

**INSPECTION AND MAINTENANCE MANUAL
FOR STORMWATER MANAGEMENT AND
RELATED STORMWATER FACILITIES**

**421 WARREN AVENUE COMMERCIAL COMPLEX
PORTLAND, ME**

PREPARED FOR:

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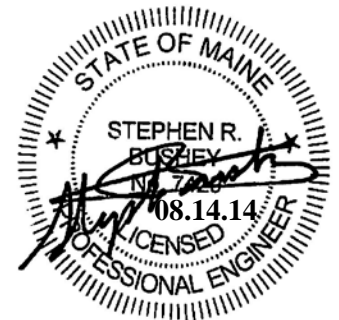


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I. SUMMARY

The proposed Warren Avenue Commercial Complex is subject to the City of Portland's Performance Standards for Stormwater Management, specifically, contained in Chapter 32 Storm Water of the City's Code of Ordinances. The responsibilities and requirements for monitoring and reporting a development's stormwater management system are more fully outlined on the following narrative. This Inspection and Maintenance Manual is intended to be a tool for reference by the development's owner/operator and their third party inspector as they perform required inspections and system maintenance. The owner will be responsible for compliance with the "Stormwater Drainage System Maintenance Agreement and Release of Liability" to be executed with the City of Portland, prior to the release of a Building permit.

II. INTRODUCTION

Relatively complex stormwater management facilities are commonly installed in development projects including commercial facilities, and many other developments. The complexity and goals of these systems vary with the nature of the receiving water, as well as the type of development. Runoff from developed areas of the project, including rooftops, paved or lawn areas typically contain materials that can impact the receiving waters. Source control and the installation of wet ponds, infiltration galleries, and green infrastructure practices often combined with pretreatment measures or followed by vegetated buffer strips, filtration, and other best management practices, can significantly reduce the non-point pollution discharge from the developed area. These measures are particularly important to projects in the watersheds of sensitive water bodies, or projects with potential impacts to groundwater. With the increased cost of land and development and operational costs, there is an increased tendency to construct portions of the stormwater management systems underground, to employ green infrastructure practices where practicable, and to enhance pretreatment devices to capture non-point contaminants as close to the source as possible.

The effectiveness of water quality management provisions and other components of the stormwater management system are dependent on the site setting, the design, upkeep, and maintenance to assure they meet their intended function over an extended period of years. It is critical that the stormwater management facilities are designed considering both the opportunities and constraints of the site be regularly inspected, and that maintenance is performed on an as-needed basis. It must also be recognized that the effectiveness of these formal treatment BMP's and their maintenance requirements, are related to the routine maintenance of effective source control, inspection, and maintenance of the stormwater drainage facilities that collect and transport the flow to the ponds, infiltration galleries, green infrastructure elements, and other treatment measures. Thus, maintenance should be directed to the total system, not just the primary stormwater management facility.



Figure 1 – Wetpond

The purpose of this document is to define, in detail, the inspection and maintenance requirements deemed necessary to assure that the stormwater management facilities function as intended when they were designed. This manual is specific to this site and the defined BMP's selected for

application on this specific project. Subsequent sections identify individual maintenance items; give a brief commentary of the function and need for the item; a description of the work required; and a suggested frequency of accomplishment. While the suggested programs and schedules must be adapted to specific projects, the material presented should provide guidance for a successful long-term program for operation and maintenance. A supplemental section provides guidance for construction monitoring of the facilities during their installation and more detailed checklists (Attachment D). Certain facilities are not intended to be placed in service until the tributary catchment area has the permanent cover in place and any contributing turf areas have achieved a 90% catch of vegetation (i.e. established). This manual discusses the specific measures designed and intended to be featured in this project.

A. GUIDELINES OVERVIEW

A summary of the individual components of stormwater management facilities has been prepared. The format used in the summary is as follows:

Preface: A general description of what function/benefit the element is intended to provide. This is a short summary and not intended to provide the design basis, which can be found in other sources.

Inspection: This section provides the inspection requirements for the individual component.

Maintenance: The section provides general information on the routine maintenance requirements of this element.

Frequency: This section outlines the frequency of maintenance on the system as recommended by the designer.

Comments: This section provides any particular comment on the site-specific features of this element. This is a summary only. The owner/operator should review the design drawings and documents carefully to understand the particular elements of the project. The end of this section should allow the owner/operator to make notes on the specific program. This may include the selected maintenance procedure, cross-references to applicable design drawings, etc.

A list of the individual inspection/maintenance elements is provided in the table of contents. The guidelines are proposed for initial use with adjustments made as appropriate based upon specific project experience.

III. PROJECT OVERVIEW

Key permits issued (or applied for) on the project include:

- City of Portland Site Plan
- Maine Department of Environmental Protection Maine Construction General Permit.

The permit applications pending for the project include the design information for the stormwater system.

A copy of the permits and Stormwater Management Report should be appended to this manual as Attachment B. The Owner/Operator of the stormwater management system should review these permits for a general description and background of the project, as well as any specific permit conditions or requirements of the project.

The applicant has retained Fay, Spofford & Thorndike for civil engineering for the new commercial building located at 421 Warren Avenue in Portland, Maine. Fay, Spofford & Thorndike has prepared the design for the stormwater management facilities and may be contacted at:

Fay, Spofford & Thorndike
778 Main Street, Suite 8
South Portland, Maine 04106
Tel. (207) 775-1121

It is recommended the preparer of the plan be contacted with any particular questions on the design intent or similar issues. This plan includes measures for Green Infrastructure elements including gravel wetlands.

The Owner/Operator of the plan will be:

PH Warren Avenue, LLC
401 Warren Avenue
Portland, Maine 04101
Tel. 207-878-4496

The applicable plans/design documents, which apply to the project, are:

1. Site Plans/Permit Applications
2. The Erosion Control/Sedimentation Control Plan for the project.
3. The Stormwater Management Plan for the project.

A copy of these documents should be retained with the manual.

The proposed design will include gravel wetlands, sediment forebays, collection and conveyance discharge systems and drainage swales.

IV. STANDARD INSPECTION/MAINTENANCE DESCRIPTIONS

The following narratives describe the inspection/maintenance provisions for the Stormwater Management area. These O&M procedures will complement scheduled source control sweeping of the pavement areas and routine maintenance of the cover in the drainage catchment controlled by the applicant. Source control includes not over-salting the parking field and access roadway which can be encouraged in the design process by maintaining adequate grades to avoid ponding and icing, and generally maintaining the surfaces free of litter and deleterious debris. This also includes elements such as repair of winter damage that can expose cover material to erosion, to maintaining good cover in vegetated areas, to maintaining landscape materials which can reduce storm water flows through inception and evapotranspiration. Proper O&M is necessary to make sure the system will provide its intended purpose of conveying runoff, removing a substantial amount of the suspended solids, and other contaminants in the stormwater runoff.

A. GRAVEL WETLANDS

Preface: Gravel wetlands are designed horizontal flow-through treatment cells that are preceded by a sediment basin used to treat/detain flow on a site. Gravel wetlands are

utilized on sites that are flat because they do not require as much hydraulic head as a typical bio-retention cell or under-drain soil filter.

Inspection: 1st year Post Construction: Inspect and confirm that system drains within 24-48 hours to make sure water quality controls are working properly after significant rain events. Inspecting vegetation (especially during the first growing season) to ensure vegetation is growing adequately. Quarterly inspection of soil and repairing eroded areas especially on slopes in necessary. Checking inlets, outlets and overflow spillways are also necessary on a regular basis.

General Post Construction: Inspect filter surface for dense, complete root mat establishment across wetland surface. Inspect gravel wetland surface for water or other evidence of gravel wetland risers clogging.

Maintenance: Plants need to be watered as necessary especially during first growing season. Areas of poor growth may need to be re-vegetated. Any vegetation that appears diseased needs to be treated. Removal of any trash and debris should be removed from sediment forebay as needed. Sediment should be removed from sediment forebay when it accumulates to a depth of 12 inches or 10% of pretreatment volume. Sediment should be removed from gravel wetland cells when sediment depth is greater than 3 inches.

Frequency: Gravel wetlands shall be inspected regularly during the first year after construction to ensure that device is working properly. After the first year of construction the gravel wetland system shall be inspected every 6 months.

Design Guidelines: The Gravel wetlands for the Warren Avenue commercial building have been designed based on the assumption that they will be inspected and maintained according the criteria laid out. Failure to do so will cause the system to function incorrectly.

B. VEGETATED SWALES

Preface: Vegetated swales are often used to convey stormwater. Swales can be intended to be part of a green infrastructure system and may be:

1. Mowed and maintained
2. Reverted to wetlands
3. Naturalized

Inspection: Swales should be inspected for erosion and sedimentation and examined for deleterious material that could clog downstream inlets.

Maintenance: Eroded or silted channels need to be repaired when discovered. If erosion is a problem, the swale design should be examined. Likewise, if situation is a continuing problem, the upgradient conditions should be assumed.

Frequency: It is recommended vegetated swales be inspected quarterly until vegetation is established and a year after installation. Thereafter, if no problems have been noticed, the frequency can be reduced to once per year.

Design Guidelines: The vegetated swale should consider channel cover at the time of concentration as well as several years after construction.

Design computations should state the assumed channel of vegetation and provide the basis for the Manning's or other roughness coefficient and for design.

Applicability: The Warren Avenue facility will have minor open channel systems as shown on the drainage and stormwater management plans.



VEGETATED SWALE WITH HAY BALE CHECK DAM TO REDUCE VELOCITIES UNDER CONSTRUCTION

C. **TRIBUTARY DRAINAGE SYSTEM**

Preface: Stormwater from some of the project will be directed through a conveyance system which transports the flow ultimately to its discharge location. This conveyance system will be principally overland flow and a limited amount of piped drain systems. Most of the sediment carried by the drainage system is intended to be trapped in sediment sumps in structures. Maintenance of this system can play a major role in the long-term maintenance costs and the effectiveness of the stormwater management system.

Inspection: The tributary drainage system should be periodically inspected to assure that it is operating as intended, and that its carrying capacity has not been diminished by accumulations of debris and sediment or other hydraulic impediments. On piped systems the inlets must be inspected to ensure the rims are set at the proper elevation to optimize flow entry and are not clogged with leaves or other debris. The inlet basins are normally equipped with sumps fitted with hooded outlets, which will remove large sediment particles from the flow stream.

The level of sediment in the sumps should be checked to assure their effectiveness. Pipelines connecting the inlets should be checked to determine if siltation is occurring. This will be most critical on drain lines laid at minimal slopes. This can usually be accomplished by a light and mirror procedure.

In some projects most of the stormwater is carried in open swales, channels, or ditches. These conveyance channels may be rip rapped or vegetated, depending on the gradient and expected flow velocities. These facilities must be inspected to insure debris or

sedimentation does not reduce their carrying capacity. Excess vegetative growth must also be noted. The surface protection for the channels, either stone or vegetation, must be inspected to insure its integrity. Any areas subject to erosion should be noted.

Maintenance: Maintenance of the storm drainage system must assure that it continues to serve its design function on a long-term basis, and that its operation does not transport excessive sedimentation to any downstream receiving waters. Elevations on the rim of catch basins should be adjusted as needed to assure optimal water entry. Depending on the frost susceptibility of the soil, the rims may become elevated over time causing flow to circumvent the inlet. When the filter bag in an inlet restricts capacity and is coated with silt or other deleterious materials, the bag should be removed and catch basin cleaning would normally be accomplished with vacuum trucks contracted as a maintenance service for the site. The removed material must be disposed of at an approved site for such materials.

If sediment in the pipeline exceeds 20% of the diameter of the pipe, it should be removed. This may be accomplished by hydraulic flushing, or by mechanical means. If hydraulic flushing is used the downstream conditions should be analyzed. In general a sump or sediment trap should be used to capture flushed sediment for removal.

Frequency: The piped drainage system should be inspected on an annual basis. Adjustment of inlet rim elevations should be on an as needed basis. Cleaning catch basin sumps and pipelines will depend on the rate of accumulation.

Maintenance/Inspection Responsibility:

Maintenance Personnel: PH Warren Avenue, LLC

Special Services: The owner may elect to contract with an independent agent for cleaning or replacement of components of the drainage system. Remedial source control measures may be performed by the owner or an outside service depending upon the nature of the particular situation.

D. ROOF DRIPLINE FILTER

Preface: Similar to the vegetated soil filter, roof dripline filters control stormwater quality by capturing and retaining runoff within a stone reservoir and passing it through a filter bed comprised of a specific filter media. Once through the soil media, the runoff is collected in a perforated underdrain pipe and discharged downstream. The filter structure provides for the slow release of smaller storm events, minimizing stream channel erosion and cooling the discharge.

Inspection: A roof dripline filter must be inspected to ensure it is draining within 48 hours following a one inch storm or greater.

Maintenance: Debris must be removed from the reservoir stone. If the filter is not draining within 72 hours, the filter media shall be replaced.

Frequency: During the first year, the filter should be inspected semi-annually and following all major storm events. Thereafter, the filter should be inspected at least every 6 months. Debris and sediment buildup should be removed as needed.

E. LITTER

Litter should be removed as a matter of course by workers and be a part of the grounds maintenance contract.

F. SUMMARY CHECKLIST

The above described inspection and maintenance items have been summarized on a checklist attached hereto as Attachment C.

V. PROGRAM ADMINISTRATION

A. GENERAL

A reliable administrative structure must be established to assure implementation of the maintenance programs described in the foregoing section. Key factors that must be considered in establishing a responsive administrative structure include:

1. Administrative body must be responsible for long-term operation and maintenance of the facilities.
2. Administrative body must have the financial resources to accomplish the inspection and maintenance program over the life of the facility.
3. The administrative body must have a responsible administrator to manage the inspection and maintenance programs.
4. The administrative body must have the staff to accomplish the inspection and maintenance programs, or must have authority to contract for the required services.
5. The administrative body must have a management information system sufficient to file, retain, and retrieve all inspection and maintenance records associated with the inspection and maintenance programs.

If any of the above criteria cannot be met by the entity assigned inspection and maintenance responsibilities, it is likely that the system will fail to meet its water quality objectives at some point during its life. While each of the above criteria may be met by a variety of formats, it is critical to clearly establish the assigned administrative body in a responsible and sustainable manner.

B. RECORD KEEPING

The owner must comply with the conditions of the construction stormwater management plan and erosion and sediment control plan based on City Standards and State Guidelines. The owner of the approved stormwater management system and all assigns shall comply with the conditions of Chapter 32 Stormwater of the City of Portland Code of Ordinances, including Article III, Post Construction Stormwater Management, which specifies the annual inspections and reporting requirements. The system is the responsibility of the property owner and is subject to a Maintenance Agreement with the City of Portland.

Records of all inspections and maintenance work accomplished must be kept and maintained to document facility operations. These records should be filed and retained for a minimum 5-year time span. The filing system should be capable of ready retrieval

of data for periodic reviews by appropriate regulatory bodies. Where possible, copies of such records should also be filed with the designated primary regulatory agency for their review for compliance with permit conditions. Typical inspection and maintenance record forms are attached hereto as Attachment B.

C. CONTRACT SERVICES

In some instances or at specific times, the Maintenance Personnel may not have the staff to conduct the required inspection and/or maintenance programs as outlined in this document. In such cases the work should be accomplished on a contractual basis with a firm or organization that has the staff and equipment to accomplish the required work.

The service contract for inspection and maintenance should be formal, well written legal document which clearly defines the services to be provided, the contractual conditions that will apply, and detailed payment schedules. Liability insurance should be required in all contracts.

ATTACHMENT A

Sample Inspection Logs

WARREN AVENUE COMMERCIAL COMPLEX
PORTLAND, ME

STORMWATER MANAGEMENT
FACILITIES POND
ANNUAL INSPECTION & MAINTENANCE LOG

FACILITY:		YEAR:	
LOCATION:		CONTRACTOR:	
FUNCTION:		INSPECTOR:	
DATE OF INSPECTION:			
ITEM IDENTIFICATION	DESCRIPTION OF CONDITIONS	MAINTENANCE ACCOMPLISHED	DATE OF MAINTENANCE
GENERAL COMMENTS:			

WARREN AVENUE COMMERCIAL COMPLEX
PORTLAND, ME

STORMWATER MANAGEMENT
MONTHLY INSPECTION & MAINTENANCE LOG

FACILITY:			YEAR:			
LOCATION:			CONTRACTOR:			
FUNCTION:						
MONTH	DAY	INSPECTOR	WATER DEPTH	OVERFLOW WEIR		WEIR CONDITION
				CLEAR	DEBRIS	
JANUARY						
FEBRUARY						
MARCH						
APRIL						
MAY						
JUNE						
JULY						
AUGUST						
SEPTEMBER						
OCTOBER						
NOVEMBER						
DECEMBER						
LIST SPECIAL MAINTENANCE UNDERTAKEN:						

WARREN AVENUE COMMERCIAL COMPLEX
PORTLAND, ME

STORMWATER MANAGEMENT
 SEMI-ANNUAL INSPECTION & MAINTENANCE LOG

SEMI-ANNUAL INSPECT 1.2	FACILITY:
DATE:	LOCATION:
INSPECTOR:	FUNCTION:
WEIR CONDITION:	
OUTLET CONDITION	

FORE BAY SUMP	EST. DEPTH SED.	REMOVED? Y/N	EST. VOL. CY	WHERE DISPOSED OF	STRUCTURAL CONDITION

CONTROL STRUCTURE:
DESCRIBE CONDITIONS FOUND & MAINTENANCE ACCOMPLISHED:

ATTACHMENT B

Permits for Project

(To be Added at a Subsequent Time)

ATTACHMENT C

Summary Checklist Inspection and Maintenance

**Stormwater Management System
Maintenance Program – Summary Checklist**

Item	Commentary	Frequency				
		Monthly	Quarterly	Semi-Annual	Annual	Long Term
Tributary Drainage	Inspect to assure that the carrying capacity has not been diminished by debris, sediment or other hydraulic impediments.			X		
Vegetated Swales	Swales should be inspected for erosion and sedimentation		X (until vegetation established)		X	
Gravel Wetlands	Inspect to assure satisfactory establishment of vegetation and operation of piping and outlet controls			X		
Parking Lot Cleaning	Parking lot is to be swept at mid winter and spring. Power washing with an appropriate vacuum/power wash vehicle to be done twice a year.			X		
Litter	Litter should be removed daily.					
Roof Dripline Filter	Inspect dripline filter to ensure it is draining properly within 48 hours following a 1" storm or greater			X		
Berms	Inspect berms for sags, sloughing, or erosion and undesirable tree growth. Mow berm slope to control vegetation repair structure flaws upon identification.	Mow X Summer			X	
Submerged Pipelines and Sediment Storage Manholes	The pipeline should be inspected quarterly		X			