



Basement / Groundwater Separation and Soils

4/13/2022

Waukesha County Stormwater Workshop

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Land Resources Division

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Presentation Outline

- ❖ Introduction & background
- ❖ Code requirements
- ❖ Soil characteristics, testing procedures & forms
- ❖ Permitting process
- ❖ Questions and discussion





In 2005, Waukesha County adopts “site drainage standards” as part of the Storm Water Management and Erosion Control Ordinance

- Drainage Easements
- Site Grading
- Street Drainage
- Bridges and Cross-Culverts
- Subsurface Drainage
- Open Channels
- Storm Sewers
- Changes to Stormwater Discharges
- Structure Protection and Safety



Source: Google Images





Basement Flood Prevention Standards

Waukesha County SW & Zoning Ordinances

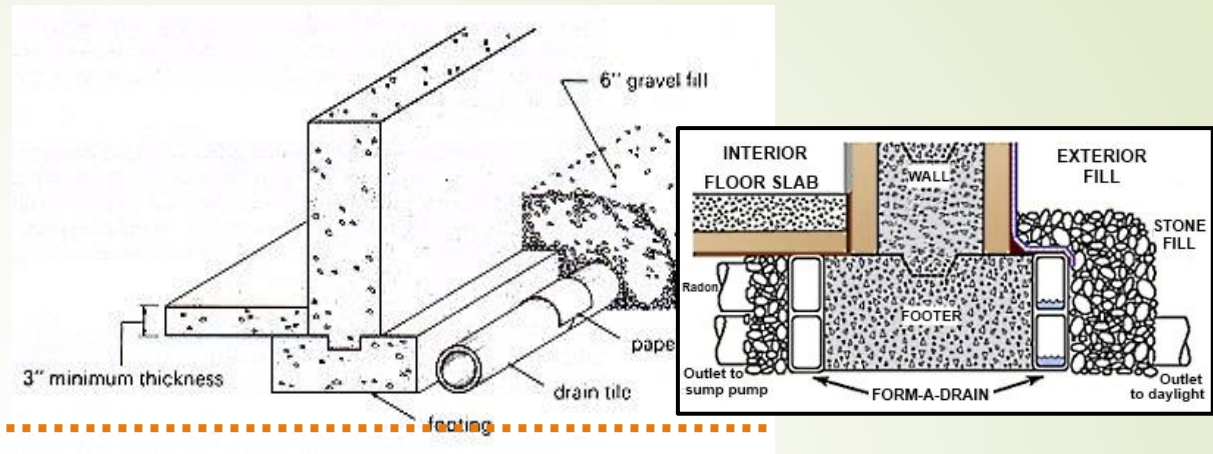
- Groundwater:
 - 1 foot above highest record (using soils)
 - Avoid “hydric” soils (< 1 foot to water table)





Why 1 foot groundwater separation?

Water table →



- Minimize:
 - Constant flows / discharge "drainage wars"
 - High energy bills (electric)
 - Damages from sump pump burn-out / failure





Paul Farrow
County Executive



Dale R. Shaver
Director

Basement Wetness and Flooding Prevention Standards
Waukesha County Stormwater Management and Erosion Control Ordinance
Land Resources Division (LRD)

Background:

It has become commonplace for residential homes to construct walkout basements and finish lower levels as an extension to their living space. As a result, wetness in or near these areas can cause significant property damage and could lead to other safety or health issues. Let's face it - nobody wants a wet basement. Wetness can occur due to groundwater seepage, surface water runoff, or a combination of both. Most of these problems are preventable, but to be effective, must be addressed during site planning.

To address these concerns, the 2005 update to the Waukesha County Stormwater Management and Erosion Control Ordinance (and many other local ordinances) contains four specific design standards that must be met for any buildings designed for human occupation. These standards apply to all sites that require a Stormwater Permit where a basement is proposed. Since deed restrictions may be involved, these issues *must be addressed at the time of land division*. The standards are briefly summarized below.

Summarized Design Standards (see ordinance for details)

Surface Water (see page 2):

1. A minimum 2-foot vertical separation between the lowest exposed building surface and the peak water surface elevation produced by the 100-year, 24-hour design storm; and
2. A minimum 50-foot horizontal setback from the 100-year design storm elevation.

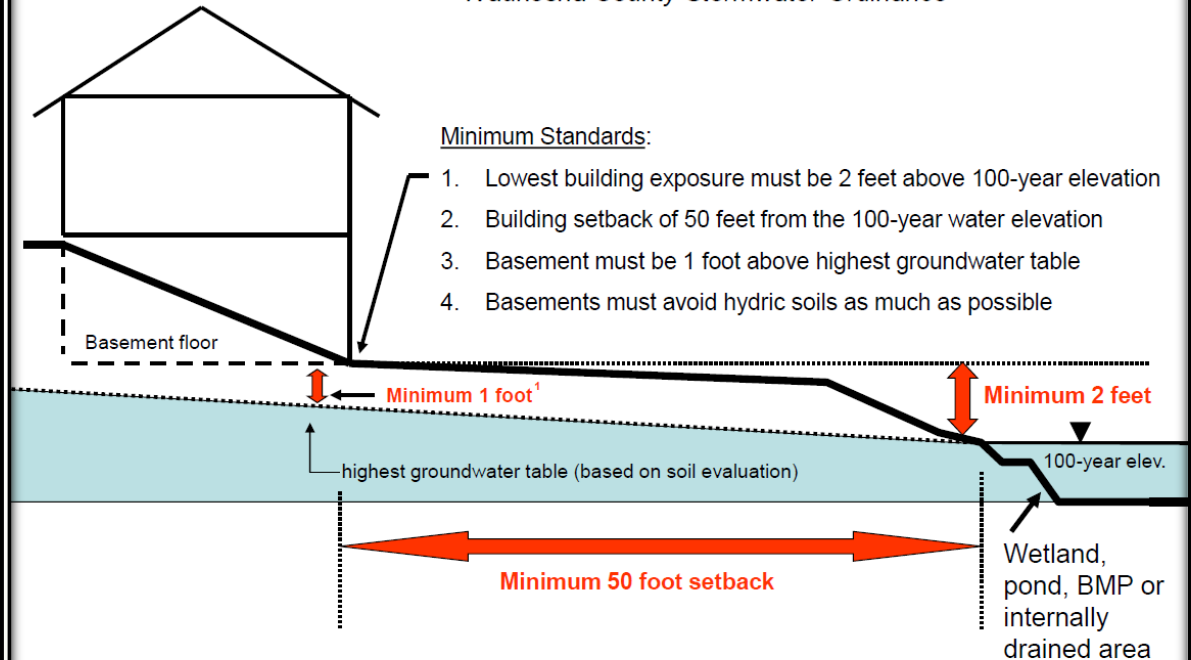
Groundwater (see pages 3-6):

3. A minimum 1-foot vertical separation between highest groundwater table and the basement floor surface; and
4. Avoid hydric (very poorly drained) soils for basement construction as much as possible.

This document provides more information on how the LRD enforces these provisions and what the permit applicant needs to provide to the LRD to demonstrate compliance. Two procedures follow. The first one explains how to comply with the first two standards relating to surface water runoff in internally drained areas. The second explains how to comply with the third and fourth standards relating to basement separation from highest groundwater table.

Minimum Site Drainage Standards

Waukesha County Stormwater Ordinance



Minimum Standards:

1. Lowest building exposure must be 2 feet above 100-year elevation
2. Building setback of 50 feet from the 100-year water elevation
3. Basement must be 1 foot above highest groundwater table
4. Basements must avoid hydric soils as much as possible

¹ On sloped sites, the soil evaluation results must be interpolated through the building site. If any portion of the proposed basement floor is less than one foot above the highest groundwater table, a gravity drain system and suitable outlet is required. Contact the Waukesha County Department of Parks and Land Use for details (262) 896-8300.



When is a soil test needed for a basement?

- Where soils are mapped by the USDA-NRCS as being either hydric, hydric inclusions, Hochheim or Theresa (Exhibit X in the standard and blue hatching on GIS under building limitations);
- Within 8 vertical feet of a lake, river, stream, pond or wetland;
- Where nearby soil testing shows indicators of high groundwater;
- Other areas of the County where there is a risk for shallow groundwater;

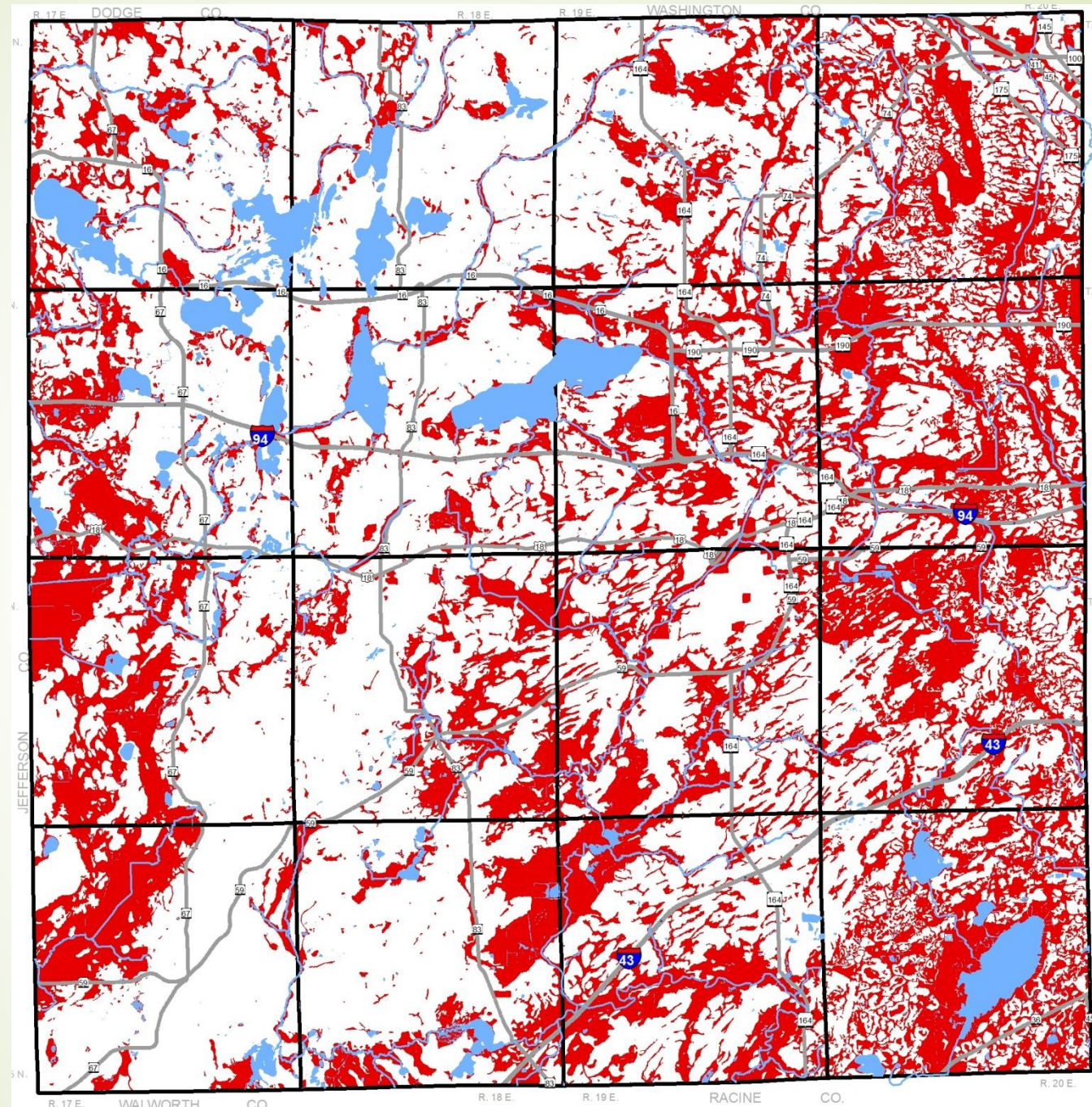




Wet Soils

Waukesha County

≤ 3 feet to seasonal high water table





Blue Hatching on GIS

MAP WAUKESHA county

Search...

Navigation Search Tasks Buffers

Tool Labels

Show Layers Pan Zoom In Zoom Out Full Extent Previous Extent Next Extent Identify Clear Highlight Clear Markup Bookmarks Metadata Help ArcGIS Groups

Layers

Filter Layers... Filter

- Soils
- Building Limitations
 - Soil Testing Required by County for Basements
 - Hydric Soils
 - Hydric Inclusions
 - Steep Slopes
 - Shallow Bedrock
- Hydric Classification
- Surface Texture
- Percent Slope
- SW Infiltration Potential
- Land Capability Class

I want to...

Scale 1: 7,950

0 300 600ft

Waukesha County - Land Information System Division | Waukesha County Department of Public Works





Redoximorphic Features (Soil Mottling)

Reduced

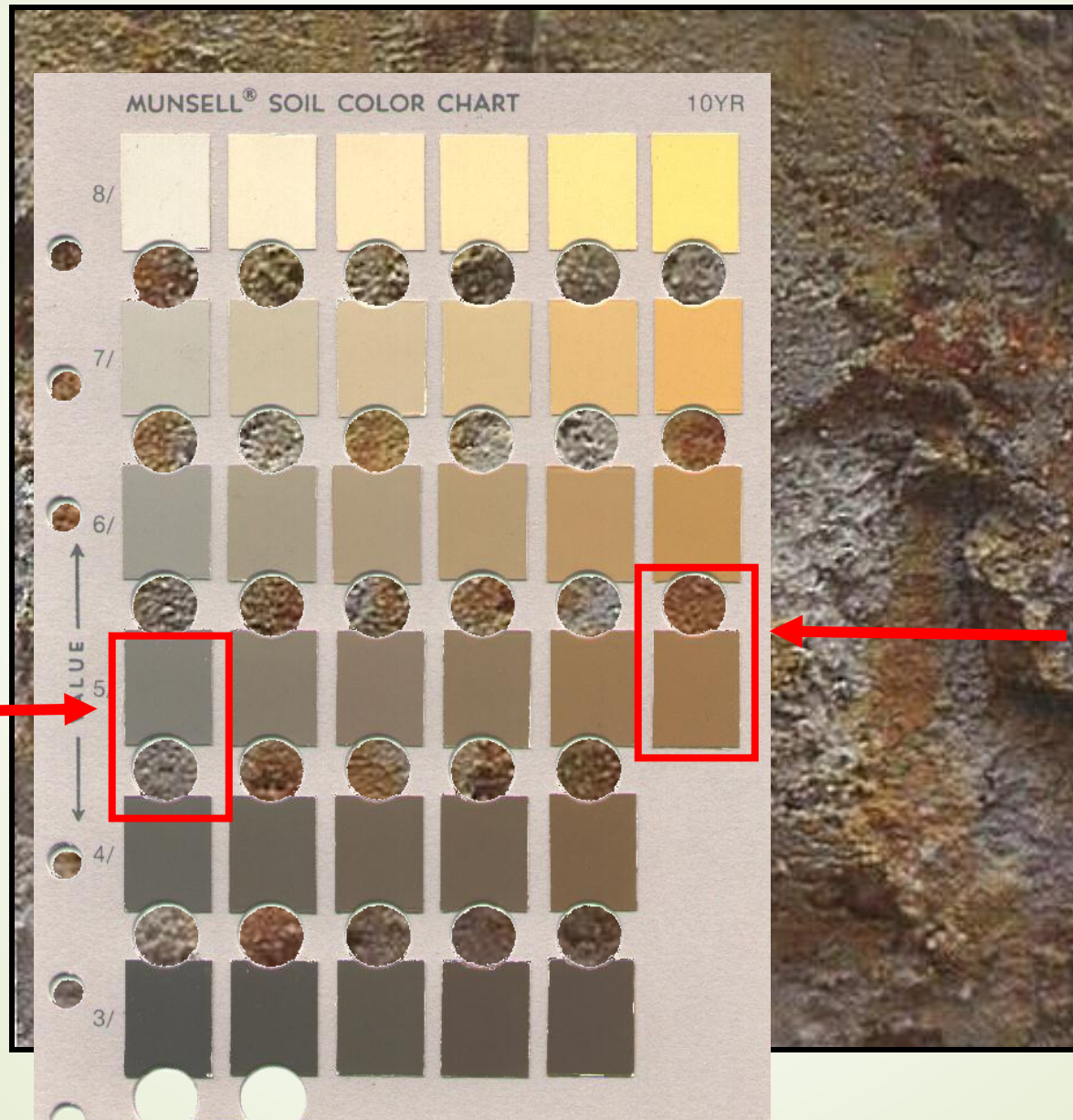
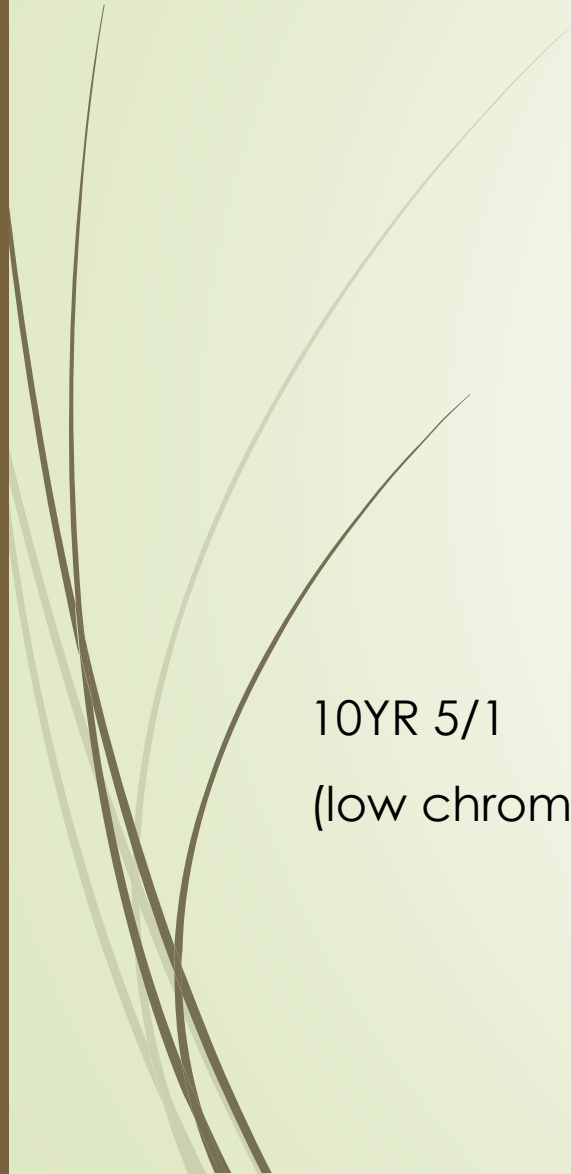


Oxidized





Redoximorphic Features (Soil Mottling)



10YR 5/1
(low chroma)

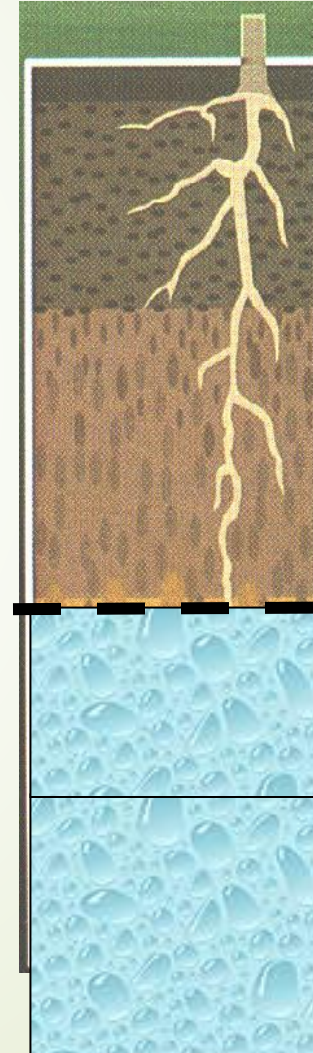
10YR 5/8
(high chroma)





“Seasonal High Groundwater”

“The upper limit of the zone of soil saturation caused by underlying groundwater at its highest level”





Hochheim and Theresa soil map units



Hochheim Dry
←

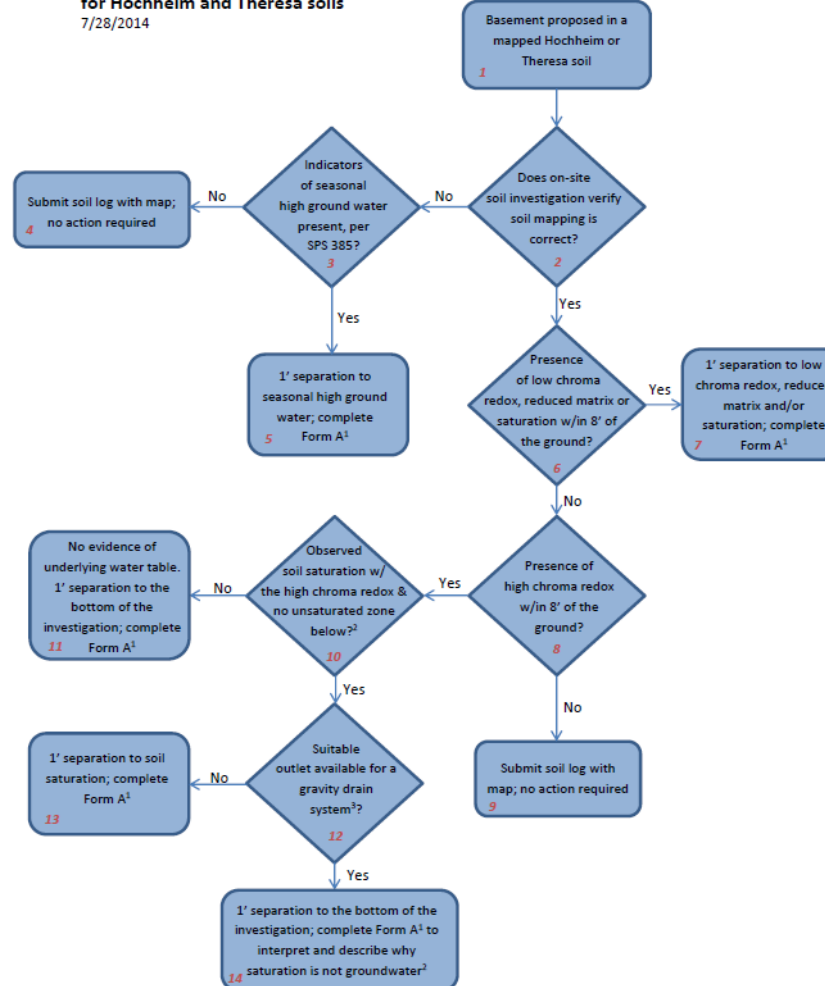
Hochheim Wet
→





Special Provisions for Hochheim and Theresa Soils

Basement/groundwater separation procedure for Hochheim and Theresa soils 7/28/2014



¹Form A is the seasonal high groundwater determination report which can also serve as an interpretative determination per SPS 385.60.
²The County may require soil investigations be completed to demonstrate saturated conditions do not exist at other times of the year.
³Plans must meet County standards, including design, construction verification and recording as-builts and maintenance plan.





Now what? Fill out a Form A, then pass go!

Form A - Highest Groundwater Table Determination Report *(with sample language)*

Project/Plat Name: _____ Date: _____

Project Location (PLS/CSM#): _____

The following table summarizes my interpretation of the soil profile evaluations conducted on the above noted site. The purpose of this report is to demonstrate compliance with a Waukesha County ordinance requirement to maintain basement floor elevations at least 1 foot above the highest groundwater table. I understand that the definition for highest groundwater table means the upper limit of the zone of soil saturation caused by underlying groundwater at its highest level. I certify that the information presented in this report represents my best professional judgment in estimating the highest groundwater table elevation based on soil and site evaluations in accordance with the procedures contained in Chapter SPS 385 Wisconsin Administrative Code.

Stamp, Sign & Date Here

Interpreters Signature: _____

Interpreters Printed Name/Credentials/Lic. #: _____

Interpreters Company Name/Address: _____

Site Benchmark/Elevation (Co. Stds.): _____

References: (sample) The following references apply to the data presented herein: 1) Map 1 for soil test pit locations; and 2) Dept. of Safety and Professional Services Soil Evaluation forms (5 sheets).

Lot #	Soil Observ. (#)	Surface Elev. (NGVD 29)	Bottom Elev. of Soil Profile	Soil Map Unit Symbol (NRCS)	Elevation of Highest Groundwater Table	Depth to Highest Ground - Water Table (Feet)	Proposed Basement Floor Elevation	Notes: List information used to determine the highest groundwater table, including any soil color pattern exemptions under SPS 385.30(3) for a basement floor proposed less than 1-foot above redoximorphic features shown in the referenced soil evaluation reports.
(sample)	103	900.0	889.2	HmB	893.4	6.6	894.4	Soil saturation at elev. 889.8 and redox features up to 893.4. Unsaturated loamy sand between elevations 893.4 to 895.0. Less prominent redox features between elev. 895.0 and 897.0 determined to be caused by texture of B2t horizon [tension zone under SPS 385.30(3)3.], not highest groundwater table conditions, as defined above.

Page ___ of ___

Waukesha County Land Resources Division

Rev. 4/16

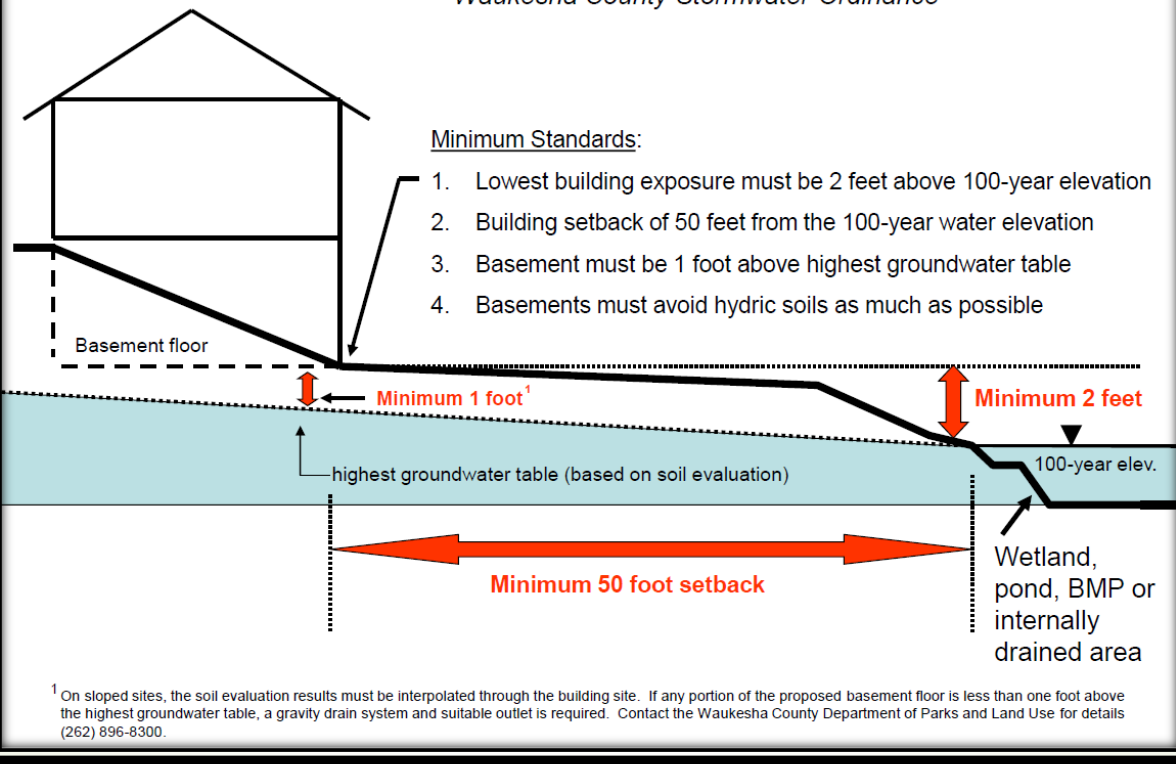
Can be filled out by a CST, PSS, PHG or PE





Minimum Site Drainage Standards

Waukesha County Stormwater Ordinance



On sloped sites, the soil evaluation results must be interpolated through the building site. If any portion of the proposed basement floor is less than one foot above the highest groundwater table, a gravity drain system and suitable outlet is required. Contact the Waukesha County Department of Parks and Land Use for details (262) 896-8300.





If any portion of the basement will not have 1-foot of separation, then...

Paul Farrow
County Executive



Dale R. Shaver
Director

Foundation Drainage System Checklist
For Basements Constructed Partially Below Highest Groundwater Table
Where Gravity Flow Outlets Are Available

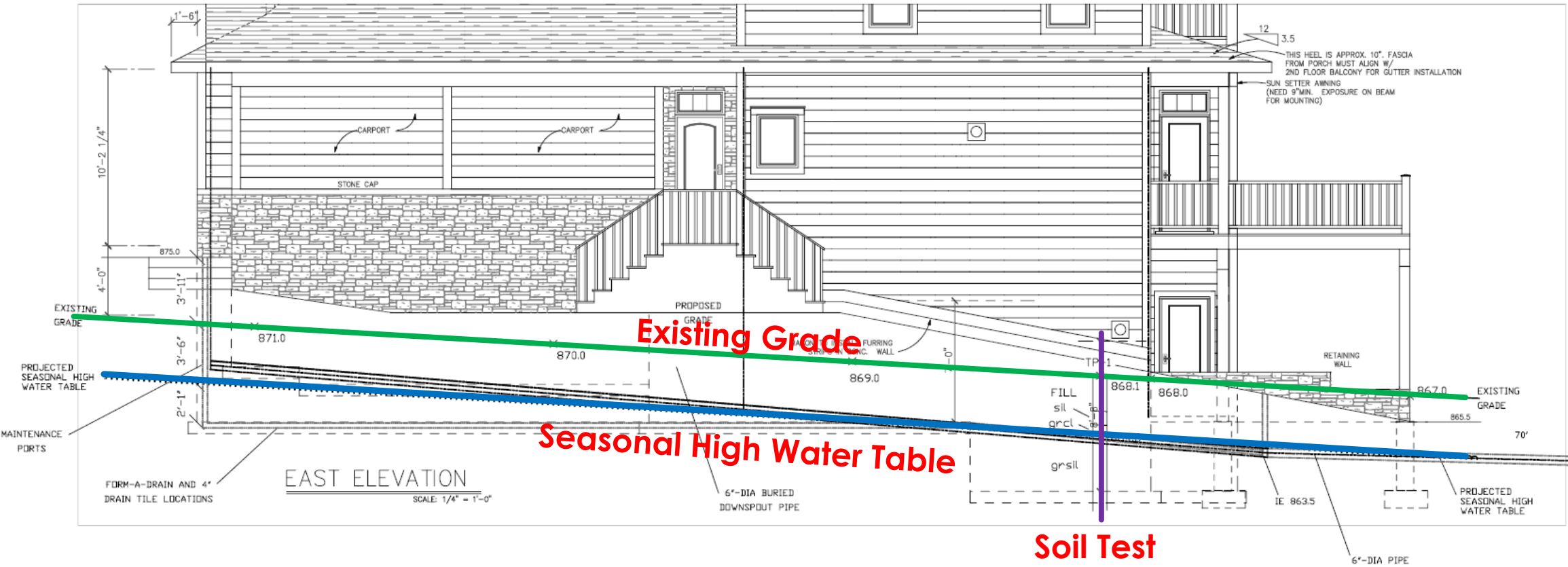
- **Soil Data.** Submittal of a Soil Investigation Report completed by a Certified Soil Tester or Soil Scientist only and Form A – Highest Groundwater Table Determination Report, completed by a Certified Soil Tester, Soil Scientist, P.E., or Hydrogeologist in accordance with standards contained in Chapter SPS 385 WI Admin. Code. Form A must identify the elevation of the highest water table within 50 ft. of the proposed structure. Multiple soil tests may be required based on topography and variable soil conditions.
- **Basement Drainage System Plan.** Submitted by a qualified professional engineer, to include the following:
 - Narrative describing key components of the proposed drainage system and how it will work.
 - Plan view, cross-section and profile drawings of the proposed system with key elevations, pipe grades, dimensions, etc. Show details where pipes are proposed to cross or connect.
 - System design must include or address the following:
 - Flow calculations for groundwater seepage and system conveyance.
 - Measures to intercept flows and/or alleviate hydrostatic pressure on the walls and floor of the structure.
 - Separation of sump pump system, gravity drains, and exterior down spouts. If connections are proposed, flow impacts must be described and supported by calculations.
 - Access/clean out traps for future maintenance.
 - Location and detail design of the outfall structure, including material specifications, elevations, cover depth/frost protection, animal guards and erosion control measures.
 - The outfall shall not cause adverse drainage on adjacent properties or road right-of-ways, or negatively impact natural resources. Written approval of the downstream landowners or municipality (if public road), may be required.
 - Material specifications for all key components of the system.
 - Construction inspection plan and contact information for the engineer who will oversee and verify proper system installation.
 - Long term maintenance plan and procedures.
- **Recorded Maintenance Plan & As-built Drawings.** The maintenance plan must be recorded on the deed to notify future owners of the existence of the basement drainage system, its purpose, design, construction, and long-term maintenance needs. A professional engineer licensed in the State of Wisconsin must oversee installation of the drainage system and verify proper construction, including the use of specified materials and an as-built survey of key system elevations. As-built documents and a construction verification letter by the project engineer must be recorded as part of the Maintenance Plan (may be an addendum).

1/21/2016





Interpolating the soil test results through the proposed foundation





LRD Spreadsheet for Calculating Flows Through form-a-drain

Formadrain calcs rev 12-2-14.xlsx - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

Clipboard Font Alignment Number Styles

E6 : 5000

Inputs by User				Outputs				
4	Seepage Face Height	1	ft	Seepage Rate	50,000.00	gal/day, or	0.07737	cfs
5	Seepage Face Length	50	ft	Flow depth in Drain Tile	0.107	ft, or	1.284	inches
6	Seepage Face Hydraulic Conductivity	5,000.0000	gal/day/ft ² , see below	Max depth in Formadrain*	0.495	ft, or	5.94	inches
7	Ground or Water Table Slope at seep face	0.2	ft/ft, or 20 percent					
8	Drain Tile Diameter (4" or 6") *	4	inches, or 0.333 ft					
9	Elevation difference btwn tile and FAD at joint	0.5	inches					
10	Drain Tile Slope	0.02	ft/ft, or 2 percent	Comment:	Formadrain overflows to interior drainage system with bleeder elevation at two inches			
11	Manning's number for Drain Tile	0.01	dimensionless, 0.010 for PVC					
12	Formadrain Length	90	ft					

yellow = enter site-specific data
green = outputs

Suggested hydraulic conductivities		K
Soil		(gal/day/ft ²)
Clay, silty clay		0.01
Silt loam, silty clay loam, loam, clay loam, sandy clay loam		10
Sandy loam		100

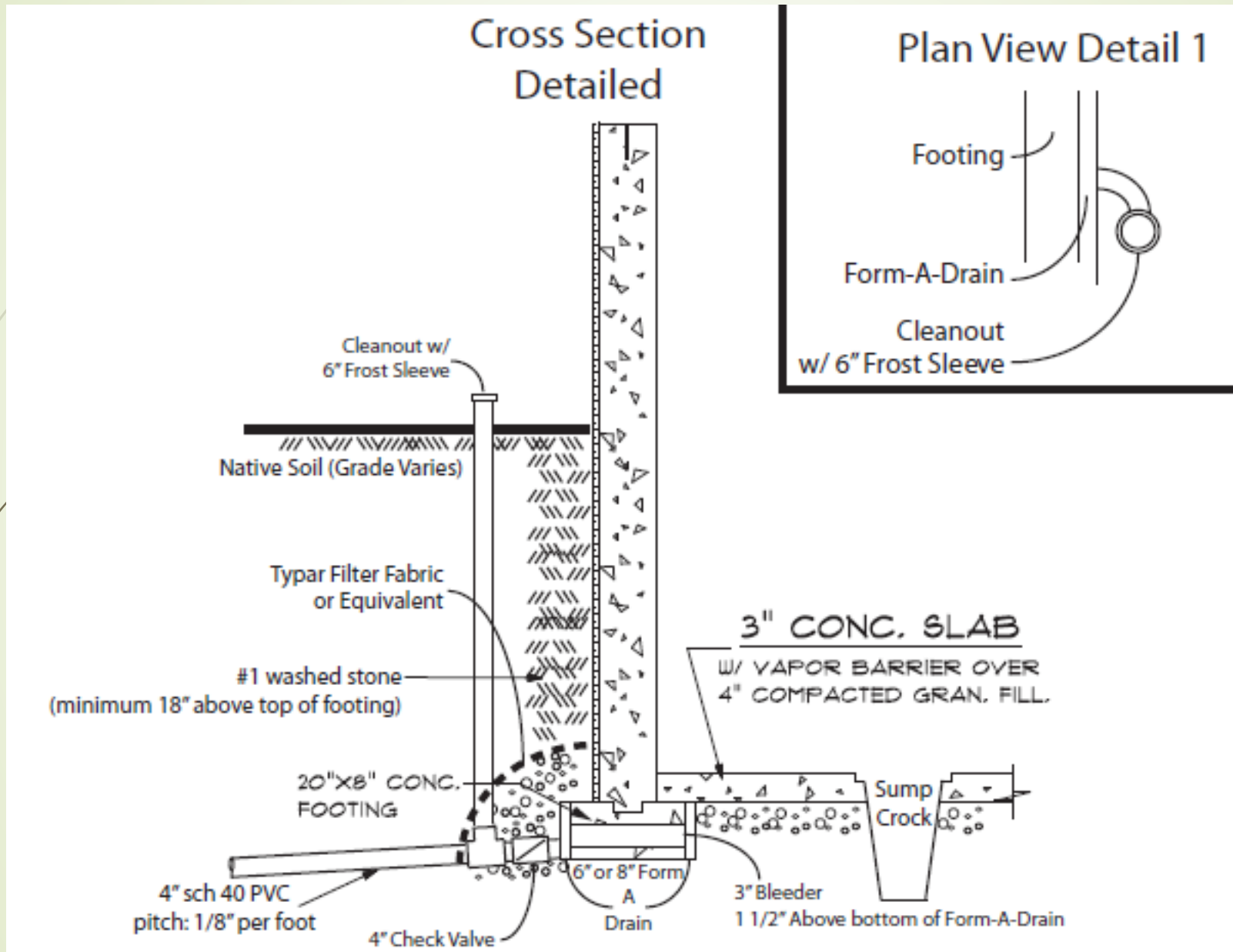
* For seepage rates > 8,100 gal/day, exceeds capacity of Formadrain with bleeders at two inches from bottom

Water Depth Profile in Formadrain

Chart Area

Data Entry | flow in drain tile | flow in FAD







Sample Recorded Maintenance Plan

FOUNDATION DRAINAGE SYSTEM MAINTENANCE PLAN

Document Number

Document Title

Return Address:

Waukesha County Dept. of Parks and Land Use – Land Resources
515W. Moreland Blvd., Room AC 260
Waukesha, Wisconsin 53188

Parcel Identification Number (PIN):

_____, as the “Owner” of the property known as _____,
located in part of the ____th/₄ of Section ____ of Section ____, T__N, R__E, Town of _____,
Wisconsin (the “Property”) acknowledges that a foundation drainage system has been installed
due to the basement being partially below the seasonal high ground water level. The foundation
drainage system is gravity-fed and has been designed to intercept ground water seepage,
minimize ground water intrusion into the basement and route intercepted water around the
residence before being discharged.

The purpose of this document is to record the foundation drainage system design and to explain
the long-term maintenance instructions to minimize ground water intrusion into the basement.
This maintenance plan includes the following exhibits:

- Exhibit A:** Legal Description – Shows the property for which this plan applies (“Property”)
- Exhibit B:** Drainage System Plan - Plan view and cross-section drawings of the design
- Exhibit C:** Maintenance Plan – Prescribes those activities that must be carried out to
maintain the foundation drainage system.

Through execution of this document, the Owners hereby subject the Property to the following
covenants, conditions and restrictions:

1. After construction verification has been accepted by Waukesha County staff for the
foundation drainage system, an addendum to this maintenance plan shall be recorded by
the Owner. The addendum may contain several additional exhibits, including an as-built
survey and a verification letter from the project engineer.
2. The Owners shall be responsible for the routine and extraordinary maintenance and repair
of the foundation drainage system identified in Exhibit B;
3. The Owners shall inspect and properly maintain the foundation drainage system outlined
in Exhibit C;
4. These covenants, conditions and restrictions are to go with the land and are to transfer to
all successors, heirs and assigns. The Owner may modify this maintenance plan by a
written instrument executed by the Owner and Waukesha County.

The undersigned is aware that Waukesha County and the Town of _____ shall not be
liable for the failure of the basement due to water or any other condition or for the pre- or post-
construction of the residence or attached garage.





Construction Inspection Schedule

Foundation Drainage System Inspection Schedule

Project Name: _____

Storm Water Permit #: _____

Project Location: Section ____, Town of _____

Elements for Inspection	Inspection By	Approx. Date of Inspection or When in Construction Sequence	Notice Needed	Phone Number for Inspection	Inspector	Inspectors Initials	Date of Inspection
Footing Drain & Bleeders							
Footing Inspection	Building Inspector						
Foundation Inspection	Building Inspector						
Foundation Waterproofing							
Foundation Drain Tiles	Project Engineer						
Washed Stone & Fabric	Project Engineer						
Backfill							
Clean Out Ports	Project Engineer						
Outlet Pipe Connection and Outfall	Project Engineer						
Outfall Scour Protection							
County Final inspection: Rodent Protection, Outfall Vegetation, Grading, Stabilization, Sediment Control BMP Removal	Land Resources Division		7 days	262-896-8300			





Summary

- Basement flooding is preventable
- County standards are a prevention tool
- Soil evaluations: the earlier the better
 - Deep enough and in the right places
 - Use for storm water BMP, septic, buildings, roads, utility, dewatering planning, etc.
- Compliance protects the buyer & seller





Thank you
Any Questions?

