

CHAPTER 4

Storm Water Management

A. Introduction

This chapter outlines standards for the design and construction of storm water management facilities. These facilities require special design considerations to provide safe and efficient runoff management, in accordance with the City's storm water control ordinance, Oak Creek's Storm Water Management Master Plan, Oak Creek's WPDES NR 216 permit, [Wisconsin Administrative Code Chapter NR 151](#) and the Milwaukee Metropolitan Sewerage District's storm water rules.

B. Requirements

1. Storm water quantity - Land development or redevelopment activities subject to Oak Creek's Storm Water Management Ordinance shall establish on-site management practices to:
 - a. Control the runoff leaving the site to a release rate of less than 0.40 cfs/ac for the one (1) percent probability event (100-year recurrence interval) and less than 0.15 cfs/ac for the fifty (50) percent probability event (2-year recurrence interval), or
 - b. Control the runoff volume from the site over the critical time period of the watershed. Runoff volume shall be limited to existing conditions for the one and fifty percent probability events according to Milwaukee Metropolitan Sewerage District's guidance.
2. Storm water quality - Land development or redevelopment activities subject to Oak Creek's Storm Water Management Ordinance shall establish on-site management practices that meet the following minimum standard:
 - a. Storm water discharges shall be treated to remove, on an average annual basis, a minimum of 80% of the total suspended solids load. To achieve this level of control, storm water practices shall be designed to accommodate, at a minimum, the runoff resulting from a 1-year, 24-hour SCS Type II rainfall event. A rainfall depth of 2.3 inches shall be used.
 - b. Storm water discharges shall be pre-treated prior to infiltration to prolong the life of the infiltration practice and to prevent discharge of storm water pollutants at concentrations that will result in exceedances of groundwater preventive action limits or enforcement standards established by the Department of Natural Resources in NR 140 Wisconsin Administrative Code.
 - c. Storm water ponds and infiltration devices shall not be located closer to water supply wells than indicated below without first notifying the City Engineer:
 - (1) 100 feet from a well serving a private water system or a transient, non-community public water system;
 - (2) 1,200 feet from a well serving a municipal public water system, a non-municipal public water system, or a non-transient non-community public water system;
 - (3) The boundary of a recharge area to a wellhead identified in a wellhead area protection plan.
3. Discharge to wetlands - Wetlands shall be protected from the damaging modifications and adverse changes in runoff quality and quantity associated with new developments. In new developments where wetlands are shown on Figure 3-4 of Oak Creek's Storm Water Management Master Plan were classified into Category I, II or III and shall follow the following criteria:
 - a. Increased volumes of storm water shall not be discharged to wetlands classified as Category III wetlands.
 - b. Untreated storm water shall not be discharged to wetlands classified as Category II wetlands. The discharge of treated storm water is allowed provided that inundation of the vegetation is for periods of less than one week.

- c. Storm water shall be pretreated for sediment removal before discharging to wetlands classified as Category I wetlands.

4. Infiltration – Post development runoff shall be infiltrated in accordance with Section 13.106(i) of the Oak Creek Municipal Code. The Department of Natural Resources Technical Standard 1002 (site evaluation for stormwater infiltration) shall be used in evaluating the suitability of infiltration in the proposed development. The initial screening shall be completed before the preliminary plat or site plan is considered by the Plan Commission. The Soil and Site Evaluation Report shall be completed and submitted with the storm water management plan.

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5. Protective areas – Protective areas shall be established in accordance with Section 13.106(j) of the Oak Creek Municipal Code.

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a. Delineated wetlands shall be categorized as wetlands in areas of special natural resource interest, highly susceptible wetlands or less susceptible wetlands in accordance with the Department of Natural Resources guidance for establishment of protective areas for wetlands.

b. Protective areas shall be shown on the subdivision plat or Certified Survey Map for developments involving land divisions.

c. Protective area provisions

(1) Impervious surfaces shall be kept out of the protective area to the maximum extent practicable. This includes but is not limited to houses, buildings, accessory structures, decks, driveways, patios, sidewalks, pools, retaining walls, stockpiles and storm sewers and laterals that do not drain into a BMP.

(2) Adequate sod or self-sustaining vegetative cover of 70% or greater shall be established and maintained where land disturbing construction activity occurs within a protective area. The storm water management plan shall contain a written site-specific explanation for any parts of the protective area that are disturbed during construction.

(3) BMPs, utilities, fences, trees and shrubs are permissible in protective areas.

6. Fueling and vehicle maintenance areas – BMPs shall be designed, installed and maintained to reduce petroleum within runoff to the maximum extent practicable such that the runoff entering waters of the state contains no visible petroleum sheen. A combination of the following BMPs may be used: oil and grease separators, canopies, petroleum spill cleanup materials or any other structural or non-structural method of preventing or treating petroleum in runoff.

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7. Rainfall depth and distribution - unless prior authorization is given by the City Engineer, the following rainfall data shall be used in hydrologic calculation to meet the storm water quantity requirements:

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a. The most recent rainfall depths identified by Southeastern Wisconsin Regional Planning Commission. The 24-hour depths from Technical Report No. 40 are as follows:

- 2-year 2.57 inches
- 5-year 3.14 inches
- 10-year 3.62 inches
- 25-year 4.41 inches
- 50-year 5.11 inches
- 100-year 5.88 inches

b. The 24-hour, SCS Type II rainfall distribution shall be used.

8. All hydrologic and hydraulic calculations shall be based on the principles of the SCS curve method document entitled "Urban Hydrology for Small Watersheds" (Technical Report 55) published by Natural Resources Conservation Service (NRCS), United States Department of Agriculture, June 1992, or other methods acceptable to the City Engineer. Computer models that may be used include:

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- U.S. Army Corps of Engineers HEC-1
- U.S. Army Corps of Engineers HEC-HMS
- Natural Resources Conservation Service TR-20
- Natural Resources Conservation Service TR-55
- U.S. EPA's SWMM

C. Standards

1. Technical standards approved by the City of Oak Creek or identified, developed or disseminated by the Wisconsin Department of Natural Resources under subchapter V of chapter NR 151 of the Wisconsin Administrative Code shall be used in designing water quality and infiltration components of storm water management practices. The technical standards can be referenced at the following website: <http://www.dnr.state.wi.us/org/water/wm/nps/stormwater/techstds.htm>.

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2. **Wet Detention Basin** - The storm water quantity and quality requirements can be met by designing a wet detention basin with the following criteria:

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- a. Permanent Pool - All basins shall be designed to include a permanent pool of water consisting of a sediment forebay and main pool. (See fig. ST-28 and fig. ST-29)
 - (1) The minimum surface area of the permanent pool shall be based on the total drainage area to the basin or it shall be 10,000-sq. ft., whichever is greater. The following table shall be used. Values shall be prorated for mixed land uses.

Calculation of Minimum Permanent Pool Surface Area

Land Use/Description/Management	Total Impervious (%)	Minimum Surface Area of the Permanent Pool (% of Watershed Area)	
Residential			
• < 2.0 units/acre (> 1/2 acre lots)	8 - 28	0.7	
• 2.0 - 6.0 units/acre	> 28 - 41	0.8	
• > 6.0 units/acre (high density)	> 41 - 68	1.0	
Office Park/Institutional/Warehouse (Non-retail related business, multi-storied buildings, usually more lawn/landscaping not heavily traveled, no outdoor storage/manufacturing)	< 60 60 - 80 > 80	1.6 1.8 2.0	
Commercial/Manufacturing/Storage (Large heavily used outdoor parking areas, material storage or manufacturing operations)	< 60 60 - 80 > 80	1.8 2.1 2.4	
Parks/Open Space/Woodlawn/Cemeteries	0 - 12	0.6	
Highways/Freeways (Includes right-of-way area)			
• Typically grass banks/conveyance	< 60	1.4	
• Mixture of grass and curb & gutter	60 - 90	2.1	
• Typically curb & gutter conveyance	> 90	2.8	
Cropland (Cropland that is draining to the basin) Dominant Surface Soil Texture		Erosion < Tolerable	Erosion > Tolerable
• S, LS		0.6	0.9
• SC, SCL, SL, L, SiL, Si		1.6	2.4
• C, CL, SiCL, SiC		2.0	3.0
S=Sand, Si=Silt, C=Clay, L=Loam (USDA Textural Soil Classification System)			

- (2) A sediment forebay shall be located at the inlet to trap large particles such as road sand. The storage volume of the sediment forebay shall be consistent with the maintenance plan, with a goal of 5-15% of the permanent pool surface area. The sediment forebay shall be a minimum depth of 3 ft. plus the depth for sediment storage.

- (3) The length to width ratio of the flow path shall be maximized with a goal of 3:1 or greater. The flow path is considered the general direction of water flow within the basin including the permanent pool and forebay.
 - (4) A safety shelf shall extend a minimum of 8 ft. from the edge of the permanent pool, with a slope of 10h:1v or flatter. The maximum depth of water over the shelf shall be 1.5 ft.
 - (5) Excluding the safety shelf and sediment storage, the average water depth of the permanent pool shall be a minimum of 3 ft.
 - (6) A minimum of 2 ft. shall be added for sediment storage.
 - (7) For basins 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 basins less than 20,000-sq. ft., maximize the area of 5-ft. depth.
 - (8) All side slopes below the safety shelf shall be 3h:1v or flatter as required to maintain soil stability.
- b. Extended Detention Volume - Volume above permanent pool that is released slowly. (see fig. ST-28 and ST-29)
- (1) Extended detention volume shall be the runoff volume produced by a 1-yr., 24-hr. design storm (2.3 inches). Use the post development curve number.
 - (2) Outlet design shall allow for the release of the extended detention volume over a period of 24 hours or greater. The release time period is measured from the time runoff starts entering the basin until the time it drains back down to the normal pool elevation.
- c. Peak Flow Control - Peak flow control shall be designed to maintain stable downstream conveyance systems. At a minimum outflow shall not exceed 0.15 cfs/acre for the 2-year, 24-hour design storm and 0.40 cfs/acre for the 100-year, 24-hour design storm.
- d. Inflow Points - All inlets shall be designed to prevent erosion during peak flows. Any rock riprap or other channel liners shall extend a minimum of 1.5 vertical feet below the permanent pool elevation.
- e. Outlets - All outlet designs shall incorporate preventive measures for ice damage, trash accumulation, and erosion at the outfall.
- f. Emergency Spillway - All basins shall have an emergency spillway sized to safely pass the 100-year, 24-hour design storm should the primary outlet structure become clogged. The basin design shall ensure the top of embankment, after settling, is a minimum of 1 vertical foot above the emergency spillway elevation.
- g. Freeboard - The basin design shall ensure that the emergency spillway elevation, after settling, is a minimum of 0.5 vertical feet above the routed 100-year, 24-hour design storm peak elevation.
- h. Side Slopes - All interior side slopes above the safety shelf shall be 4h:1v or flatter with 5h:1v being preferred.
- i. Earthen Embankments - Earthen embankments (see fig. ST-29) 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.
- (1) The base of the embankment shall be stripped of all vegetation, stumps, topsoil and other matter. Stripping shall be minimum of 6 in.

- (2) For embankments where the permanent pool is ponded 3 ft. or more against the embankment, there shall be a core trench or key-way along the centerline of the embankment up to the permanent pool elevation. The core trench or key-way shall be a minimum of 2 ft. deep and 8 ft. wide with a side slope of 1:1 or flatter.
 - (3) All embankments shall be constructed with non-organic soils and compacted to 90% standard proctor according to the procedures outlined in ASTM D-698 or by using compaction requirements of USDA Natural Resource Conservation Service, Wisconsin Construction Specification 3. No tree stumps, or other organic material shall be buried in the embankment. The constructed embankment height shall be increased by a minimum of 5% to account for settling.
 - (4) Any pipes extending through the embankment shall be bedded and backfilled with embankment or equivalent soils. The bedding and backfill shall be compacted in lifts and to the same standard as the original embankment. Excavation through a completed embankment shall have a minimum side slope of 1:1 or flatter.
 - (5) Measures shall be taken to minimize seepage along any conduit buried in the embankment. Measures such as anti-seep collars or sand diaphragms are acceptable.
 - (6) Downstream side slopes shall be 3h:1v or flatter.
 - (7) Minimum embankment top width shall be 5 ft.
- j. Topsoil and Seeding - Topsoil shall be spread on all disturbed areas, except for elevations below the safety shelf, as areas are completed. Install erosion matting as required and seed all areas above the safety shelf.

3. Floodplains

- a. Dikes and flood walls shall not be used to facilitate new development in the floodplain. New development in floodplains shall only be on engineered fill. Where dikes or flood walls are used to protect human life in existing development, the minimum dike or flood wall top elevation shall be determined using whichever of the following produces the highest profile:
 - (1) The 100-year recurrence interval flood profile plus 3' of freeboard.
 - (2) The 500-year recurrence interval flood profile.
- b. Reduced regulatory flood protection elevations and accompanying reduced floodway or floodplain areas resulting from any proposed dikes, floodwalls, storage ponds, or channel modifications shall not become effective for the purposes of land use regulation until the storage facilities are actually constructed, operative, and approved.
- c. Any loss of flood storage from the floodway and flood fringe due to filling or diking shall be compensated at a ratio of not less than 1.1:1. All compensatory storage must be hydraulically equivalent for the 10-year and 100-year recurrence interval flood discharge.

Deleted: <#>Artificial Wetland Storm Water Management Systems - A minimum of 80% of the total suspended solids load shall be removed from the runoff volume generated by the drainage area on an average annual basis. This requirement can be met using either the SLAMM model or by designing the artificial wetland using the criteria in the latest edition of the [Wisconsin Storm Water Manual](#). ¶

<#>Dry Extended Detention Basins - The water quality requirements cannot be met using only a dry extended detention basin. They can be used in combination with filter strips, grassed swales or sand filters. A SLAMM analysis is required showing the system meets the 80% removal of total suspended solids. ¶

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4. **Operation and Maintenance** - An operation and maintenance plan shall be developed that is consistent with the purposes of the practices incorporated, its intended life, safety requirements and the criteria for its design. The plan shall address the responsible party for operation, maintenance, and documentation of the plan. The plan shall also include details on inspecting sediment depths, frequency of sediment removal, inlet and outlet maintenance, keeping embankments clear of woody vegetation, keeping the practice clean from trash and debris, mowing and providing access to perform the operation and maintenance activities. At a minimum, detention basins shall be maintained to the standards outlined in the following table:

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DETENTION BASIN MAINTENANCE STANDARDS

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Side Slopes and Embankments	Trash & Debris	Any visual evidence of dumping, trash or debris.	Trash and debris cleared from site.
	Unmowed vegetation/ Ground Cover	If facility is located in a platted subdivision, multi-family apartment complex, planned development or a mobile home district, mowing is needed when vegetation exceeds 6 inches in height. In all other areas, mowing is needed when vegetation exceeds one foot in height. Mowed vegetation should be removed from areas where it could enter the pond, either when the pond level rises or by rainfall runoff.	When mowing is needed, grass/ground cover should be mowed to 2 inches in height. Trees and bushes should be removed where they interfere with pond maintenance activities; that is, at the inlet, outlet and near engineered structures.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired.
	Tree Growth	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal or equipment movements).	Trees do not hinder maintenance activities.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes should be stabilized by using appropriate erosion control measures; e.g., rock rip-rap, planting of grass, erosion mat, compaction.
Inlet/ Outlet Structures	Debris and Sediment	Sediment and/or debris clogging more than 10% of the structure opening.	No clogging or blockage in the inlet and outlet structures.
	Damaged Pipe	Rust is causing more than 50% deterioration to any part of metal pipes, cracks in plastic pipe or cracks or exposed rebar in concrete pipes.	Pipe repaired or replaced.
		Any dent that decreases the cross section area of pipe by more than 10% or retards the flowage of water.	Pipe repaired or replaced.
	Erosion/Scouring	Eroded or scoured bottom at inlet or outlet pipes; undermining of structure or end section.	Area should be stabilized by using appropriately sized rock rip-rap.
	Damaged or Missing Orifice Plate	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
Orifice Plate Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.	
Trash Racks/Hoods	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier clear to receive capacity flow.
	Damaged/ Missing Bars or Hood.	Bars or hood are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Repair or replace barrier to design standards.
Pool Area	Sediment Accumulation in Pond Bottom	Sediment accumulations in pond bottom that exceeds the design sediment depth.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Water Level	Water level does not drain down to normal designed pool elevation.	Check outlet structure and downstream conveyance system for obstructions.
	Oil Sheen on Water	Prevalent and visible oil sheen.	Remove oil from water by use of oil-absorbent pads or by vactor truck. Refer problem to locate source and correct.
Emergency Overflow/Spillway and Dikes	Settlements	Any part of these components that has settled 4-inches lower than the design elevation, or inspector determines dike/ berm is unsound.	Dike should be built back to the design elevation and repaired to specifications.
	Rock Missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top emergency spillway.	Replace rocks to design standards.

5. Miscellaneous

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- a. Storm water management practices outlet structures.
 - (1) Outlet structures shall be 3 (three) inches in diameter or larger.
 - (2) Outlet structures 6 (six) inches or smaller shall be protected from clogging due to ice formation or trash build-up by incorporating hoods, trash racks or submerged outlets into the design.
- b. Existing and proposed right-of-way shall not be used or considered as a detention facility or to supplement a detention facility.
- c. Existing and proposed parking facilities may be used as part of detention facility provided that the inundation depth does not exceed 6 (six) inches at any point over the paved surface.
- d. A corridor at least 30-feet wide shall be provided for access to storm water management practices. The access corridor may be provided by easement, outlot or right-of-way. The slope on the access corridor shall not exceed 10% in any direction and shall be free of obstructions.
- e. Detention basins designed as part of a development creating more than one parcel shall be placed in an outlot.
- f. The bottoms of all dry detention basins shall have a minimum 1% slope, and a low flow pilot channel incorporated into the design.
- g. Undeveloped conditions shall reflect a good level of land management and not exceed the following:

Hydrologic Soil Group

	A	B	C	D
CN Grain	55	68	77	80
CN Meadow	30	58	71	78
CN Pasture	39	61	74	80
CN Woods	30	55	70	77

D. Submittal Requirements

- 1. Completed storm water management permit application and applicable fee.
- 2. Two copies of the storm water management report (see checklist in permit application for required information).
- 3. Two copies of the site and drainage map (see checklist in permit application for required information).
- 4. One copy of the Soil and Site Evaluation Report.
- 5. Two copies of the erosion control plan and schedule.
- 6. Signed maintenance agreement.

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