is consistent with the conditions of the MS4 General Permit;
  - Follow any public notice and participation requirements established in the MS4 General Permit; and
  - Are documented in the annual report.
- Replacing, or eliminating without replacement, any ineffective or infeasible strategies, policies, and practices described in this manual with alternate strategies, policies, and BMPs may be requested at any time. Such requests must include the following:
  - An analysis of how or why the practices, strategies, or policies are ineffective or infeasible, including cost prohibitive;
  - Expectations on the effectiveness of the replacement practices, strategies, or policies;
  - An analysis of how the replacement BMPs are expected to achieve the goals of the practices to be replaced;
  - A schedule for implementing the replacement practices, strategies, and policies;
  - An analysis of how the replacement strategies and policies are expected to improve Salem's ability to meet the goals of the strategies and policies being replaced;
  - Requests or notifications must be made in writing to DEQ and signed by a principle executive officer or a duly authorized representative. The duly authorized representative must have overall responsibility of the City operations and written authorization must be provided to the Department.
  - Salem follows the public involvement requirements identified in the MS4 General Permit.

3.0 STORMWATER MANAGEMENT FACILITIES

This section describes the types of City-owned BMP's and their general layout and function. If additional BMPs are added that differ in type, the manual will require updates for compliance.

The type of City-owned stormwater facilities that can be found are Dry Detention and Retention Ponds. An explanation of these BMP types and key components of each are included in the sub-sections below. Inventory of individual City owned BMPs is maintained by the Director of the Department of Community Development or designee and should be utilized and updated for tracking inspection and maintenance of stormwater facilities.

3.1.1 Bioretention

Bioretention facilities are shallow landscaped depressions that incorporate many of the pollutant removal mechanisms that operate in our natural environment. The primary component of a bioretention practice is the filter bed, which has a mixture of sand, soil, and organic material as the filtering media in the ground with a surface mulch layer. During storms, runoff temporarily ponds 6 to 12 inches above the mulch layer and then rapidly filters through the bed. Normally, the filtered runoff is collected in an underdrain and returned to the storm drain system or receiving channel. The underdrain consists of a perforated pipe in a gravel layer installed along the bottom of the filter bed. Bioretention facilities can also be designed to infiltrate runoff into native soils without an underdrain. This can be done at sites with permeable soils, a low groundwater table, and a low risk of groundwater contamination. The second most critical component of bioretention facilities is the landscaping plan and plantings. The plantings are designed specific to the site and facility and they remove and store pollution. Small residential applications of bioretention are termed rain gardens.

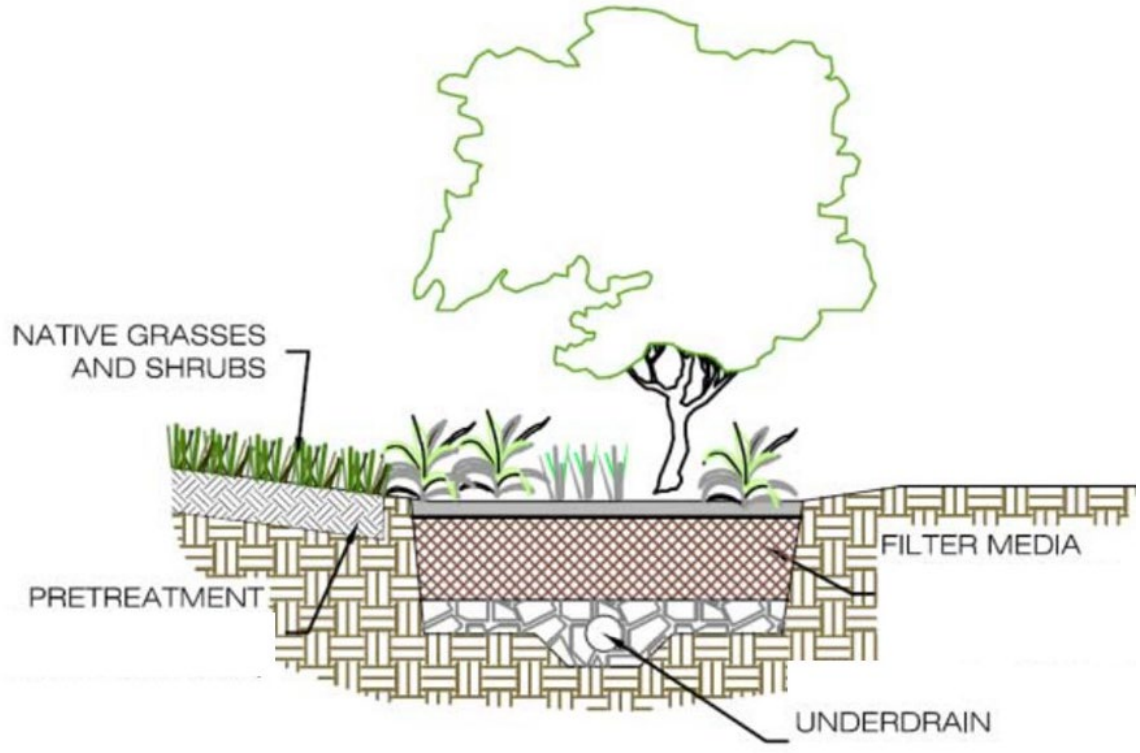


Figure 1: Typical Bioretention Facility Schematic

3.1.2 Dry Detention

These basins have at least one inflow channel, an embankment/dam, a bottom level orifice, sometimes a riser in the basin, a principal spillway structure to route drainage through the dam, and an outlet structure. These basins do not have a normal pool, and remain dry except during and shortly after storm events. Some extended detention facilities may have a wet marsh with plantings in the bottom for additional pollutant removal. On rare occasions the extended detention basin may be designed to have a wet normal pool, in which case verification with the design plans may be necessary.

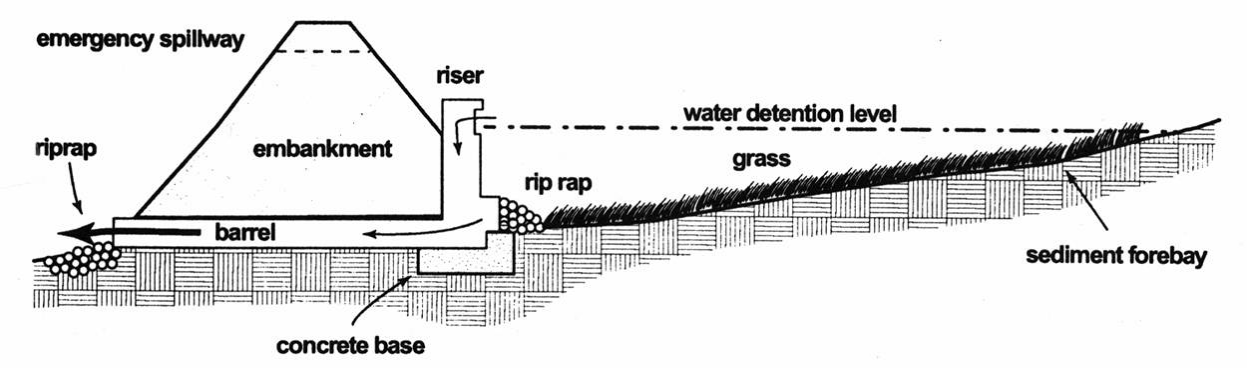


Figure 2: Typical Dry Detention Basin Schematic.

3.1.3 Retention

These basins have at least one inflow channel, an embankment/dam, typically a riser in the basin although not always, a principal spillway structure to route the drainage through the embankment, and an outlet structure. Wet ponds consist of a permanent pool of standing water that promotes pollution removal and reduces flooding. Retention basins can also be dry facilities which would mimic the dry detention schematic above. Runoff from each storm enters the pond and raises the normal water level, and the outlet structure releases the drainage at a slower rate over a longer period of time. This "draw down" or holding time allows pollutants to settle out of the stormwater and lessens the impact of the flow volume on the outlet channel.

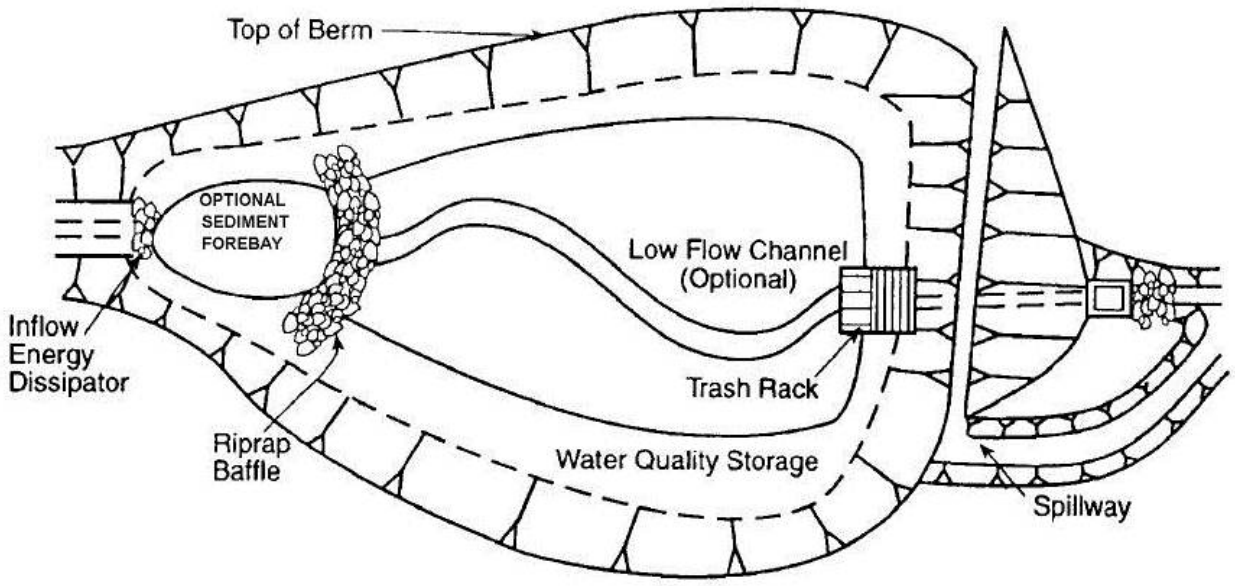
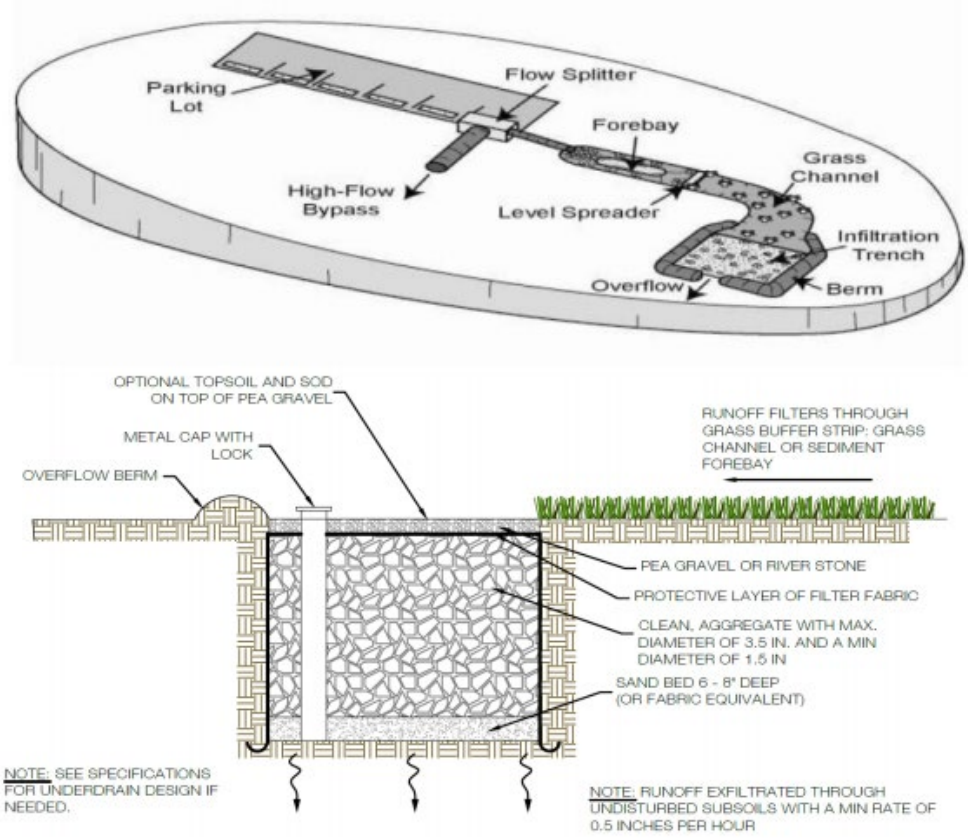


Figure 4: Typical Retention Facility Schematic Top View

3.1.4 Infiltration

Infiltration practices utilize temporary surface or underground storage that allows the incoming stormwater runoff to settle into underlying soils. Typically, the runoff will first pass through pretreatment mechanisms to trap sediment and organic matter before it reaches the practice and then settle into the underlying soils. As the stormwater penetrates the underlying soil, chemical and physical adsorption processes will remove pollutants. Infiltration practices come in many types such as rain gardens, infiltration trenches, vegetated swales, porous pavement and others.



Source: http://www.vwrrc.vt.edu/swc/documents/2013/DEQ%20BMP%20Spec%20No%208_INFILTRATION_Final%20Draft_v1-9_03012011.pdf

Figure 4: Possible Infiltration Facility Schematic Top View

4.0 INSPECTION FORMS

Inspection forms are an integral part of the Post-Construction Stormwater Management program and provide documentation that the inspection took place. The following sub-sections are intended to provide a description of headings and components found in the inspection forms located in Appendix A.

4.1 DEQ Stormwater Inspector Certification

Individual's performing inspection of stormwater management facilities for the City of Hopewell are required to maintain a Stormwater Inspector Certification from DEQ. Information regarding the certification requirements is available at the DEQ Stormwater Certification webpage.

4.2 Inspection Frequency

The MS4 Permit requires an annual inspection of all City of Hopewell owned stormwater management facilities and inspections every five years for privately owned stormwater management facilities. In addition to the annual inspections, the Virginia Stormwater Management Program and regulations require a stormwater facility inspection after any storm event that exceeds the principal spillway, or more specifically, whenever the emergency spillway is engaged. The inspection requirements are in the BMP Clearinghouse. Inspection should utilize the forms in Appendix A.

4.3 Stormwater Management Facility Information

This describes general information found on the inspection form in Appendix A.

- "Owner": The owner of the facility.
- "Facility Name": This is the name of the facility on the Inventory List and the site mapping
- "Property Address": Address where the facility is located.
- "Date BMP Placed in Service" The date the BMP became functional and was accepted as complete post construction. This is typically at bond release.
- "Latitude (N)" is the GPS latitude reading of the top of the dam at or above the principal spillway.
- "Longitude (W)" is the GPS longitude reading at the top of the dam or above the principal spillway.
- "As-Built Plans Available": Are the original As-Built plans available for reference? Indicate yes or no.
- **"**Inspection Date": The date the inspection took place.
- "Date of Last Inspection": The date the last inspection took place.
- **"**Inspector(s)": The name of the inspector performing the inspection.
- "Contact Information": Contact information for the inspector. Phone numbers and/or email addresses are appropriate.

4.4 Inspection Criteria

The inspection form in Appendix A is designed so that individual components of the stormwater facility are inspected for specific issues. Each numbered heading is a different component of the facility. The lettered items list the issues to evaluate for that are specific to that component of the facility. Facilities may not have all components listed.

Each of the inspection component criteria are rated as either "Yes," they need repairs, or "No," they do not need repairs. Recommend maintenance actions based on design plans for the facility, actions recommended in the Virginia Stormwater Management handbook or follow the recommended

maintenance actions described in the "Maintenance action" column. Further information on maintenance recommendations for various stormwater BMPs can be found at the Virginia BMP Clearinghouse at *http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html*.

4.4.1 Contributing Drainage Area

The contributing drainage area includes any lands that drain to the facility, both onsite and offsite. These areas should be examined as a potential source of trash, debris, or erosion that affect the functionality of the BMP. Eliminating the source of the issue is essential and works as a preventative measure to ensure long term functionality of the BMP.

4.4.2 Pretreatment

Pretreatment is the initial structure through which stormwater drainage is routed before it enters the main BMP facility. It serves as a preliminary filter to remove silt and sediment that will impact the main system. As a result, the pretreatment structures require clean out more often than the facility itself. If there are significant amounts of sediment or growth in the pretreatment structure, it cannot store and filter the volume of flow it was designed for and therefore cannot fully function.

4.4.3 Inlets

Inlets route flow into the BMP facility for treatment from the contributing drainage area. Some issues in the inflow system may indicate upstream issues that are being transported to the facility. Inlets should be stable to properly function and not create additional impacts to the BMP facility, such as debris or sediment that may hinder access to the wetland plant system.

4.4.4 Sediment Forebay

A sediment forebay is a pretreatment structure that traps debris, trash, sediment and other pollutants from entering the BMP. Sediment must be cleaned out once the level in the forebay reaches 50% of the capacity. This is usually indicated on a stake placed in the forebay during construction to measure that level.

4.4.5 Vegetation

A main design component for several types of BMPs is the planting plan, which is designed by a professional. The facility plantings should match the design plans for the number and species of plants present. Having more plants than what is shown on the plans is acceptable as long as it is not an invasive species and/or the overgrowth is not impacting the storage volume and the facility's ability to drain. Checking the general planting location in the facility is also helpful. For example, if there is a section of plants adjacent to a road shoulder that is dying, it may be indicative of contaminated runoff. De-icing salts on the roads is an example of this. Vegetation should be replaced in accordance with the approved plans, or permission for an equivalent replacement species granted.

4.4.6 Emergency Spillway

The emergency spillway is a channel that conveys stormwater during large storm events from the facility to an outfall, usually the same one as the principle spillway or main outlet. It prevents the facility from overtopping during the large storm events. Not all facilities have an emergency spillway. Spillways can be lined with various materials including grass with or without erosion control matting, rip-rap, or concrete, based on the flow rate. The spillway is usually visible as a low spot a minimum of 1' below the top of embankment off to one side. Consult the design plans for additional details.

4.4.7 Outfall

The outfall channel is the receiving channel for the discharge from the stormwater facility. At the point of discharge there is usually a section of riprap, termed outlet protection, to slow the outflow and dissipate energy to prevent erosion in the channel. The purpose of many stormwater facilities is to protect the downstream channels, and thus a thorough evaluation of the outfall should be conducted.

4.4.8 Outlet

The outlet section refers to the structural end of the BMP system where drainage exits the BMP and enters the receiving channel. The outlet structure engages on all storm events, unlike the emergency spillway that is only used during very large events.

4.4.9 Principle Spillway

The principle spillway is the structure routing flow out of the facility to the receiving channel through the embankment, if present. It can be in the form of a pipe or an open channel. The principle spillway is used in most storm events, unlike the emergency spillway that is only used during very large events. Because this is typically the only conduit through the dam, the functionality and structural integrity of the principle spillway is critical.

4.4.10 Riser

The riser is a vertical structure that connects with the principal spillway pipe to route flows out of the facility. The riser usually has a small opening, or orifice, in the front of it that controls the amount of flow through the system. Thus, the functionality of the riser can have a large impact on the water level in the basin, the outlet system as a whole, and meeting the designed pollutant removal. Damage or deterioration can take the form of rust, cracking, exposed rebar, or additional holes in the structure.

4.4.11 Berm/Embankment

The embankment or berm, also termed a dam, is the fill section that blocks the drainage and holds the water in the facility. The face of the dam is the front side that interacts with the water level and the top, or crown, is the highest flat surface. The downstream side is the back of the dam from the top down to where the fill section meets the natural grade structure (called the “toe” of the dam), typically just below the outlet. Basins outlet on the downstream side, which can be a more problematic area due to the effects of water pressure and saturation on the face and through the embankment. A dug basin, however, will not have all of these components since it is excavated into the existing earth and not created by fill placement. Additionally, roadways are not considered embankments because they typically have culvert pipes through them to convey stormwater effectively, but are not designed as a stormwater facilities.

Issues with the embankment can be critical to the function of the facility. Note the conditions related to the principal spillway through the dam, as damage in this area can have a significant impact on facility operation.

4.4.12 Low Flow Orifice

The low flow orifice is the smaller outflow hole, usually in the riser, that meters out the flow and decreases the post-development flows to the receiving channel. The low flow orifice tends to clog because of its size and will typically have a trash rack grate on the front of it.

4.4.13 Pond Drain System

Some facilities have a drainage system to fully raise and lower the water level. This is usually in the form of a gate valve, which is a steel plate that can be raised and lowered to cut off or open up various outlets of the facility. Be sure to exercise them at least yearly to keep them functional.

4.4.14 Miscellaneous

This section captures any other pertinent features or issues of the facility. It evaluates the facility footprint area and general issues such as access. Note any of the criteria needing repair, and include applicable location information for reporting.

5.0 FACILITY MAINTENANCE

The effectiveness of post-construction stormwater control BMPs depends upon regular inspections and maintenance of all aspects of the facility. There are typically two types of BMP maintenance, referred to as routine maintenance and corrective maintenance. Corrective maintenance consists of repairs performed to correct a deficient part of the BMP facility as identified in the inspection. Maintenance action returns the BMP component to the original design conditions for proper function. These activities are further described below.

5.1 Routine Maintenance

Routine maintenance consists of preventative measures that are essential to the ongoing care and upkeep of a BMP facility, and it should be performed regularly to ensure proper function. It helps prevent potential nuisances (odors, mosquitoes, weeds, etc.), reduces the need for corrective maintenance, and reduces the chance of polluting stormwater runoff by identifying and repairing problems before they further deteriorate. The failure of structural stormwater BMPs can lead to downstream flooding, which can cause property damage, injury, and even death. This also leads to very costly repairs. Upon being identified during an inspection, routine maintenance should be conducted within six (6) months of the inspection.

Examples of routine maintenance include:

- Remove any accumulated sediment from the forebays and micro-pools.
- Replace any plantings or vegetation called for in the approved plans that has died or is diseased.
- Repair the stormwater structures for erosion or undercutting as needed.
- Repair any erosion in the facility, including sloughing, animal burrows and slopes.
- Repair any deterioration at the outfall of the facility, including the riprap outlet protection.
- Remove blockages of all trash racks, inlets and outlets.
- Maintain adequate access to the facility and remove woody vegetation as needed.
- Exercise valves to prevent them from locking up where applicable.
- Remove all trash, debris and floatables periodically from the facility.

5.2 Corrective Maintenance

Corrective maintenance is any maintenance that should be addressed for the facility to properly function in accordance with the plans. These items require more intensive repair efforts and should be addressed as a higher priority than routine maintenance. If there are structural deficiencies, or issues that raise the water level in the facility beyond the design requirements, corrective action is required and should be conducted as soon as possible to prevent downstream damage to properties and/or the environment. Upon being identified during an inspection, corrective maintenance should be conducted within one (1) year of the inspection contingent on complexity. Reasonable progress steps should at least be taken.

Examples of Corrective Maintenance include:

- Repair any deterioration or issues with the principal spillway and riser, such as evidence of spalling, joint failure, leakage, corrosion, etc.
- Extensive sediment removal is required when inspections indicate that 50% of the forebay sediment storage capacity has been filled.
- Control or remove invasive species when their coverage exceeds 15% of a wetland cell as soon as possible. Take care to preserve the designed plantings and vegetation.

- All woody vegetation should be removed from the embankment, if present, to prevent structural damage. Additionally, removal of growth should be considered more frequently if there are impacts to the storage volume (i.e. water levels rise because the vegetation is taking up the water storage space).

Further information on maintenance recommendations for various stormwater BMPs can be found at the Virginia BMP Clearinghouse at: *http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html*

Appendix A: Salem Post-Construction Stormwater Facility Inspection Forms

Separate forms are provided for:
(1) Detention, Retention and Extended Detention Basins
(2) Bioretention

Note that plans should be referenced for inspection of underground and proprietary BMPs.

Appendix B: Salem Post-Construction BMP Maintenance Follow-up Form