

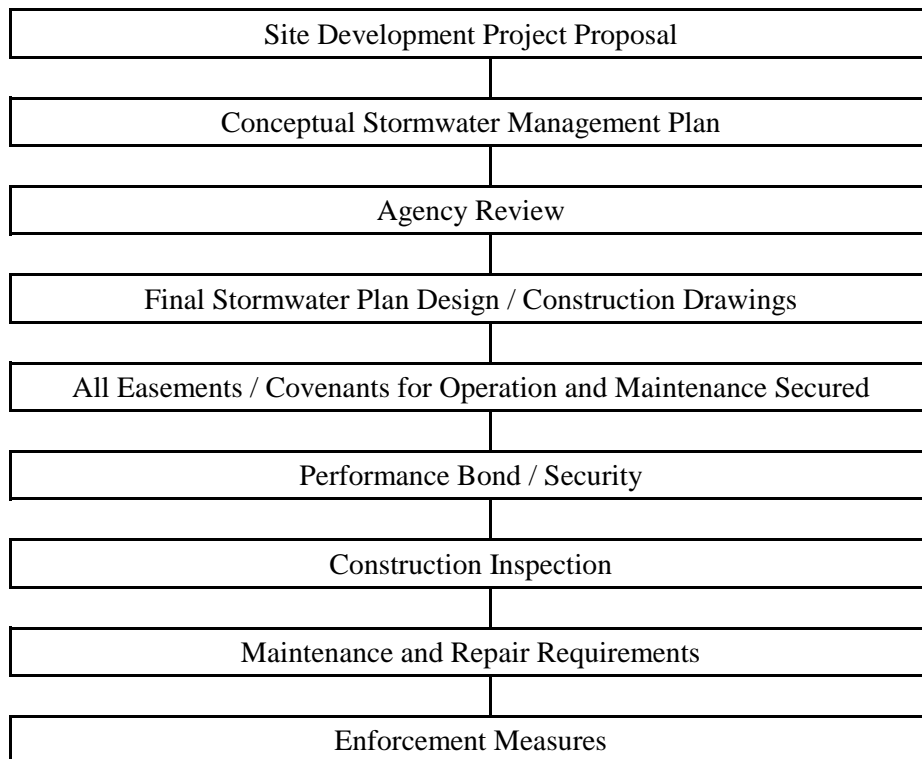
Introduction to the Model Post Construction Stormwater Runoff Control Ordinance

This model ordinance is intended to be a tool for communities who are currently or may soon be responsible for meeting the stormwater management requirements of the National Pollutant Discharge Elimination System (NPDES) regulations. The goal of providing this model ordinance is to assist communities in creating their own stormwater management ordinance. In designing a model stormwater ordinance for a national audience, we purposely avoided creating too complex an ordinance, and instead tried to include suggestions for standard language and concepts that we believe a good stormwater management ordinance should contain. This ordinance should not be construed as an exhaustive listing of all the language needed for a local ordinance, but represents a good base that communities can build upon and customize to be consistent with the staff resources available in their locality. We recommend that you use this document in conjunction with other sources, such as existing ordinances created by other stormwater management programs in your geographic region that have objectives similar to your program's.

Feel free to download and alter any and all portions of this document to meet your needs. Throughout the ordinance, there are sections in which you must insert the name of the agency that you have given regulatory power over stormwater management issues in order to customize it. These sections are denoted by text placed in brackets - (. By using this ordinance and customizing these sections, you can create a viable local ordinance with minimal editing.

Italicized text with this symbol 5 should be interpreted as comments, instructions, or information to assist the ordinance writer. This text *should not appear* in your final ordinance.

Flow Chart Illustrating the Stormwater Permit Review Process



Model Ordinance for the Control of Post Construction Stormwater Runoff

Table of Contents

- Section 1. General Provisions
- Section 2. Definitions
- Section 3. Permit Procedures and Requirements
- Section 4. Waivers
- Section 5. General Performance Criteria for Stormwater Management
- Section 6. Specific Performance Criteria for Stormwater Treatment Practices
- Section 7. Requirements for Stormwater Management Plan Approval
- Section 8. Construction Inspection Provisions
- Section 9. Maintenance and Repair Requirements
- Section 10. Enforcement and Violations

Section 1. General Provisions

1.1. Findings of Fact

It is hereby determined that:

Land development projects and associated increases in impervious cover alter the hydrologic response of local watersheds and increase stormwater runoff rates and volumes, flooding, stream channel erosion, and sediment transport and deposition;

This stormwater runoff contributes to increased quantities of water-borne pollutants, and;

Stormwater runoff, soil erosion and nonpoint source pollution can be controlled and minimized through the regulation of stormwater runoff from development sites.

Therefore, the _____ (jurisdictional stormwater authority) establishes this set of water quality and quantity policies applicable to all surface waters to provide reasonable guidance for the regulation of stormwater runoff for the purpose of protecting local water resources from degradation. It is determined that the regulation of stormwater runoff discharges from land development projects and other construction activities in order to control and minimize increases in stormwater runoff rates and volumes, soil erosion, stream channel erosion, and nonpoint source pollution associated with stormwater runoff is in the public interest and will prevent threats to public health and safety.

1.2. Purpose

The purpose of this ordinance is to establish minimum stormwater management requirements and controls to protect and safeguard the general health, safety, and welfare of the public residing in watersheds within this jurisdiction. This ordinance seeks to meet that purpose through the following objectives:

- (1). minimize increases in stormwater runoff from any development in order to reduce flooding, siltation and streambank erosion and maintain the integrity of stream channels;
- (2). minimize increases in nonpoint source pollution caused by stormwater runoff from development which would otherwise degrade local water quality
- (3). minimize the total annual volume of surface water runoff which flows from any specific site during and following development to not exceed the pre-development hydrologic regime to the maximum extent practicable.
- (4). reduce stormwater runoff rates and volumes, soil erosion and nonpoint source pollution, wherever possible, through stormwater management controls and to ensure that these management controls are properly maintained and pose no threat to public safety.

5 The above list is a general set of objectives to reduce the impact of stormwater on receiving waters. The local stormwater authority may wish to set some more specific objectives, based on priority water quality and habitat problems.

1.3. Applicability

This ordinance shall be applicable to all major subdivision or site plan applications, unless eligible for an exemption or granted a waiver by the _____ (jurisdictional stormwater authority) under the specifications of Section 4 of this ordinance. The ordinance also applies to land development activities that are smaller than the minimum applicability criteria if such activities are part of a larger common plan of development that meets the following applicability criteria, even though multiple separate and distinct land development activities may take place at different times on different schedules. In addition, all plans must also be reviewed by local environmental protection officials to ensure that established water quality standards will be maintained during and after development of the site and that post construction runoff levels are consistent with any local and regional watershed plans.

5 The size of the site development to which post-construction stormwater management runoff control applies varies but many communities opt for a size limit of 5000 square feet or more. For sites less than 5000 square feet, local officials may wish to grant an exemption as long as the amount of impervious cover created does not exceed 1000 square feet.

To prevent the adverse impacts of stormwater runoff, the _____ (jurisdictional stormwater authority) has developed a set of performance standards that must be met at new development sites. These standards apply to any construction activity disturbing _____ or more square feet of land. The following activities may be exempt from these stormwater performance criteria:

1. Any logging and agricultural activity which is consistent with an approved soil conservation plan or a timber management plan prepared or approved by the _____ (agency), as applicable.
2. Additions or modifications to existing single family structures
3. Developments that do not disturb more than _____ square feet of land, provided they are not part of a larger common development plan;
4. Repairs to any stormwater treatment practice deemed necessary by the _____ (jurisdictional stormwater authority).

When a site development plan is submitted that qualifies as a redevelopment project as defined in Section 2 of this ordinance, decisions on permitting and on-site stormwater requirements shall be governed by special stormwater sizing criteria found in the current stormwater design manual. This criteria is dependent on the amount of impervious area created by the redevelopment and its impact on water quality. Final authorization of all redevelopment projects will be determined after a review by the _____ (jurisdictional stormwater authority).

5 There are a number of decisions to be made by local communities when addressing the issue of redevelopment and stormwater treatment. The first is defining exactly what qualifies as redevelopment. The definition in Section 2 is from the current Maryland Stormwater Management regulations, and uses the square foot size of the project and its land use classification to establish the definition of a redevelopment project. The second decision involves to what level of stormwater management standards redevelopment projects will be held. Providing cost effective stormwater treatment at redevelopment sites is often a difficult task, and these projects may be given reduced criteria to meet to allow for site constraints. The State of Maryland currently requires that proposed redevelopment project designs include either at least a 20 percent reduction in existing site impervious area, management of at least 20 % of the water quality volume, or some combination of both.

1.4. Compatibility with Other Permit and Ordinance Requirements

This ordinance is not intended to interfere with, abrogate, or annul any other ordinance, rule or regulation, statute, or other provision of law. The requirements of this ordinance should be considered minimum requirements, and where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, 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.

1.5. Severability

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

1.6. Development of a Stormwater Design Manual

The _____ (jurisdictional stormwater authority) may furnish additional policy, criteria and information including specifications and standards, for the proper implementation of the requirements of this ordinance and may provide such information in the form of a Stormwater Design Manual.

This manual will include a list of acceptable stormwater treatment practices, including the specific design criteria for each stormwater practice. The manual may be updated and expanded from time to time, at the discretion of the local review authority, based on improvements in engineering, science, monitoring and local maintenance experience. Stormwater treatment practices that are designed and constructed in accordance with these design and sizing criteria will be presumed to meet the minimum water quality performance standards.

5 *Local communities will need to select the minimum water quality performance standards (e.g., 80% TSS, 40% P) they will require for stormwater treatment practices and place these in their design manual. The 80% removal goal for total suspended solids (TSS) is a management measure developed by EPA as part of the Coastal Zone Act Reauthorization Amendments of 1990. It was selected by EPA for the following factors: (1) removal of 80% is assumed to control heavy metals, phosphorus, and other pollutants; (2) a number of states including DE, FL, TX, MD, and MA require/recommend TSS removal of 80% or greater for new development; and (3) data show that certain structural controls, when properly designed and maintained, can meet this performance level. Further discussion of water quality standards for stormwater management measures can be found in the CZARA Coastal Zone 6217(g) management measures document entitled "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters" (US EPA, 1993).*

5 *There are a number of good stormwater design manuals available around the country that communities may wish to refer to in creating their own local manual. One such manual is the new Maryland Department of the Environment 2000 Maryland Stormwater Design Manual Volumes I & II. This manual contains innovative criteria for stormwater management, and is available online at www.mde.state.md.us/environment/wma/stormwatermanual/mdswmanual.*

5 *Local communities may also wish to consult a new resource available on the Internet called the **Stormwater Managers Resource Center (SMRC)**. This site is dedicated to providing information to stormwater management program managers in Phase II communities to assist in meeting the requirements of the new National Pollutant Discharge Elimination System Phase II regulations. Among the resources available at the website will be a section devoted to supplying guidance on how to build a stormwater manual, including sizing and design criteria. The SMRC website and the manual-builder resources are located at www.stormwatercenter.net.*

Section 2. Definitions

"Accelerated Erosion" means erosion caused by development activities that exceeds the natural processes by which the surface of the land is worn away by the action of water, wind, or chemical action.

"Applicant" means a property owner or agent of a property owner who has filed an application for a stormwater management permit.

"Building" means any structure, either temporary or permanent, having walls and a roof, designed for the shelter of any person, animal, or property, and occupying more than 100 square feet of area.

"Channel" means a natural or artificial watercourse with a definite bed and banks that conducts continuously or periodically flowing water.

"Dedication" means the deliberate appropriation of property by its owner for general public use.

"Detention" means the temporary storage of storm runoff in a stormwater management practice with the goals of controlling peak discharge rates and providing gravity settling of pollutants.

"Detention Facility" means a detention basin or alternative structure designed for the purpose of temporary storage of stream flow or surface runoff and gradual release of stored water at controlled rates.

"Developer" means a person who undertakes land disturbance activities.

"Drainage Easement" means a legal right granted by a landowner to a grantee allowing the use of private land for stormwater management purposes.

"Erosion and Sediment Control Plan" means a plan that is designed to minimize the accelerated erosion and sediment runoff at a site during construction activities.

"Fee in Lieu" means a payment of money in place of meeting all or part of the storm water performance standards required by this ordinance.

“**Hotspot**” means an area where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater.

“**Hydrologic Soil Group (HSG)**” means a Natural Resource Conservation Service classification system in which soils are categorized into four runoff potential groups. The groups range from A soils, with high permeability and little runoff production, to D soils, which have low permeability rates and produce much more runoff.

“**Impervious Cover**” means those surfaces that cannot effectively infiltrate rainfall (e.g., building rooftops, pavement, sidewalks, driveways, etc).

“**Industrial Stormwater Permit**” means an National Pollutant Discharge Elimination System permit issued to a commercial industry or group of industries which regulates the pollutant levels associated with industrial stormwater discharges or specifies on-site pollution control strategies.

“**Infiltration**” means the process of percolating stormwater into the subsoil.

“**Infiltration Facility**” means any structure or device designed to infiltrate retained water to the subsurface. These facilities may be above grade or below grade.

“**Jurisdictional Wetland**” means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

“**Land Disturbance Activity**” means any activity which changes the volume or peak flow discharge rate of rainfall runoff from the land surface. This may include the grading, digging, cutting, scraping, or excavating of soil, placement of fill materials, paving, construction, substantial removal of vegetation,, or any activity which bares soil or rock or involves the diversion or piping of any natural or man-made watercourse.

“**Landowner**” means the legal or beneficial owner of land, including those holding the right to purchase or lease the land, or any other person holding proprietary rights in the land.

“**Maintenance Agreement**” means a legally recorded document that acts as a property deed restriction, and which provides for long-term maintenance of storm water management practices.

“**Nonpoint Source Pollution**” means pollution from any source other than from any discernible, confined, and discrete conveyances, and shall include, but not be limited to, pollutants from agricultural, silvicultural, mining, construction, subsurface disposal and urban runoff sources.

“**Offset Fee**” means a monetary compensation paid to a local government for failure to meet pollutant load reduction targets.

“**Off-Site Facility**” means a stormwater management measure located outside the subject property boundary described in the permit application for land development activity.

“**On-Site Facility**” means a stormwater management measure located within the subject property boundary described in the permit application for land development activity.

“**Recharge**” means the replenishment of underground water reserves.

“**Redevelopment**” means any construction, alteration or improvement exceeding ___ square feet in areas where existing land use is high density commercial, industrial, institutional or multi-family residential.

“**Stop Work Order**” means an order issued which requires that all construction activity on a site be stopped.

“**Storm Water Management**” means the use of structural or non-structural practices that are designed to reduce storm water runoff pollutant loads, discharge volumes, and/or peak flow discharge rates.

“**Storm Water Retrofit**” means a stormwater management practice designed for an existing development site that previously had either no stormwater management practice in place or a practice inadequate to meet the stormwater management requirements of the site.

“**Stormwater Runoff**” means flow on the surface of the ground, resulting from precipitation.

“**Stormwater Treatment Practices (STPs)**” means measures, either structural or nonstructural, that are determined to be the most effective, practical means of preventing or reducing point source or nonpoint source pollution inputs to stormwater runoff and water bodies.

“**Water Quality Volume (WQ_v)**” means the storage needed to capture and treat 90% of the average annual stormwater runoff volume. Numerically (WQ_v) will vary as a function of long term rainfall statistical data.

“**Watercourse**” means a permanent or intermittent stream or other body of water, either natural or man-made, which gathers or carries surface water.

Section 3. Permit Procedures and Requirements

3.1. Permit Required

No land owner or land operator shall receive any of the building, grading or other land development permits required for land disturbance activities without first meeting the requirements of this ordinance prior to commencing the proposed activity.

5 The intent is to ensure that no activities that disturb the land are issued permits prior to review and approval of the stormwater management plan. Communities may elect to issue a stormwater management permit separate of any other land development permits they require, or, as in this ordinance, to tie the issuing of construction permits to the approval of a final stormwater management plan.

3.2. Application Requirements

Unless specifically excluded by this ordinance, any land owner or operator desiring a permit for a land disturbance activity shall submit to the _____ (jurisdictional stormwater authority) a permit application on a form provided by the _____ (jurisdictional stormwater authority) for that purpose.

Unless otherwise excepted by this ordinance, a permit application must be accompanied by the following in order that the permit application be considered: a stormwater management concept plan; a maintenance agreement; and a non-refundable permit review fee.

The stormwater management plan shall be prepared to meet the requirements of Sec. 5 of this ordinance, the maintenance agreement shall be prepared to meet the requirements of Sec. _____ of this ordinance, and fees shall be those established by the _____ (jurisdictional stormwater authority).

3.3. Application Review Fees

The fee for review of any land development application shall be based on the amount of land to be disturbed at the site, and the fee structure shall be established by the _____ (jurisdictional stormwater authority). All of the monetary contributions shall be credited to an appropriate capital improvements program project, and shall be made prior to the issuance of any building permit for the development.

5 Local communities can use these review fees to raise funds for staff and resources to further their stormwater management programs.

3.4. Application Procedure

1. Applications for land disturbance activity permits must be filed with the _____ (appropriate review agency) on any regular business day.
2. A copy of this permit application shall be forwarded to _____ (jurisdictional stormwater authority) for review
3. Permit applications shall include the following: two copies of the stormwater management concept plan, two copies of the maintenance agreement, and any required review fees.
4. Within _____ business days of the receipt of a complete permit application, including all documents as required by this ordinance, the _____ (jurisdictional stormwater authority) shall inform the applicant whether the application, plan and maintenance agreement are approved or disapproved.

5 Local officials will need to decide the appropriate time frame for review of an application. This will often be determined by the staff available for permit review and for an inspection of sites undergoing construction.

1. If the permit application, stormwater management plan or maintenance agreement are disapproved, the applicant may revise the stormwater management plan or agreement. If additional information is submitted, the _____ (jurisdictional stormwater authority) shall have _____ business days from the date the additional information is received to inform the applicant that the plan and maintenance agreement are either approved or disapproved.
2. If the permit application, final stormwater management plan and maintenance agreement are approved by the _____

_____ (jurisdictional stormwater authority), all appropriate land disturbance activity permits shall be issued.

3.5. Permit Duration

Permits issued under this section shall be valid from the date of issuance through the date the _____ (jurisdictional stormwater authority) notifies the permitholder that all stormwater management practices have passed the final inspection required under permit condition.

Section 4. Waivers to Stormwater Management Requirements

4.1. Waivers for Providing Stormwater Management

Every applicant shall provide for stormwater management, unless they file a written request to waive this requirement. Requests to waive the stormwater management plan requirements shall be submitted to the _____ (jurisdictional stormwater authority) for approval.

The minimum requirements for stormwater management may be waived in whole or in part upon written request of the applicant, provided that at least one of the following conditions applies:

1. It can be demonstrated that the proposed development is not likely to impair attainment of the objectives of this ordinance.
2. Alternative minimum requirements for on-site management of stormwater discharges have been established in a stormwater management plan that has been approved by the _____ (jurisdictional stormwater authority) and that is required to be implemented by local ordinance.
3. Provisions are made to manage stormwater by an off-site facility. The off-site facility is required to be in place, to be designed and adequately sized to provide a level of stormwater control that is equal to or greater than that which would be afforded by on-site practices and has a legally obligated entity responsible for long-term operation and maintenance of the stormwater practice.
4. The _____ (jurisdictional stormwater authority) finds that meeting the minimum on-site management requirements is not feasible due to the natural or existing physical characteristics of a site.
5. Non-structural practices are provided that reduce the generation of stormwater from the site, the size and cost of stormwater storage and provide partial removal of many pollutants are to be used at the site. These non-structural practices are explained in detail in the current design manual and the amount of credit available for using such practices shall be determined by the _____ (jurisdictional stormwater authority)

In instances where one of the conditions above applies, the _____ (jurisdictional stormwater authority) may grant a waiver from strict compliance with stormwater management provisions that are not achievable, provided that acceptable mitigation measures are provided. However, to be eligible for a variance, the applicant must demonstrate to the satisfaction of the _____ (jurisdictional stormwater authority) that the immediately downstream waterways will not be subject to:

- Deterioration of existing culverts, bridges, dams, and other structures;
- Deterioration of biological functions or habitat;
- Accelerated streambank or streambed erosion or siltation;
- Increased threat of flood damage to public health, life and property.

Furthermore, where compliance with minimum requirements for stormwater management is waived, the applicant will satisfy the minimum requirements by meeting one of the mitigation measures selected by the jurisdictional stormwater authority. Mitigation measures may include, but are not limited to, the following:

- The purchase and donation of privately owned lands, or the grant of an easement to be dedicated for preservation and/or reforestation. These lands should be located adjacent to the stream corridor in order to provide permanent buffer areas to protect water quality and aquatic habitat,
- The creation of a stormwater management facility or other drainage improvements on previously developed properties, public or private, that currently lack stormwater management facilities designed and constructed in accordance with the purposes and standards of this ordinance,
- Monetary contributions (Fee-in-Lieu) to fund stormwater management related studies including regional wetland delineation studies, stream monitoring studies for water quality and macroinvertebrates, stream flow monitoring, and threatened and

endangered species studies.

4.2. Fee in Lieu of Stormwater Management Practices

Where the _____ (jurisdictional stormwater authority) waives all or part of the minimum stormwater management requirements, or where the waiver is based on the provision of adequate stormwater facilities provided downstream of the proposed development, the applicant shall be required to pay a fee in an amount as determined by the _____ (jurisdictional stormwater authority).

When an applicant obtains a waiver of the required stormwater management, the monetary contribution required shall be in accordance with a fee schedule (unless the developer and the stormwater authority agree on a greater alternate contribution) established by the _____ (jurisdictional stormwater authority), and based on the cubic feet of storage required for stormwater management of the development in question. All of the monetary contributions shall be credited to an appropriate capital improvements program project, and shall be made by the developer prior to the issuance of any building permit for the development.

4.3. Dedication of Land

In lieu of a monetary contribution, an applicant may obtain a waiver of the required stormwater management by entering into an agreement with the _____ (jurisdictional stormwater authority) for the granting of an easement or the dedication of land by the applicant, to be used for the construction of an off-site stormwater management facility. The agreement shall be entered into by the applicant and the _____ (jurisdictional stormwater authority) prior to the recording of plats or, if no record plat is required, prior to the issuance of the building permit.

Section 5. General Performance Criteria for Stormwater Management

Unless judged by the _____ (jurisdictional stormwater authority) to be exempt or granted a waiver, the following performance criteria shall be addressed for stormwater management at all sites:

- (A). All site designs shall establish stormwater management practices to control the peak flow rates of stormwater discharge associated with specified design storms and reduce the generation of stormwater. These practices should seek to utilize pervious areas for stormwater treatment and to infiltrate stormwater runoff from driveways, sidewalks, rooftops, parking lots, and landscaped areas to the maximum extent practical to provide treatment for both water quality and quantity.

5 There are several sources of climatological references that can be consulted to find the rainfall depths for the appropriate design storm intervals (1, 10, 25, and 100 year). The NOAA National Climatological Data Center has a "Summary of the Day" database that can provide rainfall numbers for most major cities and airports in the country. Another possible source is the Urban Hydrology for Small Watersheds, TR-55 (Technical Release 55) published by the Engineering Division, United States Natural Resource Conservation Service (formerly known as the Soil Conservation Service) United States Department of Agriculture, June 1986.

- (B). All stormwater runoff generated from new development shall not discharge untreated stormwater directly into a jurisdictional wetland or local water body without adequate treatment. Where such discharges are proposed, the impact of the proposal on wetland functional values shall be assessed using a method acceptable to the _____ (jurisdictional stormwater authority). In no case shall the impact on functional values be any less than allowed by the Army Corp of Engineers (ACE) or the _____ (Appropriate State Agency) responsible for natural resources.

- (C). Annual groundwater recharge rates shall be maintained, by promoting infiltration through the use of structural and non-structural methods. At a minimum, annual recharge from the post development site shall mimic the annual recharge from pre-development site conditions.

5 Recharge is a relatively new stormwater criteria, and has been implemented so far in the Massachusetts coastal zone and in Maryland. The recharge criteria requires considerable effort to use existing pervious areas for stormwater treatment and infiltration, which means that it must be considered very early in the site design process when basic decisions about layout and vegetative cover are made.

- (D). For new development, structural STPs shall be designed to remove ___% of the average annual post development total suspended

solids load (TSS). It is presumed that a STP complies with this performance standard if it is:

sized to capture the prescribed water quality volume (WQ_v),
designed according to the specific performance criteria outlined in the local stormwater design manual,
constructed properly, and
maintained regularly.

5 *For post construction stormwater runoff, the ability of stormwater management programs to meet federal guidelines under the NPDES regulations will become increasingly important. A local government seeking to manage runoff to achieve water quality standards has a number of options for reaching their goal. The options are listed below, from the most typical standard stormwater quality practice to more advanced program options. Each option has an associated level of effort for the management of stormwater, and the likelihood of realizing water quality treatment goals depends on the option a local government selects. Local governments should assess the option they wish to select in light of new Phase II regulations and the current ability of their stormwater management staff to meet more extensive local/state staff review and inspection requirements.*

Option 1. Require Stormwater Treatment Practices for Stormwater Quality

Many current stormwater programs simply require that the developer install stormwater treatment practices, but do not specify a target for specific pollutant reduction performance. These programs simply require that a standard volume of stormwater be treated (e.g., a half-inch of runoff). Many of these programs also have generous waiver and exemption provisions, so that as much as 25% of all new development can avoid criteria for water quality. Typically, these programs have no formal maintenance programs. Unless the target removal goals are very low, these communities cannot expect their current programs to eliminate net additional pollutants associated with future development.

Option 2. Institute More Rigorous Design Standards for Stormwater Practices

A number of communities have improved their stormwater programs by strengthening their design standards for stormwater practices. This has involved narrowing the list of acceptable practices to those with a proven ability to remove particular pollutants, increasing the volume of runoff that is treated by each practice (e.g., treat first 1" of stormwater runoff), clamping down on waivers and exemptions (or requiring a fee-in-lieu), and requiring design features that reduce maintenance problems.

The advantage of this program option is that compliance can be presumed as long as designers follow the design rules. It does require a good stormwater manual and more extensive local/state staff review and training. It can achieve significant reduction for some pollutants, such as sediment and nutrients. The disadvantage of the program option is that current stormwater technology may not be effective enough for some pollutants (e.g., bacteria), or capable of reducing the net additional load for high levels from future development.

Option 3. Require On-Site Load Calculation

A handful of communities have adopted an approach whereby the design engineer must calculate pre- and post- development loads for a particular pollutant, and then design a system of practices to meet a load reduction target, based on STP removal rates. Phosphorus has been used in most cases, and the load reduction target varies. This option results in more directed design geared more specifically to the pollutant of concern.

The on-site load calculation option has several disadvantages. First, designers often utilize STP math tricks to come into compliance (fudging loads, removal efficiencies, etc). Second, technical data to support the program option are limited to just a few parameters, such as phosphorus, nitrogen and sediment. Third, the removal rates for the stormwater practices seldom account for factors where pollutant load removal is compromised, and tend to be optimistic. Lastly, this program option is very intensive in terms of local review and compliance, and requires more staffing to implement.

Option 4. Load Calculation w/ Stormwater Offset Fee to Provide Retrofits on Existing Development

In this program option, a community requires the on-site load calculation described in Option 3, but is very conservative in the assumptions it allows on loading and removal efficiency. Consequently, designers at most sites cannot fully comply with the load reduction for the requirement at their site. To fully comply, they must pay an offset fee to the local government which is used to support design and construction of stormwater retrofits at existing development in the watershed. The fee is set at the cost of providing an equivalent amount of pollutant removal elsewhere (dollars/pound).

The advantage of this approach is that it provides a means of financing the stormwater retrofits needed to reduce pollutant loads from

existing development. It does require greater local staffing to find, design and build the retrofits which offset the loads from new development. If administered properly, this program option can potentially eliminate the net additional load from new development. Several communities currently provide this option for developers, but it is not clear how much revenue has been collected so far.

- (E). To protect stream channels from degradation, a specific channel protection criteria shall be provided as prescribed in the current stormwater manual.

5 Channel protection is a relatively new criteria, but is increasingly viewed as a critical one due to the mounting evidence that stream channels enlarge in response to watershed development. Studies have found higher bank erosion rates and increased instream sediment loads for urban streams when compared to the 5-20% estimate for the annual sediment budget attributable to bank erosion in rural streams (Walling and Woodward, 1995; Collins et al., 1997). Research also indicates that channel enlargement can begin at a relatively low level of watershed development, as indicated by the amount of impervious cover. One study estimated that channel erosion rates were three to six times higher in a moderately urbanized watershed (14% impervious cover) than in a comparable rural one, with less than 2% impervious cover (Neller, 1988).

The basic methodology to calculate channel enlargement relies on obtaining historical cross-sectional data from past surveys (often obtained from transportation agencies or public works departments that conducted surveys at the time of road construction or improvement projects) and comparing these with current cross-sectional data obtained from field surveys conducted at the time of the study. The approach also utilizes predictive (i.e., empirical) equations to estimate an ultimate channel enlargement ratio once the channel has enlarged sufficiently to be in balance with its hydrological forces.

Basic Options for Stream Channel Protection

As many as five different design criteria have been suggested to protect downstream channels from erosion. It should be clearly noted that none of these criteria have yet been monitored in the field to demonstrate their effectiveness, and most are based on hydrologic or hydraulic modeling of streams. The five options are:

Option 1. 24 hour detention of the one year storm event. This criteria would result in up to 24 hours of detention for runoff generated by a rainfall depth based on annual rainfall for a region. Smaller storms events would also experience some detention, but probably much less than 24 hours. The premise of this criteria is that runoff would be stored and released in such a gradual manner that critical erosive velocities would seldom be exceeded in downstream channels. The required volume needed for 1 year extended detention is significant; it is roughly equivalent to about 90 to 95% of the required volume needed for ten year peak discharge control. Consequently, the need for two year peak discharge management would be eliminated when the 1 year ED is provided, as long as the ten year peak discharge control is achieved.

Option 2. Two year control (post development peak discharge rate from two year storm is held to pre development levels). It is very important to note that research studies indicate that this criteria does not protect channels from downstream erosion, and may actually exacerbate erosion since banks are exposed to a longer duration of erosive bankfull and sub-bankfull events. (MacCrae, 1993 and 1996, McCuen and Moglen, 1988). In addition, many communities have provided anecdotal evidence that two year control has failed to protect downstream channels from erosion. This evidence suggests that while the magnitude of the peak discharge is unchanged from pre to post development under two year control, the duration of erosive flows sharply increases. As a result, "effective work" on the channel (*sensu* Wolman et al, 1964) is shifted to smaller runoff events that range from the half year event up to the 1.5 year runoff event (MacRae, 1993). Consequently, the two year control approach is considered ineffective for stream channel protection, although it remains a useful criterion for prevention of overbank flooding.

Option 3. Two year over-control (post development peak discharge rate to 50% or less of predevelopment level). First proposed by McCuen and Moglen (1988), this design approach recognizes the inherent limitations of two year control. The approach emphasizes "overcontrol" of the two year storm. The most common numerical approach is to control the two year post development discharge rate to the one year predevelopment rate, using the 24 hour storm event. Subsequent analysis by Macrae (1996), however, indicates that this design criteria is still not fully capable of protecting the stream channel from erosion. His modeling suggests that "tail-end" of the post development hydrograph is subject to a considerable duration of effective work".

Option 4. Distributed runoff control (DRC). This criteria has been developed by MacCrae (1993) and involves complex field assessments and modeling to determine the hydraulic stress and erosion potential of bank materials. The criteria states that channel erosion is minimized if the alteration in the transverse distribution of erosion potential about a channel parameter is maintained constant with predevelopment values, over the range of available flows, such that the channel is just able to move the dominant particle size of the bed

load. This Canadian method holds promise, but has not been tested extensively in the United States and requires significantly greater data collection and modeling than any of the other methods.

Option 5. Bankfull capacity/duration criteria. This criteria has been advanced by Tapley et al 1996, and states that the post-development, bankfull flow frequency, duration and depth must be controlled to predevelopment values at a designated control point(s) in the channel. The Rule of thumb for selecting control point(s) is to use a 10: 1 ratio of peak discharge from the one year storm for the developed site to the discharge from the stream for the same frequency storm (Tapley et al, 1996). In theory, this criteria should result in a high level of downstream protection. The practical problem is in defining how the criteria is to be interpreted; whether sub-bankfull events (that typically erode the toe of the streambank) should also be considered; and precisely where the "bankfull" should be measured. For example, the channel of many streams have been modified in the past by prior land uses and channelization, and may not represent the "true" channel. In other cases, the stormwater outfall discharge laterally to a stream, and it is therefore difficult to assign which flows the developer is actually responsible for controlling.

Pros and Cons of Channel Protection Sizing Criteria

If two year control and two year overcontrol are deemed inadequate to fully protect channels from erosion, then only three options remain, each of which has some limitations. For example, both the DRC and bankfull capacity sizing criteria options lack widely accepted or universal design methodologies. In each case, local stream cross-section and/or soil measurements are needed, and considerable contention between the designer and the reviewer can be expected on how and where the analysis should be performed. Given the many operational problems currently associated with either option, and the lack of a tested design methodology at present, the two options probably deserve further study, but are not ready for wide application.

This leaves only one remaining option-- the one-year 24 hour detention criteria. It, too, has some limitations:

- results in unacceptably small diameter orifices for sites less than ten acres in size.*
- requires a storage volume roughly equivalent to that needed for two year control.*
- has not been "tested" by continuous simulation modeling to determine if acceptable detention times can be achieved for smaller storms can be achieved (1.0 to 1.5 inches).*
- is only needed in streams that are susceptible to bank erosion.*

Based on the foregoing, it appears that the best option to provide channel protection (C_p) is 12 to 24 hour extended detention of the one-year 24 hour storm event. This C_p requirement only applies to sites greater than ten acres in size. Local governments may wish to retain the option of employing the DRC or bankfull capacity/duration criteria as an alternative, should their analytical and design requirements become more simplified and refined in the future

There are some basic exemptions to where the channel protection criteria should be applied (small drainage areas, direct discharge to tidal waters or a lake, flat terrain etc), and communities must decide how and when this criteria will be required.

- (F). Stormwater discharges to critical areas with sensitive resources (i.e., cold water fisheries, shellfish beds, swimming beaches, recharge areas, water supply reservoirs) may be subject to additional performance criteria, or may need to utilize or restrict certain stormwater management practices.
- (G). Certain industrial sites are required to prepare and implement a stormwater pollution prevention plan, and shall file a notice of intent (NOI) under the provisions of the National Pollutant Discharge Elimination System (NPDES) general permit. The stormwater pollution prevention plan requirement applies to both existing and new industrial sites.

5 Applicants and local communities may wish to consult the Environmental Protection Agency website at <http://www.epa.gov/owm/swm/phase2> for more information on Phase II requirements.

- (H). Stormwater discharges from land uses or activities with higher potential pollutant loadings, known as "hotspots", may require the use of specific structural STPs and pollution prevention practices.
- (I). Prior to design, applicants are required to consult with the _____ (jurisdictional stormwater authority) to determine if they are subject to additional stormwater design requirements.
- (J). The calculations for determining peak flows as found in the Stormwater Design Manual shall be used for sizing all stormwater

management practices.

Section 6. Basic Stormwater Management Design Criteria

5 *Rather than place specific stormwater design criteria into an ordinance, it is often preferable to fully detail these requirements in a stormwater design manual. This allows specific design information to change over time as new information or techniques become available without requiring the formal process needed to change ordinance language. The ordinance can then require those submitting any development application to consult the current stormwater design manual for the exact design criteria for the stormwater management practices appropriate for their site.*

In the Maryland Stormwater Design Manual, for example, there are a set of specified performance criteria for each stormwater management practice, based on six factors:

*Site Design Feasibility -
Conveyance Issues -
Pretreatment Requirements -
Treatment/Geometry Conditions
Environmental/Landscaping Standards
Maintenance Needs*

Each community will need to decide the specific design and sizing criteria for the stormwater management practices they allow, and select a storm event frequency (1, 2, 10, 100 year) that they believe will meet their stormwater quality and quantity control requirements.

6.1. Minimum Control Requirements

All stormwater management practices will be designed so that the specific storm frequency storage volumes (e.g., recharge, water quality, channel protection, 10 year, 100 year) as identified in the current stormwater design manual are met, unless the _____ (jurisdictional stormwater authority) grants the applicant a waiver or the applicant is exempt from such requirements.

In addition, if hydrologic or topographic conditions warrant greater control than that provided by the minimum control requirements, the _____ (jurisdictional stormwater authority) reserves the right to impose any and all additional requirements deemed necessary to control the volume, timing, and rate of runoff.

6.2. Site Design Feasibility

Stormwater management practices for a site shall be chosen based on the physical conditions of the site. Among the factors that should be considered:

1. Topography
2. Maximum Drainage Area
3. Depth to Water Table
4. Soils
5. Slopes
6. Terrain
7. Head
8. Location in relation to environmentally sensitive features or ultra-urban areas

Applicants shall consult the Stormwater Design Manual for guidance on the factors that determine site design feasibility when selecting a stormwater management practice.

6.3. Conveyance Issues

All stormwater management practices shall be designed to convey stormwater to allow for the maximum removal of pollutants and reduction in flow velocities. This shall include, but not be limited to:

1. Maximizing of flowpaths from inflow points to outflow points
2. Protection of inlet and outfall structures
3. Elimination of erosive flow velocities
4. Providing of underdrain systems, where applicable

The Stormwater Design Manual shall provide detailed guidance on the requirements for conveyance for each of the approved stormwater management practices.

6.4. Pretreatment Requirements

Every stormwater treatment practice shall have an acceptable form of water quality pretreatment, in accordance with the pretreatment requirements found in the current stormwater design manual. Certain stormwater treatment practices, as specified in the Stormwater Design Manual, are prohibited even with pretreatment in the following circumstances:

1. Stormwater is generated from highly contaminated source areas known as “hotspots”
2. Stormwater is carried in a conveyance system that also carries contaminated, non-stormwater discharges
3. Stormwater is being managed in a designated groundwater recharge area.
4. Certain geologic conditions exist (e.g., karst) that prohibit the proper pretreatment of stormwater

6.5. Treatment/Geometry Conditions

All stormwater management practices shall be designed to capture and treat stormwater runoff according to the specifications outlined in the Stormwater Design Manual. These specifications will designate the water quantity and quality treatment criteria that apply to an approved stormwater management practice.

6.6. Landscaping Plans Required

All stormwater management practices must have a landscaping plan detailing both the vegetation to be in the practice and how and who will manage and maintain this vegetation. This plan must be prepared by a registered landscape architect or soil conservation district.

6.7. Maintenance Agreements

All stormwater treatment practices shall have an enforceable operation and maintenance agreement to ensure the system functions as designed. This agreement will include any and all maintenance easements required to access and inspect the stormwater treatment practices, and to perform routine maintenance as necessary to ensure proper functioning of the stormwater treatment practice. In addition, a legally binding covenant specifying the parties responsible for the proper maintenance of all stormwater treatment practices shall be secured prior to issuance of any permits for land disturbance activities.

6.8. Non-Structural Stormwater Practices

The use of non-structural stormwater treatment practices is encouraged in order to minimize the reliance on structural practices. Credit in the form of reductions in the amount of stormwater that must be managed can be earned through the use of non-structural practices that reduce the generation of stormwater from the site. These non-structural practices are explained in detail in the current design manual and applicants wishing to obtain credit for use of non-structural practices must ensure that these practices are documented and remain unaltered by subsequent property owners.

Section 7. Requirements for Stormwater Management Plan Approval

7.1. Stormwater Management Plan Required for All Developments

No application for development will be approved unless it includes a stormwater management plan detailing in concept how runoff and associated water quality impacts resulting from the development will be controlled or managed. This plan must be prepared by an individual approved by the _____(jurisdictional stormwater authority) and must indicate whether stormwater will be managed on-site or off-site and, if on-site, the general location and type of practices.

The stormwater management plan(s) shall be referred for comment to all other interested agencies, and any comments must be addressed in a final stormwater management plan. This final plan must be signed by a licensed professional engineer (PE), who will verify that the design of all stormwater management practices meet the submittal requirements outlined in the Submittal Checklist found in the stormwater design manual. No building, grading, or sediment control permit shall be issued until a satisfactory final stormwater management plan, or a waiver thereof, shall have undergone a review and been approved by the _____(jurisdictional stormwater authority) after determining that the plan or waiver is consistent with the requirements of this ordinance.

5 One way to handle the submittal requirements for both the concept plan and the final design plan is to place Submittal Checklists in the stormwater design manual and require that they are used for submission of any plan. The benefit of this is that changes in submittal requirements can be made as needed without needing to revisit and alter the original ordinance. Attached are three model checklists that local communities may wish to review for ideas on requirements in their own submittal checklist.

7.2. Stormwater Management Concept Plan Requirements

A stormwater management concept plan shall be required with all permit applications and will include sufficient information (e.g., maps, hydrologic calculations, etc) to evaluate the environmental characteristics of the project site, the potential impacts of all proposed development of the site, both present and future, on the water resources, and the effectiveness and acceptability of the measures proposed for managing stormwater generated at the project site. The intent of this conceptual planning process is to determine the type of stormwater management measures necessary for the proposed project, and ensure adequate planning for management of stormwater runoff from future development. To accomplish this goal the following information shall be included in the concept plan:

- (A) A map (or maps) indicating the location of existing and proposed buildings, roads, parking areas, utilities, structural stormwater management and sediment control facilities. The map(s) will also clearly show proposed land use with tabulation of the percentage of surface area to be adapted to various uses; drainage patterns; locations of utilities, roads and easements; the limits of clearing and grading; A written description of the site plan and justification of proposed changes in natural conditions may also be required.

5 This project description and site plan requirement includes information normally found in an Erosion and Sediment Control plan. For local governments that do not currently have ESC plan requirements or are looking to upgrade their ESC ordinance language, there is a model Erosion and Sediment Control ordinance located at this website.

- (B) Sufficient engineering analysis to show that the proposed stormwater management measures are capable of controlling runoff from the site in compliance with this ordinance and the specifications of the Stormwater Design Manual.
- (C) A written or graphic inventory of the natural resources at the site and surrounding area as it exists prior to the commencement of the project and a description of the watershed and its relation to the project site. This description should include a discussion of soil conditions, forest cover, topography, wetlands, and other native vegetative areas on the site. Particular attention should be paid to environmentally sensitive features that provide particular opportunities or constraints for development.
- (D) A written description of the required maintenance burden for any proposed stormwater management facility.
- (E) The _____ (jurisdictional stormwater authority) may also require a concept plan to consider the maximum development potential of a site under existing zoning, regardless of whether the applicant presently intends to develop the site to its maximum potential.

For development or redevelopment occurring on a previously developed site, an applicant shall be required to include within the stormwater concept plan measures for controlling existing stormwater runoff discharges from the site in accordance with the standards of this Ordinance to the maximum extent practicable.

7.3. Final Stormwater Management Plan Requirements

After review of the stormwater management concept plan, and modifications to that plan as deemed necessary by the _____ (jurisdictional stormwater authority), a final stormwater management plan must be submitted for approval. The final stormwater management plan, in addition to the information from the concept plan, shall include all of the information required in the Final Stormwater Management Plan checklist found in the Stormwater Design Manual. This includes:

1. **Contact Information**
The name, address, and telephone number of all persons having a legal interest in the property and the tax reference number and parcel number of the property or properties affected.
2. **Topographic Base Map**
A 1" = 200' topographic base map of the site which extends a minimum of ___ feet beyond the limits of the proposed development and indicates existing surface water drainage including streams, ponds, culverts, ditches, and wetlands; current land use including all existing structures; locations of utilities, roads, and easements; and significant natural and manmade features not otherwise shown.
3. **Calculations**
Hydrologic and hydraulic design calculations for the pre-development and post-development conditions for the design storms specified in this ordinance. Such calculations shall include (i) description of the design storm frequency, intensity and duration, (ii) time of concentration, (iii) Soil Curve Numbers or runoff coefficients, (iv) peak runoff rates and total runoff volumes for each watershed area, (v) infiltration rates, where applicable, (vi) culvert capacities, (vii) flow velocities, (viii) data on the increase in rate and volume of runoff for the design storms referenced in the Stormwater Design Manual, and (ix) documentation of sources for all computation methods and field test results.
4. **Soils Information**
If a stormwater management control measure depends on the hydrologic properties of soils (e.g., infiltration basins), then a soils report shall be submitted. The soils report shall be based on on-site boring logs or soil pit profiles. The number and location of required soil borings or soil pits shall be determined based on what is needed to determine the suitability and distribution of soil types present at the location of the control measure.
5. **Maintenance and Repair Plan**
The design and planning of all stormwater management facilities shall include detailed maintenance and repair procedures to ensure their continued function. These plans will identify the parts or components of a stormwater management facility that need to be maintained and the equipment and skills or training necessary. Provisions for the periodic review and evaluation of the effectiveness of the maintenance program and the need for revisions or additional maintenance procedures shall be included in the plan.
6. **Landscaping Plan**
The applicant must present a detailed plan for management of vegetation at the site after construction is finished, including who will be responsible for the maintenance of vegetation at the site and what practices will be employed to ensure that adequate vegetative cover is preserved. This plan must be prepared by a registered landscape architect or by the soil conservation district.
7. **Maintenance Easements**
The applicant must ensure access to all stormwater treatment practices at the site for the purpose of inspection and repair by securing all the maintenance easements needed on a permanent basis. These easements will be recorded with the plan and will remain in effect even with transfer of title to the property.
8. **Maintenance Agreement**
The applicant must execute an easement and an inspection and maintenance agreement binding on all subsequent owners of land served by an on-site stormwater management measure in accordance with the specifications of this ordinance.
9. **Erosion and Sediment Control Plans for Construction of Stormwater Management Measures**
The applicant must prepare an erosion and sediment control plan for all construction activities related to implementing any on-site stormwater management practices.
10. **Other Environmental Permits**
The applicant shall assure that all other applicable environmental permits have been acquired for the site prior to approval of the final stormwater design plan.

7.4. Performance Bond / Security

The _____ (jurisdictional stormwater authority) may, at its discretion, require the submittal of a performance security or bond prior to issuance of a permit in order to insure that the stormwater practices are installed by the permit holder as required by the approved stormwater management plan. The amount of the installation performance security shall be the total estimated construction cost of the stormwater management practices approved under the permit, plus 25%. The performance security shall contain forfeiture provisions for failure to complete work specified in the stormwater management plan.

The installation performance security shall be released in full only upon submission of "as built plans" and written certification by a registered professional engineer that the stormwater practice has been installed in accordance with the approved plan and other applicable provisions of this ordinance. The _____ (jurisdictional stormwater authority) will make a final inspection of the stormwater practice to ensure that it is in compliance with the approved plan and the provisions of this ordinance. Provisions for a partial pro-rata release of the performance security based on the completion of various development stages can be done at the discretion of the _____ (jurisdictional stormwater authority).

5 Some communities elect to also require a maintenance performance security. This bond typically is set at the maintenance costs estimated in the stormwater plan for the period during which the permit holder has maintenance responsibility and is released when the responsibility for practice maintenance is passed on to another party, via an approved maintenance agreement.

Section 8. Construction Inspection

8.1. Notice of Construction Commencement

The applicant must notify the _____ (jurisdictional stormwater authority) in advance before the commencement of construction. Regular inspections of the stormwater management system construction shall be conducted by the staff of the _____ (jurisdictional stormwater authority) or certified by a professional engineer or their designee who has been approved by the jurisdictional stormwater authority. All inspections shall be documented and written reports prepared that contain the following information:

1. The date and location of the inspection;
2. Whether construction is in compliance with the approved stormwater management plan
3. Variations from the approved construction specifications
4. Any violations that exist

If any violations are found, the property owner shall be notified in writing of the nature of the violation and the required corrective actions. No added work shall proceed until any violations are corrected and all work previously completed has received approval by the _____ (jurisdictional stormwater authority).

8.2. As Built Plans

All applicants are required to submit actual "as built" plans for any stormwater management practices located on-site after final construction is completed. The plan must show the final design specifications for all stormwater management facilities and must be certified by a professional engineer. A final inspection by the _____ (jurisdictional stormwater authority) is required before the release of any performance securities can occur.

8.3. Landscaping and Stabilization Requirements

Any area of land from which the natural vegetative cover has been either partially or wholly cleared or removed by development activities shall be revegetated within ten (10) days from the substantial completion of such clearing and construction. The following criteria shall apply to revegetation efforts:

- Reseeding must be done with an annual or perennial cover crop accompanied by placement of straw mulch or its equivalent of sufficient coverage to control erosion until such time as the cover crop is established over ninety percent (90%) of the seeded area.
- Replanting with native woody and herbaceous vegetation must be accompanied by placement of straw mulch or its equivalent

of sufficient coverage to control erosion until the plantings are established and are capable of controlling erosion. Any area of revegetation must exhibit survival of a minimum of seventy-five percent (75%) of the cover crop throughout the year immediately following revegetation. Revegetation must be repeated in successive years until the minimum seventy-five percent (75%) survival for one (1) year is achieved.

In addition to the above requirements, a landscaping plan must be submitted with the final design describing the vegetative stabilization and management techniques to be used at a site after construction is completed. This plan will explain not only how the site will be stabilized after construction, but who will be responsible for the maintenance of vegetation at the site and what practices will be employed to ensure that adequate vegetative cover is preserved. This plan must be prepared by a registered landscape architect or by the soil conservation district, and must be approved prior to receiving a permit.

Section 9. Maintenance and Repair of Stormwater Facilities

5 *A model operation and maintenance ordinance for stormwater facilities is available at this website. This ordinance goes into greater detail on the elements needed to create an effective stormwater maintenance ordinance. Requirements for inspection are also included in the model.*

9.1. Maintenance Easement

Prior to the issuance of any permit that has an stormwater management facility as one of the requirements of the permit, the applicant or owner of the site must execute a maintenance easement agreement that shall be binding on all subsequent owners of land served by the stormwater management facility. The agreement shall provide for access to the facility at reasonable times for periodic inspection by the _____(jurisdictional stormwater authority), or their contractor or agent, and for regular or special assessments of property owners to ensure that the facility is maintained in proper working condition to meet design standards and any other provisions established by this ordinance. The easement agreement shall be recorded by the _____(jurisdictional stormwater authority) in the land records.

9.2. Maintenance Covenants

Maintenance of all stormwater management facilities shall be ensured through the creation of a formal maintenance covenant that must be approved by the _____(jurisdictional stormwater authority) and recorded into the land record prior to final plan approval. As part of the covenant, a schedule shall be developed for when and how often maintenance will occur to ensure proper function of the stormwater management facility. The covenant shall also include plans for periodic inspections to ensure proper performance of the facility between scheduled cleanouts.

The _____(jurisdictional stormwater authority), in lieu of an maintenance covenant, may accept dedication of any existing or future stormwater management facility for maintenance, provided such facility meets all the requirements of this chapter and includes adequate and perpetual access and sufficient area, by easement or otherwise, for inspection and regular maintenance.

9.3. Requirements for Maintenance Covenants

All stormwater management facilities must undergo, at the minimum, an annual inspection to document maintenance and repair needs and ensure compliance with the requirements of this ordinance and accomplishment of its purposes. These needs may include; removal of silt, litter and other debris from all catch basins, inlets and drainage pipes, grass cutting and vegetation removal, and necessary replacement of landscape vegetation. Any maintenance needs found must be addressed in a timely manner, as determined by the _____(jurisdictional stormwater authority), and the inspection and maintenance requirement may be increased as deemed necessary to ensure proper functioning of the stormwater management facility.

9.4. Inspection of Stormwater Facilities

Inspection programs may be established on any reasonable basis, including but not limited to: routine inspections; random inspections; inspections based upon complaints or other notice of possible violations; inspection of drainage basins or areas identified as higher than typical sources of sediment or other contaminants or pollutants; inspections of businesses or industries of a type associated with higher than usual discharges of contaminants or pollutants or with discharges of a type which are more likely than the typical discharge to cause

violations of state or federal water or sediment quality standards or the NPDES stormwater permit; and joint inspections with other agencies inspecting under environmental or safety laws. Inspections may include, but are not limited to: reviewing maintenance and repair records; sampling discharges, surface water, groundwater, and material or water in drainage control facilities; and evaluating the condition of drainage control facilities and other stormwater treatment practices.

9.5. Right-of-Entry for Inspection

When any new drainage control facility is installed on private property, or when any new connection is made between private property and a public drainage control system, sanitary sewer or combined sewer, the property owner shall grant to the _____ (jurisdictional stormwater authority) the right to enter the property at reasonable times and in a reasonable manner for the purpose of inspection. This includes the right to enter a property when it has a reasonable basis to believe that a violation of this ordinance is occurring or has occurred, and to enter when necessary for abatement of a public nuisance or correction of a violation of this ordinance.

9.6. Records of Installation and Maintenance Activities

Parties responsible for the operation and maintenance of a stormwater management facility shall make records of the installation and of all maintenance and repairs, and shall retain the records for at least ___ years. These records shall be made available to the (jurisdictional stormwater authority) during inspection of the facility and at other reasonable times upon request.

9.7. Failure to Maintain Practices

If a responsible party fails or refuses to meet the requirements of the maintenance covenant, the _____ (jurisdictional stormwater authority), after reasonable notice, may correct a violation of the design standards or maintenance needs by performing all necessary work to place the facility in proper working condition. In the event that the stormwater management facility becomes a danger to public safety or public health, the _____ (jurisdictional stormwater authority) shall notify the party responsible for maintenance of the stormwater management facility in writing. Upon receipt of that notice, the responsible person shall have ___ days to effect maintenance and repair of the facility in an approved manner. After proper notice, the _____ (jurisdictional stormwater authority) may assess the owner(s) of the facility for the cost of repair work and any penalties; and the cost of the work shall be a lien on the property, or prorated against the beneficial users of the property, and may be placed on the tax bill and collected as ordinary taxes by the county.

Section 10. Enforcement and Penalties

10.1. Violations

Any development activity that is commenced or is conducted contrary to this Ordinance, may be restrained by injunction or otherwise abated in a manner provided by law.

10.2. Notice of Violation

When the _____ (jurisdictional stormwater authority) determines that an activity is not being carried out in accordance with the requirements of this Ordinance, it shall issue a written notice of violation to the owner of the property. The notice of violation shall contain :

- (1) the name and address of the owner or applicant;
- (2) the address when available or a description of the building, structure or land upon which the violation is occurring;
- (3) a statement specifying the nature of the violation;
- (4) a description of the remedial measures necessary to bring the development activity into compliance with this Ordinance and a time schedule for the completion of such remedial action;
- (5) a statement of the penalty or penalties that shall or may be assessed against the person to whom the notice of violation is directed;
- (6) a statement that the determination of violation may be appealed to the municipality by filing a written notice of appeal within fifteen (15) days of service of notice of violation.

10.3. Stop Work Orders

Persons receiving a notice of violation will be required to halt all construction activities. This “stop work order” will be in effect until the _____ (jurisdictional stormwater authority) confirms that the development activity is in compliance and the violation has been satisfactorily addressed. Failure to address a notice of violation in a timely manner can result in civil, criminal, or monetary penalties in accordance with the enforcement measures authorized in this ordinance.

10.4. Civil and Criminal Penalties

In addition to or as an alternative to any penalty provided herein or by law, any person who violates the provisions of this Ordinance shall be punished by a fine of not less than _____ Dollars (\$xx) or by imprisonment for a period not to exceed ____ (xx) days, or both such fine and imprisonment. Such person shall be guilty of a separate offense for each day during which the violation occurs or continues.

10.5. Restoration of Lands

Any violator may be required to restore land to its undisturbed condition. In the event that restoration is not undertaken within a reasonable time after notice, the _____ (jurisdictional stormwater authority) may take necessary corrective action, the cost of which shall become a lien upon the property until paid.

10.6. Holds on Occupation Permits

Occupation permits will not be granted until a corrections to all stormwater practices have been made and accepted by the _____ (jurisdictional stormwater authority).

Approved by: _____

Date: _____

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Example Checklist for Preliminary/Concept Stormwater Management Plan Preparation and Review

Applicant information

Name, legal address, and telephone number

Common address and legal description of site

Vicinity map

Existing and proposed mapping and plans (recommended scale of 1" = 50'.) which illustrate at a minimum:

- > Existing and proposed topography (minimum of 2-foot contours recommended)
- > Perennial and intermittent streams
- > Mapping of predominant soils from USDA soil surveys
- > Boundaries of existing predominant vegetation and proposed limits of clearing
- > Location and boundaries of resource protection areas such as wetlands, lakes, ponds, and other setbacks (e.g., stream buffers, drinking water well setbacks, septic setbacks)
- > Location of existing and proposed roads, buildings, and other structures
- > Existing and proposed utilities (e.g., water, sewer, gas, electric) and easements
- > Location of existing and proposed conveyance systems such as grass channels, swales, and storm drains
- > Flow paths
- > Location of floodplain/floodway limits and relationship of site to upstream and downstream properties and drainages
- > Preliminary location and dimensions of proposed channel modifications, such as bridge or culvert crossings
- > Preliminary location, size, and limits of disturbance of proposed structural stormwater management practices

Hydrologic and hydraulic analysis including:

- > Existing condition analysis for runoff rates, volumes, and velocities presented showing methodologies used and supporting calculations
- > Proposed condition analysis for runoff rates, volumes, and velocities showing the methodologies used and supporting calculations
- > Preliminary analysis of potential downstream impact/effects of project, where necessary
- > Preliminary selection and rationale for structural stormwater management practices
- > Preliminary sizing calculations for structural stormwater management practices including, contributing drainage area, storage, and outlet configuration

Preliminary landscaping plans for structural stormwater management practices and any site reforestation or revegetation

Preliminary erosion and sediment control plan that at a minimum meets the requirements outlined in local Erosion and Sediment Control guidelines

Identification of preliminary waiver requests

Example Checklist for Final Stormwater Management Plan Preparation and Review

Applicant information

- > Name, legal address, and telephone number

Common address and legal description of site

Signature and stamp of registered engineer/surveyor and design/owner certification

Vicinity map

Existing and proposed mapping and plans (recommended scale of 1" = 50' or greater detail) which illustrate at a minimum:

- > Existing and proposed topography (minimum of 2-foot contours recommended)
- > Perennial and intermittent streams
- > Mapping of predominant soils from USDA soil surveys as well as location of any site-specific borehole investigations that may have been performed.
- > Boundaries of existing predominant vegetation and proposed limits of clearing
- > Location and boundaries of resource protection areas such as wetlands, lakes, ponds, and other setbacks (e.g., stream buffers, drinking water well setbacks, septic setbacks)
- > Location of existing and proposed roads, buildings, and other structures
- > Location of existing and proposed utilities (e.g., water, sewer, gas, electric) and easements
- > Location of existing and proposed conveyance systems such as grass channels, swales, and storm drains
- > Flow paths
- > Location of floodplain/floodway limits and relationship of site to upstream and downstream properties and drainages
- > Location and dimensions of proposed channel modifications, such as bridge or culvert crossings
- > Location, size, maintenance access, and limits of disturbance of proposed structural stormwater management practices

Representative cross-section and profile drawings and details of structural stormwater management practices and conveyances (i.e., storm drains, open channels, swales, etc.) which include:

- > Existing and proposed structural elevations (e.g., invert of pipes, manholes, etc.)
- > Design water surface elevations
- > Structural details of outlet structures, embankments, spillways, stilling basins, grade control structures, conveyance channels, etc.
- > Logs of borehole investigations that may have been performed along with supporting geotechnical report

Hydrologic and hydraulic analysis for all structural components of stormwater system (e.g., storm drains, open channels, swales, Management practices, etc.) for applicable design storms including:

- > Existing condition analysis for time of concentrations, runoff rates, volumes, velocities, and water surface elevations showing methodologies used and supporting calculations
- > Proposed condition analysis for time of concentrations, runoff rates, volumes, velocities, water surface elevations, and routing showing the methodologies used and supporting calculations
- > Final sizing calculations for structural stormwater management practices including, contributing drainage area, storage, and outlet configuration
- > Stage-discharge or outlet rating curves and inflow and outflow hydrographs for storage facilities (e.g., stormwater ponds and wetlands)
- > Final analysis of potential downstream impact/effects of project, where necessary
- > Dam breach analysis, where necessary

Final landscaping plans for structural stormwater management practices and any site reforestation or revegetation

Structural calculations, where necessary

Applicable construction specifications

Erosion and sediment control plan that at a minimum meets the requirements of the local Erosion and Sediment Control Guidelines

Sequence of construction

Maintenance plan which will include:

- > Name, address, and phone number of responsible parties for maintenance
- > Description of annual maintenance tasks
- > Description of applicable easements
- > Description of funding source
- > Minimum vegetative cover requirements
- > Access and safety issues
- > Testing and disposal of sediments that will likely be necessary

Evidence of acquisition of all applicable local and non-local permits

Evidence of acquisition of all necessary legal agreements (e.g., easements, covenants, land trusts)

Waiver requests

Review agency should have inspector's checklist identifying potential features to be inspected on site visits

Example Checklist for Incorporation of Better Site Design Techniques into a Stormwater Management Plan

Applicant information

- > Name, legal address, and telephone number

Common address and legal description of site

Vicinity map

Existing and proposed mapping and plans (recommended scale of 1" = 50'.) which illustrate at a minimum:

- > Existing and proposed topography (minimum of 2-foot contours recommended)
- > Perennial and intermittent streams
- > Mapping of predominant soils from USDA soil surveys as well as location of any site-specific borehole investigations that may have been performed.
- > Boundaries of existing predominant vegetation and proposed limits of clearing
- > Location and boundaries of resource protection areas such as wetlands, lakes, ponds, and other setbacks (e.g., stream buffers, drinking water well setbacks, septic setbacks)
- > Grading plan with location of existing and proposed roads, buildings, and other structures
- > Location of existing and proposed utilities (e.g., water, sewer, gas, electric) and easements
- > Location of existing and proposed conveyance systems such as grass channels, swales, and storm drains
- > Flow paths
- > Location of floodplain/floodway limits and relationship of site to upstream and downstream properties and drainages
- > Location and dimensions of proposed channel modifications, such as bridge or culvert crossings
- > Location, size, maintenance access, and limits of disturbance of proposed structural stormwater management practices
- > Location of proposed community recreation/open space areas
- > Landscape plan

Narrative and supporting calculations describing:

- > Zoning, acreage, types and amounts of land uses (e.g., parking spaces, density, green areas, building footprint areas, etc.)
- > Traffic analysis estimating average daily trips for street network and parking requirements
- > Site impervious area
- > Reforestation and/or resource conservation protection measures
- > Comparison of proposed development data with allowable density, land use, etc.
- > Representative low-impact development techniques (with supporting evidence that technique is compatible with site characteristics) such as on-lot bioretention, tree clearing minimization, minimizing directly connected impervious surfaces, open section roads (also called roadside swales), etc.
- > Development phasing or implementation sequence