

BACKGROUND

The Clean Water Act, passed in 1972, is the cornerstone of surface water quality protection in the United States. The goal of the Clean Water Act is to restore and maintain the nation's waters so that they can support "the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water". The initial emphasis of the Clean Water Act was on point source pollution discharges from industry and municipal sewage facilities, discharges that could be identified as coming from a specific source, a specific point. And that continues to be a major focus of the National Pollutant Discharge Elimination System (NPDES) program.

After years of issuing NPDES permits and regulating point source discharges, the issue of pollution from non-point discharge (stormwater runoff) became a priority. The passage of the Water Quality Act in 1987 granted the EPA authority to regulate stormwater runoff through state administered programs. Phase I communities (cities with populations of 100,000 or greater) were first required to establish stormwater management programs and apply for discharge permits from the state. More recent legislation has expanded stormwater programs to include smaller communities like the Town of Harrisburg. These Phase II rules require programs that include the development and implementation of six specified measures that reduce stormwater pollution. The "six minimum measures" are as follows:



Non-point litter and pollutants impair our waterbodies

1. Public education and outreach on stormwater impacts.
2. Public involvement and participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management for new development and re-development.
6. Pollution prevention/good housekeeping for municipal operations.

The North Carolina Division of Water Quality issued a NPDES Stormwater permit to Harrisburg in 2005. The permit allows Harrisburg to discharge stormwater from its municipal separate storm sewer system (MS4) to the receiving water when managed to the intent of Phase II and the six minimum measures.

ROLE OF STORMWATER MANAGEMENT

Harrisburg maintains a stormwater management plan fashioned around the six minimum measures and best management practices selected by the Town. The stormwater management plan is the tool of compliance with Harrisburg's Permit. It includes best management practices put in place by the Town to manage the quality and occurrence of stormwater runoff. The objectives of the plan are to:

- Protect human life and health.
- Improve the quality of stormwater runoff discharge to surface waters and groundwater.

- Minimize private and public property damage resulting from erosion, sedimentation, and flooding.
- Prevent new development and redevelopment from creating a demand for public investment in flood-control and water quality improvement works.
- Provide an effective stormwater management system that will not result in excessive public or private monies being used for maintenance and replacement of existing portions of the stormwater system.
- Facilitate the design of drainage systems that are consistent with good engineering practice and design and in accordance with the County's overall planning efforts and stormwater management planning.
- Provide a mechanism that allows development with minimum adverse effects to the natural environment.
- Encourage preservation of the natural drainage systems in an aesthetically pleasing condition as best possible.

Three primary best management practices implemented in Harrisburg include the development of this manual, a Stormwater Quality Ordinance and the position of a Stormwater Administrator. These items are tools by which the stormwater management plan is implemented.

OBJECTIVE OF THIS MANUAL AND THE ORDINANCE

This manual is developed to aide the public in understanding the requirements of Harrisburg in managing stormwater runoff. It is intended for use by developers and design professionals in planning and designing new developments with better site design and prudent stormwater management. It may also be used by the public to become more familiar with stormwater management and surface water protection on existing developments and around homes and businesses. The manual is divided into the following chapters:

- Chapter 1 – Introduction
- Chapter 2 – Plan Development and Submittal Process
- Chapter 3 – Design Standards
- Chapter 4 – BMP and Stormwater System Maintenance
- Chapter 5 – Illicit Discharge Detection and Elimination
- Chapter 6 – Definitions
- Appendices

Harrisburg developed a Stormwater Quality Ordinance with the assistance a stakeholder committee composed of public citizens. The Ordinance was adopted in 2007 and seeks to meet its general purpose through the following specified objectives and means:

1. Establishing decision-making processes for development that protects the integrity of watersheds and preserves the health of water resources.
2. Requiring that new development and redevelopment maintain the pre-development hydrologic response in their post-development state as nearly as practicable for the applicable design storm to reduce flooding, steambank erosion, nonpoint and point source pollution and increases in stream temperature, and to maintain the integrity of stream channels and aquatic habitats.
3. Establishing minimum post-development stormwater management standards and design criteria for the regulation and control of stormwater runoff quantity and quality.

4. Establishing design and review criteria for the construction, function, and use of structural stormwater BMPs that may be used to meet the minimum post-development stormwater management standards.
5. Encouraging the use of better management and site design practices, such as the use of vegetated conveyances for stormwater and the preservation of green space, riparian buffers, and other conservation areas to the maximum extent practical.
6. Establishing provisions for the long-term responsibility for and maintenance of structural and nonstructural stormwater BMPs to ensure that they continue to function as designed, are maintained appropriately, and pose no threat to public safety.
7. Establishing administrative procedures for the submission, review, approval and disapproval of stormwater management plans, for the inspection of approved projects, and to assure appropriate long-term maintenance.
8. Controlling illicit discharges into the municipal separate stormwater system.
9. Controlling erosion and sedimentation from construction activities.

ROLE OF KEY PERSONNEL

Harrisburg Town Council designated a Stormwater Administrator position to administer and enforce the Stormwater Quality Ordinance. Duties include issuance of stormwater permits for new development and subsequent field inspections for final approvals (post-construction stormwater management).

The Stormwater Administrator as part of the Town's Public Works Department will also develop and manage programs for the following: public education/involvement, illicit discharge and elimination, pollution prevention/good housekeeping for Town operations. Correspondence should be sent to the following address:



Harrisburg Town Hall

Stormwater Administrator
4100 Main Street, Suite 101
Harrisburg, NC 28075
Telephone: (704) 455-5614

The Cabarrus County Development Services Department has manages construction site runoff control (sediment/erosion control) for the entire county. Harrisburg's stormwater management plan provides for Cabarrus County to continue this service to the public. Plans and questions should be submitted to an Erosion Control Specialist at the following address:

Cabarrus County Environmental Protection Division
65 Church Street
PO Box 707
Concord, NC 28206
Telephone: (704) 920-2192

PERMIT PROCESS

Effective January 1, 2008, a stormwater management permit is required for all:

- Development (including but not limited to site plan applications, subdivision applications, and grading application) or a part of a larger common development plan that cumulatively disturbs more than 10,000 square feet must comply with the provisions of the Harrisburg Stormwater Quality Ordinance.
- Redevelopment that cumulatively disturbs more than one acre or a part of a larger common development plan that cumulatively disturbs more than one acre must also comply with the provisions of the Harrisburg Stormwater Quality Ordinance.

The applicant shall engage in the outlined process below to receive a stormwater management permit. This permit governs the design and construction of stormwater management control practices on the site including structural best management practices (BMPs). Guidance on the Permit Application process is shown on pages 2-4.

Applicants are advised to read and review both the Stormwater Quality Ordinance and this Manual before preparing any plans or documents. The submittal of a Concept Plan and consultation meeting with the Stormwater Administrator are required before any detailed drawings can be submitted for review. Gather and compile the necessary information for a Concept Plan and contact the Stormwater Administrator to schedule a consultation meeting. The applicant should complete Form A (see Appendix) and submit the form with the Concept Plan prior to the consultation meeting.

Upon approval of a Concept Plan and after the consultation meeting, applicants must complete Form B (see appendix) and submit two sets of stormwater management plans with one set of calculations for their proposed development. Also required is a signed, detailed Maintenance Agreement (Form C in the Appendix) as an attachment. If the Stormwater Administrator finds that an application is incomplete, the applicant shall be notified of the deficient elements and shall be provided with an opportunity to submit a complete application.

The Town will review complete submittals and related materials within 30 working days. Submittals disapproved and requiring a subsequent submittal should be submittal within 30 working days to be considered part of the original submittal or subject to additional application fees.

Once the permit is issued and construction has begun there will be periodic inspections for compliance. Once the work is completed “as-built” drawings shall be submitted in order for the Stormwater Administrator to conduct a final inspection and verify information in the recorded plat. Only after final inspection and approval can certificates of occupancy be issued.

CONCEPT PLAN REQUIREMENTS

A Concept Plan is required prior to submittal of detail drawings and stormwater management plan. The purpose of the Concept Plan and consultation meetings is to present the details of the development and identify potential site restrictions prior to design. It is beneficial both to the Stormwater Administrator and developer or design professional, as they may become familiar with Harrisburg standards and processes. The Concept Plan should include the following components at a minimum and does not require the seal or signature of a registered, North Carolina Professional Engineer.

A written or graphic concept plan of the proposed post-development stormwater management system including:

- Preliminary selection and location of proposed structural stormwater controls
- Location of existing and proposed conveyance systems such as grass channels, swales, storm drains, and flow
- Location of floodplain/floodway limits;
- Relationship of site to upstream and downstream properties and drainages
- Preliminary location of any proposed stream channel modifications, such as bridge or culvert crossings

Mapping of these features:

- Existing and proposed topography,
- Perennial and intermittent streams, to be mapped per the Identification Methods of the Origins of Intermittent and Perennial Streams published by North Carolina Division of Water Quality
- Predominant soils from NRCS soil surveys,
- Boundaries of existing predominant vegetation,
- Proposed limits of clearing and grading, and
- Location of existing and proposed roads, buildings, parking areas and other impervious surfaces.

Finally, it should include a written or graphic inventory of the natural resources at the site and surrounding area as it exists prior to the commencement of the project. This description should include a discussion of these features:

- Soil conditions,
- Forest cover,
- Geologic features,
- Topography,
- Wetlands,
- Native vegetative areas on the site,
- Location and boundaries of other natural feature protection and conservation areas such as lakes, ponds, floodplains, stream buffers, and
- Other setbacks (e.g., drinking water well setbacks, septic setbacks, etc.).

STORMWATER PLAN REQUIREMENTS

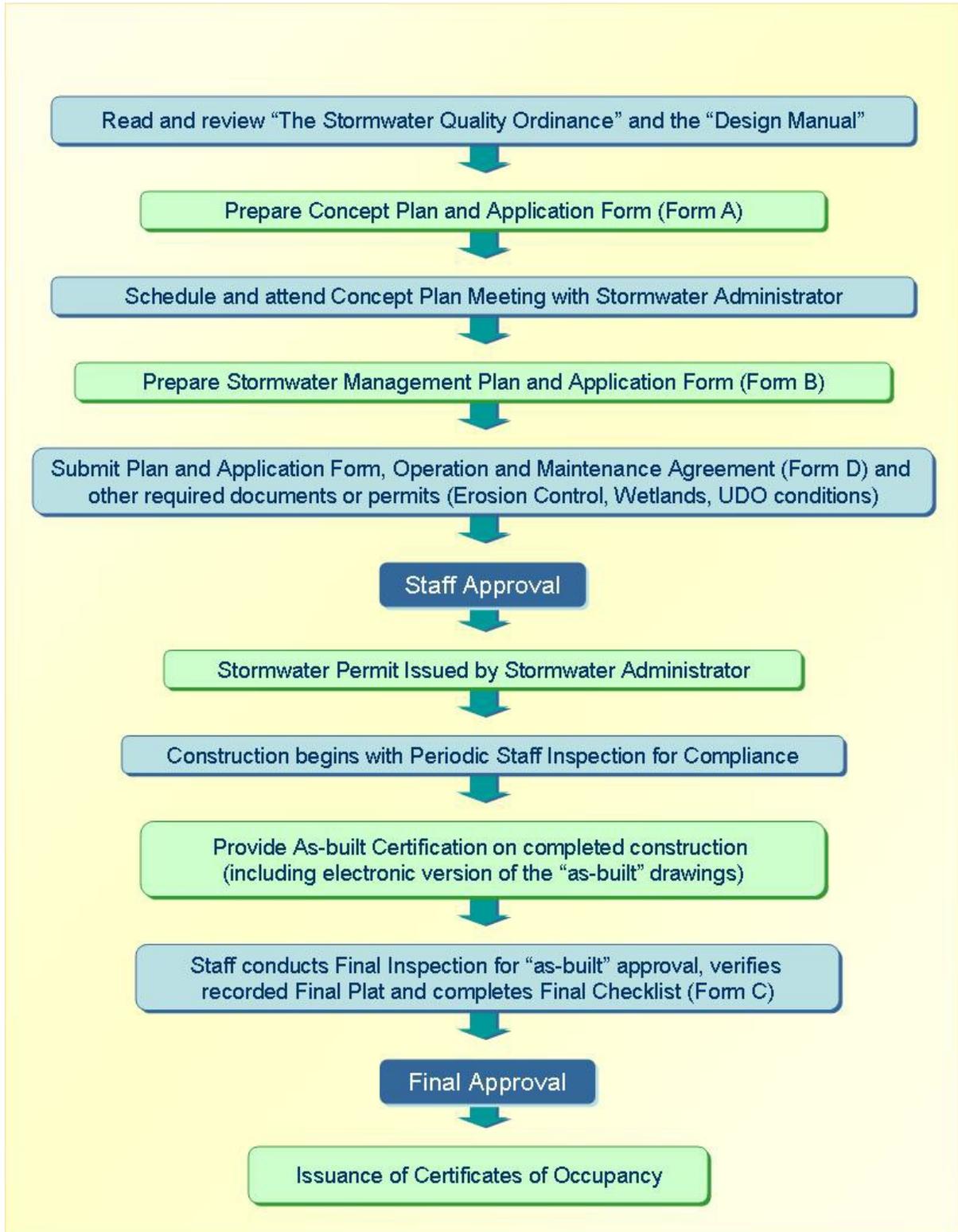
Upon approval of a Concept Plan and after meeting the Stormwater Administrator for the consultation meeting the applicant shall submit a stormwater management plan to be reviewed by the Town and permitted for construction. The plan shall detail how post-development stormwater runoff will be controlled and managed and how the proposed project will meet the requirements of the Stormwater Quality Ordinance, including Section 3, Standards. Plans shall be prepared by a qualified registered North Carolina professional engineer and the engineer shall perform services only in their area of competence. They shall also verify that the design of all stormwater management facilities and practices meets the submittal requirements for complete applications that the designs and plans are sufficient to comply with applicable standards of this Ordinance and policies found in this Manual. Supporting data analysis, such as spreadsheet calculations, model input and output, sketches, hand calculations, etc should be bound, labeled, and submitted along with the plans.

Also, as a condition of the stormwater management permit is the submittal of Form C in the Appendix. Form C is a Maintenance Agreement that binds the perpetual owner of the structural BMPs to the financial and physical operation and maintenance of those structures or facilities. Additional requirements of the stormwater management permit include other agency permits, where necessary, such as the Erosion and Sediment Control permit, Wetlands permit, or conditions of the Unified Development Ordinance (UDO). The stormwater management permit allows for periodic inspections of the development by the Town to ensure compliance with proposed designs.

AS-BUILT CERTIFICATION

Upon completion of a project, and before a certificate of occupancy shall be granted, the applicant shall certify that the completed project is in accordance with the approved stormwater management plans and designs, and shall submit actual “as built” plans for all stormwater management facilities or practices after final construction is completed. Electronic versions of the “as-built” plans shall accompany any hardcopy submittal of plans.

The plans shall show the final design specifications for all stormwater management facilities and practices and the field location, size, depth, and planted vegetation of all measures, controls, and devices, as installed. The designer of the stormwater management measures and plans shall certify, under seal, that the as-built stormwater measures, controls, and devices are in compliance with the approved stormwater management plans and designs and with the requirements of this Ordinance. A final inspection and approval by the Stormwater Administrator shall occur before the release of any performance securities for structural BMPs. Form 1-C in the Appendix presents a checklist to be completed and submitted to the Town at the final inspection and approval.

STORMWATER PLAN SUBMITTAL AND PERMIT PROCESS

DESIGN GUIDANCE

There are many manuals, textbooks, guidance documents, and software available to the design professional to design and evaluate the components of a stormwater drainage system. The Town of Harrisburg encourages the design professional to employ any necessary tools to perform the required analysis and drafting of the design. This Manual does not attempt to provide that guidance on a level of step by step instruction but references the design professional to other manuals it has deemed sufficient in providing the necessary methodologies to perform the engineering analysis.

For specific instruction on performing the engineering analysis of a component of the stormwater drainage system, the Town of Harrisburg references the Concord Technical Standards Manual for Stormwater. Please obtain the most recent version of the Concord Technical Standards Manual when referenced. The Technical Standards Manual includes comprehensive guidance on analyzing and designing stormwater drainage components. It also provides commonly used values and suggested software and example problems for demonstration.

For specific design requirements of structural BMPS, the Town of Harrisburg references the North Carolina Department of Environment and Natural Resources Stormwater Best Management Practices Manual dated July 2007. Stormwater treatment practices designed, constructed and maintained in accordance with this Manual will be presumed to meet the performance standards of the Ordinance. The Manual provides several stormwater practices for use but for a practice not identified in the Manual, the applicant shall have the burden of demonstrating conformance with the Ordinance.

The Town has outlined key Technical Design Standards by which all analysis shall be performed by and the design of stormwater practices followed. This list of Standards is not an exclusive set but a set of commonly applied Standards that provide a basis of design and performance. Review of Concept Plans or discussion from the consultation meeting may result in the incorporation of additional or a higher level of standards. If the Technical Design Standards present a conflict with standards presented in the other referenced manuals, the Standards in this Chapter shall supersede.

TECHNICAL DESIGN STANDARDS

A stormwater drainage system shall be provided for public streets and adjoining properties desiring adequate drainage (positive drainage). Stormwater drainage systems consists of positively graded or constructed flow paths to inlets for collection of stormwater runoff; pipes and culverts for the conveyance stormwater runoff; swales and channels for surface conveyance of stormwater runoff, detention structures for capturing volume and attenuating peak flows; and structural BMPs for treating or capturing water quality pollutants. The design professional shall observe the design guidance provided above and the following Design Standards listed here when designing and constructing stormwater drainage systems in Harrisburg.

Stormwater Runoff Calculations

Stormwater runoff calculations are estimated to size structural BMPs and stormwater management systems for various capacities and hydraulic loadings. Typical calculations include peak discharge, water quality volumes, and bank full capacities for channels and swales. The following outlines standards for performing commonly used estimation techniques. Please refer to Section Two of Concord's Technical Standards Manual or Chapter Three of the North Carolina's Stormwater Best Management Practices Manual for additional guidance.

Stormwater runoff can be determined using the SCS Curve Number method or other approved stormwater runoff estimation techniques. The SCS Curve Number method or other volumetric method is required for all development involving a drainage area of 20 acres or greater. When using the SCS Curve Number method, the analysis shall include rainfall event duration of 24-hours, using the Soil Conservation Service (SCS), Type II rainfall distribution with a maximum 6-minute time increment. The following table provides 24-hour rainfall depths for Harrisburg.

TABLE 3-1						
RAINFALL DEPTH (Inches) FOR THE TOWN OF HARRISBURG						
Return Period [years] – 24-hour Storms						
1	2	5	10	25	50	100
2.9	3.5	4.4	5.1	6.0	6.8	7.6
Source: Point Precipitation Frequency Estimates from NOAA Atlas 14, NOAA Precipitation Frequency Data Server, 2007						

Curve numbers are obtained from the SCS TR-55 table. A copy of this table is provided on the following page (Table 3-3). Soils data is available in hard copy format from NRCS soil surveys and electronically at no cost from the NRCS Soil Data Mart included in the References.

Smaller drainage areas are permitted to have their runoff calculations estimated by the Rational Method or Simple Method. These methods rely on rainfall intensity or a prescribed water depth; such is the case for the Simple Method when performing water quality volume calculations. The following table provides 24-hour rainfall intensities for Harrisburg.

TABLE 3-2						
RAINFALL INTENSITY (Inches/hour) FOR THE TOWN OF HARRISBURG						
Return Period [years] – 24-hour Storms						
1	2	5	10	25	50	100
0.12	0.14	0.18	0.21	0.25	0.28	0.31
Source: Point Precipitation Frequency Estimates from NOAA Atlas 14, NOAA Precipitation Frequency Data Server, 2007						

Runoff coefficients can be found in the table provided on a following page (Table 3-4). Post development runoff coefficients should represent entire build out of the drainage area even if the balance of the area is not being developed currently.

TABLE 3-3					
RUNOFF CURVE NUMBER FOR URBAN AREAS AND AGRICULTURAL LANDS¹					
NRCS (SCS) CN METHOD					
Cover Description Cover Type and Hydrologic Condition	Average Percent Impervious Area²	Curve Numbers for Hydrologic Soil Group			
		A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc) ³		68	79	86	89
Poor Condition (grass cover < 50%)		49	69	79	84
Fair Condition (grass cover 50% to 75%)		39	61	74	80

Cover Description Cover Type and Hydrologic Condition	Average Percent Impervious Area ²	Curve Numbers for Hydrologic Soil Group			
		A	B	C	D
Good Condition (grass cover >75%)					
Impervious areas: Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads: Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Urban districts: Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size: 1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
<i>Developing urban areas and agricultural land</i>					
Newly graded areas (pervious areas only, no vegetation)		77	86	91	94
Pasture, grassland, or range: continuous forage for grazing ⁴	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow: continuous grass, protected from grazing and generally mowed for hay	-	30	58	71	78
Brush-brush, weed, grass mixture with brush the major element ⁵	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	⁷ 30	48	65	73

Source: NRCS (SCS), TR-55, second Edition, June 1986

¹ Average runoff condition, and $I_a = 0.2S$

² The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. If the impervious area is not connected, the NRCS (SCS) method has an adjustment to reduce the effect.

³ CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space cover type.

⁴ Poor: <50% ground cover or heavily grazed with no mulch.
Fair: 50% to 75% ground cover and not heavily grazed.

Good: >75% ground cover and lightly or only occasionally grazed.

⁵ Poor: <50% ground cover

Fair: 50% to 75% ground cover

Good: >75% ground cover

⁶ CNs shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CNs for woods and pastures.

⁷ Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.

TABLE 3-4 RECOMMENDED RUNOFF COEFFICIENT "C" VALUES RATIONAL METHOD	
Description of Area	Runoff Coefficients "C"
Lawns:	
Sandy soil, flat, 2%	0.10
Sandy soil, average, 2 - 7%	0.15
Sandy soil, steep, > 7%	0.20
Clay soil, flat, 2%	0.17
Clay soil, average, 2 - 7%	0.22
Clay soil, steep, > 7%	0.35
Business:	
Downtown areas	0.95
Neighborhood areas	0.70
Residential:	
Single-family areas	0.50
Multi-units, detached	0.60
Multi-units, attached	0.70
Suburban	0.40
Apartment dwelling areas	0.70
Industrial:	
Light areas	0.70
Heavy areas	0.80
Parks and cemeteries	0.25
Playgrounds	0.35
Railroad yard areas	0.40
Unimproved areas (forest)	0.30
Streets:	
Asphalt and Concrete	0.95
Brick	0.85
Drives, walks, and roofs	0.95
Gravel areas	0.50
Graded or no plant cover	
Sandy soil, flat, 0 - 5%	0.30
Sandy soil, flat, 5 - 10%	0.40
Clayey soil, flat, 0 - 5%	0.50
Clayey soil, average, 5 - 10%	0.60

Inlets and Catch Basins

Inlets and catch basins represent the initial point of collection for stormwater drainage systems. They intercept the runoff and transmit the stormwater to an underground storm sewer system or route it to system of surface swales or channels. Typical inlet and catch basin calculations include spread width and depth for street and curb sections and capacity and overflow calculations for inlets. The following provides standards to observe when analyzing and designing inlets and catch basins. Please refer to Section Three and Four of Concord's Technical Standards Manual for additional guidance.

- Design intensity for inlets and catch basins - 4 inches per hour
- Local and single-lane collector roadways, spread in a travel lane should not exceed 6 feet at any given section and 8 feet with a standard curb and gutter section.
- For arterial and multi-lane collector roadways, spread should not exceed one-half of a travel lane on a two-lane roadway and may encroach a full travel lane on a four-lane roadway.
- No curb overtopping may occur in sags.
- Depth of spread should not exceed 6 inches.
- Inlet spacing along curb and gutter lines should not exceed 500 feet.
- Catch basins should be placed at lot lines to avoid conflict with driveways.
- Yard inlet catch basins shall be NCDOT 840.04 or 840.05
- Curb and gutter catch basins shall be designed to Drawings 10 and 11 in the Appendix C of the Harrisburg UDO or similar NCDOT standard.

Pipes and Culverts

Pipe and culverts convey stormwater runoff from inlet and catch basin systems to detention structures, structural BMPs, or major drainage ways. Typical pipe and culvert calculations include flow capacity and velocity and erosion and scour analysis. Please refer to Sections Five and Seven of Concord's Technical Standards Manual for additional guidance. When designing pipes and culverts for conveyance of stormwater away from streets and impervious areas the following design storm events shall be used:

- Storm sewer collectors - 10-year storm
- Cross drainage on secondary roads - 25-year storm
- Culverts under or through the roadway - 25-year storm
- Culverts under or through major thoroughfare roads - 50-year storm
- The 100-year design storm shall be routed through the pipe or culvert system to determine that no finished floor of residential dwellings, public, commercial, and industrial buildings will be inundated by the 100-year floodwater surface elevation.

Other design considerations and performance criteria include:

- The minimum pipe diameter shall be 15 inches. The minimum slope on all 15" pipe shall be 0.5%.
- Pipes larger than 15 inches should have a slope such that 2.5 feet per second minimum velocity is obtained for the 2-year design storm flow.
- Maximum pipe velocity for all pipes is 10 feet per second.
- A freeboard of 18 inches shall be maintained for all roads and surrounding structures on design storms other than the 100-year.
- HW/D (head water depth/diameter) limitations shall consider maintaining the $HW/D < 1.5$ for culverts with cross section area less than or equal 30 square feet and maintaining the $HW/D < 1.2$ for culverts with cross sectional area greater than 30 square feet.

- RCP (minimum Class III) is suggested material for all slopes less than or equal to 12%. Other pipe material may be used only with specific approval by the Town.
- Corrugated aluminized steel pipe (Type 2) (minimum 16 gauge) shall be used for slopes greater than 12%.
- Storm sewer pipes shall be placed at least 5 feet horizontally from all water and sanitary sewer mains. Publicly maintained drainage pipe shall be located within the right-of-way at intersections and under pavement/curb elsewhere in street cross-section.
- Storm sewer pipes shall be placed a minimum of 24 inches below sub-grade. Pipe diameters 30 inches and larger shall be deep enough to accommodate drainage structures.
- Storm sewers pipes shall be designed to be deeper than the water mains but shallower than the sanitary sewer mains and shall have a minimum of 12 inches of vertical clearance from water and sanitary sewer mains.
- All storm drain systems should be analyzed to establish the hydraulic grade line. No storm drain system should surcharge or operate under pressure for the design storm.
- All storm drainage easements shall be shown on the plan sheet and labeled, “Public Storm Drainage Easement.” Minimum width shall be 30 feet.
- Storm drainage pipe and structure information shall be listed on each sheet of plan and profile drawings. This information shall include pipe diameter, material, length, slope, rim elevation, invert elevation, grate type, and the drainage area and flow into the pipe structure. This information should be written in a table format with corresponding pipe or structure numbers shown in plan view.

Open Channels and Swales

Open channels and swales provide an opportunity for surface water conveyance rather than an underground storm sewer system. Channels offer a higher conveyance capacity than pipes, albeit at lower velocity, and swales when constructed properly can assist in capturing stormwater pollutants and infiltrating stormwater runoff (i.e. less volume to control). Typical channel and swale calculations include flow capacity and velocity and erosion and scour analysis. Please refer to Section Six of Concord’s Technical Standards Manual for additional guidance on channel analysis and design and Chapter 14 of the North Carolina’s Stormwater Best Management Practices Manual for additional guidance on swales. When designing channels and swales the following design standards shall be observed. Use open channel standards to design conveyance that drain areas larger than five acres and swale standards for smaller drainage areas.



Typical vegetated swale

- Design storm for swales - 10-year storm shall be maintained within the bank full elevation.
- Design storm for open channels - 10-year storm shall be maintained below its freeboard height and the 25-year event below its bank full elevation.
- The 100-year design storm shall be routed through the channel system to determine that no finished floor of residential dwellings, public, commercial, and industrial buildings will be inundated by the 100-year floodwater surface elevation.
- The open channel side slopes shall stable for the entire length and not exceed a slope 2:1 (H:V).
- For open channels three feet or less in depth, 6 inches of freeboard shall be provided.

- For open channels deeper than three feet and up to five feet in depth, one foot of freeboard shall be provided. Open channels deeper than 5 feet shall maintain a freeboard of 18 inches.
- Permissible velocities shall be consistent with surface linings used. A list of permissible velocities by surface lining is available in the referenced manuals.

Detention Structures

Prior to discharge of stormwater runoff to receiving waters and channels, stormwater drainage system incorporate a detention structure to capture the increased runoff volume for storage and extended release. This practice of attenuating peak flow attempts to control runoff velocities and volumes to undisturbed landscape levels. With a higher emphasis on water quality of stormwater runoff now, detention structures are incorporating treatment measures to shift them into structural BMPs. Typical detention calculations include peak discharge, volume, and exit velocity. Please refer to Section Eight of Concord's Technical Standards Manual additional guidance on detention analysis and design and applicable Chapters of the North Carolina's Stormwater Best Management Practices Manual for depending of the type of detention facility planned. When designing detention structures the following design standards shall be observed.

- Design storms for detention structures – 1- and 10-year storm
- Storage volume shall be adequate to control post-development peak discharges to pre-development peak discharges for the design storms.
- Runoff volume drawdown time shall be between 48 to 120 hours for the extended detention volume. Extended detention volume is the volume of runoff to be stored and released. It is not to be confused with the permanent volume found in wet ponds.
- An emergency overflow shall be adequately designed for the 50-year discharge and constructed.
- Detention facilities shall discharge its volume at non-erosive velocities for the design storm via an energy dissipation device or zone.

Structural BMPS

Structural BMPs represent the end of the line for most stormwater drainage systems and consequently perform the treatment of the water quality of the stormwater runoff prior to discharge to receiving waters. Structural BMPs may be constructed separately from higher volume detention structures or incorporated as part of them. Typical structural BMP calculations include water quality volume and discharge velocity. Please refer to North Carolina's Stormwater Best Management Practices Manual for determining, locating, designing, constructing, and maintaining a variety of structural BMPs. All development and redevelopment meeting the conditions on page 2-1 shall implement structural BMPs that comply with each of the following standards.

- Design storm for peak discharge control – 1- and 10-year storm
- Post-development peak discharges must be controlled to pre-development discharges for the design storms
- Control and treat at a minimum, the stormwater runoff from the first one (1) inch of rain.
- Runoff volume drawdown time shall be between 48 to 120 hours.
- Stormwater treatment systems shall be designed to have a minimum of 85% average annual removal for total suspended solids.

The North Carolina's Stormwater Best Management Practices Manual provides siting guidance, design procedures, and maintenance steps and schedules for a range of structural BMPs. Due to environmental limitations found in Harrisburg and the Town's working experience with certain BMPs, the Town recommends the following structural BMPs for use. This does not preclude the use

of other listed BMPs however, these limitations may require additional site preparation or performance demonstration on behalf of the developer or engineer to permit their usage.

- Level Spreader
- Stormwater Wetlands
- Wet Detention Basin (Wet Pond)
- Sand Filter
- Bioretention
- Filter Strip
- Grass Swale
- Reforested Riparian Buffer
- Infiltration Device
- Dry Extended Detention Basin (Dry Pond)
- Permeable Pavements Systems
- Rooftop Runoff Management
- Proprietary Systems



Bioretention Area

STORMWATER MAINTENANCE

The performance of structural BMPs and stormwater drainage systems is diminished when routine maintenance is not performed. A lack of attention to maintenance can jeopardize the systems ability to perform as intended possibly resulting in flooding and erosion. Flooding and uncontrolled stormwater runoff could lead to inundated structures, like houses and outbuildings, erosion of yards,



Storm sewer inlet failure

driveways, and roads and ultimately damage to personal property. The Town intends to reduce the potential for hazards due to a lack of maintenance by requiring developers and subsequently the owners of BMPs to enter into an Operation and Maintenance Agreement (Form D in appendix).

The operation and maintenance of structural BMPs is the sole responsibility of the property owner(s). A signed Maintenance Agreement must be received by the Stormwater Administrator prior to plan approval and permit issuance. It shall be referenced on the final plat and shall be recorded with the county Register of Deeds

upon final plat approval. A copy of the recorded maintenance agreement shall be given to the Stormwater Administrator within fourteen (14) days following its recordation. This agreement shall require timely maintenance, repair, and even replacement if necessary on behalf of the owner. The agreement shall also include appropriate maintenance schedules (see appendix). As part of the agreement, the owner will be required to perform annual inspections of their BMPs and submit a report to the Town. This is a requirement of NPDES Phase II.

ANNUAL MAINTENANCE REPORT

The property owner, who is responsible for maintenance of any structural BMP, shall submit an annual inspection report from a qualified registered North Carolina professional engineer (Form E in appendix). The report shall be submitted annually prior to the anniversary date of the final construction inspection and as-built certification. The report at a minimum shall include the following:

- The name and address of the owner,
- The recorded book and page number of the lot of each structural BMP,
- A statement that an inspection was made of all structural BMPs,
- The date the inspection was made,
- A statement that all inspected structural BMPs are performing properly and comply with the terms and conditions of the approved maintenance agreement required by this Ordinance,
- The original signature and seal of the engineer inspecting the structural BMPs, and
- Digital photographs of the structural BMPs and pertinent components integral to its operation, including but not limited to inlet/outlet control structures, downstream receiving channel/area, embankments and spillways, safety features, and vegetation.

Forms for documentation of the inspection are provided in the Appendix and are intended to be copied for multiple use. Pursuant to the Stormwater Quality Ordinance the property owner of the structural BMPs is required to maintain copies of inspection forms at least five (5) years from the date of creation of the record and shall submit the same upon reasonable request to the Stormwater Administrator.

MAINTENANCE RECORDS AND INSPECTIONS

The effectiveness of each of the structural BMPs described in the previous section depends upon appropriate design and maintenance. Many of the health and safety concerns that may arise when the structural BMPs or stormwater drainage systems are installed can be addressed by the required maintenance plan. The maintenance plan must address both maintenance and monitoring procedures and is intended to prevent:

- Conditions of blocking, hindering or obstructing the natural or intended flow of surface waters;
- Improper operation of stormwater retention or impoundment device or any structure or device used for the improvement of the quality of surface runoff;
- Any condition that would damage the Town's stormwater collection system or that would harm the quality of the Town's waters; and
- Any conditions specifically declared to be dangerous to the public health, safety, and general welfare of the Town's inhabitants.

Failure to properly operate and maintain stormwater facilities and BMPs in accordance with the approved Stormwater Plan is a violation of the Town's Stormwater Quality Ordinance. Please use the maintenance schedules provided in the Appendix in the development of a maintenance plan.

TOWN INSPECTION

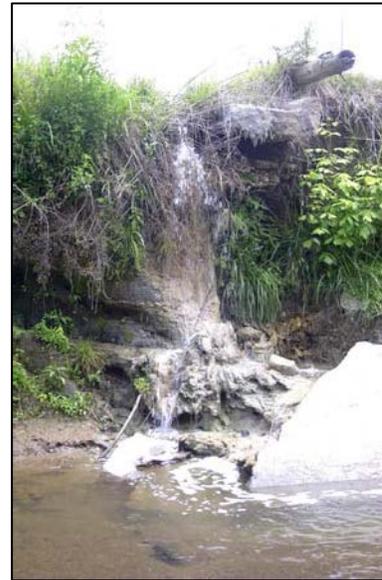
The Town may conduct inspections or develop an inspection program on any reasonable basis. The nature of these inspections may include but are limited to routine inspections; random inspections; inspections based upon complaints or other notice of possible violations; and joint inspections with other agencies inspecting under environmental or safety laws. Inspection activities may include, but are not limited to, reviewing maintenance and repair records; sampling discharges, surface water, groundwater and material or water in structural BMPs; and evaluating the condition of structural BMPs. If the owner or occupant of any property refuses to permit such inspection, the Stormwater Administrator shall proceed to obtain an administrative search warrant pursuant to G.S. 15-27.2 or its successor. No person shall obstruct, hamper or interfere with the Stormwater Administrator while carrying out the official duties of the Town.

ILLICIT DISCHARGES

What are illicit discharges and when did they become illegal?

There exists public confusion that the stormwater drainage system is either connected to the sanitary sewer system or is the same system. Therefore, many people either have connected wastewater connections to or discharged to the storm sewer system thinking the waste would be treated at some point. This is not the case; in fact, many storm sewer systems connect directly to our receiving waters with no treatment whatsoever. Unknowingly, water quality violations are being committed and the Town as owner and operator the MS4 is responsible. The Town will address illicit discharges through a comprehensive effort.

1. Make illicit connections (i.e. structural features conveying non-stormwater) and discharges (i.e. acts of discharging non-stormwater) illegal by the Stormwater Quality Ordinance punishable by civil and criminal penalties.
2. Develop awareness in the community on the function of the MS4 and prohibited discharges to it through a public education and outreach program.
3. Prohibit the creation of any new illicit connections through inspection of stormwater management plans.
4. Identify illicit discharges and connections through mapping efforts of stream outfalls.
5. Respond to public complaints regarding illicit discharge or dumping activities. Citizens can contact the Town Hall to report any illegal activity.



Illicit discharge to stream

The public should refrain from dumping or discharging any liquid or solid matter onto the ground or into any inlet, catch basin, channel, or stream. However, the following discharges and practices are acceptable under the Clean Water Act for discharge to receiving waters and do not require a permit.

ACCEPTABLE NON-STORMWATER DISCHARGES TO THE MS4	
Waterline Flushing	Springs
Uncontaminated Rising Ground Water	Lawn Watering
Discharges from potable water sources	NPDES permitted discharges
Irrigation Water	Diverted Stream Flows
Uncontaminated Footing Drains	Uncontaminated Pumped Ground Water
Flows from Riparian Habitats and Wetlands	Uncontaminated Air Conditioning Condensation
Dechlorinated backwash and draining associated with swimming pools	Uncontaminated Water from Crawl Space Pumps
Landscape Irrigation	Non-commercial Car Washing
Uncontaminated Ground Water Infiltration to Stormwater collection system	Street wash water
Uncontaminated Foundation Drains	

If you are witness to any illicit discharging or know the whereabouts of an illicit connection, you should contact Town Hall at (704) 455-5614. This includes spills and accidental discharges. Town



Storm sewers drain directly to streams

Hall is staffed with personnel trained to respond to your call and collect the details. Be prepared to provide specific details regarding the location, volume, color, odor, or known composition of the discharged material. If you perceive the discharge to be hazardous, do not hesitate and call 911 first. Caller may choose to remain anonymous and will be given an incident ID to follow back up with if they desire.

DEFINITIONS

Built-upon area (BUA)

That portion of a development project that is covered by impervious or partially impervious surface including, but not limited to, buildings; pavement and gravel areas such as roads, parking lots, and paths; and recreation facilities such as tennis courts. “Built-upon area” does not include a wooden slatted deck, the water area of a swimming pool, or pervious or partially pervious paving material to the extent that the paving material absorbs water or allows water to infiltrate through the paving material.

Development

Any land-disturbing activity that increases the amount of built-upon area or that otherwise decreases the infiltration of precipitation into the soil.

Larger common plan of development or sale

Any area where multiple separate and distinct construction or land-disturbing activities will occur under one plan. A plan is any announcement or piece of documentation (including but not limited to a sign, public notice or hearing, sales pitch, advertisement, loan application, drawing, permit application, zoning request, or computer design) or physical demarcation (including but not limited to boundary signs, lot stakes, or surveyor markings) indicating that construction activities may occur on a specific plot.

Municipal Separate Storm Sewer System (MS4)

A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

1. Owned and operated by a state, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to state law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under state law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act (CWA) that discharges to waters of the United States;
2. Designed or used for collecting or conveying stormwater;
3. Which is not a combined sewer; and
4. Which is not part of a publicly owned treatment works (POTW).

n-year, 24-hour storm

The surface runoff resulting from a 24-hour rainfall intensity expected to be equaled or exceeded, on average, 1 in n chances in 12 months.

NPDES

National Pollutant Discharge and Elimination System, a provision of the Clean Water Act which prohibits discharge of pollutants into waters of the United States unless a special permit is issued by EPA, a state, or, where delegated, a tribal government on an Indian reservation.

NRCS Soil Survey

A soil survey is a detailed report on the soils of an area with maps with soil boundaries and photos, descriptions, and tables of soil properties and features. Soil surveys are used by farmers, real estate

agents, land use planners, engineers and others who desire information about the soil resource. The survey is produced and published by the National Resources Conservation Service.

Owner

The legal or beneficial owner of land, including but not limited to a mortgagee or vendee in possession, receiver, executor, trustee, or long-term or commercial lessee, or any other person or entity holding proprietary rights in the property or having legal power of management and control of the property. “Owner” shall include long-term commercial tenants; management entities, such as those charged with or engaged in the management of properties for profit; and every person or entity having joint ownership of the property. A secured lender not in possession of the property does not constitute an owner, unless the secured lender is included within the meaning of “owner” under another description in this definition, such as a management entity.

Receiving Waters

All natural water bodies, including oceans, salt and freshwater marsh areas, lakes, rivers, streams, ponds, wetlands, and groundwater. Stormwater management ponds, wetlands, ditches, and swales constructed for the sole purpose of controlling and treating stormwater are excluded.

Redevelopment

Any development on previously developed land, other than a rebuilding activity that results in no net increase in built-upon area and provides equal or greater stormwater control than the previous development.

Sheet Flow

Conveyance of surface water or runoff at a depth significantly less than the width of the flow path on which it flows. Sheet flow is maintained until the flow begins to concentrate into rills or micro-channels. The purpose for sheet flow in regards to this Ordinance is that sheet flow maintains a lower energy and higher surface area of contact with the flow path than concentrated flow.

Stormwater Management Plan

Stormwater management plan or SWMP means the set of drawings and other documents that comprise all of the information and specifications for the programs, drainage systems, structures, BMPs, concepts, and techniques for the control and treatment of stormwater pursuant to the Harrisburg Stormwater Quality Ordinance

Stormwater Permit

An approval issued by the Town to the permittee that grants permittee the right to discharge stormwater to the Town’s MS4 or receiving waters where compliance with the requirements and conditions of the Harrisburg Stormwater Quality Ordinance are achieved through planning and engineering and maintained by operation and maintenance of post-construction stormwater management system.

Structural BMP

A physical device designed to trap, settle out, or filter pollutants from stormwater runoff; to alter or reduce stormwater runoff velocity, amount, timing, or other characteristics; to approximate the pre-development hydrology on a developed site; or to achieve any combination of these goals. Structural BMP includes physical practices such as constructed wetlands, vegetative practices, filter strips, grassed swales, and other methods installed or created on real property. “Structural BMP” is synonymous with “structural practice,” “stormwater control facility,” “stormwater control practice,” “stormwater treatment practice,” “stormwater management practice,” “stormwater control measures,” “structural stormwater treatment systems,” and similar terms used in this Ordinance.

USGS Maps

A series of topographic maps developed and published by the United States Geological Survey. The maps, also known as quadrangle maps, depict 7.5-minutes of the Earth's surface at 1:24,000 scale.

REFERENCES**Concord Technical Standards for Stormwater (November 2005)**

http://www.ci.concord.nc.us/devserve/tech_stand_0.asp

NOAA Atlas 14. NOAA Precipitation Frequency Data Server

http://hdsc.nws.noaa.gov/hdsc/pfds/orb/nc_pfds.html

North Carolina Department of Environment and Natural Resources Stormwater Best Management Practices Manual (July 2007)

http://h2o.enr.state.nc.us/su/bmp_forms.htm

North Carolina Intermittent and Perennial Stream Workshop

<http://www.ces.ncsu.edu/nreos/forest/feop/>

North Carolina Division of Water Quality Identification Methods for the Origins of Intermittent and Perennial Streams (February 2005)

http://h2o.enr.state.nc.us/ncwetlands/documents/NC_Stream_ID_Manual.pdf

NRCS Soil Data Mart

<http://soildatamart.nrcs.usda.gov/>

Town of Harrisburg Unified Development Ordinance

<http://www.co.cabarrus.nc.us/Commerce/ordinance/harrisburgudo.html>

BMP MAINTENANCE SCHEDULES

The following tables outline the specific maintenance tasks and frequency for each type of BMP. These tables represent a minimum set of tasks and prescribed schedules to perform maintenance. Routine and annual inspections might provide evidence to perform routine maintenance at a higher frequency indicated in the tables. Tables are presented for the following BMPs:

- Wet Pond
- Dry Pond
- Stormwater Wetland
- Bioretention Areas
- Sand Filter
- Infiltration
- Vegetative Channels and Swales
- Filter Strips

Wet Pond Maintenance Tasks and Schedule	
Task	Frequency
Forebay inspection and cleanout	Monthly inspection. Remove sediment every 7 years or whenever the sediment volume exceeds 50% of storage volume
Volume measurement	Yearly – Dredging needed every 20 years or when 25% of permanent pool volume has been lost
Bank mowing and inspection/stabilization of eroded areas	Monthly
Outlet/inlet inspection and cleanout	Monthly
Unwanted vegetation and trash removal	Monthly
Visual inspection of water quality	Monthly
Inspect/exercise all mechanical devices, valves, etc.	Yearly
Inspect for structural damage, leaks, et.	Yearly
Rodent management	As needed
Security	As needed

Dry Pond Maintenance Tasks and Schedule	
Task	Frequency
Forebay inspection and cleanout	Monthly inspection. Remove sediment every 7 years or when sediment volume exceeds 50% of storage volume
Bank mowing and inspection/stabilization of eroded areas	Monthly
Outlet/inlet inspection and cleanout	Monthly
Unwanted vegetation and trash removal	Monthly
Inspect for structural damage, leaks, etc.	Yearly
Inspect/exercise all mechanical devices, valves, etc.	Yearly
Evaluate sediment level (remove as needed)	Yearly
Security	As needed

Stormwater Wetland Maintenance Tasks and Schedule	
Task	Frequency
Forebay cleanout	Monthly inspection. Remove sediment every 7 years or whenever the sediment volume exceeds 50% of storage volume
Invasive species control/vegetation management and replanting to maintain design densities	Semi-Annual
Bank mowing and stabilization of eroded areas	Monthly
Outlet/inlet inspection and cleanout	Monthly
Trash removal	Monthly
Inspect for structural damage, leaks, etc.	Yearly
Visual inspection of water quality	Monthly
Rodent and mosquito management	As needed
Evaluate sediment level (remove 20 yrs. Or when plants are being impacted)	Yearly
Security	As needed.

Bioretention Maintenance Tasks and Schedule	
Task	Frequency
Sedimentation prevention	Monthly inspection and watch on surrounding drainage areas such as out parcels and parking lots
Drop box clean off	Monthly
Perimeter mowing	Monthly (maintain 2 to 6 inch height)
Inspect for proper drawdown/clogging	Monthly
Stabilization of eroded areas	Monthly
Trash removal	Monthly
Pruning	Yearly
Mulch renewal	Yearly
Inspect plants, replace as necessary	Monthly
Test P Index of soil media and replace if over 50 ppm	Every 2 years
Replace pea gravel diaphragm	As Needed
Remove sediment	As needed
Perimeter mowing	Monthly

Sand Filter Maintenance Tasks and Schedule	
Task	Frequency
Street sweep parking lot	Quarterly
Trash removal	Monthly
Inspect outlet for obstructions	Monthly
Inspect for clogging	Monthly
Inspect inlet grates	Monthly
Skim sand media	Yearly
Pump oil and grit from sedimentation chamber	Yearly or at 50% full
Replace sand media	As needed (expect 3 years)

Infiltration Trench Maintenance Tasks and Schedule	
Task	Frequency
Maintain stone or mulch top surface	Yearly
Clean forebay if present	Yearly or at 50% full
Trash removal	Monthly
Remove unwanted vegetation	Monthly
Check observation wells following precipitation events to ensure proper infiltration	Monthly

Vegetative Channels and Swales Maintenance Tasks and Schedule	
Task	Frequency
Mowing	Weekly – Monthly (as needed to retain 2-6 inch height)
Inspect condition of dispersion devices and check dams	Yearly
Trash removal	Weekly – Monthly (prior to mowing)
Reseed	Yearly
Stabilization of eroded areas	Monthly
Removal of sediment	Yearly
Inspect for clogging (enhanced swale)	Monthly
Inspect pea gravel diaphragm and replace/repair as necessary	Monthly

Filter Strip with Flow Dispersion Maintenance Tasks and Schedule	
Task	Frequency
Mowing of grass	Weekly – Monthly (as needed to retain 2-6 inch height)
Stabilization of eroded areas throughout the filter strip and below the flow dispersion device	Monthly
Inspect gravel diaphragm (if present) and remove sediment	Yearly
Check outlet pipes on berms (if present) for clogging	Monthly
Remove debris/unwanted vegetation from behind lip of level spreader (if present)	Monthly
Repair flow dispersion device to prevent formation of channels in filter strip	Monthly as needed
Reseeding of grass	Yearly

ADMINISTRATIVE FORMS

The following is a series of administrative forms to be used by both the developer/owner/professional engineer and the Stormwater Administrator when conducting business with the Town. These forms are intended to serve as originals for duplication to be used for multiple project submittals. The Town may update or amend these forms as it sees fit to conduct business pursuant to the Harrisburg Stormwater Quality Ordinance. It is incumbent to the user of this Manual to ensure that they have the most up to date forms for submittal. Registering your name and contact information with the Stormwater Administrator may be beneficial to the user in being notified of updates to the forms and Manual. The current list of forms includes:

- Form A: Permit Application – Concept Plan
- Form B: Permit Application – Stormwater Management Plan and Submittal Checklist
- Form C: Final Inspection – Approval Checklist
- Form D: Operation and Maintenance Agreement
- Form E: BMP Inspection

PERMIT APPLICATION – CONCEPT PLAN

Consultation Meeting Requested for Project: Yes No Date _____

Date Received: _____ Application Number: _____

Project Name: _____

Project Location: _____

Total Area (acres): _____ Disturbed Area (acres): _____ % Built Upon: _____

Type of Development Commercial Residential Mixed Use Subdivision

Owner Information

Name: _____

Address: _____

Phone: _____ Fax: _____

Email: _____

Professional Engineer Information (if available at this time)

Name: _____

Address: _____

Phone: _____ Fax: _____

Email: _____

Reviewed By: _____ Date: _____

Comments: _____

Approved By: _____ Date: _____

PERMIT APPLICATION – STORMWATER MANAGEMENT PLAN

Date Received: _____ Application Number: _____

Review Fee: _____

Project Name: _____

Project Location: _____

Total Area (acres): _____ Disturbed Area (acres): _____ % Built Upon: _____

Type of Development Commercial Residential Mixed Use Subdivision

Owner Information

Name: _____

Address: _____

Phone: _____ Fax: _____

Email: _____

Professional Engineer Information

Name: _____

Address: _____

Phone: _____ Fax: _____

Email: _____

Erosion Control Plan Approval Date: _____

Review By: _____ Date: _____

Approved Approved as Noted Disapproved

Approved By: _____ Date: _____

SUBMITTAL CHECKLIST

Project Name: _____ Application Number: _____

Plan Reviewer: _____ Date: _____

Concept Plans

- A vicinity map indicating a north arrow, scale, boundary lines of the site, and other information necessary to locate the development site.
- Site map of physical improvements on the site including both existing and proposed development.
- Written or graphical document presenting the conceptual plan including the preliminary selection and location of proposed structural stormwater controls; location of existing and proposed conveyance systems such as grass channels, swales, storm drains, and flow; location of floodplain/floodway limits; relationship of site to upstream and downstream properties and drainages; preliminary location of any proposed stream channel modifications, such as bridge or culvert crossings
- Mapping of existing and proposed topography, perennial and intermittent streams (as determined by USGS maps or NRCS soil surveys), predominant soils from NRCS soil surveys, boundaries of existing predominant vegetation, proposed limits of clearing and grading, and location of existing and proposed roads, buildings, parking areas and other impervious surfaces.
- Written or graphic inventory of the natural resources at the site including, soil conditions, forest cover, geologic features, topography, wetlands, native vegetative areas, location and boundaries of other natural feature protection and conservation areas such as lakes, ponds, floodplains, stream buffers, and other setbacks (e.g., drinking water well setbacks, septic setbacks, etc.)

Stormwater Management Plans (all the above plus the following)

- Location, dimensions, elevations, and characteristics of all stormwater management facilities.
- Anticipated starting and completion dates of the various stages of land disturbing activities and the expected date the final stabilization will be completed.
- Designation of all rights-of-way and easements needed for inspection and maintenance of the drainage systems and stormwater management facilities.
- Construction and design details for structural stormwater controls.
- Completed and signed Operations and Maintenance Agreement (Form D).

-
- Performance security for installation and maintenance (if required by the Town).
 - Designs and analysis prepared and submitted by a registered, North Carolina Professional Engineer
 - Erosion and Sedimentation Control Approval and Permit. Attached copy of Erosion and Sedimentation Permit.
 - Maintenance escrow account for structural BMPs owned and maintained by home owner's or property owners' association (or similar entities).
 - Sealed, signed & dated calculations

FINAL INSPECTION CHECKLIST

Project Name: _____ Application Number: _____

Plan Reviewer: _____ Date: _____

- On-site inspection by Stormwater Administrator
- As-built certification by Professional Engineer (hard copy and electronic version)
- Stormwater drainage easements and 100-year floodplain water surface elevations recorded on plat.
- Erosion and sedimentation controls disassembled from project site and properly disposed.
- Structural BMPs and site in stable and vegetated condition.
- Operations and Maintenance Agreement recorded with Cabarrus County Register of Deeds. Copy to be mailed to Stormwater Administrator in 14 days.

Cover Sheet

(this cover sheet is required by the Cabarrus County Register of Deeds Office for recordation purposes of the Storm Water BMP O & M Agreement)

Type of Document: Storm Water BMP Operations & Maintenance Agreement

Grantee: Town of Harrisburg

Grantor: _____

Prepared by: Town of Harrisburg

Mail to Address: Town of Harrisburg
Engineering Department
P.O. Box 100
Harrisburg, NC 28075

BMP OPERATIONS AND MAINTENANCE AGREEMENT

WHEREAS, the _____ (Owner), its administrators, executors, successors, heirs or assigns, recognizes that the structural Best Management Practice (BMP) must be operated, maintained, and inspected in perpetuity as required by the Stormwater Quality Ordinance for the development or redevelopment called, _____ (Project Name), located at _____ (Property), and located on parcels numbered _____ of the Town of Harrisburg, North Carolina; and,

WHEREAS, the Owner is the owner of real Property more particularly described on the attached Exhibit A as recorded in the Register of Deeds of Cabarrus County in Deed Book _____ at page(s) _____, and,

WHEREAS, The Town and the Owner agree that the health, safety and welfare of the citizens of the Town require that the structural BMP(s) be constructed, operated, maintained, and inspected on the Property, and,

WHEREAS, the Stormwater Quality Ordinance requires that structural BMP(s) as shown on the approved stormwater managements plans and specifications be constructed, operated, and maintained by the Owner.

NOW, THEREFORE, in consideration of the foregoing premises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

SECTION 1.

The structural BMP(s) shall be constructed by the Owner in accordance with the plans and specifications for the development or redevelopment.

SECTION 2.

The Owner shall maintain the structural BMP(s) in good working condition acceptable to the Town and in accordance with the schedule of long-term maintenance activities provided in the Harrisburg Stormwater Manual and referenced documents contained therein. If the structural BMP(s) are not in good working condition acceptable to the Town then the Owner shall return the structural BMP(s) to good working condition.

SECTION 3.

The Owner hereby grants permission to the Town, its authorized agents and employees, to enter upon the property and to inspect and monitor the structural BMP(s) whenever the Town deems necessary. Whenever possible, the Town shall provide notice prior to entry.

SECTION 4.

In the event the Owner fails to maintain the structural BMP(s) as shown on the approved plans and specifications in good working order acceptable to the Town, the Town, with due notice, may enter the property and take whatever steps it deems necessary to return the structural BMP(s) to good working order. This provision shall not be construed to allow the Town to erect any structure of a permanent nature on the property. It is expressly understood and agreed that the Town is under no obligation to maintain or repair the structural BMP(s) and in no event shall this Agreement be construed to impose any such obligation on the Town.

SECTION 5.

In the event the Town, pursuant to the Agreement, performs work of any nature, or expends any funds in the performance of said work for labor, use of equipment, supplies, materials, and the like, the Owner shall reimburse the Town, or shall forfeit any required bond upon demand within forty-five (45) days of receipt thereof for all the costs incurred by the Town hereunder. If not paid within the prescribed period, the Town shall secure a lien against the real property in the amount of such costs. Interest, collection costs, and attorney fees may be added to the recovery of costs. The actions described in this section are in addition to and not in lieu of any and all legal remedies available to the Town as a result of the Owner's failure to maintain the structural BMP(s).

SECTION 6.

It is the intent of this Agreement to insure the proper maintenance of the structural BMP(s) by the Owner; provided, however, that this Agreement shall not be deemed to create or affect any additional liability of any party for damage alleged to result from or caused by stormwater runoff.

SECTION 7.

If directed by the Town, pursuant to Section 404 of the Stormwater Quality Ordinance, the Owner shall provide the Town with a performance security or bond with surety, cash escrow, letter of credit or other acceptable legal arrangement providing for the maintenance of the structural BMP(s) for a period of perpetual duration. The performance security or bond shall be in the amount of an annuity based on a reasonable estimate of the annual cost of inspection, operation and maintenance of the structural BMPs approved under the permit, at a discount rate that reflects the Town's cost of borrowing minus a reasonable estimate of long-term inflation. A copy of the bond or letter of credit is attached to this Agreement and by reference made a part thereof.

SECTION 8.

Homeowner's and other associations, as Owner shall establish an escrow account to be spent solely maintenance, repair, or reconstruction costs for structural BMP(s). Both developer contribution and annual sinking funds shall fund the escrow account. Prior to plat recordation or issuance of construction permits, whichever shall first occur, the developer shall pay into the escrow account an amount equal to fifteen (15) per cent of the initial construction cost of the structural BMPs. Two-thirds (2/3) of the total amount of sinking fund budget shall be deposited into the escrow account within the first five (5) years and the full amount shall be deposited within ten (10) years following initial construction of the structural BMPs. Funds shall be deposited each year into the escrow account. A portion of the annual assessments of the association shall include an allocation into the escrow account. Any funds drawn down from the escrow account shall be replaced in accordance with the schedule of anticipated work used to create the sinking fund budget.

SECTION 9.

The Owner shall comply with the requirement of an annual inspection of the structural BMP(s) located on the Property and submit the results of the inspection to the Town, as referenced in the Stormwater Quality Ordinance. The inspection shall be performed by a Professional Engineer and recorded on the structural BMP Inspection Forms provided by the Town in the Harrisburg Stormwater Manual.

SECTION 10.

The Owner hereby indemnifies and holds harmless the Town and its authorized agents and employees for any and all damages, accidents, casualties, occurrences or claims which might arise or be asserted against the Town from the construction, presence, existence or maintenance

of the structural BMP(s) by the Owner or the Town. In the event a claim is asserted against the Town, its authorized agents or employees, the Town shall promptly notify the Owner and the Owner shall defend at its own expense any suit based on such claim. If any judgment or claims against the Town, its authorized agents or employees shall be allowed, the Owner shall pay for all costs and expenses in connection herewith.

SECTION 11.

This Agreement shall be recorded among the Register of Deeds of Cabarrus County on the final plat, shall constitute a covenant running with the land, and shall be binding on the Owner, its administrators, executors, heirs, assigns and any other successors in interest. A recorded copy of the Agreement shall be submitted to the Town within fourteen (14) days of recordation.

SECTION 12.

This Agreement may be enforced by proceedings at law or in equity by or against the parties hereto and their respective successors in interest.

SECTION 13.

Invalidation of any one of the provisions of this Agreement shall in no way effect any other provisions and all other provisions shall remain in full force and effect.

MAINTENANCE AGREEMENT

SO AGREED this _____ day _____ of 19 _____

OWNER

By: _____ Attest: _____

Title: _____ Title: _____

Contact Information for Day-to-Day Operations & Maintenance of Storm Water Device(s):

Name: _____ Title: _____

Business Phone No: _____ Business Address: _____

Email Address: _____

HARRISBURG, NORTH CAROLINA

Attest: _____ By: _____
Stormwater Administrator Town Manager

Print Name: _____ Print Name: _____

STATE OF NORTH CAROLINA
COUNTY OF _____

This _____ day of _____, 20__ , personally came before me
_____, who, being by me duly sworn says that (s)he is the
_____ of _____, and that by authority duly given and as the
(title) (organization)
act of such entity, (s)he signed the foregoing instrument in its name on its behalf as its act and deed.

[NOTARIAL SEAL]

Notary Public

Print/type name: _____

My commission expires: _____

STATE OF NORTH CAROLINA
COUNTY OF _____

This _____ day of _____, 20__ , personally came before me
_____, who, being by me duly sworn says that (s)he is the
_____ of _____, and that by authority duly given and as the
(title) (organization)
act of such entity, (s)he signed the foregoing instrument in its name on its behalf as its act and deed.

[NOTARIAL SEAL]

Notary Public

Print/type name: _____

My commission expires: _____

GENERAL BMP INSPECTION NOTES

Project Name: _____

Project Address: _____

Owner's Name: _____

Owner's Address: _____

Recorded Book and Page Number of the Lot: _____

- I. General BMP Information: Complete this table or similar table with each structural BMP that is inspected within the project or development. Use the same naming system used on the approved plans, such as Phase I Bioretention 1.

BMP ID Name	Street with Block Number	Parcel Tax ID	Contract Person/Phone#

- II. BMP Site Location Map with Easements: Attach a small site plan map coinciding with the table above to show the general location of each structural BMP within the development and their easements.
- III. BMP Inspection Sheets: The following tables outline the specific maintenance tasks and frequency for each type of structural BMP. Delete tables that are not needed according to the types of structural BMPs within the development and make copies of the blank sheets for additional BMPs of the same type. A separate sheet shall be completed and submitted for each structural BMP.
- IV. Provide documentation of structural BMP maintenance escrow account activity. This may be provided in the form of a bank statement which includes the current balance, deposits and withdraws for the previous 12 months.
- V. Maintenance Inspection Reports: As indicated in the Stormwater Quality Ordinance, annual maintenance inspection reports shall be submitted to the Stormwater Administrator. The first report shall be submitted one year following the final approval date of the structural BMP and each year thereafter on or before the approval anniversary date. All maintenance activities and inspection reports shall be documented using the forms contained in the Harrisburg Stormwater Manual. Digital photographs of the inspection should be submitted on CD-ROM with this report. Annual maintenance inspection reports shall be sealed by a registered North Carolina professional engineer.

GRASSED CHANNELS/SWALES INSPECTION

[Note: a separate form must be used for each structural BMP]

BMP Name and Location: _____
 Inspection Date: _____
 Professional Engineer: _____
 Professional Engineer Phone Number: _____
 Date Last Inspected: _____

Maintenance Item	Satisfactory	Unsatisfactory	Inspection Frequency	Comments/Actions Required
1. Debris Cleanout				
Clear of trash and debris			W-M	
2. Vegetation Management				
Grass height (maintain 2-6 inch height)			W-M	
Unwanted vegetation present			M	
Ground cover well established (yearly reseeding needed)			Q	
3. Erosion				
Evidence of soil erosion in swale or contributing areas			M	
4. Dewatering				
Evidence of standing water			M	
5. Sedimentation				
Sediment accumulation			Y	
6. Energy dispersion/check dams				
Condition of dispersion devices			Y	
Condition of check dams			Y	
Inspect pea gravel diaphragm and replace/repair as necessary			M	
7. Miscellaneous				

W=Weekly, M=Monthly, Q=Quarterly, Y=Yearly

WET POND INSPECTION

[Note: a separate form must be used for each structural BMP]

BMP Name and Location: _____

Inspection Date: _____

Professional Engineer: _____

Professional Engineer Phone Number: _____

Date Last Inspected: _____

Maintenance Item	Satisfactory	Unsatisfactory	Inspection Frequency	Comments/Actions Required
1. Debris Cleanout				
Clear of trash and debris			M	
2. Vegetation Management				
Banks/surrounding areas mowed			M	
Unwanted vegetation present			M	
Condition of wetland plants			M	
3. Erosion				
Evidence of soil erosion on banks or contributing drainage areas and outlet			M	
4. Sedimentation				
Forebay sediment inspection (cleanout every 7 years or when 50% full)			M	
Pond volume measurement (dredge every 20 years or when 25% of permanent pool volume lost)			Y	
5. Energy Dissipators				
Condition of dissipators at inlets			Y	
Condition of dissipators at outfall			Y	
6. Inlet				
Condition of pipe and/or swale (cracks, leaks, sedimentation, woody vegetation)			M	
7. Outlet				
Condition of orifice (drawdown device)			M	
Condition of riser outlet and trash rack			M	
8. Emergency Spillway and Dam				
Condition of spillway				
Condition of dam (i.e. Leaks, holes, woody vegetation)			Y	
9. Mechanical devices				
Inspection of all valves, etc. (should be exercised yearly)			Y	
10. Visual Inspection				
Appearance of water (i.e. sheen, muddy, oily, clear, algae, etc.)			M	
Mosquito larvae			M	
11. Forebay Embankment				
Condition of forebay embankment (breached?)			M	
12. Water Elevation				
Is pond at normal pool elevation?			M	
13. Miscellaneous				

W=Weekly, M=Monthly, Q=Quarterly, Y=Yearly

STORMWATER WETLAND INSPECTION

[Note: a separate form must be used for each structural BMP]

BMP Name and Location: _____

Inspection Date: _____

Professional Engineer: _____

Professional Engineer Phone Number: _____

Date Last Inspected: _____

Maintenance Item	Satisfactory	Unsatisfactory	Inspection Frequency	Comments/Actions Required
1. Debris Cleanout				
Clear of trash and debris			M	
2. Vegetation Management				
Banks/surrounding areas mowed				
Unwanted vegetation present (replant semiannually to maintain design densities)			M	
Condition of wetland plants				
3. Erosion				
Evidence of soil erosion on banks or contributing drainage areas and outlet			M	
4. Sedimentation				
Forebay sediment inspection (cleanout every 7 years or when 50% full)			M	
Sedimentation level in wetland (cleanout every 20 years or when plants are being impacted)			Y	
5. Energy Dissipators				
Condition of dissipators at inlets			Y	
Condition of dissipators at outfall			Y	
6. Inlet				
Condition of pipe and/or swale (cracks, leaks, sedimentation, woody vegetation)			M	
7. Outlet				
Condition of orifice (drawdown device)			M	
Condition outlet			M	
8. Mechanical Devices				
Inspection of all valves, etc. (should be exercised yearly)			Y	
9. Visual Water Inspection				
Appearance of water (i.e. sheen, muddy, oily, clear, algae, etc.)			M	
Water level maintained at permanent pool			Y	
Mosquito larvae			M	
10. Dam/embankment				
Seepage through embankment			Y	
Woody vegetation on embankment			Y	
13. Miscellaneous				

W=Weekly, M=Monthly, Q=Quarterly, Y=Yearly

BIORETENTION INSPECTION

[Note: a separate form must be used for each structural BMP]

BMP Name and Location: _____

Inspection Date: _____

Professional Engineer: _____

Professional Engineer Phone Number: _____

Date Last Inspected: _____

Maintenance Item	Satisfactory	Unsatisfactory	Inspection Frequency	Comments/Actions Required
1. Debris Cleanout				
Clear of trash and debris			M	
2. Vegetation Management				
Banks/surrounding areas mowed			M	
Unwanted vegetation present			M	
Condition of plants			M	
Condition of mulch – Must be double hammered hardwood, 3 inches deep (replace at least every 3 years and renew yearly)			M	
3. Erosion				
Evidence of soil erosion on banks or contributing drainage areas			M	
4. Sedimentation				
Forebay (if present) sediment inspection (cleanout when 50% full)			M	
Evidence of sediment in bioretention cell			M	
5. Energy Dissipators				
Condition of dissipators at inlets			Y	
Condition of dissipators at outfall			Y	
Inspect pea gravel diaphragm (replace as needed)			M	
6. Inlet				
Condition of pipe of swale (cracks, leaks, sedimentation, woody vegetation)			M	
7. Outlet				
Condition of outlet/drop box			M	
8. Dewatering (drawdown must be between 48 hours and 120 hours)				
Evidence of standing water			M	
9. Overall Functionality				
Evidence of bypass			M	
P Index test results for soil media (indicate test results and date last tested)			Y2	
10. Miscellaneous				

W=Weekly, M=Monthly, Q=Quarterly, Y=Yearly

EXTENDED DETENTION (DRY POND) INSPECTION

[Note: a separate form must be used for each structural BMP]

BMP Name and Location: _____

Inspection Date: _____

Professional Engineer: _____

Professional Engineer Phone Number: _____

Date Last Inspected: _____

Maintenance Item	Satisfactory	Unsatisfactory	Inspection Frequency	Comments/Actions Required
1. Debris Cleanout				
Clear of trash and debris			M	
2. Vegetation Management				
Banks/surrounding areas mowed			M	
Unwanted vegetation present			M	
3. Erosion				
Evidence of soil erosion on banks, contributing drainage areas or bottom of pond			M	
4. Sedimentation				
Forebay (if present) sediment inspection (cleanout every 7 years or when 50% full)			M	
Sediment level in pond			Y	
5. Energy Dissipators				
Condition of dissipators at inlets			Y	
Condition of dissipators at outfall			Y	
6. Outlet/Inlet				
Condition of orifice (drawdown device)/trash rack			M	
Condition of outlet			M	
Condition of inlet			M	
7. Mechanical Devices				
Inspection of all valves, etc. (exercise yearly)			Y	
8. Dewatering				
Evidence of standing water			M	
9. Structural Integrity				
Evidence of structural damage (leaks, cracks, etc.)			Y	
10. Emergency Spillway & Dam				
Condition of spillway			Y	
Condition of dam			Y	
11. Miscellaneous				

W=Weekly, M=Monthly, Q=Quarterly, Y=Yearly

SAND FILTER INSPECTION

[Note: a separate form must be used for each structural BMP]

BMP Name and Location: _____
 Inspection Date: _____
 Professional Engineer: _____
 Professional Engineer Phone Number: _____
 Date Last Inspected: _____

Maintenance Item	Satisfactory	Unsatisfactory	Inspection Frequency	Comments/Actions Required
1. Debris Cleanout				
Clear of trash and debris			M	
2. Street Sweeping				
Parking lot street sweeping			Q	
3. Erosion				
Evidence of soil erosion around contributing areas			M	
4. Sedimentation Chamber				
Sediment level in chamber (pump yearly or when 50% full)			M	
5. Sand Media				
Condition of media (skim annually, replace as necessary)			M	
6. Outlet/Inlet				
Condition of outlet			M	
Condition of inlets and grates			M	
7. Mechanical Devices				
Inspection of all valves, etc.			Y	
8. Dewatering				
Evidence of filter clogging			M	
9. Structural Integrity				
Evidence of structural damage (leaks, cracks, etc)			Y	
10. Overall Functionality				
Evidence of odors			M	
Evidence of bypass			M	
12. Miscellaneous				

W=Weekly, M=Monthly, Q=Quarterly, Y=Yearly

INFILTRATION TRENCH INSPECTION

[Note: a separate form must be used for each structural BMP]

BMP Name and Location: _____

Inspection Date: _____

Professional Engineer: _____

Professional Engineer Phone Number: _____

Date Last Inspected: _____

Maintenance Item	Satisfactory	Unsatisfactory	Inspection Frequency	Comments/Actions Required
1. Debris Cleanout				
Clear of trash and debris			M	
2. Vegetation Management				
Banks/surrounding areas mowed			M	
Unwanted vegetation present			M	
3. Erosion				
Evidence of soil erosion around contributing drainage areas			M	
4. Sedimentation				
Forebay sediment inspection (cleanout yearly or when 50% full)			M	
Evidence of sediment in trench			M	
5. Energy Dissipators				
Condition of dissipators at inlets			Y	
Condition of dissipators at outfall			Y	
6. Surface Aggregate				
Condition of stone or mulch			Y	
7. Dewatering				
Evidence of standing water			M	
Check water level in observation well			M	
8. Overflow Spillway				
Condition of spillway			Y	
9. Overall Functionality				
Evidence of bypass			M	
10. Miscellaneous				

W=Weekly, M=Monthly, Q=Quarterly, Y=Yearly

FILTER STRIP INSPECTION

[Note: a separate form must be used for each structural BMP]

BMP Name and Location: _____

Inspection Date: _____

Professional Engineer: _____

Professional Engineer Phone Number: _____

Date Last Inspected: _____

Maintenance Item	Satisfactory	Unsatisfactory	Inspection Frequency	Comments/Actions Required
1. Debris Cleanout				
Clear of trash and debris			W-M	
2. Vegetation Management				
Grass height (maintain 2-6 inch height)			W-M	
Unwanted vegetation present			M	
Ground cover well established (yearly reseeding needed)			Y	
3. Erosion				
Evidence of soil erosion in filter strip and below dispersion device			M	
4. Drainage				
Evidence of standing water			M	
Evidence of bypass			M	
Check outlet pipes for clogging			M	
5. Sedimentation				
Sediment accumulation			Y	
Sediment in gravel diaphragm (if present)			Y	
6. Energy Dispersion/Check Dams				
Condition/functionality of dispersion devices			M	
Debris on dispersion devices			M	
Condition of check dams			M	
Inspect pea gravel diaphragm (replace as needed)			M	
7. Miscellaneous				

W=Weekly, M=Monthly, Q=Quarterly, Y=Yearly

