

Unified Rules and Regulations
for Stormwater Management
for use by
Planning Boards, Boards of Health, and
Conservation Commissions

Developed by the
Buzzards Bay National Estuary Program

John Rockwell,
Environmental Planner

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draft final



Buzzards Bay National Estuary Program

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Dear Municipal Official,

During the past fifteen years, the Buzzards Bay National Estuary Program¹ has been providing grants and technical assistance to municipalities around Buzzards Bay to remediate existing stormwater discharges that are contributing to water quality decline and subsequent closure of shellfish beds and swimming areas. At the same time, we have also been helping these municipalities prevent any new stormwater discharges to rivers, ponds, and our bays so that municipalities are not forced to fix these new problems down the road, typically at taxpayer expense. Preventing new direct untreated discharges to surface waters was one of the most important goals in the Buzzards Bay Comprehensive Conservation and Management Plan. It was common sense; it is simply true that an ounce of prevention is worth a pound of cure.

The question is, "How do communities go about preventing new stormwater discharge problems?" In the past, many Planning Boards, Conservation Commissions, and Boards of Health have adopted regulations or policies that address stormwater discharges. However, we have found that many of these regulations do not meet the current objectives of the town board that has adopted them. For example, many local regulations that address stormwater, only deal with controlling stormwater flow rate, and not stormwater volume or quality. A town can prevent new shellfish bed closures or other degradation of water quality only if rate, volume and quality of stormwater discharges are simultaneously addressed.

In addition to stormwater controls by individual boards, we have observed a lack of consistency - and sometimes outright contradiction - between town boards. More than once we have heard a developer complain "One board asked me to do one thing, and the other board just the opposite!"

To address these problems, in 1996 the Buzzards Bay National Estuary Program has developed a set of "Unified" regulations to ensure consistency among Planning Boards, Conservation Commissions, and Boards of Health in addressing stormwater issues in their community. We called these the "Unified Rules and Regulations for Stormwater Management for use by Planning Boards, Boards of Health, and Conservation Commissions." These rules went beyond the later-issued state Stormwater Policy, which was directed only to Conservation Commission's for implementation of the state's Wetlands Protection Act. The principal behind these regulations was simple:

¹ *The Buzzards Bay National Estuary Program, a unit of the Massachusetts Office of Coastal Zone Management, is often confused with two non-profit corporations: the Buzzards Bay Action Committee (BBAC)- an organization composed of municipal officials, and the Coalition for Buzzards Bay, a citizens group. All three organizations are working together to implement the Buzzards Bay Comprehensive Conservation and Management Plan.*



1) No new construction, whether public or private should create any new direct untreated stormwater discharges that degrade water quality or living resources. (Justification: it is cheaper to prevent new stormwater discharge problems than to fix them.)

2) Stormwater must be treated onsite. (Justification: New private development should not discharge stormwater to public sewer or stormwater systems that may already be overburdened and thereby become the problem of the taxpayer)

In the last 10 years, much progress has been made on how to regulate and manage stormwater discharges. New concepts and strategies have arisen to promote "Low Impact Development," especially strategies to minimize the discharge of untreated stormwater to surface water and wetlands. In 2003, the US Environmental Protection Agency issued to all towns in the Buzzards Bay watershed a stormwater permit for their collective municipal stormwater discharge networks (called small municipal separate storm sewer systems or MS4 permits). These permits require that town boards coordinate and adopt consistent regulations to treat stormwater and to meet the goals and objectives of the stormwater permit.

Because of these changes, and because we have seen more clearly which regulatory standards work, and which do not work well, we have updated our 1996 model unified stormwater regulations with the attached 2006 update. As before, each town board identically uses the detailed regulations in Appendix A to ensure consistent implementation of stormwater management. Only the authorizing preamble is different to match the legal authority of the respective boards.

At first glance, these model regulations may seem too complex for your board to implement. It is true that the regulations enclosed are technical and detailed, but they have a very specific target audience – the applicant's engineer. Moreover, most town boards have the authority to hire a stormwater specialist for complex projects (at the applicants expense) to professionally review these plans. When a new subdivision is submitted to a town today, an engineer prepares a copy of the subdivision plan including drainage and stormwater treatment. Regrettably, many of these plans still address only one aspect of stormwater treatment--keeping stormwater off the roads and people's properties, and not treating that stormwater to prevent water quality degradation. Even when stormwater treatments are proposed, the designs may not truly protect water quality. The enclosed regulations will help ensure that the town's environmental protection goals are met, and designs are developed to address the specific problems of concern.

In preparing these updated regulations, we have used design standards from state-of-the-art stormwater Best Management Practices manuals and incorporated the latest concepts in stormwater design, and new runoff curve numbers to properly evaluate low impact development strategies. The Buzzards Bay National Estuary Program has adopted the standard of treating the "first flush" of runoff from a 1¼ inch rainfall on the impervious surface within a watershed. It is the first flush that contains the greatest pollutant load contributing to water quality degradation. A rainfall of 1¼ inch or greater occurs in the Buzzards Bay area on average every 4 months. This rule captures on average 90% of the rainfall volume that falls in a given year. We believe this

first flush standard more adequately protects water quality in the watershed.

How do towns go about adopting these stormwater regulations? In many cases, a town board need only have a public hearing and vote upon a set of regulations, but the process will vary depending upon what rules and regulations a town may already have upon its books. In some situations town meeting approval may be required for certain bylaw or regulation changes. If your town needs assistance in implementing these stormwater regulations, please contact the Buzzards Bay National Estuary Program for free technical assistance.

If you have any questions regarding these materials, do not hesitate to contact John Rockwell at the Buzzards Bay National Estuary Program office at 508-291-3625 x14. A digital copy of the regulations is available at the BBNEP website, www.buzzardsbay.org

Sincerely,

Joseph E. Costa, PhD
Executive Director

{Board of Health}

{Example preamble authorization, Appendix A and B should be attached}

Board of Health Regulations for Stormwater Quality and Quantity Control in {townname}, Massachusetts

1. Authority:

These regulations are adopted under the provisions of MGL Chapter 111, Section 31.

2. Purpose and Goals:

The purpose of this Bylaw is to protect, maintain and enhance the public health, safety, environment and general welfare by establishing minimum requirements and procedures to control the adverse effects of increased post-development stormwater runoff and nonpoint source pollution associated with new development and redevelopment. It has been determined that proper management of post-development stormwater runoff will minimize damage to public and private property and infrastructure, safeguard the public health, safety, environment and general welfare of the public, protect water and aquatic resources, and promote groundwater recharge to protect surface and groundwater drinking supplies.

3. Jurisdiction:

Except as permitted by these regulations, no person shall alter land within the town without having obtained a Stormwater Management Permit (SMP) for the property with the following exceptions:

- a. Any activity that will disturb an area less than [5000] square feet or less than [25%] of a contiguous property, whichever is less. This exception may not be applied for contiguous properties held in common ownership at the time of adoption of this Bylaw that may have been previously subdivided and/or are attributed to multiple separate owners;
- b. Normal maintenance and improvement of land in agricultural use as defined by the Wetlands Protection Act regulation 310 CMR 10.04 and MGL Chapter 40A Section 3.
- c. Maintenance of existing landscaping, gardens or lawn areas associated with a single family dwelling;
- d. Repair or replacement of an existing roof of a single-family dwelling;
- e. The construction of any fence that will not alter existing terrain or drainage patterns;
- f. Construction of utilities (gas, water, electric, telephone, etc.) other than drainage, which will not alter terrain, ground cover, or drainage patterns;
- g. Emergency repairs to any stormwater management facility or practice that poses a threat to public health or safety, or as deemed necessary by the Board of Health;
- h. Any work or projects for which all necessary approvals and permits have been issued before the effective date of these regulations;
- i. Redevelopment projects are presumed to meet the specified stormwater management requirements described in the these regulations if the total impervious cover is reduced by

[40%] from existing conditions.

Notwithstanding a.-i., any alteration, redevelopment, or conversion of land use to a hotspot such as, without limitation: auto salvage yards, auto fueling facilities, fleet storage yards, commercial parking lots with high intensity use, road salt storage areas, commercial nurseries and landscaping, outdoor storage and loading areas of hazardous substances, or marinas, shall require a Stormwater Management Permit.

4. Permits Required:

It shall be the responsibility of the applicant to obtain a stormwater discharge permit from the Board of Health prior to any alteration of land unless otherwise specified in **3. Jurisdiction** a. - i.

5. Submittal Requirements:

The application for a stormwater discharge permit shall consist of submittal of a Stormwater Management Plan (SMP) and applicable fees to the Board. The SMP shall contain sufficient information for the Board of Health to evaluate the environmental impact, and the effectiveness and acceptability of those measures proposed by the applicant for reducing adverse impacts from stormwater.

The Stormwater Management Plan shall contain all information listed in Appendix A as applicable as well as any other information requested by the Board of Health to evaluate the Stormwater Management Plan.

6. Design Standards:

Proposed stormwater treatment facilities should be designed and maintained in accordance with the standards and specifications stated in Appendix A.

7. Maintenance

All stormwater management systems shall be maintained in accordance with these regulations and Appendix A. The following are the minimum standards for the maintenance of stormwater management systems:

- a. Stormwater management systems shall be inspected annually and cleared of debris, sediment and vegetation when they affect the functioning and/or design capacity of the facility,
- b. Where lack of maintenance is causing or contributing to a water quality problem, immediate action shall be taken to correct the problem.
- c. The applicant shall post acceptable surety to cover the cost of maintenance of the selected stormwater management system. The cost shall cover anticipated maintenance costs (including full or partial replacement, if necessary) for a design life of twenty (20) years.
- d. The surety mechanism shall be structured to allow the Town to draw funds as necessary to conduct maintenance activities.

8. Inspection

After the stormwater management system has been constructed and before the Performance Guarantee for the development has been released, the applicant shall submit an "as-built" plan detailing the actual stormwater management system as installed. The Consulting Engineer for the Board of Health shall inspect the system to confirm its as-built features. This engineer shall also evaluate the effectiveness of the system in an actual storm. If the system is found to be inadequate by virtue of physical evidence of operational failure, even though it was built as called for in the Permit, it shall be corrected before the performance guarantee is released. Examples of inadequacy shall be limited to: errors in the infiltrative capability, errors in the maximum ground water elevation, failure to properly define or construct flow paths, or erosive discharges from basins.

{Planning Boards}

{Example preamble authorization, Appendix A and B should be attached}

Rules and Regulations Governing the Subdivision of Land in {townname}, Massachusetts

F. Stormwater Management

1. Stormwater management for each development shall accomplish the following:

- a. reproduce, as nearly as possible, the hydrological conditions in the ground and surface waters prior to the development;
- b. reduce stormwater pollution to the maximum extent possible using Best Management Practices (BMPs);
- c. have an acceptable future maintenance plan covering method and execution;
- d. have a beneficial effect on the natural and human environment;
- e. be appropriate for the site given physical constraints;
- f. provide a sufficient level of health and environmental protection during the construction phase; and
- g. provide proper management prior to the discharge of such runoff onto adjacent property owned by others, into the existing storm drainage system, or wetland resources listed in the Wetland Protection Act Regulations, 310 CMR 10.00.

2. Submittal Requirements:

The applicant shall submit a Stormwater Management Plan (SMP) detailing the existing environmental and hydrological conditions of the site, proposed alterations of the site, and all proposed components of the drainage system and any measures for the detention, retention, or infiltration of water, for the protection of water quality and protection from flooding. The SMP shall contain sufficient information for the Planning Board to evaluate the environmental impact, effectiveness, and acceptability of those measures proposed by the applicant for reducing adverse impacts from stormwater.

The Stormwater Management Plan shall contain all information listed in Appendix A, as applicable, as well as any other information requested by the Planning Board to evaluate the Stormwater Management Plan.

3. Design Standards:

Proposed stormwater treatment facilities should be designed and maintained in accordance with the standards and specifications stated in Appendix A of the Subdivision Rules and Regulations.

4. Maintenance:

All stormwater management systems shall be maintained in accordance with these regulations and Appendix A. The following are the minimum standards for the maintenance of stormwater management systems:

- a. Stormwater management systems shall be inspected annually and cleared of debris, sediment and vegetation when they affect the functioning and/or design capacity of the facility,
- b. Where lack of maintenance is causing or contributing to a water quality problem, immediate action shall be taken to correct the problem.
- c. The applicant shall post acceptable surety to cover the cost of maintenance of the selected stormwater management system. The cost shall cover anticipated maintenance costs (including full or partial replacement, if necessary) for a design life of twenty (20) years.
- d. The surety mechanism shall be structured to allow the Town to draw funds as necessary to conduct maintenance activities.

5. Inspection:

After the stormwater management system has been constructed and before the Performance Guarantee for the development has been released, the applicant shall submit an "as-built" plan detailing the actual stormwater management system as installed. The Consulting Engineer for the Planning Board shall inspect the system to confirm its as-built features. This engineer shall also evaluate the effectiveness of the system in an actual storm. If the system is found to be inadequate by virtue of physical evidence of operational failure, even though it was built as called for in the Definitive Plan, it shall be corrected before the performance guarantee is released. Examples of inadequacy shall be limited to: errors in the infiltrative capability, errors in the maximum ground water elevation, failure to properly define or construct flow paths, or erosive discharges from basins.

6. BMP Location:

Stormwater basin and/or ponds shall be located only on a common lot used for service and utilities, recreation or conservation.

{Conservation Commission}

{Example preamble authorization, Appendix A and B should be attached²}

Conservation Commission Regulations for Stormwater Quality and Quantity Control in {townname}, Massachusetts

Section *. Stormwater Management

1. Stormwater management for each development shall accomplish the following:

- a. reproduce, as nearly as possible the hydrological conditions in the ground and surface waters prior to the development;
- b. reduce stormwater pollution to the maximum extent possible using Best Management Practices (BMPs);
- c. have an acceptable future maintenance plan covering method and execution;
- d. be appropriate for the site given physical constraints;
- e. provide a sufficient level of health and environmental protection during the construction phase; and
- f. provide proper management prior to the discharge of such runoff onto adjacent property owned by others, into the existing storm drainage system, or wetland resources listed in the Wetland Protection Act Regulations, 310 CMR 10.00.

2. Submittal Requirements:

The applicant shall submit a Stormwater Management Plan (SMP) detailing the existing environmental and hydrological conditions of the site, proposed alterations of the site, and all proposed components of the drainage system and any measures for the detention, retention, or infiltration of water, for the protection of water quality and protection from flooding. The SMP shall contain sufficient information for the Planning Board to evaluate the environmental impact, effectiveness, and acceptability of those measures proposed by the applicant for reducing adverse impacts from stormwater.

The Stormwater Management Plan shall contain all information listed in Appendix A, as applicable, as well as any other information requested by the Planning Board to evaluate the Stormwater Management Plan.

² Note: A Conservation Commission could adopt these regulations within a bylaw or as rules and regulations under a bylaw. Please contact the Buzzards Bay National Estuary Program as to the approach appropriate to your town.

3. Design Standards:

Proposed stormwater treatment facilities should be designed and maintained in accordance with the standards and specifications stated in Appendix A of the {town name} Wetlands Protection Bylaw Rules and Regulations.

4. Maintenance:

All stormwater management systems shall be maintained in accordance with these regulations and Appendix A. The following are the minimum standards for the maintenance of stormwater management systems:

- a. Stormwater management systems shall be inspected annually and cleared of debris, sediment and vegetation when they affect the functioning and/or design capacity of the facility;
- b. Where lack of maintenance is causing or contributing to a water quality problem, immediate action shall be taken to correct the problem;
- c. The applicant shall post acceptable surety to cover the cost of maintenance of the selected stormwater management system. The cost shall cover anticipated maintenance costs (including full or partial replacement, if necessary) for a design life of twenty (20) years; and
- d. The surety mechanism shall be structured to allow the Town to draw funds as necessary to conduct maintenance activities.

5. Inspection:

After the stormwater management system has been constructed and before the Performance Guarantee for the development has been released, the applicant shall submit an "as-built" plan detailing the actual stormwater management system as installed. The Consulting Engineer for the Conservation Commission shall inspect the system to confirm its as-built features. This engineer shall also evaluate the effectiveness of the system in an actual storm. If the system is found to be inadequate by virtue of physical evidence of operational failure, even though it was built as called for in the Order of Conditions, it shall be corrected before the performance guarantee is released. Examples of inadequacy shall be limited to: errors in the infiltrative capability, errors in the maximum ground water elevation, failure to properly define or construct flow paths, or erosive discharges from basins.

APPENDIX A

Standards and Specifications for Stormwater Management Systems

Control of stormwater runoff shall meet the design criteria for both flood (volume and peak discharge) control and nonpoint source pollution reduction as indicated below. All assumptions, methodologies, and procedures used to design BMPs shall accompany the design.

I. GENERAL REQUIREMENTS for Stormwater Management Plans (SMPs):

I.A. Flooding: The design and construction of each project shall be done in a manner such that post-development runoff will not exacerbate, create, or otherwise cause flooding conditions, or alter surface water flow paths that will impact adjacent properties, overburden existing drainage systems, or adversely affect wetland resources for the [1, 2, 10, 25, and 100-year 24 hour storm events].

1. There shall be no increase in the peak rate of runoff for any of the above design storms.
 - a. Notwithstanding the provisions of **I.A. Flooding** 1., where the discharge of stormwater is to a coastal resource area, the project shall maintain or reduce the rate of runoff so that said discharge is non-erosive and maintain or reduce the volume of discharge up to the two (2) year, twenty-four (24) hour design storm, provided that there exists no downstream control, such as a bridge or culvert, that restricts the flow of water.
2. There shall be no increase in the volume of runoff for the [ten (10) year, twenty-four (24) hour design storm].
 - a. Notwithstanding the provisions of **I.A. Flooding** 2., where the discharge of stormwater is to the ocean or an estuary, the project shall maintain the volume of discharge up to the two (2) year, twenty-four (24) hour design storm.
3. Discharges to Closed Depressions. Notwithstanding the provisions of **I.A. Flooding** 1. & 2., where the discharge of stormwater is to a closed depression (e.g. kettle hole) solely owned by the applicant with no outlet for storms up to the one hundred (100) year, twenty-four (24) hour design storm, the discharge shall be non-erosive and no other rate or volume standards are required.

I.B. Water Quality: The "first flush" of stormwater runoff shall be treated prior to discharge. The treatment system(s) shall be designed to accommodate the first flush from the entire project area.

1. Treatment shall be provided to achieve 80% removal of total suspended solids (TSS) from the first flush.
2. Any project in a watershed to an area sensitive to increased nitrogen loading [*list watersheds in your town*] shall incorporate treatment processes to remove nitrogen at an efficiency rate of 50% or greater. *Note: Transference of stormwater to groundwater shall not constitute "removal."*
3. Any project in the [*list freshwater ponds*] watershed shall incorporate phosphorous removal at a design rate of 50% or greater.

4. No project in a watershed to a water body on the state 303d list that is closed to shellfishing shall have a surface discharge or discharge to the municipal storm drain system for the first flush.

II. SUBMITTAL REQUIREMENTS:

The existing environmental and hydrological conditions of the site, proposed alterations of the site, and all proposed components of the drainage system and any measures for the detention, retention, or infiltration of water, for the protection of water quality and protection from flooding, shall be described in detail with sufficient information to evaluate the proposed Stormwater Management Plan.

II.A. Site Characteristic Information to be included in the Stormwater Management Plan (SMP) as shown on a site plan:

1. General
 - a. Contact information. The name, address, and telephone number of all persons having a legal interest in the property, and the tax reference number and parcel number.
 - b. a locus map;
 - c. the existing land use at the site;
 - d. location of existing and proposed easements;
 - e. location of existing and proposed utilities;
 - f. location of any public or private water supplies within 100 feet of the property as well as on the property; and
 - g. location of any subsurface wastewater disposal system.
2. Pre-development Conditions:
 - a. the location of all surface waters and wetlands, on or adjacent to the site;
 - b. the delineation of the 100 year flood elevation as indicated on the Flood Insurance Rate Maps (FIRM). If FIRM data does not exist for flooding from a rainfall event, or if the waterbody or watercourse 100-year flood elevation is not indicated on the map, the elevation shall be calculated utilizing an appropriate methodologies such as TR-55 or TR-20 or HEC2;
 - c. the principal vegetation types sufficient to determine an appropriate runoff curve number;
 - d. the soil types on the site and the hydrological soil groups based the most current Natural Resource Conservation Service (formerly SCS) soils map of the site (available at the NRCS office in Wareham); or in the case of sites less than 5 acres in size a high intensity soil survey performed by a certified soil scientist with a minimum soil map unit of 0.04 acres.
 - e. the topography described at 1 foot intervals, with areas of steep slopes over 15% highlighted;
 - f. areas of ponding and swamping;
 - g. the existing watersheds on the property, as well as upgradient areas contributing

- runoff to the property;
- h. the flow path(s);
- i. design points for each watershed; and
- j. soil log locations.

3. Post-development Conditions:

- b. the location of all surface waters and wetlands, on or adjacent to the site;
- b. the delineation of the 100 year flood elevation as indicated on the Flood Insurance Rate Maps (FIRM). If FIRM data does not exist for flooding from a rainfall event, or if the waterbody or watercourse 100-year flood elevation is not indicated on the map, the elevation shall be calculated utilizing an appropriate methodologies such as TR-55 or TR-20 or HEC2;
- c. the proposed principal vegetation types sufficient to determine an appropriate runoff curve number, showing areas where vegetation will be cleared or altered;
- d. the soil types on the site and the hydrological soil groups based the most current Natural Resource Conservation Service (formerly SCS) soils map of the site (available at the NRCS office in Wareham); or in the case of sites less than 5 acres in size a high intensity soil survey performed by a certified soil scientist with a minimum soil map unit of 0.04 acres;
- e. the topography described at 1 foot intervals, with areas of steep slopes over 15% highlighted;
- f. areas of ponding and swamping;
- g. the proposed development layout including:
 - i. locations of roadways, common parking areas, and other impervious surfaces;
 - ii. locations of drainage systems and stormwater treatment facilities; and
- h. areas to be utilized in overland flow, i.e. grass swales and filter strips, showing:
 - i. proposed vegetation; and
 - ii. the soil susceptibility to erosion (using the NRCS classification);
- i. the proposed watersheds on the property, as well as upgradient areas contributing runoff to the property;
- j. the flow path(s);
- k. design points for each watershed; and
- l. soil log locations.

II.B. Water Quantity/Duration/Quality Information to be submitted in the SMP.

- 1. Pre-development conditions in narrative form with supporting calculations³:
 - a. peak discharge rate for the 1-, 2-, 10-, 25-, and 100-year 24 hour storm event using NRCS TR-55 or TR-20;
- b. volume of the surface runoff for the 10-year storm; and

³ The narrative may take the form of a summary sheet comparing pre- and post- development rate and volume of runoff for each design storm, the volume of storage required, and the volume of storage provided.

- c. existing state surface water quality classifications found in 314 CMR 4.04.
2. Post-development conditions in narrative form with supporting calculations [All calculations, supporting data, and reference materials relating to the design and construction of flood control and pollution reduction BMPs.]:
 - a. peak discharge rate for the 1-, 2-, 10-, 25-, and 100-year 24 hour storm event using NRCS TR-55 or TR-20;
 - b. volume of the surface runoff for the 10 year storm;
 - c. detention/retention time, discharge rate, and approximate time of concentration through the BMP(s) for the water quality storm;
 - d. a description of, and calculations for the proposed outlet structure(s); both the principle outlet and emergency spillway; and
 - e. a discussion regarding whether the proposed BMPs meet or exceed the performance standards, identified in **I. GENERAL REQUIREMENTS for SMP's**, as well as an evaluation of the pollutant removal efficiency of each proposed treatment facility or group of facilities. Citations of the design guidance and determination of the pollutant removal effectiveness used for each facility shall be included in this narrative.
 3. **Stormwater Management Summary**

The pre and post-development conditions shall be summarized for each watershed on the Stormwater Management Summary Form

II.C. Maintenance Information to be included in the SMP.

3. **Operation and Maintenance Plan Contents.** An Operation and Maintenance plan (O&M Plan) is required at the time of application. The O&M Plan shall be designed to ensure compliance with the Permit, this Bylaw and that the Massachusetts Surface Water Quality Standards, 314, CMR 4.00 are met in all seasons and throughout the life of the system. The O&M Plan shall remain on file with the issuing authority and shall be an ongoing requirement. The O&M Plan shall include:
 - a. the name(s) of the owner(s) for all components of the system;
 - b. a map showing the location of the systems and facilities including catch basins, manholes/access lids, main, and stormwater devices;
 - c. maintenance agreements that specify:
 - i. the names and addresses of the person(s) responsible for operation and maintenance;
 - ii. the person(s) responsible for financing maintenance and emergency repairs;
 - iii. an Inspection and Maintenance Schedule for all stormwater management facilities including routine and non-routine maintenance tasks to be performed;
 - iv. a list of easements with the purpose and location of each; and
 - v. the signature(s) of the owner(s).
 - d. **Stormwater Management Easement(s)**
 - i. Stormwater management easements shall be provided by the property owner(s) as necessary for:

1. access for facility inspections and maintenance;
 2. preservation of stormwater runoff conveyance, infiltration, and detention areas and facilities, including flood routes for the 100-year storm event; and
 3. direct maintenance access by heavy equipment to structures requiring regular maintenance.
- ii. The purpose of each easement shall be specified in the maintenance agreement signed by the property owner.
 - iii. Stormwater management easements are required for all areas used for off-site stormwater control, unless a waiver is granted by the issuing authority.
 - iv. Easements shall be recorded with the [Plymouth] County Registry of Deeds prior to issuance of a Certificate of Completion by the issuing authority.
- e. **Changes to Operation and Maintenance Plans**
- i. The owner(s) of the stormwater management system must notify the issuing authority of changes in ownership or assignment of financial responsibility.
 - ii. The maintenance schedule in the O & M Plan may be amended to achieve the purposes of this Regulation by mutual agreement of the issuing authority and the Responsible Parties. Amendments must be in writing and signed by all Responsible Parties. Responsible Parties shall include owner(s), persons with financial responsibility, and persons with operational responsibility.

Note: See MAINTENANCE on page 14 of Appendix A.

III. PERFORMANCE STANDARDS AND DESIGN SPECIFICATIONS

Control of stormwater runoff shall meet the design criteria for both flood (volume and peak discharge) control and nonpoint source pollution reduction as indicated in **I. GENERAL REQUIREMENTS for SMPs**. All assumptions, methodologies, and procedures used to design stormwater BMPs shall conform to the criteria listed herein.

III A. Stormwater Design Methodology Considerations for Stormwater Management:

1. Runoff calculations for flood control shall be done according to the rational formula, the Natural Resource Conservation Service TR-20, or TR-55, as appropriate for the site. The appropriate methodology shall be determined from the restrictions on each method described in Hydrology Handbook for Conservation Commissioners, (2002). The Rational Method cannot be used to determine volume.
2. The appropriate pre- and post-development worksheets as shown in Hydrology Handbook for Conservation Commissioners, (2002), shall be submitted with the SMP.
3. The flow length for pre-development sheet flow to determine the time of concentration (Tc) or travel time (Tt) shall not exceed 50 feet.
4. The design points shall be at the:
 - a. edge of wetlands;
 - b. property line; or
 - c. existing storm drain system.The design point shall be the first location listed above intercepted by the flow path.

Submittal Requirements

- For each pre-development design point there shall be a corresponding post-development design point.
5. Estimated seasonal high ground water elevation in areas used for stormwater retention, detention, or infiltration, as determined by a certified soil scientist.
 6. Soil observation holes shall extend a minimum of four feet below the bottom of any stormwater BMP and be observed by the agent of the Board of Health.
 7. Infiltration rates shall be determined by the use of a double-ring infiltrometer.
 8. Impervious cover is measured from the site plan and includes all impermeable surfaces and any other surface that is not vegetated.
 9. Off-site areas shall be assessed based on their “pre-developed condition” for computing the water quality volume (i.e, treatment of only on-site areas is required). However, if an offsite area drains to a proposed BMP, flow from that area must be accounted for in the sizing of a specific practice.
 10. Off-site areas should be modeled as "present condition" for peak-flow attenuation requirements.
 11. Detention time for the one-year storm is defined as the center of mass of the inflow hydrograph and the center of mass of the outflow hydrograph.
 12. The standard for characterizing pre-development land use for on-site areas is “good woods.” Pre-development Runoff Curve Numbers by NRCS hydrologic soil group (HSG) shall be:
 - HSG A - 30
 - HSG B - 55
 - HSG C - 70
 - HSG D - 77
 13. For the landuses listed below use the Runoff Curve Number provided:
 - a. Greenroofs - 88⁴
 - b. Paved areas with tree canopy - 92⁵
 - c. Gravel road or parking lot - 95
 - d. Gravel road or parking lot with tree canopy - 89
 - e. Subdivisions by special permit, user defined⁶
 - f. Water - 100
 - g. Bioretention facility - 80
 - h. Bioretention with tree canopy -74

⁴ The RCN of 88 is based on study by Amy Moran with 4 inches of growth medium. Curve numbers for differing depths may be accepted by the issuing authority provided proper documentation is provided.

⁵ Tree canopy may be determined by documentation of species canopy size at tens year growth. For more information on the effect of trees on the RCN use CITYgreen software from American Rivers.

⁶ RCN for a subdivision must consider the lot itself but the lot share of the road, sidewalk etc. Since larger lots will be less than 30% impervious, a disconnected impervious design should be considered.

- i. Lawn, no soil amendment - 80
- j. Lawn with 4" Compost Soil Amendment⁷
 - HSG A - 36
 - HSG B - 58
 - HSG C - 72
 - HSG D - 77
- 14. Determination of flooding and channel erosion impacts to receiving streams due to land development projects shall be measured at each point of discharge from the development project and such determination shall include any runoff from the balance of the watershed which also contributes to that point of discharge.
- 15. The specified design storms shall be defined as a 24-hour storm using the rainfall distribution recommended by the U.S. Soil Conservation Service when using U.S. Soil Conservation Service methods or the Northeast Regional Climate Center "Atlas of Precipitation Extremes for the Northeastern United State and Southeastern Canada." [*List rain amounts for each storm*]
- 16. Proposed residential, commercial, or industrial subdivisions shall apply these stormwater management criteria to the land development as a whole. Individual lots in new subdivisions shall not be considered separate land development projects, but rather the entire subdivision shall be considered a single land development project. Hydrologic parameters shall reflect the ultimate land development and shall be used in all engineering calculations.
- 17. Treatment Train Calculations. To achieve the water quality discharge limits, treatment trains are permitted. Calculations as to the additive nature of specific BMP strategies must be documented by field experimentation.
- 18. Water Quality Basin and Volume Recharge Basin Sizing. The calculations to determine the size both infiltration structures water quality basins shall assume the surface of the structure to be impervious.⁸
- 19. Infiltration for volume control shall be designed and constructed with the bottom of the infiltration area one foot above the maximum high ground water elevation.

III.B. General Standards and Specifications - The design, construction, and maintenance of Stormwater BMPs shall be consistent with the following:

- 1. discharging runoff directly into rivers, streams, watercourses, or wetlands, is prohibited;
- 2. natural watercourses shall not be dredged, cleared of vegetation, deepened, widened, straightened, stabilized, or otherwise altered;
- 3. neighboring properties shall not be used in the stormwater management plan unless a recordable easement has been granted for such use, and a copy of the easement has been submitted to the issuing authority as part of the SMP;
- 4. the site shall be graded so that surface water shall be directed into the stormwater management system;

⁷ Installed pursuant to "Hydrologic Response on Residential Scale Lawns on Till Containing Various Amounts of Soil Amendment."

⁸ Q_{in}/Q_{out} calculations shall not be allowed for determining for determining infiltration V_b .

5. intermittent watercourses such as swales shall be vegetated;
6. prior to discharging any stormwater runoff into a BMP, the following conditions must also be met:
 - a. the BMP shall be installed according to applicable standards and specifications of this Appendix;
 - b. all components of the BMP shall be stabilized; and
 - c. all upland areas contributing stormwater runoff to the BMP shall be stabilized (non-erosive);
7. Where stormwater basins are designed with a permanent pool depth, a post and rail fence with pressure treated posts or locust posts, with a backing of plastic coated wire fencing shall be used when the basin is in close proximity to residential units, and shall further inhibit access by a planting of rugosa rose (*Rosa rugosa*) surrounding the basin;
8. Operational failure of the infiltrative capacity of the system must be manifested by indicators which are readily visible.

III.C. Selecting a Water Quality BMP

Three designs for water quality BMPs - biofiltration, gravel wetlands and manufacture infiltration systems are listed in Section III.D. One of these BMPs may be appropriate for the site. These three BMP types comply with the requirements of section **I.B. Water Quality** where a discharge is allowed. More information on the testing of stormwater practices is provided at the University of New Hampshire Stormwater Center.⁹ In addition, certain practices are problematic in certain situations.

1. Greenroof technology will not be approved in locations where recharge to groundwater is desired.¹⁰
2. Street sweeping will receive no TSS removal credit.
3. Infiltration practices are required to utilize redundant pretreatment.
4. Oil/grit separators are not needed for the type of pollutants associated with subdivisions.
5. Other water quality BMPs may be approved provided the pollutant removal rate meets or exceeds the requirements of **I. GENERAL REQUIREMENTS for SMPs:**

III.D. Specific Standards and Specifications

1. Biofiltration design may be based on the New York State Stormwater Design Manual¹¹
2. Subsurface gravel wetland design may be based upon Volume 2 of the Georgia Stormwater Management Manual¹²
3. Vendor design specifications may be used for infiltration structures.

⁹ <http://www.unh.edu/erg/cstev/>

¹⁰ One example is the Mattapoisett River Valley

¹¹ www.dec.state.ny.us/website/dow/toolbox/swmanual/

¹² www.georgiastormwater.com

IV. MAINTENANCE:

1. Maintenance Responsibility
 - a. Stormwater management facilities and practices included in a stormwater management plan with an O & M Plan in accordance with **Section II.C.** of these Regulations must undergo regular inspections to document maintenance and repair needs and ensure compliance with the requirements of the agreement, the plan and this Regulation.
 - b. The owner of the property on which work has been done pursuant to this Regulation 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 sedimentation controls, and other protective devices. Such repairs or restoration and maintenance shall be in accordance with approved plans.
2. Maintenance Inspections
 - a. All stormwater management facilities must undergo inspections to document maintenance and repair needs and ensure compliance with the requirements of this bylaw and accomplishment of its purposes as specified in the O & M Plan described under **Section II.C.** of these regulations.
 - b. At a minimum, inspections shall occur during the first year of operation and at least once every [three] years thereafter. In addition, a maintenance agreement as specified under **Section II.C.** of these regulations between the owner and the issuing authority shall be executed for privately-owned stormwater management systems that specifies the Responsible Party for conducting long term inspections.
 - c. Inspection reports shall be submitted to and maintained by the issuing authority for all stormwater management systems. Inspection reports for stormwater management systems shall include:
 - i. The date of inspection;
 - ii. Name of inspector;
 - iii. The condition of:
 1. Pretreatment devices
 2. Vegetation or filter media
 3. Fences or other safety devices
 4. Spillways, valves, or other control structures
 5. Embankments, slopes, and safety benches
 6. Reservoir or treatment areas
 7. Inlet and outlet channels and structures
 8. Underground drainage
 9. Sediment and debris accumulation in storage and forebay areas (including catch basins)
 10. Any nonstructural practices
 11. Any other item that could affect the proper function of the stormwater management system
 - iv. Description of the need for maintenance;
3. Right-of-Entry for Inspection

The terms of the inspection and maintenance agreement as specified in Section 6.M of these regulations shall provide for the issuing authority or its designee to enter the property at reasonable times and in a reasonable manner for the purpose of inspection. The issuing authority, its agents, officers, and employees shall have authority to enter upon privately owned land for the purpose of performing their duties under this Regulation and may make or cause to be made such examinations, surveys, or sampling as the issuing authority deems necessary.

4. **Records of Maintenance and Repair Activities**

Parties responsible for the operation and maintenance of a stormwater management facility shall provide records of all maintenance and repairs to the issuing authority, upon request. Parties responsible for the operation and maintenance of a stormwater management facility shall make records of the installation and of all maintenance and repairs, and shall retain the records for at least [5] years. These records shall be made available to the issuing authority during inspection of the facility and at other reasonable times upon request.

5. **Failure to Maintain**

- a. If a responsible person fails or refuses to meet the requirements of the inspection and maintenance agreement, the issuing authority, after [*thirty (30)*] days written notice (except, that in the event the violation constitutes an immediate danger to public health or public safety, 24 hours notice shall be sufficient), may correct a violation of the design standards or maintenance requirements by performing the necessary work to place the facility or practice in proper working condition. The issuing authority may assess the owner(s) of the facility for the cost of repair work which shall be a lien on the property.
- b. After notification is provided to the person responsible for carrying out the maintenance plan of any deficiencies discovered from an inspection of a stormwater management system, the person responsible for carrying out the maintenance plan shall have 30 days or other time frame mutually agreed to between the issuing authority and the person responsible for carrying out the maintenance plan to correct the deficiencies. The issuing authority shall then conduct a subsequent inspection to ensure completion of repairs.

V. DEFINITIONS

Except for the following definitions, terms are defined in the MA Department of Environmental Protection's Nonpoint Source Management ("The Mega-manual"), June 1993.

BMP's - Best management practices are structural, non-structural and managerial techniques that are recognized to be the most effective and practical means to prevent and/or reduce nonpoint source pollution.

First Flush - the volume generated by the first 1.25 inches of stormwater runoff. This first inch of runoff carries the majority of accumulated pollutants from impervious surfaces. The first flush treatment volume in cubic feet (V_t) is determined by the following formula:

$$V_t = (1.25/12 \text{ inches})(R_v)(\text{Site Area in square feet})$$

where, $R_v = 0.05 + 0.009(I)$ I = the % impervious area. Impervious area is defined as any manmade cover that is not vegetated. In residential areas, the % impervious is obtained from the TR-55 table "Runoff Curve Numbers for Urban Areas, Residential District by Average Lot Size."

Hydrologic Soil Group - a soil characterization classification system defined by the U.S. Natural Resource Conservation Service. Soils within the same group have the same runoff potential under similar storm and cover conditions.

Peak Discharge - the maximum rate of flow during a storm, usually in reference to a specific design storm event (i.e. 2-yr, 5-yr, 10-yr, 25-yr, 100-yr., 24 hour storm event).

Soil Mottling - Redoximorphic features.

Surface Water Quality Classifications - waters designated for protection under 314 CMR 4.04 (2).

TR-20 - a NRCS hydrology procedure for complex watersheds. The computer program calculates runoff volumes, peak discharges and hydrographs at various locations in the watershed. Design storms and actual rainfall events can be analyzed.

TR-55 - presents simplified hydrology procedures to calculate runoff volumes and peak discharge in small watersheds. It is based on TR-20 hydrology procedures and actual TR-20 computer runs.

Appendix B

Applicant Check-off for The Submittal of Stormwater Management Plans

I. Site Characteristic Information to be included in the Stormwater Management Plan (SMP).

A. Pre-development conditions:

- 1. the existing watersheds on the property, as well as upgradient areas contributing runoff to the property;
- 2. location of all surface waters and wetlands on or adjacent to the site;
- 3. the delineation of the 100 year flood elevation as indicated on the FIRM maps. If FIRM maps do not exist or if the waterbody or watercourse 100-year flood elevation is not indicated on the map, the elevation shall be calculated utilizing an appropriate methodologies such as NRCS TR-55 or TR-20 or HEC2. **Note: The floodplain location determined by the FIRM maps are approximate. When a specific elevation is given, the location of the floodplain shall correspond to that elevation.**
- 4. the principal vegetation types sufficient to determine an appropriate curve number;
- 5. a. the topography described at 1 foot intervals;
 b. with areas of steep slopes over 15% highlighted;
- 6. the soil types on the site and the hydrological soil groups based the most current Natural Resource Conservation Service soils map of the site (available at the NRCS office in Wareham) or on sites less than 5 acres, a high intensity soil survey;
- 7. the location of any public or private water supplies within 100 feet of the property as well as on the property;
- 8. the flow path(s);
- 9. design points for each watershed; and
- 10. areas of ponding or swamping.

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B. Postdevelopment conditions:

- 1. changes in topography at 1 foot intervals;
- 2. areas where vegetation will be cleared or otherwise altered;
- 3. the proposed watersheds on the property, as well as upgradient areas contributing runoff to the property;
- 4. the proposed development layout including:
 - a. locations of roadways, buildings, common parking areas, and undisturbed lands;
 - b. locations of drainage systems and stormwater treatment facilities;
- 5. areas to be utilized in overland flow, i.e. grass swales and filter strips, showing:
 - a. proposed vegetation; and
 - b. the soil susceptibility to erosion (using the NRCS classification).
- 6. the flow path(s) for the 2-, 10-, 25-, and
 - 100-year 24 hour storm event
- 7. design points for each watershed;
- 8. soil logs for each proposed BMPs control system site (documentation should be for a minimum of 4 feet below the bottom of the BMP and be submitted for both flood control BMPs and pollution reduction BMPs) and
- 9. maximum groundwater levels at the proposed BMPs locations.

II. Water Quantity/Duration/Quality Information to be submitted in the SMP.

A. Pre-development conditions in narrative form or calculations:

- 1. peak discharge rate, based on the 2-,
 - 10-,
 - 25-, and
 - 100-year 24 hour storm event using NRCS TR-55 or TR-20; and
- 2. volume of the surface runoff for 10-year 24 hour storm event using NRCS TR-55 or TR-20;

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3. existing state surface water quality classifications found in 314 CMR 4.04.

B. Post development conditions:

1. peak discharge rate, based on the 2-,

10-,

25-, and

100-year 24 hour storm event using NRCS TR-55 or TR-20; and

2. volume of the surface runoff for the 10-year 24 hour storm event using NRCS TR-55 or TR-20;

3. design point(s) for each watershed.

4. detention/retention time, discharge rate, and approximate time of concentration through the BMP for the water quality storm;

5. a description of and calculations for the proposed outlet structure(s); both the principle outlet and emergency spillway; and

6. a discussion regarding how the proposed BMPs meet or exceed the performance standards identified in **Appendix A Section I**, as well as an evaluation of the pollutant removal efficiency of each proposed treatment facility or group of facilities;

Appendix C

Stormwater Management Summary Form

Applicant: _____ Project Name

Stormwater Plan Prepared by:

Subwatershed # _____

ITEM	Pre-development	Post- Development
Runoff Curve Number		
Time of Concentration		
Rate 1 yr		
Rate 2 yr		
Rate 10 yr		
Rate 25 yr		
Rate 100 yr		
Volume 10 yr		
Sq. ft. impervious	XXXXXXXXXXXXXX	
Water Quality Volume	XXXXXXXXXXXXXX X	