



Engineering Design Standards for Stormwater Management

City of St. Paul Park

January 2015

Prepared by WSB & Associates



Engineering Design Standards

TABLE OF CONTENTS

1.	DESIGN OVERVIEW.....	2
2.	DEFINITIONS.....	2
3.	PROCEDURE FOR REVIEWING STORMWATER MANAGEMENT PLANS.....	4
4.	SUBMITTAL REQUIRMENTS	7
5.	LIST OF ACCEPTABLE PRACTICES.....	10
6.	CONSTRUCTION SITE STORMWATER RUNOFF CONTROL.....	12
7.	GUIDANCE ON STORMWATER TREATMENT PRACTICES (STPS)	20
8.	BASIC SIZING CRITERIA	20
10.	STORMWATER TREATMENT PRACTICE DESIGN STANDARDS	28
11.	DESIGN EXAMPLES.....	34
12.	STORMWATER TREATMENT PRACTICE DETAIL DRAWINGS	34
13.	CONSTRUCTION SPECIFICATIONS.....	34
14.	CHECKLISTS	35

APPENDICES

Appendix A	Stormwater Management Plan Checklist
Appendix B	Erosion and Sediment Control Inspection Checklists
Appendix C	Maintenance Agreement
Appendix D	Standard Details

Engineering Design Standards

1. DESIGN OVERVIEW

The City of St. Paul Park's Stormwater Pollution Prevention Plan (SWPPP) identifies the goals and policies that define the City's stormwater management program, which are implemented via the City Stormwater Management Ordinance (Chapter 62: Subdivisions, Section 95), the City's Surface Water Management Plan (Section VII), and these Engineering Design Standards. St. Paul Park's stormwater requirements were written to meet the City's goals to preserve, protect, and manage its water resources as well as to meet federal, state, and watershed district stormwater regulations and to meet the following objectives:

- Minimize increases in stormwater runoff rates from any development in order to reduce flooding, siltation and erosion and in order to maintain the integrity of stream channels,
- Minimize increases in nonpoint source pollution caused by stormwater runoff from development which would otherwise degrade local water quality,
- Minimize the total annual volume of surface water runoff that flows from any specific site during and following development so as not to exceed the predevelopment hydrologic regime to the maximum extent practicable,
- Ensure that these management controls are properly maintained and pose no threat to public safety, and
- Implement stormwater management controls to help meet current and future total maximum daily load (TMDL) goals, to address the need to improve water quality, and to meet objectives in the Local Surface Water Management Plan.

2. DEFINITIONS

For the purpose of this Design Manual, the following definitions describe the meaning of the terms used in this Design Manual:

Applicant means a property owner or agent of a property owner who has filed an application for a City Permit.

Applicability means any land disturbing activity requiring a City of St. Paul Park Stormwater Management Plan and erosion control plan, as defined in Stormwater Management Ordinance (Chapter 62: Subdivisions, Section 95).

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

Engineering Design Standards

Impervious Area means those surfaces that cannot effectively infiltrate rainfall (e.g., building rooftops, pavement, sidewalks, gravel, driveways, swimming pools, etc.).

Land Disturbance Activity means any activity that changes the volume or peak discharge rate of stormwater runoff from the land surface. This may include the grading, digging, cutting, scraping, or excavating of soil, placement of fill materials, paving, construction, substantial removal of vegetation, or any activity that bares soil or rock or involves the diversion or piping of any natural or fabricated watercourse.

Maintenance Agreement means document recorded against the property which provides for long-term maintenance of stormwater treatment practices.

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

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

Redevelopment means any construction activity where, prior to the start of construction, the areas to be disturbed have 15 percent or more of impervious surface(s) (*MPCA, Tech Support Document for Post-Construction Stormwater Management*).

Responsible Party means the entity which will be responsible for ownership and maintenance of Stormwater Treatment Practices.

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

Stormwater Management means the use of structural or non-structural practices that are design to reduce stormwater runoff pollutant loads, discharge volumes, and/or peak discharge rates.

Stormwater Management Plan means a set of drawings or other documents submitted by a person as a prerequisite to obtaining a stormwater management approval, which contains all of the required information and specifications pertaining to Stormwater Management.

Stormwater Reviews means any site that the either increases impervious surface by greater than 1 acre or redevelops 1 acre or greater of impervious. The review will be completed to

Engineering Design Standards

evaluate compliance with the City of St. Paul Park's water quality and water quality requirements as specified in these standards. For sites either creating or redeveloping less than 1 acre of impervious the City will work with the applicant to determine if water quality practices can be incorporated into the site. Sites less than 1 acre will also not be allowed their drainage to negatively impact downstream properties (or water bodies).

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

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

Water Quality Volume (WQ_v) means that runoff storage volume needed to treat the specified phosphorus loading as determined in the St. Paul Park Engineering Design Standards.

Watercourse means a permanent or intermittent stream or other body of water, either natural or fabricated, which gathers or carries surface water.

Watershed means the total drainage area contributing runoff to a single point.

3. PROCEDURE FOR REVIEWING STORMWATER MANAGEMENT PLANS

All projects either creating or disturbing 1 acre or greater of new impervious will require the submittal of a Stormwater Management Plan and erosion control plan meeting the following standards. All construction sites regardless of size will be required to provide and maintain minimum erosion control measures during construction.

The general review process, from the submittal of the concept and final plans to the issuance of the Stormwater Management Plan approval, is summarized in the following seven steps:

1. Determine what stormwater management provisions apply (stormwater management, erosion control, buffers, floodplain management).
2. What permits, or approvals, are required for the project site, and what waivers and/or exemptions are applicable (COE, DNR, MPCA, Watershed District, WCA, etc.). Any applicant required to obtain a NPDES general stormwater permit from the MPCA shall, prior to the start of construction, submit written verification of such permit to the city.
3. Are the selected practices appropriate for this site?
4. Are the practices designed to meet the minimum performance criteria?

Engineering Design Standards

5. Does the Plan meet other resource protection requirements as specified in the City of St. Paul Park Code?
6. Are provisions for long-term maintenance adequate, including access and methods for maintenance defined?

Actions Requiring Review by the South Washington Watershed District (SWWD) (per the Rules adopted January 13, 2015)

The South Washington Watershed District recognizes that the primary control and determination of appropriate land uses is the responsibility of the municipalities. Accordingly, the District will coordinate development permit application reviews with the municipality where the property is located. Primary responsibility for management of water quality and stormwater runoff lies with the District.

Erosion & Sediment Control

1. Land alterations that remove or cover surface vegetation of 1 acre or more,
2. Land disturbing activity on a slope of greater than 12%
3. Land disturbing activity that disturbs more than 100 lineal feet of road ditch, grass waterway, or other land area where surface drainage flows in a defined open channel; including the placement, repair, or removal of any underground pipe utility or other facility within the cross-section of the channel
4. Any new public or private roads or access drives longer than 125 feet
5. Development that requires a subdivision plat, as defined in the applicable local land division ordinance, or
6. Projects that could reasonably be expected to introduce sediment to water resources of the District.

Wetland Management

Activities within the District where the primary receiving water body is a wetland as defined by the United States Army Corps of Engineers Manual (1987) are subject to SWWD permit requirements under Rule 3. Wetlands without a SWWD designated management class will require delineation and functional assessment by a wetland professional prior to project application.

Wetlands which are clearly identified in historic local surface water management plans as integral to stormwater conveyance and management under full development may be granted a variance by the SWWD. However, all other applicable permits from other agencies still must be addressed.

Engineering Design Standards

Projects for which SWWD receives a Letter of Compliance are not subject to SWWD permitting, unless required under the municipal LWMP or the applicant requests a variance.

Waterbody Crossings

A District permit under the Waterbody Crossings Rule is required for work on roads, highways, utilities, or associated structures that cross the bed or bank of any waterbody.

Floodplain Management

A District permit under the Wetland Management Rule is required for the following activities within the District:

1. Land alterations that remove, cover, or disturb a surface area of one acre or more
2. All work within the waters or floodplains of the District
3. Subdivisions, plats, and developments within a floodplain of the District

Landlocked Basins

A District permit under the Landlocked Basins Rule is required for the following activities within the District:

1. Land alterations that remove, cover, or disturb a surface area of one acre or more and drain to a landlocked basin, or
2. Projects that propose to outlet a landlocked basin.

Stormwater Management & Water Quality

1. A District permit under the Stormwater Management and Water Quality Rule is required for the following activities within the District:
 - 1) Land alterations that remove, cover, or disturb a surface area of one acre or more, or
 - 2) Result in the augmentation or diversion of stormwater to a receiving water body.
2. In case of emergency action performed without a District Permit, the Managers shall be notified of the action and pertinent facts as soon as possible. A permit shall be required so that the action taken conforms to the Plan and Rules. In the event the Managers determine the facts do not warrant issuance of a permit (retroactive), the action will be considered a violation of these Rules and Regulations and treated accordingly.

Groundwater Management

A District permit under Waterbody Crossings is required for the following activities within the District:

1. Land alterations that remove, cover, or disturb a surface area of one acre or more, or
2. Proposed projects on sites with known karst features.

Engineering Design Standards

Greenways & Open Spaces

A District permit under Rule 10 is required for the following activities within the District:

1. Land alterations that remove, cover, or disturb a surface area of one acre or more, or
2. Result in the augmentation or diversion of stormwater to a receiving water body.

4. SUBMITTAL REQUIREMENTS

Requirements for Stormwater Management Plan Approval

Stormwater Management Plan Required

No land disturbing activities consisting of an acre of land or more will be approved unless it includes a Stormwater Management Plan detailing how runoff and associated water quality impacts resulting from the development will be controlled or managed (note the exceptions in Section 3). All proposed stormwater BMPs shall be required to maintain or improve water quality prior to discharge from the site. This plan must indicate whether stormwater will be managed on-site or off-site and, if on-site, the general location and type of practices.

The Stormwater Management Plan must be signed by a licensed professional engineer in the State of Minnesota, who will verify that the design of all stormwater management practices meet the submittal requirements outlined in the Submittal Checklist found in Appendix A. No building permit, grading permit, sediment control permit, or subdivision approval shall be issued until a satisfactory final Stormwater Management Plan, or a waiver thereof, shall have undergone a review and been approved by the City after determining that the plan waiver is consistent with the requirements of this manual.

Stormwater Management Conceptual Plan Requirements (Optional)

A stormwater management concept plan submittal is optional, but highly encouraged. A concept plan identifies basic site information, locations of proposed development features, and preliminary locations and sizing of STPs. The concept submittal has a greater chance of identifying major obstacles and can facilitate alternative stormwater management arrangements in a timely fashion and at the onset of project planning. If a concept plan is submitted for review, it should include sufficient information (e.g., maps, basic hydrologic and water quality calculations etc.) to evaluate the environmental characteristics of the project site. This information should show the potential impacts of all proposed development of the site, both present and future, on the water resources, and show the effectiveness and acceptability of the measures proposed for managing stormwater generated at the project site. The intent of this conceptual planning process is to determine the type of stormwater management of stormwater runoff from future development, and to identify major issues prior to completing final plans. The concept plan is less time consuming and more efficient to evaluate proposed development plans with this step of the review process.

Engineering Design Standards

The final plan provides more detailed design information for the proposed STPs, and includes much more detail in terms of hydrologic conditions and site features.

For redevelopment an applicant should include within a concept plan measures for controlling existing stormwater runoff discharges and water quality from the site in accordance with the standards of this Manual. After review of the concept plan and modifications are made to that plan as deemed necessary by the City, a final Stormwater Management Plan may be submitted for approval.

Stormwater Management Plan Requirements (Required)

Record drawings are required for all projects that impact wetlands and/or the floodplain, require water quality ponding, have significant grade changes, and/or have other unusual circumstances. Record drawings must be certified by a professional land surveyor or civil engineer. (Record drawings should not include temporary erosion control measures.)

Plan Details

- North arrow, street names, and lot and block numbers for property or subdivision
- Location of benchmark, based on the City/County benchmark system
- Key with all line types, symbols, shading, and cross-hatching denoted
- Illustration key showing symbols for all information pertaining to lot and building design, including grades, easements, lot and block, setbacks, etc...
- Plan scale (shown graphically on a bar scale) of: 1 inch = 20 feet, 1 inch = 30 feet, 1 inch = 40 feet, or 1 inch = 50 feet. Plans in other scales will not be reviewed.
- Total area of subject property, with subtotals of disturbed **and** undisturbed areas (tabulation permitted)
- Subject property's boundary lines, lot lines and right of way lines
- All existing and proposed drainage and utility easements
- All man-made features, including existing and proposed buildings, structures, and paved areas
- All existing storm sewer facilities within 150 feet of the subject parcel
- All proposed storm sewer facilities (include grades and size of structures)
- All existing and proposed natural features including, but not limited to, significant trees and tree lines, wetlands, ponds, lakes, streams, drainage channels, floodplain, etc.
- Soil types with highly erodible soils identified. sites with high erosion potential characterized by steep slopes or erodible soil will be required to provide site-specific construction recommendation by a Soils Engineer for City review.
- If work is being done inside the "Critical Areas" as defined by the MNRRA, the plan shall show no proposed grading in areas equal to or greater than 18%.

Engineering Design Standards

- Show setbacks and buffers for wetlands, ponds, lakes, streams, and floodplains
- All adjacent plats, parcels, rights-of-way, section lines, extended a minimum of 100 feet (50 feet for single family home construction) beyond the subject parcel in all directions
- Crossing out of incorrect information (elevations, distances, etc.) will not be allowed on record plans. Incorrect information must be cleanly removed and replaced with the correct record plan information. Proposed elevations and lengths that are not changed should be check-marked to indicate them as being as- built.

Topography

- Topography details in a minimum of two-foot contour intervals with existing contours as **dashed lines** and proposed contours as dark, **solid lines**, labeled at each edge of the plan and at other appropriate locations
- Standard lot benching detail, where appropriate (maximum slopes 3:1)
- Direction arrows indicating swales and lot drainage patterns (show percent grades along drainage swales on plan)

Elevation Information

- Proposed top of curb elevations at lot corners and driveway or entrances
- Finished spot elevations at all high and low points
- Proposed elevations at garage and lowest floor for proposed buildings
- Proposed finished ground elevations around home for final grading

Erosion Control Best Management Practices (BMPs)

Show location of all temporary and permanent erosion control measures (with standard detail plates and maintenance information for each), including, but not limited to:

- Temporary rock entrance/exit for all vehicle access points (show on plan and provide detail)
- Perimeter silt fence; silt fence and/or bale checks should also be placed along swales or slopes greater than 50 feet in length (flare ends of silt fence up slope)
- Storm sewer inlet filters (indicate type and show graphically on plan at each location)
- Temporary sediment basins
- Dewatering if applicable)
- Erosion control mats, fiber blankets, netting, temporary seed, or temporary mulch. All exposed soil areas must be stabilized as soon as possible to limit soil erosion but in no case later than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased and no later than seven (7) days after construction activity in that portion of the site has temporarily or permanently ceased when discharge points on the project is within one mile of a special or impaired water and flows to that special or impaired water.

Engineering Design Standards

- Soil stockpile areas (indicate temporary stabilization measures)
- If infiltration basins are proposed for the construction site, a note must appear on the plan stating “The proposed infiltration basins shall be roped off as not to allow heavy construction site traffic to enter any basin and the basins shall be staked off before any construction can begin. The infiltration basin area(s) cannot be used to treat construction site runoff, and shall not be constructed to final grade until the contributing drainage area achieves final stabilization and approved by the City Engineer or the City Engineer’s authorized designee.”
- Street Sweeping Required**

Plans must include a note indicating that all adjacent streets will be swept daily, or as directed by the City, to remove all accumulated materials. Failure to perform any street sweeping within six hours of notice by the City will result in the work being performed by the City and all associated costs billed.. The City also requires removal of accumulated materials on streets during winter.

Final Stabilization

New resident construction requires vegetated stabilization from the front curb line to the back of the structure for the entire width of the lot. Show seeding and/or turf establishment locations and specifications, including:

- Type of seeding (permanent, temporary, dormant)
- Seed type and application rate
- Fertilizer type and application rate
- Mulch type, application rate, and method of anchoring
- Specifications for installation and maintenance of erosion control mats, blankets, or netting
- Note requiring seeding/restoration to be completed within 48 hours of final grading
- Location of all areas to be vegetated

5. LIST OF ACCEPTABLE PRACTICES

In the development of the STP appropriate for the development or redevelopment, infiltration (water quality volume) is foremost in importance to apply in the design. Filtration is warranted when site conditions do not allow for an effective infiltration facility. For flooding or rate control, detention systems are typically the preferred practice. Low Impact Design (LID) practices are encouraged when they can be functionally incorporated into the design. Alternative practices may be approved at the discretion of the City Engineer.

Volume Control Systems:

- Infiltration trench
- Infiltration basin

Engineering Design Standards

- Raingarden
- Underground storage
- Reuse
- Green Roofs
- Trees/Tree Planters

Filtration Systems:

- Surface sand filter
- Underground sand filter
- Perimeter sand filter
- Organic filter
- Bioretention system
- Raingarden with underdain
- Pervious pavement with underdrain
- Underground storage with underdrain
- Tree trench

Detention Systems:

- Wet pond
- Stormwater re-use systems
- Multiple pond systems
- Extended detention basin
- Micro-pool extended detention basin
- Dry detention ponds
- Underground storage
- Other, as approved by the City of St. Paul Park

Wetlands:

- Shallow wetland
- Pond/wetland systems

Open Channel Systems:

- Dry swale
- Wet swale
- Grass swale
- Natural channel, or stream

6. CONSTRUCTION SITE STORMWATER RUNOFF CONTROL

6.1 Erosion Control

1. The Permittee must plan for and implement appropriate construction phasing vegetative buffer strips, horizontal slope grading, and other construction practices to minimize erosion. All areas not to be disturbed shall be marked (e.g. with flags, stakes, signs, silt fence etc.) on the project site before any work begins.
2. All exposed soil areas must be stabilized as soon as possible to limit soil erosion but in no case later than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased and no later than seven (7) days after construction activity in that portion of the site has temporarily or permanently ceased when discharge points on the project is within one mile of a special or impaired water and flows to that special or impaired water.
3. Additional BMPs together with enhanced runoff controls are required for discharges to special waters and impaired waters. The BMPs identified for each special or impaired water are required for those areas of the project draining to a discharge point on the project that is within one mile of a special or impaired water and flows to that water. The additional BMPs are identified in Appendix A of the NPDES Construction General Permit.
4. The permittee must stabilize the normal wetted perimeter of any temporary or permanent drainage ditch or swale that drains water from any portion of the construction site, or diverts water around the site, within 200 lineal feet from the property edge, or from the point of discharge into any surface water. Stabilization of the last 200 lineal feet must be completed within 24-hours after connecting to a surface water or property edge.
5. Pipe outlet must have temporary or permanent energy dissipation before connecting to surface water.
6. When possible, all slopes must be graded in such a fashion so that tracking marks made from heavy equipment are perpendicular to the slope.
7. All areas disturbed during construction must be restored as detailed in these requirements. The type of permanent restoration shall be clearly shown on the plans including but not limited to sod, seed, impervious cover and structures. A minimum of 6 inches of topsoil must be installed prior to permanent restoration. Areas in which the top soil has been placed and finish graded or areas that have been disturbed and other grading or site building construction operations are not actively underway must be temporary or permanently restored as set forth in the following requirements.
 - 1) Areas with slopes that area less than 3:1 must be seeded and mulched within 14 days of the area not being actively worked.

Engineering Design Standards

- 2) Areas with slopes that are greater or equal to 3:1 must be seeded and erosion control blanket placed within 14 days of the area not being actively worked.
- 3) All seeded area must be either mulched and disc anchored, hydro-mulched, or covered by erosion control blanket to reduce erosion and protect the seed. Temporary or permanent mulch must be disc anchored and applied at a uniform rate of 2 tons per acre and have 90% coverage.
- 4) If the disturbed area will be re-disturbed within a six month period, temporary vegetative cover shall be required consisting of an approved seed mixture and application rate.
- 5) If the disturbed area will not be re-disturbed within a six month period, permanent vegetative cover shall be required consisting of an approved seed mixture and application rate.
- 6) All areas that will not have maintenance done such as mowing as part of the final design shall be permanently restored using an approved seed mixture and application rate.
- 7) Restoration of disturbed wetland areas shall be accomplished using an approved seed mixture and application rate.
8. All erosion control measures must be maintained for the duration of the project until final stabilization has been achieved. If construction operations or natural events damage or interfere with any erosion control measures, they shall be restored to serve their intended function.
9. Additional erosion control measures shall be added as necessary to effectively protect the natural resources of the City. The temporary and permanent erosion control plans shall be revised as needed based on current site conditions and to comply with all applicable requirements

6.2 Sediment Control Practices

1. Sediment control practices must be established on all down gradient perimeters before any upgradient land disturbing activities begin. These practices must remain in place until final stabilization has been achieved.
2. If down gradient treatment system is overloaded additional up gradient sediment control practices must be installed to eliminate overloading. The SWPPP must be amended to identify the additional practices.
3. All storm drain inlets must be protected by approved BMPs during construction until all potential sources for discharge have been stabilized. These devices must be maintained until final stabilization is achieved. Inlet protection may be removed if a specific safety concern (street flooding/freezing) has been identified.
4. Temporary stockpiles must have silt fence or other effective sediment controls on the down gradient side of the stockpile and shall not be placed at least twenty five

Engineering Design Standards

- (25) feet from any road, wetland, protected water, drainage channel, or stormwater inlets. Stockpile left for more than 14 days must be stabilized with mulch, vegetation, tarps or other approved means.
5. Vehicle tracking of sediment from project shall be minimized by approved BMPs. These shall be installed and maintained at the City approved entrances. Individual lots shall each be required to install and maintained entrances throughout the construction building until a paved driveway is install.
 6. Sediment that has washed or tracked from site by motor vehicles or equipment shall be cleaned from paved surfaces throughout the duration of construction.
 7. Silt fence or other approved sediment control devices must be installed in all areas as shown on the SWPPP.
 8. Silt fence or other approved sediment control devices shall be required along the entire curb line, except for approved opening where construction entrance will be installed or drainage flows away from curb. This device must be maintained until final stabilization is achieved. Ditch checks shall be required in ditch bottoms. Spacing for the check must be as follows: [***Height in feet*** (of the sediment device used)] ***X 100 / Slope Gradient***
 9. Dust control measures, such as application of water must be performed periodically due to weather, construction activity, and/or as directed by the City.
 10. Flows from diversion channels or pipes (temporary or permanent) must be routed to sedimentation basins or appropriate energy dissipaters to prevent the transport of sediment to outflow or lateral conveyors and to prevent erosion and sediment buildup when runoff flows into the conveyors.
 11. A concrete washout shall be installed on projects that require the use of concrete. All liquid and solid wastes generated by concrete washout operations must be contained in a leak-proof containment facility or impermeable liner. A sign must be installed adjacent to each washout facility to inform operators to utilize the proper facilities.
 12. All sediment control measures shall be used and maintained for the duration of the project until final. If construction operations or natural events damage or interfere with any erosion control measures, they must be restored to serve their intended function.
 13. Additional sediment control measures shall be added as necessary to effectively protect the natural resources of the City. The temporary and permanent erosion control plans shall be revised as needed based on current site conditions and to comply with all applicable requirements.
 14. Restrict clearing and grading within 20 feet of an existing wetland boundary to provide for a protective buffer strip of natural vegetation.

Engineering Design Standards

6.3 Waterway and Watercourse Protection

1. A temporary stream crossing must be installed and approved by the local government unit and regulating agency if a wet watercourse will be crossed regularly during construction.
2. The watercourse channel shall be stabilized before, during, and within 24 hours after any in-channel work.
3. No in-water work shall be allowed in Public Waters during the MnDNR's work exclusion dates.
4. Prior to placement of any equipment into any waters, all equipment must be free of aquatic plants and non-native animals.
5. All on-site stormwater conveyance channels designed according to the criteria outlined in this document. Stabilization adequate to prevent erosion located at the outlets of all pipes and paved channels is required.

6.4 Temporary Sediment Basins

A temporary sediment basin (or permanent) shall be provided when 10 or more acres of disturbed soil drain to a common location prior to the runoff leaving the site or entering surface waters. The Permittee is also encouraged, but not required to install temporary sediment basins in areas with steep slope or highly erodible soils even if the area is less than ten (10) acres and it drains to one common area. The basins shall be designed and constructed according to the following requirements:

1. The basins must provide storage below the outlet pipe for a calculated volume of runoff from a 2-year, 24-hour storm from each acre drained to the basin, except that in no case shall the basin provide less than 1,800 cubic feet of storage below the outlet pipe from each acre drained to the basin.
2. Where no such calculation has been performed, a temporary (or permanent) sediment basin providing 3,600 cubic feet of storage below the outlet pipe per acre drained to the basin shall be provided where attainable until final stabilization of the site.
3. Temporary basin outlets will be designed to prevent short-circuiting and the discharge of floating debris. The basin must be designed with the ability to allow complete basin drawdown (e.g., perforated riser pipe wrapped with filter fabric and covered with crushed gravel, pumps or other means) for maintenance activities, and provide a stabilized emergency overflow to prevent failure of pond integrity. Energy dissipation must be provided for the basin outlet.
4. Temporary (or permanent) basins must be constructed and made operational concurrent with the start of soil disturbance that is up gradient of the area and contributes runoff to the pond.

Engineering Design Standards

5. Where the temporary sediment basin is not attainable due to site limitations, equivalent sediment controls such as smaller sediment basins, and/or sediment traps, silt fences, vegetative buffer strips or any appropriate combination of measures are required for all down slope boundaries of the construction area and for those side slope boundaries deemed appropriate as dictated by individual site conditions. In determining whether installing a sediment basin is attainable, the Permittee must consider public safety and may consider factors such as site soils, slope, and available area on site. This determination must be documented in the SWPPP.
6. The Permittee shall maintain the sedimentation basins and will remain functional until an acceptable vegetative cover is restored to the site, resulting in a pre-development level rate of erosion. The city will not issue building permits for lots containing sediment basins until they have been removed or relocated based on the projects restoration progress.
7. Basins designed to be used for permanent stormwater management shall be brought back to their original design contours prior to acceptance by the City.

6.5 Dewatering and Basin Draining

1. If water cannot be discharged into a sedimentation basin before entering a surface water it must be treated with the appropriate BMPs, such that the discharge does not adversely affect the receiving water or downstream landowners. The Permittee must make sure discharge points are appropriately protected from erosion and scour. The discharge must be dispersed over riprap, sand bags, plastic sheeting or other acceptable energy dissipation measures. Adequate sediment control measures are required for discharging water that contains suspended soils.
2. All water from dewatering or basin draining must discharge in a manner that does not cause nuisance conditions, erosion in receiving channels, on down slope properties, or inundation in wetlands causing significant adverse impact to wetlands.

6.6 Inspections and Maintenance

1. The Permittee shall be responsible for inspecting and maintenance of the BMPs
2. The Permittee must routinely inspect the construction project once every seven (7) days during active construction and within 24-hours of a rainfall event of 0.5 inches or greater in 24-hours.
3. All inspections and maintenance conducted during construction must be recorded in writing and must be retained with the SWPPP. Records of each inspection and maintenance activity shall include:
 - 1) Date and time of inspection.

Engineering Design Standards

- 2) Name of person(s) conducting the inspections.
- 3) Findings of inspections, including recommendations for corrective actions.
- 4) Corrective actions taken (including dates, times, and the party completing the maintenance activities).
- 5) Date and amount of all rainfall events 0.5 inches or greater in 24-hours.
- 6) Documentation of changes made to SWPPP.
4. Parts of the construction site that have achieved final stabilization, but work continues on other parts of the site, inspections of the stabilized areas can be reduced to once a month. If work has been suspended due to frozen ground conditions, the required inspections and maintenance must take place as soon as runoff occurs or prior to resuming construction, whichever happens first.
5. All erosion and sediment BMPs shall be inspected to ensure integrity and effectiveness. All nonfunctional BMPs shall be repaired, replaced or supplemented with a functional BMP. The Permittee shall investigate and comply with the following inspection and maintenance requirements.
6. All silt fences must be repaired, replaced, or supplemented when they become nonfunctional or the sediment reaches 1/2 of the height of the fence. These repairs shall be made within 24-hours of discovery, or as soon as field conditions allow access.
7. Temporary and permanent sedimentation basins must be drained and the sediment removed when the depth of sediment collected in the basin reaches 1/2 the storage volume. Drainage and removal must be completed within 72-hours of discovery, or as soon as field conditions allow access.
8. Surface waters, including drainage ditches and conveyance systems, must be inspected for evidence of sediment being deposited by erosion. The Permittee shall remove all deltas and sediment deposited in surface waters, including drainage ways, catch basins, and other drainage systems, and restabilize the areas where sediment removal results in exposed soil. The removal and stabilization shall take place within seven (7) days of discovery unless precluded by legal, regulatory, or physical access constraints. The Permittee shall use all reasonable efforts to obtain access. If precluded, removal and stabilization shall take place within seven (7) calendar days of obtaining access. The Permittee is responsible for contacting all local, regional, state and federal authorities and receiving any applicable permits, prior to conducting any work.
9. Construction site vehicle exit locations shall be inspected for evidence of off-site sediment tracking onto paved surfaces. Tracked sediment shall be removed from all off-site paved surfaces, within 24-hours of discovery, or if applicable, within a shorter time.

Engineering Design Standards

10. The Permittee is responsible for the operation and maintenance of temporary and permanent water quality management BMPs, as well as all erosion prevention and sediment control BMPs, for the duration of the construction work at the site. The Permittee is responsible until another Permittee has assumed control over all areas of the site that have not been finally stabilized or the site has undergone final stabilization, and a NOT has been submitted to the MPCA.
11. If sediment escapes the construction site, off-site accumulations of sediment shall be removed in a manner and at a frequency sufficient to minimize off-site impacts (e.g., fugitive sediment in streets could be washed into storm sewers by the next rain and/or pose a safety hazard to users of public streets).
12. All infiltration areas shall be inspected to ensure that no sediment from ongoing construction activities is reaching the infiltration area and these areas are protected from compaction due to construction equipment driving across the infiltration area.

6.7 Pollution Management Measures/Construction Site Waste Control

1. The Permittee must implement the following pollution prevention management measures on the site.
 - 1) Solid Waste – Collected sediment, asphalt and concrete millings, floating debris, paper, plastic, fabric, construction and demolition debris and other wastes must be disposed of properly and must comply with MPCA disposal requirements.
 - 2) Hazardous Materials such as oil, gasoline, paint and any hazardous substances must be properly stored, including secondary containment, to prevent spills, leaks or other discharge. Restricted access to storage areas shall be provided to prevent vandalism. Storage and disposal of hazardous waste shall be in compliance with MPCA regulations.
 - 3) External washing of trucks and other construction vehicles must be limited to a defined area of the site. Runoff shall be contained and waste properly disposed of. No engine degreasing is allowed on site.
 - 4) The City of St. Paul Park prohibits discharges of any material other than stormwater, and discharges from dewatering or basin draining activities. Prohibited discharges include but are not limited to vehicle and equipment washing, maintenance spills, wash water, and discharges of oil and other hazardous substances.
 - 5) The Permittee must comply with all other pollution prevention/good housekeeping requirements of the MPCA NPDES Construction General Permit.

Engineering Design Standards

6.8 Final Stabilization

1. The Permittee must ensure final stabilization of the project. Final stabilization can be achieved in one of the following ways.
2. All soil disturbing activities at the site have been completed and all soils will be stabilized by a uniform perennial vegetative cover with a density of at least 70 percent over the entire pervious surface area, or other equivalent means necessary to prevent soil failure under erosive conditions and;
 - 1) All drainage ditches, constructed to drain water from the site after construction is complete, must be stabilized to preclude erosion; and
 - 2) All temporary synthetic, and structural erosion prevention and sediment control BMPs (such as silt fence) must be removed as part of the site final stabilization; and
 - 3) The Permittee must clean out all sediment from conveyances and from temporary sedimentation basins that are to be used as permanent water quality management basins. Sediment must be stabilized to prevent it from washing back into the basin, conveyances or drainage ways discharging off-site or to surface waters. The cleanout of permanent basins must be sufficient to return the basin to design capacity.
3. For residential construction only, final stabilization has been achieved when:
 - 1) Temporary erosion protection and down gradient perimeter control for individual lots has been completed and the residence has been transferred to the homeowner.
 - 2) The Permittee must distribute the MPCA “homeowner factsheet” to the homeowner so the homeowner is informed for the need, and benefits, of final stabilization.

6.9 Training

1. The SWPPP must provide a chain of command showing who prepared the SWPPP, who is responsible for the management of the construction site and inspections.
2. The training shall consist of a course developed by a local, state or federal agency, professional organization, water management organization, or soil and water conservation district and must contain information that is related to erosion prevention, sediment control, or permanent stormwater management and must relate to the work that you are responsible for managing.

7. GUIDANCE ON STORMWATER TREATMENT PRACTICES (STPS)

Designers are expected to follow the requirements of this section to meet the volume control, water quality, and water quantity requirements of the City of St. Paul Park. Designs should meet the stormwater design standards of these Engineering Standards and the *Minnesota Stormwater Manual*. Deviations from recommended guidance will require detailed written explanation with discretion given by the City. Approval of any deviation from the *Minnesota Stormwater Manual* guidance will be at the discretion of the City.

8. BASIC SIZING CRITERIA

Proposed Stormwater Management Plans must incorporate Volume Control, Water Quality Control, and Rate Control as the basis for stormwater management in the proposed development plan. The City of St. Paul Park, as a permitted MS4, requires for new development projects to have a no net increase from pre-project conditions of total volume, TSS, and TP; in addition, for redevelopment projects within the city, it is required to have a net reduction from pre-project conditions of total volume, TSS and TP.

8.1 Volume Control Requirements

Volume control measures are required on projects to meet the water quality criteria of the South Washington Watershed District's (SWWD) Rules and Standards Manual, and to meet the requirements of the City of St. Paul Park's MS4 Permit obligations. Volume control shall be required for proposed net new impervious areas greater than 1 acre. If an applicant can demonstrate that the volume control standard has been met, then the water quality sizing criteria shall be considered satisfied.

Per the SWWD Rules, all projects must maintain the annual average existing conditions infiltration capacity of the site. The standard is applied to entire site, expressed as total annual runoff volume resulting from typical climatic conditions. Public Improvement projects are exempt from Rule 7.3.2. Requirement may be met through credits earned for projects within the same subwatershed. BMPs should be designed following guidance provided in the SWWD Standards Manual or Minnesota Stormwater Manual.

8.2 Volume Control Calculations

Depending on applicability, a proposed development shall capture and retain on site 1.0 inch of runoff from the impervious surfaces in post-construction conditions for increases in impervious surface greater than 1 acre.

Engineering Design Standards

For linear projects with lack of right-of-way, easements or other permissions from property owners to install treatments systems that are capable of treating the total water quality volume on site, the project must maximize treatment through other methods or combination of methods before runoff is released to nearby surface waters. Alternative treatment options include: grassed swales, filtration systems, smaller ponds, or grit chambers. In all circumstances, a reasonable attempt must be made to obtain right-of-way during the project planning and all attempts of infeasibility must be recorded.

For projects less than 1 acre the City encourages applicants to incorporate volume control or water quality provisions to the extent feasible. Applicants may choose to satisfy volume control with the construction of a raingarden. The required stormwater runoff volume shall be calculated as follows:

$$\text{Required Volume (ft}^3\text{)} = \text{Impervious surfaces (ft}^2\text{)} \times 1.0(\text{in}) \times 1/12 (\text{ft/in})$$

The use of infiltration techniques shall be restricted and subject to additional City review where the infiltration BMP will be constructed in any of the following areas:

1. Where industrial facilities are not authorized to infiltrate industrial stormwater under and NPDES/SDS Industrial Stormwater Permit issued by the MPCA.
2. Where vehicle fueling and maintenance occur.
3. With less than three (3) feet of separation distance from the bottom of the infiltration system to the elevation of the seasonally saturated soils or the top of the bedrock.
4. Where high levels of contaminant in soil or groundwater will be mobilized by the infiltrating stormwater.
5. Soils are predominately Hydrologic Soil Group D (clay) soils.
6. Within 1,000 feet up-gradient, or 100 feet down-gradient of active karst features.
7. Drinking Water Supply Management Areas are present, as defined by Minn. R. 4720.51000, subp.13, unless precluded by a local unit of government with an MS4 permit.
8. Soil infiltration rates are more than 8.3 inches per hour unless soils are amended to slow the infiltration rate below 8.3 inches per hour.

Where the site factors listed above limit the construction of infiltration systems, the project proposer shall provide appropriate documentation to the City regarding the limitations. If the City determines that infiltration is restricted or prohibited onsite, the applicant shall consider alternative volume reduction BMPs, and the water quality volume must be treated by a wet sedimentation basin, filtration system, regional ponding or similar method prior to the release of stormwater to surface water.

Engineering Design Standards

8.3 Water Quality Control

The overall stormwater management plan shall be designed to remove 80% TSS in the stormwater discharge on an average annual basis for new development and redevelopment. The Walker P8 model is the preferred model to demonstrate TSS and TP removals.

Per the SWWD's Rules:

1. All projects must meet minimum NPDES Phase II requirements for on-site treatment.
2. All projects must provide treatment necessary to meet applicable annual total phosphorus loading rates listed below, or maintain existing loading rates, whichever is less:

Receiving Water Body	Maximum Allowable Total Phosphorus Loading Rate (lbs/ac/yr)
Mississippi River	0.22

3. All projects must provide treatment necessary to provide a net reduction of off-site Total Suspended Solids discharge rates from existing conditions on an average annual basis.
4. No direct (untreated) discharges of stormwater to natural or improved waterbodies are allowed.
5. BMPs should be designed following guidance provided in the SWWD Standards Manual or MN Stormwater Manual. Phosphorus removal rates in excess of maximum removal rates listed in 10.6 of the MN Stormwater Manual may not be claimed.
6. In addition, the maximum expected benefits for BMPs should conform to the standards shown in Table 2.4 of the SWWD Standards Manual (page 27):

Best Management Practice for Site Design	Expected Range for Estimated Annual Benefit:		Empirical Typical Nutrient (TP) Pollutant Removal Efficiency
	Volume Reduction	Nutrient (TP) Load Reduction	
Detention Ponds	0	60%	50%
Buffers	0		
On-site infiltration, ½-inch	90-100%		65%
On-site infiltration, 1-inch	90-100%		
Regional infiltration	Case-by-case evaluation		
Biofiltration/Sand Filter	0	60%	50%
Porous Pavers, ½-inch	90-100%		N/A
Porous Pavers, 1-inch	90-100%		N/A
Swales, Dry	60%	60%	8-99%
Swales, Conventional	15%	30%	34%

Engineering Design Standards

Soil Decompaction	25-30%		N/A
Impervious Disconnection	10-15%	15-20%	N/A
Tandem: Decompaction and Disconnection	35-40%	40-45%	N/A

NOTE:

- ½-inch means runoff volume equal to ½-inch depth spread across the entire contributing area (pervious and impervious)
- 1-inch means runoff volume equal to 1-inch depth spread across the entire impervious area.

Mitigation Requirements

Under certain circumstances, some construction projects cannot meet the TSS and/or TP reduction requirements for new or redevelopment projects on the site of the original construction. All methods must be exhausted prior to considering alternative locations where TSS and TP treatment standards can be achieved. If the City has determined that all methods have been exhausted, the permittee will be required to identify alternative locations where TSS and TP treatment standards can be achieved. Mitigation projects will be chosen in the following order of preference:

1. Locations that yield benefits to the same receiving water that receives runoff from the original construction activity.
2. Locations within the same Department of Natural Resource (DNR) catchment area as the original construction activity.
3. Locations in the next adjacent DNR catchment area up-stream.
4. Locations anywhere within the City of St. Paul Park.

In addition, mitigation projects shall also meet the following criteria:

1. Mitigation projects shall involve the establishment new structural stormwater BMPs or the retrofit of existing structural stormwater BMPs, or the use of a properly designed regional structural stormwater BMP.
2. Previously required routine maintenance of structural stormwater BMPs cannot be considered mitigation.
3. Mitigation projects must be finished within 24 months after the original construction activity begins.
4. A maintenance agreement specifying the responsible party for long-term maintenance shall be identified.

Engineering Design Standards

9.1 **Rate Control**

1. BMPs should be designed following guidance provided in the SWWD Standards Manual or MN Stormwater Manual.
2. At a minimum, the rate of runoff from the developed or redeveloped site shall not exceed the existing runoff rates for the 2, 10, and 100-year 24-hour rainfall events in accordance to the Atlas14 data as shown in the table below:

Event	Rainfall/Snowmelt Depth (inches)
2-year, 24 hour	2.79
10-year, 24 hour	4.15
100-year, 24 hour	7.41
100-year, 10 day snowmelt	9.91

3. The predevelopment infiltration capacity of the site must be maintained.
4. Where timing of peak runoff is of particular concern, SWWD may require a critical duration event analysis.
5. If post development discharges from sites are being compared to the peak direct discharges identified in these Engineering Design Standards, the curve numbers for each land use should be based on Technical Resource 55 (TR-55) guidance, except that under no circumstances shall predevelopment conditions exceed a curve number of 72.
6. Detention basins shall be designed with capacity for the critical 100-year event, which is defined as the 100-year event that produces the highest water level among a 24-hour rainfall event or the 10-day snowmelt runoff event.
7. The maximum duration for rainfall critical event analysis shall be 24-hours except in cases where basins are landlocked, where back to back 24-hour events and the 10-day snowmelt runoff event shall also be used.
8. All runoff calculations shall be according to the methodology described in the Natural Resources Conservation Service's TR-55, "Urban Hydrology for Small Watersheds". Acceptable modeling software includes Hydrocad and XP-SWMM. Other methodology may be used with prior approval by the City.
9. All drainage system analyses and designs shall be based on proposed full development land use patterns.
10. Development adjacent to a landlocked basin (basin is not provided an overland outlet), freeboard should be determined based on one of three methods (whichever provides for the highest freeboard elevation):
 - 1) Two feet above the HWL determined by modeling back to back 100-year, 24-hour events,
 - 2) Three feet above the highest known water level, or

Engineering Design Standards

- 3) Five feet above the HWL determined by modeling a single 100-year, 24-hour event.
11. When modeling landlocked basins, the starting water surface elevation should be the basins Ordinary High Water elevation, which can be determined through hydrologic modeling or, in the case of a DNR regulated basin, from a DNR survey.
12. The volume of runoff may not increase due to the proposed project when the receiving area downstream is landlocked and not capable of accommodating the increased runoff volume of runoff. In landlocked areas, the City will encourage construction of a stormwater outlet system and will require easements around ponded areas and the downstream conveyance systems.
13. Runoff draining onto a site must be accommodated in the analysis and design of new BMPs.
14. For basins with a suitable outlet, freeboard will be 2 feet above the HWL determined by modeling the 100-year critical event. Emergency overflows a minimum of 1.5 feet below lowest ground elevation adjacent to a structure should also be provided.
15. Adjacent to channels, creeks, and ravines freeboard will also be 2 feet to the 100-year critical event elevation.
16. A Type II 24-hour nested rainfall distribution with average antecedent moisture conditions should be utilized for runoff calculations.
17. The recommended minimum outlet diameter is 6 inches due to plugging susceptibility and may supersede the rate control requirement for the 2-year event.
18. City standard detail plates should be utilized for pond outlet structures.
19. Outlet structures should be designed in three phases with primary outlet structure and secondary overflow structure routed to the storm sewer and a defined emergency overflow as the tertiary outlet structure.

9.2 Alternative BMPs

Alternative BMPs will be allowed where practicable and feasible. Each individual BMP downstream conveyance system shall be designed for the 100-year, 24-hour storm event and at the point of ultimate discharge, the flow-rates must be below existing conditions for the 5-year and 100-year events. The alternative STPs must also have emergency overflows provided. The STP or the series of STPs must show treatment levels that meet or exceed MPCA standards, provide 80% TSS and 50% TP removal on an average annual basis and must use acceptable engineering methods.

Engineering Design Standards

9.3 Freeboard

Elevation separations of buildings with respect to ponds, lakes, streams, and stormwater features shall be designed as follows:

1. The basement floor elevation of any new building shall be constructed a minimum of three feet above the projected 100-year high-water elevation or MDNR OWH (whichever is higher) of nearby surface waterbodies or stormwater ponds and placed at least three feet above the elevation of any known historic high groundwater elevations for the area and at least two feet above the 100-year high surface water elevation in the area. . The City will consider allowing a minimum of two feet separation where high-water conditions are well established.
2. The low building opening elevation of any new building shall be at least three feet above the projected 100-year high water elevation for the area. If this standard is considered a hardship, the standard may be lowered to placing the low building opening elevation at least two feet above the projected 100-year high water elevation if the following can be demonstrated:
 - 1) That within the two-foot freeboard area above the 100-year high water elevation, stormwater storage is at least 50 percent of the stormwater storage capacity below the 100-year high water elevation; and
 - 2) That a 25 percent obstruction of the basin outlet for a 100-year critical-duration rainfall event would not result in a high water elevation greater than one foot above the 100-year high water elevation; and
 - 3) An adequate overflow route from the basin will assure that water levels, even for extreme rainfall events, will be greater than 1.5 feet below the low building opening elevation.
3. Emergency overflows shall be at least 1.5 feet below any adjacent building openings in other low areas (i.e. street low points, backyard low points) that do not have an established 100-year high-water elevation, or in low points served by storm sewer that is normally dry after storm events. Emergency overflows shall be provided and identified on plans to protect structures against flooding. An emergency spillway from ponding areas shall be installed a minimum of 1.5 feet below the lowest building opening and shall be designed to have a capacity to overflow water at an elevation below the lowest building opening at a rate not less than three times the 100-year peak discharge rate from the basin or the 100-year inflow rate to the basin, whichever is higher.

9.4 Floodplain Management

The City prohibits encroachment or filling activities within the 100-year floodplain. Encroachment into a 100-year floodplain is discouraged but will be allowed if compensatory floodplain storage is provided in the same waterbody or drainage district and excavated areas

Engineering Design Standards

are properly protected against erosion. Applications proposing to alter the floodplain shall submit the following:

1. Cut/fill diagrams along with calculations demonstrating that the filling or alteration of the floodplain is not resulting in a reduction in the flood stage/storage;
2. Compensatory floodplain storage within +/- 1 foot of the floodplain impacts in the same water body or drainage district of the proposed work; and
3. Proper stabilization of excavated areas.

9.5 Buffers

Buffers are required for areas adjacent to wetlands, as defined in the City's Surface Water Management Plan and the SWWD's Watershed Management Plan. The following standards shall guide the creation or restoration of buffers to achieve the goals and policies of the City's Surface Water Management Plan and the SWWD's Watershed Management Plan. The Administrator may modify or waive standards depending on each project Site and goals for the wetland.

1. The City will require placement of native, unmaintained buffer strips adjacent to wetlands to limit erosion and nutrient transportation to the wetlands. Buffer areas shall be identified by permanent monuments, a minimum of one per lot or for each 300 feet of wetland edge.
2. The minimum buffer widths will comply with the SWWD Wetland Buffer Standards. Buffer widths for wetlands, per the SWWD are as follows:

Criteria	Protect	Manage 1	Manage 2
Wetlands < 1 acre	75 feet	50 feet	25 feet
Wetlands > 1 acre	100 feet	75 feet	50 feet

9.6 Shoreland Management

The City Code has established setbacks for placement of structures and impervious and also requirements for shoreland alterations. The City also encourages the following for work occurring within the shoreland zone:

1. Encourage the use of natural vegetation or bioengineering techniques for the stabilization of shorelines.
2. Use materials such as granite or fieldstone for shoreline stabilization project where hard armoring is necessary.
3. Encourage the use of techniques that will minimize runoff and improve water quality associated with new development and redevelopment. When possible use existing natural drainage ways, wetlands, and vegetated soil surfaces to convey, store, filter, and retain stormwater runoff before discharge to public waters. When

Engineering Design Standards

development density, topographic features, and soil and vegetation conditions are not sufficient to adequately handle stormwater runoff using natural features and vegetation, various types of constructed facilities such as diversions, settling basins, skimming devices, dikes, waterways, and ponds may be used. Preference shall be given to designs using surface drainage, vegetated filter strips, bioretention areas, rainwater gardens, enhanced swales, off-line retention areas, and natural depressions for infiltration rather than buried pipes and human-made materials and facilities (*MnDNR Alternative Shoreland Standards, 2005*).

9.7 Long Term Inspection and Maintenance of Stormwater Facilities

1. No private stormwater facilities may be approved unless a maintenance plan is provided that defines how access will be provided, who will conduct the maintenance, the type of maintenance and the maintenance intervals. At a minimum, all private stormwater facilities shall be inspected annually and maintained in proper condition consistent with the performance goals for which they were originally designed and as executed in the stormwater facilities maintenance agreement.
2. Access to all stormwater facilities must be inspected annual and maintained as necessary. The applicant shall obtain all necessary easement or other property interests to allow access to the facilities for inspection or maintenance for both the responsible party and the City of St. Paul Park.
3. All settled materials including settled solids, shall be removed from ponds, sumps, grit chambers, and other devices, and disposed of properly.

10. STORMWATER TREATMENT PRACTICE DESIGN STANDARDS

10.1 Storm Sewers

1. Manhole spacing shall not exceed 400 feet.
2. Where more than one pipe enters a structure, a catch basin/manhole shall be used.
3. Storm sewer pipe should match top of pipe on top of pipe unless grade constraints prevent this. In that case, hydraulic calculations will be necessary to verify that excessive surcharging will not occur.
4. Stormwater pipes shall be designed utilizing the Rational Method. Channel design shall be hydrograph method only. All methods are subject to the City Engineer's approval.
5. Lateral systems shall be designed for the 5-year rainfall using the Rational Method. State Aid roadway storm sewer shall be designed per the State Aid requirements.

Engineering Design Standards

6. Runoff “C” values and IDF curves used for the rational method shall be in accordance with MNDOT Drainage Manual Dated September 27, 2005 as revised herein.
7. Stormwater ponding areas and downstream conveyance systems shall be designed for the 100-year, 24-hour storm event with a multi-staged outlet to control the 5-year and 100-year events to pre-development levels.
8. The minimum full flow velocity within the storm sewer should be 3 feet per second (fps). The maximum velocity shall be 10 fps, except when entering a pond, where the maximum velocity shall be limited to 6fps.
9. Trunk storm sewer should be designed at a minimum to carry 100-year pond discharge in addition to the 5-year design flow for directly tributary areas. The following table shall be used for the calculation of peak rates using the Rational Method:

Cover Type	10-Year Runoff Coefficient
Single-family Residential	0.4
Multi-family Residential	0.5
Commercial	0.7
Industrial	0.7
Parks, Open Space	0.2
Ponds, Wetlands	1.0

10. For storms greater than the 5-year event, and in the case of plugged inlets, transient street ponding will occur. For safety reasons, the maximum depth in streets should not exceed 1.5 feet at the deepest point.
11. To promote efficient hydraulics within manholes, manhole benching shall be provided to 1/2 diameter of the largest pipe entering or leaving the manhole.
12. Vaned grate (3067V) catch basin castings shall be used on all streets.
13. The maximum design flow at a catch basin for the 5-year storm event shall be three (3) cubic feet per second (cfs), unless high capacity grates are provided. Catch basins at low points will be evaluated for higher flow with the approval of the City Engineer.
14. All structures located in the street are to be a minimum of four feet deep (rim to invert) and a minimum of three feet deep elsewhere. Two-by-three catch basins are to be four (4) feet deep.

10.2 Outlet and Inlet Pipes

1. Inlet pipes of stormwater ponds shall be extended to the pond normal water level whenever possible.

Engineering Design Standards

2. Outfalls with velocities greater than 4 fps into channels, where the angle of the outfall to the channel flow direction is greater than 30 degrees, requires energy dissipation or stilling basins.
3. Outfalls with velocities of less than 4 fps, that project flows downstream into a channel in a direction 30 degrees or less from the channel flow direction, generally do not require energy dissipaters or stilling basins, but will require riprap protection.
4. In the case of discharge to channels, riprap shall be provided on all outlets to an adequate depth below the channel grade and to a height above the outfall or channel bottom. Riprap shall be placed over a suitably graded filter material and filter fabric to ensure that soil particles do not migrate through the riprap and reduce its stability. Riprap shall be placed to a thickness at least 2.5 times the mean rock diameter to ensure that it will not be undermined or rendered ineffective by displacement. If riprap is used as protection for overland drainage routes, grouting may be recommended.
5. Discharge velocity into a pond at the outlet elevation shall be 6 fps or less. Riprap protection is required at all inlet pipes into ponds from the NWL to the pond bottom.
6. Where outlet velocities to ponds exceed 6 fps, the design should be based on the unique site conditions present. Submergence of the outlet or installation of a stilling basin approved by the City is required when excessive outlet velocities are experienced.
7. Submerged outlet pipes from ponds are not allowed.

10.3 Channels and Overland Drainage

1. Overland drainage routes where velocities exceed 4 fps should be reviewed by the City Engineer and approved only when suitable stabilization measures are proposed.
2. Open channels and swales are recommended where flows and small grade differences prohibit the economical construction of an underground conduit. Open channels and swales can provide infiltration and filtration benefits not provided by pipe.
3. The minimum grade in all unpaved areas shall be 2%.
4. Maximum length for drainage swales shall be 400 feet.
5. Channel side slopes should be a maximum of 4:1 (horizontal to vertical) with gentler slopes being desirable.
6. Riprap shall be provided at all points of juncture, particularly between two open channels and where storm sewer pipes discharge into a channel.

Engineering Design Standards

7. Open channels should be designed to handle the expected velocity from a 10-year design storm without erosion. Riprap may need to be provided.
8. Periodic cleaning of an open channel is required to ensure that the design capacity is maintained. Therefore, all channels shall be designed to allow easy access for equipment.

10.4 Ponds

1. Where on-site water quality detention basins are required, copies of the calculations determining the design of the basin(s) will be provided. The size and design considerations will be dependent on the receiving water body's water quality category, the imperviousness of the development and the degree to which on-site infiltration of runoff is achieved. Design of on-site detention basins, as described in the site's runoff water management plan, shall incorporate recommendations from the nationwide urban runoff program (NURP) and "Protecting Water Quality in Urban Areas", published by the Minnesota pollution control agency, as adopted by the City, or the applicable publications, as adopted by the City. The following design considerations are required for on-site water quality detention basins based on the receiving water's water quality category. These designs include permanent detention for water quality treatment; extended detention designs may be substituted provided that they provide treatment equivalent to the requirements below:
 - 1) A permanent pool (dead storage) volume below the normal outlet shall be greater than or equal to the runoff from a two and one-half inch (2.5") 24-hour storm over the entire contributing drainage area assuming full development.
 - 2) A permanent pool average depth (basin volume/basin area) which shall be greater than four feet (4'), with a maximum depth of less than ten feet (10').
 - 3) An emergency spillway (emergency outlet) adequate to control the 100-year frequency critical duration rainfall event.
 - 4) Basin side slopes above the normal water level should be no steeper than three to one (3:1) when possible, and preferably flatter. A basin shelf with a minimum width of ten feet (10') and a maximum slope of ten to one (10:1) below the normal water level is recommended to enhance wildlife habitat, reduce potential safety hazards, and improve access for long term maintenance.
 - 5) To prevent short circuiting, the distance between the major inlets and normal outlet shall be maximized.
 - 6) A flood pool (temporary storage) volume above the principal outlet spillway shall be adequate so that the peak discharge rate from the 1-, 10- and 100-year

Engineering Design Standards

- frequency critical duration storm is not greater than the peak discharge for a similar storm and predevelopment watershed conditions.
- 7) Extended detention of runoff from the more frequent (1-year to 5-year) storms shall be achieved through a principal spillway design which shall include a perforated vertical riser, a small orifice outlet or a compound weir. The spillway must be constructed of a limited maintenance material. The use of treated or naturally decay resistant timber shall not be allowed.
 - 8) Effective energy dissipation devices which reduce outlet velocities to four feet (4') per second or less shall consist of riprap, stilling pools or other such measures to prevent erosion at all storm water outfalls into the basin and at the detention basin outlet.
 - 9) Trash and floatable debris skimming devices shall be placed on the outlet of all wet detention basins where feasible, to provide treatment up to the critical duration 10-year storm event. Skimmer device inlets must be placed at least 1 foot below the treatment pond's established NWL.
 - 10) These devices can consist of baffled weirs, submerged inlets or other such measures capable of restricting the overflow of floatable materials, including litter, oil and grease. The skimming device must be constructed of a limited maintenance material. The use of treated or naturally decay resistant timber shall not be allowed. Computations for the design of such devices shall be included. The maximum velocity through the skimming device shall be less than one foot (1') per second (fps) on the 2-year 24-hour event.
 - 11) For purposes of erosion control, vegetation protection and wildlife habitat enhancement, the 10-year flood level of the basin shall be no more than two feet (2') above the normal level of the basin.
 - 12) All constructed ponds shall be provided a maintenance access from an adjacent roadway. The maintenance access shall be provided in the form of an easement no narrower than 20 feet. The maintenance access shall have a longitudinal slope no steeper than 6:1 and minimal cross slope. Maintenance access routes, due to their extra width, also serve well as emergency overflow (EOF) routes.

10.5 Infiltration/Filtration Practices

1. All infiltration/filtration practices will be required to comply with all MPCA and SWWD standards regarding infiltration/filtration and will be subject to approval by the City Engineer.
2. Sizing of filtration/infiltration practices shall be in conformance with the volume control requirements of this manual and the *Minnesota Stormwater Manual*.

Engineering Design Standards

3. When designing an infiltration practice for volume control and water quality management, on-site testing and detailed analysis are strongly encouraged in order to determine the infiltration rates of the proposed infiltration facility. Documented site-specific infiltration or hydraulic conductivity measurements (double-ring infiltrometer) completed by a licensed soil scientist or engineer is required. In the absence of a detailed analysis, the saturated infiltration rates listed in the Infiltration Rates for Infiltration BMPs table found on the *Minnesota Stormwater Manual* shall be used. A piezometer shall be installed in order to ascertain the level of the local groundwater table and demonstrate at least three feet of separation between the bottom of the proposed facility and the groundwater. The soil boring is required to go to a depth of at least five feet below the proposed bottom of the BMP. The soils shall be classified using the Unified Soil Classification system. The least permeable soil horizon will dictate the infiltration rate. Infiltration practices shall be designed to infiltrate the required runoff volume within 48 hours.
4. Pretreatment, in the form of ponds, forebays, filter strips, or other approved methods, shall be provided for all infiltration areas. Pretreatment upstream of volume management practices is a key element in the long-term viability of infiltration areas. The level of pretreatment varies largely depending on the BMP and drainage area of the watershed, City and SWWD requirements, and *Minnesota Stormwater Manual* recommendations shall be utilized for determining the appropriate level of pretreatment on a case-by-case basis.
5. The infiltration practice shall not be used within fifty feet of a municipal, community or private well, unless specifically allowed by an approved wellhead protection plan.
6. The infiltration practice shall be installed a minimum of 10 feet away from all buildings.
7. The infiltration practice shall not be used for runoff from fueling and vehicle maintenance areas and industrial areas with exposed materials posing contamination risk, unless the infiltration practice is designed to allow for spill containment.
8. Vegetation of infiltration/filtration practices shall be as shown in the City of St. Paul Park Standard Details. A plan for management for vegetation shall be included in the Stormwater Management Plan.
9. If soils are unsuitable for infiltration, then filtration may be used with drain tile, provided in accordance with the City of St. Paul Park's Standard Details.
10. Subgrade soils for infiltration/filtration practices shall be as presented in the City of St. Paul Park's Standard Details. Assume a 40% void ratio for clean washed rock and 20% for construction sand for the purposes of volume calculations.

11. Rock storage beds shall be constructed using crushed angular granite that has been thoroughly washed to remove all fine particles that could result in clogging of the system.
12. For infiltration benches adjacent to ponds, benches shall have slopes no steeper than 5:1 over the proposed infiltration zone. A slope of 10:1 is preferred. The *Minnesota Stormwater Manual* cites concerns with locating infiltration features immediately adjacent to ponds. To address this, benches shall be located to maintain hydraulic separation from the saturated zone of the pond in order to minimize the loss of infiltration potential over time.

10.6 Emergency Overflow Paths

1. Emergency Overflows (EOFs) shall be sized with a minimum bottom width of five feet and 4:1 side slopes.
2. The maximum flow depth in EOFs shall be less than equal to one foot as calculated for a 100-year back-to-back storm event.

11. DESIGN EXAMPLES

The design process for each of the acceptable Stormwater Treatment Practices is detailed in the *Minnesota Stormwater Manual*, http://stormwater.pca.state.mn.us/index.php/Main_Page.

12. STORMWATER TREATMENT PRACTICE DETAIL DRAWINGS

Please refer to the City of St. Paul Park's Engineering Details for the following:

- Bioretention
- Media Filter System
- Vegetative Filter System
- Infiltration Trench
- Infiltration Basin
- Stormwater Pond/Wetland

13. CONSTRUCTION SPECIFICATIONS

Construction specifications and details are found in the *Minnesota Stormwater Manual* for each of the acceptable STPs, unless otherwise restricted by this manual.

14. CHECKLISTS

Refer to Appendix A & B

- Checklists for Construction Inspection and Operation & Maintenance
- Construction Inspection and Operation & Maintenance Checklists for each of the approved Stormwater Treatment Practices are available in the *Minnesota Stormwater Manual*.