# TOWN OF BARGERSVILLE
# DEPARTMENT OF
# STORM WATER MANAGEMENT
# (STORM WATER UTILITY)

# DRAINAGE MANUAL

**Town of Bargersville**
**Department of Storm Water Management**
**24 North Main Street, P.O. Box 420**
**Bargersville, Indiana 46106**

Adopted February 25, 2013

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## AUTHORITY & BACKGROUND

The Town of Bargersville Department of Storm Water Management (the Department, Storm Water Utility or Utility) was formed by official action of the Town Council of the Town of Bargersville on December 12, 2000, Ordinance 2000-9. In doing so, through the authority of IC 8-1.5-5, the Council created a Board of Directors to control the department and a special taxing district to fund the Department's activities. The Board has powers enumerated by IC 8-1.5-5-6, including the powers and duties prescribed by IC 8-1.5-3-4(a) and may:

(1) hold hearings following public notice;
(2) make findings and determinations;
(3) install, maintain, and operate a storm water collection and disposal system;
(4) make all necessary or desirable improvements of the grounds and premises under its control; and
(5) issue and sell bonds of the district in the name of the unit served by the department for the acquisition, construction, alteration, addition, or extension of the storm water collection and disposal system or for the refunding of any bonds issued by the board.
(11) adopt rules for the safe, economical, and efficient management and protection of each utility (8-1.5-3-4(a))

The Board, then, has been given responsibility and authority to manage storm water within the limits of the Town. The Board is also responsible for preparing an annual budget, subject to approval by the Town Council as well as further duties prescribed by IC 8-1.5-3-4(a). The day to day operations of the Department are managed by the Utility Superintendent, or his designee.

> ***"Storm water"*** *means water resulting from rain, melting or melted snow, hail, or sleet.*
> *327 IAC 15-13-5 (78)*

Through the requirements of the Clean Water Act, the federal government requires all small urbanized communities to be permitted under the National Pollutant Discharge Elimination System (NPDES) program. Phase II of these requirements became effective for the Town of Bargersville when it was designated as a municipality with a population served by a municipal separate storm sewer system (MS4). In Indiana, storm water discharge permits are issued by the Indiana Department of Environmental Management (IDEM). To comply with Phase II requirements, a new general NPDES permit rule was written, and codified by 327 IAC 15-13.

The new general permit rule, referred to as Rule 13, provided permit coverage for most Phase II MS4 entities. This rule requires, among other things, the Town of Bargersville to file for a permit through IDEM. The Town must comply with the permit conditions until the permit expires, including annual updates and reporting. The Town must implement and enforce their permit conditions by providing a compliance mechanism that assists in the attainment of measurable goals. Within Rule 13, ordinances, or other regulatory mechanisms, are required to address the illicit discharge detection and elimination, construction site storm water run-off control, and post-construction storm water run-off control in new development and redevelopment minimum control measures. [1] This then has become a major component of Department responsibilities.

The storm water system within the Town of Bargersville consists of the following:

- Storm sewer systems, including:
  - Storm sewer piping
  - Detention ponds
  - Manholes
  - Curb Inlets
  - Area or Yard Inlets
  - Water Quality Structures
- Bridges (20’ or longer along centerline of road)
- Structures (between 3’ and 20’ in length)
- Culverts
- Field and underdrain tiles
- Rivers, creeks and streams
- Lakes and ponds
- Legal Drains
- Drainage swales, including rear and side yards
- Roadside ditches

> ***Storm water system:*** *All means and methods for the transport of storm related water.*

Although the above components are not all regulated or the responsibility of the Department of Storm Water Management, the Board has been given a certain level of governance over the complete storm water system.

The Board of Directors (Board) of the Bargersville Department of Storm Water Management has adopted this Drainage Manual (hereinafter called “manual” or “the Manual” or also known as the “Drainage Standards Manual”) as its policy regarding stormwater management. The Manual contains the minimum drainage standards and procedures that are to be followed for submittal to the Board for the purpose of obtaining storm water drainage approval for drainage altering and land disturbing projects within the Bargersville Storm Water Management District (District).

This Manual was prepared by the joint efforts of the Storm Water Utility Board, consultants and staff. The Drainage Standards Manual was originally compiled by M.D. Wessler & Associates, Inc. in 2001 with subsequent revisions through 2008. The current version was compiled by IXOYE Civil Engineering, Inc. as a combination of the Drainage Standards Manual and the Policy and Procedures Manual.

## DEFINITIONS

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

Bargersville Storm Water System – all facilities and conveyances subject to the control of and/or under the ownership of the Town of Bargersville 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 designed to transport, move or regulate storm water. The system includes public streets, roads and highways.

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.

Construction Activity – 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.

Construction Plan – 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.

Construction Site Access – 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 exiting the project site.

Contractor – 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.

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

Developer – 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.

Disturbed Area – the complete area where soils are disturbed including all surfaces regardless of proposed finished surface type.

Drainage Manual – the storm water standards (or Drainage Standards Manual) for the Town of Bargersville that contain policies and procedures, drainage, erosion and sediment control, and post-construction standards that new development and redevelopment must meet.

Equivalent Residential Unit (ERU) – the average amount of impervious surface area for a single-family residential property located within the corporate limits of the Town of

Bargersville. The ERU for the Town of Bargersville is 4,110 square feet, and shall be used in calculating user fees for non-residential and combined residential/business properties.

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

Erosion and Sediment Control Measure – a practice, or a combination of practices, to control erosion and resulting sedimentation.

Erosion and Sediment Control System – 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.

Final Stabilization – the establishment of permanent vegetative cover or the application of a permanent non-erosive material to areas where all land disturbing activities have been completed and no additional land disturbing activities are planned under the current permit.

Grading – the cutting and filling of the land surface to a desired slope or elevation.

Impervious Surface – surfaces, such as pavement and rooftops, which impede or prevent the infiltration of storm water into the soil.

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, lawns and fields are not considered impervious surface area

Individual Building Lot – a single parcel of land within a multi-parcel development.

Individual Lot Operator – a person who has financial control of construction activities for an individual lot.

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

Flood Hazard Areas – those flood plains which have not been adequately protected from flooding by the Regulatory Flood by means of dikes, levees, or reservoirs, and are shown on the Flood Insurance Rate Maps (FIRMs) of the Federal Emergency Management Administration (FEMA) or maps from the State Natural Resources Commission.

Flood Plain – the area adjoining the river or stream which has been or may hereafter be covered by flood water from the Regulatory Flood.

Flood Protection Grade – the elevation of the lowest point around the perimeter of a building at which flood waters may enter the interior of the building.

Floodway. See Regulatory Floodway

Floodway Fringe – those portions of the Flood Hazard Areas lying outside the Flood Insurance Rate Maps (FIRMs) of the Federal Emergency Management Administration.

Green Initiatives – reduced or low impact stormwater site design solutions that serve to minimize the amount of impervious surface while maximizing the use of pervious surfaces to manage and treat stormwater pollution and limit stormwater contamination potential.

Land Disturbing Activity – any manmade change of the land surface, including removing vegetative cover that exposes the underlying soil, excavating, filling, transporting, and grading.

Larger Common Plan of Development or Sale – 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.

MS4 – an abbreviation for "Municipal Separate Storm Sewer System".

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 and Industrial property
- Community and Retirement centers
- Federal, state and local government property
- Schools
- Properties whose primary function is not as a single-family residence
- Residential properties that have four units or more in a single building
- 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.

Permanent Stabilization – the establishment, at a uniform design of seventy percent (70%) across the disturbed area, of vegetative cover or permanent non-erosive material that will ensure the resistance of the soil to erosion, sliding, or other movement.

Phasing of Construction – 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.

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.

Regulatory Flood – that flood having a peak discharge which can be equaled or exceeded on the average of once in a one hundred year period, as calculated by a method and procedure which is acceptable to and approved by the Indiana Department of Natural Resources; this flood is equivalent to a flood having a probability of occurrence of one percent in any given year.

Regulatory Flood Elevation – the maximum elevation reached by the Regulatory Flood at the locations in question relevant to approval of a given subdivision under construction.

Regulatory Floodway – the channel of a river or stream and those portions of the Flood Plains adjoining the channel which are reasonably required to efficiently carry and discharge the peak flow of the Regulatory Flood of any river or stream shown on the Flood Insurance Rate Maps (FIRMs) of the Federal Emergency Management Administration.

Residential Property – a lot or parcel on which a building or mobile home is situated in which a single family resides and/or a unit within a building in which the primary purpose of the unit is for a single family to reside. For multiple family dwellings, those buildings with three units or less shall be billed as a residential property. Four units or more shall be billed as a non-residential property.

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

Rule 5 – the Indiana Administrative Code 327 IAC 15-5. The code also contains additional definitions for language used in that rule

Sediment – 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.

Site – the entire area within the property lines of the legal boundaries of the proposed development that is under the ownership or usage rights of the Site Owner, including all easements and off-site work areas.

Site Owner – the person required to submit the NOI letter per Rule 5 and required to comply with the terms of these standards, Ordinance 2005-01, and Rule 5, including either of the following:

- A developer

- 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

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

Soil Survey – the National Cooperative Soil Survey prepared by the U.S. Department of Agriculture, Soil Conservation Service in cooperation with Purdue University.

Storm Water User – the owner/renter of a lot or parcel of residential property, non-residential property or combined residential/business property within the Town of Bargersville's storm water management district.

Storm Water Pollution Prevention Plan (SWPP) – 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.

Storm Water Quality Measure – a practice, or a combination of practices, to control or minimize pollutants associated with storm water run-off.

Strip Development – a multi-lot project where building lots front along an existing road.

Subdivision – 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.

SWCD – an abbreviation for "Soil and Water Conservation District".

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.

Temporary Stabilization – the covering of soil to ensure its resistance to erosion, sliding, or other movement. The term includes vegetative cover, anchored mulch, or other non-erosive material applied at a uniform density of seventy percent (70%) across the disturbed area.

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

Trained Individual – 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.

# PART I – PROCEDURES & FEES

## PURPOSE

This Part I of the Manual describes the policies and procedures of the Bargersville Department of Storm Water Management (the Department, Storm Water Utility or Utility) for:

A. Development and application for drainage approval, and

B. Equivalent Residential Unit (ERU) establishment and multiplier for storm water users, determining impervious surface area, billing and collection procedures.

## A. DEVELOPMENT & APPLICATION FOR DRAINAGE APPROVAL

### A.1 INTRODUCTION

In general, all drainage-altering or land-disturbing activities within the limits of the Town of Bargersville are governed under this Manual, subject to definitions and exceptions given under State law. A subdivision, as defined in the Bargersville Subdivision Ordinance, or any site that is part of a subdivision, shall be required to adhere to the policies and criteria in this manual. All commercial and retail developments or redevelopments shall also conform to the requirements of the Manual. Single-family or double-family dwelling sites not requiring professionally prepared and certified storm water plans shall have separate submittal requirements as defined herein or on other Town application forms, unless the dwelling is a part of a subdivision.

The policy of the Board is that persons, entities, developers or subdividers that are planning or proposing new development or redevelopment within the District shall submit for approval a drainage plan that prevents increased storm water run-off resulting from land alteration. Whenever evidence available to the Board indicates the existing natural surface drainage to be inadequate, an adequate storm water sewer system shall be provided. When the existing surface drainage is shown to be adequate, easements for such surface drainage shall be provided. 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, in accordance with the requirements of this Manual, and

- be constructed and installed in accordance with the plans and specifications as approved by the Board

An erosion and sediment control plan shall be submitted and the control measures 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. Drainage approval for all projects must be received from the Board prior to construction.

Prior to obtaining final drainage approval for a proposed subdivision, the developer shall submit a copy of a petition for establishing the drainage facilities within a subdivision as either: 1) a legal drain or, 2) provide Homeowner's Association maintenance of the drainage system that exists outside of public right-of-way. Said petition shall comply with the requirements of IC 36-9-27-54 et. seq. and include any detention or retention ponds, storm sewers, ditches, rear yard swales or portions thereof, as required by the Board.

## A.2 APPLICATION

A copy of the standard application as required by the Planning Department, two (2) complete sets of professionally certified plans, specifications, supporting calculations and Certification of Sufficiency of Plan shall be submitted to the Utility along with the appropriate fees.

A submittal will not be considered complete until all required items included within this Manual have been submitted. 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. Upon notification of final drainage approval, three (3) sets of final plans and specifications, professionally certified, shall be submitted to the Storm Water Utility along with one (1) copy of the final, professionally certified, drainage report and related documents, as well as a digital copy on CDrom or DVD of all submittal documents. Special circumstances that are not covered by these standards shall be regulated and reviewed on a case-by-case basis.

Construction projects required to submit Storm Water Pollution Prevention and Erosion and Sediment Control Plans shall submit two (2) complete copies to the Bargersville Storm Water Utility along with a with the appropriate fees. A review letter or form 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 the proposed plans. 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 IDEM, the County Soil and Water Conservation District (SWCD) and the Storm Water Utility. .

In addition, construction projects required to submit Post-Construction Storm Water Quality Storm Water Pollution Prevention Plans shall submit two (2) complete sets of plans to the Bargersville Storm Water Utility along with the appropriate fees. 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 the Post-Construction controls.

## A.3 FEES

Fees are established to adequately compensate the public entity for private endeavors, accounting for administrative and technical cost accrual. Fees may be modified periodically and are subject to change.

The fees for the Storm Water Utility (Department of Storm Water Management) are established by Ordinance by the Town Council. Ordinance 2008-2, Exhibit B as subsequently amended, repealed or revised, is herein referenced and incorporated as the established fees for the Strom Water Utility.

Initial review fees include two hours of plan review. Projects requiring more than two hours of plan review due to their complexity or deficiency in design or submittal shall be assessed plan review fees at the established rate per hour (rounded to the nearest half hour).

Inspection fees for construction and maintenance inspections will be charged on an hourly rate basis for the actual hours (rounded to the nearest half hour) accrued to perform the work, whether by Town personnel or Consultant, at the Town's discretion. For erosion and sediment control, the actual inspection fees shall be assessed based upon the actual hours of inspection completed (rounded to the nearest half hour) until a Notice of Termination form is submitted to the Utility and a final inspection is completed.

The property Owner/Developer shall be responsible for making payment to the Utility for the inspection fees in a timely manner after invoicing by the Town. Additional or more frequent inspections required (including but not limited to inspections for non-compliance or permit violations) will be charged at the hourly rate.

In order to release a stop-work order that has been issued, a $200.00 fine and $50.00 re-inspection fee must be paid to the Bargersville Storm Water Utility.

Plan review and inspection fees shall be made payable to the Bargersville Storm Water Utility.

## B. EQUIVALENT RESIDENTIAL UNIT (ERU) ESTABLISHMENT & STORM WATER UTILITY RATES

### B.1 STORM WATER UTILITY RATES

The Utility will fund storm water management activities by charging user fees to the owner/renter of each impervious property within the corporate limits of the Town of Bargersville.

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 by the Town of Bargersville based upon information obtained from the Johnson County Assessor's Office and by field measurements. Public right-of-way is exempt from the user fee.

Payment of, or non-payment of, user fees does not relieve any property owner from compliance with the Town of Bargersville and/or Johnson County ordinances and/or other applicable state and/or federal laws/regulations.

The monthly storm water utility user fee is uniform for all residential properties, which are assigned one (1) ERU. This allocates that all residents of the Town of Bargersville place demands on the storm water system and benefit from the storm water management activities. The current user fee for one (1) ERU shall be as 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 4,110 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 10,000 square feet of impervious surface area receives an ERU multiplier of 2.4: (10,000/4,110). 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 one (1) ERU for the residential portion and the ERU multiplier shall be calculated for the business portion as follows:

1. If the property contains less than 4,110 square feet of impervious surface area, the business portion shall be assigned an ERU of zero (0). Provided the property only receives one utility bill, the total storm water utility fee would then be equivalent to the residential user fee.

2. If the property contains more than 4,110 square feet of impervious surface area, the ERU multiplier shall be calculated as follows:

(Total impervious surface area on the property – 4,110) / 4,110. The ERU multiplier shall be rounded to the nearest one tenth and the minimum ERU may be less than one (1). For example, a combined residential/business property with 5,000 square feet of impervious surface area receives 0.2 ERU for the business portion [(5,000 – 4,110) / 4,110]. The user fee for the business portion would then be 0.2 x the current fee for one (1) ERU. Provided the property only receives one utility bill, the total storm water utility fee would then be the residential user fee plus the business user fee.

## B.2 UTILITY FEE BILLING & COLLECTION

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

Storm water utility 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 utility fees shall be the obligation of the property owner and shall also be the obligation of any renter occupying the property. Storm water utility fees shall be billed to the property owner if there is no renter known to the Utility, and to the renter if the property is rented and the renter is known to the Utility. If a renter receives a bill and the bill is not paid within one (1) month, 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 Utility 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 Johnson County Recorder and certified to the Auditor of Johnson 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.

# PART II – DRAINAGE STANDARDS

# CHAPTER 1: DRAINAGE DESIGN

## *A. Submittal Requirements*

Single And Double Family Dwellings

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

- Name and address of the owner of the property
- Legal street address of the property
- Legal description of the property
- Dimensions of the property
- Locations of improvements, structures, paved and graveled areas, drainage and utility easements and rights-of-way
- Impervious surface area of the property (in square feet). Do not include impervious surface area that is located within the public right-of-way.
- Existing and proposed grading, by contours or spot elevations, sufficient to show positive drainage including perimeter swale grades along the perimeter of the property to cone storm water runoff to a positive outlet onsite at an discharge point previously approved on the master drainage of the overall development.
- Locations of ditches, culverts, etc with arrows to show direction of flow.

At a minimum, land-disturbing activities shall require the installation of erosion control measures such as straw tubes, slit fences, and other BMPs outlined in the pamphlet titled "Erosion Control for The Home Builder" prepared by the Town of Bargersville Storm Water Utility. The individual home builder is also responsible for immediate removal of all sediment tracked onto the streets.

Subdivisions, Commercial/Industrial Sites & Multi-Family Developments

Drainage submittals, consisting of complete drainage analysis, plans, details and specifications shall, at a minimum, include the following:

1. Completed "Certification of Sufficiency of Plan"
2. Proof of Public Notice Requirements, if required
3. Construction Plans, which generally follow all of the plan submission requirements of the Town of Bargersville Subdivision Control Ordinance, including:
    a. Name and location map of proposed project
    b. Owner's name

c. Seal and signature of professional engineer/land surveyor responsible for completing the design

d. Date of plans

e. North arrow and scale

f. Existing and proposed site conditions, including contours, spot elevations, entire storm water system with applicable inverts and elevations, storm sewer profiles, drainage flow arrows, pond cross section, streets, all other utilities, building foot prints and finish floor elevations, parking areas, easements, rights-of-way, property lines, benchmarks, and floodway/floodplain boundaries.

g. All applicable construction and installation details

h. Technical Specifications

4. Storm Water Pollution Prevention Plan (SWPPP) as applicable:

    a. Rule 5 submittal requirements (see Fig. 2.1)

    b. Draft Notice of Intent (NOI) (Fig. 2.2)

    c. Post-Construction Storm Water Quality submittal requirements for BMPs including manuals

    d. All erosion and sediment control measures and details

5. Technical Drainage Report that contains the following:

    a. A summary of all drainage aspects of the project, including the scope of development and its impact on downstream areas, the pre-developed and post-developed site conditions, as well as clear and concise conclusions, with summary data, stating how the proposed development meets the required standards.

    b. An overall drainage map showing contributory as well as adjacent non-contributory areas.

    c. Existing and proposed storm water runoff calculations including:

        i. Drainage area calculations

        ii. Weighted runoff coefficient or curve number calculations

        iii. Time of concentration (Tc) calculations showing overland (sheet) flow, shallow concentrated flow, and flow time in channel, gutter or pipe

        iv. Mapping, at a clearly legible scale, depicting all drainage and sub-drainage areas, soil type delineations, Tc flow paths and slopes

    d. Detention/Retention Design summary with outlet control structure information (outlet structure discharge rating curve, stage/storage/discharge information during storm event)

e. Storm pipe and open channel design calculations including:
    i. Size of pipe and typical channel cross section
    ii. Pipe and channel slopes
    iii. Material roughness coefficients
    iv. Velocities if feet per second (fps)
    v. Capacities in cubic feet per second (cfs)
    vi. Storm pipe flow and hydraulic grade line (HGL) calculations
    vii. Comparison of HGLs with casting elevations
    viii. Name of computer model used where applicable
    ix. Highlight of pertinent data, if computer printouts are submitted
f. Grate capacities
g. Water quality design of BMP's including Operation and Maintenance (O&M) manuals
h. Appendices with computer model data and output, as required, with highlights of pertinent data

## *B. Floodways, Flood Elevations and Protection*

1. The drainage plan shall analyze the flooding potential for the site and minimize flood exposure and effects on all proposed facilities, including both above-ground and below-ground utilities and to ensure avoidance of impairment or contamination of same.

2. The analysis shall include the ponding results of a post-developed 100-year storm event and establishing flood protection grades for all structures and verifying an adequate outlet for the 100-year storm in the event that the storm systems and outlet structures become clogged.

3. Floodway and floodway fringe locations per the Flood Insurance Rate Maps (FIRMs) shall be delineated for the site or mapping shown for the closest such area to the site.

4. An emergency flood routing plan shall depict overland flow paths in a clogged system condition and shall include invert and/or weir elevations along the route(s). The plan and report shall include analysis and conclusions regarding the potential impacts of the proposed routing on downstream properties, the capacities of outlet points and downstream facilities, relationships to other flood routing plans, and other information as necessary to ensure viability of the proposed plan. Capacity calculations shall be provided indicating the route is sufficient to pass the 100-yr storm event.

5. A lowest exterior building Flood Protection Grade shall be provided for each lot. The elevation shall be a minimum of two (2) feet above the emergency flood outlet stage for each lot. This grade is inclusive of all potential localized flooding outside of the known federally regulated one hundred (100) year flood zones.

## *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 during the 2-, 10-, or 100-year storm event. 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 defined: a storm water control facility that stores storm water run-off indefinitely or detains it 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 peak discharge from the proposed site 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 10-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.

2. All areas within the legal property boundaries of the site are to be included in the analysis. Areas of the site which by-pass detention shall be included in the overall discharge totals. Upstream pass-through flows shall be documented and properly accounted for in the design. Sites with multiple outlets shall require analysis of the individual pre- and post release rates for each outlet. Pre-existing depressional areas should not be considered as contributing to the pre-developed discharge.

3. The USDA Soil Conservation Service (SCS) method of calculating run-off shall be utilized for detention/retention design. The IDD Table (Figure 1.1) shall be used for rainfall depths. The 2nd Quartile Huff Rainfall Distribution – 50% probability curve and/or table (Figures 1.2 and 1.3, respectively) shall be used for hydrograph computations.

4. Run-off curve number determination by land uses and hydrologic soil groups shall be in accordance with the Run-off Curve Number Tables (Figures 1.4 to 1.6). Calculations shall show the average weighted curve numbers and the methods used for the calculations including areas and logical naming conventions and references. Scalable maps depicting the various areas shall be included.

5. Soil type and area calculations shall be tabulated and scalable maps included depicting the calculated areas in a logical fashion.

6. 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.

Storm durations shall be equal for each basin in this determination. The storm duration shall be equal to or greater than the site time of concentration, but shall not be less than thirty (30) minutes.

7. 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, in accordance with SCS methodology. 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 sample worksheet for time of concentration calculations is provided in Figure 1.7. A list of Manning's roughness coefficients for sheet flow is provided in Figure 1.8. These "Manning's n" values are used only in the sheet flow equation on the worksheet and not for open channel design.

8. All impervious areas of the site shall drain through the detention/retention facility.

9. Wet detention/retention ponds shall have a minimum ten (10) feet 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. Wet ponds shall consider a minimum water depth of 12' for at least 25% of the pond surface.

10. 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.

11. Detention/retention ponds shall have a minimum freeboard of one (1) foot. Freeboard is the difference in elevation from the maximum design flow depth through the spillway to the top edge of a pond. Freeboard provides a factor of safety and protects against unknown factors such as wave action, uncertainties in design assumption, or unpredictable effects from ice or debris.

12. Detention/retention facilities shall be designed with emergency spillways capable of handling 1¼ times the peak discharge resulting from the post-developed 100-year storm event for the entire upstream contributing watershed.

13. The emergency spillway calculations shall include analysis of velocities and erosion potential and provide adequate armoring and protection as required.

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

## *D. Open Channels*

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 1.9 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 Town Engineer.

4. Channels shall be analyzed for erodibility with adequate permanent or temporary protections designed and included in the plans.

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

Open channels shown as blue lines or intermittent blue lines on the USGS Quadrangle mapping, which are located along dedicated roadways and within right-of-ways, or on easements dedicated to the Town, 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/Town Engineer has approved appropriate sized culverts or other structures. Other regulatory agencies may also have governance over such channels.

Lots abutting a watercourse, drainage way, channel or stream shall have additional minimum width or depth as required to provide an adequate building site and afford the minimum usable area required for front, rear and side yards and the respective drainage and utility easements.

A minimum building setback of seventy-five (75) feet is required from all legal drainage ways, unless modified by the Johnson County Drainage Board.

## *E. 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. Proper run-off coefficients (Figure 1.10) shall be used in conjunction with the Rational Formula. Due to Bargersville's close proximity, rainfall intensities specified by the City of Indianapolis shall be employed for drainage analysis. The Intensity-Duration-Frequency (IDF) Table (Figure 1.11) 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/Town Engineer. Design calculations for sizing of the storm pipe shall be submitted on the Storm Pipe Flow Calculation Form (Figure 1.12) 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/Town 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 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 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.

    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 more restrictive spacing is required by the Board/Town Engineer. Gutter spread calculations shall be submitted verifying that the gutter spread is limited to one-half of the driving lane.

    f. The minimum pipe size shall be 12" diameter. The minimum design velocity for full pipe flow shall be 2.5 feet per second (fps).

    g. Height of cover for pipes shall meet the most restrictive requirements of either manufacturer's 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.

h. Exposed ends of storm pipes shall have a standard end section, with a minimum 18” toewall (36” at outlets into ponds), and riprap designed for the appropriate flow velocities and culvert end protection.

## *F. Streets, Roadways, Driveways & Other Appurtenances*

1. Generally, all streets shall be provided with an adequate storm drainage system consisting of curbs, gutters and storm sewers, or side ditches and culverts, as determined by the Board. A 6-inch minimum perforated pipe underdrain, with a minimum one (1) square inch of opening per foot of pipe, shall be required on each side of all streets and shall:

    a. be 18 inches below the soil sub-grade and parallel with the longitudinal pavement grade, but no lower than the invert of the curb box;

    b. have a minimum slope of 0.2%,

    c. flow to the low point and into the storm drainage system;

    d. be placed below the pavement under the curbing;

    e. be backfilled with #8 washed gravel.

2. Building down spouts and sump pump outlets shall discharge onto a grass surface and be no closer to the road than the building setback line. For non-residential properties that do not have a grass surface in which to discharge, these flows must be directed to the storm water detention facility. The flows may be directed to the detention facility via the on-site storm system or overland flow.

3. Culverts under local public roadways 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/Town Engineer. Culverts under collector or arterial roadways shall be sized to pass the peak run-off from the 100-year storm event. Culverts lengths shall be appropriately designed for roadway shoulders and sideslopes.

4. Culverts used under private drives and driveways will be evaluated and approved on a case-by-case basis and shall be sized for a minimum ten (10) year rainfall event. All culverts shall extend at least two (2) feet beyond either edge of the paved driveway, or as required for roadway safety.

5. Roadside Swales. Streets that do not include curbing shall provide the following:

    a. Side ditch swales measuring a minimum of one (1) foot deep at their centerline.

    b. Release from side ditches and swales along the roadway through the use of adequate off-street storm water basins and/or drainage channels.

6. Provision shall be made for the protection and continuation of all subsurface tiles.

## *G. Easements*

The following applicable easements shall be granted to the Town of Bargersville by way of a *Grant of Perpetual Drainage Easement*:

1. Twenty (20) feet for pipes 15 inches in diameter and smaller.

2. Twenty-five (25) feet for pipes larger than 15 inches in diameter.

3. Thirty (30) feet measured horizontally outside the 100-year flood elevation for detention/retention ponds and access to the pond as determined by the Storm Water Utility.

4. Fifteen (15) feet for yard swales.

5. Thirty (30) feet around a storm water quality treatment BMP. Easement shall include an access easement to the BMP.

6. Easements for open channels are to be determined by the Storm Water Utility Board on a case-by-case basis. Where a site is traversed by a watercourse, drainage-way, channel or stream, adequate areas for storm water or drainage easements shall be allocated for the purpose of widening, deepening, sloping, improving or protecting said watercourses.

7. Easements for drainage conveyances shall be centered on the centerline of the conveyance.

# CHAPTER 2: STORM WATER POLLUTION PREVENTION PLAN (SWPPP) AND EROSION & SEDIMENT CONTROL STANDARDS

## *A. Purpose, Authority and Compliance*

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).

Per Ordinance 2005-01, the Town of Bargersville 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 2005-01.

Construction sites where land disturbing activities meet the requirements of Ordinance 2005-01, at a minimum, shall be in compliance with all terms and conditions of said Ordinance, the Bargersville Drainage Manual, and Rule 5. In those circumstances where the requirements of said Ordinance and these standards are more stringent than those contained in Rule 5, the requirements of said Ordinance and these standards shall be followed.

The Town of Bargersville has the right to impose additional requirements and restrictions beyond those outlined in this Manual, Ordinance 2005-01, and Rule 5 for projects where unique or special conditions exist.

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 2005-01, this Manual, 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. 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), to be submitted for review and approval.

3. Exceptions:
   Individual, single-family construction projects not part of a larger, common development are exempt from the submittals outlined herein, 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.

4. Reviews:
   A Technical Review and Comment Form (Figure 2.1) stating that the "Plan is Adequate" shall be obtained from the Town prior to the initiation of any land disturbing activities. Detailed submittal requirements are contained in 327 IAC 15-5 Section 6 through Section 6.5. 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 stating that the "Plan is Adequate" from the Town of Bargersville, the following shall be submitted to IDEM and the County Soil and Water Conservation District at least 48 hours prior to the initiation of land disturbing activities.

- Notice of Intent Form (Figure 2.2)
- A copy of the "Plan is Adequate" Technical Review and Comment Form
- Proof of Publication required by 327 IAC 15-5-5 (9)

5. MS4 Projects:
   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 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 Department of Natural Resources, division of soil conservation.

   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 Storm Water Pollution Prevention Plan must address all requirements 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.

6. Inspection Services:
   See Chapter 4 – Project Construction

7. Self Inspection Responsibilities:
   A self-monitoring program meeting the requirements of 327 IAC 15-5-7 shall be implemented by the project site owner. 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 on a weekly basis, at minimum, and also performed after every storm event with a total measured rainfall accumulation equal to or greater than 0.5 inch. Refer to Figure 2.4 for a copy of the *Town of Bargersville Rule 5 Inspection Form*. This form shall be used by the trained individual for written evaluation reports.

Written evaluation reports shall be prepared by the end of the business day following the day of the inspection. The written evaluation reports shall also be available to the Town of Bargersville 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

8. 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 site inspections will be based on priority determinations.

## *B. 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 a 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 plans if the project site does not have an on-site location to store the plans.

7. This permit and posting of the notice of under subdivision (6) 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 Storm Water Pollution Prevention Plan 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 Storm Water Pollution Prevention Plan 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 cover density of less than seventy percent (70%) shall be re-stabilized 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 Section A - Self Inspection Responsibilities).

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 pre-construction agricultural use or disturbed areas, not previously used for agricultural production, such as filter strips and areas that are not being returned to their pre-construction agricultural use, meet the final stabilization requirements listed above.

## *C. 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 this Manual 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. Installation and maintenance of a stable construction site access.

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

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

4. 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.

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

6. 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.

*D. Technical Design Criteria*

Erosion and sediment controls shall be designed and installed in accordance with Rule 5 and this Manual. The Indiana Storm Water Quality Manual may be used as guidance. Technical review of the erosion and sediment control program, Storm Water Pollution Prevention Plan, and other required submittals shall be completed by the Storm Water Utility. The technical review shall assess the adequacy of proposed erosion and sediment control practices. All proposed measures shall be approved by the Utility.

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. Non-woven geotextile filter fabric material shall be specified when silt fence is to be used. The drainage area flowing to a silt fence control measure must be less than one quarter acre per 100 feet of silt fence. The following table lists distance down a slope at which silt fence should be placed based on steepness of the slope.

| Percent Slope | Maximum Runoff Distance |
|---|---|
| Less than 2% (less than 50:1) | 100 feet |
| 2% to 5% (50:1 to 20:1) | 75 feet |
| 5% to 10% (20:1 to 10:1) | 50 feet |
| 10% to 20% (10:1 to 5:1) | 25 feet |
| Greater than 20% (greater than 5:1) | 15 feet |

Notes: Multiple rows of silt fence are not allowed on the same slope.
Consider alternate measures when slopes are greater than 5%

5. 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.

6. Storm sewer inlet and catch basin sediment control measures must be the drop-in style practice where sediments are collected inside the structure and under the storm sewer grate.

7. 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 construction entrance must be a minimum of 20 feet by 150 feet in dimension. The aggregate must be periodically maintained (cleaned, top dressed) in order to provide continual proper function.

8. 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.

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

10. 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 fifteen (15) days.

10. Dust control measures shall be implemented as necessary.

11. Erosion control blankets shall be required on all fill slopes exceeding 3:1 (horizontal to vertical).

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

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

14. Dewatering of sediment-laden water from trenches, ponds, or other excavations by means of a pump or similar means shall discharge into a manufactured filter bag in accordance with the manufacturer's recommendations unless the pumped water is routed through another erosion control measure such as a sediment basin or outlets onto a well-established vegetated area without eroding. Filter bags shall either be biodegradable or be properly disposed of from the site along with other wastes.

## *E. 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 2.3) to the Storm Water Utility, 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 to the Storm Water Utility, the County SWCD, and IDEM within two (2) weeks of project termination, and contain a statement(s) verifying that each of these conditions have been met.

The Storm Water Utility or a representative thereof may inspect the project site to confirm the information provided in the NOT. Upon verification of the NOT letter, the Storm Water Utility 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 this Manual, Ordinance 2005-01, and Rule 5. To do so, 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 Storm Water Utility 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 – 5 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

## *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 2005-11, 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 pollutants, thus affecting the welfare of the public residing within local watersheds. Major sources of sediment include wash-off 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.

A proposed development should also consider "green" stormwater site design solutions that serve to minimize the amount of impervious surface and maximize pervious areas, which reduces peak runoff flows, volumes and pollution export and may also result in lower stormwater user fees. Green design initiatives may involve inclusion of many of the pre-approved BMPs given herein or may consider the following:

- Green roof tops
- Roof plantings or gardens
- Pervious pavements
- Tree plantings
- Street-side swales
- Rainwater harvesting
- Drywells

The Storm Water Utility Board will review each individual application in regards to "green" design proposals that meet or exceed the minimum water quality requirements. The developer should approach the Board with such proposals in consideration of various project site constraints, potential waiver requests and overall site requirements.

The Town of Bargersville and the Bargersville Storm Water Utility 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 Bargersville Storm Water Utility. 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.

*B. Applicability*

Any land disturbing project, including new development and redevelopment, within the Town of Bargersville 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 three (3) or fewer lots,

3. Individual lots within a larger common development plan that has been previously permitted for storm water quality 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. Plan 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 elsewhere 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. 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.

## *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 quality management may be utilized upon approval by the Storm Water Utility. 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 U.S. silica OK110 sand micron range (very fine/fine sand) without re-suspension 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. Those mechanical BMPs listed in the *"City of Indianapolis Stormwater Quality Unit (SQU) Selection Guide"* shall also be considered pre-approved, subject to verification and approval of calculations for appropriate project applicability and solution viability.

A quick reference, minimum design criteria and maintenance and inspection checklists for each pre-approved BMP are provided in Appendix B 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 by 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 that are 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.

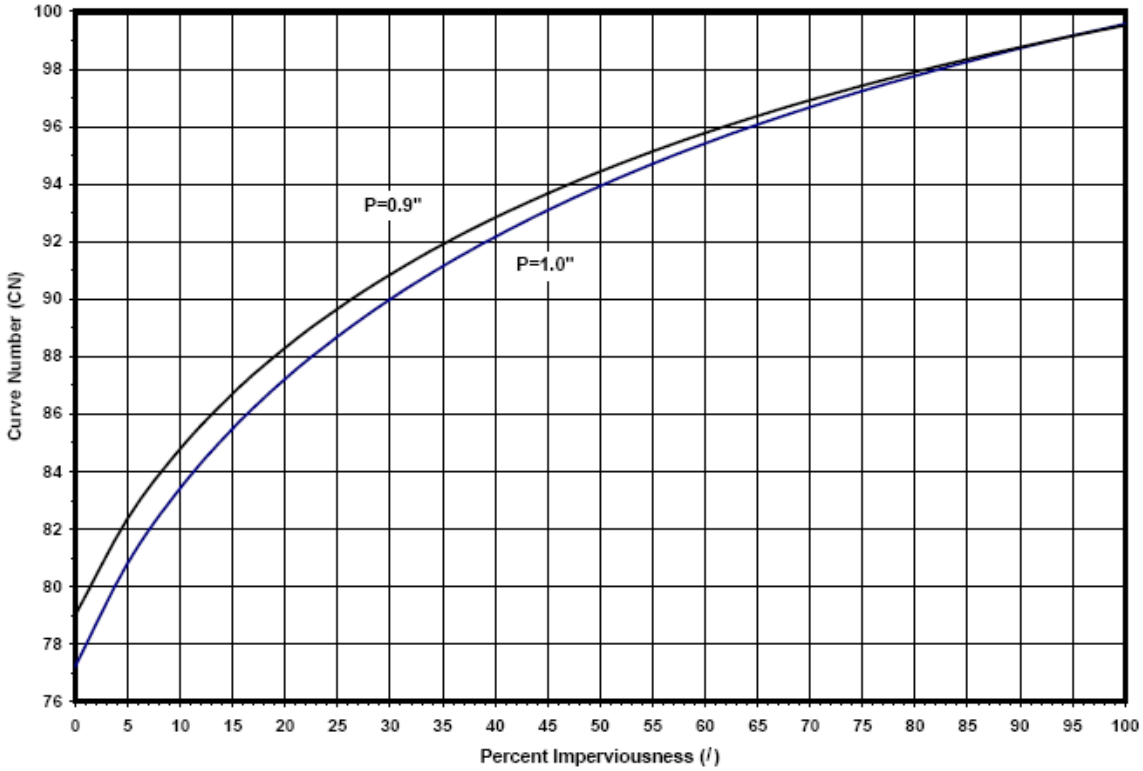
Step 1 - Using the water quality volume, calculate the adjusted $CN_{wq}$:

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

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. Maintenance*

Each BMP must have an operation and maintenance plan signed by the BMP Owner and submitted with the SWPPP. The Storm Water Utility 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 Town of Bargersville.

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

*F. Pre-Approved BMPs*

Pre-approved BMPs include those listed below. In addition, those mechanical BMPs listed in the "*City of Indianapolis Stormwater Quality Unit (SQU) Selection Guide"* shall also be considered, "Pre-approved", subject to verification and approval of calculations.

**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 |

# CHAPTER 4: CONSTRUCTION & INSPECTION

*A. Materials*

1. All public storm sewers, including storm sewers to be maintained by a Home Owners Association (HOA), and storm sewers to be dedicated to the Town shall be gasket type, reinforced concrete pipe (RCP) as follows:

    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.

2. Storm sewers that are not considered "public" as described above, shall be considered "private" and may be RCP as described above or may be polyvinyl chloride (PVC) pipe, or high-density polyethylene (HDPE) pipe as follows:

    a. 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 soil-tight 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.

    b. 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.

3. Drainage Structures:

   All storm sewer manholes, catch basins, and inlets shall be precast concrete, unless otherwise approved by the Board/Town Engineer. Precast concrete storm sewer manholes shall meet or exceed the requirements of ASTM C478 and shall be in accordance with Indiana Department of Transportation (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".

4. 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. Indiana Department of Transportation (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 remaining backfill shall be Class I or II material compacted to 95% standard proctor density. Outside the pavement zone, the

remaining backfill shall be clean fill material. Figure 4.1 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 remaining backfill shall be Class I or II material compacted to 95% standard proctor density. Outside the pavement zone, the remaining backfill shall be clean fill material. Figure 4.2 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.

## *B. Project Construction*

All construction shall be completed in accordance with the Occupational Safety and Health Act (OSHA) and other applicable safety regulations. The Bargersville Storm Water Utility assumes no responsibility for construction safety.

Construction site owners shall allow right-of-entry for personnel representing the Storm Water Utility, the Town of Bargersville, or other local, county or state regulatory agencies to inspect any project site involved in construction activities covered under this Manual, at reasonable times.

1. Inspection Services:
   The Utility will inspect all projects for drainage compliance to approved plans during construction. As noted above, the Utility 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 Bargersville Storm Water Utility for Storm Water System Inspection Services*.

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

   Erosion & Sediment Control
   The Utility will inspect all projects for Storm Water Pollution Prevention and Erosion and Sediment Control compliance to approved plans during construction. If required by the Town of Bargersville, the applicant shall execute an *Inspection Services Agreement* with the Town of Bargersville and pay all applicable inspection fees per the terms stated in the agreement. The applicant must notify the Town of Bargersville 48 hours in advance of construction of the storm water management system. Inspection shall be completed until a Notice of Termination form is submitted to the Utility and a final inspection is completed to verify that all land disturbing activities are complete, and all bare areas have been adequately stabilized.

   Post-Construction Storm Water Quality
   The staff of the Storm Water Utility or their designated representative may conduct inspections of the water quality treatment system construction. If required by the Town of Bargersville, the applicant shall execute an *Inspection Services Agreement* with the Town of Bargersville and pay all applicable inspection fees per the terms stated in the agreement. The applicant must notify the Town of Bargersville 48 hours in advance of construction of the storm water management system.

   The Town of Bargersville reserves the right perform periodic inspections of BMPs. Inspection fees shall apply and are payable upon invoicing. Fees associated with maintenance violations shall be assessed through enforcement actions if necessary.

The Storm Water Utility, Town of Bargersville, 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.

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 oval shape 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 (L) 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. If deemed necessary by the Town representative, the pipe, or designated portions thereof, shall be video inspected in accordance with INDOT standards.

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.

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 re-inspected.

3. Enforcement of Standards:
All persons engaging in construction activities on a project site shall be responsible for complying with the requirements of this Manual, with Ordinance 2005-01, and with Rule 5. Failure to comply with these standards may result in a Stop Work Order or necessary legal action by the Utility or Town on behalf of the Utility. Any person causing or contributing to a violation of any provisions of this Manual, Ordinance 2005-01, and Rule 5 shall be subject to enforcement and penalty.

In the event the Town of Bargersville or other regulatory agency determines the project is not in compliance with this Manual, Ordinance 2005-01, 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 Town of Bargersville to correct the deficiency. In the event the deficiency is not corrected within this period, a fine of no less then $25 and no more than $500 per incidence of non-compliance shall be assessed to the project site owner. Each day of non-compliance shall be considered a separate incidence.

A stop-work order (revocation of Building Permit) may be issued in the event that any person violates the terms of this Manual, Ordinance 2005-01, 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 Town of Bargersville may also issue fines to that individual.

4. Transfer of Ownership of Storm Water System:
Owners/Developers that will dedicate the storm water system to the Town of Bargersville shall enter into an agreement - *Storm Water System Agreement – Developer-Installed and Contributed Storm Water System.* The Owner/Developer, at no cost to the Town of Bargersville, shall furnish the design, labor and materials to install the storm water system. The Utility 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. (See sample documents given in Appendix A)

5. Performance and Maintenance Bond Requirements:
For improvements whose ownership is to be transferred to the Town, the Owner/Developer shall provide a performance bond to the Bargersville Storm Water

Utility 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 - *Bargersville Storm Water Utility 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 - *Bargersville Storm Water Utility Maintenance Bond*.

6. Record Drawings:
   Record "as-built" drawings of the completed drainage improvements, certified by a Professional Engineer or Land Surveyor, shall be provided to the Bargersville Storm Water Utility within 30 days of project completion or at the time of transfer of ownership, whichever is sooner. Record drawings for public facilities shall include both a hard copy and an electronic copy (AutoCAD compatible CD) of as-built information including horizontal alignments, elevations, inverts, top-of-castings, pond cross sections, and flow lines of swales. Record drawings for private facilities may include a hard copy set of the above or an electronic copy upon request.

## LIST OF FIGURES

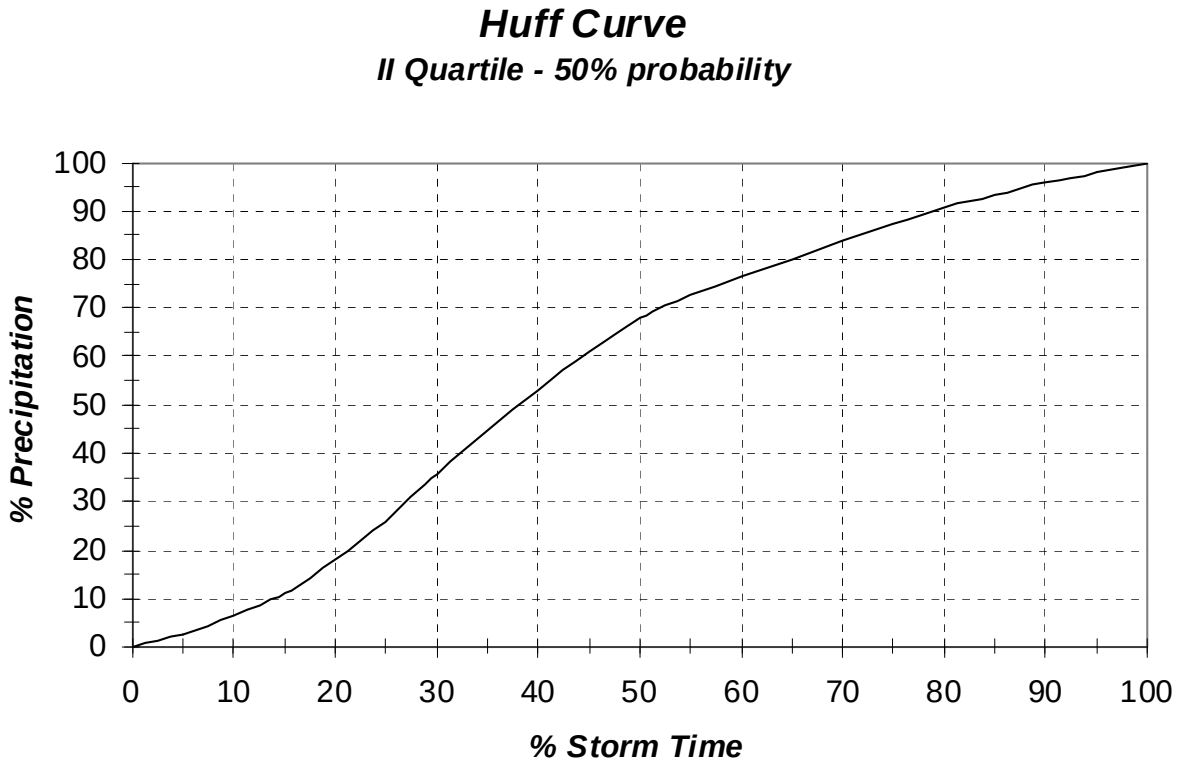
# IDD TABLE FOR BARGERSVILLE, IN

(from City of Indianapolis Stormwater Design & 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 | 2.80 | 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<br>Cover type and hydrologic condition | Average percent impervious area[2] | Curve numbers for hydrologic soil group<br>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 $\geq$ 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<br>Cover type | Hydrologic Condition | Curve numbers for hydrologic soil group<br>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 $\leq$ 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.

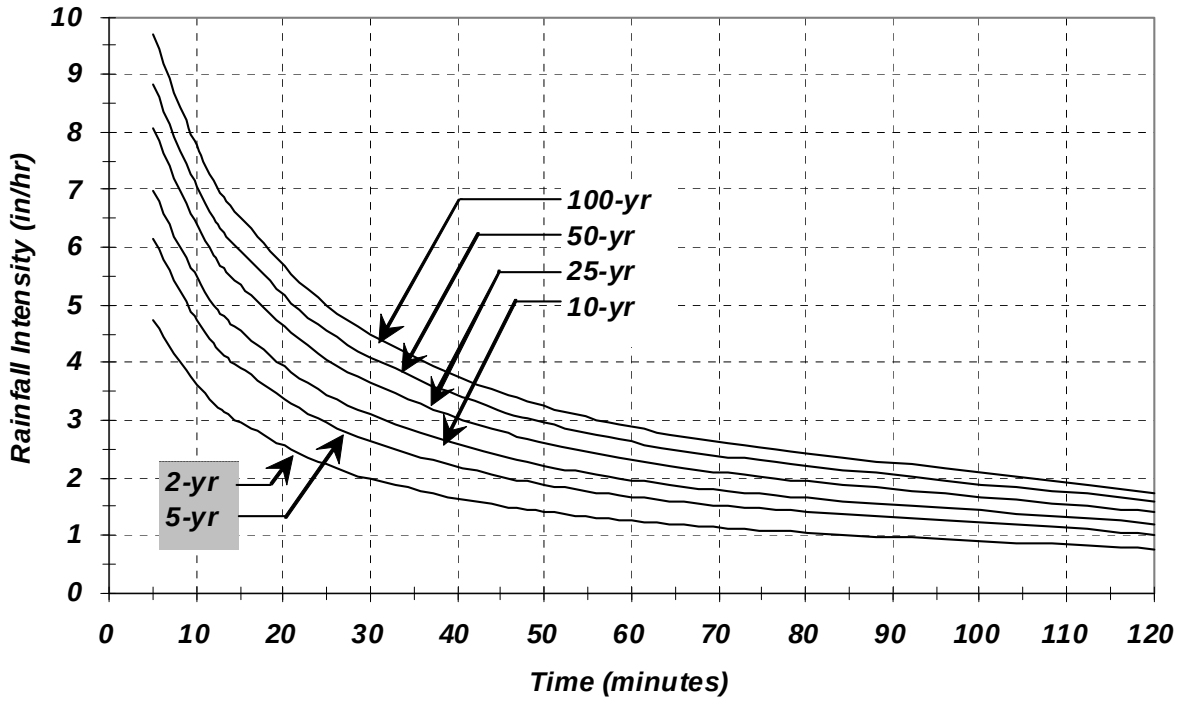
# RATIONAL METHOD RUNOFF COEFFICIENTS

| 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 BARGERSVILLE, IN

(from City of Indianapolis Stormwater Design & 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) |
| | | | | | | | | | | | | | | | | | | | | |
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# TOWN OF BARGERSVILLE - RULE 5 INSPECTION FORM

A trained individual shall perform a written evaluation of the project site:

a. By the end of the next business day following each rainfall that exceeds 0.5"
b. A minimum of one (1) time per week

Project Name: _____

Name of Trained Individual:_____ Date of Inspection:_____

Is this Evaluation following a rainfall? _____ yes _____ no. If yes, date the rain stopped: _____ _____inches

| No. | PROBLEM or CONCERN | YES | NO | N/A |
|---|---|---|---|---|
| | | | | |
| 1 | Is the site information posted at the entrance? | | | |
| 2 | Are all necessary permits attained and special provisions being implemented? | | | |
| 3 | Is a construction entrance installed? is it effective? is it large enough? | | | |
| 4 | Public and private streets are clean? | | | |
| 5 | Are appropriate practices installed where storm water leaves the site? | | | |
| 6 | Silt fence is entrenched into the ground? | | | |
| 7 | Silt fence is upright? Fabric and stakes meet specifications? Fabric is not torn? Terminated to higher ground? Properly joined at ends? | | | |
| 8 | Sediment basins and traps are installed according to the plan? The pipe or rock spillway is functional? | | | |
| 9 | The earthwork for erosion and sediment control practices is properly graded, seeded and/or mulched? | | | |
| 10 | Diversion swales and/or waterbars are installed to plan and protected? | | | |
| 11 | Perimeter practices have adequate capacity and do not need to be cleaned out? | | | |
| 12 | Inlet protection is installed on all functional inlets? (not filter fabric under grate) | | | |
| 13 | Inlet protection is installed so water does not flow under it? | | | |
| 14 | The frame, cross-bracing and/or stakes are adequate and meet specifications? | | | |
| 15 | The fabric, straw, mulch and/or stone is intact without holes or tears? | | | |
| 16 | Catch basin insert protection is installed where required? | | | |
| 17 | Sediment has been removed from the practice? | | | |
| 18 | Swales and ditches have been stabilized or protected? | | | |
| 19 | Storm water outlets are adequately stabilized? | | | |
| 20 | Temporary stabilization of disturbed ground has been addressed? | | | |
| 21 | Disturbed areas that will lie dormant for 15 days are planned to be protected? | | | |
| 22 | All protected dormant areas meet a minimum 70% coverage? | | | |
| 23 | Growing vegetation has sufficient water and/or nutrients to grow? | | | |
| 24 | Permanent stabilization of disturbed ground is progressing though the project? | | | |
| 25 | Final grading and stabilization is progressing on completed areas? | | | |
| 26 | The soil has been properly prepared for seeding? | | | |
| 27 | Hard or soft armoring is installed where natural vegetation will erode? | | | |
| 28 | Water pumping operations have a protected outlet and discharge water is clear? | | | |
| 29 | A designated washout area is established for concrete trucks? | | | |
| 30 | A dumpster is onsite for trash disposal? | | | |
| 31 | Fuel tanks and other toxic materials are safely stored and protected? | | | |
| 32 | Smaller construction sites not required to file a separate NOI are complying with the overall plan? | | | |
| 33 | | | | |
| 34 | | | | |

**ALL PROBLEMS OR CONCERNS NEED TO BE ADDRESSED WITH A CORRECTIVE ACTION**

Identify the problem by number and/or provide additional explanation as needed.

Problems were discussed/addressed with the following:

Developer Representative contacted, name and date: _____

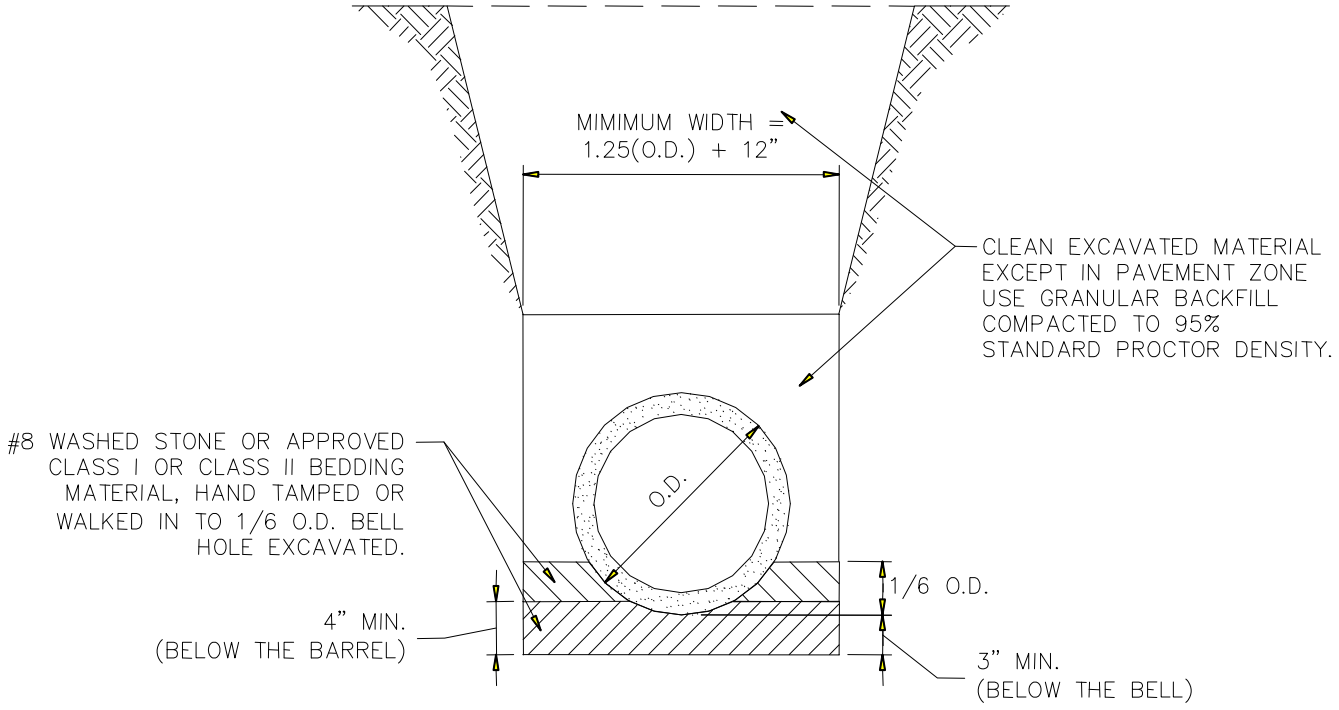
Contractor Representative contacted, name and date: _____

Owner or Representative contacted, name and date: _____

Trained Individual: _____ Date: _____
(signature)

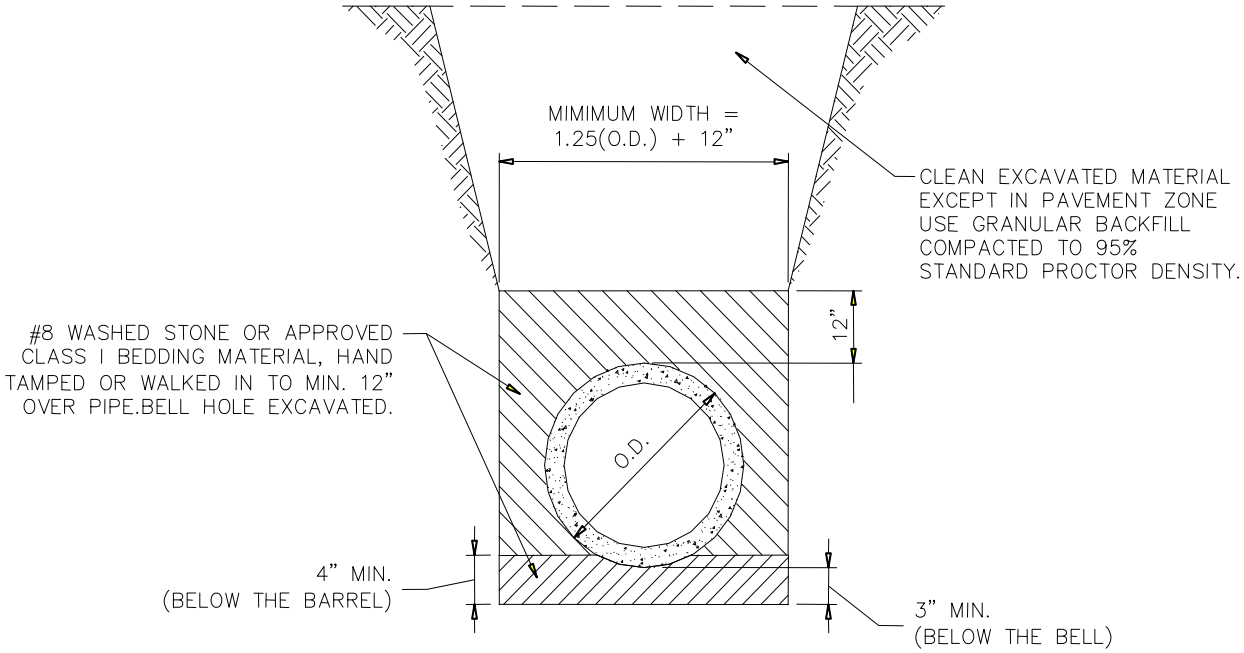
# RCP BEDDING AND BACKFILL DETAIL

| 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.

# APPENDIX A

# Storm Water System Transfer Agreements & Information

BARGERSVILLE STORM WATER UTILITY
PROJECT NO._____

STORM WATER SYSTEM AGREEMENT
DEVELOPER-INSTALLED AND CONTRIBUTED STORM WATER SYSTEM

THIS AGREEMENT, entered into this day _____ of _____, 20___, by and between _____ (collectively, the "Developer" or "Developers") and the Town of Bargersville, Indiana ("Town"), d/b/a/ Bargersville Storm Water Utility ("Utility"), WITNESSETH THAT:

WHEREAS, the Town, through the Utility, owns, operates and maintains a Storm Water System ("System") serving the Town of Bargersville in Johnson County, Indiana, and "Utility", as used in this Agreement, includes "Town"; and

WHEREAS, the Developer owns real estate in the vicinity of _____ _____, in Johnson County, Indiana (the "development"), and the Developer will install a Local Storm Water System in said development and as shown on Exhibit "A", and the Developer will contribute said Local Storm Water System to the Town for the System operated by the Utility; and

WHEREAS, the Utility is willing to take ownership of the Local Storm Water System upon the following terms and conditions; and

WHEREAS, Utility and Developer agree the Developer at its cost and expense shall furnish the necessary design and engineering services, labor and materials to install the Local Storm Water System and obtain all necessary easements, permits, right-of-way grants or other authority which is required, before the start of construction, to provide storm water service to the development as shown on Exhibit "A";

NOW THEREFORE, in consideration of the premises, covenants, agreements and undertakings hereinafter provided, and each act to be performed pursuant hereto, the parties agree that:

1. Drainage Plans. Developer shall provide the Utility with two (2) sets of drainage plans and technical specifications, which adhere to the criteria in the Utility's Drainage Standards Manual. Submittals shall be made on 24-inch by 36-inch sheets at a minimum 1"= 50' scale. If applicable, the Utility will determine the size of the off-site storm sewer reasonably necessary to serve the Developer without degrading the integrity of the Utility's Storm Water System.

2. Review of Drainage Plan. The Utility shall review Developer's drainage plan, drainage calculations, offsite drainage conditions, and easement drawings (if required), for compliance to the Utility's Drainage Standards Manual. The Utility may require storm sewers large enough to provide for future service. The additional cost of installing such sewers shall be at the Developer's expense. If the drainage plans are in compliance with the Utility's Drainage Standards Manual, the Utility will issue the Developer an approval letter. The Developer will

submit three (3) copies of the final construction plans on 24-inch by 36-inch sheets. Upon completion of construction, the Developer shall submit as-built drawings to the Utility on both 24-inch by 36-inch sheets and in electronic format (AutoCAD is preferred).

3. Contractor and Materials. Upon issuance of a drainage approval letter to the Developer from the Utility, the Developer shall notify the Utility in writing of the installation contractor Developer seeks to engage. The Utility must approve the Developer's selected contractor, based upon reliability and responsiveness, and the Utility may withhold approval at its sole discretion. The Utility shall inform Developer of any withheld approval within 14 days after Developer notifies Utility of the intended contractor, or contractor approval is deemed.

The Developer shall purchase pipe, manholes, inlets, catch basins and other appurtenances ("Materials"). All materials must meet or exceed the Utility's published standards and specifications, and are subject to Utility approval.

4. Developer Installation. Upon approval of the contractor and the materials by the Utility, the Developer agrees to commence construction within one hundred and twenty (120) days after required permits have been obtained, and to prosecute construction to full completion with all reasonable diligence consistent with good business practices and the availability of required equipment, materials and labor. The Developer shall give the Utility a minimum of one week's notice prior to commencing construction. The Developer hereby agrees to enter into an *Agreement Between Owner/Contractor and Bargersville Storm Water Utility for Storm Water System Inspection Services* with the Utility. During installation of the Local Storm Water System, the Utility will have the authority to inspect the installation at the Utility's convenience and discretion. The Utility shall have authority to halt construction if the installation is not consistent with Utility standards. However, the Utility assumes no responsibility for construction safety, and its inspection is not for and does not include construction safety.

The Developer further agrees the Utility, during the installation, at its discretion may request, and the Developer will honor such request, changes in the Local Storm Water System related to location, workmanship and materials.

5. Other Requirements of Developer. Coincident with delivery of the *Transfer of Ownership* and other documents required hereinabove by the Developer to the Utility, there shall also be delivered to the Utility by the Developer:

a) All required permits, and any other information pertaining to the Local Storm Water System;

b) Copy of the final platted map that is to be recorded for the development and/or address listing;

c) *Waivers of Lien* for material suppliers, subcontractors, and contractor;

d) *Performance and Repair Bond* on Local Storm Water System for materials and workmanship. Repair work performed during the one-year warranty period must be

coordinated with and inspected by Utility. Emergency repairs may be performed by the Utility, and the Developer/bonding company will be billed the cost of the repair;

*e) Maintenance Bond* that warrants the materials and workmanship on the Local Storm Water system for a period of three (3) years;

f) *Cost of Local Storm Water System* itemized by pipe and structure size; certified as being accurate;

g) "As-built" drawings including materials listing, manufacturer, elevations and locations;

h) All company fees, tax impact, and subsequent connector fees, if applicable; and

i) Recorded final platted map of the development when available from the County Recorder.

6. Testing. Developer's Contractor, in compliance with the Utility's Drainage Standards Manual requirements, shall test the installed storm sewers and structures. Developer and/or Contractor shall notify Utility and the assigned Inspector at least forty-eight (48) hours prior to testing of the local storm water system.

7. Ownership of Local Storm Water System. Upon conveyance of the Local Storm Water System by Developer to the Utility (including all pipes, structures, appurtenances, easements and any equipment), it shall become the sole property of the Utility. The Developer shall be responsible for maintenance of the Local Storm Water System for three (3) years from the date of the *Transfer of Ownership*, at Developer's sole expense. Thereafter, the Utility shall be responsible for the maintenance and repair of the same. The Developer shall have no right of property in the Local Storm Water System or any part thereof by reason of or on account of the Developer having furnished a part or all of the funds used in the purchase of materials and equipment for, or the employment of labor in connection with, the construction of the Local Storm Water System.

8. Determination of Cost of Local Storm Water System. The Utility and Developer agree that the cost of the Local Storm Water System shall be the amount of _____($_____).

9. Other Local Storm Water System Connections. Notwithstanding any other provisions of this Agreement, the Utility shall have the absolute right at any time to construct and install other storm water facilities connecting to the Local Storm Water System. Neither the connection of any such other facilities nor any service furnished by or from such other facilities shall be subject to or in any manner affect this Agreement.

10. Developer Safety Measures. The Developer and its contractor(s) shall take all steps necessary to ensure the safety of any Utility Inspector or other employee at the worksite. The Utility shall have no responsibility for identifying, eliminating or otherwise abating any safety,

health or environmental hazard created or otherwise resulting at the worksite from the activities of the Developer or any other person. Nothing in this Agreement shall be construed or interpreted, directly or indirectly, as requiring that the Utility undertake any legal duty of the Developer or contractor(s) to the Developer's or contractor's employees, invitees or licensees or to any federal, state or local government agency.

11. Liability and Indemnity. The Developer and its contractor(s) shall be solely responsible for all labor, materials, equipment and work at the worksite. The Developer shall defend, indemnify, hold harmless and protect the Utility, its employees, agents, officers and directors, from and against any and all claims, demands, causes of action, liabilities, losses, damage, penalties, costs (including reasonable attorneys' fees) and suits, including without limiting the generality of the foregoing, those claims, demands, causes of action, liabilities, losses, damage, penalties, costs (including reasonable attorneys' fees) and suits for which the Utility may be, or may be claimed to be, liable through negligence or otherwise, for death, personal injury, illness or loss of damage to property, or economic loss alleged to arise out of, result from, relate to, or be in any manner connected with activities of the Developer or the services provided by the Utility under this Agreement. The Developer shall provide such defense and indemnity whether the claim, demand, cause of action or suit alleges that the occurrence, omission, action, liability, loss or damage was caused or contributed to by the concurrent, joint, comparative, active or passive negligent act or omission of the Utility, except that the Developer assumes no liability for the negligent acts or omissions of the Utility, its employees, agents, officers and directors, which, without contributory fault on the part of the Developer, its contractor(s) , subcontractor(s) or their employees, agents, officers or directors, is the sole cause of loss, damage to person or property, or injury to or death of any person.

The Utility shall give the Developer prompt written notice of any claim for which indemnification is sought hereunder. The Developer shall at its own expense assume the defense of such claim with counsel selected in consultation with the Utility; provided, however, that the Developer shall not be entitled to settle any claim against the Utility without the prior written consent of the Utility, which consent shall not be unreasonably withheld. The Utility shall have the right, but not the duty, to employ, at its expense, its own counsel in any such case.

12. Insurance. The Developer shall add the Utility as an additional insured under all of the Developer's liability insurance policies covering work at the worksite. As an additional insured, the Utility shall be provided the same extent and quality of coverage as the Developer and any other primary insured party. The Developer shall provide the Utility a C*ertificate of Insuranc*e evidencing such coverage prior to the Utility's performance of any services under this Agreement.

13. Utility Employees. Under no circumstances shall Utility employees be deemed employees, agents or representatives of the Developer. Under no circumstances shall this Agreement be deemed to constitute either party hereto as the agent or representative of the other party.

14. Successors and Assigns. This Agreement shall inure to the benefit of and be binding upon the parties hereto, including any subsequent connectors, and their respective successors and assigns.

15. Agent of Developer. The Developers constitute _____ _____, jointly and severally, as their agent and attorney in fact ("Agent") to deal with the Utility on all matters relating to this Agreement. The authority of the Agent includes but is not limited to the power to sign all documents on behalf of all of the Developers.

IN WITNESS WHEREOF, the Utility and Developer have properly executed this Agreement or caused the same to be properly executed as of the date hereinabove set forth.

DEVELOPER

_____
Name of Corporation (If applicable)

_____
Signature (of Officer)

_____
Printed Name and Title

STATE OF INDIANA )
) SS:
COUNTY OF JOHNSON)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, personally appeared _____ DEVELOPER, who acknowledged the execution of the foregoing Agreement to be his free and voluntary act and deed. WITNESS my hand and Notarial seal this _____ day of _____, 20____.

_____
Notary Public

_____
Name (Typed or Printed)

_____
County of Residence

My Commission Expires: _____

STORM WATER UTILITY
TOWN OF BARGERSVILLE

ATTEST:

| | |
|---|---|
| _____ | _____ |
| Signature | Signature |
| _____ | _____ |
| Printed Name | Printed Name |
| _____ | _____ |
| Title | Title |

# EXHIBIT “A”

# Department of Storm Water Management

Date:

Business Name
Mr/Mrs. Business Associate
Business Address
City, State, Zip

Dear :

Enclosed you will find the following Transfer of Ownership documents for Storm Water for the Enclave, Section II-B:

- *Transfer of Ownership of Developer Installed Storm Water System*
- *Vendor Waiver of Lien to the Town of Bargersville*
- *Contractor Release of Liens for Storm Water System*
- *Subcontractor and Supplier's Release of Liens for Storm Water System*
- *Contractor's Waiver of Liens and Warranty to the Town of Bargersville*
- *Cost of Storm Water System Contributed by Developer to the Town of Bargersville*

In addition to the above mentioned forms, we need to have included in the package we receive back from you, as-built drawings for the storm water system on a disk with a version of AutoCad 2004 or newer, a set of mylars and payment for all inspection fees in full.

After the forms and as-builts have been accepted, we will require a Maintenance Bond from your contractor or the developer, for storm water that is good for three (3) years with a value of 25% of the construction costs.




Thank you for your prompt attention to this matter. If you have any questions, please do not hesitate to contact our Administrative Assistant, Mrs. Niki Balish at 317-422-5115 ext. 120.

Respectfully,

Kenneth E. Zumstein, President
Bargersville Storm Water Utility Board

KZ/nab
Enclosures

cc: Bookkeeping
File

# TRANSFER OF OWNERSHIP
# OF DEVELOPER INSTALLED STORM WATER SYSTEM

BY VIRTUE OF THIS DOCUMENT, THE UNDERSIGNED DOES SELL AND COVENANT AND ASSIGN ALL RIGHTS, INTEREST AND OWNERSHIP OF STORM WATER SYSTEM INSTALLED AT:

_____

(Project Name)

_____

(Location)

AS NOTED BY THE AS BUILT DRAWINGS AND PER THE MATERIALS LISTED ON THE "FINAL ACTUAL COST FORM" WHICH REFLECTS A TOTAL COST FOR MATERIALS AND INSTALLATION OF $_____ TO THE Town of Bargersville

DEVELOPERS CERTIFICATION

I certify that no advance or contribution for the construction of this facility have been made by the owners of any lots being served by this facility, and there are no agreements which might result in claims that all or some part of the cost of the installed storm water mains and appurtenances at (project) _____ _____ has been contributed by any such person. The Title to all facilities having been vested in the **Town of Bargersville** provided that any construction warrant is received by this Developer in connection with the installation there of shall automatically be assigned to **Town of Bargersville** (utility owning) for its benefit. This Developer further agrees that it shall not charge directly or indirectly, customers or potential customers of **Town of Bargersville** for any facilities installed by the Developers.

It is mutually understood and agreed that **Town of Bargersville** is a municipal utility and that its rights and obligations hereunder shall be subject to all applicable orders and rules and regulations of such regulatory commissions or regulatory authorities as may have jurisdiction and accordingly, applies to the operation, maintenance and ownership of these and all facilities described above.

Name:_____

By:_____

Title:_____

Dated:_____, 20___

STATE OF INDIANA )

) SS:

COUNTY OF _____)

Before me, the undersigned, a Notary Public in and for said County and State, this _____ day of_____ _____ 20___, personally appeared _____ and acknowledge the execution of the foregoing Transfer of Ownership of Developer Installed Storm Water System to the Town of Bargersville. WITNESS my hand and official seal.

_____

Notary Public

_____

Name-Typed or Printed

_____

County of Residence

My commission Expires:

_____

# VENDOR WAIVER OF LIEN
# TO THE TOWN OF BARGERSVILLE FOR STORM WATER MAINS

Please be informed that _____
(Name of Vendor)

_____

for and in consideration of ($_____)_____

_____ Dollars

and other good and valuable considerations, lawful money of the United States of America, to me in hand paid, the receipt whereof is hereby acknowledged, does hereby waive, release, remiss and relinquish any and all right to claim any lien or liens for work done or material furnished, or any kind of class of lien whatsoever on the following development project:_____

_____
Vendor Affix Corporate Seal Here

By:_____

_____
Authorized Representative Signature

_____
Title

_____
Date

By:_____

_____
Name of Vendor

_____
Address of Vendor

STATE OF INDIANA )
) SS:

COUNTY OF _____)

Before me, the undersigned, a Notary Public in and for said County and State, this _____ day of_____ _____ 20___, personally appeared _____ and acknowledge the execution of the foregoing Vendor Waiver of Liens to the Town of Bargersville. WITNESS my hand and official seal.

_____
Notary Public

_____
Name-Typed or Printed

_____
County of Residence

My commission Expires:

_____

# CONTRACTOR

# RELEASE OF LIENS FOR STORM WATER MAINS

# TO THE TOWN OF BARGERSVILLE

WHEREAS, we, the undersigned, have installed or furnished labor, materials and/or equipment for the installation of the Development Project entitled _____, installed pursuant to a written agreement dated ____, 20__ between the _____, having an office at _____ hereinafter called OWNER and _____ _____hereinafter called CONTRACTOR and having an office at _____ _____, which said facilities are owned by the OWNER and described and located as follows:

_____

_____

_____

_____

_____

WHEREAS, we, the undersigned, have agreed to release any and all claims and liens which we have, or might have, against the OWNER, or said facilities by reason of the labor, materials and equipment furnished by us in connection with said installation;

NOW THESE PRESENTS WITNESS that we, the undersigned, in consideration of the premises, and of the sum of one Dollar ($1.00) in hand paid by the said OWNER, at and before the sealing and delivery hereof, the receipt whereof we do hereby acknowledge, have remised, release and forever quitclaim, unto the said OWNER, its successor and assigns, any and all manner of liens, claims and demands whatsoever which we now have, or might or could have, on or against the said facilities, or the

owner thereof, for work done, or for equipment or materials furnished in connection with the installation thereof. It is the intent of this release that the OWNER, its successors and assigns shall and may hold, have, use and enjoy the said facilities free and discharged from all liens and demands whatsoever which we now have, or might or could have against the same if these presents had not been made. IN WITNESS WHEREOF, we have hereunto set our hand and seal the day written opposite our signature.

Name:_____

By:_____

Title:_____

Dated:_____, 20__

STATE OF INDIANA )
) SS:
COUNTY OF _____)

Before me, the undersigned, a Notary Public in and for said County and State, this _____ day of_____ _____ 20__, personally appeared _____ and acknowledge the execution of the foregoing Contractors Release of Liens to the Town of Bargersville. WITNESS my hand and official seal.

_____
Notary Public

_____
Name-Typed or Printed

_____
County of Residence

My commission Expires:

_____

# SUBCONTRACTOR AND SUPPLIER'S
# RELEASE OF LIENS FOR STORM WATER

WHEREAS, we, the undersigned, have installed or furnished labor, materials and/or equipment for the installation of the Development Project entitled _____ installed pursuant to a written agreement dated _____, 20__, between _____, having an office at_____ _____ hereinafter called OWNER and _____, having an office at _____ hereinafter called CONTRACTOR, which said facilities are owned by the OWNER and described and located as follows:

_____

_____

_____

_____

WHEREAS, we, the undersigned, have agreed to release any and all claims and liens which we have, or might have, against the OWNER, or said facilities by reason of the labor, materials and equipment furnished by us in connection with said installation.

NOW THESE PRESENTS WITNESS that we, the undersigned, in consideration of the premises, and of the sum of one Dollar ($1.00) in hand paid by the said OWNER, at and before the sealing and delivery hereof, the receipt whereof we do hereby acknowledge, have remised, release and forever quitclaim, unto the said OWNER, its successor and assigns, any and all manner of liens, claims and demands whatsoever which we now have, or might or could have, on or against the said facilities, or the

owner thereof, for work done, or for equipment or materials furnished in connection with the installation thereof. It is the intent of this release that the OWNER, its successors and assigns shall and may hold, have, use and enjoy the said facilities free and discharged from all liens and demands whatsoever which we now have,-or might or could have against the same if these presents had not been made. And we do further certify and acknowledge, that we have received of and from the said CONTRACTOR, payment in full on account of labor done or materials or equipment furnished for or in connection with said facilities.

IN WITNESS WHEREOF, we have hereunto set our hand and seal the day written opposite our signature.

Name: _____

By: _____

Title: _____

Dated: _____, 20__

STATE OF INDIANA )

) SS:

COUNTY OF _____)

Before me, the undersigned, a Notary Public in and for said County and State, this _____ day of_____ _____ 20__, personally appeared _____ and acknowledge the execution of the foregoing Subcontractor & Supplier's Release of Liens to the Town of Bargersville. WITNESS my hand and official seal.

_____
Notary Public

_____
Name-Typed or Printed

_____
County of Residence

My commission Expires:

_____

# CONTRACTOR'S WAIVER OF LIENS AND WARRANTY FOR STORM WATER MAINS TO THE TOWN OF BARGERSVILLE

I, _____ being _____ of
(Individual) (Title)

_____
(Name and Address of Contractor)

_____

this date _____, certify that I have received payment in full for _____
(Type of Work)
per my contract with land owner and/or land developer, performed under Contract Agreement with ____ _____ under a certain Contract issued

to him by_____ dated_____for the

construction of (Development Project): _____

_____

for the full amount (consideration) of ($_____)_____

_____.

The Undersigned further certifies that all labor performed under Contract for the above stated work has been paid in full, in compliance with General Conditions of the Contractor that all materials, equipment, fees, licenses, insurance and taxes of every description have been paid in full, that there are no liens against the Undersigned; the Undersigned further certifies and states that he will indemnify and save harmless the Contractor, Owners, and Utility owning from any and all manner of claims, liens, or suits, loss or damage arising by virtue of said Contractor or subcontractors with the Undersigned, and hereby releases forever, all claim, title, and interest in the above property as described to the Utility owning.

Contractor Affix Corporate Seal Here

By:_____
Authorized Representative

_____
Title

_____
Date

By:_____
Name of Contractor

_____
Address of Contractor

STATE OF INDIANA )
) SS:
COUNTY OF _____)

Before me, the undersigned, a Notary Public in and for said County and State, this _____ day of_____ _____ 20__, personally appeared _____ and acknowledge the execution of the foregoing Contractors Waiver of Liens and Warranty to the Town of Bargersville. WITNESS my hand and official seal.

_____
Notary Public

_____
Name-Typed or Printed

_____
County of Residence

My commission Expires:

_____

# COST OF STORM WATER SYSTEM CONTRIBUTED BY DEVELOPER TO THE TOWN OF BARGERSVILLE

NAME OF DEVELOPMENT:_____ DATE PLACED IN SERVICE:_____

DEVELOPER:_____ LOCATION (T,R,S):_____

STORM WATER SYSTEM (ACCOUNT ____)
(Including piping, structures (inlets, boxes, catch basin, manholes), bedding, appurtenances, labor, equipment and special construction)

**PIPING (INCLUDING BEDDING & END SECTIONS)**

Quantity of Piping (in feet with material type) $ Cost Total

| Size | |
|---|---|
| 12” | |
| 15” | |
| 18” | |
| 21” | |
| 24” | |
| 27” | |
| 30” | |
| 36” | |
| 42” | |
| 48” | |
| 54” | |
| | |

**Total Piping:**_____

**STRUCTURES**

Quantity of Each $ Cost Total

| Description | |
|---|---|
| Curb Inlets | |
| Yard Inlets | |
| Junction Inlets | |
| Catch Basins | |
| | |
| Special Structure | |
| BMP | |
| | |
| | |
| | |
| | |
| | |

**Total Structures:**_____

***Grand Total:***_____

DATE:_____

CERTIFIED BY:_____

DEVELOPER:_____

PRINTED NAME & TITLE:_____

# APPENDIX B

## Storm Water BMPs, Maintenance & Inspection Forms

**B.1 – BMP Inspection Form**

**B.2 – Storm Water Ponds**

**B.3 – Storm Water Wetlands**

**B.4 – Bioretention Areas**

**B.5 – Water Quality Swales**

**B.6 – Sand Filters**

**B.7 – Infiltration Trenches**

**B.8 – Biofilters**

# BEST MANAGEMENT PRACTICE INSPECTION FORM
# TOWN OF BARGERSVILLE

Inspector(s): _____

Inspection Date: _____ Time: _____ Duration: _____

Weather Conditions: _____

Date of last Precipitation: _____ Amount: _____

Reason for Inspection: ☐ Routine ☐ Flooding ☐ Complaint ☐ Other _____

Property Address/Location: _____

Type of SWQ Structure:

☐ Pond (Permanent Pool)
☐ Pond (Dry Pool)
☐ Bioretention Basin
☐ Oil/Water Separator
☐ Open Channel (Vegetated/Geotextile)
☐ Hydrodynamic Separator/Swirl
☐ Infiltration BMP
☐ Other _____

**STORM WATER QUALITY MEASURE INSPECTION ITEMS**

| | | | | | |
|---|---|---|---|---|---|
| A. | Debris Clean-Out | | | | |
| 1. | Contributing areas clean of debris | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| 2. | Inlets and outlets clear of debris | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| B. | Drainage Area Stabilization | | | | |
| 1. | Contributing drainage area stabilized (vegetation) | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| 2. | No evidence of erosion | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| 3. | Area mowed and clippings removed | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| C. | BMP Outfalls | | | | |
| 1. | No evidence of scouring around outfall | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| 2. | Vegetation is healthy and not distressed | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| 3. | No evidence of erosion | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| D. | Structural Components | | | | |
| 1. | No evidence of structural deterioration | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| 2. | Any grates are in good condition | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| 3. | No evidence of chipping or cracking of structural parts | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| E. | Sediment Deposition | | | | |
| 1. | Inlets and outlets clear of sediments | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| 2. | Sediment depth in main structure is below the manufacturer's maintenance limit or designed depth | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| F. | Overall function of facility | | | | |
| 1. | No evidence of flow bypassing facility | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |
| 2. | No noticeable odors outside of facility | ☐ Yes | ☐ No | ☐ NA | ☐ Maintenance |

**Notes:** _____

# APPENDIX B-2 – 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<br>Length to width ratio is 3:1<br>Maximum depth of permanent pool should not exceed 8 feet<br>Side slopes of pond should not exceed 3:1<br>High permeable soils (hydrologic group A or B) may require a liner | |
| Advantages: | Moderate to high removal rate of urban pollutants<br>Can use for water quality and flood control<br>High community acceptance when designed with attention to aesthetics and maintained properly<br>Opportunity for wildlife habitat | |
| Disadvantages: | Potential for thermal impacts/downstream warming<br>Pond drainage can be problematic for low relief terrain<br>Dam height restrictions for high relief areas<br>Improperly designed or maintained ponds may become stagnant causing unpleasant conditions | |
| Maintenance: | Monitor sediment accumulation and remove periodically<br>Remove debris from inlet and outlet structures<br>Maintain side slopes and remove invasive vegetation | |

# APPENDIX B-2 – 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 re-suspension of previously settled sediments.
- Multiple ponds – provides the water quality storage volume in two or more cells that create longer pollutant removal pathways.

*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 re-suspension 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.

# APPENDIX B-2 – 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 Bargersville 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? | | |

# APPENDIX B-2 – STORM WATER PONDS

| | | |
|---|---|---|
| **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:_____

# APPENDIX B-3 – 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<br>(Min. 5 acres for Pocket Wetland) |
| | Residential Subdivision Use: | Yes |
| | High Density/Ultra-Urban: | No |
| Design Criteria: | Sediment forebay and micropool required<br>Minimum dry weather flow path length to width ratio is 2:1<br>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)<br>High permeable soils (hydrologic group A or B) may require a liner | |
| Advantages: | Effective nutrient removal<br>Natural aesthetic qualities and wildlife habitat | |
| Disadvantages: | Requires large land area<br>Require a continuous base flow<br>Sediment regulation is critical to sustain wetlands | |
| Maintenance: | Replace wetland vegetation to maintain at least 50% surface area coverage<br>Remove invasive vegetation<br>Monitor sediment accumulation and remove periodically | |

# APPENDIX B-3 – 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.

# APPENDIX B-3 – STORM WATER WETLANDS

*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.

# APPENDIX B-3 – 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 Bargersville 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? | | |

# APPENDIX B-3 – 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:_____

# APPENDIX B-4 – 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.<br>Typically requires 5 feet of head. | |
| Advantages: | High pollutant removal.<br>Often located in landscaping islands of parking lots.<br>Good retrofit capability for redevelopment.<br>Aesthetic qualities. | |
| Disadvantages: | Requires extensive landscaping.<br>Not acceptable for site slopes greater than 6%.<br>Generally requires an underdrain system.<br>Clogging may be a problem in areas with high sediment loads. | |
| Maintenance: | Inspect and repair/replace treatment area components. | |

# APPENDIX B-4 – 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 re-aerate 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.

## *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.

# APPENDIX B-4 – BIORETENTION AREAS

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 non-erosive 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.

# APPENDIX B-4 – 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 Bargersville 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. 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? | | |

# APPENDIX B-4 – BIORETENTION AREAS

Additional Comments:

Recommended Actions:

Recommended Timeframe for Actions:

# APPENDIX B-5 – STORM WATER 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.<br>Longitudinal slopes must be less than 4%.<br>Maximum side slopes 2:1 with 4:1 preferred. | |
| Advantages: | Combines storm water treatment with runoff conveyance system.<br>Relatively inexpensive to install.<br>Reduces runoff velocities.<br>Aesthetic qualities. | |
| Disadvantages: | Cannot be used on steep slopes.<br>Large area requirement - not feasible for high-density areas. | |
| Maintenance: | Maintain grass height of 4 to 6 inches<br>Remove sediment from forebay and channel | |

# APPENDIX B-5 – STORM WATER 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.

## *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.

# APPENDIX B-5 – STORM WATER 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 Bargersville 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? | | |
| 2. Any clogging of underdrain? | | |
| 3. Is overflow structure operating properly? | | |
| 4. Other problems evident? | | |

# APPENDIX B-5 – STORM WATER SWALES

Additional Comments:

Recommended Actions:

Recommended Timeframe for Actions:

# APPENDIX B-6 – 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.

# APPENDIX B-6 – 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 re-aerate 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.

*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.

# APPENDIX B-6 – SAND FILTERS

## 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.

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.

# APPENDIX B-6 – 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 Bargersville 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? | | |
| | | |
| **Structural** | | **Inspect Annually** |
| 1. Any evidence of deterioration, spalling or cracking of concrete vault, spillway, etc.? | | |

# APPENDIX B-6 – SAND FILTERS

| | | |
|---|---|---|
| 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:

# APPENDIX B-7 – SAND FILTERINFILTRATION 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.

# APPENDIX B-7 – SAND FILTERINFILTRATION 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.

## *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 non-erosive.

9. Overflow structure - a non-erosive 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.

# APPENDIX B-7 – SAND FILTERINFILTRATION 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 Bargersville 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. | | |

# APPENDIX B-7 – SAND FILTERINFILTRATION TRENCHES

Additional Comments:

Recommended Actions:

Recommended Timeframe for Actions:

# APPENDIX B-8 – 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%.<br>Level spreader required where concentrated runoff flows into biofilter. | |
| Advantages: | Relatively inexpensive to install.<br>Reduces runoff velocities.<br>Aesthetic qualities and preservation of riparian zones. | |
| Disadvantages: | TSS removal is less than 80%.<br>Cannot be used on steep slopes.<br>Large land requirement. | |
| Maintenance: | Maintain grass height of 2 to 6 inches.<br>Requires periodic sediment removal. | |

# APPENDIX B-8 – 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.

## *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.

# APPENDIX B-8 – 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 Bargersville 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? | | |

# APPENDIX B-8 – BIOFILTERS

Additional Comments:

Recommended Actions:

Recommended Timeframe for Actions:

# REFERENCES

1. *Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 Guidance, A guide to accompany the MS4 general permit requirements under 327 IAC 15-13*, Indiana Department of Environmental Management, Office of Water Quality, Urban Wet Weather Section, Storm Water Group, 100 North Senate Avenue, P.O. Box 6015, Indianapolis, Indiana 46206, (800) 451-6027, May 2003, http://www.IN.gov/idem/water/npdes/permits/wetwthr/storm/rule13.html