CITY OF CONNERSVILLE
POLICIES AND PROCEDURES
AND DRAINAGE STANDARDS
MANUALS

Revised September, 2006

CITY OF CONNERSVILLE
DEPARTMENT OF
STORM WATER MANAGEMENT

POLICIES AND PROCEDURES
MANUAL

Prepared for:

City of Connersville
Department of Storm Water Management
Connersville, IN 47331

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INTRODUCTION

This manual describes the policies and procedures of the Connersville Board of Public Works and Safety (BPWS) for determining impervious surface area, establishing the Equivalent Residential Unit (ERU) and multiplier for storm water users, for billing and collection, and for the credit process.

The City of Connersville has adopted Indiana Code 8-1.5-5, which enables an Indiana municipality to establish a Department of Storm Water Management. The Department will be responsible for the management of the Connersville Storm Water System and will fund storm water management activities by charging user fees to the owner/renter of each property containing impervious surface area within the corporate limits of the City of Connersville.

All residential properties will be charged a uniform user fee. User fees for non-residential and combined residential/business properties will be based upon the amount of impervious surface area contained within the property. The amount of impervious surface area for each property has been determined based upon measurements using aerial photography and plat maps obtained from the Fayette County Surveyor's Office and by field measurements. Public right-of-way is exempt from the user fee.

Properties within the corporate limits of Connersville that are assessed a Fayette County ditch tax will no longer pay the ditch tax. Instead, the BPWS will pay the county ditch tax effective the date storm water user fees are initiated.

Non-residential and combined residential/business properties may apply for user fee credits if they have private storm water management infrastructure that reduces the amount or rate of storm water runoff or increases the quality of the storm water runoff discharged to the Connersville Storm Water System.

User fees do not relieve any property owner from compliance with the City of Connersville and/or Fayette County ordinances and/or other applicable state and/or federal laws/regulations.

DEFINITIONS

As used in this manual, the following terms shall have meanings attributed to them as follows:

Combined Residential/Business Property – a residential property in which business is conducted on the property. Business shall mean an act or means of providing goods or services for compensation. For example, a residential property that conducts accounting services in the home shall be classified as a combined residential/business property.

Credit – a reduction in the storm water user fee for a non-residential or combined residential/business property based upon the attainment of criteria specified in the User Fee Credit Process section contained in this manual.

Detention Facility – a facility that collects and stores storm water runoff thereby reducing the rate at which runoff is discharged from the property.

Equivalent Residential Unit (ERU) – the average amount of impervious surface area for a single-family residential property located within the corporate limits of the City of Connersville. The ERU for the City of Connersville is 2,662 square feet, and shall be used in calculating user fees for non-residential and combined residential/business properties.

Impervious Surface Area – the horizontal surface area of property covered with materials that include, but are not limited to, concrete, asphalt, rooftop, blacktop and gravel, such that the infiltration of storm water is prevented or impeded. The total amount of impervious surface area located on a property without regard to topographic features of the property is included. Driveways, roadways, parking lots and other areas used for vehicular traffic are considered impervious surface areas. Undisturbed land, tilled agricultural land, ponds, lawns and fields are not considered impervious surface area.

Infiltration – the process of allowing runoff to penetrate the ground surface and flow through the upper soil surface.

Multi-Family Property – a multi-family property containing five or more units shall be classified as a non-residential (business) property. User fees shall be charged according to the total impervious square footage of the property. User fees for a multi-family property containing two to four units shall be charged in the same manner as its water service is charged, i.e., according to the number of water meters. For example, a multi-family property containing four units in which the water usage is measured on a single meter shall be considered a single residential property. For a multi-family property containing four units in which the water usage is measured on four separate meters, each unit shall be classified as an individual residential property.

DEFINITIONS

Non-Residential Property – all properties not categorized as Residential Properties or Combined Residential/Business Properties. Non-residential properties include, but are not limited to the following:

- Agricultural property
- Businesses
- Churches and other places of religious affiliation
- Colleges
- Commercial property
- Community centers
- Federal, state and local government property
- Hospitals and medical centers
- Industrial property
- Multi-family properties which contain five or more units
- Mobile home parks in which water service is master metered
- Retirement centers
- Schools
- Properties whose primary function is not as a single-family residence
- Common areas of residential properties including, but not limited to, private streets and parking lots, recreational areas, office areas, maintenance areas and all other areas not occupied by residential units.

Private Storm Water Facilities – facilities designed to transport, move, or regulate storm water that are not subject to the control and/or not under the ownership of the local, state or federal government.

Public Storm Water Facilities – facilities designed to transport, move or regulate storm water that are subject to the control and/or under the ownership of the local, state or federal government. This shall include facilities in the right-of-way.

Residential Property – a lot or parcel on which a building or mobile home is situated in which a single family resides. Furthermore, some multi-family properties shall be classified as residential. See the definition for Multi-Family Property.

Retention Facility – a facility that collects storm water runoff without releasing it. The storm water infiltrates into the ground and/or evaporates.

Storm Water Quality – an increase in quality is a reduction of the amount of pollutants in the storm water runoff. In compliance with Indiana Department of Environmental Management (IDEM) regulations, the BPWS will establish policies requiring standards for water quality best management practices for all new development and redevelopment.

DEFINITIONS

Storm Water User – the owner/renter of a lot or parcel of residential property, non-residential property or combined residential/business property within the City of Connersville's Storm Water Management District.

Temporary Structures – structures that do not require footers or partial or full foundations, or held down with a permanent anchor device. These structures are used for short periods of time and can be removed with ease.

Connersville Storm Water System – all facilities and conveyances subject to the control of and/or under the ownership of the City of Connersville used for collecting and conveying storm water to, through and from drainage areas to the point of final outlet, including, but not limited to, inlets, conduits and appurtenant features, pipes, pumping stations, manholes, structures, channels, outlets, creeks, catch basins, ditches, streams, culverts, retention or detention basins and other structural components and equipment that transport, move or regulate storm water. The system includes public streets, roads and highways.

STORM WATER USER FEE DETERMINATION

The monthly user fee is uniform for all residential properties, which are assigned one (1) ERU. This allocates that all residents of the City of Connersville place demands on the storm water system and benefit from storm water management activities. The current user fee for one (1) ERU shall be established by ordinance.

The monthly user fee for non-residential properties is determined using an ERU multiplier, which is calculated by dividing the total impervious surface area within the property by the base ERU of 2,662 square feet. This method allows for the non-residential property user fees to be based upon the demand the property places on the storm water system as compared to the demands of the average residence. For example, a non-residential property with 20,000 square feet of impervious surface area receives an ERU multiplier of 7.5 (20,000/2,662). The ERU multiplier shall be rounded to one decimal place and the minimum ERU shall be one (1). The ERU multiplier is then multiplied by the current fee for one (1) ERU to determine the actual user fee in dollars.

The monthly user fee for combined residential/business properties shall be determined according to the manner in which its water service is metered. The residential portion of the property will be charged the uniform residential rate of one (1) ERU. The business portion of the property will be charged according to the amount of impervious surface area within the property that exceeds 2,662 square feet with a minimum charge of one (1) ERU. For example:

Case 1: A combined residential/business property containing 4,000 square feet of impervious surface area shall be charged one (1) ERU to the residential portion and one (1) ERU to the business portion.

Case 2: A combined residential/business property containing 6,000 square feet of impervious surface area shall be charged one (1) ERU to the residential portion and 1.3 ERUS [(6,000-2,662)/2,662] to the business portion.

BILLING AND COLLECTION

A database has been developed consisting of the property owner's/renter's name, property address, property's square footage of impervious surface area, user fee multiplier, and monthly user fee.

Charges for storm water service shall be billed by and through Connersville Utilities on the monthly utility bill and with the implementing of related policies. Where the property having a delinquent account for charges for storm water service is served by the City's Water Department, said Department may, after reasonable notice to the owner and/or customer, shut off the water service to the property. Water service may not be restored until the delinquent account and associated costs have been paid.

Storm water user fees are hereby made a lien upon the corresponding lot, parcel of land, building or premises at or upon which such fees are incurred. Storm water user fees shall be the obligation of the property owner and shall also be the obligation of any renter occupying the property. Storm water user fees shall be billed to the property owner if there is no renter known to the Department and to the renter if the property is rented and the renter is known to the Department. If a renter receives a bill and the bill is not paid within fifteen (15) days, the owner will be notified. If the owner does not pay within one (1) month after the owner's first receipt of the bill, the Department may take action to collect delinquent fees. Delinquent fees may be collected in either or both of the following ways (and also in any other way allowed by law):

1. A civil action may be brought against the renter and/or property owner.

2. The fees may be recorded in the Office of the Fayette County Recorder and certified to the Auditor of Fayette County, who shall place the same on the tax duplicate of the county with the interest and penalties allowed by law to be collected as ad valorem property taxes are collected.

USER FEE CREDIT PROCESS

A reduction in the storm water user fee based on specific qualifying conditions that mitigate the effects of increased storm water runoff or reduces pollutants in the storm water runoff on a continuous basis may be available to non-residential and combined residential/business properties. In order for a property to receive a credit, application to the BPWS is required using the guidelines in this manual and the *Storm Water User Fee Credit Application Package*. Applicable review fees must accompany each application. Non-residential and combined residential/business properties that meet the following criteria may apply for credit:

1. *Retention Credit* – Impervious area(s) draining to private retention facilities that reduce the volume of storm water runoff discharged to the Connersville Storm Water System. A Professional Engineer registered in the state of Indiana must certify the retention analysis. The storm water user fee credit shall be calculated as follows:

   (Impervious surface area draining to private retention facility / 2,662 square feet) x 45% x current User Fee for 1 ERU

   Example: The retention credit for a non-residential property containing 30,000 square feet of impervious surface area in which 10,000 square feet of the impervious surface area drains into the retention facility would be calculated as follows:

   (10,000 / 2,662) x 45% x current User Fee for 1 ERU = 1.7 ERUs x current User Fee for 1 ERU

   To receive full credit, the retention facility shall be capable of storing the storm water runoff produced from the drainage area tributary to the retention facility from the 100-year, 6-hour storm (4.5" rainfall) above the normal pool elevation without creating flooding conditions at the site. Partial credit shall be granted for retention facilities that hold less than the 100-year runoff volume and have adequate overflow facilities. Partial credit = (Impervious surface area draining to private retention facility / 2,662 square feet) x (actual rainfall / 4.5") x 45% x current User Fee for 1 ERU.

2. *Detention Credit* – Impervious area(s) draining to private detention facilities that reduce the peak flow of storm water runoff discharged to the Connersville Storm Water System and meet the detention requirements of the Connersville *Drainage Standards Manual*. A Professional Engineer registered in the state of Indiana must certify the detention analysis. The storm water user fee credit shall be calculated as follows:

   (Impervious surface area draining to private detention facility / 2,662 square feet) x 45% x current User Fee for 1 ERU

   Example: The detention credit for a non-residential property containing 30,000 square feet of impervious surface area in which all of the impervious surface area drains into the detention facility would be calculated as follows:

   (30,000 / 2,662) x 45% x current User Fee for 1 ERU = 5.1 ERUs x current User Fee for 1 ERU

3. *Storm Water Quality Credit* – Qualifying criteria for credit for reduction of pollutants in storm water runoff from a property shall be added to this manual at a future date. The credit amount shall be applied to the portion of impervious surface area actually treated for reduction of pollutants and shall be 5%.

4. *Temporary Structures* – Structures that do not require a partial or full foundation, footers, or are held down with an anchor device. Temporary structures that generate runoff such as tents, awning, and hoop shelters, may not be charged user fees if one of the following conditions apply:
    a. The structure will be used for a short period of time and then removed from the property.
    b. An adequate pervious buffer exists around the structure to allow storm water runoff to infiltrate or absorb into the surrounding ground.

    The City will evaluate whether or not to charge user fees for temporary structures.

The maximum storm water user fee credit that may be obtained is 50% of the original user fee determined by these standards. Maintenance of the private storm water management infrastructure is the responsibility of the owner. A maintenance schedule must be submitted to and approved by the Board of Directors (Board) of the BPWS. Continuing credit will be allowed only to properties that maintain their private storm water facilities in continuing compliance to the approved maintenance plan schedule. Upon written notice, the Board may revoke a credit for good reason, including failure to meet minimum maintenance requirements.

The credit procedures outlined in this manual are not intended to be all-inclusive. Storm water user fee credit may be allowed for circumstances not described in this manual upon approval of the Board.

For credit review, submit the Application for User Fee Credit for Non-Residential Properties (page 10) accompanied by the specified information listed in the Submittal Checklist for Application for User Fee Credit for Non-Residential Properties (page 11) and the application review fee. The application process does not relieve the property owner of payment of user fees during the review process. The Board will give written notification of the credit determination within 60 days upon receipt of a complete credit application package. The written notification shall state the conditions of the issuance of the user fee credit and effective date of the credit. Any applicant who does not submit a complete application package will be notified in writing of deficiencies. Deficiencies shall be submitted within 90 days of notification of deficiencies or the applicant will be required to file a new application. Approved credits shall be applied based upon the application date if all deficiencies are submitted within 90 days.

Storm water users may petition the Board for an adjustment if sufficient cause exists to believe the user fees were determined erroneously. The petitioner must not be delinquent in the storm water user fees and must file the petition within three (3) months of receiving the storm water user fee billing in question. The petitioner shall state in writing why it is believed an adjustment is justified and shall include any supporting evidence, clearly defined, with the petition. The Board appointed reviewer shall examine the petition and any submitted documentation, make a determination as to

whether the petitioner is entitled to an adjustment of the storm water user fee and notify the petitioner in writing of the decision and the basis of the decision within 60 days. The reviewer may grant, deny or modify the adjustment requested in the petition.

The petitioner may appeal the reviewer's decision to the Board provided the Board has received written notice of the appeal from the petitioner within 30 days of the reviewer's determination. The Board shall notify the petitioner of the time and place of the hearing on the appeal. The hearing shall be recorded by audiotape. The Board will make a determination as to whether the petitioner is entitled to an adjustment of the storm water fee and notify the petitioner in writing within 30 days of the appeal hearing. The Board may grant, deny, or modify the adjustment requested in the petition. If the Board determines the petitioner is entitled to an adjustment of the user fees, the adjustments will be made in the form of a credit against future storm water user fees.

Appeals of user fee credit determination and credit revocation shall follow these same procedures except the petition must be received by the Board within 60 days of the receipt of the credit determination or revocation letter.

SUBMITTAL CHECKLIST FOR APPLICATION FOR USER FEE CREDIT FOR NON-RESIDENTIAL PROPERTIES

The following information shall be included with all Applications for User Fee Credit:

1. _____ Completed *Application for User Fee Credit for Non-Residential Properties*
2. _____ Application Fee (Check payable to Connersville Utilities)
3. _____ Plat or survey of the property certified by a Registered Land Surveyor
4. _____ 2 sets of Drainage Plans (to scale) highlighting existing/proposed impervious areas, drainage patterns and storm water facilities (if applicable). Sufficient topographic data or elevations shall be provided to verify drainage patterns across the property.

For the Retention Credit, 2 sets of the following additional information shall be included with the Application:

1. _____ A stage-storage curve for determination of the facility's capacity.
2. _____ The normal pool elevation of the pond (normal water surface elevation).
3. _____ Storm water runoff calculations for the retention facility. To receive full credit the facility shall be capable of storing the storm water runoff produced from the drainage area tributary to the facility from the 100-year, 6-hour storm (4.5" rainfall) above the normal pool elevation without creating flooding conditions at the site. Partial credit shall be granted for retention facilities that hold less than the 100-year runoff volume and have adequate overflow facilities.

For the Detention Credit, 2 sets of the following additional information shall be included with the Application:

1. _____ Design storm hydrographs for the area(s) discharging to the detention facility for pre- and post-development conditions (see *Connersville Drainage Standards Manual).* Include all pertinent engineering calculations and assumptions employed in generating the hydrographs.
2. _____ Stage-storage-discharge tables for the detention facility and its outfall structure(s). Sufficient information shall be provided in the form of engineering details and calculations to verify the outfall structure capacity.
3. _____ Post-development hydrograph routings through the detention facility.

APPLICATION FOR USER FEE CREDIT
FOR NON-RESIDENTIAL PROPERTIES

Connersville Utilities
Attn: Utilities Inspector
216 Vine Street
P.O. Box 325
Connersville, IN 47331

Application fees is to be submitted with this application. Make checks payable to Connersville Utilities. All items on checklist must be submitted for application to be complete.

Property Owner Information

Name: _____

Address: _____

Address of Property Applying for User Fee Credit: _____

_____

Parcel No: _____ Impervious Area of Property (in square feet): _____

Current Monthly User Fee: $_____

Check those credits being applied for:

____ *Retention Credit* – Impervious area(s) draining to private retention systems that reduce the volume of storm water runoff discharge to the Connersville Storm Water System. The maximum allowable credit is 45%. The application fee for Retention Credit is $100.00 which shall cover one hour of review time. Each additional hour required for review shall be charged at the applicable rate and is payable in full before credits are applied to the user fee.

____ *Detention Credit* – Impervious area(s) draining to private detention systems that reduce the peak flow of storm water runoff discharged to the Connersville Storm Water System and meet the City of Connersville's Drainage Standards. The maximum allowable credit is 45%. The application fee for Detention Credit is $100.00 which shall cover one hour of review time. Each additional hour required for review shall be charged at the applicable rate and is payable in full before credits are applied to the user fee.

____ *Storm Water Quality Credit* – Impervious area(s) draining to a private facility designed to reduce pollutants in storm water runoff discharged to the Connersville Storm Water System. The maximum allowable credit is 5%. There is no application fee for this credit when applied for in conjunction with another type of credit above.

____ *Temporary Structures* - Structures that are used for short periods of time and can be removed with ease. Storm water fees may be waived on a case-by-case basis. There is no application fee for this credit.

Information required for processing credits is listed in the attached *Submittal Checklist for Application for User Fee Credit for Non-Residential Properties.*

Type and Condition of Storm Water Drainage System _____

Party Responsible for Performing System Maintenance _____

_____ Telephone _____

System Maintenance is Performed _____ per year and includes the following activities _____

_____

_____

Calculated User Fee Credit $_____

I hereby certify the information contained in this application for which the user fee credit determination is based upon is accurate and has been prepared per my instruction. I hereby grant to the City of Connersville access to the facility for the sole purpose of inspecting the maintenance and operation of the facility for which I am requesting user fee credits.

Property Owner's Signature_____ Date _____

I hereby certify the information contained in this application for which the user fee credit determination is based upon is accurate and has been prepared under my supervision (for Retention/Detention Credits only)

Person Completing the Application _____

Address _____ Telephone _____

Signature _____ Date _____

Indiana Registered Professional Engineer No. _____

Seal:

Date Submitted _____ **Approved Date _____**

Approved By _____

CITY OF CONNERSVILLE
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DRAINAGE STANDARDS
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INTRODUCTION

INTRODUCTION

This manual contains minimum drainage standards and procedures to be followed for submittal to the Board of Directors (Board) of the Connersville Department of Storm Water Management (CDSWM) for the purpose of obtaining storm water drainage approval for land disturbing projects within the Connersville Storm Water Management District (District). Drainage approval for all land disturbing projects, including activities in the public right-of-way, must be received from the Board prior to construction and/or land disturbing activity. The standards and procedures in this manual shall rule over any previous drainage standards pertaining to the District.

It shall be the policy of the Board that developers of new development and redevelopment within the District submit for approval a drainage plan that prevents increased storm water run-off resulting from land alteration. The drainage plan shall provide for the proper drainage of storm water run-off from the developed site and the drainage basin in which it is contained. The drainage system shall be constructed and installed in accordance with the plans and specifications as approved by the Board/City Engineer. A Storm Water Pollution Prevention and Erosion and Sediment Control Plan shall be submitted and shall be in accordance with the Indiana Administrative Code 327 IAC 15-5 and the standards in this manual. Permits as required by Indiana Department of Environmental Management (IDEM, including Rule 5), Indiana Department of Natural Resources (IDNR), Army Corps of Engineers (COE), Indiana Department of Transportation (InDOT) and any other local, state, and federal regulatory agencies are the responsibility of the property owner/developer.

An *Application for Drainage Approval*, two complete sets of professionally certified plans, specifications, supporting calculations and *Certification of Sufficiency of Plan* shall be submitted to the CDSWM along with the initial drainage review fee of $100.00. The initial review fee includes one hour of plan review. Projects requiring more than one hour of plan review due to their complexity or deficiency in design or submittal shall be assessed plan review fees at the rate of $125.00 per hour. Plan review fees shall be made payable to the Connersville Department of Storm Water Management. A submittal will not be considered complete until all items on the *Drainage Plan Submittal Checklist* included with this manual (see Figure 1) have been submitted. It is recommended that new development projects include with their drainage plan submittal the *Storm Water User Fee Credit Application Package* found in the CDSWM's *Policies and Procedures Manual*, if applicable. A response letter with any comments generated as a result of the drainage review will be issued to the professional engineer/land surveyor responsible for completing the design. Upon notification of final drainage approval, three (3) sets of professionally certified plans and specifications shall be submitted to the CDSWM.

A single- or double- family dwelling constructed or placed on an individual lot and not requiring professionally prepared and certified storm water plans shall require drainage approval from the Board. Submittal requirements shall be as defined in the *Drainage Plan Submittal Checklist (Single- and Double-Family Dwellings)* in Figure 2. A complete application package shall be submitted to the CDSWM along with the drainage review fee of $50.00.

Special circumstances that are not covered by these Drainage Standards shall be regulated and reviewed on a case-by-case basis.

For construction projects required to submit Storm Water Pollution Prevention and Erosion and Sediment Control Plans shall submit three complete copies to the Fayette County Area Planning commission (one copy will be forwarded to the CDSWM and one copy will be forwarded to the Fayette County Soil and Water Conservation District for review) along with the initial drainage review fee of $100.00. The initial review fee includes one hour of plan review. Projects requiring more than one hour of plan review due to their complexity or deficiency in design or submittal shall be assessed plan review fees at the rate of $125.00 per hour. Plan review fees shall be made payable to the Connersville Department of Storm Water Management. Land disturbing activities shall not begin until the project site owner has received a *Technical Review and Comment Form* stating "The Plan is Adequate" and has submitted all appropriate documentation to the IDEM, the County Soil and Water Conservation District (SWCD) and the CDSWM. All submittal requirements and standards are included in this manual.

For construction projects required to submit Storm Water Pollution Prevention Plans (SWPPPs) for Post-Construction Storm Water Quality shall submit plans to the CDSWM along with an initial review fee of $100.00. The initial review fee includes one hour of plan review. Projects requiring more than one hour of plan review due to their complexity or deficiency in design or submittal shall be assessed plan review fees at the rate of $125.00 per hour. Plan review fees shall be made payable to the Connersville Department of Storm Water Management. A review letter with any comments generated as a result of the review will be issued to the professional engineer/land surveyor responsible for completing the design of Post-Construction controls.

CHAPTER 1: DRAINAGE STANDARDS

A. Storm Sewer Design

1. In designing storm sewer systems, the following minimum standards shall apply:

   a. The Rational Method is acceptable for calculating peak flows to storm sewers (for watersheds less than 200 acres in size). Manning's equation is acceptable for sizing storm pipes for gravity flow, non-submerged outfall conditions. Figure 3 contains run-off coefficients for use in the Rational Formula. Due to Connersville's close proximity, rainfall intensities specified by the City of Indianapolis shall be employed for drainage analysis. The Intensity-Duration-Frequency (IDF) table in Figure 4 from the City of Indianapolis Stormwater Design and Construction Specifications Manual shall be used for rainfall intensity values.

   b. The storm sewer system shall pass the 10-year storm event under gravity flow conditions (no surcharging). A 25-year storm event shall stay within the system and not cause aboveground flooding. More stringent storm event criteria may be required at the discretion of the Board/City Engineer. Design calculations for sizing of the storm pipe shall be submitted on the Storm Pipe Flow Calculation Form provided in Figure 5 or a computer program output with similar information may be submitted. Headloss computations may be required for storm sewer systems with free outfalls at the discretion of the Board/City Engineer if pipes are at less than 0.5% slope.

   c. Storm sewer systems with the potential of operating under submerged outfall conditions shall include hydraulic grade calculations using a reasonable tail water elevation. Headloss computations shall be included with the hydraulic grade calculations.

   d. For streets, inlets grates shall be sized to pass a 10-year storm with no more than one and a half (1.5) inches of ponding above the street inlet grate, or such that no more than one half (1/2) of the driving lane is flooded. (Ditch inlet grates shall have no more than six (6) inches of ponding above the grate). Flow capacities of storm inlet grates shall be calculated using weir and orifice flow equations with consideration given to square footage of grate open areas and flow perimeter dimensions provided by casting manufacturers. All grates shall be safe for bicycle and pedestrian (especially children) traffic. For curb inlets, a barred-style curb box is required. Open curb boxes will not be allowed for new development or redevelopment.

   e. Storm street inlets shall be placed at all low areas and spaced a maximum of 300 feet apart or 300 feet from the high point in the street unless the Board or the City Engineer requires more restrictive spacing. Gutter spread calculations shall be submitted upon request by the Board/City Engineer. Gutter spread shall be limited to one half (1/2) of the driving lane.

f. Exposed ends of storm pipes shall have 6-inch thick reinforced concrete slope walls (See Figure 8) or riprap placed as directed by the Board/City Engineer. All outfall pipes may be required to have flap gates, flap valves or other end treatment to prevent backflow or other types of intrusion into the storm drain system.

g. For land disturbing activities, whenever evidence available to the Board/City Engineer indicates natural surface drainage to be inadequate, the subdivider or developer shall provide an adequate storm sewer system.

h. Height of cover for pipes shall meet the most restrictive requirements of either manufacturers' recommendations or AASHTO Standard Specifications for Highway Bridges. However, when installed under pavement, the minimum pipe cover shall be two (2) feet for flexible pipe and one (1) foot for RCP.

B. Materials

1. Storm sewers:
   Storm sewers shall be gasket type, reinforced concrete pipe (RCP), polyvinyl chloride (PVC) pipe, or high-density polyethylene (HDPE) pipe. The minimum pipe size shall be 12" diameter. The minimum design velocity for full pipe flow shall be 2.5 feet per second (fps).

   a. RCP:
      RCP shall be Class III, IV, or V in accordance with ASTM C76. A minimum Wall "B" thickness is required. Gasketed joints shall be in conformance with ASTM C443.

   b. PVC pipe:
      (1) PVC solid wall gravity flow storm sewer pipe shall be the bell and spigot type with elastomeric seal joints and smooth inner walls in accordance with ASTM D3034 (4"-15") or ASTM F679 (18"-36").

      PVC dual wall gravity flow storm sewer pipe shall be the bell and spigot type with elastomeric seal joints with smooth inner walls and corrugated outer walls in accordance with ASTM F949 (4"-36").

      PVC closed profile gravity flow storm sewer pipe shall be the bell and spigot type with elastomeric seal joints with smooth inner and outer walls braced inside circumferentially with projections or ribs in accordance with ASTM F1803 (18"-60").

      All PVC pipe shall have a minimum Cell Class as set forth by ASTM D1784 and shall have a minimum pipe stiffness of 46 psi.

      (2) Flexible, gasketed joints shall be compression type so that when assembled, the gasket inside the bell is compressed radially on the pipe spigot to form a soiltight seal. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations, and ASTM D3212. The gasket shall conform to the requirements of ASTM F477. All field cutting of pipe shall be completed in a neat, trim manner using a hand or power saw.

      (3) PVC Pipe shall be Type PSM or Pro 21 as manufactured by Diamond Plastics Corporation, Ring-Tite as manufactured by JM Pipe, A-2000 as manufactured by Contech Construction Products, or approved equal.

   c. HDPE pipe:
      (1) HDPE pipe shall be in accordance with AASHTO M294 Type S, consisting of an annular outer corrugated pipe wall and a smooth inner wall, or Type D, consisting of a smooth inner wall braced circumferentially with circular ribs joined to a smooth outer wall. Pipe

manufactured under this specification shall conform to the cell classification as defined in ASTM D3350. The flexibility factor of HDPE pipe shall not exceed 0.095.

(2) HDPE pipe shall possess male and female pipe ends which allow the construction of overlapping, gasketed pipe joints, in conformance with the requirements of ASTM D3212. The gasket material shall conform to all requirements of ASTM F477.

(3) HDPE pipe shall be Sure-Lok as manufactured by Hancor, Inc., N-12 Soil-Tight as manufactured by ADS, or approved equal.

2. Drainage Structures:

All storm sewer manholes, catch basins, and inlets shall be precast concrete, unless approved otherwise by the Board/City Engineer. Precast concrete storm sewer manholes shall meet or exceed the requirements of ASTM C478 and shall be in accordance with InDOT standard specifications. Precast concrete catch basins and inlets shall be in accordance with InDOT standard specifications.

Inlet grates or curb inlets must be pre-stamped with a pollution prevention message such as "No Dumping, Drains to Stream".

3. Bedding and backfill materials shall be as follows:

a. Class I :
Angular, six (6) to forty (40) millimeters (¼ to 1½ inch) graded stone such as crushed stone. InDOT Classification No. 5, No. 8 and No. 9. A No. 8 washed gravel possessing a minimum 50% mechanical crush count, and meeting the following nominal sizes and percents passing will be considered an equivalent Class I material: 100% passing 1" sieve, 75-95% passing ¾" sieve, 40-70% passing ½" sieve, 20-50% passing $^{3}/_{8}$" sieve, 0-15% passing No. 4 sieve, and 0-10% passing No. 8 sieve.

b. Class II:
Coarse sands and gravel-sand mixtures with a maximum particle size of forty (40) millimeters (1½ inches), including variously graded sands and gravels containing small percentages of fine, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class. InDOT Classification for "B" borrow material.

c. Pavement zone shall be defined as the area under and within five (5) feet of the edge of pavement, curb and/or sidewalk.

d. RCP shall be provided with Class I or Class II bedding material from a minimum of four (4) inches below the pipe barrel to 1/6 the outside pipe

diameter. Within the pavement zone, the backfill shall be Class II material compacted to 95% standard proctor density. Outside the pavement zone, the backfill shall be clean fill material. Figure 6 provides a bedding and backfill detail for RCP.

e. PVC and HDPE pipe shall be provided with Class I bedding material from a minimum of four (4) inches below the pipe barrel to twelve (12) inches above the crown of the pipe. Within the pavement zone, the backfill shall be Class II material compacted to 95% standard proctor density. Outside the pavement zone, the backfill shall be clean fill material. Figure 7 provides a bedding and backfill detail for PVC and HDPE pipe.

f. Bedding and backfill for drainage structures shall conform to InDOT specifications and standard drawings.

C. Design of Detention/Retention Facilities

In general, storm water detention analysis shall be required for land-altering projects if the impervious surface area will be increased by 0.5 acre or more. Storm water detention shall be required if the peak discharge of storm water from the developed site will exceed the peak discharge from the site in its present land use. (See No. 5 below). These general requirements will be reviewed on a case-by-case basis by the Board when making a determination to allow direct discharge or for requiring detention facilities. Preliminary discussion of the project with the Board or a representative of the Board is encouraged.

Detention/retention facility – a storm water control facility that stores storm water run-off indefinitely (retention) or detains it (detention) in order to reduce the storm water run-off from a property, or a combination thereof.

In designing storm water detention/retention facilities, the following minimum standards shall apply:

1. The USDA Soil Conservation Service (SCS) method of calculating run-off and generating hydrographs shall be utilized for detention/retention design. Figure 9 shall be used for rainfall depths. The 2nd Quartile Huff Rainfall Distribution – 50% probability curve and/or table shown in Figures 10 and 11 respectively shall be used for hydrograph computations.

2. Tables provided in Figures 12 through 14 shall be referenced for determination of run-off curve numbers according to land uses and hydrologic soil groups.

3. Storm durations shall be used that maximize the peak flow for the pre-developed condition and maximize detention storage volume for the post-developed condition. The storm duration shall be equal to or greater than the site time of concentration, but shall not be less than thirty (30) minutes.

4. Time of concentration shall be the time it takes for run-off to travel from the hydraulically most distant point in the subarea to its outfall point. Time of concentration calculations shall consist of overland (sheet) flow time, shallow concentrated flow time, and travel time in channels, pipes, gutters, etc. The maximum sheet flow calculation shall be 300 feet for pervious area and 100 feet for impervious area. After these distances, flow over land is calculated as shallow concentrated flow or channel flow as appropriate. The minimum time of concentration shall be five (5) minutes. A worksheet for time of concentration calculations is provided in Figure 15. A list of Manning's roughness coefficients for sheet flow is provided in Figure 16. These "Manning's n" values are used only in the sheet flow equation on the worksheet and not for open channel design.

5. The peak discharge resulting from the 100-year post-developed storm event shall not exceed the peak discharge resulting from the 10-year pre-developed storm event. In addition, the peak discharge resulting from the 2-year post-developed

storm event shall not exceed the peak discharge resulting from the 2-year pre-developed storm event. Outlet control structures of ponds shall be designed to meet the required release rates.

6. Wet detention/retention ponds shall have a minimum ten (10) foot wide safety ledge placed below the normal pool water level at a maximum slope of 10:1. The slope of the vegetated bank above the safety ledge shall not exceed 3:1. Below the safety ledge, ponds with slopes steeper than 3:1 shall be secured with riprap and no bank shall exceed a slope of 1½:1.

7. Dry detention/retention ponds shall have a minimum bottom slope of 1% or be designed with subsurface drainage. Maximum vegetated bank side slopes on the pond shall be 3:1.

8. Detention/retention ponds shall have a minimum freeboard of one (1) foot. Freeboard is additional depth above the maximum flow depth through the spillway.

9. All impervious area of the site shall drain through the detention/retention facility.

10. The depth of storm water run-off in parking lots providing detention shall not exceed ten (10) inches during the 100-year storm event.

11. Detention/retention facilities shall be designed with emergency spillways capable of handling 1¼ times the peak discharge resulting from the 100-year storm event. The developer is responsible for analyzing the ponding results of a 100-year storm event and establishing flood protection grade for all structures and verifying an adequate outlet for the 100-year storm.

12. Fencing or a barrier shall be required around wet detention ponds to prevent children from accessing the pond.

D. Open Channel Design

In general, Manning's equation may be used for open channel flow calculations for unobstructed channels. Open channels with culverts may require additional analysis. See Figure 17 for Manning's "n" values.

In the design of open channels, the following minimum standards shall apply:

1. Open channels shall be designed to pass the run-off from the 10-year storm event.

2. Grass-lined channel side slopes shall be no steeper than 3:1.

3. For yard ditches, longitudinal slopes of grass channels shall not be less than 1%. Slopes between 0.3% and 1% shall require subsurface drainage tile, shall be paved using 6-inch reinforced concrete, or shall be provided with a fabric-wrapped, washed gravel trench. No channel shall have less than a 0.3% longitudinal slope. Alternative channel treatments shall be subject to approval of the Board/City Engineer.

4. For relatively large open channels, channel slopes and invert treatments shall be approved on a case-by-case basis.

E. Streets

1. All streets shall be provided with an adequate storm drainage system consisting of curbs, gutters, storm sewers and inlets, or side ditches and culverts, as determined by the Board/City Engineer.

    a. A 6-inch minimum perforated pipe underdrain shall be required on each side of all streets as required by the Board/City Engineer.

    b. Where curbs and gutters are not provided in the street, ditches with inverts at least 12 inches below the subgrade of the pavement may be required.

2. Down spouts and sump pump outlets discharging onto a grass surface shall be no closer to the road than the building setback line.

3. Open channels along dedicated roadways and within right-of-ways, or on easements dedicated to the City, are not to be altered in any way without written permission from the Board. Driveways may be constructed over these swales or ditches only when the Board has approved appropriate sized culverts or other structures.

4. Culverts under public roadways shall be RCP (minimum Class III, Wall B) and shall be sized to pass the peak run-off from the 25-year storm event. Run-off from the 100-year storm event shall be analyzed to assure overtopping of the roadway does not exceed 6 inches. More restrictive overtopping conditions may be required at the discretion of the Board/City Engineer.

5. Culvert materials used under private drives and driveways will be evaluated and approved on a case-by-case basis.

F. Project Construction

All construction shall be completed per the Occupational Safety and Health Act (OSHA) and other applicable safety regulations. The CDSWM assumes no responsibility for construction safety.

1. Inspection Services:
   The CDSWM shall inspect all projects for drainage and erosion control compliance to approved plans during construction. As noted above, the CDSWM assumes no responsibility for construction safety, and its inspection is not for and does not include construction safety. Inspection shall be part-time or full-time, based upon the nature of construction and facilities. Inspection services shall be performed per the *Agreement between Owner/Contractor and Connersville Department of Storm Water Management for Storm Water System Inspection Services*. The property Owner/Developer shall be responsible for making payment to the CDSWM for the estimated inspection fees prior to project construction. The inspection fees shall be estimated by the Utility based upon the Contractor's estimated time to complete the drainage portion of the project. The actual inspection fees shall be assessed based upon the actual number of hours of inspection required. Inspection fees shall be charged at the rate of $50.00 per hour.

   The Contractor/Developer shall notify the CDSWM and the Inspector at least forty-eight (48) hours in advance of the installation, backfilling and testing of storm sewers and manholes.

2. Testing:
   All storm sewers and manholes shall be soil tight. The Contractor shall repair all visible points of possible bedding and/or backfill infiltration into the system to the satisfaction of the Inspector. When necessary, the Contractor shall remove and reconstruct as much of the work as is necessary to obtain a system that passes the following minimum tests:

   a. Mandrel Tests for Flexible Pipes:
      All gravity flow storm sewers constructed of flexible pipe (PVC and HDPE) shall be mandrel tested. The Inspector shall be notified of the proposed testing times and locations forty-eight (48) hours in advance. Arrangements for the cost and supply of all equipment necessary to perform mandrel tests shall be the responsibility of the Contractor/Developer.

      A seven and one-half (7½) percent "GO-NO-GO" Mandrel Deflection Test shall be performed on all flexible gravity storm sewer pipe. These pipes shall be mandrelled with a rigid device sized to pass seven and one-half (7½) percent or less deflection (or deformation) of the base inside diameter of the pipe. The mandrel test shall be conducted no earlier than thirty (30) days after reaching final trench backfill grade. The mandrel device shall be cylindrical in

shape and constructed with nine (9) or ten (10) evenly spaced arms or prongs. Variations of mandrel diameter dimensions due to pipe wall thickness tolerances or ovality shall not be deducted from the diameter dimension of the mandrel but shall be counted as part of the seven and one-half (7½) percent or lesser deflection allowance. The mandrel diameter dimension shall carry a minimum tolerance of 0.01 inches.

The mandrel shall be hand pulled through all sewer lines and any section of sewer not passing the mandrel shall be uncovered, replaced or repaired, and retested. The contact length shall be measured between points of contact on the mandrel arm. The Contractor shall provide proving rings to check the mandrel. The Contractor shall furnish drawings of mandrels with complete dimensions to the Inspector upon request for each diameter and specification of pipe.

b. RCP Inspection:
All reinforced concrete storm sewer pipes that are thirty-six (36) inches in diameter and smaller shall be visually inspected by lamping in the presence of the Inspector. Inspection of RCP shall be required to identify problems such as excessive sedimentation, joint failures, structural defects, misalignments, sags or other defects that have the potential of affecting the hydraulic performance, durability, or structural integrity of the pipe segment.

All reinforced concrete storm sewer pipes larger than thirty-six (36) inches in diameter shall be visually surveyed along their entire length in the presence of the Inspector. The Board/City Engineer has the option of requiring televising of the lines.

c. Manhole and Box Inlet Inspection:
The Inspector shall visually check each manhole and box inlet structure for excessive leakage, backfill infiltration, or improper workmanship and materials. Structures that fail to meet minimum construction standards shall be repaired or, if necessary, replaced, and reinspected.

d. Enforcement of Standards:
Failure to comply with the Connersville Drainage Standards may result in a Stop Work Order or necessary legal action by the CDSWM.

e. Easements:
The following applicable easements shall be granted to the City of Connersville by way of a *Grant of Perpetual Drainage Easement*.

a. Twenty (20) feet for pipes 15 inches in diameter and smaller.
b. Twenty-five (25) feet for pipes between 15 and 36 inches in diameter.
c. Forty (40) feet for pipes greater than 36 inches in diameter.

d. Thirty (30) feet measured horizontally outside the 100-year flood elevation for detention/retention ponds and access to the pond as determined by the CDSWM.
e. Twenty (20) feet for yard swales.
f. Easements for open channel are to be determined by the CDSWM on a case-by-case basis.
g. Easements for drainage conveyances shall be centered on the centerline of the conveyance.

5. Transfer of Ownership of Storm Water System:
Owners/Developers that will dedicate the storm water system to the City of Connersville shall enter into an agreement - *Storm Water System Agreement – Developer-Installed and Contributed Storm Water System.* The Owner/Developer, at no cost to the City of Connersville, shall furnish the design, labor and materials to install the storm water system. The CDSWM must approve the design, materials and the Owner/Developer's selected contractor, based upon reliability and responsiveness. *Waivers of Lien* for suppliers, subcontractors and contractors will be required at the time of completion of the *Transfer of Ownership* form.

6. Performance and Maintenance Bond Requirements:
The Owner/Developer shall provide a performance bond to the CDSWM prior to project construction. The performance bond shall be in the amount of 120% of the contract amount to construct drainage improvements and shall be provided on the standard form - *Connersville Department of Storm Water Management Performance and Repair Bond*. After completion of the project, the Owner/Developer shall provide a three-year maintenance bond in the amount of 25% of the contract amount to construct said drainage improvements to protect against defective materials and workmanship. The maintenance bond shall be provided on the standard form - *Connersville Department of Storm Water Management Maintenance Bond*.

7. Record Drawings:
Record drawings shall be completed within 30 days after the completion of the project and submitted to the CDSWM for final approval of the project. Record drawings shall be certified by a Professional Engineer or Land Surveyor. Record drawings shall include both a hard copy and an electronic copy (AutoCAD compatible drawings on CD) of as-built information including easements, horizontal alignments, elevations, inverts, top-of-castings, pond cross sections, and flow lines of swales.

CHAPTER 2: STORM WATER POLLUTION PREVENTION AND EROSION AND SEDIMENT CONTROL STANDARDS

CHAPTER 2: STORM WATER POLLUTION PREVENTION AND EROSION AND SEDIMENT CONTROL STANDARDS

A. Purpose

This chapter is intended to establish the minimum standards for design and construction of erosion and sedimentation controls and storm water pollution prevention measures for construction sites where land disturbing activities shall take place. These standards were developed in accordance with the requirements of 327 IAC 15-13, Storm Water Run-Off Associated with Municipal Separate Storm Sewer System Conveyances (Rule13) and Indiana Administrative Code 327 IAC 15-5 for Storm Water Run-off Associated with Construction Activities (Rule 5).

Projects meeting the requirements of the Post-Construction Storm Water Quality section shall also be required to install water quality treatment best management practices prior to project completion.

B. Authority and Compliance

Per Ordinance 4533, the CDSWM has the authority to permit, provide construction plan review for, inspect, and take appropriate enforcement actions against construction sites that meet the requirements of Ordinance 4533.

Construction sites where land disturbing activities meet the requirements of Ordinance 4533, at a minimum, shall be in compliance with all terms and conditions of Ordinance 4533, the Connersville Drainage Standards Manual, and Rule 5. In those circumstances where the requirements of Ordinance 4533 and the Drainage Standards Manual are more stringent than those contained in Rule 5, the requirements of Ordinance 4533 and the Drainage Standards Manual shall be followed.

The CDSWM has the right to impose additional requirements and restrictions beyond those outlined in these Standards, Ordinance 4533, and Rule 5 for projects where unique or special conditions exist.

C. Definitions

1. "Construction Activity" means land disturbing activities and land disturbing activities associated with the construction of infrastructure and structures. This term does not include routine ditch or road maintenance or minor landscaping projects.

2. "Construction plan" means a representation of a project site and all activities associated with the project. The plan includes the location of the project site, buildings and other infrastructure, grading activities, schedules for implementation, and other pertinent information related to the project site. A storm water pollution prevention plan is a part of the construction plan.

3. "Construction site access" means a stabilized stone surface at all points of ingress or egress to a project site for the purpose of capturing and detaining sediment carried by tires of vehicles or other equipment entering or existing the project site.

4. "Contractor" means an individual or company hired by the project site or individual lot owner, their agent, or the individual lot operator to perform services on the project site.

5. "Drainage Standards Manual" means the storm water standards for the City of Connersville that contain policies and procedures, drainage, erosion and sediment control, and post-construction standards that new development and redevelopment must meet.

6. "Developer" means any person financially responsible for construction activity; or an owner of property who sells or leases, or offers for sale or lease, any lots in a subdivision.

7. "Erosion" means the detachment and movement of soil, sediment, or rock fragments by water, wind, ice, or gravity.

8. "Erosion and sediment control measure" means a practice, or a combination of practices, to control erosion and resulting sedimentation.

9. "Erosion and sediment control system" means the use of appropriate erosion and sediment control measures to minimize sedimentation by first reducing or eliminating erosion at the source and then, as necessary, trapping sediment to prevent it from being discharged from or within a project site.

10. "Final stabilization" means the establishment of permanent vegetative cover or the application of a permanent nonerosive material to areas where all land disturbing activities have been completed and no additional land disturbing activities are planned under the current permit.

11. "Grading" means the cutting and filling of the land surface to a desired slope or elevation.

12. "Impervious surface" means surfaces, such as pavement and rooftops, which imbede or prevent the infiltration of storm water into the soil.

13. "Individual building lot" means a single parcel of land within a multiparcel development.

14. "Individual lot operator" means a person who has financial control of construction activities for an individual lot.

15. "Land disturbing activity" means any manmade change of the land surface, including removing vegetative cover that exposes the underlying soil, excavating, filling, transporting, and grading.

16. "Larger common plan of development or sale" means a plan, undertaken by a single project site owner or a group of project site owners acting in concert, to offer lots for sale or lease; where such land is contiguous, or is known, designated, purchased or advertised as a common unit or by a common name, such land shall be presumed as being offered for sale or lease as part of a larger common plan. The term also includes phased or other construction activity by a single entity for its own use.

17. "MS4" means Municipal Separate Storm Sewer System.

18. "Permanent stabilization" means the establishment, at a uniform design of seventy percent (70%) across the disturbed area, of vegetative cover or permanent nonerosive material that will ensure the resistance of the soil to erosion, sliding, or other movement.

19. "Phasing of construction" means sequential development of smaller portions of a large project site, stabilizing each portion before beginning land disturbance on subsequent portions, to minimize exposure of disturbed land to erosion.

20. "Project site" means the entire area on which construction activity is to be performed.

21. "Project site owner" means the person required to submit the NOI letter per Rule 5 and required to comply with the terms of these standards, Ordinance 4533, and Rule 5, including either of the following:
    a. a developer
    b. a person who has financial and operational control of construction activities and project plans and specifications, including the ability to make modifications to those plans and specifications.

22. "Sediment" means solid material (both mineral and organic) that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface.

23. "Soil" means the unconsolidated mineral and organic material on the surface of the earth that serves as then natural medium for the growth of plants.

24. "Storm Water Pollution Prevention Plan (SWPPP)" means a plan developed to minimize the impact of storm water pollutants resulting from construction activities. The plan indicates the specific measures and sequencing to be used to control sediment, soil erosion and other construction site wastes during and after construction.

25. "Storm water quality measure" means a practice, or a combination of practices, to control or minimize pollutants associated with storm water run-off.

26. "Strip development" means a multilot project where building lots front on an existing road.

27. "Subdivision" means any land that is divided or proposed to be divided into lots, whether contiguous or subject to zoning requirements, for the purpose of sale or lease as part of a larger common plan of development or sale.

28. "SWCD" means Soil and Water Conservation District.

29. "Technical Review and Comment Form": A form issued by the building department stating that the Erosion and Sediment Control Plan is adequate or stating revisions needed in the Erosion and Sediment Control Plan and Storm Water Pollution Prevention Plan.

30. "Temporary stabilization" means the covering of soil to ensure its resistance to erosion, sliding, or other movement. The term includes vegetative cover, anchored mulch, or other nonerosive material applied at a uniform density of seventy percent (70%) across the disturbed area.

31. "Tracking" means the deposition of soil that is transported from one (1) location to another by tires, tracks of vehicles, or other equipment.

32. "Trained individual" means an individual who is trained and experienced in the principles of storm water quality, including erosion and sediment control as may be demonstrated by state registration, professional certification, experience, or completion of coursework that enable the individual to make judgments regarding storm water control or treatment and monitoring.

Note: Rule 5 also contains additional definitions for language used in that rule.

D. Polices and Procedures

1. Coverage:
   All residential and non-residential construction projects which result in land disturbing activities equal to or greater than one (1) acre shall be in compliance with Ordinance 4533, these Standards, and Rule 5. The area of land disturbance resulting from the construction activity shall be calculated per 327 IAC 15-5-2(h)(1).

2. Exceptions:
   Individual, single-family construction projects not part of a larger, common development are exempt from the submittals outlined in the following section (Submittals), but must comply with the provisions of 327 IAC 15-5 section 7(b)(1) through 7(b)(5), 7(b)(10) through 7(b)(17), 7(b)(19), and 7(b)(20) throughout construction activities and until the areas are permanently stabilized.

3. Submittals:
   A Technical Review and Comment Form stating that the "Plan is Adequate" and an Improvement Location Permit shall be obtained prior to the initiation of any land disturbing activities. Construction site owner shall submit a review fee of $100 and 3 copies (forward one copy to the CDSWM and one copy to the Fayette County Soil and Water Conservation District for review) of the following information to the Fayette County Area Plan Commission:

   - Construction Plans
   - Construction Storm Water Pollution Prevention Plan (SWPPP)
   - Post-Construction SWPPP

   The detailed submittal requirements are contained in 327 IAC 15-5 Section 6 through Section 6.5 and summarized in Figure 18 of this manual. The construction project Post- Construction SWPPP must also be in compliance with Post-Construction Storm Water Quality section of this manual.

   After receiving the Technical Review and Comment Form (Figure 19) stating that the "Plan is Adequate" and an Improvement Location Permit, the following shall be submitted to IDEM, and the Fayette County Soil and Water Conservation District at least 48 hours prior to the initiation of land disturbing activities.

   - Notice of Intent Form (Figure 20)
   - A copy of the Technical Review and Comment Form verifying plan approval by the CDSWM
   - Proof of Publication required by 327 IAC 15-5-5 (9)

   A copy of the Notice of Intent shall also be submitted to the Fayette County Area Planning Commission (the APC will forward a copy to the CDSWM).

Single-family residential development consisting of four (4) or fewer lots or a single-family residential strip development where the developer offers for sale or lease without land improvements, and the project is not part of a larger common plan of development or sale, shall meet the detailed submittal requirements contained in 327 IAC 15-5-6.5(b).

For those construction activities operated by the MS4 operator or MS4 municipalities within the MS4 area, construction plans must be submitted to the local SWCD, the Indiana Department of Natural Resources, division of soil conservation, or other entity designated by IDEM for review and approval. If the MS4 operator does not receive either a notice of deficiency or an approval within thirty-five (35) days of the submittal, the plan will be considered adequate. After a one (1) year period of permit compliance, the MS4 operator or the designated MS4 entity need not submit the plans and may review MS4-operated project construction plans internally with the written authorization of the Indiana Department of Natural Resources, division of soil conservation.

4. MS4 Projects:
   In addition to the requirements of 327 IAC 15-5-6.5, for those construction activities operated by the MS4 operator or MS4 municipalities within the MS4 area, project construction plans must include a traffic phasing plan for those projects that have the potential to alter vehicular traffic routes. Also, the project SWPPP must address all requirement of 327 IAC 15-5-6.5(a)(7) and the following areas located outside of right-of-ways:

   a. Utility relocation areas.
   b. Material hauling and transportation routes/roads.
   c. Borrow pits.
   d. Temporary staging and material stockpile areas.
   e. Temporary disposal areas for waste materials.

5. Inspection Responsibilities:
   A self-monitoring program meeting the requirements of 327 IAC 15-5-7 shall be implemented. A trained individual shall perform an inspection of the project site to verify the erosion and sediment controls are being maintained and functioning properly and to determine whether additional controls are necessary. Inspections shall be performed after every storm event with a total measured rainfall accumulation equal to or greater than 0.5 inch and at a minimum, inspections shall be performed weekly.

   Written evaluation reports must be prepared by the end of the business day following the day of the inspection. The written evaluation reports must also be available to the CDSWM or other local, county or state entity within 48 hours of a request.

Written evaluation reports must contain the following information:

- Name of individual performing the inspection
- Date of the inspection
- Problems identified at the project
- Corrective actions recommended and completed

Construction site owners shall allow right-of-entry for the City of Connersville, or local, county, or state regulatory agency or a representative thereof to inspect any project site involved in construction activities, at reasonable times.

6. Priority Sites:
When construction plans are submitted for review, the reviewer will identify priority sites for inspection and enforcement. The criteria for priority sites will be based on the nature and extent of construction, proximity to sensitive areas, steep topography on or adjacent to proposed construction site, proximity to wetlands, and potential for direct run-off to receiving waters. Construction sites inspections will be based on priority determinations.

The CDSWM, or local, county, or state regulatory agency or a representative thereof may make recommendations to the project site owner or their representative to install appropriate measures beyond those specified in the storm water pollution prevention plan to achieve compliance.

7. Enforcement:
All persons engaging in construction activities on a project site shall be responsible for complying with these Standards, Ordinance 4533, and Rule 5. Any person causing or contributing to a violation of any provisions of these Standards, Ordinance 4533, and Rule 5 shall be subject to enforcement and penalty.

In the event the CDSWM or other regulatory agency determines the project is not in compliance with these Standards, Ordinance 4533, or Rule 5, the project site owner has five (5) business days following the written notification (warning letter of noncompliance or violation notice) from the CDSWM to correct the deficiency. In the event the deficiency is not corrected within this period, a fine of not less than 25 dollars per day per infraction shall be assessed to the project site owner. This fine shall not exceed $1000 per day.

A stop-work order (revocation of Improvement Location Permit) may be issued in the event that any person violates the terms of these Standards, Ordinance 4533, Rule 5 or implements a construction activity in such a manner as to materially adversely affect the health, welfare, or safety of persons residing or working in or adjacent to the project site.

If remaining storm water quality measures are not properly maintained by the person occupying or owning the property, the CDSWM may also issue fines to that individual.

E. General Requirements for Storm Water Pollution Prevention Plans

All land disturbing projects shall implement controls to minimize the transport of sediment from the project sites. Per 327 IAC 15-5-7, the project site owner shall, at least, meet the following requirements:

1. Sediment-laden water which otherwise would flow from the project site shall be treated by erosion and sediment control measures to minimize sedimentation.

2. Appropriate measures shall be implemented to minimize or eliminate wastes or unused building materials, including garbage, debris, cleaning wastes, wastewater, concrete truck washout, and other substances from being carried from a project site by run-off or wind. Identification of areas where concrete truck washout is permissible must be clearly posted at appropriate areas of the site. Wastes and unused building materials shall be managed and disposed of in accordance with all applicable statutes and regulations.

3. A stable construction site access shall be provided at all points of construction traffic ingress and egress to the project site.

4. Public or private roadways shall be kept cleared of accumulated sediment that is a result of run-off or tracking. Bulk clearing of sediment shall not include flushing the area with water. Cleared sediment shall be redistributed or disposed of in a manner that is in accordance with all applicable statues and regulations.

5. Storm water run-off leaving a project site must be discharged in a manner that is consistent with applicable state or federal law.

6. The project site owner shall post a notice near the main entrance of the project site. For linear project sites, such as a pipeline or highway, the notice must be placed in a publicly accessible location near the project field office. The notice must be maintained in a legible condition and contain the following information:

    - Copy of the completed NOI letter and the NPDES permit number, where applicable.
    - Name, company name, telephone number, e-mail address (if available), and address of the project site owner or a local contact person.
    - Location of the construction plan if the project site does not have an on-site location to store the plan.

7. This permit and posting of the notice of intent does not provide the public with any right to trespass on a project site for any reason, nor does it require that the project site owner allow members of the public access to the project site.

8. The SWPPP shall serve as a guideline for storm water quality, but should not be interpreted to be the only basis for implementation of storm water quality

measures for a project site. The project site owner is responsible for implementing, in accordance with Rule 5, all measures necessary to adequately prevent polluted storm water run-off.

9. The project site owner shall inform all general contractors, construction management firms, grading or excavating contractors, utility contractors, and the contractors that have primary oversight on individual building lots of the terms and conditions of this rule and the conditions and standards of the SWPPP and the schedule for proposed implementation.

10. Phasing of construction activities shall be used, where possible, to minimize disturbance of large areas.

11. Appropriate measures shall be planned and installed as part of an erosion and sediment control system.

12. All storm water quality measures must be designed and installed under the guidance of a trained individual.

13. Collected run-off leaving a project site must be either discharged directly into a well-defined, stable receiving channel or diffused and released to adjacent property without causing an erosion or pollutant problem to the adjacent property owner.

14. Drainage channels and swales must be designed and adequately protected so that their final gradients and resultant velocities will not cause erosion in the receiving channel or at the outlet.

15. Natural features, including wetlands and sinkholes, shall be protected from pollutants associated with storm water run-off.

16. Unvegetated areas that are scheduled or likely to be left inactive for fifteen (15) days or more must be temporarily or permanently stabilized with measures appropriate for the season to minimize erosion potential. Alternative measures to site stabilization are acceptable if the project site owner or their representative can demonstrate they have implemented erosion and sediment control measures adequate to prevent sediment discharge. Vegetated areas with a density of less than seventy percent (70%) shall be restabilized using appropriate methods to minimize the erosion potential.

17. During the period of construction activities, all storm water quality measures necessary to meet the requirements of this rule shall be maintained in working order.

18. A self-monitoring program shall be implemented (see Inspection page 22).

19. Proper storage and handling of materials, such as fuels or hazardous wastes, and spill prevention and clean-up measures shall be implemented to minimize the potential for pollutants to contaminate surface or ground water or degrade soil quality.

20. Final stabilization of a project site shall be achieved when:
    - All land disturbing activities have been completed and a uniform (for example, evenly distributed, without large bare areas) perennial vegetative cover with a density of seventy percent (70%) has been established on all unpaved areas and areas not covered by permanent structures, or equivalent permanent stabilization measures have been employed; and

    - Construction projects on land used for agricultural purposes are returned to its preconstruction agricultural use or disturbed areas, not previously used for agricultural production, such as filter strips and areas that are not being returned to their preconstruction agricultural use, meet the final stabilization requirements listed above.

F. *Individual Building Lots within a Permitted Project*

Per 327 IAC 15-5-7.5, all storm water quality measures, including erosion and sediment control, necessary to comply with Rule 5 and these Standards shall be implemented in accordance with the plan. Provisions for erosion and sediment control on individual building lots regulated under the original permit of a project site owner must include the following requirements:

1. The individual lot operator, whether owning the property or acting as the agent of the property owner, shall be responsible for erosion and sediment control requirements associated with activities on individual lots.

2. Installation and maintenance of a stable construction site access.

3. Installation and maintenance of appropriate perimeter erosion and sediment control measures prior to land disturbance.

4. Sediment discharge and tracking from each lot must be minimized throughout the land disturbing activities on the lot until permanent stabilization has been achieved.

5. Clean-up of sediment that is either tracked or washed onto roads. Bulk clearing of sediment shall not include flushing the area with water. Cleared sediment must be redistributed or disposed of in a manner that is in compliance with all applicable statutes and rules.

6. Adjacent lots disturbed by an individual lot operator must be repaired and stabilized with temporary or permanent surface stabilization.

7. For individual residential lots, final stabilization meeting the criteria in item (20) of the previous section will be achieved when the individual lot operator:
   - Completes final stabilization; or
   - Has installed appropriate erosion and sediment control measures for an individual lot prior to occupation of the home by the homeowner and has informed the homeowner of the requirement for, and benefits of, final stabilization.

G. Technical Design Criteria

Erosion and sediment controls shall be designed and installed in accordance with Rule 5, these Standards, and the Indiana Storm Water Quality Manual. Technical review of the erosion and sediment control program, SWPPP, and other required submittals shall be completed by the CDSWM. The technical review shall assess the adequacy of proposed erosion and sediment control against the technical design criteria contained in the Indiana Storm Water Quality Manual.

The following guidelines shall be used during development of the Storm Water Pollution Prevention Plan:

1. Construction sequencing shall minimize the amount of exposed land and the duration of exposure without temporary or permanent protection.

2. Grading activities shall minimize the amount of cut and fill.

3. Perimeter controls shall be installed prior to land disturbing activities.

4. Storm sewer inlets and conveyance outfalls shall be equipped with appropriate erosion and sediment controls and shall remain in place until the entire contributing drainage area is permanently stabilized.

5. Project access points shall have 2-inch to 3-inch or larger aggregate for a depth of at least 6 inches placed at all ingress and egress points to minimize tracking of sediment beyond the project site by vehicles and construction equipment. The aggregate must cover a minimum area of 20’ x 50’, and be periodically maintained (cleaned, top dressed).

6. Sediment tracked to road surfaces shall be removed using acceptable practices, such as shoveling or street sweeping, daily. Washing of road surfaces is not acceptable, unless the run-off flows to a sediment control measure.

7. Storm water run-off velocities from the project site shall be kept as low as possible.

8. Erosion from soil stockpiles shall be minimized via stabilization or erosion control measures.

9. Permanent seeding shall take place as soon as practicable. Temporary seeding shall be utilized in areas left undisturbed for more than thirty (30) days.

10. Dust control measures shall be implemented as necessary.

11. Erosion control blankets shall be required on all fill slopes exceeding 4 (horizontal) to 1 (vertical).

12. Mulching material is required for all temporary and permanent seeding.

13. The minimum thickness of rock riprap shall be 6 inches.

H. Project Termination

The project site owner shall plan an orderly and timely termination of the construction activities, including the implementation of storm water quality measures that are to remain on the project site.

The project site owner, or a representative thereof, shall submit a written notice of termination (NOT) form (See Figure 21) to the CDSWM, the County SWCD, and IDEM upon project termination once the following requirements are met:

1. All land disturbing activities, including construction on all building lots, have been completed.

2. Final stabilization of the entire site has been completed.

3. All permanent storm water quality measures (if required per Post-Construction Storm Water Quality section) have been implemented and are operational.

4. Temporary erosion and sediment control measures have been removed.

The NOT must be submitted within two (2) weeks of project termination, and contain a statement(s) verifying that each of these conditions have been met.

The CDSWM or a representative thereof may inspect the project site to confirm the information provided in the NOT. Upon verification of the NOT letter, the CDSWM shall issue written approval to the project site owner that the project site owner shall no longer be responsible for compliance with the requirements of this Chapter.

Early Project Termination Requirements:

The project site owner may submit an NOT letter to obtain early release from compliance with these Standards, Ordinance 4533, and Rule 5.

The project site owner must meet the requirements per 327 IAC 15-5-8(b)(2) as outlined below:

1. The remaining, undeveloped acreage does not exceed five (5) acres, with contiguous areas not to exceed one (1) acre.

2. A map of the project site, clearly identifying all remaining undeveloped lots, is attached to the NOT letter. The map must be accompanied by a list of names and addresses of individual lot owners or individual lot operators of all undeveloped lots.

3. All public and common improvements, including infrastructure, have been completed and permanently stabilized and have been transferred to the appropriate local entity.

4. The remaining acreage does not pose a significant threat to the integrity of the infrastructure, adjacent properties, or water quality.

5. All permanent storm water quality measures have been implemented and are operational.

Upon verification of the NOT letter, the CDSWM shall issue written approval to the project site owner. Upon receipt of this approval, the project site owner shall notify all current individual lot owners and all subsequent individual lot owners of the remaining undeveloped acreage and acreage with construction activity that they be responsible for complying with the General Requirements for Individual Building Lots within a Permitted Project. The remaining individual lot owners do not need to submit an NOI letter or NOT letter. The notice must contain a verified statement that each of the conditions in Items 1 through 5, listed above, have been met. The notice must also inform the individual lot owners of the requirements to:

1. Install and maintain appropriate measures to prevent sediment from leaving the individual building lot; and

2. Maintain all erosion and sediment control measures that are to remain on-site as part of the construction plan.

CHAPTER 3: POST-CONSTRUCTION STORM WATER QUALITY

CHAPTER 3: POST CONSTRUCTION STORM WATER QUALITY

A. Introduction

The purpose of this chapter is to establish minimum performance standards for management of post-construction storm water run-off quality, which is necessary to reduce the impacts of sediment and pollutants on local habitat and water resources. In addition to the standards in this manual, projects meeting the applicability of this chapter must also comply with Ordinance 4700, an ordinance to establish requirements for post-construction storm water run-off controls.

Sediments can have adverse effects on aquatic life in streams and lakes and can transport other attached pollutants affecting the welfare of the public residing in local watersheds. Major sources of sediment include washoff of particles that are deposited on impervious surfaces and the erosion of stream banks and construction sites. Improvements in the quality of post-construction storm water run-off can be met by best management practices (BMPs) including maximizing the use of site design to reduce run-off, managing and treating storm water run-off through the use of structural controls, and implementing pollution prevention practices to prevent erosion and reduce potential contaminants.

Hydrologic studies show that small-sized, frequently occurring storms account for the majority of rainfall events. The run-off from these storms accounts for a major portion of the annual pollutant loadings. By treating the frequently occurring smaller rainfall events, and a portion of the storm water run-off from larger events, it is possible to effectively mitigate the water quality impacts from developed areas.

The City of Connersville and the Connersville Department of Storm Water Management (CDSWM) has adopted a policy that the control of storm water run-off quality will be based on the management of total suspended solids (TSS). This requirement will serve as the basis of the storm water quality management program for all areas within the jurisdiction of the City of Connersville. The target TSS removal rate is 80%.

One approach to reduce the post-development TSS loadings by 80% is to require treatment of a water quality volume from a site. A second approach is to require treatment of a water quality flow rate from the site. Approved methods for calculating the water quality volume and flow rate are described in this chapter.

The appropriate storm water quality volume (WQ_v) and/or storm water quality flow rate (Q_{wq}) generated from a qualifying site shall be adequately treated before discharge. Pre-approved structural BMPs are provided in Table 1 located at the end of this chapter and are presumed to comply with the 80% TSS removal rate where indicated if:

1. Sized to capture the prescribed water quality volume or flow rate, as applicable,
2. Designed according to the specific performance criteria outlined in this manual,
3. Constructed properly, and
4. Maintained regularly.

Post-construction storm water quality measures must be properly maintained to ensure storm water run-off is continuously treated from the developed and stabilized site.

Special circumstances that are not covered by these standards shall be regulated and reviewed on a case-by-case basis.

CHAPTER 3: POST CONSTRUCTION STORM WATER QUALITY

B. Applicability

Any land disturbing project, including new development and redevelopment, within the City of Connersville that results in the disturbance of one (1) acre or more of total land area is subject to the requirements of this chapter. Furthermore, land disturbing activities that are less than one (1) acre but part of a larger common plan of development are required to comply with this chapter.

Per ordinance, the following activities are exempt from these requirements:

1. Construction of, or modifications to, single family structures that are not a part of a larger common plan of development,
2. Single family residential development consisting of four (4) or fewer lots,
3. Individual lots within a larger common development plan that has been previously permitted for storm water management, and
4. Any logging, agricultural, or other activity which is consistent with an approved soil conservation plan or a timber management plan prepared or approved by county, state, or federal regulating agencies.

C. Submittal Requirements

A submittal for storm water quality treatment review will not be considered complete until all of the items below have been submitted.

1. A Storm Water Pollution Prevention Plan (SWPPP) shall be required that details how run-off and associated water quality impacts resulting from the development will be controlled or managed. In addition to submittal requirements listed in this manual, the following items shall be included in the SWPPP:

    a. A description of potential pollutant sources from the proposed land use, which may reasonably be expected to add a significant amount of pollutants to storm water discharges.
    b. A description of measures that will be installed to control pollutants in storm water discharges that will occur after construction activities have been completed. Such practices include infiltration of run-off, flow reduction by use of open vegetated swales and natural depressions, buffer strip and riparian zone preservation, filter strip creation, minimization of land disturbance and surface imperviousness, maximization of open space, and storm water retention and detention ponds.
    c. A sequence describing when each post-construction storm water quality measure will be installed.
    d. Storm water quality measures that will remove or minimize pollutants from storm water run-off.
    e. Storm water quality measures that will be implemented to prevent or minimize adverse impacts to stream and riparian habitat.
    f. A narrative description and checklist of operation and maintenance guidelines for all post-construction storm water quality measures to facilitate their proper long-term function. This narrative description and checklist shall be made available to future parties who will assume responsibility for the operation and maintenance of the post-construction storm water quality measures.

2. An *Application for Drainage Approval* form with the applicable initial review fee of $100.00. The initial review fee includes one (1) hour of storm water quality treatment review. Projects requiring more than one (1) hour of review due to their complexity or deficiency in design or submittal shall be assessed plan review fees at the rate of $125.00 per hour. Review fees shall be payable to the Connersville Department of Storm Water Management. A review letter with any comments generated as a result of the review will be issued to the professional engineer responsible for completing the design.

3. A complete set of professionally certified construction plans showing the location, dimensions, and construction details of all post-construction storm water quality measures, detailed specifications and supporting water quality BMP sizing calculations.

4. Unless otherwise stated in this manual (refer to the Project Construction section of this manual for additional details on easements), a thirty-foot easement around the water quality treatment BMP along with an access easement to the BMP is required. Upon approval of the easement location shown on the construction plans, the easement shall be granted to the City of Connersville by way of a *Grant of Perpetual Drainage Easement*.

D. Methods for Sizing BMPs

There are two (2) methods for calculating the required size of a BMP. The first method calculates the water quality volume to be treated, which applies to detention-based BMPs. The second method calculates the water quality peak flow rate to be treated, which applies to filtration processes and mechanical-type BMPs such as hydrodynamic devices.

The water quality volume or flow rate shall be treated by an acceptable (pre-approved) BMP(s) from Table 1 or an equivalent practice. Such practices or techniques and devices not pre-approved that may be more functional and desirable for storm water management may be utilized upon approval by the CDSWM. Mechanical-type BMPs must meet ASTM standard methods for verifying performance and must be certified by a professional engineer. The BMP must meet the 80% TSS removal rate at a US silica OK110 sand micron range (very fine/fine sand) without resuspension of particles at the design water quality flow rate resulting from a 1-inch rainfall depth. Testing of the TSS removal rate must be conducted by an independent testing facility rather than by the manufacturer.

A quick reference, minimum design criteria and maintenance and inspection checklists for each pre-approved BMP are provided in the Appendices of this manual.

1. WATER QUALITY VOLUME (WQ_v)

The WQ_v is the storage needed to capture and treat the run-off from the first one-inch of rainfall. The WQ_v is equivalent to one inch of rainfall multiplied by the volumetric run-off coefficient (R_v) and the site area. The volume of run-off is directly related to the amount of impervious cover at the site and is calculated using the following equation:

$$WQ_v = \frac{(P)\,(R_v)\,(A)}{12}$$

where:

WQ_v = water quality volume (acre-feet)
P = 1 inch of rainfall
R_v = volumetric run-off coefficient
= 0.05 + 0.009(I), where I is the percent (%) impervious cover
A = area in acres

2. WATER QUALITY FLOW RATE (Q_{wq})

The Q_{wq} is needed to size BMP devices designed to treat run-off at a peak design flow rate through the system.

Conventional SCS methods have been found to underestimate the volume and rate of run-off for rainfall events less than 2 inches. The following procedure can be used to calculate the Q_{wq}. The method relies on the water quality volume in conjunction with an adjusted curve number (CN_{wq}) and the NRCS TR-55 methodology.

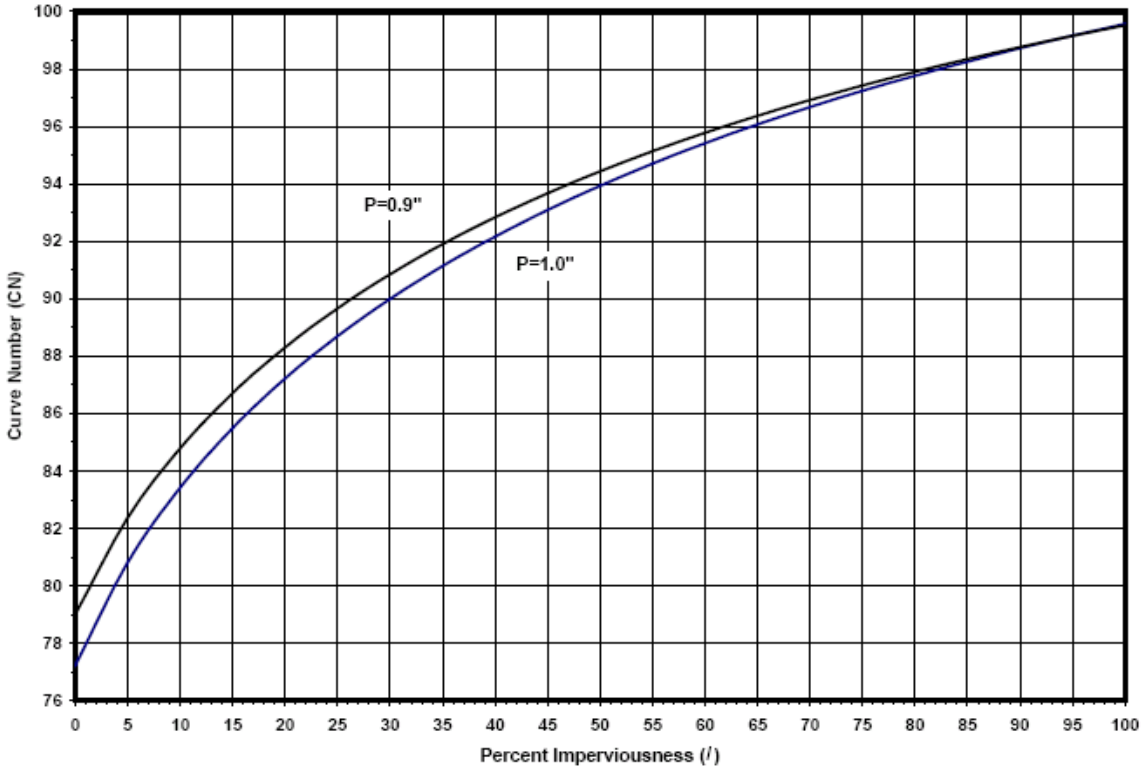
Step 1 - Using the water quality volume, calculate the adjusted CN_{wq}:

$$CN_{wq} = 1000/[10 + 5P + 10WQ_{vi} - 10(WQ_{vi}^2 + 1.25WQ_{vi}P)^{1/2}]$$

where:

CN_{wq} = adjusted curve number for water quality flow rate calculation
P = rainfall in inches (use 1 inch for water quality storm)
WQ_{vi} = water quality volume in inches = 1.0 inch (R_v)
R_v = volumetric run-off coefficient
= 0.05 + 0.009(I), where I is the percent (%) impervious cover

Graphically:



Step 2 – Calculate the site time of concentration (t_c) and area in acres (A).

Step 3 – Use the adjusted CN_{wq}, t_c and A as input for TR-55 calculations in conjunction with the Huff II rainfall distribution, for 1 inch of rainfall depth using the storm duration that produces the highest peak flow rate to calculate the Q_{wq}.

E. Inspection and Maintenance

The staff of the CDSWM or their designated representative may conduct inspections of the water quality treatment system construction. If required by the City of Connersville the applicant shall execute an *Inspection Services Agreement* with the City of Connersville and pay all applicable inspection fees per the terms stated in the agreement. The applicant must notify the City of Connersville 48 hours in advance of construction of the storm water management system.

Each BMP must have an operation and maintenance plan signed by the BMP Owner and submitted with the SWPPP. The CDSWM must approve the plan. Routine inspection and maintenance is the responsibility of the BMP Owner. The approved maintenance plan and inspection forms provided in this manual may be used in performing maintenance activities. Records of routine inspection are the responsibility of the owner and must be made available upon request of the City of Connersville.

Minimum design criteria, maintenance and inspection checklists and example calculations for each pre-approved BMP are provided as Appendix A of this manual.

F. Pre-Approved BMPs

TABLE 1- PRE-APPROVED BMPs

BMP	Description	80% TSS Removal	Selection Guidelines
Storm Water Pond	Constructed basin with a permanent pool of water in which run-off is captured and treated.	Yes	Minimum 10 acres
Storm Water Wetland	Constructed wetland areas consisting of shallow marsh areas, open water and semi-wet areas above a permanent pool.	Yes	Regional sites Minimum 10 acres
Bioretention Area	Shallow basins or landscaped areas with engineered soils and vegetation and filter strip treatment prior to ponding area.	Yes	0.5 – 2 acres preferred Maximum 5 acres
Water Quality Dry Swale with Pretreatment	Vegetated open channel that captures and treats storm water run-off within dry cells.	Yes	Maximum 5 acres
Sand Filters with Pretreatment	Structure that treats run-off through filtration using a sand bed as the primary filter media. Requires pretreatment due to high clog factor.	Yes	Maximum 2 - 10 acres
Infiltration Trench with Forebay	Trench that captures and treats storm water run-off by allowing it to infiltrate into the ground through aggregate into highly porous underlying soils.	Yes	Maximum 5 acres
Biofilters	Densely vegetated land engineered as pretreatment or as part of a treatment train	No	Used in conjunction with other water quality treatment measures

References:
Georgia Storm Water Management Manual, Volume 2
Maryland Storm Water Design Manual, Volume II
Indianapolis Storm Water Specifications Manual

FIGURES

DRAINAGE PLAN SUBMITTAL CHECKLIST

_____ 1. Completed *Application for Drainage Approval.*
_____ 2. Initial Drainage Approval review fee of $100.00.
_____ 3. *Storm Water User Fee Credit Application Package*, if applicable, with User Fee Credit review fee(s).
_____ 4. 2 sets Site/Drainage plans which contain the following:
- _____ Name and location map of proposed project
- _____ Owner's name
- _____ Seal and signature of professional engineer/land surveyor responsible for completing the design
- _____ Date of plans
- _____ North arrow and scale
- _____ Existing and proposed site conditions, including contours, elevations, entire stormwater system with applicable inverts and elevations, storm sewer profiles, drainage flow arrows, pond cross section, utilities, building footprints and finished floor elevations, streets, drives, parking areas, easements, rights-of-way, property lines, bench marks, floodway/floodplain boundaries, all applicable construction/installation details, and erosion control measures and details.

_____ 5. Storm Water Pollution Prevention Plan (SWPPP) as applicable:
- _____ Rule 5 submittal requirements (see Fig 18)
- _____ $100.00 initial review fee for Rule 5 plan review
- _____ Post-Construction Storm Water Quality submittal requirements
- _____ $100.00 initial review fee for Post-Construction plan review

_____ 6. Technical Specifications
_____ 7. Technical Drainage Report which contains the following:
- _____ Narritive of pre-developed and post-developed site conditions containing a summary of all calculation or location of information by page number reference.
- _____ Storm water runoff calculations including:
  - _____ Drainage area calculation
  - _____ Weighted runoff coefficient or curve number calculations
  - _____ Time of concentration calculations showing overland (sheet) flow, shallow concentrated flow, and flow time in channel, gutter or pipe
- _____ Grate capacities
- _____ Storm pipe and open channel design calculations including:
  - _____ Size of pipe and typical channel cross section
  - _____ Pipe and channel slopes
  - _____ Material and roughness coefficient
  - _____ Velocities in feet per second (fps)
  - _____ Capacities in cubic feet per second (cfs)
- _____ Storm pipe flow and hydraulic grade line calculations
- _____ Name of computer model used where applicable
- _____ Highlight pertinent data if computer printouts are submitted
- _____ Detention/Retention Design summary with outlet control structure information (outlet structure discharge rating curve, stage/storage/discharge information during storm event)

_____ 8. Completed *Certification of Sufficiency of Plan*

APPLICATION FOR DRAINAGE APPROVAL

Connersville Utilities
Attn: Utilities Inspector
216 Vine Street
P.O. Box 325
Connersville, IN 47331

Initial review fee of $100 for drainage review, $100 for Rule 5 review and $100 for post-construction review is to be submitted with this application. Make checks payable to Connersville Department of Storm Water Management. All items on checklist must be submitted for application to be complete.

Name of Project _____

Legal Address _____

Township _____ Parcel No. _____

Total Acres of Site _____ Disturbed Acres of Site _____ Impervious Area _____

Property Use (check one) _____ Proposed Subdivision

_____ Commercial/Industrial/Apartment

_____ Other _____

Owner Information

Name _____

Address _____

Contact Person _____

Telephone _____ Fax _____

Design Firm Information

Company Name _____

Address _____

Professional Engineer _____

Contact Person _____

Telephone _____ Fax _____

As owner, or an authorized representative of the owner, I agree to pay all fees incurred for the requested drainage review for the above project. (Initial drainage review fee is $100 for first hour of review time. Addition review time is charged at $125 per hour of review time.)

Printed Name and Title _____

Signature _____ Date _____

Address _____

CONNERSVILLE DEPARTMENT OF STORM WATER MANAGEMENT

Date Submitted _____ Project No. _____

Approval Date _____

DRAINAGE PLAN SUBMITTAL CHECKLIST (for single- and double-family dwellings)

A stormwater plan that is neat, accurate and readable must be submitted that includes the following:

1. Completed *Application For Drainage Approval For Single- and –Double Family Dwellings.*
2. Review fee of $50.00. Make checks payable to Connersville Department of Storm Water Management.
3. Legal description of the property
4. Legal street address of the property
5. Name and address of the owner of the property
6. Dimensions of the property
7. Locations of improvements, structures, paved and graveled areas, drainage and utility easements and rights-of-way
8. Existing and proposed grading, by contours or spot elevations, sufficient to show positive drainage
9. Locations of ditches, culverts, etc with arrows to show direction of flow.

At a minimum, land-disturbing activities shall include the installation of perimeter type erosion control measures such as straw bales, silt fences and gravel drives. Tracking of sediment into the street is to be minimized.

APPLICATION FOR DRAINAGE APPROVAL FOR SINGLE- AND DOUBLE- FAMILY DWELLINGS

Connersville Utilities
Attn: Utilities Inspector
216 Vine Street
P.O. Box 325
Connersville, IN 47331

Review fee of $50 is to be submitted with this application. Make checks payable to Connersville Department of Storm Water Management. All items on checklist must be submitted for application to be complete.

Legal Address _____

Township _____ Parcel No. _____

Total Acres of Site _____

Owner Information

Name _____

Address _____

Contact Person _____

Telephone _____ Fax _____

As owner, or an authorized representative of the owner, I certify that the above information is true and correct to the best of my knowledge.

Printed Name and Title _____

Signature _____ Date _____

Address _____

CONNERSVILLE DEPARTMENT OF STORM WATER MANAGEMENT

Date Submitted _____ Project No. _____

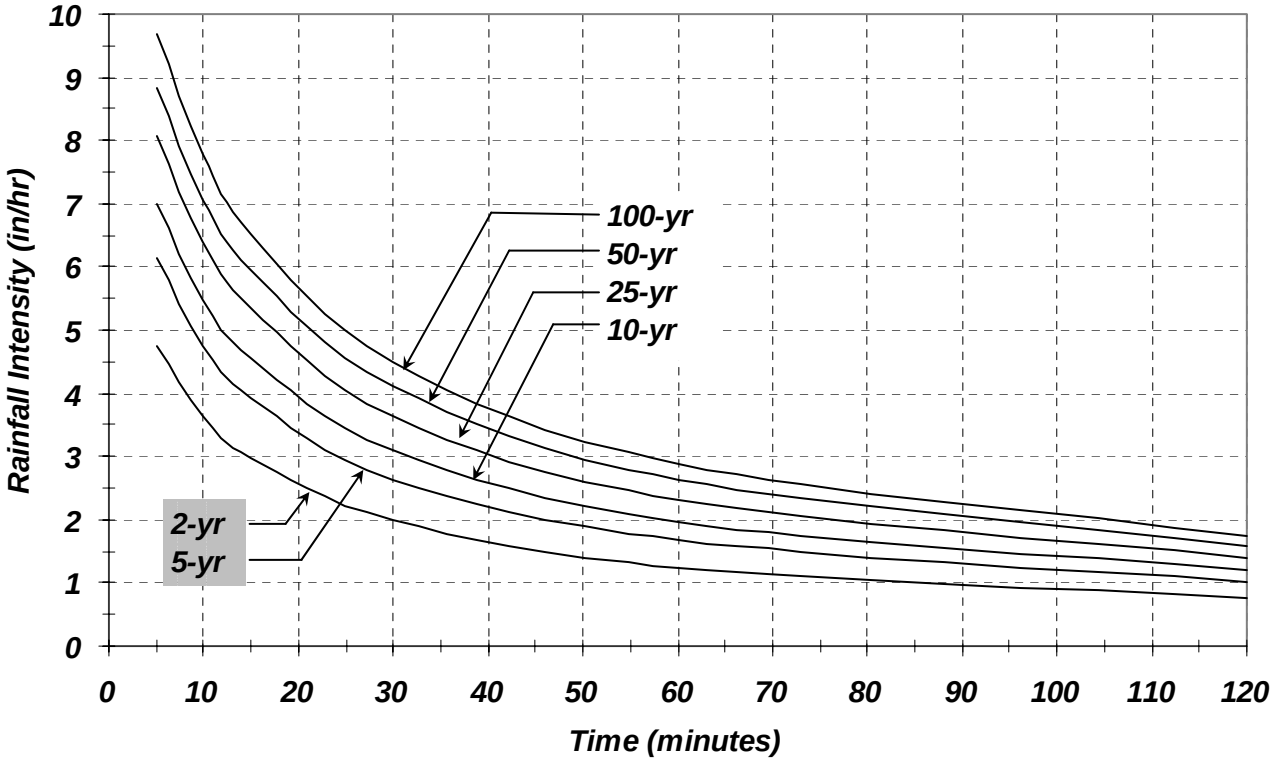
Approval Date _____

RATIONAL METHOD RUNOFF COEFFICIENTS

SURFACE	RUNOFF COEFFICIENT
Urban Areas	
Roof surfaces	0.90
Pavement	0.85
Gravel	0.85
Business, Commercial, Industrial Lots	0.85
Apartments and Townhouses	0.70
Schools and Churches	0.55
Parks and Cemeteries	0.30
Single-family lots < ½ acre	0.45
Single-family lots > ½ acre	0.35
Heavy Impervious Soils	0.55
With turf	0.45
Slightly Pervious Soils	0.25
With turf	0.20
Moderately Pervious Soils	0.15
With turf	0.10
Non-Urban Areas	
Bare Earth	0.55
Steep Grassy Slopes (2:1)	0.60
Turf Meadows	0.25
Forested areas	0.20
Cultivated fields	0.30

IDF TABLE AND CURVE FOR CONNERSVILLE, IN (from City of Indianapolis Stormwater Design and Construction Specifications Manual)

Hours	Minutes	Return Period - Rainfall Intensity (in/hr)					
		2	5	10	25	50	100
0.8	5	4.75	6.14	6.99	8.08	8.83	9.69
0.17	10	3.63	4.75	5.48	6.40	7.07	7.77
0.25	15	2.97	3.92	4.55	5.34	5.94	6.53
0.5	30	1.98	2.64	3.09	3.65	4.10	4.50
1	60	1.25	1.67	1.96	2.31	2.62	2.88
2	120	0.76	1.02	1.20	1.40	1.59	1.75
3	180	0.56	0.75	0.88	1.03	1.17	1.29
6	360	0.33	0.44	0.52	0.60	0.68	0.75
12	720	0.20	0.25	0.30	0.35	0.39	0.43
24	1440	0.11	0.15	0.17	0.20	0.22	0.25



RATIONAL FORMULA STORM SEWER WORKSHEET

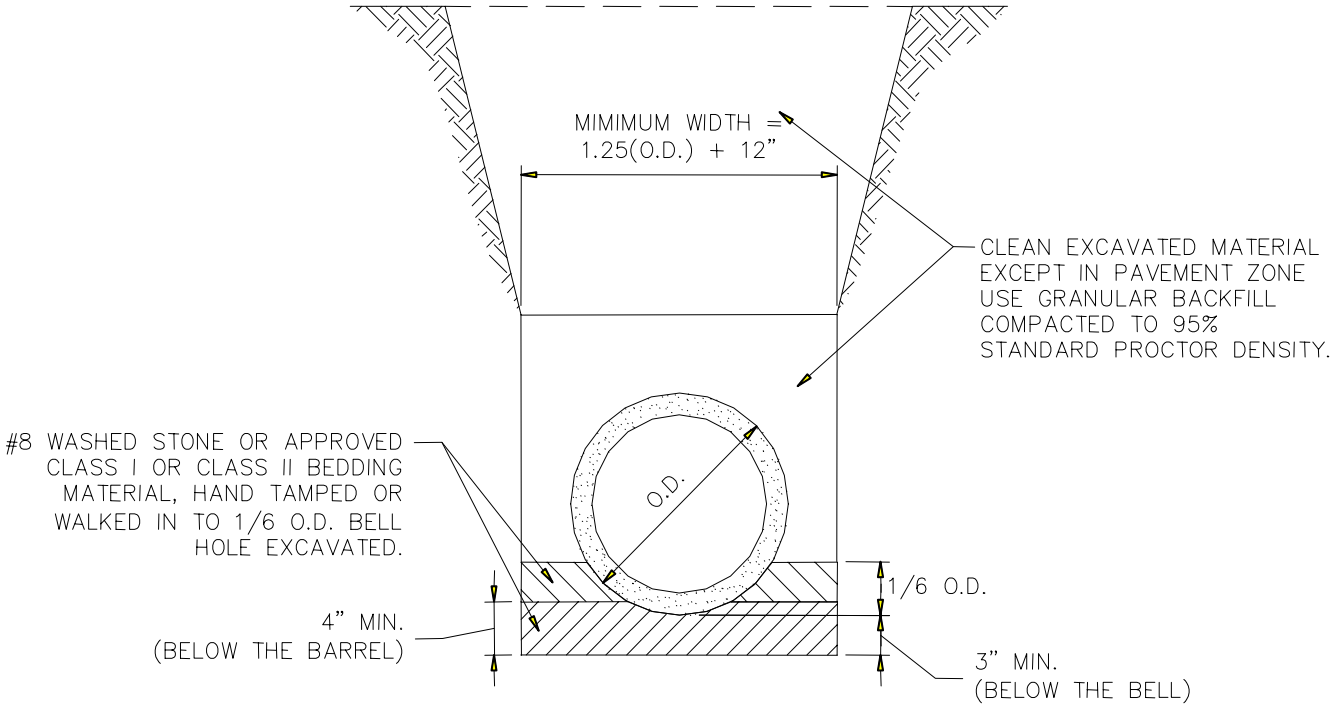
PROJECT _____ PAGE ____ of _____

COMPUTED BY _____ Date _____

Station		Length	Drainage Area		Runoff	Area x C		Time of Conc.		Rain Int.	Runoff	Pipe ϕ	Cap. Full	Velocity		Sect. Time	Inv. Elev.		Crown Drop	Slope
From	To		Inc.	Tot.	"C"	Inc.	Tot.	Inlet	Syst.	"i"	"Q"			Full	Design		U/S	D/S		
		(ft)	(ac)	(ac)		(ac)	(ac)	(min)	(min)	(in/hr)	(cfs)	(in)	(cfs)	(fps)	(fps)	(min)	(ft)	(ft)	(ft)	(ft/ft)

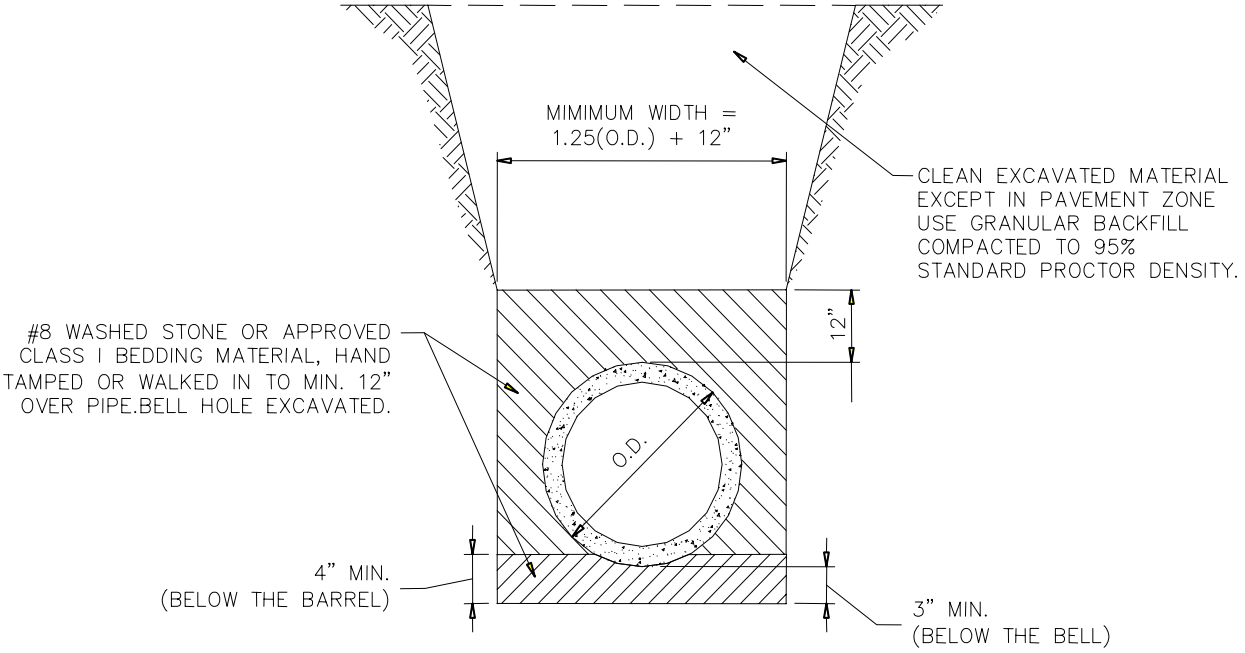
RCP BEDDING AND BACKFILL DETAIL

PIPE SIZE	8" TO 15"	18" & OVER
BEDDING BELOW THE PIPE BARREL	MIN. = 4"	O.D./4 MAX. = 8"



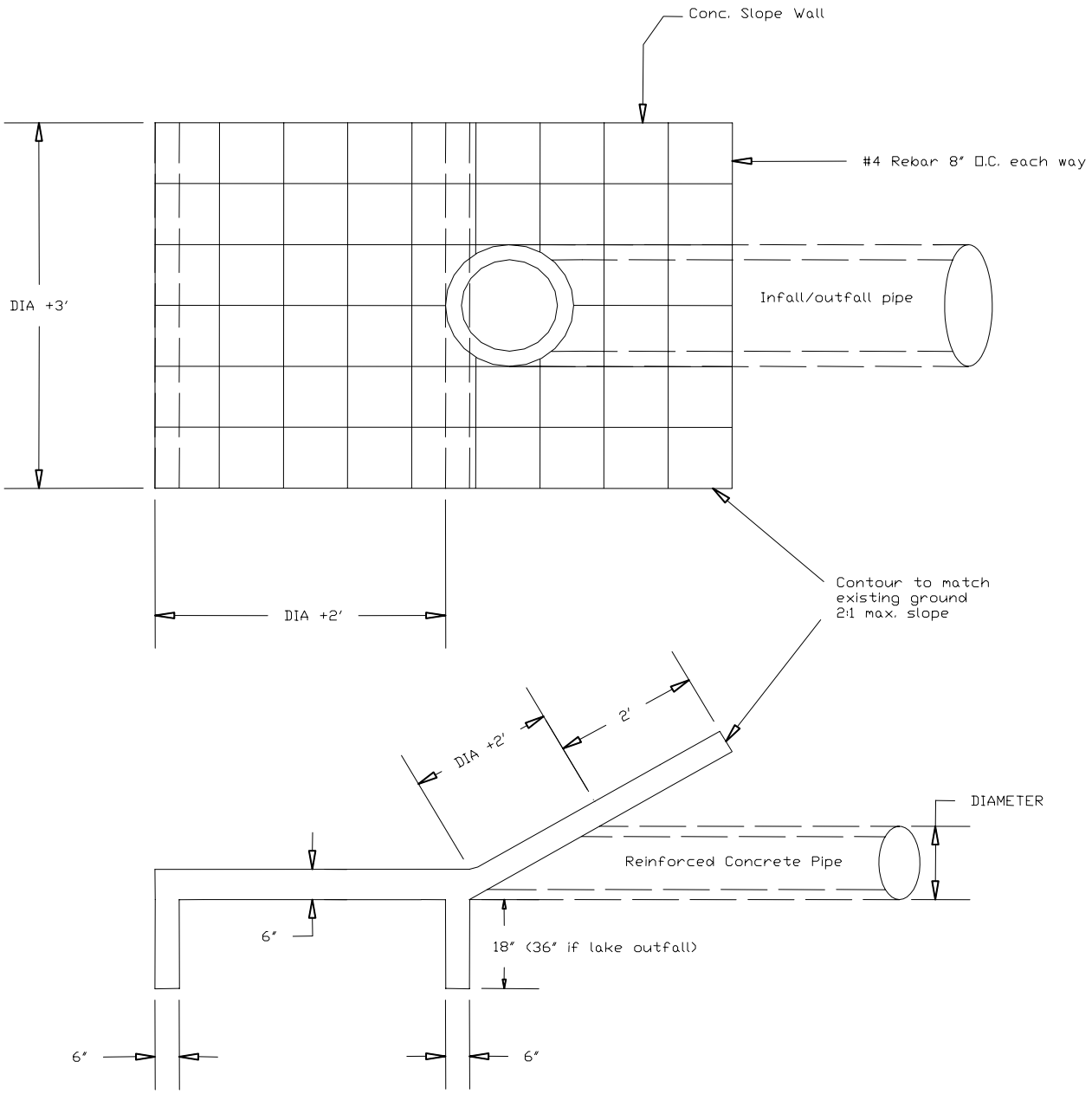
PVC AND HDPE PIPE BEDDING AND BACKFILL DETAIL

PIPE SIZE	8" TO 15"	18" & OVER
BEDDING BELOW THE PIPE BARREL	MIN. = 4"	O.D./4 MAX. = 8"



NOTE: ALL BEDDING AND INITIAL BACKFILL SHALL BE INSTALLED IN 6"–12" BALANCED LIFTS.

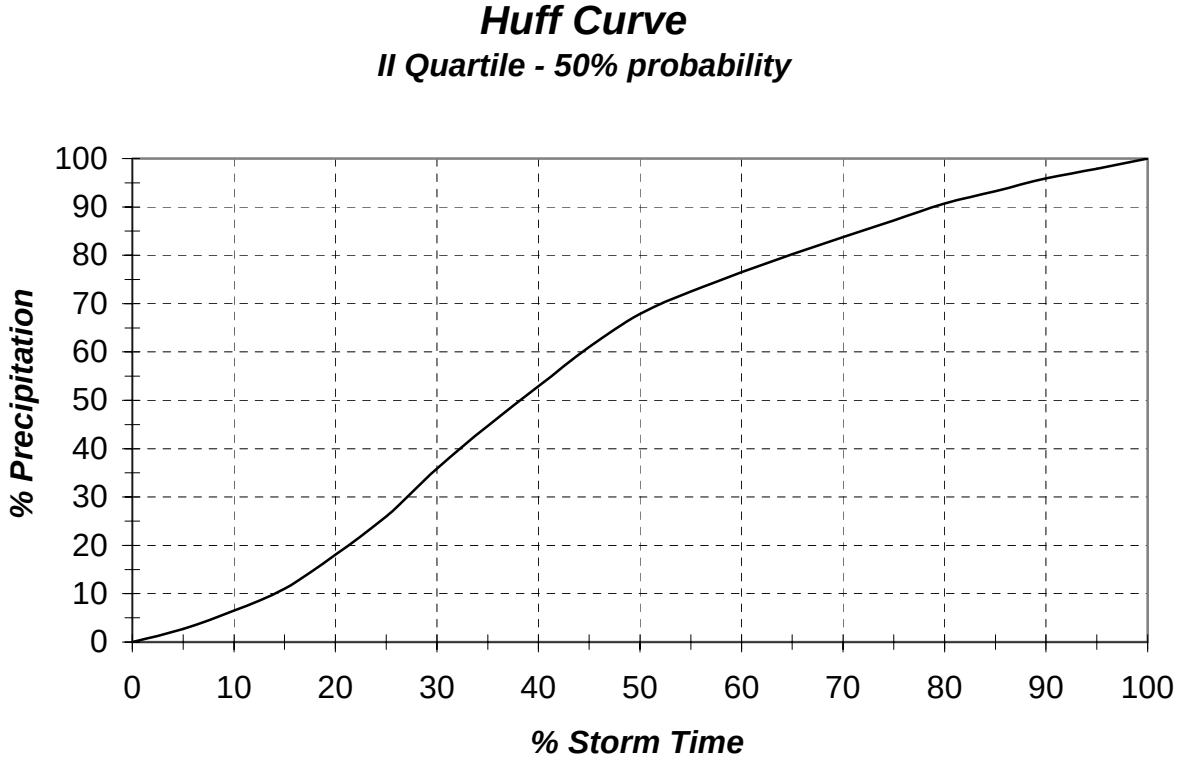
CONCRETE SLOPE WALL



IDD TABLE FOR CONNERSVILLE, IN (from City of Indianapolis Stormwater Design and Construction Specifications Manual)

Hours	Minutes	Return Period - Rainfall Depth (in)					
		2	5	10	25	50	100
0.08	5	0.40	0.51	0.58	0.67	0.74	0.81
0.17	10	0.51	0.79	0.91	1.07	1.18	1.30
0.25	15	0.74	0.98	1.14	1.34	1.49	1.63
0.5	30	0.99	1.32	1.55	1.83	2.05	2.25
1	60	1.25	1.57	1.96	2.31	2.62	2.88
2	120	1.52	2.04	2.40	2.31	3.18	3.50
3	180	1.68	2.25	2.64	3.09	3.51	3.87
6	360	1.98	2.64	3.12	3.60	4.08	4.50
12	720	2.40	3.12	3.60	4.20	4.68	5.16
24	1440	2.64	3.50	4.08	4.80	5.28	6.00

SECOND QUARTILE HUFF RAINFALL DISTRIBUTION (from Purdue et. al, "Statistical Characteristics of Storm Time Increment Rainfall")



HUFF CURVE ORDINATES (from Purdue et. al, "Statistical Characteristics of Storm Time Increment Rainfall")

% STORM TIME	% PRECIPITATION
0	0.0
5*	2.7
10	6.5
15*	11.0
20	18.1
25*	26.0
30	35.9
35*	44.7
40	52.9
45*	61.0
50	67.9
55*	72.5
60	76.5
65*	80.2
70	83.8
75*	87.2
80	90.7
85*	93.3
90	95.9
95*	97.9
100	100.0

*Estimated Values

RUNOFF CURVE NUMBERS FOR URBAN AREAS[1] (from 210-V1-TR-55, Second Ed., June 1986)

Cover description Cover type and hydrologic condition	Average percent impervious area[2]	Curve numbers for hydrologic soil group A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries (etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%).....		39	61	74	80
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
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders).....		96	96	96	96
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
¼ acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
½ acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres.....	12	46	65	77	82
<u>Developing urban areas</u>					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).....					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. 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. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

RUNOFF CURVE NUMBERS FOR CULTIVATED AGRICULTURAL LANDS[1] (from 210-V1-TR-55, Second Ed., June 1986)

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment[2]	Hydrologic Condition[3]	A	B	C	D
Fallow	Bare soil	--	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T + CR	Poor	65	73	79	91
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T + CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow.	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and $I_a = 0.2S$.

[2] *Crop residue cover* applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydrologic condition is based on a combination of factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes in rotations, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

RUNOFF CURVE NUMBERS FOR OTHER AGRICULTURAL LANDS[1] (from 210-V1-TR-55, Second Ed., June 1986)

Cover description Cover type	Hydrologic Condition	Curve numbers for hydrologic soil group A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	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.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[4]30	48	65	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	[4]30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	--	59	74	82	86

[1] Average runoff condition, and $I_a = 0.2S$.

[2] *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.

[3] *Poor:* < 50% ground cover.
Fair: 50 to 75% ground cover.
Good: > 75% ground cover.

[4] Actual curve number is less than 30: use CN = 30 for runoff computations.

[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6] *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

TIME OF CONCENTRATION WORKSHEET
(From 210-VI-TR-55, Second Ed., June 1986)

Project _____By _____Date _____

Location _____Checked _____ Date _____

Circle one: Present Developed _____

Circle one: T_c T_t through subarea _____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID								
1. Surface description									
2. Manning's roughness coeff., n									
3. Flow length, L (total ≤ 300 ft) ft									
4. Two-yr 24-hr rainfall, P_2 in									
5. Land slope, s ft/ft									
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t hr			+		=				
Shallow concentrated flow	Segment ID								
7. Surface description (paved or unpaved)									
8. Flow length, L ft									
9. Watercourse slope, s ft/ft									
10. Average velocity, v ft/s									
11. $T_t = \frac{L}{3600V}$ Compute T_t hr			+		=				
Channel Flow	Segment ID								
12. Cross sectional flow area, a ft^2									
13. Wetted perimeter, P_w ft									
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ft									
15. Channel slope, s ft/ft									
16. Manning's roughness coeff., n									
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V ft/s									
18. Flow length, L ft									
19. $T_t = \frac{L}{3600V}$ Compute T_t hr			+		=				
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr									

ROUGHNESS COEFFICIENTS FOR SHEET FLOW

Surface Description	**Manning's n for Sheet Flow**
Smooth surfaces (concrete, asphalt, gravel, bare soil)	0.011
Fallow (no residue)	0.05
Cultivated Soils:	
Residue cover <= 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short grass prairie	0.15
Dense grass	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods:	
Light underbrush	0.40
Dense underbrush	0.80

MANNING COEFFICIENT (n) FOR CHANNELS AND PIPES (from Urban Drainage Design Manual – Hec 22, November 1996)

Conduit Material	Manning n*
Closed conduits	
Asbestos-cement pipe	0.011 – 0.015
Brick	0.013 – 0.017
Cast iron pipe	
Cement-lined & seal coated	0.011 – 0.015
Concrete (monolithic)	0.012 – 0.014
Concrete pipe	0.011 – 0.015
Corrugated-metal pipe (½ in x 2 ½ in corrugations)	
Plain	0.022 – 0.026
Paved invert	0.018 – 0.022
Spun asphalt lined	0.011 – 0.015
Plastic pipe (smooth)	0.011 – 0.015
Vitrified clay	
Pipes	0.011 – 0.015
Liner plates	0.013 – 0.017
Open channels	
Lined channels	
a. Asphalt	0.013 – 0.017
b. Brick	0.012 – 0.018
c. Concrete	0.011 – 0.020
d. Rubble or riprap	0.020 – 0.035
e. Vegetal	0.030 – 0.40
Excavated or dredged	
Earth, straight and uniform	0.020 – 0.030
Earth, winding, fairly uniform	0.025 – 0.040
Rock	0.030 – 0.045
Unmaintained	0.050 – 0.14
Natural channels (minor streams, top width at flood stage < 100 ft)	
Fairly regular section	0.030 – 0.070
Irregular section with pools	0.040 – 0.10

Lower values are usually for well-constructed and maintained (smoother) pipes and channels.

Section	Description	Location in Plans
PROJECT NARRATIVE AND SUPPORTING DOCUMENTS		
1 A	An index indicating the location, in the construction plans, of all information required by this subsection.	
1 B	Description of the nature and purpose of the project.	
1 C	Legal description of the project site. The description should be to the nearest quarter section, township, and range, and include the civil township.	
1 D	Soil properties, characteristics, limitations, and hazards associated with the project site and the measures that will be integrated into the project to overcome or minimize adverse soil conditions.	
1 E	General construction sequence of how the project site will be built, including phases of construction.	
1 F	Hydrologic Unit Code (14 Digit) available from the United States Geological Survey (USGS).	
1 G	A reduced plat or project site map showing the lot numbers, lot boundaries, and road layout and names. The reduced map must be legible and submitted on a sheet or sheets no larger than eleven (11) inches by seventeen (17) inches for all phases or sections of the project site.	
1 H	Identification of any other state or federal water quality permits that are required for construction activities associated with the owner's project site.	
2	Vicinity map depicting the project site location in relationship to recognizable local landmarks, towns, and major roads, such as a USGS topographic quadrangle map, or county or municipal road map.	
EXISTING PROJECT SITE LAYOUT		
3 A	Location and name of all wetlands, lakes, and water courses on, or adjacent to, the project site.	
3 B	Location of all existing structures on the project site.	
3 C	One hundred (100) year floodplains, floodway fringes, and floodways. Please note if none exists.	
3D	Soil map of the predominant soil types, as determined by the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Soil Survey, or an equivalent publication, or as determined by a soil scientist. A soil legend must be included with the soil map.	
3 E	Identification and delineation of vegetative cover such as grass, weeds, brush, and trees on the project site.	
3 F	Land use of all adjacent properties.	

Figure 18 – Submittal Requirements for Plan Review

Section	Description	Location in Plans
3 G	Existing topography at a contour interval appropriate to indicate drainage patterns.	
FINAL PROJECT SITE LAYOUT		
4 A	Location of all proposed site improvements, including roads, utilities, lot delineation and identification, proposed structures, and common areas.	
4 B	One hundred (100) year floodplains, floodway fringes, and floodways. Please note if none exists.	
4 C	Proposed final topography, at a contour interval appropriate to indicate drainage patterns.	
GRADING PLAN		
5 A	Delineation of all proposed land disturbing activities, including off-site activities that will provide services to the project site.	
5 B	Location of all soil stockpiles and borrow areas.	
5 C	Information regarding any off-site borrow, stockpile, or disposal areas that are associated with a project site, and under the control of the project site owner.	
5 D	Existing and proposed topographic information.	
DRAINAGE PLAN		
6 A	An estimate of the peak discharge, based on the ten (10) year storm event, of the project site for both preconstruction and postconstruction conditions.	
6 B	Location, size, and dimensions of all storm water drainage systems such as culverts, storm sewers, and conveyance channels.	
6 C	Locations where storm water may be directly discharged into ground water, such as abandoned wells or sinkholes. Please note if none exists.	
6 D	Locations of specific points where storm water discharge will leave the project site.	
6 E	Name of all receiving waters. If the discharge is to a separate municipal storm sewer, identify the name of the municipal operator and the ultimate receiving water.	
6 F	Location, size, and dimensions of features such as permanent retention or detention facilities, including existing or manmade wetlands, used for the purpose of storm water management.	
STORM WATER POLLUTION PREVENTION PLAN ASSOCIATED WITH CONSTRUCTION ACTIVITIES		
7 A	Location, dimensions, detailed specifications, and construction details of all temporary and permanent storm water quality measures.	
7 B	Temporary stabilization plans and sequence of implementation.	
7 C	Permanent stabilization plans and sequence of implementation.	
7 Di	Temporary and permanent stabilization plans shall include the following:	

Figure 18 – Submittal Requirements for Plan Review

Section	Description	Location in Plans
	(i) Specifications and application rates for soil amendments and seed mixtures.	
7 Dii	The type and application rate for anchored mulch.	
7 E	Construction sequence describing the relationship between implementation of storm water quality measures and stages of construction activities.	
7 F	Self-monitoring program including plan and procedures.	
7 G	A description of potential pollutant sources associated with the construction activities, which may reasonably be expected to add a significant amount of pollutants to storm water discharges.	
7 H	Material handling and storage associated with construction activity shall meet the spill prevention and spill response requirements in 327 IAC 2-6.1.	
POSTCONSTRUCTION STORM WATER POLLUTION PREVENTION PLAN		
8 A	A description of potential pollutant sources from the proposed land use, which may reasonably be expected to add a significant amount of pollutants to storm water discharges.	
8 B	Location, dimensions, detailed specifications, and construction details of all postconstruction storm water quality measures.	
8 C	A description of measures that will be installed to control pollutants in storm water discharges that will occur after construction activities have been completed. Such practices include infiltration of run-off, flow reduction by use of open vegetated swales and natural depressions, buffer strip and riparian zone preservation, filter strip creation, minimization of land disturbance and surface imperviousness, maximization of open space, and storm water retention and detention ponds.	
8 D	A sequence describing when each postconstruction storm water quality measure will be installed.	
8 E	Storm water quality measures that will remove or minimize pollutants from storm water run-off.	
8 F	Storm water quality measures that will be implemented to prevent or minimize adverse impacts to stream and riparian habitat.	
8 G	A narrative description of the maintenance guidelines for all postconstruction storm water quality measures to facilitate their proper long term function. This narrative description shall be made available to future parties who will assume responsibility for the operation and maintenance of the postconstruction storm water quality measures.	

Figure 18 – Submittal Requirements for Plan Review

Construction/Stormwater Pollution Prevention Plan
Technical Review and Comment *(Form 1)*

Project Information

Project Name: **County:**

Plan Submittal Date: **Hydrologic Unit Code:**

Project Location Description:

Latitude and Longitude:

Civil Township: **Quarter:** **Section:** **Township:** **Range:**

Project Owner Name:

Contact:

Address:

City: **State:** **Zip:**

Phone: **FAX:** **E-Mail:**

Plan Preparer Name:

Affiliation:

Address:

City: **State:** **Zip:**

Phone: **FAX:** **E-Mail:**

Plan Review

Review Date:

Principal Plan Reviewer:

Agency:

Address:

City: **State:** **Zip:**

Phone: **FAX:** **E-Mail:**

Assisted By:

☐ **PLAN IS ADEQUATE: A comprehensive plan review has been completed and it has been determined that the plan satisfies the minimum requirements and intent of 327 IAC 15-5.**

- ☐ **Please refer to additional information included on the following page(s).**
- ☐ **Submit Notice of Intent (NOI):** *Attach a copy of this cover page when submitting the NOI to the Indiana Department of Environmental Management. Construction activities may begin 48 hours following the submittal of the NOI. A copy of the NOI must also be sent to the Reviewing Authority (e.g. SWCD, DNR).*

☐ **A preliminary plan review has been completed; a comprehensive review will not be completed within the 28-day review period. The reviewing authority reserves the right to perform a comprehensive review at a later date and revisions to the plan may be required at that time to address deficiencies.**

- ☐ **Please refer to additional information included on the following page(s).**
- ☐ **Submit Notice of Intent (NOI):** *Attach a copy of this cover page when submitting the NOI to the Indiana Department of Environmental Management. Construction activities may begin 48 hours following the submittal of the NOI. A copy of the NOI must also be sent to the Reviewing Authority (e.g. SWCD, DNR).*

☐ **PLAN IS DEFICIENT: Significant deficiencies were identified during the plan review.**

- ☐ **Please refer to additional information included on the following page(s).**
- ☐ **DO NOT file a Notice of Intent for this project.**
- ☐ **DO NOT commence land disturbing activities until all deficiencies are adequately addressed, the plan re-submitted, and notification has been received that the minimum requirements have been satisfied.**

☐ **Plan Revisions** ☐ **Deficient Items should be mailed or delivered to the Principal Plan Reviewer identified in the Plan Review Section above.**

Construction/Stormwater Pollution Prevention Plan - Technical Review and Comment *(Form 1)*

Project Name: 0
Date Reviewed: 01/00/00

The technical review and comments are intended to evaluate the completeness of the Construction/Stormwater Pollution Prevention Plan for the project. The Plan submitted was not reviewed for the adequacy of the engineering design. All measures included in the plan, as well as those recommended in the comments should be evaluated as to their feasibility by a qualified individual with structural measures designed by a qualified engineer. The Plan has not been reviewed for other local, state, or federal permits that may be required to proceed with this project. Additional information, including design calculations may be requested to further evaluate the Plan.

All proposed stormwater pollution prevention measures and those referenced in this review must meet the design criteria and standards set forth in the "Indiana Stormwater Quality Manual" from the Indiana Department of Natural Resources, Division of Soil Conservation or similar Guidance Documents.

Please direct questions and/or comments regarding this plan review to:
0
Please refer to the address and contact information identified in the Plan Review Section on page 1.

Assessment of Construction Plan Elements *(Section A)*

The Construction Plan Elements are adequately represented to complete a plan review:
☑ **Yes** ☑ **No**

The items checked below are deficient and require submittal to meet the requirements of the rule.

A			A		
☐	1	Index showing locations of required Plan Elements	☐	2	11 by 17 inch plat showing building lot numbers/boundaries and road layout/names
☐	3	Narrative describing the nature and purpose of the project	☐	4	Vicinity map showing project location
☐	5	Legal Description of the Project Site (Include Latitude and Longitude - NOI Requirement)	☐	6	Location of all lots and proposed site improvements (roads, utilities, structures, etc.)
☐	7	Hydrologic unit code (14 Digit)	☐	8	Notation of any State or Federal water quality permits
☐	9	Specific points where stormwater discharge will leave the site	☐	10	Location and name of all wetlands, lakes and water courses on and adjacent to the site
☐	11	Identification of all receiving waters	☐	12	Identification of potential discharges to ground water (abandoned wells, sinkholes, etc.)
☐	13	100 year floodplains, floodways, and floodway fringes	☐	14	Pre-construction and post construction estimate of Peak Discharge (10 Year storm event)
☐	15	Adjacent landuse, including upstream watershed	☐	16	Locations and approximate boundaries of all disturbed areas (Construction Limits)
☐	17	Identification of existing vegetative cover	☐	18	Soils map including soil descriptions and limitations
☐	19	Locations, size and dimensions of proposed stormwater systems (e.g. pipes, swales and channels)	☐	20	Plans for any off-site construction activities associated with this project (sewer/water tie-ins)
☐	21	Locations of proposed soil stockpiles and/or borrow/disposal areas	☐	22	Existing site topography at an interval appropriate to indicate drainage patterns
☐	23	Proposed final topography at an interval appropriate to indicate drainage patterns			

Construction/Stormwater Pollution Prevention Plan - Technical Review and Comment ***(Form 1)***

Project Name:	0
Date Reviewed:	01/00/00

Assessment of Stormwater Pollution Prevention Plan *(Sections B & C)*

Stormwater Pollution Prevention Plan - Construction Component *(Section B)*

Adequate	Deficient	Not Applicable	B	
				The construction component of the Stormwater Pollution Prevention Plan includes stormwater quality measures to address erosion, sedimentation, and other pollutants associated with land disturbance and construction activities. Proper implementation of the plan and inspections of the construction site are necessary to minimize the discharge of pollutants. The Project Site Owner should be aware that unforeseen construction activities and weather conditions may affect the performance of a practice or the effectiveness of the plan. The plan must be a flexible document, with provisions to modify or substitute practices as necessary.
☐	☐		1	**Description of potential pollutant sources associated with construction activities**
☐	☐		2	**Sequence describing stormwater quality measure implementation relative to land disturbing activities**
☐	☐		3	**Stable construction entrance locations and specifications (at all points of ingress and egress)**
☐	☐	☐	4	**Sediment control measures for sheet flow areas**
☐	☐	☐	5	**Sediment control measures for concentrated flow areas**
☐	☐	☐	6	**Storm sewer inlet protection measure locations and specifications**
☐	☐	☐	7	**Runoff control measures** (*e.g. diversions, rock check dams, slope drains, etc* .)
☐	☐	☐	8	**Storm water outlet protection specifications**
☐	☐	☐	9	**Grade stabilization structure locations and specifications**
☐	☐		10	**Location, dimensions, specifications, and construction details of each stormwater quality measure**
☐	☐		11	**Temporary surface stabilization methods appropriate for each season** (*include sequencing*)
☐	☐		12	**Permanent surface stabilization specifications** (*include sequencing*)
☐	☐		13	**Material handling and spill prevention plan**
☐	☐		14	**Monitoring and maintenance guidelines for each proposed stormwater quality measure**
☐	☐	☐	15	**Erosion & sediment control specifications for individual building lots**

Stormwater Pollution Prevention Plan - Post Construction Component *(Section C)*

Adequate	Deficient	Not Applicable	C	
				The post construction component of the Stormwater Pollution Prevention Plan includes the implementation of stormwater quality measures to address pollutants that will be associated with the final landuse. Post construction stormwater quality measures should be functional upon completion of the project. Long term functionality of the measures are critical to their performance and should be monitored and maintained.
☐	☐		1	**Description of pollutants and their sources associated with the proposed land use**
☐	☐		2	**Sequence describing stormwater quality measure implementation**
☐	☐		3	**Description of proposed post construction stormwater quality measures** *(Include a written description of how these measures will reduce discharge of expected pollutants)*
☐	☐		4	**Location, dimensions, specifications, and construction details of each stormwater quality measure**
☐	☐		5	**Description of maintenance guidelines for post construction stormwater quality measures**

Construction/Stormwater Pollution Prevention Plan

Project Name:
Date Reviewed:

Priority Site Information

____ Nature and Extent of Construction
____ Close Proximity to Sensitive Area
____ Steep Topography on Proposed Construction Site
____ Close Proximity to Wetlands
____ Potential for Direct Runoff to Receiving Waters
____ Not a Priority Site

Construction/Stormwater Pollution Prevention Plan Comments

Indiana Department of Environmental Management
Notice of Intent (NOI)
Storm Water Runoff Associated with Construction Activity
NPDES General Permit Rule 327 IAC 15-5 **(Rule 5)**

Submission of this Notice of Intent letter constitutes notice that the project site owner is applying for coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit Rule for Storm Water Discharges Associated with Construction Activity. Permitted project site owners are required to comply with all terms and conditions of the General Permit Rule 327 IAC 15-5 (Rule 5).

Check the type of Submittal: ☐ Initial ☐ Amendment, ☐ Renewal ☐ Extension

Project Name and Location:

- Project Name: _____ County: _____
- Brief Description of Project Location: _____
- Latitude _____ **and** Quarter _____ Section _____
- Longitude _____ Township_____ __ Range_____
- Does ☐ all or ☐ part of this project lie within the jurisdictional boundaries of a Municipal Separate Storm Sewer System (MS4) as defined in 327 IAC 15-13? ☐ Yes ☐ No If yes, please name the MS4(s):

  _____

Project Site Owner and Project Contact Information:

- Company Name (If Applicable): _____

  Project Site Owner's Name (An Individual): _____ Title/Position: _____

  Address: _____

  City: _____ State: _____ Zip: _____

  Phone: _____ FAX: _____ E-Mail Address (If Available): _____
- Ownership Status (check one): Governmental Agency: ☐ Federal ☐ State ☐Local

  Non-Governmental: ☐ Public ☐ Private ☐ Other (Explain): _____
- Contact Person: _____ Affiliation with Project Site Owner: _____

  Address (if different from above): _____

  City: _____ State: _____ Zip: _____

  Phone: _____ FAX: _____ E-Mail Address (If Available): _____

Project Description:

☐Residential-Single Family ☐Residential-Multi-Family ☐Commercial ☐Industrial ☐Other_____

Discharge Information:

- Name of Receiving Water:_____
  (If applicable, name of municipal operator of storm sewer. Please note that even if a retention pond is present on the property, the name of the nearest possible receiving water is required).

Project Acreage:

- Total Acreage: _____ Acres Proposed Acreage to be Disturbed: _____ Acres
- Total Impervious Surface Area (Estimated for Completed Project): _____ Square Feet

Timetable (Maximum of 5 Years):

- Start Date: _____ and Estimated End Date for all Land Disturbing Activity: _____

(Continued on Reverse Side)

Construction Plan Certification:

By signing this Notice of Intent letter, I certify the following:

A. The storm water quality measures included in the Construction Plan comply with the requirements of 327 IAC 15-5-6.5, 327 IAC 15-5-7, and 327 IAC 15-5-7.5;
B. the storm water pollution prevention plan complies with all applicable federal, state, and local storm water requirements;
C. the measures required by section 7 and 7.5 of this rule will be implemented in accordance with the storm water pollution prevention plan;
D. if the projected land disturbance is One (1) acre or more, the applicable Soil and Water Conservation District or other entity designated by the Department, has been sent a copy of the Construction Plan for review;
E. storm water quality measures beyond those specified in the storm water pollution prevention plan will be implemented during the life of the permit if necessary to comply with 327 IAC 15-5-7; and
F. implementation of storm water quality measures will be inspected by trained individuals.

In addition to this form, I have enclosed the Following:

☐ Verification by the reviewing agency of acceptance of the Construction Plan.

☐ Proof of publication in a newspaper of general circulation in the affected area that notified the public that a construction activity is to commence, including all required elements contained in 327 IAC 15-5-5 (9).

☐ $100 check or money order payable to the Indiana Department of Environmental Management. If the project lies solely within the permitted jurisdiction of an MS4 and is regulated by the MS4 under 327 IAC 15-13 – a fee is not required with submittal of this Notice of Intent.

A permit issued under 327 IAC 15-5 is granted by the commissioner for a period of five (5) years from the date coverage commences. Once the five (5) year permit term duration is reached, a general permit issued under this rule will be considered expired, and, as necessary for construction activity continuation, a new Notice of Intent letter would need to be submitted ninety (90) days prior to the termination of coverage.

Project Site Owner Responsibility Statement:

By signing this Notice of Intent letter, I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information or violating the provisions of 327 IAC 15-5, including the possibility of fine and imprisonment for knowing violations.

Printed Name of Project Owner_____

Signature of Project Owner _____ Date: _____

This Notice of Intent must be signed by an individual meeting the signatory requirements in 327 IAC 15-4-3(g)

Mail this form to: **Indiana Department of Environmental Management**
Office of Water Quality, Storm Water (Rule 5) Desk
100 North Senate Avenue, P.O. Box 6015
Indianapolis, IN 46206-6015

327 IAC 15-5-6 (a) also requires a copy of the completed Notice of Intent letter be submitted to the local Soil and Water Conservation District or other entity designated by the Department, where the land disturbing activity is to occur.

Questions regarding the development of the Construction Plan and/or field implementation of 327 IAC 15-5 may be directed to your local Soil and Water Conservation District office or the Department of Natural Resources at 317-233-3870. Questions regarding the Notice of Intent may be directed to the Rule 5 contact person at 317/233-1864 or 800/451-6027 ext 31864.

State Form 47487 (R/ /03)

Indiana Department of Environmental Management
Notice of Termination (NOT)
Storm Water Runoff Associated with Construction Activity
NPDES General Permit Rule 327 IAC 15-5 **(Rule 5)**

Submission of this Notice of Termination letter constitutes notice to the Commissioner that the project site owner is applying for Termination of Coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit Rule for Storm Water Discharges Associated with Construction Activity.

Project Name and Location:

- Permit Number:
- Project Name: _____ County: _____
- Company Name (If Applicable): _____

Project Site Owner's Name (An Individual): _____

Address: _____

City: _____ State: _____ Zip: _____

Phone: _____ FAX: _____ E-Mail Address (If Available): _____

This Notice of Termination is Being Submitted for the Following:

Select one of the three Options that apply to Permit Termination by checking the appropriate box, complete all information associated with that option, and complete the "Project Site Owner Responsibility Statement".

Option # 1

☐ **Certification for Change of Ownership:**

(Does not Apply to the Sale of Individual lots within the Permitted Acreage; only the Sale of the Entire Project Site as Originally Permitted)

By Signing this Notice of Termination, I Certify the Following:

A. The project was sold; I am no longer the project site owner as was designated in my Notice of Intent. The new owner of the project site is:
   - Company Name (If Applicable): _____

   Project Site Owner's Name (An Individual): _____

   Address: _____

   City: _____ State: _____ Zip: _____

   Phone: _____ FAX: _____ E-Mail Address (If Available): _____
B. I have notified the new Project Site Owner of his/her responsibilities to comply with 327 IAC 15-5 and the requirements associated with the rule including filing a new Notice of Intent.

Option # 2

☐ **Certification for Termination of Construction Activities:**

By Signing this Notice of Termination, I Certify the Following:

A. All land disturbing activities, including construction on all building lots have been completed and the entire site has been stabilized;
B. No future land disturbing activities will occur on this project site;
C. all temporary erosion and sediment control measures have been removed; and
D. a copy of this notice has been sent to the appropriate SWCD or other designated entity.

Option # 3

☐ **Notice of Termination to Obtain Early Release from Compliance with 327 IAC 15-5**

By Signing this Notice of Termination, I Certify the Following:

A. The remaining, undeveloped acreage does not exceed five (5) acres, with contiguous areas not to exceed one (1) acre.
B. A map of the project site, clearly identifying all remaining undeveloped lots, is attached to this letter. The map must be accompanied by a list of names and addresses of individual lot owners or individual lot operators of all undeveloped lots.
C. All public and common improvements, including infrastructure, have been completed and permanently stabilized and have been transferred to the appropriate local entity.
D. The remaining acreage does not pose a significant threat to the integrity of the infrastructure, adjacent properties, or water quality.
E. All permanent storm water quality measures have been implemented and are operational.

Upon Written Notification of the Department the Project Site Owner Certifies that he/she will Notify:

A. All current individual lot owners and all subsequent individual lot owners of the remaining undeveloped acreage and acreage with construction activity that they are responsible for complying with section 7.5 of 327 IAC 15-5 *(the remaining individual lot owners do not need to submit a Notice of Intent letter or Notice of Termination letter)*; and
B. the individual lot owners of the requirements to install and maintain appropriate measures to prevent sediment from leaving the individual building lot and maintain all erosion and sediment control measures that are to remain on-site as part of the construction plan.

Project Site Owner Responsibility Statement:

By signing this Notice of Termination letter, I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Printed Name of Project Site Owner: _____

Signature of Project Site Owner: _____ Date: _____

This Notice of Termination must be signed by an individual meeting the signatory requirements in 327 IAC 15-4-3(g)

Upon written notification by the Department of Environmental Management, the Project Site Owner's termination for coverage under 327 IAC 15-5 shall be considered approved.

Mail this form to: **Indiana Department of Environmental Management**
Office of Water Quality, Storm Water (Rule 5) Desk
100 North Senate Avenue, P.O. Box 6015
Indianapolis, IN 46206-6015

327 IAC 15-5-8 (b) also requires a copy of the completed Notice of Termination letter be submitted to the local Soil and Water Conservation District or other entity designated by the Department, where the Project Site is located.

For Agency Use Only

(SWCD, DNR-DSC, or Other Entity Designated by the Department)

The above referenced site has been inspected to determine that the request to terminate this project is compliant with the requirements of 327 IAC 15-5-8.

_____	_____	_____	_____
Signature	**Printed Name**	**Agency**	**Date**

State Form (R/ /03)

APPENDICES

STORM WATER PONDS

QUICK REFERENCE

Description: Constructed storm water retention basin that has a permanent pool of water in which runoff from each rain event is captured and treated in the pool.

Site Feasibility:

Drainage Area:	Minimum 10 acres
Residential Subdivision Use:	Yes
High Density/Ultra-Urban:	No

Design Criteria:
Sediment forebay required
Length to width ratio is 3:1
Maximum depth of permanent pool should not exceed 8 feet
Side slopes of pond should not exceed 3:1
High permeable soils (hydrologic group A or B) may require a liner

Advantages:
Moderate to high removal rate of urban pollutants
Can use for water quality and flood control
High community acceptance when designed with attention to aesthetics and maintained properly
Opportunity for wildlife habitat

Disadvantages:
Potential for thermal impacts/downstream warming
Pond drainage can be problematic for low relief terrain
Dam height restrictions for high relief areas
Improperly designed or maintained ponds may become stagnant causing unpleasant conditions

Maintenance:
Monitor sediment accumulation and remove periodically
Remove debris from inlet and outlet structures
Maintain side slopes and remove invasive vegetation

STORM WATER PONDS

GENERAL

Description: Constructed Storm water ponds are constructed storm water retention basins that contain a permanent pool of water in which runoff from each rain event is captured and treated in the pool. The purpose of the pond is to retain runoff and allow contaminated sediments to settle removing particulates and, through biological uptake, some nutrients attached to the particulates. A forebay placed in front of the pond is required to intercept the majority of sediments providing for ease of cleanout.

Underlying soils of hydrologic group C or D should be adequate to maintain a permanent pool. Most group A soils and some group B soils will require a pond liner. Subsurface analysis and permeability tests may be required to evaluate soils. Wet ponds require an adequate water source to maintain a permanent pool of water.

If storm water ponds are used on a site with an underlying water supply aquifer, a separation distance of 2 feet is required between the bottom of the pond and the elevation of the seasonally high water table.

Variations:

- Wet pond – provides all of the water quality volume storage volume in a permanent pool.
- Wet extended detention (ED) pond – provides the water quality storage volume through a combination of the permanent pool and ED storage above the permanent pool. The ED storage volume should be detained and released over a 24 hour period.
- Micropool ED pond – only a small micropool of water within an ED pond is maintained at the outlet to the pond, which is sized to detain the water quality volume for 24 hours. The micropool prevents resuspension of previously settled sediments.
- Multiple ponds – provides the water quality storage volume in two or more cells that create longer pollutant removal pathways.

STORM WATER PONDS

DESIGN CRITERIA

The following criteria are minimum standards for the design of a wet storm water pond. A storm water pond may be designed to meet water quantity and quality requirements. If considered for water quality treatment only, the pond shall be designed to capture the water quality volume (WQ_v) using the equation in the Post-Construction Storm Water Quality Chapter.

1. The minimum drainage area tributary to the pond is 10 acres.

2. Pond geometry:
    a. The pond should have a minimum length to width ratio of 3:1. The flow path between the inlet and outlet should be maximized and shaped so that flow enters the pond and gradually spreads out, improving sediment removal. Baffles, pond shaping and islands can be utilized to increase the flow path.
    b. The depth of the permanent pool should be greater than 4 feet to avoid resuspension of particles and less than 8 feet to avoid stratification and anoxic conditions.
    c. Vegetated side slopes to the pond should not exceed 3:1 and shall terminate on a minimum 10-foot safety ledge with a maximum 10:1 slope. Side slopes steeper than 3:1 require riprap to stabilize the banks. Below the safety ledge, ponds with slopes steeper than 3:1 shall also be secured with riprap and no bank shall exceed a slope of 1½:1.

3. Sediment forebay:
    a. All ponds shall include a sediment forebay that consists of a separate cell, formed by an acceptable barrier. A forebay is to be provided at each inlet to the pond unless the inlet provides less than 10% of the total design storm inflow to the pond.
    b. The forebay shall be sized to contain 10% of the water quality volume. The forebay storage volume is part of the total WQ_v requirement.
    c. Entrance and exit velocities from the forebay must be non-erosive.
    d. A fixed vertical depth marker shall be installed in the forebay to continually measure sediment deposition. Sediment in the forebay shall be removed after 50% of the forebay capacity has been depleted.
    e. Direct maintenance access for appropriate equipment shall be provided to the forebay.

4. Outlet Structures:
    a. The outlet structure should be design to detain the water quality volume above the permanent pool for 24 to 48 hours.
    b. Flow control from a pond is typically accomplished with the use of a riser and barrel. The riser is a vertical pipe or inlet structure that is attached to the base of the pond with a watertight connection. The outlet barrel is a horizontal pipe attached to the riser that conveys flow under the

embankment. The riser should be located within the embankment for maintenance access, safety and aesthetics. Suitable erosion control measures must be provided for the outlet and all inlet structures to the pond. Energy dissipaters should be placed at the outlet of the barrel to prevent scouring and erosion.

c. Anti-seep collars or filter diaphragms must be provided for the barrel of the outlet structure. If reinforce concrete pipe is used, O-ring gaskets shall be used to create watertight joints.
d. Orifice-type outlets below the permanent pool elevation of the pond shall have an appropriate anti-clogging device.
e. Provide trash racks, filters, hoods or other debris control. A negatively sloped pipe from the riser to one foot below the permanent pool, away from floating debris, can reduce the risk of clogging. An orifice covered by wire mesh and a hood may accomplish protection of the extended detention orifice.
f. Design and install an emergency drain (i.e. sluice gate or drawdown pipe) capable of draining within 24 hours.

5. An emergency spillway shall be designed to pass 1.25 times the peak discharge and peak flow velocity from the 100-year storm event for the entire contributing drainage area (unless bypassed), assuming post-development conditions. Provide a one-foot minimum freeboard above the maximum anticipated flow depth through the emergency spillway.

6. To prevent drawdown of the permanent pool, a clay or poly liner may be needed. Hydrologic group A soils generally require a pond liner and group B soils may require infiltration testing.

7. Storm water ponds must be constructed within an easement either platted or legally described and recorded as a perpetual storm water drainage easement. The easement shall extend a minimum of 30 feet horizontally outside of the design 100-year floodwater elevation of the basin and provide a minimum 10-foot wide access easement. A copy of the easement should be included in the BMP operations and maintenance manual.

8. A pond buffer should extend 25 feet outward from the maximum water surface elevation.

9. If the pond is used as a sediment control measure during active construction, the sediment must be cleaned out of the pond and elevations and grades reestablished as noted in the approved storm water management plan for post-construction runoff control.

STORM WATER PONDS

MAINTENANCE AND INSPECTION CHECKLIST

Regular inspection and maintenance is critical to the effective operation of storm water ponds. The following inspection checklist, to be completed at periods indicated, is provided for the BMP owner and should be retained as a record by the owner for a period of five (5) years from the approval date of the Storm Water Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the Connersville Department of Storm Water Management upon request.

Project Name/Site Location: _____

Owner Name: _____ Phone: _____

Owner Address: _____

Date: _____ Inspector: _____

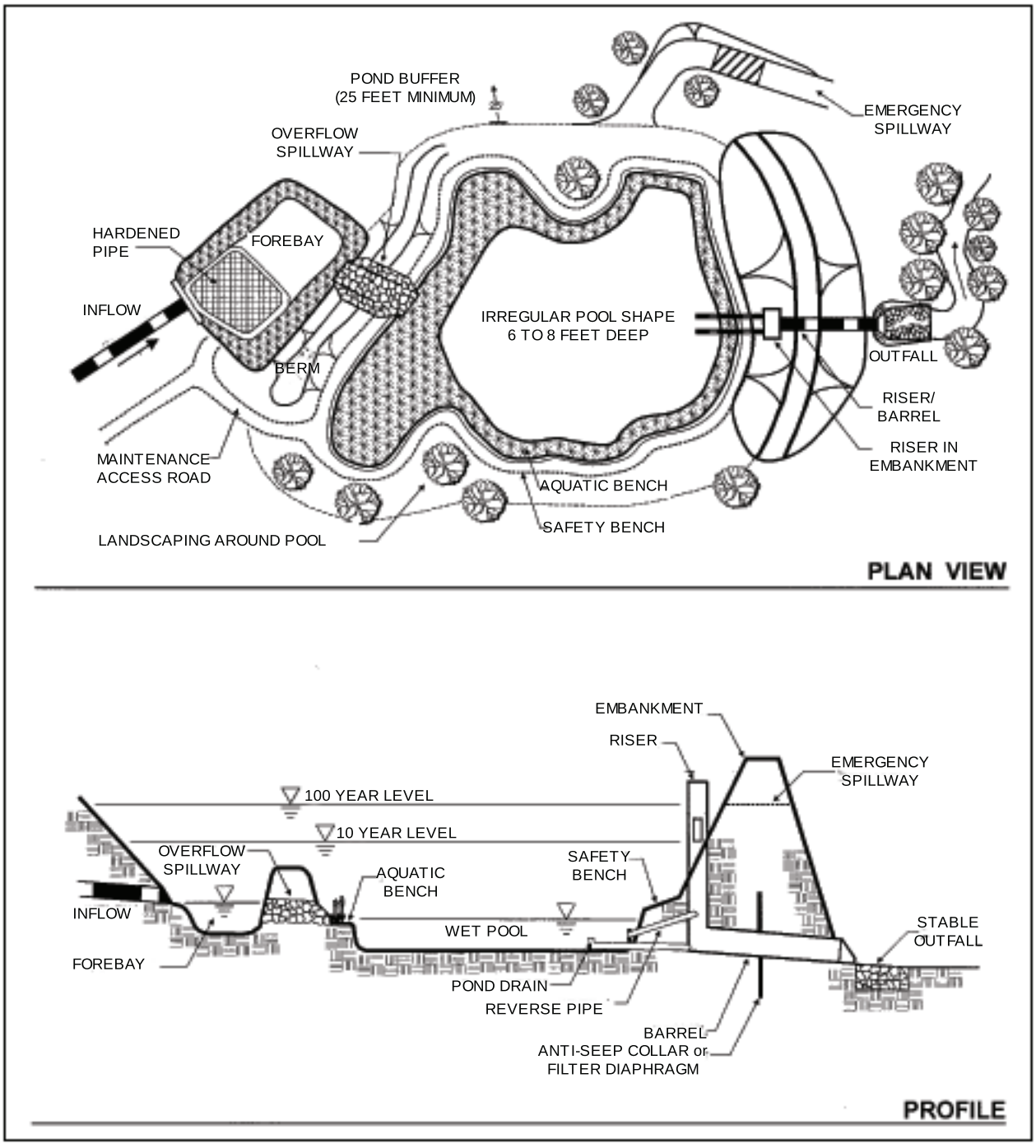
MAINTENANCE ITEM	YES/NO	COMMENTS
Embankment and Emergency Spillway		**Inspect Annually**
1. Vegetation established and thriving?		
2. Any erosion?		
3. Animal burrows present?		
4. Cracking, bulging, or sliding of dam?		
5. All drains clear and functioning?		
6. Any leaks or seeps in embankment?		
7. Any slope failure?		
8. Obstructions in emergency spillway?		
9. Other problems evident?		
Outlet Structure		**Inspect Annually**
1. Low flow orifice blocked?		
2. Trash rack clear of debris?		
3. Any corrosion evident on trash rack?		
4. Excessive sediment in riser?		
5. Cracks or spalling in concrete?		
6. Any corrosion evident on metal pipes?		
7. Are all control valves operational?		
8. Outfall channels functioning?		

9. Other problems evident?		
Permanent Pool		**Inspect Monthly**
1. Undesirable vegetative growth?		
2. Floatable debris removal needed?		
3. Any visible pollution?		
4. Any shoreline problems?		
5. Other problems evident?		
Sediment Forebay		**Inspect Monthly**
1. Sedimentation marker visible?		
2. Sediment cleanout needed (50% full)?		
3. Other problems evident?		
Other		**Inspect Monthly**
1. Erosion at inflow or outfall points?		
2. Condition of headwalls satisfactory?		
3. Encroachments in pond easement area?		
4. Complaints from area residents?		
5. Any public hazards present?		
6. Other problems evident?		

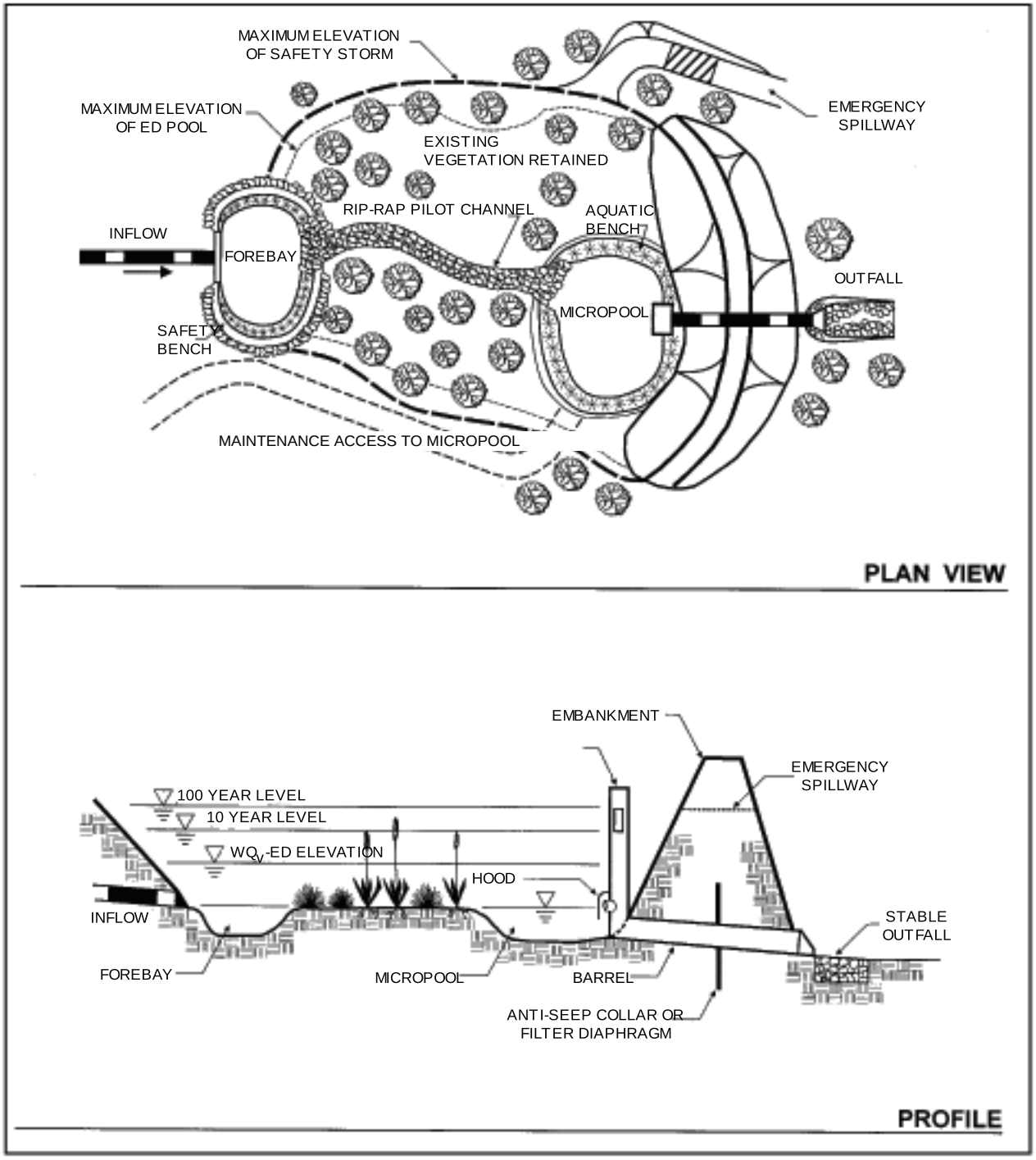
Additional Comments:_____

Recommended Actions:_____

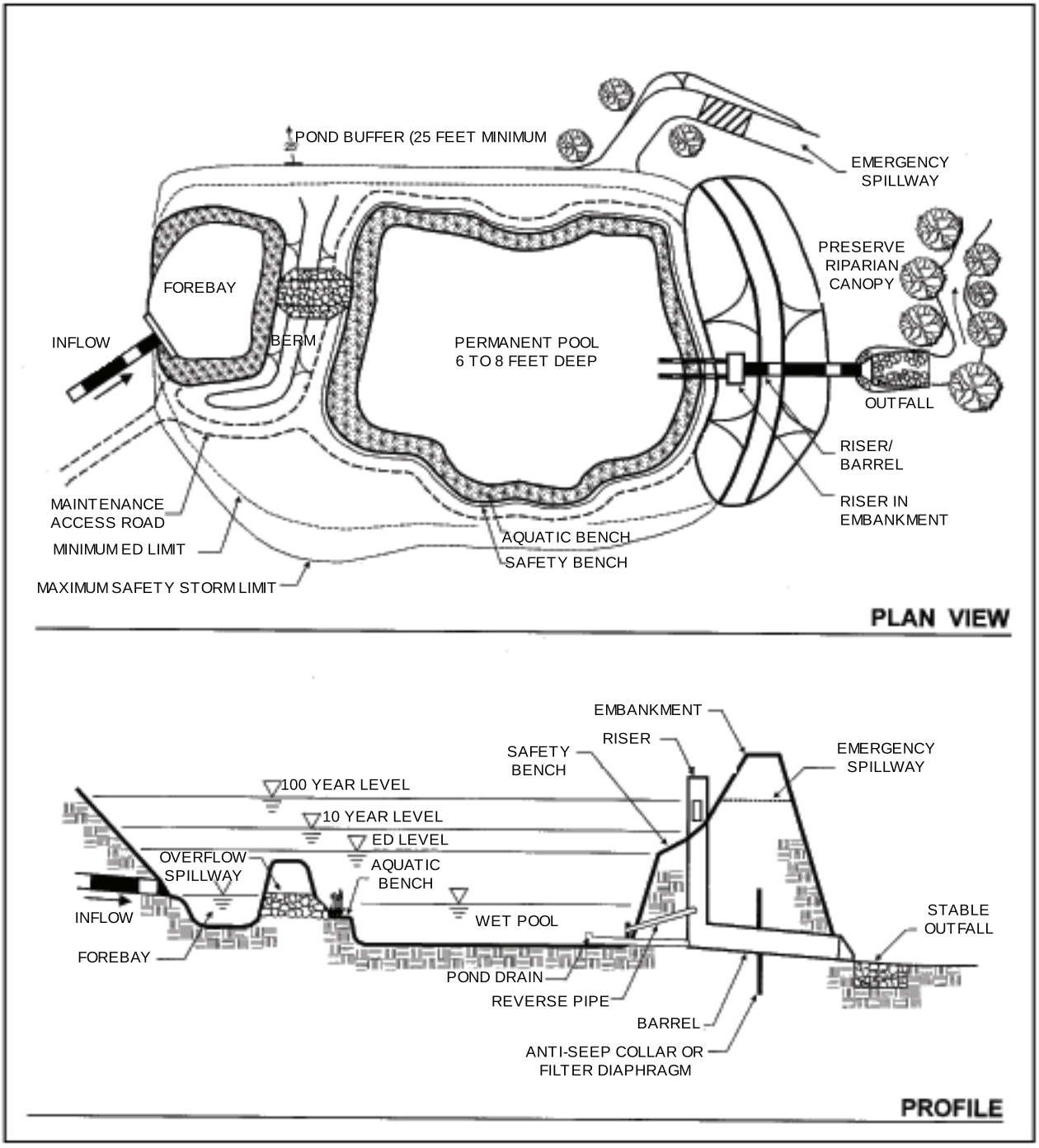
Recommended Timeframe for Actions:_____



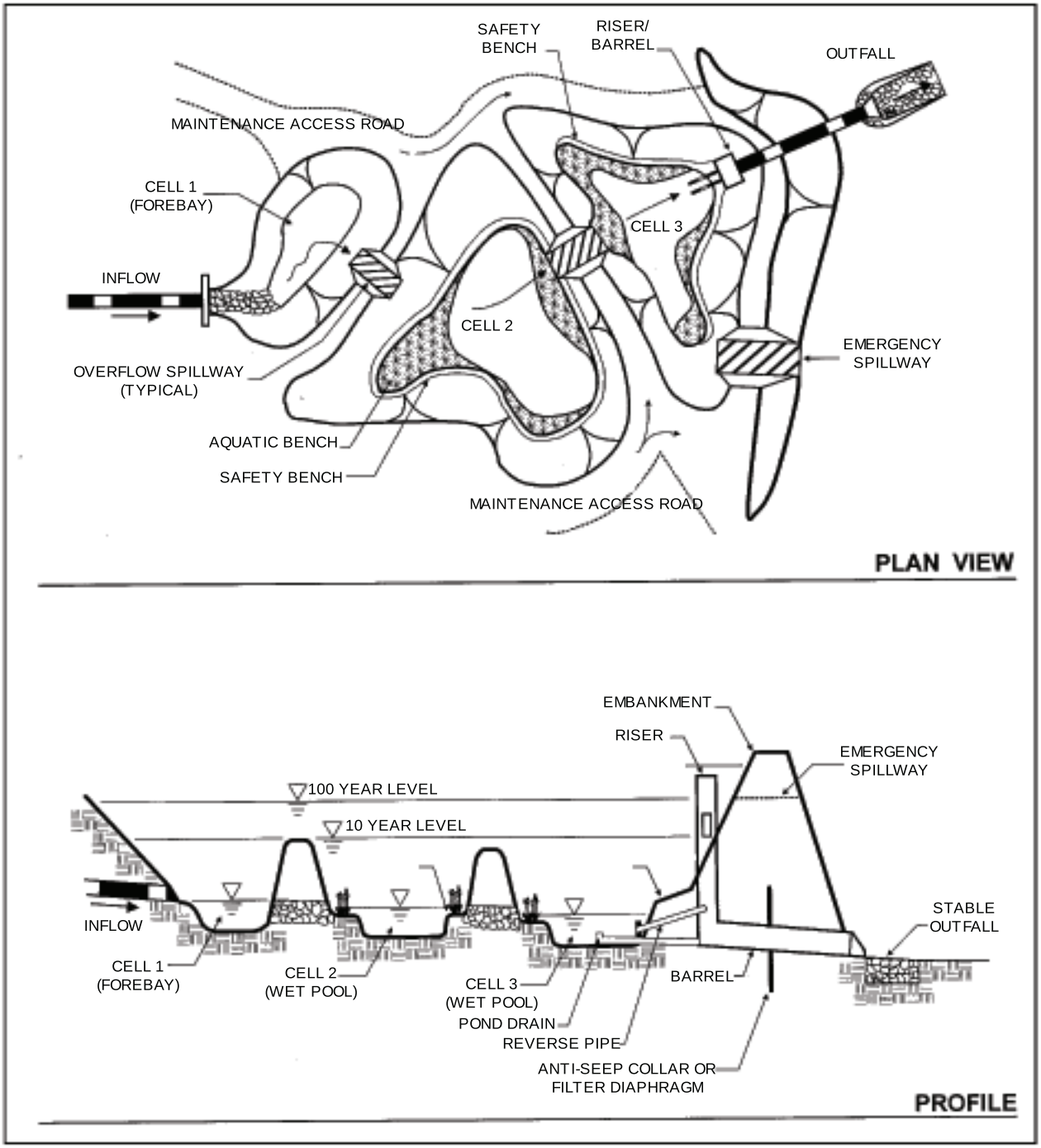
Schematic of a Wet Pond
(Source: Center for Watershed Protection, modified)



Schematic of Micropool Extended Detention Pond
(Source: Center for Watershed Protection, modified)



Schematic of Wet Extended Detention Pond
(Source: Center for Watershed Protection, modified)



Schematic of Multiple Pond System
(Source: Center for Watershed Protection, modified)

STORM WATER WETLANDS

QUICK REFERENCE

Description: Constructed shallow marsh systems designed to treat storm water runoff through settling and vegetative uptake and to control runoff volumes.

Site Feasibility:

Drainage Area:	Minimum 25 acres (Min. 5 acres for Pocket Wetland)
Residential Subdivision Use:	Yes
High Density/Ultra-Urban:	No

Design Criteria:
Sediment forebay and micropool required
Minimum dry weather flow path length to width ratio is 2:1
Minimum 35% of total surface area should have a depth of 6 inches or less; 10% to 20% of surface area should be deep pool (1.5 to 6-foot depth)
High permeable soils (hydrologic group A or B) may require a liner

Advantages:
Effective nutrient removal
Natural aesthetic qualities and wildlife habitat

Disadvantages:
Requires large land area
Require a continuous base flow
Sediment regulation is critical to sustain wetlands

Maintenance:
Replace wetland vegetation to maintain at least 50% surface area coverage
Remove invasive vegetation
Monitor sediment accumulation and remove periodically

STORM WATER WETLANDS

GENERAL

Description: Storm water wetlands are constructed shallow marsh systems designed to control the quantity and quality of storm water runoff. Microbial breakdown, settling, adsorption, retention and vegetative uptake remove pollutants as storm water moves through the wetland under low flow conditions. Runoff volumes are reduced by evapotranspiration and infiltration. Peak flow is reduced by storage and slow release. Wetlands further offer erosion control, aesthetic value, and wildlife habitat.

A sediment forebay at the inflow point to a wetland is required to allow heavier sediments to drop out before the runoff enters the wetland marsh. Underlying soils of hydrologic group C or D should be adequate to maintain a permanent pool. Most group A soils and some group B soils may require a liner. Subsurface analysis and permeability tests may be required to evaluate soils. A continuous base flow or a high water table is required to support aquatic vegetation in a wetland facility. A water balance must be performed to demonstrate the wetland can withstand a thirty-day drought at summer evaporation rates without completely drawing down.

If storm water wetlands are used on a site with an underlying water supply aquifer, a separation distance of 2 feet is required between the bottom of the pond and the elevation of the seasonally high water table. A pocket wetland is typically below the water table.

Variations:

- Shallow Wetland – most of the water quality treatment volume is in the shallow high marsh or low marsh depths. The only deep portions of the shallow wetland are the forebay and the micropool. A relatively large amount of land is typically needed to store the water quality volume.
- Extended Detention (ED) Shallow Wetland – the same as the shallow wetland, except part of the water quality treatment volume is provided as extended detention above the surface of the marsh and released over a period of 24 hours. This design allows for treatment in a smaller space than the shallow wetland. Plants that can tolerate both wet and dry periods need to be specified in the ED zone.
- Pond/Wetland System – this system has two (2) separate cells, a wet pond and a shallow marsh. The wet pond traps sediments and reduces runoff velocities prior to entry into the wetland where storm water flows receive additional treatment. Less land is required than for the shallow wetland or the ED shallow wetland systems.
- Pocket Wetland – intended for smaller drainage areas of 5 to 10 acres and typically requires excavation down to the water table for a reliable water source to support the wetland system.

DESIGN CRITERIA

The following criteria are minimum standards for the design of a wetland. A storm water wetland may be designed to meet water quantity and quality requirements. If considered for water quality treatment only, the pond shall be designed to capture the water quality volume (WQ_v) using the equation in the Post-Construction Storm Water Quality Chapter of this manual.

1. The minimum drainage area tributary to the wetland is 25 acres (5 acres for a pocket wetland).

2. Base flow:
   A water balance must be calculated to insure enough inflow to sustain the wetland:

   $$S = Q_i + R + Inf - Q_o - ET$$

   Where:
   S = net change in storage
   Q_i = storm water runoff inflow
   R = contribution from rainfall
   Inf = net infiltration (infiltration – exfiltration)
   Q_o = surface outflow
   ET = evapotranspiration

3. Wetland geometry:
   a. The surface area of the wetland should be approximately 3% of the tributary drainage area.
   b. The wetland should have a minimum length to width ratio of 2:1, with 3:1 preferred. The flow path may be achieved using internal dikes or berms, marsh plantings, or multiple cells.
   c. Side slopes to the wetland should not exceed 4:1, with 6:1 preferred. Minimal longitudinal slopes are required. Safety and aquatic benches should surround the perimeter of all deep pool areas.
   d. Contours of the wetland should be irregular to provide a natural landscaping effect.
   e. The volume of the ED must not comprise more than 50% of the total WQ_v and its maximum water surface elevation must not extend more than 2 feet above the normal pool. Peak flow storage can be provided above the maximum WQ_v elevation within the wetland.

4. Depth zones:
   Wetlands should be designed with the recommended proportion of depth zones as follows:
   a. Deepwater zone – 1.5 to 6 feet below normal pool elevation. Includes the outlet micropool and deepwater channels through the wetland facility.

This zone supports little emergent wetland vegetation, but may support submerged or floating vegetation.

b. Low marsh zone – 6 to 8 inches below normal pool elevation. This zone is suitable for the growth of several emergent wetland plant species.
c. High marsh zone – 6 inches or less below normal pool elevation. This zone will support a greater density and diversity of wetland species than the low marsh zone. The high marsh zone should have a higher surface area to volume ratio than the low marsh zone.
d. Semi-wet zone – areas above normal pool elevation that are inundated during larger storm events. This zone supports a number of species that can survive flooding.

Recommended Design Criteria for Storm Water Wetlands

Modified from Massachusetts DEP, 1997; Schueler, 1992

Design Criteria	Shallow Wetland	ED Shallow Wetland	Pond/ Wetland	Pocket Wetland
Minimum Length to Width Ratio	2:1	2:1	2:1	2:1
Extended Detention (ED)	No	Yes	Optional	Optional
Allocation of WQ_v (pool/marsh/ED) in %	25/75/0	25/25/50	70/30/0 (includes pond volume)	25/75/0
Allocation of surface area (deepwater/low marsh/high marsh/semi-wet) in %	20/35/40/5	10/35/45/10	45/25/25/5 (includes pond surface area)	10/45/40/5
Forebay	Required	Required	Required	Optional
Micropool	Required	Required	Required	Required
Outlet Configuration	Reverse-slope pipe or hooded broad-crested weir	Reverse-slope pipe or hooded broad-crested weir	Reverse-slope pipe or hooded broad-crested weir	Hooded broad-crested weir

5. Sediment forebay:
   a. All wetlands shall include a sediment forebay that consists of a separate cell, formed by an acceptable barrier. A forebay is to be provided at each inlet to the wetland unless the inlet provides less than 10% of the total design storm inflow to the wetland.
   b. The forebay shall be sized to contain 10% of the water quality volume and should be 3 to 6 feet deep. The forebay storage volume is part of the total WQ_v requirement.
   c. Entrance and exit velocities from the forebay must be non-erosive. Inflow channels should be stabilized with flared riprap aprons, or the equivalent.

d. A fixed vertical depth marker shall be installed in the forebay to measure sediment deposition. Sediment in the forebay shall be removed after 50% of the forebay capacity has been depleted.
e. Direct maintenance access for appropriate equipment shall be provided to the forebay.

6. Outlet Structures:
   a. The outlet structure should be design to detain the water quality volume above the permanent pool for 24 to 48 hours.
   b. Flow control from a storm water wetland is typically accomplished with the use of a riser and barrel. The riser is a vertical pipe or inlet structure that is attached to the base of the micropool with a watertight connection. The outlet barrel is a horizontal pipe attached to the riser that conveys flow under the embankment. The riser should be located within the embankment for maintenance access, safety and aesthetics.
   c. Suitable erosion control measures must be provided for the outlet and all inlet structures to the pond. Energy dissipaters should be placed at the outlet of the barrel to prevent scouring and erosion.
   d. Anti-seep collars or filter diaphragms must be provided for the barrel of the outlet structure. If reinforce concrete pipe is used, O-ring gaskets shall be used to create watertight joints.
   e. Orifice-type outlets below the permanent pool elevation of the pond shall have an appropriate anti-clogging device.
   f. Provide trash racks, filters, hoods or other debris control. A negatively sloped pipe from the riser to one foot below the permanent pool, away from floating debris, can reduce the risk of clogging. An orifice covered by wire mesh and a hood may accomplish protection of the ED orifice.
   g. Design and install an emergency drain (i.e. sluice gate or drawdown pipe) capable of draining within 24 hours.
   h. A micropool, 3 to 6 feet deep, shall be provided before the outlet structure of the wetland to aid in the prevention of clogging of the low flow pipe and sediment resuspension. Protection against blockage must be installed as part of the outlet design.

7. An emergency spillway shall be designed to pass 1.25 times the peak discharge and peak flow velocity from the 100-year storm event for the entire contributing drainage area (unless bypassed), assuming post-development conditions. Provide a one-foot minimum freeboard above the maximum anticipated flow depth through the emergency spillway.

8. To prevent drawdown of the permanent pool, a clay or poly liner may be needed below the planting soil. Permeable soils are not well suited for a wetland without a high water table. Hydrologic group A soils generally require a pond liner and group B soils may require infiltration testing through subsurface analyses.

9. A landscaping plan must be provided that indicates the methods used to establish and maintain wetland coverage. Minimum elements of a plan include: delineation of pondscaping zones, selection of corresponding plant species, planting configuration, and sequence for preparing wetland bed, including any needed soil amendments. If a minimum coverage of 50% is not achieved in the planted wetland zones after the second growing season, a reinforcement planting will be required.

10. Storm water wetlands must be constructed within an easement either platted or legally described and recorded as a perpetual storm water drainage easement. The easement shall include the frequently flooded zone surrounding the wetland and provide a minimum 10-foot wide access to the wetland facility including the forebay and outlet structure. A copy of the easement should be included in the BMP operations and maintenance manual.

11. A wetland buffer should extend 25 feet outward from the maximum water surface elevation with an additional 15-foot setback to structures.

12. If the wetland is used as a sediment control measure during active construction, the sediment must be cleaned out of the wetland and forebay and elevations and grades reestablished as noted in the approved storm water management plan for post-construction runoff control.

STORM WATER WETLANDS

MAINTENANCE AND INSPECTION CHECKLIST

Regular inspection and maintenance is critical to the effective operation of storm water wetlands. The following inspection checklist, to be completed at periods indicated, is provided for the BMP owner and should be retained as a record by the owner for a period of five (5) years from the approval date of the Storm Water Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the Connersville Department of Storm Water Management upon request.

Project Name/Site Location: _____

Owner Name: _____ Phone: _____

Owner Address: _____

Date: _____ Inspector: _____

MAINTENANCE ITEM	YES/NO	COMMENTS
Embankment and Emergency Spillway		**Inspect Annually**
1. Vegetation established and thriving?		
2. Any erosion?		
3. Animal burrows present?		
4. Cracking, bulging, or sliding of dam?		
5. All drains clear and functioning?		
6. Any leaks or seeps in embankment?		
7. Any slope failure?		
8. Obstructions in emergency spillway?		
9. Other problems evident?		
Outlet Structure		**Inspect Annually**
1. Low flow orifice blocked?		
2. Trash rack clear of debris?		
3. Any corrosion evident on trash rack?		
4. Excessive sediment in riser?		
5. Cracks or spalling in concrete?		
6. Any corrosion evident on metal pipes?		
7. Are all control valves operational?		
8. Outfall channels functioning?		
9. Other problems evident?		

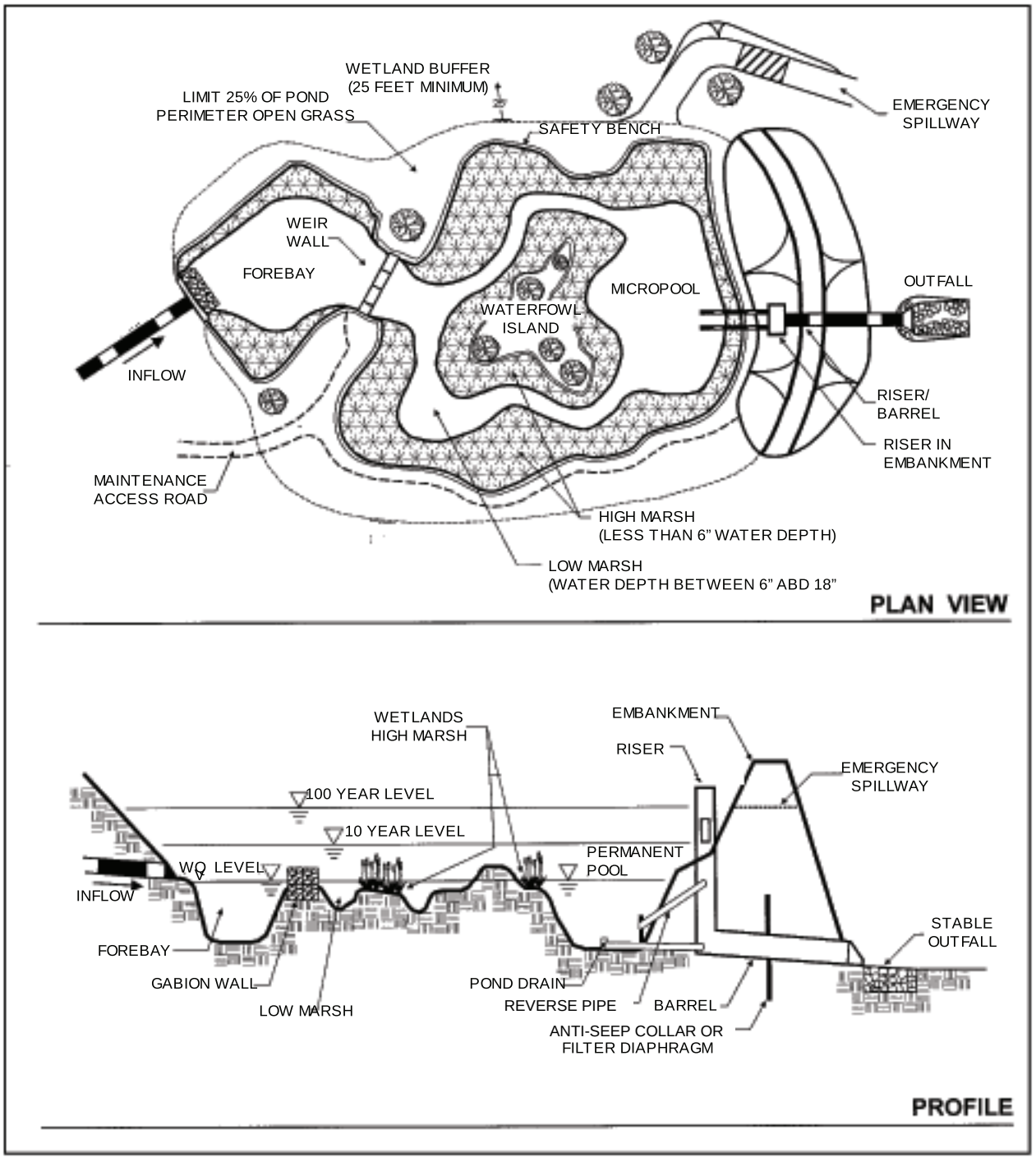
STORM WATER WETLANDS

Wetland Area		**Inspect Annually**
1. Is vegetation healthy and growing?		
2. Any evidence of invasive species?		
3. Sediment cleanout needed (50% full)?		
4. Other problems evident?		
Permanent Pool		**Inspect Monthly**
1. Undesirable vegetative growth?		
2. Floatable debris removal needed?		
3. Any visible pollution?		
4. Any shoreline problems?		
5. Other problems evident?		
Sediment Forebay		**Inspect Monthly**
1. Sedimentation marker visible?		
2. Sediment cleanout needed (50% full)?		
3. Other problems evident?		
Other		**Inspect Monthly**
1. Erosion at inflow or outfall points?		
2. Condition of headwalls satisfactory?		
3. Encroachments in pond easement area?		
4. Complaints from area residents?		
5. Any public hazards present?		
6. Other problems evident?		

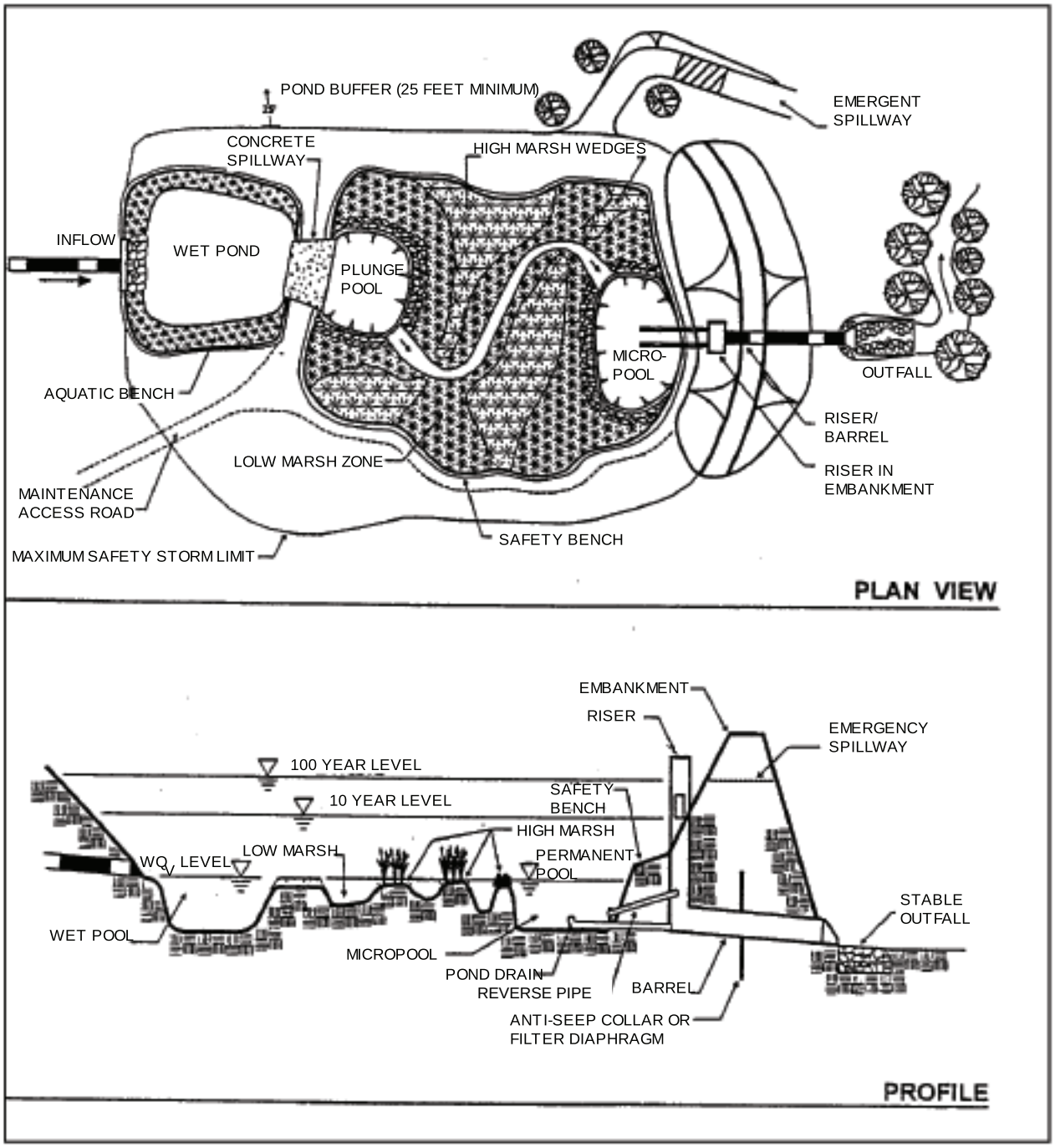
Additional Comments:_____

Recommended Actions:_____

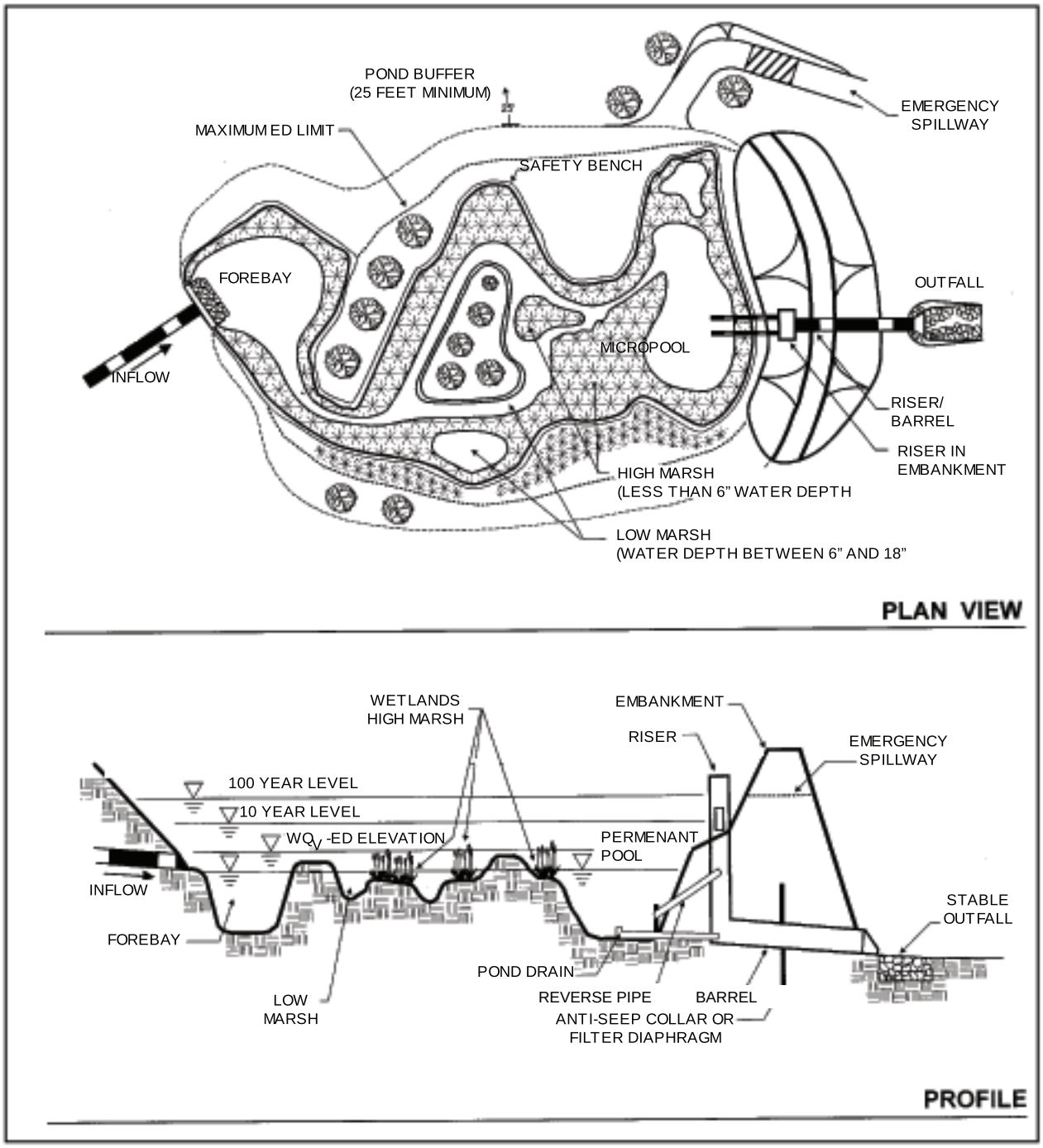
Recommended Timeframe for Actions:_____



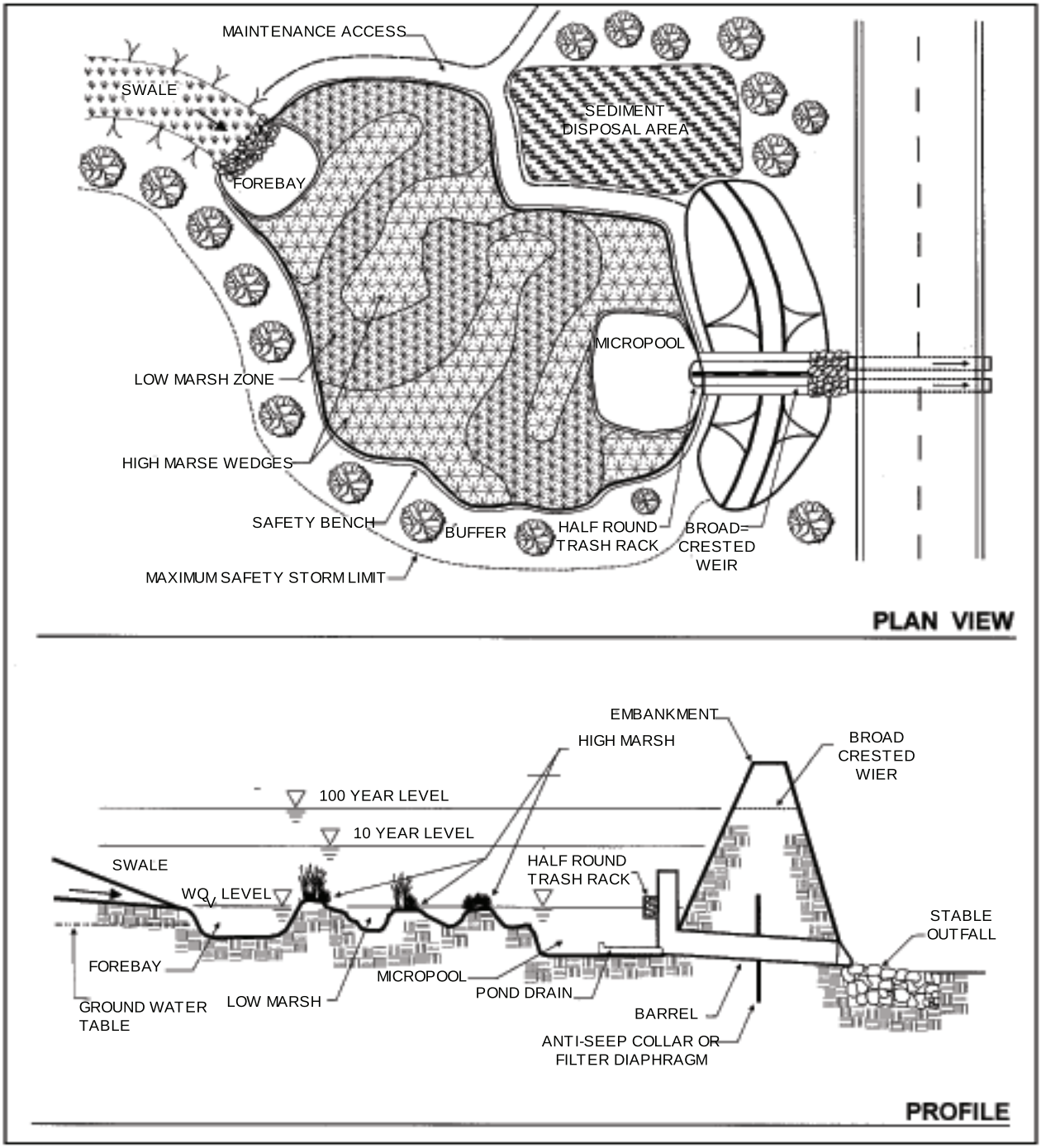
Schematic of Shallow Wetland
(Source: Center for Watershed Protection, modified)



Schematic of Pond/Wetland System
(Source: Center for Watershed Protection, modified)



Schematic of Extended Detention Shallow Wetland
(Source: Center for Watershed Protection, modified)



Schematic of Pocket Wetland
(Source: Center for Watershed Protection, modified)

BIORETENTION AREAS

QUICK REFERENCE

Newly Constructed Bioretention Area

Description:	Shallow storm water basins or landscaped areas that utilize engineered soils and vegetation to capture and treat runoff.	
Site Feasibility:	Drainage Area:	Maximum 5 acres
	Residential Subdivision Use:	Yes
	High Density/Ultra-Urban:	Yes
Design Criteria:	Consists of grass filter strip, ponding area, organic/mulch layer, planting soil, vegetation, and possibly a sand bed. Typically requires 5 feet of head.	
Advantages:	High pollutant removal. Often located in landscaping islands of parking lots. Good retrofit capability for redevelopment. Aesthetic qualities.	
Disadvantages:	Requires extensive landscaping. Not acceptable for site slopes greater than 6%. Generally requires an underdrain system. Clogging may be a problem in areas with high sediment loads.	
Maintenance:	Inspect and repair/replace treatment area components.	

BIORETENTION AREAS

GENERAL

Description: Bioretention areas are structural storm water controls that capture and temporarily store the WQ_v using engineered soils and vegetation in shallow basins or landscaped areas to remove pollutants from storm water runoff. Runoff is conveyed as sheet flow to the bioretention area, which consists of a grass filter strip, ponding area, organic or mulch layer, planting soil, and vegetation. A sand bed can also be included in the design to provide aeration and drainage of the planting soil. The filtered runoff is typically collected and returned to the conveyance system, though it can also be exfiltrated into the surrounding soil in areas with porous soils.

Bioretention systems are designed for intermittent flow and need to drain and reaerate between rainfall events. The systems should not be used on sites with a continuous flow from groundwater, sump pumps, or other sources.

A separation distance of 2 feet is required between the bottom of the bioretention facility and the elevation of the seasonally high water table.

Bioretention Components:

- Stone diaphragm at the beginning of the grass filter strip - to reduce runoff velocities and spread flow into the grass filter strip.
- Grass filter strip – further reduces incoming runoff velocity and filters particulates from runoff.
- Ponding area – provides temporary storage of storm water runoff prior to its evaporation, infiltration, or uptake and provides settling capacity.
- Organic or mulch layer – provides filtration as well as an environment conducive to the growth of microorganisms that degrade hydrocarbons and organic material.
- Planting soil – acts as a filtration system, and clay in the soil provides adsorption sites for hydrocarbons, heavy metals, nutrients and other pollutants.
- Woody and herbaceous plants – provide vegetative uptake of runoff and pollutants and serve to stabilize the surrounding soils.
- Sand bed – provides positive drainage and aerobic conditions in the planting soil and serves as a final treatment media.
- Gravel and perforated pipe underdrain system – collects runoff that has filtered through the soil layers. Bioretention areas can be designed to infiltrate into surrounding soils having infiltration rates greater than 0.5 inch per hour.

BIORETENTION AREAS

DESIGN CRITERIA

The following criteria are minimum standards for the design of a bioretention area, which is designed for storm water quality treatment only. Flow from runoff in excess of the WQ_v must be diverted or the bioretention area designed to safely pass higher flows to protect the ponding area, mulch layer and vegetation. The WQ_v in the bioretention area can be subtracted from detention storage requirements for the contributing area.

1. The maximum drainage area tributary to a bioretention area is 5 acres (½ to 2 acres is preferred).

2. Bioretention area geometry:
    a. The surface area of the bioretention area should be approximately 5% of the tributary impervious area and a minimum of 200 ft^2 for small sites. The bioretention area should have a minimum length to width ratio of 2:1
    b. The elevation difference (head) needed from inflow to outflow is 5 feet.
    c. The site slope should be a maximum of 6%. Velocities entering the mulch layer should be less than 2 fps.
    d. The maximum ponding depth in the bioretention area is 6 inches.
    e. The area of the planting soil filter bed is sized using Darcy's Law equation with a filter bed drain time of 48 hours and a coefficient of permeability (k) of 0.5 ft/day. The planting soil bed must be at least 4 feet in depth.

$$A_f = (WQ_v)(d_f) / [(k)(h_f+d_f)(t_f)]$$

Where:
A_f = surface area of ponding area (ft^2)
WQ_v = water quality volume (ft^3)
d_f = filter bed depth (4 feet minimum)
k = coefficient of permeability of filter media (ft/day) (use 0.5 ft/day for silt-loam)

h_f = average height of water above filter bed (ft) (typically 3 inches, which is half of the 6-inch ponding depth)

t_f = design filter bed drain time (days) (2 days maximum)

3. Pretreatment:
    a. A grass filter strip with a pea gravel diaphragm is typically utilized for pretreatment. See the attached schematic for design criteria for the grass filter strip.
    b. For off-line applications, a grass channel with a pea gravel diaphragm flow spreader is typically used for pretreatment. The minimum grassed channel length is 20 feet. See the attached schematic for design criteria for the grass channel.

4. Components:
    a. Pea gravel for the diaphragm and curtain should be ASTM D 448 size No. 6 ($^1/_8$" to ¼"). A drop of at least six inches should be provided at the inlet of the stone diaphragm.
    b. The mulch layer shall consist of 2 to 4 inches of commercially available fine shredded hardwood mulch or shredded hardwood chips.
    c. Planting soils shall be sandy loam, loamy sand, or loam texture and shall have an infiltration rate of at least 0.5 inches per hour. The planting soil shall be tested and shall meet the following criteria:

clay content	10% to 25% by volume
silt content	30% to 55% by volume
sand content	35% to 60% by volume
pH	5.2 to 7.0
organic matter	1.5% and 4% by weight
magnesium	35 lb./ac
phosphorus (phosphate–P_2O_5)	75 lb./ac
potassium (potash-K_2O)	85 lb./ac
soluble salts	500 ppm maximum

    d. The sand bed should be 12 to 18 inches thick. Sand should be clean and have less than 15% silt or clay content.
    e. The underdrain collection system shall consist of a 4- to 6-inch perforated PVC pipe (Schedule 40 or greater in strength) in an 8-inch gravel layer (clean washed aggregate 0.5 to 2-inches in diameter). The pipe is spaced at a maximum of 10 feet on center at a minimum grade of 0.5%. A permeable filter fabric is required between the gravel layer and the planting soil bed. An observation well/clean out must be provided; a minimum of one well for every 1000 ft^2 of surface area. A visible floating marker shall be provided to indicate the water level. The ends of the underdrain pipes must be capped. The underdrain pipe must discharge to an appropriate facility.
    f. Compaction during construction must be minimized at both the base of the bioretention area and for the backfill materials. Use of equipment causing excessive compaction will result in reduced infiltration rates contributing to failure of the system and is not acceptable. Do not use heavy equipment within the bioretention basin.

5. Overflow structure:
    a. An overflow structure and nonerosive overflow channel must be provided to safely pass flows from the bioretention area that exceeds the system storage capacity to a stabilized downstream area or watercourse. An overflow structure within the bioretention system may consist of a catch basin with the inlet placed 6 inches above the mulch layer at the elevation of the shallow ponding area.

b. An overflow structure may consist of a weir sized using the Weir equation.

$$Q = CLH$$

Where:
Q = peak flow
C = 2.65 for a smooth crested grass weir
L = length
H = 6 inches of head

6. A landscaping plan must be provided. The bioretention area should be vegetated to resemble a terrestrial forest ecosystem, with a mature tree canopy, sub canopy of understory trees, scrub layer, and herbaceous ground cover. Three species each of trees and shrubs should to be planted. The tree-to-shrub ratio should be 2:1 to 3:1. Trees should be spaced 8 feet apart.

7. Bioretention areas must be constructed within an easement either platted or legally described and recorded as a perpetual storm water drainage easement. The easement shall extend a minimum of 30 feet horizontally outside of the bioretention system limits and provide a minimum 10-foot wide access easement. A copy of the easement should be included in the BMP operations and maintenance manual.

8. The bioretention facility shall not be constructed until all contributing drainage area has been stabilized. The bioretention facility shall not be used as a sediment control measure during active construction.

BIORETENTION AREAS

MAINTENANCE AND INSPECTION CHECKLIST

Regular inspection and maintenance is critical to the effective operation of bioretention facilities. The following inspection checklist, to be completed at periods indicated, is provided for the BMP owner and should be retained as a record by the owner for a period of five (5) years from the approval date of the Storm Water Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the Connersville Department of Storm Water Mangement upon request.

Project Name/Site Location:_____

Owner Name:_____ Phone:_____

Owner Address:_____

Date:_____ Inspector:_____

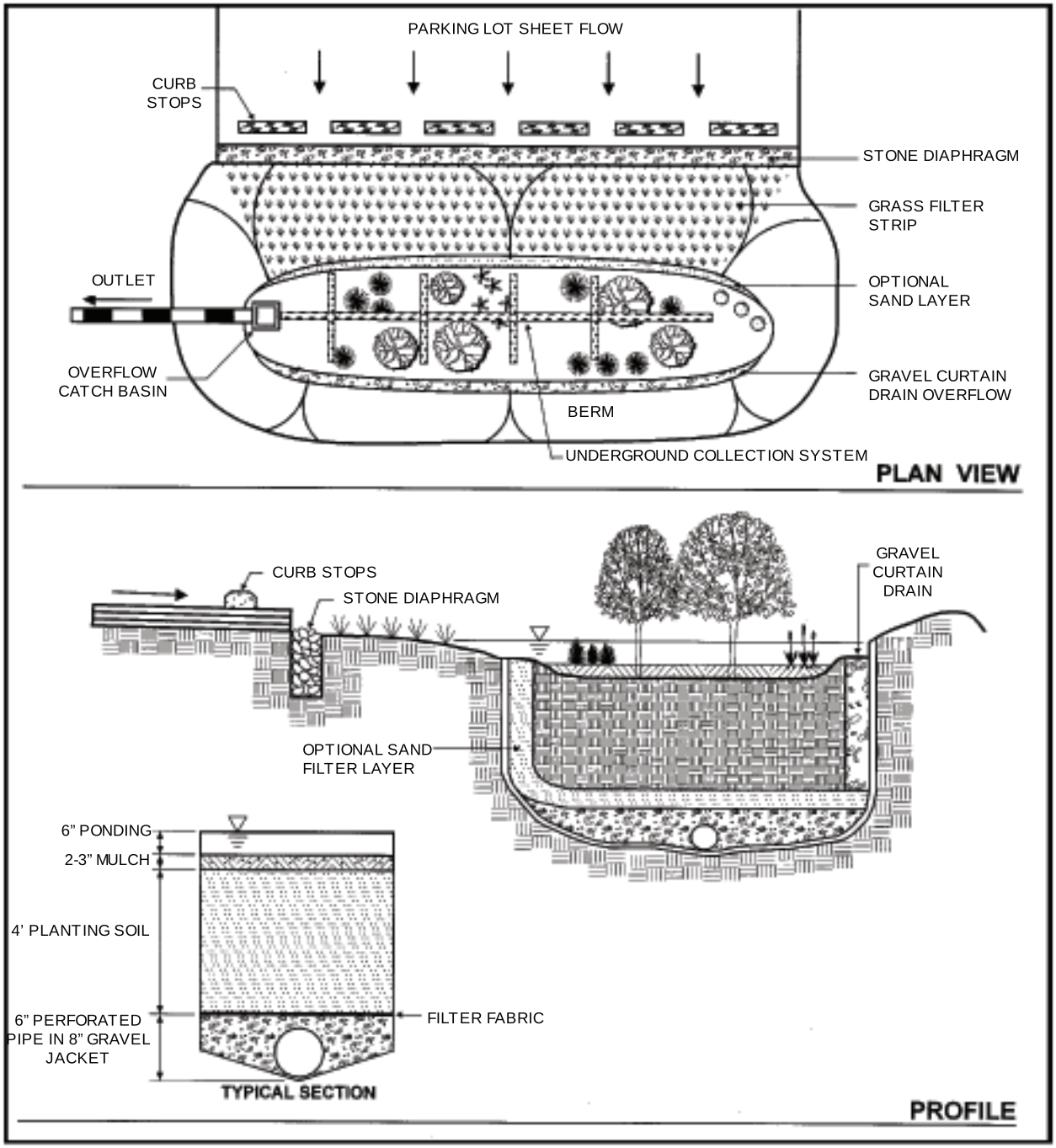
MAINTENANCE ITEM	YES/NO	COMMENTS
Vegetation		**Inspect Monthly**
1. Vegetation established and thriving?		
2. Does mulch require replacement due to erosion, silting, or deterioration? (Mulch should be replaced every 3 years).		
3. Any weeding or pruning needed?		
4. Grass less than 6 inches in height?		
5. Any trash or plant debris to be cleared?		
6. Any dead or diseased vegetation or trees to be cleared and replaced?		
7. Is soil pH test satisfactory? (5.2 to 7.0)		**Inspect Annually**
8. Is surface of ponding area becoming clogged with sediment?		
9. Other problems evident?		
Inflow/outlet areas		**Inspect Annually**
1. Does filter strip need reseeding?		
2. Does sediment need to be removed?		
3. Does pea gravel diaphragm need to be replaced due to clogging?		
4. Any clogging of underdrain?		**Inspect Monthly**
5. Is overflow structure operating properly?		
6. Other problems evident?		

BIORETENTION AREAS

Additional Comments:

Recommended Actions:

Recommended Timeframe for Actions:



Schematic of a Typical On-line Bioretention Area
(Source: Claytor and Schueler, 1996)

WATER QUALITY DRY SWALES

QUICK REFERENCE

Description: Vegetated open channels that are explicitly designed and constructed to capture and treat storm water runoff within dry cells formed by check dams or other means.

Site Feasibility:

Drainage Area:	Maximum 5 acres
Residential Subdivision Use:	Yes
High Density/Ultra-Urban:	No

Design Criteria: Pretreatment forebay required.
Longitudinal slopes must be less than 4%.
Maximum side slopes 2:1 with 4:1 preferred.

Advantages: Combines storm water treatment with runoff conveyance system.
Relatively inexpensive to install.
Reduces runoff velocities.
Aesthetic qualities.

Disadvantages: Cannot be used on steep slopes.
Large area requirement - not feasible for high-density areas.

Maintenance: Maintain grass height of 4 to 6 inches
Remove sediment from forebay and channel

WATER QUALITY DRY SWALES

GENERAL

Description: Water quality swales are conveyance channels engineered to capture and treat the WQ_v for a drainage area. They differ from normal drainage channels or swales through the incorporation of specific features that remove storm water pollutants by filtration through an engineered media. Water quality swales are not the same as filter strips, which are limited application structural controls and not considered acceptable for meeting the TSS removal requirements independently. Water quality swales are designed to include a forebay in addition to a filter bed of prepared soil that overlays an underdrain system. The swales are sized to allow the entire WQ_v to be filtered and discharged or infiltrated through the bottom of the swale. Limited longitudinal slopes, in conjunction with berms and/or check dams installed perpendicular to the flow path, force the flow to be slow and shallow allowing for particulates to settle and limiting erosion. Runoff is collected by a perforated pipe and discharged to an appropriate outlet.

A separation distance of 2 feet is required between the bottom of the water quality swale and the elevation of the seasonally high water table.

WATER QUALITY DRY SWALES

DESIGN CRITERIA

The following criteria are minimum standards for the design of a water quality swale, which is acceptable for storm water quality treatment only and does not provide detention storage. Flow from runoff in excess of the WQ_v must be diverted or the water quality swale adequately designed to safely pass higher flows to prevent erosion of the swale.

1. The maximum drainage area tributary to a water quality swale is 5 acres.

2. Peak flows are limited to 10 cfs and runoff velocities are limited to 2.5 fps.

3. The maximum ponding time in the water quality swale is 48 hours.

4. The swale shall have a maximum ponding time of 48 hours. Soil media shall have an infiltration rate of at least 1 foot per day (f_c > 0.5 inches per hour), with 1.5 feet per day maximum. Infiltration of the WQ_v will only be allowed when proven by geotechnical evaluation that underlying soils have an infiltration rate of 0.5 inches per hour (typically hydrologic group A soils). Infiltration will not be allowed in wellhead protection areas.

5. Water quality swale geometry:
    a. The surface area of the water quality swale should be approximately 10% to 20% of the tributary impervious.
    b. The elevation difference (head) generally needed from inflow to outflow is 3 to 5 feet.
    c. The longitudinal slope of the swale shall be a maximum of 4%, with 1% to 2% preferred.
    d. Side slopes of the swale shall be no greater than 3:1. Swales shall be parabolic or trapezoidal in shape to maximize vegetative areas and to provide ease of maintenance.
    e. The maximum design flow depth shall be 12 inches. The depth of the WQ_v at the downstream end of the swale should not exceed 18 inches.
    f. A minimum bottom channel width of 2 feet is required to ensure adequate filtration.
    g. The bed of the swale shall have a minimum permeable soil layer 30 inches in depth.
    h. The swale must have a minimum length of 100 feet.

6. Pretreatment:
    a. All water quality swales shall include a sediment forebay that consists of a separate cell, formed by an acceptable barrier. See A.1. - Storm Water Ponds for design criteria for a forebay.
    b. Runoff can also enter along the sides of the channel as sheet flow through a grass filter strip containing a pea gravel flow spreader trench (diaphragm) along the entrance to the filter strip. Slopes to the diaphragm shall not exceed 6% for the last 20 feet prior to entering the spreader.

7. The underdrain collection system shall consist of a 4- to 6-inch perforated PVC pipe (Schedule 40 or greater in strength) in an 8-inch gravel layer (clean washed aggregate 0.5 to 2-inches in diameter). A permeable filter fabric is required between the gravel layer and the planting soil bed. A clean out must be provided and the underdrain pipe must discharge to an appropriate facility.

8. Compaction during construction must be minimized at both the base of the water quality swale and for the backfill materials. Use of equipment causing excessive compaction will result in reduced infiltration rates contributing to failure of the system and is not acceptable. Do not use heavy equipment within the bioretention basin.

9. An overflow structure and nonerosive overflow channel must be provided to safely pass flows from the water quality swale that exceeds the system storage capacity to a stabilized downstream area or watercourse.

10. Proper grass species and plants should be specified for the water quality swale.

11. Water quality swales must be constructed within an easement either platted or legally described and recorded as a perpetual storm water drainage easement. The easement shall extend a minimum of 30 feet horizontally outside of the water quality swale limits and provide a minimum 10-foot wide access easement. A copy of the easement should be included in the BMP operations and maintenance manual.

12. The water quality swale shall not be constructed until all contributing drainage area has been stabilized. The swale shall not be used as a sediment control measure during active construction.

WATER QUALITY DRY SWALES

MAINTENANCE AND INSPECTION CHECKLIST

Regular inspection and maintenance is critical to the effective operation of water quality swales. The following inspection checklist, to be completed at periods indicated, is provided for the BMP owner and should be retained as a record by the owner for a period of five (5) years from the approval date of the Storm Water Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the Connersville Department of Storm Water Management upon request.

Project Name/Site Location: _____

Owner Name: _____ Phone: _____

Owner Address: _____

Date: _____ Inspector: _____

MAINTENANCE ITEM	YES/NO	COMMENTS
Vegetation		**Inspect Monthly**
1. Is vegetation and/or grass cover dense and vigorous?		
2. Any weeds or debris to be cleared?		
3. Any erosion of swale?		
4. Any sediment build-up in bottom of swale?		
5. Is grass height maintained at 4 to 6 inches?		
6. Other problems evident?		
Pretreatment		**Inspect Monthly**
1. Sedimentation marker visible?		
2. Sediment cleanout needed (50% full)?		
3. Does pea gravel diaphragm need to be replaced due to clogging?		
4. Other problems evident?		
Outlet areas		**Inspect Monthly**
1. Any evidence of erosion or failure at berms or check dams?		

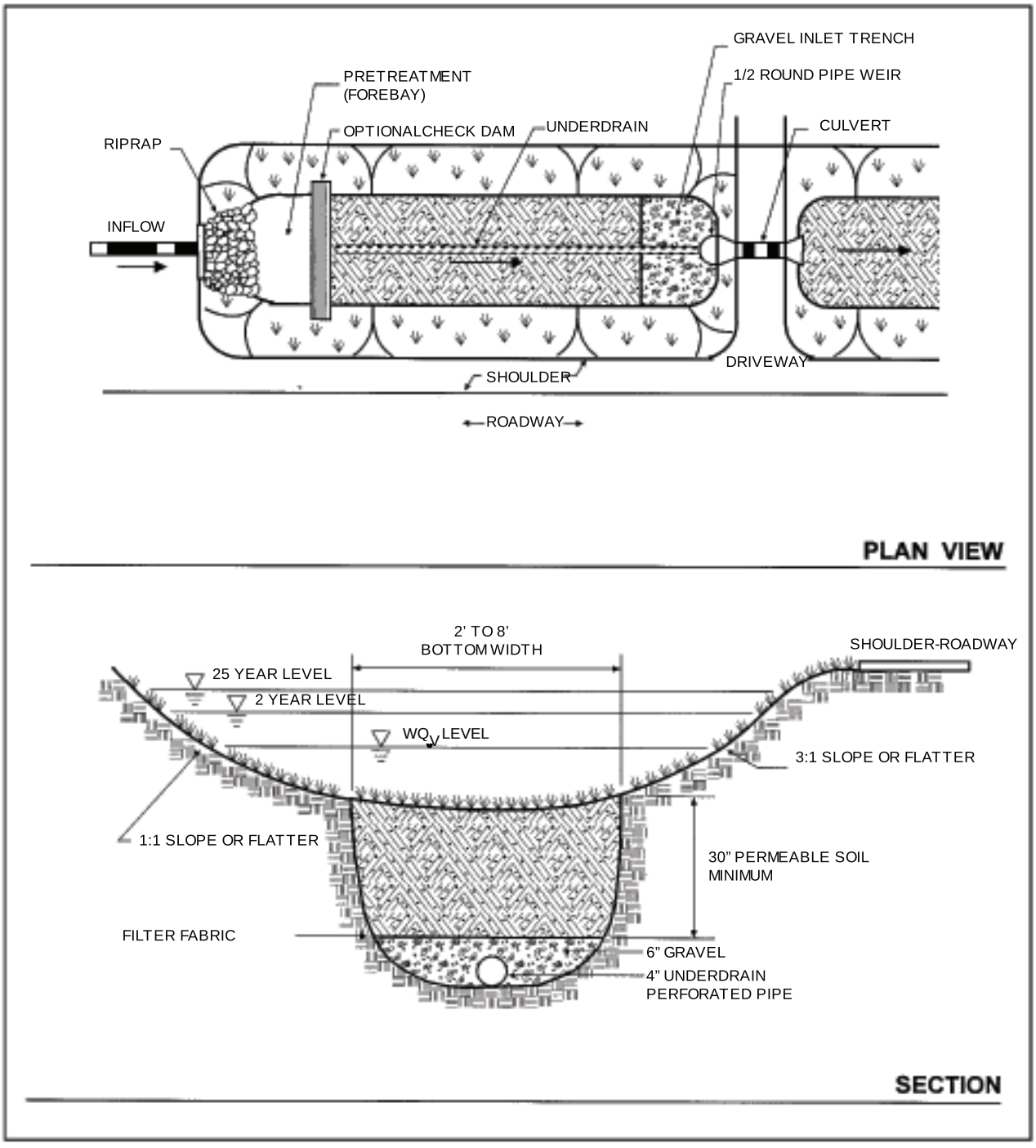
WATER QUALITY DRY SWALES

2. Any clogging of underdrain?		
3. Is overflow structure operating properly?		
4. Other problems evident?		

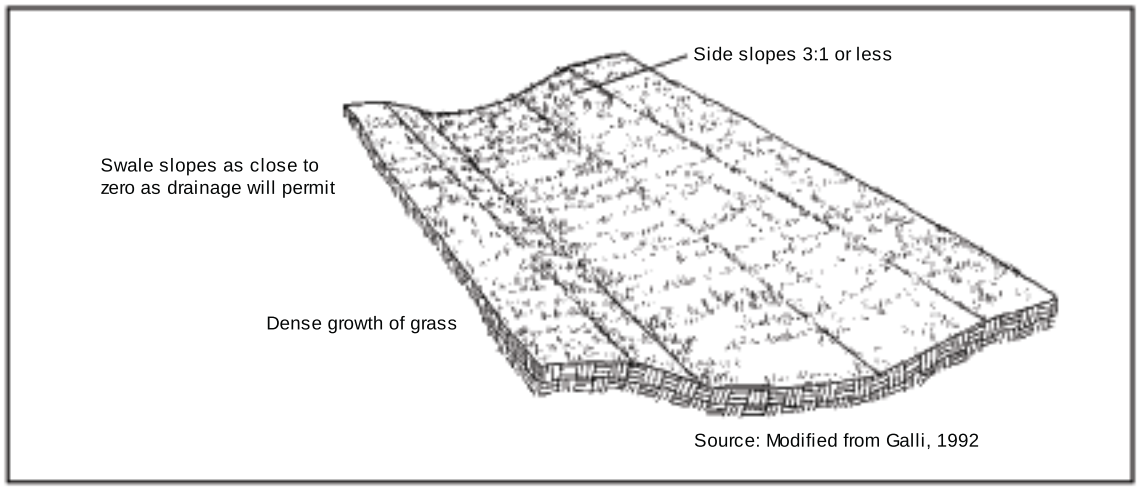
Additional Comments:_____

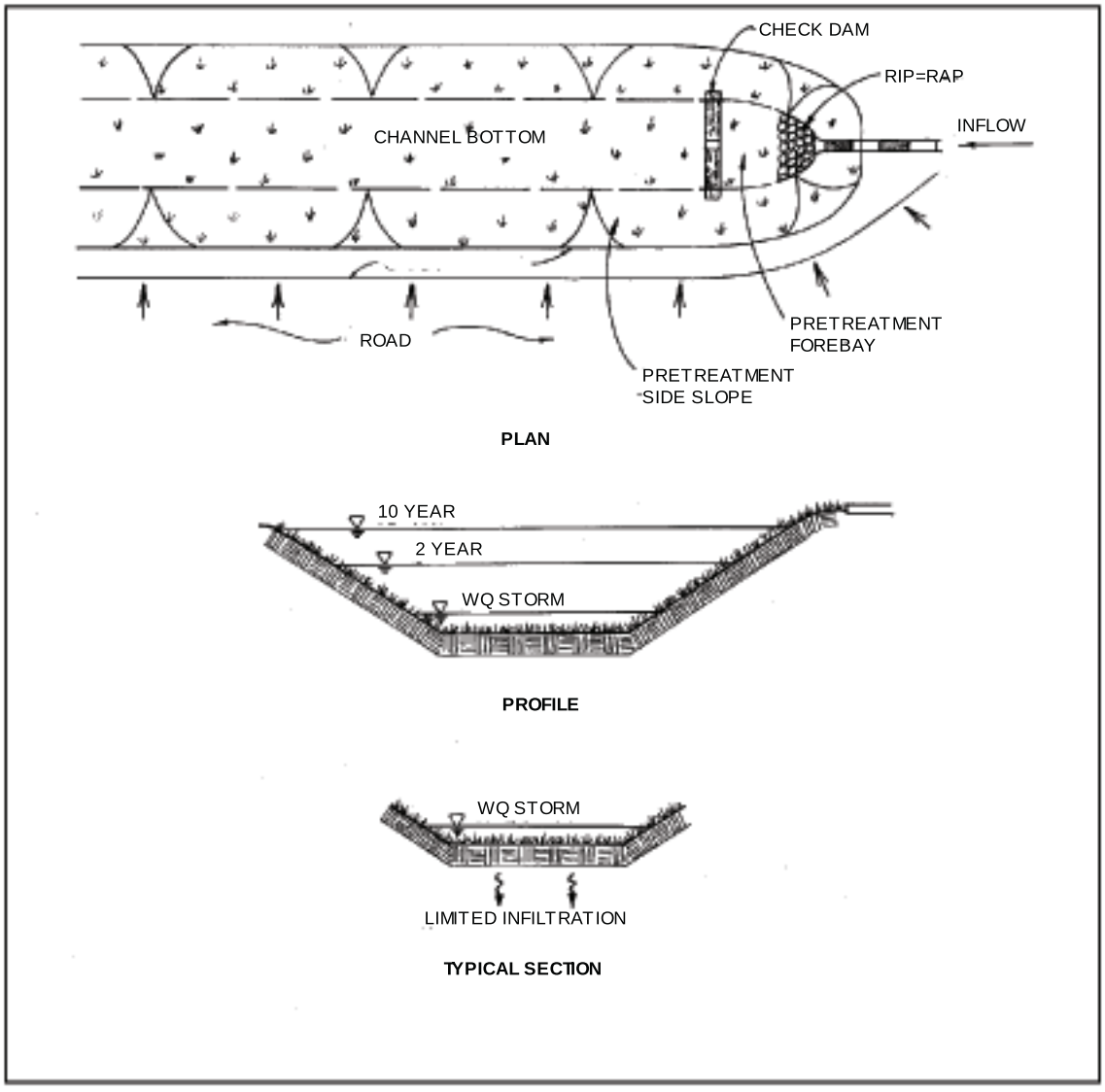
Recommended Actions:_____

Recommended Timeframe for Actions:_____



Schematic of Dry Swale
(Source: Center for Watershed Protection, modified)





Schematic of Grass Channel

SAND FILTERS

QUICK REFERENCE

Description: Multi-chamber structure consisting of a pretreatment chamber, a sand bed as its primary filter media, and an underdrain collection system - designed to treat storm water runoff through filtration.

Site Feasibility:

Drainage Area:	Maximum 2-10 acres
Residential Subdivision Use:	No
High Density/Ultra-Urban:	Yes

Design Criteria:
Pretreatment forebay/chamber required.
Requires 2 to 6 feet of head.

Sand filter media with underdrain system.

Advantages:
Good for highly impervious areas.
Good retrofit capability.

Disadvantages:
High maintenance burden.
Not recommended for areas with high sediment content in runoff.
Relatively costly.
Possible odor problems.

Maintenance:
Inspect for clogging.
Remove sediment from forebay/chamber.
Replace sand filter media as needed.

SAND FILTERS

GENERAL

Description: Sand filters are structural storm water controls that capture and temporarily store storm water runoff and pass it through a filter bed of sand. Most sand filter systems consist of two-chamber structures. The first chamber is a sediment forebay or chamber, which removes floatables and heavy sediments. The second is the filtration chamber, which removes additional pollutants by filtering the runoff through a sand bed. The filtered runoff is collected and returned to the conveyance system by way of an underdrain system.

Sand filters are typically designed as off-line systems. Storm water pollutants are removed through a combination of gravitational settling, filtration and adsorption. Surface sand filters with a grass cover have additional opportunities for bacterial decomposition as well as vegetation uptake of pollutants, particularly nutrients. Sand filter systems are designed for intermittent flow and must be allowed to drain and reaerate between rainfall events. They should not be used on sites with a continuous flow from groundwater, sump pumps, or other sources.

Because they have few site constraints besides head requirements, sand filters can be used on development sites where the use of other structural controls may be precluded. However, sand filter systems can be relatively expensive to construct and install.

Variations:

- Surface sand filter – a ground-level open-air structure that consists of a pretreatment sediment forebay and a filter bed chamber. This system can treat drainage areas up to 10 acres in size and is typically located off-line. Surface sand filters can be designed as an excavation with earthen embankments or as a concrete or block structure.
- Perimeter sand filter – an enclosed filter system typically constructed just below grade in a vault along the edge of an impervious area such as a parking lot. The system consists of a sedimentation chamber and a sand bed filter. Runoff flows into the structure through a series of inlet grates located along the top of the control.
- Underground sand filter – located in an underground vault designed for high-density land use or ultra-urban applications. Typically a three-chamber system consisting of a sedimentation chamber, a filter chamber, and an overflow chamber. Underground sand filters have a high maintenance burden and should only be used where adequate inspection and maintenance can be ensured. Underground sand filters are typically constructed on-line, but can be constructed off-line. For off-line construction, the overflow between the second and third chambers is not included.

SAND FILTERS

DESIGN CRITERIA

The following criteria are minimum standards for the design of a sand filter system, which is acceptable for storm water quality treatment only and does not provide detention storage. The WQ_v is generally routed to the sand filter using a diversion structure. Runoff in excess of the WQ_v must be diverted or the sand filter adequately designed to safely pass higher flows to prevent erosion of pretreatment sediment and filter media.

Surface Sand Filter Criteria

1. Description - A surface sand filter facility consists of a two-chamber open-air structure, which is located at ground level. The first chamber is the sediment forebay and the second chamber contains the sand filter bed. Flow enters the forebay for settling of larger sediment particles. Runoff is then discharged from the forebay through a perforated standpipe into the filtration chamber. After passing through the filter bed, runoff is collected by a perforated pipe and gravel underdrain system. In the following pages, a schematic of a surface sand filter is provided.

2. The maximum drainage area tributary to a surface sand filter is 10 acres.

3. Surface sand filter geometry:
    a. The elevation difference (head) needed from inflow to outflow is 5 feet.
    b. The slope across the filter location shall be a maximum of 6%.
    c. The area of the filter bed is sized using Darcy's Law equation with a filter bed drain time of 36 hours and a coefficient of permeability (k) of 3.5 ft/day.

$$A_f = (WQ_v)(d_f) / [(k)(h_f+d_f)(t_f)]$$

Where:

A_f = surface area of filter bed (ft^2)

WQ_v= water quality volume (ft^3)

d_f = filter bed depth (1.5 feet minimum)

k = coefficient of permeability of filter media (ft/day)

(use 3.5 ft/day for sand)

h_f = average height of water above filter bed (ft)

t_f = design filter bed drain time (days) (1.5 days maximum)

4. Pretreatment:
    a. The surface sand filter system shall include a sediment forebay that consists of a separate cell, formed by an acceptable barrier. The forebay shall be sized to contain 25% of the WQ_v.
    b. The forebay shall have a minimum length-to-width ratio of 2:1.
    c. Inlet and outlet structures shall be located at opposite ends of the forebay.
    d. Entrance and exit velocities to the forebay shall be non-erosive. A flow distribution chamber shall be provided at the entrance to the filter media to spread the flow evenly across the surface of the filter media. Erosion protection shall be provided over the filter media using riprap, grass or other dissipation devices.

5. Filter media shall be a minimum 18-inch layer of clean washed medium sand (ASTM C-33 concrete sand) on top of an underdrain system. Three inches of topsoil (or other erosion protection) are placed over the sand bed. Permeable filter fabric is required above and below the sand bed to prevent clogging of the sand filter and underdrain system.

6. The underdrain collection system shall consist of a 4- to 6-inch perforated PVC pipe (Schedule 40 or greater in strength) in an 8-inch gravel layer (clean washed aggregate 0.5 to 2-inches in diameter). The underdrain shall have a minimum slope of 1%. A clean out must be provided and the underdrain pipe must discharge to an appropriate facility.

7. The surface sand filter structure may be constructed of concrete or earthen embankments. When constructed with earthen walls/embankments, filter fabric shall be used to line the bottom and side slopes of the structures before installation of the underdrain system and filter media.

8. An emergency spillway must be included to safely pass flows that exceed the design storm flows.

Perimeter Sand Filter Criteria

1. Description - A perimeter sand filter facility is a vault structure located just below grade level. Runoff enters a sedimentation chamber through inlet grates along the top of the structure. Runoff is discharged from the sedimentation chamber through a weir into the filtration chamber. After passing through the filter, runoff is collected by a perforated pipe and gravel underdrain system. Refer to the schematics on the following pages for a perimeter sand filter.

2. The maximum drainage area tributary to a perimeter sand filter is 2 acres.

3. Perimeter sand filter geometry:
    a. The elevation difference (head) needed from inflow to outflow is 2 to 3 feet.
    b. The area of the filter bed is sized using Darcy's Law equation with a filter bed drain time of 36 hours and a coefficient of permeability (k) of 3.5 ft/day. (See 3.c. above - surface sand filter criteria.)

4. Pretreatment:
    a. The perimeter sand filter system shall include a sediment chamber that consists of a separate cell. The sediment chamber shall be sized to contain 50% of the WQ_v.

5. Filter media shall be a minimum 18-inch layer of clean washed medium sand (ASTM C-33 concrete sand) on top of an underdrain system. Permeable filter fabric is required between the sand bed and the underdrain gravel layer to prevent clogging.

6. The underdrain collection system shall consist of a 4- to 6-inch perforated PVC pipe (Schedule 40 or greater in strength) in an 8-inch gravel layer (clean washed aggregate 0.5 to 2-inches in diameter). The underdrain shall have a minimum slope of 1%. A clean out must be provided and the underdrain pipe must discharge to an appropriate facility.

Underground Sand Filter Criteria

1. Description – An underground sand filter is located in an underground vault. The filter is a three-chamber system. The first chamber is a sedimentation chamber that temporarily stores runoff and utilizes a wet pool to capture sediment. The sedimentation chamber is connected to the sand filter chamber by a submerged wall that protects the filter bed from oil and trash. The filter bed is 18 to 24 inches deep and may have a protective screen of gravel or permeable geotextile to limit clogging. The sand filter chamber also includes an underdrain system with inspection and clean out wells. Perforated pipes under the sand filter bed extend into a third chamber that collects filtered runoff. Flows beyond the filter capacity are diverted through an overflow weir.

2. The maximum drainage area tributary to a perimeter sand filter is 2 acres.

3. Underground sand filters are typically constructed on-line, but can be constructed off-line. For off-line construction, the overflow between the second and third chambers is not included.

4. The underground vault shall be tested for water tightness prior to placement of filter layers.

5. Adequate maintenance access must be provided to the sedimentation and filter bed chambers.

SAND FILTERS

General

1. Sand filter facilities must be constructed within an easement either platted or legally described and recorded as a perpetual storm water drainage easement. The easement shall extend a minimum of 30 feet horizontally outside of the facility limits and provide a minimum 10-foot wide access easement. A copy of the easement should be included in the BMP operations and maintenance manual.

2. The sand filter facility shall not be constructed until all contributing drainage area has been stabilized. The sand filter facility shall not be used as a sediment control measure during active construction.

SAND FILTERS

MAINTENANCE AND INSPECTION CHECKLIST

Regular inspection and maintenance is critical to the effective operation of sand filter facilities. The following inspection checklist, to be completed at periods indicated, is provided for the BMP owner and should be retained as a record by the owner for a period of five (5) years from the approval date of the Storm Water Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the Connersville Department of Storm Water Management upon request.

Project Name/Site Location: _____

Owner Name: _____ Phone: _____

Owner Address: _____

Date: _____ Inspector: _____

MAINTENANCE ITEM	YES/NO	COMMENTS
Pretreatment		**Inspect Monthly**
1. Any evidence of erosion?		
2. Are grass clippings removed from contributing areas that are mowed?		
3. Are inlets, outlets, and filter area clear of debris?		
4. Is normal pool level being retained (perimeter and underground facilities)? Any leaks evident?		
5. Other problems evident?		
Filter Bed		**Inspect Monthly**
1. Is filter bed free of sediments? Is sediment cleanout needed (50% full or 6 inches, whichever is less)?		
2. Is filter bed free of oil and grease?		
3. If clogging of filter bed is present, remove the top few inches of sand and replace.		
4. Any clogging of underdrain?		
5. Any clogging of filter fabric?		
6. Other problems evident?		

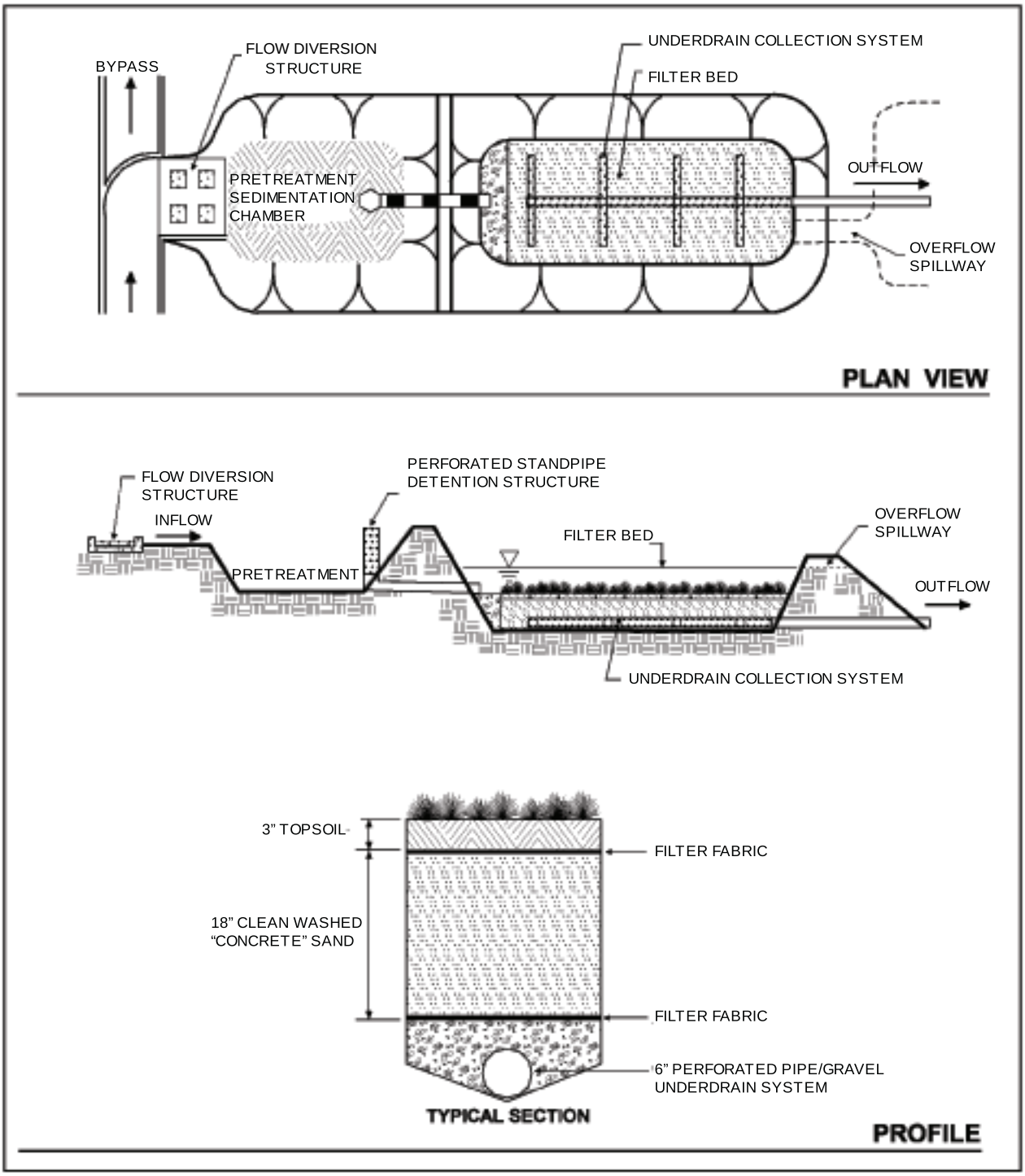
SAND FILTERS

Structural		**Inspect Annually**
1. Any evidence of deterioration, spalling or cracking of concrete vault, spillway, etc.?		
2. Are inlet grates in good condition?		
3. Is overflow structure operating properly?		
4. Other problems evident?		
Other		**Inspect Monthly**
1. Any odors?		
2. Any evidence of flow bypassing the facility?		

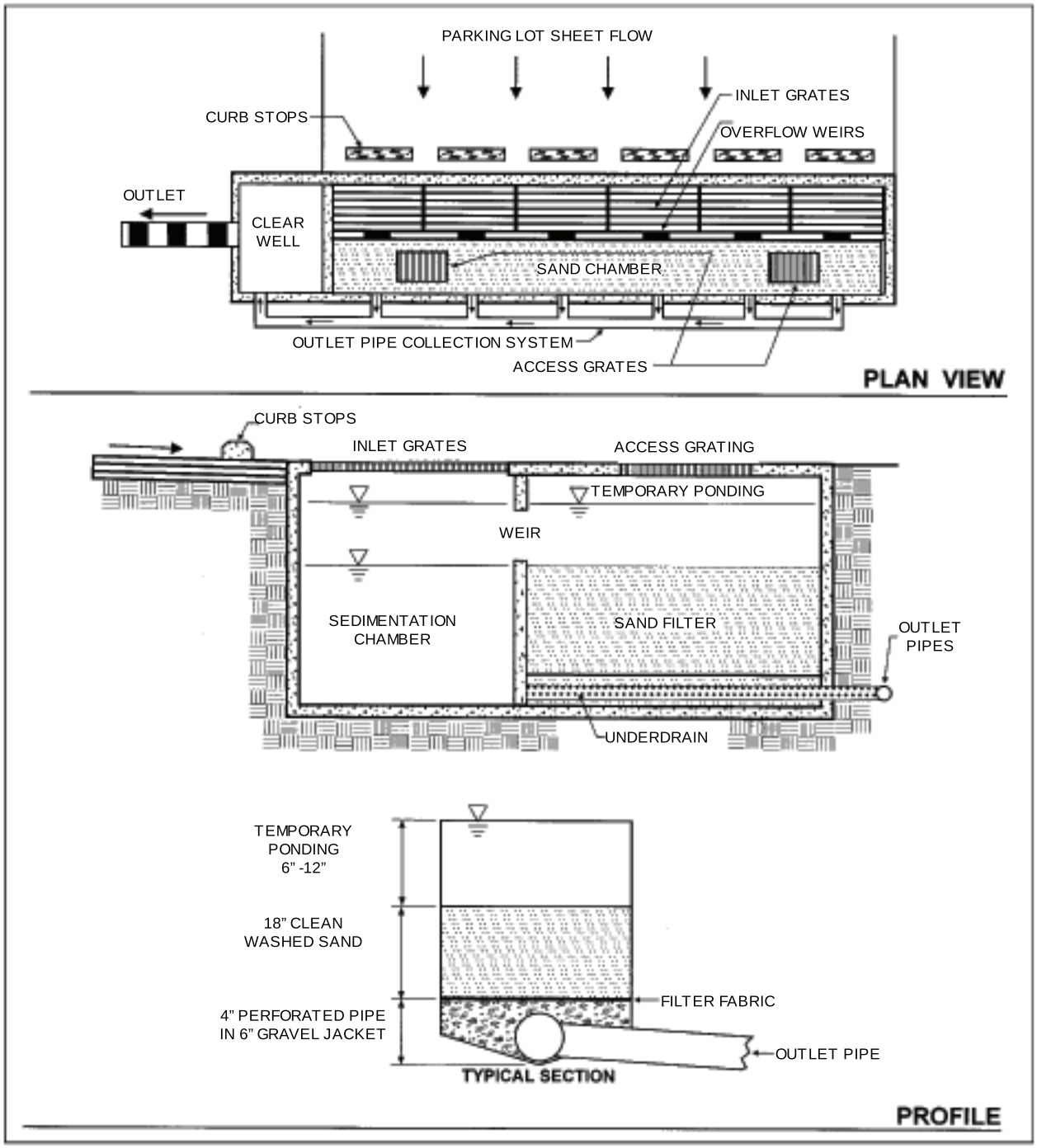
Additional Comments:_____

Recommended Actions:_____

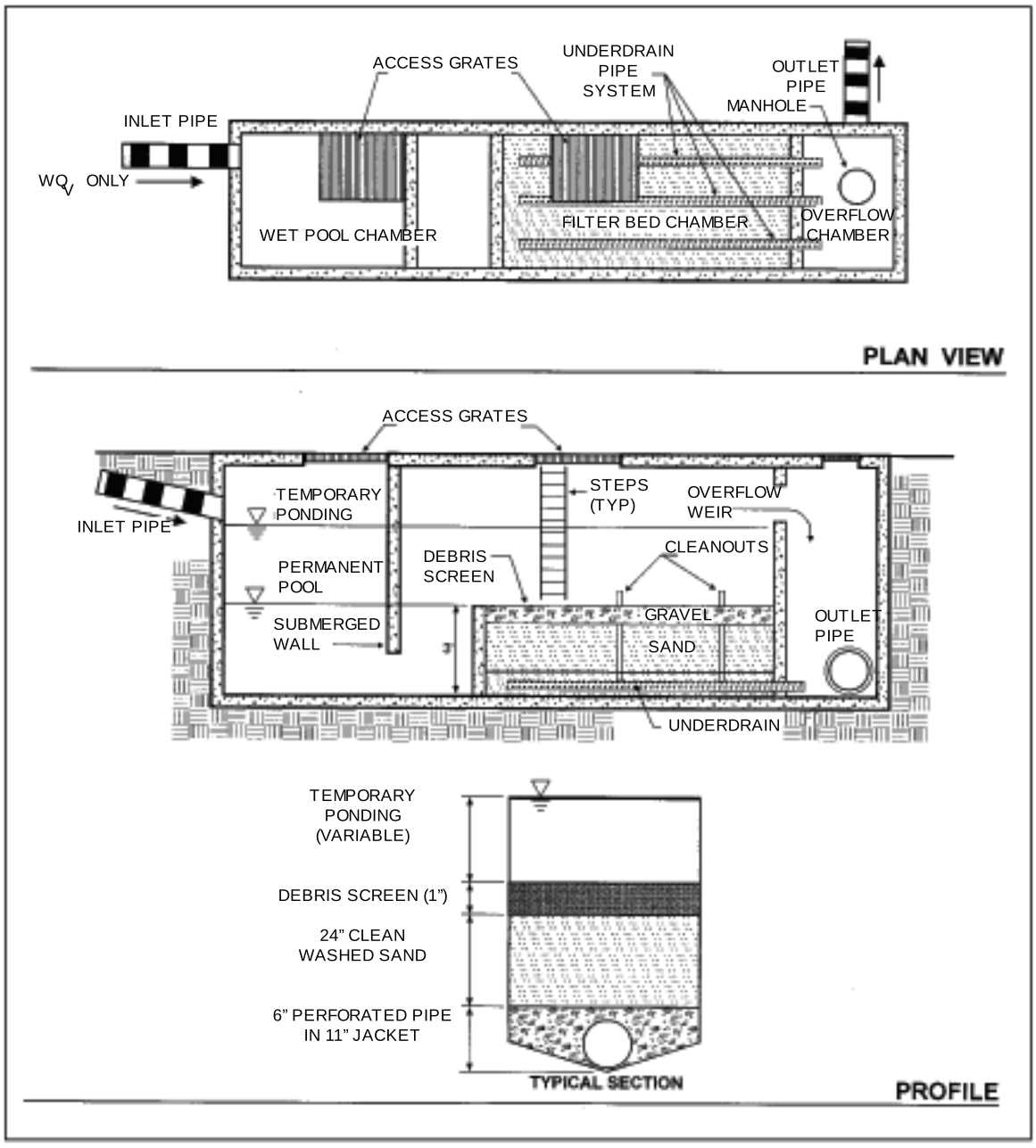
Recommended Timeframe for Actions:_____



Schematic of Surface Sand Filter
(Source: Center for Watershed Protection)



Schematic of Perimeter Sand Filter
(Source: Center for Watershed Protection)



Schematic of Underground Sand Filter
(Source: Center for Watershed Protection)

INFILTRATION TRENCHES

QUICK REFERENCE

Description: Excavated trench filled with stone aggregate used to capture and allow infiltration of storm water runoff into the surrounding soils from the bottom and sides of the trench.

Site Feasibility:

Drainage Area:	Maximum 5 acres
Residential Subdivision Use:	Yes
High Density/Ultra-Urban:	Yes

Design Criteria:
Pretreatment forebay required.
Minimum surrounding soil infiltration rate of 0.5 inches per hour.
Excavated trench filled with stone media, pea gravel and sand filter layers
Observation well required to monitor percolation.

Advantages:
Good for small sites with porous soils.
Good retrofit capability for redevelopment.

Disadvantages:
Geotechnical testing required.
High clogging potential; not to be used on sites with fine-particle soils in drainage area.

Maintenance:
Remove sediment from forebay.
Inspect for clogging.
Replace pea gravel layer as needed.

INFILTRATION TRENCHES

GENERAL

Description: Infiltration trenches are excavations filled with stone to create an underground reservoir of storm water runoff. The runoff volume gradually exfiltrates through the bottom and sides of the trench into the subsoil over a 2-day period and eventually reaches the water table. By diverting runoff into the soil, an infiltration trench treats the water quality volume and helps to preserve the natural water balance on a site and can recharge groundwater and preserve base flow. Due to this fact, infiltration systems are limited to areas with highly porous soils where the water table and/or bedrock are located well below the bottom of the trench. Infiltration trenches must be carefully sited to avoid the potential of groundwater contamination.

Infiltration trenches are not intended to trap sediment and must always be designed with a sediment forebay and grass channel or filter strip, or other appropriate pretreatment measures to prevent clogging and failure. The facility is only for impervious areas where there are not high levels of fine particulates (clay/silt soils) in the runoff and will only be considered for sites where the sediment load is relatively low.

A separation distance of 4 feet is required between the bottom of the infiltration trench and the elevation of the seasonally high water table.

Infiltration trenches are designed for intermittent flow and need to drain and reaerate between rainfall events. The systems should not be used on sites with a continuous flow from groundwater, sump pumps, or other sources.

Infiltration trenches shall not be used for manufacturing and industrial sites, where there is a potential for high concentrations of soluble pollutants and heavy metals. In addition, infiltration shall not be considered for areas with a high pesticide concentration.

INFILTRATION TRENCHES

DESIGN CRITERIA

The following criteria are minimum standards for the design of an infiltration trench, which is designed for storm water quality treatment only. Flow from runoff in excess of the WQ_v must be diverted. The WQ_v in the infiltration trench can be subtracted from detention storage requirements for the contributing area.

1. The maximum drainage area tributary to an infiltration trench is 5 acres.

2. Underlying soils shall have a minimum infiltration rate (f_c) of 0.5 inches per hour as determined from geotechnical tests. The minimum geotechnical testing is one test hole per 5,000 ft^2, with a minimum of two borings per facility taken within the limits of the facility. Infiltration trenches cannot be used in fill soils.

3. Soils on the drainage area tributary to an infiltration trench shall have a clay content of less than 20% and a silt/clay content of less than 40% to prevent clogging and failure.

4. Clay lenses, bedrock and other restrictive layers below the bottom of the trench will reduce infiltration rates unless excavated.

5. To reduce the potential for costly maintenance and/or system reconstruction, the trench should be located in an open or lawn area. Infiltration trenches shall not be located beneath paved surfaces.

6. Minimum setback requirements for infiltration trench facilities (unless otherwise specified by local ordinance or criteria):
    a. From a property line – 10 feet
    b. From a building foundation – 25 feet
    c. From a private well – 100 feet
    d. From a public water supply well – 1,200 feet
    e. From a septic system tank/leach field – 100 feet
    f. From surface waters – 100 feet
    g. From surface drinking water sources – 400 feet (100 feet for a tributary)

7. Infiltration trench geometry:
    a. The required trench storage volume is equal to the WQ_v.
    b. The trench must be designed to fully dewater the WQ_v within 24 to 48 hours. The slowest infiltration rate obtained from geotechnical tests performed at the site should be used in the design calculations.
    c. Trench depths should be 3 to 8 feet. The width of the trench must be less than 25 feet.
    d. Broader, shallow trenches reduce the risk of clogging by spreading the flow over a larger area for infiltration.

e. The surface area is calculated based on the trench depth, soil infiltration rate, aggregate void space, and fill time (assume a fill time of 2 hours for most designs).
f. The bottom of a trench shall be flat across its length and width to evenly distribute flow, encourage uniform infiltration through the bottom, and reduce the risk of clogging.
g. Stone aggregate should be washed, bank-run gravel, 1.5 to 2.5 inches in diameter with a void space of about 40%. Aggregate contaminated with soil shall not be used. A porosity value (void space/total volume) of 0.32 should be used in calculations, unless aggregate specific data exist.
h. A 6-inch layer of clean, washed sand is placed on the bottom of the trench to encourage drainage and prevent compaction of the native soil while the stone aggregate is added.
i. The trench shall be lined on the sides and top by an appropriate geotextile filter fabric that prevents soil piping but has greater permeability than the parent soil. The top layer of filter fabric is placed 2 to 6 inches from the top of the trench to prevent sediment from passing into the stone aggregate. This top layer will need to be replaced more frequently and must be readily separated from the side section.
j. The top surface of the trench above the filter fabric is covered with pea gravel to improve sediment filtering. It shall be removed and replaced should the device clog. Alternatively, the trench can be covered with permeable topsoil and planted with grass in a landscaped area.
k. An observation well consisting of 4- to 6-inch perforated PVC pipe must be installed and extend to the bottom of the trench. The well should be installed along the centerline of the structure, flush with the ground elevation of the trench. A visible floating marker shall be provided to indicate the water level.
l. The trench excavation shall be limited to the width and depth specified in the design. The bottom of the excavated trench shall not be loaded in a way that causes soil compaction and shall be scarified prior to placement of sand. The sides of the trench shall be trimmed of all large roots.

8. Pretreatment:
   a. For an infiltration trench receiving sheet flow from an adjacent drainage area, the pretreatment system may consist of a vegetated filter strip with a minimum 25-foot length. A vegetated buffer strip around the entire trench is required if the facility is receiving runoff from other directions. See the attached schematic for design criteria for the vegetated filter strip.
   b. For off-line applications, pretreatment shall consist of a sediment forebay or similar sedimentation chamber (with energy dissipaters) sized to 25% of the WQ_v. Exit velocities from the pretreatment chamber must be nonerosive.

9. Overflow structure - a nonerosive overflow channel must be provided to safely pass flows from the infiltration trench that exceeds the system storage capacity to a stabilized downstream area or watercourse.

10. Infiltration trenches must be constructed within an easement either platted or legally described and recorded as a perpetual storm water drainage easement. The easement shall extend a minimum of 30 feet horizontally outside of the system limits and provide a minimum 10-foot wide access easement. A copy of the easement should be included in the BMP operations and maintenance manual.

11. The infiltration trench shall not be constructed until all contributing drainage area has been stabilized. The infiltration trench shall not be used as a sediment control measure during active construction.

INFILTRATION TRENCHES

MAINTENANCE AND INSPECTION CHECKLIST

Regular inspection and maintenance is critical to the effective operation of infiltration trenches. The following inspection checklist, to be completed at periods indicated, is provided for the BMP owner and should be retained as a record by the owner for a period of five (5) years from the approval date of the Storm Water Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the Connersville Department of Storm Water Management upon request.

Project Name/Site Location: _____

Owner Name: _____ Phone: _____

Owner Address: _____

Date: _____ Inspector: _____

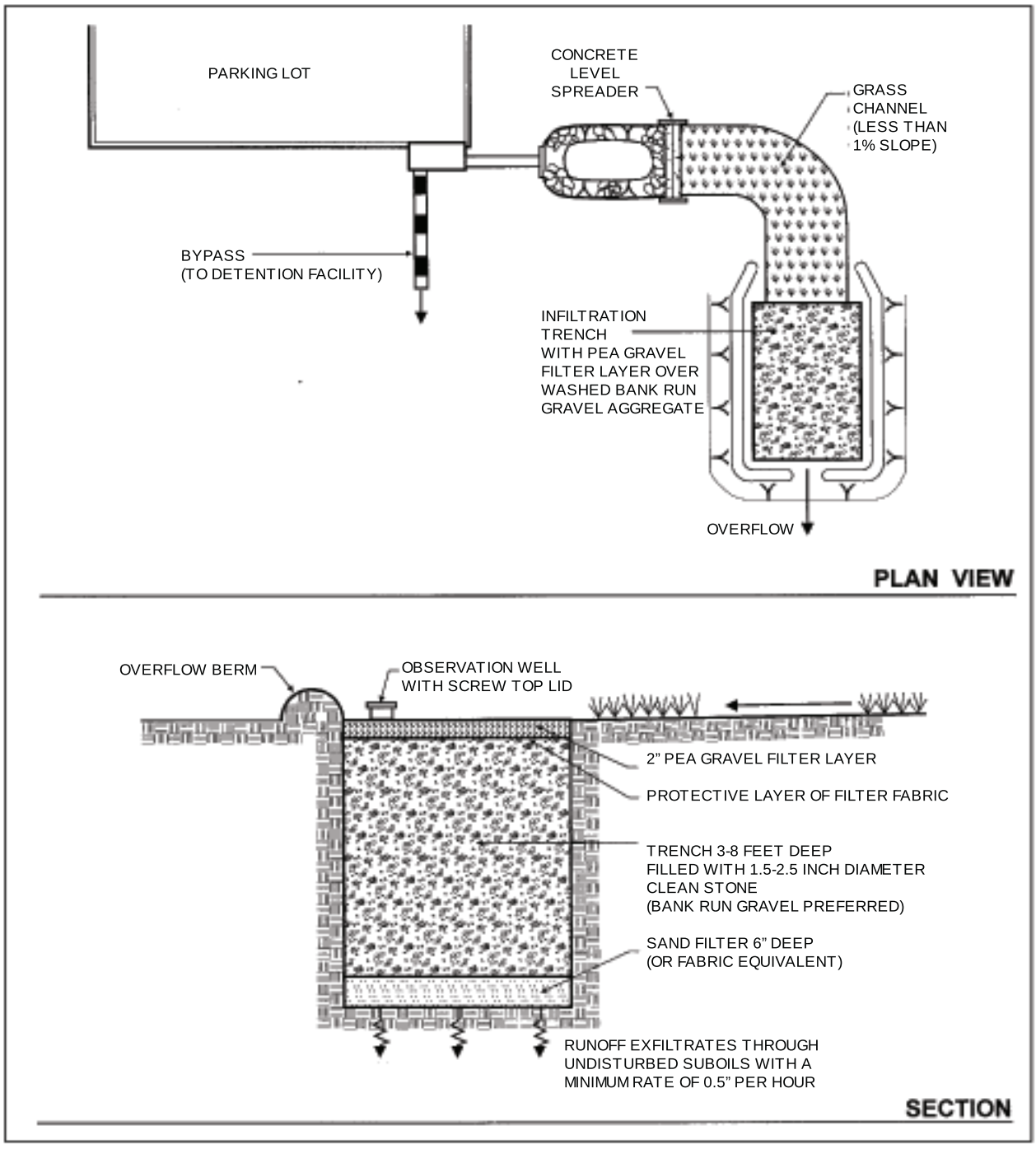
MAINTENANCE ITEM	YES/NO	COMMENTS
Vegetation/Pretreatment		**Inspect Monthly**
1. Any evidence of erosion? Does filter strip need to be reseeded?		
2. Are grass clippings removed from contributing areas that are mowed?		
3. Are inlets and filter area clear of debris?		
4. Sedimentation marker visible?		
5. Sediment cleanout needed (50% full)?		
6. Other problems evident?		
Trench		**Inspect Monthly**
1. Any vegetative growth in trench area?		
2. Are observation wells clear of water after 3 days of dry weather?		
3. Does pea gravel/topsoil need to be replaced due to clogging?		
4. Does top surface filter fabric need to be replaced due to clogging?		
5. Other problems evident?		
6. Upon failure of trench, perform total rehabilitation to maintain design storage capacity. Excavate trench walls to expose clean soil.		

INFILTRATION TRENCHES

Additional Comments:

Recommended Actions:

Recommended Timeframe for Actions:



Schematic of Infiltration Trench
(Source: Center for Watershed Protection)

BIOFILTERS

QUICK REFERENCE

Description: Uniformly graded and densely vegetated sections of land engineered and designed to treat runoff and remove pollutants through vegetative filtering and infiltration.

Site Feasibility:

Drainage Area:	10 acres maximum - 5 preferred
Residential Subdivision Use:	Yes
High Density/Ultra-Urban:	No

Design Criteria: Requires slopes between 2% and 6%.
Level spreader required where concentrated runoff flows into biofilter.

Advantages: Relatively inexpensive to install.
Reduces runoff velocities.
Aesthetic qualities and preservation of riparian zones.

Disadvantages: TSS removal is less than 80%.
Cannot be used on steep slopes.
Large land requirement.

Maintenance: Maintain grass height of 2 to 6 inches.
Requires periodic sediment removal.

BIOFILTERS

GENERAL

Description: Biofilters are densely vegetated sections of land designed to treat runoff and remove pollutants through vegetative filtering and infiltration. Biofilters must receive runoff from adjacent areas as sheet flow to provide treatment and prevent erosion. The vegetation slows the runoff and filters out sediment and other pollutants. Biofilters provide less than 80% TSS removal but can be used as pretreatment measures in conjunction with other water quality treatment practices.

Biofilters are best suited to treat runoff from roads and highways, rooftops, small parking lots, and pervious surfaces. Biofilters can be incorporated into residential developments as land-use buffers and setbacks.

Variations:
Filter strip – a uniformly graded and densely vegetated strip of land. The vegetation can be grasses or a combination of grass and woody plants.

Riparian buffer – a strip of land with natural, woody vegetation along a stream or other watercourse. The riparian zone includes deep-rooted trees with undergrowth of grasses and herbaceous vegetation.

BIOFILTERS

DESIGN CRITERIA

The following criteria are minimum standards for the design of biofilters, which can be used as pretreatment in conjunction with other water quality measures. Biofilters alone do not fulfill the 80% TSS removal requirement.

1. Uniform sheet flow must be maintained across the entire biofilter through the use of consistent grades and low slopes. The biofilter area shall be free of gullies or rills that can concentrate overland flow.

2. Filter strips can be used as pretreatment measures. The minimum length (parallel to the flow path) sizing criteria shall be:
    a. Impervious area approach length of 35 feet or less – 15 feet minimum filter strip length.
    b. Impervious area approach length of 35 to 75 feet – 25 feet minimum filter strip length.
    c. Pervious area approach length of 75 feet or less – 12 feet minimum filter strip length.
    d. Pervious area approach length of 75 to100 feet – 18 feet minimum filter strip length.

3. A level spreader is required at the end of sheet flow paths longer than 75 feet for impervious surfaces and 100 feet for pervious surfaces. In addition, areas of concentrated runoff tributary to a biofilter shall require a level spreader.
    a. The maximum drainage area tributary to a biofilter is 10 acres with 5 acres preferred.
    b. The level spreader shall have a 0% slope and encompass the entire width of the biofilter (perpendicular to the flow path).
    c. The slope of the surface prior to the level spreader should provide a smooth transition into the spreader.
        i. If a channel is directing runoff to the level spreader, the last 20 feet of the channel shall have a slope of 1% or less and shall provide a smooth transition of flow to the level spreader. The depth of the level spreader must be a minimum of six inches. The level spreader lip must be constructed on undisturbed soil to a uniform height and 0% slope over the length of the spreader to ensure even runoff distribution.
        ii. If the runoff is being directed to the level spreader overland as sheet flow, the last 20 feet of the ground shall be 6% or less.
    d. A pea gravel diaphragm at the top of the slope of a biofilter receiving sheet flow provides settling of sediment particles and acts as a level spreader, maintaining sheet flow over the biofilter.

4. Filter strip geometry:
   The filter strip should be designed based on Manning's equation for channel design using the following criteria:

a. Rectangular shape for the filter strip.
b. Maximum design flow depth of 0.5 inches.
c. Velocity no greater than 0.9 ft/s to prevent flattening of grasses.
d. Manning's *n* of 0.02 for grassed strips, 0.024 for infrequently mowed strips, or appropriate *n* for wooded strips.
e. Width of the strip shall be dependent upon where uniform flow is obtained from the site.
f. Because the strip is wide, the hydraulic radius approaches the flow depth and is taken to be equal to the design flow depth.
g. Slope is between 2% and 6%.
h. Dense grasses must be specified.

5. Riparian zone geometry:
   At a minimum, a riparian zone should consist of a 20-foot strip of trees and herbaceous vegetation closest to the stream or watercourse and a 30-foot strip of dense grasses prior to the tree zone.

6. Biofilters must be constructed within an easement either platted or legally described and recorded as a perpetual storm water drainage easement. The easement shall encompass the biofilter and level spreader and provide a minimum 10-foot wide access easement. A copy of the easement should be included in the BMP operations and maintenance manual.

BIOFILTERS

MAINTENANCE AND INSPECTION CHECKLIST

Regular inspection and maintenance is critical to the effective operation of biofilters. The following inspection checklist, to be completed at periods indicated, is provided for the BMP owner and should be retained as a record by the owner for a period of five (5) years from the approval date of the Storm Water Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the Connersville Department of Storm Water Management upon request.

Project Name/Site Location:_____

Owner Name:_____ Phone:_____

Owner Address:_____

Date:_____ Inspector:_____

MAINTENANCE ITEM	YES/NO	COMMENTS
Vegetation		**Inspect Monthly**
1. Is vegetation and/or grass cover dense and vigorous?		
2. Any gullies or rills present?		
3. Any erosion evident?		
4. Any sediment build-up present?		
5. Is grass height maintained at 2 to 6 inches?		
6. Other problems evident?		
Level Spreader		**Inspect Monthly**
1. Is vegetation and/or grass cover dense and vigorous?		
2. Any signs of erosion on lip of spreader?		
3. Any sediment build-up present?		
2. Does pea gravel diaphragm need to be cleaned out due to sediment build-up?		
3. Does pea gravel diaphragm need to be replaced due to clogging?		
4. Other problems evident?		

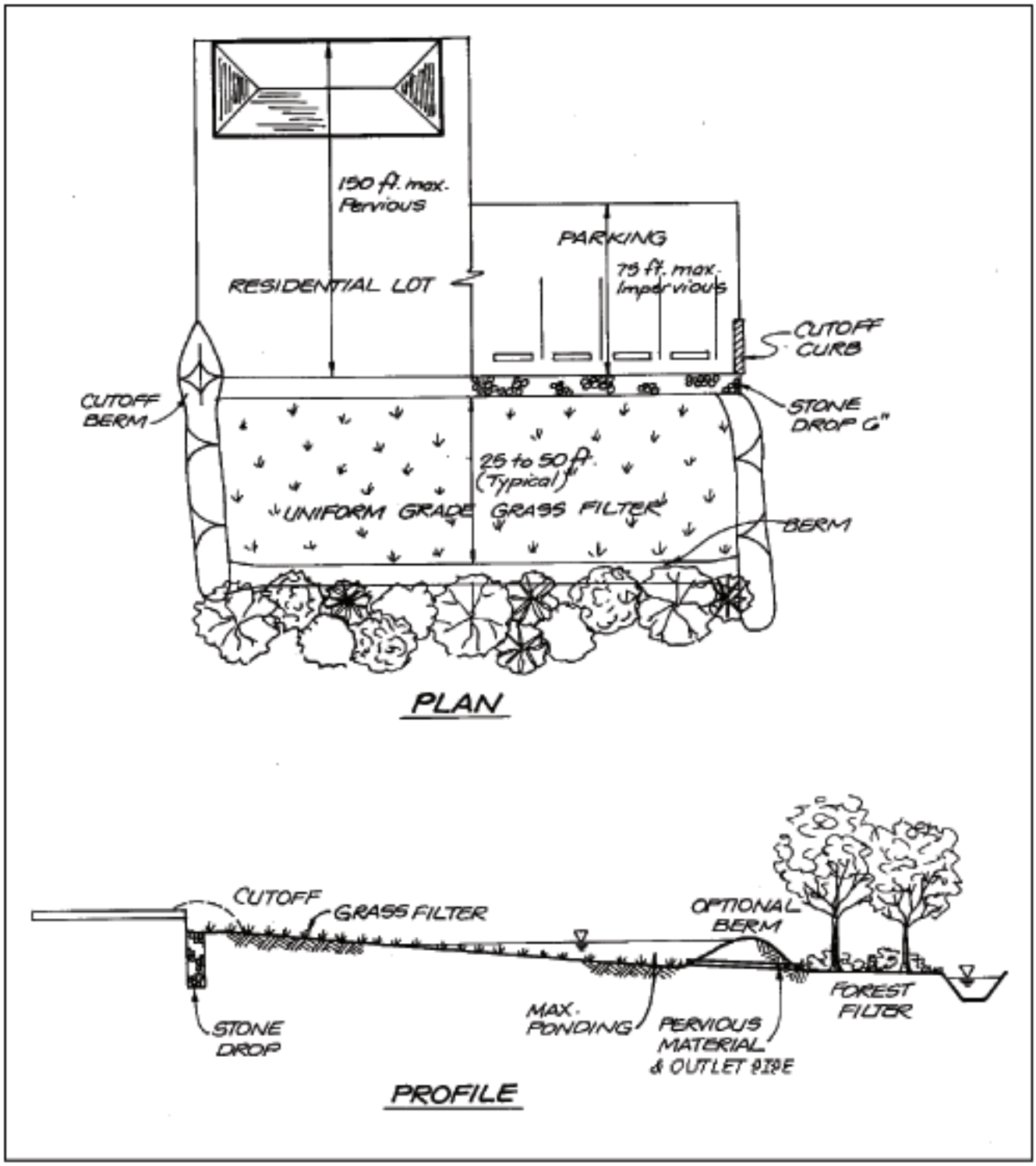
Additional Comments:_____

_____

BIOFILTERS

Recommended Actions:

Recommended Timeframe for Actions:



Schematic of Filter Strip (with Berm)