Baltimore City  
Stormwater Management Manual  

Prepared for:  
Baltimore City  
Department of Public Works  

Prepared By:  
Engineering Technologies Associates, Inc.  
Columbia, MD 21046  

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1 Introduction

1.1 Purpose of the Supplement

The purpose of this manual is to present the procedures used by the Baltimore City Department of Public Works to administer the stormwater management ordinance (City ordinance 02-367).

The City of Baltimore, as the largest existing urban center in the State of Maryland, faces a number of special concerns related to the implementation of the new State stormwater management criteria. Most stormwater management programs are directed at new development and traditionally have not addressed the needs of existing urban areas such as Baltimore City, very well, if at all. Most of the guidance for stormwater management control is focused on newly developing suburban areas and are based on the use of end of pipe control technology that requires a considerable amount of space, which is often not available or practical in older urban areas.

In contrast to the suburban development scenario, most development in existing urban centers such as Baltimore City consists of infill parcels or redevelopment of existing, older areas. As a result, many of the standard Best Management Practices (BMPs) contained in the 2000 Maryland Stormwater Design Manual, such as extended detention, wet ponds, and wetlands may not be suitable because of space constraints or underlying soil conditions.

Attachment D presents a number of innovative ultra urban Best Management Practices, which may be better suited for use in urban areas. The Baltimore Department of Public Works is willing to consider these practices, especially where the practices in the 2000 Maryland Stormwater Design Manual are infeasible.

1.2 Scope of Supplement

This manual provides guidance for the Baltimore City stormwater management regulatory program. The program includes the Baltimore City Stormwater Management ordinance (City ordinance 02-367) and the 2000 Maryland Stormwater Design Manual. The manual includes procedures for waivers, variances, concept plan submission, and plan review. This manual identifies and describes maintenance and monitoring requirements for stormwater management facilities. This guidance includes scheduling of inspections and maintenance activities, maintenance standards, monitoring requirements, and inspection requirements.
2 Stormwater Management Plans

2.1 Overview

Land development and construction projects in Baltimore City are subject to a number of permitting and approval processes, which are administered by the Departments of Housing, and Community Development, (HCD), Planning (DP), and Public Works (DPW). Each agency’s role in the permitting process is described in the “Development Guidebook: Requirements for Building in Baltimore City,” which is distributed by the Baltimore City Department of Planning.

Figure 2.1 outlines the process involved in the administration of the stormwater management requirements in accordance with the Baltimore City Stormwater Management ordinance (City Ordinance 02-367).

2.2 Exemptions

All development, building and land disturbance activities require stormwater management except:

- agricultural activities; and
- construction, grading, or development that does not disturb more than 5,000 square feet.

Stormwater management at State regulated project sites such as mines and landfills are regulated by the State agencies. Stormwater plans for these projects should not be submitted to the Department.

2.3 Minimum Control Requirements

The City of Baltimore stormwater management program follows the State of Maryland program. The procedures to follow are detailed in the 2000 Maryland Stormwater Design Manual, Volumes I and II, hereinafter referred to as the Design Manual.

The water quality volume, the recharge volume, and the channel protection storage volume sizing criteria shall be used to design BMP’s according to the Design Manual. Control of the 24-hour, 10-year frequency storm event is required using practices consistent with the Design Manual.
Figure 2-1 Baltimore City Stormwater Management Review/Approval Process

Pre Submittal Meeting

Exempt?  
- YES: DPW approval
- NO: Submission of Concept Plan

Critical Area?  
- YES: Critical Area Criteria Apply
- NO: Redevelopment?

Redevelopment?  
- YES: Criteria
  - Water Quality (WQv)
  - Recharge (Rev)
  - Channel Protection (Cpv)
  - Overbank Protection (Qp)
  - Extreme Flood (Qf)
- NO: Criteria
  - Reduce 20% of total impervious area or provide treatment
Calculate Offset fees

Submission of Final Plan

Final Plans acceptable?

YES

DPW approval

Construct and inspect BMP's

Submission of as-builts to DPW

Release of bond

Maintenance and Inspection

NO
Watersheds with known flooding hazards shall require management measures necessary to maintain the post-development peak discharges for the 24-hour, 100-year frequency storm events at a level that is equal to, or less than the 24-hour 100-year pre-development peak discharge rates. The stormwater management practices shall control the volume, timing, and rate of flows necessary to maintain a "no increase" in the downstream peak discharge for the 100-year frequency storm event.

The Department may require more than the minimum control requirements specified in these Guidelines if hydrologic or topographic conditions warrant, or if flooding, stream channel erosion, or water quality problems exist downstream from a proposed project.

2.4 Structural and Nonstructural Practices

2.4.1 Nonstructural Stormwater Management Measures.

1) The following nonstructural stormwater management practices shall be applied according to the Design Manual to minimize increases in new development runoff:
   a. natural area conservation;
   b. disconnection of rooftop runoff;
   c. disconnection of non-rooftop runoff;
   d. sheet flow to buffers;
   e. grass channels; and
   f. environmentally sensitive development.

2) The use of nonstructural stormwater management practices shall be strongly encouraged to minimize the reliance on structural BMP’s.

3) The minimum control requirements listed in these Guidelines may be reduced in accordance with the Design Manual when nonstructural stormwater management practices are incorporated into site designs.

4) The use of nonstructural stormwater management practices may not conflict with existing State laws, regulations, or policies.

5) Nonstructural stormwater management practices used to reduce the minimum control requirements must remain unaltered by owners. Approval from the Department shall be obtained prior to alteration of nonstructural stormwater practices.

6) For the purposes of modifying the minimum control requirements or design criteria, the applicant shall submit to the Department an analysis of the impacts of stormwater flows downstream in the watershed. The analysis shall include hydrologic and hydraulic calculations necessary to determine the impact of hydrograph timing modifications of the proposed development upon a dam, highway, structure, or natural point of restricted streamflow. The point of investigation is to be established, with the concurrence of the Department, at the first downstream tributary whose drainage area equals, or exceeds, the contributing area to the project or stormwater management facility.
2.4.2 Structural Stormwater Management Measures.

1) The following structural stormwater management practices shall be designed according to the Design Manual to satisfy the applicable minimum control requirements:
   a. Stormwater management ponds;
   b. Stormwater management wetlands;
   c. Stormwater management infiltration;
   d. Stormwater management filtering systems; and
   e. Stormwater management open channel systems.

2) The performance criteria specified in the Design Manual with regard to general feasibility, conveyance, pretreatment, treatment and geometry, environment and landscaping, and maintenance shall be considered when selecting structural stormwater management practices.

3) Structural stormwater management practices shall be selected to accommodate the unique hydrologic or geologic regions of the site.

4) Recycling of stormwater runoff will be considered to be treatment to the extent that recycled runoff does not leave the site.

2.4.3 Specific Design Criteria.

The basic design criteria, methodologies, and construction specifications, subject to the approval of the Department, shall be those of the Design Manual.

A. Infiltration systems shall be designed in accordance with the Design Manual and shall meet the following requirements:
   The facility design shall provide an overflow system with measures to provide a non-erosive velocity of flow along its length and at the outfall. Infiltration trenches shall be provided with observation wells in accordance with the Design Manual.

B. Ponds, wetlands, filtering systems and open channel systems shall be designed and constructed in accordance with the Design Manual and shall include the following items:
   1) Velocity dissipation devices shall be placed at the outfall of all detention or retention structures and along the length of any outfall channel as necessary to provide a non-erosive velocity of flow from the structure to a water course.
   2) Where deemed necessary by the Department, the applicant shall submit an analysis of the impacts of stormwater flows downstream in the watershed. The analysis shall include hydrologic and hydraulic calculations necessary to determine the impact of hydrograph timing modifications resulting from the proposed development upon a dam, highway, structure, or natural
point of restricted stream flow, established with the concurrence of the Department, and shall extend downstream to the first downstream tributary whose drainage area equals or exceeds the contributing area to the pond; or to the first downstream tributary whose peak discharge exceeds the largest designed release rate of the pond.

3) The designed release rate of the facility shall be modified if any increase in flooding or stream channel erosion would result at the downstream dam, highway, structure, or natural point of restricted stream flow. The release rate of the facility shall:
   a. Be reduced to a level that will prevent any increase in flooding or stream channel erosion at the downstream control point;
   b. Be not less than 1-year pre-development peak discharge rate; and
   c. Meet the minimum requirements established in the State Design Manual.

4) Where the selected BMP is a pond, small pond approval shall be obtained from the Department.

C. Off-site structures to be considered:
   1) Shall have a contributory drainage area not in excess of 400 acres unless, on a case by case basis, a larger drainage area is approved by the Department;
   2) Shall provide for a permanent pool of water or provide for 24-hour detention period (a 12-hour detention period may be approved, at the discretion of the Department, for Use III or Use IV streams) for detaining and releasing the volume of runoff from the 1-year frequency storm;
   3) Shall manage the increase in peak discharges for the 10 and possibly the 100-year frequency storm events; and

D. When calculating the overbank flood protection (Qp10) the pre-development peak discharge rate shall be computed assuming that all land uses within the project site are in good hydrologic condition.
   1) Design considerations shall be given for incorporating the use of natural topography and land cover, such as wetlands, ponds, natural swales, and depressions, as they exist prior to development, to the degree that they can accommodate the increased flow of water.
   2) Where deemed necessary, due to increased volume or rate of discharge from the project site, the Department may require easements or other necessary property interests, concerning flowage of water, from adjacent property owners. It shall be the responsibility of the applicant to provide said easements or other necessary property interests. Approval of a stormwater management plan does not create or affect any such rights.

E. Water quality treatment for roadway and/or parking lot construction shall be in accordance with the Design Manual and the following:
1) Grassed Channel Water Quality Credit.
   a. When computing the discharge for the water quality storm for
grassed channel credit, the out-of-project (off-site) drainage area
contributing runoff to the grassed channel must be included.
   b. Credit may be applied only for that portion of the impervious area
that reaches the grassed channel via sheet flow or approved
pretreatment practice.
   c. When expanding the limits of paving, grassed channel credit will
be applied as follows:
      (1) the length of the post-development vegetative buffer (the
      grassed area between the edge of the paving and the centerline of
      the channel) shall be proportional to the ratio of the pre-
development buffer/paving lengths; for EXAMPLE: *the pre-
development buffer length (the length of vegetated buffer receiving
sheet flow from the existing paved area) equals 50 feet. The pre-
development paving length sheet flowing to the buffer equals 25
feet. The pre-development ratio of buffer/paving equals 50/25 or
2/1. The post-development paving length (the length of paving that
sheet flows to the grassed buffer) equals 35 feet. Therefore,
maintaining the 2/1 ratio, the post-development vegetated buffer
length must equal 70 feet minimum.*
      (2) where the buffer/paving length ratio cannot be provided, the
Department may consider, on a case by case basis, mitigation for
reduced buffer length in the form of landscaping and/or grading.

2) Conversion of open section paving to closed section.
   a. Quantifying efficiency of water quality treatment provided by
existing conditions.
      The presence of an existing vegetated filter strip through which
runoff sheet flows is an effective water quality measure for the
runoff from existing open section paving. Likewise, the presence
of an existing vegetated conveyance (swale or channel) that
transports the runoff from a "one-inch rainfall" event, at a velocity
of 1 fps or less, is an effective water quality measure. When
converting open section paving to closed section, the quality of
runoff may be negatively impacted due to the loss of these
vegetative filtering and/or infiltration measures. This existing
water quality value shall be quantified as follows:
      (1) Step 1
         • Enter Figure 2-2 with the appropriate slope and read the filter
length required to achieve removal goals for total suspended solids
(TSS).
         • Determine the length of the existing filter.
The ratio of the existing filter length to the filter length obtained from Figure 2-2 is the efficiency.

(2) Step 2

• Determine the velocity of the runoff from the one-inch rainfall event in the existing swale/channel.

• Determine the filter efficiency as follows: a velocity of 1 fps or less, equals 100% water quality (WQ) efficiency; a velocity of 3 fps or greater equals 0% water quality efficiency. The efficiency is directly proportional to the velocities of the one-inch rainfall within the existing conveyance.

(3) Step 3

• The greater of the Step 1/Step 2 efficiencies is the percent of water quality provided by the existing conditions.

b. Compensation for the percent of water quality provided by the existing conditions shall be as follows: The area of the existing impervious surface converted from open section to closed section shall be multiplied by the percent of water quality provided by the existing conditions (as determined in Step 3 above). Water quality shall be provided for this area of existing paving due to the conversion of open section to closed section.

3) Conversion of closed section pavement to open section.

Water quality compensation for conversion of closed section paving to open section paving may be quantified by use of Steps 1 through 3 in Subsection 2.4.3.E.2.a.

4) Compensating Water Quality Treatment (WQv and Rev)

a. Projects may have drainage areas where it is not possible to provide water quality treatment for all new paved areas. Compensating water quality treatment of existing paving, equal to 120% of the untreated new paved area, may be provided elsewhere within the same watershed. Provision of the compensating water quality treatment shall be included within the project.

b. In order for existing paving to qualify as compensating water quality treatment, there must be no, or substandard, existing water quality treatment for said existing paving. Substandard means less than 100 percent (%), as determined by the method in Subsection 2.4.3.E.2.a. of these Guidelines.
Figure 1. Minimum Vegetative Filter Length Requirements To Meet TSS Removal Goals (Manning’s “n” = 0.20)
5) **On-Line BMPs**

Water quality practices that are placed On-Line (in medians or side channels/ditches/swales) shall include offsite impervious area in the calculation of the water quality requirements.

**F. Channel Protection Volume (Cpv)**

Channel Protection Volume (Cpv) shall be derived in accordance with the Design Manual.

Extended detention facilities for projects that include combined redevelopment and new development, shall be in accordance with the following:

1) Cpv shall be computed using the new development drainage area only.

2) The extended detention facility may be designed to control the Cpv, as computed in accordance with Subsection 2.4.3.F.1. of these Guidelines, and by-pass the excess runoff contribution from the redevelopment portion of the contributing drainage area.

### 2.5 Concept Plans

If a proposed project does not qualify for an exemption, the applicant should proceed to prepare a Stormwater Management Concept Plan. A Stormwater Management Concept Plan Application Form is provided in Attachment B. The purpose of the concept plan is to let the department have the opportunity to review the stormwater management planned for a site before final design is completed. This concept plan will be submitted to the Department of Public Works Development Center for review and approval. Approval of the Concept Plan is required before the applicant can proceed to submission of construction drawings for technical stormwater approval. The Concept Plan will provide the following information:

1) Project Location and description
2) Applicant's Name and address
3) Owner's Name and address
4) Type of development/Overview of Project/Land use
5) Approximate Maryland State Plane coordinates
6) ADC map location
7) Drainage area and watershed
8) 100-year Floodplain location, if applicable
9) Proposed stormwater management controls and unified sizing criteria volume computations including disturbed area
10) Waiver requests, if any
11) Site plan showing topography and vicinity map

Attachment B is an application form and checklist for the concept plan submittal. If a waiver or variance is requested, the request should be in the concept plan submittal.
2.6 Construction Drawings and Reports

2.6.4 Review and Approval of Stormwater Management Plans.

For any proposed development, the developer shall submit a stormwater management plan or waiver application to the Department for review and approval, unless otherwise exempted. The stormwater management plan shall contain supporting computations, drawings, and sufficient information describing the manner, location, and type of measures in which stormwater runoff will be managed from the entire development. The Department shall review the plan to determine compliance with the requirements of the Stormwater Management ordinance prior to approval. The plan shall serve as the basis for all subsequent construction.

Notification of approval or reasons for disapproval or modification shall be given to the applicant within 30 days after submission of the completed stormwater plan. If a decision is not made within 30 days the applicant shall be informed of the status of the review process and the anticipated completion date. The stormwater management plan shall not be considered approved without the inclusion of the signature and date of signature of the Department.

2.6.5 Contents of the Stormwater Management Plan.

The developer is responsible for submitting a stormwater management plan that meets the design requirements of the Ordinance. The plan shall be accompanied by a report that includes sufficient information to evaluate the environmental characteristics of affected areas, the potential impacts of the proposed development on water resources, and the effectiveness and acceptability of measures proposed for managing stormwater runoff. The developer or builder shall certify on the drawings that all clearing, grading, drainage, construction, and development shall be conducted in strict accordance with the plan. The minimum information submitted for support of a stormwater management plan or application for a waiver shall be as follows:

Reports submitted for stormwater management plan approval shall include:

1) A brief narrative description of the project;
2) Geotechnical investigations including soil maps, borings, site specific recommendations, and any additional information necessary for the proposed stormwater management design;
3) Descriptions of all water courses, impoundments, and wetlands on or adjacent to the site or into which stormwater directly flows;
4) Hydrologic computations, including drainage area maps (scale of 1"=200') depicting pre development and post development runoff flow path segmentation and land use;
5) Hydraulic computations;
6) Structural computations;
7) Copies of all permits required by the project;
8) Construction cost estimate;
9) Completed checklist (see Attachment F);
10) Unified sizing criteria volume computations according to the Maryland Design Manual; and
11) Any other information required by the Department.

Construction drawings (scale of 1"=10', 20', 30', 40' or 50') submitted for stormwater management plan approval shall include the following:

1) A vicinity map at a scale of 1"=2000';
2) Topography survey showing existing and proposed contours, including the area necessary to determine downstream analysis for proposed stormwater management facilities;
3) Any proposed improvements including location of buildings or other structures, impervious surfaces, storm drainage facilities, and all grading;
4) The location of existing and proposed structures and utilities;
5) Any easements and rights-of-way;
6) The delineation, if applicable, of the 100-year floodplain and any on site wetlands;
7) Structural and construction details for all components of the proposed drainage system or systems, and stormwater management facilities;
8) All necessary construction specifications including materials, source of materials, and name of suppliers (sources and suppliers may be furnished at preconstruction meeting);
9) A sequence of construction;
10) Data for total site area, disturbed area, new impervious area, and total impervious area;
11) A table showing the unified sizing criteria volumes required in the Maryland Design Manual;
12) A table of materials to be used for stormwater management facility planting;
13) All soil boring logs and locations;
14) A maintenance schedule;
15) Certification by the owner/developer that all stormwater management construction will be done according to this plan (see Attachment H);
16) An as-built certification signature block to be executed after project completion (see Attachment H);
17) An engineer's certification (see Attachment H);
18) A maintenance and liability certification (see Attachment H);
19) A proposed construction and inspection control schedule; and
20) Any other information required by the Department.

2.6.6 Preparation of the Stormwater Management Plan.

The design of stormwater management plans shall be prepared by either a professional engineer, professional land surveyor, or landscape architect licensed in the State, as necessary to protect the public or the environment.

If a stormwater BMP requires a dam safety permit from MDE, a professional engineer licensed in the State must prepare the design.
2.7 Waivers

The Department may grant a waiver of the stormwater management QUANTITY and QUALITY or only QUALITY control requirements where the Applicant can demonstrate to the satisfaction of the Department that:

1. the project shall return the disturbed area to a predevelopment runoff condition (no hydrologic change and/or redevelopment occurs), i.e., pipeline or conduit projects, certain landscaping projects, certain maintenance projects, certain underground projects; or
2. the project lies within an area with an approved watershed management plan; or the project lies within an approved master plan that has been developed consistent with Section 2.9.

The Department may grant a waiver of the stormwater management QUANTITY control requirements where the Applicant can demonstrate to the satisfaction of the Department that:

1. the impervious area created by the project does not exceed six (6) feet in width, is linear in nature, i.e., bike paths, walkways, highway noise barriers, etc., and retains the predevelopment drainage patterns; or
2. the project is served by an existing public storm drain system; or
3. the project has direct discharge to tidally influenced receiving waters.

A request for a Waiver shall be submitted as part of the concept plan and shall specifically state the item of this section for which the project is eligible. The applicant shall provide sufficient descriptions, drawings, and other information necessary to evaluate the proposed project and confirm the applicability of the waiver request. Any waiver shall be valid only after written notice of granting such waiver is received from the Department.

Waivers granted shall:

1. be on a case-by-case basis;
2. may require an offset fee;
3. consider the cumulative effects of the waiver policy; and
4. ensure no adverse impact on the downstream watercourse.

2.8 Variances

The Department may grant a written variance from any requirement of the Stormwater Management ordinance if there are exceptional circumstances applicable to the site such that strict adherence will result in unnecessary hardship and not fulfill the intent of the ordinance. A written request for variance shall be provided to the Department and shall state the specific variances sought and reasons for their granting. Alternative best management practices (see Attachment D) may be approved as variances. The Department shall not grant a variance unless and until the applicant provides sufficient justification.
Applicants who meet the requirements for a variance may be required to pay an offset fee as described in Attachment C.

Requests for variances related to compliance with the runoff pollution reduction requirements in the Critical Area shall be submitted to and processed by the Baltimore City Department of Planning.

2.9 Master Plans

Master Plans for stormwater management are encouraged by the Department. Master plans are appropriate where development will occur over a period of time on a site. A Master Plan developed for the purpose of implementing site–wide stormwater management practices shall:

A. Include detailed hydrologic and hydraulic analyses to determine hydrograph timing;
B. evaluate both quantity and quality management;
C. include cumulative impact assessment of institutional development;
D. identify existing flooding and receiving stream channel conditions;
E. be presented at a reasonable scale (dictated by the size of area in the analysis);
F. specify where on-site or off-site quantitative and qualitative stormwater management practices and watershed improvement are (to be) implemented;
G. be consistent with the General Performance Standards for Stormwater Management in Maryland found in Section 1.2 of the Design Manual;
H. be consistent with local watershed management plan(s), and
I. be approved by the Department.

Development consistent with an approved Master Plan may not require a new or separate stormwater management permit. For example, building a road (that was completely designed and specified in the Master Plan) or a stormwater management pond does not require a separate permit. Developing a site within the Master Plan area may require a new application and may require site specific BMPs for water quality and recharge volumes.

Master plans approved before the effective date of the stormwater management ordinance (July 27, 2002) may be implemented as designed until July 27, 2004. After July 27, 2004, site plans or the master plan must be revised to include water quality and recharge volumes according to the Design Manual. Quantity control will not have to be changed.

2.10 Redevelopment

The stormwater management ordinance and State Design Manual recognize that redevelopment does not allow the same stormwater management opportunities as new development. Redevelopment is defined as development where the existing land use is industrial, commercial or multifamily. The ordinance requires a 20 percent reduction in
impervious area. Where a 20 percent reduction in impervious area cannot be achieved, runoff from 20 percent of the existing impervious area must be treated using water quality BMPs.

Most projects in Baltimore City will be redevelopment projects. The following polices will apply to stormwater management plans that are covered by the stormwater management ordinance applicable to redevelopment (City ordinance 02-367 § 23-7).

1. Stormwater management plans for redevelopment shall be consistent with the Design Manual except that the recharge, channel protection storage volume, and overbank flood protection volume requirements do not apply unless required by the Department.

2. All redevelopment projects shall reduce existing impervious areas impacted within project limits by a minimum of 20 percent. Where project site conditions prevent the reduction of impervious area, then stormwater management practices shall be implemented to provide qualitative control for a minimum of 20 percent of the project’s predevelopment impervious area. When a combination of impervious area reduction and stormwater practice implementation is used, the combined reduction and treated areas shall be equal to, or exceed, 20 percent of the predevelopment impervious area within the project limits. The necessary water quality volume to be treated will be calculated as follows:

   The area of imperviousness to be treated shall be calculated using the runoff formula for the entire site and the imperviousness fraction shall be the impervious area to be treated (maximum of 20 percent of the existing impervious area) divided by the total site area.

   For example, on a 10 acre site, that is 50 percent impervious, the required reduction in impervious area is

   impervious area = .5 (10 acres) = 5 acres
   reduction = 20% (5 acres) = 1 acre

   If the impervious area cannot be reduced, then the required water quality treatment volume is calculated as

   \[ WQv = P \cdot Rv \cdot A \]

   where
   \[ P = 1 \text{ inch of precipitation (per Design Manual)} \]
   \[ Rv = .05 + .009 (I), \text{ runoff coefficient} \]
   \[ A = 10 \text{ acres (site area)} \]
   \[ I = 0.1 \times 100, \text{ (1 acre required area to be treated)/10 acres x 100} \]

   thus
   \[ Rv = .05 + .009 (10) = 0.1400 \]
   \[ WQv = (1) (0.14) (10) = 1.40 \text{ acre-in} \]
0.1167 acre-ft
1830 cu ft

If only some of the required reduction in impervious area may be achieved, say 0.8 acre with a total of 4.2 acres of impervious area remaining, then the required WQv is

\[
I = 0.02 \times 100 = 2, \quad (0.2 \text{ acres remaining area to be treated})/10 \text{ acres} \times 100
\]
\[
Rv = 0.05 + 0.009 (2) = 0.0680
\]
\[
WQv = \left( 1 \right) \times (0.0680) \times (10) = 0.680 \text{ acre-in}
\]
\[
= 0.0047 \text{ acre-ft}
\]
\[
= 206 \text{ cu ft}
\]

3. If a net increase in impervious area occurs for the project, the increased impervious area shall be considered new development and shall follow Stormwater Management Criteria, Section 2.4 of this Manual. Additionally, water quality shall be provided for 20 percent of the project's predevelopment impervious area.

EXAMPLE #1: A new building and parking garage are constructed on an existing one (1) acre paved parking lot. The footprint of the new building and parking garage is one and a half (1.5) acres and completely covers the footprint of the existing 1.0 acre parking lot. The total water quality required equals 0.7 acres \( [0.5 \text{ acres for the new impervious, plus 0.2 acres for redevelopment (20 percent of the predevelopment impervious area)}] \).

EXAMPLE #2: A new building and parking garage are constructed on an existing, paved parking lot. The footprint of the new building and parking garage is one and a half (1.5) acres and covers one half (1/2) acre of the existing 1.0 acre parking lot (the remaining ½ acre parking lot will remain undisturbed). The total water quality required equals 1.1 acres \( [1.0 \text{ acre for the new impervious, plus 0.1 acres for redevelopment (20 percent of the ½ acre predevelopment impervious area replaced by new impervious)}] \).

4. When a redevelopment project changes the site runoff characteristics, in a manner that increases the discharge rate, channel protection volume and overbank flood protection volume may be required by the Department.

5. If the site area (project limits) is in doubt (this may be an issue for redevelopment), contact the Department before filing the concept plan.

6. The existing land use will be the most intensive use while in the same ownership. An industrial, commercial, or multifamily building may be demolished and the vegetation planted and then redeveloped at a later time and the project will be a redevelopment for the purposes of stormwater management if the property has remained in the same ownership. If the land is sold after the demolition, the site will be considered undeveloped for stormwater management purposes.
2.11 Critical Area Requirements

Development within the Critical Area (within 1000 feet of the shoreline) is subject to the requirements of the Critical Area Program as detailed in the Baltimore City Critical Area Management Program document. There are specific requirements for the reduction of pollutants in runoff. Appendix D-4 of the State Design Manual details a step-by-step approach to calculate compliance with these requirements.

The requirements of the Stormwater Management Ordinance still apply and must be met. The water quality offset fee required for a waiver of the water quality treatment requirement is not applicable, however, it is replaced by the Critical Area Program fee where the 10 percent pollutant removal requirement cannot be met.

When the offset fee for the stormwater management best management practice is higher than the offset fee for the Critical Area Program, the difference must be paid to the Department.
3 Permits, Fees, Security

3.1 Permit Requirement.

A grading or building permit may not be issued by the Department or HCD for any parcel or lot unless a stormwater management plan has been approved or waived by the Department as meeting all the requirements of this Ordinance. Where appropriate, a building permit may not be issued without:

A. Recorded easements for the stormwater management facility and easements to provide adequate access for inspection and maintenance from a public right-of-way;

B. A recorded stormwater management maintenance agreement; and

C. A performance bond.

3.2 Permit Fees.

Non-refundable permit fees for plan review, offsets, and stormwater permits, will be collected by the Department in addition to the usual fee charged for processing a grading or building permit, at the time the stormwater management plan or application for waiver is submitted. The permit fees provide for the cost of plan review, administration, and management of the permitting process, and inspection of all projects subject to this Ordinance. Projects not required to obtain a grading or building permit shall be exempt from such permit fees.

A schedule of permit fees is provided in Attachment E. This fee schedule may be amended from time to time.

3.3 Permit Suspension and Revocation.

Any grading or building permit issued by the Department or HCD may be suspended or revoked by the Department after written notice is given to the permittee by the Department for any of the following reasons:

A. Any violation(s) of the conditions of the stormwater management plan approval.

B. Changes in site runoff characteristics upon which an approval or waiver was granted.

C. Construction is not in accordance with the approved plan.

D. Noncompliance with correction notice(s) or stop work order(s) issued for the construction of the stormwater management facility.
E. An immediate danger exists in a downstream area in the opinion of the Department representative.

3.4 Permit Conditions.

In granting the plan approval, the Department may impose such conditions that may be deemed necessary to ensure compliance with the provisions of this Ordinance and the preservation of the public health and safety.

3.5 Offset Fees

Offset fees will be required of applicants who cannot meet the requirements of the stormwater management ordinance. Offset fees may also be required of applicants who are only in partial compliance with the requirements. Attachment C details these offset fees.

3.6 Bonding Requirements and Procedures

3.6.1 Performance Bond

The Department shall require from the applicant a surety or cash bond, irrevocable letter of credit, or other means of security acceptable to Baltimore City prior to the issuance of any building and/or grading permit for the construction of a development requiring a stormwater management facility. The amount of the security shall not be less than the total estimated construction cost of the stormwater management facility. This estimate shall be prepared by the applicant and submitted with the plan. The bond required in this section shall include provisions relative to forfeiture for failure to complete work specified in the approved stormwater management plan, compliance with all of the provisions of the Stormwater Management ordinance, and other applicable laws and regulations, and any time limitations. The bond shall not be fully released without a final inspection of the completed work by the Department, submission of "As-built" plans, and certification of completion by the Department that the stormwater management facilities comply with the approved plan and the provisions of the Stormwater Management ordinance. A procedure may be used to release parts of the bond, pro-rated upon completion and acceptance of the various stages of development and construction as specifically delineated, described, and scheduled on the required plans and specifications. The applicant shall notify the Department upon completion of each stage that the facility is ready for inspection. The procedures used for partially releasing performance bonds must be specified by the Department in writing prior to stormwater management plan approval. Sample instructions and forms for letters of credit and bonds are provided in Attachment E.
4 Inspection

4.1 Inspection Schedule and Reports.

Before work can begin, the Contractor must receive a written notice from the Department, Stormwater Management Section. The Environmental Engineering Inspections Section must be notified of the various stages of work to be done on the facility. Call 410 396-6513 prior to 10:00 AM on the proceeding day to arrange for the inspection.

A preconstruction meeting must be held between the contractor and the Department to review plans and answer questions regarding construction and/or inspection procedures.

A description of all materials, source of materials, and the name of suppliers must be furnished if not included in construction specifications.

Inspections shall be conducted by the Department, its authorized representative, or certified by a professional engineer licensed in the State. Written inspection reports shall be made of the periodic inspections necessary during construction of stormwater management systems to ensure compliance with the approved plans. Geotechnical engineers must monitor earth work.

Written inspection reports shall include:

   i. The date and location of the inspection;
   ii. Whether construction was in compliance with the approved stormwater management plan;
   iii. Any variations from the approved construction specifications; and
   iv. Any violations that exist.

The owner/developer and on site personnel shall be notified in writing when violations are observed. Written notification shall describe the nature of the violation and the required corrective action.

No work shall proceed until the Department inspects and approves the work previously completed and furnishes the developer with the results of the inspection reports as soon as possible after completion of each required inspection, as detailed in Section 2.12.2

4.2 Inspection Requirements During Construction.

At a minimum regular inspections shall be made and documented at the following specified stages of construction:
1) For Ponds:
   a) Upon completion of excavation to sub-foundation and when required, installation of structural supports or reinforcement for structures, including but not limited to:
      i) Core trenches for structural embankments
      ii) Inlet and outlet structures, anti-seep collars or diaphragms, and watertight connectors on pipes; and
      iii) Trenches for enclosed storm drainage facilities;
   b) During placement of structural fill, concrete, and installation of piping and catch basins;
   c) During backfill of foundations and trenches;
   d) During embankment construction; and
   e) Upon completion of final grading and establishment of permanent stabilization.

2) Wetlands – at the stages specified for pond construction in this section, during and after wetland reservoir area planting, and during the second growing season to verify a vegetation survival rate of at least 50 percent.

3) For infiltration trenches:
   a) During excavation to subgrade;
   b) During placement and backfill of under drain systems and observation wells;
   c) During placement of geotextiles and all filter media;
   d) During construction of appurtenant conveyance systems such as diversion structures, pre-filters and filters, inlets, outlets, and flow distribution structures; and
   e) Upon completion of final grading and establishment of permanent stabilization;

4) For infiltration basins – at the stages specified for pond construction in this section and during placement and backfill of underdrain systems.

5) For filtering systems:
   a) During excavation to subgrade;
   b) During placement and backfill of underdrain systems;
   c) During placement of geotextiles and all filter media;
   d) During construction of appurtenant conveyance systems such as flow diversion structures, pre-filters and filters, inlets, outlets, orifices, and flow distribution structures; and
   e) Upon completion of final grading and establishment of permanent stabilization.

6) For open channel systems:
   a) During excavation to subgrade;
   b) During placement and backfill of under drain systems for dry swales;
c) During installation of diaphragms, check dams, or weirs; and

d) Upon completion of final grading and establishment of permanent stabilization.

7) For nonstructural practices – upon completion of final grading, the establishment of permanent stabilization, and before issuance of use and occupancy approval.

4.3 Enforcement

The Department may, for enforcement purposes, use any one or a combination of the following actions:

1. A notice of violation shall be issued specifying the need for a violation to be corrected if stormwater management plan noncompliance is identified;
2. A stop work order shall be issued for the site by the approving agency if a violation persists;
3. Bonds or securities may be withheld or the case may be referred for legal action if reasonable efforts to correct the violation have not been undertaken; or
4. In addition to any other sanctions, a civil action or criminal prosecution may be brought against any person in violation of the Stormwater Management subtitle or the Stormwater Management ordinance.

Any step in the enforcement process may be taken at any time, depending on the severity of the violation.

Once construction is complete, two (2) prints and one (1) reproducible mylar copy of as-built drawings shall be submitted to the Environmental Engineering Section. The as-built drawings shall be affixed with a State of Maryland Registered Professional Engineer's written certification (see Attachment H) that the as-built drawing truly represents field conditions including, but not limited to locations, sizes, diameters, line and grade, and elevations. The Department may require additional information.

A notice of construction shall be submitted within 30 days of construction completion. Attachment I shows the notice of completion form.
5 Maintenance

5.1 Maintenance Inspection.

6) The Department shall ensure that preventative maintenance is performed by inspecting all stormwater management systems. Inspection shall occur during the first year of operation and at least once every 3 years thereafter. In addition, a maintenance agreement between the owner and the approving agency shall be executed for privately owned stormwater management systems. The maintenance agreement is provided in Attachment G.

B. Inspection reports shall be maintained by the Department for all stormwater management systems.

C. Inspection reports for stormwater management systems shall include the following:
   1) The date of inspection;
   2) Name of inspector
   3) The condition of:
      a) Vegetation or filter media;
      b) Fences or other safety devices;
      c) Spillways, valves, or other control structures;
      d) Embankments, slopes, and safety benches;
      e) Reservoir or treatment areas;
      f) Inlet and outlet channels or structures;
      g) Underground drainage;
      h) Sediment and debris accumulation in storage and forebay areas;
      i) Any nonstructural practices to the extent practicable; and
      j) Any other item that could affect the proper function of the stormwater management system.
   4) Description of needed maintenance.

D. After notification is provided to the owner of any deficiencies discovered from an inspection of a stormwater management system, the owner shall have 30 days or other time frame mutually agreed to between the approving agency and the owner, to correct the deficiencies. The Department shall then conduct a subsequent inspection to ensure completion of the repairs.

E. If repairs are not undertaken or are not found to be done properly, then enforcement procedures described in Section 2.12.1 shall be followed by the Department.

F. If, after an inspection by the Department, the condition of a stormwater management facility presents an immediate danger to the public health or safety, because of an unsafe condition or improper maintenance, the Department shall
take such action as may be necessary to protect the public and make the facility safe. Any cost incurred by the Municipality shall be assessed against the owner(s), as provided in Section 2.15.

5.2 Maintenance Agreement

Prior to the issuance of any building permit for which stormwater management is required, the Department shall require the applicant or owner to execute an inspection and maintenance agreement binding on all subsequent owners of land served by a private stormwater management facility. Such agreement shall provide for access to the facility at reasonable times for regular inspections by the Department, or its authorized representative to ensure that the facility is maintained in proper working condition to meet design standards.

The agreement shall be recorded by the applicant and/or owner in the land records of Baltimore City.

The agreement shall also provide that, if after written notice by the Department to correct any nonconformance with an approved plan, satisfactory corrections are not made by the owner(s) within a reasonable period of time, not to exceed 30 days, unless extended for good cause shown, the Department, or its designee, may perform all necessary work to place the facility in proper working condition. The owner(s) of the facility shall be assessed the cost of the work and any penalties. This may be accomplished by revoking the maintenance bond or placing a lien on the property, which may be placed on the tax bill and collected as ordinary taxes by the Department of Finance.

5.3 Maintenance Responsibility.

The owner of the property on which work has been done pursuant to this Ordinance for private stormwater management facilities, or any other person or agent in control of such property, shall maintain in good condition and promptly repair and restore all grade surfaces, walls, drains, dams and structures, vegetation, erosion and sediment control measures, and other protective devices. Such repairs or restoration and maintenance shall be in accordance with approved plans.

A maintenance schedule shall be developed for the life of any stormwater management facility and shall state the maintenance to be completed, the time period for completion, and who shall perform the maintenance. This maintenance schedule shall be printed on the approved stormwater management plan.

5.4 Maintenance Bond

The Department requires a performance bond for stormwater structural stormwater management BMPs that are in private ownership. The amount of the bond will be the estimated cost of five years of maintenance including all mowing, periodic inspection and a prorated cost of maintenance that would not be performed in a five year period, such as pond dredging. The bond shall be for a five-year period. Attachment E contains sample forms for bonds or other financial assurance documents.
ATTACHMENT A

Baltimore City Stormwater Management Ordinance
ATTACHMENT B

BALTIMORE CITY DEPARTMENT OF PUBLIC WORKS
APPLICATION FOR STORMWATER CONCEPT PLAN APPROVAL
Baltimore City Department of Public Works
Application for Stormwater Concept Plan Approval

Date of Submittal __________________________

General Information:

Approval is required prior to submission of construction drawings for technical stormwater approval for all proposed development in Baltimore City. Submit the completed form and a site plan showing topography and vicinity) map to the Department of Public Works, Bureau of General Services, Engineering Division, Stormwater Management Services. Space is provided at the end of this form for answers to questions. Attach additional information as necessary. You are encouraged to contact the Development center at 410-396-4840 if you have any questions.

Property Tax Account Number or Complete Property Address: __________________________
____________________________________________________________________________
____________________________________________________________________________

Project Name:
____________________________________________________________________________

Applicant Name, Address and Phone:
____________________________________________________________________________
____________________________________________________________________________

Engineer's Name, Address and Phone
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

Owner's Name, Address and Phone
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
TYPE OF DEVELOPMENT (Check as Applicable)

____ Single Family Residential  ____ Commercial  ____ Institutional

____ Road Improvements  ____ Residential (all others)  ____ Industrial

____ Other _______________________________________________________

____ Redevelopment

Locator Page & Grid__________  200' Sheet__________

Zoning ______________________________________________

Total Site Acreage _______________

Current impervious area on-site __________________________

Proposed impervious area on-site __________________________

Will site discharge directly to tidal waters? (yes or no) _______

Will site discharge to public storm drain? (yes or no) _______

Please include the following items in your submission:

____ Narrative describing project including project purpose.

____ Location map including scale and north arrow.

____ Drainage area maps. Show drainage areas for all site runoff on suitable scale topographic map (1”=200’ preferred). Drainage area map must include at least 100 feet outside site boundary and 100 feet downstream of outfall. Show time of concentration pathway and label. Include soil types. Include scale and north arrow.

____ Hydrologic calculations. Include time of concentration, runoff curve number, area, and reference to drainage area map for each subarea. Show how predevelopment peak flows were calculated.

____ Site plan. Include proposed development features, property lines, setbacks, topography, flood plain limits, environmental buffers, storm drains, sewers, rights-of-way, streams, bays, and other relevant features. Show proposed stormwater management BMPs, and outfall location.

____ Calculations showing compliance with stormwater management requirements. These will include unified stormwater sizing criteria calculations (water quality requirements,
recharge capacity requirements, channel protection volume requirements, peak flow requirements), and peak flow after development with and without proposed BMPs.

Waiver requests, if applicable. If requesting a waiver from any stormwater management requirement include waiver request and rationale.

This application must be prepared and signed by a registered Professional Engineer or Land Surveyor and accompanied by the appropriate review fee (see Attachment B)

SUBMITTED BY:

_________________________________________  _______________
Signature        Date

_________________________________________  __________________
Printed Name      MD P.E. or LS #

____________________________________________
Firm
ATTACHMENT C

Baltimore City Department of Public Works
Stormwater Management Offset Fee Schedule
Applicants who receive waivers or variances from the stormwater management requirements of Baltimore City will be required to pay offset fees.

**Fee In-lieu of Waiver**
New Projects - not redevelopment

<table>
<thead>
<tr>
<th>Category</th>
<th>Fee per increased impervious acre</th>
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<td>Channel protection volume</td>
<td>$2,500</td>
</tr>
<tr>
<td>Overbank flood control</td>
<td>$7,500</td>
</tr>
<tr>
<td>Extreme Flood Control</td>
<td>$10,000</td>
</tr>
<tr>
<td>Water Quality and Recharge Volume</td>
<td>Estimated cost that would have been practical for the site</td>
</tr>
</tbody>
</table>

Not applicable to direct tidal discharge

**Offset Fee for a Variance**
The offset fee shall be no more than 75 percent of the estimated cost of the quantity or quality control that would have been practical for the site.

Critical Area offset fees are calculated by the Department of Planning and are in addition to the offset fees calculated by the Department.
ATTACHMENT D

ULTRA URBAN BMP DESIGN CRITERIA
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5.5 INTRODUCTION

This Attachment identifies and provides guidance on a number of supplementary ultra urban Best Management Practice(s) (BMP(s)). These BMPs are not typically not approved practices like those in the 2000 Maryland Stormwater Design Manual (Design Manual); they may be proposed and approved as variances where Design Manual BMPs are infeasible. There are other practices that the Department of Public Works may consider as well. It is contemplated that additional BMPs will be added to this Attachment over time.
ROOFTOP RUNOFF MANAGEMENT BMPs

Rooftop runoff management BMPs refers to a series of techniques, which involve modifications to conventional building design, that retards, and in some cases treats runoff originating from roofs. The modifications include vegetated roof covers, roof gardens and meadows, and roof ponding areas. Figures 1a, b and c, illustrate some examples of rooftop garden technologies currently in use in Germany.

Roofs are one of the most important sources of concentrated runoff from developed sites. If runoff is retarded at the source, the size of other BMPs throughout the site can generally be significantly reduced in size. Rooftop runoff management effectively increases the time of concentration of runoff derived from roofs, delaying runoff peaks and lowering runoff discharge rates. In highly urbanized areas, rooftop measures may be the only practical alternative for relieving pressure on overtaxed storm sewer systems.

Managing rooftop runoff is of the greatest benefit in highly urbanized settings where space for other BMPs is limited. In addition to achieving specific stormwater runoff management objectives, rooftop runoff management is also aesthetically and socially beneficial. Rooftop runoff management measures are suitable for flat or gently sloping roofs. Nevertheless, engineers should check the runoff curve number in TR-20 calculations and/or Manning roughness factor calculations to determine the effect of the runoff rates on rooftop flow. Furthermore, rooftop runoff management techniques can be retrofitted to most conventionally constructed buildings. Rooftop management, particularly roof gardens, can be effectively used to address the heat island effect of large metropolitan centers.

Vegetated Roof Covers

Vegetated roof covers, also called green roofs and extensive roof gardens, involve blanketing roofs with a veneer of living vegetation. Vegetative roof covers are particularly effective when applied to extensive roofs, such as those that typify commercial and institutional buildings. The filtering effect of vegetated roof covers results in a roof discharge that is free of leaves and roof litter, and therefore is recommended where roof runoff will be directed to infiltration or other water quality management BMPs such as, bioretention cells, dry wells, infiltration trenches and sand filters.

Because of recent advances in synthetic drainage materials, vegetated covers are now feasible on most conventional flat roofs. An efficient drainage layer is placed between the growth media and the roof surface. This layer rapidly conveys water off of the roof surface and prevents water from “laying” on the roof. In fact, vegetated roof covers can be expected to protect roof materials and prolong their life.
Figures 1a, b, c. Examples of rooftop garden technology in Germany.
Vegetated roof covers are an effective means of retarding runoff from roof surfaces. Initially during a rainfall event, nearly all precipitation striking the foliage is intercepted. As rain continues, water percolates into and begins to saturate the growth media and root zone of the cover. Not until the field capacity of the media is overcome will significant quantities of water begin to drain from the roof. For small rainfall events, little runoff will occur and most of the precipitation eventually will return to the atmosphere by evaporation and transpiration. For larger storms, vegetated roof covers can delay and attenuate the runoff peak significantly.

If materials are selected carefully to reduce the weight of the system, vegetated roof covers generally can be created on existing flat roofs without additional structural support. Drainage nets or sheet drains constructed from lightweight synthetic materials can be used as underlayments to carry away water and prevent ponding. Frequently, the total load of a fully vegetated and saturated roof cover system actually will be less than the design load computed for gravel ballast on conventional tar roofs. A structural engineer should check the capability of the roof to carry the load.

Although vegetative roof covers are most effective during the growing season, they also are beneficial during the winter months if the vegetative matter from the dead or dormant plants is left in place and intact.

**Roof Gardens / Meadow**

Vegetated roof covers blanket an entire roof area and, although presenting an attractive vista, generally are not intended to accommodate routine traffic by people. Roof gardens, on the other hand, are landscaped environments, which may include planters and potted shrubs and trees. Roof gardens can be tailor-made natural areas, designed for outdoor recreation, and perched above congested city streets. Because of the special requirements for access, structural support, and drainage, roof gardens are found most frequently in new construction. The services of a Professional Engineer will be required to evaluate the architectural and engineering constraints associated with roof garden design.

**Roof Ponding Areas**

Roof ponding is applicable where the increased load of impounded water on a roof will not increase the building costs significantly or require extensive reinforcement. Roof ponding generally is not viable for large-area commercial buildings where clear spans are required. Special consideration must be given to ensuring that the roof will remain watertight under a range of adverse weather conditions. Low-cost plastic membranes can be used to construct an impermeable lining for the containment area.
Flat roofs can be converted to ponding areas by restricting the flow to downspouts. Figure 2 shows a simple device that can be used to modify downspout inlets. The device features drain holes that will retard outflow as the water level rises and a weir ring that will allow free drainage once the design ponding level is attained. Even small ponding depths of 1 or 2 inches can attenuate stormwater runoff peaks effectively for most storms.

Figure 2. Modification of Downspout Inlet (Adapted from Tourbier, 1974).

**Design Criteria for Rooftop Management BMPs**

The requirements for regulatory compliance are described in the Design Manual. Of the five sizing criteria in the unified sizing criteria described in the manual, rooftop storage can be used to meet the storage volume requirements for channel protection, Cpv; overbank protection, Qp; and flood protection Qf. It is not anticipated that rooftop storage will be able to address the requirements for water quality control, WQv, or groundwater recharge. Vegetated roof cover may meet water quality, WQv, requirements. Guidelines for coupling roof covers and gardens with runoff treatment and disposal areas which can address the water quality and groundwater recharge criteria are provided separately in this section under, “Rooftop Runoff Treatment and Disposal.”

The performance-based guideline of rooftop management BMPs measures primarily runoff peak attenuation. The methods for evaluating the peak attenuation properties of these measures are based on approaches used for other runoff peak attenuation BMPs, and are described in the Design Manual.

Runoff peak attenuation design storms larger than the 2-year return frequency event are generally not used in designing vegetated roof covers. However, vegetated roof
covers will contribute to the attenuation of runoff peaks from larger storms, and should be taken into account when sizing related runoff peak attenuation BMPs at a site. The emphasis of the design should be promoting rapid roof drainage and minimizing the weight of the system. By using appropriate materials, the total weight of fully saturated vegetated roof covers can readily be maintained below 20 pounds per square foot (psf). At present, because most of the pioneering work has been done in Europe, many of the engineering design manuals are not yet available in English. Because of the many factors that may influence the design of vegetated roof covers, it is advisable to obtain the services of installers that specialize in this area. All vegetated roof covers share certain common design elements:

- **Impermeable Lining** - Must be 'root-proof' unless an additional roof barrier membrane is introduced to prevent root penetration. Various systems are acceptable, but not 'built-up' tar roofs.

- **Drainage Net or Sheet Drain** - The drainage net or sheet drain is a continuous layer that underlies the entire cover system. A variety of lightweight, high-performance drainage products will function well in this environment. The product selected should be capable of conveying the discharge associated with the runoff peak attenuation storm without ponding water on top of the roof cover. The drainage layer must have a good hydraulic connection to the roof gutters, drains, and downspouts.

- **Geotextile** – A geotextile layer prevents the growth media from penetrating and clogging the drainage layer. The geotextile should be installed immediately over the drainage net or sheet drains. Many vendors will bond the geotextile to the upper surface of the drainage material.

- **Lightweight Growth Media** - The depth of the growth media should be kept as small as the cover vegetation will allow. Typically, a depth of 3 to 4 inches will be sufficient. Low-density substrate materials with good water-retention capacity should be specified. Examples are mixtures containing crushed pumice and terra cotta. Media that are appropriate for this application will retain 40 to 60 percent water by weight and have bulk dry densities of between 35 and 50-lb/cubic feet (ft³). Earth and topsoil are too heavy for most applications.

- **Adapted Plants and Grasses** - A limited number of plants can thrive in the roof environment where periodic rainfall alternates with periods that are hot and dry. Effective plant species must include the following capabilities:

  1. Tolerate mildly acidic conditions and poor soil,
  2. Prefer very-well-drained conditions and full sun,
  3. Tolerate dry soil, and
  4. Be vigorous colonizers.
Both annual and perennial plants can be used. Dozens of species have been successfully field-tested. Among these, some species of sedum (*Sedum*) have been shown to be particularly well adapted. Other candidates include hardy species of sedge (*Carex*), fescue (*Festuca*), feather grass (*Stipa*), and yarrow (*Achillea*). Vegetative roof covers may include provisions for occasional watering during extended dry periods, conventional lawn sprinklers work well.

Roof gardens generally are designed to achieve specific architectural objectives. The load and hydraulic requirements for roof gardens will vary according to the intended use of the space. Intensive roof gardens typically include design elements such as planters filled with topsoil, decorative gravel or stone, and containers for trees and shrubs. Complete designs also may detain runoff ponding in the form of water gardens or storage in gravel beds. A wide range of hydrologic principles may be exploited to achieve stormwater management objectives, including runoff peak attenuation and runoff volume control.

Effective designs will ensure that all direct rainfall is cycled through one or more devices before being discharged to downspouts as runoff. For instance, rainfall collected on a raised tile patio can be directed to a media-filled planter where some water is retained in the root zone and some is detained and gradually discharged through an overflow to the downspout. Guidelines for coupling roof gardens with treatment and disposal measures are provided separately in this section.

Roof ponding measures can be designed for rainfall events of all sizes. However, the structural loads associated with the impounded runoff may impose limitations on their use. This is especially true if ponding areas must also accommodate runoff derived from adjacent roof surfaces. Devices, such as the one shown in Figure 2, are easily fabricated. However, some form of emergency overflow also is advisable. Emergency overflow can be as simple as a free overfall through a notch in the roof parapet wall.

Many methods can be used for sealing roofs, including tar and mastics or plastic membranes. If membranes are used, their resistance to ultraviolet (UV) radiation, extremes of temperature, and puncture must be known. In most cases, covering the sealing material with a protective layer of gravel or geotextile is advisable.

Roof ponding areas are designed like any other above ground impoundment. To evaluate the performance of these measures, an appropriate design storm must be selected and the hydraulic characteristics of the outlet device determined.

All rooftop runoff management measures must be inspected and maintained periodically. Furthermore, the vegetative measures require the same normal care and maintenance that a planted area does. The maintenance includes attending to plant nutritional needs, irrigating as required during dry periods, and occasionally weeding. The cost of maintenance can be significantly reduced by judiciously selecting hardy plants that will out compete weeds. In general, fertilizers must be applied
periodically. Fertilizing usually is not a problem on flat or gently sloping roofs where access is unimpeded and fertilizers can be uniformly broadcast. Properly designed vegetated roof covers should not be damaged by treading on the cover system. Maintenance contracts for the routine care of the vegetative cover frequently can be negotiated with the installer.

When retrofitting existing roofs, preserve easy access to gutters, drains, spouts, and other components of the roof drainage system. It is good practice to thoroughly inspect the roof drainage system quarterly. Foreign matter, including leaves and litter, should be removed.

Roofs that are sheltered by vegetative covers have long life expectancies compared to conventional tar roofs that are exposed to UV and extremes of temperature.

Vegetative roof covers can reduce bare roof temperatures in summer by as much as 40 percent. Because of the insulating properties of the covers, significant saving in both heating and cooling energy is achievable. The savings in energy costs and the extended life of the roof will frequently offset the additional capital costs of vegetated roof covers. Vegetative roof covers are a proven technology in central Europe where urban population density is higher than in most American cities. Several European cities, in an effort to reduce the overloading of sewer systems, provide incentives for homeowners to install vegetated roof covers or roof gardens. Some of the cities are Stuttgart, West Berlin, Cologne, Dusseldorf, and Hamburg.

Roof gardens, vegetated roof covers, and vegetated facades add aesthetic value to residential and commercial property. In addition to the attractive textures and colors of the foliage, these natural urban islands attract songbirds, bees, and butterflies. Although the methods should not be used as water quality measures, they will benefit water quality by reducing the acidity of runoff and trapping airborne particulates.

**Specifications and Methodology**

Vegetative roof covers influence the runoff hydrograph in two ways:

- Intercept rainfall during the early part of a storm.
- Limit the maximum release rate.

Hydrologic properties are specific to the growth medium. If the supplier does not provide information, prospective media should be laboratory tested to establish:

- Porosity,
- Moisture content at field capacity,
- Moisture content at the wilting point (nominally 0.33 bar), and
- Saturated hydraulic conductivity.
Rainfall retention properties are related to field capacity and wilting point. Appropriate media for this application should be capable of retaining water at the rate of 40 percent by weight, or greater. The media must be uniformly screened and blended to achieve its rainfall retention potential. During the early phases of a storm, the media and roof systems of the cover will intercept and retain most of the rainfall, up to the retention capacity. For instance a 3-inch cover with 40 percent retention potential will effectively control the first 0.6 inches rainfall. Although some water will percolate through the cover during this period, this quantity generally will be negligible compared to the direct runoff rate without the cover in place.

Once the field capacity of the cover is attained, water will drain freely through the media at a rate that is approximately equal to the saturated hydraulic conductivity for the media. Through the selection of the media, the release rate from the roof can be controlled. The media is a mechanism for “buffering” or attenuating the peak runoff rates from roofed areas. The attenuation can be important even for large storms. By using specific information about the hydraulic properties of the cover media, the effect of the roof cover system on the runoff hydrograph can be approximated with numerical modeling techniques. As appropriate, the predicted hydrographs can be added into site-wide runoff models to evaluate the effect of the vegetative roof covers on site runoff. The hydraulic analysis of roof covers will require the services of a Professional Engineer who is experienced with drainage design.

![Figure 4. Influence of vegetated roof cover on runoff hydrograph.](image)

Drainage nets or sheet drains with transmissivities of 15 gallons per minute per foot, or larger, are recommended. When evaluating a drainage layer design, the roof topography should be evaluated to establish where the longest travel distances to a roof gutter, drain, or downspout occur. If flow converges near drains and gutters, the
design unit-flow rate should be increased accordingly. The drainage layer should be able to convey the design unit flow rate at the roof grade without water ponding on top of the cover media. For larger storms, direct roof runoff is permitted to occur. The design flow rates should be based on the largest runoff peak attenuation design storm considered in the design of the vegetated roof cover.

The net weight of the fully vegetated roof cover should be compared against the design loads for the roof. Preliminary designs commonly are too light to satisfy the ballast requirements for flat tar roofs. As required, deepening the media can increase the weight of the cover system. In Baltimore, the maximum roof design loads must incorporate expected snow accumulation. The design snow load should be added to the weight of the roof system.

The analysis of roof ponding systems is very similar to the design of dry ponds and other runoff peak attenuation facilities. The procedure for storage routing is described in TR-55. The necessary data that the input hydrograph needs are:

1. Depth-storage function, and
2. Depth-discharge function.

Because the roof is impermeable, the runoff hydrograph is simply the rainfall distribution for the design storm multiplied by the area of the roof. The depth to storage relationship can be computed from the topography of the roof. For perfectly flat roofs, the storage volume of a ponding level is equal to the roof area times the ponding level. The depth-discharge relationship will be unique to the outlet device used. For simple ponding rings, the discharge rate will approximately equal:

\[ O = C \times 3.141 \times D \times (d-H)^{3/2} \]

where:

- \( O \) = outflow rate
- \( D \) = diameter of the ring
- \( d \) = depth of ponding
- \( H \) = height of the ring
- \( C \) = discharge coefficient (3.22)

With this information, the attenuation effectiveness of the roof ponding system can be predicted by using the Modified Puls or other storage-routing procedure. The performance of the ponding area can be adjusted by changing the height or diameter of the ponding ring or by modification of the optional weirs.

It should be noted that the potential deflection of the roof must be taken into account for the design volume.
Rooftop Runoff Treatment and Disposal

Rooftop runoff treatment and disposal is the handling of rooftop runoff by systems and techniques that avoid or replace direct connections of roof drainage systems to storm or sanitary sewer systems. This may be applicable wherever direct connection of roof drainage systems to public sewer, storm sewer or stormwater management systems exists or is planned.

In many urban areas, roof drainage systems are connected directly to sewer systems to reduce the inconvenience to property owners of excess surface runoff. Such connections may be permitted, or they may be illicit connections made for the convenience of property owners without consideration of the effects on public sewer systems. Flooding of street and road areas may result with accompanying hazards to health and safety.

Maintenance for infiltration and storage of runoff is covered in the Design Manual.

Four techniques are described below for handling rooftop runoff without direct connections. Depending upon the size of rooftops and local rainfall conditions, these techniques can be used singly or in combination to achieve the desired results.

1. Surface Drainage - The simplest and most widely used technique for disposing of rooftop runoff is to allow it to disperse over the surface of the land. This technique is especially applicable where there is sufficient open space and permeable soils to allow infiltration of surface runoff to occur. This practice is often avoided where property owners fear flooding, excessive surface ponding, or erosion from concentrated runoff. However, if proper precautions are taken, the practice can usually be used without significant problems. The Design Manual provides guidance for the disconnection of rooftop runoff in Section 5.2 of the Manual under “Disconnection of Rooftop Runoff Credit”.

2. Subsurface Infiltration - Where surface drainage of rooftop runoff is not feasible the use of subsurface infiltration practices may become a suitable alternative. Exfiltration trenches may be installed to dispose of rooftop runoff beneath the land surface. Of course, soils must have a relatively high permeability in order for these systems to function properly. As with surface drainage, adequate precautions should be taken to prevent flooding. Design, construction and maintenance criteria for subsurface retention devices are provided in the Design Manual in Section 3.3 “Stormwater infiltration”. Typical applications of subsurface infiltration techniques for rooftop runoff disposal are illustrated in Figures 5 and 6.

3. Runoff Collection and Storage - In certain circumstances, neither surface drainage nor would subsurface infiltration techniques be feasible because of poor soils or other site conditions. A suitable alternative may be to collect and
store rooftop runoff for later release or use. Rain barrels at downspout outlets are an example of how this technique has been applied in the past. Aboveground storage facilities such as rain barrels, however, are generally not desirable in densely urbanized areas. One solution may be to install cisterns underground to collect the water. The stored water can be utilized for some purpose, which does not require treated water, such as garden or lawn watering. The benefit of the cistern system will be a reduction of the sediment and pollutants from rooftop runoff. The use of the withheld water is for lawns and other non-potable uses. A typical application of a cistern for rooftop runoff collection is illustrated in Figure 7.

4. Dripline Planters - The description of dripline planter BMPs refers to a number of landscaping features that can be placed to receive runoff from roofs to water vegetation. Possible configurations include foundation plantings below the edge of the roof or above ground box planters along the side of a building. Figure 8 illustrates a typical application of dripline technology.

The design characteristics of dripline planter BMPs are runoff can be conveyed to the planter from downspouts or directly as a spray using rain dispersers instead of gutters. Additional storage can be obtained placing a coarse medium at the bottom of the box planter. The volume of the planter should be estimated according to the area of the roof. If using foundation plantings, care must be exercised to avoid leakage into basements. Figure 9 illustrates design characteristics of dripline planter technology.

Dripline planter BMPs can be applied in new, existing developments and in virtually any type of building.

Figure 5. Infiltration Drainage of Rooftop

Infiltration Drainage of Rooftop

Plan View

Downspouts feed underground perforated pipe. Water pressure from roof storage forces water through this pipe and out of perforations, providing plant available moisture without evaporation loss.

Overflow so roof or downdrain can drain completely in reasonable time for next storm.

Section A
Figure 6. Typical Infiltration Trench Under Gutterless Roof
Figure 7. Typical Retention Cistern

Source: Virginia Soil and Water Conservation Commission
Figure 8. Dripline Planters

Figure 9. Dripline Planter Detail
PARKING LOT AND ROAD RUNOFF MANAGEMENT BMPS

Concrete Grid and Modular Pavement

Definition

Concrete grid and modular pavement is a pavement consisting of strong structural materials having regularly interspersed void areas that are filled with pervious materials, such as sod, gravel or sand. See Figure 10 for a Concrete Grid and Modular Pavement design in Maryland.

Purpose

The intention of concrete grid and modular pavement is to reduce water pollution from low-volume traffic areas by providing a bearing surface having adequate strength to accommodate vehicles while allowing infiltration of surface water and filtration of pollutants.

Planning Considerations

Concrete grid and modular pavement systems vary considerably in configuration (See Figure 10 and 11). Categories include:

- **Poured-in-Place Concrete Grids** - Reinforced concrete grids covering large areas are poured in place on the ground to be covered. Special forms are used to shape the void areas, and flat surface results. Because the slab is continually reinforced with steel, this pavement is suitable for heavy loads and has maximum resistance to movement caused by frost heave or settling.

- **Pre-Cast Concrete Grids** - Concrete paving units incorporating void areas are usually precast in a concrete products plant and trucked to a job site for placement on the ground. However, for large jobs these units can be formed...
The following are the major types of grid pavers:

1. **Lattice Pavers** - generally flat and grid-like in surface configuration.

2. **Castellated Pavers** - distinguished by a more complex surface configuration characterized by crenels and merlons that are exposed when pervious materials are added. These units show a higher percentage of grass surfaces.

- **Modular Unit Pavers** - Smaller pavers that may be clay bricks, granite sets, or cast concrete of various shapes. These pavers are monolithic units which do not have void areas incorporated into their configuration. They are installed on the ground to be covered with pervious material placed in the gaps between the units. The condition where concrete grid and modular pavement practice applies is where pavement is desirable or required for low-volume traffic areas and the underlying soils allow for rapid drainage. This practice is most applicable for new construction, but it can be used in existing developments to expand a parking area or even to replace existing pavement if that is a cost-effective measure. This practice should NOT be used in areas where infiltrated pollutants may reach and degrade groundwater to below state standards.
Figure 11. Types of Grid and Modular Paving
Possible areas for use of these paving materials include:

- Parking lots especially fringe or overflow parking areas.
- Parking aprons, taxiways, blast pads, and runway shoulders at airports (heavier loads may demand the use of reinforced grid systems).
- Emergency stopping and parking lanes and vehicle crossovers on divided highways.
- On-street parking aprons in residential neighborhoods.
- Recreational vehicle camping area parking pads.
- Private roads, easement service roads and fire lanes.
- Industrial storage yards and loading zones (heavier loads may demand the use of reinforced grid systems).
- Driveways for residential and light commercial use.
- Bike paths, walkways, patios and swimming pool aprons.

Production of Units - There are a number of manufacturers of precast concrete grids and unit pavers, and various styles can be purchased from distributors. Forms are required for poured-in-place systems. Contractors who have been trained in the use of the forms should install these systems.

Site Characteristics - To determine the suitability of the types of paving materials and to plan and design their installation, the following information about the site should be known:

- **Environmental Data** - Soil permeability and bearing capacity; slope; depth, direction of movement, natural quality, and confined or unconfined condition of groundwater; and surface drainage conditions.

- **Pollution Information** - Types of pollutants generated by the prevailing and intended land uses and the effect of the practice on pollutants, generally and specifically. Pollution control effectiveness is not currently documented for these products, but research into these factors is in progress and results are expected to be forthcoming.

- **Intended Use of the Area** - This is a key determinant of the choice of paving material. Is the installation temporary or permanent? What type of maintenance will be necessary? Is pavement coloring desired? What type of performance will be required of the paving surface? Can the practice be coupled with other BMPs for increased effectiveness?

Design Criteria and Construction Specifications - All installations of modular pavement should be designed and constructed according to the manufacturer's specifications. To be consistent with other BMP forms of treatment, the storage volume for these systems must be determined using the Maryland Unified Sizing Criteria described in the Design Manual.
With respect to water quality management, these systems must be capable of providing a storage volume for the first inch of runoff above the soil surface and including the subgrade base (if applicable), so they can also be considered to provide 90% pollutant removal. Stored water must be percolated prior to the time limit specified for other onsite retention systems (72 hours). However, facilities using vegetative cover in combination with pavers must be capable of disposing of stored waters within time limits necessary to avoid damage to the ground cover (24 to 36 hours for most grasses). Parking areas should avoid extensive ponding for periods exceeding more than an hour or two.

Experience shows a definite potential for large errors in estimating the infiltration rate of the underlying soils for the purpose of evaluating the storage recovery period. Consequently, the use of a safety factor of two or more is normally recommended. This allowance may be accomplished by reducing the percolation rate by one-half its original value or by limiting the drawdown period to half the allowable 72-hour value.

Maintenance - Where turf is incorporated into these installations, normal turf maintenance, watering, fertilizing and mowing will be necessary. Mowing is seldom required in areas of frequent traffic. It is documented that the hard surfaces in these installations require very little maintenance. However, fertilizers, pesticides and other chemicals may have adverse effects on concrete products. The use of such chemicals should be restricted as much as possible.

Special Application 1 - Parking Groves

A parking grove is a special application of concrete grids or modular paving. It consists of individual parking stalls covered with a pervious surface. The parking stalls are delimited with trees that also provide shade and increase the aesthetic value of the site. (See Figure 12)

The design characteristic of parking groves includes a variety of pervious materials that can be used in a parking grove: gravel, wood chips, or grass over a geogrid that provides stability. The material must be chosen according to the expected traffic volume and vehicle speed. The width of individual stalls needs to accommodate the width of the trees when they mature. To allow adequate space for the canopy, the trees should be planted every other stall. Wooden posts or other markers may be needed as stall delimiters between the trees. Additional water storage can be provided under the pervious layer. Snow removal must be considered in the design. The native soils must have adequate drainage characteristics.
The applicability of parking groves can be installed in any new commercial or institutional parking lots. Old parking lots can be retrofitted with parking groves.

The sources for additional information include: Richman, T. (1999), Start at the Source, prepared for Bay Area Stormwater Management Agencies Association (BAASMA), Forbes, New York

Special Application 2 - Below-Pavement Infiltration Basins

This BMP is similar to special application 1 but provides a stone layer for use as a below-pavement infiltration basin. The stone layer stores runoff that percolates through porous pavement into an underlying layer of coarse material. The water subsequently infiltrates into the natural soil. Under most circumstances, only a portion of the site is covered with porous pavement and heavy-traffic areas receive conventional pavement.

The design characteristic of below grade infiltration BMPs installed in soil below the pavement should have adequate drainage and be left uncompacted. The thickness of the storage layer depends on the volume of water that must be stored. If necessary, drainpipes may be installed to assist in draining the void space. The drainpipes lead to other BMPs. The thickness of the asphaltic layer should be selected according to the bearing capacity needs of the parking area. Using cobblestones or other pavers as markers and borders can enhance infiltration. There is a potential for failure of the porous pavement due to traffic, snow removal, or clogging with fine sediments.

The applicability of below grade infiltration BMPs is adequate for flat, 10 feet wide parking traffic areas. Porous pavement under parking bays usually needs to be
combined with strips of conventional pavement in high traffic areas. The BMP could be installed in parking lots, highway shoulders and pullover zones, and in parking zones along residential streets.


Figure 13   Below Pavement Infiltration Basins – Plan View

Figure 14   Below Pavement Infiltration Basins – Cross section
Parking Lot Storage

Definition

Parking lot storage provides temporary surface storage and controlled release of stormwater runoff on paved (impervious) parking areas or within parking lot landscaped islands.

Purpose

Parking lot storage reduces the adverse impact of runoff from impervious parking surfaces on receiving waters. The condition where parking lot storage applies is where portions of large, paved parking lots can be temporarily used for stormwater storage without significantly interfering with normal vehicle and pedestrian traffic. Shopping centers and large employee parking areas are likely places for use of this measure or wherever parking lot landscaped islands are required.

Design Criteria

Parking lot ponding is usually accomplished by using specifically designed or modified inlet structures, which cause stormwater to temporarily pond in specially graded areas of a parking lot.

The design criteria where parking lot storage applies:

- **Increasing Storage Volume and Release Rates** - Design of the storage volume and release rate is dependent upon the purpose of the system. In parking lot detention systems, the size and grade of the parking lot and the proximity of ponding areas to structures and traffic routes usually limit the storage volume. There will seldom be enough storage volume to control moderate or major flooding downstream unless additional storage volume is provided.

- **Reducing Nonpoint Source Pollution** - This is where a slow release rate is needed (i.e., 0.1 inch per day to 1 inch per day). Detention times in excess of 30-40 hours are most effective. Unfortunately, stormwater detention for such long periods of time may not be desirable on a parking surface. A good alternative is to design the parking lot storage system in conjunction with a subsurface retention/detention system such as infiltration trenches and/or pits. The subsurface system can be designed to collect a small initial volume of runoff while the surface ponding system can be designed to control a specific design storm at a pre-development level.

- **Minimum Slope** - The storage area should have at least 0.5 % percent slope toward the outlet to assure complete drainage following a storm.

- **Maximum Depth** - The maximum depth of water within the pond area should not exceed six (6) inches.
• **Location** - The portion of the parking lot where runoff storage is planned should be located so that there will be minimum interference with pedestrian and vehicular traffic during a storm. Remote perimeter areas of large parking lots are usually best suited.

• **Overflow** - The parking lot storage system should be designed so that overflow from storms larger than the design storm will not cause excessive damage or inconvenience. Specifically, there should be no potential for flooding of nearby buildings, major thoroughfares or other important facilities.

• **Warning Sign** - Ponding areas should be well marked with signs or pavement markings advising users to avoid these areas during storms in order to protect their vehicle brake linings from wetting and to prevent inconvenience to themselves.

An illustration of a typical parking lot storage system cross-section is shown in Figure 15.

**Planning Consideration**

Where parking lot storage applies is where paved parking areas can have a significant impact on downstream receiving waters. The impervious surface that often replaces natural vegetative cover causes increases in the volume and peak rate of runoff and also provides a place for traffic-generated residues and airborne pollutants to accumulate and become available for washoff.

The effectiveness of parking lot storage for nonpoint source pollution control can be increased by routing ponded water over infiltration areas and/or trenches. An easy way of promoting infiltration is to place raised storm sewer inlets within recessed landscaped areas. Curb cuts will allow runoff to enter the mini-retention/detention area where infiltration can occur before the stormwater rises to the elevation of the inlet.

Infiltration allows a certain amount of the ponded water to be purified by the soil. Before using infiltration techniques in conjunction with parking lot storage a determination must be made as to the possible effect upon groundwater. Other infiltration practices such as porous pavement, concrete grid and modular pavement, grassed waterways, filter strips and seepage areas can also be used in conjunction with parking lot storage to reduce nonpoint source pollution.
Figure 15  Parking Lot Storage
Discharge control structures should be inspected periodically and following each storm. Accumulated debris and litter should be removed as necessary to assure proper functioning. Parking lot surfaces must be cleaned following storms to provide a reasonable level of pollution control and reduce accumulation of litter, debris, traffic-generated residues and other nonpoint source pollutants. Sweeping or vacuuming is recommended.

**Bioretention Islands**

**Definition**

Bioretention systems are flat, landscaped areas used primarily for the water quality treatment of stormwater. Water quality is improved through filtration, sedimentation, and biological processes. Figure 16 illustrates a typical bioretention island application. Bioretention systems may also be sized to meet water quantity control requirements. Bioretention can be implemented as "islands" receiving runoff from surrounding paved areas. These systems capture all of the runoff from small storms and the initial runoff from larger storms. Temporary shallow ponding occurs in these systems while the remaining stormwater flow from large storms can be bypassed or directed to other stormwater management systems. Figure 17 shows the bioretention island with a centralized stormdrain. Bioretention is an approved BMP in the Design Manual.

**Design Criteria**

Bioretention islands can have almost any shape but should be at least 10 feet wide, although smaller widths are used. In parking lot applications they may look like long strips between rows of parking stalls. The sites are landscaped with a variety of native water-tolerant plants including trees, shrubs and herbaceous vegetation. Runoff may need to be directed to the islands. Excess water either bypasses or flows through the facility. To reduce the possibility of clogging caused by fine sediments, stormwater can be passed through a grass filter prior to entering the bioretention area. If stormwater flows are concentrated, a dispersion trench is used to slow and spread out flows prior to entering the grass filter. However, space limitations may preclude the use of filters or dispersion trenches. Design criteria for bioretention practices are provided in the Design Manual.
Figure 16  Bioretention Islands

Figure 17  Bioretention Island with Storm Drain Inlet
Applicability

These types of bioretention systems can be used in almost any type of land use or in-situ soil. Bioretention islands are well suited for the retrofitting of existing development where available space is limited and grade adjustments are difficult. Where there are adverse slopes, a pipe below grade may be used to supply water to the area. The reduction in water requirements for plants in these systems eases maintenance and makes this technique particularly attractive for parking lots, street intersections, and paved areas adjacent to roads. In areas where safety may be compromised if sight lines are blocked by tall vegetation, a short ground cover can be planted.

The sources for additional information include: Prince George's County (1999), Bioretention Manual. Maryland Department of the Environment (MDE), 2000 Maryland Stormwater Design Volumes I & II.
STREETS, SIDEWALKS AND ALLEYS BMPS

Alley Filter

Definition

Alley filters are BMPs that can be used to serve as a filtering, or a combination of filtering and storage device, in alleyways. A filter device, such as the perimeter (Delaware) sand filter can be used to provide treatment of runoff from rooftops, backyards and alleyways. In addition subsurface storage can be achieved by coupling the filter device to an oversized pipe with a low flow control to regulate the discharge rate from the storage pipe.

Design Criteria

Criteria for the alley filters are contained in the design procedures for the filter device as provided in the Design Manual.

Grated Sidewalk Infiltration / Filtration Systems

Definition

Grated sidewalk infiltration/filtration systems are typically installed to protect trees located along sidewalks or in parking areas and may be retrofitted to provide off-line stormwater management using curb cuts to divert runoff. These locations can be used in combination with a grate over an infiltration system, or over a perimeter sand filter. Grated infiltration trenches, and sand filters can also be installed over pedestrian crossings and along the periphery of parking lots. Figure 18 illustrates a typical grated sidewalk infiltration/filtration system.

Design Criteria

Grated sidewalk infiltration/filtration systems must be sized and designed following the guidelines for infiltration trenches provided in the Design Manual. Grated infiltration trenches usually receive stormwater inputs through a curb-and-gutter system or as sheet flow. Overflow may be directed to other controls or to landscaped areas. A replaceable sand or cloth filter above the in-situ soils improves long-term performance and eases maintenance. The grate must be capable of bearing the weight of pedestrians and or vehicles. In areas where pedestrian traffic is expected, the grating should be alternated with nongrated surfaces to allow safe passage. The grates should be removable to allow for maintenance.
Pedestal Sidewalks

Definition

Pedestal sidewalks are a special application of modular paving. Storage can be made available under flat surfaces by using spacers to create pedestals that support paving units over the subgrade. Water infiltrates through the interstices in the paving units and fills the space underneath. The water can be slowly removed through evaporation, infiltrated into the surface soils, or directed to a sand filter device. Figure 19 illustrates a typical pedestal sidewalk.

Design Criteria

If infiltration is used as part of the design, the sizing and design must follow the procedures provided in the Design Manual. Likewise if a filter device is used for the treatment the sizing and design must follow the procedures provided in the Design Manual.

The spacers should be stacked to achieve at least one inch of storage. A sufficient number of pedestals must be provided to assure that the pavers are stable. The storage space must be contained in a rigid frame to prevent the pavers from shifting. The pavers should be inspected annually to determine if removal is required to clean the storage space of sediment.
Applicability

This practice can be used wherever pavers are used. The need for inspection and maintenance must be considered when implementing this BMP.
STORMFILTER®

The StormFilter® is a proprietary BMP that has been used in Baltimore City. StormFilter® is a trademark of Stormwater Management, Inc. It consists of a premanufactured vault containing filtration cartridges. These cartridges are filled with an array of media, selected to treat the specific pollutant loadings at each site. These site-specific media options give the system the ability to remove high levels of stormwater pollutants such as sediments, oil and grease, soluble heavy metals, organics and soluble nutrients.

The StormFilter® should be sized to meet the water quality volume criteria of the Design Manual. The system typically requires 2.3 feet of head differential between the inlet and the outlet.

Figure 20. StormFilter

Selecting and Sizing your StormFilter

Overview

There are four different StormFilter models, Catch Basin, Linear, Precast and Cast-In-Place. The Catch Basin model is designed to replace a standard catch basin and can treat flows up to 0.13 cfs. The Linear model consists of one or two precast concrete channels that are 10’ or 20’ long and 2’9” in width. The Precast StormFilter can consist of one or
more precast concrete vaults ranging from 6’x8’ to 8’x18’ in size. These units treat peak water quality design flows up to 2.0 cfs. The Cast-In-Place models are for higher flows.

The discussion here will focus on the Precast model, but similar principles apply to the other units. Precast units can be placed in series or in parallel to treat higher flows if needed. The Precast units have an internal bypass capability of 2.2 cfs. If peak flows to the system exceed 2.2 cfs, a high flow bypass is needed.

Typically, a Precast StormFilter is installed online with the storm system. It can be installed with a traffic-bearing lid for parking lot applications, and it takes up no land area. However, if detention, pretreatment, or bypassing is required, the StormFilter can be installed offline of the storm system. For examples of possible offline StormFilter configurations, see the web site at: http://www.stormwatermgt.com/products/stormfilter.

Design operation

The typical precast StormFilter unit is composed of three bays: the inlet bay, the filtration bay, and the outlet bay. Stormwater first enters the StormFilter vault and the inlet bay through the inlet pipe. The stormwater is then directed through a flow spreader and over an energy dissipater into the filtration bay for full treatment. The flow spreader in the inlet bay acts as a baffle, trapping some floatables, oils, and surface scum as the stormwater is directed towards the filtration bay.

Once in the filtration bay, the stormwater begins to pond and percolate horizontally through the media contained in the filter cartridges. After passing through the media, treated water that has collected in the cartridge center tube is directed into the outlet bay by an under-drain manifold. The treated water in the outlet bay is then discharged through the single outlet pipe.

Applications

The Precast StormFilter can be used for the following applications:
- Parking lots
- Roadways
- Residential developments
- Retail/commercial developments
- Business/industrial sites
- Maintenance facilities

Special Considerations

When designing the Precast StormFilter into your system, you should consider the following:
- The single or series precast units should maintain 2.3 feet of drop from the invert of the inlet to the invert of the outlet.
- Stormwater Management recommends a minimum of 4.5 feet of headroom inside the vault for maintenance access.
- For depths greater than 12 feet, contact Stormwater Management for information on additional vault requirements.

Figure 21. StormFilter Plan View
REFERENCES:


Maryland Department of the Environment (MDE), 2000 Maryland Stormwater Design Volumes I & II.

Richman, T. (1999), Start at the Source, prepared for Bay Area Stormwater Management Agencies Association (BAASMA), Forbes, New York


MDWRA, 1984, Maryland Standards and Specifications for Infiltration Practices in Stormwater Management, prepared by Michael Clar, Hydro-Terra, Inc., and Richard McCuen, University of Maryland, prepared for the Maryland Water Resources Administration, Annapolis, MD


ATTACHMENT E

STORMWATER MANAGEMENT PERMIT REVIEW
AND PENALTY FEE SCHEDULE AND BOND INSTRUCTION FORMS
# STORMWATER MANAGEMENT PERMIT REVIEW
## AND PENALTY FEE SCHEDULE
### BALTIMORE CITY
#### DEPARTMENT OF PUBLIC WORKS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>FEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWM Concept Review Fee</td>
<td>$500</td>
</tr>
<tr>
<td>SWM Plan Review for 2 acres or less, waivers or simple projects</td>
<td>$2500</td>
</tr>
<tr>
<td>SWM Plan Review for more than 2 acres</td>
<td>$4000</td>
</tr>
<tr>
<td>SWM Master Plan Review</td>
<td>$8000</td>
</tr>
<tr>
<td>Critical Area Review</td>
<td>$1000</td>
</tr>
<tr>
<td>Civil Fines for Minor Infractions (each day is a separate offense)</td>
<td>$500 per offense</td>
</tr>
<tr>
<td>Criminal Penalties (each day is a separate offense)</td>
<td>$1000 per offense</td>
</tr>
<tr>
<td>Miscellaneous charges - not provided for elsewhere</td>
<td>$35 per hour for inspection</td>
</tr>
<tr>
<td>Miscellaneous charges - not provided for elsewhere</td>
<td>$60 per hour for engineering review</td>
</tr>
</tbody>
</table>

Fees collected by Baltimore City Department of Public Works.
BOND INSTRUCTION FORMS

A. INSTRUCTIONS FOR BOND

1. Performance Bonds Surety (Insurance Company Bonds), Letter of Credit, Certified Check, Cash or Assignment of Credit. All performance bonds will be 100% of construction cost.

2. The bond number will be the same number as the public stormwater system permit (i.e., SD33333A).

3. See instructions for authorized Bank and how to fill out form.

4. All bonds and filled out forms are to be returned to this office to be processed. No permit will be issued until the bond is completed and accepted.

B. INSTRUCTIONS FOR BANKS/BONDING COMPANIES:

SURETY BONDS: (Requires only the bond forms)

1. Surety/Bonding Company will date bond document in upper right-hand corner.
2. Surety/Bonding Company will check appropriate space and insert their bond number.
3. Surety/Bonding Company will type in Corporation name in last paragraph.
4. Surety/Bonding Company will type in Corporation name at lower right-hand corner.
5. Attorney-in-Fact will sign and include Agency Address & Certification/License No.
6. Counter-signature by Maryland Resident Agent (if required by Maryland law).
7. Surety/Bonding Company must furnish a Power of Attorney for each bond.
8. Power-of-Attorney must have current date and include raised seal.

LETTER OF CREDIT: (Requires letter of credit from bank/bond form)

1. Bank will prepare Letter(s) of Credit on Bank's letterhead.

SAVINGS ACCOUNT: (Requires Assignment form/bond form)

1. Bank to complete date on first line. Name and address of bank on line 2.
2. Bank to fill in account number being assigned to Prince George's County.
3. Bank to type in Bank's name (above signature blocks).
4. Signature and title of officer of bank, with witness on left side of signature.
5. Notary Public to complete top portion of Acknowledgment for Bank's signature.
6. Contractor to sign where indicated, including title.
7. Witness to signature.
8. Notary Public to complete lower section of Acknowledgment for contractor’s signature.

CASH BOND:

(Requires bond form only)

1. Permittee to sign bond document in lower right-hand corner.
2. Witness to signature.
3. Notary public to complete Acknowledgment section.

C. INSTRUCTIONS FOR PRIVATE DEVELOPER

1. In all cases, except corporate surety bond, permittee will fill in date in upper right-hand corner of bond document.
2. Permittee will check appropriate space for type of security being offered.
3. Permittee to sign in lower right-hand corner. Signature must include title of person and date of signature.
4. Witness to signature.
5. Acknowledgment portion of bond is to be complete by a Notary Public.

Also attached is the acceptable form of letter of credit.
SAMPLE:  IRREVOCABLE STANDBY LETTER OF CREDIT

IRREVOCABLE STANDBY LETTER OF CREDIT

LETTER OF CREDIT NO :_______ DATE OF ISSUE:

BENEFICIARY:  APPLICANT:

Mayor and City Council of Baltimore
100 Holliday Street
Baltimore, MD 21202

WITH A MAIL TO:

Development Center
204 Abel Wolman Municipal Bldg.
200 Holliday Street
Baltimore, Maryland 21202

EXPIRY DATE:
PLACE OF EXPIRATION: AT OUR COUNTERS

RE:  Permit_______

Dear Sir(s):

We hereby issue this Irrevocable Standby Letter of Credit in favor of the Beneficiary (the “City”), which is available by one or more sight drafts drawn on us accompanied by the following:

(1) The original of the Letter of Credit.
(2) A written statement signed by the authorized representative of the City that (a) the draft is drawn under Issuer's Standby Letter of Credit No. _______ in connection with permit _______; (b) the requirements for discharge if the bond have not been satisfied; and (c) the amount of the draft is ________.

The expiry date of this Letter of Credit shall be automatically extended at each expiry date for an additional calendar year unless the authorized representative of the City shall receive notice of non-extension by registered mail, return receipt requested, no less than forty-five (45) days prior to such expiry date.
This Letter of Credit sets forth the full terms of Issuer's Obligation to the City. It is separate from and shall not be subject to or supplemented or modified by any agreement, which refers to this Letter of Credit or to which this Letter of Credit relates.

Except as otherwise stated, this Letter of Credit is governed by the Maryland Uniform Commercial Code and is subject to the "Uniform Customs and Practice for Documentary Credits" (1983 Revision) International Chamber of Commerce Publication No. 500. In case of conflict between the Maryland Uniform Commercial Code and the Uniform Customs and Practice for Documentary Credits, the Maryland Uniform Commercial Code shall control.

We hereby agree to honor each draft drawn under and in compliance with the terms of this Letter of Credit if duly presented at the address of Issuer given above or at a branch office of Issuer within Baltimore City on or before the expiry data set forth above.

Very Truly Yours,

By:______________________________
SAMPLE: STORMWATER MANAGEMENT PERFORMANCE BOND

STORMWATER MANAGEMENT PERFORMANCE BOND NUMBER _______ PB

DATE: __________

RE: PERMIT NO. _______ for construction related to

SUBDIVISION/ ADDRESS: __________________________________________________

KNOW ALL MEN BY THESE PRESENTS THAT:

As a condition precedent to issuance of the above Permit (the "Permit),

PERMITTEE ______________________________________, hereby binds
itself and its successors and assigns, to pay to the Mayor and City Council of Baltimore
(the "City") the full amount of _________________________________________
($____________) subject to the conditions stated below. To secure said payment,

Permittee has provided the City with the following Security in the full amount of this

Bond:

from____________________________________________________________Bank

The condition of this Bond is that if Permittee shall fully perform the following
requirements in a manner satisfactory to the City, then this Bond shall be discharged, but
otherwise it shall remain in full force and effect:

1. Complete within the prescribed time limits all work required under the terms
and conditions of the Permit, including the application, plans and
specifications, as approved by the City, and Subtitle - of the Baltimore City
Code (the "Ordinance").

2. Provide and maintains the Security in full force and effect until all work under
this Permit, including stormwater management facilities, where applicable, is
completed and accepted by the City.

3. Indemnify and save harmless the City from all expenses, damages, claims, and
actions arising from or relating to the performance or nonperformance of the
work under the Permit by Permittee or its agents, employees, or subcontractors.

If Permittee fails to satisfy any of the above Requirements, the City shall enforce this
Bond and draw upon the Security for up to the full amount thereof unless Permittee
promptly completes, and has accepted, by the City, all work required under this Bond, the
City should not thereby incur any liability to complete the work. If the Permittee
afterwards completes the work as required, the City shall return the Security or its
proceeds less the amount of any claims, damages, or costs incurred by the City in connection with this Bond.

If the City is prevented from drawing upon the Security, Permittee shall pay interest on the unpaid amount of the demand at the rate of ten percent (10%) per annum. If suit is filed to collect on this Bond or the Security, Permittee shall pay the costs of the collection, including attorney's fees at the rate of $60 per hour.

SURETY ______________ binds itself and its successors and assigns to pay the full amount of this Bond in accordance with and subject to the terms and conditions set forth above.

SIGNED AND SEALED on the date set forth above.

PERMITTEE:____________________________

____________________________ BY:_____________________(SEAL)_______

WITNESS  Date

Print Name:_______________________________
Print TITLE:_______________________________

____________________________ BY:_______________________Date_________

WITNESS                                                     (Attorney-In-Fact)

SURETY:______________________________(SEAL)

____________________________

WITNESS  AGENCY NAME:_______________________
ADDRESS:_______________________________
APPROVED:  

Certification/License: ________________

Counter-signed by Maryland Resident
Agent Director of Public Works (if required by Maryland law)

_______________________________
_______________________________
City Attorney

ACKNOWLEDGEMENT

State of ____________________________
City of _____________________________

On this _______ day of ______________________, 20__, before me a Notary Public of the State and City aforesaid, personally appeared

__________________________________ who acknowledged that he/she is the -

__________________________ of the Permittee identified in the above Bond and that being so authorized he/she executed the above Bond for and on behalf of the Permittee.

_____________________________  My Commission expires: __________
Notary Public
ATTACHMENT F

STORMWATER MANAGEMENT PLAN CHECKLIST
STORMWATER MANAGEMENT PLAN CHECKLIST

DATE

OBJECTIVE

The reasons for this checklist are:

1. To guide the engineer with developing a complete submittal.
2. To guide the Baltimore City Environmental Engineering Section’s plan reviewers in their review.

LEGEND FOR REVIEW CHECKLIST

√ - Accepted  X - Not Accepted  Inc - Incomplete
NA - Not Accepted  R - Required

Review #_______  ESD #_________  Plan #_______  Contract #_________

Project Name________________________________________
Address_____________________________________________
Official Property Owner________________________________
Owner’s Mailing Address________________________________
Engineer’s Mailing Address______________________________
Engineer’s Phone Number_______________________________

GENERAL SUBMITTAL REQUIREMENTS

<table>
<thead>
<tr>
<th>FINAL PLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Final Plan must include this checklist, compiled by the consultant.</td>
</tr>
<tr>
<td>2. The submittal must consist of 2 copies of all documents, including the SWM Report and the SWM Drawings, with signed P.E. seal.</td>
</tr>
<tr>
<td>3. The Final Plan submittal must concur with the approved concept plan.</td>
</tr>
</tbody>
</table>

STORMWATER MANAGEMENT - FINAL PLAN CHECKLIST

<table>
<thead>
<tr>
<th>Status</th>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SWM REPORT</td>
</tr>
<tr>
<td></td>
<td>must be on 8½” x 11”, with maps included under same cover</td>
</tr>
<tr>
<td>1.</td>
<td>Narrative – should address the following</td>
</tr>
<tr>
<td>a.</td>
<td>Existing and proposed site conditions</td>
</tr>
</tbody>
</table>
### STORMWATER MANAGEMENT - FINAL PLAN CHECKLIST

<table>
<thead>
<tr>
<th>Status</th>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SWM DRAWING</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Cover Sheet</td>
</tr>
<tr>
<td>a.</td>
<td>Vicinity map at scale 1&quot;=2000'</td>
</tr>
<tr>
<td>b.</td>
<td>Earthwork tabulation</td>
</tr>
<tr>
<td>c.</td>
<td>Zoning/setbacks</td>
</tr>
<tr>
<td>d.</td>
<td>Outfall statement</td>
</tr>
<tr>
<td>e.</td>
<td>Stormwater Management Note</td>
</tr>
<tr>
<td>f.</td>
<td>Impervious Area Tabulation</td>
</tr>
<tr>
<td>g.</td>
<td>Owner/Developer name, contact person and telephone number</td>
</tr>
<tr>
<td>h.</td>
<td>Engineer/Design Professional signature and seal</td>
</tr>
<tr>
<td>i.</td>
<td>Engineer/Design Professional organization and telephone number</td>
</tr>
<tr>
<td>2.</td>
<td>DRAINAGE AREA MAPS –Image must extend at least 100 feet outside the site and 100 feet downstream of the proposed outfall at a scale of 1&quot;=200'. Provide the following information:</td>
</tr>
<tr>
<td>a.</td>
<td>Pre-development site conditions, land use and runoff flow paths</td>
</tr>
<tr>
<td>b.</td>
<td>Post-development features and Tc flow paths</td>
</tr>
</tbody>
</table>
**STORMWATER MANAGEMENT - FINAL PLAN CHECKLIST**

<table>
<thead>
<tr>
<th>Status</th>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>h.</td>
<td>Impervious surface – pavement, curb lines, sidewalks</td>
</tr>
<tr>
<td>i.</td>
<td>Vegetation, landscape areas, areas to be sodded</td>
</tr>
<tr>
<td>j.</td>
<td>Soil types, soil boring locations</td>
</tr>
<tr>
<td>k.</td>
<td>Wetland and Stream Buffer limits</td>
</tr>
<tr>
<td>l.</td>
<td>Forest conservation areas</td>
</tr>
<tr>
<td>m.</td>
<td>100-year floodplain, if applicable, and any on-site wetlands</td>
</tr>
<tr>
<td>n.</td>
<td>Existing Utilities – checked against record drawings, and verified in field and/or with utility companies</td>
</tr>
<tr>
<td>o.</td>
<td>Proposed utilities – shown with proper symbols</td>
</tr>
<tr>
<td>p.</td>
<td>Legend of drawing lines and symbols</td>
</tr>
<tr>
<td>q.</td>
<td>North arrow</td>
</tr>
<tr>
<td>r.</td>
<td>Drawing scales</td>
</tr>
<tr>
<td>s.</td>
<td>Proposed drainage facilities (grassed swales, roof drain locations, pipes, infiltration devices, outfall, etc.) each identified with sizes</td>
</tr>
<tr>
<td>t.</td>
<td>Construction details for all components of proposed drainage system and stormwater management facilities</td>
</tr>
<tr>
<td>u.</td>
<td>Drain structures numbered S-1, S-2, M-1, M-2, etc. starting from downstream end of system, and inlet structures numbered 1-1, 1-2, etc. starting from downstream end of system</td>
</tr>
<tr>
<td>v.</td>
<td>Structure schedules, as needed</td>
</tr>
<tr>
<td>w.</td>
<td>Storm drain profile including hydraulic grade line</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>x.</td>
<td>Pond profile along embankment and through spillway</td>
</tr>
</tbody>
</table>
y. | Pond profile or other BMP sections and details |
z. | BMP dimensions, setbacks, easements, easements, etc. |
|aa. | BMP access |
|bb. | Construction specifications |
|cc. | Sequence of construction |
|dd. | Site tabulation – total disturbed area, predevelopment impervious, total impervious area |
|ee. | Table showing unified sizing criteria volumes required |
|ff. | Table of materials to be used for stormwater management facility planting |
|gg. | Maintenance schedule for private SWM practices |
|hh. | Owner/developer certification |
|ii. | Engineer's certification |
|jj. | Maintenance and liability certification |
|kk. | As-built certification signature block to be completed after project completion. |

### III CRITICAL AREA

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
a. Worksheets |

F-5
ATTACHMENT G

MAINTENANCE AGREEMENT
DECLARATION OF COVENANTS

Inspection/Maintenance Agreement For Stormwater Management Facility

This Declaration, made this ___day of_______, 20___, between hereinafter referred to as the "Owner" of the following property: Baltimore, Maryland, hereinafter referred to as the "Property" and City of Baltimore, Maryland, hereinafter referred to as the "City".

W I T N E S S E T H:

The Owner, with full authority to execute deeds, mortgages, other covenants, and with all rights, titles and interests in the Property described above, does hereby covenant with the City as follows:

1. The Owner hereby agrees to provide maintenance for the stormwater management facility hereinafter referred to as the "Facility", located on and serving the above-described Property to ensure that such Facility is and remains in proper working condition in accordance with the approved plans on file with the City, with the design standards, and with the law and applicable regulations.

   The Facility shall be maintained on a periodic schedule as noted on the approved plans on file with the City. The Owner from time to time shall provide the City, on demand, with a statement certifying compliance with the maintenance responsibilities for the Facility.

2. The Owner hereby grants to the City a non-exclusive easement in, over and through the Property, as shown on the plat attached hereto as Exhibit A and by reference made a part hereof, for the purposes of providing access from public right-of-ways to the Facility and to allow for inspection, maintenance, and repairs to the Facility.

3. The Owner hereby grants to the City, or its agents its right of entry to the Facility for the purpose of inspecting or maintaining the Facility.

4. If, after reasonable notice by the City, the Owner shall fail to maintain the Facility in accordance with the approved plans, standards, laws, and regulations, the City may perform all necessary repair and maintenance work, and the City may assess the Owner for the cost of the work and any applicable penalties. The cost of the work and any applicable penalties may be placed on the property tax bills of said Property and collected as ordinary taxes by the City.
5. The Owner hereby indemnifies and saves the City harmless from any and all claims for damages to persons or property arising from the maintenance, repair, operation or use of the Facility other than claims resulting from City's negligence.

6. The covenants contained herein shall run with the land and shall bind the Owner, its heirs, executors, administrators, successors and assignees, and shall bind all present and subsequent owners of the Property.

7. This Declaration shall be recorded in the City Land Records.

IN WITNESS WHEREOF, this Declaration has been signed and sealed as of the day and year first above written.

WITNESS:

______________________________ (SEAL)

BY:

STATE OF MARYLAND, CITY OF BALTIMORE, TO WIT:

I HEREBY CERTIFY that on this ______ day of ______, 20____, before me, the subscriber, a Notary Public of the State of Maryland, in and for Baltimore City, personally appeared __________________________, the __________, of __________________________, and acknowledged this Declaration of Covenants to be the act and deed of

______________________________
Notary Public

My Commission Expires:____________________
CERTIFICATION

THE UNDERSIGNED hereby certifies that the above instrument was prepared by an attorney admitted to practice before the Court of Appeals of Maryland, or under the supervision of an attorney admitted to practice before the Court of Appeals of Maryland, or by one of the parties named in the instrument.

AFTER RECORDING, PLEASE RETURN TO:
DEVELOPMENT CENTER
ABEL WOLMAN MUNICIPAL BUILDING, RM 204
200 HOLLIDAY STREET
BALTIMORE, MARYLAND 21202
ATTACHMENT H

CERTIFICATION STATEMENTS
**Engineer's Certification**

I hereby certify that this plan has been prepared by me or under my supervision and meets the minimum standards of the Baltimore City Department of Public Works requirements and specifications.

<table>
<thead>
<tr>
<th>Print Name</th>
<th>Address</th>
<th>Phone Number</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Signature</th>
<th>Date</th>
<th>License #</th>
</tr>
</thead>
</table>

**Developer's / Landowner's Certification**

I/we certify that all proposed work shown on these construction drawing(s) and on the approved Sediment Control drawings(s) will be accomplished pursuant to these plans. I/we also understand that it is my/our responsibility to have the construction supervised and certified including the submittal of "As-Built" plans within thirty (30) days of completion, by a registered professional engineer.

<table>
<thead>
<tr>
<th>Owner/Developer</th>
<th>Address</th>
<th>Phone Number</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
</table>
As-Built Certification

I hereby certify that the facility shown on this plan was constructed as shown on the "as-built" plans and complies with the approved plans and specifications.

<table>
<thead>
<tr>
<th>Print Name</th>
<th>Address</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signature</td>
<td>Date</td>
<td>License #</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Maintenance and Liability

Maintenance of the Stormwater Management Facility and appurtenant drainage structures shall be the responsibility of the property owner. The property owner shall also be fully liable for all damages or injuries that may be sustained by any person or property as a result of any failure or malfunction of the Stormwater Management Facility and appurtenances.

<table>
<thead>
<tr>
<th>Owner/Developer</th>
<th>Address</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signature</td>
<td>Date</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ATTACHMENT I

NOTICE OF COMPLETION
MARYLAND DEPARTMENT OF THE ENVIRONMENT
WATER MANAGEMENT ADMINISTRATION
NOTICE OF CONSTRUCTION COMPLETION FORM

Jurisdiction  Baltimore City

Structure/Project Name ________________________________________________

Structure/Project Address _____________________________________________

Location:
Northing (or Latitude)* ______________________________________________
Easting (or Longitude)* ______________________________________________
ADC Map Coordinates* _________________________________________________

State Watershed Designation*__________________________________________

Structure Drainage Area:
Facility Drainage Area (acres) ____________ Total Project Area (acres) ____________

Landuse Code*  Runoff Curve Number

Structure Description:
Structure Type (Check One):
Detention Structure (Dry Pond)  Dry Well
Extended Detention, Dry  Extended Detention, Wet
Infiltration Basin  Infiltration Trench
Oil Grit Separator/WQ Inlet  Porous Pavement
Retention Structure (Wet Pond)  Sand Filter
Shallow Marsh (Artificial Wetland)  Underground Storage

Other (Describe) ____________________________________________________________

Facility Site Location: On-Site Facility _______ Off-Site Facility _______
Permit Approval Date  _____________________ Permit or Structure Number ________
Construction Completion Date ________________________
General Comments: __________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

The person completing this form should provide the following information:
Name: ________________________  Title ______________________  Phone _______________

Signature: __________________________________________  Date: _____________________