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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.

Procedures for Internally Drained Areas *(to meet design standards #1 and #2)*

Stormwater planning in areas that are internally drained presents a unique challenge to planners, homebuilders and engineers in Wisconsin, especially during frozen ground periods. Flooding of lower levels can occur after heavy rains and snowmelts during these periods if proper precautions are not taken. The procedures below describe what must be done to comply with the first two standards near internally drained areas (i.e. areas with no/limited outlet for overflow).

1. Calculate the total runoff *volume* produced by the 100-year, 24-hour design storm using the entire watershed draining to the internally drained area. Use 6.18" rain depth and NRCS runoff curve number of 98 to reflect frozen ground conditions.

Note: Watershed land use and ownership does not matter. No infiltration credits are allowed for existing or proposed upstream stormwater BMPs or internally drained areas. Runoff volume credits will only be allowed for verified dead-storage volumes for existing infiltration basins or other internally drained areas, based on detailed site surveys (as-built for BMPs) and deed restrictions ensuring the area will remain in perpetuity.

2. Conduct a detailed topographic survey of the internally drained area.

Note: Make sure to survey a large enough area to demonstrate compliance with the vertical and horizontal setbacks noted above. County 2' topographic maps may NOT be used for the following steps unless the applicant agrees to additional setbacks the LRD determines to be necessary to allow for accuracy limitations in county maps (see #3 note below).

3. Apply the runoff volume calculated in #1 above to the internally drained area under #2 above and determine the peak water surface elevation. Delineate this elevation on the plat or CSM and label it **"Peak water surface elevation for 100-year design storm".**

Note: To account for frozen ground periods, NO assumed outflow rate is allowed for water infiltration into the soil surface when establishing this elevation, even if infiltration trenches or other structures are installed. Outflow rates are only allowed for gravity flows away from the internally drained area, such as a constructed spillway or natural overflow point. If county topographic maps are used to establish the elevation under this step, an additional minimum 2-foot vertical separation and 10-foot horizontal setback shall apply. The LRD may require additional separation or setbacks, or not allow the use of these maps at all, depending on site conditions and the proximity of proposed structures to stormwater BMPs.

4. Add 2 feet to the 100-year peak water elevation calculated in #3 above and delineate a drainage easement at or above this elevation on the CSM or plat, based on the site survey under #2 above. Label it as **"Drainage easement for stormwater storage and infiltration – see restrictions".**

5. Use the 100-year peak + 2 feet elevation from #4 above to write the following deed restriction for all lands impacted by the elevation: **"No grading or filling in this area. For any building designed for human occupation on a regular basis, the ground surface at the lowest exposed portion of the building shall be above the easement elevation of (*insert elevation from #4 above*)."**

6. Delineate a setback line 50 feet from the elevation under #3 above. If this line extends outside of the easement boundary under #4 above, label the line as **"50-Foot setback for any building designed for human occupation on a regular basis".**

*Note: Any well proposed near the internally drained area may be subject to a 100-foot horizontal setback to reduce the potential for well contamination from the infiltration of stormwater. If required, the setback boundary should be delineated on the CSM or plat and the following statement added: "**No Wells Allowed in this Area."***

Procedures for Basement/Groundwater Separation *(to meet standards #3 and #4):*

Groundwater seepage is one of the most common sources of wetness in basements and lower levels in structures. Foundation drain tiles and sump pumps can work well until the power goes out, the pump fails, a tile plugs or a downstream landowner complains about the discharge water. Damages from groundwater may not be covered by homeowners insurance. The best solution is to avoid placing basements below groundwater, which is what the above-noted standards intend to do.

Soil and topographic map reviews, followed up by on-site soil profile evaluations and site assessments, are the primary tools used during site planning to prevent wet basement problems caused by groundwater. Soil maps contain valuable information about depth to groundwater and are widely available over the Internet. While they are a great site screening and general planning tool, their preparation scale (1"=1,320') and limited boring depths (5 feet) prevent them from being used exclusively for site design or to demonstrate compliance with the 1-foot basement/groundwater separation requirement. Only on-site soil profile evaluations at depths proposed for basement construction can confirm actual soil and groundwater conditions.

The sections below describe the minimum requirements for demonstrating compliance with the hydric soil and basement/groundwater separation requirements.

Avoiding Hydric Soils As Much as Possible (standard #4)

In their natural state, "hydric" soils are generally considered capable of supporting wetland vegetation because the water table is often at or near the ground surface. Because these conditions also present significant limitations for buildings with basements, the county Stormwater Ordinance requires these types of soils to be avoided as much as possible. Exhibit X contains a listing of "hydric" soils in Waukesha County. Maps of these soils are also available on the County's website through the Internet GIS. On-site soil profile evaluations should be used to verify the existence of hydric soils and to document the highest groundwater table elevation, as described below.

1-Foot Basement/Groundwater Separation (standard #3)

On-site soil profile evaluations near proposed basement locations and depths (8 feet min.) are required to demonstrate that proposed basement floor surface elevations are at least 1 foot above highest groundwater table. The evaluation results must be submitted to the LRD during the preliminary plat or CSM stage, following the standards described below. Developers are strongly encouraged to conduct at least one soil profile evaluation for every lot where a basement is proposed. However, the LRD may allow larger spacing between soil test pits for proposed subdivisions located on homogenous sites with few soil limitations and elevation changes.

Site Screening and Planning On-Site Soil Evaluations

Soil and topographic maps, along with the preliminary site plan, should be used to plan the locations of on-site soil profile evaluations. To minimize costs and delays, it is highly recommended to plan soil evaluation sites at locations and depths that can be used for determining basement restrictions while also collecting data needed to plan and design stormwater facilities, utilities and on-site waste treatment systems. Since the same soil evaluation standards apply to all these uses, coordinating them may only require extending the boring depth or slightly changing its location. **At a minimum, one 8-foot deep on-site soil profile evaluation is required within 50 feet of each basement proposed in an area that meets <u>any</u> <u>one</u> of the following conditions**:

1. Within a soil series listed in Exhibit X. These soils are classified by the Natural Resource Conservation Service as having seasonal high groundwater table within 5 feet of the surface, or have historically demonstrated poor drainage features locally.
   <u>Note</u>: NRCS data on depth to highest groundwater for each soil map unit can be found on the Waukesha County GIS web site, as noted above, or by contacting the LRD office. For mapping purposes, the LRD has grouped all soils into three general categories of depth to highest groundwater table: <1 foot (hydric), <3 feet, or >5 feet.
2. Where nearby on-site soil evaluations show indicators of highest groundwater table less than 8 feet from the ground surface.

3. Within 8 vertical feet of wetlands, other surface water features (lake, stream, pond, etc.), or soils classified as <1 foot to highest groundwater table (hydric soils).
4. Within other areas that the LRD determines to be at risk of shallow water table based on site topography, historical records, drainage patterns, observed hillside seeps or other indicators.

If several options exist for locating the basement, a boring must demonstrate that a site exists that meets the 1-foot separation requirement. Other borings may identify where basement restrictions exist, or where further testing may be required. The LRD may require additional soil evaluations if significant changes in elevation or soil conditions occur between sampling sites, or may allow fewer soil evaluations if very homogeneous subsurface conditions exist. Ultimately, the person certifying basement elevation restrictions (see below) must also be comfortable with the number and location of soil profile evaluations used to make the determination.

Regulatory Standards for Soil Profile Evaluations

All soil profile evaluations and forms submitted for review by the LRD must be completed in accordance with the USDA classification system, following standards described in Chapter SPS 385 Wis. Admin. Code, and using form SBD-8330 (R11/11). All soil profile evaluations and forms must be completed and signed by a Certified Soil Tester (CST) or Professional Soil Scientist (PSS) registered in the State of Wisconsin, including their CST/PSS number. Soil pits are strongly encouraged. Soil borings by split spoon are acceptable, but power augers are not allowed. For purposes of enforcing these requirements, the LRD will serve the same role as the WI Department of Safety and Professional Services in SPS 385.

Soil Profile Interpretations

Any soil profile evaluation that includes groundwater table indicators (see below) must be accompanied by a written determination of "highest groundwater table" elevation on LRD "Form A" ("Highest Groundwater Determination Report") and signed by a certified soil tester, professional soil scientist, hydrogeologist, or professional engineer, including their Wisconsin license number and stamp. For sites located on hydric soils, a professional soil scientist must sign and stamp any report and verify proposed basement elevation restrictions and highest groundwater table determinations. (See section below for more details on "highest groundwater table" Determinations.)

Documentation of Basement Restrictions

The limiting basement elevation must be recorded with the plat/CSM through the Register of Deeds or on an approved Master Grading Plan, including one of the following statements (or their equivalent) on the face of the document:

1. "**Basement floor surface elevations shall not be lower than (xxx.xx) due to the potential for high groundwater**."
2. **"Basement floor surface shall not be deeper than (xx.x) feet below the ground surface due to the potential for high groundwater."**
3. "**Basement floor surface elevation restrictions apply to this site due to the potential for high groundwater. Details are contained in (referenced deed restrictions)**." *Note: Combined with a map legend, this option may also be used to identify soil limitations that exist only within certain portions of a large lot.*

Optional Language (all options): "An amendment to these elevations may be made upon additional on-site soils evaluation and written acceptance by Waukesha County and the Town.")

"Highest Groundwater Table" Determinations

For purposes of enforcing the 1-foot basement/groundwater separation requirement, **"Highest groundwater table" means the upper limit of the zone of soil saturation caused by underlying groundwater at its highest level based on soil and site evaluations in accordance with the standards contained in this document**. Since the groundwater table often fluctuates with the seasons and from year-to-year due to variable precipitation, evapotranspiration, soils and other site conditions, the highest groundwater table must usually be estimated based on soil and site evaluations by technical experts. The presence of low chroma or gleyed soil colors, redoximorphic features, observed soil saturation, water level in wells, landscape features, site topography, hydrology, and other factors are all used as indicators of the highest groundwater table. Soil related features must be documented following the technical standards of the USDA-Natural Resources Conservation Service. Chapter SPS 385 Wisconsin Administrative Code has used NRCS standards and other

procedures to establish minimum requirements for evaluating and reporting soil and site characteristics. The Waukesha County Stormwater Management and Erosion Control Ordinance requires compliance with SPS 385 for all soil profile evaluations, including determining the elevation of highest groundwater table. All highest groundwater table interpretations must be properly documented on LRD "Form A" and supported by the individual soil evaluation forms SBD-8330 (R11/11).

It is possible for soils to have redoximorphic and other features indicating periodic saturation without the presence of underlying groundwater table conditions. For example, a seasonally saturated soil layer can occur above an unsaturated zone due to soil texture, structure, capillary forces, etc. (ex: Hochheim and Theresa soils). By code, these soil conditions are not subject to the 1-foot basement separation requirement, but may still require some specific drainage practices to prevent periodic basement wetness. Since some soils are subject to this seasonal saturation zone and high groundwater conditions, it is important to collect enough information to make the distinction – and correctly apply the 1-foot basement separation requirement. Assumptions are not acceptable.

Therefore, the 1-foot basement separation requirement will be enforced on any site that shows highest groundwater table indicators, unless otherwise documented on "Form A" as meeting exemption criteria consistent with SPS 385.30(3), and accepted by the LRD. For any other site proposing to locate a basement less than 1-foot above highest groundwater table indicators, the following additional requirements will apply.

1. In accordance with SPS 385.60, a written "soil saturation determination" report must be provided based on soil profile and site evaluations. The report must conclusively demonstrate that existing redoximorphic features, low chroma soil colors, saturated soils or other water table indicators are not indicative of high groundwater conditions, as defined above.
    a. This soil saturation determination can be based on completing at least one of the following:
        i. An *"Interpretative determination"* in accordance with SPS 385.60(2), including an interpretive review of soil evaluations (extending well below redox features), local hydrology, geomorphologic history, soil survey reports, landscape position, local topography, any applicable soil disturbance or hydrologic modification, and other LRD recommendations; or
        ii. *"Groundwater elevation observation pipes"* in accordance with SPS 385.60(3), including but not limited to all the requirements for installing the observation pipes, properly observing and recording the results, and complying with the minimum precipitation record keeping and results contained in the code.
    b. Under either option noted above, the final report must be based on adequate data to support the conclusions. The report must identify the specific soil profile features, monitoring results or site evaluation data that support the conclusions.
    c. All reports must include a summary of data collected and its source; clear references to scaled maps, cross-sections and other supporting information; definitive conclusion statements, and the signature and applicable license number of the author. All elevations must be consistent with county mapping standards and tied to an on-site benchmark.

2. The LRD has 20 working days to review the report to determine compliance with SPS 385, the above noted procedures, and the 1-foot basement floor separation from highest groundwater table, in accordance with the County Stormwater Ordinance.
    a. If the LRD accepts the report as demonstrating compliance with all of the above, the applicant may proceed with the permit process. Any drainage system design to address seasonal soil saturation absent of groundwater is subject to the recommendations of the soils/engineering consultants and the Town Engineer.
    b. If the LRD determines the report does not conclusively demonstrate compliance with the above, a rejection letter will be provided stating the specific reasons.

Note: The applicant may resubmit another report to address the stated reasons for rejection or appeal the LRD's decision to the Waukesha County Board of Adjustment. Basements proposed within 1-foot of the highest groundwater table are not eligible for a technical exemption and LRD staff is not authorized to grant a variance from the ordinance. Only the Board of Adjustment can grant variances.

Sloped Sites with Shallow Groundwater

On sloped sites, the LRD may approve basements that are partially below the highest groundwater table on the upslope side of the structure with the following conditions:

1. The basement floor surface elevation on the downslope side of the structure is one (1) foot above highest groundwater table elevation;
2. A drainage system is designed by a professional engineer licensed in the State of Wisconsin ("Project Engineer");
3. The designed drainage system provides for the discharge of collected groundwater by gravity;
4. Obtaining written approval of the proposed outlet from the drainage system from all affected property owner(s) downstream of the proposed discharge, including municipalities if the discharge drains to a public right-of-way or drainage easement;
5. The Project Engineer oversees and verifies the proper installation of the drainage system, and prepares as-built drawings with the stamp of the Project Engineer;
6. A maintenance plan, including the above noted as-built drawings, is prepared for the drainage system and is recorded on the property through the Waukesha County Register of Deeds.

Appeals and Variance Requests

Any applicant that wishes to appeal a determination of the LRD, or request a variance from the 1-foot groundwater separation requirement for basements, must apply to the Waukesha County Board of Adjustment in accordance with county procedures. If requesting a variance, the applicant must demonstrate that requiring compliance with the 1-foot basement separation requirement would create an unnecessary hardship. The LRD will make a recommendation to the Board of Adjustment based on county ordinance requirements and available data.

In general, it should be noted that locating basements below highest groundwater table, or artificially lowering the water table for purposes of basement construction, is considered to be in conflict with several of the stated purposes/guiding principles of the Stormwater Management and Erosion Control Ordinance, including:

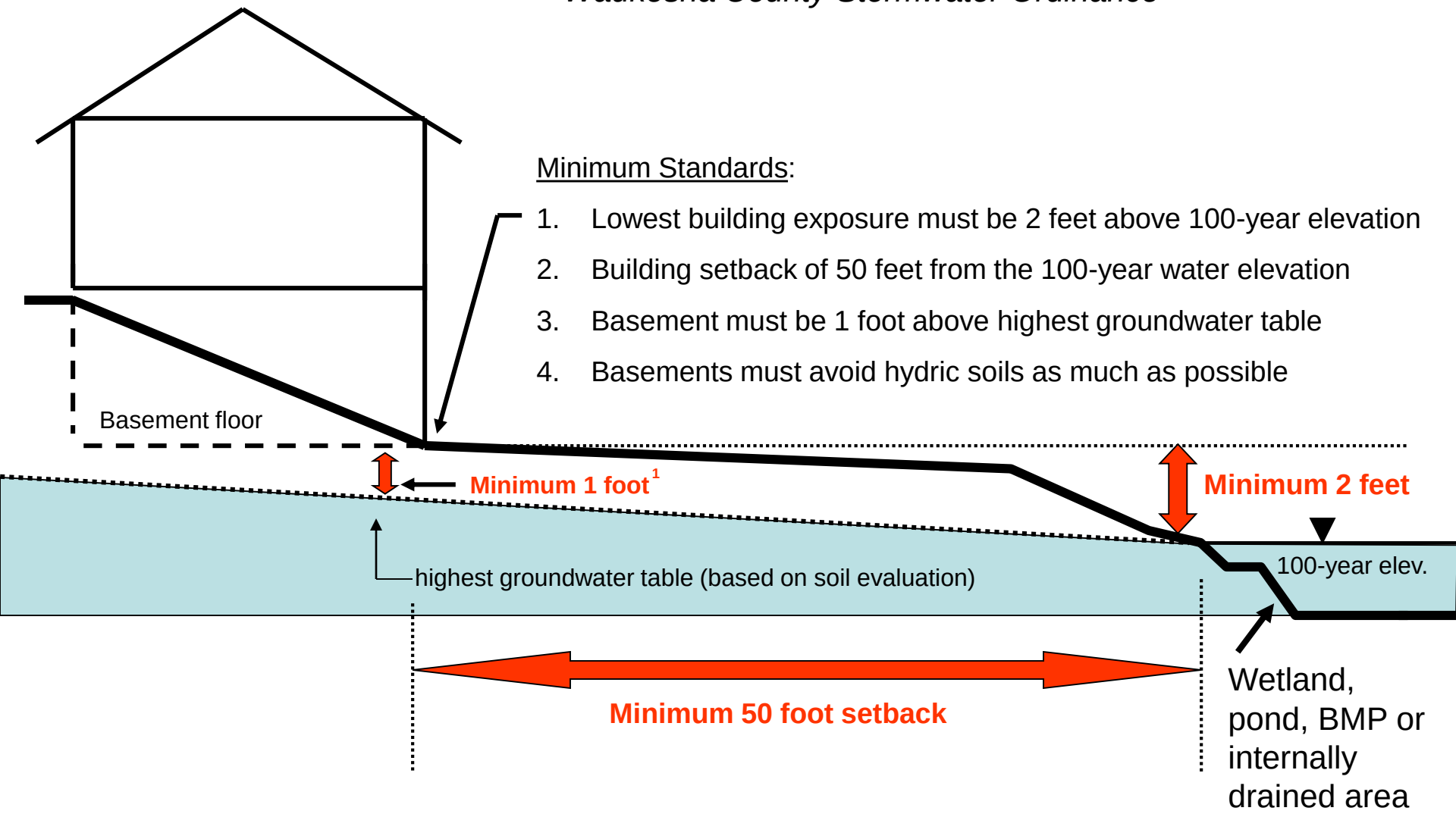
- Maintaining safe and healthful conditions [14-328(a)1.]
- Preventing conditions that endanger property [14-328(a)3.]
- Preserving natural drainage patterns [14-341(b)A.]
- Maintaining predevelopment groundwater recharge areas [14-341(b)D.]

The LRD will provide technical analysis and recommendations to the Board of Adjustment relating to potential issues involved with the installation of any proposed artificial drainage system designed to lower the highest groundwater table elevation, including:

- Engineering and regulatory oversight to ensure proper system installation;
- Downstream impacts due to chronic discharges from the system; and
- Long-term maintenance of the system, which may include: "as-built" record keeping, inspections, replacements, backup power sources, disclosure/notification to future property owners, maintenance enforcement authority (for multiple landowners), etc.

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.

Exhibit X
Waukesha County Soil Series Designated as Hydric or Having Highest Groundwater Table Within 5 feet of the Surface*

Soil Map Symbol**	NRCS Soil Series Name	Depth to Water Table (inches)	Hydric Soil (X)
Ac	Adrian muck	0	X
Am	Alluvial land	12-24	
As	Ashkum silty clay	0	X
Az	Aztalan loam	12-36	
Bl	Blount silt loam	12-36	
Bs	Brookston silt loam	0	X
Cv	Clayey land	12-72	
Cw	Colwood silt loam	0	X
Dt	Drummer silt loam, gravelly substratum	0	X
Es	Elliot silt loam	12-36	
Fa	Fabius loam	12-24	
Gd	Gilford loam	0	X
Gf	Granby fine sandy loam	0	X
Gw	Griswold silt loam, mottled subsoil variant	12-36	
Hm/Ho	Hochheim loam, Hochheim	***	
Ht	Houghton muck	0	X
Ke	Kane silt loam	12-36	
Kl	Kendall silt loam	12-36	
Lm	Lamartine silt loam	12-36	
Lo	Lawson silt loam	12-36	
Lu	Loamy land	12-72	
Me	Markham silt loam	24-42	
Mf	Marsh	0	X
Mg	Martinton silt loam	12-36	
Mh	Matherton sandy loam	12-24	
Mm	Matherton silt loam	12-24	
Mo	Mayville silt loam	24-72	
Mt	Mequon silt loam	12-36	
Mzb	Montgomery silty clay loam	0	X
Mzf	Mundelein silt loam	12-36	
Mzg	Muskego muck	0	X
Mzk	Mussey loam	0	X
Na	Navan silt loam	0	X
Oc	Ogden muck	0	X
Pa	Palms muck	0	X
Ph	Pella silt loam	0	X
Pm	Pella silt loam, moderately shallow variant	0	X
Pr	Pistakee silt loam	12-36	
Rl	Ritchey silt loam, mottled subsoil variant	12-36	
Ru	Rollin muck, deep	0	X
Rv	Rollin muck, shallow	0	X
ScA	St. Charles silt loam	40-60	
ScB	St. Charles silt loam	40-60	
Sf	Sandy and gravelly land	24-72	
Sg	Sawmill silt loam, calcareous variant	0-12	X
Sm	Sebewa silt loam	0	X
Th	Theresa silt loam	***	
Vs	Virgil silt loam, gravelly substratum	12-36	
Wa	Wallkill silt loam	0	X
Wm	Wasepi sandy loam	12-24	

* All information derived from the Soil Survey for Waukesha County, published by the USDA-Natural Resources Conservation Service (NRCS), 2015 Web Soil Survey.

** Slope categories (A, B, C, D, E) may follow the map symbol, but are not included in this list.

*** While NRCS ranks these two soil series as well drained, in Waukesha County they are commonly associated with seasonal high water table conditions.

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

Project/Plat Name: _____ Date: _____

Project Location (PLS/CSM#): _____

Stamp, Sign & Date Here

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.

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.

Form A - Seasonal High Groundwater Determination Report (continued) *(with sample language)*

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.**