Report

Erosion Control and Stormwater Management Requirements

Town of

Cedarburg, WI

July 2008

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TABLE OF CONTENTS

SECTION 1
TECHNICAL STANDARDS

1.01 TECHNICAL STANDARDS AND REFERENCES

A. Erosion Control and Stormwater Management Technical Standards

All drainage facilities and practices required to comply with the Erosion Control and Stormwater Management Ordinances shall incorporate technical standards and design methods specified in this document, maintained and periodically updated by the Director of Municipal Operations. Where not superceded by stricter requirements in this document, the following standards are also incorporated by reference:

1. Other design guidance and technical standards identified or developed by the DNR under subchapter V of chapter NR 151, Wisconsin Administrative Code.

2. DNR is required by recent rule revisions to develop technical standards to provide guidance for measurement and evaluation of this performance standard. Measurement and evaluation of this performance standard shall be based on guidance published by the DNR. Until such guidance is published, total suspended solids removal shall be achieved to the maximum extent practical through implementation of approved Best Management Practices (BMPs).

1.02 PRECIPITATION DEPTH, DISTRIBUTION, AND AVERAGES

A. Precipitation Depths

Precipitation depths specified in the document *Rainfall Frequency in the Southeastern Wisconsin Region, SEWRPC Technical Report No. 40, April 2000* shall be used as a source for design rainfall depths:

Note that the SEWRPC 90th percentile temporal distribution is recommended to be applied With the SEWRPC 2000 rainfall depths for design and planning purposes.

B. Precipitation Distribution

1. Rainfall depths referenced above may be used in conjunction with either the SCS Type II rainfall distribution for a 24-hour storm duration or the SEWRPC 90th Percentile temporal distribution.

2. Where SEWRPC 90^{th} Percentile distribution is used, the storm duration producing the highest peak discharge shall be calculated and used for design.

C. Average Annual Rainfall

For applications requiring use of average annual rainfall, recorded City of Milwaukee depths for March 28 through December 6, 1969, shall be used.

1.03 DESIGN METHODS

A. Stormwater Runoff Calculations

1. For design of volume-dependent practices (detention basins, retention basins, infiltration systems), a hydrograph-producing method hydrologic model shall be developed. The following computer programs shall be allowed:

   a. TR-55
   b. TR-20
   c. HEC-1
   d. HEC-HMS
   e. Other computer programs as allowed by the Director of Public Works

2. The Rational Method may be used to calculate peak discharges for tributary areas less than 20 acres for purposes of conveyance system design.

3. Estimation of Required Storage Volume

   a. Final detention basin sizing shall be based on hydrograph routing through the basin with the proposed outlet structure.

   b. The Soil Conservation Service TR-55 Approximate Method may be utilized to calculate the required storage volume. This may be used for developments with watershed areas of less than 25 acres which do not involve significant off-site drainage that must be passed through the detention basin or routing of stormwater runoff through a series of detention basins. Soil Conservation Service Type II rainfall shall be utilized to estimate storage volume and peak inflow requirements.

4. Stormwater Conveyance System Design

   a. Storm sewers shall be designed in accordance with procedures described in Procedures 13-25-35 through 13-25-45 of the Wisconsin Department of Transportation (WisDOT) Facilities Design Manual (FDM).

   b. Ditches shall be designed in accordance with procedures described in Procedures 13-30-5 through 13-30-10 of the WisDOT FDM.

   c. Cross culverts shall be designed in accordance with procedures described in Procedure 13-15-10 of the WisDOT FDM.

1.04 DESIGN CRITERIA

A. Wet Detention Basins

Design in accordance with the Wet Detention Basin Conservation Practice Standard (DNR), Section V.A.1, 2, 4-11 (Appendix C).

B. Dry Detention Basins

1. Minimum grades for the bottom of the basin shall be 2 percent unless underdrain is installed. If underdrains are installed, the minimum grade shall be 0.5 percent.

2. Basin side slopes shall not be steeper than 4:1 or flatter than 10:1.

3. Dry detention basins shall be designed to drain completely within 24 hours after the storm event.

4. Forebays shall be used to the maximum extent practical to prevent concentrated flow from entering the basin and allow sediment to settle prior to entering the basin.

    a. Forebay area should be 10 to 25 percent of the basin's surface area.
    b. Length-to-width ratio shall be at least 2:1.
    c. The forebay shall be located opposite of the basin's outlet to increase detention time.

5. The basin shall be designed with an emergency spillway designed to convey the 100-year peak discharge entering the basin.

6. The basin shall have a ponding depth of less than 10 feet, with at least 1 foot of freeboard above the 100-year flood elevation or emergency spillway elevation, whichever is higher.

7. The basin shape should be designed with a length-to-width ratio of 3:1 in either a long narrow shape or a teardrop shape, to the maximum extent practical.

8. The basin shall be seeded with vegetation that is tolerant of inundation.

9. The basin outlet structure shall discharge to a stable outlet.

C. Storm Sewers

1. Unless otherwise approved by the Director of Public Works, all storm sewer in the public right-of-way (R/W) shall be constructed of reinforced concrete pipe of appropriate class for the expected loading. Storm sewer materials outside of the R/W shall be subject to approval of the Director of Public Works.

2. The minimum allowable pipe diameter shall be 12 inches.

3. Sewer grades shall be designed so that, in general, a minimum of 3-foot cover is maintained over the top of the pipe. The developer shall consider elliptical pipe to increase the amount of available cover beneath roadways and driveways. Pipe cover less than the minimum may be used upon site-specific approval by the Director of Public Works. Uniform slopes shall be maintained between inlets, manholes, and inlet to manhole. Minimum and maximum allowable slopes shall be those capable of producing velocities between 2 and 12 feet per second, respectively, when the sewer is flowing full. Velocities lower than the minimum or higher than the maximum may be used upon site-specific approval by the Director of Public Works.

4. The maximum distance for overland flow of stormwater runoff to an underground storm sewer system shall be 600 feet unless a longer distance is approved by the Director of Public Works.

5. All inlets and catch basins shall be constructed with a 24-inch sump. In bedrock situations, a 12-inch sump would be acceptable. If the drainage area is served by a wet detention pond, then sumps are not necessary.

D. Ditches

1. Ditch side slopes shall be no steeper than 4:1.

2. The minimum ditch grade is 1 percent. Ditch grades of less than 1 percent may be allowed but may require ditch underdrains.

3. Ditches and open channels shall be protected with erosion mat as necessary to prevent erosion. The erosion mat shall be of an approved type and application specified in the "Erosion Control Product Acceptability List," most current revision, by the WisDOT.

E. Culverts

1. Culverts and similar structures shall have a capacity that meets or exceeds the capacity of the surface drainageway and shall be a minimum of 18 inches in diameter for culverts under roadways and 15 inches for culverts under private entrances. The flowline of a culvert shall match the flowline of the surface drainage way. Submitted plans shall indicate the sizes for all culverts including the opening size of culverts for private entrances.

2. No plastic culvert piping is allowed, unless approved by the Director of Public Works.

3. A minimum of 2 feet of cover (measured as top of pipe to top of pavement surface) shall be maintained over culverts under private entrances. A minimum of 1.7 feet of cover (measured as top of pipe to top of pavement surface at centerline of roadway) shall be maintained over culverts under roadways. If these cover standards cannot be met,

backfill around and over the culverts shall be slurry backfill or ready-mix concrete according to the Town's specifications. The developer shall consider pipe arches and elliptical pipe to increase the amount of available cover beneath roadways and driveways. The developer shall consider ductile iron pipe for structural integrity, if necessary.

4. Culvert backfill shall be compacted granular fill material. Culverts shall be properly bedded.

5. Culverts shall not create backwater that adversely impacts upstream properties. Design of new culverts shall consider impacts of future upstream development.

6. End sections shall be provided for all culverts. Grates/trash racks shall be required on end sections for all culverts greater than 18 inches in diameter on both ends of the pipe.

7. A culvert permit must be obtained for all culverts prior to installation. The culvert permit application is available on the Town's website. For temporary culverts, please contact the Director of Public Works for more information. The Town installs and removes temporary culverts at owner's expense.

F. Infiltration Practices

The need for, applicability of and design of infiltration practices shall be in conformance with Technical Standards and supporting guidelines published by the DNR. The Site evaluation for Stormwater Infiltration Conservation Practice Standard is included in Appendix D.

SECTION 2
PERFORMANCE STANDARDS

2.01 EROSION AND SEDIMENT CONTROL PERFORMANCE STANDARDS

A. Total Suspended Solids Removal Goals (Ref: NR 151.11 and 12)

1. The Erosion and Sediment Control Plan shall include best management practices (BMPs) that, by design, achieve to the maximum extent practicable, a reduction of 80 percent of the sediment load carried in runoff based on an average annual rainfall, as compared with no sediment or erosion controls until the construction site has undergone final stabilization. An 80 percent sediment reduction shall meet the requirement of this paragraph. Erosion and sediment control BMPs may be used alone or in combination to meet the requirements of this paragraph. Credit toward meeting the sediment reduction may be given for limiting the duration or area, or both, of land-disturbing construction activity.

2. If BMPs cannot be designed and implemented to reduce the sediment load by 80 percent, based on an average annual rainfall, the plan shall include a written and site-specific explanation as to why the 80 percent reduction goal is not attainable, and the sediment load shall be reduced to the maximum extent practicable.

3. DNR is required by recent rule revisions to develop technical standards to provide guidance for measurement and evaluation of this performance standard. Measurement and evaluation of this performance standard shall be based on guidance published by the DNR. Until such guidance is published, total suspended solids removal shall be achieved to the maximum extent practical through implementation of approved BMPs.

B. Required Best Management Practices

Where appropriate, the plan shall include sediment controls to do all of the following to the maximum extent practicable:

1. Each site shall provide an access drive and parking area of sufficient dimensions and design, surfaced with a material that will prevent erosion and minimize tracking or washing of soil onto public or private roadways. All nonpaved access drives shall be designed so that stormwater runoff from adjacent areas does not flow down the drive surface.

2. Any significant amount of runoff from upslope land area, rooftops, or other surfaces that drain across the proposed land disturbance shall be diverted around the disturbed area, if practical. Any diversion of upslope runoff shall be done in a manner that prevents erosion of the flow path and the outlet.

3. Any cuts and fills shall be planned and constructed to minimize the length and steepness of slope and stabilized in accordance with the approved erosion control plan timelines and standards of this document.

4. Open channels shall be stabilized as required to prevent erosion.

5. Inlets to storm drains, culverts, and other stormwater conveyance systems shall be protected from siltation until final site stabilization.

6. Water pumped from the site shall be treated by temporary sedimentation basins or other appropriate controls designed for the highest dewatering pumping rate. Water may not be discharged in a manner that causes erosion of the site or receiving channels.

7. All waste and unused building materials shall be properly disposed of and not allowed to be carried by runoff into a receiving channel or storm sewer system.

8. All off-site sediment deposits occurring as a result of a storm event shall be cleaned up by the end of the next workday. All other off-site sediment deposits occurring as a result of land-disturbing activities shall be cleaned up by the end of the workday. Flushing may not be used unless the sediment will be controlled by a filter fabric barrier, sediment trap, sediment basin, or equivalent.

9. All activities on the site shall be conducted in a logical sequence to minimize the area of bare soil exposed at one time. Existing vegetation shall be maintained as long as possible.

10. Soil stockpiles shall be located no closer than 25 feet from lakes, streams, wetlands, ditches, drainageways, or roadway drainage systems. Stockpiles shall be stabilized by mulching, vegetative cover, tarps, or other means if remaining 20 days or more.

11. For any disturbed area that remains inactive for greater than seven working days, or where grading work extends beyond annual permanent seeding deadlines, the Town of Cedarburg may require the site to be treated with temporary stabilization measures.

12. When the disturbed area has been stabilized by permanent vegetation or other means, temporary BMPs such as silt fences, straw bales, and sediment traps shall be removed and these areas stabilized.

C. Maintenance and Inspection

The landowner, or the landowner's representative, shall inspect erosion and sediment control practices weekly, and within 24 hours following a rainfall of 0.5 inches or greater. Written documentation of each inspection shall be maintained at the construction site and shall include the time, date and location of inspection, the phase of land disturbance at the construction site, person conducting the inspection, assessment of control practices, and a description of any erosion or sediment control measure installation or maintenance performed in response to the inspection. A copy of the inspection results shall be provided to the Town, upon request.

2.02 STORMWATER MANAGEMENT PERFORMANCE STANDARDS

A. Total Suspended Solids (Ref: NR 151.12)

1. BMPs shall be designed, installed, and maintained to control total suspended solids carried in runoff from the postconstruction site as follows:

   a. For new development, by design, reduce to the maximum extent practicable the total suspended solids load by 80 percent, based on the average annual rainfall, as compared to no runoff management controls. An 80 percent total suspended solids reduction shall meet the requirements of this subdivision.

   b. For redevelopment sites one acre or larger, by design, reduce to the maximum extent practicable the total suspended solids load by 40 percent, based on the average annual rainfall, as compared to no runoff management controls. A 40 percent total suspended solids reduction shall meet the requirements of this subdivision.

   c. Notwithstanding items a. and b., if the design cannot achieve the applicable total suspended solids reduction specified, the stormwater management plan shall include a written and site-specific explanation why that level of reduction is not attained, and the total suspended solids load shall be reduced to the maximum extent practicable.

   d. Measurement and evaluation of this standard shall be based on guidance published by the DNR. In the absence of such guidance, total suspended solids removal shall be achieved to the maximum extent practical through implementation of approved BMPs.

B. Peak Discharge

1. By design, BMPs shall be employed to maintain or reduce the peak runoff discharge rates, to the maximum extent practicable, as compared to predevelopment conditions for the 2- through 10-year design storm applicable to the development site.

2. Predevelopment conditions shall assume “good hydrologic conditions” for appropriate land covers as identified in TR-55 or an equivalent methodology. The meaning of “hydrologic soil group” and “runoff curve number” are as determined in TR-55. However, when predevelopment land cover is cropland, rather than using TR-55 values for cropland, the runoff curve numbers in Table 2.02-1 shall be used.

Hydrologic Soil Group	A	B	C	D
Runoff Curve Number	56	70	79	83

Table 2.02-1 Maximum Predevelopment Runoff Curve Numbers for Cropland Areas

C. Infiltration and Runoff Volume (Ref: NR 151.12(5)(c))

At locations where site conditions permit and where technically feasible, infiltration of stormwater to reduce the volume of runoff may be required. Where applicable, evaluation of the need for, appropriateness of, and required volume of infiltration shall be based on the most current DNR rules and technical standards. Infiltration shall not be permitted at locations specifically excluded in the DNR rules. BMPs shall be designed, installed, and maintained to infiltrate runoff to the maximum extent practicable in accordance with the following, except at locations where infiltration is excluded or exempted.

1. Residential Development

Infiltration shall be provided for residential development in accordance with one of the following criteria:

a. Infiltrate sufficient runoff volume so that the post-development infiltration volume shall be at least 90 percent of the predevelopment infiltration volume, based on an average annual rainfall. However, when designing appropriate infiltration systems to meet this requirement, no more than 1 percent of the project site is required as an effective infiltration area. Guidance for estimating the required infiltration volume is included in Appendix D.

b. Infiltrate 25 percent of the postdevelopment runoff from the 2-year, 24-hour design storm with a type II distribution. Separate curve numbers for pervious and impervious surfaces shall be used to calculate runoff volumes and not composite curve numbers as defined in TR-55. However, when designing appropriate infiltration systems to meet this requirement, no more than 1 percent of the project site is required as an effective infiltration area.

2. Nonresidential Development, including commercial, industrial and institutional development.

Infiltration shall be provided for nonresidential development in accordance with one of the following criteria:

a. Infiltrate sufficient runoff volume so that the postdevelopment infiltration volume shall be at least 60 percent of the predevelopment infiltration volume, based on an average annual rainfall. However, when designing appropriate infiltration systems to meet this requirement, no more than 2 percent of the project site is required as an effective infiltration area. Guidance for estimating the required infiltration volume is included in Appendix D.

b. Infiltrate 10 percent of the runoff from the 2-year, 24-hour design storm with an NRCS Type II Rainfall Distribution. Separate curve numbers for pervious and impervious surfaces shall be used to calculate runoff volumes, and not composite curve numbers as defined in TR-55. However, when designing

appropriate infiltration systems to meet this requirement, no more than 2 percent of the project site is required as an effective infiltration area.

3. Predevelopment conditions shall assume "good hydrologic conditions" for appropriate land covers as identified in TR-55 or an equivalent methodology. The meaning of "hydrologic soil group" and "runoff curve number" are as determined in TR-55. However, when predevelopment land cover is cropland, rather than using TR-55 values for cropland, the runoff curve numbers in Table 2.02-1 shall be used.

4. Pretreatment of stormwater runoff from parking lots and new roads in commercial, industrial and institutional areas that will enter an infiltration system is required. The pretreatment shall be designed to protect the infiltration system from clogging prior to scheduled maintenance and to protect groundwater quality in accordance with Section 2.02 (c) (8). Pretreatment options may include, but are not limited to, oil/grease separation, sedimentation, biofiltration, filtration, swales, or filter strips.

5. Exclusions

Stormwater runoff from the following areas is prohibited from meeting the requirements of this paragraph because of the potential for groundwater contamination:

a. Areas associated with tier 1 industrial facilities identified in s. NR 216.21(2)(a), Wis. Adm. Code, including storage, loading, rooftop and parking.

b. Storage and loading areas of tier 2 industrial facilities identified in s. NR 216.21(2)(b), Wis. Adm. Code.

Note: Runoff from tier 2 parking and rooftop areas may be infiltrated but may require pretreatment.

c. Fueling and vehicle maintenance areas.

d. Areas within 1,000 feet upgradient or within 100 feet downgradient of karst features.

e. Areas with less than 3 feet of separation distance from the bottom of the infiltration system to the elevation of seasonal high groundwater or the top of bedrock. This requirement does not prohibit infiltration of roof runoff.

f. Areas with runoff from industrial, commercial and institutional parking lots and roads and residential arterial roads with less than 5 feet of separation distance from the bottom of the infiltration system to the elevation of seasonal high groundwater or the top of bedrock.

g. Areas within 400 feet of a community water system well as specified in s. NR 811.16(4), Wis. Adm. Code, or within 100 feet of a private well as specified in s. NR 812.08(4), Wis. Adm. Code, for runoff infiltrated from commercial, industrial and institutional land uses or regional devices for residential development.

h. Areas where contaminants of concern, as defined in s. NR 720.03(2), Wis. Adm. Code are present in the soil through which infiltration will occur.

i. Any area where the soil does not exhibit one of the following soil characteristics between the bottom of the infiltration system and the seasonal high groundwater and top of bedrock: at least a 3-foot soil layer with 20 percent fines or greater; or at least a 5-foot soil layer with 10 percent fines or greater. This does not apply where the soil medium within the infiltration system provides an equivalent level of protection. This requirement does not prohibit infiltration of roof runoff.

6. Exemptions

The following are not required to meet the requirements of this paragraph:

a. Areas where the infiltration rate of the soil is less than 0.6 inches/hour measured at the site.

b. Parking areas and access roads less than 5,000 square feet for commercial and industrial development.

c. Redevelopment postconstruction sites.

d. In-fill development areas less than 5 acres.

e. Infiltration areas during periods when the soil on the site is frozen.

f. Roads in commercial, industrial and institutional land uses, and arterial residential roads.

7. Where alternate uses of runoff are employed, such as for toilet flushing, laundry or irrigation, such alternate use shall be given equal credit toward the infiltration volume required by this paragraph.

8. Infiltration systems shall, to the extent technically and economically feasible, minimize the level of pollutants infiltrating to groundwater and shall maintain compliance with the preventive action limit at a point of standards application in accordance with ch. NR 140, Wis. Adm. Code. However, if site specific information indicates that compliance with a preventive action limit is not achievable, the infiltration BMP may not be installed or shall be modified to prevent infiltration to the

maximum extent practicable. Notwithstanding, the discharge from BMPs shall remain below the enforcement standard at the point of standards application.

D. Oil and Grease

Fueling and vehicle maintenance areas shall have BMPs designed, installed, and maintained to reduce petroleum within runoff so that the runoff that leaves the site contains no visible petroleum sheen.

E. Protective Areas (Ref: NR 151.12 (5) (d))

1. A "Protective area" is an area of land that commences at the top of the channel of lakes, streams and rivers, or at the delineated boundary of wetlands, and that is the greatest of the widths specified in Table 2.02-2, as measured horizontally from the top of the channel or delineated wetland boundary to the closest impervious surface. A protective area does not include any area of land adjacent to any stream enclosed within a pipe or culvert, such that runoff cannot enter the enclosure at this location.

Type of Resource	Protective Area
Outstanding and Exceptional Resource Waters and Wetlands in Areas of Special Natural Resource Interest as Specified in s. NR 103.04. (3)	75 feet
Perennial/Intermittent Streams per USGS Map or County Soil Survey map, whichever is more current	50 feet
Lakes	50 feet
Highly Susceptible Wetlands (1) (3)	50 feet
Less Susceptible Wetlands (2) (3)	10 percent of the average wetland width, but no less than 10 feet nor more than 30 feet
Other Waterways with Drainage Areas > 130 ac	10 feet

(1) Highly susceptible wetlands include the following types: fens, sedge meadows, bogs, low prairies, conifer swamps, shrub swamps, other forested wetlands, fresh wet meadows, shallow marshes, deep marshes and seasonally flooded basins. Wetland boundary delineations shall be made in accordance with s. NR 103.08(1m). This paragraph does not apply to wetlands that have been completely filled in accordance with all applicable state and federal regulations. The protective area for wetlands that have been partially filled in accordance with all applicable state and federal regulations shall be measured from the wetland boundary delineation after fill has been placed.

(2) Less susceptible wetlands include degraded wetlands dominated by invasive species such as reed canary grass.

(3) Determinations of the extent of the protective area adjacent to wetlands shall be made on the basis of the sensitivity and runoff susceptibility of the wetland in accordance with the standards and criteria in s. NR 103.03.

Table 2.02-2 Types of Resources and Protective Areas

2. Impervious surfaces shall be kept out of the protective area unless impractical, with consideration of the planned use. The stormwater management plan shall contain a written site-specific explanation for any parts of the protective area that are disturbed during construction.

3. Where land-disturbing construction activity occurs within a protective area, and where no impervious surface is present, adequate sod or self-sustaining vegetative cover of 70 percent or greater shall be established and maintained. The adequate sod or self-sustaining vegetative cover shall be sufficient to provide for bank stability, maintenance of fish habitat, and filtering of pollutants from upslope overland flow areas under sheet flow conditions. Nonvegetative materials, such as rock riprap, may be employed on the bank as necessary to prevent erosion, such as on steep slopes or where high velocity flows occur.

   In selecting the vegetative cover for the protective area, existing natural vegetative cover shall be left undisturbed, to the maximum extent practical. Where existing vegetative cover must be disturbed, consider revegetating the protective area with native plantings, where feasible.

4. BMPs such as filter strips, swales, or wet detention basins that are designed to control pollutants from nonpoint sources may be located in the protective area.

5. The protective area requirement does not apply to:

   a. Redevelopment sites.

   b. In-fill development areas less than 5 acres.

   c. Structures that cross or access surface waters such as boat landings, bridges, and culverts.

   d. Structures constructed in accordance with s. 59.692(1v), Wis. Stats.

   e. Postconstruction sites from which runoff does not enter the surface water, except to the extent that vegetative ground cover is necessary to maintain bank stability.

F. Stormwater Conveyance Systems

1. Storm sewers shall be designed to convey the peak discharge for a 10-year frequency storm event.

2. Cross culverts shall be designed to convey the peak discharge for a 25-year frequency storm event without flows entering the traveled way.

3. Ditches shall be designed to convey the peak discharge for a 25-year frequency storm event without flows entering the traveled way or private property. Drainage easements on private property are required if 25-year flows can't be contained within the road R/W.

4. All conveyance systems shall be designed to safely pass the 100-year storm flow without damage to adjacent structures. Unless waived by the Town of Cedarburg, all new structures shall be constructed at least 2 feet higher than the estimated 100-year overflow elevation.

SECTION 3
GENERAL CONSIDERATIONS

3.01 GENERAL CONSIDERATIONS

A. All concentrated stormwater discharges leaving a site must be conveyed into an existing channel, storm sewer, or overland flow path with adequate downstream stormwater capacity and shall not result in increased flood hazard, erosion, or other adverse impacts.

B. Natural topography and land cover features such as natural swales, natural depressions, native soil infiltrating capacity, and natural groundwater recharge areas shall be preserved and used, to the extent possible, to meet the requirements of this section.

C. Emergency overland flow for all stormwater facilities shall be provided to prevent exceeding the safe capacity of downstream drainage facilities and prevent endangerment of downstream property or public safety.

3.02 DRY WEATHER WATER OUTLET STANDARDS

A. Dry weather water outlets are prohibited from discharging directly onto any public property, public R/W, public street, or public sidewalk if such discharge creates or contributes to a public hazard or public nuisance. No person shall hereafter construct, build, establish, replace, or maintain any dry weather water outlet which discharges onto a public R/W, public street, public sidewalk, roadside ditch, or other public property maintained by the Village without first obtaining written permission to do so from the Director of Public Works.

Failure to obtain written permission from the Director of Public Works for a dry weather water outlet discharge onto a public street, public sidewalk, or other public property shall be deemed a violation of the Stormwater Ordinance.

B. Sump pumps installed to receive or discharge groundwaters or stormwater runoff shall be connected to the storm sewer where possible or discharged into a designated stormwater runoff drainage facility. No sump pump shall discharge directly onto a street surface or public sidewalk. Sump pumps are prohibited from discharging in any way that would cause water to flow onto any public sidewalks, streets, or driveways within the public R/W. Sump pump discharges shall discharge a minimum of ten feet away from the Town right-of-way and shall be equipped with an acceptable method of energy dissipation at the discharge point.

C. Footing drains and drainage tile shall discharge into a storm sewer or other storm drainage facility. No footing drains or drainage tile shall be connected to a sanitary sewer or be discharged directly onto a street surface or public sidewalk.

D. Downspouts and roof drains shall discharge onto the ground. No downspouts or roof drains shall be connected to a sanitary sewer or be discharged directly onto a street surface or public sidewalk. Downspouts and roof drains shall discharge a minimum of ten feet away from the Town right-of-way and shall be equipped with an acceptable method of energy dissipation at the discharge point.

SECTION 4
SUBMITTAL REQUIREMENTS

4.01 EROSION AND SEDIMENT CONTROL PLAN

Submittal requirements for Erosion and Sediment Control Plans are summarized below. The Director of Public Works may waive a portion of these submittal requirements where such information is not necessary to demonstrate compliance with the ordinance.

A. Responsible Party and Legal Description

1. Name, address, and telephone number for the following or their designees: landowner; developer; project engineer for practice design and certification; person(s) responsible for installation of stormwater management practices; and person(s) responsible for maintenance of stormwater management practices prior to the transfer, if any, of maintenance responsibility to another party.

2. A site location map and proper legal description of the property proposed to be developed, referenced to the US Public Land Survey system or to block and lot numbers within a recorded land subdivision plat.

B. Predevelopment Site Conditions Mapping

1. A USGS Quadrangle or other appropriate map showing the project location and nearby regional water resources potentially impacted by the project.

2. A copy of the applicable Soils Survey Map showing predominant soil types and hydrologic soil groups.

3. Mapping or description of existing cover type and condition.

4. A predeveloped conditions site map including the following information described below. Mapping shall include enough of the contiguous properties to show runoff patterns onto, through, and from the site.

    a. Existing topographic contours of the site at a contour interval not to exceed 2 feet.

    b. Property lines.

    c. Existing flow paths and direction across the site.

    d. Outlet locations identifying where stormwater drainage leaves the property.

    e. Drainage basin divides and subdivides to all outlet locations where stormwater drainage leaves the property.

    f. Existing drainage structures on and adjacent to the site.

g. Watercourses that may affect or be affected by runoff from the site.

h. Lakes, streams, wetlands, channels, ditches, and other watercourses on and immediately adjacent to the site.

i. Limits of the 100-year floodplain.

C. Proposed Site Grading and Erosion Control Plan

A Site Grading and Erosion Control Plan shall be provided that includes the following items. The plan shall be at an appropriate scale for the size of the development.

1. Boundaries of the construction site.

2. Drainage patterns and approximate slopes anticipated after major grading activities.

3. Areas of soil disturbance.

4. Location of major structural and nonstructural controls identified in the plan.

   a. Location of areas where stabilization practices will be employed.

   b. Areas which will be vegetated following construction.

5. Extent of wetland acreage on the site and locations where stormwater is discharged to a surface water or wetland.

D. Calculations

Calculations shall be provided including computer modeling input and output files, as needed, to demonstrate compliance with ordinance performance standards. All major assumptions used in developing input parameters shall be clearly stated. The drainage basin areas used in making the calculations shall be clearly cross-referenced to the required map(s).

E. Narrative

A narrative description of the proposed Erosion and Sediment Control Plan shall be provided, including the following:

1. Name of the immediate named receiving water from the United States Geological Service 7.5 minute series topographic maps, as well as locations of all surface waters and wetlands within 1 mile of the construction site.

2. A description of the site and the nature of the construction activity.

3. A sequence of construction of the development site, including stripping and clearing; rough grading; construction of utilities, infrastructure, and buildings; and final grading and landscaping. Sequencing shall identify the expected date on which clearing will begin, the estimated duration of exposure of cleared areas, areas of clearing, installation of temporary erosion and sediment control measures, and establishment of permanent vegetation.

4. Estimates of the total area of the site and the total area of the site that is expected to be disturbed by construction activities.

5. Estimates, including calculations, if any, of the runoff coefficient of the site before and after construction activities are completed.

6. A description of appropriate controls and measures that will be performed at the site to prevent pollutants from reaching waters of the state. The plan shall clearly describe the appropriate control measures for each major activity and the timing during the construction process that the measures will be implemented. The description of erosion controls shall include, when appropriate, the following minimum requirements:

    a. Description of interim and permanent stabilization practices, including a practice implementation schedule. Site plans shall ensure that existing vegetation is preserved where attainable and that disturbed portions of the site are stabilized.

    b. Description of structural practices to divert flow away from exposed soils, store flows, or otherwise limit runoff and the discharge of pollutants from the site. Unless otherwise specifically approved in writing by the Town of Cedarburg, structural measures shall be installed on upland soils.

    c. Descriptions of any other practices proposed to meet requirements of the ordinance and prevent erosion from the site.

4.02 STORMWATER MANAGEMENT PLAN SUBMITTAL REQUIREMENTS

Submittal requirements for Stormwater Management Plans are summarized below. The Director of Public Works may waive a portion of these submittal requirements where such information is not necessary to demonstrate compliance with the ordinance.

A. Responsible Party and Legal Description

The stormwater management plan required under S.08 (1) should contain, at a minimum, the following information:

1. Name, address, and telephone number for the following or their designees: landowner; developer; project engineer for practice design and certification;

person(s) responsible for installation of stormwater management practices; and person(s) responsible for maintenance of stormwater management practices prior to the transfer, if any, of maintenance responsibility to another party.

2. A proper legal description of the property proposed to be developed, referenced to the U.S. Public Land Survey system or to block and lot numbers within a recorded land subdivision plat.

B. Predevelopment Site Conditions Mapping

1. A USGS Quadrangle or other appropriate map showing the project location and nearby regional water resources potentially impacted by the project.

2. A copy of the applicable Soils Survey Map showing predominant soil types and hydrologic soil groups.

3. Mapping or description of existing cover type and condition.

4. A predeveloped conditions site map including the following information described below. Mapping shall include enough of the contiguous properties to show runoff patterns onto, through, and from the site:

   a. Existing topographic contours of the site at a contour interval not to exceed 2 feet.

   b. Property lines.

   c. Existing flow paths and direction across the site.

   d. Outlet locations identifying where stormwater drainage leaves the property.

   e. Drainage basin divides and subdivides to all outlet locations where stormwater drainage leaves the property.

   f. Existing drainage structures on and adjacent to the site.

   g. Watercourses that may affect or be affected by runoff from the site.

   h. Lakes, streams, wetlands, channels, ditches, and other watercourses on and immediately adjacent to the site.

   i. Limits of the 100-year floodplain.

   j. Location of wells and wellhead protection areas covering the project area and delineated pursuant to s. NR 811.16, Wis. Adm. Code.

C. Postdevelopment Site Conditions Mapping

1. Proposed pervious areas including vegetative cover type and condition.

2. Proposed impervious surfaces including all buildings, structures, and pavement.

3. Proposed topographic contours of the site at a scale not to exceed 1 foot.

4. Proposed drainage network including enough of the contiguous properties to show runoff patterns onto, through, and from the site; locations and dimensions of drainage easements.

5. Locations of maintenance easements specified in the maintenance agreement.

6. Flow path and direction for all stormwater conveyance sections.

7. Location and type of all stormwater management conveyance and treatment practices, including the on-site and off-site tributary drainage area.

8. Location and type of conveyance system that will carry runoff from the drainage and treatment practices to the nearest adequate outlet such as a curbed street, storm drain, or natural drainageway.

9. Proposed drainage divides and subdivides identified to each outlet location where stormwater will discharge from the proposed development site.

D. Detailed Drawings

Detailed drawings including cross sections and profiles of all permanent stormwater conveyance and treatment practices.

E. Calculations

Calculations, including computer modeling input and output files, as needed to demonstrate compliance with ordinance performance standards. All major assumptions used in developing input parameters shall be clearly stated. The drainage basin areas used in making the calculations shall be clearly cross-referenced to the required map(s).

F. Narrative

A narrative including, at a minimum, the following:

1. A description of methodologies and major assumptions used in developing hydrologic and hydraulic analyses.

2. A summary of analysis results and conclusions that shall include the following:

a. Tables summarizing predeveloped and postdeveloped hydrologic parameters for each drainage basin. Tables shall include subbasin areas, runoff curve numbers, impervious areas, and times of concentration for predeveloped and postdeveloped conditions.

b. Tables summarizing peak discharge rates for the 2-year, 5-year, 10-year, 25-year, and 100-year storm events for predeveloped, postdeveloped without practices, and postdeveloped with practices conditions.

3. Explanation of the provisions to preserve and use natural topography and land cover features to minimize changes in peak flow runoff rates and volumes to surface waters and wetlands.

4. Explanation of any restrictions on stormwater management measures in the development area imposed by wellhead protection plans and ordinances.

5. Results of investigations of soils and groundwater required for the placement and design of stormwater management measures.

6. A description and installation schedule for the stormwater management practices needed to meet the performance standards in S.06.

7. A maintenance plan developed for the life of each stormwater management practice including the required maintenance activities and maintenance activity schedule.

8. Cost estimates for the construction, operation, and maintenance of each stormwater management practice.

9. Other information requested in writing by the Village of Bonduel to determine compliance of the proposed stormwater management measures with the provisions of this ordinance.

G. Certification of Site Investigations, Plans, Designs, Computations, and Drawings

All site investigations, plans, designs, computations, and drawings shall be certified by a Wisconsin-licensed professional engineer to be prepared in accordance with accepted engineering practice and requirements of the ordinance.

SECTION 5
FORMS

GENERAL INFORMATION
STORMWATER MANAGEMENT PERMIT APPLICATION

Send Application to:

Town of Cedarburg
1293 Washington Ave.
Cedarburg, Wisconsin 53012

Official Use Only

Date Received _____
Number _____
Fee Received _____
Reviewer _____

Instructions: Please type or print. Read all instructions before completing application.

Name of Project:
_____

Applicant/Entity Receiving Permit

Name of Applicant: _____
First Name of Contact: _____Last Name:_____
Street (1): _____
Street (2): _____
City: _____State: _____ Zip Code: ___
Telephone Number: (____) _____
Fax Number: (____)_____

Property Owner

First Name: _____ Last Name: _____
Street (1): _____
Street (2): _____
City: _____State: _____ Zip Code: _____
Telephone Number: (_____) _____
Parcel Identification Number(s): _____

Engineer

Name of Firm: _____
First Name of Contact: _____Last Name:_____
Street (1): _____
Street (2): _____
City: _____State: _____ Zip Code: ____
Telephone Number: (_____) _____
Fax Number: (_____)_____

Town of Cedarburg
Stormwater Management Plan
Application Checklist

Permit #: _____

Project Name: _____ **Date:** _____

Please check the appropriate box: I = Included; NA = Non-Applicable *(If "NA" is checked, an explanation must be entered.)*

Plan Requirement	I	NA	Explanation/Location in Plan
A. Submittal Requirements			
1. Permit Application Form			
2. Maintenance Agreement			
3. Financial Guarantee			
4. Certification/Stamp by Wisconsin Prof. Engineer			
B. Predevelopment Site Conditions Mapping			
1. Location Map			
2. Soils Survey Map			
3. Existing Land Use Mapping			
4. Predeveloped Site Conditions			
a. Existing Contours			
b. Property lines			
c. Existing flow paths and direction			
d. Outlet locations			
e. Drainage basin divides and subdivides			
f. Existing drainage structures on and adjacent to the site.			
g. Nearby Watercourses			
h. Lakes, streams, wetlands, channels, ditches, etc.			
i. Limits of the 100-year floodplain;			
j. Wells/Wellhead Protection Areas			
C. postDevelopment Site Conditions Mapping			
1. Pervious Surfaces			
2. Impervious Surfaces			
3. One Foot Topographic Contours			
4. Proposed Drainage System (including applicable off-site)			
5. Proposed Easement Locations			
6. Proposed Flow Paths, Overland Flow Routes			
7. Proposed Outlets/Drainage Divides			
D. Drawings/Details			
1. Practice Location/Layout/Cross Sections			
2. Outlet Structure Details			
3. Ditch/Storm Sewer Plan/Profile			
4. Other			
E. Calculations, including computer modeling input and output files.			
1. Hydrograph Parameter Calculations			
2. Computer Modeling Input/Output (Pre and Postdeveloped)			
3. Detention Pond Routing			
4. Conveyance System Design			
5. Other			

Town of Cedarburg
Stormwater Management Plan
Application Checklist

Permit #: _____

Project Name: _____ **Date:** _____

Please check the appropriate box: I = Included; NA = Non-Applicable *(If "NA" is checked, an explanation must be entered.)*

Plan Requirement	I	NA	Explanation/Location in Plan
F. Narrative			
1. Methodologies and Assumptions			
2. Results/Conclusions			
a. Pre, and Postdeveloped parameter summary			
b. Pre, and Postdeveloped peak discharge Summary			
3. Provisions to preserve natural topography/cover features			
4. Limitations from wellhead protection plans and ordinances.			
5. Results of investigations of soils and groundwater			
6. Practice Installation Schedule			
7. Maintenance Plan			
8. Cost Estimates			
9. Other Information			

TOWN OF CEDARBURG

STORMWATER MANAGEMENT PERMIT NO. _____

Date of Application _____
Site Address_____
Plat Name_____
Certified Survey Map_____
Lots No. (s) _____

General Conditions:

(a) All stormwater management measures shall be installed in accordance with the approved stormwater management plan and this permit.

(b) The Director of Public Works shall be notified at least 3 business days before commencing any work in conjunction with the stormwater management plan, and within 3 business days upon completion of the stormwater management practices.

(c) Practice installations shall be certified "as built" by a licensed professional engineer. Completed stormwater management practices must pass a final inspection by the Director of Public Works or its designee to determine if they are in accordance with the approved stormwater management plan and ordinance.

(d) The Director of Public Works shall be notified of any significant proposed modifications to an approved stormwater management plan.

(e) All stormwater management practices shall be maintained in accordance with the stormwater management plan until the practices either become the responsibility of the Town of Cedarburg, or are transferred to subsequent private owners as specified in the approved maintenance agreement.

(f) The Town of Cedarburg is authorized to perform any work or operations necessary to bring stormwater management measures into conformance with the approved stormwater management plan, and consent to a special assessment or charge against the property as authorized under subch. VII of ch. 66, Wis. Stats., or to charging such costs against the financial guarantee posted under S.10.

(g) If so directed by the Director of Public Works, all damage to adjoining facilities and drainage ways caused by runoff, where such damage is caused by activities that are not in compliance with the approved stormwater management plan shall be repaired at the permitee's expense.

(h) Access is permitted to the Director of Public Works or its designee for the purpose of inspecting the property for compliance with the approved stormwater management plan and this permit.

APPLICANT MUST FILL IN BOXED AREA

Owner _____
(please print or type full name)
Address_____
_____
_____
Signature or Owner or Authorized Representative

Gross Aggregate Area (Square Feet) _____

SPECIAL CONDITIONS: _____
_____
_____
_____

CONDITIONAL APPROVAL: _____

Administrative Authority Title Date

Permit VALID for a period of twelve (12) months from date of issuance by Director of Public Works and all work must be completed prior to the expiration unless authorized in writing from the Director of Public Works.

GENERAL INFORMATION
CONSTRUCTION SITE EROSION CONTROL PERMIT APPLICATION

Send Application to:

Town of Cedarburg
1293 Washington Ave.
Cedarburg, Wisconsin 53012

Official Use Only

Date Received _____
Number _____
Fee Received _____
Reviewer _____

Instructions: Please type or print. Read all instructions before completing application.

Name of Project:
_____

Applicant/Entity Receiving Permit

Name of Applicant: _____
First Name of Contact: _____Last Name:_____
Street (1): _____
Street (2): _____
City: _____State: _____ Zip Code: ___
Telephone Number: (____) _____
Fax Number: (____)_____

Property Owner

First Name: _____ Last Name: _____
Street (1): _____
Street (2): _____
City: _____State: _____ Zip Code: _____
Telephone Number: (_____) _____
Parcel Identification Number(s): _____

Engineer (Where Applicable)

Name of Firm: _____
First Name of Contact: _____Last Name:_____
Street (1): _____
Street (2): _____
City: _____State: _____ Zip Code: ____
Telephone Number: (_____) _____
Fax Number: (_____)_____

Town of Cedarburg
Construction Site Erosion Control Plan
Application Checklist
(Sites > One Acre)

Permit #: _____

Project Name: _____ **Date:** _____

Please check the appropriate box: I = Included; NA = Non-Applicable *(If "NA" is checked, an explanation must be entered.)*

Plan Requirement	I	NA	Explanation/Location in Plan
A. Submittal Requirements			
1. Permit Application Form			
B. Predevelopment Site Conditions Mapping			
1. Location Map			
2. Soils Survey Map			
3. Existing Land Use Mapping			
4. Predeveloped Site Conditions			
a. Existing Contours			
b. Property lines			
c. Existing flow paths and direction			
d. Outlet locations			
e. Drainage basin divides and subdivides			
f. Existing drainage structures on and adjacent to the site			
g. Nearby Watercourses			
h. Lakes, streams, wetlands, channels, ditches, etc.			
i. Limits of the 100-year floodplain			
C. Proposed Site Grading and Erosion Control Plan			
1. Boundaries of the construction site.			
2. Drainage Patterns/slopes after grading activities			
3. Areas of land disturbance			
4. Locations of structural and nonstructural controls			
5. Drainage basin delineations and outfall locations			
D. Drawings/Details			
1. Practice Location/Layout/Cross Sections			
2. Construction Details			
E. Calculations, as required to demonstrate ordinance compliance			
F. Narrative			
1. Name of receiving waters			
2. Site Description/Nature of construction activity			
3. Sequence of Construction			
4. Estimate of site area and disturbance area			
5. Pre- and postdeveloped runoff coefficients			
6. Description of proposed controls, including			
a. Interim and permanent stabilization practices			
b. Practices to divert flow from exposed soils			
c. Practices to store flows or trap sediment			
d. Any other practices proposed to meet ordinance			

TOWN OF CEDARBURG

CONSTRUCTION SITE EROSION CONTROL PERMIT NO. _____

Date of Application _____
Site Address_____
Plat Name_____
Certified Survey Map_____
Lots No. (s) _____

Permit Conditions:

(a) Permittee shall notify the Director of Public Works 48 hours prior to commencing any land disturbing construction activity.

(b) Permittee shall notify the Director of Public Works of practice installation within 5 days of installation.

(c) Permittee shall obtain permission in writing from the Director of Public Works prior to any modification pursuant to S.08(2) of the erosion and sediment control ordinance.

(d) Permittee shall install all practices as identified in the approved erosion and sediment control plan.

(e) Permittee shall maintain all road drainage systems, stormwater drainage systems, BMPs and other facilities identified in the erosion and sediment control plan.

(f) Permittee shall repair any siltation or erosion damage to adjoining surfaces and drainage ways resulting from land disturbing construction activities and document repairs in a site erosion control log. Remove accumulated sediment from downstream culverts, storm sewers, and other drainage facilities.

(g) Permittee shall inspect the practices within 24 hours after each rain of 0.5 inches or more which results in runoff during active construction periods, and at least once each week, make needed repairs and document the findings of the inspections in a site erosion control log with the date of inspection, the name of the person conducting the inspection, and a description of the present phase of the construction at the site.

(h) Permittee shall allow the Director of Public Works to enter the site for the purpose of inspecting compliance with the erosion and sediment control plan or for performing any work necessary to bring the site into compliance with the control plan. Permittee shall keep a copy of the erosion and sediment control plan at the construction site.

APPLICANT MUST FILL IN BOXED AREA

Owner _____
(please print or type full name)
Address_____
_____
_____
Signature or Owner or Authorized Representative

Area of Land Disturbance (Square Feet) _____

SPECIAL CONDITIONS: _____
_____
_____

CONDITIONAL APPROVAL: _____
Administrative Authority Title Date

Permits issued under this section shall be valid for a period of 180 days, or the length of the building permit or other construction authorizations, whichever is longer, from the date of issuance. The Director of Public Works may extend the period one or more times for up to an additional 180 days. The Director of Public Works may require additional BMPs as a condition of the extension if they are necessary to meet the requirements of this ordinance.

AGREEMENT TO MAINTAIN
STORMWATER FACILITIES
BY AND BETWEEN
THE TOWN OF CEDARBURG AND
_____, AND
ITS HEIRS, SUCCESSORS, OR ASSIGNS

The upkeep and maintenance of stormwater facilities and the implementation of pollution source control best management practices (BMPs) is essential to the protection of water resources in the Town of Cedarburg. All property owners are expected to conduct business in a manner that minimizes impacts of stormwater runoff. This Agreement contains specific provisions with respect to maintenance of stormwater facilities. The authority to require maintenance and pollution source control is provided in the Town of Cedarburg Post-Construction Stormwater Management Ordinance.

FACILITY LOCATION AND AREA SERVED (Attach Map if Necessary):

Whereas, Owner has constructed improvements, including but not limited to, buildings, pavement, and stormwater facilities on the property described above. In order to further the goals of the stormwater management goals of the Town of Cedarburg, the Town of Cedarburg and Owner hereby enter into this Agreement. The responsibilities of each party to this Agreement are identified below.

OWNER SHALL:

(1) Implement the stormwater facility maintenance plan included herein as Attachment A.

(2) Implement the stormwater management plan included herein as Attachment B.

(3) Allow the Director of Public Works or designee to access the property to conduct inspections of storm water management practices as necessary to ascertain that the practices are being maintained and operated in accordance with the agreement.

(4) Undertake corrective actions required by the Town within a reasonable time frame as set by the Director of Public Works or designee.

(5) Maintain a record of steps taken to implement the programs referenced in (1) and (2) above. Record shall be available for inspection by Town staff at Owners business during normal business hours. The record shall catalog the action taken, who took it, when it was done, how it was done, and any problems encountered or follow-on actions recommended.

THE TOWN OF OMRO SHALL:

(1) Provide technical assistance to Owner in support of its operation and maintenance activities conducted pursuant to its maintenance and source control programs. Said assistance shall be

provided upon request, and as Town time and resources permit.

(2) Maintain public records of the results of the site inspections, inform the party responsible for maintenance of the inspection results, and specifically indicate any corrective actions required to bring the storm water management practice into proper working condition.

(3) Notify the Owner of maintenance problems that require correction.

REMEDIES:

(1) If corrective actions required by the town are not completed within the time set by the Director of Public Works, written notice will be sent to the persons who were given notice stating the Town intention to perform such maintenance and bill the owner for all incurred expenses.

(2) If at any time the Town determines that the existing system creates any imminent threat to public health or welfare, the Director of Public Works may take immediate measures to remedy said threat. No notice to the persons listed in (1), above, shall be required under such circumstances.

(3) The owner grants unrestricted authority to the Town for access to any and all stormwater system features for the purpose of performing maintenance or repair as may become necessary under Remedies (1) and/or (2).

(4) The persons listed in (1), above, shall assume all responsibility for the cost of any maintenance and for repairs to the stormwater facility. Such responsibility shall include reimbursement to the Town within 30 days of the receipt of the invoice for any such work performed. Overdue payments will require payment of interest at the current legal rate for liquidated judgments. If legal action ensues, any costs or fees incurred by the Town will be borne by the parties responsible for said reimbursements.

(5) The owner hereby grants to the Town a lien against the above-described property in an amount equal to the cost incurred by the Town to perform the maintenance or repair work described herein.

This Agreement is intended to protect the value and desirability of the real property described above and to benefit all the citizens of the Town. It shall run with the land and be binding on all parties having or acquiring from Owner or their successors any right, title, or interest in the property or any part thereof, as well as their title, or interest in the property or any part thereof, as well as their heirs, successors, and assigns. They shall inure to the benefit of each present or future successor in interest of said property or any part thereof, or interest therein, and to the benefit of all citizens of the Town.

_____

_____

STATE OF WISCONSIN)

) ss
COUNTY OF _____)

On this day and year above personally appeared before me, a Notary Public in and for the State of Wisconsin duly commissioned and sworn, personally appeared _____, to me known to be the _____ of _____ and acknowledge the said instrument to be the free and voluntary act and deed of said corporation, for the uses and purposes therein mentioned, and on oath stated that _____ is authorized to execute the said instrument and that the seal affixed is the corporate seal of said corporation.

WITNESS my hand and official seal the day and year first above written.

_____

Notary Public in and for the State of Wisconsin, residing in _____

My Commission Expires: _____

Dated at Cedarburg, Wisconsin, this _____ day of _____, _____.

TOWN OF CEDARBURG

By:_____
Authorized Agent for the Town of Cedarburg

Town of Cedarburg
Stormwater Management Plan

Financial Guarantee

To: [permit holders name]
Date:
Subject: **Financial Guarantee** in the Amount of $_____
Check # _____ Received by (staff initials): _____

Project Name: _____

Location: Section [no.], Town of [public land survey township name]

This memo shall serve as a receipt for the above noted Financial Guarantee and as an agreement of the purpose and conditions for release by the Town of Cedarburg (herein referred to as the "Town").

Authority.
The authority of the Town to collect and hold this Financial Guarantee is stated in Chapter___, Section ___ of the Town of Cedarburg Code of Ordinances – Stormwater Management Zoning Ordinance (herein referred to as the "Ordinance").

Purpose.
The purpose of this Financial Guarantee is to ensure compliance with the Ordinance and the terms and conditions of a Stormwater Management Permit issued for the above noted project and location.

Conditions For Release.
Terms for release of the Financial Guarantee shall include all of the following:

1. Construction Certification. A professional engineer licensed in Wisconsin shall certify that construction of all stormwater management practices comply with the approved plans and the technical standards of the Town. "As-built" plans shall be submitted for stormwater management practices showing actual location, elevations, materials, construction methods and other items as deemed necessary by the Town to determine compliance.

2. Maintenance Agreement. A copy of an approved maintenance agreement for all stormwater management practices associated with this project must be provided to the Town. The agreement shall be stamped by the Register of Deeds, showing that it has been recorded for all applicable properties.

3. Final Inspection. The Town shall complete a final inspection of the property and certify compliance with the permit and the Ordinance.

If the Town should use any portion of the Financial Guarantee to complete permit activities, due to default or improper action by the permit holder, the Town shall withhold any amounts owed for this work, in accordance with the Ordinance.

Town of Cedarburg
Application Checklist
Summary Tables

Hydrologic Parameters

Basin Name	Drainage Area (Ac)		Runoff Curve Number		Time of Concentration (min.)	
	Existing	Proposed	Existing	Future	Existing	Future

Town of Cedarburg
Application Checklist
Summary Tables

Peak Discharge Summary

Outfall No._____

Storm Frequency	Peak Discharge (cfs)		
	Predev.	Postdev.	Postdev. w/Detention
2-Year			
5-Year			
10-Year			
25-Year			
50-Year			
100-Year			

Note: Provide 1 table for each oufall location.

Detention Basin Summary

Detention Basin _____

Storm Frequency	Storage Volume (ac-ft)	Peak Discharge (cfs)		
		Inflow	Discharge	Pond Elevation
2-Year				
5-Year				
10-Year				
25-Year				
50-Year				
100-Year				

Note: Provide 1 table for each detention basin.

APPENDIX A
STORMWATER MANAGEMENT ORDINANCE

TOWN OF CEDARBURG

STORMWATER MANAGEMENT ORDINANCE

CHAPTER ____

TABLE OF CONTENTS

TOWN OF CEDARBURG

STORMWATER MANAGEMENT ORDINANCE

CHAPTER ____

S.01 AUTHORITY.

(1) This ordinance is adopted by the Town Board under the authority granted by s. 60.627,; Wis. Stats. This ordinance supersedes all provisions of an ordinance previously enacted under s. 60.62, Wis. Stats., that relate to storm water management regulations. Except as otherwise specified in s. 60.627, or, Wis. Stats., s. 60.62,, Wis. Stats., applies to this ordinance and to any amendments to this ordinance.

(2) The provisions of this ordinance are deemed not to limit any other lawful regulatory powers of the same governing body.

(3) The Town Board hereby designates the Director of Public Works to administer and enforce the provisions of this ordinance.

(4) The requirements of this ordinance do not pre-empt more stringent storm water management requirements that may be imposed by any of the following:

(a) Wisconsin Department of Natural Resources administrative rules, permits or approvals including those authorized under ss. 281.16 and 283.33, Wis. Stats.

(b) Targeted non-agricultural performance standards promulgated in rules by the Wisconsin Department of Natural Resources under s. NR 151.004, Wis. Adm. Code.

S.02 FINDINGS OF FACT.

The Town Board finds that uncontrolled, post-construction runoff has a significant impact upon water resources and the health, safety and general welfare of the community and diminishes the public enjoyment and use of natural resources. Specifically, uncontrolled post-construction runoff can:

(1) Degrade physical stream habitat by increasing stream bank erosion, increasing streambed scour, diminishing groundwater recharge, diminishing stream base flows and increasing stream temperature.

(2) Diminish the capacity of lakes and streams to support fish, aquatic life, recreational and water supply uses by increasing pollutant loading of sediment, suspended solids, nutrients, heavy metals, bacteria, pathogens and other urban pollutants.

(3) Alter wetland communities by changing wetland hydrology and by increasing pollutant loads.

(4) Reduce the quality of groundwater by increasing pollutant loading.

(5) Threaten public health, safety, property and general welfare by overtaxing storm sewers, drainage ways, and other minor drainage facilities.

(6) Threaten public health, safety, property and general welfare by increasing major flood peaks and volumes.

(7) Undermine floodplain management efforts by increasing the incidence and levels of flooding.

S.03 PURPOSE AND INTENT.

(1) PURPOSE. The general purpose of this ordinance is to establish long-term, post-construction runoff management requirements that will diminish the threats to public health, safety, welfare and the aquatic environment. Specific purposes are to:

(a) Further the maintenance of safe and healthful conditions.

(b) Prevent and control the adverse effects of storm water; prevent and control soil erosion; prevent and control water pollution; protect spawning grounds, fish and aquatic life; control building sites, placement of structures and land uses; preserve ground cover and scenic beauty; and promote sound economic growth.

(c) Control exceedance of the safe capacity of existing drainage facilities and receiving water bodies; prevent undue channel erosion; control increases in the scouring and transportation of particulate matter; and prevent conditions that endanger downstream property.

(2) INTENT. It is the intent of the Town Board that this ordinance regulates post-construction storm water discharges to waters of the state. This ordinance may be applied on a site-by-site basis. The Town Board recognizes, however, that the preferred method of achieving the storm water performance standards set forth in this ordinance is through the preparation and implementation of comprehensive, systems-level storm water management plans that cover hydrologic units, such as watersheds, on a municipal and regional scale. Such plans may prescribe regional storm water devices, practices or systems, any of which may be designed to treat runoff from more than one site prior to discharge to waters of the state. Where such plans are in conformance with the performance standards developed under s. 281.16, Wis. Stats., for regional storm water management measures and have been approved by the Town Board, it is the intent of this ordinance that the approved plan be used to identify post-construction management measures acceptable for the community.

S.04 APPLICABILITY AND JURISDICTION.

(1) APPLICABILITY.

(a) Where not otherwise limited by law, this ordinance applies after final stabilization to a site of land disturbing construction activity that results in one or more acres of land disturbing construction activities.

(b) A site that meets any of the criteria in this paragraph is exempt from the requirements of this ordinance.

1. A redevelopment post-construction site with no increase in exposed parking lots or roads.
2. A post-construction site with less than 10% connected imperviousness based on complete development of the post-construction site, provided the cumulative area of all parking lots and rooftops is less than one acre.
3. Nonpoint discharges from agricultural facilities and practices.
4. Nonpoint discharges from silviculture activities.
5. Routine maintenance for project sites under 5 acres of land disturbance if performed to maintain the original line and grade, hydraulic capacity or original purpose of the facility.
6. Underground utility construction such as water, sewer and fiber optic lines. This exemption does not apply to the construction of any above ground structures associated with utility construction.

(c) Notwithstanding the applicability requirements in paragraph (a), this ordinance applies to post-construction sites of any size that, in the opinion of the Director of Public Works, is likely to result in runoff that exceeds the safe capacity of the existing drainage facilities or receiving body of water, that causes undue channel erosion, that increases water pollution by scouring or the transportation of particulate matter or that endangers property or public safety.

(2) JURISDICTION.

This ordinance applies to post construction sites within the boundaries and jurisdiction of the Town of Cedarburg.

(3) EXCLUSIONS.

This ordinance is not applicable to activities conducted by a state agency, as defined under s. 227.01 (1), Wis. Stats., but also including the office of district attorney, which is subject to the state plan promulgated or a memorandum of understanding entered into under s. 281.33 (2), Wis. Stats.

S.05 TECHNICAL STANDARDS. AND DESIGN METHODS

DESIGN CRITERIA, STANDARDS AND SPECIFICATIONS. All drainage facilities and practices required to comply with this ordinance shall incorporate technical standards and design methods specified in the document Town of Cedarburg Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works. Where not superseded by stricter requirements in Town of Cedarburg Erosion Control and Stormwater Management Requirements, the following standards are also incorporated for reference:

(1) Applicable design criteria, standards and specifications identified in the Wisconsin Construction Site Best Management Practice Handbook, WDNR Pub. WR-222 November 1993 Revision.

(2) Other design guidance and technical standards identified or developed by the Wisconsin Department of Natural Resources under subchapter V of chapter NR 151, Wis. Adm. Code.

(3) OTHER STANDARDS. Other technical standards not identified or developed in sub. (1), may be used provided that the methods have been approved by the Director of Public Works

S.06 PERFORMANCE STANDARDS.

(1) RESPONSIBLE PARTY. The entity holding fee title to the property shall be responsible for either developing and implementing a stormwater management plan, or causing such plan to be developed and implemented through contract or other agreement. This plan shall be developed in accordance with S. 09, which incorporates the requirements of this section.

(2) PLAN. A written storm water management plan in accordance with S.0 8 shall be developed and implemented for each post-construction site.

(3) STORMWATER MANAGEMENT PERFORMANCE STANDARDS. All drainage facilities and practices required to comply with this ordinance shall meet performance standards specified in the document Town of Cedarburg Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works.

(4) LOCATION AND REGIONAL TREATMENT OPTION.

(a) Stormwater Management Facilities required to meet this ordinance may be located on-site or off-site as part of a regional stormwater device, practice or system.

(b) The Director of Public Works may approve off-site management measures provided that all of the following conditions are met:

1. The Director of Public Works determines that the post-construction runoff is covered by a stormwater management system plan that is approved by the Town of Cedarburg and that contains management requirements consistent with the purpose and intent of this ordinance.

2. The off-site facility meets all of the following conditions:

a. The facility will be in place before the need for the facility arises as a result of on-site construction activities.

b. The facility is designed and adequately sized to provide a level of stormwater control equal to or greater than that which would be afforded by on-site practices meeting the performance standards of this ordinance.

c. The facility has a legally obligated entity responsible for its long-term operation and maintenance.

d. Where a regional treatment option exists such that the Director of Public Works may exempt the applicant from all or part of the minimum on-site stormwater management requirements, the applicant shall be required to pay a fee in an amount determined in negotiation with the Director of Public Works. In determining the fee for post-construction runoff, the Director of Public Works shall consider an equitable distribution of the cost for land, engineering design, construction, and maintenance of the regional treatment option.

(5) ALTERNATE REQUIREMENTS. The Director of Public Works may establish stormwater management requirements more stringent than those set forth in Town of Cedarburg Erosion Control and Stormwater Management Requirements, if the Director of Public Works determines that an added level of protection is needed for to address downstream stormwater management issues.

S.07 PERMITTING REQUIREMENTS, PROCEDURES AND FEES.

(1) PERMIT REQUIRED. No responsible party may undertake a land disturbing construction activity without receiving a post-construction runoff permit from the Director of Public Works prior to commencing the proposed activity.

(2) PERMIT APPLICATION AND FEES. Unless specifically excluded by this ordinance, any responsible party desiring a permit shall submit to the Director of Public Works a permit application made on a form provided by the Director of Public Works for that purpose.

(a) Unless otherwise excepted by this ordinance, a permit application must be accompanied by a storm water management plan, a maintenance agreement (where required) and, where not otherwise covered by a developer's agreement, a non-refundable permit administration fee. The permit administration fee, where applicable, shall be consistent with a fee schedule maintained by the Town of Cedarburg and available at Town Hall.

(b) The storm water management plan shall be prepared to meet the requirements of SS.06 and 08, the maintenance agreement shall be prepared to meet the requirements of S.9, the financial guarantee shall meet the requirements of S.10, and fees shall be those established by the Town Board as set forth in S.11.

(3) REVIEW AND APPROVAL OF PERMIT APPLICATION. The Director of Public Works shall review any permit application that is submitted with a storm water management plan, maintenance agreement, and the required fee. The following approval procedure shall be used:

(a) The Director of Public Works may request additional information if required for a complete application within 15 business days of receipt of any permit application. Within 30 business days of the receipt of a complete permit application, including all items as required by sub. (2), the Director of Public Works shall inform the applicant whether the application, plan and maintenance agreement are approved or disapproved based on the requirements of this ordinance.

(b) If the storm water permit application, plan and maintenance agreement are approved, or if an agreed upon payment of fees in lieu of storm water management practices is made, the Director of Public Works shall issue the permit.

(c) If the storm water permit application, plan or maintenance agreement is disapproved, the Director of Public Works shall detail in writing the reasons for disapproval.

(d) The Director of Public Works may request additional information from the applicant. If additional information is submitted, the Director of Public Works shall have 30 business days from the date the additional information is received to inform the applicant that the plan and maintenance agreement are either approved or disapproved.

(e) Prior to commencing the land development activity, the project may be subject to additional approvals as required by the Town's municipal code.

(4) PERMIT REQUIREMENTS. All permits issued under this ordinance shall be subject to the following conditions, and holders of permits issued under this ordinance shall be deemed to have accepted these conditions. The Director of Public Works may suspend or revoke a permit for violation of a permit condition, following written notification of the responsible party. An action by the Director of Public Works to suspend or revoke this permit may be appealed in accordance with S.13.

(a) Compliance with this permit does not relieve the responsible party of the responsibility to comply with other applicable federal, state, and local laws and regulations.

(b) The responsible party shall design and install all structural and non-structural storm water management measures in accordance with the approved storm water management plan and this permit.

(c) The responsible party shall notify the Director of Public Works at least 2 business days before commencing any work in conjunction with the storm water management plan, and within 3 business days upon completion of the storm water management practices. If required as a special condition under sub. (5), the responsible party shall make additional notification according to a schedule set forth by the Director of Public Works so that practice installations can be inspected during construction.

(d) Practice installations required as part of this ordinance shall be certified "as built" by a licensed professional engineer. Completed storm water management practices must pass a final inspection by the Director of Public Works or its designee to determine if they are in accordance with the approved storm water management plan and ordinance. The Director of Public Works or its designee shall notify the responsible party in writing of any changes required in such practices to bring them into compliance with the conditions of this permit.

(e) The responsible party shall notify the Director of Public Works of any significant modifications it intends to make to an approved storm water management plan. The Director of Public Works may require that the proposed modifications be submitted to it for approval prior to incorporation into the storm water management plan and execution by the responsible party.

(f) The responsible party shall maintain all storm water management practices in accordance with the storm water management plan until the practices either become the responsibility of the Town Board, or are transferred to subsequent private owners as specified in the approved maintenance agreement.

(g) The responsible party authorizes the Director of Public Works to perform any work or operations necessary to bring storm water management measures into conformance with the approved storm water management plan, and consents to a special assessment or charge against the property as authorized under subch. VII of ch. 66, Wis. Stats., or to charging such costs against the financial guarantee posted under S.10.

(h) If so directed by the Director of Public Works, the responsible party shall repair at the responsible party's own expense all damage to adjoining municipal facilities and drainage ways caused by runoff, where such damage is caused by activities that are not in compliance with the approved storm water management plan.

(i) The responsible party shall permit property access to the Director of Public Works or its designee for the purpose of inspecting the property for compliance with the approved storm water management plan and this permit.

(j) Where site development or redevelopment involves changes in direction, increases in peak rate and/or total volume of runoff from a site, the Director of Public Works may require the responsible party to make appropriate legal arrangements with affected property owners concerning the prevention of endangerment to property or public safety.

(k) The responsible party is subject to the enforcement actions and penalties detailed in S.12, if the responsible party fails to comply with the terms of this permit.

(5) PERMIT CONDITIONS. Permits issued under this subsection may include conditions established by Director of Public Works in addition to the requirements needed to meet the performance standards in S.06 or a financial guarantee as provided for in S.10.

(6) PERMIT DURATION. Permits issued under this section shall be valid from the date of issuance through the date the Director of Public Works notifies the responsible party that all storm water management practices have passed the final inspection required under sub. (4)(d). The permit shall be invalid if work is not commenced within 1 year of permit issuance.

S.08 STORM WATER MANAGEMENT PLAN.

(1) PLAN REQUIREMENTS. A Stormwater Management Plan shall be prepared and submitted to the Director of Public Works. The Stormwater Management Plan shall include, at a minimum, information required in the Town of Cedarburg Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works. The Director of Public Works may waive certain submittal requirements if determined by the Director of Public Works to be unnecessary to demonstrate compliance with ordinance standards.

(2) ALTERNATE REQUIREMENTS. The Director of Public Works may prescribe alternative submittal requirements for applicants seeking an exemption to on-site storm water management performance standards under S.06 (5).

S.09 MAINTENANCE AGREEMENT.

(1) MAINTENANCE AGREEMENT REQUIRED. The maintenance agreement required under S.07(2) for storm water management practices shall be an agreement between the Director of Public Works and the responsible party to provide for maintenance of storm water practices beyond the duration period of this permit. The maintenance agreement shall be filed with the County Register of Deeds as a property deed restriction so that it is binding upon all subsequent owners of the land served by the storm water management practices.

(2) AGREEMENT PROVISIONS. The maintenance agreement shall contain the following information and provisions and be consistent with the maintenance plan required by S.07(2.

(a) Identification of the storm water facilities and designation of the drainage area served by the facilities.

(b) A schedule for regular maintenance of each aspect of the storm water management system consistent with the storm water management plan required under S.06 (2).

(c) Identification of the responsible party(s), organization or city, county, town or village responsible for long term maintenance of the storm water management practices identified in the storm water management plan required under S.06 (2).

(d) Requirement that the responsible party(s), organization, or city, county, town or village shall maintain storm water management practices in accordance with the schedule included in par. (b).

(e) Authorization for the Director of Public Works to access the property to conduct inspections of storm water management practices as necessary to ascertain that the practices are being maintained and operated in accordance with the agreement.

(f) A requirement on the Director of Public Works to maintain public records of the results of the site inspections, to inform the responsible party responsible for maintenance of the inspection results, and to specifically indicate any corrective actions required to bring the storm water management practice into proper working condition.

(g) Agreement that the party designated under par. (c), as responsible for long term maintenance of the storm water management practices, shall be notified by the Director of Public Works of maintenance problems which require correction. The specified corrective actions shall be undertaken within a reasonable time frame as set by the Director of Public Works.

(h) Authorization of the Director of Public Works to perform the corrected actions identified in the inspection report if the responsible party designated under par. (c) does not make the required corrections in the specified time period. The Director of Public Works shall enter the amount due on the tax rolls and collect the money as a special charge against the property pursuant to subch. VII of ch. 66, Wis. Stats.

S.10 FINANCIAL GUARANTEE.

(1) ESTABLISHMENT OF THE GUARANTEE. The Director of Public Works may require the submittal of a financial guarantee, the form and type of which shall be acceptable to the Director of Public Works. The financial guarantee shall be in an amount determined by the Director of Public Works to be the estimated cost of construction and the estimated cost of maintenance of the storm water management practices during the period which the designated party in the maintenance agreement has maintenance responsibility. The financial guarantee shall give the Director of Public Works the authorization to use the funds to complete

the storm water management practices if the responsible party defaults or does not properly implement the approved storm water management plan, upon written notice to the responsible party by the Director of Public Works that the requirements of this ordinance have not been met.

(2) CONDITIONS FOR RELEASE. Conditions for the release of the financial guarantee are as follows:

(a) The Director of Public Works shall release the portion of the financial guarantee established under this section, less any costs incurred by the Director of Public Works to complete installation of practices, upon submission of "as built plans" by a licensed professional engineer. The Director of Public Works may make provisions for a partial pro-rata release of the financial guarantee based on the completion of various development stages.

(b) The Director of Public Works shall release the portion of the financial guarantee established under this section to assure maintenance of storm water practices, less any costs incurred by the Director of Public Works, at such time that the responsibility for practice maintenance is passed on to another entity via an approved maintenance agreement.

S.11 FEE SCHEDULE.

The fees referred to in other sections of this ordinance shall be established by the Town Board and may from time to time be modified by resolution. A schedule of the fees established by the Director of Public Works shall be available for review in the Town Hall.

S.12 ENFORCEMENT.

(1) Any land disturbing construction activity or post-construction runoff initiated after the effective date of this ordinance by any person, firm, association, or corporation subject to the ordinance provisions shall be deemed a violation unless conducted in accordance with the requirements of this ordinance.

(2) The Director of Public Works shall notify the responsible party by certified mail of any non-complying land disturbing construction activity or post-construction runoff. The notice shall describe the nature of the violation, remedial actions needed, a schedule for remedial action, and additional enforcement action which may be taken.

(3) Upon receipt of written notification from the Director of Public Works under sub. (2), the responsible party shall correct work that does not comply with the storm water management plan or other provisions of this permit. The responsible party shall make corrections as necessary to meet the specifications and schedule set forth by the Director of Public Works in the notice.

(4) If the violations to a permit issued pursuant to this ordinance are likely to result in damage to properties, public facilities, or waters of the state, the Director of Public Works may enter the land and take emergency actions necessary to prevent such damage. The costs incurred by the Director of Public Works plus interest and legal costs shall be billed to the responsible party.

(5) The Director of Public Works is authorized to post a stop work order on all land disturbing construction activity that is in violation of this ordinance, or to request the Town Attorney to obtain a cease and desist order in any court with jurisdiction.

(6) The Director of Public Works may revoke a permit issued under this ordinance for non-compliance with ordinance provisions.

(7) Any permit revocation, stop work order, or cease and desist order shall remain in effect unless retracted by the Director of Public Works or by a court with jurisdiction.

(8) The Director of Public Works is authorized to refer any violation of this ordinance, or of a stop work order or cease and desist order issued pursuant to this ordinance, to the Town Attorney for the commencement of further legal proceedings in any court with jurisdiction.

(9) Any person, firm, association, or corporation who does not comply with the provisions of this ordinance shall be subject to a forfeiture per the Town Schedule of Deposits. Each day that the violation exists shall constitute a separate offense.

(10) Compliance with the provisions of this ordinance may also be enforced by injunction in any court with jurisdiction. It shall not be necessary to prosecute for forfeiture or a cease and desist order before resorting to injunctional proceedings.

(11) When the Director of Public Works determines that the holder of a permit issued pursuant to this ordinance has failed to follow practices set forth in the storm water management plan, or has failed to comply with schedules set forth in said storm water management plan, the Director of Public Works or a party designated by the Director of Public Works may enter upon the land and perform the work or other operations necessary to bring the condition of said lands into conformance with requirements of the approved plan. The Director of Public Works shall keep a detailed accounting of the costs and expenses of performing this work. These costs and expenses shall be deducted from any financial security posted pursuant to S.10 of this ordinance. Where such a security has not been established, or where such a security is insufficient to cover these costs, the costs and expenses shall be entered on the tax roll as a

special charge against the property and collected with any other taxes levied thereon for the year in which the work is completed.

S.13 APPEALS.

(1) BOARD OF ZONING APPEALS. The board of ZONING APPEALS, created pursuant to section 16.2 of the Town of Cedarburg ordinances pursuant to s. 60.65 Wis. Stats, shall hear and decide appeals where it is alleged that there is error in any order, decision or determination made by the Director of Public Works in administering this ordinance. The board shall also use the rules, procedures, duties, and powers authorized by statute in hearing and deciding appeals. Upon appeal, the board may authorize variances from the provisions of this ordinance that are not contrary to the public interest, and where owing to special conditions a literal enforcement of the ordinance will result in unnecessary hardship.

(2) WHO MAY APPEAL. Appeals to the Board of Zoning Appeals may be taken by any aggrieved person or by an officer, department, board, or bureau of the Town of Cedarburg affected by any decision of the Director of Public Works.

S.14 SEVERABILITY.

If any section, clause, provision or portion of this ordinance is judged unconstitutional or invalid by a court of competent jurisdiction, the remainder of the ordinance shall remain in force and not be affected by such judgment.

S.15 DEFINITIONS.

(1) "Administering authority" means a governmental employee, or a regional planning commission empowered under s. 60.627 Wis. Stats., that is designated by the Town Board to administer this ordinance.
(2) "Agricultural facilities and practices" has the meaning given in s. 281.16, Wis. Stats.
(3) "Average annual rainfall" means a calendar year of precipitation, excluding snow, which is considered typical.
(4) "Best management practice" or "BMP" means structural or non-structural measures, practices, techniques or devices employed to avoid or minimize sediment or pollutants carried in runoff to waters of the state.
(5) "Business day" means a day the office of the Director of Public Works is routinely and customarily open for business.
(6) "Cease and desist order" means a court-issued order to halt land disturbing construction activity that is being conducted without the required permit.
(7) "Combined sewer system" means a system for conveying both sanitary sewage and storm water runoff.

(8) “Connected imperviousness" means an impervious surface that is directly connected to a separate storm sewer or water of the state via an impervious flow path.

(9) “Design storm” means a hypothetical discrete rainstorm characterized by a specific duration, temporal distribution, rainfall intensity, return frequency, and total depth of rainfall.

(10) “Development” means residential, commercial, industrial or institutional land uses and associated roads.

(11) “Division of land” means the creation from one parcel of 2 or more parcels or building sites of 5 or fewer acres each in area where such creation occurs at one time or through the successive partition within a 5 year period.

(12) “Effective infiltration area” means the area of the infiltration system that is used to infiltrate runoff and does not include the area used for site access, berms or pretreatment.

(13) “Erosion” means the process by which the land’s surface is worn away by the action of wind, water, ice or gravity.

(14) "Exceptional resource waters" means waters listed in s. NR 102.11, Wis. Adm. Code.

(15) “Extraterritorial” means the unincorporated area within 3 miles of the corporate limits of a first, second, or third class city, or within 1.5 miles of a fourth class city or village.

(16) "Final stabilization" means that all land disturbing construction activities at the construction site have been completed and that a uniform, perennial, vegetative cover has been established, with a density of at least 70% of the cover, for the unpaved areas and areas not covered by permanent structures, or employment of equivalent permanent stabilization measures.

(17) “Financial guarantee” means a performance bond, maintenance bond, surety bond, irrevocable letter of credit, or similar guarantees submitted to the Director of Public Works by the responsible party to assure that requirements of the ordinance are carried out in compliance with the storm water management plan.

(18) “Governing body” means town board of supervisors, county board of supervisors, city council, Town Board of trustees or village council.

(19) “Impervious surface” means an area that releases as runoff all or a large portion of the precipitation that falls on it, except for frozen soil. Rooftops, sidewalks, driveways, parking lots and streets are examples of areas that typically are impervious.

(20) “In-fill area” means an undeveloped area of land located within existing development.

(21) “Infiltration” means the entry of precipitation or runoff into or through the soil.

(22) “Infiltration system” means a device or practice such as a basin, trench, rain garden or swale designed specifically to encourage infiltration, but does not include natural infiltration in pervious surfaces such as lawns, redirecting of rooftop downspouts onto lawns or minimal infiltration from practices, such as swales or road side channels designed for conveyance and pollutant removal only.

(23) “Karst feature” means an area or surficial geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater, and may include caves, enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps or swallets.

(24) “Land Development Activity” means any construction related activity that results in the addition or

replacement of impervious surfaces such as rooftops, roads, parking lots, and other structures. Measurement of areas impacted by land development activity includes areas that are part of a larger common plan of development or sale where multiple separate and distinct land disturbing construction activities may be taking place at different times on different schedules but under one plan.

(25) “Land disturbing construction activity” means any man-made alteration of the land surface resulting in a change in the topography or existing vegetative or non-vegetative soil cover, that may result in runoff and lead to an increase in soil erosion and movement of sediment into waters of the state. Land disturbing construction activity includes clearing and grubbing, demolition, excavating, pit trench dewatering, filling and grading activities.

(26) “Maintenance agreement” means a legal document that provides for long-term maintenance of storm water management practices.

(26) “MEP” or “maximum extent practicable” means a level of implementing best management practices in order to achieve a performance standard specified in this ordinance which takes into account the best available technology, cost effectiveness and other competing issues such as human safety and welfare, endangered and threatened resources, historic properties and geographic features. MEP allows flexibility in the way to meet the performance standards and may vary based on the performance standard and site conditions.

(27) “New development” means development resulting from the conversion of previously undeveloped land or agricultural land uses.

(28) “Off-site” means located outside the property boundary described in the permit application.

(29) “On-site” means located within the property boundary described in the permit application.

(30) "Ordinary high-water mark" has the meaning given in s. NR 115.03(6), Wis. Adm. Code.

(31) “Outstanding resource waters” means waters listed in s. NR 102.10, Wis. Adm. Code.

(32) “Percent fines” means the percentage of a given sample of soil, which passes through a # 200 sieve.

(33) “Performance standard” means a narrative or measurable number specifying the minimum acceptable outcome for a facility or practice.

(34) “Permit” means a written authorization made by the Director of Public Works to the applicant to conduct land disturbing construction activity or to discharge post-construction runoff to waters of the state.

(35) “Permit administration fee” means a sum of money paid to the Director of Public Works by the permit applicant for the purpose of recouping the expenses incurred by the authority in administering the permit.

(36) “Pervious surface” means an area that releases as runoff a small portion of the precipitation that falls on it. Lawns, gardens, parks, forests or other similar vegetated areas are examples of surfaces that typically are pervious.

(37) “Pollutant” has the meaning given in s. 283.01(13), Wis. Stats.

(38) “Pollution” has the meaning given in s. 281.01(10), Wis. Stats.

(39) “Post-construction site" means a construction site following the completion of land disturbing construction activity and final site stabilization.

(40) “Pre-development condition” means the extent and distribution of land cover types present before the initiation of land disturbing construction activity, assuming that all land uses prior to development activity are managed in an environmentally sound manner.

(41) “Preventive action limit” has the meaning given in s. NR 140.05(17), Wis. Adm. Code.

(42) "Redevelopment ” means areas where development is replacing older development.

(43) “Responsible party” means any entity holding fee title to the property or other person contracted or obligated by other agreement to implement and maintain post-construction storm water BMPs.

(44) “Runoff” means storm water or precipitation including rain, snow or ice melt or similar water that moves on the land surface via sheet or channelized flow.

(45) “Separate storm sewer” means a conveyance or system of conveyances including roads with drainage systems, streets, catch basins, curbs, gutters, ditches, constructed channels or storm drains, which meets all of the following criteria:

(a) Is designed or used for collecting water or conveying runoff.

(b) Is not part of a combined sewer system.

(c) Is not draining to a storm water treatment device or system.

(d) Discharges directly or indirectly to waters of the state.

(46) “Site” means the entire area included in the legal description of the land on which the land disturbing construction activity occurred.

(47) “Stop work order” means an order issued by the Director of Public Works which requires that all construction activity on the site be stopped.

(48) “Storm water management plan” means a comprehensive plan designed to reduce the discharge of pollutants from storm water after the site has under gone final stabilization following completion of the construction activity.

(49) “Storm water management system plan” is a comprehensive plan designed to reduce the discharge of runoff and pollutants from hydrologic units on a regional or municipal scale.

(50) "Technical standard" means a document that specifies design, predicted performance and operation and maintenance specifications for a material, device or method.

(51) “Top of the channel” means an edge, or point on the landscape, landward from the ordinary high-water mark of a surface water of the state, where the slope of the land begins to be less than 12% continually for at least 50 feet. If the slope of the land is 12% or less continually for the initial 50 feet, landward from the ordinary high-water mark, the top of the channel is the ordinary high-water mark.

(52) “TR-55” means the United States Department of Agriculture, Natural Resources Conservation Service (previously Soil Conservation Service), Urban Hydrology for Small Watersheds, Second Edition, Technical Release 55, June 1986.

(53) "Type II distribution" means a rainfall type curve as established in the "United States Department of Agriculture, Soil Conservation Service, Technical Paper 149, published 1973". The Type II curve is applicable to all of Wisconsin and represents the most intense storm pattern.

(54) "Waters of the state" has the meaning given in s. 281.01 (18), Wis. Stats.

S.16 EFFECTIVE DATE.

This ordinance shall be in force and effect from and after its adoption and publication. The above and foregoing ordinance was duly adopted by the Town Board of the Town of Cedarburg on the [number] day of [month], [year].

Approved: _____

Attested _____

Published on [day, month, year].

APPENDIX B
CONSTRUCTION SITE EROSION CONTROL ORDINANCE

TOWN OF CEDARBURG

CONSTRUCTION SITE EROSION CONTROL ORDINANCE

CHAPTER _____

TABLE OF CONTENTS

TOWN OF CEDARBURG

CONSTRUCTION SITE EROSION CONTROL ORDINANCE

CHAPTER _____

S.01 AUTHORITY.

(1) This ordinance is adopted under the authority granted by s. 60.627, Wis. Stats., ;. This ordinance supersedes all provisions of an ordinance previously enacted under s. 60.62, Wis. Stats., that relate to construction site erosion control. Except as otherwise specified in s. 60.627, Wis. Stats., s. 60.62, Wis. Stats., applies to this ordinance and to any amendments to this ordinance.

(2) The provisions of this ordinance are deemed not to limit any other lawful regulatory powers of the same governing body.

(3) The Town Board hereby designates the Director of Public Works to administer and enforce the provisions of this ordinance.

(4) The requirements of this ordinance do not pre-empt more stringent erosion and sediment control requirements that may be imposed by any of the following:

(a) Wisconsin Department of Natural Resources administrative rules, permits or approvals including those authorized under ss. 281.16 and 283.33, Wis. Stats.

(b) Targeted non-agricultural performance standards promulgated in rules by the Wisconsin Department of Natural Resources under s. NR 151.004, Wis. Adm. Code.

S.02 FINDINGS OF FACT.

The finds that runoff from land disturbing construction activity carries a significant amount of sediment and other pollutants to the waters of the state in Town of Cedarburg.

S.03 PURPOSE.

It is the purpose of this ordinance to further the maintenance of safe and healthful conditions; prevent and control water pollution; prevent and control soil erosion; protect spawning grounds, fish and aquatic life; control building sites, placement of structures and land uses; preserve ground cover and scenic beauty; and promote sound economic

growth, by minimizing the amount of sediment and other pollutants carried by runoff or discharged from land disturbing construction activity to waters of the state in the Town of Cedarburg.

S.04 APPLICABILITY AND JURISDICTION.

(1) APPLICABILITY.

(a) This ordinance applies to construction sites that have one or more acres of land disturbing construction activity except as provided under sub. (b):

(b) This ordinance does not apply to the following:

1. A construction project that is exempted by federal statutes or regulations from the requirement to have a national pollutant discharge elimination system permit issued under chapter 40, Code of Federal Regulations, part 122, for land disturbing construction activity.
2. Nonpoint discharges from agricultural facilities and practices.
3. Nonpoint discharges from silviculture activities.
4. Routine maintenance for project sites under 5 acres of land disturbance if performed to maintain the original line and grade, hydraulic capacity or original purpose of the facility.

(c) Notwithstanding the applicability requirements in paragraph (a), this ordinance applies to construction sites of any size that, in the opinion of the Director of Public Works, are likely to result in runoff that exceeds the safe capacity of the existing drainage facilities or receiving body of water, that causes undue channel erosion, that increases water pollution by scouring or the transportation of particulate matter or that endangers property or public safety.

(2) JURISDICTION.

This ordinance applies to land disturbing construction activity on construction sites located within the boundaries and jurisdiction of the Town of Cedarburg.

(3) EXCLUSIONS.

This ordinance is not applicable to activities conducted by a state agency, as defined under s. 227.01 (1), Wis. Stats., but also including the office of district attorney, which is subject to the state plan promulgated or a memorandum of understanding entered into under s. 281.33 (2), Wis. Stats.

S.05 TECHNICAL STANDARDS.

(1) DESIGN CRITERIA, STANDARDS AND SPECIFICATIONS. All drainage facilities and practices required to comply with this ordinance shall incorporate technical standards and design methods specified in the document Town of Cedarburg Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Pubilc Works. Where not superceded by stricter requirements in Town of Cedarburg Erosion Control and Stormwater Management Requirements, the following standards are also incorporated by reference:

(a) Other design guidance and technical standards identified or developed by the Wisconsin Department of Natural Resources under subchapter V of chapter NR 151, Wis. Adm. Code.

(2) OTHER STANDARDS. Other technical standards not identified or developed in sub. (1), may be used provided that the methods have been approved by the Director of Public Works.

S.06 PERFORMANCE STANDARDS.

(1) RESPONSIBLE PARTY. The responsible party shall implement an erosion and sediment control plan, developed in accordance with S. 08, that incorporates the requirements of this section.

(2) PLAN. A written plan shall be developed in accordance with S. 08 and implemented for each construction site.

(3) EROSION AND SEDIMENT CONTROL PERFORMANCE STANDARDS. All drainage facilities and practices required to comply with this ordinance shall meet performance standards specified in the document Town of Cedarburg Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works.

(4) ALTERNATE REQUIREMENTS. The Director of Public Works may establish erosion and sediment control requirements more stringent than those set forth in Town of Cedarburg Erosion Control and Stormwater Management Requirements, if the Director of Public Works determines that an added level of protection is needed to address downstream stormwater management issues.

S.07 PERMITTING REQUIREMENTS, PROCEDURES AND FEES.

(1) PERMIT REQUIRED. No responsible party may commence a land disturbing construction activity subject to this ordinance without receiving prior approval of an erosion and sediment control plan for the site and a permit from the Director of Public Works.

(2) PERMIT APPLICATION AND FEES. At least one responsible party desiring to undertake a land disturbing construction activity subject to this ordinance shall submit an application for a permit and an erosion and sediment control plan that meets the requirements of S.09 and shall pay an application fee consistent with the fee schedule maintained by the Director of Public Works. By submitting an application, the applicant is authorizing the Director of Public Works to enter the site to obtain information required for the review of the erosion and sediment control plan.

(3) REVIEW AND APPROVAL OF PERMIT APPLICATION. The Director of Public Works shall review any permit application that is submitted with an erosion and sediment control plan, and the required fee. The following approval procedure shall be used:

(a) The Director of Public Works may request additional information if required for a complete application within 15 business days of receipt of any permit application. Within 30 business days of the receipt of a complete permit application, as required by sub. (2), the Director of Public Works shall inform the applicant whether the application and plan are approved or disapproved based on the requirements of this ordinance.

(b) If the permit application and plan are approved, the Director of Public Works shall issue the permit.

(c) If the permit application or plan is disapproved, the Director of Public Works shall state in writing the reasons for disapproval.

(d) The Director of Public Works may request additional information from the applicant. If additional information is submitted, the Director of Public Works shall have 30 business days from the date the additional information is received to inform the applicant that the plan is either approved or disapproved.

(4) FINANCIAL GUARANTEE. As a condition of approval and issuance of the permit, the Director of Public Works may require the applicant to deposit a surety bond or irrevocable letter of credit to guarantee a good faith execution of the approved erosion control plan and any permit conditions.

(5) PERMIT REQUIREMENTS. All permits shall require the responsible party to:

(a) Notify the Director of Public Works 2 full business days prior to commencing any land disturbing construction activity.

(b) Notify the Director of Public Works of completion of any BMPs within 3 full business days after their installation.

(c) Obtain permission in writing from the Director of Public Works prior to any modification pursuant to S.08(3) of the erosion and sediment control plan.

(d) Install all BMPs as identified in the approved erosion and sediment control plan.

(e) Maintain all road drainage systems, stormwater drainage systems, BMPs and other facilities identified in the erosion and sediment control plan.

(f) Repair any siltation or erosion damage to adjoining surfaces and drainage ways resulting from land disturbing construction activities and document repairs in a site erosion control log. Remove accumulated sediment from downstream culverts, storm sewers, and other drainage facilities.

(g) Inspect the BMPs within 24 hours after each rain of 0.5 inches or more which results in runoff during active construction periods, and at least once each week, make needed repairs and document the findings of the inspections in a site erosion control log with the date of inspection, the name of the person conducting the inspection, and a description of the present phase of the construction at the site.

(h) Allow the Director of Public Works to enter the site for the purpose of inspecting compliance with the erosion and sediment control plan or for performing any work necessary to bring the site into compliance with the control plan. Keep a copy of the erosion and sediment control plan at the construction site.

(6) PERMIT CONDITIONS. Permits issued under this section may include conditions established by Director of Public Works in addition to the requirements set forth in sub. (5), where needed to assure compliance with the performance standards in S.06.

(7) PERMIT DURATION. Permits issued under this section shall be valid for a period of 180 days, or the length of the building permit or other construction authorizations, whichever is longer, from the date of issuance. The Director of Public Works may extend the period one or more times for up to an additional 180 days. The Director of Public Works may require additional BMPs as a condition of the extension if they are necessary to meet the requirements of this ordinance.

(8) MAINTENANCE. The responsible party throughout the duration of the construction activities shall maintain all BMPs necessary to meet the requirements of this ordinance until the site has undergone final stabilization.

S.08 EROSION AND SEDIMENT CONTROL PLAN, STATEMENT, AND AMENDMENTS.

(1) PLAN REQUIREMENTS. An Erosion and Sediment Control Plan shall be prepared and submitted to the Director of Public Works. The Erosion and Sediment Control Plan shall include, at a minimum, information required in the Town of Cedarburg Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works.

(2) AMENDMENTS. The applicant shall amend the plan if any of the following occur:

(a) There is a change in design, construction, operation or maintenance at the site which has the reasonable potential for the discharge of pollutants to waters of the state and which has not otherwise been addressed in the plan.

(b) The actions required by the plan fail to reduce the impacts of pollutants carried by construction site runoff.

(c) The Director of Public Works notifies the applicant of changes needed in the plan.

S.09 FEE SCHEDULE.

The fees referred to in other sections of this ordinance shall be established by the Town Board and may from time to time be modified by resolution. A schedule of the fees established by the Director of Public Works shall be available for review at the Town Hall.

S.10 INSPECTION.

If land disturbing construction activities are being carried out without a permit required by this ordinance, the Director of Public Works may enter the land pursuant to the provisions of ss. 66.0119(1), (2), and (3), Wis. Stats.

S.11 ENFORCEMENT.

(1) The Director of Public Works may post a stop-work order if any of the following occurs:

(a) Any land disturbing construction activity regulated under this ordinance is being undertaken without a permit.

(b) The erosion and sediment control plan is not being implemented in a good faith manner.

(c) The conditions of the permit are not being met.

(2) If the responsible party does not cease activity as required in a stop-work order posted under this section or fails to comply with the erosion and sediment control plan or permit conditions, the Director of Public Works may revoke the permit.

(3) If the responsible party, where no permit has been issued, does not cease the activity after being notified by the Director of Public Works, or if a responsible party violates a stop-work order posted under sub. (1), the Director of Public Works may request the Town Attorney to obtain a cease and desist order in any court with jurisdiction.

(4) The Director of Public Works may retract the stop-work order issued under sub. (1) or the permit revocation under sub. (2).

(5) After posting a stop-work order under sub. (1), the Director of Public Works may issue a notice of intent to the responsible party of its intent to perform work necessary to comply with this ordinance. The Director of Public Works may go on the land and commence the work after issuing the notice of intent. The costs of the work performed under this subsection by the Director of Public Works, plus interest at the rate authorized by Director of Public Works shall be billed to the responsible party. In the event a responsible party fails to pay the amount due, the clerk shall enter the amount due on the tax rolls and collect as a special assessment against the property pursuant to subch. VII of ch. 66, Wis. Stats.

(6) Any person violating any of the provisions of this ordinance shall be subject to a forfeiture per Town Schedule of Deposits. Each day a violation exists shall constitute a separate offense.

(7) Compliance with the provisions of this ordinance may also be enforced by injunction in any court with jurisdiction. It shall not be necessary to prosecute for forfeiture or a cease and desist order before resorting to injunctional proceedings.

S.12 APPEALS.

(1) BOARD OF ZONING APPEALS. The Board of Zoning Appeals created pursuant to section 17.29 of the Town of Cedarburg ordinances pursuant to 60.65 Wis. Stats.:

(a) Shall hear and decide appeals where it is alleged that there is error in any order, decision or determination made by the Director of Public Works in administering this ordinance except for cease and desist orders obtained under S.11 (3).

(b) Upon appeal, may authorize variances from the provisions of this ordinance which are not contrary to the public interest and where owing to special conditions a literal enforcement of the provisions of the ordinance will result in unnecessary hardship; and

(c) Shall use the rules, procedures, duties and powers authorized by statute in hearing and deciding appeals and authorizing variances.

(2) WHO MAY APPEAL. Appeals to the Board of Zoning Appeals may be taken by any aggrieved person or by any office, department, board, or bureau of the Town of Cedarburg affected by any decision of the Director of Public Works.

S.13 SEVERABILITY.

If a court of competent jurisdiction judges any section, clause, provision or portion of this ordinance unconstitutional or invalid, the remainder of the ordinance shall remain in force and not be affected by such judgment.

S.14 DEFINITIONS.

(1) "Administering authority" means a governmental employee, or a regional planning commission empowered under s. 60.627 Wis. Stats., that is designated by the Town Board to administer this ordinance.

(2) "Agricultural facilities and practices " has the meaning in s. 281.16(1), Wis. Stats.

(3) "Average annual rainfall" means a calendar year of precipitation, excluding snow, which is considered typical.

(4) "Best management practice" or "BMP" means structural or non-structural measures, practices, techniques or devices employed to avoid or minimize soil, sediment or pollutants carried in runoff to waters of the state.

(5) "Business day" means a day the office of the Director of Public Works is routinely and customarily open for business.

(6) "Cease and desist order" means a court-issued order to halt land disturbing construction activity that is being conducted without the required permit.

(7) "Construction site" means an area upon which one or more land disturbing construction activities occur, including areas that are part of a larger common plan of development or sale where multiple separate and distinct land disturbing construction activities may be taking place at different times on different schedules but under one plan.

(8) "Division of land" means the creation from one parcel of 2 or more parcels or building sites of 5 or fewer acres each in area where such creation occurs at one time or through the successive partition within a 5 year period.

(9) "Erosion" means the process by which the land's surface is worn away by the action of wind, water, ice or gravity.

(10) "Erosion and sediment control plan" means a comprehensive plan developed to address pollution caused by erosion and sedimentation of soil particles or rock fragments during construction.

(11) "Extraterritorial" means the unincorporated area within 3 miles of the corporate limits of a first, second, or third class city, or within 1.5 miles of a fourth class city or village.

(12) "Final stabilization" means that all land disturbing construction activities at the construction site have been

completed and that a uniform perennial vegetative cover has been established, with a density of at least 70 percent of the cover, for the unpaved areas and areas not covered by permanent structures, or that employ equivalent permanent stabilization measures.

(13) "Governing body" means town board of supervisors, county board of supervisors, city council, village board of trustees or village council.

(14) "Land disturbing construction activity" means any man-made alteration of the land surface resulting in a change in the topography or existing vegetative or non-vegetative soil cover, that may result in runoff and lead to an increase in soil erosion and movement of sediment into waters of the state. Land disturbing construction activity includes clearing and grubbing, demolition, excavating, pit trench dewatering, filling and grading activities.

(15) "MEP" or "maximum extent practicable" means a level of implementing best management practices in order to achieve a performance standard specified in this chapter which takes into account the best available technology, cost effectiveness and other competing issues such as human safety and welfare, endangered and threatened resources, historic properties and geographic features. MEP allows flexibility in the way to meet the performance standards and may vary based on the performance standard and site conditions.

(16) "Performance standard" means a narrative or measurable number specifying the minimum acceptable outcome for a facility or practice.

(17) "Permit" means a written authorization made by the Director of Public Works to the applicant to conduct land disturbing construction activity or to discharge post-construction runoff to waters of the state.

(18) "Pollutant" has the meaning given in s. 283.01 (13), Wis. Stats.

(19) "Pollution" has the meaning given in s. 281.01 (10), Wis. Stats.

(20) "Responsible party" means any entity holding fee title to the property or performing services to meet the performance standards of this ordinance through a contract or other agreement.

(21) "Runoff" means storm water or precipitation including rain, snow or ice melt or similar water that moves on the land surface via sheet or channelized flow.

(22) "Sediment" means settleable solid material that is transported by runoff, suspended within runoff or deposited by runoff away from its original location.

(23) "Separate storm sewer" means a conveyance or system of conveyances including roads with drainage systems, streets, catch basins, curbs, gutters, ditches, constructed channels or storm drains, which meets all of the following criteria:

(a) Is designed or used for collecting water or conveying runoff.

(b) Is not part of a combined sewer system.

(c) Is not draining to a storm water treatment device or system.

(d) Discharges directly or indirectly to waters of the state.

(24) "Site" means the entire area included in the legal description of the land on which the land disturbing construction activity is proposed in the permit application.

(25) “Stop work order” means an order issued by the Director of Public Works which requires that all construction activity on the site be stopped.

(26) "Technical standard" means a document that specifies design, predicted performance and operation and maintenance specifications for a material, device or method.

(27) “Waters of the state” has the meaning given in s. 281.01 (18), Wis. Stats.

S.15 EFFECTIVE DATE.

This ordinance shall be in force and effect from and after its adoption and publication. The above and foregoing ordinance was duly adopted by the Town Board of the Town of Cedarburg on the [number] day of [month], [year].

Approved: _____

Attested _____

Published on [day, month, and year].

APPENDIX C
WET DETENTION BASIN TECHNICAL STANDARD

Wet Detention Pond
(1001)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A permanent pool of water with designed dimensions, inlets, outlets and storage capacity, constructed to collect, detain, treat and release stormwater runoff.

II. Purposes

The primary purposes of this practice are to improve water quality and reduce peak flow.

III. Conditions Where Practice Applies

This practice applies to urban sites where stormwater runoff pollution due to particulate solids loading and attached pollutants is a concern. It also applies where increased runoff from urbanization or land use change is a concern. Site conditions must allow for runoff to be directed into the pond and a permanent pool of water to be maintained.

This standard establishes criteria for ponds to detain stormwater runoff, although some infiltration may occur. In some instances, detention ponds may present groundwater contamination risks, and this standard sets criteria for determining when liners may be necessary to address risks to groundwater. Where the detention pond will be discharging to an infiltration practice, see WDNR Conservation Practice Standards 1002-1004.

Application of this standard is not intended to address flood control. Modifications to the peak flow criteria or additional analysis of potential flooding issues may be needed or required by local authorities. For ponds used during the construction period, see WDNR Conservation Practice Standard 1064, Sediment Basin.

This practice provides a method to demonstrate that a wet detention pond achieves the total suspended solids (TSS) reduction and peak flow control required by NR 151.12, Wis. Adm. Code, for post-construction sites. Pollutant loading models such as SLAMM, P8, DETPOND or equivalent methodology may also be used to evaluate the efficiency of the design in reducing TSS.

IV. Federal, State and Local Laws

The design, construction and maintenance of wet detention ponds shall comply with all federal, state and local laws, rules or regulations. The owner/operator is responsible for securing required permits. This standard does not contain the text of any federal, state or local laws governing wet detention ponds.

The location and use of wet detention ponds may be limited by regulations relating to stormwater management, navigable waters (Ch. 30, Wis. Stats.), floodplains, wetlands, buildings, wells and other structures, or by land uses such as waste disposal sites and airports. The pond embankment may be regulated as a dam under Ch. 31, Wis. Stats., and further restricted under NR 333, Wis. Adm. Code, which includes regulations for embankment heights and storage capacities.

V. Criteria

The following minimum criteria apply to all wet detention pond designs used for the purposes stated in Section II of this standard. Use more restrictive criteria as needed to fit the conditions found in the site assessment.

A. Site Assessment – Conduct and document a site assessment to determine the site characteristics that will affect the placement, design, construction and maintenance of the pond. Document the pond design. Items to assess include:

1. At the pond site, on a site map:

    a. Identify buildings and other structures, parking lots, property lines, wells, wetlands, 100-year floodplains, surface

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

drains, navigable streams, known drain tile, roads, and utilities (both overhead and buried) showing elevation contours and other features specified by the applicable regulatory authority.

b. Show location of soil borings and test pits on site map, characterize the soils, *seasonally high groundwater level*[1], and *bedrock* conditions to a minimum depth of 5 feet below the proposed bottom of the pond or to bedrock, whichever is less. Conduct one test pit or boring per every 2 acres of permanent pool footprint, with a minimum of two per pond. Include information on the soil texture, color, structure, moisture and groundwater indicators, and bedrock type and condition, and identify all by elevation. Characterize soils using both the USDA and USCS classification systems.

Note: USCS characterization is used for soil stability assessment while USDA soil characterization identifies the soil's potential permeability rate.

c. Investigate the potential for *karst features* nearby.

2. In the watershed, on a watershed map:

a. Identify predominant soils, the drainage ways, navigable streams and floodways, wetlands, available contour maps, land cover types and known karst features. Identify the receiving surface waters, or whether the drainage basin drains directly to groundwater.

b. Show channels and overland flow before and after development, contours, and property lines.

c. Refer to the Tc (time of concentration) flow paths and subwatershed boundaries used in runoff calculations.

B. Pond Design – Properly designed wet detention ponds are effective at trapping smaller particles, and controlling peak flows (see App. C, Figures 1-3).

1. Water Quality – Pollutant reduction (TSS and phosphorus) is a function of the permanent pool area and depth, the outlet structure and the active storage volume. The following criteria apply:

a. Permanent Pool – The elevation below which runoff volume is not discharged and particles are stored.

i. Design ponds to include a permanent pool of water. The surface area of the permanent pool is measured at the invert of the lowest outlet. The minimum surface area of the permanent pool must address the total drainage area to the pond.

Note: Use App. A for the initial estimate of the permanent pool area based on drainage area. Prorate values for mixed land uses.Use Equation 1 to solve for q_o and iterate as needed.

ii. The permanent pool surface area is sized based on the particle size and the peak outflow during the 1-yr., 24-hour design storm using Equation 1:

$$\mathbf{S_a = 1.2 * (q_o / v_s)}$$ [Equation 1(a)]

or

$$\mathbf{q_o = (v_s * S_a) / 1.2}$$ [Equation 1(b)]

Where:

$\mathbf{S_a}$ = Permanent pool surface area measured at the invert of the lowest outlet of the wet detention pond (square feet)

$\mathbf{q_o}$ = Post-construction peak outflow (cubic feet/second) during the 1-yr., 24-hour design storm for the principal outlet

$\boldsymbol{v_s}$ = Particle settling velocity (feet/second)

1.2 = EPA recommended safety factor

iii. Particle settling velocities (v_s) shall be based on representative particle sizes for the desired percent TSS reduction.

- 80% (3 micron): $\boldsymbol{v_s} = 1.91 \times 10^{-5}$ ft./sec.
- 60% (6 micron): $\boldsymbol{v_s} = 7.37 \times 10^{-5}$ ft./sec.
- 40% (12 micron): $\boldsymbol{v_s} = 2.95 \times 10^{-4}$ ft./sec.

Note: Particle settling velocities were calculated assuming a specific gravity of 2.5, a water temperature of 50 degrees Fahrenheit (10 degrees C) and a kinematic viscosity of 0.01308 $cm.^2/sec.$ (Pitt, 2002). The calculations also assume discrete and quiescent settling conditions per Stoke's Law.

b. Active Storage Volume – Volume above the permanent pool that is released slowly to settle particles. Calculate the volume with the following method:

Use a hydrograph-producing method, such as the one outlined in Natural Resources Conservation Service, Technical Release 55 (TR-55), to determine the storage volume for detention ponds. This can be accomplished by using App. B where:

$\mathbf{q_o}$ = Peak outflow during the 1-yr., 24-hour design storm for the principal outlet calculated using Equation 1 (see V.B.1.a.ii).

$\mathbf{q_i}$ = Calculated post-construction peak inflow or runoff rate during the 1-yr., 24-hour design storm.

$\mathbf{V_R}$ = Calculated volume of runoff from the 1-year, 24-hour design storm for the entire contributory area.

$\mathbf{V_S}$ = The required active storage volume determined using App. B.

Note: This method may require iterative calculations.

c. Safety – Include a safety shelf (or aquatic shelf) that extends a minimum of 8 ft. from the edge of the permanent pool waterward with a slope of 10:1 (horizontal:vertical) or flatter. The maximum depth of the permanent pool of water over the shelf shall be 1.5 ft.

d. Depth – The average water depth of the permanent pool shall be a minimum of 3 ft., excluding the safety shelf area and sediment storage depth.

e. Length to Width – Maximize the length to width ratio of the flow path to prevent short-circuiting and dead zones (areas of stagnant water). See Section VII, Considerations D and N for options to prevent short circuiting.

f. Sediment Storage – After all construction has ceased and the contributory watershed has been stabilized, one of the following applies:

i. A minimum of 2 ft. shall be available for sediment storage (for a total of 5 ft. average depth, excluding the safety shelf area). For ponds greater than 20,000 sq. ft., 50% of the total surface area of the permanent pool shall be a minimum of 5 ft. deep. For ponds less than 20,000 sq. ft., maximize the area of 5 ft. depth.

ii. Modeling shows that for 20 years of sediment accumulation, less than 2 ft. sediment storage is needed (not to be less than 0.5 feet).

iii. A minimum of 4 ft. shall be available for sediment storage if the contributory area includes cropland not stabilized by any other practice, such as strip cropping, terraces and conservation tillage.

For information on sediment storage in forebays, see Section VII, Consideration C.

Note: Municipalities that use sand in the winter may consider increasing the sediment storage depth.

g. Side Slopes Below Safety Shelf – All side slopes below the safety shelf shall be 2:1 (horizontal:vertical) or flatter as required to maintain soil stability, or as required by the applicable regulatory authority.

h. Outlets – Wet detention ponds shall have both a principal outlet and an emergency spillway.

i. Prevent Damage – Incorporate into outlet design trash accumulation preventive features, and measures for preventing ice damage and scour at the outfall. Direct outlets to channels, pipes, or similar

conveyances designed to handle prolonged flows.

ii. Principal Water Quality Outlet – Design the outlet to control the proposed 2-yr., 24-hour discharge from the pond within the primary principal outlet without use of the emergency spillway or other outlet structures. If a pipe discharge is used as the primary principal outlet, then the minimum diameter shall be 4 inches. Where an orifice is used, features to prevent clogging must be added.

iii. Backward Flow – Any storm up to the 10-yr., 24-hour design storm shall not flow backward through the principal water quality outlet or principal outlet. Flap gates or other devices may be necessary to prevent backward flow.

iv. Emergency Spillway – All ponds shall have an emergency spillway. Design the spillway to safely pass peak flows produced by a 100-yr., 24-hour design storm routed through the pond without damage to the structure. The flow routing calculations start at the permanent pool elevation.

v. Peak Flow Control – Design the peak flow control to maintain stable downstream conveyance systems and comply with local ordinances or conform with regional stormwater plans where they are more restrictive than this standard. At a minimum:

a) The post-development outflow shall not exceed pre-development peak flows for the 2-yr., 24-hour design storm.

b) Use a hydrograph-producing method such as TR-55 for all runoff and flow calculations.

c) When pre-development land cover is cropland, use the runoff curve numbers in Table 1, unless local ordinances are more restrictive**.**

d) For all other pre-development land covers, use runoff curve numbers from TR-55 assuming "good hydrologic conditions."

e) For post-development calculations, use runoff curve numbers based on proposed plans.

Note: Local ordinances may require control of larger storm events than the 2-yr., 24-hour storm. In these cases, additional or compound outlets may be required.

Table 1 - Maximum Pre-Development Runoff Curve Numbers for Cropland Areas

Hydrologic Soil Group	A	B	C	D
Runoff Curve Number	55	69	78	83

2. Other Pond Criteria

a. Inflow Points – Design all inlets to prevent scour during peak flows produced by the 10-yr., 24-hr. design storm, such as using half-submerged inlets, stilling basins and rip-rap. Where infiltration may initially occur in the pond, the scour prevention device shall extend to the basin bottom.

b. Side Slopes **–** All interior side slopes above the safety shelf shall be 3:1 (horizontal:vertical), or flatter if required by the applicable regulatory authority.

c. Ponds in Series – To determine the overall TSS removal efficiency of ponds in series, the design shall use an *approved model* such as DETPOND or P8, that can track particle size distribution from one pond to the next.

d. Earthen Embankments – Earthen embankments (see App. C, Figure 3) shall be designed to address potential risk and structural integrity issues such as seepage and saturation. All constructed earthen embankments shall meet the following criteria.

i. Vegetation – Remove a minimum of 6 in. of the parent material (including all vegetation, stumps, etc.) beneath the proposed base of the embankment.

ii. Core Trench or Key-way – For embankments where the permanent pool is ponded 3 ft. or more against the embankment, include a core trench or key-way along the centerline of the embankment up to the permanent pool elevation to prevent seepage at the joint between the existing soil and the fill material. The core trench or key-way shall be a minimum of 2 ft. below the existing grade and 8 ft. wide with a side slope of 1:1 (horizontal:vertical) or flatter. Follow the construction and compaction requirements detailed in V.B.2.d.iii below for compaction and fill material.

iii. Materials – Construct all embankments with non-organic soils and compact to 90% standard proctor according to the procedures outlined in ASTM D-698 or by using compaction requirements of USDA Natural Resources Conservation Service, Wisconsin Construction Specification 3. Do not bury tree stumps, or other organic material in the embankment. Increase the constructed embankment height by a minimum of 5% to account for settling.

iv. Freeboard – Ensure that the top of embankment, after settling, is a minimum of 1 vertical foot above the flow depth for the 100-yr., 24-hr. storm.

v. Pipe Installation, Bedding and Backfill – If pipes are installed after construction of the embankment, the pipe trench shall have side slopes of 1:1 or flatter. Bed and backfill any pipes extending through the embankment with embankment or equivalent soils. Compact the bedding and backfill in lifts and to the same standard as the original embankment.

vi. Seepage – Take measures to minimize seepage along any conduit buried in the embankment. Measures such as anti-seep collars, sand diaphragms or use of bentonite are acceptable.

vii. Exterior side slopes shall be 2:1 (horizontal:vertical) or flatter, with a minimum top width of the embankment of 4 ft., or 10 ft. if access for maintenance is needed. The embankment must be designed for slope stability.

e. Topsoil and Seeding – Spread topsoil on all disturbed areas above the safety shelf, as areas are completed, to a minimum depth of 4 inches. Stabilize according to the permanent seeding criteria in WDNR Conservation Practice Standard 1059, Seeding for Construction Site Erosion Control.

f. Liners – Use the Liner Flowchart in App. D to determine when a liner is needed. For types of liners, see the Liner Flowchart and specifications in App. D. If a liner is used, provide a narrative that sets forth the liner design and construction methods.

Note: Some municipalities have wellhead protection areas and all municipalities have source water protection areas delineated by WDNR. Consult with the local community about when a liner will be needed if located within one of these areas.

g. Depth to Bedrock – The separation distance from the proposed bottom of a wet detention pond to bedrock will determine which of the following apply:

i. If the separation distance is a minimum of 5 ft. and the soil beneath the pond to bedrock is 10% fines or more, refer to the Liner Flowchart to determine if a liner may be needed for reasons other than proximity to bedrock;

ii. If the separation distance is a minimum of 3 ft. and the soil beneath the pond to bedrock is 20% fines or more, refer to the Liner Flowchart to determine if a liner may be needed for reasons other than proximity to bedrock;

iii. If conditions in (i) or (ii) are not met, then a Type B liner is required at a minimum. Refer to the Liner

Flowchart to determine if a Type A liner may be needed for reasons other than proximity to bedrock (see liner specifications in App. D);

iv. If blasting in bedrock is performed to construct a wet detention pond in bedrock, then a Type A liner is required (see liner specifications in App. D) and an engineering design must be conducted.

h. Separation from Wells – Wet detention ponds shall be constructed 400 feet from community wells (NR 811, Wis. Adm. Code) and 25 feet from non-community and private wells (NR 812, Wis. Adm. Code).

Note: The 25 foot setback from non-community and private wells is a final construction distance. This may not be sufficient to prevent running over the well with heavy equipment during construction of the pond.

i. Wetlands – For wet detention ponds that discharge to wetlands, use level spreaders or rip-rap to prevent channelization, erosion and reduce sedimentation in the wetlands.

j. Off-site runoff – Address off-site runoff in the design of a wet detention pond.

k. Aerators/Fountains – If an aerator or fountain is desired for visual and other aesthetic effects (aerators designed to mix the contents of the pond are prohibited) they must meet one of the first two items (i – ii), and items (iii) and (iv) below.

i. Increase the surface area of the wet detention pond beyond the area needed to achieve compliance with a stormwater construction site permit. The increase in surface area is equal to or greater than the *area of influence* of the aerator/fountain. Use an aerator/fountain that does not have a *depth of influence* that extends into the sediment storage depth (see App. E, Figure 4).

ii. For wet detention ponds where the surface area is no more than required to meet the stormwater construction site permit conditions, the depth of influence of the device cannot extend below the sediment storage elevation. Include in the design an automatic shut-off of the aerator/fountain as the pond starts to rise during a storm event. The aerator/fountain must remain off while the pond depth returns to the permanent pool elevation and, further, shall remain off until such time as required for the design micron particle size to settle to below the draw depth of the pump. (See V.B.1.a.iii for the design micron particle sizes that correlate with a TSS reduction.)

iii. Aerator/fountains are not allowed in wet detention ponds with less than a 5 ft. permanent pool designed depth.

iv. Configure the pump intake to draw water primarily from a horizontal plane so as to minimize the creation of a circulatory pattern from bottom to top throughout the pond.

VI. Operation and Maintenance

Develop an operation and maintenance plan that is consistent with the purposes of this practice, the wet detention pond's intended life, safety requirements and the criteria for its design. The operation and maintenance plan will:

A. Identify the responsible party for operation, maintenance and documentation of the plan.

B. Require sediment removal once the average depth of the permanent pool is 3.5 ft. At a minimum, include details in the plan on inspecting sediment depths, frequency of accumulated sediment removal, and disposal locations for accumulated sediment (NR 500, Wis. Adm. Code).

C. Include inlet and outlet maintenance, keeping embankments clear of woody vegetation, and providing access to perform the operation and maintenance activities.

D. Identify how to reach any forebay, safety shelf, inlet and outlet structures.

E. Address weed or algae growth and removal, insect and wildlife control and any landscaping practices.

F. If a liner is used, show how the liner will be protected from damage during sediment removal or when the liner is undergoing repair.

G. Prohibit excavation below the original design depth unless geotechnical analysis is completed in accordance with V.A.1.b & c.

VII. Considerations

Consider the following items for all applications of this standard:

A. Additional conservation practices should be considered if the receiving water body is sensitive to temperature fluctuations, oxygen depletion, excess toxins or nutrients.

B. To prevent nuisance from geese, consider not mowing around the pond perimeter. To maximize safety and pollutant removal, consider spreading topsoil along the safety shelf to promote plant growth.

C. For ease of maintenance, a sediment forebay should be located at each inlet (unless inlet is < 10% of total inflow or an equivalent upstream pretreatment device exists) to trap large particles such as road sand. The storage volume of the sediment forebay should be consistent with the maintenance plan, with a goal of 5%-15% of the permanent pool surface area. The sediment forebay should be a minimum depth of 3 ft. plus the depth for sediment storage.

D. The length to width ratio of the flow path should be maximized with a goal of 3:1 or greater. The flow path is considered the general direction of water flow within the pond, including the permanent pool and forebay.

E. Consider providing additional length to the safety shelf, above or below the wet pool elevation, to enhance safety.

F. To prevent damage or failure due to ice, all risers extending above the pond surface should be incorporated into the pond embankment.

G. The use of underwater outlets should be considered to minimize ice damage, accumulation of floating trash or vortex control.

H. Watershed size and land cover should be considered to ensure adequate runoff volumes to maintain a permanent pool.

I. Aesthetics of the pond should be considered in designing the shape and specifying landscape practices. Generally, square ponds are aesthetically unappealing.

J. If downstream flood management or bank erosion is a concern, consider conducting a watershed study to determine the most appropriate location and design of stormwater management structures, including consideration of potential downstream impacts on farming practices and other land uses.

K. For wet detention ponds with surface area more than 2 acres or where the fetch is greater than 500 feet, consider reinforcing banks, extending the safety shelf, vegetating the safety shelf or other measures to prevent erosion of embankment due to wave action.

L. To prevent failure, consider reinforcing earthen emergency spillways constructed over fill material to protect against erosion.

M. All flow channels draining to the pond should be stable to minimize sediment delivery to the pond.

N. Baffles may be used to artificially lengthen the flow path in the pond. In some designs, a circular flow path is set up in a pond even when the inlet and outlet are next to each other and no baffles are used. Then the flow path can be calculated using the circular path.

O. Consider using low fertilizer inputs on the embankments and collecting the clippings.

P. Consider providing a method to facilitate dewatering during accumulated sediment removal.

Q. Consider using backflow preventers to minimize fish entrapment.

R. Consider providing a terrestrial buffer of 10-15 feet around the pond if it has low or no embankments.

S. Consider a hard surface for the bottom of the forebay to ease sediment removal.

T. Use of algaecides, herbicides or polymers to control nuisance growths or to enhance sedimentation must receive a permit under NR 107, Wis. Adm. Code. Contact the appropriate DNR specialist.

U. Consider additional safety features beyond the safety shelf where conditions warrant them.

V. Consider vegetative buffer strips along drainage ways leading to the detention pond to help filter pollutants.

W. After the site assessment is complete, review and discuss it with the local administering agency at a pre-design conference to determine and agree on appropriate pond design for the site.

X. Design so that the 10-yr., 24-hour design storm does not flow through the emergency spillway. The 10-yr. design criteria protects the embankment from premature failure due to frequent or long-duration flows through the emergency spillway.

Y. Where practical, construct the emergency spillway on original grade.

Z. Conduct a groundwater boring to 15 feet below the pond and consider the historic "mottling marks" in assessing groundwater levels.

AA. For partially or fully submerged inlet pipes, consider using pipe ties or some other method to keep pipes from dislodging during frost movement.

BB. Consider employing a geotechnical engineer if stability of the embankment is a concern and to justify slopes steeper than 2.5:1.

CC. Assess potential environmental hazards at the site from previous land uses. The assessment should use historical information about the site to determine if the potential for environmental hazard exists, e.g., contaminated soils, contaminated groundwater, abandoned dumps or landfills. Contaminated areas can be located by reviewing the Bureau of Remediation and Redevelopment Tracking System (BRRTS), the DNR Registry of Waste Disposal Sites in Wisconsin and the Solid and Hazardous Waste Information System (SHWIMS) available through the WDNR website.

DD. Consider direct and indirect impacts to area wetland hydrology and wetland hydroperiod due to area hydrologic modifications that result from routing wetland source waters through a wet detention pond or releasing the discharge from a wet detention pond directly into a wetland.

EE. Consider conducting more than one test pit or boring per every 2 acres of permanent pool footprint, with a minimum of two per pond, if more are needed to determine the variability of the soil boundary or to identify perched water tables due to clay lenses. For the soils analysis, consider providing information on soil thickness, groundwater indicators—such as soil mottle or redoximorphic features—and occurrence of saturated soil, groundwater or disturbed soil.

FF. Where the soils are fine, consider groundwater monitoring if the groundwater table is less than 10 feet below the bottom of the wet pond because the water table may fluctuate seasonally. Other impacts on the groundwater table elevation may be from seasonal pumping of irrigation wells or the influence of other nearby wells. Monitoring or modeling may be necessary in these situations to identify the groundwater elevation.

GG. For additional guidance on seepage control for embankments, consult sections V.B.1.c and V.B.1.e(2) of NRCS Conservation Practice Standard 378, Pond, particularly if a wet detention pond's embankment is considered to be a dam.

VIII. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall specify the materials, construction processes, location, size and elevations of all components of the practice to allow for certification of construction upon completion.

IX. References

Center for Watershed Protection, *Stormwater BMP Design for Cold Climates*, December 1997.

R. Pitt and J. Voorhees, *The Design and Use of Detention Facilities for Stormwater Management Using DETPOND*, 2000.

United States Department of Agriculture, Natural Resources Conservation Service, Conservation Practice Standard 378, *Pond*, July 2001.

United States Department of Agriculture, Natural Resources Conservation Service, *Engineering Field Handbook.*

United States Department of Agriculture, Natural Resources Conservation Service, *Ponds – Planning, Design, Construction*, Agriculture Handbook 590, revised September 1997.

United States Department of Agriculture, Natural Resources Conservation Service, Technical Release 55, *Urban Hydrology for Small Watersheds*.

United States Department of Agriculture, Natural Resources Conservation Service, *Wisconsin Field Office Technical Guide, Section IV*.

United States Department of Commerce, Weather Bureau, *Rainfall Frequency Atlas of the United States, Technical Paper 40*.

University of Wisconsin – Extension, *The Wisconsin Storm Water Manual, Part Four: Wet Detention Basins*, Publication No. G3691-P.

Wisconsin State Legislature, Revisor of Statutes Bureau, *Wisconsin Administrative Code*; for information on the codes of state agencies, including WDNR, see http://www.legis.state.wi.us/rsb/code.htm.

X. Definitions

Approved Model (V.B.2.c) – A computer model that is used to predict pollutant loads from urban lands and has been approved by the applicable regulatory authorities. SLAMM and P8 are examples of models that may be used to verify that a detention pond design meets the desired total suspended solids reduction.

Area of Influence (V.B.2.k.i) – The area of influence of an aerator/fountain is a function of the circular area of impact of the return water and the mixing area of the pump, whichever is greater.

Bedrock (V.A.1.b) – Consolidated rock material and weathered in-place material with > 50%, by volume, larger than 2 mm in size.

Depth of Influence (V.B.2.k.i) – The depth of influence of an aerator/fountain is a function of the impact depth of the return water and the draw depth of the pump, whichever is greater.

Karst Feature (V.A.1.c) – An area or surficial geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater. May include caves, enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps, swallets, fracture trace (linear feature, including stream segment, vegetative trend and soil tonal alignment), Karst pond (closed depression in a karst area containing standing water) or Karst fen (marsh formed by plants overgrowing a karst lake or seepage area).

Seasonally high groundwater level (V.A.1.b) – The higher of either the elevation to which the soil is saturated as observed as a free water surface in an unlined hole, or the elevation to which the soil has been seasonally or periodically saturated as indicated by soil color patterns throughout the soil profile.

Appendix A—Calculation of Preliminary Permanent Pool Surface Area for TSS Reduction [1]

Land Use/Description/Management[2]	Total Impervious (%)[3]	80% Minimum Surface Area of the Permanent Pool (% of Watershed Area)	60% Minimum Surface Area of the Permanent Pool (% of Watershed Area)
Residential • < 2.0 units/acre (>1/2 acre lots) (low density • 2.0 - 6.0 units/acre (medium density) • > 6.0 units/acre (high density)	8 - 28 >28 -41 >41 - 68	0.7 0.8 1.0	0.3
Commercial/Office Park/Institutional/Warehouse/Industrial/Manufacturing/Storage[4] (Non-retail related business, multi-storied buildings, large heavily used outdoor parking areas, material storage, or manufacturing operations	<60 60-80 80-90 >90	1.8 2.1 2.4 2.8	0.6
Parks/Open Space/Woodland/Cemeteries	0-12	0.6	0.2
Highways/Freeways (Includes right-of-way area) • Typically grass banks/conveyance • Mixture of grass and curb/gutter • Typically curb/gutter conveyance	<60 60-90 >90	1.4 2.1 2.8	1.0

[1] Multiply the value listed by the watershed area within the category to determine the minimum pond surface area. Prorate for drainage areas with multiple categories due to different land use, management, percent impervious, soil texture, or erosion rates. For example, to achieve an 80% TSS reduction, a 50 acre (residential, 50% imperviousness) x 0.01 (1% of watershed from table) = 0.5 acre + 50 acres (office park, 85% imperviousness) x 0.024 (2.4% of watershed) = 1.2 acre. Therefore 0.5 acre + 1.2 acre = 1.7 acres for the minimum surface area of the permanent pool.

[2] For offsite areas draining to the proposed land use, refer to local municipalities for planned land use and possible institutional arrangements as a regional stormwater plan.

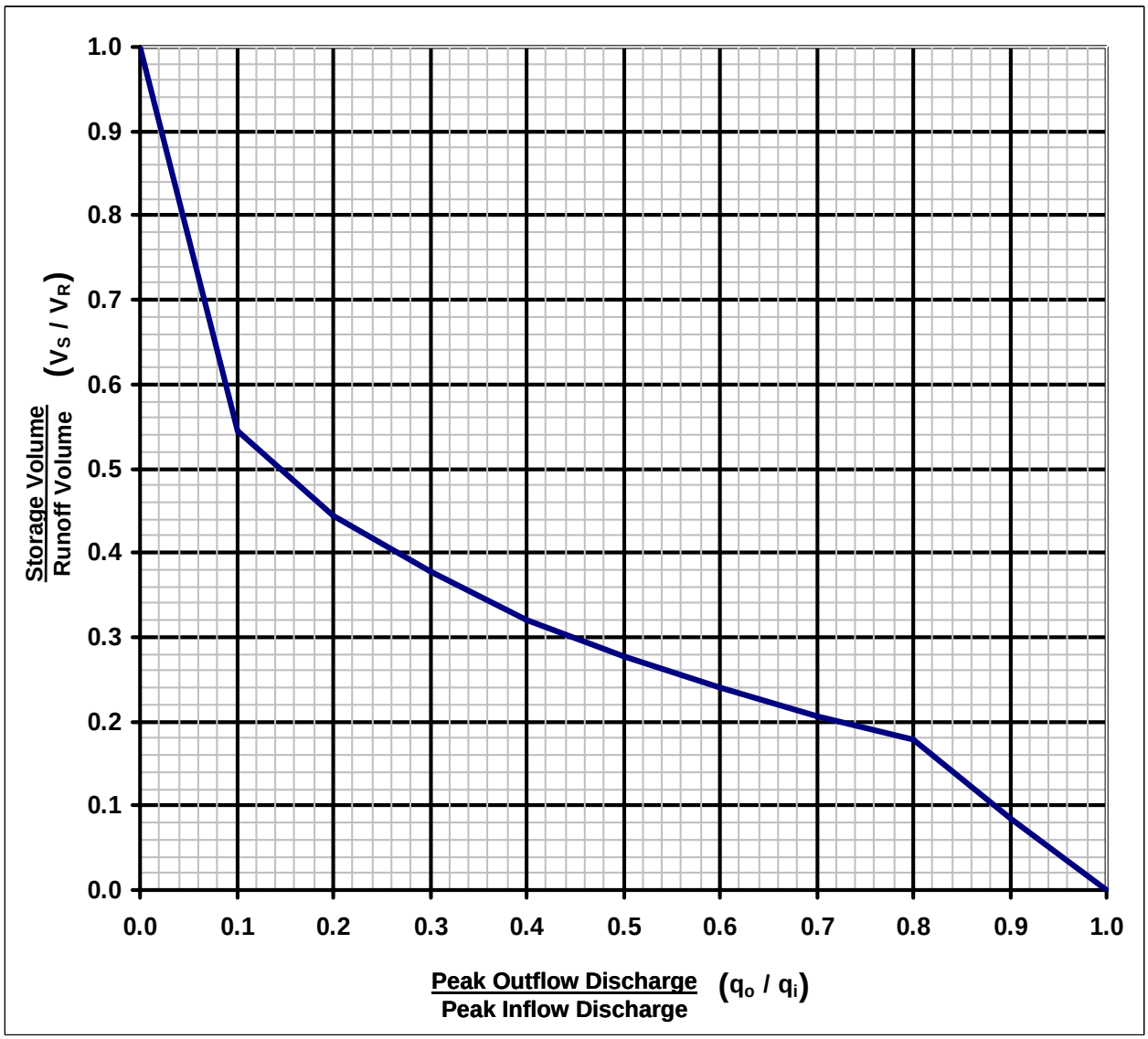
[3] Impervious surfaces include rooftops, parking lots, roads, and similar hard surfaces, including gravel driveways/parking areas.

[4] Category includes insurance offices, government buildings, company headquarters, schools, hospitals, churches, shopping centers, strip malls, power plants, steel mills, cement plants, lumber yards, auto salvage yards, grain elevators, oil tank farms, coal and salt storage areas, slaughter houses, and other outdoor storage or parking areas.

Source: This table was modified from information in "The Design and Use of Detention Facilities for Stormwater Management Using DETPOND" by R. Pitt and J. Voorhees (2000).

Appendix B

Approximate Detention Basin Routing for Type II Storms



Source: Technical Release 55, United States Department of Agriculture, Natural Resources Conservation Service, Washington, D.C. 1986. NRCS Bulletin No. WI-210-8-16 (Sept. 12, 1988) amended the TR-55 routing graph for Type II storms to include flows outside the original range.

Appendix B (cont'd.)

Rainfall Quantities:

Table 2 provides a summary of the 1-year, 24-hour rainfall totals using NRCS mandated TP-40, which has not been updated since 1961. Table 3 provides a summary of more current data from the Rainfall Frequency Atlas of the Midwest published in 1992. Local requirements may dictate the use of one dataset over the other.

Table 2 – Rainfall for Wisconsin Counties for a 1-year, 24-hour Rainfall[1]	
Inches of Rainfall	County
2.1 in.	Door, Florence, Forest, Kewaunee, Marinette, Oconto, Vilas
2.2 in.	Ashland, Bayfield, Brown, Calumet, Douglas, Iron, Langlade, Lincoln, Manitowoc, Menominee, Oneida, Outagamie, Price, Shawano, Sheboygan
2.3 in.	Barron, Burnett, Dodge, Fond du Lac, Green Lake, Marathon, Milwaukee, Ozaukee, Portage, Racine, Rusk, Sawyer, Taylor, Washburn, Washington, Waukesha, Waupaca, Waushara, Winnebago, Wood
2.4 in.	Adams, Chippewa, Clark, Columbia, Dane, Dunn, Eau Claire, Jackson, Jefferson, Juneau, Kenosha, Marquette, Pepin, Pierce, Polk, Rock, St. Croix, Walworth
2.5 in.	Buffalo, Green, Iowa, La Crosse, Monroe, Richland, Sauk, Trempealeau, Vernon
2.6 in.	Crawford, Grant, Lafayette
[1]TP – 40: Rainfall Frequency Atlas of the United States, U.S. Department of Commerce Weather Bureau.	

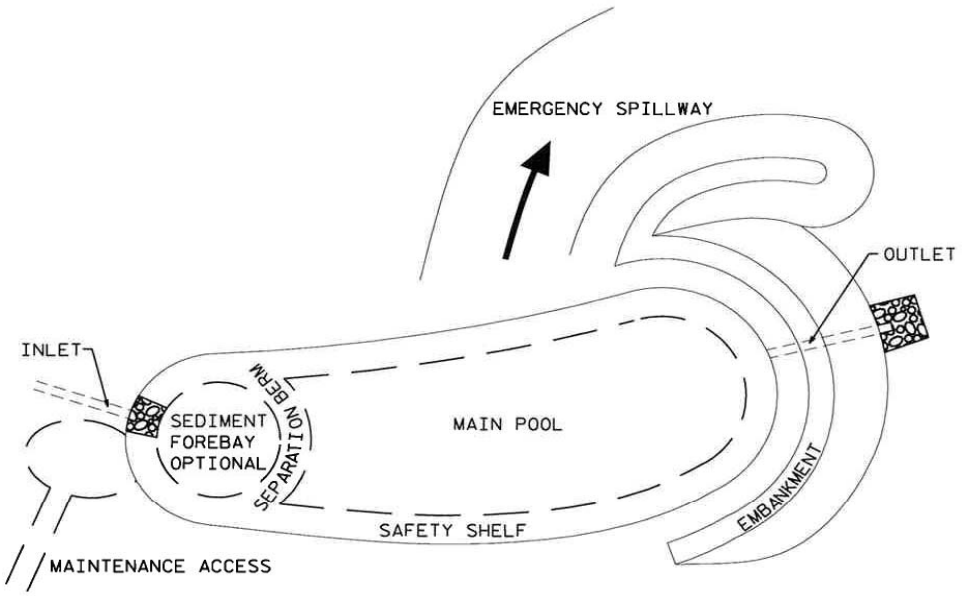
Table 3 - Rainfall for Wisconsin Counties for a 1-year, 24-hour Rainfall[2]		
Zone	Inches of Rainfall	County
1	2.22	Douglas, Bayfield, Burnett, Washburn, Sawyer, Polk, Barron, Rusk, Chippewa, Eau Claire
2	2.21	Ashland, Iron, Vilas, Price, Oneida, Taylor, Lincoln, Clark, Marathon
3	1.90	Florence, Forest, Marinette, Langlade, Menominee, Oconto, Door, Shawano
4	2.23	St. Croix, Dunn, Pierce, Pepin, Buffalo, Trempealeau, Jackson, La Crosse, Monroe
5	2.15	Wood, Portage, Waupaca, Juneau, Adams, Waushara, Marquette, Green Lake
6	1.96	Outagamie, Brown, Kewaunee, Winnebago, Calumet, Manitowoc, Fond du Lac, Sheboygan
7	2.25	Vernon, Crawford, Richland, Sauk, Grant, Iowa, Lafayette
8	2.25	Columbia, Dodge, Dane, Jefferson, Green, Rock
9	2.18	Ozaukee, Washington, Waukesha, Milwaukee, Walworth, Racine, Kenosha
[2]Bulletin 71: Rainfall Frequency Atlas of the Midwest, Midwest Climate Center and Illinois State Water Survey, 1992.		

Appendix B (cont'd.)

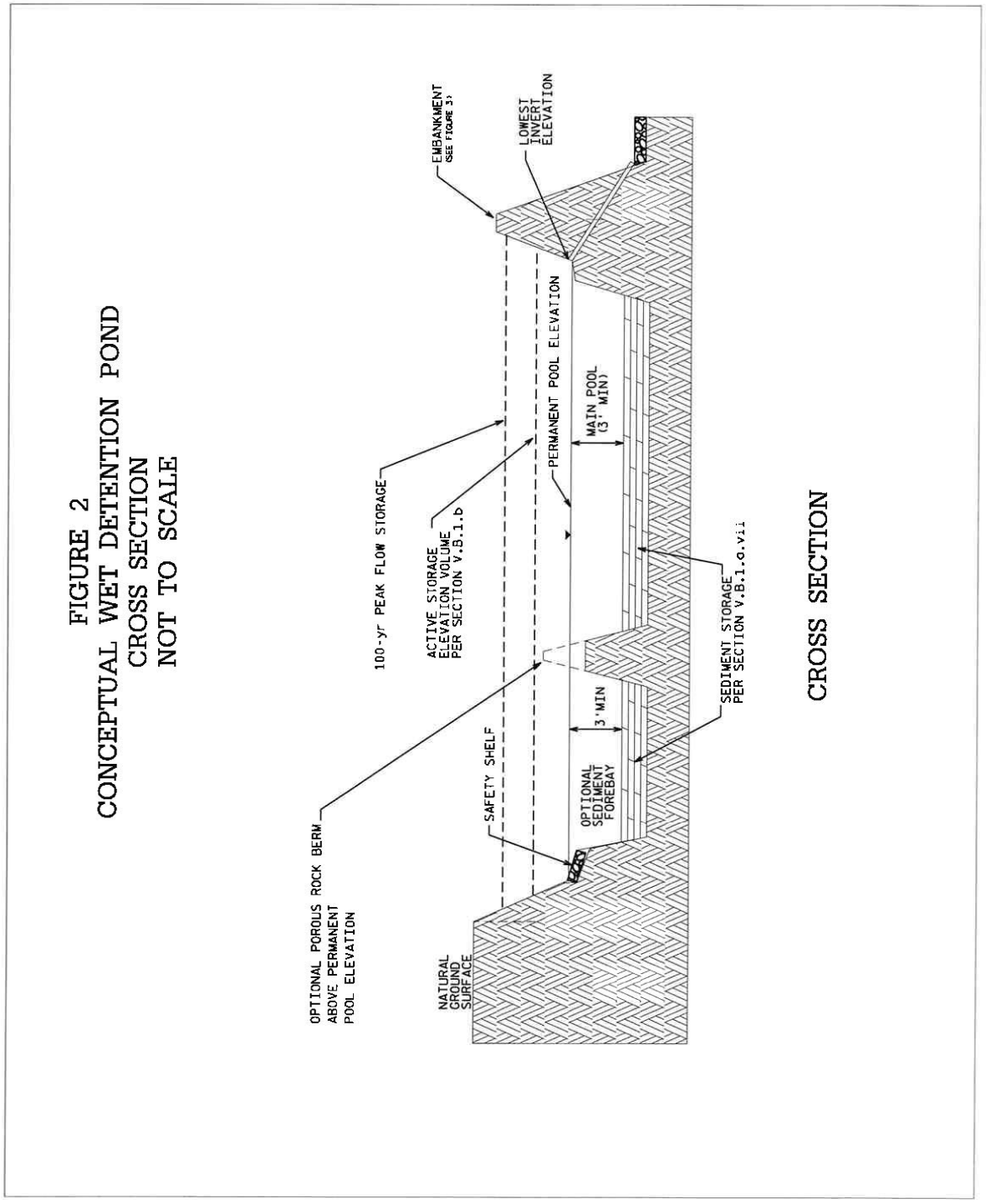
Table 4 – Runoff for Selected Curve Numbers and Rainfall Amounts[1]											
Runoff Depth in Inches for Curve Number of:											
Rainfall (inches)	50	55	60	65	70	75	80	85	90	95	98
1.9	0.00	0.01	0.04	0.11	0.20	0.33	0.50	0.72	1.01	1.39	1.68
1.96	0.00	0.01	0.05	0.12	0.23	0.36	0.54	0.77	1.06	1.44	1.73
2.1	0.00	0.02	0.08	0.16	0.28	0.43	0.62	0.87	1.18	1.58	1.87
2.15	0.00	0.03	0.09	0.18	0.30	0.46	0.66	0.91	1.22	1.63	1.92
2.18	0.00	0.03	0.10	0.19	0.31	0.47	0.68	0.93	1.25	1.65	1.95
2.2	0.00	0.04	0.10	0.19	0.32	0.48	0.69	0.94	1.27	1.67	1.97
2.21	0.00	0.04	0.10	0.20	0.32	0.49	0.69	0.95	1.28	1.68	1.98
2.22	0.00	0.04	0.10	0.20	0.33	0.49	0.70	0.96	1.28	1.69	1.99
2.23	0.01	0.04	0.11	0.20	0.33	0.50	0.71	0.97	1.29	1.70	2.00
2.25	0.01	0.04	0.11	0.21	0.34	0.51	0.72	0.98	1.31	1.72	2.02
2.3	0.01	0.05	0.12	0.23	0.36	0.54	0.75	1.02	1.35	1.77	2.07
2.4	0.02	0.07	0.15	0.26	0.41	0.59	0.82	1.10	1.44	1.87	2.17
2.5	0.02	0.08	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.96	2.27
2.6	0.03	0.10	0.20	0.34	0.50	0.71	0.96	1.26	1.62	2.06	2.37
[1]NRCS TR-55, Equations 2-1 to 2-4 used to determine runoff depths.											

Appendix C—Pond Geometry

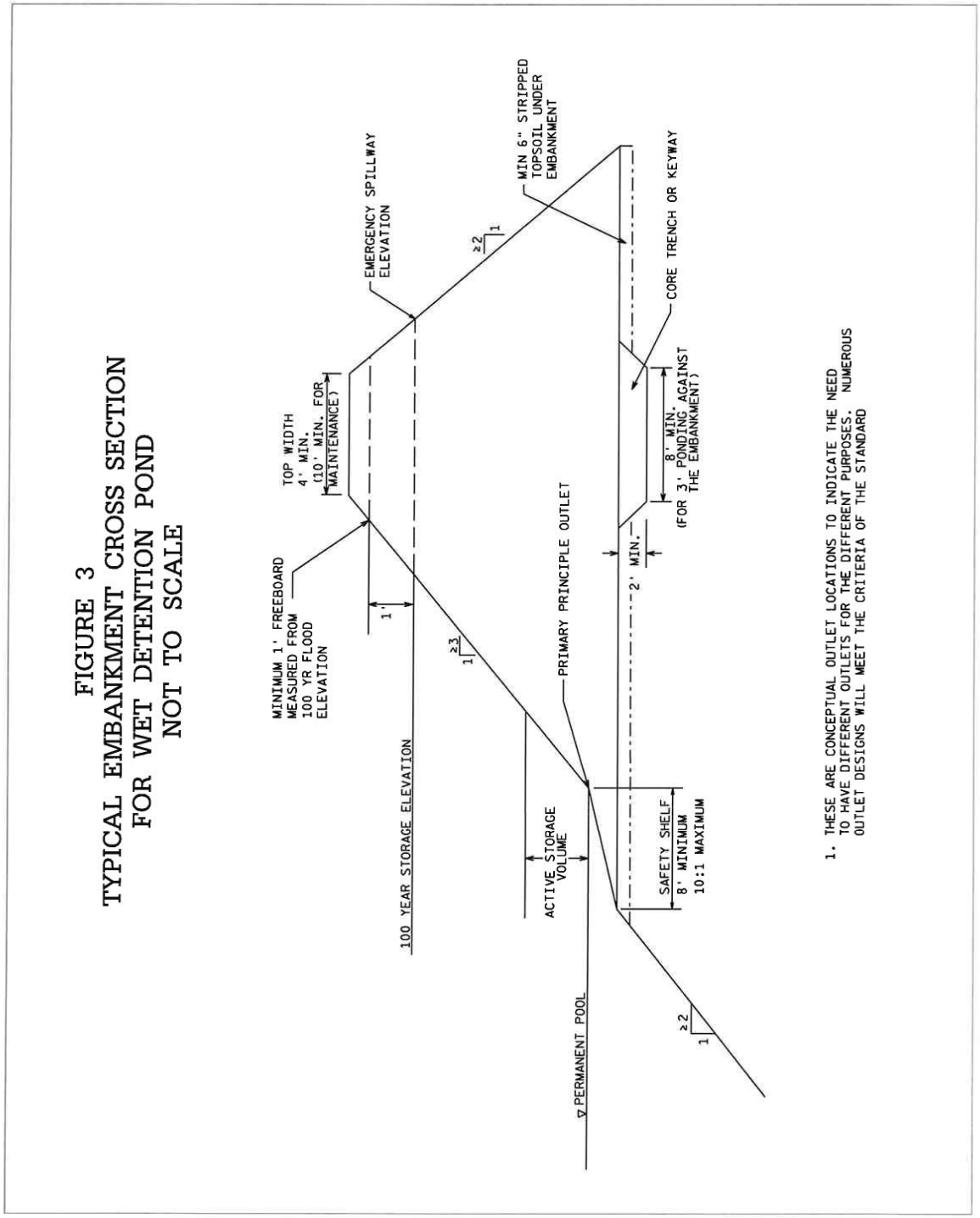
FIGURE 1
CONCEPTUAL WET DETENTION POND
PLAN VIEW
NOT TO SCALE



Appendix C—Pond Geometry (cont'd.)



Appendix C—Pond Geometry (cont'd.)



Appendix D—Pond Liner Design, Decision Flowchart

Pond Liner Design Specifications for Three Levels of Liners

A. Type A Liners—for sites with the highest potential for groundwater pollution. They include:
- Clay (natural soil, not bentonite)
- High Density Polyethylene (HDPE)
- Geosynthetic Clay Liners (GCL)

1. Clay liner criteria (essentially the same as the clay below landfills but not as thick):
   a. 50% fines (200 sieve) or more.
   b. An in-place hydraulic conductivity of 1×10^{-7} cm./sec. or less.
   c. Average liquid limit of 25 or greater, with no value less than 20.
   d. Average PI of 12 or more, with no values less than 10.
   e, Clay installed wet of optimum if using standard Proctor, and 2% wet of optimum if using modified Proctor.
   f. Clay compaction and documentation as specified in NRCS Wisconsin Construction Specification 300, Clay Liners.
   g. Minimum thickness of two feet.
   h. Specify method for keeping the pool full or use of composite soils below liner.
2. HDPE liner criteria:
   a. Minimum thickness shall be 60 mils.
   b. Design according to the criteria in Table 3 of the NRCS 313, Waste Storage Facility technical standard.
   c. Install according to NRCS Wisconsin Construction Specification 202, Polyethylene Geomembrane Lining.
3. GCL liner criteria:
   a. Design according to the criteria in Table 4 of NRCS 313, Waste Storage Facility technical standard.
   b. Install according to NRCS Wisconsin Construction Specification 203, Geosynthetic Clay Liner.

B. Type B Liners—for sites with medium potential for groundwater pollution or where need for a full pool level is high. They include:
- All liners meeting Type A criteria
- Clay
- HDPE
- Polyethylene Pond Liner (PPL)

1. Clay liner criteria:
   a. 50% fines (200 sieve) or more.
   b. An in-place hydraulic conductivity of 1×10^{-6} cm./sec. or less.
   c. Average liquid limit value of 16 or greater, with no value less than 14.
   d. Average PI of 7 or more with no values less than 5.
   e. Clay compaction and documentation as specified in NRCS Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.
   f. Minimum thickness of two feet.
   g. Specify method for keeping the pool full or use of composite soils below liner.
2. HDPE liner criteria:
   a. Minimum thickness shall be 40 mils.
   b. All other criteria same as for Type A HDPE liner.
3. PPL liner criteria:
   a. Minimum thickness shall be 30 mils.
   b. All other criteria same as for Type A HDPE liner.

C. Type C Liners—for sites with little potential for groundwater pollution or where the need for a full pool is less important. They include:
- All liners meeting Type A or B criteria
- Silts and clays
- HDPE (<40 mil)
- PPL (20-24 mil)
- PVC (30-40 mil)
- EPDM (45 mil)

1. Silt/Clay liner criteria:
   a. 50% fines (200 sieve), or 20% fines and a PI of 7.
   b. Soil compaction and documentation as specified in NRCS Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.
   c. Minimum thickness of two feet.
   d. Specify method for keeping the pool full or use of composite soils below liner.

D. Liner Elevation—All liners must extend above the permanent pool up to the elevation reached by the 2-yr., 24-hour storm event.

E. For synthetic liners, follow the manufacturers' recommendations for installation.

Appendix E—Aerators/Fountains

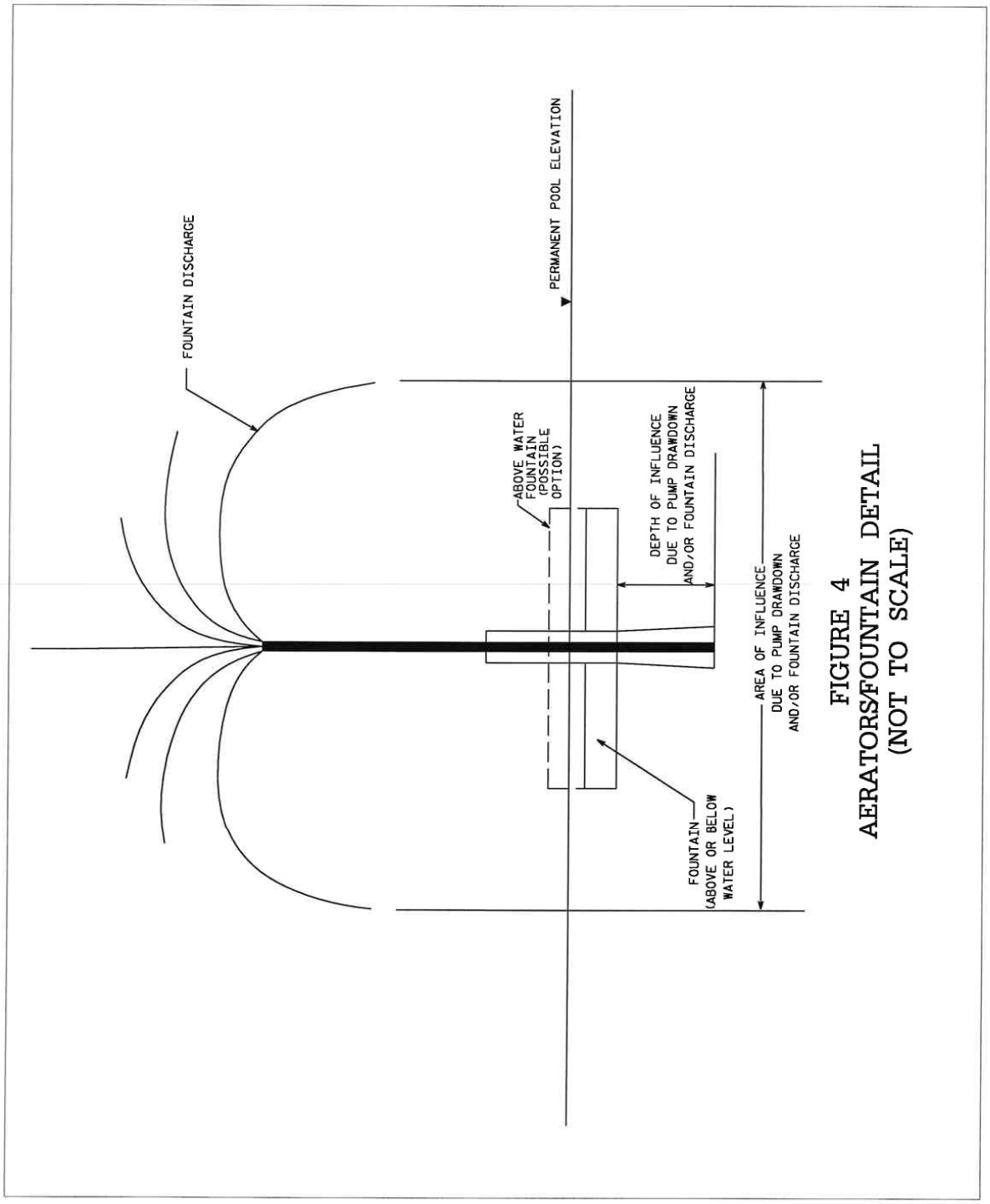
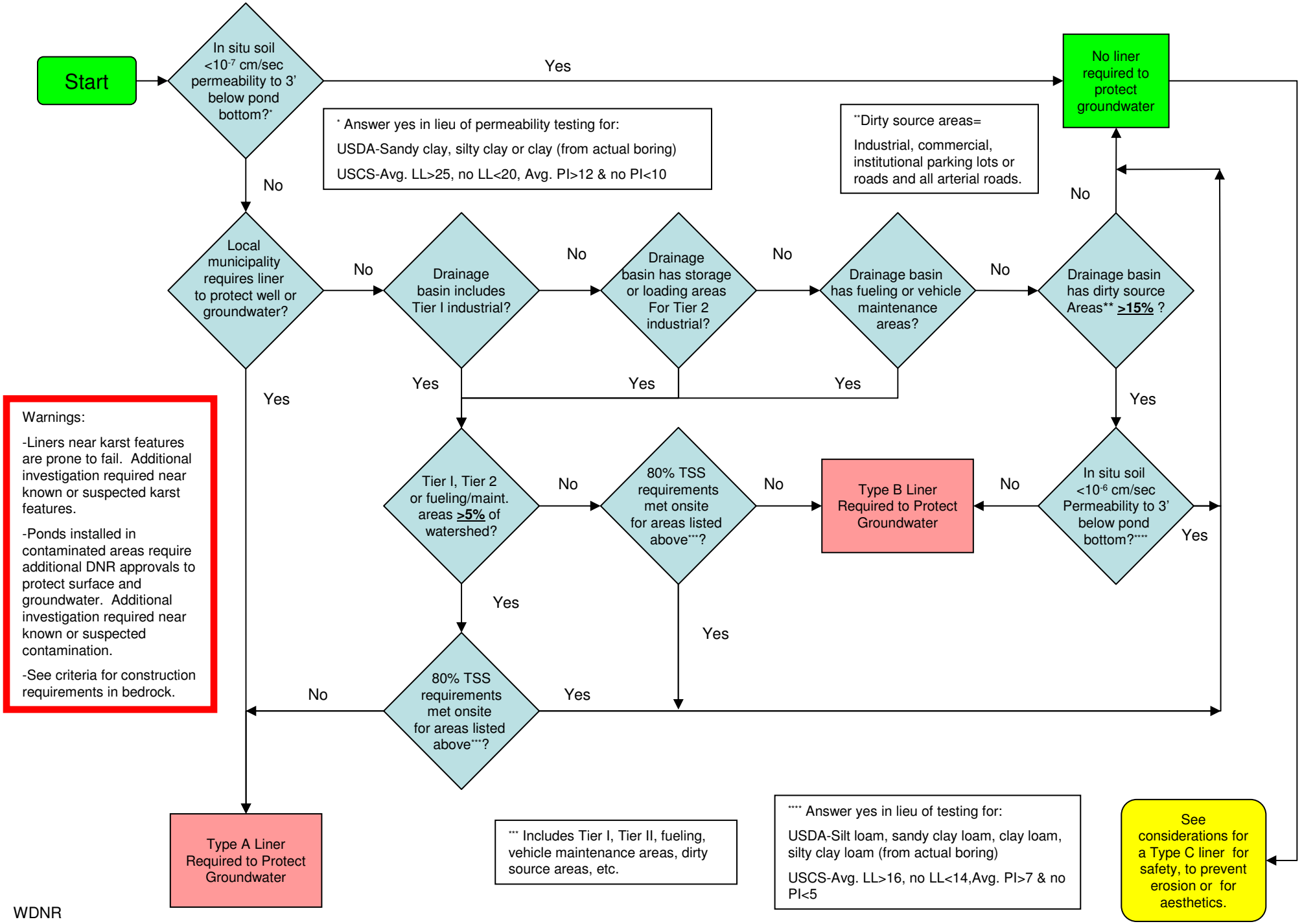


FIGURE 4
AERATORS/FOUNTAIN DETAIL
(NOT TO SCALE)

Appendix D - Liner Flow Chart for Wet Detention Ponds



WDNR
10/07

APPENDIX D
INFILTRATION TECHNICAL STANDARDS

Site Evaluation for Stormwater Infiltration
(1002)

Wisconsin Department of Natural Resources
Conservation Practice Standards

I. Definition

This standard defines site evaluation procedures to:

1. Perform an initial screening of a *development site*[1] to determine its suitability for infiltration.
2. Evaluate each area within a development site that is selected for infiltration.
3. Prepare a site evaluation report.

II. Purpose

1. Establish methodologies to characterize the site and screen for exclusions and exemptions under Chapter NR 151 Wis. Adm. code.
2. Establish requirements for siting an *infiltration device* and the selection of design infiltration rates.
3. Define requirements for a site evaluation report that insures appropriate areas are selected for infiltration and an appropriate *design infiltration rate* is used.

III. Conditions where Practice Applies

This standard is intended for development sites being considered for stormwater infiltration devices. Additional site location requirements may be imposed by other stormwater infiltration device technical standards.

IV. Federal, State and Local Laws

Users of this standard shall be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing infiltration devices. This standard does not contain the text of federal, state or local laws.

V. Criteria

The site evaluation consists of four steps for locating the optimal areas for infiltration, and properly sizing infiltration devices.

- Step A. Initial Screening.
- Step B. Field Verification of information collected in Step A.
- Step C. Evaluation of Specific *Infiltration Areas*.
- Step D. Soil and Site Evaluation Reporting.

The steps shall coincide, as much as possible, for when the information is needed to determine the following: 1) the potential for infiltration on the site, 2) the optimal locations for infiltration devices, and 3) the design of the infiltration device(s). Steps A and B shall be completed as soon as possible in the approval process. See Consideration VI.M for an example.

Step A. Initial Screening

The initial screening identifies potential locations for infiltration devices. The purpose of the initial screening is to determine if installation is limited by ss. NR 151.12(5)(c)5. or NR 151.12(5)(c)6., and to determine where field work is needed for Step B. Optimal locations for infiltration are verified in Step B.

Information collected in Step A will be used to explore the potential for multiple infiltration areas versus relying on a regional infiltration device. Smaller infiltration devices dispersed around a development are usually more sustainable than a single *regional device* that is more likely to have maintenance and groundwater mounding problems.

The initial screening shall determine the following: Note: Useful references for the existing resource maps and information are listed in Considerations VI.I and J.

1. Site topography and slopes greater than 20%.
2. Site soil infiltration capacity characteristics as defined in NRCS County soil surveys.
3. *Soil parent material.*
4. Regional or local depth to groundwater and bedrock. Use seasonally *high groundwater* information where available.

[1] Words in the standard that are shown in italics are described in VIII. Definitions. The words are italicized the first time they are used in the text.

5. Distance to sites listed on the GIS Registry of Closed Remediation sites within 500 feet from the perimeter of the development site.
6. Distance to sites listed on the Bureau of Remediation and *Redevelopment* Tracking System within 500 feet from the perimeter of the development site.
7. Presence of endangered species habitat.
8. Presence of flood plains and flood fringes.
9. Location of hydric soils based on the USDA County Soil Survey and wetlands from the WDNR Wisconsin Wetland Inventory map.
10. Sites where the installation of stormwater infiltration devices is excluded, due to the potential for groundwater contamination, by chapter NR 151 Wis. Adm. Code.
11. Sites exempted by chapter NR 151 Wis. Adm. Code from the requirement to install infiltration devices.
12. Potential impact to adjacent property.

Step B. Field Verification of the Initial Screening

A. Field verification is required for areas of the development site considered suitable for infiltration. This includes verification of Step A.1, 2, 3, 4, 9, 10 and 11.

B. Sites shall be tested for depth to groundwater, depth to bedrock and *percent fines* information to verify any exemption and exclusion found in Step A.10 and 11. The following is a description of the percent fines expected for each type of soil textural classification.

   1. Several textural classes are assumed to meet the percent fines limitations of Ch. NR 151.12(5)(c)5.i. for both 3 and 5 foot soil layers. These classifications include the sandy loams, loams, silt loams and all the clay textural classifications. *Coarse sand* is the only soil texture that by definition will not meet NR 151.12(5)(c)5.i. limitations for a 3 foot soil layer consisting of 20% fines. Other sand textures and loamy sands may need the percent fines level verified with a laboratory analysis.

   2. Borings and pits shall be dug to verify soil infiltration capacity characteristics and to determine depth to groundwater and bedrock.

C. The following information shall be recorded for Step B:

   1. The date or dates the data was collected.
   2. A legible site plan/map that is presented on paper that is no less than 8 ½ X 11 inches in size and:

      a. Is drawn to scale or fully dimensional.
      b. Illustrates the entire development site.
      c. Shows all areas of planned filling and/or cutting.
      d. Includes a permanent vertical and horizontal reference point.
      e. Shows the percent and direction of land slope for the site or contour lines. Highlight areas with slopes over 20%.
      f. Shows all flood plain information that is pertinent to the site.
      g. Shows the location of all pits/borings included in the report.
      h. Location of wetlands as field delineated and surveyed.
      i. Location of karst features, private wells within 100 feet of the development site, and public wells within 400 feet of the development site.

   3. Soil profile descriptions must be written in accordance with the descriptive procedures, terminology and interpretations found in the Field Book for Describing and Sampling Soils, USDA, NRCS, 1998. Frozen soil material must be thawed prior to conducting evaluations for soil color, texture, structure and consistency. In addition to the data determined in Step B, soil profiles must include the following information for each soil horizon or layer:

      a. Thickness, in inches or decimal feet.
      b. Munsell soil color notation.
      c. Soil mottle or redoximorphic feature color, abundance, size and contrast.
      d. USDA soil textural class with rock fragment modifiers.
      e. Soil structure, grade size and shape.
      f. Soil consistence, root abundance and size.
      g. Soil boundary.
      h. Occurrence of saturated soil, groundwater, bedrock or disturbed soil.

Step C. Evaluation of Specific Infiltration Areas

This step is to determine if locations identified for infiltration devices are suitable for infiltration, and to provide the required information to design the device.

A minimum number of borings or pits shall be constructed for each infiltration device (Table 1). The following information shall be recorded for Step C:

1. All the information under Step B.C.3.

2. A legible site plan/map that is presented on paper no less than 8 1/2 X 11 inches in size and:

   a. Is drawn to scale or fully dimensional.
   b. Illustrates the location of the infiltration devices.
   c. Shows the location of all pits and borings.
   d. Shows distance from device to wetlands.

3. An analysis of groundwater mounding potential is required as per Table 1. The altered groundwater level, based on mounding calculations, must be considered in determining the vertical separation distance from the infiltration surface to the *highest anticipated groundwater elevation* as specified in NR 151. References include but are not limited to Finnemore 1993 and 1995, and Hantush 1967.

4. One of the following methods shall be used to determine the design infiltration rate:

   a. Infiltration Rate Not Measured - Table 2 shall be used if the infiltration rate is not measured. Select the design infiltration rate from Table 2 based on the least permeable soil horizon five feet below the bottom elevation of the infiltration system.

   b. Measured Infiltration Rate - The tests shall be conducted at the proposed bottom elevation of the infiltration device. If the infiltration rate is measured with a *Double-Ring Infiltrometer* the requirements of ASTM D3385 shall be used for the field test.

      The measured infiltration rate shall be divided by a correction factor selected from Table 3. The correction factor adjusts the measured infiltration rates for the occurrence of less permeable soil horizons below the surface and the potential variability in the subsurface soil horizons throughout the infiltration site.

      A less permeable soil horizon below the location of the measurement increases the level of uncertainty in the measured value. Also, the uncertainty in a measurement is increased by the variability in the subsurface soil horizons throughout the proposed infiltration site.

      To select the correction factor from Table 3, the ratio of design infiltration rates must be determined for each place an infiltration measurement is taken. The design infiltration rates from Table 2 are used to calculate the ratio. To determine the ratio, the design infiltration rate for the surface textural classification is divided by the design infiltration rate for the least permeable soil horizon. For example, a device with a loamy sand at the surface and a least permeable layer of loam will have a design infiltration rate ratio of about 6.8 and a correction factor of 4.5. The depth of the least permeable soil horizon should be within five feet of the proposed bottom of the device or to the depth of a limiting layer.

5. To determine if infiltration is not required under NR 151.12(5)(c)6.a., a scientifically credible field test method is required unless the least permeable soil horizon five feet below the bottom of infiltration system is one of the following: sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, or clay. The infiltration rate used to claim the exemption shall be the actual field measurement and shall be used without the correction factors found in Table 3.

Step D. Soil and Site Evaluation Report Contents

The site's legal description and all information required in Steps B and C shall be included in the Soil and Site Evaluation Report. These reports shall be completed prior to the *construction plan* submittal.

Table 1: Evaluation Requirements Specific to Proposed Infiltration Devices

Infiltration Device	Tests Required[1]	Minimum Number of Borings/Pits Required	Minimum Drill/Test Depth Required Below the Bottom of the Infiltration System
Irrigation Systems[2]	Pits or borings	NA[2]	5 feet or depth to *limiting layer*, whichever is less.
Rain Garden[2]	Pits or Borings	NA[2]	5 feet or depth to limiting layer, whichever is less.
Infiltration Trenches (≤ 2000 sq feet impervious drainage area)	Pits or borings	1 test/100 linear feet of trench with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer, whichever is less.
Infiltration Trenches (> 2000 sq ft of impervious drainage area)	• Pits or borings • Mounding potential	1 pit required and an additional 1 pit or boring/100 linear feet of trench, and sufficient to determine variability	Pits to 5 feet or depth to limiting layer Borings to 15 feet or depth to limiting layer
Bioretention Systems	• Pits or borings • Mounding potential	1 test/50 linear feet of device with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer
Infiltration Grassed Swales	Pits or borings	1 test/1000 linear feet of swale with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer
Surface *Infiltration Basins*	• Pits or borings • Mounding potential	2 pits required per infiltration area with an additional 1 pit or boring for every 10,000 square feet of infiltration area, and sufficient to determine variability	Pits to 10 feet or depth to limiting layer Borings to 20 feet or depth to limiting layer
Subsurface Dispersal Systems greater than 15 feet in width.	• Pits or borings • Mounding potential	2 pits required per infiltration area with an additional 1 pit or boring for every 10,000 square feet of infiltration area, and sufficient to determine variability	Pits to 10 feet or depth to limiting layer Borings to 20 feet or depth to limiting layer

[1]Continuous soil borings shall be taken using a bucket auger, probe, split-spoon sampler, or shelby tube. Samples shall have a minimum 2-inch diameter. Soil pits must be of adequate size, depth and construction to allow a person to enter and exit the pit and complete a morphological soil profile description.

[2]Information from Step B is adequate to design rain gardens and irrigation systems.

Table 2: Design Infiltration Rates for Soil Textures Receiving Stormwater

Soil Texture[1]	Design Infiltration Rate Without Measurement inches/hour[2]
Coarse sand or coarser	3.60
Loamy coarse sand	3.60
Sand	3.60
Loamy sand	1.63
Sandy loam	0.50
Loam	0.24
Silt loam	0.13
Sandy clay loam	0.11
Clay loam	0.03
Silty Clay loam	0.04[3]
Sandy clay	0.04
Silty clay	0.07
Clay	0.07

[1]Use sandy loam design infiltration rates for fine sand, loamy fine sand, very fine sand, and loamy fine sand soil textures.

[2] Infiltration rates represent the lowest value for each textural class presented in Table 2 of Rawls, 1998.

[3] Infiltration rate is an average based on Rawls, 1982 and Clapp & Hornberger, 1978.

Table 3: Total Correction Factors Divided into Measured Infiltration Rates

Ratio of Design Infiltration Rates[1]	Correction Factor
1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16.0	6.5
16.1 or greater	8.5

[1]Ratio is determined by dividing the design infiltration rate (Table 2) for the textural classification at the bottom of the infiltration device by the design infiltration rate (Table 2) for the textural classification of the least permeable soil horizon. The least permeable soil horizon used for the ratio should be within five feet of the bottom of the device or to the depth of the limiting layer.

Required Qualifications

A. Site Evaluations - Individuals completing site evaluations shall be a licensed professional acceptable to the authority having jurisdiction and have experience in soil investigation, interpretation and classification.

B. Soil Evaluations - Individuals completing the soils evaluation shall be a Soil Scientist licensed by the Department of Regulation and Licensing or other licensed professional acceptable to the authority having jurisdiction.

VI. Considerations

Additional recommendations relating to design that may enhance the use of, or avoid problems with this practice but are not required to insure its function are as follows:

A. Groundwater monitoring wells, constructed as per chapter NR 141, Wis. Adm. Code, can be used to determine the seasonal *high groundwater level*. Large sites considered for infiltration basins may need to be evaluated for the direction of groundwater flow.

B. Karst Inventory Forms on file with the Wisconsin Geological and Natural History Survey should be filled out if a karst feature is located within the site.

C. Cation Exchange Capacity (CEC) of the soil can indicate the number of available adsorption sites. Sandy soils have limited adsorption capacity and a CEC ranging from 1-10 meq/100g. Clay and organic soils have a CEC greater than 20 and have a high adsorption rate.

D. Soil organic matter and pH can be used to determine adsorption of stormwater contaminants. A pH of 6.5 or greater is optimal. A soil organic content greater than 1 percent will enhance adsorption.

E. NR 151 provides for a maximum area to be dedicated for infiltration depending upon land use. This cap can be voluntarily exceeded.

F. One or more areas within a development site may be selected for infiltration. A development site with many areas suitable for infiltration is a good candidate for a dispersed approach to infiltration. It may be beneficial to contrast regional devices with onsite devices that receive runoff from one lot or a single source area within a lot, such as rooftop or parking lot.

G. Stormwater infiltration devices may fail prematurely if there is:

1. An inaccurate estimation of the Design Infiltration Rate;
2. An inaccurate estimation of the seasonal high water table;
3. Excessive compacting or sediment loading during construction;
4. No pretreatment for post-development and lack of maintenance.

H. No construction erosion should enter the infiltration device. This includes erosion from site grading as well as home building and construction. If possible, rope off areas selected for infiltration during grading and construction. This will preserve the infiltration rate and extend the life of the device.

I. Resources available for completing Step A. Initial screening:

1. Sites listed on the GIS Registry of Closed Remediation sites. http://gomapout.dnr.state.wi.us/org/at/et/geo/gwur/index.htm
2. Sites listed in the Bureau of Remediation and Redevelopment Tracking System. http://dnr.wi.gov/org/aw/rr/brrts/index.htm
3. Flood plain areas as regulated under s. 87.30, Wis. Stats. and NR 116, NR 30 and NR 31, Wis. Adm. Code.
4. Wetlands as defined in Ch. NR 103, Wis. Adm. Code.
5. Endangered species habitat as shown on National Heritage Inventory County maps
6. Access points and road setbacks as determined by county or municipal zoning plans.
7. Existing reports concerning the groundwater and bedrock. Examples include: Publications from USGS, NRCS, Regional Planning Commissions, DNR, DATCP, DOT, UW system or WGNHS.
8. The Drinking Water and Groundwater pages of the DNR http://dnr.wi.gov/org/water/dwg/
9. The Wisconsin Grain Size Database http:\\www.geology.wisc.edu/~qlab/

J. The development site should be checked to determine the potential for archeological sites. This search may be conducted by state staff for projects required or funded by the state.

K. Slopes 20% or greater are inappropriate for some infiltration devices.

L. Expect to complete the preliminary design work (Criteria Step A through Step C) before the approval process (platting). Once required information is compiled, the initial design work for an infiltration device can begin.

M. The approval process requirements for development sites vary across the state and may also vary within a municipality depending on the number of lots being developed. The timing of Steps A, B, and C might have to be adjusted for the type of approval process. The following is an example of when the steps might be completed for a typical development site requiring a plat. The sequence in the example would comply with the criteria for timing of Steps A, B, and C.

Step A should be completed before the preliminary plat and Step B should be completed before the final plat, or CSM is approved. For regional infiltration devices, and for devices constructed on public right-of-ways, public land or jointly owned land, Step C should be completed before the final plat or final CSM approval.

It can be difficult to select the final location and drainage area for an infiltration device before the use of the lot is known. Sometimes it is more desirable to design an infiltration device for an individual lot after the lot is purchased. For this situation Step C would be completed after the final plat is approved. The information for Step C would be collected when the lot is purchased. To give future devices credit towards achieving the infiltration performance standard, the final plat would contain approximate sizing information for each device. Information from Step A and B would be used to determine the approximate sizing information.

N. The inner ring of the Double-Ring Infiltrometer should be at least 12 inches in diameter.

O. Section NR 151.12(5)(c)5., is included in the administrative code as a means to discourage infiltration of runoff from or into the listed areas, due to potential concerns of groundwater contamination. Although it is not illegal to infiltrate storm water in areas with the listed limitations, DNR will not give credit for this infiltration towards meeting the infiltration requirements of ss. NR 151.12(5)(c)1. or NR 151.12(5)(c)2. Runoff that is infiltrated must be in compliance with s. NR 151.12(5)(c)8., which requires minimizing infiltration of pollutants so that groundwater quality standards are maintained.

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VIII. Definitions

Bioretention systems (Table 1): Bioretention is an infiltration device consisting of an excavated area that is back-filled with an engineered soil, covered with a mulch layer and planted with a diversity of woody and herbaceous vegetation. Storm water directed to the device percolates through the mulch and engineered soil, where it is treated by a variety of physical, chemical and biological processes before infiltrating into the native soil.

Construction Plan (V.Step D): A map and/or plan describing the built-out features of an individual lot.

Coarse sand (V.Step B.B.1): Soil material that contains 25% or more very coarse and coarse sand, and <50% any other one grade of sand.

Design infiltration rate (II.3): A velocity, based on soil structure and texture, at which precipitation or runoff enters and moves into or through soil. The design rate is used to size an infiltration device or system. Rates are selected to be minimal rates for the different types of soils. Selection of minimal rates will provide a robust design and maximize the longevity of the device.

Development site (I.1): The entire area planned for development, irrespective of how much of the site is disturbed at any one time or intended land use. It can be one lot or multiple lots.

Double-ring infiltrometer (V.Step C.4.b): A device that directly measures infiltration rates into a soil surface. The double-ring infiltrometer requires a fairly large pit excavated to depth of the proposed infiltration device and preparation of a soil surface representative of the bottom of the infiltration area.

High groundwater level (V.Step A.4): The higher of either the elevation to which the soil is saturated as observed as a free water surface in an unlined hole, or the elevation to which the soil has been seasonally or periodically saturated as indicated by soil color patterns throughout the soil profile.

Highest anticipated groundwater elevation (V.Step C.3): The sum of the calculated mounding effects of the discharge and the seasonal high groundwater level.

Infiltration areas (V): Areas within a development site that are suitable for installation of an infiltration device.

Infiltration basin (Table 1): An open impoundment created either by excavation or embankment with a flat densely vegetated floor. It is situated on permeable soils and temporarily stores and allows a designed runoff volume to infiltrate the soil.

Infiltration device (II.2): A structure or mechanism engineered to facilitate the entry and movement of precipitation or runoff into or through the soil. Examples of infiltration devices include irrigation systems, rain gardens, infiltration trenches, bioretention systems, infiltration grassed swales, infiltration basins, subsurface dispersal systems and infiltration trenches.

Infiltration trench (Table 1): An excavated trench that is usually filled with coarse, granular material in which stormwater runoff is collected for temporary storage and infiltration. Other materials such as metal pipes and plastic domes are used to maintain the integrity of the trench.

Irrigation system (Table 1): A system designed to disperse stored stormwater to lawns or other pervious areas.

Limiting layer (Table 1): A limiting layer can be bedrock, an aquatard, aquaclude or the seasonal high groundwater table.

Percent fines (V. Step B.B): the percentage of a given sample of soil, which passes through a # 200 sieve.

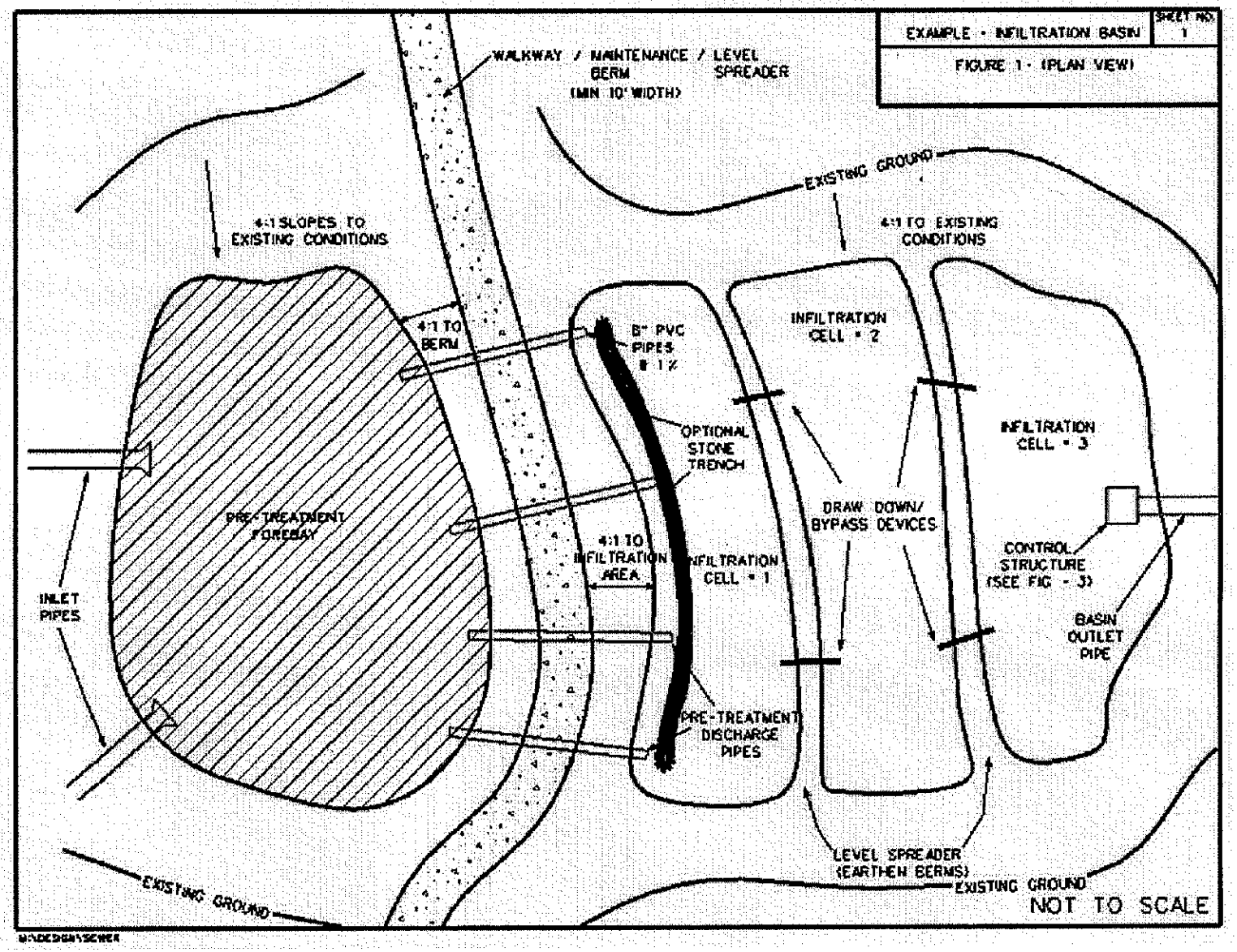
Rain garden (Table 1): A shallow, vegetated depression that captures stormwater runoff and allows it to infiltrate.

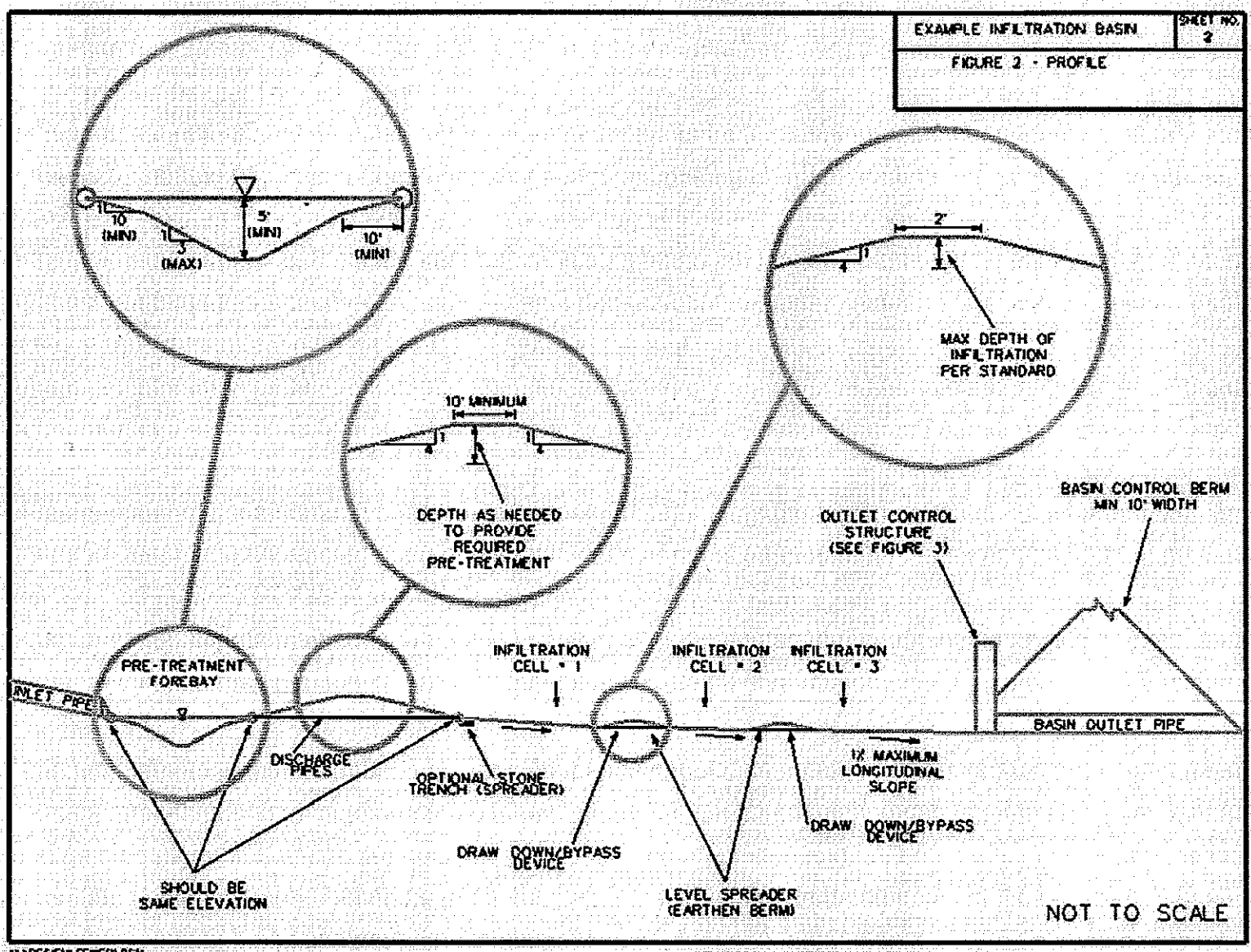
Regional device (V.Step A): An infiltration system that receives and stores stormwater runoff from a large area. Infiltration basins are the most commonly used regional infiltration devices.

Redevelopment (V.Step A.6): Areas where new development is replacing older development.

Soil parent material (V.Step A.3): The unconsolidated material, mineral or organic, from which the solum develops.

Subsurface dispersal systems (Table 1): An exfiltration system that is designed to discharge stormwater through piping below the ground surface, but above the seasonal high groundwater table.


EXAMPLE - INFILTRATION BASIN
SHEET NO. 1
FIGURE 1 - (PLAN VIEW)
WALKWAY / MAINTENANCE / LEVEL SPREADER BERM (MIN 10' WIDTH)
EXISTING GROUND
4:1 SLOPES TO EXISTING CONDITIONS
4:1 TO EXISTING CONDITIONS
4:1 TO BERM
8" PVC PIPES @ 1%
INFILTRATION CELL - 2
INFILTRATION CELL - 3
OPTIONAL STONE TRENCH
PRE-TREATMENT FOREBAY
4:1 TO INFILTRATION AREA
INFILTRATION CELL - 1
DRAW DOWN/ BYPASS DEVICES
CONTROL STRUCTURE (SEE FIG - 3)
INLET PIPES
BASIN OUTLET PIPE
PRE-TREATMENT DISCHARGE PIPES
LEVEL SPREADER (EARTHEN BERMS)
EXISTING GROUND
EXISTING GROUND
NOT TO SCALE


EXAMPLE INFILTRATION BASIN
SHEET NO. 2
FIGURE 2 - PROFILE
10' (MIN)
3 (MAX)
5' (MIN)
10' (MIN)
2'
MAX DEPTH OF INFILTRATION PER STANDARD
10' MINIMUM
DEPTH AS NEEDED TO PROVIDE REQUIRED PRE-TREATMENT
BASIN CONTROL BERM MIN 10' WIDTH
OUTLET CONTROL STRUCTURE (SEE FIGURE 3)
PRE-TREATMENT FOREBAY
INLET PIPE
INFILTRATION CELL # 1
INFILTRATION CELL # 2
INFILTRATION CELL # 3
BASIN OUTLET PIPE
DISCHARGE PIPES
OPTIONAL STONE TRENCH (SPREADER)
1% MAXIMUM LONGITUDINAL SLOPE
DRAW DOWN/BYPASS DEVICE
DRAW DOWN/BYPASS DEVICE
SHOULD BE SAME ELEVATION
LEVEL SPREADER (EARTHEN BERM)
NOT TO SCALE
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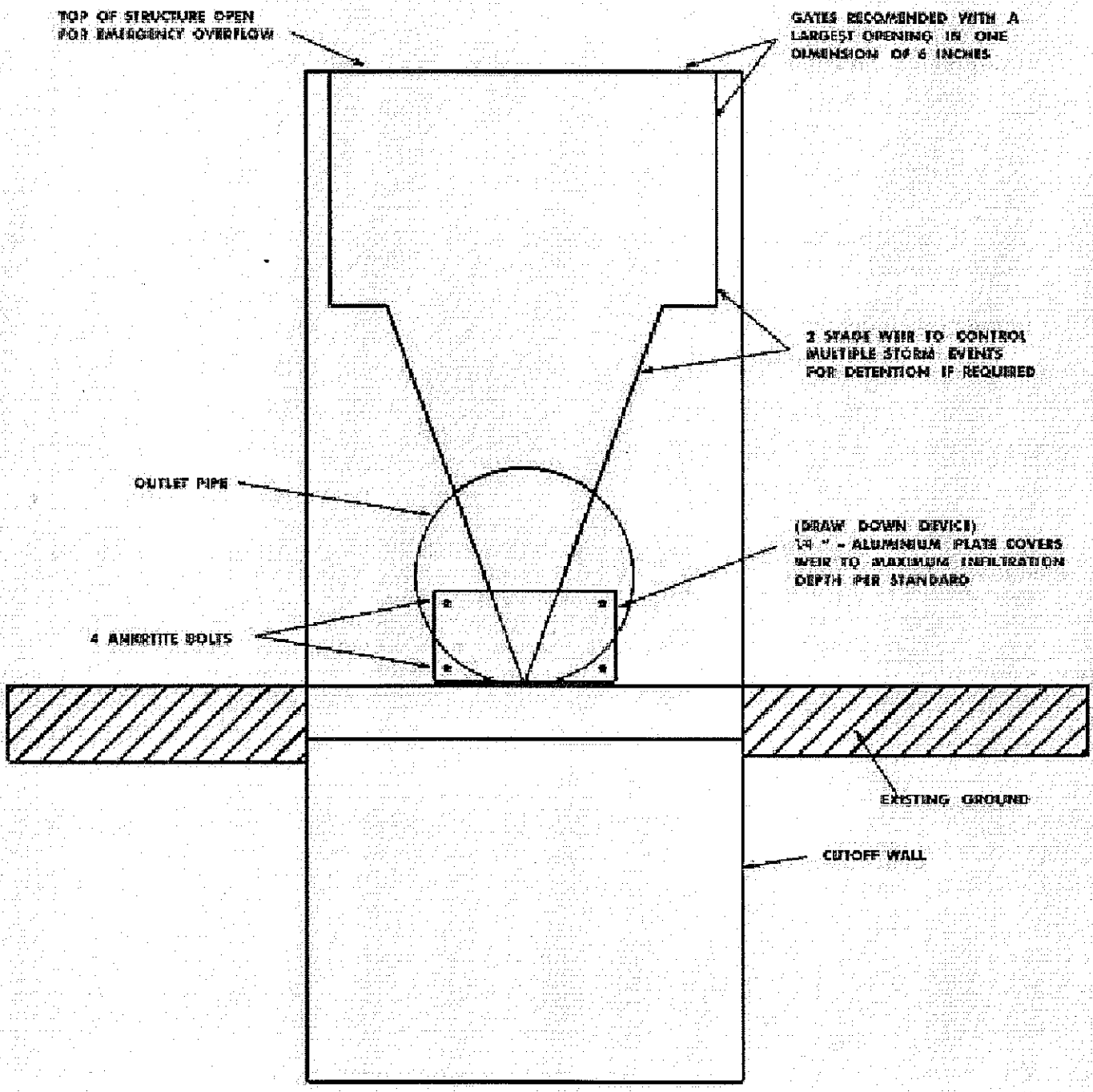
EXAMPLE INFILTRATION BASIN OUTLET STRUCTURE	SHEET NO. 3

FIGURE 3 - FRONT VIEW



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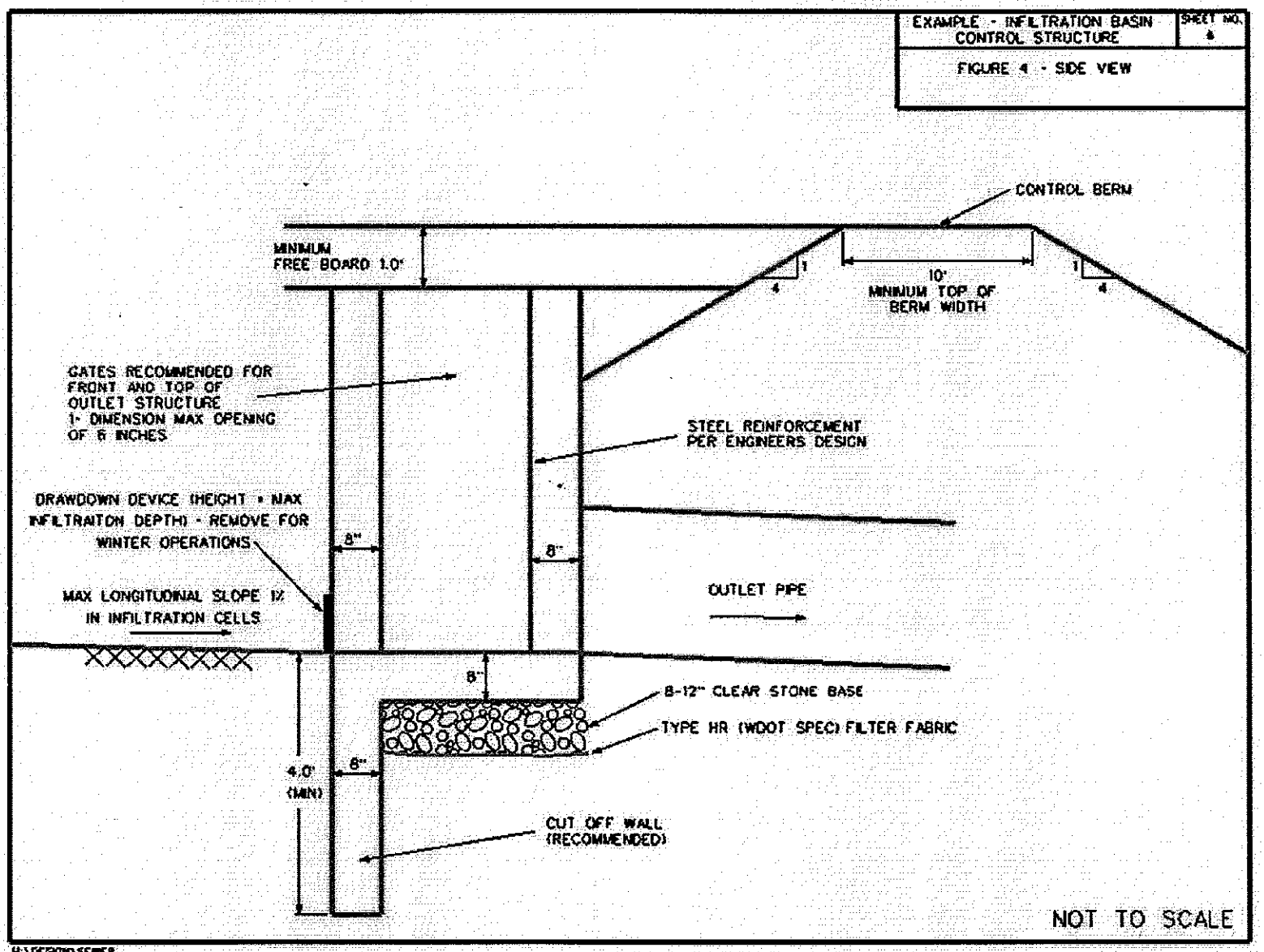
EXAMPLE - INFILTRATION BASIN CONTROL STRUCTURE

SHEET NO. 6

FIGURE 4 - SIDE VIEW



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Infiltration Basin

(Acre-Feet)
(1003)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

An infiltration basin is defined as an open impoundment (greater than 15 feet wide in its minimum dimension) created either by excavation or embankment with a flat, densely vegetated floor dedicated to the infiltration of runoff through the ground surface.

II. Purpose

The practice may be applied as part of a structural stormwater management practice system to support one or more of the following purposes:

- Reduce stormwater pollutants
- Increase discharge to groundwater
- Decrease runoff peak flow rates and volumes
- Preserve base flow in streams
- Reduce temperature impacts of runoff.

III. Conditions Where Practice Applies

The infiltration basin practice applies to urban areas where increased pollutant loadings, thermal impacts, or increased runoff volumes are a concern and the area is suitable for infiltration. (See NR 151.12(5) (c) 5 and 6 and WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002).)

IV. Federal, State and Local Laws

Users of this standard shall be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing infiltration basins. This standard does not contain the text of federal, state or local laws.

V. Criteria

A. Screening criteria located in the WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002) shall be followed. In addition, the following site location criteria shall be met.

1. Building location – The basin shall not be *hydraulically connected*[1] to foundations or pavements, or cause negative impacts to structures. These negative impacts could include: water in basements and foundation instability.

2. 20% Slopes - Infiltration shall not cause seepage, contribute to hill slope failure or increase erosion on down gradient slopes. A minimum horizontal setback distance of 200 feet shall be maintained from down gradient slopes greater than 20% unless slope stability calculations demonstrate that the slope is stable under saturated conditions at a shorter distance from the practice. Note: Berms constructed as part of the practice are not included in this separation distance.

B. Design

1. Bypass/Dewatering – The basin shall be designed with a maintenance draw down capability. An example of this device is shown on Figure #3.

   When infiltration cells are used, a *draw down device* shall be provided for each cell.

2. Pretreatment Practices – Space must be allotted for pretreatment prior to infiltration to remove the following percentage of total suspended solids, on an average annual basis, based on the following land uses.

   a. 60% for residential (and associated roads)

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

b. 80% for commercial, industrial, institutional (and associated roads)

3. Infiltration Rates - See WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002) for design infiltration rates.

4. Dimensions

   a. Depth – Depth is a function of the maximum draw down time of 24 hours (for the infiltration portion of the practice only), using the design infiltration rate, with a not to exceed depth of 24 inches.

      The maximum depth of 24 inches applies to all infiltration cells within the practice.

   b. *Target Stay-on Depth* – The target stay-on depth shall meet the requirements of NR 151. (See Consideration L.)

   c. Effective Infiltration Area – The maximum depth along with the storage volume of water to be infiltrated can be used to determine the preliminary *effective infiltration area* necessary for the infiltration basin. (See Consideration L.)

   d. Slopes

      1. Longitudinal Slope – If used, the longitudinal slope shall not exceed 1% (0% longitudinal slope is recommended). If any longitudinal slope is specified, "infiltration cells" as described in V.B.4.f. shall be required.

      2. Lateral Slopes in the effective infiltration area shall be 0%.

Example: (This example is a continuation of the 20 acre mixed land use example presented in "Technical Note for Sizing Infiltration Basins and Bioretention Devices to Meet State of Wisconsin Stormwater Infiltration Performance Standards." See Consideration L. for reference.)

This example assumed an average pre-development curve number of 75 for the pre-development soil condition in the drainage basin, sandy loam soils at the infiltration site and a post-development curve number of 70 for the pervious areas in the drainage basin. From that example, the preliminary effective infiltration area is 8,930 square feet or 0.2 acres. Therefore, the storage volume (SV) at a one-foot maximum depth (MD) is 0.2 acre-ft or 8,930 cu. ft.

Calculate the dimensions of the basin. Assume a rectangular basin with a length to width ratio of 3:1
SV=MD * L * W substitute L=3W
SV=MD * $3W^2$.
Solve for W:
8,930 cu. ft. = 1 X $3W^2$ $2,977 = W^2$
W = 55 ft
L= 3W so L = 164 ft

If using a longitudinal slope, it is still required that the maximum depth, at any point in the basin, not exceed 24 inches (or in this case 12 inches due to the soil type). This slope results in a 3D triangle of infiltration volume versus the cubic volume created by a basin with a flat floor.

To correct for this and to provide the required infiltration volume, the preliminary effective infiltration area originally calculated must be divided by 0.5. This will correct for the triangle of lost volume created by the sloped floor of the basin, the maximum depth and the water surface.

8,930 sq. ft. / 0.5 = 17,860 sq. ft. The new W and L are now W = 77ft. and L = 3W = 231ft.

Note: The surface area calculated is the minimum effective infiltration area and does not include slopes or setbacks. Additional site area will be needed to account for berms and slopes.

e. Side Slopes – All side slopes for interior and exterior berms shall have a 4:1 slope (horizontal: vertical) or flatter.

f. Infiltration Cells – To maximize the effective infiltration area utilized and to prevent channelized flow, the effective infiltration area shall be subdivided into multiple smaller "cells" using *level spreaders* (example shown in Figure 1 & 2). These "cells" shall be used if a longitudinal slope is specified or if the length of the flow path exceeds 300 linear feet.

The effective infiltration area shall be divided such that as a downstream cell reaches the depth of its level spreader, the elevation of the water in that cell does not exceed the downstream toe of slope from the next upstream level spreader. The height of any level spreader shall not exceed the maximum ponding depth.

Example (continued)

Given: MD = 12 inches, SA = 17, 860 sq. ft., longitudinal slope = 1%. W = 77 ft. L = 231 ft.

With a length of 231 feet and a slope of 1% we know the basin rises 2.3 feet along its length from the outlet to the toe of the pre-treatment area. Given a 12-inch maximum depth of water in the practice for infiltration, the basin needs to be divided into multiple cells with each cell a maximum 300 feet length or a maximum of 12 inches of depth in each cell.

As this example has a longitudinal slope of 1% the maximum cell is 100 feet in length (100 * 1% = 1 feet which is the maximum depth). Had this basin had no longitudinal slope on the floor, a cell up to 300 feet long could have been utilized.

The first level spreader should be located 100 feet upstream from the outlet structure. This leaves us with 131 feet to the pretreatment area. At 1% slope, the height of the level spreader should be 1.3 feet, which is greater than allowed. So the second level spreader should be 1 foot in height, with the third being 100 more feet upstream with a height of 0.43 feet.

Note: To improve the aesthetics of the basin, the second and third cells may be evened out to two cells of 66 feet each and level spreader heights of 0.66 feet.

5. Basin Inlets and Cell Dividers / Level Spreader – The design shall evenly spread the outflow from the pretreatment device or between cells across the width of the basin. The pretreatment discharge pipes and stone trench shown in Figures 1 & 2 (plan and profile view) provide an example of level spreaders.

6. Basin Outlets – The infiltration basin outlet shall safely convey stormwater

from the basin through all of the following mechanisms. An example of outlet pipes is shown in Figures 3 & 4 (front and side view)

a. Draw Down Device – A means shall be provided to quickly remove standing water from the basins for maintenance and winter diversion.

b. Emergency Spillway – A means shall be provided to release discharge in excess of the infiltration volume safely into the downstream stormwater conveyance system. The spillway shall be designed for a 100 year 24-hour storm event.

c. Freeboard – One foot of freeboard above the flow depth in the spillway shall be provided.

7. Maintenance Access – Provide a 12 foot wide access route, with a 6:1 slope, to the floor of the basin for sediment and debris removal.

8. Embankment Construction – Embankments shall conform with WDNR Conservation Practice Standard Wet Detention Basin (1001). A basin embankment may be regulated as a dam under ch. 31 Stats., and further restricted under ch. NR 333, Wis. Adm. Code, which includes regulations for embankment heights and storage capacities.

C. Construction

1. Construction shall be suspended during periods of rainfall or snowmelt. Construction shall remain suspended if ponded water is present or if residual soil moisture contributes significantly to the potential for soil smearing, clumping or other forms of compaction.

2. An assessment of the active erosion in the drainage area to the infiltration basin shall be performed to determine when to bring the infiltration basin on-line. The basin shall be brought on-line when the area draining to the basin has achieved 90% build out of all lots in any of the first 3 years or 75% build out in any subsequent year. By 5 years from the start of construction in the drainage area, all infiltration basins shall be brought on-line. Build out means that the lot has been fully developed and stabilized from erosion. If the infiltration basin area is to also provide peak flow control for the fully built out 5-year, 24-hour event or greater, then a bypass device to divert those flows into the practice will be allowed until the infiltration basin is brought fully on-line. Erosion and sediment control practices shall be implemented for the remaining 10-25% of the undeveloped lots with the goal of preventing any sediment from reaching the infiltration basin.

3. During construction one of the following methods shall be used:

a. No disturbance – The infiltration area shall be fenced off to prevent heavy equipment access during development.

b. Compaction Mitigation – If the active infiltration area is graded the effects of compaction shall be mitigated using the following methods:

(1) Incorporate soil additives consisting of two inches of compost mixed into two inches of topsoil.

(2) The soil mix (V.C.3.b.1) shall be incorporated into the existing soil using a chisel plow or rotary device with the capability of reaching to 12 inches below the existing surface.

(3) The compost component shall meet the following WDNR Specification S100 Compost.

4. The basin shall be constructed to the grades, elevations, and specifications in the plan. After grading and top soiling, the elevation of the basin shall be surveyed for conformance to design specifications.

D. Vegetation Cover

1. Establishment – Cover crops need to be applied in conjunction with the initial seeding of permanent vegetation. When establishing turf type grass, use the criteria contained in the DNR Conservation Practice Standard Seeding for Construction Site Erosion Control (1059). Sod shall not be used.

   If turf grass is utilized, the basin cannot be used for recreational purposes due to compaction concerns.

2. Native Seeding – Native vegetation shall be established in conformance with recommendations from a qualified native nursery in the area. If trees are to be used, species shall be selected that will not interfere with the function of the basin, or cause maintenance problems. Section IX References, lists sources that provide suggested seed mixtures.

   Native (prairie) seeding shall be completed in the fall (as dormant seeding prior to first snowfall) or in the spring (between May 1 and June 20), or plugs shall be used.

3. Fertilizer – Soil testing shall be used to determine proper applications for nutrients and liming. Fertilizer application shall conform to the criteria located in NRCS Conservation Practice Technical Standard, Critical Area Planting (342) or WDNR Conservation Practice Standard Seeding for Construction Site Erosion Control (1059).

4. Mulch – Mulch shall conform to the criteria located in WDNR Conservation Practice Standard Mulching for Construction Sites (1058).

VI. Considerations

A. Pretreatment Options - See WDNR Conservation Practice Technical Standards Wet Detention Basin (1001), Ditch Check (1062), and Vegetated Infiltration Swale (1005) for guidance. Estimates of pollutant reduction by proprietary devices should be based on monitoring using the EPA Environmental Testing Verification protocol.

B. Well Locations - If well locations in relation to the basin are a concern, the site should be evaluated for the direction of ground water flow.

C. Multiple Uses - Basins can be used for both infiltration and peak shaving as shown on Figure 1 and 2. However, another option is to include a *flow splitter* or diversion prior to pretreatment. By limiting the inflow into a BMP, a flow splitter can enhance the longevity of the BMP by reducing the volumetric rate of treatment, erosion or scour, and vegetation damage. Flow splitters need to be designed to address site conditions and flows.

D. Drainage Area Size – The drainage area should be between 5 and 50 acres. If the drainage area is more than 50 acres, multiple basins should be provided.

E. Regulatory Caps - Ch. NR 151 provides for a maximum area to be dedicated for infiltration depending upon land use. This cap can be voluntarily exceeded.

F. Native Vegetation - The use of prairie grass or other deep-rooted plants is encouraged because these plants can increase the infiltration capacity of the basin. Dense vegetation will also reduce soil erosion on the basin floor.

G. Level Spreader - Since it is often difficult to construct a level spreader, a combination of a berm and stone trench is recommended. Other methods to disperse flows include irrigation practices such as ridge and furrow irrigation systems. Refer to American Society of Agricultural Engineering Standards for guidelines on construction of irrigation dispersal systems.

H. Tracked vehicles should be used during construction to lessen compaction.

I. The final grading should be conducted by the landscape contractor so that the drainage area can be stabilized first.

J. Snow should not be placed in the effective infiltration area. It may be placed on the

pretreatment area or areas draining into the pretreatment area.

K. Internally Drained Watersheds – There are unique considerations for watersheds that are closed basins which are internally drained. Infiltration basins constructed in internally drained watersheds shall meet the requirements of NR 151 and this standard. Storms with a recurrence interval greater than a 2-year 24-hour storm must also be considered in the design and engineering judgment may determine that criteria such as draw down time and maximum depth may be exceeded for these larger storms. Infiltration basins in internally drained watershed may have different needs for plants, pretreatment, safety, maintenance or other characteristic that must be considered during design and construction.

L. The DNR has created a technical note that may be used to size infiltration basins. The "Technical Note for Sizing Infiltration Basins and Bioretention Devices To Meet State Of Wisconsin Stormwater Infiltration Performance Standards" contains an approved method to determine the target stay-on depth and 12 design charts that can be used to size these basins for a variety of conditions. In addition, the technical note contains a reference to an approved infiltration model (RECARGA) that can also be used to determine effective infiltration area requirements. Other models may be used if approved. The Technical Note can be accessed at: http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm#Post

VII. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall specify the materials, construction processes, location, size and elevations of all components of the practice to allow for certification of construction upon completion.

VIII. Operations and Maintenance

An operation and maintenance plan shall be developed that is consistent with the purposes of this practice, intended life of the components, safety requirements, and the criteria for the design. There may be state and local laws that require adequate O&M of public and private facilities and the identification of responsible parties. At a minimum, the plan shall include:

A. Inspection Intervals – At minimum, quarterly inspections shall occur. Inspection shall include spreader and overflow spillway for indication of failure. Note the condition of vegetation as part of inspection. If standing water is observed over 50% of the basin floor 3 days after rainfall, the basin is clogged and measures should be undertaken to unclog it. (See section VIII.C).

B. Native Vegetation - Maintenance of Native Vegetation – Mowing (cutting) or burning shall be used to maintain the vegetation.

1. Establishment - The first mowing of newly planted seed shall occur once it reaches a height of 10 to 12 inches.
2. Mowing
   a. Mowing shall reduce the height of plants to 5 to 6 inches.
   b. After establishment, if burning cannot be accommodated, mowing shall occur once in the fall (after November 1). The area shall be mowed to a height of 5 to 6 inches.
3. Burning
   a. Routine Maintenance - Beginning the second year, burning shall occur in the early spring (prior to May 1st) or in the late fall (after November 1st)
   b. Burning shall be done two consecutive years and then up to three years can pass before the next burning.
   c. Under no circumstances shall burning occur every other year.

C. Restoration Procedures – these include removing the top 2 to 3 inches, chisel plowing and adding topsoil and compost. If deep tilling is used, the basin shall be drained and the soils dried to a depth of 8 inches. If the basin was planted in turf grass and clogging again occurs after these restoration procedures have been used, the owner /operator shall replant with prairie

style vegetation using the soil preparation method recommended by the native nursery in the area.

D. Trash shall be removed as quickly as possible once observed.

E. Pretreatment – If wet detention is used, see WDNR Conservation Practice Technical Standard Wet Detention Basin (1001) for operations and maintenance requirements.

F. Winter Maintenance – All draw down devices in the pond shall be opened during winter months to discourage infiltration of runoff water containing high levels of chlorides. If this practice is an enclosed basin, the use of chloride deicers shall be limited in the area draining to the basin to reduce the chance of exceeding the limits in ch. NR 140.

IX. References

Metropolitan Council, 2003. Urban Small Sites Best Management Practice Manual, Chapter 3, Vegetative Methods 3-85 – 3-91. Minneapolis.

United States Department of Agriculture – Natural Resources Conservation Service. Engineering Field Handbook, Chapters 16 and 18.

UWEX Publication A3434 Lawn and Establishment & Renovation.

WisDOT, 2003. State of Wisconsin Standard Specifications for Highway and Structure Construction. Section 630, Seeding.

X. Definitions

Draw down device (V.B.1): A draw down device can consist of any device that allows for the dewatering of the infiltration basin or the infiltration cells down to the ground elevation. Examples include removable weir plates (shown in Figure 3), pipes with valves, weirs with removable stop logs.

Effective infiltration area (V.B.4.c.): An effective infiltration area means the area of the infiltration system that is used to infiltrate runoff and does not include the area used for site access, berms or pretreatment.

Flow Splitter (VI.C): A flow splitter is a device used to direct a fraction of runoff into the BMP facility while bypassing excess flows from larger storm events.

Hydraulically connected (V.A.1.): Two entities are said to be hydraulically connected if a surface or subsurface conduit exists between the two such that water is transmitted from one entity to the other.

Level spreader (V.B.4.f): A level spreader is a device used to disperse concentrated flows back over a wide area, dissipating the energy of the runoff and promoting sheet flow. Common types of level spreaders include vegetated, earthen or stone berms, weirs and stone trenches.

Target Stay-on Depth (IV.B.4.b.): The amount of infiltration required on an average annual basis. It is the portion of the annual rainfall (inches) on the development site that must be infiltrated on an annual basis to meet the infiltration goal.

Bioretention For Infiltration
(1004)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A bioretention device is an *infiltration device*[1] consisting of an excavated area that is back-filled with an engineered soil, covered with a mulch layer and planted with a diversity of woody and herbaceous vegetation. Storm water directed to the device percolates through the mulch and engineered soil, where it is treated by a variety of physical, chemical and biological processes before infiltrating into the *native soil*.

II. Purpose

A bioretention device may be applied individually or as part of a system of stormwater management practices to support one or more of the following purposes:

- Enhance storm water *infiltration*
- Reduce discharge of storm water pollutants to surface and ground waters
- Decrease runoff peak flow rates and volumes
- Preserve base flow in streams
- Reduce temperature impacts of storm water runoff

III. Conditions Where Practice Applies

Bioretention devices are suitable for small drainage areas where increased urban storm water pollutant loadings, thermal impacts, runoff volumes and peak flow discharges are a concern and the area is suitable for infiltration. Bioretention devices are best suited to providing on-site stormwater management opportunities adjacent to *source areas* such as landscaped areas, rooftops, parking lots and streets.

Bioretention devices are not suitable for controlling construction site erosion. These devices will not treat chlorides, and will be damaged by heavy loading of salt-based deicers.

IV. Federal, State and Local Laws

Users of this standard shall be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing bioretention devices. This standard does not contain the text of federal, state or local laws.

V. Criteria

A. Site Criteria

1. A site selected for construction of a bioretention device shall be evaluated in accordance with the WDNR Conservation Practice Standard 1002, "Site Evaluation for Stormwater Infiltration" and shall meet the site requirements of that standard.

2. The following site criteria shall also be met:

   a. Private Onsite Wastewater Treatment System (POWTS) – The bioretention device shall be located a minimum of 50 feet from any POWTS and shall not be *hydraulically connected* to the POWTS dispersal cell or cause negative impacts such as cross contamination.

   b. Foundations – The bioretention device shall not be hydraulically connected to building or pavement foundations or cause negative impacts to structures.

   c. Slopes – Sloped areas immediately adjacent to the bioretention device shall be less than 20% but greater than 0.5% for pavement and greater than 1% for vegetated areas to ensure positive flow towards the device.

   d. Maximum Drainage Area – The area draining to the bioretention device shall not exceed 2 acres. The drainage area shall not contain significant sources of soil erosion.

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

B. Design – The bioretention device shall be sized using an *approved model.* (See Consideration L.)

1. Configuration - Bioretention components include *pretreatment,* flow regulation, ponding area, planting bed vegetation and surface mulch layer, engineered soil planting bed, storage layer, *underdrain,* sand/native soil interface layer and observation well (See Figures 1 - 3).

2. *Target Stay-on Depth* – The target stay-on depth shall be determined using an approved model. (See Consideration L.)

3. Flow Regulation

   a. Inflow – The flow at the inlet to the bioretention device shall be controlled to prevent erosion and achieve uniform distribution across the surface of the soil planting bed.

   b. Overflow – The overflow system shall meet the following requirements:

      (1) A weir or standpipe shall be used to regulate the maximum ponding depth. The invert of the overflow structure shall be at the elevation of the maximum ponding depth of the bioretention device. This component shall meet the ponding requirements of section V.B.4.

      (2) Water discharged from the overflow shall be conveyed to a stable outlet leading to a suitable conveyance such as a swale, storm drain or surface water.

      (3) Overflow control structures, such as *curtain drains,* that bypass the soil planting bed and discharge directly to ground water are allowed only if the sole source of stormwater runoff is from rooftops without significant contamination from industrial activity.

   c. Underdrain – The underdrain shall meet the requirements of section V.B.8.

4. Ponding Area

   a. Maximum *Design Ponding Depth* – The design ponding depth shall not exceed 12 inches.

   b. Drawdown Time - In designing the bioretention device, the design ponding depth divided by the *Design Drawdown Rate* shall not exceed 24 hours.

   c. Side slopes – The side slopes of the berm that forms the ponding area shall be 2H:1V or flatter.

5. Planting Bed Vegetation and Surface Mulch Layer

   a. Vegetation Plan – A vegetation plan and planting specifications shall be prepared. The following apply:

      (1) The plan shall identify planting zones based on anticipated depth of water level fluctuations and duration of inundation.

      (2) Rootstock and plugs shall be used in establishing trees, shrubs and herbaceous perennials. Seed shall not be used to establish vegetation.

      (3) If the bioretention device receives runoff from non-residential source areas or streets, the plant density at maturity must be low enough to accommodate long-term maintenance or replenishment of the surface mulch layer. If the bioretention device receives runoff only from residential land uses other than streets, the mulch layer can be discontinued at maturity provided that a dense vegetation layer is formed.

      (4) Plants shall be native to the area and capable of withstanding the environmental conditions of the bioretention device such as insect and disease infestations, drought, water level fluctuations and regional temperature variations. Vegetation shall be salt tolerant when the bioretention device is likely to receive runoff containing salt-based deicers.

(5) Turf grass shall not be used to vegetate the bioretention device, although it may be used in the pretreatment area. Invasive plants and noxious weeds shall not be used.

(6) Woody vegetation shall not be specified at inflow locations. Trees and vegetation shall not block flow paths, create traffic or safety issues, or obstruct utilities.

(7) The planting plan shall cover plant placement, planting sequence, planting time of year, fertilizing, watering and protection from other stresses such as animals, wind and sun to maximize plant growth and survival.

(8) If the engineered soil will be left to settle prior to planting, the surface shall be mulched.

b. Surface Mulch Layer – Shredded hardwood mulch or chips, aged a minimum of 12 months, shall be placed on the surface of the bioretention area. The mulch shall be 2 to 3 inches in depth. The mulch shall be free of foreign material, including other plant material.

6. Engineered Soil Planting Bed

a. Surface Area – The surface area shall be determined using an approved model. (See Consideration L.)

b. Surface Slope – The surface slope of the device shall not exceed 1%.

c. Engineered Soil Depth – After settling, there shall be sufficient soil to support the rooting depth of the vegetation. If the storage layer (V.B.7.) uses gravel, a lens of pea gravel not to exceed 4 inches shall separate the engineered soil from the storage layer. The soil layer (including the pea gravel lens) shall be at least 3 feet deep.

d. Engineered Soil Composition– The soil shall be engineered to the following specifications:

(1) The planting mixture shall consist of a mixture of sand, compost and topsoil. The mix shall be designed to approximate the percentages in Table 1.

Table 1. Engineered Soil Mix

Engineered Soil Component	Percentage Composition (by Volume)
Silica Sand	40%
Topsoil	20% if loam texture
	30% if sandy loam or loamy sand texture
Compost	30% - 40%

Note: This mixture meets the equivalency requirements of s. *NR 151.12(5)(c)5.i., Wis. Adm. Code.*

(2) The silica sand component shall be USDA coarse sand (0.02 to 0.04 inch diameter), pre-washed to remove clay and silt particles, and well-drained or dry prior to mixing. Calcium carbonated, dolomitic sand, and other substitutions are not allowed.

(3) The topsoil component shall be a USDA classified sandy loam, loamy sand or loam texture. The topsoil component textural class shall be verified by a laboratory analysis or a professional acceptable to the jurisdiction having authority.

(4) The compost component shall meet the requirements of Wisconsin Department of Natural Resources Specification S100, Compost.

(5) The engineered soil mix shall be free of rocks, stumps, roots, brush or other material over 1 inch in diameter. No other materials shall be mixed with the planting soil that may be harmful to plant growth or prove a hindrance to planting or maintenance.

(6) The engineered soil mix shall have a pH between 5.5 and 6.5.

(7) The engineered soil mix shall have adequate nutrient content to meet plant growth requirements.

7. Storage layer – A sand or gravel storage layer situated beneath the underdrain will facilitate groundwater recharge because water in this storage area can not exit via the underdrain. It can only exit the bioretention device by

infiltration into the native soil. The following requirements shall be met in designing the storage layer.

a. The storage layer is required when the design infiltration rate of the native soil is less than 3.6 inches/hour, as determined using DNR Technical Standard 1002, "Site Evaluation for Stormwater Infiltration."

b. The design thickness of the storage layer shall be that which results in a *total device drain time* of 72 hours, but shall not exceed 48 inches. In calculating the total device drain time, assume that event runoff has ended and the bioretention device is *fully saturated* prior to the initiation of drawdown. (Refer to Section VI.U for guidance in determining the storage layer thickness.)

c. Gravel Specifications – The gravel shall meet the coarse aggregate #2 and other specifications of Wisconsin Standards and Specifications for Highway and Structure Construction, Section 501.2.5, 2003 edition, or an equivalent as approved by the administering authority. Gravel shall be double-washed.

   Note: Inadequate washing of aggregate may lead to clogging at the native soil interface.

d. Sand Specifications – A layer of sand may be used in lieu of gravel to form the storage layer. The sand shall be washed quartz or silica. Sand particles shall be 0.02 to 0.04 inches in diameter (USDA Coarse Sand). Calcium carbonated, dolomitic sand, and other substitutions are not allowed.

8. Underdrain – A perforated underdrain pipe is required unless there is no suitable pipe outlet or the risk of infiltration failure at the native soil interface is minimal. The risk of infiltration failure is assumed to be minimal if the design infiltration rate of the native soil is determined to be at least 3.6 inches/hour, as determined using DNR Technical Standard 1002, "Site Evaluation for Stormwater Infiltration."

   a. Pipe Location - The underdrain pipe shall be placed at the top of the gravel or sand storage layer.

   b. Size and Material – The pipe shall have a minimum diameter of 6 inches and be made of flexible pipe or other material approved by the administering authority. The pipe shall be capable of withstanding expected traffic loads over portions of the pipe extending beyond the soil planting bed.

   c. Orifice Diameter – The underdrain orifice shall be restricted as necessary so that the *design infiltration rate* plus the *underdrain flow rate* equals the design draw down rate. The restriction shall be achieved by using an adjustable restrictor plate or valve. The restriction device shall be accessible for adjustment.

   d. Perforations – The total opening area of all perforation holes combined shall be sufficient to allow the underdrain pipe to discharge at full capacity, as would occur if there were no orifice restriction. The amount of perforation shall be increased to provide a margin of safety but shall not be so great as to compromise structural integrity of the pipe material.

   e. Pipe Protection – The underdrain pipe shall be protected from clogging by use of filter fabric or a filter sock. If the storage layer is sand, a filter sock shall be used. A cover of pea gravel may also be used.

      (1) Pea Gravel – If used, the pea gravel layer shall be at least 4 inches thick. Pea gravel shall be washed. Pea gravel shall be large enough to prevent its falling through the perforations of the under-drain pipe.

      (2) Filter Fabric – Filter fabric shall cover the underdrain pipe and shall not extend laterally from either side of the pipe more than two feet. The fabric shall meet the specifications of Wisconsin Standards and Specifications for Highway and Structure Construction, Section 645.2.4, Schedule Test B, 2003 edition, or an equivalent approved by the administering authority.

      (3) Filter Sock - The openings in the fabric shall be small enough to prevent sand particles from entering the underdrain pipe. The flow rate of the fabric shall be capable of passing water at a rate equal to or greater than the flow rate capacity of the total combined perforations in the

underdrain pipe. In addition, the fabric shall meet the other requirements of Wisconsin Standards and Specifications for Highway and Structure Construction, Section 612.2.8(1-3), 2003 edition, or an equivalent approved by the administering authority.

f. Clean-out Port – The underdrain pipe shall have a vertical, connecting standpipe to serve as a clean-out port for the underdrain pipe. The pipe shall be rigid, non-perforated PVC pipe, a minimum of 6 inches in diameter and covered with a watertight cap that is flush with the ground elevation of the device.

g. Outlet – The underdrain pipe shall discharge to an existing drainage system. Examples of drainage systems include swales, storm sewers, subsurface dispersal fields and surface waters.

(1) A check valve shall be installed when backflow is possible.

(2) Access for maintenance of the check-valve shall be provided.

9. Sand/Native Soil Interface Layer

a. The interface layer is required when the design infiltration rate of the native soil is less than 3.6 inches/hour, as determined using DNR Technical Standard 1002, "Site Evaluation for Stormwater Infiltration."

b. Three inches of sand shall be placed below the gravel or sand storage layer, and vertically mixed with the native soil interface to a depth of 2-4 inches.

c. Sand shall be washed quartz or silica 0.02 to 0.04 inches in diameter (USDA Coarse Sand). Calcium carbonated, dolomitic sand, and other substitutions are not allowed.

10. Design Infiltration Rate – The design infiltration rate of the native soil shall not exceed the rate identified in accordance with WDNR Conservation Practice Standard 1002 "Site Evaluation for Stormwater Infiltration".

11. Observation Wells – If there is no underdrain, one or more observation wells shall be installed to monitor drainage from the device. There shall be a minimum of one well per 1,000 square feet of *effective infiltration area*. The wells shall be:

a. Located at the center of each section being monitored.

b. A minimum 6 inch diameter slotted PVC pipe, anchored vertically to a footplate at the bottom of the bioretention device. The top of the pipe shall be high enough to prevent the entry of water ponded within the infiltration device.

c. Have a secured aboveground cap.

C. Construction Sequencing and Oversight – A person trained and experienced in the construction, operation and maintenance of infiltration devices shall be responsible for construction of the device. The following apply:

1. Construction Site Stabilization – Construction site runoff from disturbed areas shall not be allowed to enter the bioretention device. Runoff from pervious areas shall be diverted from the device until the pervious areas have undergone *final stabilization.*

2. Suitable Weather – Construction shall be suspended during periods of rainfall or snowmelt. Construction shall remain suspended if ponded water is present or if residual soil moisture contributes significantly to the potential for soil smearing, clumping or other forms of compaction.

3. Compaction Avoidance – Compaction and smearing of the soils beneath the floor and side slopes of the bioretention area, and compaction of the soils used for backfill in the soil planting bed, shall be minimized. During site development, the area dedicated to the bioretention device shall be cordoned off to prevent access by *heavy equipment.* Acceptable equipment for constructing the bioretention device includes excavation hoes, light equipment with turf type tires, marsh equipment or wide-track loaders.

4. Compaction Remediation – If compaction occurs at the base of the bioretention device, the soil shall be refractured to a depth of at least 12 inches. If smearing occurs, the smeared areas of the interface shall be corrected by raking or roto-tilling.

5. Placement and Settling of Engineered Soil – The following apply:

   a. Prior to placement in the bioretention device, the engineered soil shall be pre-mixed and the moisture content shall be low enough to prevent clumping and compaction during placement.

   b. The engineered soil shall be placed in multiple lifts, each approximately 12 inches in depth.

   c. Steps may be taken to induce mild settling of the engineered soil bed as needed to prepare a stable planting medium and to stabilize the ponding depth. Vibrating plate-style compactors shall not be used to induce settling.

6. Planting – The entire soil planting bed shall be mulched prior to planting vegetation to help prevent compaction of the planting soil during the planting process. Mulch shall be pushed aside for the placement of each plant.

VI. Considerations

A. This infiltration device is especially suitable where other benefits are desired such as shade, windbreak, noise absorption, reduction in reflected light, microhabitat for plants and wildlife and improved aesthetics.

B. Place the infiltration device in a site that is visible to encourage routine up-keep and maintenance. Choose a site that provides ample room for maintenance access to all parts of the device. Consider traffic visibility and other safety issues when siting the infiltration device.

C. The bioretention device may be constructed as a filtration and recovery system followed by discharge to a storm sewer or surface outlet. Table 2 shows estimated pollutant removal rates for bioretention when used as a filtration device:

Table 2. Typical Pollutant Removal Rates for Bioretention

Pollutant	Removal Rate (percent)
Total Suspended Solids	90[1]
Metals (Cu, Zn, Pb)	> 95[2]
Total Phosphorus	80[3]
Total Kjeldahl Nitrogen	65-75[3]
Ammonium	60-80[3]
Organics	90[1]
Bacteria	90[1]

Source: [1]Prince George's County Department of Environmental Resources, 1993
[2]Davis, et al., 2003.
[3]Davis, et al., 2001.

D. This infiltration device is not suitable for treating chlorides. Chloride use on source areas tributary to the bioretention device can be reduced or eliminated by minimizing the amount of compound used, using alternative de-icers or using clean sand. Aggressive sweeping in these areas, along with pretreatment sumps and filter strips, will reduce the impact of the sand on the bioretention device.

E. A maximum drainage area is established to protect the device and reduce risk of failure. Potential problems such as erosion at the inflow points, disruption of the mulch layer, premature clogging of the device and inputs of chlorides and sodium will be reduced. Additionally, numerous smaller bioretention devices are expected to have better long term performance when compared to one large device. For large impervious areas, such as parking lots, dividing the drainage area up into smaller portions (0.5 – 1 acre) is recommended. If the total drainage area to a treatment device must be larger than 2 acres, an alternative practice should be selected.

F. Longevity of the engineered soil is decreased by clogging, reduced cation exchange capacity and accumulation of sodium. Clogging problems can be reduced by limiting the input of sediment. Cation exchange capacity can be rejuvenated by the replacement of the engineered soil. Sodium accumulation can be countered by adding gypsum to the soil and/or by allowing about 1" of clean water to percolate through the planting bed 3 to 4 times in the spring

G. Erosion at the inlet to the bioretention device can be reduced by using a sump inlet or gravel bed. Level spreading can be enhanced by the use of a level spreader or by using multiple pipe inlets.

H. Pretreatment - Pretreatment will extend the life of the bioretention device, particularly when runoff is from parking lots and streets. Alternatives include grass channels, grass filter strips, sumps or forebays. Sumps and forebays should be sized to trap coarse sand (.02 - .04 inches). Table 3 provides sizing guidelines for pretreatment grass channels. Table 4 provides guidelines for sizing filter strips. Pretreatment is not considered part of the effective infiltration area for purposes of section NR 151.12(5)(c) or NR 151.24(5)(a), Wis. Adm. Code.

I. When possible, the dimensions of the planting bed should have a minimum width of 10 feet, a minimum length of 15 feet and a width to length ratio of about 2:1.

J. If no vegetated pretreatment area is provided, snow may be piled upgradient of the bioretention device, preferably upgradient of the pretreatment forebay or sump. If a vegetated pretreatment area, such as a filter strip, is provided, it may be used for snow storage but heavy machinery should not be driven onto or across the vegetated area.

Table 3. Pretreatment Grass Channel Guidance

The grass channel length should be at least 20 feet long. A level spreader should be used between the grass channel and the bioretention device.

The channel shape should have:

- A parabolic or a trapezoidal cross-section with a bottom width of 2 to 8 feet.
- Channel side slopes that are 3 horizontal:1 vertical or flatter.
- Flow velocities under 1 fps for the 1-year, 24-hour design storm.
- Flow depth 4 inches or less for the 1-year, 24-hour design storm.

Table 4. Pretreatment Filter Strip Sizing Guidance

Parameter	Stormwater Runoff Inflow Approach From Impervious Parking Lots				Stormwater Runoff Inflow Approach From Lawns/Landscaped Areas				Notes
Maximum inflow approach length (feet)	35		75		75		150		
Filter strip slope	≤2%	>2%	≤2%	>2%	≤2%	>2%	≤2%	>2%	Maximum Slope = 6%
Filter strip Minimum length	10'	15'	20'	25'	10'	12'	15'	18'	

Example: To pretreat runoff that flows 75 feet across a parking lot before reaching the bioretention device, the filter strip should be 20 feet long if the filter strip slope is <2% and 25 feet long if the filter strip slope is over 2%.

K. Regulatory Sizing "Caps" – If a bioretention device designed in accordance with this standard exceeds the maximum required effective infiltration area established in s. NR 151.12(5)(c), the designer may reduce the effective infiltration area in the final design. Such a reduction is not required, however, and sizing based on an approved model will achieve optimal infiltration and device longevity. If the size of the device is reduced as provided for in NR 151.12(5)(c), then the design should consider maximizing the pond depth and gravel storage thickness to compensate for the decrease in the effective infiltration area.

L. The DNR has created a technical note that may be used to size bioretention devices. The "Technical Note for Sizing Infiltration Basins and Bioretention Devices To Meet State Of Wisconsin Stormwater

Infiltration Performance Standards" contains an approved method to determine the target stay-on depth and presents an approved infiltration model (RECARGA) that can be used to determine the effective infiltration area requirements. Other models may be used if approved. The Technical Note can be accessed at: http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm#Post

M. If possible, settling of the planting bed should be accomplished naturally by allowing the filled bed to sit for several months. This will require over-filling the planting area so that after settling the proper ponding depth is achieved. Watering each lift of the planting bed to induce settling is not recommended unless water can be gently applied and the watered lift is allowed sufficient time (at least 24 hours) to thoroughly drain prior to adding the subsequent lift and at least 48 hours prior to adding mulch.

N. The sidewalls of the planting bed and sand/gravel storage area may be sloped as needed to assure a stable configuration.

O. To reduce lateral flow of water from the bioretention device towards pavement foundations, a geotextile fabric may be placed along the side-walls of the device.

P. The optimal design pond depth for overall system function is 6-9 inches.

Q. Plants can be selected to simulate a variety of plant communities. Forest and forest fringe communities should contain a mix of trees and shrubs. Trees should be planted 11-19 feet apart, shrubs 4-7 feet apart and shrub-tree mixes about 7 feet apart. Ornamental communities should contain a mix of shrubs and perennial herbaceous plants. The foliage canopy of ornamental communities should completely cover the soil planting bed at the end of two growing seasons. Meadows and meadow gardens that employ a mixture of grasses and wildflowers may also be planted.

R. Use plant materials from a certified nursery that offers a plant warranty. Select plants that can thrive with minimum maintenance in the environment of the bioretention device and that have added wildlife value as food or cover. Section IX includes two references for plant selection (Shaw and Schmidt, 2003; Bannerman and Considine, 2003). It is recommended that experienced individuals be consulted to assist with vegetation selection and establishment.

S. The rooting depth of plants and the depth of the soil planting bed should be matched to prevent plant roots from clogging holes in the underdrain.

T. A reasonable underdrain perforation safety factor is 2 to 4. The underdrain outlet may be fitted with an end wall and rodent shield if allowed by the local jurisdiction.

U. A 72-hour time limit is established in this standard for draining water from a fully saturated bioretention device. This limit is established to reduce the risk of declining infiltration caused by persistent saturation at the native soil interface.

The maximum allowable thickness of the storage layer will depend on how much time is available to drain water from that layer after time is taken to drain water from the ponding area and engineered soil. The water in the ponding area and the engineered soil exits the bioretention device via the underdrain and the native soil. The water in the storage layer exits only via the native soil. The following equations may be used to determine the allowable storage layer thickness:

$H_P = D_P/(K_u + K_n)$
$H_{ES} = (D_{ES} * P_{ES})/(K_u + K_n)$
$D = (72 \text{ hours} - (H_p + H_{ES})) * K_n$
$T_{SL} = D/P_{SL}$

Where:
H_P = Time to drain the ponding area (hours)
D_P = Depth of ponding area (inches)
K_u = Underdrain flow rate (inches/hour)
K_n = Native soil infiltration rate (inches/hour)
H_{ES} = Time to drain the engineered soil (hours)
D_{ES} = Depth of the engineered soil (inches)
P_{ES} = Porosity of engineered soil
D = Maximum depth of water in storage layer (inches)
T_{SL} = Thickness of storage layer (inches)
P_{SL} = Porosity of gravel storage layer

Using these equations, Table 5 shows sample storage layer thicknesses for a variety of conditions. Variables include pond depth, drawdown rate (underdrain flow rate (Ku) +design infiltration rate (Kn)) and design infiltration rate (Kn).

Table 5. Sample storage layer thicknesses (inches) that meet the 72-hour total device drain time								
		Kn (in/hr)						
Pond Depth	Ku+Kn	0.07	0.11	0.13	0.24	0.5	1.63	3.6
(in)	(in/hr)	*Storage Layer Thickness (inches)*						
6	0.24	*1*	*2*	*3*	*6*			
6	0.5	*9*	*14*	*16*	*29*	*48*		
6	1.63	*13*	*21*	*25*	*45*	*48*	*48*	
6	3.6	*14*	*23*	*27*	*48*	*48*	*48*	*48*
9	0.5	*7*	*12*	*14*	*25*	*48*		
9	1.63	*13*	*20*	*24*	*44*	*48*	*48*	
9	3.6	*14*	*22*	*26*	*48*	*48*	*48*	*48*
12	1.63	*12*	*20*	*23*	*43*	*48*	*48*	
12	3.6	*14*	*22*	*26*	*48*	*48*	*48*	*48*

The following assumptions are incorporated into Table 5:

- Maximum pond depth will drain in 24 hours or less,
- The maximum allowable storage layer thickness is 48 inches,
- The engineered soil depth is 36 inches,
- Engineered soil porosity is assumed to be 27%,
- Storage layer porosity is assumed to be 33%.

V. A municipal easement may be acquired to facilitate maintenance.

W. Once the design depth of the storage layer is determined, it can be reduced as long as the total storage volume is maintained. This will require making a corresponding increase in the surface area of the storage layer. This may be necessary at some sites to meet the required groundwater separation.

VII. Plans and Specifications

A. Plans and specifications shall be prepared for each specific field site in accordance with the criteria of this standard and shall describe the requirements for applying the infiltration device to achieve its intended use. Plans shall specify the materials, construction processes and sequence, location, size, and elevations of all components of the infiltration device to allow for certification of construction upon completion.

B. The plans shall include:

1. A vicinity map showing the drainage area, device location and flow paths to and from the device.

2. A plan view of the device showing the shape, dimensions, flow paths to and from the device, vegetation plan (including plant names and planting locations) and pretreatment components.

3. Longitudinal and cross-section views of the device

C. Specifications shall include the following:

1. A description of the contractor's responsibilities.

2. A requirement for the contractor to submit certifications prior to use for all materials that are to be incorporated into the project stating compliance with the standards.

3. Initial maintenance requirements.

4. Additional specifications relating to vegetation, including:

   a. Site preparation sufficient to establish and grow selected species.

   b. Planting dates, care, and handling of the plants to ensure that planted materials have an acceptable rate of survival, including weeding and watering responsibilities.

   c. Vegetation warranty period

VIII. Operation and Maintenance

A. An operation and maintenance plan shall be developed that is consistent with the purposes of this infiltration device, its intended life, safety requirements and the criteria for its design. The plan shall be developed for inspection, operation and maintenance of the device. The plan shall assign responsibility for activities and the qualifications of the personnel performing the work.

B. At a minimum, the plan shall address operation and maintenance of all vegetative and non-vegetative components identified in this standard.

C. At a minimum, the plan shall also include details on the following: frequency of inspections; inspecting for sediment buildup and clogging, erosion, trash and debris build-up and plant health; frequency of sediment removal; disposal locations for sediment; pH testing of the soil; frequency of soil, mulch, and plant replacement; inlet and outlet maintenance, and providing access to perform the operation and maintenance activities. The maintenance activities in the plan shall be consistent with Table 6.

Table 6. Typical Maintenance Activities for Bioretention Areas

ACTIVITY	FREQUENCY
Water Plants	As necessary during first growing season
Water as necessary during dry periods	As needed after first growing season
Re-mulch void areas	As needed
Treat diseased trees and shrubs	As needed
Inspect soil and repair eroded areas	Monthly
Remove liter and debris	Monthly
Add additional mulch	Once per year

D. Snow shall not be dumped directly onto the conditioned planting bed.

IX. References

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X. Definitions

Approved Model (V.B.): A computer model with an infiltration component that has been approved by the applicable regulatory authorities.

Curtain Drain (V.B.3.b.(3)): An overflow system structures consisting of vertical columns of gravel or sand, called curtain drains, that allow the water quality volume to bypass the soil planting bed and discharge untreated to ground water.

Design Drawdown Rate (V.B.4.b.). The rate (inches/hour) at which water drains from the ponding area through a combination of infiltration into the native soil and loss through the underdrain.

Design Infiltration Rate (V.B.8.c.): The infiltration rate of the native soil selected as a basis to size an infiltration device.

Design Ponding Depth (V.B.4.a.) The distance (inches) between the top of the mulch layer and the invert of the overflow structure.

Effective Infiltration Area (V.B.11) The area of the infiltration system that is used to infiltrate runoff, not to include the area used for site access, berms or pretreatment. For bioretention, the effective infiltration area is considered to be the surface area of the bottom of the excavated hole, at the native soil interface.

Final Stabilization (V.C.1) A condition achieved on pervious areas when uniform perennial vegetative cover has been established with a density of at least 70%.

Fully Saturated(V.B.7.b) A bioretention device that has a saturated storage layer, a saturated engineered soil layer and water ponded to the invert of the overflow pipe in the ponding area.

Heavy Equipment (V.C.3): Equipment with narrow tracks or narrow tires, rubber tires with large lugs, or high-pressure tires.

Hydraulically connected (V.A.2.a): Two entities are said to be hydraulically connected if a surface or subsurface conduit exists between the two such that water is transmitted from one entity to the other.

Infiltration (II): Entry and movement of precipitation or runoff into or through the soil. It includes water that may be subsequently evapotranspired. It does not include water discharged through underdrains or overflow devices.

Infiltration Device (I): A structure or mechanism engineered to facilitate the entry and movement of precipitation or runoff into or through the soil.

Native Soil (I): The undisturbed soil, situated below the bioretention device.

NR 151 (V.B.6.d.(1)): Chapter NR 151, Wisconsin Administrative Code (Runoff Management) that includes State of Wisconsin performance standards for infiltration.

Pretreatment (V.B.1): Preliminary reduction of pollutants from storm water prior to discharge of the storm water to the bioretention device.

Source Area (III): A component of urban land use including rooftops, sidewalks, driveways, parking lots, storage areas, streets and lawns from which urban runoff pollutants and volumes are generated during periods of snow melt and rainfall runoff.

Target Stay-on Depth (V.B.2): The amount of infiltration required on an average annual basis. It is the portion of the annual rainfall (inches) on the development site that must be infiltrated on an annual basis to meet the infiltration goal.

Total Device Drain Time (V.B.7.b): The time it takes water to drain from a fully saturated bioretention device. This includes the time it takes to drain water from the ponding area, the engineered soil and the storage layer. Water from the ponding area and engineered soil exit via a combination of the underdrain and native soil. Water from the storage layer exits only via the native soil.

Underdrain (V.B.1.): A perforated drain pipe situated below the engineered soil bed and above the gravel storage layer.

Underdrain Flow Rate (V.B.8.c.): The rate at which water is discharged from the underdrain, as determined by the orifice flow equation.

Figure 1. Example of **Bioretention Device – plan view**

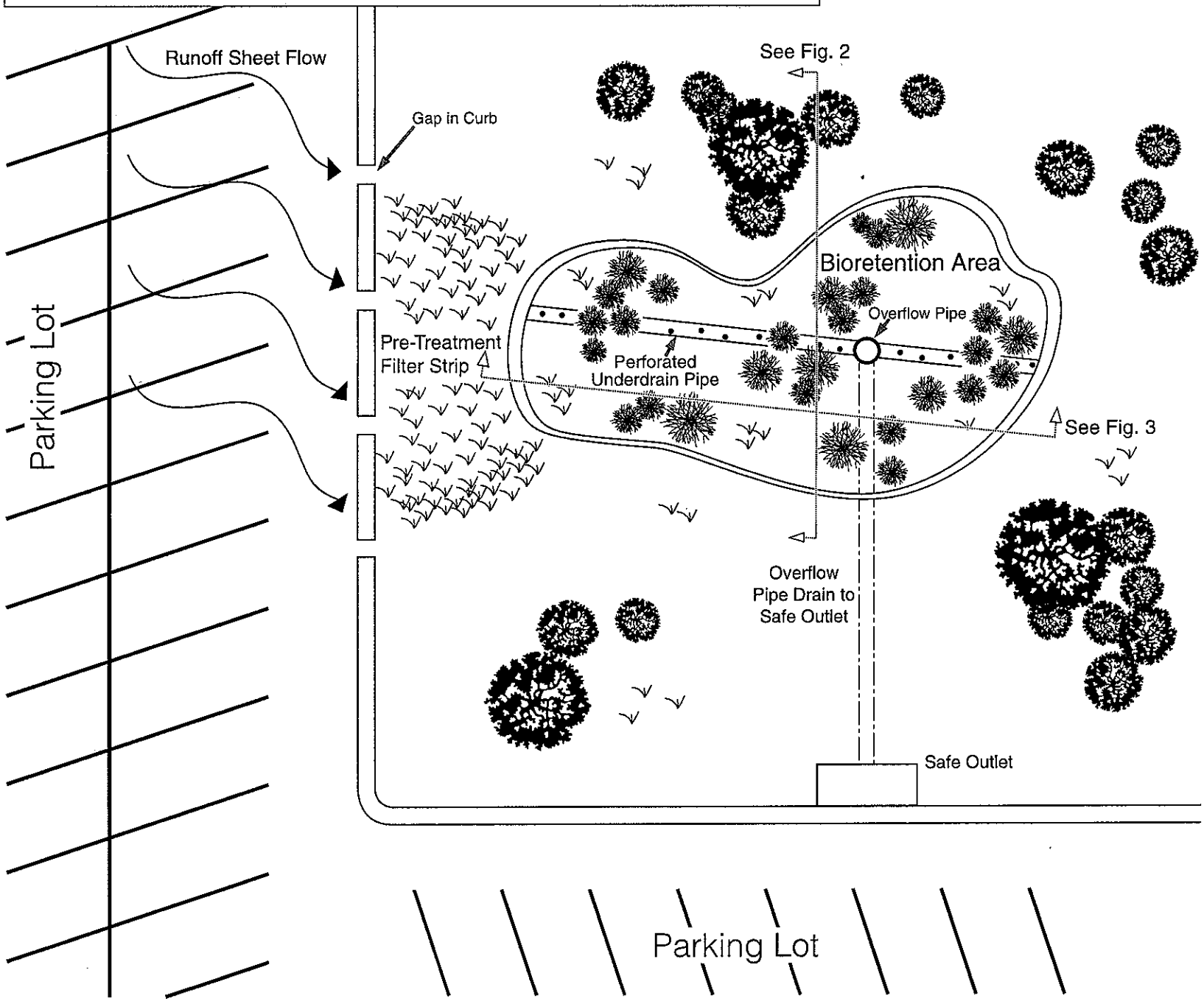

Figure 2. Example of **Bioretention Device** – cross-section across width of device

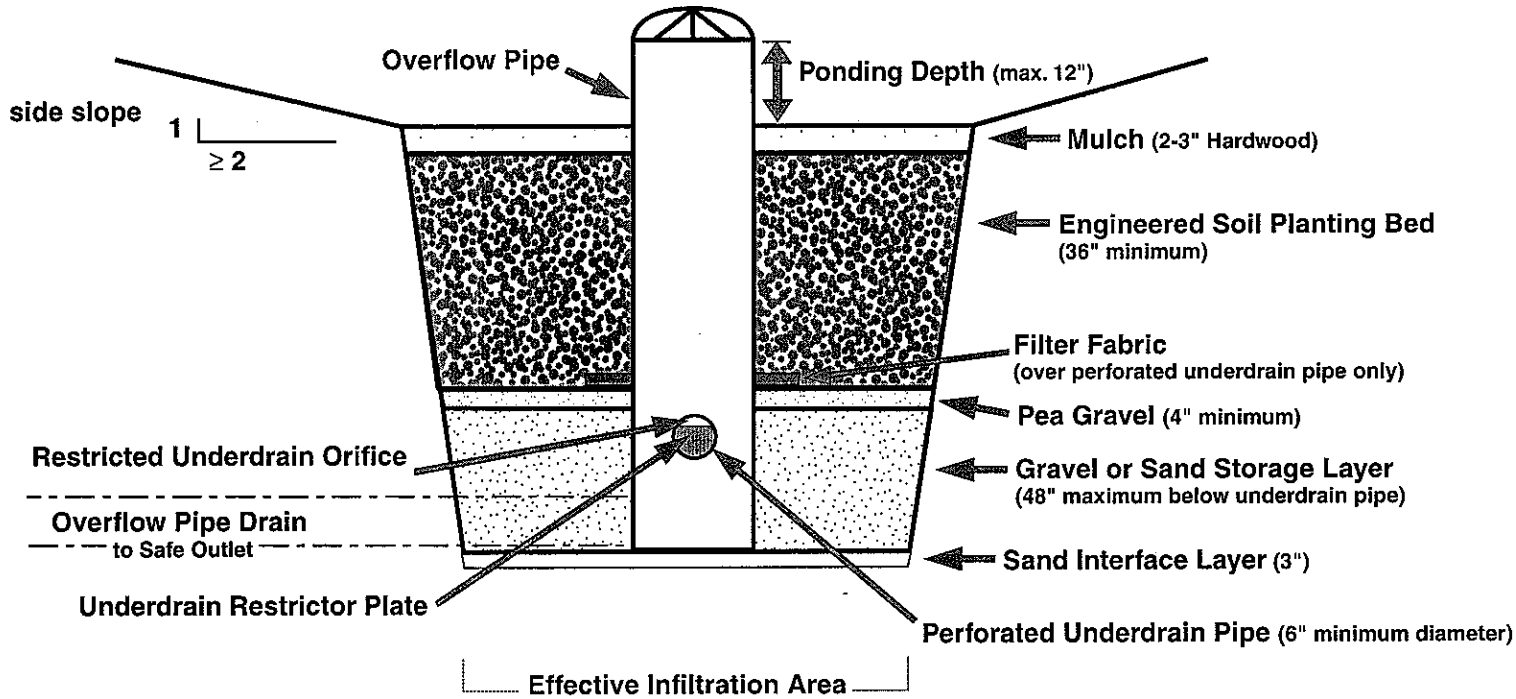

Figure 3. Example of **Bioretention Device – cross-section across length of device**