CITY OF BEECH GROVE, INDIANA
STORMWATER UTILITY

STORMWATER STANDARDS MANUAL

Prepared for:

City of Beech Grove

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Chapter 1 - Introduction

This manual contains minimum stormwater standards and procedures to be followed for submittal to the City of Beech Grove (City) for the purpose of obtaining stormwater drainage approval for land disturbing projects within the corporate limits of the City of Beech Grove. Drainage approval for all land disturbing projects, including activities in the public right-of-way, must be received from the City prior to construction and/or land disturbing activity. The standards and procedures in this manual shall rule over any previous stormwater standards pertaining to the City.

These standards were developed in accordance with the requirements of the Indiana Department of Environmental Management (IDEM) issued Municipal Separate Storm Sewer System (MS4) General Permit (MS4GP) and the Construction Stormwater General Permit (CSGP).

It shall be the policy of the City that developers or persons developing or redeveloping a property within the city limits, including single or double-family residences, submit for approval a drainage plan that complies with this manual. Refer to Chapter 3 for the application and submittal requirements. The drainage plan shall provide for the proper drainage of stormwater runoff from the developed site and the drainage basin in which it is contained. The drainage system shall be constructed and installed in accordance with the plans and specifications as approved by the City.

1.1 Authority

The City has the authority to inspect the interior and exterior of all buildings and structures, properties and construction sites; present stop work orders; assess and issue notices of violations and enforcement actions to persons in violation of the City's ordinances, the requirements of this manual and applicable federal, state, and other local statutes as well as assess fines.

1.2 Responsibility for Administration

The City shall administer, implement and enforce the provisions of this manual. Any powers granted or duties imposed upon the City may be delegated in writing by the City to persons or entities acting in the beneficial interest of or in the employ of the City.

1.3 Severability

The provisions of this manual are hereby declared to be severable. If any provision, clause, sentence, or paragraph of this manual or the application thereof to any person, establishment, or circumstances shall be held invalid, such invalidity shall not affect the other provisions or application of this manual.

1.4 Ultimate Responsibility

The standards set forth herein and promulgated pursuant to this manual are minimum standards; therefore this manual does not intend nor imply that compliance by any person will ensure that there will be no contamination, pollution, nor unauthorized discharge of pollutants.

Chapter 2 - Definitions and Acronyms

2.1 Definitions

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

Agricultural Conservation Practices - practices that are constructed on agricultural land for controlling soil erosion and sedimentation. These practices include, but are not limited to grass waterways, sediment basins, terraces, and grade stabilization structures.

Agricultural Land Disturbing Activity – tillage, planting, cultivation, or harvesting operations for the production of agricultural or nursery vegetative crops. The term also includes pasture renovation and establishment, the construction of agricultural conservation practices, and the installation and maintenance of agricultural drainage tile. For purposes of this ordinance, the term does not include land disturbing activities for the construction of agricultural related facilities, such as barns; buildings to house livestock; roads associated with infrastructure; agricultural waste lagoons and facilities; lakes and ponds; wetlands; and other infrastructure.

As-Built Plans – a drawing or drawings accurately indicating the locations and dimensions of all improvements installed in relation to development and/or redevelopment of a property or site.

Backfill, Initial – granular or other specified material placed from the springline of the pipe to the specified height above the crown of the pipe, to provide adequate pipe support and to protect the pipe from damage due to compaction of the final backfill.

Backfill, Final – granular or other specified material placed from the top of the initial backfill to the top of the trench.

Bedding – granular material placed beneath the pipe to provide pipe support and to establish line and grade.

Best Management Practices (BMPs) – schedule of activities, prohibition of practices, general good housekeeping practices, pollution prevention and educational practices, maintenance procedures, treatment practices, operating procedures, and practices to control site runoff, spillage or leaks, sludge or water disposal, or drainage from raw materials storage, and any other management practices to prevent or reduce the discharge of pollutants directly or indirectly to stormwater, receiving waters, or stormwater conveyance systems. BMPs also include any structural or nonstructural control measures utilized to improve the quality and, as appropriate, reduce the quantity of stormwater runoff.

Borrow Area – an area where materials are excavated for use as fill.

Buffer Strip - an existing, variable width strip of vegetated land intended to protect water quality and habitat.

Certified Contractor – a person who has received training and is licensed by the state or other local agency to inspect and maintain erosion and sediment control practices and best management practices.

Class V Injection Well - type of well, which typically has a depth greater than its largest surface dimension, emplaces fluids into the subsurface, and does not meet the definitions of Class I through Class IV wells as defined under 40 CFR 146.5. While the term includes the specific examples described in 40 CFR 144.81, septic systems that serve more than one (1) single-family dwelling or provide service for non-domestic waste, dug wells, bored wells, improved

sinkholes, french drains, infiltration sumps, and infiltration galleries, it does not include surface impoundments, trenches, or ditches that are wider than they are deep

Clean Water Act – the Federal Water Pollution Control Act (33 U.S.C. § 1251 et seq.), and any subsequent amendments thereto.

Clearing – any activity that removes the vegetative surface cover.

Combined Sewer – sewer which has been designed or intended to receive both surface runoff and sewage.

Compacted Gravel – a gravel, crushed stone, or rock surface that impedes or prevents the infiltration of stormwater into the soil. Such surfaces are subject to vehicular or equipment traffic or may be used as a roadway, driveway, alley or parking surface.

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 General Permit – see NPDES Construction Stormwater General Permit.

Construction Plan - a representation of a project site and all activities associated with the project.

Conveyance – A combination of drainage components that are used to convey stormwater discharge, either within or downstream of the land-disturbing activity including a:

(1) "Manmade stormwater conveyance system" meanings a pipe, ditch, vegetated swale, or other stormwater conveyance system constructed by man except for restored stormwater conveyance systems;
(2) "Natural stormwater conveyance system" meanings the main channel or a natural stream and the flood-prone area adjacent to the main channel; or
(3) "Restored stormwater conveyance system" meanings a stormwater conveyance system that has been designed and constructed using natural channel design concepts. Restored stormwater conveyance systems include the main channel and the flood-prone area adjacent to the main channel.

Cover – the depth of backfill material over a pipe installation, measured from the crown of the pipe to the bottom of asphalt pavement sections or to the ground surface for concrete pavement sections or installations outside pavement.

Culvert – a pipe or conduit open on both ends, intended to provide for the free passage of surface water runoff under highways, streets, roads, railroads, and embankments.

Detention – holding back stormwater runoff in temporary storage.

Detention Facility – a facility that collects and stores stormwater runoff thereby reducing the rate at which runoff is discharged from the property. Detention storage involves detaining or slowing runoff and then releasing it. A detention basin has a positive outlet that completely empties stored stormwater between storm events.

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.

Dewatering - the act of draining rainwater and/or ground water from excavations, stormwater measures, building foundations, vaults, and trenches.

Discharge – the flow of any stormwater runoff, pollutant, or other substance into or from a watershed, point source, or stormwater facility into a stormwater system. The rate of flow may be measured in cubic feet per second.

Disposal - the discharge, deposit, injection, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that the solid waste or hazardous waste, or any constituent of the waste, may enter the environment, be emitted into the air, or be discharged into any waters, including ground waters.

Ditch Maintenance - to restore a conveyance system to its originally constructed channel capacity and to perform the function for which it was originally constructed as defined in 1C 36-9-27. Maintenance includes: cleaning (removal of accumulated sediments, de-brushing, and mowing), spraying, removing obstructions, and conducting minor repairs

Drainage Area – the area that contributes runoff to a point of interest, such as a development site.

Drainage Basin – as in the Ohio River Basin or the Lick Creek Watershed, it is the land comprised of one or more drainage areas or subbasins, from which the drainage flows to a common point. The boundaries are determined by aerial photograph interpretation, topographic maps, and visually viewing the land. Also called a Watershed.

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.

Filter Strip - an area of undisturbed or planted vegetation used to retard or collect sediment for the protection of watercourses, reservoirs, or adjacent properties.

Floatable - any solid or liquid that, due to its physical characteristics, will float on the surface of water. For this chapter, the term does not include naturally occurring floatables, such as leaves or tree limbs.

Freeboard – the additional depth above the maximum flow elevation through the spillway of stormwater detention/retention facilities, serving as a factor of safety to compensate for unknown factors.

Grading – the excavation of the land surface to a desired slope or elevation.

Haunching – granular or other specified material placed from the top of the bedding to the springline of the pipe, installed uniformly in lifts on either side of the pipe and shoveled under the sides of the pipe to provide resistance against soil and traffic loading.

Hazardous Materials – any material, including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, a substantial present or potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

IDEM – Indiana Department of Environmental Management

Illegal Discharge – any direct or indirect non-stormwater discharge to the stormwater conveyance system, except as exempted in Part 9.2(A)(1) of this manual.

Illicit Connections – an illicit connection is defined as either of the following:

- Any drain or conveyance, whether on the surface or subsurface, which allows an illegal discharge to enter the stormwater conveyance system including but not limited to any conveyances which allow any non-stormwater discharge including sewage, process wastewater, and wash water to enter the stormwater conveyance system and any connections to the stormwater conveyance system from indoor drains and sinks, regardless of whether said drain or connection had been previously allowed, permitted, or approved by the City; or
- Any drain or conveyance connected from a commercial or industrial land use to the stormwater conveyance system which has not been documented in plans, maps, or equivalent records and approved by the City.

Illicit Discharge – any discharge to an MS4 conveyance that is not composed entirely of stormwater, except naturally occurring floatables, such as leaves or tree limbs. Sources of illicit discharges include, but are not limited to, sanitary wastewater, septic tank effluent, commercial car wash wastewater, oil spills or disposal, radiator flushing disposal, laundry wastewater, roadway accident spillage, and household hazardous wastes. Exempted activities are identified in Part 9.2(A)(1) of this manual.

Impervious Surface or Impervious Area – an area where the land surface has been altered in such a way that it decreases the amount of rainwater infiltration. Impervious surfaces include, but are not limited to, paved roads, sidewalks, streets, parking areas, and paved driveways, packed gravel or soil, and rooftops. Materials may include concrete, asphalt, and compacted gravel.

Industrial Activity – activities subject to NPDES Industrial Permits as defined in 40 CFR 122.26 (b)(14).

Infiltration – the process by which surface water enters the soil and recharges streams, lakes, rivers, and underground aquifers. Stormwater infiltration is a fundamental component of the water cycle and is a centerpiece of stormwater management strategies.

Infiltration Practices - Any structural system designed to facilitate the percolation of run-off through the soil to groundwater. Examples include infiltration basins or trenches, dry wells, and porous pavement.

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

Land Disturbing Activity – see Land Disturbance.

Larger Common Plan of Development - 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 must 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 use.

Low-Impact Development – systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration, or use of stormwater to protect water quality and associated aquatic habitat.

Maximum Extent Practicable - a performance standard or requirement within a permit to reduce the discharge of pollutants from a MS4 to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act.

Measurable Storm Event – a precipitation event that results in a total measured precipitation accumulation equal to, or greater than, 0.5 inch of rainfall. A measurable storm event excludes an accumulated snow event.

Municipal Separate Storm Sewer System or MS4 - a conveyance or system of conveyances, including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains, that is:

(1) owned or operated by a federal, state, city, town, county, district, association, or other public body (created by or per state law) having jurisdiction over stormwater, including special districts under state law such as a sewer district, flood control district, or drainage district, or similar entity, or a designated and approved management agency under Section 208 of the Clean Water Act (33 U.S.C. 1288) that discharges into water of the state; or privately owned stormwater utility, hospital, university, or college having jurisdiction over stormwater that discharges into waters of the state;
(2) designed or used for collecting or conveying stormwater;
(3) not a combined sewer; and not part of a publicly owned treatment works (POTW) as defined at 40 CFR 122.2

MS4 General Permit (MS4GP) – see NPDES Stormwater Municipal Separate Storm Sewer System (MS4) Permit.

MS4 Stop Work Order – a legal notice requiring persons to immediately suspend all work and operations.

National Pollutant Discharge Elimination System (NPDES) – A permit issued by EPA or IDEM that authorizes the discharge of pollutants to waters of the United States, whether the permit is applicable on an individual, group, or general area-wide basis.

Notice of Intent (NOI) - A written notification from the project site owner sent to IDEM and to Beech Grove at least 48 hours prior to initiating construction activities at the construction site.

Notice of Termination (NOT) - A written notification from the project site owner to IDEM and to Beech Grove that the construction activities for a site have been terminated and have met the requirements of this chapter.

Non-Stormwater Discharge – Discharges that do not originate from storm events. These discharges include, but are not limited to process water, air conditioner condensate, non-contact cooling water, sanitary waste, wastewater, spills, concrete washout water, paint wash water, irrigation water, or pipe testing water..

NPDES Construction Stormwater General Permit – IDEM issued permit for authorization for stormwater discharges associated with construction activities. Commonly known as the Construction Stormwater General Permit (CSGP).

NPDES Stormwater Municipal Separate Storm Sewer Permit (MS4) – IDEM issued permit for authorization for stormwater discharges associated with MS4 activities. Commonly known as the Municipal Separate Storm Sewer System General Permit (MS4GP).

Nuisance – no person shall erect, construct, cause, permit, keep or maintain within the city limits, anything whatsoever which is injurious to the public health or safety, or offensive to the senses of inhabitant. The existence of any of the above is declared to be a nuisance and shall be regulated as set forth in Part 11.8 of this manual.

Pavement Loading Zone – the area within 5 feet horizontally of any edge of pavement, curb, gutter, sidewalk, building, or other structure.

Person – any individual, association, organization, partnership, firm, corporation or other entity recognized by law and acting as either the owner or as the owner's agent.

Pervious Surface Area – the horizontal surface area of property covered with materials that include, but are not limited to, undisturbed land, tilled agricultural land, ponds, lawns (grass and landscaped areas), and fields, such that the infiltration of stormwater is allowed or encouraged.

Pollutant – anything that causes or contributes to pollution. Pollutants may include, but are not limited to: paints, varnishes, and solvents; oil and other automotive fluids; non-hazardous liquid and solid wastes and yard wastes; refuse, rubbish, garbage, litter, or other discarded or abandoned objects, ordinances, and accumulations, so that same may cause or contribute to pollution; floatables; pesticides, herbicides, and fertilizers; hazardous substances and wastes; sewage, fecal coliform and pathogens; dissolved and particulate metals; animal wastes; wastes and residues that result from constructing a building or structure; and noxious or offensive matter of any kind.

Post-Development Condition – the condition of a site which has been developed.

Pre-Development Condition – the condition of a site prior to land altering activities.

Premises – any building, lot, parcel of land, or portion of land whether improved or unimproved including adjacent sidewalks and parking strips.

Project Site – the entire area on which construction activity is to be performed.

Project Site Owner – the person required to submit the Notice of Intent (NOI) letter per the Construction General Permit and required to comply with the terms of these standards, this ordinance, and the Construction General Permit, including either a developer; or 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.

Property Owner – the individual, partnership, corporation, or other legal entity holding the deed or record of title to the property. A contract purchaser whose contract has been recorded shall be considered a property owner.

Receiving Stream or Receiving Water - A waterbody that receives a discharge from an outfall. The term does not include private drains, retention and detention basins, or constructed wetlands used as treatment.

Retention – holding back stormwater runoff naturally in undrained ponds or artificially by man-made ponds and planned retention basins for flood control.

Retention Facility – a facility that collects stormwater runoff without releasing it. Retention facilities store runoff indefinitely and have no positive outlet. Stored stormwater is removed only by infiltration into the ground or evaporation.

Runoff – water that originates during a precipitation event and flows over the land rather than infiltrating into the ground or evaporating.

Sanitary Sewer – a sewer which carries sanitary and industrial wastes, and to which stormwater, surface water and ground water are not intentionally admitted.

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.

Sediment Control – measures that prevent eroded sediment from leaving the project site.

Sewage – raw, untreated wastewater.

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

Solid Waste - Any garbage, refuse, sludge from a water supply treatment plant, sludge from an air pollution control facility, or other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations or from community activities. The term does not include:

(1) solid or dissolved material in:
    a. domestic sewage; or
    b. irrigation return flows or industrial discharges; that are point sources subject to permits under Section 402 of the Federal Water Pollution Control Act Amendments (33 U.S.C. 1342);
(2) source, special nuclear, or byproduct material (as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et. seq.));
(3) manures or crop residues returned to the soil at the point of generation as fertilizers or soil conditioners as part of a total farm operation; or
(4) vegetative matter at composting facilities registered under IC 13-20-10

Spill – any unexpected, unintended, abnormal, or unapproved dumping, leakage, drainage, seepage, discharge or other loss of petroleum, hazardous substances, extremely hazardous substances, or objectionable substances. The term does not include releases to impermeable surfaces when the substance does not migrate off the surface or penetrate the surface and enter the soil.

Storm Sewer – a sewer (underground piped system) which carries storm and surface water and drainage

Stormwater – any surface flow, runoff, and drainage consisting entirely of water from any form of natural precipitation and resulting from such precipitation.

Stormwater Conveyance System – all publicly-owned facilities and conveyances used for collecting and conveying stormwater to, through and from drainage areas to the point of final outlet. Also called a Municipal Separate Storm Sewer System (MS4).

Stormwater Facilities – all stormwater and drainage components used for collecting and conveying stormwater including but not limited to conduits and appurtenant features; public streets, roads, alleyways, and highways; gutters; curbs; inlets, catch basins, manholes, and structures; pumping stations; pipes and culverts; outfalls; natural and human-made or altered channels, creeks, ditches, swales, and streams; retention or detention facilities; and other structural components and equipment that transport, move or regulate stormwater.

Stormwater Management Measure – a practice or a combination of practices selected to improve the quality of run-off discharges, divert run-off, or mitigate the impacts related to quantity run-off.

Stormwater Pollution Prevention Plan (SWPPP) – a plan developed minimize the impacts of stormwater pollutants resulting from construction activities.

Stormwater Quality – a measurement of pollutant loadings contained in stormwater runoff. An increase in stormwater quality is a reduction of the amount of pollutants in the stormwater runoff.

Stormwater Quality Measure – a practice, or a combination of practices, to control or minimize pollutants associated with stormwater runoff.

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.

Trained Individual – an individual who is trained and experienced in the principles of stormwater management, including erosion and sediment control as is demonstrated by state registration, professional certification, completion of coursework, or annual training that enable the individual to make judgments regarding stormwater control or treatment and monitoring.

Wastewater – any water or other liquid, other than uncontaminated stormwater, discharged from a facility.

Watercourse – a natural or manmade channel through which water flows; includes legal drains, creeks, ditches, swales, streams, and other open channels. Also called a Waterway.

Watershed – see Drainage Basin.

Waterway – see Watercourse.

Water Quality Volume (WQv) – The volume of run-off generated by one inch of rainfall on a site.

2.2 Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ACOE	Army Corps of Engineers
ASTM	American Society of Testing and Materials
BMP	Best Management Practice
CMP	Corrugated Metal Pipe
CSGP	Construction Stormwater General Permi
EPA	United States Environmental Protection Agency
HDPE	High Density Polyethylene
IAC	Indiana Administrative Code
IC	Indiana Code
IDEM	Indiana Department of Environmental Management
IDF	Intensity-Duration-Frequency
IDNR	Indiana Department of Natural Resources
INDOT	Indiana Department of Transportation
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer System
MS4GP	Municipal Separate Storm Sewer System General Permit
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O&M	Operations and Maintenance
PCPP	Perforated Corrugated Polyethylene Pipe
PP	Polypropylene
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
SCS	Soil Conservation Service
SDR	Standard Dimension Ratio
SWCD	Soil and Water Conservation District
SWPPP	Stormwater Pollution Prevention Plan
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USGS	United States Geological Survey

Chapter 3 - Submittal Requirements and Procedures

3.1 Minimum Requirements

(A) All projects shall comply with the requirements of this manual, including both Residential and Non-Residential properties. Refer to Figure 3-1 and Figure 3-2 for an overview of the submittal requirements for all projects.

(B) An *Application for Drainage Approval* and all other applicable documents must be submitted to the City for the purpose of obtaining stormwater drainage approval for all land disturbing projects, including activities in the public right-of-way, prior to construction and/or land disturbing activity.

3.2 Critical or Sensitive Areas

(A) A project is considered within a critical or sensitive area when the project site is located within, near, or tributary to an environmentally critical / sensitive area (e.g. wetlands) or an area with known erosion or drainage problems.

(B) The City may require projects within these critical or sensitive areas to comply with Stormwater Pollution Prevention Plan, erosion control, post-construction water quality, downstream analysis to ensure an adequate outlet is present, stormwater detention analysis, and other requirements as necessary to protect the critical or sensitive area.

3.3 Applications for Drainage Approval

(A) All Non-Residential properties and Residential properties with 3 or more units may refer to the submittal requirements summarized in Figure 3-1.

(B) A complete *Application for Drainage Approval* (Form B-1 in Appendix B) shall include the items identified on the *Application for Drainage Approval Submittal Checklist* (Form B-2 in Appendix B). A submittal will not be considered complete until all applicable items on the submittal checklist have been submitted. Application fees are non-refundable.

(C) New development projects may include with their *Application for Drainage Approval* the *Application for Stormwater User Fee Credit* found in the City of Beech Grove *Stormwater Utility Policies and Procedures Manual*, if applicable.

(D) A response letter with any comments generated as a result of the drainage review will be issued to the professional engineer/land surveyor responsible for completing the design.

(E) Upon notification of final drainage approval, 3 sets of professionally certified plans and specifications shall be submitted to the City.

3.4 Applications for Single or Double Family Dwellings

(A) Single and Double-Family Residential properties may refer to the submittal requirements summarized in Figure 3-2.

(B) A single or double family dwelling constructed or placed on an individual lot with land disturbance greater than or equal to 10,000 square feet shall require drainage approval from the City. Application fees are non-refundable.

(C) Submittal requirements shall be as defined in the *Application for Drainage Approval for Single and Double-Family Dwellings* (Form B-3 in Appendix B).

3.5 Applications for Special Circumstances

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

Figure 3-1: Submittal Requirements for Non-Residential Properties and Residential Properties with 3 or More Units

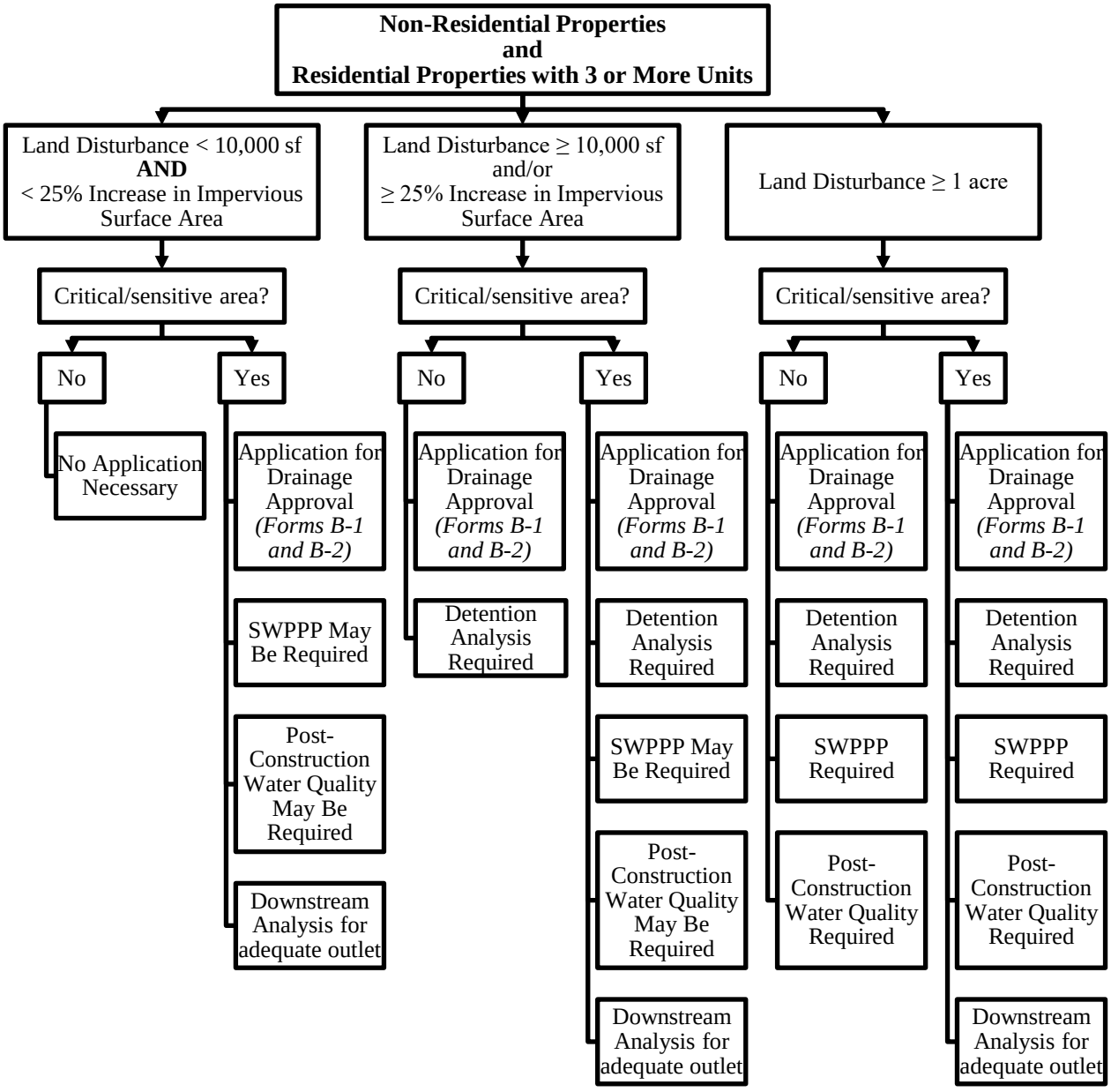
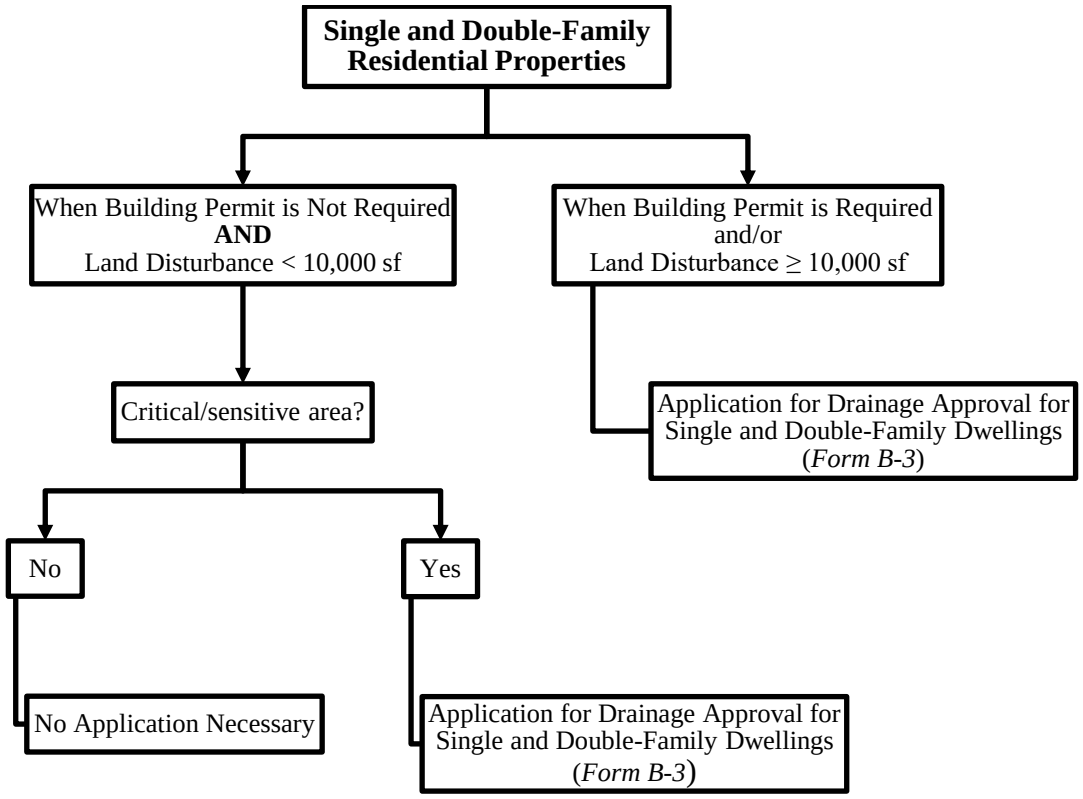


Figure 3-2: Submittal Requirements for Single and Double-Family Residential Properties



Chapter 4 - Stormwater Quantity Management

4.1 Hydrology

(A) Hydrologic Method

(1) The same hydrologic method shall be used for runoff peak determination for both pre-developed and post-developed condition calculations.

(2) Recommended hydrologic methods are listed in Part 4.1(G) of this manual. If a designer proposes an alternative method, the method must first be calibrated to local conditions and tested for accuracy and reliability. Complete source documentation shall be submitted for review and approval by the City. USGS Regression equations are not applicable for projects within Marion County.

(B) Design Storm Frequency

(1) Peak runoff calculations and stormwater facility design shall be based upon the design storm frequency for each type of facility as shown in Table 4-1.

Table 4-1: Design Storm Requirements for Stormwater Facility Design

Stormwater Facility Type	Return Interval
Storm Sewer (Enclosed Stormwater Facility)	10-year[(1)]
Storm Inlet Grates	10-year
Culvert (Public)	25-year
Bridge Structure [(2)]	100-year
Open Channel	10-year
Regulatory Floodway	100-year
Detention/Retention Facilities	Varies, see Part 4.3 of this manual

[(1)] *The water surface elevation resulting from a 10-year storm shall remain in the storm sewer pipe. The water surface elevation resulting from a 25-year storm shall remain within the drainage easement.*

(C) Upstream Off-Site Hydrologic Analysis

(1) Stormwater systems shall be designed to accommodate the following:

(a) Upstream off-site overland drainage and diffused stormwater flows
(b) Upstream drainage tiles, storm sewers, open channels, or other stormwater facilities
(c) Stormwater runoff and stormwater collected within the project site or property

(2) Due to the potential impact of site development on the character of a watershed and area-wide drainage, investigation of stormwater facilities outside the boundaries of the site shall be required as part of the design process except in the case where an oversized detention facility is provided in lieu of downstream analysis as described in Part 4.1(D) of this manual. The extent of these analyses shall depend upon the nature of the off-site stormwater facilities, and circumstances unique to each developing property. These guidelines for off-site analysis should be viewed by the designer as a minimum performance standard only, and are not intended to replace engineering judgment. As such, site conditions may dictate a more extensive off-site analysis than that set forth herein.

(D) Downstream Conveyance Analysis for Adequate Outlet

For all projects, stormwater and drainage from the site must be discharged into an adequate outlet or outlets so as not to adversely affect other landowners or receiving conveyance or waterways. The criteria for outletting are as follows:

(1) All storm sewers, subsurface drains and open channels shall outlet into an open channel, storm pipe, detention/retention facility or waterway.

(2) Detention/retention ponds shall outlet into an open channel, storm pipe or waterway.

(3) Infiltration areas may filter into the ground, but bypass or overflow routing must flow to a channel, pipe or waterway.

(4) Flood Routing discharge shall outlet to a storm conveyance including open channel, storm pipe, detention/retention facility, waterway or street curb and gutter.

(5) All outlets must have adequate capacity for proposed flows, must not be deteriorated, and can be maintained.

Analysis is required when connecting an outlet to an existing stormwater system. Include calculations showing that the receiving conveyance has adequate capacity for the total flow, including any additional flow from the proposed project area.

(E) Time of Concentration

(1) Time of concentration shall be the time it takes for runoff to travel from the hydraulically most distant point in the subarea to its outfall point under consideration. Time of concentration calculations shall consist of overland (sheet) flow time, shallow concentrated flow time, and travel time in channels, pipes, gutters, etc.

(2) A worksheet for time of concentration calculations is provided as Form B-6 in Appendix B.

(3) The minimum time of concentration shall be 5 minutes.

(4) Overland (Sheet) Flow

(a) The maximum overland (sheet) flow length shall be 300 feet for pervious area and 100 feet for impervious area. After these distances, flow over land shall be calculated as shallow concentrated flow or channel flow as appropriate.

(b) Overland flow time shall be calculated as follows:

Equation 4-1

$$T_t = \frac{0.007\,(n\,L)^{0.8}}{(P_2)^{0.5}\,S^{0.4}}$$

where:
T_t = travel time (hours, hr)
n = Manning's roughness coefficient for sheet flow – see Table 4-2
L = flow path length (feet, ft)
P_2 = rainfall depth for the 2-year, 24-hour rainfall (inches, in) – see Table 4-4
S = land slope (feet/feet, ft/ft)

Table 4-2: Manning's Roughness Coefficient *n* for Sheet Flow[1]

Type of Surface	*n*
Cultivated soils, cover > 20%	0.17
Cultivated soils, cover ≤ 20%	0.06
Fallow (with no residue)	0.05
Grass, bermudagrass	0.41
Grass, dense grass	0.24
Grass, short grass, prairie	0.15
Range	0.13
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Woods, dense underbrush	0.80
Woods, light underbrush	0.40

(5) Shallow Concentrated Flow

(a) Over long distances, overland (sheet) flow normally becomes shallow concentrated flow. The average velocity of shallow concentrated flow can be determined from Figure 4-1, in which the average velocity is a function of the watercourse slope and the type of surface.

(6) Channel Flow

(a) The travel time within storm sewers, gutters, open channels, or other stormwater conveyances can be determined by analyzing the hydraulic properties of the conveyances at bankfull or pipe full conditions. First the flow velocity shall be calculated using Manning's equation (Equation 4-2).

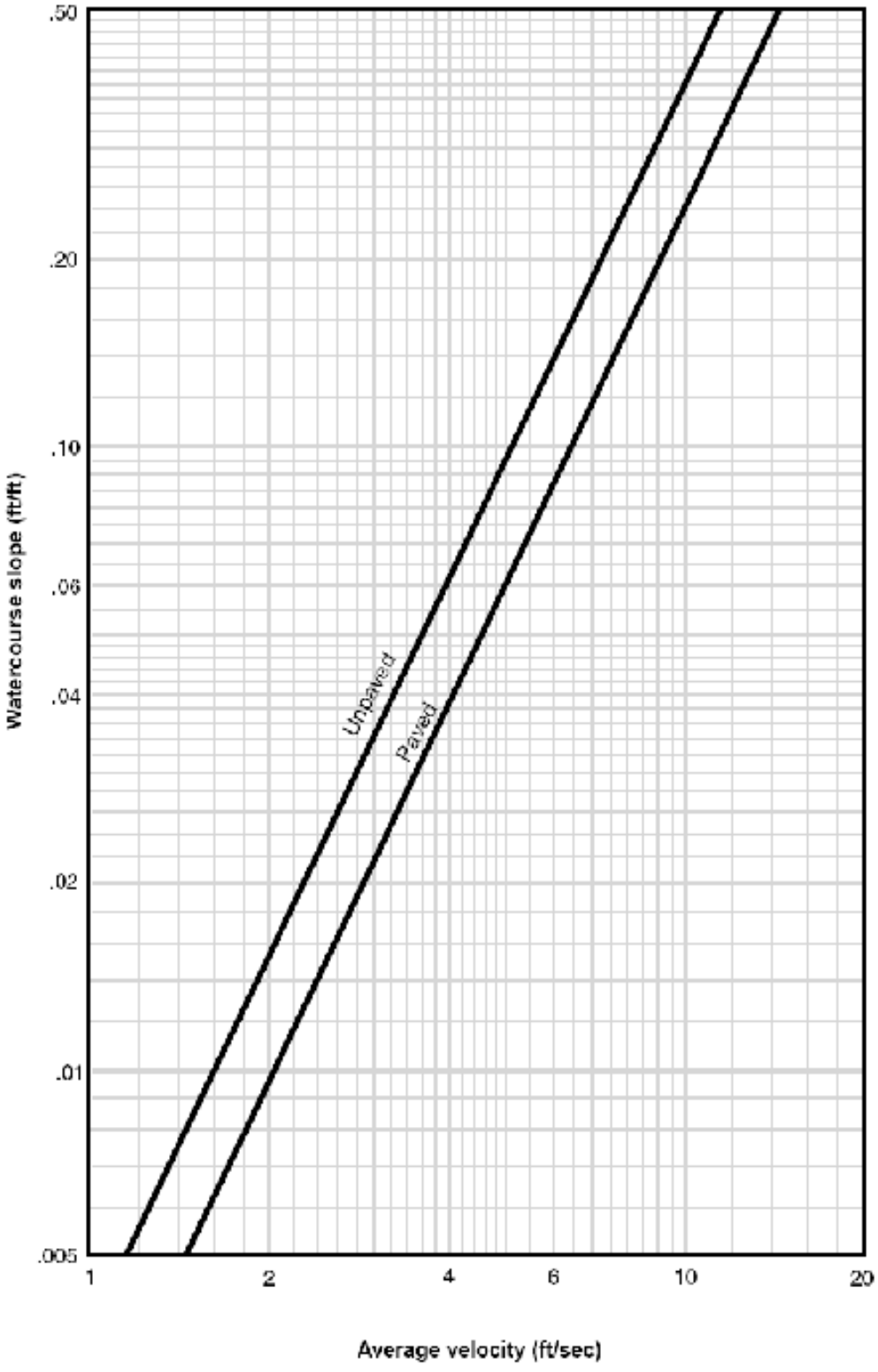
Equation 4-2

$$V = \frac{1.486}{n} R^{2/3} ½^{1/2}$$

where:
V = average velocity (feet per second, ft/s)
n = Manning's roughness coefficient for pipe or open channel flow – see Table 4-9, Table 4-12, and Table 4-13
R = hydraulic radius (feet, ft)
S = slope of energy grade line / channel slope (feet/feet, ft/ft)

[1] Adapted from Indiana LTAP Stormwater Drainage Manual (Feb 2008 Revision), Table 3.2.6.

Figure 4-1: Average Velocities for Estimating Travel Time for Shallow Concentrated Flow[2]



[2] Adapted from Indiana LTAP Stormwater Drainage Manual (Feb 2008 Revision), Figure 3.4.5.

(b) Using the flow velocity, the travel time can be calculated as follows:

Equation 4-3

$$T_t = \frac{L}{3600\ V}$$

where:
T_t = travel time in pipe, channel, gutter, etc. (hours, hr)
L = reach length (feet, ft)
V = average flow velocity in reach (feet per second, ft/s)

(F) Rainfall

(1) Intensity

(a) The rainfall intensity is the average rainfall rate for a given frequency, having a duration equal to the time of concentration. The rainfall intensities listed in Table 4-3 and depths listed in Table 4-4 shall be used for all hydrologic analysis in the City of Beech Grove.

Table 4-3: Rainfall Intensity (in/hr)[3]

Duration		Return Period					
Hours	**Minutes**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
0.08	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
0.50	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	0.26	0.30	0.35	0.39	0.43
24	1440	0.11	0.15	0.17	0.20	0.22	0.25

[3] Adapted from City of Indianapolis Stormwater Specifications Manual (Jan 2011 Revision), Table 202-02.

Table 4-4: Rainfall Depth (in)[4]

Duration		Return Period					
Hours	**Minutes**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
0.08	5	0.40	0.51	0.58	0.67	0.74	0.81
0.17	10	0.61	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
0.50	30	0.99	1.32	1.55	1.83	2.05	2.25
1	60	1.25	1.67	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	3.60	4.08	4.80	5.28	6.00

(b) After the design storm frequency has been selected and the total time-of-concentration has been determined, the rainfall intensity may be determined from Table 4-3 or Figure 4-2, the rainfall Intensity-Duration-Frequency (IDF) Curve for Indianapolis, Indiana. The intensities based on the appropriate durations and frequencies may also be determined by Equation 4-4. The coefficients were derived for the Indianapolis, Indiana area from a combination of locally derived data and NOAA isopluvial maps.

Equation 4-4

$$i = \frac{a}{(t + b)^{N}}$$

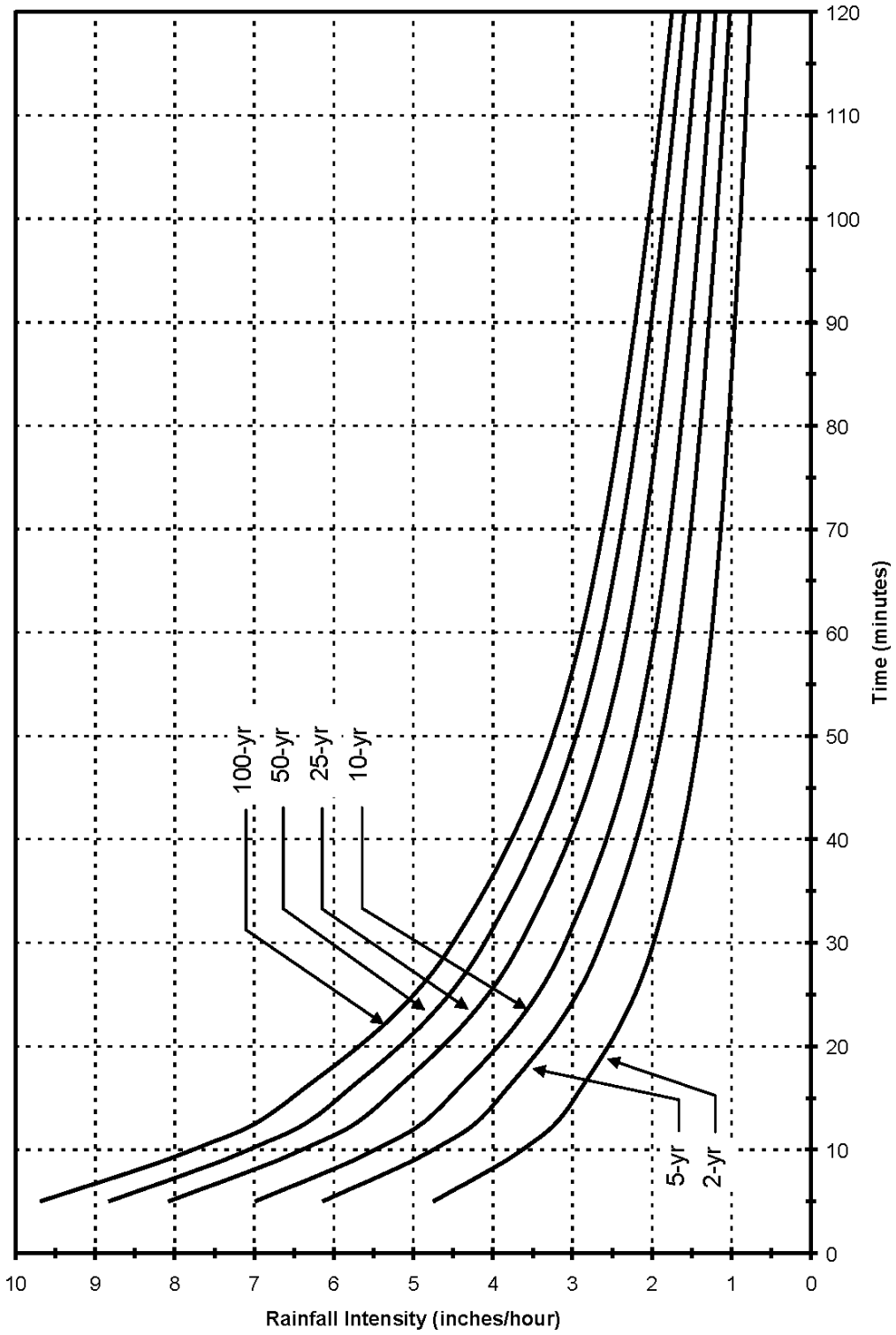
where:
i = rainfall intensity (inches per hour, in/hr)
t = time (minutes, min)
a, b, and N are fitting values listed in Table 4-5

Table 4-5: IDF Equation Values for Indianapolis, IN[5]

Return Period	***a***	***b***	***N***	R^2
2	32.852	7	0.7780	0.99966
5	46.060	8	0.7859	0.99958
10	56.974	9	0.7953	0.99952
25	72.739	10	0.8115	0.99942
50	84.475	11	0.8147	0.99940
100	92.718	11	0.8145	0.99942

[4] Adapted from City of Indianapolis Stormwater Specifications Manual (Jan 2011 Revision), Table 202-02.
[5] Adapted from City of Indianapolis Stormwater Specifications Manual (Jan 2011 Revision), Table 202-01.

Figure 4-2: Indianapolis IDF Curve[6]



[6] Adapted from City of Indianapolis Stormwater Specifications Manual (Jan 2011 Revision), Figure 202-01.

(2) Distribution

(a) The Second-Quartile Huff Type II Rainfall Distribution most accurately represents rainfall conditions in Marion County, Indiana. The Huff storm distribution is represented in Table 4-6 and shall be used for hydrograph computations.

Table 4-6: 50% Huff Curve Ordinates, Type II[7]

Cumulative Storm Time (%)	Cumulative 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

(G) Peak Flow Estimation

(1) Procedures to determine the peak runoff rate will depend on the size of the upstream drainage area, as follows:

(a) Rational Method

(i) The Rational Method is acceptable for calculating peak flows when all of the following conditions are true.

(1) The total tributary drainage area is 5 acres or less.

(2) The tributary drainage area has no existing depressional storage.

(3) Downstream Conveyance Analysis is not required, as discussed in Part 4.1(D) of this manual.

[7] Adapted from City of Indianapolis Stormwater Specifications Manual (Jan 2011 Revision), Table 202-03.

(ii) The Rational Method is based on:

Equation 4-5

$$Q = C\,i\,A$$

where:
Q = peak discharge (cubic feet per second, cfs)
C = runoff coefficient, or the ratio of peak runoff rate to average rainfall rate over the watershed during the time of concentration
i = rainfall intensity (inches/hour, in/hr)
A = contributing area of watershed under consideration (acres)

(iii) Runoff coefficients for use in the Rational Method as summarized in Table 4-7. Where the land use or features vary, a composite or weighted runoff coefficient C shall be required.

Table 4-7: Runoff Coefficients for Use in the Rational Method[8]

Type of Surface	**Runoff Coefficient, *C***
Non-Urban Areas	
Bare earth	0.55
Cultivated fields	0.30
Forested areas	0.20
Steep grass areas (slope 2:1)	0.60
Turf meadows	0.25
Urban Areas	
Apartments & Townhouses	0.70
Business, Commercial, & Industrial	0.85
Gravel	0.85
Parks, Cemeteries, & Unimproved Areas	0.30
Pavement (asphalt, concrete)	0.85
Roofs & watertight surfaces	0.90
Schools & Churches	0.55
Single family lots, < 12,000 sf (1/4 acre)	0.45
Single family lots, < 17,000 sf (1/3 acre)	0.40
Single family lots, > 21,000 sf (1/2 acre)	0.35
Soil, impervious	0.55
Soil, impervious (with turf)	0.45
Soil, moderately pervious	0.15
Soil, moderately pervious (with turf)	0.10
Soil, slightly pervious	0.25
Soil, slightly pervious (with turf)	0.20

[8] Adapted from City of Indianapolis Stormwater Specifications Manual (Jan 2011 Revision), Table 204-01.

(b) Runoff Hydrographs

(i) Hydrograph generation shall be required when any one or more of the following conditions are true.

(1) The total tributary drainage area is greater than 5 acres.

(2) The tributary drainage area has existing depressional storage.

(3) Downstream Conveyance Analysis is required, as discussed in Part 4.1(D) of this manual.

(4) Flows must travel through multiple storage basins.

(ii) The USDA Natural Resource Conservation Service (NRCS) method (also known as the SCS method) shall be used for calculating runoff and generating hydrographs. The method is summarized below; refer to the USDA NRCS National Engineering Handbook (NEH-4) publication for additional information.

(iii) The designer shall perform calculations for multiple storm durations to determine the maximum discharge produced and storage required.

(iv) First, the runoff curve number shall be determined. Runoff curve numbers are derived from comparisons of different combinations of the potential maximum retention after runoff begins (S_m) and the rainfall depth (P). The major factors that determine the runoff curve number are the hydrologic soil group, surface cover type, land treatment, hydrologic condition, and antecedent runoff condition. Soils are classified into four hydrologic soils groups according to their minimum infiltration rate. The USDA NRCS ("CS) "Soil Survey for Marion County, Indiana should be referenced for soils information.

(1) Refer to Table 4-8 in order to determine runoff curve numbers for various land uses and hydrologic soil groups. Where distinctive land features are known, use of a composite or "weighted" curve number shall be required. A worksheet for weighted curve numbers calculations is provided as Form B-7 in Appendix B.

(2) When two soils types are listed (e.g. drained / undrained) drained soil conditions should be used for the pre-developed / allowable release rate calculations and undrained conditions shall be assumed in the post-developed model for soils unaffected by the proposed construction.

(3) Agricultural soils shall assume crops in good condition for the predeveloped / allowable release rate and bare with no cover for the post developed model for soils unaffected by the proposed construction.

(v) The potential maximum retention after runoff begins (S_m) is related to the soil and cover conditions of the watershed.

Equation 4-6

$$S_m = \frac{1000}{CN} - 10$$

where:
S_m = potential maximum retention after runoff begins (inches, in)
CN = NRCS curve number

Table 4-8: Runoff Curve Numbers for Urban Areas[9]

Cover Type and Hydrologic Condition	Curve Numbers for Hydrologic Soil Group			
	A	B	C	D
Undeveloped Areas				
Cultivated land, with conservation treatment	62	71	78	81
Cultivated land, without conservation treatment	72	81	88	91
Meadow, good condition	30	58	71	78
Pasture or range land, good condition	39	61	74	80
Pasture or range land, poor condition	68	79	86	89
Wood or forest land, good cover	25	55	70	77
Wood or forest land, thin stand, poor cover, no mulch	45	66	77	83
Fully Developed Urban Areas				
Impervious areas, parking lots, roofs, & driveways	98	98	98	98
Impervious areas, paved streets and roads	98	98	98	98
Impervious areas, gravel streets and roads	76	85	89	91
Impervious areas, dirt streets and roads	72	82	87	89
Open space, good condition (grass cover > 75%)	39	61	74	80
Open space, fair condition (grass cover 50-75%)	49	69	79	84
Open space (lawns, parks golf courses, cemeteries), poor condition (grass cover < 50%)	68	79	86	89
Residential, 1/8 acre or less & townhouses (65% impervious)	77	85	90	92
Residential, 1/4 acre lots (38% impervious)	61	75	83	87
Residential, 1/3 acre lots (30% impervious)	57	72	81	86
Residential, 1/2 acre lots (25% impervious)	54	70	80	85
Residential, 1 acre lots (20% impervious)	51	68	79	84
Residential, 2 acre lots (12% impervious)	46	65	77	82
Urban Districts, commercial and business (85% impervious)	89	92	94	95
Urban Districts, industrial (72% impervious)	81	88	91	93
Developing Urban Areas				
Newly graded areas (no vegetation)	77	86	91	94

[9] Adapted from Indiana LTAP Stormwater Drainage Manual (Feb 2008 Revision), Table 3.3.3.

(vi) The initial abstraction (I_a) represents all of the rainfall losses before runoff begins, including water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. The initial abstraction is generally correlated with the soil and cover parameters and can be approximated by Equation 4-7.

Equation 4-7

$$I_a = 0.2\, S_m$$

where:
I_a = initial abstraction (inches, in)
S_m = potential maximum retention after runoff begins (inches, in) – from Equation 4-6

(vii) The cumulative rainfall (P) for a particular storm duration can be determined using Table 4-4. If the cumulative rainfall is less than or equal to the initial abstraction ($P \leq I_a$), then no runoff occurs. If the cumulative rainfall is greater than the initial abstraction ($P > I_a$), then the runoff can be calculated as follows.

Equation 4-8

$$Q_v = \frac{(P - I_a)^2}{(P - I_a) + S_m} = \frac{(P - 0.2\, S_m)^2}{P + 0.8\, S_m}$$

where:
Q_v = accumulated runoff (inches, in)
P = cumulative rainfall (inches, in)
I_a = initial abstraction (inches, in) – from Equation 4-7
S_m = potential maximum retention after runoff begins (inches, in) – from Equation 4-6

(viii) The peak runoff rate may be calculated using unit hydrographs. Using the dimensionless unit hydrograph and mass curve in Figure 4-3 and Figure 4-4, the following relationships are true.

Equation 4-9

$$T_l = 0.6\, T_c$$

where:
T_l = watershed lag time (hours, hr)
T_c = time of concentration (hours, hr) – calculated as described in Part 4.1(E)

Equation 4-10

$$\Delta D = 0.133\ T_c$$

where:
ΔD = duration of unit excess rainfall (hours, hr)
T_c = time of concentration (hours, hr) – calculated as described in Part 4.1(E)

Equation 4-11

$$T_p = \frac{\Delta D}{2} + T_l$$

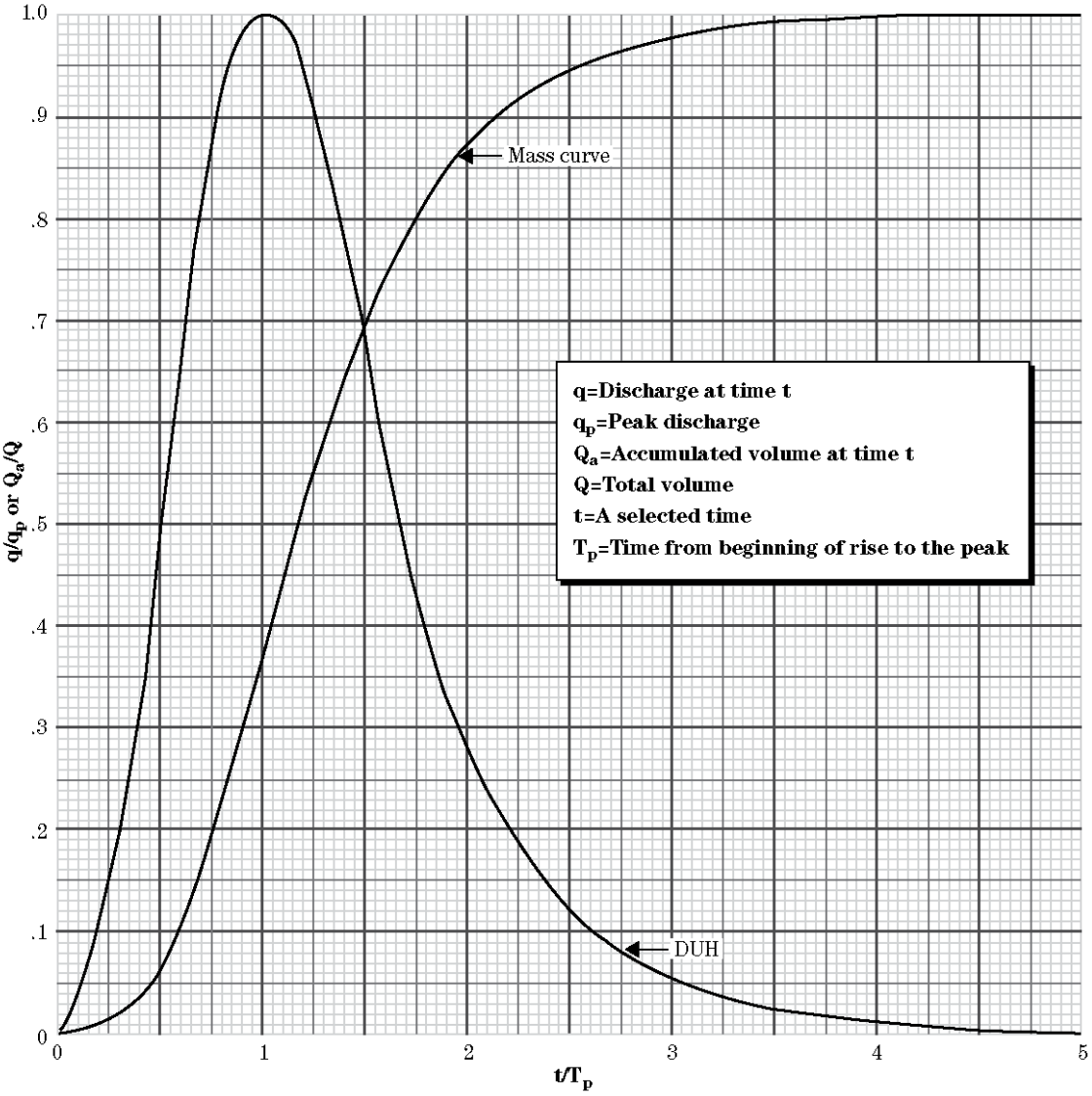
where:
T_p = time to peak (hours, hr)
ΔD = duration of unit excess rainfall (hours, hr) – from Equation 4-10
T_l = watershed lag time (hours, hr) – from Equation 4-9

Equation 4-12

$$q_p = \frac{484\ A\ Q_v}{T_p}$$

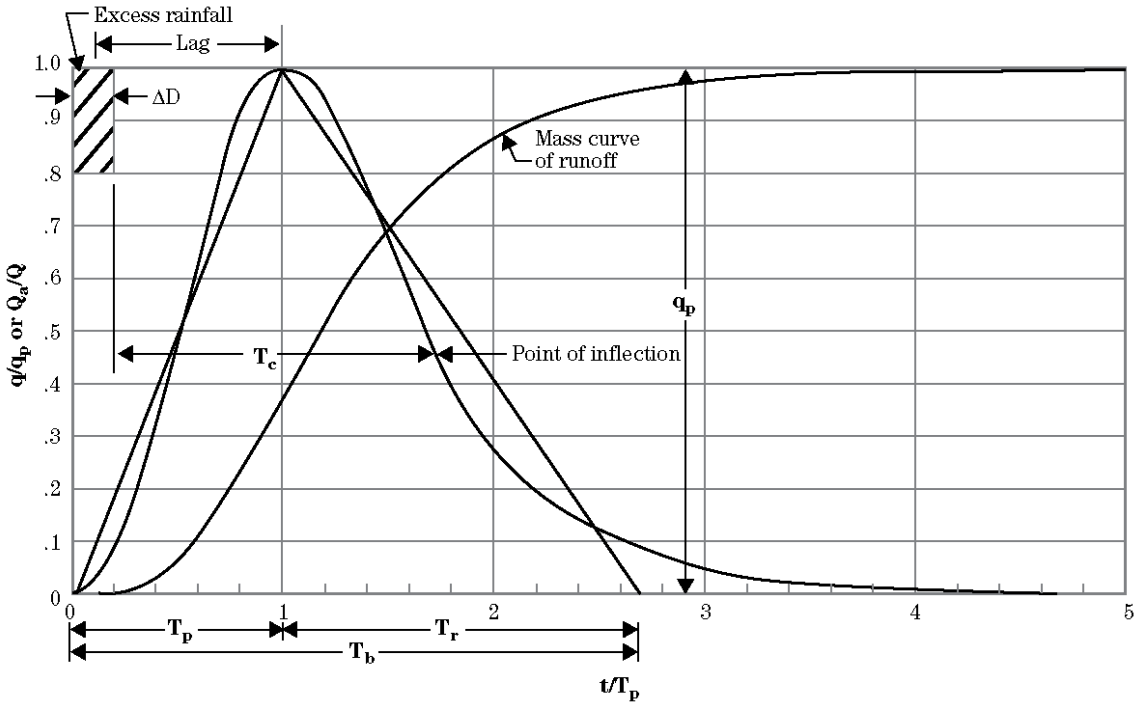
where:
q_p = peak discharge (cubic feet per second, cfs)
A = drainage area (square miles, mi^2)
Q_v = accumulated runoff (inches, in) – from Equation 4-8
T_p = time to peak (hours, hr) – from Equation 4-11

Figure 4-3: Dimensionless Unit Hydrograph and Mass Curve[10]



[10] Adapted from USDA NRCS Part 630 Hydrology National Engineering Handbook (Mar 2007 Revision), Chapter 16: Hydrographs, Figure 16-1.

Figure 4-4: Dimensionless Curvilinear Unit Hydrograph and Equivalent Triangular Hydrograph[11]



4.2 Stormwater System Design Requirements

(A) General Requirements

(1) This section provides the policies and technical requirements for analyzing the majority of stormwater facilities; however, more detailed analysis may be required depending on specific site characteristics.

(2) All streets shall be provided with an adequate storm drainage system consisting of curbs, gutters, storm sewers and inlets, or side ditches and culverts. Refer to Section 4.2(D)(3) for gutter spread and inlet spacing requirements.

(a) A 6-inch minimum perforated pipe underdrain shall be required on each side of all streets.

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

(3) Stormwater runoff and drainage from the site must be discharged into an adequate outlet or outlets so as not to adversely affect other landowners. The criteria for outletting is as follows:

(a) Open channels shall outlet into an existing open channel, provided that the stream bank and channel erosion shall not be aggravated and that the hazard of flooding shall not be increased.

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[11] Adapted from USDA NRCS Part 630 Hydrology National Engineering Handbook (Mar 2007 Revision), Appendix 16A: Elements of a Unit Hydrograph, Figure 16A-1.

(b) All storm sewers shall outlet into an open channel, storm sewer pipe, or stormwater detention/retention facility.

(c) Underdrains shall outlet into an open channel, storm sewer pipe, or stormwater detention/retention facility.

(d) Detention/retention facilities shall outlet into an open channel or storm sewer pipe.

(4) Down spouts and sump pump outlets discharging onto a grass surface shall be at least 10 feet from the edge of pavement, sidewalk, trail, pedestrian facilities, or back of curb but no closer to the road than the building setback line.

(B) Open Channel Design

(1) Design Criteria

(a) In general, Manning's equation (Equation 4-13) may be used for open channel flow calculations for unobstructed channels. Open channels with culverts may require additional analysis.

Equation 4-13

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

where:
Q = discharge flow (cubic feet per second, cfs)
n = Manning's roughness coefficient – see Table 4-9
A = cross sectional area (square feet, ft^2) – see Figure 4-5
R = hydraulic radius (feet, ft) – see Figure 4-5
S = slope of energy grade line / channel slope (feet/feet, ft/ft)

(b) Backwater analysis shall be performed to determine the 100-year water surface elevation along open channel systems. The 100-year flood boundary shall be delineated on the plans.

(c) Any alteration of an existing open channel shall be sized as described below or for the capacity of the existing channel, whichever is greater. Provisions shall be made to prevent flooding of adjacent structures, buildings, or properties for the peak 100-year storm event.

(d) For all areas within their jurisdiction, Indiana Department of Natural Resources (IDNR), Indiana Department of Environmental Management (IDEM), and United States Army Corps of Engineers (USACE) approval must be obtained and requirements must be followed.

(e) All open channels:

(i) Shall have a minimum channel velocity of 2 feet per second to prevent sediment deposition within the channel,

(ii) Shall accommodate the peak runoff from the 10-year storm event,

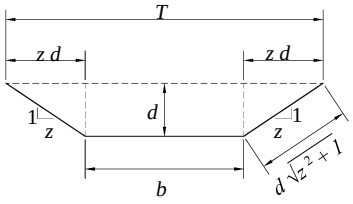
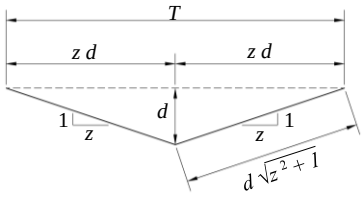
(iii) Shall accommodate the peak runoff from the 25-year storm event without overflowing the banks, and

(iv) Shall accommodate the peak runoff from the 100-year storm event within the drainage easement.

Table 4-9: Manning's Roughness Coefficient *n* for Open Channels[12]

Type of Channel Lining	*n*
Asphalt, rough	0.016
Asphalt, smooth	0.013
Concrete, rough, clean	0.016
Concrete, rough, some gravel / debris in bottom	0.017
Concrete, smooth, clean	0.013
Concrete, smooth, some gravel / debris in bottom	0.015
Earth, fairly uniform section, clean sides and cobble bottom	0.035
Earth, fairly uniform section, clean sides and gravel bottom	0.028
Earth, fairly uniform section, dense weeds	0.033
Earth, fairly uniform section, grass and some weeds	0.028
Earth, fairly uniform section, no vegetation	0.024
Earth, uniform section, no vegetation	0.017
Earth, uniform section, with short grass or gravelly soils	0.024
Gravel	0.023
Minor streams, fairly regular section, heavy brush on banks	0.060
Minor streams, fairly regular section, light brush on banks	0.040
Minor streams, fairly regular section, some grass and little to no brush	0.033
Natural, brush on sides and clean bottom	0.090
Natural, dense weeds and brush	0.100
Vegetated, grass, length 2"	0.060
Vegetated, grass, length 4-6"	0.075
Vegetated, grass, length 12"	0.090
Vegetated, grass, length 24"	0.150

Figure 4-5: Typical Open Channel Cross-Sectional Configurations

Section		Area A	Wetted Perimeter P_w	Hydraulic Radius R	Top Width T
Trapezoid		$b\,d + z\,d^2$	$b + 2\,d\sqrt{z^2+1}$	$\frac{b\,d + z\,d^2}{b + 2\,d\sqrt{z^2+1}}$	$b + 2\,z\,d$
V-ditch		$z\,d^2$	$2\,d\sqrt{z^2+1}$	$\frac{z\,d^2}{2\sqrt{z^2+1}}$	$2\,z\,d$

[12] Adapted from various sources.

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

(g) Flood routing calculations shall be provided in accordance with Part 4.5 of this manual.

(2) Channel Geometry

(a) The cross-sectional geometry of open channels may be v-shaped, trapezoidal, or two-staged.

(b) Channel Grade

(i) Longitudinal slopes less than 2.0% shall require a subsurface underdrain to prevent chronic wetness in the invert of open channels.

(ii) Longitudinal slopes of vegetated channels shall be no less than 1.0%.

(iii) Longitudinal slopes between 0.3% and 1.0% shall be paved using 6-inch reinforced concrete or shall be provided with a fabric-wrapped, washed gravel trench.

(iv) No channel shall have less than a 0.3% longitudinal slope.

(v) Alternative channel treatments shall be subject to approval of the City.

(3) Channel Lining

(a) Channel lining shall be designed to accommodate the 10-year peak runoff. The channel lining material shall be selected such that the design shear stress is less than the maximum permissible shear stress for the lining material.

(b) Shear stress analysis for channel lining selection shall be in accordance with the Federal Highway Administration procedure. The method is summarized below; refer to *Federal Highway Administration Hydraulic Engineering Circular No. 15, Third Edition (HEC-15) Design of Roadside Channels with Flexible Linings* publication for additional information.

(c) The process of channel lining design shall follow:

Select a channel lining material and determine the permissible shear stress (τ_p) from

(i) Table 4-10.

(ii) Choose an initial Manning's *n* value. Selected values are summarized in Table 4-11.

Table 4-10: Summary of Permissible Shear Stress for Various Types of Cover[13]

Protective Cover	Underlying Soil	τ_p (lb/ft^2)
Class A Vegetation(1)		3.7
Class B Vegetation(1)		2.1
Class C Vegetation(1)		1.0
Class D Vegetation(1)		0.6
Class E Vegetation(1)		0.35
Bare Soil Cohesive (PI = 10)	Clayey Sands Inorganic Silts Silty Sands	0.037-0.095 0.027-0.110 0.024-0.072
Bare Soil Cohesive (PI ≥= 20)	Clayey Sands Inorganic Silts Silty Sands Inorganic Clays	0.094 0.083 0.072 0.140
Bare Soil Non-cohesive (PI < 10)	Finer than coarse sand D_{75} = 0.05 in Fine gravel D_{75} = 0.3 in Gravel D_{75} = 0.6 in	0.037-0.095 0.027-0.110 0.024-0.072
Gravel	Coarse gravel D_{50} = 1 in Very coarse gravel D_{50} = 2 in	0.40 0.80
Riprap	D_{50} = 0.5 ft D_{50} = 1.0 ft	2.4 4.8

(1) *The classification of grass channel lining depends on the degree of retardance as a function of the height and density of grass cover. A summary can be found in HEC-15, Table 4.1.*

Table 4-11: Typical Roughness Coefficients for Selected Linings[14]

Lining Type	Maximum	Typical	Minimum
Concrete Riprap	0.015	0.013	0.011
Asphalt	0.018	0.016	0.016
Bare Soil	0.025	0.020	0.016
Soil Cement	0.025	0.022	0.020
Open-weave Textiles	0.028	0.025	0.022
Turf Reinforcement Mat	0.036	0.030	0.024
Grouted Riprap	0.040	0.030	0.028
Stone Masonry	0.042	0.032	0.030
Rock Cut (smooth, uniform)	0.045	0.035	0.025
Erosion Control Blankets	0.045	0.035	0.028

[13] Adapted from City of Indianapolis Stormwater Specifications Manual (Jan 2011 Revision), Table 303-01 and Federal Highway Administration Hydraulic Engineering Circular No. 15, Third Edition (HEC-15) Design of Roadside Channels with Flexible Linings, Table 2.3.

[14] Adapted from Federal Highway Administration Hydraulic Engineering Circular No. 15, Third Edition (HEC-15) Design of Roadside Channels with Flexible Linings, Table 2.1.

(iii) Calculate normal flow depth (D) at design discharge, using Manning's formula.

(iv) Compute maximum shear stress (τd) at normal depth from Equation 4-14.

Equation 4-14

$$\tau_d = (62.4 \text{ lb/ft}^3)\, D\, S$$

where:
τ_d = maximum shear stress (pounds per square foot, lb/ft^2)
D = normal flow depth (feet, ft)
S = average channel slope (feet/feet, ft/ft)

(v) Confirm $\tau_d < \tau_p$; therefore, the channel lining is acceptable. If $\tau_d \geq \tau_p$; consider the following options:
(1) Choose a more resistant channel lining material.
(2) Decrease channel slope.
(3) Decrease channel slope in combination with drop structures.
(4) Increase channel width and/or flatten side slopes.

(d) Vegetated Channels

(i) The maximum allowable side slope of vegetated channels shall be 3 horizontal to 1 vertical (3:1).

(ii) The maximum allowable bottom width of trapezoidal vegetated channels shall be 15 feet. Consider a two-stage ditch design if the bottom width will be greater than 15 feet to provide a low flow channel.

(iii) Vegetated channels are not acceptable for channels intended to convey continuous low or trickling flows (i.e. such as for a detention pond outlets, perimeter drains, sump lines, etc.). An enclosed storm sewer, subsurface tile, or riprap low flow channel shall be required.

(e) Armored Channels

(i) Armoring may include turf reinforcement mat, riprap, or other materials to stabilize and protect the channel side slopes. Manufactured products shall be installed per the manufacturer's instructions.

(ii) The maximum allowable side slope of armored channels shall be 1.5 horizontal to 1 vertical (1.5:1).

(iii) The maximum allowable side slope vegetated channels with turf reinforcement shall be 3 horizontal to 1 vertical (3:1).

(iv) For riprap side slopes, the toe of the riprap shall be extended below the channel bed a minimum distance of 1 foot or 1.5 D_{50} (whichever is greater) except where alternate methods are approved or the channel bottom is also covered with riprap.

(v) Riprap layer thickness shall be designed according to INDOT standards.

(C) Culvert Design

(1) Design Criteria

(a) Culverts shall be sized in accordance with the *Federal Highway Administration's Hydraulic Design Series No. 5 (HDS-5) Hydraulic Design of Highway Culverts*. Computer models such as the *Federal Highway Administration's HY-8 Culvert Hydraulic Analysis Program* may be used to perform culvert and bridge design computations.

(b) All culverts:

(i) Shall be a minimum of 12 inches,

(ii) Shall have a minimum full-flow velocity of 2.5 feet per second to prevent sedimentation in the pipe,

(iii) Are recommended to have full-flow velocity less than 10.0 feet per second,

(iv) Shall have a minimum of 12 inches of cover for RCP culverts and a minimum of 24 inches of cover for flexible (HDPE, PP, and PVC) culverts.

(v) Shall be designed to safely pass the peak runoff from the 25-year storm event without overtopping the roadway, and

(vi) Shall result in a ponding water depth of no more than 6 inches above the surface of the pavement during peak runoff from the 100-year storm event.

(c) CMP is not an approved material and shall not be used in public facilities or ROW.

(d) Flood routing calculations shall be provided in accordance with Part 4.5 of this manual.

(2) Outlet Protection

(a) Outlet protection and energy dissipaters shall be used wherever the velocity of the flow leaving a culvert exceeds the erosive velocity of the downstream channel.

(b) Outlet Protection Apron Design

(i) Outlet protection aprons shall be provided in all areas where stormwater is flowing from concentrated flow system and where a pipe system discharges to a vegetated area or waterway.

(ii) Rock is to be placed over geotextile fabric.

(iii) If possible, determine the tailwater conditions for the channel. If tailwater is less than one-half the discharge flow depth (pipe diameter, if flowing full), minimum tailwater conditions exist and Figure 4-6 applies. Otherwise, maximum tailwater exists and Figure 4-7 applies.

(iv) If tailwater conditions are unknown or if both minimum and maximum tailwater conditions may occur, the outlet protection apron shall be designed for both conditions, as shown in Figure 4-8.

Figure 4-6: Outlet Protection with Minimum Tailwater Condition

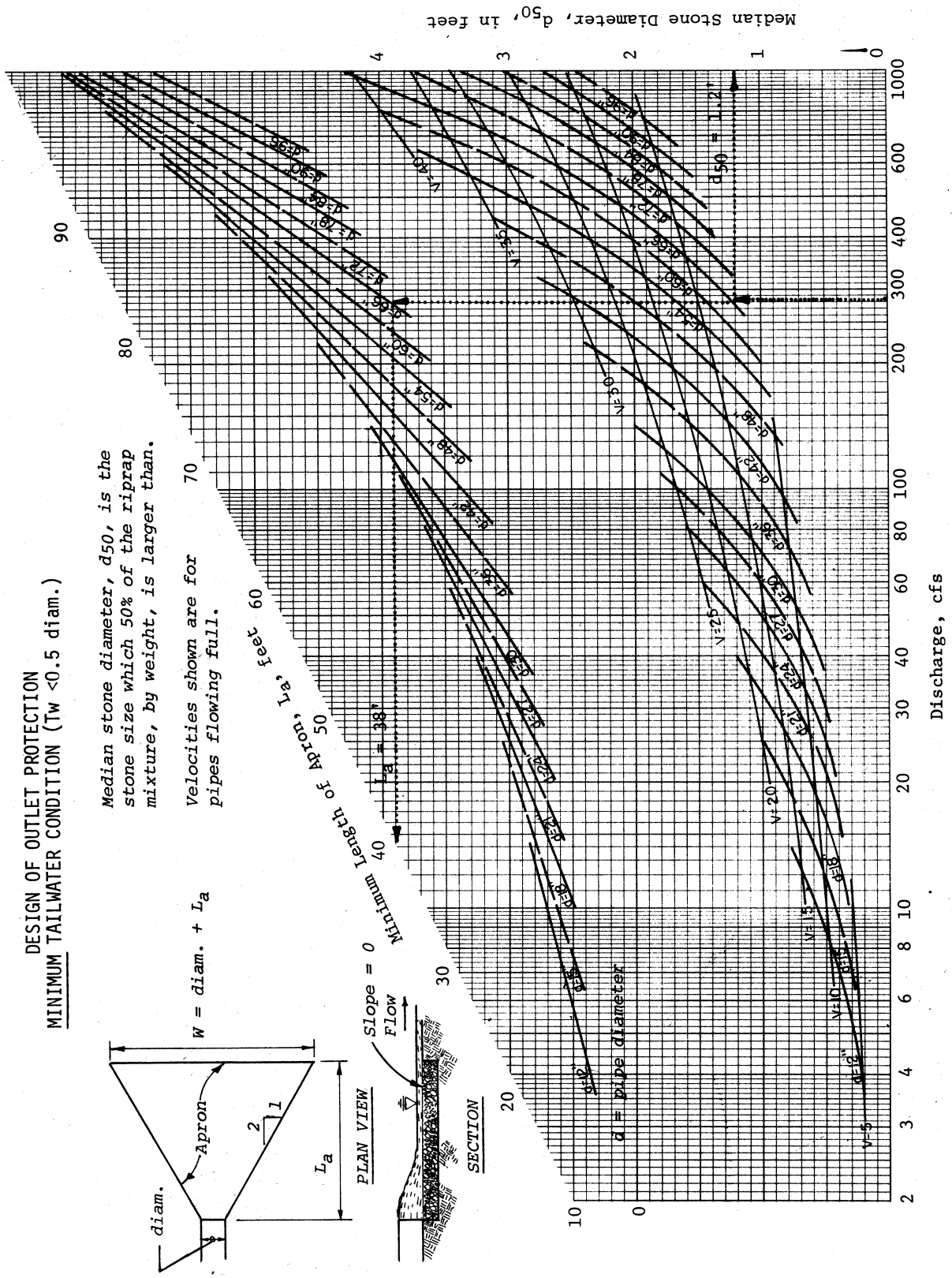


Figure 4-7: Outlet Protection with Maximum Tailwater Condition

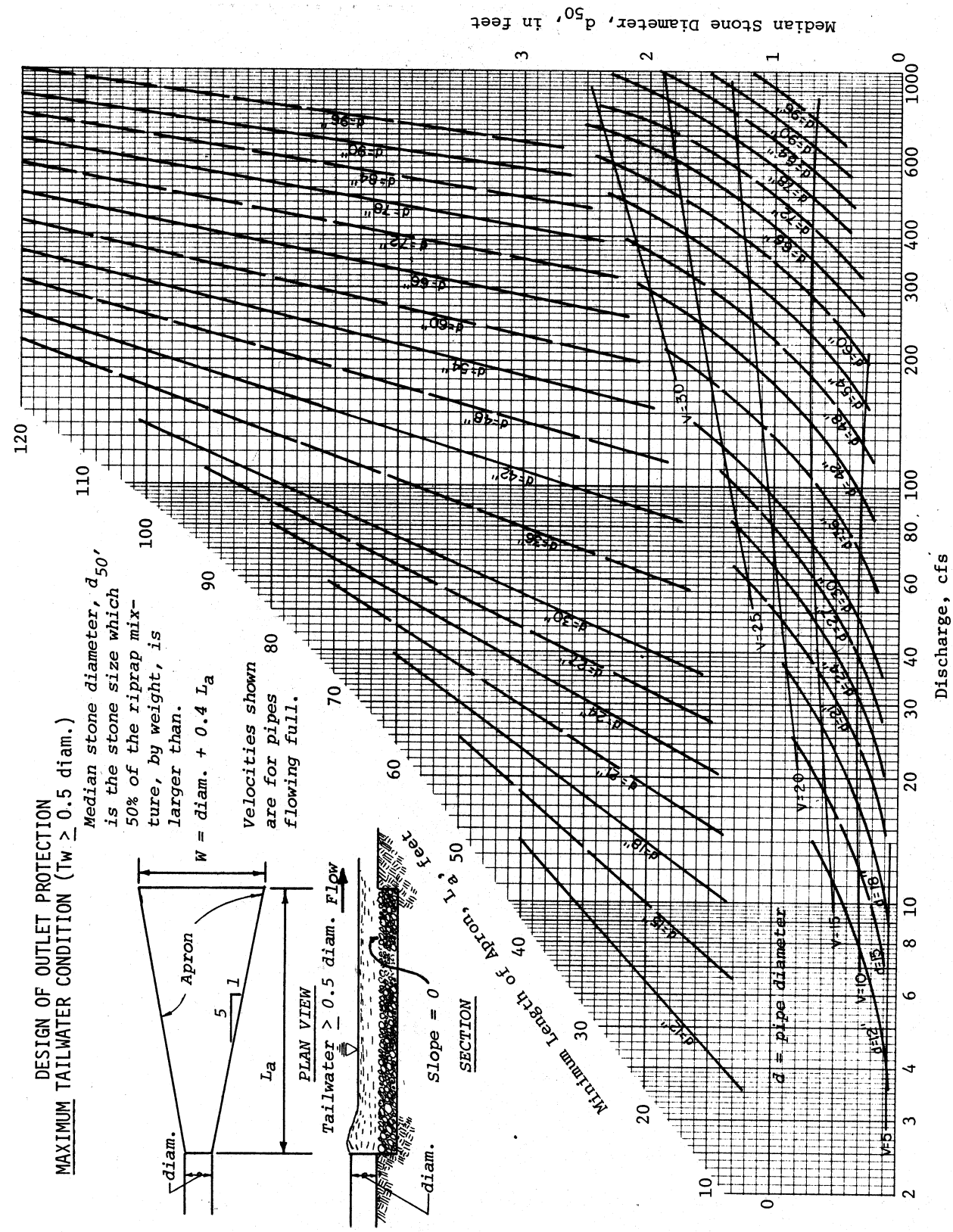
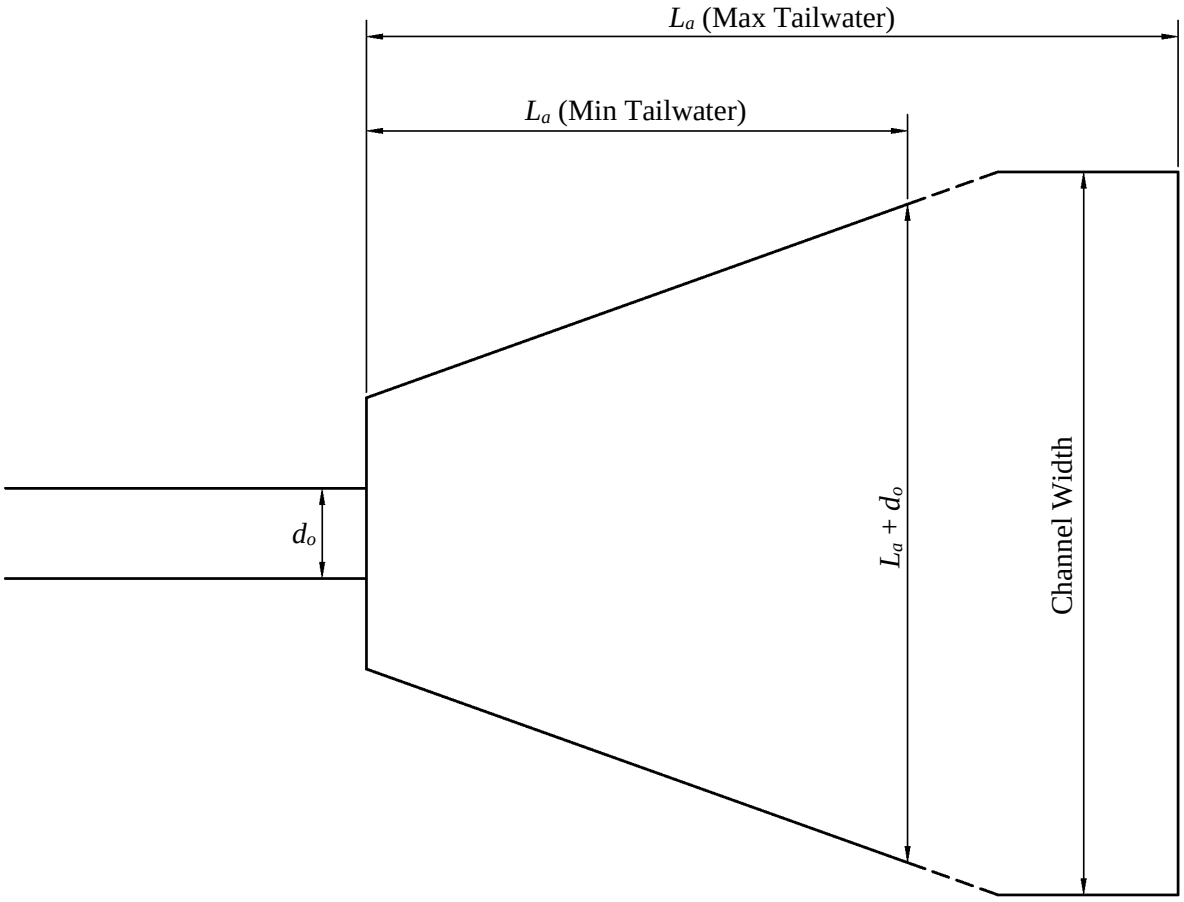


Figure 4-8: Outlet Protection Apron for Uncertain Tailwater Conditions



(i) Determine the minimum apron length and median riprap diameter, d_{50}, using the appropriate curves from Figure 4-6 and Figure 4-7.

(1) For pipes flowing full, use the depth of flow, d, and the design discharge to obtain the apron length, L_a, and median riprap diameter, d_{50}.

(2) For pipes flowing partially full, use the depth of flow, d, and velocity, v, on the lower curves of the appropriate figure to find the intersection of the d and v curves. From the intersection point select the appropriate median riprap diameter, d_{50}, from the scale on the right. From the intersection point, move vertically to the upper d curves to obtain the apron length, L_a, from the scale on the left.

(D) Storm Sewer System Design

(1) Design Criteria

(a) Storm sewers shall operate under gravity flow conditions.

(b) All storm pipes:

(i) Shall be a minimum of 12 inches,

(ii) Shall have a minimum full-flow velocity of 2.5 feet per second (fps) to prevent sedimentation in the pipe,

(iii) Are recommended to have full-flow velocity less than 10.0 fps,

(iv) Shall have a minimum grade of 0.001 feet per foot,

(v) Shall have a minimum of 12 inches of cover for RCP and a minimum of 24 inches of cover for flexible (HDPE, PP, and PVC) pipe.

(vi) Shall be designed to safely pass the peak runoff from the 10-year storm event with the free water surface below the crown of the pipe (design discharge shall be no more than 90% of the pipe capacity),

(vii) Shall be designed such that the peak 25-year storm event stays within the system and does not cause surface flooding,

(viii) Shall result in a ponding water depth of no more than 6 inches above the surface of the pavement during peak runoff from the 100-year storm event.

(ix) An orifice plate or other device should control the rate of release for detention ponds where a 12-inch pipe will not limit the rate or release as required. The minimum stormwater orifice size is 4 inches.

(x) All outlet pipes into ponds shall have inverts above the normal pool.

(c) Manning's equation (Equation 4-13) is acceptable for sizing storm pipes for gravity flow, non-submerged outfall conditions. Typical Manning's *n* values are provided in Table 4-12.

(d) Design computations shall be on the *Storm Sewer System Design Form* (Form B-8 in Appendix B) or a computer program output with similar information may be submitted.

(e) Storm systems with the potential of operating under submerged outfall conditions shall include hydraulic grade calculations using a reasonable tailwater elevation. Head loss computations shall be included with the hydraulic grade calculations. Backflow prevention may be required if the system's capacity will be limited by submerged conditions.

(f) Flood routing calculations shall be provided in accordance with Part 4.5 of this manual. If an overflow route is not available, the storm sewer system shall be designed for the 100-year storm even within the system and inlets must pass the 100-year storm through the grate opening at 50% clogged.

Table 4-12: Manning's Roughness Coefficient *n* for Closed Conduits[15]

Type of Conduit	*n*
Brick	0.016
Cast iron pipe, coated	0.013
Cast iron pipe, uncoated	0.014
Concrete pipe	0.013
Corrugated-metal pipe or pipe arch	0.018-0.030
Plastic, smooth interior (HDPE, PP, PVC)	0.010
Vitrified clay pipe	0.012-0.014

(2) Storm Structure Requirements

(a) Storm structures shall be provided at the following locations:

(i) Where two or more storm sewers converge,

(ii) Where the pipe size changes,

(iii) Where the pipe material changes,

(iv) Where a change in horizontal alignment occurs,

(v) Where a change in pipe grade occurs, and

(vi) At intervals not to exceed 400 feet for pipes less than 48 inches in diameter and 500 feet for pipes 48 inches and larger.

(b) A minimum drop of 0.1-foot shall be provided in each storm structure.

(c) When changing pipe sizes in a storm structure, the crowns of the pipes shall be matched unless hydraulic grade line modeling shows that another arrangement would be as effective.

(d) Grate castings shall not be located in the path where a pedestrian or bicycle is likely to travel.

(3) Gutter Spread and Inlet Spacing

(a) Flow capacities of storm inlet grates shall be calculated using weir and orifice flow equations with consideration given to square footage of grate open areas and flow perimeter dimensions provided by casting manufacturers.

(b) Manning's *n* for gutter flow are provided in Table 4-13.

(c) Calculations shall follow the procedures outlined in the *Federal Highway Administration Hydraulic Engineering Circular No. 12 (HEC-12) Drainage of Highway Pavements* or the nomograph provided in Figure 4-9.

(d) Inlet spacing and grate openings shall be designed to pass the 10-year storm peak flow with 50% of the inlet area clogged.

(e) Inlets shall be spaced to prevent water spread over 6 feet on pavement or 1/2 of the driving lane, whichever is less. No more than 1.5 inches of ponding above a street inlet grate will be permitted. At a minimum, street inlets shall be placed at all low areas and spaced a maximum of 400 feet apart or 400 feet from the high point in the street.

(f) For all other inlet locations, no more than 6 inches of ponding above the inlet grate will be permitted.

(g) When underground detention is utilized, inlet grate openings shall be designed to pass the 100-year peak flow with 50% of the inlet area clogged with a maximum 6 inches of ponding depth.

[15] Adapted from various sources.

(h) Bypass flow from upstream inlets shall be incorporated into inlet calculations.

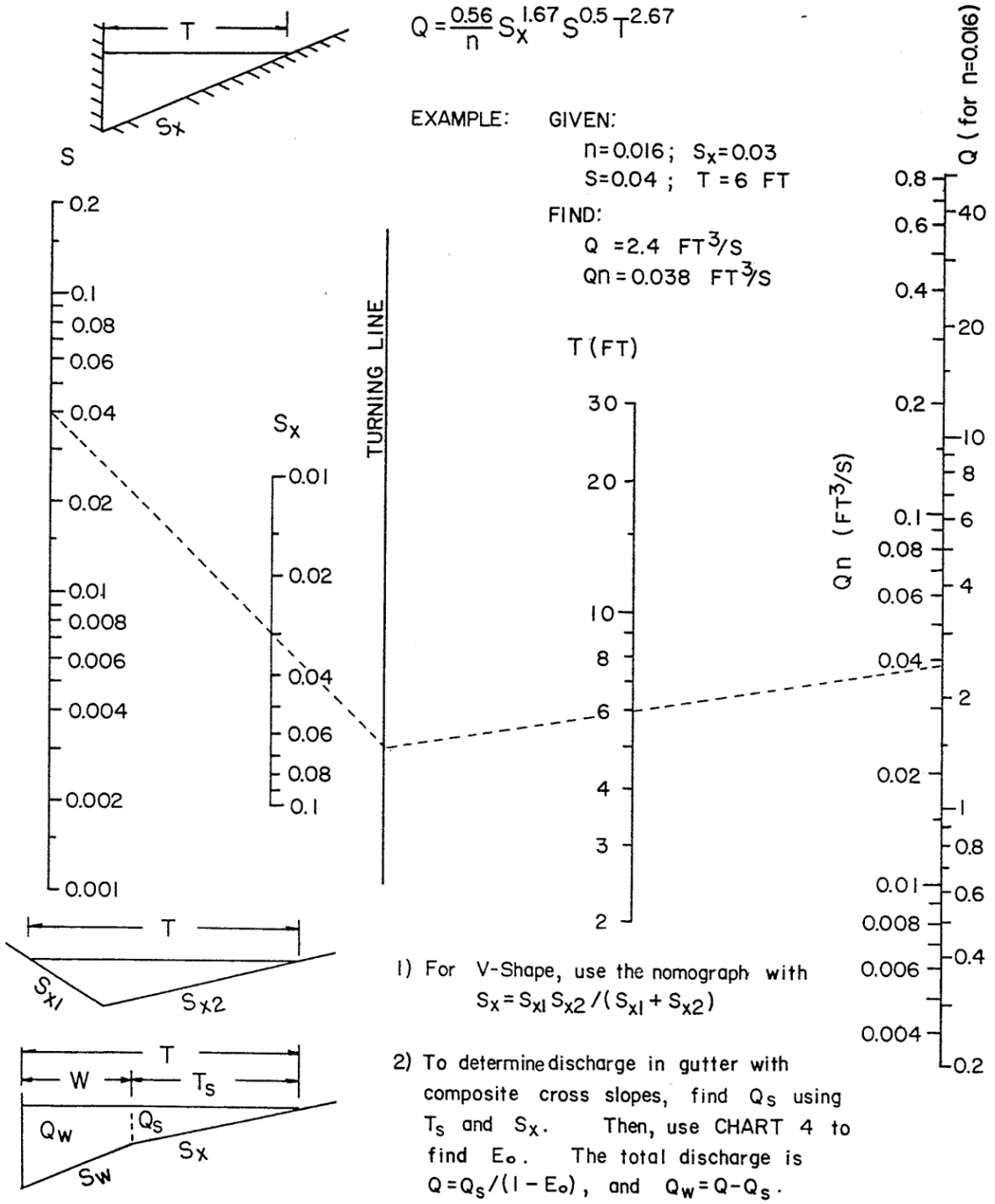
(i) Manufacturer's literature should provide the inlet casting's flow-intercept efficiency coefficient. The *Federal Highway Administration Hydraulic Engineering Circular No. 12 (HEC-12) Drainage of Highway Pavements* may also be used.

Table 4-13: Manning's Roughness Coefficient *n* for Street and Highway Gutters[16]

Type of Surface	***n***
Asphalt pavement	0.013
Concrete gutter	0.012
Concrete gutter with asphalt pavement	0.013

[16] Adapted from various sources.

Figure 4-9: Gutterline Capacity Nomograph



(E) Underdrain and Hybrid Ditch System Design

(1) Design Criteria

(a) Underdrains:

(i) Shall be a minimum of 6 inches in diameter for areas receiving only subsurface flow,

(ii) Shall be a minimum of 12 inches in diameter for areas receiving both surface (downspouts, yard inlets, etc.) and subsurface flows,

(iii) Shall have a minimum of 24 inches of cover, and

(iv) Shall have an access structure at minimum 300-foot intervals.

(2) General Requirements

(a) For residential lots with basements, a "tee" should be provided to the lot's underdrain or to a stormwater structure for the purpose of discharging footing drains and sump pumps directly into the drain.

(b) Residential sump pumps shall not discharge into pavement underdrains.

(c) Flood routing calculations shall be provided in accordance with Part 4.5 of this manual.

4.3 Detention/Retention Design

(A) Stormwater Detention/Retention

(1) Stormwater detention analysis shall be required for all new developments and site redevelopment where land disturbance is greater than or equal to 10,000 square feet or where the development or redevelopment will increase the impervious surface area of the site by 25% or more. In all instances an adequate outlet must be present (refer to section 4.1(D))

(2) Allowable Release Rates

(a) All impervious area of the project site shall drain through a detention/retention facility.

(b) When computing the discharges for detention/retention basin design the entire upstream area that contributes runoff to the design point must be included in the computations. Upstream drainage areas may be bypassed and therefore not considered in the computations as long as the flows are bypassed for all levels of flow. If any overflow discharge will be routed to the detention/retention facility, the drainage area may not be reduced.

(c) The peak runoff for a stormwater facility must meet the following minimum hydraulic requirements with a minimum allowable orifice size of 4 inches.

Equation 4-15

$$Q_{2p} = 0.5\ Q_{2e}$$
$$Q_{10p} = 0.5\ Q_{10e}$$
$$Q_{100p} = Q_{10e}$$

where:
Q_{2p} = 2-year runoff rate for the proposed (developed) condition
Q_{2e} = 2-year runoff rate for the existing condition
Q_{10p} = 10-year runoff rate for the proposed (developed) condition
Q_{10e} = 10-year runoff rate for the existing condition
Q_{100p} = 100-year runoff rate for the proposed (developed) condition

(d) An anti-clog device is required for the outlet control orifice.

(e) Outlet control structures should be designed to operate as simply as possible and shall require little or no maintenance or attention for proper operation. Discharges must flow into existing or planned downstream channels, conveyances, or storm pipes so as to not exceed the maximum permitted peak flow rate of the receiving conveyance. Outlet structures shall be constructed of pre-cast concrete. CMP is not an approved material.

(f) In the event the downstream receiving conveyance is inadequate to accommodate the release rate as determined above, then the allowable release rate shall be reduced to that rate permitted by the capacity of the receiving conveyance.

(3) Storage Volume

(a) Storage volume shall be calculated using runoff hydrographs and routing techniques as described in *USDA Natural Resources Conservation Service (NRCS) Conservation Engineering Division Technical Release 55 (TR-55) Urban Hydrology for Small Watersheds, Chapter 6: Storage Volume for Detention Basins*.

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

(4) General Detention/Retention Facility Requirements

(a) A minimum of 90% of the water storage volume shall be released from the facility at the design release rate within 48 hours of the start of the peak 100-year storm event.

(b) Detention/retention facilities (including underground facilities) shall be designed with an additional 10% available capacity to account for sediment accumulation in order to allow the facility to function for reasonable periods between cleansings. Facilities should be designed to collect sediment and debris upstream of detention areas to minimize cleaning and removal costs.

(c) No building or structure may be located within 25 feet horizontally of the 100-year water surface elevation of a detention/retention facility.

(d) No electric pole or high voltage electric lines may be located within 20 feet horizontally of any detention/retention facility, permanent or temporary.

(e) The Lowest Adjacent Grade for all residential, commercial, industrial, or otherwise occupied buildings shall be a minimum of 2 feet above the 100-year water surface elevation or 2 feet above the emergency overflow weir elevation, whichever is higher. Any basement floor must be at least 1-foot above the normal pool water elevation of any wet-bottom facility.

(f) Maximum vegetated side slopes shall be 3 horizontal to 1 vertical (3:1) for safety, erosion control, stability, and ease of maintenance.

(g) Every detention/retention facility (including surface and underground detention/retention facilities and those facilities which are serving less than 1-acre sites) shall be equipped with an upstream pretreatment system to capture sediments and floatables. Pretreatment shall be in the form of a BMP immediately upstream of each inlet to the detention/retention facility unless the inlet provides less than 10% of the total design storm inflow to the pond. Pre-approved stormwater BMPs are listed in Table 6-1 and shall be designed in accordance with Chapter 6 and Appendix C.

(h) Underground detention facilities shall have inspection ports or observation wells, minimum 10-inch diameter, sufficiently arranged to allow access to all portions of the facility.

(i) Each facility shall be designed with an emergency overflow facility for the release of exceptional storm runoff or in the event that the normal outlet device becomes totally or partially inoperable

(j) Flood routing calculations shall be provided in accordance with Part 4.54.5 of this manual.

(k) All facilities shall have a minimum freeboard of 1 foot above the 100-year pond elevation to the top of bank.

(l) For leveed detention/retention facilities which generate 3 feet or more head pressure, the principal spillway outlet pipe shall be provided with anti-seep devices. As a general guide, anti-seep collars shall be a minimum of 5 feet by 5 feet square and be spaced a maximum of 25 feet apart.

(m) When the outfall of a facility will be below the 100-year floodplain elevation, a backflow prevention device is required. The device must be watertight.

(5) Additional Requirements for Dry Detention Facility Design

(a) Dry detention basins shall have minimum longitudinal and transverse bottom slopes of 2.0% or be designed with underdrains.

(b) An underdrain system shall be provided in the flow path from each inlet to the basin outlet.

(c) The stormwater storage depth shall not exceed 4 feet.

(d) Grass cover or native vegetation shall be established and maintained in accordance with the site's approved O&M Manual.

(6) Additional Requirements for Wet Detention/Retention Facility Design

(a) Wet detention/retention facilities shall have a minimum 6 foot wide safety ledge placed 18 inches below the normal pool water elevation at a maximum slope of 10 horizontal to 1 vertical (10:1). The slope of the bank below the safety ledge shall not exceed 3 horizontal to 1 vertical (3:1).

(b) Wet detention/retention facilities shall have a minimum 6 foot wide maintenance ledge placed 12 inches above the normal pool water elevation at a maximum slope of 10 horizontal to 1 vertical (10:1). The slope of the bank

between the maintenance ledge and safety ledge shall not exceed 6 horizontal to 1 vertical (6:1). The slope of the bank above the maintenance ledge shall not exceed 6 horizontal to 1 vertical (6:1).

(c) The minimum normal depth shall be 8 feet, maintained over at least 25% of the pond area.

(d) For stormwater pipes discharging into a pond, all pipes shall be at or above the normal pool elevation.

(e) If a pond is intended to be wet, soil conditions must be assessed for permeability. To prevent drawdown of the normal pool, an impervious soil layer may be needed.

(7) Parking Lot Storage Design

(a) Stormwater may be stored on remote areas of parking lot pavement with a maximum water depth of 6 inches for the peak 100-year storm event. Stormwater may not be stored on any pavement with pedestrian traffic.

(b) The parking lot shall be designed to drain completely a maximum of 30 minutes after rainfall termination

(8) Rooftop Storage Design

(a) Stormwater may be stored on roofs with a maximum water depth of 3 inches for flat roofs and 6 inches for sloped roofs.

(b) Provide sufficient membrane liners to create a watertight seal on the roof to prevent leakage.

(c) Overflow drains shall be provided at the design depth to reduce the potential for damage due to excessive events or clogging.

(d) The roof shall be designed by a structural engineer licensed in the State of Indiana. The roof shall be designed to structurally withstand proposed loadings.

(9) Emergency Spillway

(a) The overflow facility or emergency spillway shall be designed to operate automatically and shall not require manual attention.

(b) At a minimum, emergency spillways shall be capable of handling 125% of the inlet peak runoff resulting from the 100-year storm event from the entire contributing watershed, assuming proposed (developed) conditions.

(c) Design calculations and cross sections shall be submitted for review.

(d) The surface of the spillway must be designed to prevent erosion. Turf reinforcement, armoring or energy dissipation may be required depending on proposed flows.

(10) Detention in a Floodplain

(a) All detention facilities are to be flood proofed and protected from the base flood elevation including top of bank elevation, spillway elevation, inlets into the system and backflow prevention. Lining of a detention area may also be required for porous soil conditions.

(b) City of Indianapolis regulates floodplains and flood hazard areas in Marion County. Obtain necessary approvals.

(11) Additional Requirements for Underground Storage

(a) Underground storage facilities shall have inspection ports or observation wells, minimum 10-inch diameter, sufficiently arranged to allow access to all portions of the facility.

(b) For ease of inspections and cleanout, every inlet to the chamber system must be designed to collect sediment and debris to prevent deposition within downstream components. This area may not qualify for 80% TSS removal for water quality treatment. Testing information must be provided to demonstrate TSS removal.

(c) Water quality treatment BMPs must be upstream of an underground storage system.

(d) Underground detention storage vaults shall be constructed of accepted storm pipe materials, manufactured, tested, and installed according to the manufacturer's recommendations and the guidelines set forth herein.

4.4 Low Impact Development Measures

(A) Low Impact Development (LID) is an approach to land planning and engineering design which manages rainfall at the source to reduce stormwater runoff and manage runoff timing, emphasizes conservation and natural features, and protects water quality by controlling pollutants.

(B) Designers and developers are encouraged to consider methods of runoff reduction such as reducing impervious surface area, disconnecting impervious surfaces, promoting infiltration, stormwater capture and reuse, and other LID methods in order to reduce requirements for on-site detention.

(C) LID features shall conform to current industry guidelines and will be reviewed on a case-by-case basis. Pre-approved stormwater BMPs are listed in Table 6-1 and shall be designed in accordance with Chapter 6 and Appendix C. All design calculations and justification shall be submitted for review.

4.5 Flood Routing

(A) Stormwater ponding and overflow path routing throughout a site or development shall be evaluated for the peak 100-year storm event.

(B) Peak runoff flows shall be estimated for all contributing drainage areas, on-site and off-site, in their proposed (developed) land use.

(C) Stormwater collection system (storm sewers, open channels, etc.) shall be assumed full (at capacity) from a previous storm event at the beginning of the flood routing analysis.

(D) The overflow path/ponding resulting from the flood routing event shall be clearly shown and included on the sheet legend as a hatch area on the plans. Plans shall include cross sections along the flood route path where the cross-section narrow or expands and at spill-over points. Cross sections shall include the existing surface, proposed grading, and the maximum water elevation for the peak 100-year storm event.

(E) The flood routing path and ponding areas shall remain on the property, within a right-of-way or be placed in an applicable drainage easement.

(F) Flood Routing discharge shall outlet to a storm conveyance including open channel, storm pipe, detention/retention facility, waterway or street curb and gutter

(G) If an emergency flood route is not available, the conveyances shall be designed for the 100-year storm event within the system and all inlets must pass the 100-year with less than 6 inches of ponding at 50% clogged inlets.

4.6 Material Specifications

Materials used in construction shall be in full conformance with the guidelines set forth in this manual and all applicable AASHTO, ASTM, and INDOT standards. These material specifications are minimum requirements. The Engineer shall ultimately be responsible for designing and selecting the appropriate material for each specific application. The City shall reserve the right to require material certification from the manufacturer prior to or during construction as deemed necessary to ensure the material supplied conforms to the requirements of this manual.

(A) Channel Lining & Energy Dissipation

(1) The types of treatments used to stabilize open channels may vary with flow velocities and individual site conditions within the following guidelines:

(a) Grass: The grass seed mixture shall be selected based on specific site conditions (drainage tolerance, shade tolerance, maintenance requirements, etc.) and shall contain no weeds.

(b) Turf Reinforcement Mat: Turf reinforcement mat shall be a permanent product which shall not degrade in less than 48 months. Turf reinforcement mat shall be capable of withstanding design channel velocities or 9.0 feet per second, whichever is greater.

(c) Riprap: Riprap gradation shall meet the Indiana Department of Transportation (INDOT) specifications. Riprap used on channel side slopes shall have rocks no smaller than 6 inches.

(d) All other channel lining products must be pre-approved by the City.

(B) Geotextile Fabric

(1) For use under riprap or other aggregates: Provide non-woven geotextile fabric consisting of strong, rot resistant, chemically stable long-chain synthetic polymer materials which are dimensionally stable relative to each other. The geotextile plastic yarn or fibers shall consist of at least 85% by weight of polyolefins, polyesters, or polyamides and resist deterioration from ultraviolet and heat exposure. Geotextile fabric shall meet or exceed the requirements of INDOT Standard Specifications Section 918.02.

(2) For use with underdrains or other below-grade applications: Provide non-woven needle punched or heat bonded geotextile fabric consisting of strong, rot resistant, chemically stable long-chain synthetic polymer materials which are dimensionally stable relative to each other. The geotextile plastic yarn or fibers shall consist of at least 85% by weight of polyolefins, polyesters, or polyamides and resist deterioration from ultraviolet and heat exposure. Geotextile fabric shall meet or exceed the requirements of INDOT Standard Specifications Section 918.03.

(C) Trench Bedding & Backfill

(1) Bedding and backfill materials shall be as follows:

(a) Class I: Angular, 6 to 40 millimeters (1/4 to 1-1/2-inch) graded coarse aggregate such as crushed stone, meeting the gradation requirements for an INDOT No. 8 coarse aggregate in accordance with INDOT Standard Specifications Section 904. A gravel possessing a minimum 50% mechanical crush count and meeting the INDOT No. 8 gradation will be considered an equivalent Class I material.

(b) Class II: Coarse sands and gravel-sand mixtures with a maximum particle size of 40 millimeters (1-1/2 inches), including variously graded sands and gravels

containing small percentages of fine, generally granular and non-cohesive, either wet or dry, meeting the gradation requirements of INDOT Structure Backfill in accordance with INDOT Standard Specifications Section 904. Soil types GW, GP, SW and SP are included in this class.

(c) Clean Sand: Fine aggregate No. 23 sand, in accordance with INDOT Standard Specification Section 904.

(d) Excavated Material: Excavated material suitable for use as trench backfill must be clean and free of rocks and frozen soil lumps larger than 6 inches, wood, debris, or other extraneous material.

(e) Flowable Fill: Flowable Fill: Removable, self-leveling, self-compacting, flowable material with a minimum unconfined compressive strength (28-day) of 50 psi and a maximum unconfined compressive strength of 150 psi. Provide Removable Flowable Backfill material which meets the requirements of INDOT Standard Specifications Section 213 and Section 904 classification for Type 4 Structure Backfill.

(f) Washed Aggregates: Double-washed coarse aggregate No. 8, class E or higher, in accordance with INDOT Standard Specification Section 904.

(D) Culvert & Storm Sewer Pipe

(1) Culverts and storm sewers shall be high-density polyethylene (HDPE) pipe, polypropylene (PP) pipe, polyvinyl chloride (PVC) pipe, or reinforced concrete pipe (RCP). Corrugated Metal Pipe (CMP) is not an approved material.

(2) High Density Polyethylene (HDPE) Pipe – for pipe sizes 12 to 24-inch only

(a) Pipe Material

(i) Provide dual wall corrugated HDPE pipe and fittings, consisting of an annular outer corrugated pipe wall and a smooth inner wall, in accordance with ASTM F2648 and INDOT Standard Specification Section 907.

(ii) Pipe and fittings material shall be, in accordance with ASTM D3350, either:

(1) Virgin high density polyethylene with a minimum cell class of 435400C, or

(2) Engineered compound of virgin and recycled high density polyethylene with a minimum cell class of 435420C

(iii) Flexibility factor shall not exceed 0.095.

(b) Joints

(i) Furnish HDPE pipe with bell and spigot joints in conformance with ASTM F2648.

(ii) Gasket material shall conform to ASTM F477.

(c) Fittings

(i) Provide fittings of the same manufacturer for each type of HDPE pipe.

(ii) Manufactured fittings such as wyes, tees, elbows, or adaptors will not be accepted for use in place of storm sewer manholes, inlets, catch basins, or drain basins unless otherwise indicated on the Drawings.

(d) Pipe Markings

(i) Provide pipe with each length clearly marked with the following information:

(1) Name of manufacturer or identification symbol

(2) Nominal pipe size

(3) Product/extrusion code

(3) Polypropylene (PP) Pipe – for pipe sizes 12 to 24-inch only

(a) Pipe Material

(i) Provide double wall polypropylene pipe with a smooth interior and annular exterior corrugations in accordance with ASTM F2736.

(ii) Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2736, section 4, ASTM F2881, Section 5 and AASHTO M330, Section 6.1, for the respective diameters.

(iii) Pipe shall have minimum stiffness of 46 pounds per square inch when tested in accordance with ASTM D2412.

(b) Fittings and Joints

(i) Provide pipe joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2736. Joints shall be watertight.

(ii) Fittings shall conform to ASTM F2736. Corrugated couplings shall be split collar, engaging at least 2 full corrugations.

(c) Pipe Markings

(i) Provide pipe with each length clearly marked with the following information:

(1) Name of manufacturer or identification symbol

(2) Nominal pipe size

(3) Product/extrusion code

(4) Polyvinyl Chloride (PVC) Pipe – for pipe sizes 12 to 24-inch only

(a) Pipe Material

(i) Provide solid wall gravity flow PVC storm sewer pipe and fittings with bell and spigot joints with elastomeric seals and smooth inner walls in accordance with ASTM D3034 (SDR 35, 12 to 15-inch diameter), ASTM F679 (PS 46, 18 to 36-inch diameter), and INDOT Standard Specification Section 907.

(ii) Minimum cell class in accordance with ASTM D1784:

(1) Cell class 12364 for 12 to 15-inch diameter pipes

(2) Cell class 12454 for 18 to 24-inch diameter pipes.

(iii) Pipe shall have minimum stiffness of 46 pounds per square inch when tested in accordance with ASTM D2412.

(b) Joints

(i) Furnish PVC pipe with flexible, gasketed compression type joints so that, when assembled, the gasket inside the bell is compressed radially on the pipe spigot to form a soil-tight seal. Assemble joints in accordance with the pipe manufacturer's recommendations and ASTM D3212.

(ii) The gasket shall conform to ASTM F477.

(c) Fittings

(i) Manufactured fittings such as wyes, tees, elbows, or adaptors will not be accepted for use in place of storm sewer manholes, inlets, catch basins, or drain basins unless otherwise indicated on the Drawings.

(d) Pipe Markings

(i) Provide pipe with each length clearly marked with the following information:

(1) Name of manufacturer or identification symbol

(2) Trade name or trademark
(3) Nominal pipe size
(4) Production/extrusion code
(5) Material and cell class designation
(6) ASTM designation

(5) Reinforced Concrete Pipe (RCP) – for pipe sizes 12-inch and larger

(a) Pipe Material

(i) Provide minimum Class III, Wall B type RCP which conforms to ASTM C76, AASHTO M170, and INDOT Standard Specification Section 907.

(ii) Provide elliptical RCP which conforms to ASTM C507, AASHTO M207, and INDOT Standard Specification Section 907.

(b) Joints

(i) Provide RCP with tongue and groove joints with compression type rubber gasket which conforms to ASTM C443.

(c) Fittings

(i) Provide fabricated wye and tee branches.

(E) Structures

(1) Manholes

(a) Provide precast concrete manholes with cone, flat top, riser/barrel, and base sections as applicable which conform to ASTM C478, AASHTO M199, and INDOT Standard Specifications Section 907.

(b) Provide precast concrete floor or form with Class A concrete. Floor shall be sloped to the sewer invert.

(c) Gaskets shall be 1/2-inch diameter flexible butyl rubber conforming to ASTM C990 for all manhole section joints.

(2) Inlets & Catch Basins

(a) Provide precast concrete inlets and catch basins shall be in accordance with ASTM C980.

(3) Drain Basins

(a) Provide PVC drain basins which are manufactured from PVC pipe stock, utilizing a thermo-molding process to re-form the pipe stock to the furnished configuration. Drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified type of pipe. The raw material shall conform to ASTM D1784 cell class 12454.

(b) PVC structure joints shall conform to ASTM D3212. Flexible elastomeric seals shall conform to ASTM F477.

(4) Castings, Frames, & Covers

(a) For manholes, inlets, and catch basins: Provide cast iron frames and covers in accordance with ASTM A48 Class 35B and INDOT Standard Specification Section 910. Pre-approved castings are listed in Table 4-14. All other castings must be approved by the City on a case-by-case basis.

Table 4-14: Standard Stormwater Castings

Structure Type	Casting Type	Neenah Model	EJ Model
Manhole	Flat lid	R-1772	1022-Z1
Manhole	Flat grate	R-2502	1020-N
Manhole	Beehive grate	R-2560-E1	1205-02
Manhole	Curb grate	R-3286-8V	7520-M2-T1
Inlet/Catch Basin, Type A	Ditch grate	R-4215-C	6610
Inlet/Catch Basin, Type A	Curb grate	R-3286-8V	7520-M2-T1
12” Pipe Inlet/Catch Basin	Beehive grate	R-4350-B	6532
15” Pipe Inlet/Catch Basin	Beehive grate	R-4350-C	6533
18” Pipe Inlet/Catch Basin	Beehive grate	R-4350-D	6534
24” Pipe Inlet/Catch Basin	Beehive grate	R-4350-E	6536

(b) For drain basins: Provide cast iron or ductile iron frames and covers to match the diameter of the drain basin installed. Road and highway grates shall meet minimum H 20 load rating. Castings installed in pavement shall have a concrete collar in accordance with manufacturer’s recommendations.

(c) Furnish frames and covers which are rated for traffic, of non-rocking design, and have machined horizontal and vertical bearing surfaces.

(d) All storm grate castings shall be pre-stamped with a pollution prevention message permanently attached.

(e) All grates shall be safe for bicycle and pedestrian traffic.

(5) Steps

(a) Provide steps in all structures 4 feet deep or greater in accordance with AASHTO M199 and INDOT Standard Specification Section 907.

(b) Provide steps with a minimum 10 inches of clear step width.

(c) Provide copolymer polypropylene coated steel steps meeting the requirements of ASTM D4101 and composed of deformed 1/2-inch minimum diameter reinforcing steel in accordance with ASTM A615, Grade 60.

(d) Non-coated cast iron steps will not be accepted.

(6) Pipe Connections

(a) Pipe penetration holes shall be either pre-formed by manufacturer or core drilled in the field.

(b) For RCP, provide non-shrink grout mixture of two parts No. 23 fine aggregate in accordance with INDOT Standard Specification Section 904 and one part Portland cement.

(c) For HDPE, PP, and PVC pipe, provide flexible neoprene molded boot or resilient seal which conforms to ASTM C923.

(F) Underdrains

(1) Underdrains shall be perforated high-density polyethylene (HDPE) pipe or polyvinyl chloride (PVC) pipe.

(2) High Density Polyethylene (HDPE) Pipe – for pipe sizes 6 to 24-inch only

(a) Pipe Material

(i) For pipe sizes 12-inch and larger: Provide dual wall corrugated HDPE pipe and fittings, consisting of an annular outer corrugated pipe wall

and a smooth inner wall, in accordance with ASTM F2648 and INDOT Standard Specification Section 907.

(ii) For pipe sizes under 12-inch: Provide perforated corrugated polyethylene drainage pipe (PCPP) and fittings in accordance with AASHTO M252, ASTM F2648, and INDOT Standard Specification Section 907. Perforations shall be AASHTO Class II.

(iii) HDPE pipe and fittings material shall be either:

(1) Virgin high density polyethylene with a minimum cell class of 424420C for 6 to 10-inch diameter pipe or 435400C for 12 to 24-inch diameter, as defined in ASTM D3350

(2) Engineered compound of virgin and recycled high density polyethylene with a minimum cell class of 424420C for 6 to 10-inch diameter pipe or 435420C for 12 to 24-inch diameter, as defined in ASTM D3350

(iv) The flexibility factor of HDPE pipe shall not exceed 0.095.

(b) Joints

(i) Furnish HDPE pipe with bell and spigot joints in conformance with ASTM F2648.

(ii) Gasket material shall conform to ASTM F477.

(c) Fittings

(i) Provide fittings of the same manufacturer for each type of HDPE pipe.

(ii) Manufactured fittings such as wyes, tees, elbows, or adaptors will not be accepted for use in place of drain basins unless otherwise indicated on the Drawings.

(d) Pipe Markings

(i) Provide pipe with each length clearly marked with the following information:

(1) Name of manufacturer or identification symbol

(2) Nominal pipe size

(3) Product/extrusion code

(3) Polyvinyl Chloride (PVC) Pipe – for pipe sizes 6 to 24-inch only

(a) Pipe Material

(i) Provide solid wall gravity flow PVC storm sewer pipe and fittings with bell and spigot joints with elastomeric seals and smooth inner walls in accordance with ASTM D3034 (SDR 35, 15-inch diameter and smaller), ASTM F679 (PS 46, 18 to 24-inch diameter), and INDOT Standard Specification Section 907.

(ii) Minimum cell class in accordance with ASTM D1784:

(1) Cell class 12364 for 6 to 15-inch diameter pipes

(2) Cell class 12454 for 18 to 24-inch diameter pipes.

(iii) Pipe shall have minimum stiffness of 46 pounds per square inch when tested in accordance with ASTM D2412.

(b) Joints

(i) Furnish PVC pipe with flexible, gasketed compression type joints so that, when assembled, the gasket inside the bell is compressed radially on the pipe spigot to form a soil-tight seal. Assemble joints in accordance with the pipe manufacturer's recommendations and ASTM D3212.

(ii) The gasket shall conform to ASTM F477.

(c) Fittings

(i) Manufactured fittings such as wyes, tees, elbows, or adaptors will not be accepted for use in place of storm sewer manholes, inlets, catch basins, or drain basins unless otherwise indicated on the Drawings.

(d) Pipe Markings

(i) Provide pipe with each length clearly marked with the following information:

(1) Name of manufacturer or identification symbol
(2) Trade name or trademark
(3) Nominal pipe size
(4) Production/extrusion code
(5) Material and cell class designation
(6) ASTM designation

(G) Pipe End Treatments

(1) Metal End Sections: Metal end sections shall conform to AASHTO M36 and INDOT Standard Specification Section 908.

(2) Concrete End Sections: Concrete end sections shall conform to INDOT Standard Specification Section 907.

(3) Outlet Protectors: Class A concrete shall conform to INDOT Standard Specifications Section 702.

(H) Underground Detention

(1) Underground detention storage vaults shall be constructed of accepted storm sewer pipe materials, manufactured, tested, and installed according to the manufacturer's recommendations and the guidelines set forth herein.

(2) Poured-in-place, reinforced concrete vaults for underground detention storage shall be pre-approved by the City on a case-by-case basis.

4.7 Construction and Installation

(A) Open Channels

(1) Construct open channels to the minimum requirements as shown in Appendix A, Detail No. A-1, A-2, and A-3.

(2) Vegetated channels shall be permanent seeded within 7 days after finish grading. To facilitate vegetative establishment, protect grass-lined channels with an erosion control blanket to the top of bank or to 12 inches above the flowline, whichever is less.

(3) Filter fabric or a filter course of gravel shall be placed under the riprap.

(B) Trench Bedding & Backfill

(1) Preparation

(a) Complete site clearing and grubbing.
(b) Remove existing pavement and walks from the areas of excavation.
(c) Strip topsoil and vegetation from the areas of excavation.
(d) Clean topsoil may be stockpiled for reuse. Do not mix grass, weeds, roots, brush, and stones larger than 1-inch in diameter with stockpiled topsoil. Dispose of root contaminated topsoil.

(2) Excavation

(a) Excavate carefully and cautiously to avoid damaging existing underground utilities and structures.

(b) Remove excavated material not suitable for backfilling and excess suitable material from the site. Dispose of the materials in accordance with all local, state, and federal regulations.

(3) Sheeting & Bracing

(a) Properly shore, sheet, brace, or cut back at the proper slope, all excavations to safely install utilities and to protect adjacent streets and structures.

(b) Renew and maintain sheeting, planking, timbering, shoring, bracing, and bridging, and do not remove until sufficient backfill has been placed to protect the pipe.

(c) The City shall not be responsible or accountable for sheeting and bracing used and for damages to persons or property resulting from the improper quality, strength, placement, maintenance and removal of the sheeting, shoring, and bracing, including damage to trees, shrubs, walkways and other property.

(4) Trenching

(a) Excavate trenches to the depths and widths required for the proper installation of the pipe and appurtenances.

(b) Provide a continuous, uniform bearing support for the pipe on bedding within the trench, dished to provide circumferential support to the lower third of each pipe. Dig out holes to receive pipe bells.

(c) Remove rock and soft material encountered in the trench which, in the opinion of the Engineer is incapable of providing adequate bearing to support the pipe. Remove material to accommodate the minimum specified bedding depth below the required elevation and fill with Class I or Class II material as specified.

(d) Support all sewer, gas, water or other pipes or conduits crossing the trench to prevent damage and service interruptions. The manner of supporting such pipes or conduits will be subject to the approval of the Utility involved.

(5) Backfilling

(a) For any trench that intersects any portion of the pavement loading zone use Class I or Class II backfill materials, as shown in Appendix A, Detail No. A-4, A-5, and A-6.

(b) Placement and Compaction Requirements:

(i) Place Bedding, Haunching, and Initial Backfill materials in 6 to 8-inch balanced lifts to ensure proper compaction and filling of all voids.

(ii) Use procedures and equipment for the Standard Proctor compaction test in accordance with ASTM D698/AASHTO T99.

(iii) Outside the pavement loading zone:

(1) Place final backfill in maximum 12-inch lifts.

(2) Compact each layer to a minimum of 90% of the maximum Standard Proctor dry density.

(3) Additional compaction if required to minimize settling.

(4) Place 6 inches of topsoil over areas to be seeded.

(iv) Within the pavement/structure loading zone:

(1) Place final backfill in 6 to 8-inch lifts, except place final 12 inches in 6-inch lifts.

(2) Compact each layer to 95% of the maximum Standard Proctor dry density, except the final 12 inches under pavement, compact each 6-inch lift to 100% of the maximum Standard Proctor dry density.

(3) Prepare upper portion of trench for pavement replacement as applicable.

(v) Stone and unpaved driveways and alleys:

(1) Place final backfill in 6 to 8-inch lifts.

(2) Compact each layer to 95% of the maximum Standard Proctor dry density.

(3) Replace the last 12 inches of surface with the same material as the original surface unless otherwise specified and compact to 100% of the maximum Standard Proctor dry density.

(c) Compaction Procedures

(i) Place trench backfill in balanced lifts to ensure proper compaction and filling of all voids.

(ii) Class I material: Shovel slice or otherwise carefully place; walk or hand tamp into place.

(iii) Class II material: For the first 24 inches of backfill over the pipe, use hand-operated tamping devices. Use standard mechanical methods (powered tampers, vibrators, etc.) for the remainder of the trench.

(iv) Do not flood or puddle with water to consolidate backfill.

(v) When compaction test results are unsatisfactory, re-excavate, re-compact the backfill and retest until the specified compaction is obtained.

(d) Flowable Fill

(i) Discharge the mixture from mixing equipment into the space to be filled. Do not float pipe when placing flowable fill. Bring the flowable fill up uniformly to the fill line. Keep each filling stage continuous.

(ii) Protect flowable fill from freezing until the material has stiffened and bleeding water has subsided. As the temperature nears freezing, additional curing time may be needed.

(iii) Concrete may be placed on the flowable fill as soon as bleeding water has subsided. Place all pavements on flowable fill according to manufacturer's recommendations.

(e) Maintain backfilled trenches in a smooth and uniform condition until paving or seeding operations are completed.

(6) Testing

(a) Notify the City a minimum of 72 hours prior to tests so that a representative may be present for the testing.

(b) Class II Compaction Tests: Perform compaction tests for Class II trench backfill material in accordance with ASTM D698. Tests shall be performed vertically, at 2-foot intervals in the trench:

(i) At each road crossing, and

(ii) At every 1,000 feet longitudinally in roadways along the pipe alignment.

(c) Flowable Fill Tests:

(i) Unconfined Compressive Strength

(ii) Flow Test: Conduct flow consistency testing in accordance with ASTM D6103 by filling a 3-inch diameter by 6-inch high open ended cylinder placed on a smooth, nonporous, level surface. Pull the cylinder straight up within 5 seconds and measure the spread of the fill. The diameter of the spread shall be 8 inches or more with no noticeable segregation.

(iii) Setting and Early Strength Test: Determine whether the flowable fill has hardened sufficiently for loads to be applied and construction activities to continue by conducting one of the following tests:

(1) Penetration Resistance test in accordance with ASTM C403 – minimum value of 500 pounds per square inch required for loading

(2) Ball Drop test in accordance with ASTM D6024 – maximum indentation diameter of less than 3 inches required for loading

(C) Culverts & Storm Sewers

(1) Installation

(a) Lay storm sewer pipe uniformly to line and grade so that finished storm sewer will present a uniform conduit.

(b) Set line and grade by means of laser beam and target for alignment and grade.

(c) Lay storm sewer pipe progressively upgrade in a manner to form close, concentric joints with smooth bottom inverts.

(d) Maintain 18 inches of vertical separation and 10 feet of horizontal separation between new storm sewer and new or existing water mains unless otherwise directed.

(e) After joint is made, place sufficient bedding material along each side of the pipe to prevent conditions that might tend to move the pipe off line or grade.

(f) Temporarily plug installed piping systems at end of each day's work or other interruption of progress on a given line. Plug shall be adequate to prevent entry of animals and entrance or insertion of deleterious materials.

(g) Securely attach fabricated branches for wyes and tees to wall of pipe in such a manner as to not restrict or otherwise interfere with flow characteristics of the pipe.

(h) Complete all field-cutting of pipe in a neat, trim manner using a hand or power saw. Field cutting of closed profile pipe requires any exposed channels be sealed in accordance with the manufacturer's recommendation.

(i) If any existing drainage tile systems are encountered during construction, reconstruct the tile to its original conditions or connect tile to the new storm drainage system as approved by the City.

(2) Inspection & Testing

(a) Deflection Test for Flexible (HDPE, PP, PVC) Pipes

(i) Perform testing in presence of the City's representative.

(ii) Perform deflection testing on all flexible pipes 12-inch diameter and larger after the final backfill has been in place for at least 30 days.

(iii) Perform deflection test using a mandrel pulled by hand. The mandrel (go/no-go) device shall be cylindrical in shape and constructed with nine or ten evenly spaced arms or prongs.

(iv) No pipe shall exceed a vertical deflection of 5%. Uncover, replace, and retest any pipe not passing the deflection test until a satisfactory result is achieved.

(b) Television Inspection

(i) Televise all mainline storm sewers (manhole to manhole).

(ii) Televise all lateral storm sewers (manhole to inlet, inlet to inlet, etc.) in excess of 40 feet in length.

(iii) Perform all television inspection in presence of the City's representative.

(iv) Clean all new storm sewers prior to television inspection. The image shall be clear so the interior condition of the pipe is easily evaluated.

(v) Correct all unacceptable conditions found during the television inspection and re-televise until no unacceptable conditions are found.

(vi) Unacceptable conditions are conditions that adversely affect the ability of the system to function as designed or to be properly maintained and may include, but are not limited to, the following:

(1) Protruding taps
(2) Cracked or faulty pipe
(3) Misaligned or deformed pipe
(4) Debris in line
(5) Infiltration/exfiltration
(6) Excessive gaps at joints
(7) Bellies or sags with a depth greater than or equal to 10% of the pipe diameter (maximum of 3 inches) or a length greater than 25 feet

(vii) Submit copy of the televising recording (DVD format) to the City within 14 calendar days of the inspection.

(D) Structures

(1) Installation

(a) Storm structure installations shall meet the requirements herein and as shown in Appendix A on Detail No. A-7, A-8, A-9, A-10, A-11, and A-12.

(b) Keep structure excavations free from water during construction.

(c) Fill all areas excavated below the depth required for the manhole base with Class I material.

(d) Install precast concrete risers and adjusting rings in such combination that the manhole frame will be at the proper elevation. Supply a minimum of 1 adjusting ring for each manhole. Adjusting rings shall be a minimum of 4 inches and maximum of 12 inches in height, in accordance with Detail No. A-8. Supply precast concrete riser sections for adjustment greater than 12 inches in height.

(e) Drain basin bodies shall be cut to final grade. No brick, stone, or concrete block will be permitted to set the casting to the finish grade level.

(f) Install steps beginning at 8 inches below the top of the cone or flat top section. Install steps at 10 inches on center minimum to 16 inches on center maximum, continuous and spaced uniformly.

(g) Install steps with minimum 3-inch wall embedment and minimum 4-inch clear distance projection from the wall as measured from the point of embedment.

(h) Install all storm structures so that the axis of the structure is vertical.

(i) Install gaskets for joints in accordance with the manufacturer's recommendations.

(j) Prior to backfilling, fill all holes used for handling with rapid setting patch material or with precast concrete plugs secured with Portland cement mortar.

(k) Unless otherwise indicated, set castings for all structures at finish grade level.

(l) Remove all debris and excess soil from structures after installation and prior to flushing the storm sewer pipes, to the satisfaction of the City.

(2) Pipe Connections

(a) For precast concrete structures, core drill or cast new pipe penetration at the proper location where the pipe enters the structure.

(i) For RCP, fill the annular space between the pipe and structure wall with grout.

(ii) For HDPE, PP, and PVC pipe, install flexible neoprene molded boot or resilient seal to secure the pipe in the structure wall.

(b) Join pipe bell spigot to the body of drain basins by use of a swage mechanical joint.

(E) Underdrains

(1) Installation

(a) French drain, underdrain, and hybrid ditch installations shall meet the requirements herein and as shown in Appendix A on Detail No. A-13, A-14, A-15, A-16, A-17, A-18, and A-19.

(b) After excavating to design grade, cut geotextile to a width sufficient to provide for non-tight placement in trenches and overlaps of the ends of adjacent rolls.

(c) Avoid contamination of the geotextile during construction. If it becomes contaminated, remove and replace geotextile with new material.

(d) Place the geotextile with the machine direction in the direction of water flow in the drainage system. It shall be placed loosely, but with no wrinkles or folds.

(e) Overlap the ends and edges of subsequent rolls and parallel rolls of geotextile a minimum of 1 foot. The upstream geotextile shall always be overlapped over the downstream geotextile. Join seams which are required in the longitudinal direction by means of either sewing or overlapping. Overlapped seams shall have a minimum overlap equal to the width of the trench.

(f) Place perforated pipe with the perforations facing down and securely join the pipe sections with the appropriate coupling, fitting or bands. Non-perforated pipe shall be laid with the bell end upgrade and with open joints wrapped with suitable material to permit entry of water.

(g) Place aggregate in a manner which minimizes contamination of the pipe.

(h) Place washed aggregate bedding and backfill material in 6 to 8-inch balanced lifts to ensure proper compaction and filling of all voids. Hand tamp or "walk" aggregate into place.

(i) Place fine aggregate backfill material, where required, in maximum 12-inch balanced lifts to ensure proper compaction. Compact each lift to 95% of Standard Proctor dry density in accordance with ASTM D698.

(j) Take necessary precautions to protect pipe and tile. All damaged sections shall be replaced.

(k) Locate outlet pipe(s) as close as possible to the center of the outlet protector.

(F) Pipe End Treatments

(1) Pipe end sections shall meet the requirements herein and as shown in Appendix A on Detail No. A-20 and A-21.

(G) Detention/Retention Basins

(1) Wet detention/retention basins shall meet the requirements herein and as shown in Appendix A on Detail No. A-22.

(2) Embankments and earthen levees or berms shall be compacted to a minimum 95% standard proctor dry density, utilizing suitable soil materials at appropriate moisture levels.

4.8 Easements

(A) Drainage Easements must be provided for maintenance of publicly-owned stormwater management systems and privately-owned detention/retention facilities, water quality BMPs, and LID practices located outside public right-of-way. Easements are not required for other private systems.

(B) Hydrologic and hydraulic calculations must be performed to determine the maximum inundated area resulting from the peak 25-year storm event. At a minimum, all inundated areas resulting from the peak 25-year storm event shall remain in the designated permanent drainage easement, as summarized in Table 4-15.

(C) Access easements must be provided from a public roadway to the drainage easement, for access to stormwater facilities.

(D) Upon approval of the easement location shown on the construction plans, the easement shall be granted to the City by way of a *Grant of Perpetual Drainage Easement* that is located in Appendix B.

(E) Structures, fences, landscaping, and similar items may impede the free flow of stormwater and are prohibited within the drainage easement.

(F) Drainage and access easements shall be maintained by the property owner.

(G) Easement location and dimensions shall be shown on the construction plans. A copy of the easement shall be included in the Operation and Maintenance Manual.

Table 4-15: Drainage Easement Size Requirements

Area or Situation	Easement Width
Underdrain (smaller than 12-inch)	15 feet, centered over underdrain
Storm sewer & underdrain (12 to 18-inch)	20 feet, centered over sewer
Storm sewer & underdrain (18-inch and larger)	25 feet, centered over sewer
Minor swales	Width of channel plus 15 feet, centered over channel (minimum of 20 feet)
Open channels and culverts (except minor swales)	Width of channel plus 20 feet, centered over channel
Detention or retention facility (subsurface)	Facility footprint plus 20 feet horizontally in every direction
Detention or retention facility (surface)	At the elevation of the emergency spillway design flow plus 20 feet horizontally in every direction
Emergency spillway	At the elevation of the emergency spillway design flow plus 40 feet horizontally, centered over spillway from the crown of the emergency spillway to the point where the spillway enters the downstream drainage system
Stormwater BMP	BMP footprint plus 20 feet horizontally in every direction
Flood routing path/ponding area	Width of flood path/ponding area
Access easement	10 feet

Chapter 5 - Erosion and Sediment Control for Construction Sites

During the construction process, soil is highly vulnerable to erosion by wind and water. Eroded soil endangers water resources by reducing water quality and causing the siltation of aquatic habitat for fish and other desirable species. Eroded soil also necessitates repair of sewers and ditches and the dredging of ponds. In addition, clearing and grading during construction cause the loss of native vegetation necessary for terrestrial and aquatic habitat.

The purpose of this section is to safeguard persons, protect property, and prevent damage to the environment in the City. This section will also promote the public welfare by guiding, regulating, and controlling the design, construction, use, and maintenance of any development or other activity that disturbs or breaks the topsoil or results in the movement of earth on land in the City.

These standards were developed in accordance with the requirements of the MS4 General Permit and the Construction Stormwater General Permit (CSGP). A Stormwater Pollution Prevention and Erosion and Sediment Control Plan (SWPPP) shall be submitted and shall be in accordance with the CSGP and the standards in this manual. Permits as required by Indiana Department of Environmental Management (IDEM), Indiana Department of Natural Resources (IDNR), Army Corps of Engineers (ACOE), Indiana Department of Transportation (INDOT) and any other local, state, and federal regulatory agencies are the responsibility of the property owner/developer.

5.1 Applicability and Exemptions

(A) Applicability. The requirements under this chapter are in compliance with the Construction General Permit. In general, this chapter requires the control of polluted runoff from construction sites with a land disturbance greater than or equal to 1 acre, or disturbances of less than 1 acre of land that are part of a larger common plan of development or sale if the larger common plan will ultimately disturb 1 or more acres of land.

(B) Exemptions. The requirements under this chapter do not apply to the following activities, provided other applicable state permits contain provisions requiring immediate implementation of soil erosion control measures.

- (1) Agricultural land-disturbing activities, including tillage, planting, cultivation, or harvesting operations to produce agricultural or nursery and vegetative crops, pasture renovation and establishment, the construction of agricultural conservation practices, and the installation and maintenance of agricultural drainage tile.
- (2) Silvicultural activities associated with nonpoint discharges (40 CFR 122.27).
- (3) Storm water discharges associated with oil and gas exploration, production, processing or treatment operations, or transmission facilities (40 CFR 122.26).
- (4) (Ditch maintenance for activities performed on a regulated drain by a county drainage board as defined in IC 36-9-27.
- (5) The land-disturbing activities listed below, provided other applicable permits contain provisions requiring immediate implementation of erosion and sediment control measures and storm water management measures.
  - (a) Landfills that have been issued a certification of closure under 329 IAC 10.
  - (b) Coal mining activities permitted under IC 14-34.
  - (c) Municipal solid waste landfills that are accepting waste pursuant to a permit issued by the IDEM under 329 IAC 10 that contains equivalent stormwater requirements, including the expansion of landfill boundaries and construction of new cells either within or outside the original solid waste permit boundary.

(6) Single-family residential development consisting of 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 the CSGP.

(C) Discharges authorized by this chapter. This chapter authorizes the following discharges to waters of the state:

(1) Storm water, including storm water runoff, snowmelt runoff, and surface runoff and drainage, associated with construction activity (40 CFR § 122.26(b)(14) or § 122.26(b)(15)(i)).

(2) Storm water discharges designated by IDEM as needing to obtain coverage under the CSGP (40 CFR § 122.26(a)(1)(v) or § 122.26(b)(15)(ii)).

(3) Storm water discharges from construction support activities (e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas) provided the support activity is directly related to the construction site required to have permit coverage for storm water discharges, and:

(a) The support activity is not a commercial/industrial operation, nor does it serve multiple unrelated construction projects.

(b) The support activity does not continue to operate beyond the completion of the construction activity for the project it supports; and

(c) Storm water measures are implemented in accordance with the storm water pollution prevention plan, performance standards, and this general permit.

(4) Non-storm water discharges or flows provided they are not identified by IDEM as significant sources of pollutants to waters of the state, including, but not limited to:

(a) Emergency fire-fighting water.

(b) Fire hydrant flushing water.

(c) Landscape irrigation water.

(d) Water line flushing.

(e) Routine external building washdown water that does not use detergents.

(f) Water used to wash vehicles and equipment that does not contain soaps, solvents, or detergents.

(g) Uncontaminated, non-turbid discharges of groundwater or spring water.

(h) Foundation or crawl space footing drainage where flows are not contaminated with process materials such as solvents or contaminated groundwater.

(i) Uncontaminated condensate from air conditioning units, coolers, and other compressors and from outside refrigerated gases or liquids.

(j) Construction dewatering water that has been treated by an appropriate storm water quality measure or series of measures provided other contaminants are not present.

(D) Discharges not authorized by this chapter. The following discharges from construction activities are not authorized by this chapter:

(1) Direct discharges into waters that are designated as an Outstanding National Resource Water defined at IC 13-11-2-149.5 or an Outstanding State Resource Water defined at IC 13-11-2-149.6 and listed at 327 IAC 2-1.3-3(d) when it is determined that a discharge from the land-disturbing activity will significantly lower water quality as defined under 327 IAC 2-1.3-2(50) of such a water downstream of that discharge.

(2) Direct discharges to a receiving stream when the discharge results in an increase in the ambient concentration of a pollutant which contributes to the impairment of the receiving stream for that pollutant as identified on the current 303(d) list of impaired waters.

(3) Discharges of concrete or mortar wash water from concrete washout activities or release from containment systems.
(4) Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds and other construction materials.
(5) Soaps, detergents, or solvents used in vehicle and equipment washing.
(6) Other discharges, including but not limited to fuel, oil, or other pollutants used in vehicle and equipment operation and maintenance.

5.2 Plan Sufficiency

(A) The City or the designated technical reviewer will review each application to determine its conformance with the provisions of this manual and the Construction General Permit. Within ten (10) days (for projects at least 1 acre but less than 5 acres) or within fourteen (14) days (for projects greater than or equal to 5 acres) after receiving an application, the City shall, in writing:

(1) Approve the Erosion and Sediment Control Plan and SWPPP and provide a *Construction Stormwater Pollution Prevention Plan Technical Review and Comment Form* (Form B-5 in Appendix B) stating that the "Plan is Adequate" and issue a building permit;

(2) Approve the Erosion and Sediment Control Plan and SWPPP subject to such reasonable conditions as may be necessary to secure substantially the objectives of this regulation, and issue the *Construction Stormwater Pollution Prevention Plan Technical Review and Comment Form* stating that the "Plan is Adequate"; or

(3) Provide a *Construction Stormwater Pollution Prevention Plan Technical Review and Comment Form* stating that the "Plan is Deficient" and indicating the reason(s) and procedure for submitting a revised application and/or submission.

(B) A *Construction Stormwater Pollution Prevention Plan Technical Review and Comment Form* stating that the "Plan is Adequate" and a building permit (as necessary) shall be obtained from the City prior to the initiation of any land disturbing activities.

(C) The sufficiency of the construction plans shall be based upon Construction General Permit regulations and the criteria described in this manual.

(D) After receiving a *Construction Stormwater Pollution Prevention Plan Technical Review and Comment Form* stating that the "Plan is Adequate", if revisions to the construction plans require a change in measures appropriate to control the quality or quantity of stormwater runoff, then revised plans must be submitted to the City. Pending preparation and approval of a revised plan, development activities shall be allowed to proceed in accordance with conditions established by the City.

(E) The applicant will be required to file with the City a faithful performance bond, letter of credit, or other improvement security in an amount deemed sufficient by the City to cover all costs of improvements, landscaping maintenance of improvements for such period as specified by the City, and engineering and inspection costs to cover the cost of failure to repair of improvements installed on the project site.

(F) After receiving a *Construction Stormwater Pollution Prevention Plan Technical Review and Comment Form* stating that the "Plan is Adequate" from the City, and within 48 hours of the start of construction, the following shall be submitted to IDEM:

(1) Notice of Intent (NOI) form (required by the Construction General Permit). The IDEM NOI form is sufficient for the submittal;

(2) A copy of the *Construction Stormwater Pollution Prevention Plan Technical Review and Comment Form* stating that the "Plan is Adequate"; and

(3) Proof of Publication required by the Construction General Permit.

(G) A copy of the signed NOI must also be submitted to the City.

5.3 Design Requirements

The SWPPP and erosion and sediment control measures shall meet the requirements contained in Construction General Permit, and be designed and installed in accordance with the Construction General Permit, this manual, and the *Indiana Stormwater Quality Manual*.

5.4 General and Implementation Requirements

(A) Trained Individuals must be utilized for activities associated with the development and design of the SWPPP, stormwater measure implementation, and stormwater project management.

(B) Sediment-laden water which otherwise would flow from the project site shall be managed by appropriate erosion and sediment control measures to minimize sedimentation to receiving waters and adjacent properties as discussed in the IDEM Stormwater Quality Manual and other authoritative sources.

(C) Phasing of construction activities must be used, when feasible, to minimize the footprint of disturbed unstable areas.

(D) Collected runoff 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.

(E) Natural features, including wetlands and sinkholes, shall be protected from pollutants associated with stormwater runoff, through appropriate stormwater management and/or treatment measures.

(F) Topsoil must be preserved, unless infeasible.

(G) Existing natural buffers that are adjacent to waters of the state must be preserved to promote infiltration and provide protection of the water resource, unless infeasible. Activities performed by a county drainage board under IC 36-9-27 are excluded.

(1) Natural buffers must be preserved, including the entire buffer bordering and/or surrounding the water resource. Existing buffers:

(a) 50 feet or more in width must be preserved to a minimum of 50 feet.

(b) less than 50 feet in width must be preserved in their entirety. May be enhanced with vegetation that is native and promotes ecological improvement and sustainability.

(2) Runoff directed to the natural buffer must be:

(a) treated with appropriate erosion and sediment control measures prior to discharging to the buffer.

(b) managed with appropriate runoff control measures to prevent erosion from occurring within the buffer area.

(3) Further information regarding buffer requirements is contained in IDEM's "Implementation of Buffers" guidance document.

(H) Un-vegetated areas that are left idle or scheduled to be left inactive for seven (7) days or more must be temporarily or permanently stabilized with measures appropriate for the season to

minimize erosion potential. The stabilization activity must be completed within fourteen (14) days after initiation. Initiation of stabilization includes, but is not limited to, the seeding and/or planting of the exposed area and applying mulch or other temporary surface stabilization methods where appropriate. Areas that are not accessible due to an unexpected and disruptive event that prevents construction activities are not considered idle.

(I) Discharge water from dewatering of ground water from excavations, trenches, foundations, etc. must not be discharged when:

(1) Sediment-laden water is not first directed to an appropriate sediment control measure or a series of control measures, as per IDEM Stormwater Quality Manual and other authoritative sources, that minimizes the discharge of the sediment.

(2) A visible sheen and/or pollutants are present at a level that requires additional treatment and/or an alternate permit.

(J) Concrete and cementitious wash water areas, where cementitious fluids are permissible, must be identified for the site and the locations clearly posted. Wash water must be directed into leak-proof containers or leak-proof containment areas which are located and designed to divert runoff away from the measure and sized to prevent the discharge and/or overflow of the cementitious wash water. If not evaporated, wash water must be removed (pumped) for appropriate off-site disposal.

(K) A notice must be posted near the main entrance of the project site or at a publicly accessible location. 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.

(1) The notice must be maintained in a legible condition and include:

(a) A copy of the completed IDEM NOI or a document, such as the Permit Summary Report & Notice of Sufficiency letter produced by IDEM's online ePortal system.

(b) The name permit holder's name, the project name, project location/address, name of receiving water(s), phone and email contact to direct questions.

(c) The NPDES permit number(s), upon receipt from IDEM.

(d) The location of the construction plan/SWPPP if the project site does not have an on-site location to store the plan.

(L) The use of anionic polymers (cationic polymers are not authorized for use) on the project site are authorized for sediment control provided their use is in conformance with current State of Indiana standards and specifications and the use is identified in the stormwater pollution prevention plan (SWPPP). If use of a polymer is not in the SWPPP and is selected at a later date, notification to IDEM and approval from the City of Beech Grove is required. An email notification prior to the use of the polymer to the IDEM Stormwater Program is acceptable.

5.5 Municipally Owned Projects

(A) For those construction activities owned by the MS4 operator (City of Beech Grove), project construction plans must comply with all requirements in this Manual and include:

(1) A traffic phasing plan for those projects that have the potential to alter vehicular traffic routes,

(2) Requirements of the Construction General Permit, and

(3) The project SWPPP must address all requirements for construction plans 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.

(B) For MS4 construction activities, construction plans must be submitted to the Marion County SWCD for review and approval.

5.6 Inspection, Maintenances, Recordkeeping, and Reporting

(A) Following approval of the SWPPP and commencement of construction activities, the Cit has the authority to conduct inspections of the site to ensure full compliance with this manual, and the terms and conditions of the approved Construction General Permit.

(B) A self-monitoring program shall be implemented by the project site owner to ensure the SWPPP is working effectively in accordance with the Construction General Permit. The self-monitoring program shall include::

(1) Written Evaluation – A complete written evaluation (or inspection) of the entire project site, except for those areas that are considered unsafe. A *Self-Monitoring Inspection From* is provided in Appendix B. The evaluation must be performed by a trained individual and include:

(a) Name of the individual performing the evaluation, including printed name, title, and signature (electronic signatures are acceptable).
(b) Date of the evaluation.
(c) Amount of precipitation when the evaluation is conducted after a measurable storm event. Recorded rainfall may be documented utilizing an on-site rain gauge or storm event information from a weather station that is representative of the project location.
(d) Observations of project performance in relation to implementation of the storm water pollution prevention plan.

(2) Assessment of existing storm water measures based on industry standards to ensure each measure is operational and functioning properly.
(3) Additional measures necessary in the event an existing measure fails or is not present in the landscape.
(4) Impacts including, but not limited to, sediment discharges, erosion, discharges that results in bank erosion, and operational activities that have the potential to generate pollutants and unauthorized discharges.
(5) Documentation of an actual discharge that is visible during the assessment, the location of the discharge and a visual description of the discharge. The visual description includes, but is not limited to, color (turbidity reading is an option), odor, floatables, settled/suspended solids, foam, oil sheen, and any other visible sign that may be attributed to operations occurring on the project site.
(6) Corrective Actions – Provide details of corrective action(s) recommended and/or completed, a timeline for which the corrective action will occur to remediate the discharge of pollutants and documentation of corrective action taken from the previous self-monitoring report.
(7) Inspection Frequency – Inspections are to be performed and completed:

(a) By the end of the next business day following each measurable storm event (excludes accumulated snow events); which is defined as a precipitation accumulation equal to, or greater than, 0.50-inch of rainfall. If no rain event occurs within the work week a minimum of one inspection must occur. In the event of multiple rain events during one week, no more than three (3) inspection are required.

(b) At a minimum of once per month for areas within the project which are stabilized with permanent vegetative cover at 70 percent density. Prior to reducing the monitoring to monthly, records must identify the area and the date the area became eligible for monthly monitoring. Weekly monitoring as identified above must resume if one or more of the following occurs:

(i) The vegetative cover fails or there is evidence of erosion in the identified area.

(ii) IDEM or the local inspecting authority requires monitoring to resume.

(8) All evaluation reports for the project site must be made available to the inspecting authority within 48 hours of a request.

(9) All persons engaging in construction activities on a project site must comply with the SWPPP, this manual, and the Construction General Permit.

(C) Priority Sites

(1) 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 runoff to receiving waters. Construction site inspections will be based on priority determinations.

(2) The City, or local, county, or state regulatory agency with jurisdiction, or a representative thereof may make recommendations to the project site owner or their representative to install appropriate measures beyond those specified in the SWPPP to achieve compliance.

5.7 Project Termination

(A) Final Stabilization

(1) Final stabilization of a project site shall be achieved when:

(a) All land disturbing activities have been completed and a uniform (for example, evenly distributed, without large bare areas) 70% density of perennial vegetative cover has been established on all unpaved areas and areas not covered by permanent structures, or equivalent permanent stabilization measures have been employed; and

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

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

(B) Notice of Termination

(1) The project site owner, or a representative thereof, shall submit a written Notice of Termination (NOT) form to the City and IDEM upon project termination once the following requirements are met:

(a) All land disturbing activities, including construction on all building lots, have been completed.

(b) Final stabilization of the entire site has been completed.

(c) All permanent stormwater quality measures (if required per Post-Construction Stormwater Quality section) have been implemented and are operational.

(d) Temporary erosion and sediment control measures have been removed.

(2) The IDEM NOT for Storm Water Runoff Associated with Construction Activity form is sufficient for this submittal.

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

(4) The City or a representative thereof may inspect the project site to confirm the information provided in the NOT.

(C) Early Project Termination Requirements

(1) The project site owner may submit a NOT to obtain early release from compliance with these Standards and the Construction General Permit.

(2) The project site owner must meet the requirements per Construction General Permit as outlined below:

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

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

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

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

(e) All permanent stormwater quality measures have been implemented and are operational.

(3) Upon verification of the NOT, the City 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 or NOT form. The notice must contain a verified statement that each of the conditions in Items (a) through (e), listed above, have been met. The notice must also inform the individual lot owners of the requirements to:

(a) Install and maintain appropriate measures to prevent sediment from leaving the individual building lot; and

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

Chapter 6- Stormwater Quality Management for Post-Construction

Land development projects and associated increases in impervious cover alter the hydrologic response of local watersheds and increase stormwater runoff rates, runoff volumes, flooding, stream channel erosion, and sediment transport and deposition. This stormwater runoff contributes to increased quantities of water-borne pollutants. Stormwater runoff, soil erosion and nonpoint source pollution can be controlled and minimized through the regulation of stormwater runoff from development sites.

The purpose of this chapter is to establish minimum stormwater management requirements and controls to provide reasonable guidance for the regulation of stormwater runoff for the purpose of protecting local water resources from degradation and to protect and safeguard the general health, safety, and welfare of the public residing in watersheds within the City. This chapter seeks to meet that purpose through minimizing increases in stormwater runoff rates and volumes, erosion and nonpoint source pollution caused by stormwater runoff, wherever possible, through stormwater management controls and to ensure that these management controls are properly maintained.

6.1 Applicability

(A) The provisions of this chapter are in compliance with the MS4GP

(B) In general, this chapter requires the post-construction control of stormwater discharges for both new development and redevelopment, with a land disturbance greater than or equal to 1 acre, or disturbances of less than 1 acre of land that are part of a larger common plan of development or sale if the larger common plan will ultimately disturb 1 or more acres of land.

(C) The requirements of this chapter do not apply to the following:

(1) Construction of, or modifications to, single family structures that are not a part of a larger common plan of development,

(2) Single family residential development consisting of four or fewer lots,

(3) Individual lots within a larger common development plan that has been previously permitted for stormwater management,

(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, and

(5) Land disturbance that results in no impervious surface area following construction (i.e. underground utility projects, grading projects that will establish vegetative cover).

(D) This chapter is not intended to interfere with, abrogate, or annul any other chapter, rule or regulation, stature, or other provision of law. The requirements of this chapter should be considered minimum requirements, and where any provision of this chapter imposes restrictions different from those imposed by any other chapter, rule or regulation, or other provision of law, whichever provisions are more restrictive or impose higher protective standards for human health or the environment shall be considered to take precedence.

(E) If the provisions of any section, subsection, paragraph, subdivision or clause of this chapter shall be judged invalid by a court of competent jurisdiction, such order of judgment shall not affect or invalidate the remainder of any section, subsection, paragraph, subdivision or clause of the chapter.

(F) Post-Construction Policy

(1) The City has adopted a policy that the control of stormwater runoff quality will be based on the management of total suspended solids (TSS). This requirement will serve as the basis of the stormwater quality management program for all areas within the jurisdiction of the City.

(2) BMPs shall incorporate floatables control. BMPs shall capture floating debris and remove it as part of routine maintenance of the BMP. Standalone BMPs must include floatables control. BMP systems or treatment trains shall have at least one component of the system providing floatable control, located after the last inflow point to the system.

(3) In addition, designers may be required to include in their designs the control of fecal bacteria or pollutants that are associated with a specific land use, such as hydrocarbons associated with retail gasoline outlets.

(4) Post-construction stormwater quality measures must be properly maintained to ensure stormwater runoff is continuously treated from the developed and stabilized site.

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

(6) New gasoline outlets and refueling areas, or outlets' and refueling areas that replace their existing tank systems shall be designed and installed using appropriate practices to reduce lead, copper, zinc, and polyaromatic hydrocarbons in stormwater runoff.

(G) Where appropriate, storage, infiltration, filtering, or vegetative practices shall be used to reduce the impact of pollutants in stormwater runoff on receiving waters. In addition to the practices, the following requirements shall be utilized:

(1) Infiltration practices will not be allowed in wellhead protection areas.

(2) Discharges will not be allowed directly into sinkholes or fractured bedrock without treatment that results in the discharge meeting Indiana ground water quality standards as referenced in 327 IAC 2-11.

(3) Any stormwater practice that is a Class V injection well must ensure that the discharge meets Indiana groundwater quality standards as referenced in 327 IAC 2-11.

(4) As site conditions allow, the rate at which water flows through conveyances shall be regulated to reduce outfall scouring and stream bank erosion.

(5) As site conditions allow, a vegetated filter strip of appropriate width shall be maintained along unvegetated swales and ditches.

6.2 Methods for Sizing BMPs

(A) The target TSS removal rate is 80%. For the purposes of this requirement, TSS is defined as particles smaller than 125 microns in diameter.

(B) There are two 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.

(C) The appropriate stormwater quality volume (WQ_v) and/or stormwater quality flow rate (Q_{wq}) generated from a qualifying site shall be adequately treated before discharge. Pre-approved

structural BMPs are provided in **Error! Reference source not found.** 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.

(D) The water quality volume or flow rate shall be treated by an acceptable, pre-approved BMP(s) or an equivalent practice. The pre-approved BMPs are in **Error! Reference source not found.** and must be designed according to Appendix C design criteria. Such practices or techniques and devices not pre-approved that may be more functional and desirable for storm water management may be utilized upon approval by the City.

Table 6-1: Pre-Approved Structural BMPs

BMP Type	Description	Quantity Control	80% TSS Removal
Wet Stormwater Pond or Basin with pretreatment	Constructed basin with a pretreatment area and permanent pool of water in which volume and flowrate of runoff is controlled	Yes	Yes – with TSS removal upstream of pond
Dry Detention or infiltration pond (must have upstream pretreatment)	Stormwater detention or infiltration ponds designed to hold water and release it slowly or infiltrate into the ground.	Yes	Yes, with infiltration or pretreatment
Stormwater Wetlands	Constructed wetlands are treatment systems that use natural processes involving wetland vegetation, soils and microbes to improve water quality.	Yes	Yes
Bioretention Areas: rain gardens or landscape depressions	Shallow stormwater basins or landscaped areas that utilize engineered soils and vegetation to capture and treat stormwater runoff.	Yes	Yes
Sand Filters: Surface sand filter, perimeter sand filter	Sand filters are multi-chamber structures designed to treat stormwater runoff through filtration, using a sand bed as the primary filter media.	No	Yes
Water Quality Swales: Dry swale	Water quality swales are vegetated open channels that are designed and constructed to filter stormwater runoff with vegetation and gentle slopes. Can be used as part of a treatment train but does not meet 80% TSS removal	No	No

Table 6-1: Pre-Approved Structural BMPs

BMP Type	Description	Quantity Control	80% TSS Removal
Infiltration Trench with pretreatment	Trench that captures and treats storm water runoff by allowing it to infiltrate into the ground through aggregate into highly porous underlying soils.	No	Yes
Biofilters: Filter strips, grass channels, water quality swales	Biofilters are designed and constructed to filter stormwater runoff with vegetation and gentle slopes. While biofilters provide some filtering of stormwater runoff, they can be used as part of a treatment train but do not meet 80% TSS removal	No	No
Catch Basin/Inlet Inserts	Inlet Insert BMPs the collect material under the grate are not acceptable as stand-alone BMPs and are discouraged due to high level of maintenance.	No	No
Mechanical BMP (Refert to item E below)	Hydrodynamic separator or filter system that separates and removes floatables and TSS at a water quality flow rate.	No	Yes –with laboratory testing data

(E) 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 without resuspension of particles at the design water quality flow rate resulting from a 1-inch rainfall depth. Testing of the TSS removal rate must be conducted by an independent testing facility rather than by the manufacturer.

(F) A quick reference, minimum design criteria, and maintenance and inspection checklists for each pre-approved BMP are provided in Appendix C of this manual.

(G) Water Quality Volume (WQ_V)

(1) The WQ_v is the storage needed to capture and treat the runoff from the first 1-inch of rainfall. The WQ_v is equivalent to 1 inch of rainfall multiplied by the volumetric runoff

coefficient (R_v) and the site area. The volume of runoff is directly related to the amount of impervious cover at the site and is calculated using Equation 6-1.

Equation 6-1

$$WQ_v = \frac{P\ R_v\ A}{12}$$

where:
WQ_v = water quality volume (acre-feet, ac-ft)
P = rainfall depth (inches, in) = 1 inch
R_v = volumetric runoff coefficient – see Equation 6-2
A = site area (acres)

Equation 6-2

$$R_v = 0.05 + 0.009\ I$$

where:
R_v = volumetric runoff coefficient
I = percentage of impervious cover (%)

(H) Water Quality Flow Rate (Q_{wq})

(1) The Q_{wq} is needed to size BMP devices designed to treat runoff at a peak design flow rate through the system. The rational method in conjunction with a rainfall intensity will be used to calculate the Q_{wq} (in cubic feet per second – cfs). This method relies on an intensity that is ½ the 2-year storm intensity from the intensity-duration-frequency curve along with the percent of impervious cover to identify the appropriate runoff coefficient for the proposed land use.

Step 1 - Using the percent of impervious cover, calculate the corresponding runoff coefficient for land use using the following equation.

$$C = 0.858\ i_c{}^3 - 0.78\ i_c{}^2 + 0.774\ i_c + 0.04$$

where:
C = Runoff Coefficient for Land Use
i_c = Percent of Impervious Cover (% / 100)

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

Step 3 – Using the time of concentration (T_c), define the peak intensity (in inches/hour) of the 2-year storm event utilizing the intensity-duration-frequency curve (shown in table form) from NOAA Point Precipitation Frequency Estimates which can be found at https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html?bkmrk=in. Interpolation may be necessary for times of concentration between given values.

Step 4 – To meet the design specification, divide the intensity determined in Step 3 by 2 to identify ½ the 2-year storm intensity.

Step 5 – Use the Rational Method equation shown utilizing the previously calculated values to calculate Q_{wq}.

$$\boxed{Q_{wq} = C \; x \; p \; x \; A}$$

Where:

Q_{wq} = Water Quality Flow Rate (cfs)
C = Runoff Coefficient for Land Use
p = ½ the 2-year storm intensity (inches/hour)
A = Area (acres)

Chapter 7 - Required Assurances

7.1 Performance Bonds

(A) Applicant shall provide financial performance assurance in the form of a performance bond, certified check, irrevocable letter of credit, or certificate of deposit before construction begins.

(B) Said performance bond shall guarantee a good faith execution of the SWPPP, Erosion and Sediment Control Plan, and any other conditions of plan approval including proper installation of all approved stormwater infrastructure.

(C) to cover all costs of improvements, landscaping maintenance of improvements for such period as specified by the City, and engineering and inspection costs to cover the cost of failure to repair of improvements installed on the project site

(D) Assurance shall be made out to the City of Beech Grove for an amount equal to 100% of the total costs of implementing measures required by this manual. The total costs shall be for the cost of installation of stormwater improvements including detention/retention facilities, stormwater quality BMPs, and other stormwater infrastructure and the continuous installation, monitoring, and maintenance of temporary and permanent sediment and erosion control measures, as regulated under this manual. The intent of this performance bond is not only to complete the installation of stormwater infrastructure for the project, but also to ensure that adequate stormwater pollution prevention measures are properly installed and maintained for such as period as specified by the City.

(E) Performance bonds shall be kept current until the project receives final approval from the City. Delinquent performance bonds or other assurances will result in penalties and corrective actions as defined in Chapter 11.

(F) Should the owner/applicant fail to comply with the provisions of this manual, in addition to any other remedies the City may redeem the performance bond to complete all necessary work, after giving reasonable notice and opportunity for compliance as defined in Chapter 11.

(G) Upon completion of the required temporary and permanent sediment and erosion control measures, detention/retention facilities, and stormwater quality BMPs according to the approved plans, the applicant shall provide the City with "as-built" plans in accordance with Part 8.1 of this manual. The applicant may then request the release of the performance bond. Upon satisfaction of all performance requirements, issuance of the NOT, and receipt of the maintenance guarantee as described in Part 7.2 of this manual, the City will release the performance bond within 60 days.

7.2 Maintenance Bonds

(A) Prior to the release of the performance assurance, the applicant shall provide financial maintenance guarantee in the form of a *Maintenance Bond* (Form B-13 in Appendix B) or certified check. Assurance shall be made out to the City of Beech Grove.

(B) Said maintenance bond shall guarantee the materials and workmanship of all permanent sediment and erosion control measures, detention/retention facilities, water quantity BMPs, and other stormwater infrastructure and that stormwater quality BMPs shall be maintained in accordance with the approved plans, O&M manual, and the requirements described herein.

(C) Said financial maintenance guarantee shall meet the following conditions:

(1) The *Maintenance Bond* shall run and be in force for a period of 3 years from the date of release of the performance bond.

(2) A penal sum shall be fixed and approved by the City, but in no case shall the penal sum be less than 20% of the total construction cost. The minimum *Maintenance Bond* shall be no less than $5,000.00.

(3) The *Maintenance Bond* shall be issued in the applicant's name alone or in the name of the applicant and his subcontractor as co-signers. All certified checks provided for financial maintenance guarantee shall be signed by the applicant alone.

(D) All maintenance bonds shall expire at the end of the 3-year period for which they were established. Within 60 days of the expiration date, the proper authority will return said expired maintenance bond to the applicant. In the case where a certified check has been posted as a financial maintenance guarantee, the applicant shall, at the end of the 3-year maintenance period, contact the proper authority in order to obtain the release of the maintenance guarantee.

Chapter 8 - Project Construction and Completion

8.1 Construction Inspection and Maintenance

(A) Prior to beginning construction activities, conduct a Pre-Construction Conference with the City and other stakeholders. Notify the City at least 2 business days prior to the Pre-Construction Conference.

(B) The City may conduct inspections of the installation of the stormwater management system to ensure compliance with the terms of this manual and the Stormwater Management Approval.

(C) The applicant must notify the City at least 2 business days in advance of installation of the stormwater facilities. Inspections of the system construction may be conducted by the City or their designated representative. If required, the applicant shall execute an *Agreement Between Owner / Contractor and City of Beech Grove for Construction Inspection Services* (Form B-11 in Appendix B) and pay all applicable inspection fees per the terms stated in the agreement.

(D) The City has the authority to conduct post-construction inspections to ensure the stormwater facility is maintained in good condition. Parties responsible for the operation and maintenance of a stormwater facility shall make and keep records of the installation and of all maintenance and repairs. These records shall be made available to the City upon request and shall be retained for a period of 5 years.

(E) If the responsible party fails to meet the requirements of the installation and maintenance conditions per this manual and the terms and conditions of the stormwater management approval, the City shall pursue enforcement action according to Chapter 11.

8.2 Certification of As-Built Plans

(A) For public stormwater conveyances/facilities and sites 1 acre or larger, record drawings of installed stormwater facilities shall be completed within 30 days after the completion of the project and submitted to the City for final approval of the project.

(B) Record drawings shall be certified by a Professional Engineer or Land Surveyor.

(C) Record drawings shall include both a hard copy and an electronic copy (AutoCAD compatible drawings on CD) of as-built information including easements, horizontal alignments, elevations, inverts, top-of-castings, pond cross sections, and flow lines of swales.

8.3 Operation and Maintenance for Post-Construction

(A) Operations and Maintenance (O&M) Manual Requirements.

(1) Privately-owned stormwater facilities (including pipes, structures, detention/retention facilities, swales, open channels, subsurface drains, water quality BMPs, and low impact development practices) shall have an O&M manual. The O&M manual shall be submitted with the *General Application for Drainage Approval*.

(2) Owners of ponds will be responsible for all maintenance of pond banks, erosion control measures, riprap, outlets, outfall protection, and all periodic dredging. It is the designer's responsibility to determine which additional operation and maintenance measures are necessary to prolong the optimal function of the facility.

(3) Following approval by the City, the signed and approved O&M manual shall be recorded with the property by the County Recorder's office. Refer to the Recorder's Office for requirements.

(4) The approved O&M manual shall be signed by the owner and notarized. A copy of the approved O&M manual shall be provided to the owner and the City. The signed and approved O&M manual shall be recorded with the property by the County Recorder's office. A copy of the O&M manual shall be provided to each new owner before the consummation of a sale. The O&M manual shall be signed by the new owner, notarized, and submitted to the City to be kept on record.

(5) All O&M manuals shall include the following information, at a minimum:

(a) Owner Information. The first section of the manual shall contain information about all people involved with the operations and maintenance of the facility. This section shall list the names and contact information of all responsible parties, including property owner(s), maintenance staff, and person(s) responsible for performing inspections. The responsibilities of each individual shall be clearly defined. Contact information shall include business or mobile phone number, address for giving notice, and email address (if available).

(b) Owner's Acknowledgement. The O&M Manual must include a notarized owner's statement acknowledging their responsibility to inspect, operate and maintain the stormwater management facilities.

(c) Right-of-Entry Statement. The O&M manual shall include a statement that the City of Beech Grove has the right to enter the property to inspect the stormwater management facilities. The statement shall be signed and notarized.

(d) Map and Exhibits. The O&M manual shall include the following:

(i) Maps and exhibits drawn to a legible scale on 8.5" x 11" paper.

(ii) Maps and exhibits shall clearly indicate the following

(1) The location of the stormwater facility or BMP.

(2) Plan and cross-section details, showing applicable features.

(3) The flow of stormwater through the site, including an overview of the stormwater's path through the onsite stormwater facilities.

(4) Dimensions, easements, outlets/discharge points and outfall locations, drainage patterns, stormwater runoff flow directions, the extent and depth (elevation) of high water levels, flood routing path, signage, connecting structures, weirs, invert elevations, structural controls used to control stormwater flows, and other relevant features.

(e) O&M Practices. Each stormwater facility shall require specific inspection and maintenance procedures.

(i) Guidance. Guidance shall be written in simple, layman's terms, including:

(1) Guidance on owner-required periodic inspections.

(2) Guidance on routine maintenance including mowing, litter removal, woody growth removal, etc. to be performed by the owner.

(3) Guidance on remedial maintenance such as inlet replacement, outlet maintenance, etc. to be performed by the owner.

(4) Guidance on sediment removal, both narrative and graphical, describing when sediment removal shall occur in order to ensure that the stormwater facility remains effective as a stormwater management device. Guidance shall include

instructions as to how the depth of sediment shall be measured and at what measurement removal will be required.

(5) Instructions for dredging of wet ponds to include all periodic pond dredging (including sediment accumulation at inlets into the pond). It is the designer's responsibility to determine operation and maintenance measures necessary to prolong the optimal function of the facility. Include how to measure depth of sediment accumulation and the expected frequency of dredging. The suggested method and cost of dredging must also be included.

(6) Instructions for maintenance of dry and wet ponds to include maintenance of pond banks, erosion control measures, riprap, outfall protection and clearing of the outlet control structure/orifice to prevent clogging.

(7) Instructions on inspection and clean-out of stormwater management facilities such as sumps, trash screens, settling pits, and oil/grease collection chambers.

(8) For manufactured products, include the manufacturer's published inspection and maintenance instructions.

(9) Instructions on proper disposal of removed sediments, trash, debris, and other substances.

(10) Guidance and methods for preventing water stagnation in ponds and all recommended maintenance.

(ii) Inspection and Maintenance: The minimum requirements below shall also be incorporated into the inspection and maintenance regimen and clearly documented in the O&M manual.

(1) Operation and maintenance procedures and practices shall be reviewed and assessed annually.

(2) Access routes, including roadways and sidewalks, shall be inspected annually and maintained as needed.

(3) Drainage structures and flow restrictors shall be inspected and cleaned semi-annually or per the manufacturer's recommendations, whichever is more stringent.

(4) Stormwater management facilities shall be inspected semi-annually or per the manufacturer's recommendations, whichever is more stringent.

(5) The owner shall keep an updated log book or inspection worksheets documenting the performance of the required operation and maintenance activities for perpetuity. Note inspection dates, facility components inspected, facility condition, and any maintenance performed or repairs made. Documentation must be produced upon the request of the City, within 48 hours of the request.

(6) Vegetation shall be maintained on a regular basis per design specifications.

(7) Pest control measures shall be implemented to address insects, rodents, and other pests. Natural pest control is preferred over chemical treatments.

(8) Native vegetation plantings shall have "No Mow" or other appropriate signage.

(9) Underground vaults and structures shall include design measures to facilitate regular cleaning and maintenance. Confined space entry procedures shall be followed.

(f) Implementation Schedule. An inspection and maintenance schedule shall be prepared in a tabular format and included in the O&M manual. This schedule shall provide for routine examination of all stormwater facilities on the property and incorporate the varying maintenance needs of each.

(g) Employee Training. Specific individuals shall be assigned responsibility for operation, maintenance, and inspection of all onsite stormwater facilities. Employee training shall be conducted so that these individuals are aware of proper procedures and practices. The training program and schedule shall be incorporated into the O&M manual. All personnel should be familiar with the components of the O&M manual and their personal level of responsibility. Training documentation may be requested by the City.

(h) Drainage Easement(s) Documentation. The O&M manual shall include documentation of drainage easement(s) around the stormwater facilities. The documentation must be in graphic format. Easements must be recorded.

8.4 Inspection Maintenance and Recordkeeping Post-Construction

(A) Stormwater Facility and BMP Maintenance.

(1) Stormwater facilities and BMPs shall be maintained in a properly functioning condition so that their effectiveness in managing and treating stormwater runoff is not diminished, in accordance with the operation and maintenance procedures and schedules listed in Appendix C, the *Indiana Stormwater Quality Manual*, the approved O&M manual, and the terms and conditions of the approved Drainage Plan. The stormwater facility or BMP owner is considered in violation of this manual if the facility or BMP is not maintained properly.

(2) Following construction completion and the issuance of an NOT, inspection and maintenance of stormwater facilities and BMPs shall be the long-term responsibility of the owner of those facilities (including Homeowners Associations or any other entity as specified in restrictive covenants).

(B) Records of Inspection and Maintenance Activities.

(1) The stormwater facility or BMP owner must conduct necessary inspections, at least once per year. The inspections shall follow the operation and maintenance procedures listed in Appendix C, the *Indiana Stormwater Quality Manual*, the approved O&M manual, and the terms and conditions of the approved Drainage Plan for each facility or BMP. The inspection shall cover physical conditions, available water quality storage capacity, and the operational condition of key facility elements. Completed inspection forms must be maintained by the owner and produced upon request by the City within 48 hours of the request.

(2) Annual inspection reports shall be completed by the Owner, beginning one year after construction is completed. Subsequent reports shall be completed each year within the same month of the initial report in perpetuity. All deficiencies found during the inspection shall be addressed. Reports shall be made available to the City within 48 hours of a request. If the annual inspection report is not completed within the month it is due, if there are deficiencies which exist but were not included in the report, or if

any deficiencies included in the report are not addressed in a timely manner, the City may take enforcement action in accordance with this manual.

(3) The City must be notified of any changes in ownership, major repairs, or failure in writing within 30 days.

(4) In the event that the City finds a stormwater facility in need of maintenance or repair, the City will notify the owner on record of the necessary maintenance or repairs and give the owner a timeframe for completing the work. If the maintenance or repairs are not completed within the designated timeframe, the City may perform the work and bill the owner for the actual costs of the work.

(5) The City also has the authority to perform long-term inspection of all public or privately-owned stormwater facilities. Such inspections will be in addition to the regular inspections required to be performed by the facility owner. The inspections will follow the operation and maintenance procedures included in Appendix C and/or the operation and maintenance procedures listed in the approved Drainage Plan for each facility or BMP. Noted deficiencies and recommended corrective action will be included in an inspection report.

Chapter 9 - Illicit Discharge, Detection and Elimination

The purpose of this chapter is to provide for the health, safety, and general welfare of the citizens of the City of Beech Grove through the regulations of non-stormwater discharges to the storm drainage system to the maximum extent practicable as required by federal and state law. This chapter establishes methods for controlling the introduction of pollutants into the municipal separate storm sewer system (MS4) in order to comply with requirements of the National Pollutant Discharge Elimination System (NPDES) permit process. The objectives of this chapter are:

- To regulate the contribution pollutants to the MS4 by stormwater discharges by any user;
- To prohibit illicit connections and discharges to the MS4 or waterbodies; and
- To establish legal authority to carry out all inspection, surveillance and monitoring procedures necessary to ensure compliance with this chapter.

9.1 Applicability

This chapter shall apply to anything entering the MS4 generated on any developed and undeveloped lands unless explicitly exempted by the City.

9.2 Discharge Prohibitions

(A) Prohibition of illegal discharges. No person shall discharge or cause to be discharged into the MS4 or waterways any materials, including but not limited to pollutants, wastewater or waters containing any pollutants. The commencement, conduct or continuance of any illegal discharge to the MS4 is prohibited except as described as follows:

(1) The following discharges are exempt from discharge prohibitions established by this chapter:

(a) water line and hydrant flushing or other potable water sources,
(b) landscape irrigation or lawn watering (without chemical additives),
(c) diverted stream flows,
(d) rising ground water,
(e) uncontaminated ground water infiltration,
(f) uncontaminated pumped ground water,
(g) uncontaminated foundation or footing drains (not including active groundwater dewatering systems),
(h) uncontaminated water from crawl space drains or pumps,
(i) uncontaminated condensate from air conditioning units, coolers, and other compressors, and from outside storage of refrigerated gases or liquids,
(j) springs,
(k) residential washing of vehicles,
(l) natural riparian habitat or wetland flows,
(m) swimming pool discharge (if dechlorinated to less than 1 part per million chlorine or debrominated),
(n) excess storm sewer cleaning water not collected by a vacuum truck (uncontaminated)
(o) external building wash down, without detergents
(p) pavement wash waters provided spills or leaks of toxic or hazardous materials have not occurred (unless all spill material has been removed) and where detergents are not used
(q) uncontaminated groundwater infiltration (as defined at 40 CFR 35.205(20))
(r) fire-fighting activities, and

(s) any other water source not containing pollutants.

(2) Discharges specified in writing by an authorized representative of the City as being necessary to protect public health and safety.

(3) Dye testing is an allowable discharge, but requires a verbal notification to the City prior to the time of the test.

(4) The prohibition shall not apply to any non-stormwater discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered under the authority of the Federal or State agency, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for any discharge to the stormwater conveyance system.

(B) Prohibition of illicit connections.

(1) The construction, use, maintenance or continued existence of illicit connections to the stormwater conveyance system is prohibited.

(2) This prohibition expressly includes, without limitation, illicit connections made in the past, regardless of whether the connection was permissible under law or practices applicable or prevailing at the time of connection.

(3) A person is considered to be in violation of this chapter if the person connects a line conveying sewage to the MS4, or allows such a connection to continue.

(4) All connections shall also be in compliance with other applicable City ordinances, including sanitary sewer and sump pump requirements.

9.3 Suspension of MS4 Access

(A) Suspension due to illicit discharges in emergency situations.

(1) The City may, without prior notice, suspend MS4 discharge access to a person when such suspension is necessary to stop an actual or threatened discharge which presents or may present imminent and substantial danger to the environment, or to the health or welfare of persons, or to the MS4 or waterways.

(2) If the violator fails to comply with a suspension order issued in an emergency, the City may take such steps as deemed necessary to prevent or minimize damage to the MS4 or waterways, or to minimize danger to persons.

(B) Suspension due to the detection of illicit discharge.

(1) Any person discharging to the MS4 in violation of this ordinance may have their MS4 access terminated if such termination would abate or reduce an illicit discharge.

(2) The City will notify a violator of the proposed termination of its MS4 access.

(3) The violator may petition the City for a reconsideration and hearing.

(4) A person commits an offense if the person reinstates MS4 access to premises terminated pursuant to this section, without the prior approval of the City.

9.4 Industrial or Construction Activity Discharges

Any person subject to an industrial or construction activity NPDES stormwater discharge permit shall comply with all provisions of such permit. Proof of compliance with said permit may be required in a form acceptable to the City prior to the allowing of discharges to the MS4.

9.5 Monitoring Of Discharges

(A) Access to facilities and properties.

(1) The City shall be permitted to enter and inspect facilities and properties subject to regulation under this chapter as often as may be necessary to determine compliance with this chapter. If a discharger has security measures in force which require proper identification and clearance before entry into its premises, the discharger shall make the necessary arrangements to allow access to representatives of the City.

(2) Facility operators and property owners shall allow the City ready access to all parts of the premises for the purposes of inspection, sampling, examination, and copying of records that must be kept under the conditions of an NPDES permit to discharge stormwater and the performance of any additional duties as defined by State and Federal law.

(3) The City shall have the right to set up on any property or permitted facility such devices as are necessary in the opinion of the City to conduct monitoring and/or sampling of a stormwater discharge.

(4) The City has the right to require the discharger to install monitoring equipment as necessary. The sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the discharger at its own expense. All devices used to measure stormwater flow and quality shall be calibrated to ensure their accuracy.

(5) Any temporary or permanent obstruction to safe and easy access to a facility or property to be inspected and/or sampled shall be promptly removed by the owner or operator at the written or oral request of the City and shall not be replaced. The costs of clearing such access shall be borne by the owner or operator.

(6) Unreasonable delays in allowing the City access to a facility or property is a violation of a stormwater discharge permit and of this chapter. A person who is the owner or operator of a facility with a NPDES permit to discharge stormwater associated with industrial activity commits an offense if the person denies the City reasonable access to the permitted facility for the purpose of conducting any activity authorized or required by this chapter.

(7) If the City has been refused access to any part of the premises from which stormwater is discharged, and he/she is able to demonstrate probable cause to believe that there may be a violation of this chapter, or that there is a need to inspect and/or sample as part of a routine inspection and sampling program designed to verify compliance with this chapter or any order issued hereunder, or to protect the overall public health, safety, and welfare of the community, then the City may seek issuance of a search warrant from any court of competent jurisdiction.

9.6 Requirement to Prevent, Control, and Reduce Stormwater Pollutants by the Use of Best Management Practices

(A) The City will require Best Management Practices for any activity, operation, or facility which may cause or contribute to pollution or contamination of stormwater, the MS4, or waterways.

(B) The owner or operator of a property or facility shall provide, at their own expense, reasonable protection from accidental discharge of prohibited materials or other wastes into the municipal stormwater conveyance system or watercourses through the use of these structural and non-structural BMPs.

(C) Further, any person responsible for a property or premise, which is, or may be, the source of an illicit discharge, may be required to implement, at said person's expense, additional structural and non-structural BMPs to prevent the further discharge of pollutants to the MS4.

(D) Compliance with all terms and conditions of a valid NPDES permit authorizing the discharge of stormwater associated with industrial activity, to the extent practicable, shall be deemed compliance with the provisions of this section. These BMPs shall be part of a stormwater pollution prevention plan (SWPPP) as necessary for compliance with requirements of the NPDES permit.

9.7 Notification of Spills

(A) Notwithstanding other requirements of law, as soon as any person responsible for a property, facility or operation, or responsible for emergency response for a facility or operation has information of any known or suspected release or spill of materials which are resulting or may result in illegal discharges or pollutants discharging into stormwater, the MS4, or waterways said person shall take all necessary steps to ensure the discovery, containment, and cleanup of such release or spill in accordance with State regulations.

(B) In the event of a spill, said person shall immediately notify emergency response agencies of the occurrence via emergency dispatch services. Within 2 hours of becoming aware of the spill, the person shall notify the City in person or by phone. This requirement does not relieve the discharger from notifying other entities as required by State or Federal requirements.

(C) Notifications in person or by phone shall be confirmed by written notice addressed and mailed to the City within 5 days of the phone notice. The written notice shall contain the necessary information identified in the Indiana Spill Rule (327 IAC 2-6.1).

(D) If the discharge of prohibited materials emanates from a commercial or industrial establishment, the owner or operator of such establishment shall also retain an on-site written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained for at least 3 years.

Chapter 10 – Sanitary Sewer Prohibited Discharge

10.1 Purpose

(A) The purpose of this chapter is to eliminate sump pump and other stormwater connections to the sanitary sewer system in order to reduce the burden to the system and reduce treatment of clear, unpolluted water.

(B) The rules and regulations governing the use of sump pumps or other clear water conveyance systems are being established:

(1) To set forth uniform requirements for the use and discharge of sump pumps or groundwater conveyance systems.

(2) To prevent the introduction of clean surface water, including but not limited to, water from roof or cellar drains, basement sump pumps, French drains, yard drains, and other clear water sources.

10.2 Applicability

This chapter shall apply to all water entering the sanitary sewer system generated on any developed or undeveloped lands unless explicitly exempted by an authorized enforcement authority.

10.3 Prohibited Discharges

(A) No property owner, occupant, user, or person shall discharge or cause to be discharged any stormwater, surface water, groundwater, roof runoff, subsurface drainage, cooling water, or unpolluted industrial process waters to any sanitary sewer. Unlawful connections include, but are not limited to: sump pumps, foundation drains, French drains, yard drains, gutter downspouts, cistern overflow pipes, and any other stormwater drainage receptacle(s).

(B) Stormwater and other unpolluted drainage shall be discharged to the stormwater conveyance system. Industrial cooling water or unpolluted process waters may be discharged to the stormwater conveyance system upon approval of the City of Beech Grove or its authorized representative.

10.4 Sump Pump and Rigid Pipe Required

Any existing or new construction in which a sump pump has been or will be installed, shall be required to install a rigid pipe connection discharge in accordance with Part 10.5. It shall be unlawful to maintain any connection with the sanitary sewer carrying roof water, ground water, surface water or any other natural precipitation after the effective date of this ordinance.

10.5 Sump Pump and Rigid Pipe: Method of Installation

(A) The building shall have a drain tile placed around the inside or outside perimeter of the foundation connected to a sump pit. All baseboard seepage collection systems shall be discharged to the sump pit. The sump pit shall be located at least 10 feet away from the inside sanitary floor drain.

(B) The sump pump discharge pipe shall be connected to a storm sewer when available and abutting on the property unless otherwise approved by the City. Connections to the storm sewer system shall have an approved backflow prevention device installed. The sump pump discharge pipe shall not be connected to underdrains, subsurface drainage tiles, building floor drains, downspout outlets, or other sump pump lines.

(C) When an existing sump pump discharges to the ground or when a storm sewer is not available, the sump pump shall discharge to grade and must meet all of the following provisions, unless otherwise approved by the City:

(1) The discharge pipe shall be installed to the outside wall of the building with rigid pipe (plastic, copper, galvanized or black pipe) with a 1-inch inside diameter minimum.

(2) The discharge pipe must have a check valve within 1 foot of the floor grade and a union or other approved coupling for easy disconnection for repair or replacement.

(3) The discharge pipe shall exit the building at 1 foot above finished grade.

(4) The point of discharge must be a minimum of 3 feet from the foundation wall and 5 feet from the property line.

(5) The discharge must flow parallel to or away from the nearest property line.

(6) The discharge water shall not discharge to a public way including, sidewalks, streets, or alleys. The discharge pipe shall terminate no less than 10 feet from such impervious surfaces.

(7) The discharge water shall not create an icy condition on any pedestrian walkways within or adjacent to the subject premises lot lines.

10.6 Removal of Prohibited Connection Required

(A) Any property owner who previously made any connection or installation in violation of this chapter shall immediately remove such connection or correct such an installation. All direct or indirect connections of a system as defined above intended to collect and convey unpolluted stormwater or groundwater along, adjacent to, beside, or under the foundation or basement of any building connected to the City of Beech Grove sanitary sewer shall be disconnected from the sanitary sewer system.

(B) Disconnection shall mean removal of any direct or indirect prohibited connection to the sanitary sewer system, including direction connections to the sanitary sewer service line, connections to a sanitary sewer floor drain or similar plumbing fixture that would allow unpolluted stormwater or groundwater flow to enter the sanitary sewer system. Any disconnections or openings in the sanitary sewer shall be closed or repaired in a workmanlike manner with proper materials unless the connection to the sanitary sewer is used for the proper discharge of wastewater.

10.7 Non-Compliance Fee for Prohibited Connection

(A) Every person owning property shall allow an employee of the City, a designated representative of the City, or a licensed plumber to inspect the building to determine if sump pumps or other prohibited discharges are connected to the sanitary sewer system. Any person refusing to allow their property to be inspected shall become subject to the monthly fee as defined below.

(B) Any sanitary sewer customer found with a direct or indirect prohibited connection to the sanitary sewer system or refusing a property inspection shall be provided written notice that the property will be subject to a monthly fee of $20.00 to cover the cost for treating the extraneous flow or potential extraneous flow contributed to the sanitary sewer system. The fee will be in addition to all other sanitary sewer user charges and will be added to the property owner's utility bill until the property is found to be in compliance. The fee will be included on the utility bill within 45 days of discovery of the prohibited connection.

(C) Any property found to have a prohibited connection, either direct or indirect, to the sanitary sewer system shall receive a written notice from the City that will require the property owner to make the necessary repairs and furnish proof of the repairs to the City. Upon confirmation of the elimination of the prohibited connection, the monthly fee will be removed from the property's sewer bill within 30 days. Additional enforcement and penalties may be incorporated in accordance with Chapter 11 of this manual.

(D) Exemptions may be granted in the form of a waiver for a particular property owner who can demonstrate undue hardship because of unique or extenuating circumstances. A waiver would allow the property owner to discharge directly into the sanitary sewer system. A waiver request shall be submitted to the City (City Hall, 806 Main Street, Beech Grove, Indiana 46107) in writing and, at a minimum, shall identify the property for which the waiver is being requested, the name of the property owner/applicant, and a detailed description of the circumstances justifying the request. Any person granted a waiver shall be charged a reduced monthly fee of $10.00 to cover the cost for treating the extraneous flow or potential extraneous flow contributed to the sanitary sewer system. The fee will be in addition to all other sanitary sewer user charges and will be added to the property owner's utility bill until the waiver is removed or the property is found to be in compliance.

Chapter 11- Enforcement and Penalties

11.1 Notice of Violation

(A) Whenever the City finds that a person has violated a prohibition or failed to meet a requirement of this manual, the City or the City's representative may order compliance by written notice of violation to the responsible person. Such notice may require without limitation:

(1) The performance of maintenance activities, monitoring, analyses, and reporting;

(2) The elimination of illicit connections or discharges;

(3) That violating discharges, practices, or operations shall cease and desist;

(4) The abatement or remediation of stormwater pollution or contamination hazards and the restoration of any affected property;

(5) Payment of a fine to cover administrative and remediation costs, including but not limited to remediation costs, legal fees, consultant fees, monitoring costs, construction costs, collection fees and any other costs borne by the City related to the violation;

(6) The implementation of source control or treatment BMPs;

(7) The issuance of a Stop Work Order; and/or

(8) Revocation or suspension of Stormwater Management Plan approval.

(B) If abatement of a violation or restoration of affected property is required, the notice shall set forth a deadline within which such remediation or restoration must be completed. Said notice shall further advise that, should the violator fail to remediate or restore within the established deadline, the work will be done by the City or a contractor and the expense thereof shall be charged to the violator.

11.2 MS4 Stop Work Order

(A) Issuance

(1) If conditions exist such that any work activity must be stopped immediately to cease an illicit discharge, the City issues a verbal order to stop work to the responsible person.

(2) After a verbal order is issued, the City immediately notifies the person of the condition.

(3) The City initiates a written "MS4 Stop Work Order" by providing detailed information to the person. The order states the reason for the order, the conditions under which the cited work will be permitted to resume, and the name and contact information of the official issuing the order.

(4) Any person who continues to engage in any work after having been served with an MS4 Stop Work Order, except such work as that person is directed to perform to remove a violation or unsafe condition, shall be provided a Notice of Violation and potentially be assessed penalties.

(5) Violators receiving an MS4 Stop Work Order are required to respond to the City within 2 business days of the issued notice to receive instructions on how to rescind the order.

(6) The City may impose penalties in accordance with this ordinance.

(B) Appeal

(1) Any person receiving an MS4 Stop Work Order may appeal the determination of the City. The notice of appeal must be filed with the City within 10 days from the date of the notice.

(2) Hearing on the appeal before the Board of Public Works and Safety shall take place within 30 days from the date of its receipt of the notice of appeal.

(3) The decision of the Board of Public Works and Safety shall be final.

(C) Restart Work

(1) Once the person notifies the City that they are ready to restart the work that had been stopped, the City shall verify corrective/preventative actions have been completed.

(2) The City indicates the verification of satisfactory completion of corrective and/or preventative actions, and notifies the person that work is authorized to be resumed.

(3) The City issues the approved restart to the affected persons via a letter or memorandum.

11.3 Appeal of Notice of Violation

(A) Any person receiving a notice of violation may appeal the determination of the City. The notice of appeal must be received within 15 days from the date of the notice of violation.

(B) Hearing on the appeal before the appropriate authority or his or her designee shall take place within 30 days from the date of receipt of the notice of appeal. The decision of the City or their designee shall be final.

11.4 Enforcement Measures after Appeal

(A) If the violation has not been corrected pursuant to the requirements set forth in the notice of violation or, in the event of an appeal, within 15 days of the decision of the Board of Public Works and Safety upholding the decision of the City, then representatives of the City shall enter upon the subject private property and are authorized to take any and all measures necessary to abate the violation and/or restore the property.

(B) It shall be unlawful for any person, owner, agent, or person in possession of any premises to refuse to allow the government agency or designated contractor to enter upon the premises for the purposes set forth above.

11.5 Cost of Abatement of the Violation

(A) After completion of abatement activities, the owner of the property will be notified of the cost of abatement, including administrative costs.

(B) The property owner may file a written protest objecting to the amount of the assessment within 15 days.

(C) If the amount due is not paid within a timely manner as determined by the decision of the Board of Public Works and Safety or by the expiration of the time in which to file an appeal, the charges shall become a special assessment against the property and shall constitute a lien on the property for the amount of the assessment.

(D) Any person violating any of the provisions of this manual shall become liable to the City by reason of such violation. The liability shall be paid in not more than 12 equal payments. Interest at the rate of 8% per annum shall be assessed on the balance beginning on the first day following discovery of the violation.

11.6 Injunctive Relief

(A) It shall be unlawful for any person to violate any provision or fail to comply with any of the requirements of this manual.

(B) If a person has violated or continues to violate the provisions of this manual, the City may petition for a preliminary or permanent injunction restraining the person from activities which would create further violations or compelling the person to perform abatement or remediation of the violation.

11.7 Compensatory Action

(A) In lieu of enforcement proceedings, penalties, and remedies authorized by this manual, the City may impose upon a violator alternative compensatory actions, such as storm grate stenciling, attendance at compliance workshops, creek cleanup, etc.

(B) If the compensatory action is not completed according to the provided schedule, then all fines and penalties will be immediately due from the violator.

11.8 Violations Deemed a Public Nuisance

(A) In addition to the enforcement processes and penalties provided, any condition caused or permitted to exist in violation of any of the provisions of this manual is a threat to public health, safety, and welfare, and is declared and deemed a nuisance, and may be summarily abated or restored at the violator's expense, and/or a civil action to abate, enjoin, or otherwise compel the cessation of such nuisance may be taken.

11.9 Remedies Not Exclusive

(A) The remedies listed in this manual are not exclusive of any other remedies available under any applicable federal, state, or local law, and it is within the discretion of the City to seek cumulative remedies.

11.10 Penalties

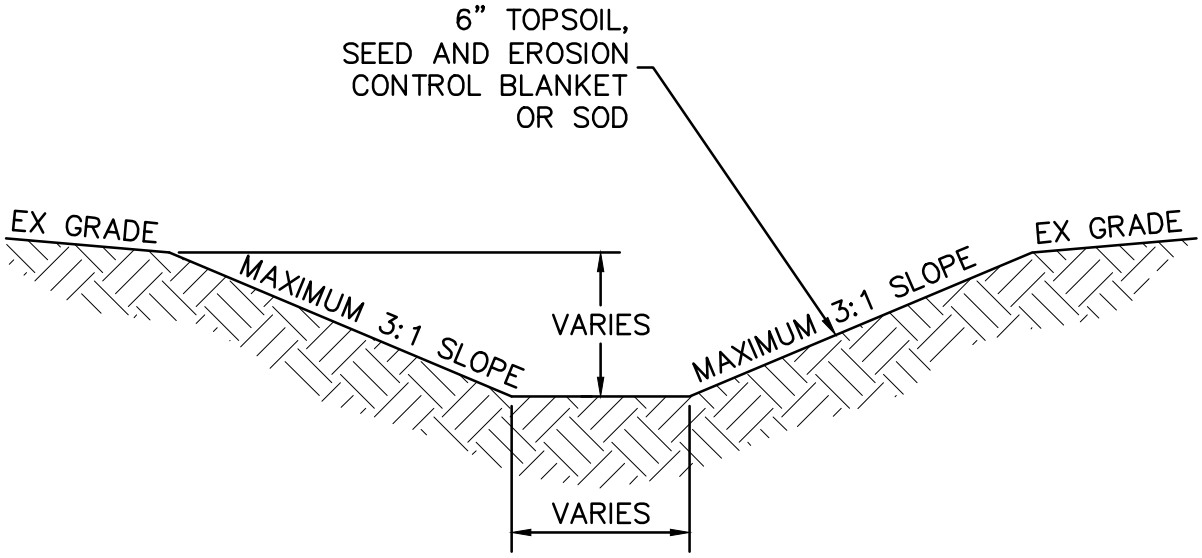
(A) Any person who violates any of the provisions of this manual may be fined.

(B) The fines described in the notice of violation may include a civil infraction and is subject to a minimum $100 fine for investigation, inspection and administrative costs and a maximum fine of $2,500 for a first offense. A maximum of $7,500 may be assessed for a subsequent offense. Each day such a violation occurs or continues shall be deemed a separate offense and shall make the violator liable for the imposition of a fine for each day.

(C) Any person responsible for the discharge or potential discharge of a prohibited substance into the stormwater drainage system shall be subject to all remedial and punitive enforcement procedures specified in this manual. In addition to fines, the owner shall be responsible for: stormwater administrative costs including labor, materials, and other fees; all costs associated with eliminating the illegal discharge or connection; any emergency response, clean-up, installation of infrastructure, remediation, or disposal fees; and ensuring that all sanitary and stormwater connections originating from the property are in full compliance with the requirements of this ordinance.

APPENDIX A

STANDARD STORMWATER CONSTRUCTION DETAILS

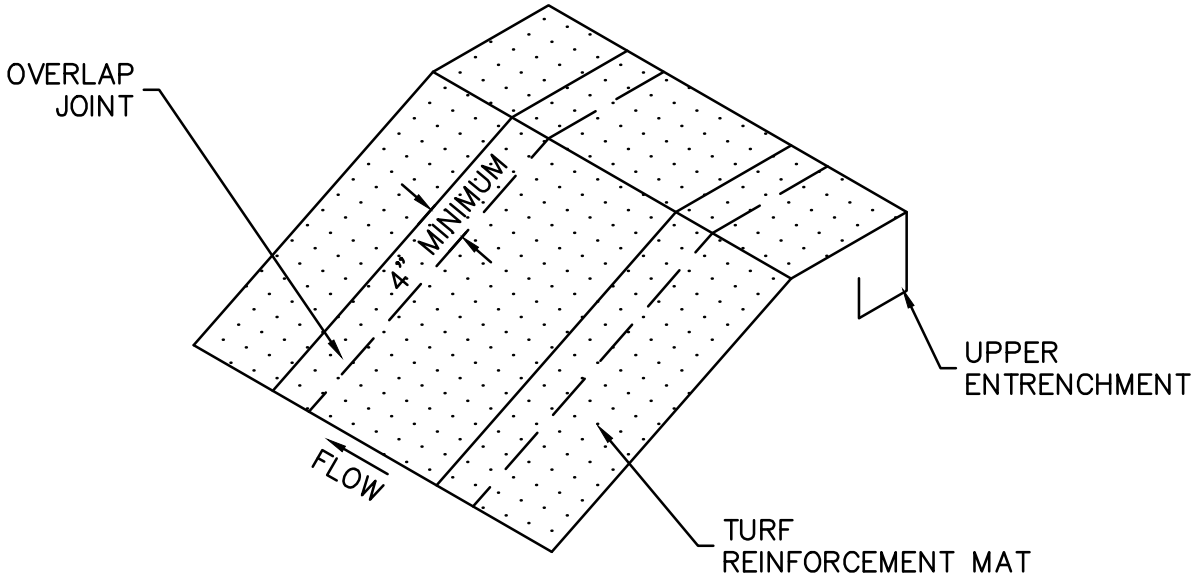


GRASS LINED CHANNEL

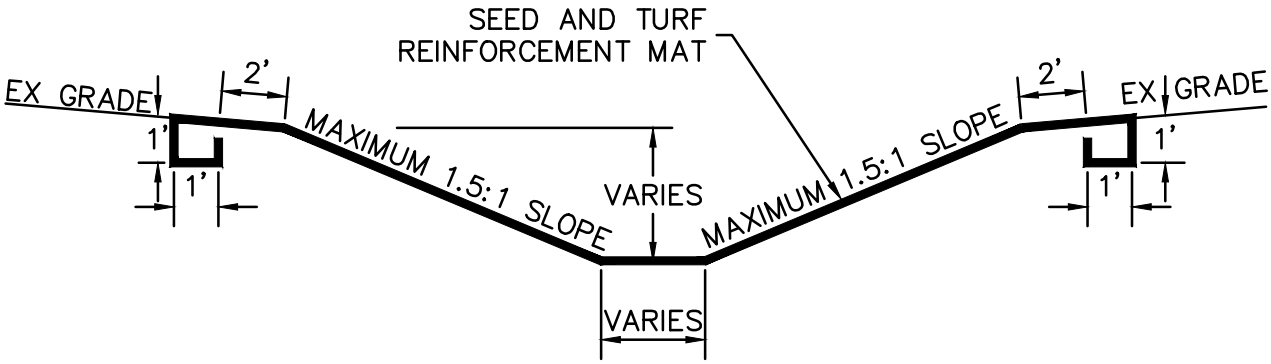
SCALE: NONE

city of beech grove

DETAIL NO. A-1
REVISION DATE: JUNE 2015



ISOMETRIC VIEW



SECTION VIEW

TURF REINFORCEMENT MAT LINED CHANNEL

SCALE: NONE

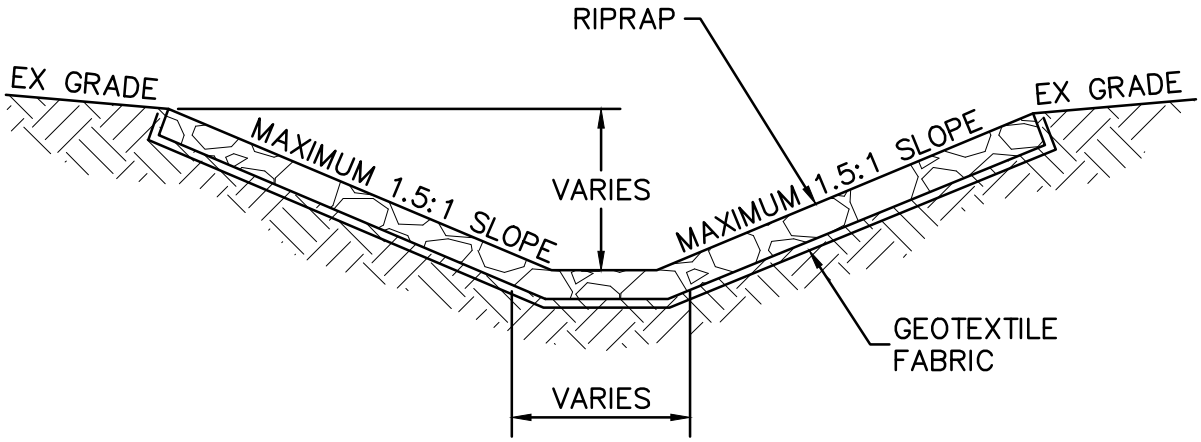
city of beech grove

DETAIL NO. A-2
REVISION DATE: JUNE 2015

RIPRAP GRADATION REQUIREMENTS			
	PERCENT SMALLER		
SIZE, mm (in.)	REVETMENT	CLASS 1	CLASS 2
750 (30)			100
600 (24)		100	85–100
450 (18)	100	85–100	60–80
300 (12)	90–100	35–50	20–40
150 (6)	20–40	10–30	0–20
75 (3)	0–10	0–10	0–10
DEPTH OF RIPRAP MINIMUM	450 MM (18 IN)	600 MM (24 IN)	750 MM (30 IN)

NOTES:

1. EACH LOADING SHALL HAVE A SIMILAR GRADATION. THE RIPRAP SHALL BE VISUALLY INSPECTED FOR SIZE AND SHAPE.



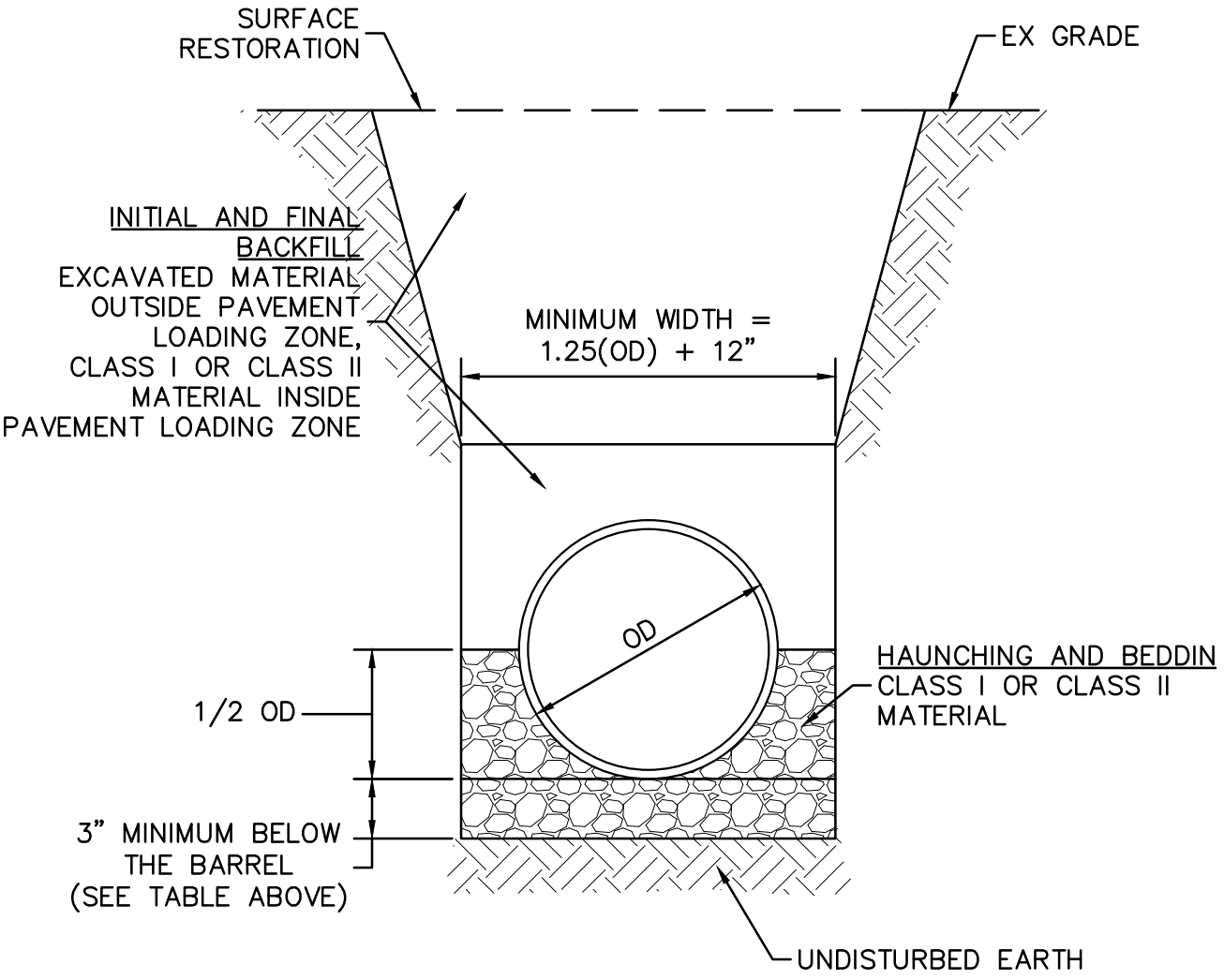
RIPRAP LINED CHANNEL

SCALE: NONE

city of beech grove

DETAIL NO. A-3
REVISION DATE: JUNE 2015

PIPE SIZE	27" AND SMALLER	30" TO 60"	66" AND LARGER
BEDDING BELOW THE PIPE BARREL	3"	4"	6"



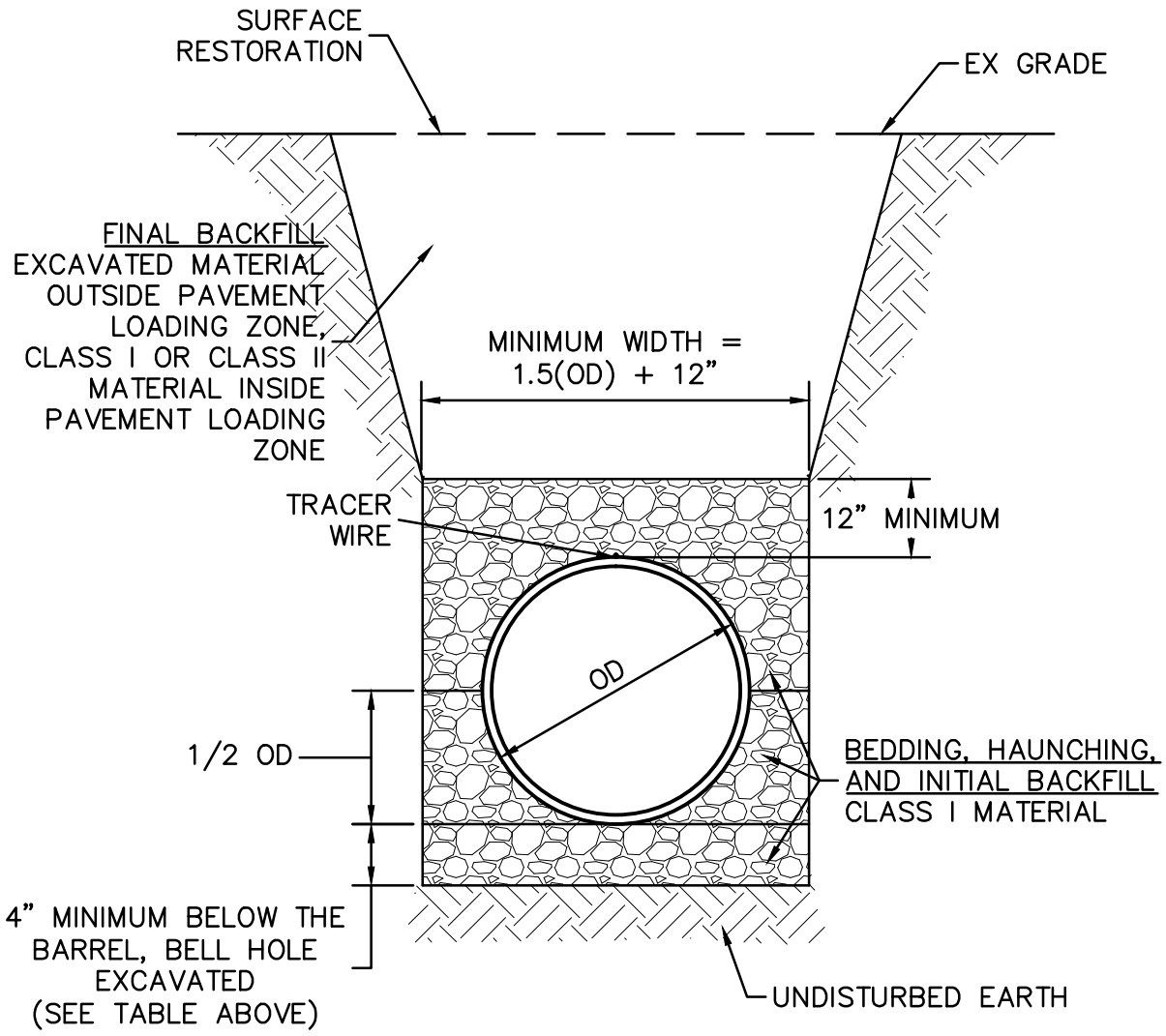
CORRUGATED METAL PIPE (CMP) TRENCH

SCALE: NONE

city of beech grove

DETAIL NO. A-4
REVISION DATE: JUNE 2015

PIPE SIZE	3" TO 15"	18" TO 30"	33" AND OVER
BEDDING BELOW THE PIPE BARREL	4"	OD / 4	8"



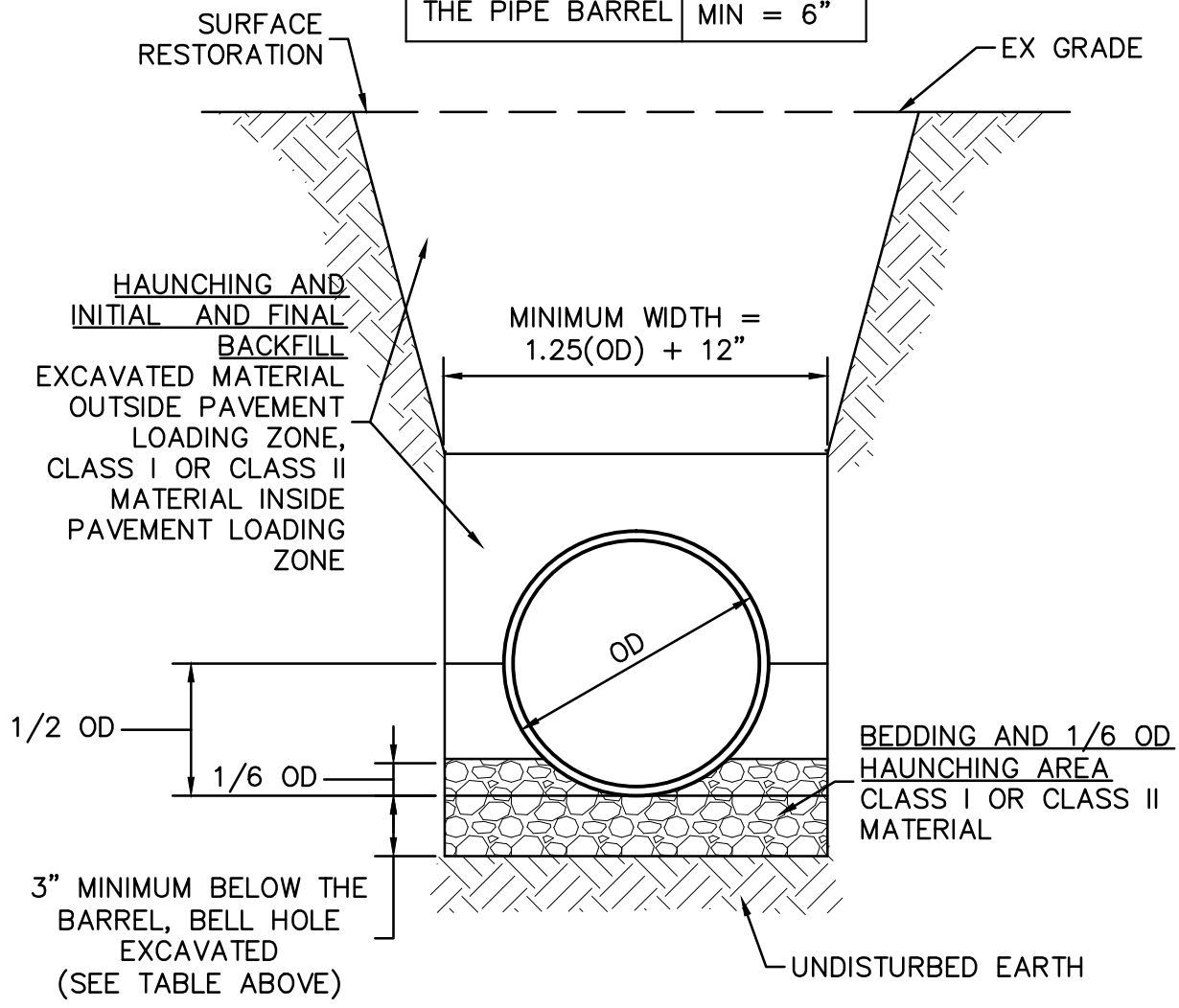
PLASTIC (PVC OR HDPE) PIPE TRENCH

SCALE: NONE

city of beech grove

DETAIL NO. A-5
REVISION DATE: JUNE 2015

SOIL FOUNDATION	
BEDDING BELOW THE PIPE BARREL	OD / 24 MIN = 3"
ROCK FOUNDATION	
BEDDING BELOW THE PIPE BARREL	OD / 12 MIN = 6"

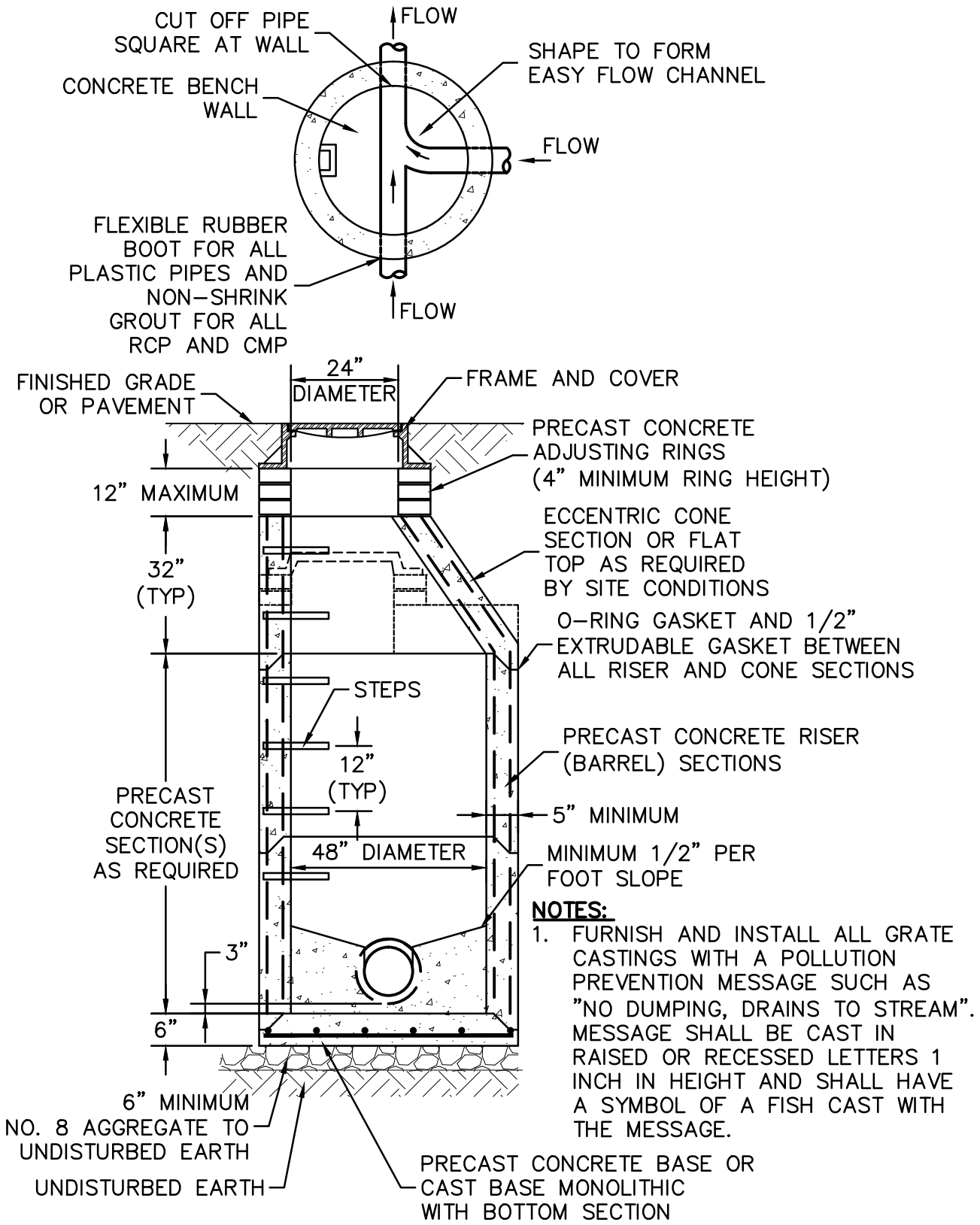


REINFORCED CONCRETE PIPE (RCP) TRENCH

SCALE: NONE

city of beech grove

DETAIL NO. A-6
REVISION DATE: JUNE 2015



NOTES:

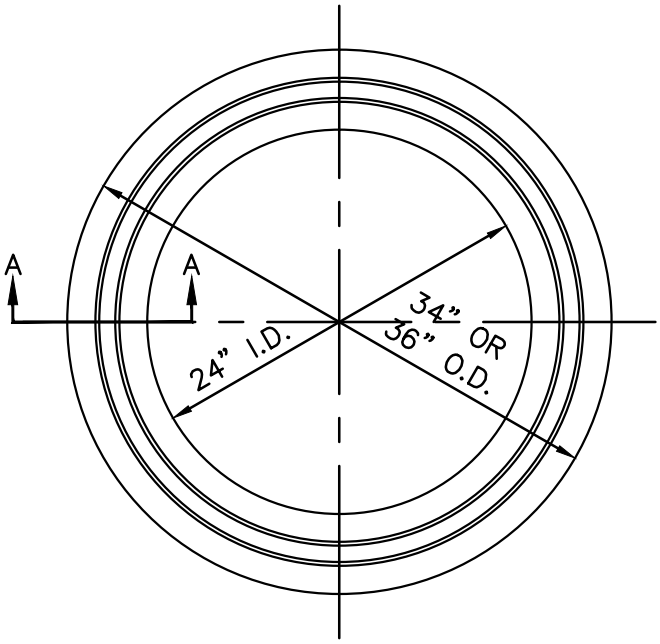
1. FURNISH AND INSTALL ALL GRATE CASTINGS WITH A POLLUTION PREVENTION MESSAGE SUCH AS "NO DUMPING, DRAINS TO STREAM". MESSAGE SHALL BE CAST IN RAISED OR RECESSED LETTERS 1 INCH IN HEIGHT AND SHALL HAVE A SYMBOL OF A FISH CAST WITH THE MESSAGE.

STANDARD STORM MANHOLE

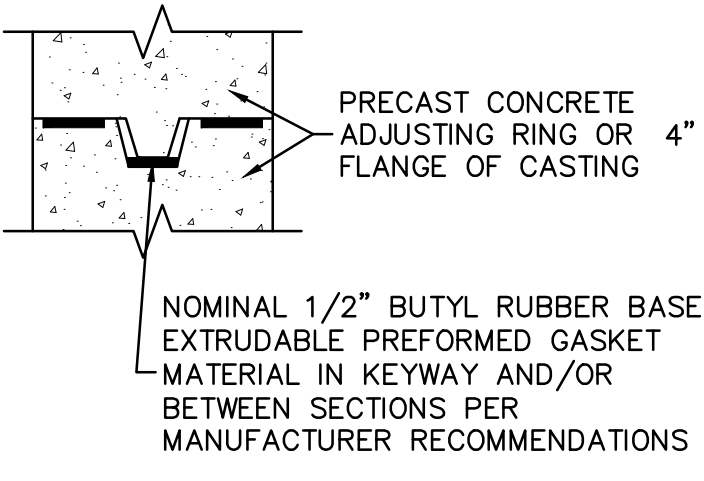
SCALE: NONE

city of beech grove

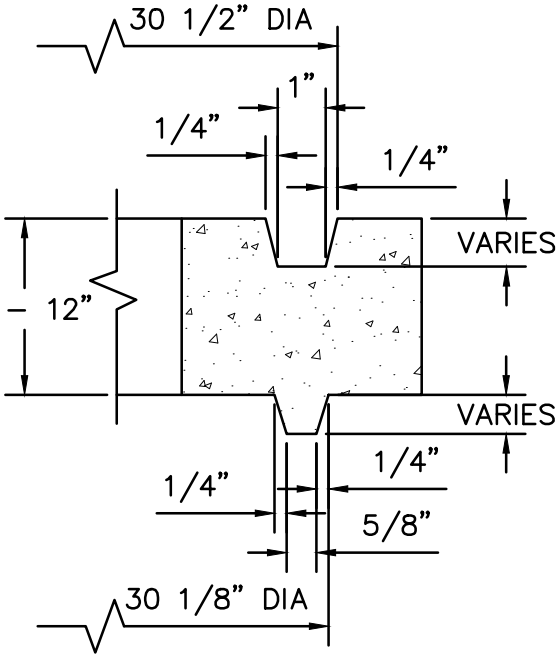
DETAIL NO. A-7
REVISION DATE: JUNE 2015



PLAN VIEW



GASKET DETAIL



SECTION A–A

NOTES:

1. PRECAST CONCRETE ADJUSTING RINGS SHALL HAVE KEYWAY/CHANNEL CONSTRUCTION. "SMOOTH" ADJUSTING RINGS SHALL NOT BE PERMITTED.

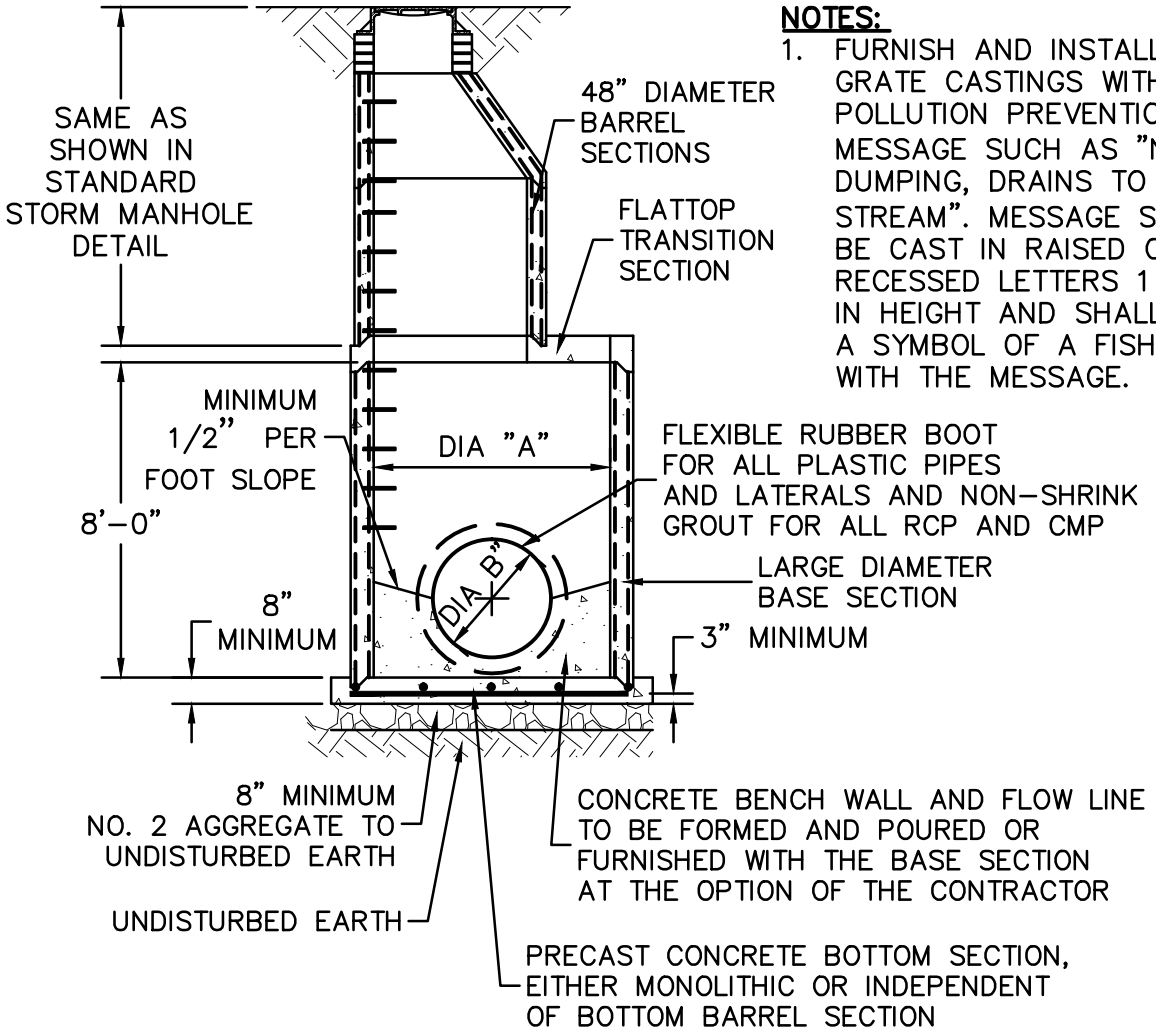
PRECAST CONCRETE ADJUSTING RING

SCALE: NONE

city of beech grove

DETAIL NO. A-8
REVISION DATE: JUNE 2015

STRUCTURE DATA SCHEDULE		
A DIA	B DIA	APPLICATION
60"	24" TO 33"	HORZ PIPE DEFLECTION GREATER THAN 45° UP TO 90°
60"	27" TO 36"	HORZ PIPE DEFLECTION STRAIGHT THRU MANHOLE UP TO 45°
72"	36"	HORZ PIPE DEFLECTION GREATER THAN 45° UP TO 90°
72"	42" TO 48"	HORZ PIPE DEFLECTION STRAIGHT THRU MANHOLE UP TO 45°
84"	42"	HORZ PIPE DEFLECTION GREATER THAN 45° UP TO 90°
96"	48"	HORZ PIPE DEFLECTION GREATER THAN 45° UP TO 90°



NOTES:

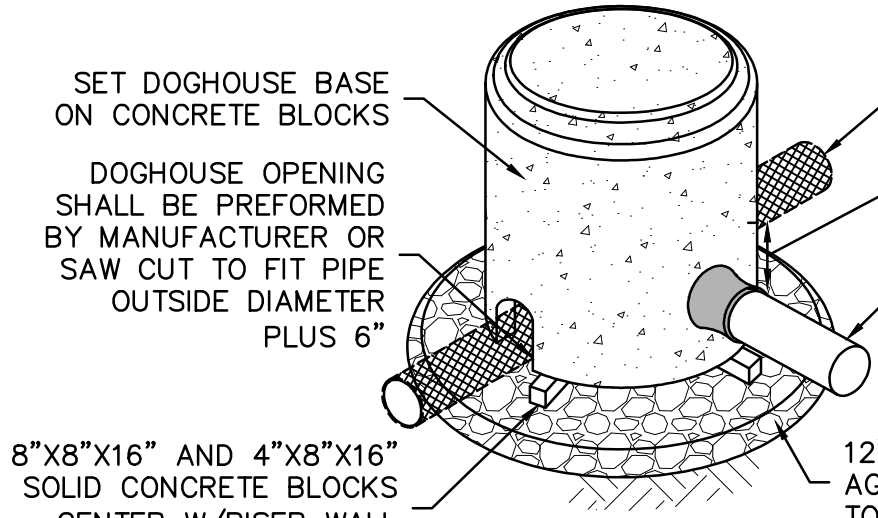
1. FURNISH AND INSTALL ALL GRATE CASTINGS WITH A POLLUTION PREVENTION MESSAGE SUCH AS "NO DUMPING, DRAINS TO STREAM". MESSAGE SHALL BE CAST IN RAISED OR RECESSED LETTERS 1 INCH IN HEIGHT AND SHALL HAVE A SYMBOL OF A FISH CAST WITH THE MESSAGE.

TYPE 1 STORM MANHOLE

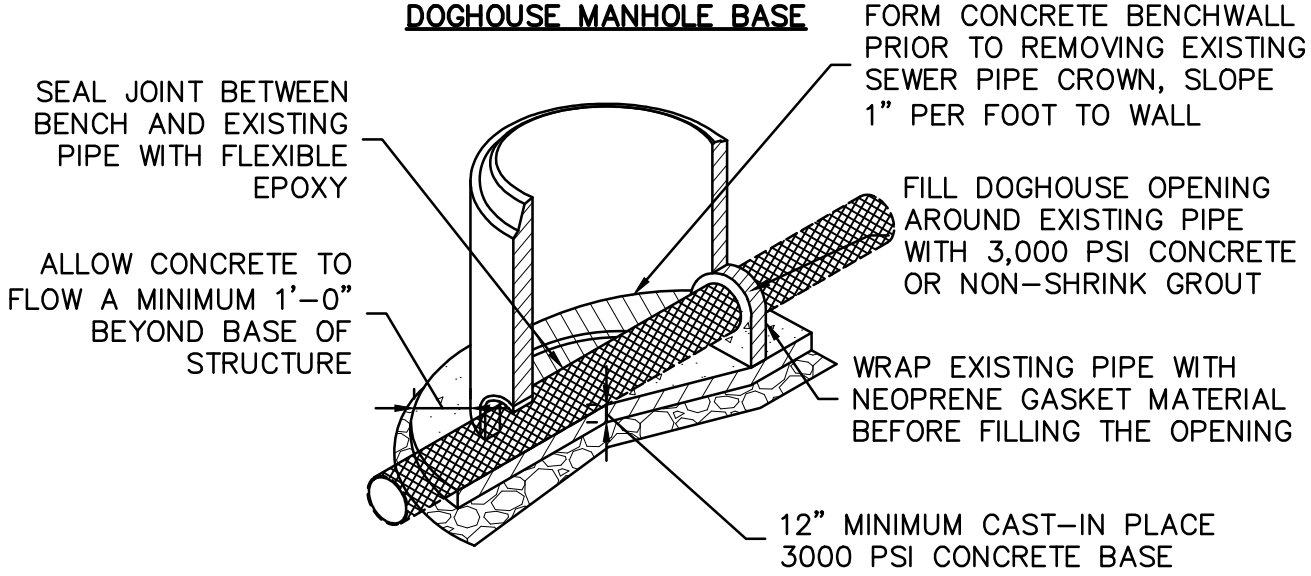
SCALE: NONE

city of beech grove

DETAIL NO. A-9
REVISION DATE: JUNE 2015



DOGHOUSE MANHOLE BASE



FOUNDATION SECTION VIEW

NOTES:

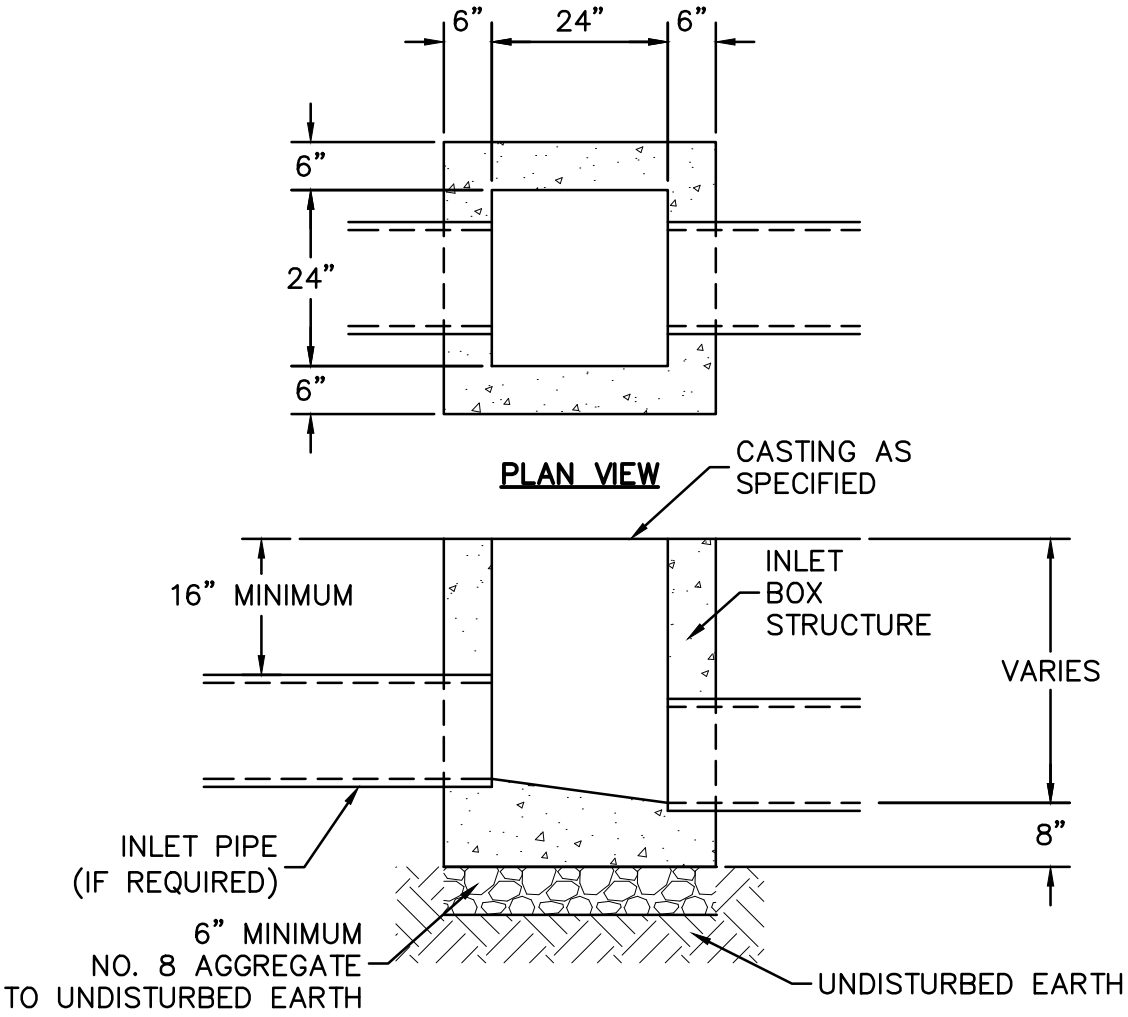
1. REQUIRES PRE-APPROVAL BY CITY OF BEECH GROVE.
2. MANHOLE CONSTRUCTION AND ACCESSORIES ABOVE BASE SAME AS SHOWN FOR STANDARD STORM MANHOLE.
3. CONSTRUCT A FORMED INVERT FROM NEW SEWER LINE TO ALLOW FLOW TO THE EXISTING PIPE.
4. CUT AND REMOVE THE TOP HALF OF EXISTING PIPE TO WITHIN 6" OF THE MANHOLE WALLS AFTER THE INVERT AND SHELF HAVE BEEN FORMED AND THE MANHOLE HAS BEEN FULLY TESTED IN ACCORDANCE WITH THESE SPECIFICATIONS.
5. PROVIDE ADEQUATE PIPE SUPPORT DURING CONSTRUCTION TO PREVENT PIPE DAMAGE.

STORM MANHOLE OVER EXISTING SEWER

SCALE: NONE

city of beech grove

DETAIL NO. A-10
REVISION DATE: JUNE 2015



NOTES:

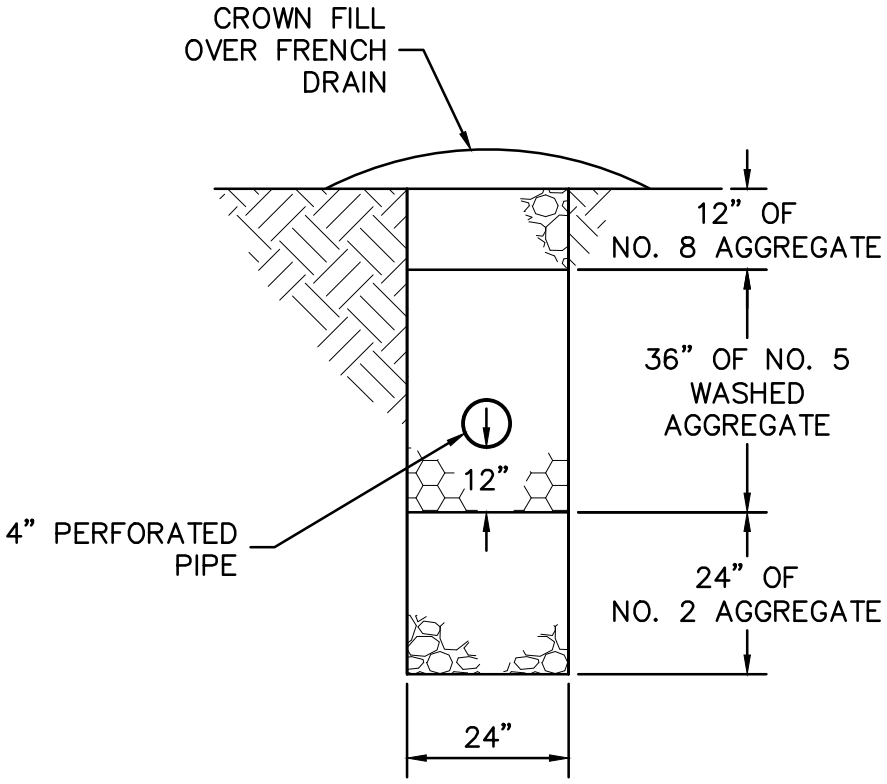
1. CATCH BASIN TYPE A SHALL HAVE 30" SUMP BELOW INVERT OF LOWEST PIPE.
2. FURNISH AND INSTALL ALL GRATE CASTINGS WITH A POLLUTION PREVENTION MESSAGE SUCH AS "NO DUMPING, DRAINS TO STREAM". MESSAGE SHALL BE CAST IN RAISED OR RECESSED LETTERS 1 INCH IN HEIGHT AND SHALL HAVE A SYMBOL OF A FISH CAST WITH THE MESSAGE.

INLET TYPE A

SCALE: NONE

city of beech grove

DETAIL NO. A-11
REVISION DATE: JUNE 2015



NOTES:

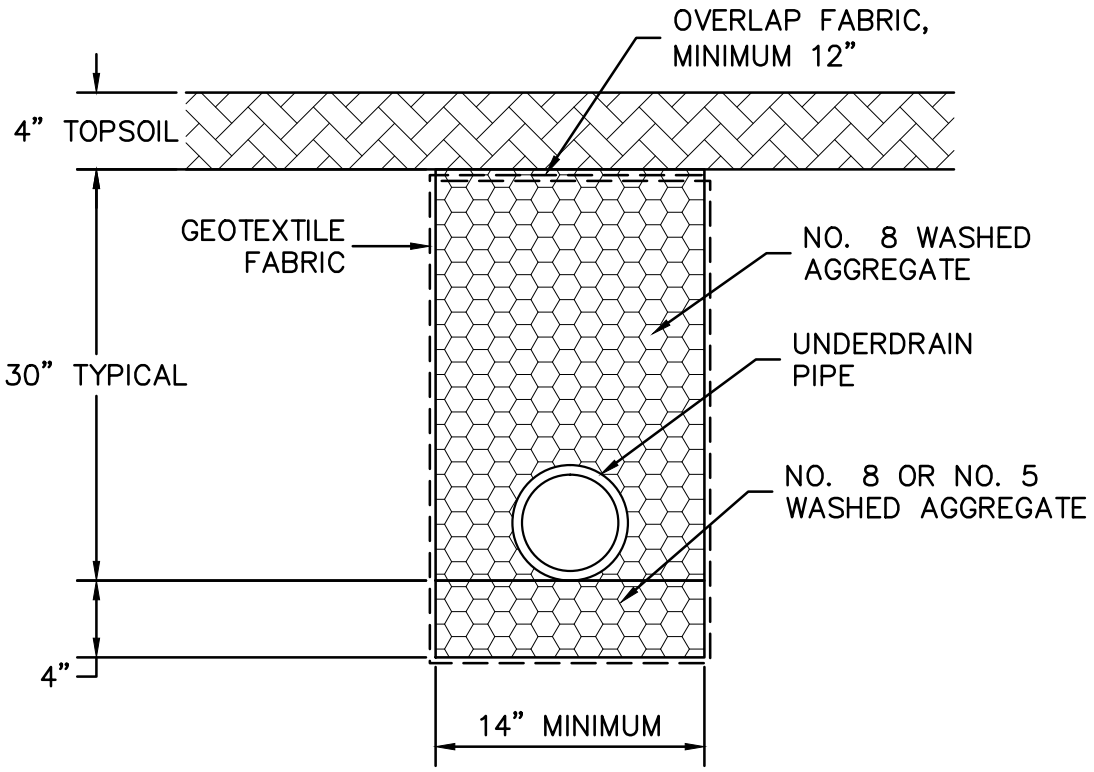
1. REQUIRES PRE–APPROVAL BY THE CITY OF BEECH GROVE.

FRENCH DRAIN

SCALE: NONE

city of beech grove

DETAIL NO. A-12
REVISION DATE: JUNE 2015

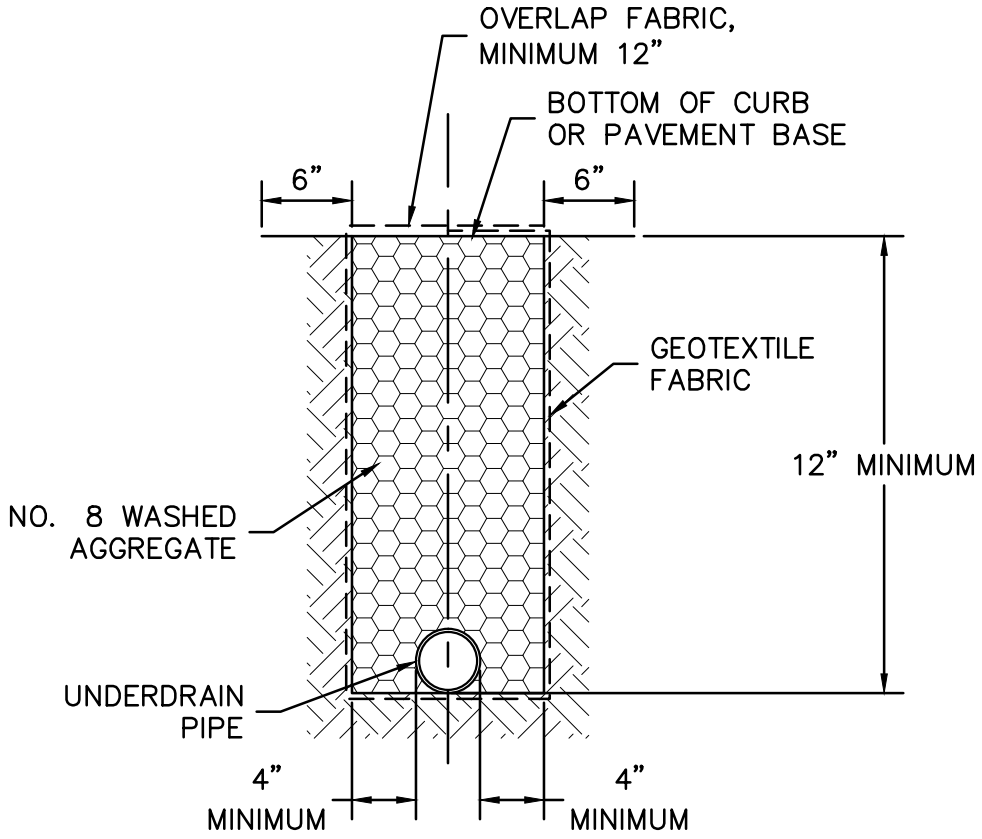


SWALE/TURF UNDERDRAIN

SCALE: NONE

city of beech grove

DETAIL NO. A-13
REVISION DATE: JUNE 2015



NOTES:

1. INSTALLATION IS REQUIRED BOTH SIDES OF PAVEMENT.

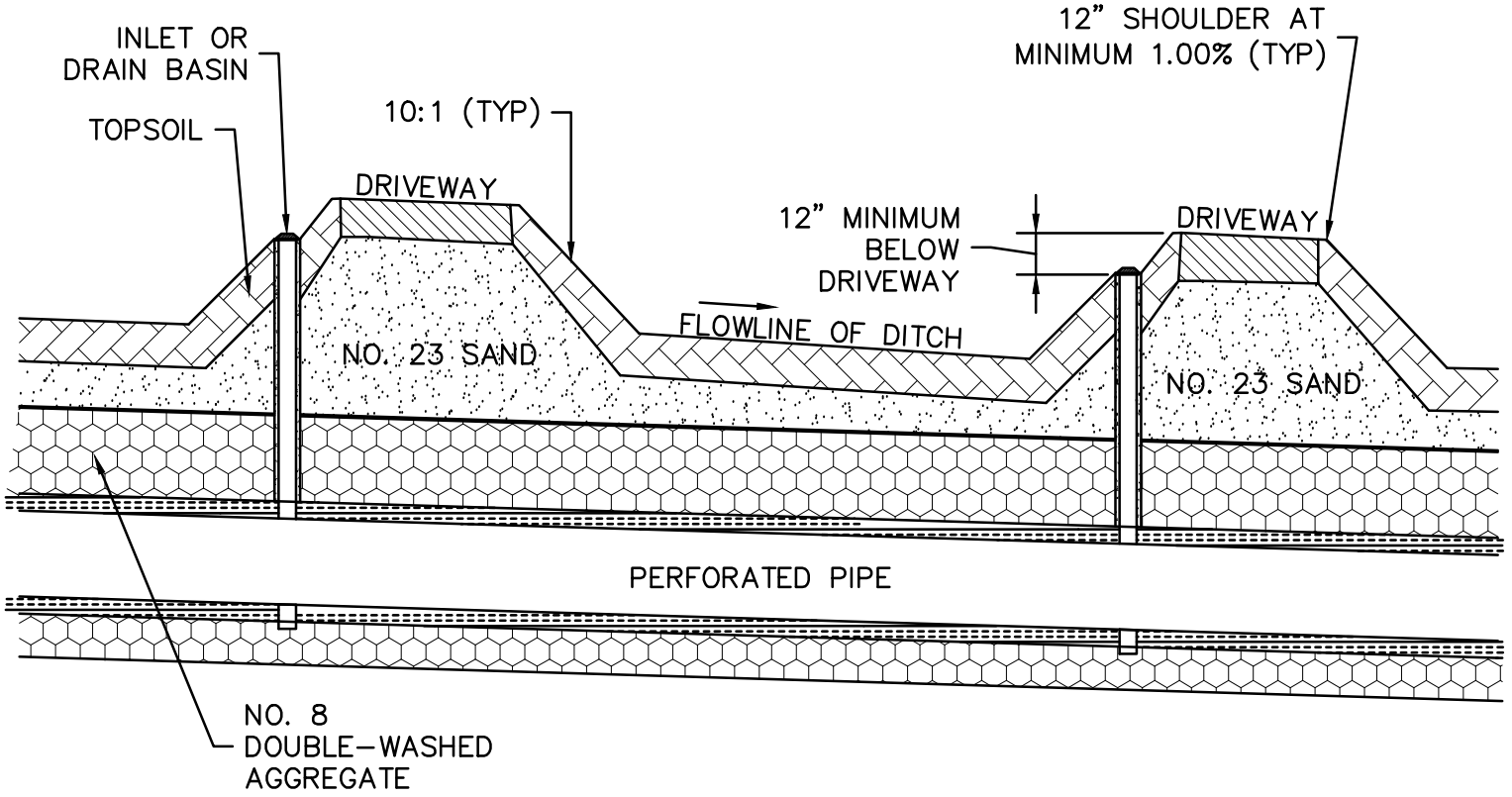
CURB UNDERDRAIN

SCALE: NONE

city of beech grove

DETAIL NO. A-14
REVISION DATE: JUNE 2015

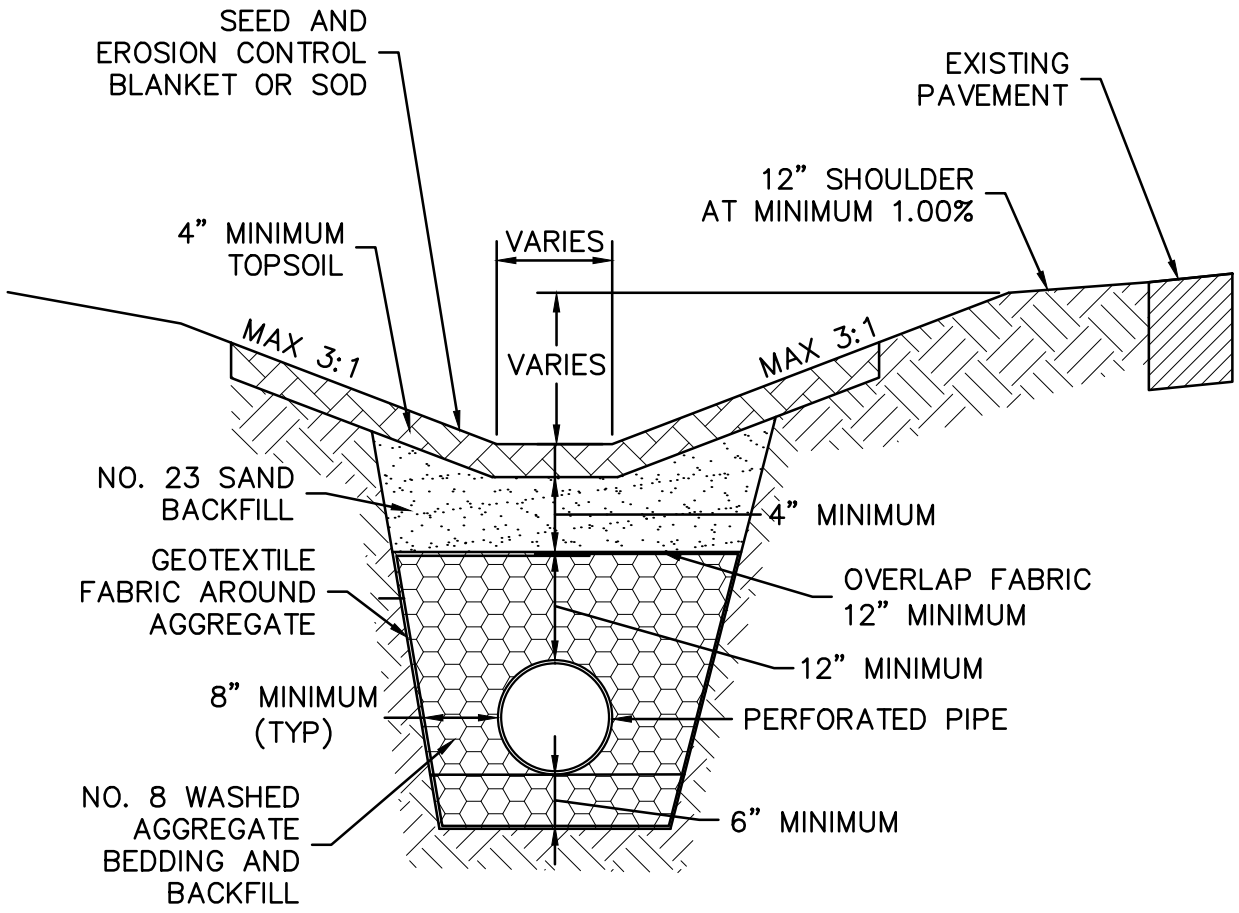
city of beech grove



HYBRID DITCH PROFILE

SCALE: NONE

DETAIL NO. A-15
REVISION DATE: JUNE 2015

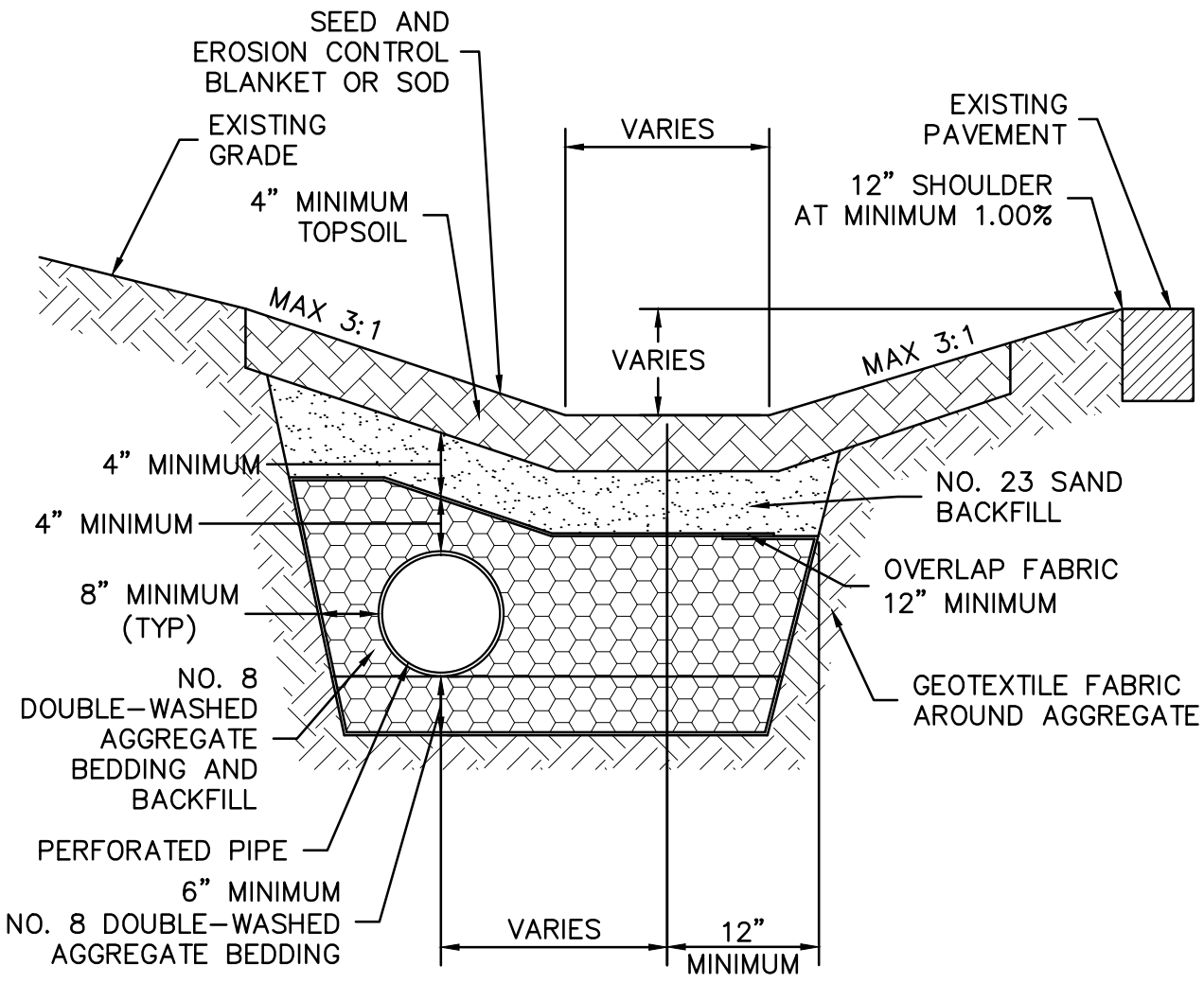


HYBRID DITCH TRENCH

SCALE: NONE

city of beech grove

DETAIL NO. A-16
REVISION DATE: JUNE 2015

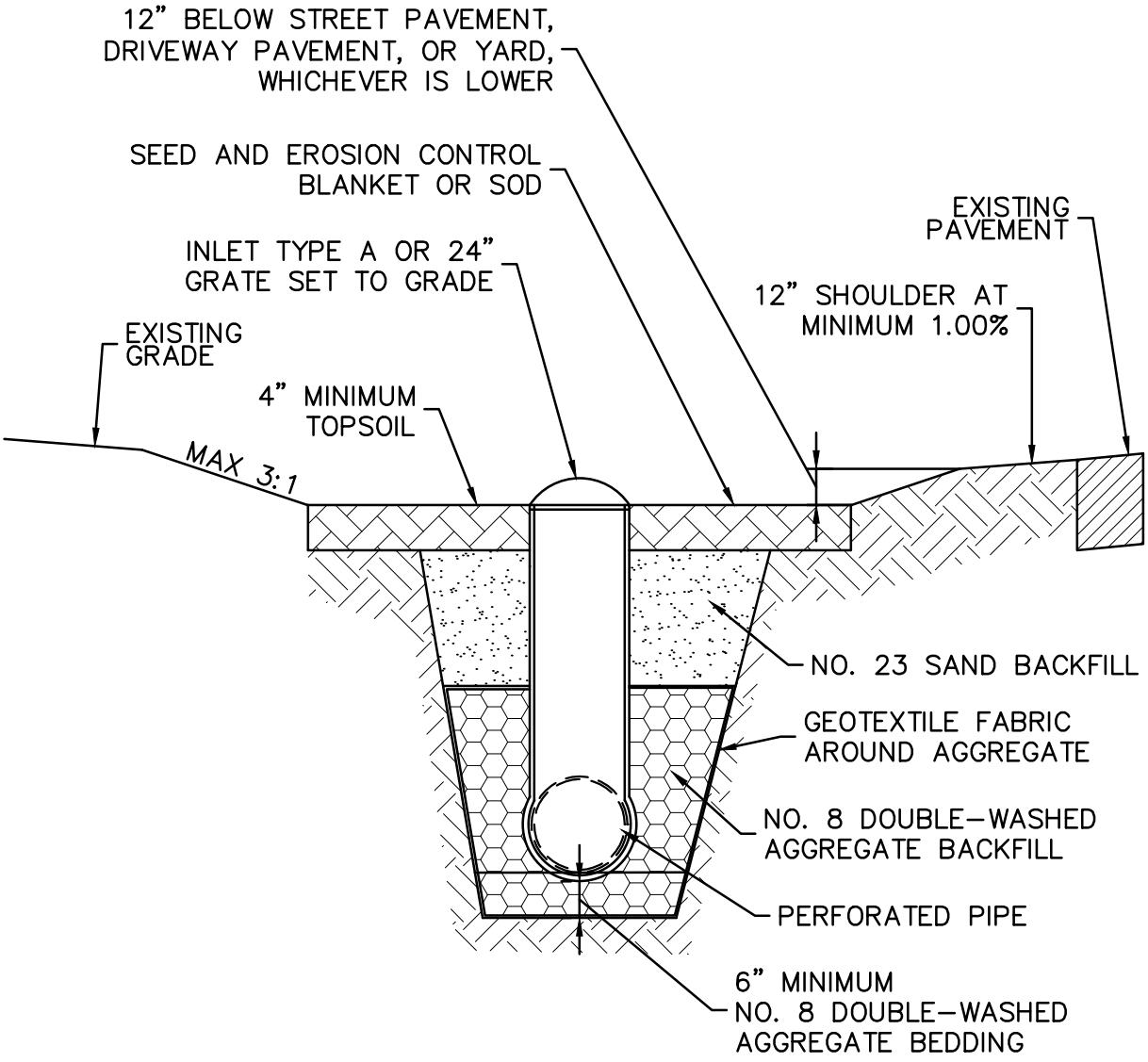


HYBRID DITCH MODIFIED TRENCH

SCALE: NONE

city of beech grove

DETAIL NO. A-17
REVISION DATE: JUNE 2015



NOTES:

1. FURNISH AND INSTALL ALL GRATE CASTINGS WITH A POLLUTION PREVENTION MESSAGE SUCH AS "NO DUMPING, DRAINS TO STREAM". MESSAGE SHALL BE CAST IN RAISED OR RECESSED LETTERS 1 INCH IN HEIGHT AND SHALL HAVE A SYMBOL OF A FISH CAST WITH THE MESSAGE.

HYBRID DITCH TRENCH AT INLET

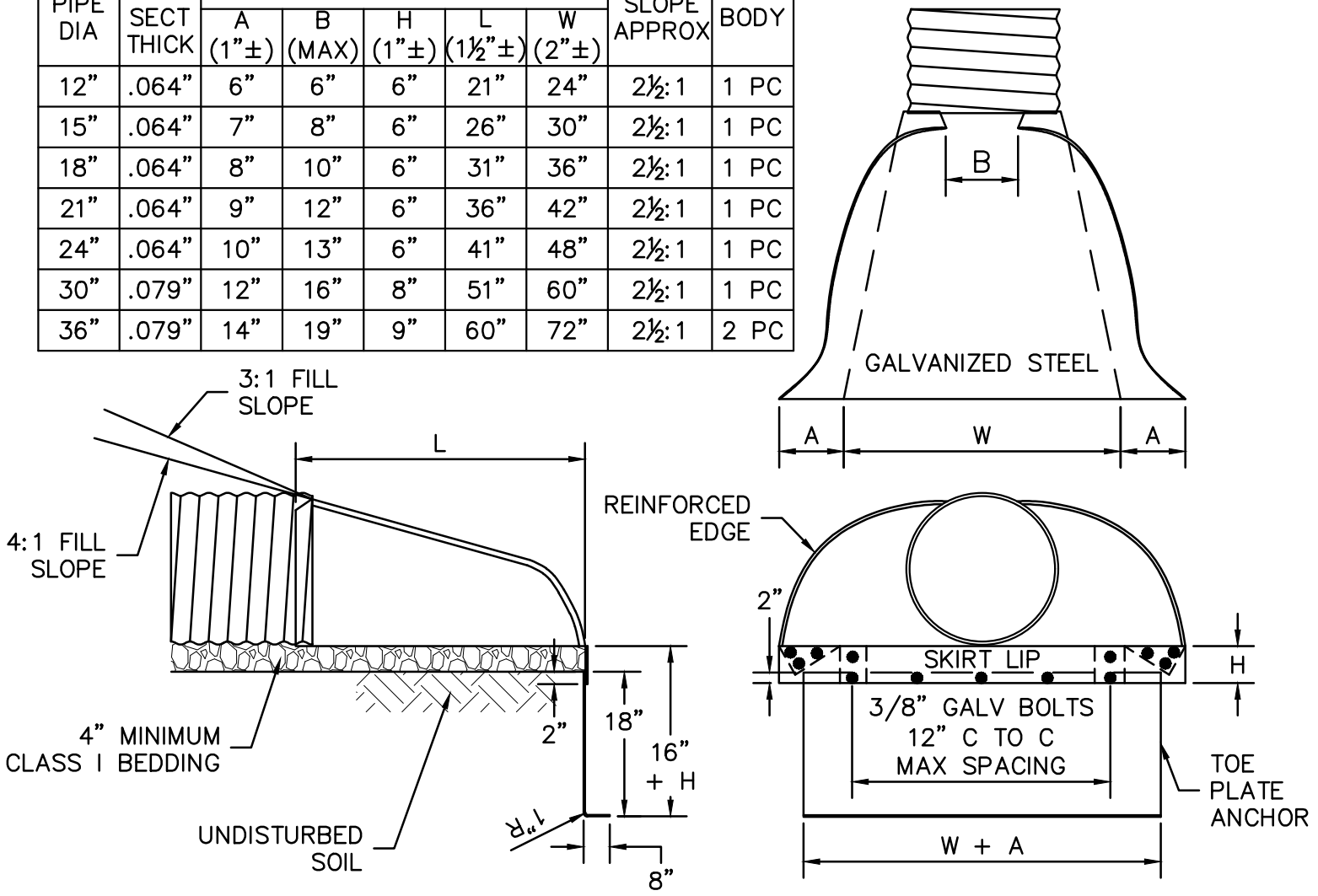
SCALE: NONE

city of beech grove

DETAIL NO. A-18
REVISION DATE: JUNE 2015

city of beech grove

PIPE DIA	END SECT THICK	DIMENSIONS					SLOPE APPROX	BODY
		A (1"±)	B (MAX)	H (1"±)	L (1½"±)	W (2"±)		
12"	.064"	6"	6"	6"	21"	24"	2½:1	1 PC
15"	.064"	7"	8"	6"	26"	30"	2½:1	1 PC
18"	.064"	8"	10"	6"	31"	36"	2½:1	1 PC
21"	.064"	9"	12"	6"	36"	42"	2½:1	1 PC
24"	.064"	10"	13"	6"	41"	48"	2½:1	1 PC
30"	.079"	12"	16"	8"	51"	60"	2½:1	1 PC
36"	.079"	14"	19"	9"	60"	72"	2½:1	2 PC

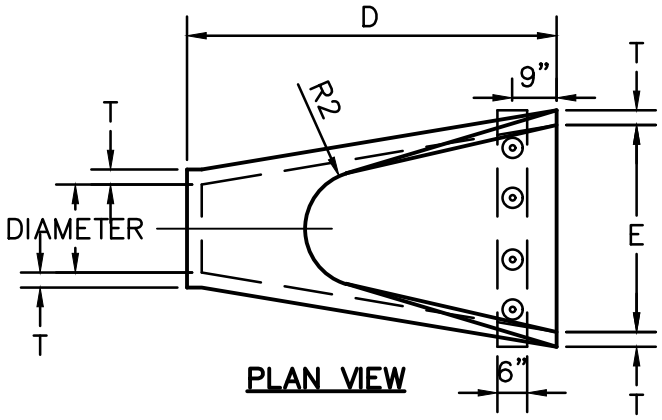


METAL END SECTION

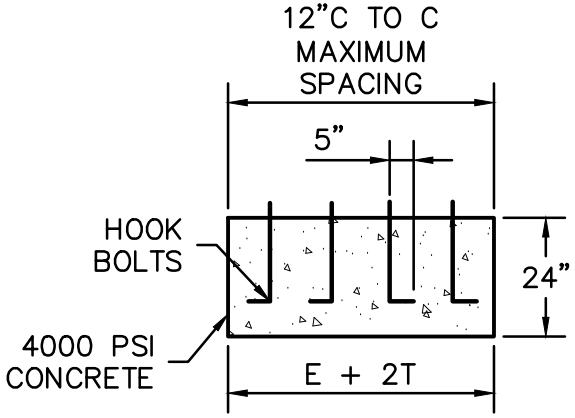
SCALE: NONE

DETAIL NO. A-19
REVISION DATE: JUNE 2015

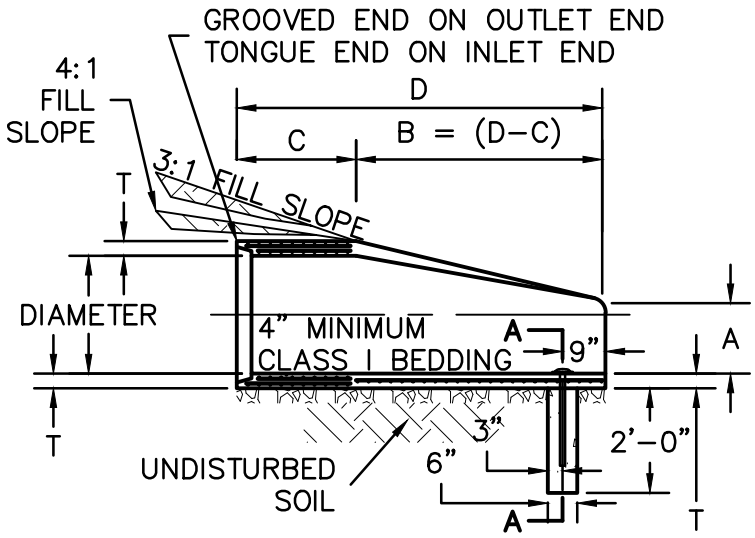
city of beech grove



PLAN VIEW



SECTION A
CONCRETE PIPE TOE ANCHOR



LONGITUDINAL SECTION

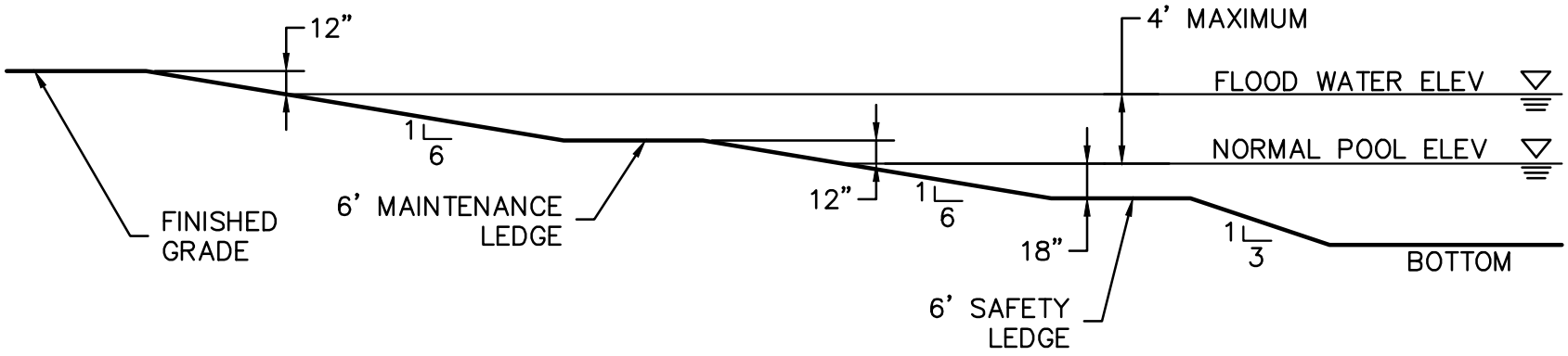
DIA	T (MIN)	A*	C*	D*	E*	R_1	R_2	APPROX WEIGHT
12"	2"	5"	51"	74"	24"	10.125"	9"	800
15"	2.25"	7"	48"	75"	30"	12.5"	11"	1100
18"	2.5"	11"	49"	74"	36"	15.5"	12"	1300
21"	2.75"	11"	42"	75"	42"	16.125"	13"	1500
24"	3"	12"	32"	75"	48"	16.375"	14"	1800
27"	3.25"	13"	29"	75"	54"	18.563"	14.5"	2100
30"	3.5"	14"	22"	75"	60"	18.5"	15"	2400
33"	3.75"	15"	42"	99"	66"	23.75"	17.5"	4100
36"	4"	17"	37"	99"	72"	24.625"	20"	4200
* TOLERANCE ±								

PRECAST CONCRETE END SECTION

SCALE: NONE

DETAIL NO. A-20
REVISION DATE: JUNE 2015

city of beech grove



POND SECTION

WET DETENTION/RETENTION BASIN

SCALE: NONE

DETAIL NO. A-21
REVISION DATE: JUNE 2015

APPENDIX B

STORMWATER FORMS

FORM B-1:
APPLICATION FOR DRAINAGE APPROVAL

*Refer to *Chapter 3 – Submittal Requirements and Procedures* and Figures 3-1 and 3-2 for submittal requirements.

Project Information:

Name of Project: _____

Legal Address: _____

Township: _____ Parcel No.: _____

Total Acres of Site: _____ Proposed Construction:

Disturbed Acres of Site: _____ ☐ Subdivision

Impervious Area: _____ ☐ Commercial/Industrial/Apartment

☐ Other: _____

Owner Information:

Name: _____

Address: _____

Contact Person: _____

Telephone: _____ Email: _____

Design Firm Information:

Name: _____

Address: _____

Professional Engineer: _____

Contact Person: _____

Telephone: _____ Email: _____

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

Signature: _____ Date: _____

Print Name: _____ Title: _____

Address: _____

City of Beech Grove Use Only:

Date Submitted: _____ Project No.: _____

Approval Date: _____ Approved By: _____

FORM B-2:
APPLICATION FOR DRAINAGE APPROVAL SUBMITTAL CHECKLIST

*Refer to *Chapter 3 – Submittal Requirements and Procedures* and Figures 3-1 and 3-2 for submittal requirements.

All applicable items listed below shall be completed, signed and notarized (when applicable), and submitted to the City of Beech Grove for review prior to initiating any land disturbing activities.

Checks shall be made payable to the City of Beech Grove.

Application package should be submitted to City Hall, 806 Main Street, Beech Grove, Indiana 46107. The completed submittal to the City shall include:

		CITY USE ONLY		
		N/A	***Acceptable***	***Deficient***
☐	**General Application for Drainage Approval**, *Form B-1*			
☐	**Application Fee**, $100.00			
☐	**Statement of Financial Responsibility**, *Form B-4*			
☐	**City of Beech Grove Building Permit Application Forms**			
☐	**Construction Plans**, 3 sets, which contain the following:			
	☐ Name and location map of proposed project			
	☐ Owner's name			
	☐ Date of plans and revision number			
	☐ North arrow and scale (maximum scale of 1" = 50' for site plans)			
	☐ Existing and proposed site conditions, including 1-foot contours, elevations, stormwater conveyance system with applicable inverts and elevations, storm sewer profiles, drainage flow arrows, pond cross section, utilities, building footprints and finished floor elevations, streets, drives, parking areas, easements, rights-of-way, property lines, benchmarks, floodway/floodplain boundaries, flood routing path, all applicable construction/installation details, and erosion control measures and details			
	☐ Traffic phasing plan			
	☐ Signature and certification by a Professional Engineer/Land Surveyor licensed in the State of Indiana			
☐	**Storm Water Pollution Prevention Plan (SWPPP)**			
	☐ SWPPP for Erosion and Sediment Control Plan, *Form B-5*			
	☐ Application fee for Erosion and Sediment Control Plan, $50.00			
	☐ Application fee for Post-Construction Stormwater Quality Plan, $50.00			
☐	**Technical Specifications**			
☐	**Drainage Report**, which contains the following:			
	☐ Description of project, including pre-developed and post-developed site condition			
	☐ Description of existing drainage problems			
	☐ Summary of all calculation or location of information by page number reference			
	☐ List of assumptions and any special conditions associated with the analysis methods used			

	CITY USE ONLY		
	N/A	***Acceptable***	***Deficient***
☐ Stormwater runoff exhibits and calculations including:			
☐ Drainage area delineation, including upstream off-site areas			
☐ Time of concentration, *Form B-6*			
☐ Weighted runoff coefficient or curve number, *Form B-7*			
☐ Design storm frequency(ies)			
☐ Peak runoff rates			
☐ Channel, culvert, and storm sewer design calculations including:			
☐ Size of pipe and typical channel cross section			
☐ Pipe and channel slopes			
☐ Channel lining or pipe material and roughness coefficient			
☐ Pipe flow and hydraulic grade line calculations			
☐ Velocities in feet per second (fps)			
☐ Capacities in cubic feet per second (cfs)			
☐ Outlet protection apron geometry			
☐ Gutter spread and inlet spacing			
☐ Name of computer model used, where applicable (highlight pertinent data if computer printouts are submitted)			
☐ Detention/Retention facility design calculations including:			
☐ Description of facility			
☐ Description of outlet control structure			
☐ Outlet control structure discharge rating curve and peak discharge rates			
☐ Stage/storage/discharge information during storm events			
☐ Emergency spillway calculations			
☐ Low Impact Development and Stormwater BMP sizing and design calculations			
☐ Flood routing calculations			
☐ **Performance Bond**			
☐ **Grant of Perpetual Right-of-Way and Easement**, *Form B-9*			
☐ **Draft IDEM Notice of Intent (NOI)**			
☐ **Operation & Maintenance (O&M) Manuals**, which contain the following:			
☐ Owner information			
☐ Site map			
☐ O&M practices			
☐ Right-of-Entry statement			
☐ Implementation schedule			
☐ Employee training			
☐ Drainage easement documentation			
☐ **Agreement for Construction of Stormwater Facilities under Private Contract**, *Form B-10*			
☐ **Inspection Services Agreement**, *Form B-11*			

FORM B-3:
APPLICATION FOR DRAINAGE APPROVAL
FOR SINGLE AND DOUBLE-FAMILY DWELLINGS

*Refer to *Chapter 3 – Submittal Requirements and Procedures* and Figures 3-1 and 3-2 for submittal requirements.

All applicable items listed below shall be submitted to the City of Beech Grove for review prior to initiating any land disturbing activities. Application package should be submitted to City Hall, 806 Main Street, Beech Grove, Indiana 46107.

Project Information:

Legal Address: _____

Township: _____ Parcel No.: _____

Total Acres of Site: _____

Description of Project: _____

_____

_____

_____

Owner Information:

Name: _____

Address: _____

Contact Person: _____

Telephone: _____ Email: _____

Submittal Requirements:

- ☐ **Application Fee**, $50.00 check made payable to the City of Beech Grove
- ☐ **Construction Plans or Exhibits**, including location of project, north arrow, existing conditions, and proposed improvements

_____

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

Signature: _____ Date: _____

Print Name: _____ Title: _____

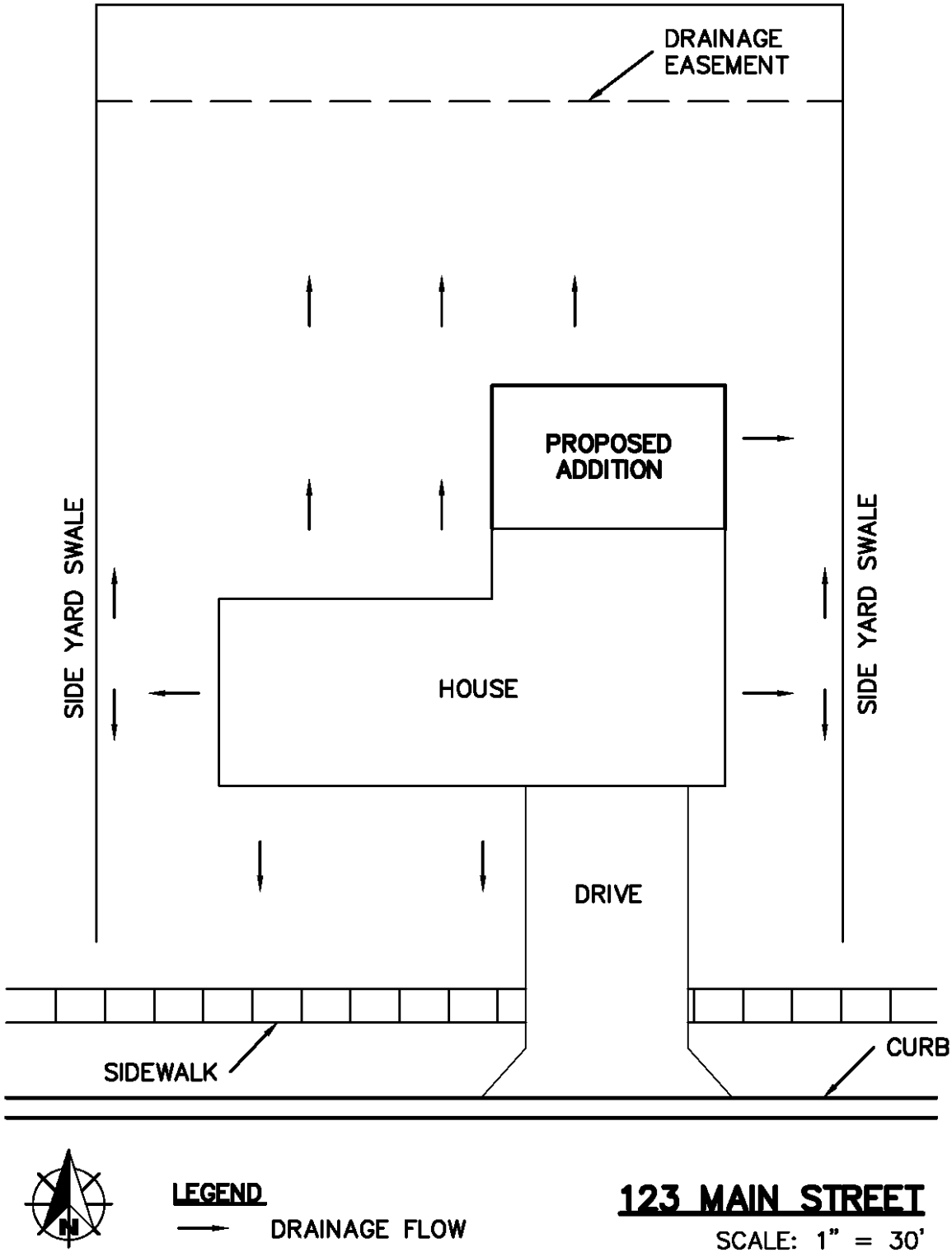
Address: _____

City of Beech Grove Use Only:

Date Submitted: _____ Project No.: _____

Approval Date: _____ Approved By: _____

Example Exhibit for Individual Single-Family Dwelling Application:



FORM B-4:
STATEMENT OF FINANCIAL RESPONSIBILITY

The undersigned of the proposed project to be known as:

_____

(project name and location or address)

do hereby agree to take full responsibility of financial payment of plan review fees incurred on the above project.

I am aware that the review fees apply for projects that require engineering review (for sanitary, stormwater, transportation or drinking water design) and will begin upon the submittal of an Application for Drainage Approval and continue until the project is approved and/or withdrawn. Review fees are charged according to the current hourly rate of the engineer performing the review. I understand that if the project is withdrawn the review fees are still due and payable from the application date to the date on the letter of withdrawal. Final review fees are due within 30 days of notification of the fee.

All review fees are to be made payable to City of Beech Grove.

The undersigned, having duly sworn upon oath, that the above information has been read and fully understood to be true and correct and is (undersigned) voluntary act and deed. The undersigned assumes responsibility for the aforementioned fees.

_____ _____

Signature Mailing Address

_____ _____

Printed City, State, Zip Code

STATE OF INDIANA)
)
COUNTY OF _____)

Subscribed and sworn before me, a Notary Public, within and for said County and State, this

_____ day of _____, 20_____.

My Commission Expires _____

Notary Public _____

(Notary Stamp or Seal)

FORM B-5:
CONSTRUCTION/STORMWATER POLLUTION PREVENTION PLAN TECHNICAL REVIEW AND COMMENT

the city of Beech Grove	**Construction/ Stormwater Pollution Prevention Plan Technical Review** **City of Beech Grove Stormwater Standards Manual** https://www.beechgrove.com/uploads/1/0/1/2/10129925/2015-09-beechgrovestormwatermanual-final-2.pdf **IDEM Construction Stormwater General Permit:** https://www.in.gov/idem/stormwater/construction-land-disturbance-permitting/ (INRA00000 effective 12/18/2021)

Construction/Stormwater Pollution Prevention Plan Technical Review and Comment

Project Name: **Scope of Project:** **Location of Project:** **County:** **Latitude:** **Longitude:**	**Plan Submittal Date:** **Click here to enter a date.** **Plan Review Date:** **Click here to enter a date.**

Plan Preparer: **Affiliation:**
Address:
City: **State:** **Zip:**
Phone: **Cell Phone:** **Email:**

Project Site Owner: **Company Name (if applicable):**
Address:
City: **State:** **Zip:**
Phone: **Cell Phone:** **Email:**

Plan Reviewer: **Affiliation:** **On behalf of:**
Assisted By:
Address:
City: **State:** **Zip:**
Phone: **Cell Phone:** **Email:**

Plan Review Status:		
☐	**Plan is Adequate**	A comprehensive plan review has been completed and it has been determined that the plan satisfies the minimum requirements of the City of Beech Grove Stormwater Management Ordinance and Standards Manual, and the Construction Stormwater General Permit INRA00000 (Effective 12-18-2021).
☐	**Preliminary Review**	A comprehensive review will not be completed at this time. The plan review authority reserves the right to perform a comprehensive review at a later date, and revisions may be required at that time.
☐	**Conditional Acceptance**	Acceptance of the plan is conditional. The conditional acceptance is contingent upon addressing the issues identified in the comment sections.
☐	**Plan is Deficient**	Significant deficiencies were identified and must be addressed. Refer to the comment sections.

Action:	
☐	**Submit a Notice of Intent:** Submit the Notice of Intent (NOI) online through the IDEM Regulatory ePortal. It is required to upload a copy of this review form when submitting the NOI through the IDEM Regulatory ePortal: (https://stormwater.idem.in.gov/ncore/external/home)
☐	**Do not file a Notice of Intent or commence land-disturbing activities:** Deficiencies must be adequately addressed and an acceptable plan review completed.
☐	**Comments:** Refer to Plan Review Comments Sections of this document.
☐	**Revisions:** Update and submit the revised Construction/Stormwater Pollution Prevention Plan as indicated below.
	☐ Update and submit a complete plan set that addresses plan deficiencies.

	☐ Update and submit a document (narrative and/or plan sheets) that address plan deficiencies.
	☐ Update and submit a complete plan set that addresses plan deficiencies. A comprehensive plan review will not be completed.

Plan Review Information

- *The technical review and comment is intended to evaluate the completeness of the Construction/Stormwater Pollution Prevention Plan for the project. The Plan submitted was not reviewed for the adequacy of engineering design. All measures included in the plan, as well as those recommended in the comments should be evaluated as to their feasibility by a qualified individual with structural measures designed by a qualified engineer. The Plan has not been reviewed for other local, state, or federal permits that may be required to proceed with this project.*
- *Additional information, including design calculations may be requested to further evaluate the plan.*
- *All proposed stormwater pollution prevention measures and those referenced in this review must meet the design criteria and standards set forth in the "Indiana Stormwater Quality Manual" from the Indiana Department of Environmental Management or similar Guidance Documents.*
- *Construction activities and unforeseen weather conditions may affect the performance of the erosion and sediment control system, individual measures, or the effectiveness of the plan. The plan must be a flexible document, with provisions to modify or substitute measures as necessary to ensure compliance.*

Priority Site Information:

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

Section A: Construction Plan Elements

Adequate	Deficient	NA	A	*The construction plan elements include general information associated with the project site that are critical for the evaluation of the stormwater pollution prevention plan component. This information includes, but is not limited to an index, resource information, reference maps, grading information, project layout and design, and drainage plan*
☐	☐	☐	**1**	Index of the location of required plan elements in the construction plan
☐	☐	☐	**2**	A vicinity map depicting the project site location in relationship to recognizable local landmarks, towns, and major roads
☐	☐	☐	**3**	Narrative of the nature and purpose of the project
☐	☐	☐	**4**	Latitude and longitude to the nearest fifteen (15) seconds
☐	☐	☐	**5**	Legal description of the project site
☐	☐	☐	**6**	11 X 17-inch plat showing building lot numbers/boundaries and road layout/names
☐	☐	☐	**7**	Boundaries of the one hundred (100) year floodplains, floodway fringes, and floodways
☐	☐	☐	**8**	Land use of all adjacent properties
☐	☐	☐	**9**	Identification of a U.S. EPA approved or established TMDL
☐	☐	☐	**10**	Name(s) of the receiving water(s)
☐	☐	☐	**11**	Identification of discharges to a water on the current 303d list of impaired waters and the pollutant(s) for which it is impaired
☐	☐	☐	**12**	Soil map of the predominant soil types
☐	☐	☐	**13**	Identification and location of all known wetlands, lakes and water courses on or adjacent to the project site (construction plan, existing site layout) – required 50-foot natural buffer
☐	☐	☐	**14**	Identification of any other state or federal water quality permits or authorizations that are required for construction activities
☐	☐	☐	**15**	Identification and delineation of existing cover, including natural buffers
☐	☐	☐	**16**	Existing topography at a contour interval appropriate to indicate drainage patterns

☐	☐	☐	**17**	Location(s) of where run-off enters the project site
☐	☐	☐	**18**	Location(s) of where run-off discharges from the project site prior to land disturbance. Erosion measures required at the discharge point.
☐	☐	☐	**19**	Location of all existing structures on the project site
☐	☐	☐	**20**	Existing permanent retention or detention facilities, including manmade wetlands, designed for the purpose of stormwater management
☐	☐	☐	**21**	Locations where stormwater may be directly discharged into ground water, such as abandoned wells, sinkholes, or karst features
☐	☐	☐	**22**	Size of the project area expressed in acres
☐	☐	☐	**23**	Total expected land disturbance expressed in acres
☐	☐	☐	**24**	Proposed final topography. Grading plan.
☐	☐	☐	**25**	Locations and approximate boundaries of all disturbed areas
☐	☐	☐	**26**	Location, size, and dimensions of all stormwater drainage systems, such as culverts, storm sewers, and conveyance channels
☐	☐	☐	**27**	Locations of specific points where stormwater and non-stormwater discharges will leave the project site
☐	☐	☐	**28**	Location of all proposed site improvements, including roads, utilities, lot delineation and identification, proposed structures, and common areas
☐	☐	☐	**29**	Location of all on-site soil stockpiles and borrow areas. Topsoil must be preserved.
☐	☐	☐	**30**	Construction support activities that are expected to be part of the project
☐	☐	☐	**31**	Location of any in-stream activities that are planned for the project including, but not limited to stream crossings and pump arounds

Section A – Comments:

-

Section B: Stormwater Pollution Prevention Plan – Erosion and Sediment Control/Project Site Management				
Adequate	Deficient	NA	B	*The construction component of the Stormwater Pollution Prevention Plan includes stormwater quality measures to address erosion, sedimentation, and other pollutants associated with land disturbance and construction activities. Proper implementation of the plan, maintenance of measures, and administering a self-monitoring program is required to manage the project site to minimize the discharge of sediment and other pollutants. Construction activities and unforeseen weather conditions may affect the performance of the erosion and sediment control system, individual measures, or the effectiveness of the plan. The plan must be a flexible document, with provisions to modify or substitute measures as necessary to ensure compliance.*
☐	☐	☐	1	Description of the potential pollutant generating sources and pollutants, including all potential non-stormwater discharges
				Where applicable, Items in 2 through 10 below will be evaluated for Location, dimensions, detailed specifications, and construction details
☐	☐	☐	2	Stable construction entrance locations and specifications. Plan to clear tracking of sediments on road. Dust suppression plan.
☐	☐	☐	3	Specifications for temporary and permanent stabilization. Include seeding and mulching plan and 70% coverage requirement for final stabilization. Include 7 day stabilization requirement.
☐	☐	☐	4	Sediment control measures for concentrated flow areas (sediment basins if used have specific requirements)
☐	☐	☐	5	Sediment control measures for sheet flow areas
☐	☐	☐	6	Run-off control measures
☐	☐	☐	7	Stormwater outlet protection locations and specifications.
☐	☐	☐	8	Grade stabilization structure locations and specifications
☐	☐	☐	9	Dewatering applications and management methods
☐	☐	☐	10	Measures utilized for work within waterbodies
☐	☐	☐	11	Maintenance guidelines for each proposed temporary stormwater quality measure
☐	☐	☐	12	Planned construction sequence describing the relationship between implementation of stormwater quality measures in relation to land disturbance
☐	☐	☐	13	Provisions for erosion and sediment control on individual building lots regulated under the proposed project
☐	☐	☐	14	Material handling and spill prevention and spill response plan meeting the requirements in 327 IAC 2-6.1
☐	☐	☐	15	Material handling and storage procedures associated with construction activity. Management of waste materials and dumpsters for runoff and wind. Concrete washout management. Fueling areas. Equipment washing. Application of pesticides, herbicides, insecticides and fertilizers. Disposal of hazardous waste. Washing of paint or grout applicators.
☐	☐	☐	16	Monitoring and project management plan to include self-monitoring program (SMP), self-inspections and project management log

Section B – Comments:

-

Section C: Stormwater Pollution Prevention Plan – Post-Construction				
Adequate	Deficient	NA	C	*The post-construction component of the Stormwater Pollution Prevention Plan includes the implementation of stormwater quality measures to address pollutants that will be associated with the final project land use. Post-construction stormwater measures should be functional upon completion of the project. Long term functionality of the measures is critical to their performance and should be monitored and maintained.*
☐	☐	☐	1	Description of pollutants and their sources associated with the proposed land use
☐	☐	☐	2	Description of proposed post-construction stormwater measures including stormwater detention and water quality treatment according to the local ordinance (refer also to separate technical review comments)
☐	☐	☐	3	Plan details for each post-construction stormwater measure
☐	☐	☐	4	Sequence describing stormwater measure implementation

☐	☐	☐	**5**	Maintenance guidelines for proposed post-construction stormwater measures. Operation and Maintenance (O&M) Manual.
☐	☐	☐	**6**	Entity that will be responsible for operation and maintenance of the post-construction stormwater measures. Include in the O&M Manual

Section C – Comments:

-

FORM B-6:
TIME OF CONCENTRATION AND TRAVEL TIME WORKSHEET

Project	Calculated By	Date
Location	Checked By	Date

Check one: ☐ Present Condition ☐ Developed Condition

Check one: ☐ T_c ☐ T_t *Notes: Include a map, schematic, or description of flow segments.*

Sheet Flow *(applicable to T_c only)*

	Segment ID				
1. Surface description (Table 4-2)					
2. Manning's roughness, *n* (Table 4-2)					
3. Flow length, *L* (total *L* ≤ 300 ft over pervious, *L* ≤ 100 ft over impervious) ft					
4. 2-year, 24-hour rainfall, P_2 (Table 4-4) in					
5. Land slope, *S* ft/ft					
6. Travel time, T_t (Equation 4-1) hr		+		=	

Shallow Concentrated Flow

	Segment ID				
7. Surface description (paved or unpaved)					
8. Flow length, *L* ft					
9. Land/watercourse slope, *S* ft/ft					
10. Average velocity, *V* (Figure 4-1) ft/s					
11. Travel time, T_t (Equation 4-3) hr		+		=	

Channel Flow

	Segment ID				
12. Cross sectional flow area, *A* ft^2					
13. Wetted perimeter, P_w ft					
14. Hydraulic radius, *R* ft					
15. Channel slope, *S* ft/ft					
16. Manning's roughness, *n* (Table 4-9 or 4-10)					
17. Velocity, *V* (Equation 4-2) ft/s					
18. Flow length, *L* ft					
19. Travel time, T_t (Equation 4-3) hr		+		=	
20. Watershed or subarea, T_c or T_t (add T_t in steps 6, 11, and 20 above) hr				=	

FORM B-7:
NRCS CURVE NUMBER WORKSHEET

Project	Calculated By	Date
Location	Checked By	Date

Check one: ☐ Present Condition ☐ Developed Condition

Soil Name and Hydrologic Soil Group	Cover Description (cover type, treatment, condition)	% Impervious	Unconnected/ Connected Impervious Area Ratio	*CN* (Table 4-8)	Area, *A* ☐ acres ☐ mi^2 ☐ %	Product *CN* x *A*
				Totals ➧		

CN (weighted) = $\frac{\text{(total } CN \text{ x } A\text{)}}{\text{(total } A\text{)}}$ = _____ = _____ ; **Use *CN*** ➧ ☐

FORM B-8:
STORM SEWER SYSTEM DESIGN WORKSHEET

Structure		Length (feet)	Drainage Area *A* (acres)		Runoff Coefficient *C*	*A* * *C*		Flow Time (min)		Rainfall Intensity *i* (in/hr)	Total Runoff (cfs)	Pipe Diameter (inches)	Full Capacity (cfs)	Velocity (fps)		Invert Elevation		Manhole Invert Drop (feet)	Slope of Sewer (ft/ft)
From (Upstream)	To (Downstream)		Increment	Total		Increment	Total	To Upstream Structure	In Section					Flowing Full	Design Flow	Upstream Structure	Downstream Structure		

FORM B-9:
SAMPLE GRANT OF PERPETUAL RIGHT-OF-WAY AND EASEMENT

Cross reference to plat or,
if not platted, to most
recent deed:
Plat Bk.
Instr. No. _____

This easement affects
Parcel Number (s):

GRANT OF PERPETUAL RIGHT-OF-WAY AND EASEMENT

THIS INDENTURE made this __ day of _____, 20____ by and between _____ ("GRANTOR(S)"), and the City of Beech Grove, Indiana, (herein after called "GRANTEE"):

WITNESSETH, that for and in consideration of the mutual covenants herein set forth and other valuable consideration, the receipt of which is hereby acknowledged, GRANTOR(S) for itself and its administrators, agents, successors and assigns, do(es) hereby grant, bargain, sell, convey and warrant to GRANTEE, its grantees, successors and assigns, an exclusive perpetual right-of-way and easement to enter upon, dig, lay erect, construct, install, reconstruct, renew and operate, maintain and patrol, replace, repair and continue the stormwater management facility(ies), as part of GRANTEE'S system and works for the collection, storage, carriage, treatment and disposal of stormwater of the City of Beech Grove (the "City"), as shall be hereafter located and constructed into, under, upon, over and across the following described real estate and premises owned by GRANTOR(S) and situated in the County of Marion, State of Indiana, to-wit:

See legal description attached hereto and incorporated herein by reference as Exhibit A.

It is expressly understood and agreed that such sanitary sewer and other equipment and fixtures used in conjunction therewith shall be at all time subject to the controls, orders, rules and regulations of the City and shall at all times remain reasonably accessible to the City.

GRANTEE, its grantees, successors, and assigns shall have the right to enter along, over and upon said easement to repair, relocate, service and maintain said stormwater management facility(ies), at will, and to make such alterations and improvements in the facility(ies) thereof as may be necessary or useful, and to remove from the extent of the right-of-way any encroaching trees, buildings, or other obstruction to the free and unobstructed use of said easement, and to build and maintain all necessary devices incident to said stormwater management facility(ies), and shall have the right of ingress and egress on, across and over adjoining premises and lands when necessary and without doing damage to such adjoining lands, and only for temporary periods necessary to complete any and all necessary work.

GRANTOR(S) covenants(s) for itself, its administrators, agents, successors and assigns that it will not erect or maintain any buildings or other structures or obstruction on or over said stormwater management facility(ies) under said tract of land in which the perpetual right-of-way and easement is hereby granted, except by express permission from GRANTEE, in writing and in accordance with the terms thereof, and which permission when in writing and recorded shall run with the real estate.

A diagram map showing the route, courses and distances through the above-described real estate and premises and the width of the right-of-way and easement is attached hereto and incorporated herein by reference as Exhibit B.

GRANTOR(S) covenant(s) that it is the owner(s) in fee simple of the above described real estate, is lawfully seized thereof and has a good right to grant and convey the foregoing right-of-way and easement therein; that it guarantee(s) the quiet possession thereof, that said real estate is free from any and all encumbrances except the following:

1. Current taxes are not delinquent

and that GRANTOR(S) will warrant and defend GRANTEE'S title to said right-of-way and easement against all lawful claims.

It is further expressly understood and agreed that such stormwater management facility(ies) and other equipment and fixtures used in connection therewith shall be and remain the sole property of the City, upon inspection and exception of same by the City.

*GRANTOR(S), additionally covenants(s) for itself, its administrators, agents, successors and assigns that if right-of-way and easement is not exclusively in favor of GRANTEE, GRANTOR does hereby indemnify and hold GRANTEE harmless for all relocation costs or damages to the property of any other occupant(s) of said right-of-way and easement.

GRANTOR(S), hereby affirm that no unauthorized alterations of this document have taken place.

IN WITNESS WHEREOF, GRANTOR(S) has/have hereunto set his, her, their respective hand(s) as of the day and year first written above.

_____	_____
Signature	Signature
_____	_____
Printed Name	Printed Name

STATE OF INDIANA)
) SS:
COUNTY OF MARION)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, personally appeared _____ GRANTOR(S), who acknowledged the execution of the above and foregoing instrument to its voluntary act and deed on the ____ day of _____, 20____.

_____	_____
Commission Expiration Date	Notary
_____	_____
County of Residence	Printed Name

FORM B-10:
AGREEMENT FOR CONSTRUCTION OF STORMWATER FACILITY UNDER PRIVATE CONTRACT

CONTRACT PRICE $_____

This Agreement made and entered into this _____ day of _____, 20____, by and between _____, hereinafter called the OWNER, and _____, hereinafter called the CONTRACTOR, and the City of Beech Grove, Indiana, acting by and through its Department of Public Works, hereinafter called the CITY or DEPARTMENT as the context may require:

WITNESSETH THAT:

WHEREAS, the OWNER has heretofore requested permission to construct an improvement hereinafter described under paragraph numbered one (1) of this Agreement, under Private Contract and connect same to the CITY's stormwater conveyance system, all work thereunder to be done at the OWNER's expense and in accordance with plans and specifications as further described in Paragraph 1 below and as approved by the City (the "Plans and Specifications"), and

WHEREAS, the OWNER has designated _____ to construct and install such improvement, and

WHEREAS, the DEPARTMENT is willing to grant its permission for the construction and connection of said described improvement by said CONTRACTOR and at said OWNER's expense upon the terms and conditions hereinafter set forth.

NOW, THEREFORE, it is agreed between the parties hereto as follows:

1. The OWNER and the CONTRACTOR are authorized to construct at the OWNER's sole expense a stormwater facility further located and particularly described as follows, to-wit:

   in accordance with Plans and Specifications filed with and approved by DEPARTMENT, and to connect the same to the CITY's Stormwater Conveyance System at _____ _____. Such construction and connection to be made in strict accordance with the Plans and Specifications and therefore as approved by this DEPARTMENT and the Engineer under date of _____, 20_____, and the Stormwater Standards of the CITY pertaining to stormwater facility construction on file in

the office of said DEPARTMENT (the “City Stormwater Standards”) both of which Plans and Specifications and the City Specifications by this reference are made a part of this Agreement, and subject at all times to the inspection approval, and acceptance of the Department.

2. All excavations over which pavement, curbs, or walks are to be built or replaced within six (6) months after the backfilling thereof, shall be backfilled with granular material as directed by the Department of Transportation of such City of Beech Grove, or other proper governmental authority as the case may be.

3. Within forty-five (45) days of completion of such proposed stormwater facility, a set of "as-built" drawings including all house connection measurements shall be prepared by such OWNER and filed with the DEPARTMENT. The “as-built” drawings must be filed with and approved by the DEPARTMENT and the proposed improvement must have been inspected and approved by a designated representative of CITY before such stormwater facility will be accepted into the public stormwater conveyance system.

4. Upon final completion thereof, but before its acceptance by the CITY, the CONTRACTOR shall furnish a Completion Affidavit in a form to be prescribed by the DEPARTMENT, and the CONTRACTOR or OWNER shall also furnish a suitable Maintenance Bond made payable to the CITY with good and sufficient surety thereon and acceptable to the CITY in an amount equal to 20% of the total contract price for said improvements. Said bond shall be in the form required by the CITY and shall guarantee said material and construction for a period of three (3) years from the date of final acceptance.

5. Upon completion of such improvement, and its acceptance by the CITY, it shall become a part of the public stormwater conveyance system of the CITY with title thereto vested in the CITY and shall be thereafter under full control, authority and jurisdiction of said CITY, to the same extent and in the same manner as though said stormwater facility had been originally constructed by the CITY under a Public Improvement Contract.

6. It is understood by the parties hereto that this stormwater facility, and the connection thereto, shall be used for and as a separate stormwater facility. No untreated wastewater, sewage, or other pollutants or illicit discharges shall be connected thereto.

7. Should annexation proceeds to the CITY be instituted at any time in the future by the proper governmental authority or by persons living in the area requested such annexation of the real estate serviced by said construction, the OWNER covenants and agrees for himself, itself, their legal representatives, heirs, devisees, grantees, successors or assigns that no objection to such annexation shall be made, that no remonstrance shall be filed nor will an appeal from any judgment approving such annexation be taken.

8. Work under said improvement shall commence within thirty (30) days after the execution of this Agreement, and the CONTRACTOR agrees to prosecute such work without delay to final

completion. The construction of the improvement provided for under this Agreement shall be completed by _____.

9. No liability of any kind for any part of the improvements shall attached to said CITY or DEPARTMENT. The OWNER and CONTRACTOR, shall indemnify, defend and hold harmless the CITY and DEPARTMENT and their respective officers, employees, elected officials, agents and assigns harmless from and against any and all losses, claims, liabilities, damages, costs and expenses, including but not limited to reasonable attorneys fees, which CITY and/or DEPARTMENT may incur as a result of or arising out of or in any way connected with this location, installation and/or construction of the improvements provided for in this Agreement. In addition, prior to the commencement of the construction authorized by this Agreement to the CONTRACTOR shall furnish to the CITY and DEPARTMENT evidence of a public liability insurance policy in the minimum amount of One Million Dollars ($1,000,000.00), each occurrence, and each aggregate for bodily injury limits, and One Million Dollars ($1,000,000.00), each occurrence, and One Million Dollars ($1,000,000.00), each aggregate for property damage limits indemnifying and holding the CITY harmless against all claims, demands, actions, causes of action, loss and expense of every nature and kind therein at any time asserted against the CITY for or on account of any person, arising out of or in any way connected with this location, installation and/or construction of said improvement.

10. CONTRACTOR further agrees that prior to the commencement of the work contemplated herein, said CONTRACTOR shall furnish a suitable irrevocable Letter of Credit or Performance Bond made payable to the DEPARTMENT with good and sufficient surety thereon and acceptable to the DEPARTMENT in an amount equal to 100% of the total contract price for said improvements.

11. CONTRACTOR further agrees that prior to the commencement of the work contemplated herein, said CONTRACTOR shall pay to said CITY, the sum of $_____ as an inspection charge covering the cost of inspecting such project. Such OWNER and/or CONTRACTOR shall also, in the event any part of such stormwater facility is to be constructed across, on, through or under any public highway or right-of-way, furnish CITY evidence of authority so to do, procured from the proper governmental agency having jurisdiction and control over such public right-of-way.

IN WITNESS WHEREOF, the Parties have hereunto set their hands and seals on the day and year first above written.

CONTRACTOR	OWNER
_____	_____
Name of Contracting Company	Name Of Corp. (If Applicable)
_____	_____
Signature	Signature (Of Officer in Corp.)
_____	_____
Printed Name & Title	Printed Name & Title

CITY OF BEECH GROVE

_____

Mayor

_____

Signature

ATTEST:

_____

Clerk-Treasurer

_____

Signature

STATE OF INDIANA)
) SS
COUNTY OF MARION)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, personally appeared _____, CONTRACTOR, and acknowledge the execution of the foregoing Private Contract Agreement to be their free and voluntary act and deed.

WITNESS my hand and Notarial Seal this _____ day of _____, 20_____.

_____ _____
Commission Expiration Date Notary Signature

_____ _____
County of Residence Printed Name

STATE OF INDIANA)
) SS
COUNTY OF MARION)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, personally appeared _____, OWNER, and acknowledge the execution of the foregoing Private Contract Agreement to be their free and voluntary act and deed.

WITNESS my hand and Notarial Seal this _____ day of _____, 20_____.

_____ _____
Commission Expiration Date Notary Signature

_____ _____
County of Residence Printed Name

FORM B-11:
AGREEMENT BETWEEN OWNER / CONTRACTOR AND CITY OF BEECH GROVE FOR CONSTRUCTION INSPECTION SERVICES

SUBJECT PROJECT: _____

ADDRESS: _____

This Agreement for Sewer Inspection Services is entered into by and among _____

(the "Owner"), _____ ("the Contractor") and the City of Beech Grove (the

"City") effective as of the latest date set forth below and on the terms and conditions set forth herein.

WITNESSETH:

WHEREAS, the Owner and the Contractor are, simultaneously with the execution hereof, entering into an Agreement for Construction for Stormwater Facilities Under Private Contract (the "Private Construction Contract") relating to the construction of stormwater facilities in accordance with the Plans and Specifications as provided for in the Private Construction Contract (the "Project");

WHEREAS, the completion of the Project by the Owner and the Contractor will require certain approvals and related inspections to be preformed by the City; and

WHEREAS, the parties desire to set forth their Agreement relating to the inspection services and the related fees necessary for the construction of the Project.

1. Inspection Services.
   The City agrees to provide the inspection services that may be required, as it determines in its sole discretion, in conjunction with the Project (the "Inspection Services"). The Inspection Services will be performed to determine if the work is proceeding in accordance with the Plans and Specifications and any and all agency approvals that may be necessary including any approvals necessary from the Indiana Department of Environmental Management. The Inspections Services shall include witnessing of all tests necessary for acceptance of the stormwater facilities by the City, and Contractor shall provide City with notice at least 2 business days before the inspection of the testing is to occur.

   The Inspection Services will be performed for a fee of $_____ per hour of actual time spent on the project by the City of Beech Grove and/or an authorized representative of the City in performing said Inspection Services.

   The estimated time for completing of the project is _____week(s).

   Estimated time of Inspection Services is _____hours.

   The total estimated cost for Inspection Services is $_____ (the "Estimated Inspection Fee").

The Owner agrees to include One Hundred percent (100%) of the total estimated cost or $_____ with this "Agreement" with the check made payable to the City of Beech Grove.

The actual Inspection fee will be based on the actual number of hours of inspection required to complete the project.

If the Estimated Inspection Fee exceeds the amount set for herein adjustments to the total Inspection Fee, the remaining fee owed shall be paid by the Contractor to the City upon the conditional acceptance of the completed work by the City and posting of a 3-year Maintenance Bond and prior to the final acceptance of the stormwater facilities by the City.

2. Indemnification.

The Owner/Contractor shall agree to indemnify and hold the City harmless from and against any and all losses, claims, liabilities, damage, costs and expenses, including but not limited to, reasonable attorney fees, which it may incur as a result of or arising from a breach by the Owner and/or Contractor of their obligations hereunder or arising from the acts or omissions of the Owner and/or Contractor performing their obligations hereunder.

This Agreement does not include construction engineering or construction stake-out.

IN WITNESS WHEREOF, the parties have executed this Agreement effective as of the latest date set forth below.

Owner:

_____
Organization (Print)

BY:_____
Name Title

Notary:
STATE OF INDIANA
COUNTY OF MARION
Subscribed and sworn to before me a notary public in and for said county and state this

_____ day of _____, 20____

My Commission Expires_____

_____
Notary Public

Resident of _____

Contractor:

_____
Organization (Print)

BY:_____
Name Title

Notary:
STATE OF INDIANA
COUNTY OF MARION
Subscribed and sworn to before me a notary public in and for said county and state this

_____ day of _____, 20____

My Commission Expires_____

_____
Notary Public

Resident of _____

City of Beech Grove, Indiana:

_____
Organization (Print)

BY:_____
Name Title

Notary:
STATE OF INDIANA
COUNTY OF MARION
Subscribed and sworn to before me a notary public in and for said county and state this

_____ day of _____, 20____

My Commission Expires_____

_____
Notary Public

Resident of _____

FORM B-12:
SELF-MONITORING CONSTRUCTION INSPECTION REPORT

The Indiana Construction General Permit (INRA00000) was issued on December 18th, 2021, by the Indiana Department of Environmental Management. The construction stormwater general permit (CSGP) is a performance-based regulation that contains specific requirements. One of the requirements is to develop and implement a self-monitoring program. The self-monitoring program is a mechanism to mange the construction project to ensure appropriate steps are taken to implement and maintain measures that will reduce the discharge of sediment and other pollutants associated with construction activities.

IDEM has developed a sample form that can be used by permittees and/or their representatives to implement the self-monitoring program. This form is not required by IDEM but is being provided to permittees that are required to comply with the CSGP and meet the requirements to conduct a self-monitoring program.

The requirements of the self-monitoring program can be found in the CSGP Section 3.6. The CSGP is available at: https://www.in.gov/idem/stormwater/construction-land-disturbance-permitting/

The form contains specific information that is required as part of a self-monitoring program. The form contains specific requirements that can be targeted to specific locations on the project site. Location information can be a narrative or used in conjunction with a map that identifies areas within the project. If a map is used, the map should be included as part of the self-monitoring report. The self-monitoring program documentation is required to be part of the project management log. Information on the project management log can be found in Section 3.7 of the CSGP.

Corrective action must be initiated within 48 hours of discovery of deficiencies when maintenance is required and within seven (7) days of discovery of deficiencies when a new (alternative) or replacement measure is required.

If the project is within and regulated by a Municipal separate Storm Sewer System (MS4), the MS4 may allow the use of this form to meet the local MS4 stormwater ordinance. It is the responsibility of the permittee and/or their representative to verify if this form is allowed for projects regulated by the MS4 or if the MS4 requires a form specific to meet the needs of the MS4 stormwater ordinance.

Self-Monitoring Report

PART A: INSPECTION INFORMATION

	Inspection Type	Inspection Date and Time
Project Name: **CSGP Project #** Number**:** **Permit # Assigned by MS4:** **Name of MS4:** **County:** **Name of Evaluator:** **Title of Evaluator:** **Affiliation:** **Email/Phone Number:**	☒ 24 hr (after >.5" rain) ☐ 24 hr (before >.5" rain) ☐ Weekly ☐ Monthly *(only applies to areas permanently stabilized)*	Click here to enter a date. **Date of Last or Forecasted (circle one) Precipitation:** Click here to enter a date. **Amount of Last or Forecasted (circle one) Precipitation:** Click here to enter a date.

PART B: SITE CONDITIONS

Current Site Information (check all that apply): ☐ Clearing ☐ Grubbing ☐ Grading ☐ Building Construction ☐ Installation of Infrastructure ☐ Utility Work ☐ Vegetative Establishment ☐ Other:

Soil Conditions: ☐ Dry ☐ Moist ☐ Wet ☐ Muddy ☐ Partial Snow Cover ☐ Snow Cover ☐ Frozen ☐ Freeze/Thaw ☐ Other:

PART C: PROJECT MANAGEMENT

(1) Was the SWP3 accessible at the time of the inspection?	☒ Yes ☐ No
(2) Is the SWP3 current and/or updated to reflect the current stage of development?	☐ Yes ☐ No
(3) Have all action items identified on the preceding reports been resolved? (a) If not identity which items require repair and provide a resolution timeline:	☐ Yes ☐ No
(4) Is the project posting information posted in accordance with the CSGP Section 3.7?	☐ Yes ☐ No

PART D: GUIDANCE FOR COMPLETION OF FORM

- Identify all areas of the site that currently have an erosion/sediment control measure in place. Using Part E, evaluate the current condition of the measure and using the middle column, determine what action needs to be taken.
- Identify all areas of the site where stormwater run-off leaves site or where any discharge occurs. In each location where run-off leave the site, evaluate:
  - If an erosion/sediment control measure is in place: evaluate each action step required in Part E
  - If no erosion/sediment control measure is in place or a measure is required, use Part E to include specifics about the location and type of measure to be implemented.
- For any area of the site where there is run-off, or a discharge provide a description and location using Part F.
  - If any sedimentation is occurring note where it is discharging: Off site, to a waterbody (on or off-site) or other sensitive area
- For Part H in the Evaluation of sheet flow and concentrated run-off:
  - Identify location of discharge/run-off and check any visual descriptions that apply to the discharge. If the discharge/run-off will resolve with the repair of a sediment or erosion control measure or good housekeeping practices, you do not need to list an action in the observations/notes section. If the discharge/run-off will not be solved with repair/replacement of a sediment control measure or good housekeeping practices, you will need to list the action taken to resolve the run-off and any additional pollutants visible in the discharge.
  - Print out additional pages for Parts E and F.

PART E: SEDIMENT CONTROL AND RUN-OFF MANAGEMENT		
Measure: Location(s):	☐ No Action Required ☐ Maintenance Required ☐ Repair Measure ☐ Temporary Measure ☐ Replace Measure ☐ Alternative Measure ☐ Additional Measure	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials
Measure: **Location(s):**	☐ No Action Required ☐ Maintenance Required ☐ Repair Measure ☐ Temporary Measure ☐ Replace Measure ☐ Alternative Measure ☐ Additional Measure	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials
Measure: Location(s):	☐ No Action Required ☐ Maintenance Required ☐ Repair Measure ☐ Temporary Measure ☐ Replace Measure ☐ Alternative Measure ☐ Additional Measure	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials
Measure: Location(s):	☐ No Action Required ☐ Maintenance Required ☐ Repair Measure ☐ Temporary Measure ☐ Replace Measure ☐ Alternative Measure ☐ Additional Measure	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials
Measure: Location(s):	☐ No Action Required ☐ Maintenance Required ☐ Repair Measure ☐ Temporary Measure ☐ Replace Measure ☐ Alternative Measure ☐ Additional Measure	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials

PART F: SURFACE STABILIZATION		
Location(s):	☐ Permanent Vegetative Cover: ☐ Continue to Monitor ☐ 70 Percent Density Achieved ☐ Perform Seeding/Reseed ☐ Temporary ☐ Permanent ☐ Apply straw mulch and anchor ☐ Install Erosion Control Blanket ☐ Repair Erosion ☐ Utilize Alternative Stabilization Method	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials
Location(s):	☐ Permanent Vegetative Cover: ☐ Continue to Monitor ☐ 70 Percent Density Achieved ☐ Perform Seeding/Reseed ☐ Temporary ☐ Permanent ☐ Apply straw mulch and anchor ☐ Install Erosion Control Blanket ☐ Repair Erosion ☐ Utilize Alternative Stabilization Method	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials
Location(s):	☐ Permanent Vegetative Cover: ☐ Continue to Monitor ☐ 70 Percent Density Achieved ☐ Perform Seeding/Reseed ☐ Temporary ☐ Permanent ☐ Apply straw mulch and anchor ☐ Install Erosion Control Blanket ☐ Repair Erosion ☐ Utilize Alternative Stabilization Method	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials
Location(s):	☐ Permanent Vegetative Cover: ☐ Continue to Monitor ☐ 70 Percent Density Achieved ☐ Perform Seeding/Reseed ☐ Temporary ☐ Permanent ☐ Apply straw mulch and anchor ☐ Install Erosion Control Blanket ☐ Repair Erosion ☐ Utilize Alternative Stabilization Method	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials

PART G: GOOD HOUSEKEEPING		
Site Ingress/Egress Location(s):	☐ Maintain Construction Entrance ☐ Remove Tracked Sediment (do not flush sediment) ☐ Install Additional Measures	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials
Trash Location(s):	☐ Continue to Monitor and Manage ☐ Cover Trash Receptacles ☐ Clean Up Wind-blown Trash ☐ Other	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials
Spills or Leaks Location(s):	Type of Leak/Spill ☐ Concrete and/or Cementitious Washout ☐ Fuel ☐ Other	Observations/Notes/Action Taken:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials

PART H: EVALUATION OF SHEET FLOW AND CONCENTRATED RUN-OFF (DISCHARGES)		
Location(s):	☐ Sediment ☐ Oil Sheen ☐ Odor ☐ Floatables/Trash ☐ Foam ☐ Color/Turbid Discharge ☐ Other	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials
Location(s):	☐ Sediment ☐ Oil Sheen ☐ Odor ☐ Floatables/Trash ☐ Foam ☐ Color/Turbid Discharge ☐ Other	Observations/Notes:
Action Initiated Date: Click here to enter a date. Initials:		Action Completed Date: Click here to enter a date. Initials

PART I: CHANGES TO SWP3	
Does the corrective action based on this inspection require modification to the SWP3? ☒ Yes ☐ No Date of SWP3 update: Brief description of the changes:	
Action Initiated Date: Click here to enter a date. Initials:	Action Completed Date: Click here to enter a date. Initials
I certify that Part A-H of this evaluation were evaluated by me as a trained individual. To the best of my knowledge and belief, the information documented in the report is true, accurate, and complete.	
Evaluator Name and Title: **Signature and Date:** _____	

SELF-MONITORING PROGRAM

The Indiana Construction General Permit (INRA00000) was issued on December 18th, 2021, by the Indiana Department of Environmental Management. The construction stormwater general permit (CSGP) is a performance-based regulation that contains specific requirements. One of the requirements is to develop and implement a self-monitoring program. The self-monitoring program is a mechanism to mange the construction project to ensure appropriate steps are taken to implement and maintain measures that will reduce the discharge of sediment and other pollutants associated with construction activities.

IDEM has developed a sample form that can be used by permittees and/or their representatives to implement the self-monitoring program. This form is not required by IDEM but is being provided to permittees that are required to comply with the CSGP and meet the requirements to conduct a self-monitoring program.

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The form contains specific information that is required as part of a self-monitoring program. The form contains specific requirements that can be targeted to specific locations on the project site. Location information can be a narrative or used in conjunction with a map that identifies areas within the project. If a map is used, the map should be included as part of the self-monitoring report. The self-monitoring program documentation is required to be part of the project management log. Information on the project management log can be found in Section 3.7 of the CSGP.

Corrective action must be initiated within 48 hours of discovery of deficiencies when maintenance is required and within seven (7) days of discovery of deficiencies when a new (alternative) or replacement measure is required.

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FORM B-13:
MAINTENANCE BOND

Instructions:

1. *Contractor/Developer must use this form or other form containing the same material conditions and provisions as approved in advance by the City of Beech Grove.*
2. *Date of Bond must not be prior to date of Contract. If Contractor/Developer is a Partnership, all partners should execute bond.*
3. *Surety company executing this bond shall appear on the most current list of "Surety Companies Acceptable on Federal Bonds," as specified in the U.S. Treasury Department Circular 570, as amended, and be authorized to transact business in the State of Indiana.*

KNOW ALL MEN BY THESE PRESENTS: that

"Contractor" or "Developer" _____

and

"Surety" Name _____

Address _____

_____

a corporation chartered and existing under the laws of the State of _____, and authorized to do business in the State of Indiana, are held and firmly bound unto the City of Beech Grove, in the penal sum of _____ Dollars, ($_____) in lawful money of the United States, for the payment of which sum well and truly to be made, together with interest at the maximum legal rate from date of demand and any attorney fees and court costs incurred by Obligee to enforce this instrument, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Contractor or Developer has entered into an Agreement for Construction of _____ by which Contractor/Developer has agreed to perform and furnish certain work for or in furtherance of construction of public improvements described generally as the _____ which Agreement, and the "Contract Documents" as referred to therein, are hereby incorporated herein by reference;

WHEREAS, the Contractor/Developer has installed and completed and met all improvements, installations and requirements applicable to the above described work, but said improvements and installations have not yet been accepted for public maintenance; and

WHEREAS, the City of Beech Grove requires a guarantee from the Contractor/Developer against defective materials and workmanship in connection with such maintenances.

NOW, THEREFORE, Contractor/Developer warrants the workmanship and all materials used in the construction, installation and completion of said Work, to be of good quality and completed in a workmanlike manner in accordance with the Agreement and Contract Documents and all laws, ordinances, rules, standards and regulations applicable to said Work;

FURTHERMORE, the conditions of the Surety's obligation hereunder are such that if Contractor/Developer at his own expense, for a period of three years after said Work, improvements and installations are accepted for public maintenance by the City of Beech Grove, shall make all repairs or replacements thereto which may become necessary by reason of improper or defective workmanship or materials, or any failure thereof to conform to the provisions of the Agreement or Contract Documents,

then Surety's obligation is to be null and void; otherwise such obligation shall remain in full force and effect. Any repairs or replacements made under this Bond shall in like manner be subject to the terms and conditions hereof.

Contractor/Developer and Surety covenant that all action required by law to be taken by them to authorize the execution and delivery of this bond have been previously been taken, that the officers whose signatures appear below have been fully empowered to execute and deliver this instrument and that once executed and delivered, it shall represent the lawful and binding obligation of the parties.

IN WITNESS WHEREOF, this instrument is executed in duplicate counterparts, each one of which shall be deemed an original, this the _____ day of _____, 20_____.

Contractor/Developer: _____

By: _____ _____
Signature Printed Name

Attest: _____ _____
Signature Title

Surety: _____

By: _____ _____
Signature, Attorney-in-Fact Printed Name

Address: _____

APPENDIX C

BMP QUICK REFERENCE FORMS

C-1: DETENTION / RETENTION FACILITIES

QUICK REFERENCE

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

Site Feasibility:

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

Design Criteria:
Sediment forebay required
Length to width ratio shall be at least 3:1
Maximum depth of permanent pool should not exceed 8 feet
Side slopes of pond – see Appendix A, Detail No. 22
High permeable soils (hydrologic group A or B) may require a liner

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

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

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

C-1: DETENTION / RETENTION FACILITIES

GENERAL

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

DESIGN CRITERIA

The following criteria are minimum standards for the design of a wet stormwater pond. A stormwater 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 Equation 6-1 in Chapter 6.

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

2. Pond geometry:
    a. The pond should have a minimum length to width ratio of 3:1. The flow path between the inlet and outlet should be maximized and shaped so that flow enters the pond and gradually spreads out, improving sediment removal. Baffles, pond shaping and islands can be utilized to increase the flow path.
    b. The depth of the permanent pool should be greater than 4 feet to avoid resuspension of particles and less than 8 feet to avoid stratification and anoxic conditions.
    c. Vegetated side slopes to the pond should not exceed 3:1 and shall meet the requirements shown in Appendix A, Detail No. 22.

3. Pretreatment:
    a. For the collection of sediment and floatable debris, all ponds shall include a BMP or sediment forebay that consists of a separate cell, formed by an acceptable barrier. A forebay or BMP shall 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/BMP shall be sized to contain 10% of the water quality volume. The forebay/BMP storage volume is part of the total WQ_v requirement.
    c. Entrance and exit velocities from the forebay/BMP must be non-erosive.
    d. A fixed vertical depth marker shall be installed in the forebay or BMP to continually measure sediment deposition. Sediment in the forebay/BMP shall be removed after 50% of the forebay/BMP capacity has been depleted.
    e. Direct maintenance access for appropriate equipment shall be provided to the forebay/BMP.

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 125% of 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 1-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. Detention/retention facilities must be constructed within an easement either platted or legally described and recorded as a perpetual stormwater drainage easement in accordance with Chapter 4, Part 4.5.

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 stormwater management plan for post-construction runoff control.

C-1: DETENTION / RETENTION FACILITIES

MAINTENANCE AND INSPECTION CHECKLIST

Regular inspection and maintenance is critical to the effective operation of stormwater 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 5 years from the approval date of the Stormwater Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the City of Beech Grove Department of Public Works, upon request.

Project Name/Site Location:_____

Owner Name:_____ Phone:_____

Owner Address:_____

Date:_____ Inspector:_____

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

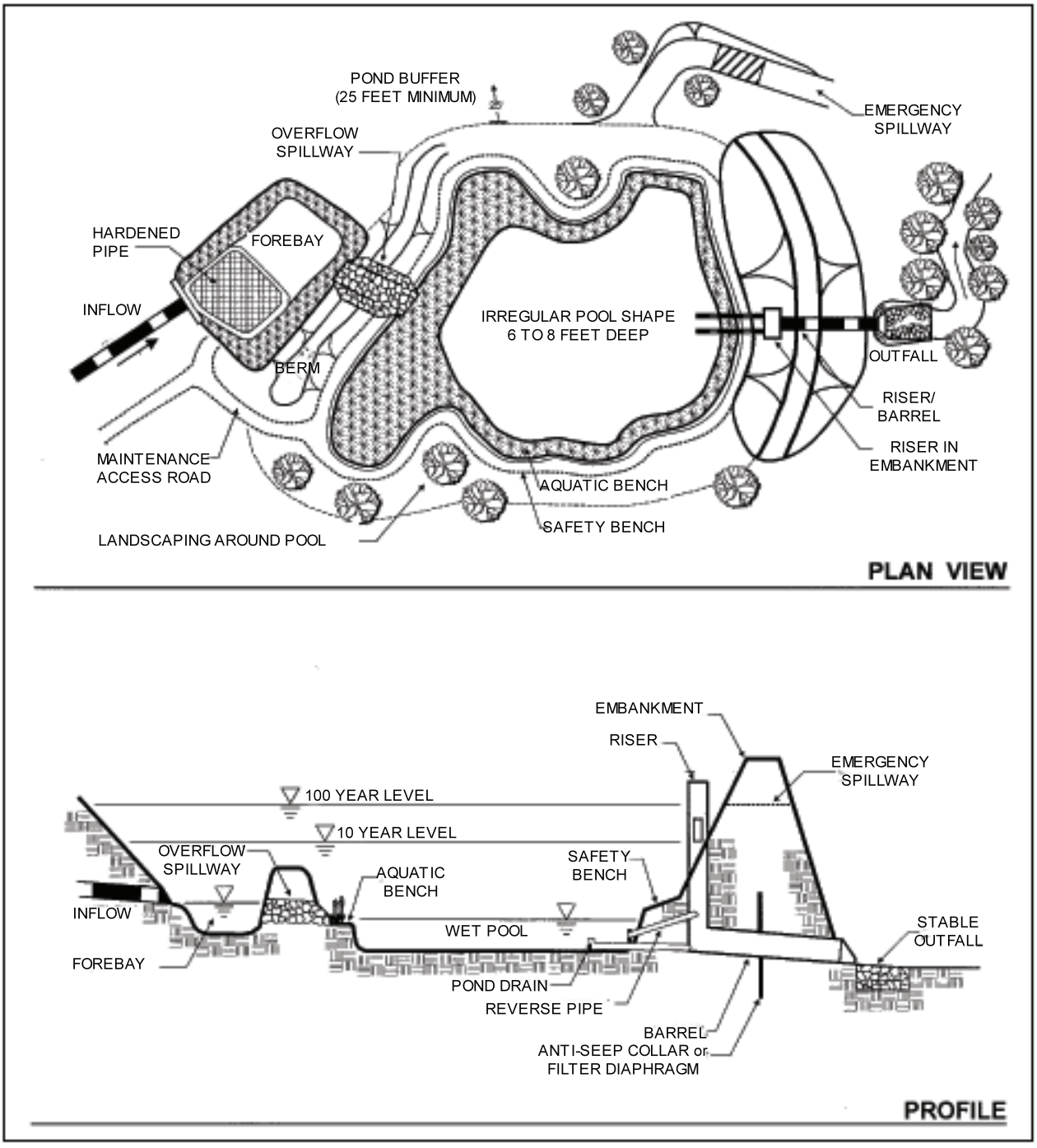
C-1: DETENTION / RETENTION FACILITIES

MAINTENANCE ITEM	YES/NO	COMMENTS
2. Floatable debris removal needed?		
3. Any visible pollution?		
4. Any shoreline problems?		
5. Other problems evident?		
Sediment Forebay		**Inspect Monthly**
1. Sedimentation marker visible?		
2. Sediment cleanout needed (50% full)?		
3. Other problems evident?		
Other		**Inspect Monthly**
1. Erosion at inflow or outfall points?		
2. Condition of headwalls satisfactory?		
3. Encroachments in pond easement area?		
4. Complaints from area residents?		
5. Any public hazards present?		
6. Other problems evident?		

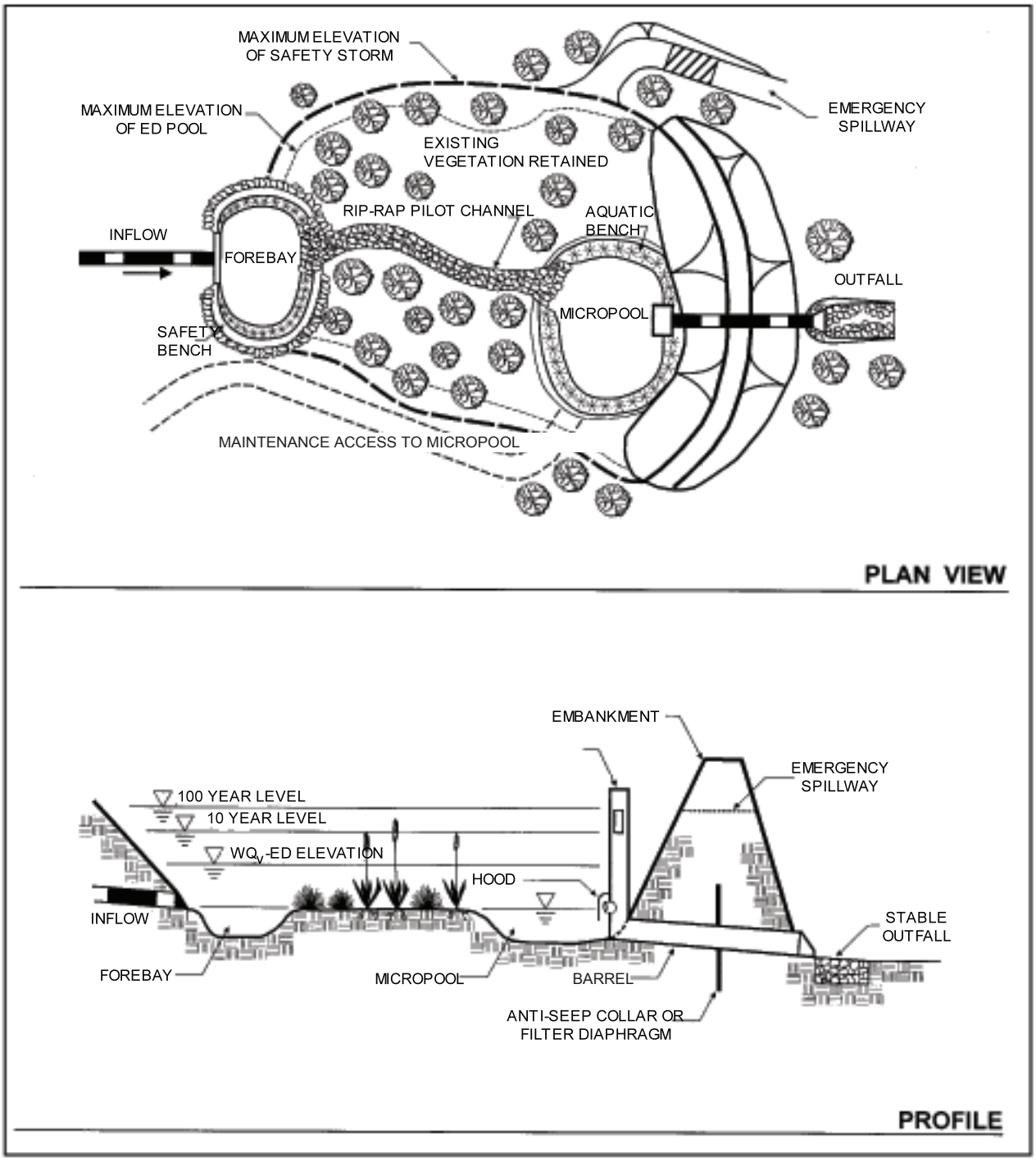
Additional Comments:_____

Recommended Actions:_____

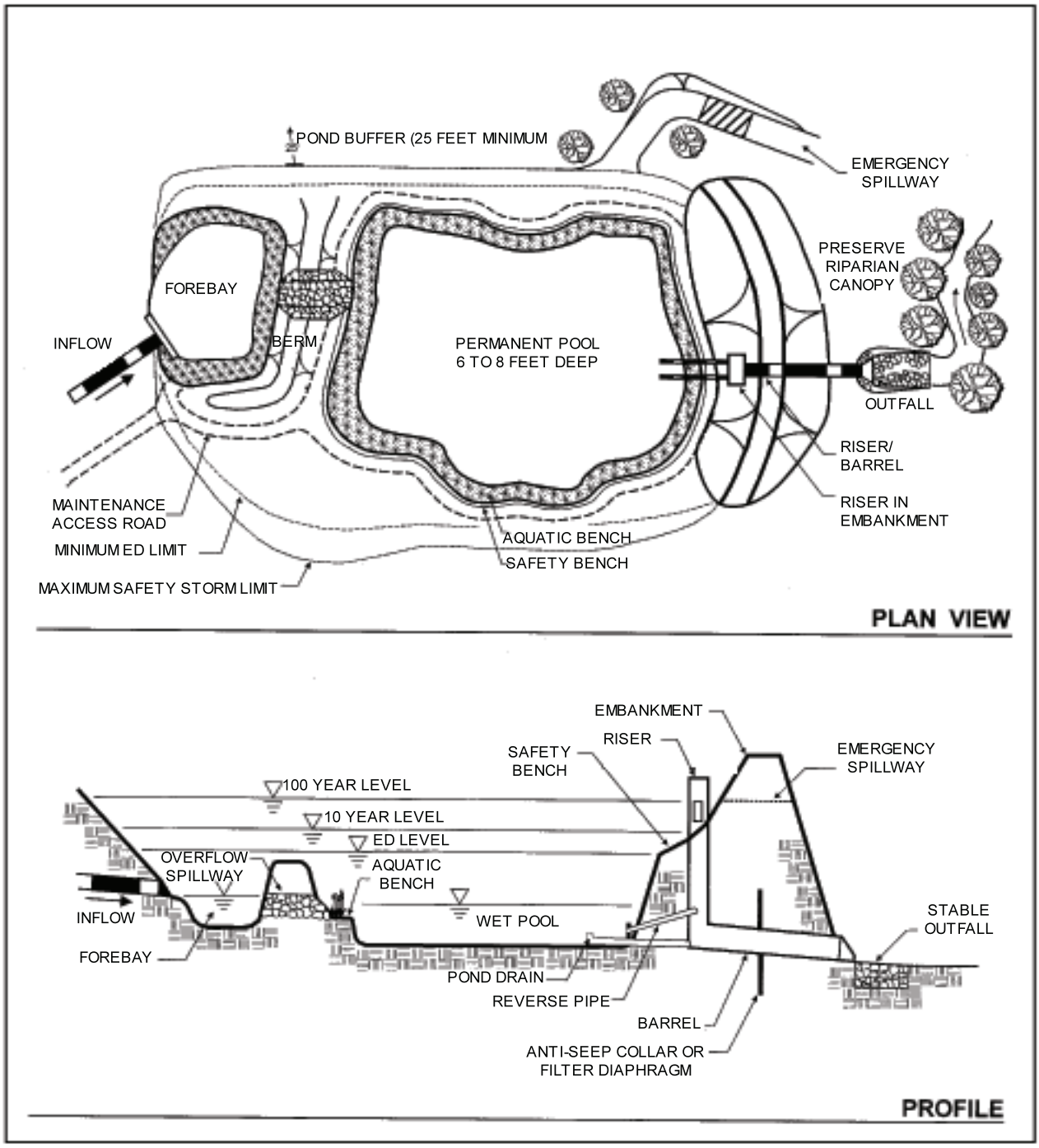
Recommended Timeframe for Actions:_____



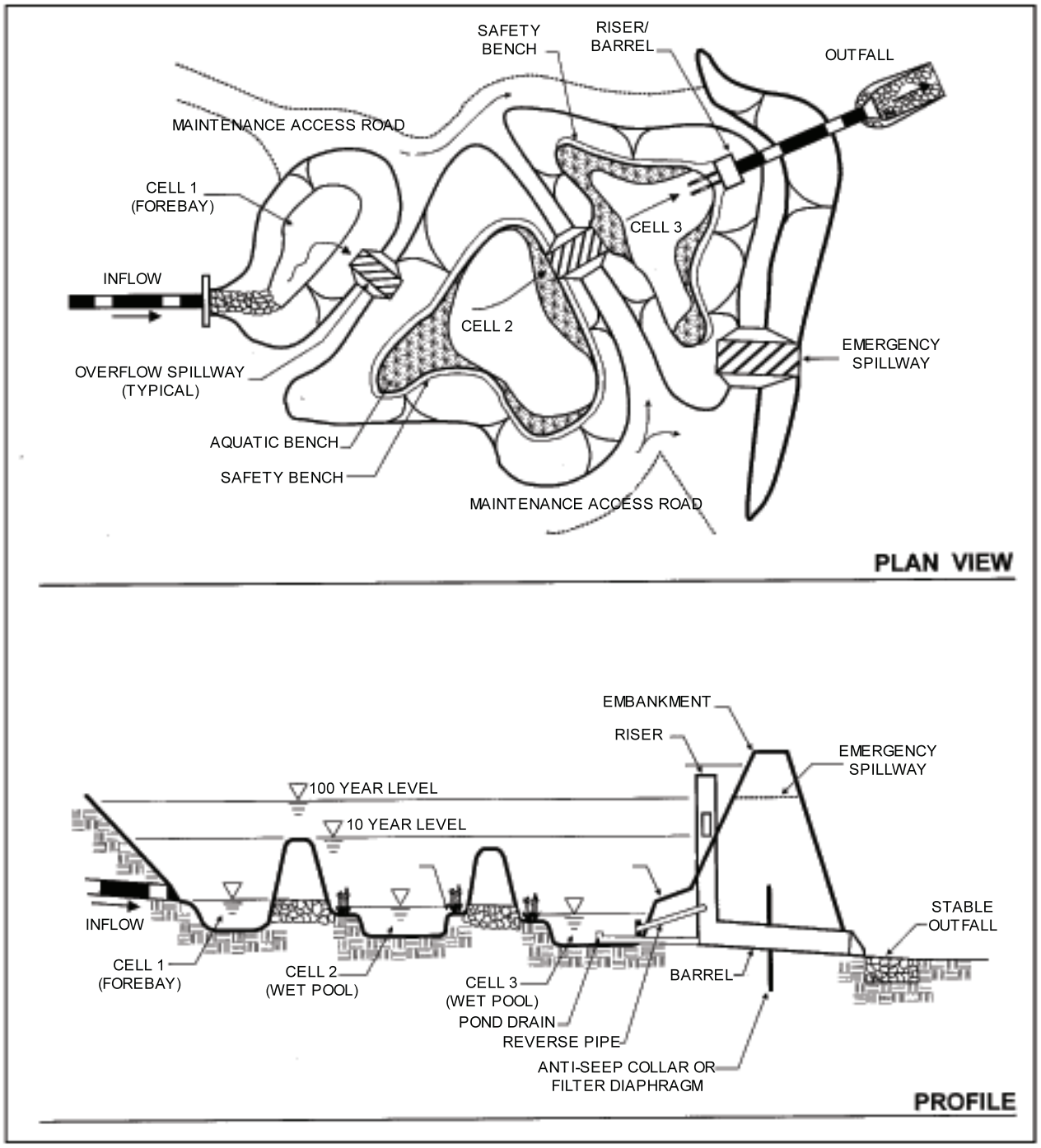
Schematic of a Wet Pond
(Source: Center for Watershed Protection, modified)



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



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



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

C-2: STORMWATER WETLANDS

QUICK REFERENCE

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

Site Feasibility:

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

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

Advantages:
Effective nutrient removal
Natural aesthetic qualities and wildlife habitat

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

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

C-2: STORMWATER WETLANDS

GENERAL

Description: Stormwater wetlands are constructed shallow marsh systems designed to control the quantity and quality of stormwater runoff. Microbial breakdown, settling, adsorption, retention, and vegetative uptake remove pollutants as stormwater 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 stormwater 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 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 stormwater flows receive additional treatment. Less land is required than for the shallow wetland or the ED shallow wetland systems.
- Pocket Wetland – intended for smaller drainage areas of 5 to 10 acres and typically requires excavation down to the water table for a reliable water source to support the wetland system.

DESIGN CRITERIA

The following criteria are minimum standards for the design of a wetland. A stormwater 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 Equation 6-1 in Chapter 6.

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 ensure enough inflow to sustain the wetland:

$$S = Q_i + R + I_{nf} - Q_o - ET$$

   where:
   S = net change in storage volume
   Q_i = stormwater runoff inflow volume
   R = contribution from rainfall volume
   I_{nf} = net infiltration volume (infiltration – exfiltration)
   Q_o = surface outflow volume
   ET = evapotranspiration volume

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 Stormwater 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
Detention Time (hours)	24	48	Varies	Varies
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. Pretreatment:
    a. For the collection of sediment and floatable debris, all wetlands shall include a BMP or sediment forebay that consists of a separate cell, formed by an acceptable barrier. A forebay or BMP shall 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/BMP shall be sized to contain 10% of the water quality volume and should be 3 to 6 feet deep. The forebay/BMP storage volume is part of the total WQ_v requirement.
    c. Entrance and exit velocities from the forebay/BMP 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/BMP to measure sediment deposition. Sediment in the forebay/BMP shall be removed after 50% of the forebay/BMP capacity has been depleted.
    e. Direct maintenance access for appropriate equipment shall be provided to the forebay/BMP.

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 stormwater 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 125% of 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 1-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. Stormwater wetlands must be constructed within an easement either platted or legally described and recorded as a perpetual stormwater drainage easement in accordance with Chapter 4, Part 4.5.

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 stormwater management plan for post-construction runoff control.

C-2: STORMWATER WETLANDS

MAINTENANCE AND INSPECTION CHECKLIST

Regular inspection and maintenance is critical to the effective operation of stormwater 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 5 years from the approval date of the Stormwater Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the City of Beech Grove Department of Public Works, 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?		

C-2: STORMWATER WETLANDS

MAINTENANCE ITEM	YES/NO	COMMENTS
Wetland Area		**Inspect Annually**
1. Is vegetation healthy and growing?		
2. Any evidence of invasive species?		
3. Sediment cleanout needed (50% full)?		
4. Other problems evident?		
Permanent Pool		**Inspect Monthly**
1. Undesirable vegetative growth?		
2. Floatable debris removal needed?		
3. Any visible pollution?		
4. Any shoreline problems?		
5. Other problems evident?		
Sediment Forebay		**Inspect Monthly**
1. Sedimentation marker visible?		
2. Sediment cleanout needed (50% full)?		
3. Other problems evident?		
Other		**Inspect Monthly**
1. Erosion at inflow or outfall points?		
2. Condition of headwalls satisfactory?		
3. Encroachments in pond easement area?		
4. Complaints from area residents?		
5. Any public hazards present?		
6. Other problems evident?		

Additional Comments:_____

_____

_____

Recommended Actions:_____

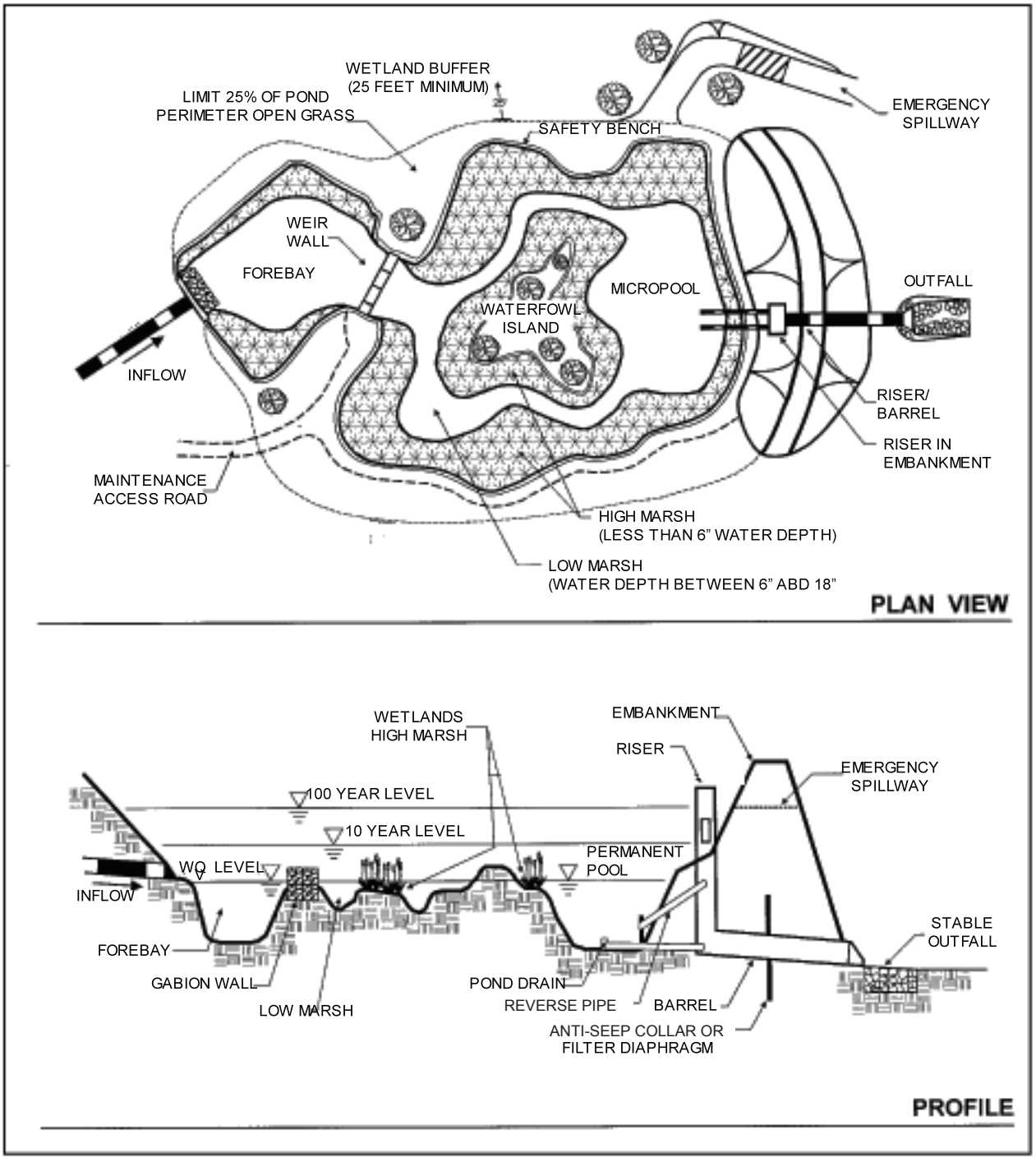
_____

_____

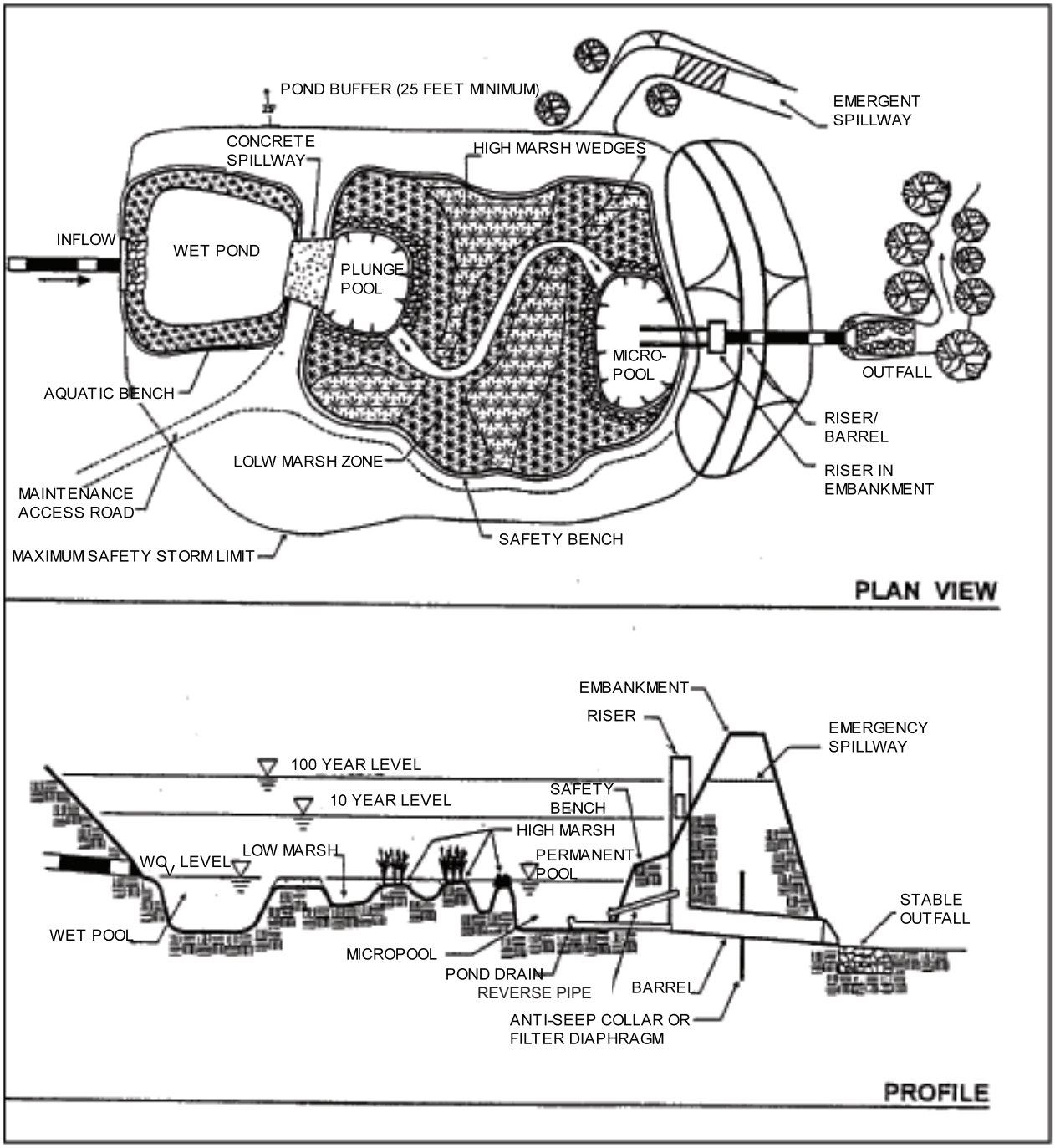
Recommended Timeframe for Actions:_____

_____

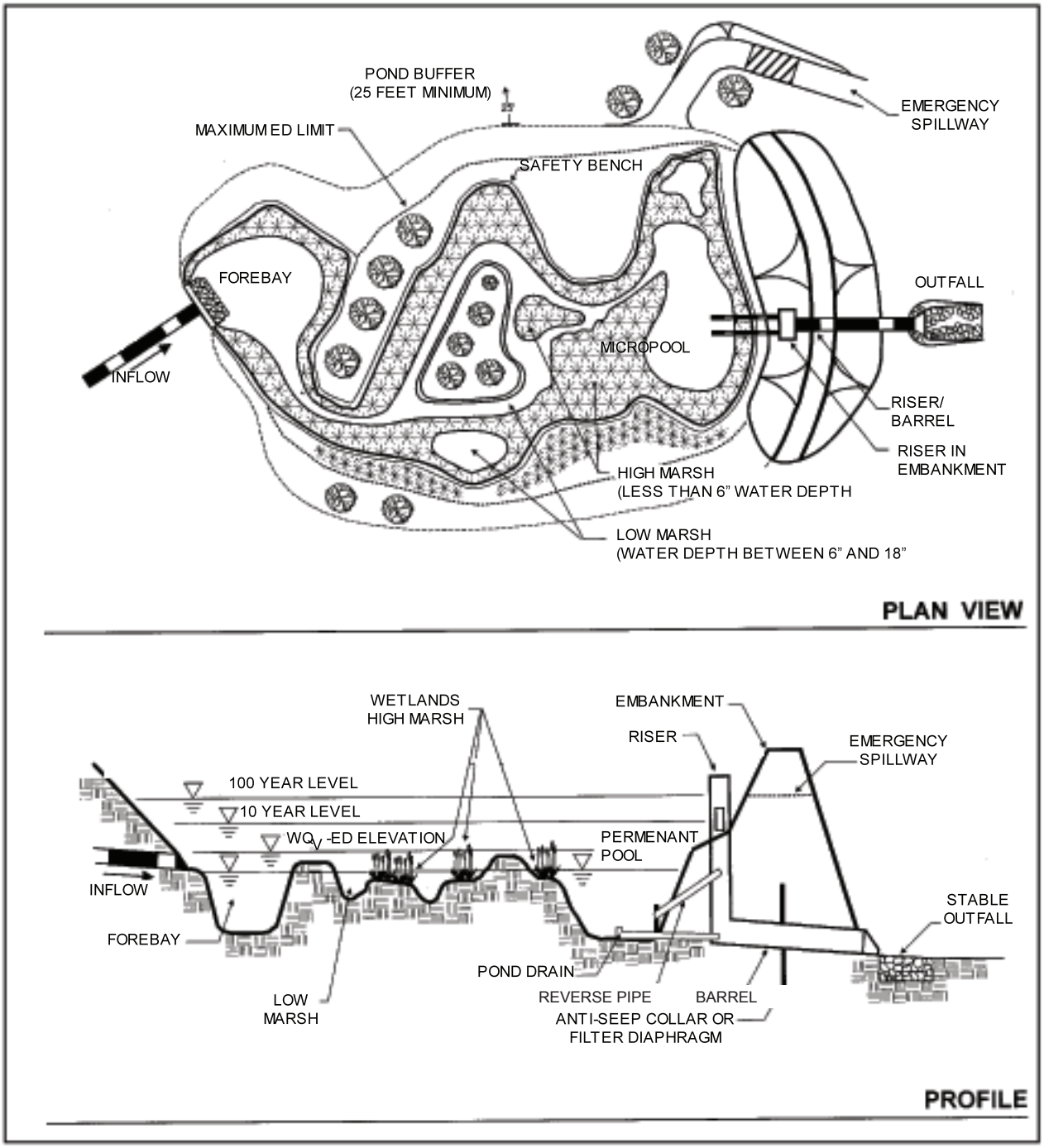
_____



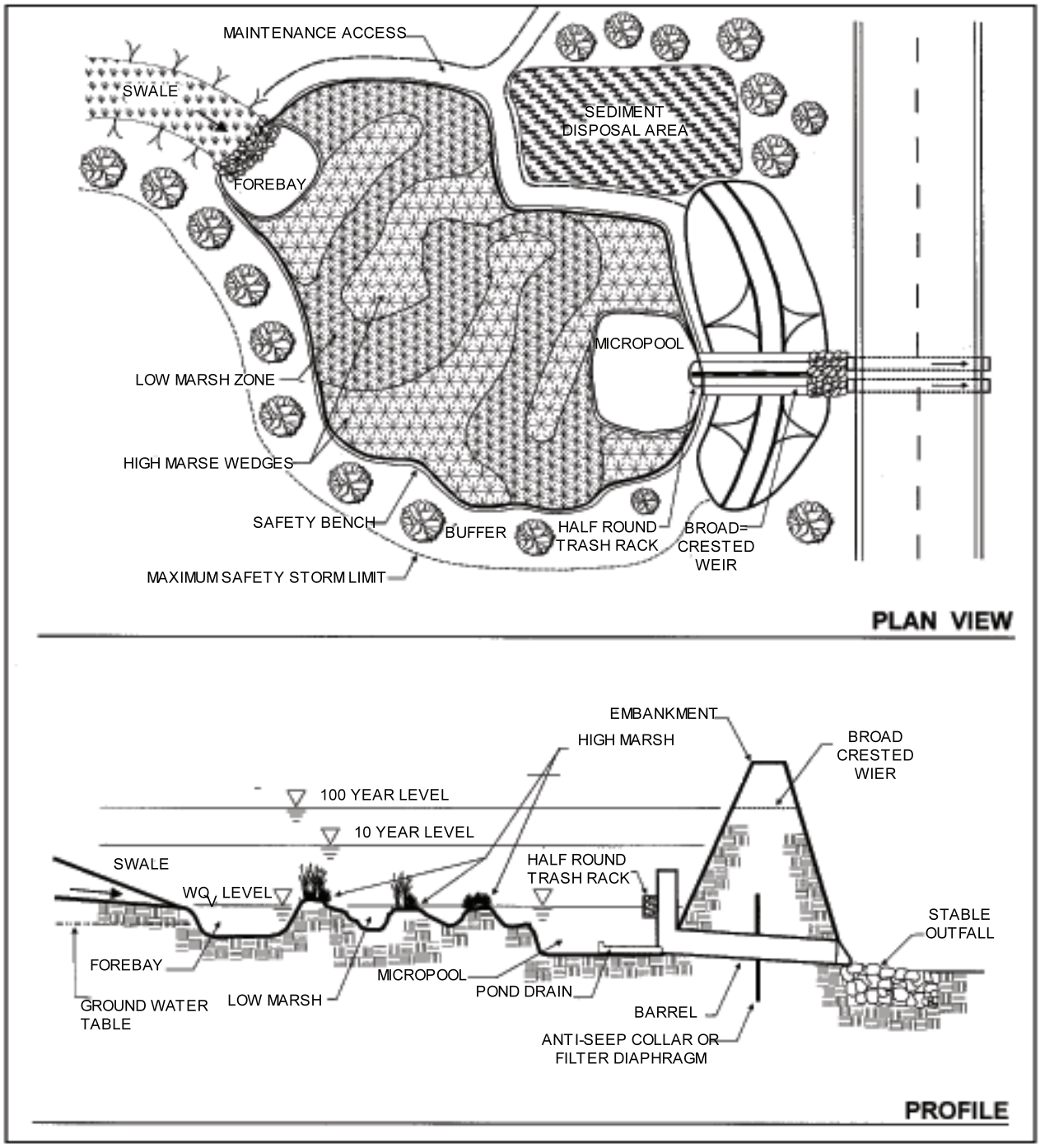
Schematic of Shallow Wetland
(Source: Center for Watershed Protection, modified)



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



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



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

C-3: BIORETENTION

QUICK REFERENCE

Description: Shallow stormwater basins or landscaped areas that utilize engineered soils and vegetation to capture and treat runoff.

Site Feasibility:

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

Design Criteria: Consists of grass filter strip, ponding area, organic/mulch layer, planting soil, vegetation, and possibly a sand bed
Typically requires 5 feet of head

Advantages:
High pollutant removal
Often located in landscaping islands of parking lots
Good retrofit capability for redevelopment
Aesthetic qualities

Disadvantages:
Requires extensive landscaping
Not acceptable for site slopes greater than 6%
Generally requires an underdrain system
Clogging may be a problem in areas with high sediment loads

Maintenance: Inspect and repair/replace treatment area components

C-3: BIORETENTION

GENERAL

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

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

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

Bioretention Components:

- Stone diaphragm at the beginning of the grass filter strip - to reduce runoff velocities and spread flow into the grass filter strip.
- Grass filter strip – further reduces incoming runoff velocity and filters particulates from runoff.
- Ponding area – provides temporary storage of stormwater 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 inches per hour.

C-3: BIORETENTION

DESIGN CRITERIA

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

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

2. Bioretention area geometry:
    a. The surface area of the bioretention area should be approximately 5% of the tributary impervious area and a minimum of 200 square feet 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 feet per second.
    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 feet per day. The planting soil bed must be at least 4 feet in depth.

$$A_f = \frac{WQ_v\,(d_f)}{K\,(h_f+d_f)\,(t_f)}$$

where:
A_f = surface area of ponding area (square feet, ft^2)
WQ_v = water quality volume (cubic feet, ft^3)
d_f = filter bed depth (4 feet minimum)
k = coefficient of permeability of filter media (feet per day, ft/day, use 0.5 ft/day for silt-loam)
h_f = average height of water above filter bed (feet, 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 6 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 square feet of surface area. A visible floating marker shall be provided to indicate the water level. The ends of the underdrain pipes must be capped. The underdrain pipe must discharge to an appropriate facility.
f. Compaction during construction must be minimized at both the base of the bioretention area and for the backfill materials. Use of equipment causing excessive compaction will result in reduced infiltration rates contributing to failure of the system and is not acceptable. Do not use heavy equipment within the bioretention basin.

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

$$Q = CLH^{3/2}$$

where:
Q = peak flow (cubic feet per second, cfs)
C = 2.65 for a smooth crested grass weir
L = length (feet, ft)
H = 0.5 feet 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 stormwater drainage easement in accordance with Chapter 4, Part 4.5.

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.

C-3: BIORETENTION

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 5 years from the approval date of the stormwater Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the City of Beech Grove Department of Public Works, upon request.

Project Name/Site Location:_____

Owner Name:_____ Phone:_____

Owner Address:_____

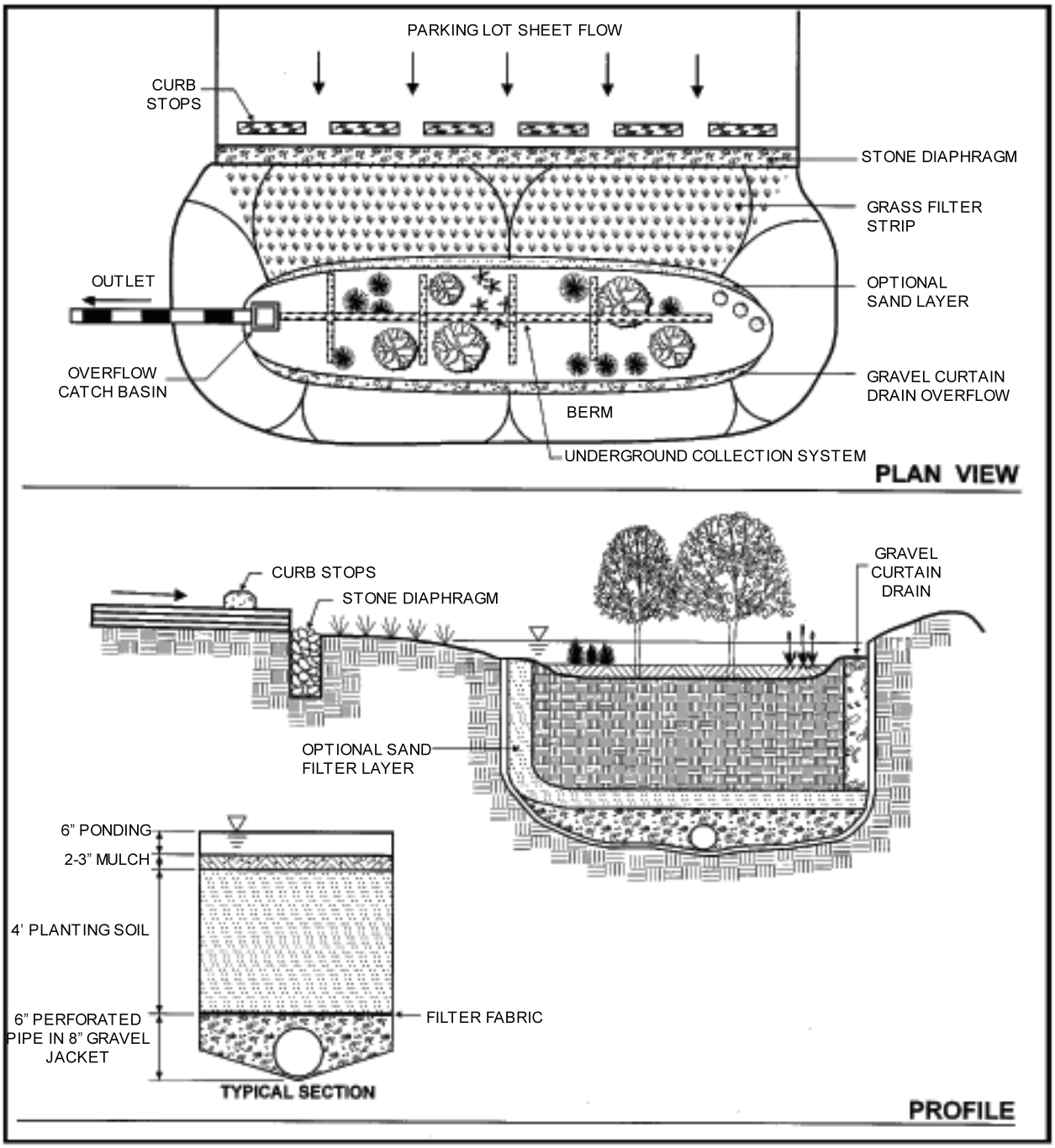
Date:_____ Inspector:_____

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?		

Additional Comments:

Recommended Actions:

Recommended Timeframe for Actions:



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

C-4: WATER QUALITY SWALE

QUICK REFERENCE

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

Site Feasibility:

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

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

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

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

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

C-4: WATER QUALITY SWALE

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 stormwater 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.

C-4: WATER QUALITY SWALE

DESIGN CRITERIA

The following criteria are minimum standards for the design of a water quality swale, which is acceptable for stormwater 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 cubic feet per second and runoff velocities are limited to 2.5 feet per second.

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 area.
    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. For the collection of sediment and floatable debris, all water quality swales shall include a BMP or sediment forebay that consists of a separate cell, formed by an acceptable barrier. See C-1: Detention/Retention Facilities for design criteria for a forebay/BMP.
    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 stormwater drainage easement in accordance with Chapter 4, Part 4.5.

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.

C-4: WATER QUALITY SWALE

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 5 years from the approval date of the Stormwater Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the City of Beech Grove Department of Public Works, upon request.

Project Name/Site Location:_____

Owner Name:_____ Phone:_____

Owner Address:_____

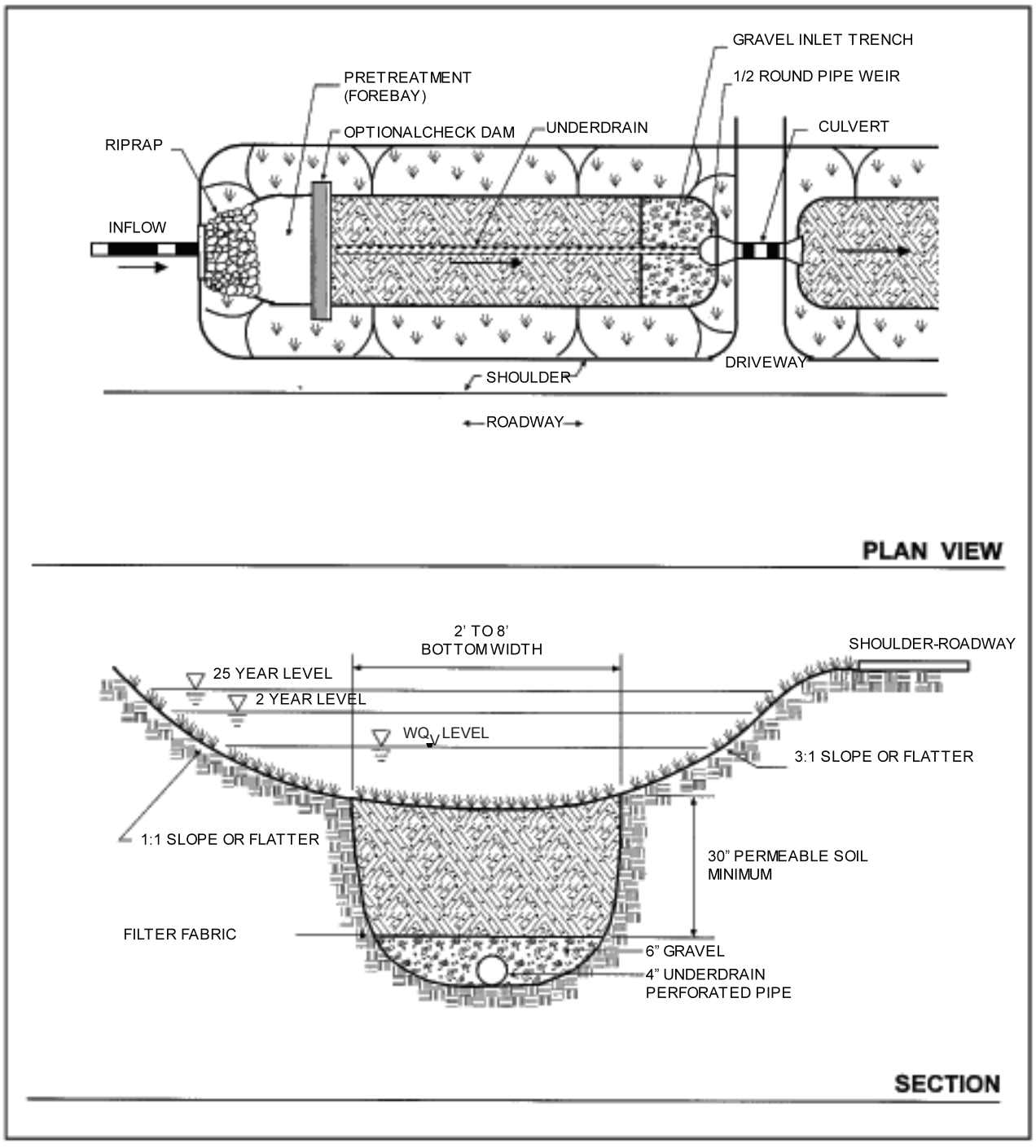
Date:_____ Inspector:_____

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?		

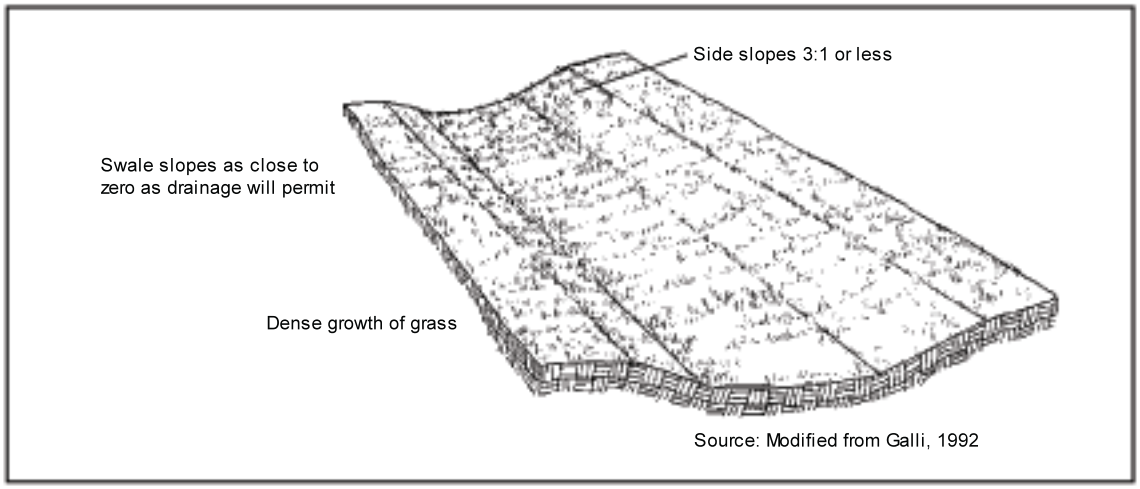
Additional Comments:

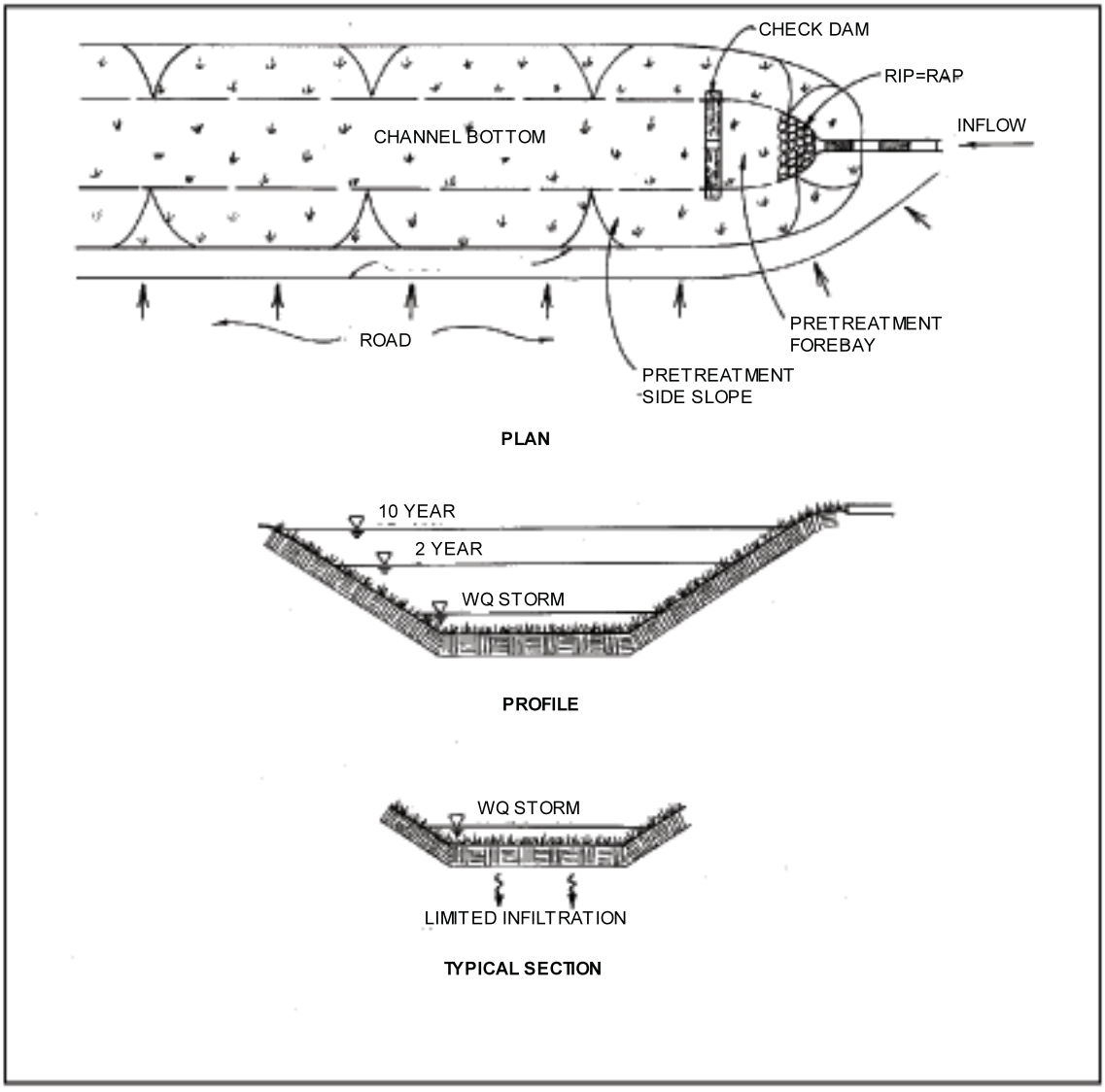
Recommended Actions:

Recommended Timeframe for Actions:



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





Schematic of Grass Channel

C-5: 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 stormwater 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

C-5: SAND FILTERS

GENERAL

Description: Sand filters are structural stormwater controls that capture and temporarily store stormwater 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. Stormwater pollutants are removed through a combination of gravitational settling, filtration and adsorption. Surface sand filters with a grass cover have additional opportunities for bacterial decomposition as well as vegetation uptake of pollutants, particularly nutrients. Sand filter systems are designed for intermittent flow and must be allowed to drain and reaerate between rainfall events. They should not be used on sites with a continuous flow from groundwater, sump pumps, or other sources.

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

Variations:

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

C-5: SAND FILTERS

DESIGN CRITERIA

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

Surface Sand Filter Criteria

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

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

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

$$A_f = \frac{WQ_v\,(d_f)}{K\,(h_f+d_f)\,(t_f)}$$

where:
A_f = surface area of filter bed (square feet, ft^2)
WQ_v= water quality volume (cubic feet, ft^3)
d_f = filter bed depth (1.5 feet minimum)
k = coefficient of permeability of filter media (feet per day, ft/day, use 3.5 ft/day for sand)
h_f = average height of water above filter bed (feet, ft)
t_f = design filter bed drain time (days, 1.5 days maximum)

4. Pretreatment:
    a. For the collection of sediment and floatable debris, all surface sand filter system shall include a BMP or sediment forebay that consists of a separate cell, formed by an acceptable barrier. The forebay/BMP 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/BMP 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 feet per 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 stormwater drainage easement in accordance with Chapter 4, Part 4.5.

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.

C-5: 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 years from the approval date of the Stormwater Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the City of Beech Grove Department of Public Works, 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.?		
2. Are inlet grates in good condition?		
3. Is overflow structure operating properly?		
4. Other problems evident?		

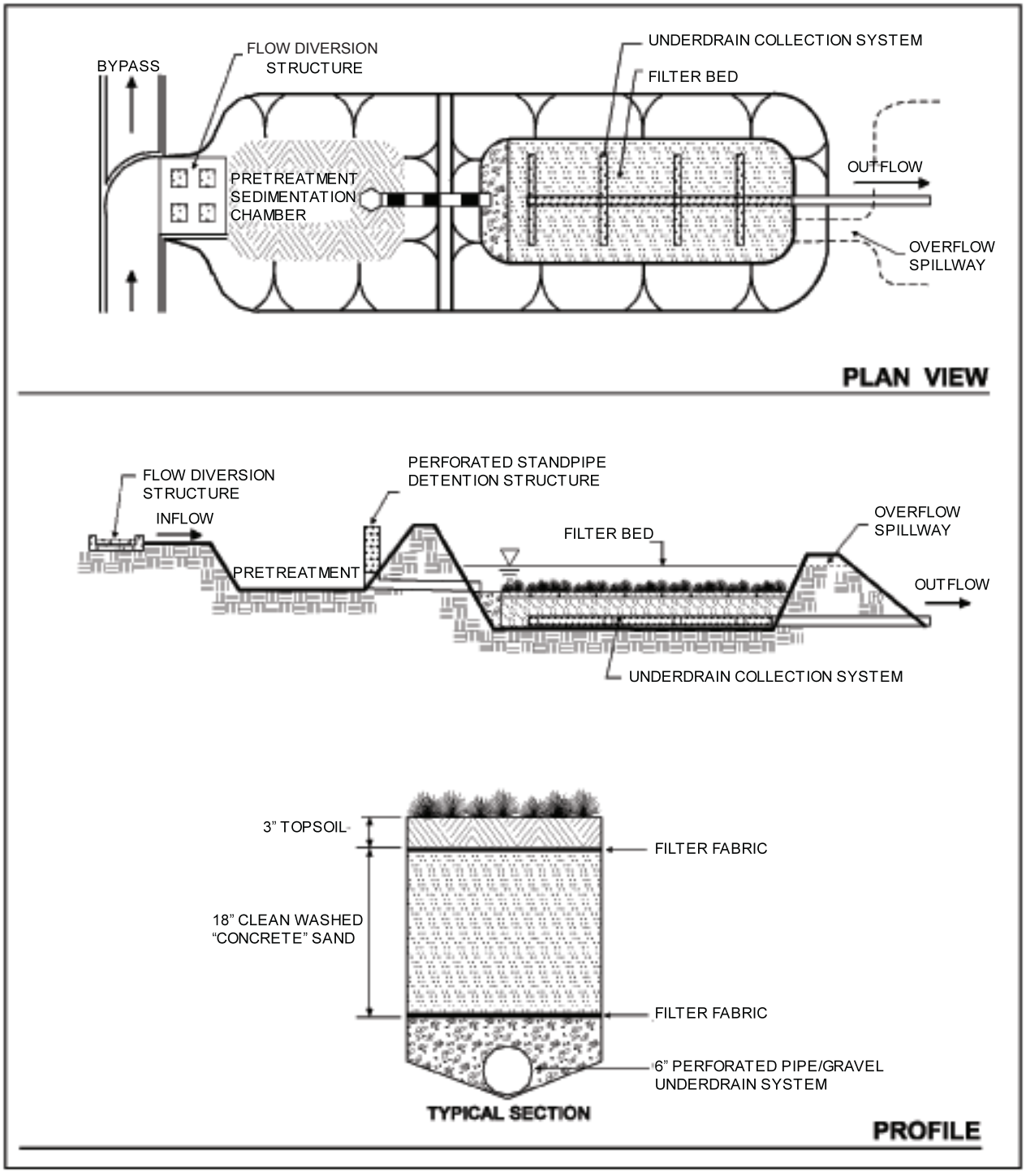
C-5: SAND FILTERS

MAINTENANCE ITEM	YES/NO	COMMENTS
Other		**Inspect Monthly**
1. Any odors?		
2. Any evidence of flow bypassing the facility?		

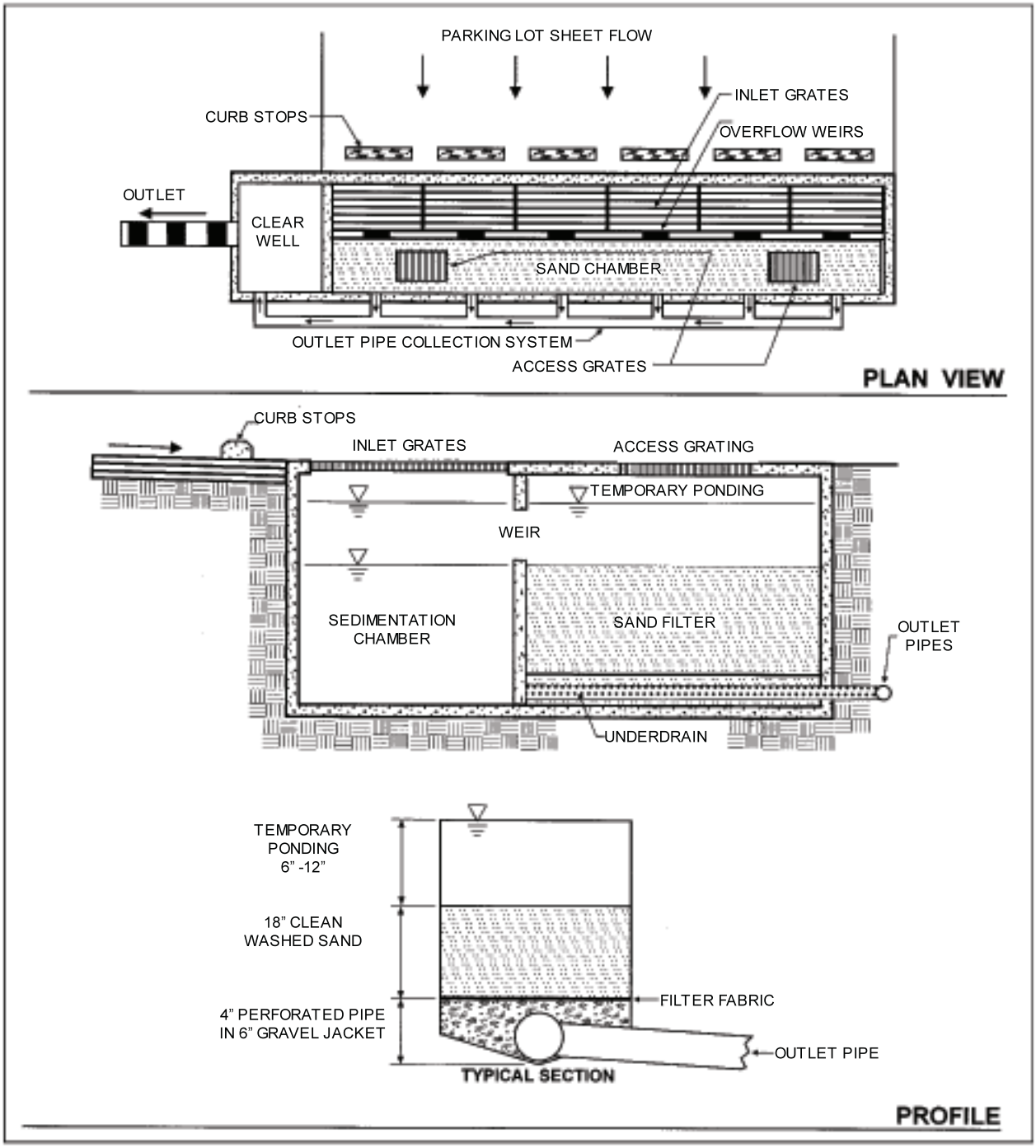
Additional Comments:_____

Recommended Actions:_____

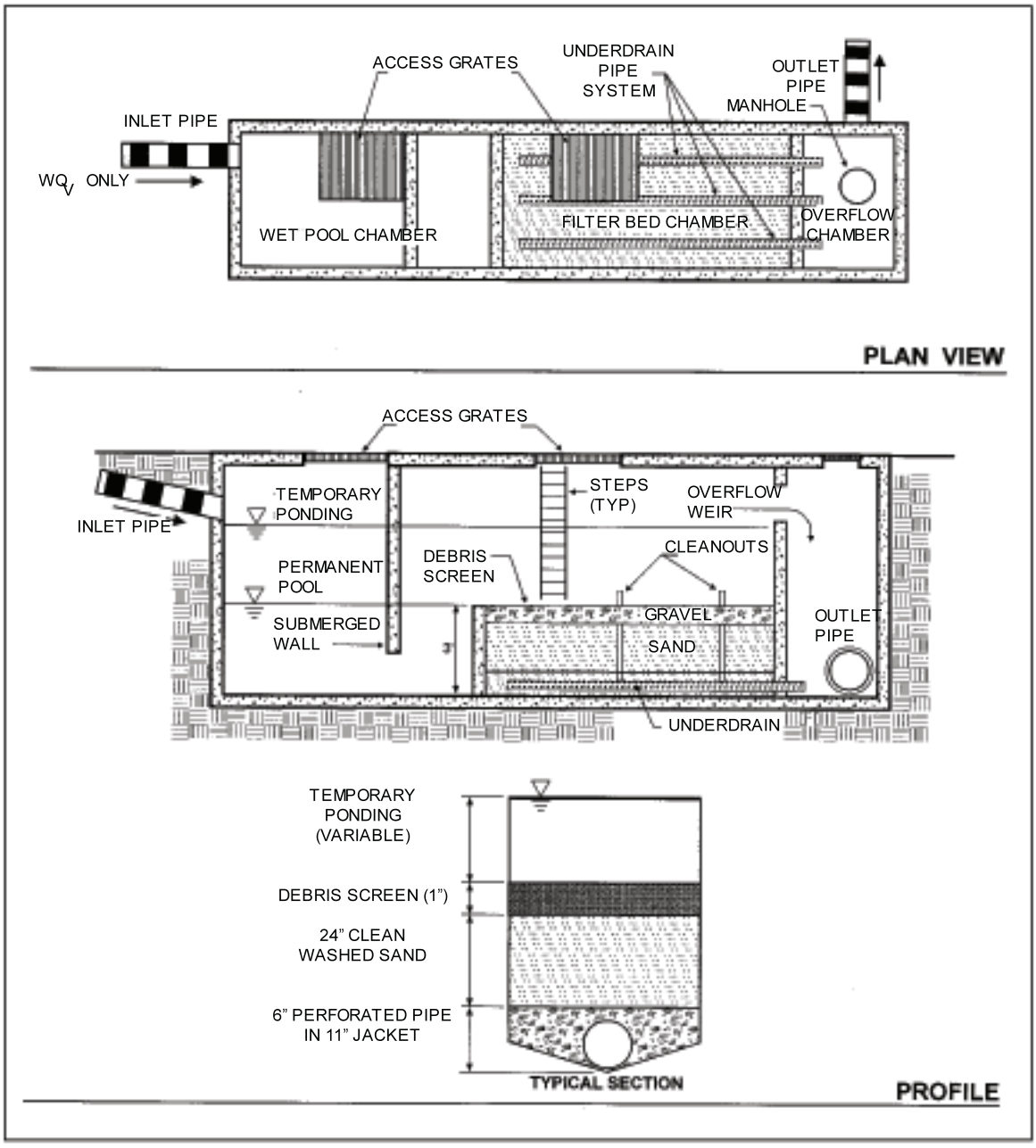
Recommended Timeframe for Actions:_____



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



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



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

C-6: INFILTRATION TRENCHES

QUICK REFERENCE

Description: Excavated trench filled with stone aggregate used to capture and allow infiltration of stormwater 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

C-6: INFILTRATION TRENCHES

GENERAL

Description: Infiltration trenches are excavations filled with stone to create an underground reservoir of stormwater 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.

C-6: INFILTRATION TRENCHES

DESIGN CRITERIA

The following criteria are minimum standards for the design of an infiltration trench, which is designed for stormwater 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 square feet, 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 a lawn or open area. Infiltration trenches shall not be located beneath paved surfaces.

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

7. Infiltration trench geometry:
    a. The required trench storage volume is equal to the WQ_v.
    b. The trench must be designed to fully dewater the WQ_v within 24 to 48 hours. The slowest infiltration rate obtained from geotechnical tests performed at the site should be used in the design calculations.
    c. Trench depths should be 3 to 8 feet. The width of the trench must be less than 25 feet.
    d. Broader, shallow trenches reduce the risk of clogging by spreading the flow over a larger area for infiltration.
    e. The surface area is calculated based on the trench depth, soil infiltration rate, aggregate void space, and fill time (assume a fill time of 2 hours for most designs).
    f. The bottom of a trench shall be flat across its length and width to evenly distribute flow, encourage uniform infiltration through the bottom, and reduce the risk of clogging.
    g. Stone aggregate should be washed, bank-run gravel, 1.5 to 2.5 inches in diameter with a void space of about 40%. Aggregate contaminated with soil shall not be used. A

porosity value (void space/total volume) of 0.32 should be used in calculations, unless aggregate specific data exist.

h. A 6-inch layer of clean, washed sand is placed on the bottom of the trench to encourage drainage and prevent compaction of the native soil while the stone aggregate is added.
i. The trench shall be lined on the sides and top by an appropriate geotextile filter fabric that prevents soil piping but has greater permeability than the parent soil. The top layer of filter fabric is placed 2 to 6 inches from the top of the trench to prevent sediment from passing into the stone aggregate. This top layer will need to be replaced more frequently and must be readily separated from the side section.
j. The top surface of the trench above the filter fabric is covered with pea gravel to improve sediment filtering. It shall be removed and replaced should the device clog. Alternatively, the trench can be covered with permeable topsoil and planted with grass in a landscaped area.
k. An observation well consisting of 4 to 6-inch perforated PVC pipe must be installed and extend to the bottom of the trench. The well should be installed along the centerline of the structure, flush with the ground elevation of the trench. A visible floating marker shall be provided to indicate the water level.
l. The trench excavation shall be limited to the width and depth specified in the design. The bottom of the excavated trench shall not be loaded in a way that causes soil compaction and shall be scarified prior to placement of sand. The sides of the trench shall be trimmed of all large roots.

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

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

10. Infiltration trenches must be constructed within an easement either platted or legally described and recorded as a perpetual stormwater drainage easement in accordance with Chapter 4, Part 4.5.

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.

C-6: INFILTRATION TRENCHES

MAINTENANCE AND INSPECTION CHECKLIST

Regular inspection and maintenance is critical to the effective operation of infiltration trenches. The following inspection checklist, to be completed at periods indicated, is provided for the BMP owner and should be retained as a record by the owner for a period of 5 years from the approval date of the Stormwater Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the City of Beech Grove Department of Public Works, upon request.

Project Name/Site Location:_____

Owner Name:_____ Phone:_____

Owner Address:_____

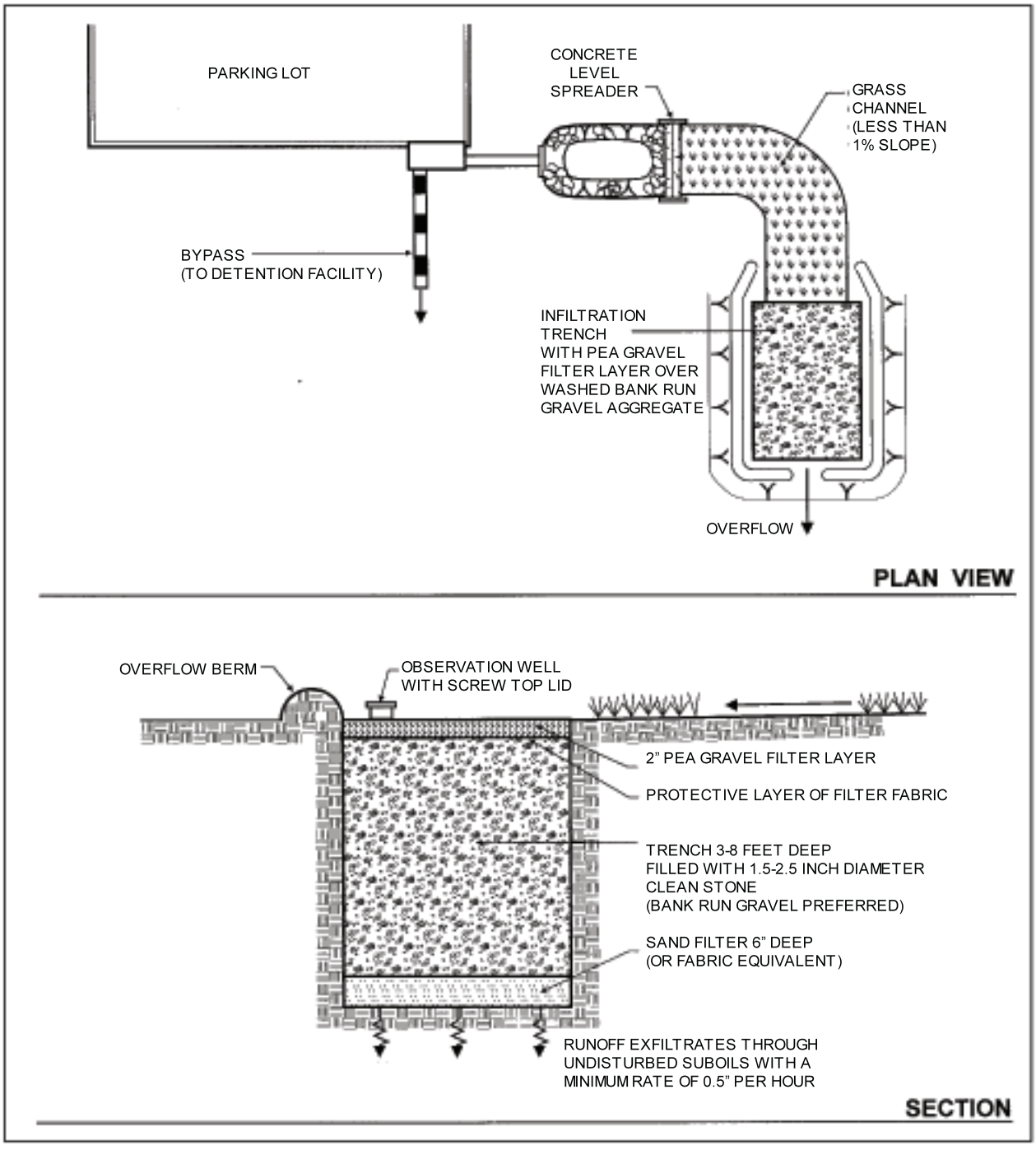
Date:_____ Inspector:_____

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.		

Additional Comments:

Recommended Actions:

Recommended Timeframe for Actions:



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

C-7: BIOFILTERS

QUICK REFERENCE

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

Site Feasibility:

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

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

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

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

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

C-7: 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.

C-7: BIOFILTERS

DESIGN CRITERIA

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

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

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

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

4. Filter strip geometry:
   The filter strip should be designed based on Manning's equation for channel design using the following criteria:
    a. Rectangular shape for the filter strip
    b. Maximum design flow depth of 0.5 inches
    c. Velocity no greater than 0.9 feet per second 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 stormwater drainage easement in accordance with Chapter 4, Part 4.5.

C-7: 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 5 years from the approval date of the Stormwater Pollution Prevention Plan. Evidence of inspection and maintenance shall be provided to the City of Beech Grove Department of Public Works, upon request.

Project Name/Site Location:_____

Owner Name:_____ Phone:_____

Owner Address:_____

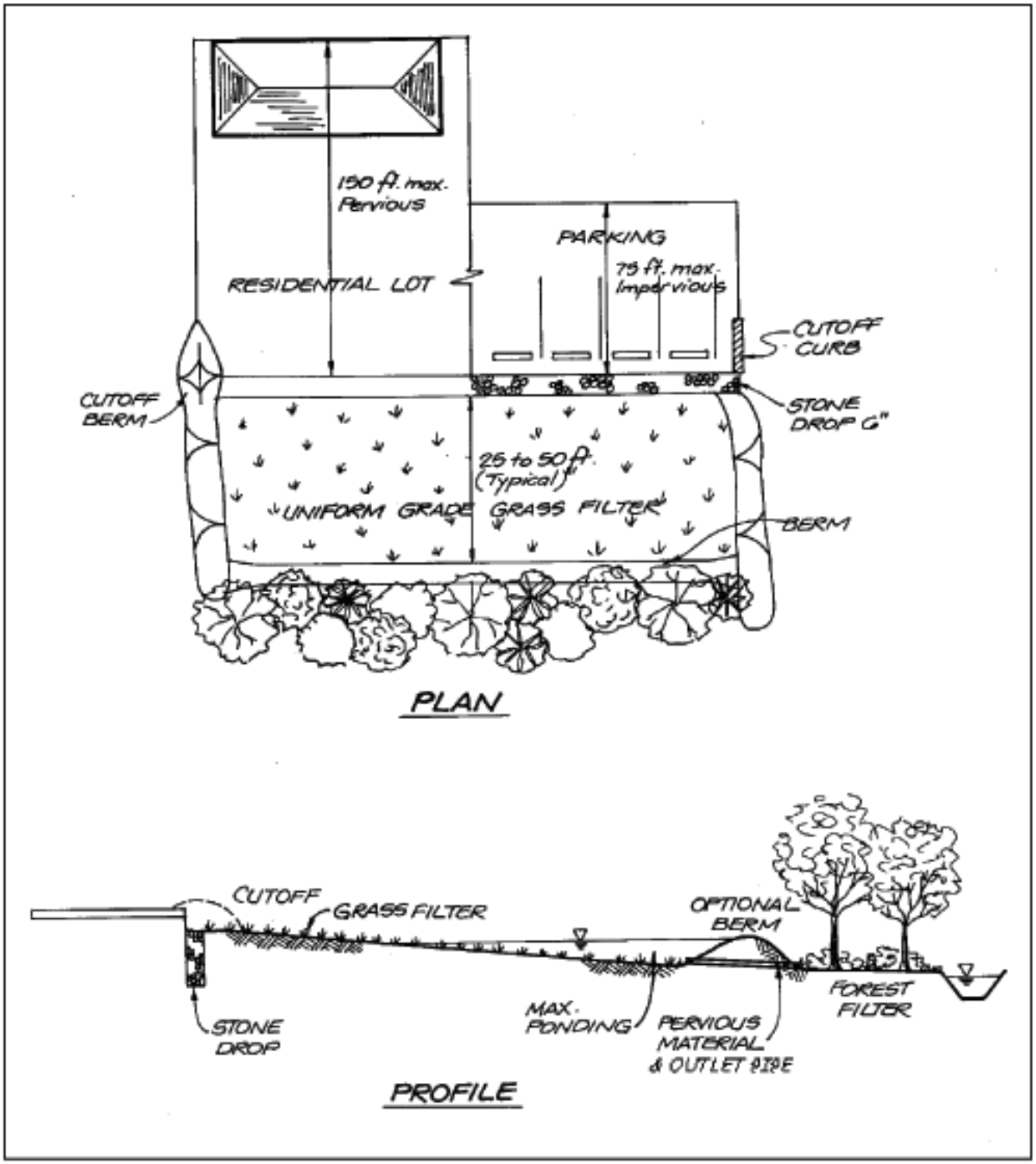
Date:_____ Inspector:_____

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

Additional Comments:

Recommended Actions:

Recommended Timeframe for Actions:



Schematic of Filter Strip (with Berm)