PART III
HYDROLOGY RULES

Site hydrology must follow the rules specified herein. These rules are based on the policy set forth in the City of Prior Lake Local Surface Water Management Plan (LSWMP), the Water Resource Management Plan of the Prior Lake Spring Lake Watershed District (PLSLWD), and the Comprehensive Water Resource Management Plan and Rules of the Scott Water Management Organization (Scott WMO).

By enforcing the rules spelled out in part III the City of Prior Lake is fulfilling requirements spelled out under State Statute Chapter 103B, 103D, and Minnesota Rules Chapter 8410. The City of Prior Lake enforces these rules under terms spelled out in a Memorandum of Understanding or Memorandum of Agreement (MOU or MOA) with both the PLSLWD and Scott WMO.

In the future, when major amendments are needed in part III, the Scott WMO Board and the PLSLWD Board must be consulted and grant approval for said amendments as required by the WMO, WD, State Statute and Rules.

Index of Sections

SECTION ONE: DEFINITIONS

Best Management Practices (BMPs): Techniques that are proven to be effective in the management of stormwater, including those documented in the Minnesota Stormwater Manual (MPCA, 2005), Protecting Water Quality in Urban Areas (MPCA 2000), and others as amended.

Buffer: An area of natural, non-invasive, permanently undisturbed, vegetated ground cover adjoining and surrounding a wetland measured from the delineated edge of the wetland.

Buffer Averaging: A buffer of variable width around a wetland equal in area to a corresponding fixed width buffer around the same wetland, set at the average width.

EOF: Emergency Overflow

Expandable Ponding: Ponds built in low areas common to multiple developments that can be easily expanded when neighboring areas develop.

HWL: 100-yr High water level

Landlocked Basin: Any drainage area greater than 1 acre that does not have a natural surface outflow below the level of the 100 year storm, or below its OHW.

LSWMP: Local Surface Water Management Plan.

Net Acre: Total land area minus any wetland, lake, or bluff acreage.

No-grade zone: An area around a wetland that no change in grade is allowed

OE: Outlet elevation

OHW: Ordinary High Water level.

Regional ponding: Permanent stormwater facility used to provide rate control and water quality treatment for an area that encompasses two or more entities (including but not limited to; developments, subdivisions, building additions, and conditional uses.)

Stormwater Management Overlay District: An area within the City that has a separate standard, generally defined by a tributary feature. (Example; Any area draining to the Outlet Channel)

Tributary Acre: Total land area tributary to a pond, wetland, ditch, stream, reach, or other point of interest on site in the existing condition, prior to any drainage alterations or landlocked basin connections.

Volume Abstraction: Policy of encouraging infiltration, evaporation and transpiration to mitigate the volume increasing effects of urbanization.

Volume Management: Policy of limiting volume and rate entering lakes by impounding water for extended durations in the upper reaches of the Tributary in stormwater ponds and wetlands to mitigate the increased water volume effects of urbanization on the watershed.

Volume Storage: Volume set aside for stormwater below a natural or created outfall that during hydrologic variation mitigates effects of increased stormwater volume.

SECTION TWO:
FORMAT AND STANDARDS

Construction Drawings
Show the OE, HWL for ponds and OHW for water bodies on the plans.

Show garage floor, low floor, and rear pad elevations and housing style for each unit on the grading plan. Include a schematic describing each housing style typical grading.

Show limits of clearing and limits of grading on grading plan and tree preservation plan. Show removal of all trees and brush below the controlled water level that will be impacted from existing and newly created ponding areas.

Show emergency overflow routes using arrows from all low points and show elevation of high point along emergency overflow route. All emergency overflow routes shall be graded and the easement area sodded prior to Building Permit issuance.

Show or define access routes for maintenance purposes to all inlets or outlets at ponding areas (must be maximum of 8% grade, 2% cross slope and 10' wide). Paving or pavers on the access routes is required with a design load to able support maintenance vehicles.

Stormwater Management Report
Calculations shall be submitted showing proposed design elements that meet requirements spelled out in this Appendix. A narrative describing the proposed system shall accompany this collection of calculations. The stormwater narrative shall be a brief and clear description of the stormwater system that summarizes and reference figures, tables and plan sheets. The following are the minimum summary/narrative elements:

SECTION THREE:
GRADING, EROSION AND SEDIMENT CONTROL

Site Erosion and Sediment Control described here augments the Stormwater Pollution Prevention Plan (SWPPP) as required by the MPCA NPDES Construction Site Permit. Even when not party to a NPDES Construction Permit the City of Prior Lake remains involved and serves as a monitor to confirm that the NPDES Construction Site Permit is being followed.

Grading Standards
Maximum 4:1 slopes are allowed in "maintained" areas except approved by the City Engineer. Maximum 3:1 slopes are allowed for road fill sections adjacent to water bodies or natural resource preservation areas.

Minimum grade for drainage swales and lot grading shall be 2% or greater. Maximum length for drainage swales shall be 300 feet or a total of eight lots draining to a point, or as approved by the City Engineer. Backyard drainage structures should be avoided. Drainage swales shall be graded and stabilized (drainage blanket, seed and mulch, or sod) prior to the issuance of Building Permits.

A minimum of 15 feet beyond the house pad shall have a slope less than 10:1.

Show or define paved access routes for maintenance purposes to all manholes outside the public right-of-way and inlets or outlets at ponding areas (8% maximum grade, 2% cross slope, and 10' wide). Access easements shall be dedicated at the time of final platting to provide this access.

Verify locations and design of all overland drainage routes for capacity and erosion potential. All low points in streets must have E.O.F's designed for the 100 year storm event.

Erosion and Sediment Control / SWPPP Standards.
All development that disturbs greater than 1 ac (or 10,000 sf in a shoreland) area must apply for and comply with the requirements of a constructions site NPDES Permit. The SWPPP must be reviewed and approved by the City before an Excavating and Grading Permit is issued.

All provisions of a NPDES Constructions Site Permit & SWPPP must be adhered to for the duration of the permit.

Provide name of company, contact person, and phone number for person responsible for erosion and sediment control plan preparation, implementation and maintenance.

Provide note on the plans specifying that all erosion control best management practices shall be installed by the Contractor and inspected by the City prior to any site work.

Slopes greater than or equal to 4:1 shall have erosion control blanket installed immediately after finished grading.

Area coming out of agricultural production must be seeded with a cover crop prior to development.

SECTION FOUR:
SITE HYDROLOGY, STORMWATER AND VOLUME MANAGEMENT

General Standards
A hydrologic method, based on sound hydrologic theory must be used to analyze runoff for the design of stormwater conveyance systems and permanent stormwater facilities. Curve numbers shall follow recommendations of SCS Technical Release 55, Second Edition (TR-55, 1986).

Rate and volume control will be required for all development, redevelopment or change in use that creates more than 3,500 SF of new impervious area and disturbs more than 10,000 SF of land.

Rate Control
2, 10 and 100 year (24hour NRCS Type II) events shall be modeled. Events for Prior Lake are 2.8", 4.2" and 6.0" for the 2, 10 and 100 year storms respectively. (See Section 1, Definitions for italicized terms)

Rate Control Standard:
Rate control shall hold total offsite peak runoff at or below the following schedule:
2 year: 0.05 cfs per *net acre*
10 year: 0.30 cfs per *net acre*

100 year: Existing peak flow

Stormwater Management Overlay District #1 – Prior Lake Outlet Channel: (Figure 1)
Rate control for areas tributary to the Prior Lake outlet channel shall hold total offsite peak runoff at or below the following schedule:

2 year: 0.25 cfs per *net acre*
10 year: 0.25 cfs per *net acre*
100 year: 0.25 cfs per *net acre*

Alternate Rate Control Standard for Wetlands Utilized for Volume Management:
A portion of the 10 and 100 year events from a development may utilize wetlands for stormwater rate control. The wetland must be eligible based on the requirements of Section 6. The following schedule shall apply to the rate control a wetland provides.

The Alternate Standard for Wetlands shall hold discharge out of a utilized wetland at or below the following rate schedule:

2 year: 0.05 cfs per *tributary acre*
10 year: 0.15 cfs per *tributary acre* *
100 year: Existing peak flow *

* May be overridden by a stormwater management overlay district.
* In the case that the wetland cannot provide the volume for active storage in the 10 and 100 year storms, the upstream stormwater system must be sized such that the system meets this requirement.

Any proposed improvements utilizing wetlands for portions of the 10 or 100 year event storage must consider the build out condition of the watershed draining to that wetland. Developments will be allowed to utilize a wetland proportional to their share of the tributary area. Rate control must be constructed to serve the build-out condition of the entire subwatershed based on current zoning.

Information on the utilization of wetlands for *volume storage* can be found in Section 6 of this appendix. Wetlands may not be eligible for utilization if land ownership or easements for stormwater uses cannot be obtained.

Additional requirements for rate control may be set by the Engineering Division. The utilization of wetlands for active storage or volume storage may only be done with the approval of the Engineering Division.

Volume Control
Volume Control Standard:
In an effort to mitigate the effects of increased volume discharged from urbanization, site runoff volume shall be reduced in the proposed condition by a volume equal to or greater than 0.5 inch over all new impervious surfaces, unless that standard is modified by a Stormwater Management Overlay District.

Methods for Volume Control:

CN Reduction Credit:
All sites shall consider the use of curve number (CN) reductions as a portion of the volume control requirement. These methods include tree plantings, native grass buffers, porous pavements, impervious disconnections, green roofs, constructed wetlands, and soil amendments.

Credit for each method is given on an **area basis** at the following depth: An example of the credit reduction can be found in Section 9.

- tree plantings 0.05 inch
- native grass buffers 0.05 inch
- natural area preservation 0.05 inch
- soil amendments 0.05 inch
- impervious disconnection 0.10 inch
- porous pavements 0.50 inch + not counted in impervious calculation
- green roofs 1.00 inch + not counted in impervious calculation

Each CN reduction has additional requirements described in Section 9. Additional CN reduction techniques may be proposed, credits will be at the discretion of the Engineer.

Greywater/Stormwater Recycling:
For many applications, use of pond water for irrigation can be a very cost effective method of volume control (reduces monthly water bills and construction cost for infiltration areas). Since these systems do not directly function on a storm by storm basis an applicant is asked to work with the Engineer to determine the required volume standard.

Infiltration:
If infiltration is used the following is required:

1. Requirements and recommendations laid out in the Minnesota Stormwater Manual shall be followed.
2. Infiltration tests shall be used to provide a base infiltration rate of surrounding soils. The base rate shall be reduced to a conservative rate for the design. The Infiltration tests shall be conducted at the location and elevation of the proposed infiltration system.

Bioretention:
If Bioretention is used the following is required:

1. Requirements and recommendations laid out in the Minnesota Stormwater Manual shall be followed.
2. Infiltration tests shall be used to provide a base infiltration rate of surrounding soils. The base rate shall be reduced to a conservative rate for the design.

Stormwater Wetlands/ Constructed Wetlands:
Constructed wetlands may be utilized to abstract volume. Since these systems do not directly function on a storm by storm basis an applicant is asked to work with the Engineer to determine the required volume standard.

1. Requirements and recommendations laid out in the Minnesota Stormwater Manual shall be followed.

Offsite Volume Control:

Any of the above credits can be used at an offsite location to meet the volume control requirement with the approval of the City Engineer. The offsite location must be within the same watershed. Off site volume control should be permanently protected through an easement, development agreement and/or maintenance agreement, to help ensure the volume reduction feature continues to function as designed.

Stormwater Management Overlay District #2 – All Landlocked Basins
If a development is tributary to a landlocked basin, the following restricted volume control is required for that tributary portion:

- Volume shall be reduced in the proposed condition by a volume equal to or greater than 1.0 inches over all new impervious surfaces.

- Extended duration detention is required such that volume discharging offsite in the proposed condition not exceed the volume discharging offsite in the existing conditions in the 24 hour period following the peak of the 100-year 24 hour NRCS Type II storm.

Additional Volume Control required under this rule is not waived if an outlet or emergency overflow is provided.

Limitations on Volume Control Method:
The method or location of Volume Control used may be limited by the following:

Groundwater table within 3' of soil infiltration feature:

- Infiltration features should be sited with the aid of soil boring information and infiltration tests on soils representative of those in the vicinity of the proposed basin.

Wellhead protection area:

- Soil infiltration features must comply with requirements and limitations of wellhead protections plans.

Impervious Soils:

- Surface infiltration features must have appropriate soils. In the case of type D/clay soils Surface infiltration is not allowed.

Low Floor / Low Opening Elevations
Low Floor Elevations and Low Opening Elevations are to be designed to the following standards:

Low floor elevations shall be at least:

- 3' Above OHW or Highest Known (whichever is greater)
- 2' Above HWL

Low opening elevations shall be at least:

- 2' Above E.O.F

In the case of a landlocked basin, low floor elevations shall be at least:

- 3' above the basin overflow elevation or 3' above the back to back 100 year flood.

Additional Requirements
In the development of any subdivision or ponding area, the developer and/or property owner is responsible for the removal of all significant vegetation (trees, stumps, brush, debris, etc.) from any

and all areas which would be inundated by the designated controlled outlet elevation (OE) of any required ponding areas as well as the removal of all dead trees, vegetation, etc., to the high water level (HWL) of the pond.

Upon the completion of the construction of a designated ponding area, developer is required to submit an as-built record plan of the ponding area certifying that the pond constructed meets all design parameters. The Developer can over-excavate the bottom of the water quality ponds to compensate for erosion that will occur. The Developer will be responsible for verifying, at the end of the Warranty Period, that the ponds are providing the required volume.

Water Quality
The water quality treatment standard is 60% reduction in Phosphorus and 90% reduction in Total Suspended Solids. Section 7 details standard wet pool detention pond design criteria.

Alternatives to water quality ponds can be proposed but must meet water quality treatment standards. If alternatives are proposed, documentation must be submitted by the applicant based on literature values or independent laboratory work to demonstrate the performance of the alternative being proposed.

SECTION FIVE:
DRAINAGE ALTERATIONS AND FLOODPLAIN MANAGMENT

Landlocked Basins
If a landlocked basin (tributary area < 25 acres) is proposed to be connected to a downstream system the following is required:

- If the landlocked basin contains a wetland, the rate of outflow from that wetland must follow provisions for the "Alternate Rate Control Standard for Wetlands utilized for Volume Management" detailed in Section 4.
- If the landlocked basin contains a wetland, Stormwater Utilization must occur to the maximum extent allowable under provisions for wetlands detailed in Section 6.
- If the landlocked basin does not contain a wetland, or the wetland is legally proposed to be filled under the Wetland Conservation act, the volume storage lost to connection must be mitigated by increasing volume storage of a pond or wetland equal to the lost volume of the landlocked basin utilized in the 100 year storm event.
- All Provisions described in Section 5, Drainage Alterations must be followed.

If a landlocked basin (tributary area > 25 acres) is proposed to be connected to a downstream system the following is required.

- All requirements listed above apply.
- The PLSLWD or Scott WMO must review the proposed connection. All conditions of Scott WMO or PLSLWD approval must be met.

Drainage Alterations
If the applicant proposes to artificially drain, connect a landlocked basin, obstruct, or redirect the natural flow of runoff the following is required:

Drainage alteration (tributary area < 5 acres) requirements:
Demonstrate:
- That overall change in flow volumes to each subwatershed do not burden downstream infrastructure.

Requirements:
- Considered a minor alteration provided applicant demonstrates that downstream burdens do not exist.
- If there is evidence to suggest there is or will be a flooding problem immediately downstream of the proposed alteration, the requirements for drainage alteration of between 5 and 25 acres shall apply.

Drainage alteration (tributary area > 5 and < 25 acres):
- All requirements listed above apply.

Demonstrate:
- There is a necessity for such a change.
- Reasonable care has been taken to avoid impact to upstream or downstream land.
- Efforts have been taken to mitigate changes in downstream volume and rates.

Requirements:
- City approval of drainage alterations is required.
- Peak rate to the gaining subwatershed of the drainage alteration must be held to rate control standard per tributary acre included in the development.

Drainage alteration (tributary area > 25 acres) requirements:
- All requirements listed above apply.
- The PLSLWD or Scott WMO must approve the proposed alteration. All conditions of Scott WMO or PLSLWD approval must be met.

Floodplain Alterations
If grading takes place within the floodplain (below the predicted 100-year flood elevation for a public water) no net decrease in flood storage is allowed.

SECTION SIX: WETLANDS

Procedure
For developments near wetlands, the following procedure is dependent on which Watershed the wetland falls. Some requirements, common to both WMO and WD are listed under “both.” To determine which watershed a project is in, refer to Figure 2.

Stormwater susceptibility is determined from the results of a MnRAM to determine if a wetland is eligible for stormwater utilization.

Both:
The applicant must submit a wetland delineation and a MnRAM 3.0 wetland assessment; these documents are then reviewed by the City.

If impacts are proposed to any wetland, the procedure follows the requirements of the Wetland Conservation Act and these rules.

A wetland is given a functional classification dependent on the value for vegetative diversity determine by the MnRAM 3.0. Rankings are: Exceptional, High, Medium, and Low.

Requirements

PLSLWD:

Wetland replacement for impacts occurring within the PLSLWD must take place within the District at a rate of 0.5:1 (New Wetland Credit per acre impacted.)

Both:

The City must review and approve of the wetland delineation and Minnesota Routine Assessment Version 3.0, (MnRAM) (as amended).

Any drainage, fill, excavation or other alteration of a public waters or wetlands is regulated by the Wetland Conservation Act (WCA), State Statutes 103G.245 and regulations adopted hereunder. The City is the Local Governing Unit (LGU) under these rules.

A conservation easement is required over all buffers.

Stormwater Susceptibility.

Both:

Highly Susceptible: A wetland is considered highly susceptible if:

- Forty percent or more of the wetland complex has highly susceptible wetland communities as shown in Table 6.1 and;
- Highly susceptible wetland communities have medium to exceptional floral diversity/integrity.

Moderately Susceptible: A wetland is considered moderately susceptible if:

- Forty percent or more of the wetland complex has a moderately susceptible wetland communities shown in Table 6.1 and;
- Moderately susceptible wetland communities have medium to exceptional floral diversity/integrity.

Least Susceptible: Wetlands with low floral diversity, as determined by MnRAM, were considered to be least susceptible wetlands.

Slightly Susceptible: Wetlands that do no fall under the high, moderate or least susceptible categories are considered slightly susceptible.

Table 6.1
Wetland Community Susceptibility to Stormwater Impacts

Highly Susceptible Wetland Communities*		**Moderately Susceptible Wetland Communities***
Sedge Meadow	Low Prairies	Shrub-Carrs
Bogs	Coniferous Swamps	Alder Thickets

Coniferous Bogs	Hardwood Swamps	Fresh (wet) Meadows
Open Bogs	Seasonally Flooded Basins	Shallow Marsh
Calcareous Fens		Deep Marsh

- Wetland communities determined using key provided in MnRAM Version 3.0.

Stormwater Utilization:

Table 6.2

Stormwater Utilization

Hydroperiod Standard	**Highly Susceptible**	**Moderately Susceptible**	**Slightly Susceptible**	**Least Susceptible**
100-year Storm Bounce	Existing	Existing + 0.5 ft	Existing + 1.0 ft	No Limit
Discharge Rate	Existing	Section 4: Wetland Standard (1)	Section 4: Wetland Standard (1)	Section 4: Wetland Standard (1)
1 & 2 year NRCS event Inundation	Existing	Existing + 1 Day	Existing + 2 Days	Existing + 7 Days
10 yr NRCS event Inundation	Existing	Existing + 7 Days	Existing + 14 Days	Existing + 21 Days
(2) Outlet Control Elevation	None: Note OE/HWL on Map	None: Note OE/HWL on Map	0 – 2 ft additional storage	0 – 4 ft additional storage

(1) Rates shall be held to the rate control spelled out in section 4, alternate rate control standard for wetlands, unless obtaining these rates is prevented by inundation period requirement.

(2) Outlet Control Elevation changes can be made to mitigate *volume storage* as required in Section 5.

Buffer & No-Grade Zone Requirements

PLSLWD:

The following are the buffer and minimum no-grade zone requirements for each functional classification. The tiered buffer requirement is based on a functional classification of; exceptional, high, medium or low, and can be found using the results of the MnRAM vegetation assessment as described above

Table 6.3

PLSLWD Buffer, Setback and No-Grade Matrix

Buffer Requirement	**Exceptional**	**High**	**Medium**	**Low**
Average Buffer Width (ft)	30	30	30	30
Minimum Buffer Width (ft)	20	20	20	20
Minimum No-Grade Zone (ft)	10	10	10	10

Foundation setback from *Buffer*	20	20	20	20

Scott WMO:
The following are the buffer and minimum no-grade zone requirements for each functional classification. The tiered buffer requirement is based on a functional classification of; exceptional, high, medium or low, and can be found using the results of the MnRAM vegetation assessment as described above.
Table 6.4
Scott WMO Buffer, Setback and No-Grade Matrix

Buffer Requirement	**Exceptional**	**High**	**Medium**	**Low**
Average Buffer Width (ft)	65	50	30	25
Minimum Buffer Width (ft)	25	25	25	25
Minimum No-Grade Zone (ft)	25	25	25	25
Foundation setback from *wetland*	35	35	35	35

Both:
Grade changes or other disturbances are not allowed in No-Grade Zones with the following exceptions: Pipe Outlets and associated riprap, reseeding or soil amendments, embankment and impacts associated with an approved CIP transportation corridor, grade changes adjacent to approved WCA impacts to wetlands, approved wetland or flood storage mitigation areas and temporary impacts associated with utility installation.

A buffer width may vary using "Buffer Averaging." Buffer width may be reduced to the minimum buffer width, but the overall buffer area must be equal in area to a hypothetical fixed width average buffer around the same wetland. This means that while one side of a buffer is reduced in width, the buffer must be increased in width in another area to make up for the loss of area.

Buffer Vegetation Requirements:
Both:
Buffer must be seeded with a native mix with forbs. A two year maintenance period is required as part of the developers agreement. If at the end of the two year maintenance period the seed has not established, there is a prevalence of invasive species, or there are other encroachments, over-seeding or reseeding may be required.

Land use within a buffer shall be subject to the following restrictions: Buffer vegetation shall not be cropped, cultivated, hayed, mowed, fertilized, or subject to the placement of mulch or yard waste or otherwise disturbed, except for the periodic cutting or burning that promotes the vegetative health of the buffer or as needed to address invasive or noxious species. Buffers may be temporarily

disturbed when permitted by the City Engineer. No new structure or hard cover may be placed within a buffer area. No fill, debris, or other material may be excavated from or placed in a buffer area.

Buffer strips shall be required whether or not the wetland is on the same parcel as the proposed development or on an adjacent parcel. Wetlands on adjacent parcels need not be delineated, but an estimation using aerial photos or other methods will be required.

If acceptable vegetation is in place, reseeding is not required. Acceptable natural vegetation has the following characteristics: A continuous dense layer of perennial grass uncultivated or unbroken for 5 years or has an overstory of trees of shrubs uncultivated or unbroken for 5 years.

Buffer Monuments and Easement:

Both:

Buffer strips shall be identified within each parcel by permanent monumentation. A monument shall be required at each parcel line where it crosses a buffer strip and shall have a maximum spacing of 200 feet along the edge of the buffer strip. An additional monument shall be placed at the midpoint of each lot and/or as necessary to accurately define the edge of the buffer strip. (considering curvature) A monument shall consist of a post and a buffer strip sign. The signs shall be 4.5" x 6.5" inch vertical, have brown field with white lettering, and shall be securely mounted on a post to a minimum height of 4 feet above grade. The signs shall include warnings about disturbing or developing the buffer strip. The signs shall be installed prior to the issuance of a Building Permit and should be shown on the approved plans. Buffer strip signs can be purchased at the Engineering Division at a cost shown on the latest fee schedule.

All buffer strips must be covered by drainage and utility easement and conservation easements.

Drainage and utility easement shall be granted to the City of Prior Lake. Conservation easements shall be dedicated to the PLSLWD in District areas or to the City in WMO areas.

SECTION SEVEN:
POND DESIGN CRITERIA

Water Quality Volume

The permanent pool volume for water quality ponds shall be calculated using the Design Calculations for Wet Detention Ponds by Dr. William W. Walker (1987) presented below.

A_W = Total Watershed area (acres)

A_I = Area of impervious surfaces draining to stormwater conveyors (acres)

F_i = Impervious Fraction $= \frac{A_i}{A_w}$

CN = area weighted mean NRCS curve number for pervious portion of watershed (Based on soil type and land cover)

P= Design storm size =2.5 (inches)

$S = \left(\frac{1000}{CN}\right) - 10 =$ Maximum soil retention (inches)

$R = P \times F_i + \frac{(P - 0.2 \times S)^2}{P + 0.8 \times S} \times (1 - F_i) =$ Runoff for design storm (inches)

$V = \frac{R \times A_w}{12} =$ Volume of permanent pool (acre-feet)

Rate Control Volume

The active volume (between the OE and the HWL) shall be sized to meet the rate control requirements outlined in Section 4, Rate Control, using a maximum slope at 4:1 (H:V).

Additional Design Criteria

The use of regional ponding, stormwater wetlands or expandable ponding is encouraged by the City.

A 10' wide aquatic vegetation bench is required below the OE of the pond, with the maximum slope of 10:1.

The invert elevations of pond inlet flared end sections shall match the OE of the pond. Submerged outlets will only be allowed at the discretion of the City Engineer.

Outlet control structures from ponding areas are required as directed by the City. Location and appearance of outlet structures shall be subject to City approval and may require landscape screening.

The E.O.F of a pond should be at least 1 foot higher than the HWL. The top of dike elevation should be at least 2 feet higher than the HWL.

Dikes used to create rate control ponds must at maximum use 4:1 slopes and measure 10' wide at top. At minimum, a clay core should be designed in consideration of groundwater flow. If head difference between OE of pond and downstream land exceeds 3', soils data will be required in the area and dike design must address maintenance of pond water level and dike stability. Outlet pipes through engineered dikes with head differences greater than 6' should be designed with anti-seep collars. Sand bedding shall not be used through dike section.

Pond outlets shall provide floatable debris skimming for the 10 year event. A manhole with a baffle wall with orifice or notch is recommended to control rate. Outlet rate control manholes shall have a top mitered to conform to fill. A 66" minimum diameter is required to provide access to both sides of the weir wall.

SECTION EIGHT:
STORM SEWER DESIGN CRITERIA

Storm water facilities shall use design criteria utilizing a rational or hydrograph method based on sound hydrologic theory to analyze the storm water runoff and proposed development. (Such as the Soil Conservation Service TR-55 Urban Hydrology for Small Watersheds)

Storm water facilities shall be designed for a 10-year frequency storm for local pipe design and a 100-year frequency storm for ponding detention basin design and trunk facilities. Pipe size and grade shall be greater than 15" ID and 0.5% slope. Pipe class shall conform to design standards as shown in "EXHIBIT M".

Drainage calculations shall be submitted to show the sizing of pipe, ponds, emergency overflow spillways, and catch basin interception analysis. Assuming catchbasins can receive a maximum of 3 cfs, multiple catch basins may be required at low points.

Provide for overflow routes to drain all street and backyard low points.

SECTION NINE: MISCELLANEOUS AND CN REDUCTIONS

Chapter 4 detailed a credit system used for volume management; the following is additional information on that credit system.

Example calculation for CN Reduction: The following is an example of volume control met entirely through the use of CN reductions, this will not be suitable for most sites but serves as an example on how to use a variety of methods to meet the requirement.
50 acre site with 20% impervious surfaces, = 10 acres new impervious (actual calculation required)
10 acres impervious x 0.5in volume control requirement = 5ac-in or 18150cf volume.

(see next page for sample calculation)

Reductions Claimed:

CN Reduction Claimed	Area (acres)	Area basis depth (in)	Credit (ac-in)
5 acres native grass buffers	5	0.05	0.25
1 acre of proposed pervious pavers	1	0.50	0.50
Same paver area no longer counted in impervious calculation	1	0.50	0.50
5 acres tree plantings (436 trees)	5	0.05	0.25
30 acres of soil amendments	30	0.05	1.50
5 acres of impervious disconnections	5	0.10	0.50
1 acre green roof	1	1.00	1.00
Same green roof no longer counted in impervious calculation	1	0.50	0.50
Total Claimed:			5.00 ac-in

Additional Requirements for CN Reduction

Tree plantings:

Area determinations for tree plantings shall be assumed at 500sf per tree. *(Based on an conservative average water use of 1cf per day per tree at 7 years in an open canopy condition, less average tree mortality, 3days water use per storm 0.7*(1/(.05/12))*3 the beneficial effects of canopy intercept are ignored).* This reduction can be used in combination with the native grass buffer (ex. Oak prairie restoration could count as tree planting, native grass and soil amendment reduction).

Native grass buffers:
Area determination shall only include buffers currently, or proposed to be, established in a native species. Area must be included in a permanent conservation easement dedicated to the City of Watershed District.

Natural area preservation:
Upland wooded or prairie areas proposed include only those areas not already prohibited from development (buffers, bluffs, etc) and must be kept in their natural state through outlet dedication and/or conservation easements. No grading is allowed in preservation areas. Preservation area must be denoted through the use of decorative fencing, informational signing, or other methods.

Soil amendments:
Area determinations for soil amendments shall include only those areas from the back of building pads to the grading limits in the rear. For areas in front and side, or under temporary constriction access to be counted, soil amendments must take place after building constructions is compete, due to the compactive nature of home construction.

Soil amendment shall be designed to mitigate the effects of compaction due to mass grading by returning the soil to a loose, friable state able to transmit water.

All soil amendments must be designed by a registered engineer or professional soil scientist. Soil design must promote deep loosening of the mass-graded soils strata, and improvement of infiltration and moisture retention characteristics of the topsoil. (Example: 18” deep ripping or tilling of base soils and compost mix after mass grading, followed by the application of a designed mix of compost, peat, sand, and topsoil and spread at 6” depth).

Impervious disconnection:
Area determination for impervious disconnections will be that roof area or select pavement area that is disconnected from the drainage system and allowed to flow over natural grounds that are designed to promote infiltration and transpiration. Design shall not cause nuisance, wet lawn conditions or basement seepage. Design must discourage reconnection to impervious surfaces by providing a minimum of a 75’ pervious flow path.

Porous pavements:
Area determination for porous pavements will be only that area meeting the following requirements:
Porous pavement systems must use permeable base material and promote infiltration. Porous pavements must be designed by a professional engineer and approved by the City Engineer.

Green roofs:

Area determination for green roofs will be only that area meeting the following requirements: Design must be must be designed by a professional architect and meet Building Code. The design must be approved by the City Engineer

(More information on these and other CN reductions and site design measures can be found in Chapters 4 and 11 or the MPCA stormwater manual).