Requirements for Improvements and Development Proposals

July 17, 2008

Bassett Creek Watershed Management Commission

Requirements for Improvements and Development Proposals

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1.0 Introduction

This document was prepared to assist developers and consultants in designing and managing projects that conform with the policies of the *Bassett Creek Watershed Management Plan* (Plan) (September 2004). The Plan, as adopted by the Bassett Creek Watershed Management Commission (BCWMC), may be reviewed or obtained from the BCWMC website at http://www.bassettcreekwmo.org/.

This document outlines the requirements designed to achieve the BCWMC's water quality, rate control and other goals. It gives a complete listing of the development requirements, water quality control standards and design criteria that have been adopted by BCWMC and includes:

1. *Review Process*
    - The nature of the review process and procedures
    - Required submittals/exhibits
    - Variance procedures
    - Application form
2. *Types of projects that require a submittal for review*
3. *Development/redevelopment guidelines*
4. *Policies, standards and requirements*
    - Floodplain requirements
    - A description of approved best management practices (BMPs) that meet the BCWMC's Level I standards. BMP descriptions have been organized into the following categories: (1) infiltration systems, (2) filtration systems, and (3) detention systems.
    - Requirements for construction erosion and sediment control plan
    - Other requirements

2.0 Review Process

2.1 Procedure for BCWMC Review

The BCWMC established the following procedures for review of improvements and development proposals:

1. The BCWMC will review the applicant's submittal only after the project has received preliminary review by the municipality indicating general compliance with existing local watershed management plans prepared pursuant to 103B.235.
2. The BCWMC meetings are generally held the third Thursday of each month. In order for a proposed project to be included on the agenda, plans must be submitted to the BCWMC engineer by the last Friday of the month, prior to the meeting date. Complex projects may require additional review time. However, not all projects are presented at the BCWMC meeting for review and approval. All submittals involving floodplains, Bassett Creek trunk system, appropriations, variances, and underground wet vaults or other alternative BMPs are presented at the BCWMC meetings. BCWMC engineer review and approval are generally provided for submittals that are designed in accordance to the BCWMC policies outlined in this document.
3. Upon receipt of a submittal, the BCWMC engineer will review the submittal and prepare recommendations to the BCWMC. A memorandum describing each project and the engineer's recommendations will be sent to the BCWMC approximately one week before each meeting. Note: the BCWMC engineer will send a letter with comments directly to the municipality and to the applicant for projects that do not require review at the BCWMC meeting.
4. The BCWMC will review and comment upon the submittal at its regularly scheduled meeting. The BCWMC will approve, conditionally approve, or reject the submittal. A letter with comments, including a list of deficiencies or required modifications, will be sent to the municipality and to the applicant. This step is not necessary for projects approved by the BCWMC engineer.
5. The applicant must provide a revised submittal addressing each deficiency, required modifications, or comment. A letter of approval will be sent to the municipality and to the applicant after comments have been satisfactorily addressed.
6. Emergency work performed by cities (utility repair, emergency traffic issues, health and safety issues, etc.) and maintenance projects (seal coating and pavement overlays, sediment and debris removal from crossings and water quality ponds, etc.) are exempt from BCWMC review. Cities shall inform the BCWMC regarding emergency work, as soon as practical, in cases that would have required an application under non-emergency conditions.

2.2 Required Exhibits

The applicant shall submit an application form, project review fee, and two sets of plans and supporting documentation for BCWMC review. The application form must be signed by City staff. The required exhibits are listed on the application form and further discussed as follows:

1. Completed Application form signed by applicant and City staff

2. Project review fee. Submit project review fee in accordance with the fee schedule

3. Wetland fee (if applicable): Submit wetland fees for projects resulting in BCWMC review of wetland issues. BCWMC is the local government unit (LGU) administering the Wetland Conservation Act for the cities of Medicine Lake, Robbinsdale, and St. Louis Park. Contact the BCWMC engineer regarding wetland review fee.

4. Project plans: Submit two copies of project plans (full size and 11-inch x 17-inch sheets), including at least:

   a. A scale drawing of the site showing property lines and delineation of lands under ownership of the applicant

   b. Proposed and existing stormwater facilities location, alignment, and elevation

   c. Existing and proposed site contour elevations related to NGVD, 1929 datum, or other datum used by municipality

   d. Construction plans and specifications of all proposed stormwater management facilities

5. A runoff water quality management plan and computations, signed by a registered professional engineer, and meeting the minimum requirements described in these standards. BMP sizing and average depth calculations for water quality ponds must also be provided. A runoff water quality management plan shall include the following items:

   a. Delineation of the subwatersheds tributary runoff from offsite, and proposed and existing subwatersheds onsite

   b. Delineation of existing onsite wetlands, marshes, and/or floodplain areas.

   c. Existing and proposed post-development normal, 5-year ,and 100-year stormwater elevations for the site

   d. Stormwater runoff volume and rate analyses for existing and proposed conditions for 5-year and 100-year storm events

   e. All hydrologic, hydraulic, and other computations necessary to design the proposed stormwater quality management facilities

f. Documentation indicating conformance with an existing municipal local watershed management plan. If a municipal plan does not exist, documentation indicating that the municipality has reviewed the project.

6. A final erosion control plan meeting the requirements of these standards.

7. A checklist of BMPs provided as part of the application form must be submitted demonstrating that, to the maximum extent practical, the plan has incorporated the structural and non-structural BMPs, as described in the referenced documents.

8. Other items required to support the proposed project.

2.3 Variance Procedure

The BCWMC has established the following variance procedures:

a. Applications for variances shall be filed with the City where the property is being developed, redeveloped, or retrofitted and shall state the exceptional conditions of the property and the peculiar and practical difficulties claimed as a basis for a variance. The applicant shall state on the application the reasons for requesting the variance, in accordance with all of the requirements set forth in section (c) below.

b. The City shall refer all applications for variances from the BCWMC requirements to the BCWMC engineer, and such applications shall be reviewed by the BCWMC. In reviewing the application, the BCWMC shall take into consideration the criteria, standards, and goals for maintaining and improving the quality of the watershed's water resources.

   To address the applicant's hardship or special situation, the BCWMC may grant the variance, contingent upon conditions that the BCWMC may set forth. Alternatively, the BCWMC may deny the request and set forth reasons for the denial.

c. In granting variances, the BCWMC shall make a finding showing that all of the following conditions exist:

   (1) There are special circumstances or conditions affecting the property such that the strict application of the provisions of these standards and criteria would deprive the applicant of the reasonable use of its land.

   (2) The variance is necessary for the preservation and enjoyment of a substantial property right of the applicant.

   (3) The granting of the variance will not be detrimental to the public welfare or injurious to the other property in the territory in which the property is situated.

(4) In applications relating to a use in the 100-year floodplain set forth in Table 5-3 of the Plan, the variance shall not allow a lower degree of flood protection than the current flood protection.

(5) The granting of the variance will not be contrary to the intent of taking all reasonable and practical steps to improve water quality within the watershed.

3.0 Types of Projects to be Submitted for Review

All persons, municipalities, or other agencies proposing improvements or developments within the Bassett Creek watershed shall submit sufficient information to the BCWMC to determine the effect that their proposal may have on the water resources of the watershed within the following guidelines. The types of improvements and development proposals that must be submitted to the BCWMC for review include:

3.1 Floodplains

Any proposal which would consist of a major alteration of existing structures, erection of new structures, filling, floodway encroachment, activities considered incompatible with acceptable floodplain uses or be subject to damage by the 100-year flood, and is located below the 100-year floodplain elevation included in the Plan (Table 5-3) must be submitted for BCWMC review. This section shall apply to structures such as bridges, footbridges, culverts, and pipe crossings of any nature, including sanitary sewer, water supply and electrical and telephone lines. Specific floodplain policies are included in Section 5.0.

3.2 Floodplain Storage Sites

Any proposal within the limits of the proposed floodplain storage sites (inundation areas) established by the BCWMC Plan (Table 5-3, Figure 15) that may be in conflict with the minimum requirements as outlined in the Plan shall be submitted for BCWMC review.

3.3 Lakes, Streams, and Wetlands

Proposals that may affect the water surface elevation, outlet storage capability, shoreline or streambank, or be incompatible with existing or proposed land use around the lakes, streams, and wetlands in the Bassett Creek watershed shall be submitted for BCWMC review. The BCWMC will defer wetland issues in cases where the municipality acts as the local government unit (LGU) for administering the Wetland Conservation Act, unless its involvement is requested by the municipality.

3.4 Water Resources

Proposals that would alter water resources in the watershed, involve the discharge of industrial or other waste to any watercourse or storm sewer, require extensive land alteration, are directly tributary to the watercourses of the watershed, or may otherwise affect the existing water quality shall be submitted for BCWMC review. In addition, the BCWMC shall be informed of the proposed application of chemicals or other treatments to lakes and ponds in the watershed.

3.5 Diversion of Surface Water Runoff

Proposals to provide intra- or inter-watershed diversion which may affect flood levels, lake levels, and minimum streamflows in the watershed shall be submitted for BCWMC review.

3.6 Land Use Changes

Proposed changes in land use, zoning, and local watershed management plans which may require modification of the BCWMC Plan shall be submitted for BCWMC review.

3.7 Appropriations

Ground or surface water appropriations which may temporarily or permanently alter the existing ground and surface water levels in the watershed shall be submitted for BCWMC review.

3.8 Utility Crossings

The construction of utilities through or paralleling the defined trunk creek system which require disturbance of the bed or banks of the creek or the diversion of the creek shall be submitted for BCWMC review.

3.9 Department of Natural Resources (DNR) Permit Applications

Permit applications to the DNR for work in public waters, including supporting documentation, shall be submitted for BCWMC review.

3.10 Development/Redevelopment

Proposals that will result in more than 200 cubic yards of cut or fill or more than 10,000 square feet of grading shall be submitted for BCWMC review. Requirements for erosion control plans are included in Section 7.0. Projects requiring water quality treatment are described in Section 4.0.

3.11 Road Construction

Road construction or reconstruction proposals which result in more than 1.0 acre of grading shall be submitted for BCWMC review. Proposals for review include projects resulting in complete removal of the road surface, exposing the base, and/or removal of the vegetated surface within the road right-of-way. Examples include road widening projects, ditch work, road replacement, and utility installation. Road overlay projects and road resurfacing projects which do not disturb the road base will not be covered by the requirements of this policy. Requirements for erosion control plans are included in Section 7.0. Note: road construction or reconstruction projects resulting in more than 5.0 acres of grading require review at a BCWMC meeting. The BCWMC engineer will review and provide comments directly to the municipality for road projects between 1.0 and 5.0 acres.

4.0 General Guidelines for Developments/Redevelopment

Following is a description of project "triggers" for development/redevelopment proposals that describe the level of BCWMC involvement and required treatment. The table in Appendix C summarizes the treatment requirements for development/redevelopment projects.

4.1 Projects Not Requiring BCWMC Review

New projects which result in less than 200 cubic yards of cut and fill or less than 10,000 square feet of grading do not require BCWMC review. Note other review triggers in Section 3.0.

4.2 Projects Requiring Construction Erosion and Sediment Control Plan

When construction is proposed that will result in more than 200 cubic yards of cut or fill or more than 10,000 square feet of grading, an application, fee, and grading, drainage, and erosion control plan must be submitted for BCWMC review. Requirements for construction erosion and sediment control plans are included in Section 7.0.

4.3 Projects Requiring Treatment to Level I Standards

The BCWMC Plan (Section 4.2.2.4, Policy A) requires treatment of all BCWMC-regulated stormwater from new development to Level I Standards. The BCWMC's rationale for this policy is that obtaining the maximum amount of stormwater treatment at the time of development will help ensure that water quality objectives are achieved throughout the watershed and avoid costly retrofit projects in the future. A project must be designed in accordance with Level I standards of the water quality policy, when the proposed site meets one of the following development or redevelopment criteria:

a. A *commercial, industrial, institutional, or public development* involving a parcel of more than 0.5 acres of land where there is no existing commercial, industrial, institutional, or public development. A *commercial, industrial, institutional or public expansion/addition* involving a site that was partially developed prior to adoption of the BCWMC's Water Quality Policy (September 14, 1994) and involves grading more than 0.5 acres of land. A *commercial, industrial, institutional, or public redevelopment* involving a site of more than 5 acres of land where the commercial, industrial, institutional, residential, or public development currently exists (see also Section 4.4).

b. A *residential development* involving a parcel of more than 2 acres and which contains four or more proposed living units. A *residential redevelopment* involving more than 10 acres where there are four or more existing living units.

c. A *road construction or reconstruction* project involving a site of more than 1.0 acre of land for which the site runoff is not currently directed to an onsite or regional treatment facility (see also Section 4.6).

d. If the BCWMC has approved a local watershed management plan pursuant to 103B.235, or a subwatershed plan within a municipality; the requirements of this policy which are met by the local watershed management plan shall be deemed satisfied upon showing compliance with the local plan.

Section 6.0 of this document outlines design criteria consistent with Level 1 standards for various water quality enhancement features.

4.4 Nondegradation Policy for Redevelopment Projects

All redevelopment projects that result in an increase in impervious area (except as noted below) must meet the requirements of Policy A, Section 4.2.2.4 of the BCWMC Plan, which requires implementation of BMPs to prevent an increase in phosphorus loading from the site. As an alternative, the entire parcel shall be developed/redeveloped in accordance to Level 1 Standards.

The following are exemptions from the nondegradation policy (Policy A 4.2.2.4) for redevelopment projects:

1. Single family homes (not part of an overall residential development/redevelopment involving a site of more than two acres and which contains four or more proposed living units)
2. Project sites (parcel) less than 0.5 acres
3. Sites described within the following table:

Parcel size (acres)	Exemption applies if added impervious surface area is no more than:
0.5 – 1.0	1,000 square feet
1.0 – 5.0	2,000 square feet
Over 5.0	10,000 square feet

4.5 Site Expansion/Addition Projects

For *commercial, industrial, institutional, or public expansion/addition* projects, the BCWMC realizes that existing development may limit the type of BMPs that can be implemented for the entire site. The most desirable BMP reduces pollutants to the maximum extent practicable and reduces runoff. At a minimum, a wet detention basin or other approved BMP must be constructed to serve the expansion/addition and, if applicable, the increase in tributary drainage area of the basin. Other appropriate BMPs will be required for the existing development if wet detention for the increased tributary drainage area is not practical. The BCWMC will work with the project applicant to assist with determining the appropriate temporary and permanent BMPs to implement for the project.

4.6 Road Projects

BMPs must be considered to improve the quality of stormwater runoff from *road construction and reconstruction* projects. The most desirable BMP reduces pollutants to the maximum extent practicable and reduces runoff. The BCWMC realizes that existing development and right-of-way constraints will limit the type of BMPs that can be implemented. At a minimum, temporary measures will be required to address erosion and sediment control during construction. The BCWMC will work with the project applicant to assist with determining the appropriate temporary and permanent BMPs to implement for the project. The project applicant must submit a description of the evaluation process used to identify feasible BMPs to be implemented on the project.

5.0 Floodplain Policies

The BCWMC adopted the following policies regarding floodplain regulation within the Bassett Creek watershed (see policies in Section 5.2.2.2 of the Plan):

1. The floodplain of Bassett Creek is defined as that area lying below the 100-year flood elevations as shown in Table 5-3 of the Plan, or as subsequently revised due to channel improvement, storage site development, or requirements established by appropriate state or federal governmental agencies. *(Policy F)*

2. Land use types that would be damaged by flood waters or that would result in increased flooding are not permitted within the floodplain. *(Policy G)*

3. Allowable types of land use that are consistent with the floodplain include: recreation areas, parking lots, excavations and storage areas, public utility lines, agriculture, and other open space uses. Permanent storage piles, fences, and other obstructions which would collect debris or restrict flood flows are not allowed. *(Policy G)*

4. Filling will generally not be allowed within the floodplain. Proposals to fill within the established floodplain must obtain BCWMC approval and must provide compensating storage and/or channel improvement so that the flood level shall not be increased at any point along the trunk system due to the fill. *(Policy H)*

5. Expansion of existing non-conforming land uses within the floodplain will be prohibited unless they are fully flood-proofed in accordance with existing codes and regulations. *(Policy I)*

6. The lowest floor of all permanent structures must be at least 2 feet above the established 100-year floodplain elevation. *(Policy J)*

7. Project applicants must apply BMPs to reduce the volume of stormwater runoff, to the maximum practical extent. Examples of stormwater runoff volume reduction methods include: *(Policy D)*

    - Reducing the amount of planned impervious surface (as areas develop)
    - Reducing the amount of impervious surface (during redevelopment)
    - Promoting infiltration

8. Economic considerations alone will not be a sufficient reason to alter the floodplain. *(Policy L)*

9. The BCWMC will not approve any diversions of surface water within, into, or out of the watershed that may have a substantial adverse effect on stream flow or water levels at any point within the watershed. Plans for intra- or inter-watershed diversions must include an analysis of the effects of the diversion on flooding, water quality, and aesthetic quality along the creek. The BCWMC will review diversion plans to determine the effect of the proposal on the Bassett Creek watershed and such plans will be subject to BCWMC approval. If it is necessary to divert surface water runoff to another watershed, every effort must be made to ensure that there is no fish migration from one watershed to another. *(Policy O)*

6.0 Level I Standards

The Plan (see Section 4.2.2.4, Policy A) requires that development proposals must be designed to meet the BCWMC's Level I water quality standard (Level I standards). Design criteria for several BMPs that meet the BCWMC's Level I standards have been adopted by the BCWMC. Except as noted, the BCWMC-approved BMPs include:

<u>Infiltration Systems</u>

- Infiltration Basin: An infiltration basin is a stormwater runoff impoundment designed to capture and hold stormwater runoff and infiltrate it into the ground over a period of days. It does not retain a permanent pool of water. Generally, infiltration basins are suitable for sites with gentle slopes, permeable soils, relatively deep groundwater levels, and a small tributary watershed area (less than two acres, ideally).

<u>Filtration Systems</u>

- Surface Sand Filter: A surface sand filter consists of a pretreatment basin, a water storage reservoir, flow spreader, and under-drain piping. A basin liner may also be needed if the treated runoff cannot be allowed to infiltrate into the soil underlying the filtration basin because of groundwater concerns. Sand filters are adaptable, and have few site constraints. They can be applied in areas with thin soils, high evaporation rates, low soil-infiltration rates, and limited space.

- Bioretention Basin: A bioretention basin is a shallow, landscaped depression that receives stormwater runoff. Stormwater flows into the bioretention basin, ponds on the surface, and gradually filtrates into the soil bed. Filtered runoff is collected by an under-drain system and discharged to the storm sewer system or directly to receiving waters. Bioretention basins should usually be used on sites with tributary areas less than two acres. Bioretention basins can be applied in almost any soils, since runoff percolates through an engineered soil bed.

<u>Detention Systems</u>

- Water Quality Pond: A water quality pond (also known as wet pond, detention basin, water quality basin, or "NURP" pond [if the pond incorporates specific design parameters]), is a constructed stormwater pond that retains a permanent pool of water. Water quality ponds are appropriate for sites where there are no space restrictions.

- Underground Wet Vault: A wet vault is an underground structure designed to provide temporary and permanent storage for stormwater runoff from a specified storm event. Wet vaults have a permanent pool of water which dissipates energy and improves the settling of particulate stormwater pollutants. Wet vaults are typically used for commercial, industrial, or roadway projects if there are space limitations precluding the use of other treatment BMPs.

All proposed wet vaults must also be reviewed and approved by the BCWMC at its monthly meeting.

Note: Sections 6.1 – 6.3 present the design and maintenance requirements for the BCMWC approved BMPs. These design requirements were developed from the following documents:

1. Bassett Creek Watershed Management Commission, *Watershed Management Plan* (Plan) (September 2004). http://www.bassettcreekwmo.org/2nd%20Generation%20Plan/Final%20Plan%20September%202004/TOC.htm

2. *Minnesota Urban Small Sites BMP Manual* Metropolitan Council, July 2001 (*Minnesota BMP Manual*) http://www.metrocouncil.org/environment/water/BMP/manual.htm

3. *State of Minnesota Stormwater Manual*, MPCA, November 2005 (*Minnesota Stormwater Manual*). http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html

4. *Protecting Water Quality in Urban Areas*, MPCA, March 1, 2000. http://www.pca.state.mn.us/water/pubs/sw-bmpmanual.html

5. *Plants for Stormwater Design, Species Selection for the Upper Midwest*. MPCA, July 2003. http://proteus.pca.state.mn.us/publications/manuals/stormwaterplants.html

6.1 Infiltration Systems

6.1.1 Infiltration Basin Design and Maintenance Requirements

6.1.1.1 Description

An infiltration basin is a stormwater runoff impoundment designed to capture and hold stormwater runoff and infiltrate it into the ground over a period of days. It does not retain a permanent pool of water. A key feature of an infiltration basin is its vegetation. It is important to vegetate the bottom of the basin with deep-rooted plants to increase the infiltration capacity of the basin.

For infiltration basins to perform as designed, pretreatment of stormwater must be provided to remove as many of the suspended solids from the runoff as possible before the water enters the infiltration basin.

Infiltration basins have limited capabilities for controlling peak discharge from storms greater than the design storm. Because infiltration basins will not significantly affect peak discharges of runoff, they must be used in conjunction with other BMPs to meet peak runoff rate control requirements.

6.1.1.2 Site Analysis

Before an infiltration system can be designed, a site sensitivity analysis must be performed. This evaluation may eliminate an infiltration practice from consideration because of soil characteristics or potential effects on groundwater. Because of varying geologic settings, a site evaluation needs to be tailored to the specific site conditions.

The suitability of using infiltration basins on a site depends on numerous site factors, including soils, slope, depth to water table, depth to bedrock or impermeable layer, tributary watershed area, land use, proximity to wells, surface waters, foundations, and others. Generally, infiltration basins are suitable for sites with gentle slopes, permeable soils, relatively deep groundwater levels, and a small tributary watershed area (less than two acres, ideally).

When performing a site evaluation, the following items must be considered:

- **Geology**: A site with highly sensitive geology, such as one with a surficial sand aquifer, may eliminate this practice from consideration.

- **Groundwater**: The seasonally high water table must be far enough below the bottom of the infiltration basin to allow the structure to function hydraulically and to allow trapping and treatment of pollutants by the soil. Specifically, the seasonally high groundwater table is recommended to be at least 3 feet from the bottom of the infiltration basin. Basins should be located at least 150 feet away from drinking water sources to limit the possibility of groundwater contamination, and should be situated at least 10 feet downgradient and 100 feet upgradient from building foundations to avoid potential seepage problems.

- **Soils**: Sites with clayey soils may not be appropriate for infiltration basins. If the infiltration rate of the site's soils is not acceptable, the filtration family of BMP systems should be considered (see Section 6.2).

- **Drainage Area**: Generally, the tributary drainage area to any individual infiltration basin must be restricted to two acres or less.

- **Wetlands:** Wetland issues must be assessed to ensure the BMP conforms to the Wetland Conservation Act and other wetland regulations.

6.1.1.3 General Design Considerations

6.1.1.3.1 Design Volume

The infiltration basin design volume must be no less than 0.5 inches of runoff from the tributary impervious surfaces, while the remaining runoff bypasses the infiltration basin.

6.1.1.3.2 Off-line Placement

The purpose of the basin is to temporarily store surface runoff and allow it to infiltrate through the bottom and sides of the basin. A flow splitter or weir is typically used to divert runoff into an off-line infiltration basin. Infiltration basins provide total peak discharge, runoff volume, and water quality control for all storm events equal to or less than the design storm. Storm events greater than the design storm simply continue down the larger conveyance system, bypassing the infiltration basin.

6.1.1.3.3 Pretreatment

Pretreatment devices such as proprietary environmental stormwater treatment systems, grit chambers, grass swales with check dams, filter strips, or sediment forebays/traps are a fundamental component of any BMP system relying on infiltration and must be incorporated into the design. It is recommended that pretreatment devices be designed to remove at least 25-30% of sediment loads.

- Sediment forebays/traps for pretreatment should be sized to treat a minimum of 25% of the design volume.

- Grit chambers for pretreatment should be designed and sized to provide theoretical settlement of a 0.3-mm grit particle in still water at 10°C (based on Stoke's Law) and provide sufficient storage volume for the settled particles consistent with the maintenance schedule.

- Grass filter strips, should be at least 20 feet long for new sites and at least 10 feet long for retrofits.

6.1.1.3.4 Infiltration Rate

Infiltration volumes and facility sizes shall be calculated using the appropriate hydrological soil group classification and design infiltration rate from Table 1. The design infiltration rate shall be selected from Table 1 based on the least permeable soil horizon within the first five feet below the bottom elevation of the proposed infiltration basin. Soil horizon must be classified under direction of a licensed soil scientist, geologist, or engineer.

Table 1 Design Infiltration Rates

Soil Group	Rate	Soil Textures	ASTM Unified Soil Class Symbols
A	1.60 in/hr	Gravel, sandy gravel, or silty gravel	GW, GP, GM, SW
	0.80 in/hr	Sand, loamy sand, or sandy loam	SP
B	0.60 in/hr	Silt loam	SM
	0.30 in/hr	Loam	MH
C	0.20 in/hr	Sandy clay loam	ML
Source: *Minnesota Stormwater Manual, November 2005.*			
D	0.03 in/hr	Clay loam, silty clay loam, sandy clay, silty clay, or clay	GC, SC, CL, OL, CH, OH
Source: *Minnesota BMP Manual,* July 2001			

As an alternative, the applicant may complete double-ring infiltrometer test measurements at the proposed bottom elevation of the infiltration BMP to the requirements of ASTM D3385. The measured infiltration rate shall be divided by the appropriate correction factor selected from the *Minnesota Stormwater Manual.* This test must be completed under the direction of a licensed soil scientist, geologist, or engineer.

6.1.1.3.5 Duration of Ponding

The drawdown time for infiltration basins shall be 48 hours (or up to 72 hours if justification can be provided) from the peak water level in the infiltration basin. The depth and area of the infiltration basin must be adjusted accordingly. Certain types of vegetation will require shorter ponding duration to survive storm events.

6.1.1.3.6 Maximum Depth

After the infiltration rate of the soil has been determined, the maximum depth of the infiltration basin is calculated with the following equation:

$d_{max} = (f) * (T_p)$

Where: d_{max} = maximum design depth (inches),

f = soil infiltration rate (in/hr), and

T_p = design ponding time (hours).

The maximum depth and ponding time of the infiltration area must promote the survival of vegetation. The maximum depth shall be calculated from Table 1 and shall be no greater than 2 feet unless justification for increased depth can be provided.

6.1.1.3.7 Basin Slopes

The bottom of the basin must be graded as flat as possible (1% or less is recommended) to provide uniform ponding and infiltration of the runoff across the floor. The side slopes of the basin should be no steeper than 3H:1V (flatter slopes are preferred) to allow for proper stabilization and maintenance.

6.1.1.3.8 Basin Shape

The length and width of the basin should be determined by the characteristics of the site in question (topography, size and shape). A desirable length-to-width ratio for an infiltration basin is 3:1 or greater.

6.1.1.3.9 Plants

Plants are an important component of an infiltration basin. Plants remove water through evapotranspiration and remove pollutants and nutrient through uptake. It is important to vegetate the bottom of the basin with deep-rooted plants to increase the infiltration capacity of the basin. The plant species selected for a infiltration basin must be designed to survive frequent periods of inundation during runoff events and drying during inter-event periods.

The bottom and side slopes of the basin must be stabilized within seven days following construction. Vegetative buffers around the perimeter of the basin are recommended for erosion control and additional sediment and nutrient removal. A diversity of plant species is recommended to allow for best survivability. Plants that are tolerant of both wet weather and drought must be used.

Plant recommendations based on different site conditions are included in *Plants for Stormwater Design, Species Selection for the Upper Midwest* (MPCA, July 2003).

6.1.1.3.10 Inflow/Bypass

If runoff is delivered by a storm drain pipe or along the main conveyance system, the infiltration basin should be designed as an off-line system to convey high flows around the basin. This will necessitate the construction of a flow splitter upstream of the basin.

To prevent incoming flow velocities from reaching erosive levels and scouring the basin floor, inlet channels to the basin should be designed to terminate in a broad apron, which spreads the runoff more evenly over the basin surface to promote better infiltration.

6.1.1.3.11 Overflow

All infiltration basins should have an emergency spillway capable of passing runoff from large storms without damage to the impounding structure.

6.1.1.3.12 Groundwater Mounding

Calculations to determine groundwater mounding may be necessary in cases where slope stability is a concern and/or a high water table is encountered.

6.1.1.4 Sequencing and Construction

- Prior to construction, the area of infiltration basin must be protected by silt fence, construction fence, or other method to prevent construction equipment from compacting the underlying soils.

- To the extent possible, the infiltration basin must be constructed after the remaining site and tributary area has been graded and stabilized.

- To the extent possible, excavation must be performed by equipment with tracks exerting relatively light pressures to prevent the basin floor from being compacted, which reduces the infiltration capacity.

- After final grading, the basin floor must be tilled to a depth of at least six inches to provide a well-aerated, porous surface texture. Six inches of compost must be tilled in at this time.

- The bottom and side slopes of the basin must be stabilized within seven days following construction

6.1.1.5 Maintenance

Maintenance is required for the proper operation of infiltration basins. The city must ensure that a maintenance agreement and maintenance plan is prepared for operation of infiltration basins. Following are maintenance requirements from the *Minnesota Stormwater Manual* (MPCA, November 2005) and the *Minnesota BMP Manual* (Metropolitan Council, July 2001):

- The plan must identify owners, parties responsible for maintenance, and an inspection and maintenance checklist and schedule.

- Pretreatment devices for basins must be inspected and cleaned at least twice a year.

- Inspections must occur after every rainfall greater than 0.5-inches in the first year after construction to ensure proper stabilization and function. Attention must be paid to how long water remains standing in the basin after a storm; water standing within the basin more than 48 hours after a storm indicates that the infiltration capacity may have been overestimated. Factors responsible for clogging (such as upland sediment erosion and excessive compaction of soils) must be repaired immediately. Also, the newly-established vegetation must be inspected to determine if any remedial actions (reseeding, irrigation, etc.) are necessary.

- Thereafter, the infiltration basin must be inspected at least twice per year. Important items to check include: differential accumulation of sediment, erosion of the basin floor, condition of riprap and the health of the vegetation. Eroded or barren spots must be replanted immediately after inspection to prevent additional erosion and accumulation of sediment.

- Sediment removal within the basin must be performed when the sediment is dry enough so that it is cracked and readily separates from the basin floor to prevent smearing of the basin floor.

- The surface of the infiltration basin may become clogged with fine sediment over time. Core aeration or cultivating of non-vegetated areas may be required to ensure adequate infiltration.

- Light equipment, which will not compact the underlying soil, must be used to remove the top layer of sediment. The remaining soils must be decompacted by tilling and revegetated as soon as possible.

- Vegetation must be maintained to control weed growth and maintain the health of the vegetation in the basin. Weeding once monthly is required during the first two growing seasons. Weeding two or three times per growing season is required after the first two growing seasons.

- Adequate access for appropriate equipment and vehicles must be provided for inspection, maintenance and landscaping upkeep.

- Snow storage is encouraged outside of the infiltration area.

- It is recommended that the maintenance agreement between the city and applicant be filed against the property with the county.

- Additional general maintenance activities and schedules are provided in the *Minnesota Stormwater Manual*, and the *Minnesota BMP Manual*.

6.2 Filtration Systems

6.2.1 Surface Sand Filter Design and Maintenance Requirements

6.2.1.1 Description

Surface sand filters consist of a pretreatment basin, a water storage reservoir, flow spreader, and under-drain piping. A basin liner may also be needed if the treated runoff cannot be allowed to infiltrate into the soil underlying the filtration basin because of groundwater concerns.

The two basic components of a sand filter design are the pretreatment basin and the sand filter. The pretreatment basin reduces the amount of sediment that reaches the sand filter and helps ensure that stormwater reaches the sand filter as sheet flow.

Drainage areas directed to each sand filter must be less than five acres in size. Sand filters are adaptable, and have few site constraints. They can be applied in areas with thin soils, high evaporation rates, low soil-infiltration rates, and limited space.

Sand filters are most effective when designed as offline BMPs; they are intended primarily for quality control, not quantity control. A diversion structure, such as a flow splitter or weir, must be provided to route the "first flush" of runoff into the sand filter, while the remainder continues on to a stormwater-quantity-control BMP.

6.2.1.2 Design Requirements

6.2.1.2.1 Design Volume

The filtration basin design volume must be no less than 1.0 inches of runoff from the tributary impervious surfaces, while the remaining runoff bypasses the filtration basin.

6.2.1.2.2 Pretreatment

Pretreatment devices such as proprietary environmental stormwater treatment systems, grit chambers, grass swales with check dams, filter strips, or sediment forebays/traps are a fundamental component of any BMP system relying on infiltration and must be incorporated in the design. It is recommended that pretreatment devices be designed to remove at least 25-30% of sediment loads.

- Sediment forebays/traps for pretreatment should be sized to treat a minimum of 25% of the design volume.

- Grit chambers for pretreatment should be designed and sized to provide theoretical settlement of a 0.3-mm grit particle in still water at 10°C (based on Stoke's Law) and provide sufficient storage volume for the settled particles consistent with the maintenance schedule.

- Grass filter strips should be at least 20 feet long for new sites and at least 10 feet long for retrofits.

6.2.1.2.3 General Principles and Sizing

- The sand filter design is based on Darcy's law:

$$Q = KiA = VA \text{ (since } V = Ki)$$

where Q = WQ design flow (cfs)

K = hydraulic conductivity (fps)

A = surface area perpendicular to the direction of flow (sf)

i = hydraulic gradient (ft/ft) for a constant head and constant media depth, computed as follows:

$$i = (h + l) / l$$

where h = average depth of water above filter (ft), defined for this design as d/2

d = maximum storage depth above filter (ft)

l = thickness of sand media (typically 1.5 ft)

When water is flowing into the ground, V is commonly called the filtration rate. It is ordinarily measured in a percolation test. The filtration rate V changes with head and media thickness, although the media thickness is constant in the sand filter design. Table 2 shows values of *V* for different water depths *d* (remember, d = 2h), assuming a media thickness of 1.5 feet and a hydraulic conductivity of 1 inch per hour.

Unlike the filtration rate *V*, the hydraulic conductivity *K* does not change with head, nor is it dependent on the thickness of the media, only on the characteristics of the media and the fluid. The hydraulic conductivity of 1 inch per hour (2.315×10^{-5} fps) used in this design is based on bench-scale tests of conditioned rather than clean sand. This design hydraulic conductivity represents a typical sand-bed condition as silt is captured and held in the filter bed. The designer must determine the correct hydraulic conductivity based on the actual sand used for the filter bed.

Table 2 Sand Filter Design Parameters

	Sand Filter Design Parameters					
Facility ponding depth d (ft)	**1**	**2**	**3**	**4**	**5**	**6**
Filtration rate V (in/hr) *	1.33	1.67	2.00	2.33	2.67	3.0
1/V (min/in)	44	36	30	26	26	20

* Note: The filtration rate is not used directly but is provided for information. V equals the hydraulic conductivity K times the hydraulic gradient i. The hydraulic conductivity used is 1 in/hr. The hydraulic gradient = (h + l) / l, where h = d / 2 and l = the sand depth (1.5 ft).

Source: King County, Washington Surface Water Design Manual, 1988 (revised 2005)

- For a basic sand filter design, it is recommended that the filter must be sized to completely empty (drawdown time) the design-storm volume in 24 hours or less (or up to 48 hours if justification can be provided). Water depth above the filter must be no more than 4 feet (or up to 6 feet if acceptable to the city). A minimum of 1-foot of freeboard is recommended when establishing the BMP depth.

6.2.1.2.4 Basic Components

- Surface sand filters generally include the following layers, from top to bottom: sand, geotextile, and an under-drain system.

- The seasonally high water table must be far enough below the bottom of the sand filter to allow the structure to function hydraulically and to allow trapping and treatment of pollutants by the filter.

- Runoff discharging to the sand filter must be pretreated (via a presettling basin, for example) to remove debris and other gross solids and any oil from high-use sites. (The type of pretreatment device must depend on the type of pollutants present.) The recommended length-to-width ratio of the presettling basin is 3:1 and the depth should be 3 to 6 feet.

- Inlet structures (such as flow spreaders, weirs, or multiple orifice openings) must be designed to minimize turbulence to spread the flow uniformly across the surface of the filter media.

- Stone riprap or other dissipation devices must also be installed to prevent gouging of the sand media and promote uniform flow. Offline outlet structures are typically sized for the 15-minute peak flow of a 2-year, 24-hour storm.

- An impermeable liner (clay, geomembrane, or concrete) is required under the filter to protect groundwater where soil contamination is present.

6.2.1.2.5 Sand Specification

The sand in a filter must consist of a medium sand meeting the size gradation (by weight) given in Table 3. The designer must obtain a grain-size analysis from the supplier to certify that the No. 100 and No. 200 sieve requirements are met. A laboratory analysis to determine the sand’s hydraulic conductivity *K* is also highly recommended. The designer must then adjust this number to account for conditioning of the sand during operation.

Table 3 Medium Sand Specification

U.S. Sieve Number	Percent Passing
4	95 – 100
8	70 – 100
16	40 – 90
30	25 – 75
50	2 – 25
100	<4
200	<2

6.2.1.2.6 Under-Drain Systems

Several types of under-drains may be used: a central collector pipe (with lateral feeder pipes or a geotextile drain strip in an 8-inch gravel backfill or drain rock bed) or a longitudinal pipe in an 8-inch gravel backfill or drain rock with a collector pipe at the outlet end.

- Hydraulically, the system is typically sized for the 15-minute peak flow from a 2-year, 24-hour storm, with 1 foot of head above the invert of the upstream end of the collector pipe. Local sizing requirements must be used when available.

- Under-drain pipes are recommended to have internal diameters with a minimum of 6 inches and two rows of half-inch holes spaced 6 inches apart longitudinally (max.), with the rows 120 degrees apart (laid with holes downward). The recommended maximum perpendicular distance between two feeder pipes is 10 feet.

- The recommended minimum grade of the under-drain piping is 1.0 percent and the recommended minimum grade of the main collector pipe is 0.5 percent.

- A geotextile fabric should be used between the sand layer and drain rock or gravel and placed so that one inch of drain rock or gravel is above the fabric. Drain rock is recommended to be 1.5- to 0.75-inch rock or gravel backfill, washed free of clay and organic material.

- Cleanout wyes with caps or junction boxes are recommended to be provided at both ends of the collector pipes. Cleanouts must extend to the surface of the filter. A valve box should be provided for access to the cleanouts.

6.2.1.2.7 Impermeable Liners

Impermeable liners (clay, concrete, geomembrane, etc.) are required when nonconventional soluble pollutants such as metals and organics are present and where the underflow could cause problems with structures or groundwater.

6.2.1.2.8 Slopes and Siting

- An access ramp with a slope not to exceed 7:1 (horizontal:vertical) or equivalent is recommended for maintenance purposes at the inlet and the outlet of a surface filter.

- Side slopes for earthen or grass embankments are recommended not to exceed 3:1 (horizontal:vertical) to facilitate mowing/maintenance.

- Some cities may require perimeter fencing or benching to reduce safety hazards.

- High groundwater may damage underground structures or affect the performance of filter under-drain systems. Sufficient clearance (at least 3 feet is recommended) between the seasonal high groundwater level and the bottom of the BMP is necessary to obtain adequate drainage.

- Maximum longevity of the sand filter may be achievable by limiting its use only to runoff from impervious areas to minimize clogging by organic material from turfed surfaces.

6.2.1.3 Sequencing and Construction

- The sand filter is recommended to be constructed after the remaining site and tributary area has been graded and stabilized.

- To the extent possible, excavation must be performed by equipment with tracks exerting relatively light pressures to prevent basin floor from being compacted, which reduces the filtration capacity.

- Sand must be placed uniformly to prevent formation of voids that could lead to short-circuiting (particularly around penetrations for under-drain cleanouts) and to prevent damage to the underlying under-drain system. To the extent possible, voids between the trench walls and the geotextile fabric must be avoided.

- Mechanical compaction of the sand filter should be avoided. The sand bed can be stabilized by wetting the sand periodically, allowing it to consolidate, and then adding extra sand. This process can be repeated until consolidation is complete.

- The bottom and side slopes of the sand filter must be stabilized within seven days following construction.

6.2.1.4 Maintenance

Maintenance is required for the proper operation of sand filters. The city must ensure that a maintenance agreement and maintenance plan is prepared for operation of sand filters. Following are maintenance requirements from the *Minnesota Stormwater Manual* (MPCA, November 2005) and the *Minnesota BMP Manual* (Metropolitan Council, July 2001):

- The plan must identify owners, parties responsible for maintenance, and an inspection and maintenance checklist and schedule.

- Adequate access to the sand filter must be provided for inspection and maintenance.

- Sand filters must be inspected after every rainfall greater than 0.5-inches in the first year after construction; thereafter, the sand filter must be inspected at least twice per year. Maintenance for sand filters consists of removing the first two or three inches of discolored sand and replacing it with new sand.

- Silt and sediment is recommended to be removed from the surface of the filter when an accumulation of one inch has occurred or when the drawdown time increases beyond 20 percent of design value.

- Sediment removal within the sand filter must be performed when the sediment is dry enough so that it is cracked and readily separates from the surface to prevent smearing of the filter.

- Vegetation must be maintained as needed. Devices with healthy vegetation tend not to clog. The use of flood- and drought-resistant varieties will minimize maintenance needs.

- To insure proper performance, sediment, trash, and debris must be removed from the sand filter and pretreatment basin on a regular basis.

- Snow storage is encouraged outside of the sand filter.

- It is recommended that the maintenance agreement between the city and applicant be filed against the property with the county.

- Additional general maintenance activities and schedules are provided in the *Minnesota Stormwater Manual*, and the *Minnesota BMP Manual*.

6.2.2 Bioretention System Design and Maintenance Requirements

6.2.2.1 Description

In general, bioretention systems can be described as shallow, landscaped depressions commonly located in parking lot islands or within small pockets in residential areas that receive stormwater runoff. Stormwater flows into the bioretention basin, ponds on the surface, and gradually infiltrates into the soil bed. Pollutants are removed by a number of processes including adsorption filtration, volatilization, ion exchange and decomposition (*Design Manual for Bioretention in Stormwater Management*, Prince George's County, MD, 1993). Filtered runoff is collected by an under-drain system and discharged to the storm sewer system or directly to receiving waters. Runoff from larger storms is generally diverted past the area to the storm drain system.

6.2.2.2 Site Analysis

Before a bioretention basin can be designed, site conditions must be considered to ensure that a bioretention basin is the appropriate BMP for the site.

- **Drainage area:** Bioretention basins should usually be used on sites with tributary areas less than two acres. When used to treat larger areas, they tend to clog. In addition, it is difficult to convey flow from a large area to a bioretention basin. For larger sites, multiple basins should be used to treat runoff.

- **Available area for the bioretention basin:** It is recommended the surface area of the bioretention basin should be between 5% and 10% of the impervious area draining to it, with a minimum of 200 square feet for small sites.

- **Soils:** Bioretention basins can be applied in almost any soils, since runoff percolates through an engineered soil bed and is returned to the stormwater system.

- **Groundwater**: The seasonally high water table must be far enough below the bottom of the bioretention basin to allow the structure to function hydraulically and to allow trapping and treatment of pollutants by the soil. Specifically, the seasonally high groundwater table is recommended to be a least 3 feet from the bottom of the bioretention basin.

- **Under-Drain:** An under-drain is a perforated pipe in a gravel bed, installed along the bottom of a soil bed that collects and removes filtered runoff, directing it to a storm drain system.

- **Wetlands:** Wetland issue must be assessed to ensure the BMP conforms to the Wetland Conservation Act and other wetland regulations.

6.2.2.3 General Design Considerations

6.2.2.3.1 Design Volume

The bioretention basin design volume must be no less than 1.0 inch of runoff from the tributary impervious surfaces, while the remaining runoff bypasses the bioretention basin.

6.2.2.3.2 Pretreatment

Pretreatment devices such as proprietary environmental stormwater treatment systems, grit chambers, grass swales with check dams, filter strips, or sediment forebays/traps are a fundamental component of any BMP system relying on infiltration and must be incorporated in the design. It is recommended pretreatment devices be designed to remove at least 25-30% of sediment loads.

- Sediment forebays/traps for pretreatment should be sized to treat a minimum of 25% of the design volume.
- Grit chambers for pretreatment should be designed and sized to provide theoretical settlement of a 0.3-mm grit particle in still water at 10°C (based on Stoke’s Law) and provide sufficient storage volume for the settled particles consistent with the maintenance schedule.
- Grass filter strips should be at least 20 feet long for new sites and at least 10 feet long for retrofits.

6.2.2.3.3 Maximum Depth

The maximum depth and ponding time of the bioretention basin must promote the survival of vegetation. Where feasible the bioretention basin must be designed to pond 6 to 9 inches (the maximum pooling depth may be up to 2 feet if justification for increased depth can be provided).

6.2.2.3.4 Duration of Ponding

Where feasible, the drawdown time for bioretention basins shall be 48 hours (or up to 72 hours if justification can be provided) from the peak water level in the bioretention basin. The depth and area of the bioretention basin must be adjusted accordingly. Certain types of vegetation will require shorter ponding duration to survive storm events.

6.2.2.3.5 Basin Slopes

The bottom of the basin must be graded as flat as possible (1% or less is recommended) to provide uniform ponding and filtration of the runoff across the floor. The side slopes of the area should be no steeper than 3H:1V (flatter slopes are preferred) to allow for proper stabilization and maintenance.

6.2.2.3.6 *Planting Soil Bed*

The planting soil bed provides water and nutrients to support plant life in the bioretention basin. Stormwater filters through the planting soil bed where pollutants are removed by the mechanisms of filtration, plant uptake, adsorption, and biological degradation.

- A well-blended, homogenous mixture of 50-60% sand, 20-30% top soil, and 20-30% organic leaf compost is recommended to provide a soil medium with a high infiltration/filtration capacity.
    - **Sand—**Provide clean sand, free of deleterious materials. AASHTO M-6, ASTM C-33 or MnDOT 3126F with grain size of 0.02-0.04 inches, to the extent possible.
    - **Top Soil—**Sandy loam, loamy sand, or loam texture per USDA textural triangle with less than 5% clay content.
    - **Organic Leaf Compost—**MnDOT Grade 2 Compost (provided by vendor approved by MnDOT's Turf Establishment and Erosion Prevention Unit)
- The recommended minimum depth of the prepared soil is 30 inches. However, if large trees are preferred in the design, a soil depth of 48 -52 inches is recommended to accommodate the root depth of the proposed trees.

6.2.2.3.7 *Plants*

Plants are an important component of a bioretention system. Plants remove water through evapotranspiration and remove pollutants and nutrient through uptake. Plant roots enhance the infiltration capacity of the soil, providing conduits for percolation. The plant species selected for a bioretention basin must be designed to survive frequent periods of inundation during runoff events and drying during inter-event periods.

The bottom and side slopes of the basin must be stabilized with appropriate plants within seven days following construction. Vegetative buffers around the perimeter of the basin are recommended for erosion control and additional sediment and nutrient removal. A diversity of plant species is recommended to allow for best survivability. Plants that are tolerant of both wet weather and drought must be used.

Plant recommendations based on different site conditions are included in *Plants for Stormwater Design, Species Selection for the Upper Midwest* (MPCA, July 2003).

6.2.2.3.8 *Inflow/Bypass*

- If runoff is delivered by a storm drain pipe or along the main conveyance system, the bioretention basin should be designed as an off-line system to convey high flows around the basin. This will necessitate the construction of a flow splitter upstream of the basin.

- To prevent incoming flow velocities from reaching erosive levels and scouring the basin floor, inlet channels to the basin must be designed to terminate in a broad apron, which spreads the runoff more evenly over the basin surface to promote better filtration.

6.2.2.3.9 Overflow

All bioretention basins should have an emergency spillway capable of passing runoff from large storms without damage to the impounding structure.

6.2.2.4 Sequencing and Construction

- Prior to construction, the area of the bioretention basin must be protected by silt fence, construction fence or other method to prevent construction equipment from compacting the underlying soils.

- To the extent possible, the bioretention basin must be constructed after the remaining site and tributary area has been graded and stabilized.

- To the extent possible, excavation must be performed by equipment with tracks exerting relatively light pressures to prevent the basin floor from being compacted, which reduces the infiltration capacity.

- After final grading, the bioretention basin floor must be tilled to a depth of at least 6 inches to provide a well-aerated, porous surface texture. Six inches of compost must be tilled in at this time.

- The bottom and side slopes of the basin must be stabilized with appropriate plants within seven days following construction

6.2.2.5 Maintenance

Maintenance is required for the proper operation of bioretention basins. The city must ensure that a maintenance agreement and maintenance plan is prepared for operation of bioretention basins. Following are maintenance requirements from the *Minnesota Stormwater Manual* (MPCA, November 2005) and the *Minnesota BMP Manual* (Metropolitan Council, July 2001):

- The plan must identify owners, parties responsible for maintenance, and an inspection and maintenance checklist and schedule.

- Pretreatment devices for bioretention basins must be inspected and cleaned at least twice a year.

- Inspections must occur after every rainfall greater than 0.5-inches in the first year after construction to ensure proper stabilization and function. Attention must be paid to how long water remains standing in the basin after a storm; water standing within the basin more than

48 hours after a storm indicates that the filtration capacity may have been overestimated. Factors responsible for clogging (such as upland sediment erosion and excessive compaction of soils) must be repaired immediately. Also, the newly-established vegetation must be inspected to determine if any remedial actions (reseeding, irrigation, etc.) are necessary.

- Thereafter, the bioretention basins must be inspected at least twice per year. Important items to check include: differential accumulation of sediment, erosion of the floor, condition of riprap and the health of the vegetation. Eroded or barren spots must be replanted immediately after inspection to prevent additional erosion and accumulation of sediment.

- The surface of the ponding area may become clogged with fine sediment over time. Core aeration or cultivating of non-vegetated areas may be required to ensure adequate filtration.

- Sediment removal within the bioretention basin must be performed when the sediment is dry enough so that it is cracked and readily separates from the floor to prevent smearing of the floor.

- Light equipment, which will not compact the underlying soil, must be used to remove the top layer of sediment. The remaining soils must be tilled and revegetated as soon as possible.

- Vegetation must be maintained to control weed growth and maintain the health of the vegetation in the basin. Weeding once monthly is recommended during the first two growing seasons. Weeding two or three times per growing season is recommended after the first two growing seasons.

- Adequate access for appropriate equipment and vehicles must be provided for inspection, maintenance, and landscaping upkeep.

- Snow storage is encouraged outside of the bioretention basin.

- It is recommended that the maintenance agreement between the city and applicant be filed against the property with the county.

- Additional general maintenance activities and schedules are in the *Minnesota Stormwater Manual* and the *Minnesota BMP Manual*.

6.3 Detention Systems

6.3.1 Water Quality Pond Design and Maintenance Requirements

6.3.1.1 Description

Water quality ponds (also known as wet ponds, detention basins, water quality basins, or "NURP" ponds [if the pond incorporates specific design parameters]), are constructed stormwater ponds that retain a permanent pool of water. Water quality ponds are generally on-line, end-of-pipe BMPs. The primary pollutant removal mechanism in a water quality pond is sedimentation. Significant loads of suspended pollutants, such as metals, nutrients, sediments, and organics, can be removed by sedimentation. Water quality ponds have a moderate to high capacity for removing most urban pollutants, depending on how large the volume of the permanent pool is in relation to the runoff from the surrounding watershed. Removal efficiency is primarily dependent on the length of time that runoff remains in the pond, which is known as the pond's hydraulic residence time (HRT)

Water quality ponds can also be constructed using multiple cells to enhance removal efficiency, incorporate skimming and provide accessible maintenance.

6.3.1.2 Site Analysis

- **Treatment Standard**: Natural or excavated low areas shall be used for the water quality ponds. Generally accepted reservoir routing procedures using critical duration runoff events shall be used for design of these areas and outlets. Based on the BCWMC Plan, all regulated stormwater must be treated to Level I standards throughout the watershed.

- **Alternatives to Onsite Ponds**: Alternative water quality management features may be used where onsite ponds are not feasible. Alternative features must be designed to provide water quality benefits that equal or exceed design criteria outlined in existing BCWMC policies.

- **Bedrock:** As with other stormwater BMPs, soils depth to bedrock and depth to water table must be investigated before designing a water quality pond. At sites where bedrock is close to the surface, high excavation costs may make water quality ponds infeasible. If the soils on the site are relatively permeable or well-drained, it will be difficult to maintain a permanent pool. It may be necessary to line the bottom of the water quality pond to reduce infiltration.

- **Wetlands:** Wetland issues must be assessed to ensure the BMP conforms to the Wetland Conservation Act and other wetland regulations.

6.3.1.3 Design Requirements

6.3.1.3.1 Design Volume

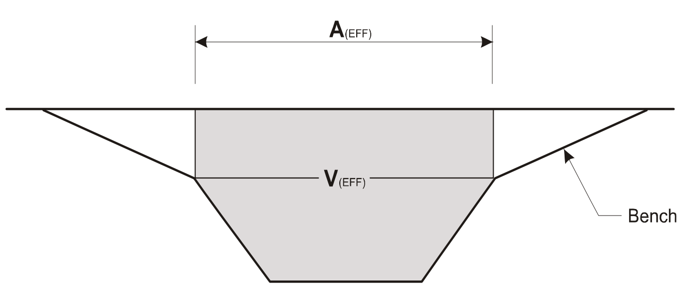
- The permanent pool (dead storage) volume below the principal spillway (normal outlet) must be greater than or equal to the runoff volume from a 2.5-inch, 24-hour storm over the project site, assuming full development. The project site includes all tributary area draining to the pond.

- The dead storage volume must be calculated separately from impervious and pervious surfaces to prevent artificially low volumes due to composite curve numbers.

- The entire tributary drainage area must be considered in computing the dead storage volume, assuming full development of the drainage area. For design purposes, the water quality volume must be considered an instant flow to the pond, not an inflow-outflow calculation. In other words, this volume must be considered to arrive at the pond all at once, rather than over the course of several hours or days. The assumption of instant runoff is conservative, but it accounts for a great deal of the variability that occurs in both storm events and runoff conditions.

6.3.1.3.2 Average Depth

The permanent pool average depth (basin volume/basin surface area) shall be $\geq$ 4 feet, with a maximum depth of $\leq$ 10 feet. For small ponds (less than 3 acre-feet in volume) average depth shall be $\geq$ 3 feet, with a maximum depth of $\leq$ 10 feet. An “effective average depth” (“effective volume”/ “effective surface area”) may be calculated for ponds that include benches. The “effective volume” and “effective surface area” are computed by extending the basin side slopes below the basin bench vertically to the water surface.



6.3.1.3.3 Emergency Overflow

An emergency overflow (emergency outlet) must be in place and adequately designed to accommodate the 100-year frequency critical duration rainfall event.

6.3.1.3.4 Basin Side Slopes

Basin side slopes above the normal water level should be no steeper than 3:1, and preferably flatter, to allow for proper stabilization and maintenance. A basin bench with a minimum width of 10 feet and 1-foot deep below the normal water level is recommended to enhance wildlife habitat, reduce potential safety hazards, and improve access for long-term maintenance. Slopes that extend below the bench to the bottom of the pond must be at a stable slope, usually no steeper than 3:1.

6.3.1.3.5 Short-Circuiting

To prevent short-circuiting, the distance between the major inlets and normal outlet must be maximized.

6.3.1.3.6 Flood Pool (Live Storage)

The flood pool (live storage) volume above the principal spillway shall be such that the peak discharge rate from the 5-year and 100-year frequency, critical duration storms do not exceed the peak discharge for similar storms under predevelopment conditions.

6.3.1.3.7 Pond Shape

To maximize stormwater contact and residence time in the pool, a length-to-width ratio of 3:1 is recommended. A minimum pool surface area of 0.25 acres is recommended. Performance of the water quality pond may be enhanced by enlarging the surface area to increase volume, as opposed to deepening the pool. However, average depth criteria must be achieved.

6.3.1.3.8 Multi-Stage Outlets

Water quality ponds may be designed with a multi-stage outlet structure to control discharges from different size storms. Usually the pond is designed to control multiple design storms (e.g., 2- and 10-year storms) and safely pass the 100-year storm event. However, the design storm may vary depending on local conditions and requirements.

6.3.1.3.9 Extended Detention

Extended detention of runoff from the more frequent (1-year to 5-year) storms is recommended by designing a principal spillway which includes a perforated vertical riser, small orifice outlet, or a compound weir.

6.3.1.3.10 Stormwater Outfalls

The design must include effective energy dissipation devices that reduce outlet velocities to 4 fps or less. These outlets shall consist of stilling basins or other such devices that prevent erosion at all stormwater outfalls into the water quality pond, and at the basin outlet. Storm sewer outfalls must extend to the water quality pond or other receiving water body and must discharge at or below its normal water elevation.

6.3.1.3.11 Outlet Structure (Skimming)

Trash and floatable debris skimming devices must be placed on the outlet of all onsite water quality ponds to provide treatment up to the critical duration 5-year storm event. Submerged inlets, permanent baffled weirs or similar devices may be employed. Timber baffled weirs are discouraged. To the extent possible, velocities through the devices shall be less than 0.5 fps. The top of submerged inlets shall be at least one foot below the normal water surface.

6.3.1.3.12 Pretreatment

Pretreatment, such as grit chambers, swales with check dams, filter strips, or sediment forebays/traps should be considered to extend the life of the water quality pond.

6.3.1.3.13 Flow Conveyance Capacity

Onsite water quality ponds shall avoid or minimize increases in predevelopment runoff rates to the greatest extent practical. The capacity of the receiving body to convey and/or store the runoff shall also be considered so as to not adversely affect water levels off the site.

6.3.1.4 Sequencing and Construction

- To the extent possible, water quality ponds must be constructed in the initial phases of a development project in order to treat site runoff during construction.
- If the water quality pond is used as a sediment trap during construction, all sediment deposited during construction must be removed before normal operation begins.
- During construction of the basin, discharge of waterborne sediments to downstream water bodies must be prevented, to the extent possible.
- The side slopes of the water quality pond must be stabilized within seven days following construction.

6.3.1.5 Maintenance

Maintenance is required for the proper operation of water quality ponds. The city must ensure that a maintenance agreement and maintenance plan is prepared for operation of water quality ponds. Following are maintenance requirements from the *Minnesota Stormwater Manual* (MPCA, November 2005) and the *Minnesota BMP Manual* (Metropolitan Council, July 2001):

- The plan must identify owners, parties responsible for maintenance, and an inspection and maintenance checklist and schedule.

- Water quality ponds must be inspected after every rainfall greater than 0.5-inches in the first year after construction.

- Thereafter, water quality ponds must be inspected at least twice per year during the growing season to ensure that they are operating as designed. Potential problems that must be checked include: subsidence, erosion, cracking or tree growth on the embankment, damage to the emergency spillway; sediment accumulation around the outlet; and erosion within the basin and banks. Any necessary repairs must be made immediately. During inspections, changes to the water quality pond or the tributary watershed must be noted, as these may affect basin performance.

- Accumulated trash and debris must be removed from the side slopes, embankment, emergency spillway, weirs, and trash grates as often as needed (at least twice during the growing season). Accumulated sediment in the forebay must be inspected at the same time.

- Sediment must be removed from the pond, as necessary. The frequency of sediment removal depends on the years of sediment accumulation that were incorporated into the design volume of the water quality pond's permanent pool and forebay and on the occurrence of any high-loading events.

- Sediment removal from water quality ponds and disposal is currently regulated by the MPCA. Sediment testing, disposal and permitting may be required and shall be investigated on an individual site basis. Sediments must be tested for toxicants in compliance with current disposal requirements as required by local, state, or federal laws or regulations.

- Adequate access for appropriate equipment and vehicles must be provided for inspection, maintenance and landscaping upkeep.

- It is recommended that the maintenance agreement between the city and applicant be filed against the property with the county.

- Additional general maintenance activities and schedules are in the *Minnesota Stormwater Manual* and the *Minnesota BMP Manual.*

6.3.2 Underground Wet Vault Design and Maintenance Requirements

6.3.2.1 Description

An underground wet vault is an underground structure designed to provide temporary and permanent storage for stormwater runoff from a specified storm event. Wet vaults have a permanent pool of water which dissipates energy and improves the settling of particulate stormwater pollutants. Wet vaults are typically on-line, end-of-pipe BMPs.

Pollutant removal mechanisms for particulate pollutants in wet vaults are similar to water quality ponds. The primary pollutant removal mechanism in a wet vault is sedimentation. Significant loads of suspended pollutants, such as metals, nutrients, sediments, and organics, can be removed by sedimentation. However, in a wet vault, the permanent pool of water is covered by a lid which blocks sunlight from entering the facility, limiting light-dependent biological activity. Consequently, biological pollutant removal mechanisms that function in the surface water quality ponds are not a part of stormwater treatment in a wet vault.

Wet vaults are typically used for commercial, industrial, or roadway projects if there are space limitations precluding the use of other treatment BMPs.

6.3.2.2 General Design Requirements

6.3.2.2.1 Design Volume

- The permanent pool (dead storage) volume below the principal spillway (normal outlet) must be greater than or equal to the runoff volume from a 2.5-inch, 24-hour storm over the project site, assuming full development. The project site includes all tributary area draining to the structure.

- The "dead storage" volume shall be calculated separately from impervious and pervious surfaces to prevent artificially low volumes due to composite curve numbers.

- The entire tributary drainage area must be considered in computing the dead storage volume, assuming full development of the drainage area. For design purposes, the water quality volume must be considered an instant flow to the wet vault, not an inflow-outflow calculation. In other words, this volume must be considered to arrive at the wet vault all at once, rather than over the course of several hours or days. The assumption of instant runoff is conservative, but it accounts for a great deal of the variability that occurs in both storm events and runoff conditions.

6.3.2.2.2 Average Depth

The permanent pool average depth (vault volume/vault surface area) shall be $\geq$ 4 feet, with a maximum depth of $\leq$ 10 feet.

6.3.2.2.3 Vault Inlet Structures and Pipes

- To the extent possible, the inlet to the wet vault shall be submerged with the inlet pipe invert a minimum of 3 feet from the vault bottom and the top of the inlet pipe shall be submerged at least 1 foot. The submerged inlet is intended to dissipate energy of the incoming flow. The distance from the bottom is intended to minimize resuspension of settled sediment. Alternative inlet designs that accomplish these objectives are acceptable.

- Unless designed as an off-line facility, it is recommended the capacity of the outlet pipe and available head above the outlet pipe should be designed to convey flows larger than the water quality design flow for developed site conditions without overtopping the vault. The available head above the outlet pipe is recommended to be a minimum of 6 inches.

- A gravity drain for maintenance is recommended if grade allows. Gravity drains should be as low as the site situation allows; however, the invert shall be no lower than the average sediment storage depth to prevent plugging.

- Wet vaults may be constructed using arch culvert sections provided the top area at the normal water surface is, at a minimum, equal to that of a vault with vertical walls designed with an average depth of 6 feet. This is to prevent decreasing the surface area available for oxygen exchange.

- Galvanized materials shall be prohibited.

- Adequate vents in the vault or other provisions must be included to ensure the water in the vault does not become “stagnant” resulting in anoxic conditions and the release of phosphorus in the water column. Lockable grates instead of solid manhole covers are recommended to increase air contact with the wet pool.

- Operational access to the valve that controls the gravity drain must be provided to the finished ground surface.

6.3.2.2.4 Short-Circuiting and the Promotion of Plug Flow

To prevent short-circuiting, water must be forced to flow, to the extent practical, to all potential available flow routes, avoiding “dead zones” (corners, etc.) and maximizing the time that water stays in the vault during the active part of a storm. Design features that encourage plug flow and avoid dead zones are:

- Providing a broad surface for water exchange across cells rather than a constricted area.

- Maximizing the distance between the major inlets and normal outlet.

- The ratio of flowpath length to width from the inlet to the outlet is recommended to be at least 3:1.

- To the extent possible, all inlets must enter the first cell. If there are multiple inlets, the length-to-width ratio should be based on the average flowpath length for all inlets.

- Flow rates must be uniform to the extent possible and not increased between cells.

6.3.2.2.5 Flood Pool (Live Storage)

The flood pool (live storage) volume above the principal spillway shall be such that the peak discharge rate from the 5-year and 100-year frequency, critical duration storm does not exceed the peak discharge for a similar storm under predevelopment conditions.

6.3.2.2.6 Outlet Structure (Skimming)

Trash and floatable debris-skimming devices shall be placed on the outlet of all wet vaults to provide treatment up to the critical-duration 5-year storm event. Submerged inlets, permanent baffled weirs, or similar devices may be employed. Timber baffled weirs are discouraged. To the extent possible, velocities through the devices shall be less than 0.5 fps. The top of submerged inlets shall be at least one foot below the normal water surface.

6.3.2.2.7 Pretreatment

Pretreatment, such as grit chambers, swales with check dams, filter strips, or sediment forebays/traps should be considered to extend the maintenance frequency of the wet vault.

6.3.2.2.8 Flow Conveyance Capacity

Onsite wet vaults shall avoid increases in predevelopment runoff rates to the greatest extent practical. The capacity of the downstream receiving body to convey and/or store the runoff shall also be considered so as to not adversely affect water levels off the site.

6.3.2.2.9 Vault Structures

Detailed examples of wet vault structures are provided in the following document:

- *Minnesota BMP Manual* (Metropolitan Council, July 2001) http://www.metrocouncil.org/environment/water/BMP/manual.htm

6.3.2.3 Sequencing and Construction

- Wet vaults may be constructed in the early phases of a development project in order to treat site runoff during construction.

- Sediment that has accumulated in the wet vault must be removed after the remaining site and tributary area has been graded and stabilized.

6.3.2.4 Maintenance

Maintenance is required for the proper operation of wet vaults. The city must ensure that a maintenance agreement and maintenance plan is prepared for operation of wet vaults. Following are maintenance requirements from the *Minnesota Stormwater Manual* (MPCA, November 2005) and the *Minnesota BMP Manual* (Metropolitan Council, July 2001):

- The plan must identify owners, parties responsible for maintenance, and an inspection and maintenance checklist and schedule.
- Following construction, the underground wet vault must be inspected after every rainfall greater than 0.5-inches in the first year after construction. Thereafter, wet vaults must be inspected at least annually.
- Structural inspection shall be performed every 5-years by a registered professional engineer.
- Accumulated trash, floating debris and petroleum products must be removed as necessary, but at least annually from the wet vault, forebay/pretreatment area, emergency spillway, weirs, and trash grates. The frequency of sediment removal depends on the years of sediment accumulation that were incorporated into the design volume of the wet vault's permanent pool and forebay and on the occurrence of any high-loading events.
- Sediment removal and disposal from underground wet vaults may currently be regulated by the MPCA. Sediment testing, disposal, and permitting may be required and shall be investigated on an individual site basis. Sediments must be tested for toxicants in compliance with current disposal requirements as required by local, state, or federal laws or regulations.
- Vault maintenance procedures must meet OSHA confined space entry requirements, which include clearly marking entrances to confined space areas.
- Adequate access for appropriate equipment must be provided for inspection, maintenance, and landscaping upkeep.
- It is recommended that the maintenance agreement between the city and applicant be filed against the property with the county.
- Additional general maintenance activities and schedules are in the *Minnesota Stormwater Manual* and the *Minnesota BMP Manual*

7.0 Requirements for Construction Erosion and Sediment Control Plans

1. For construction projects that involve more than 200 cubic yards of cut or fill, or disturb more than 10,000 square feet, an Erosion and Sediment Control Plan shall be prepared that meets the standards given in the NPDES Permit for Construction Activity (MPCA) and *Protecting Water Quality in Urban Areas* (MPCA, 1989).

2. Erosion and sediment control plans submitted for BCWMC review shall show the proposed methods of retaining waterborne sediments onsite during the period of construction, and shall specify methods and schedules to determine how the site will be restored, covered, or revegetated after construction.

3. In addition, the project proposer shall:

   a. Provide specific measures to control erosion based on the grade and length of the slopes on the site, as follows:

      (1) Silt fences or other erosion control features shall be placed along the toe of the slopes that have a grade of less than 3 percent and are less than 400 feet long from top to toe. The silt fences shall be supported by sturdy metal or wooden posts at intervals of 4 feet or less.

      (2) Flow lengths up-slope from each silt fence shall not exceed 400 feet for slopes that have a grade of less than 3 percent.

      (3) Silt fences or other erosion control features shall be placed along the toe of the slopes that have a grade of 3 to 10 percent and are less than 200 feet long from top to toe. These fences shall be supported by sturdy metal or wooden posts at intervals of 4 feet or less.

      (4) Flow lengths up-slope from each silt fence shall not exceed 200 feet for slopes that have a grade of 3 to 10 percent.

      (5) Diversion channels or dikes and pipes shall be provided to intercept all drainage at the top of slopes that have a grade of more than 10 percent and are less than 100 feet long from top to toe. Silt fence shall be placed along the toe of said slopes, and shall be supported by sturdy metal or wooden posts at intervals of 4 feet or less.

      (6) Diversion channels or dikes and pipes shall be provided to intercept all drainage at the top of slopes that have grades of more than 10 percent. Also, diversion channels or diked terraces and pipes shall be provided **across** said slopes if needed to ensure that the maximum flow length does not exceed 100 feet. Silt fence shall be placed

along the toe of said slopes, and shall be supported by sturdy metal or wooden posts at intervals of 4 feet or less.

(7) Other erosion control practices such as erosion logs, compost blankets, and compost filter berms, and other practices should also be considered for construction site erosion control.

b. Require that silt fences, silt socks, or approved inlet protection devices be installed around each catch basin inlet on the site and that this barrier remain in place until pavement surfaces have been installed and/or final turf establishment has been achieved.

c. Ensure that flows from diversion channels or pipes are routed to sedimentation basins or appropriate energy dissipators in order to prevent transport of sediment to outflow conveyors and to prevent erosion and sedimentation when runoff flows into the conveyors.

d. Provide that site-access roads be graded or otherwise protected with silt fences, diversion channels, or dikes and pipes to prevent sediment from leaving the site via the access roads. Vehicle tracking of sediment from the construction site (or onto streets within the site) must be minimized by installing rock construction entrances (with a minimum height of 2 feet above the adjacent roadway and with maximum side slopes of 4:1), rumble strips (mud mats), wood chips, wash racks, or equivalent systems at each site access.

f. Require that soils tracked from the site by motor vehicles be cleaned daily (or more frequently, as necessary) from paved roadway surfaces throughout the duration of construction.

g. Assure that silt fences and diversion channels or dikes and pipes be deployed and maintained for the duration of site construction. If construction operations interfere with these control measures, the silt fences, diversion channels or dikes and pipes may be removed or altered as needed but shall be restored to serve their intended function at the end of each day.

h. Specify that all exposed soil areas must be stabilized as soon as possible, but in no case later than 14 days after the construction activity has temporarily or permanently ceased. A schedule of significant grading work will be required as part of the erosion and sedimentation control plan.

i. Require that temporary or permanent mulch be uniformly applied by mechanical or hydraulic means and stabilized by disc-anchoring or use of hydraulic soil stabilizers.

j. Provide a temporary vegetative cover consisting of a suitable, fast-growing, dense grass-seed mix spread at 1.5 times the usual rate per acre. If temporary cover is to remain in place beyond the present growing season, two-thirds of the seed mix shall be composed of perennial grasses.

k. Provide a 4-foot wide sod buffer along the curb line of all streets adjacent to the site and along all property boundaries where runoff could leave the site.

l. Specify a permanent vegetation cover consisting of sod, a suitable grass-seed mixture, or a combination thereof. Seeded areas shall be either mulched or covered by fibrous blankets to protect seeds and limit erosion.

m. Provide temporary on-site sedimentation basins when 10 or more acres of disturbed area drain to a common location. Install temporary sediment basins where appropriate in areas with steep slopes or highly erodible soils drain to one area. On-site detention basins shall be designed to achieve pollutant removal efficiencies equal to or greater than those obtained by implementing the criteria set forth by the NPDES Permit for Construction Activity (MPCA, 2008) and *Protecting Water Quality in Urban Areas* (MPCA, 1989).

8.0 Streambank Erosion and Degradation Control

Streambank erosion and streambed degradation control measures must:

a. Be employed whenever the net sediment transport for a reach of stream is greater than zero or whenever the stream's natural tendency to form meanders directly threatens damage to structures, utilities, or natural amenities in public areas.

b. Include effective energy dissipation devices or stilling basins to prevent streambank or channel erosion at all stormwater outfalls. Specifically:

   i. Outfalls with outlet velocities of less than 4 fps that project flows downstream into the channel in a direction of 30° or less from the normal flow direction generally shall not require energy dissipators or stilling basins, but they may need some riprap protection.

   ii. Energy dissipators shall be sized to provide an average outlet velocity of no more than 6 fps. If riprap is also used, the average outlet velocity may be increased to 8 fps.

   iii. Riprap stilling basins shall not be used where outlet velocities exceed 8 fps.

c. Specify riprap consisting of natural angular stone suitably graded by weight for the anticipated velocities.

d. Provide riprap to an adequate depth below the channel grade and to a height above the outfall or channel bottom so as to ensure that the riprap will not be undermined by scour or rendered ineffective by displacement.

e. Specify that riprap be placed over a suitably graded filter material or filter fabric to ensure that soil particles do not migrate through the riprap and reduce its stability.

Streambank stabilization and streambed degradation control structures must be submitted to the BCWMC for review. The review will consider the need for the work, the adequacy of design, unique or special site conditions, energy dissipation, the potential for adverse effects, contributing factors, preservation of natural processes, and aesthetics.

9.0 Regulatory Agencies

9.1 Minnesota Department of Natural Resources (DNR)

Any project constructed below the ordinary high water mark (OHW) which alters the course, current, or cross-section of state public waters or public waters wetlands is subject to the regulatory jurisdiction of the DNR. This includes filling, excavation, construction of structures, water level control, and drainage projects.

Questions concerning the DNR's role in water resource management should be directed to the DNR Division of Waters, Metro Region, 1200 Warner Road, St. Paul, Minnesota 55106 (651) 772-7910), http://www.dnr.state.mn.us/waters/index.html.

9.2 Minnesota Pollution Control Agency (MPCA)

An NPDES/SDS General Stormwater Permit for Construction Activity is required from the MPCA for projects which disturb one acre or more of soil.

As part of the permitting process, the owner and operator must create a stormwater pollution prevention plan (SWPPP) that explains how stormwater will be controlled. After a SWPPP has been completed, site owners and their construction operators may apply for the permit by submitting an Application for General Stormwater Permit for Construction Activity (MN R100001) to the MPCA.

Questions concerning the construction stormwater permit program and MPCA's role in water resource management should be directed to the MPCA, 520 Lafayette Road, St. Paul, MN 55155, (651) 206-6300 http://www.pca.state.mn.us/water/index.html.

Appendix A

Application Form

www.bassettcreekwmo.org

Obtain City staff signature and send application,
check for fee, and submittals to:
Bassett Creek Watershed Management Commission
4700 W 77th Street, Minneapolis, MN 55435-4803

A.F. # ________________

Application Form for Development Proposals

If you have questions about this application, contact Jim Herbert at 952-832-2784 or Len Kremer at 952-832-2781.

Complete by City Staff

This application is being submitted to the Bassett Creek Watershed Management Commission for review purposes by the City of ________________________, by ____

____
City Staff Signature **Date**

Note: the contents of the application are solely the responsibility of the applicant.

Complete by Applicant

General Information:

____

(Name of development or description of project)

____ ______________________________

(City/¼ Section)

____

(Location of work—Reference major streets and highways, and attach legal description)

Name of Applicant (owner): ____

Telephone________________________________ E-mail ____________________________

Address ____

City, State, Zip ____

Name of Agent (project contact): ______________________________________

Telephone________________________________ E-mail ____________________________

Address ____

City, State, Zip ____

Submittals:

Requirements for each submittal are provided in the document *Requirements for Improvements and Development Proposals.* The required fee is shown on the Commission's Fee Schedule attached to this application.

Enclosed is the following required information for review:

- ☐ Project review fee
- ☐ Wetland fee (if applicable)
- ☐ Project plans
- ☐ Runoff water quality plan and computations
- ☐ Erosion control plan
- ☐ Applicant has completed checklist of BMPs attached to this application.
- ☐ Other:
- ☐ Other:
- ☐ Variance Request

Project Information:

Nature of work: ______________________________

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Plat area: ____________________ Area to be graded: ____________________

Existing total impervious area: ____________________ Proposed total impervious area: ____________________

Land use proposed: ______________________________

(Industrial, commercial, multiple residential, single residential, utility, public)

Number and type of units: ______________________________

____

Authorized Signature (Applicant) **Date**

Proposed Best Management Practices (BMPs)
to be implemented on project for water quality protection

Description of BMP	Was BMP used in project?	Location used or basis for nonusage:
DISCHARGE ELIMINATION BMPs		
1. Reduce area of impervious surface (pavement, roofs, etc.)		
2. French drains and subsurface drains		
3. Infiltration trench and dry well		
4. Exfiltration trench		
5. Porous pavement		
6. Retention (infiltration) basin		
STORMWATER BMPs		
7. Detention basin with outlet protection		
8. Extended detention basin		
9. Wetland treatment area		
10. Parking lot/rooftop runoff storage with outlet protection		
11. Grit chambers/manholes		
12. Diversion channel		
FLOATABLE/OIL REMOVAL BMPs		
13. Floatable skimmer		
14. Parking lot oil/grease separators		
SEDIMENT CONTROL BMPs		
15. Riprap or other storm drain outlet protection		
16. Storm drain inlet protection		
17. Slope stabilization and erosion control measures		
18. Vegetated swale		
NONSTRUCTURAL BMPs		
19. Street sweeping		
20. Fertilizer manager		
21. Other (describe):		

Fee Schedule

Project Review Fees [1, 2]

Single Family Lot	$300
Single Family Residential Development, density less than 3 units per acre	
Total Parcel Size <15 acres	$1,300
Total Parcel Size 15 to 29.99 acres	$1,600
Total Parcel Size ≥30 acres	$2,000
All Other Development	
Total Parcel Size <5 acres	$1,500
Total Parcel Size 5 to 19.99 acres	$2,000
Total Parcel Size ≥20 acres	$3,000
Variance Escrow	$2,000
Street Highway/Utility Project/Public Agency Projects	$1,000

Note: Total site area includes wetland, buffer, right-of-way and other nondeveloped areas.

Wetland Fees[1]	Minimum Fee[3]
Wetland Delineation Review	$300
Wetland Replacement Plan	$1,500
Monitoring and Reporting	$1,500
Wetland Replacement Escrow	Varies

[1]Include check for project review fee or wetland fee with application form. Check must be made payable to Bassett Creek WMO.

[2]Project review fee based on total parcel size (not disturbed area) including wetlands, buffer, right-of-way, and other nondeveloped areas.

[3]Will be billed at actual cost.

Appendix B

Water Quality Definitions

Appendix B
Water Quality Definitions[1]

BCWMC: Bassett Creek Watershed Management Commission

Best management practices (BMPs): the structural, non-structural, and institutional controls used to improve the quality of stormwater runoff. Additional BMPs may be found in *Protecting Water Quality in Urban Areas* (MPCA, 1989), *Minnesota Urban Small Sites BMP Manual* (Metropolitan Council, July 2001), *State of Minnesota Stormwater Manual*, (MPCA, November 2005)

Better site design: the application of non–structural practices at residential and commercial sites to reduce impervious cover, conserve natural areas, and use pervious areas to more effectively treat stormwater runoff

Bioretention: a soil- and plant-based stormwater management best management practice (BMP) used to filter runoff

Catch basin insert: device that attaches to the entrance of a catch basin or mounts inside the catch basin. Catch basins inserts are designed to improve stormwater quality by either preventing debris and pollutants from entering the basin, or by retaining or treating the water in the basin.

Check dam: a small temporary or permanent dam constructed across a drainage ditch, swale, or channel to lower the speed of concentrated flows for a certain design range of storm events, reducing erosion

Commercial, **industrial, institutional or public development/redevelopment projects**: typically result in larger areas of impervious surface, typically in the range of 60 to 80 percent imperviousness. Examples of these developments include shopping malls, stores, schools, hospitals, and warehouses.

Commercial, industrial, institutional or public expansion/addition projects: additions to existing projects for which approval of the existing project was obtained prior to adoption of this water quality policy (September 14, 1994). Examples of such projects include parking lot expansions/additions and building expansions/additions.

Complex projects: include projects that are 40 acres or more, controversial, involve more than one property owner, require detailed hydrologic or hydraulic modeling, require vast changes to infrastructure (such as stormwater systems), include many wetland impacts, require extensive environmental review, or involve many different land uses within the same development project

Construction sequencing: a specified work schedule that coordinates the timing of land-disturbing activities and the installation of erosion-protection and sedimentation-control measures

Critical duration runoff: generally accepted reservoir routing procedures using critical duration runoff events refer to the hydrologic methods—usually computer models—used to determine flowrates and flood levels resulting from stormwater runoff events. The event which results in the highest flood level or flowrate is the critical duration event. Examples of such methods include TR-20, Hydrocad, SWMM, HEC-1, and other approved watershed models.

Curve number: an index combining hydrologic soil group, land use factors, treatment, and hydrologic condition. Used in a method developed by the Soil Conservation Service (SCS)/Natural Resources Conservation Service (NRCS)∗ to determine the approximate amount of runoff from a rainfall event in a particular area.

Dead storage: the permanent storage volume in a pond

Detention time: the theoretical calculated time that a small amount of water is held in a settling basin

Disturbed area: total graded area as part of a commercial industrial, institutional, public, residential, or road project

Emergency spillway: a stable channel or other structure used to convey excess flood flows from a treatment device, typically for 100-year or greater flood flows

Erosion control: any efforts to prevent the wearing or washing away of the soil or land surface

Extended detention: designed to receive and detain stormwater runoff for a prolonged period of time

Filter bed: a sand- or gravel-bottomed treatment used to filter stormwater

Filter strip: vegetated areas that are intended to treat sheet flow from adjacent impervious areas

First flush: the majority of pollutants carried in urban runoff are carried in the first ½ inch of runoff from a site.

Floodplain: land adjacent to a water body which is inundated when the discharge exceeds the conveyance capacity of the normal channel. Often described in the regulatory sense as the extent of the 100-year flood.

Flood pool: live storage, or storage above the principal outlet that is used to temporarily store stormwater runoff

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∗ Natural Resources Conservation Service (NRCS): division of the United States Department of Natural Resources, formerly known as Soil Conservation Service (CSC)

Soil Conservation Service (CSC): division of the United States Department of Agriculture, currently known as the Natural Resources Conservation Service (NRCS)

Flow control: **c**ontrolling the rate and volume of water leaving a site

Flow splitter: device that is used to divert a portion of a flow (from a pipe or channel) to an offline treatment device such as an infiltration basin

Flow spreader: device use distribute water evenly over a surface such as an infiltration basin or a sand filter

Forebay: an extra storage space or small basin located near the inlet to settle out incoming sediments before water moves on into a pond or detention area

Grade breaks: point where the ground slope changes

Grit chamber: tanks designed to slow down the flow so that solids will settle out of the water

Ground water mounding: the localized rise in water table or potentiometric surface caused by the addition of water at an infiltration basin

Hydrologic soils groups (HSG): **a**n NRCS designation given to different soil types to reflect their relative surface permeability and infiltrative capability. Rankings range from high infiltration rates in Group A to very low infiltration rates in Group D.

Impervious surface: a surface in the landscape that impedes the infiltration of rainfall and results in an increased volume of surface runoff

Infiltration basin: stormwater runoff impoundment designed to capture and hold stormwater runoff and infiltrate it into the ground over a period of days. This impoundment does not retain a permanent pool of water.

Low impact development (LID): the application of non-structural practices at residential and commercial sites to reduce impervious cover, conserve natural areas, and use pervious area to more effectively treat stormwater runoff

Media filters: filtration of stormwater through a variety of different filtering materials whose purpose is to remove pollution from runoff

Nondegradation: results in no increase in pollutant loads from a redevelopment site

Offline practice: a practice that does not receive all the stormwater flow from a conveyance system such as a pipe or channel, but rather only a portion of the flow as the result of a flow splitter or other diversion device

Onsite or regional treatment facility: a stormwater treatment basin designed to treat the stormwater runoff generated from either the project site (onsite) or an area larger than the project site (regional)

Peak flow control: controlling the timing and magnitude of the largest flow either leaving the site or flowing through the watershed, utilizing stormwater management techniques to avoid flooding or damage downstream

Perimeter control: activities or practices designed to contain sediments on a project site

Permanent storage pool: the volume in a pond or reservoir below the lowest outlet level, designed to settle out particles and nutrients for water quality treatment purposes.

Pollutant load: the product of flow volume times pollutant concentration

Proprietary devices: stormwater treatment devices which are privately developed and owned

Rate control: controlling the rate that stormwater is released from localized holding areas into larger conveyance systems

Residential development/redevelopment projects: typically result in smaller areas of impervious surface, typically in the range of 25 to 60 percent imperviousness. Examples of these projects include single family home construction, townhome construction, and apartment building construction.

Retention: **t**he permanent or temporary storage of stormwater to prevent it from leaving the development site

Retrofit: the introduction of a new or improved stormwater management element where it either never existed or did not operate effectively

Road construction or reconstruction projects: include any project which results in the complete removal of the road surface, exposing the base, and/or removal of the vegetated surface within the road right-of-way. Examples include road widening projects, ditch work, road replacement and utility installation. Road overlay projects and road resurfacing projects which do not disturb the road base will not be covered by the requirements of this policy.

Runoff or stormwater runoff: under Minnesota Rule 7077.0105, subpart 41b, stormwater "means precipitation runoff, stormwater runoff, snow melt runoff, and any other surface runoff and drainage." (according to the Federal Code of Regulations under 40 CFR 122.26 [b][13], "stormwater means stormwater runoff, snow melt runoff and surface runoff and drainage."). Stormwater does not include construction site dewatering.

Seasonally high water table: the highest level the water table reaches during a given year or the highest level it has reached in the recent past as indicated by soil mottling or color changes. Methods for determining the seasonal high water table are given in Minnesota Rule part 7037.3300, subpart 5.

Sediment control: The methods employed to prevent sediment from leaving the development site. Sediment control practices include silt fences, sediment traps, earth dikes, drainage swales, check dams, subsurface drains, pipe slope drains, storm drain inlet protection, other appropriate measures, and temporary or permanent sedimentation basins.

Short circuiting: occurs when an inlet and outlet from a pond or other device are very close to each other and the treatment capacity of the device is reduced

Silt fence: fence constructed of wood or steel supports and either natural or synthetic fabric stretched across an area of non-concentrated flow during site development to trap and retain on-site sediment due to rainfall runoff

Skimmer: device used to take up or remove floating matter from the water's surface

Soil amendment: tilling and composting of new lawns and open spaces with a development site to recover soil porosity and bulk density, and reduce runoff

Source water protection area: an identified area with restricted or modified land use practices designed to protect public drinking water supply from the introduction of contaminants

Stormwater (management) facilities: include storm sewer pipes, ditches, ponds, infiltration basins, etc.

Surface sand filter: consists of a pretreatment basin, a water storage reservoir, a flow spreader, and underdrain piping that treats stormwater runoff via filtration

Temporary protection (measure): short-term methods employed to prevent erosion. Examples of such protection include straw, mulch, erosion control blankets, wood chips, and erosion netting.

Thermal protection: techniques and practices such as infiltration and shading which act to preserve and protect the ambient temperatures of streams and waterbodies from temperature-raising effects of stormwater runoff

Trunk system: The trunk creek system is the responsibility of the BCWMC and includes the Main Stem of Bassett Creek from Medicine Lake to the box culvert/tunnel; the North Branch from upstream of Co. Rd P to its junction with the Main Stem; the Sweeney Lake Branch from its source in Section 5, T117N, R21W to its junction with the Main Stem downstream of Sweeney Lake; and Plymouth Creek from the point where it intersects with Highway 55 in Section 17, T118N, R33W, to Medicine Lake.

Under drain: an underground drain or trench with openings through which the water may percolate from the soil or ground above

Water quality pond: a collection area with a permanent pool of water for treating incoming stormwater runoff

Water quality volume: the permanent pool in a water detention pond

Wetland: defined in Minn. R. 7050.0130, subp. F and includes those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Constructed wetlands designed for wastewater treatment are not waters of the state; to be a wetland the area must meet wetland criteria for soils, vegetation, and hydrology as outlined in the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual.

Wet detention basin: a collection area with a permanent pool of water for treating incoming stormwater runoff. See water quality pond.

Wet vault: a vault stormwater management device with a permanent water pool generally 3 to 5 feet deep used to treat stormwater runoff

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[1]– Some definitions taken directory from the *Minnesota Stormwater Manual*

Appendix C

General Review Requirements

Table C

General Review Requirements

Review Trigger	BCWMC Review Required	Erosion and Sediment Control Required	Level 1 Standards	Nondegradation Standards
All Projects *(except road construction/road reconstruction)*				
<200 cubic yards cut/fill or < 10,000 sq. ft. grading	No	No	No	Maybe[1]
>200 cubic yards cut/fill or > 10,000 sq. ft. grading	Yes	Yes	Maybe[1]	Maybe[1]
Commercial, Industrial, Institutional or Public Development *(where there is no existing commercial, industrial, institutional or public development)*				
Parcel ≥ 0.5 acres	Yes	Yes	Yes	No
Commercial, Industrial, Institutional or Public Expansion/Addition (*site that was partially developed prior to adoption of the Commission's Water Quality Policy - September 14, 1994*)				
New disturbed area ≥ 0.5 acres	Yes	Yes	Yes[2]	No
Commercial, Industrial, Institutional or Public Redevelopment (*where the commercial, industrial, institutional, residential or public development currently exists*) [3]				
Parcel size < 0.5 acres and >200 cubic yards cut/fill or > 10,000 sq. ft. grading	Yes	Yes	No	No
Parcel size 0.5 to 1.0 acres and impervious surface increases by at least 1,000 sq. ft	Yes	Yes	No	Yes
Parcel size >1.0 ac. to 5.0 acres and impervious surface increases by at least 2,000 sq. ft	Yes	Yes	No	Yes
Parcel size > 5.0 acres and impervious surface increases by at least 10,000 sq. ft	Yes	Yes	Yes	Yes[3]
Disturbed area ≥ 5.0 acres	Yes	Yes	Yes[4]	Yes[3]
Residential Development				
Parcel > 2 acres and which contains four or more proposed living units	Yes	Yes	Yes	No
Residential Redevelopment				
Parcel >2 acres to 10 acres which contains four or more proposed living units	Yes	Yes	No	Yes[3,5]
Parcel > 10 acres where there are four or more existing living units	Yes	Yes	Yes[3]	Yes[3]
Road Construction/Road Reconstruction *(which the site runoff is not currently directed to an onsite or regional treatment facility)*				
Disturbed Area ≥ 1 acre	Yes	Yes	Recommended	Recommended

[1] See following requirements
[2] Level 1 standards required to serve the expansion/addition
[3] Redeveloping the entire parcel to Level 1 standards provides acceptable treatment to Nondegradation Standards
[4] Level 1 standards required to serve the disturbed area
[5] See nondegradation exemptions

< less than
> greater than
≥ greater than or equal to