

Preventing Basement Flooding

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Waukesha County Storm Water Workshop
April 10, 2013

Presentation Outline

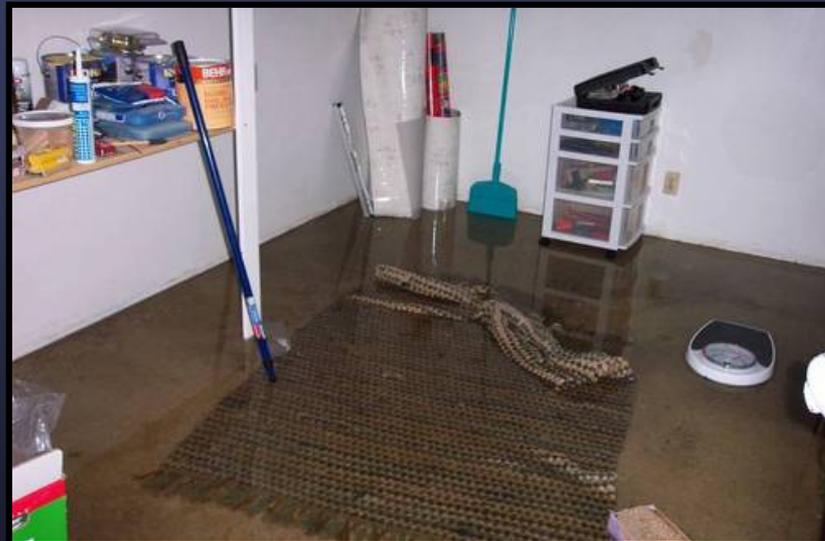
- Background
- Case study – 2008 EAP (flood program)
- County flood prevention standards

Basements: Not what they used to be

- Popularity of finished/walk-out basements
- Risk of significant flood damage/losses
- Insurance exemptions



"Drainage Wars"



- Where to discharge?
- Downstream impacts?



Municipal headaches

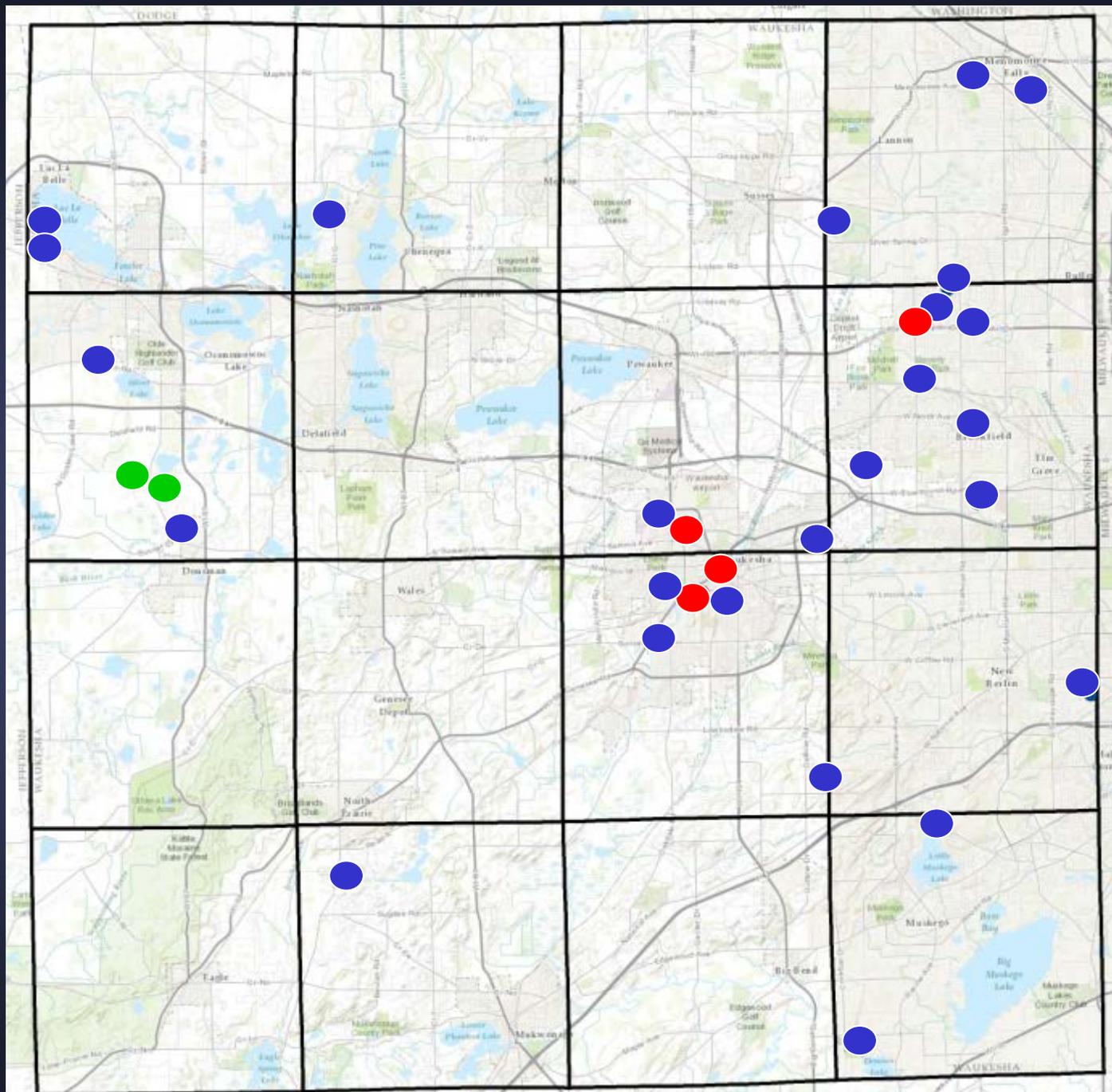
Causes of Basement Flooding

- Site grading/backfill/downspouts
- Groundwater
- Sewer backup
- Surface water/floodplain
- Combinations of the above



Causes of Basement Flooding

Waukesha County 2008 EAP Case Study (\$1.7 million)



“Primary” Cause

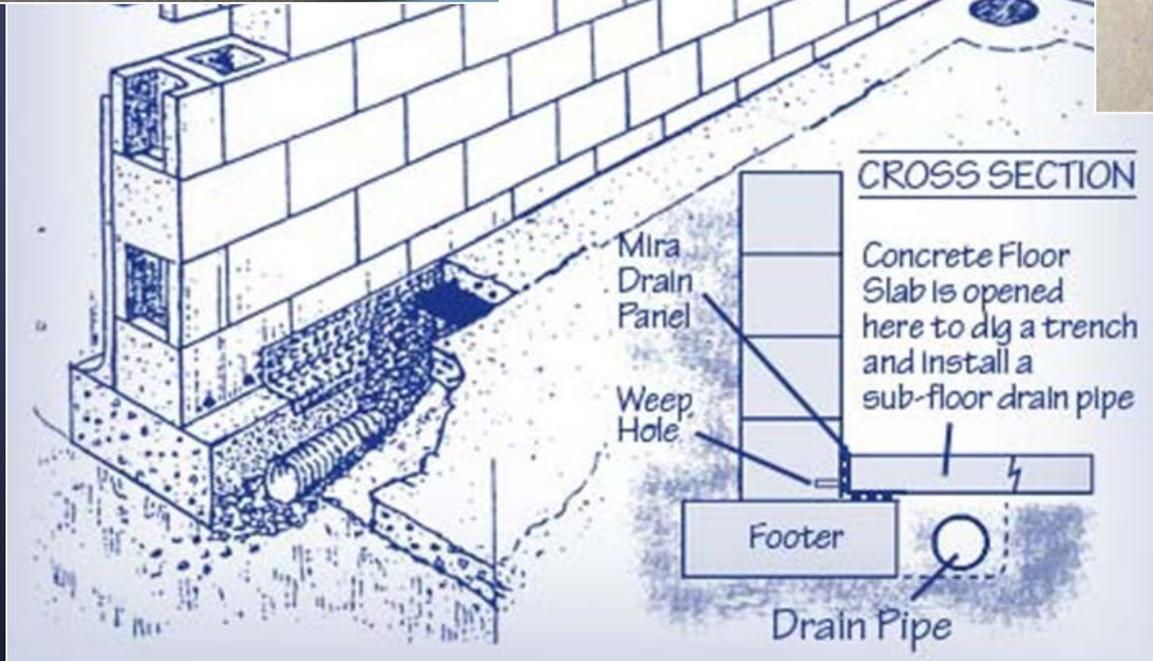
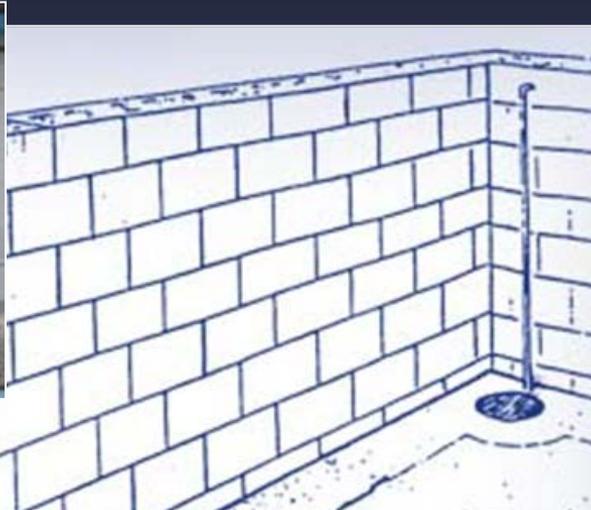
- “Groundwater”
(81%/25 homes)
- Sewer backup
(13%/4 homes)
- Floodplain
(6%/2 homes)

Flood Remediation Methods

(2008 Emergency Assistance Program)

- Foundation drainage system (19)
- Regrading around home (18)
- Anti-backflow valves on sewers (3)
- Flood-proofing/lifting home (2)
- Demolition & relocation (2)

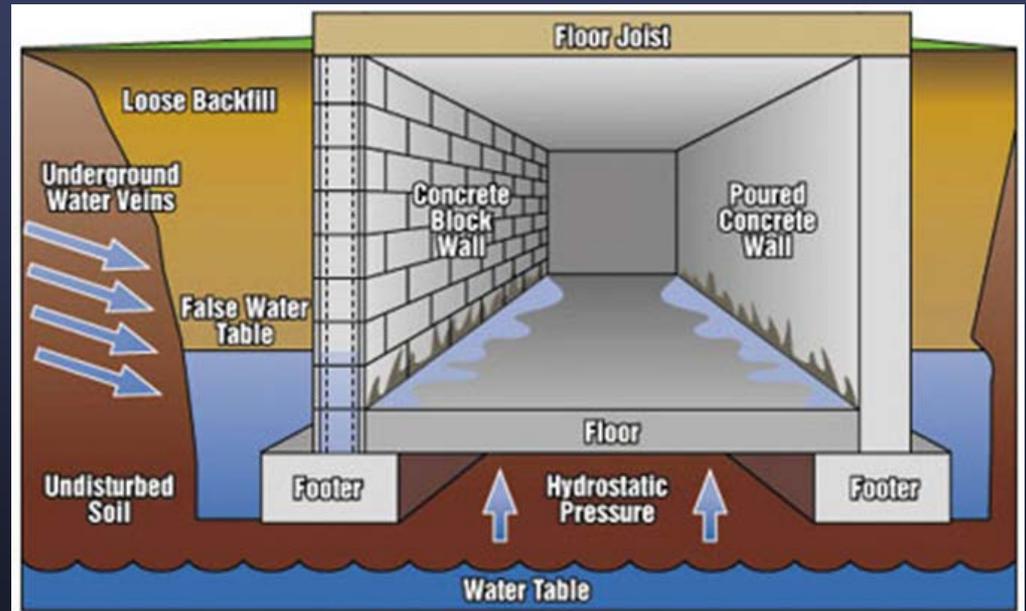
Foundation Drainage Systems (19)



- Exterior water trapped
- Cut 2' conc. along wall
- Drill weep holes
- Install plastic drain panel & interior tile
- Connect to sump

Foundation Drainage System Challenges

- Pumping rates in coarse/organic soils
- Lack of outlet for discharge water
- Hydrostatic pressure (floor)
- Bedrock



Flood-proofing/lifting Homes (2)

Lower Genesee
Lake (Summit)



After lifting

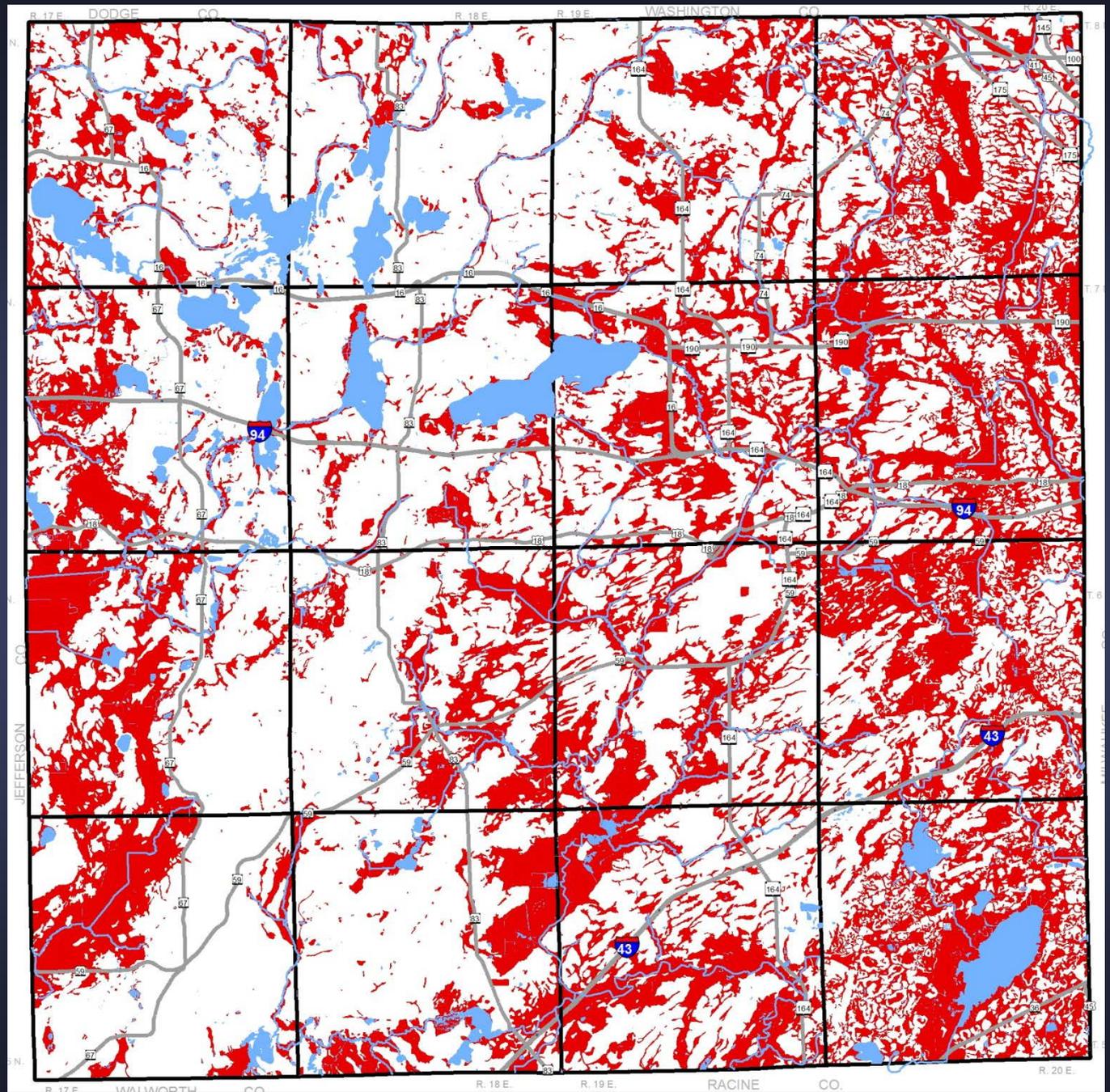
- Homes lifted 2-3 feet in elevation
- New foundation

Demolition & Relocation (2)



Wet Soils

Waukesha County





Prevention



Basement Wetness and Flooding Prevention Standards
Waukesha County Storm Water 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 Storm Water 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 Storm Water 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.

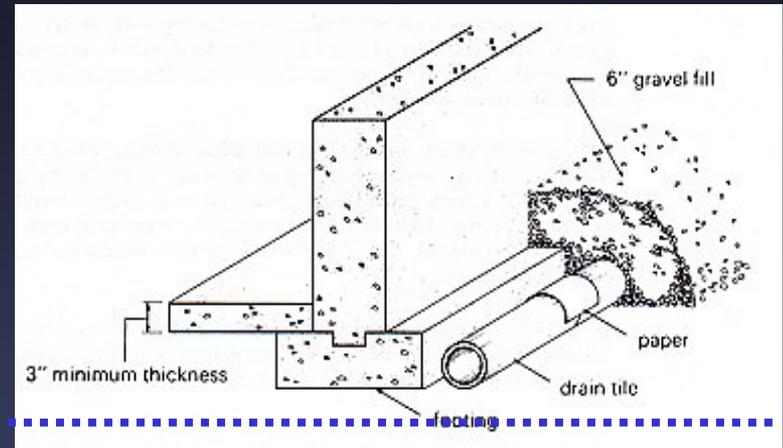
Basement Flood Prevention Standards

Waukesha County SW & Zoning Ordinances

- Site grading:
 - Positive drainage/no adverse impacts/easmt.
- Surface water:
 - 2 feet above 100-year flood elevation
 - 50 foot setback from 100-year edge
- Groundwater:
 - 1 foot above highest record (using soils)
 - Avoid “hydric” soils (< 1 foot to watertable)

Why 1 foot groundwater separation?

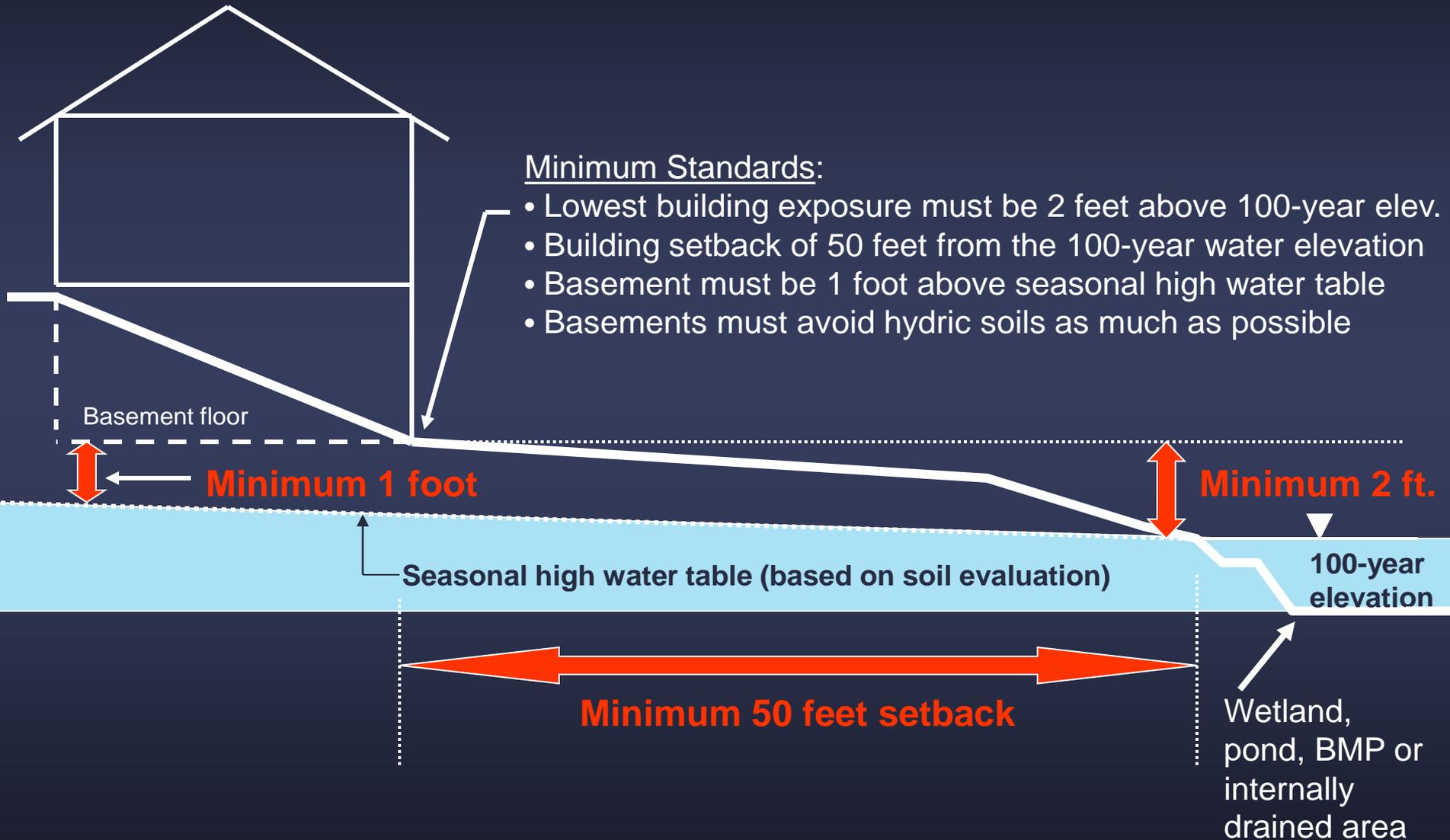
Water table



- Prevents:
 - Constant flows in drainage system
 - High energy bills (electric)
 - Sump pump burn-out
 - Damages from sump failure

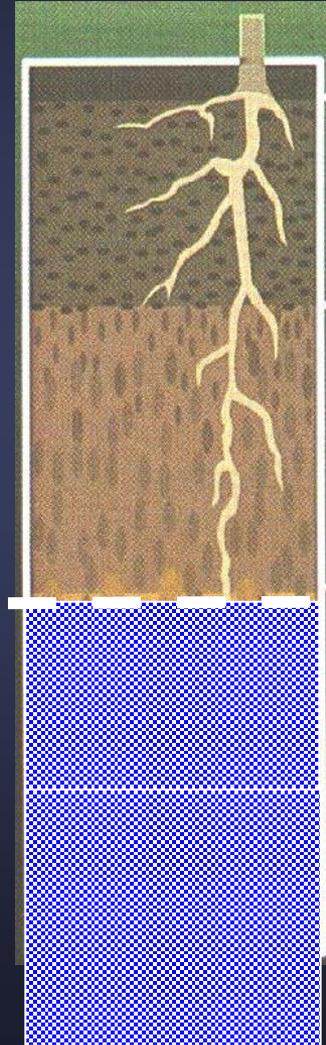
Minimum Site Drainage Standards

Waukesha County Storm Water Ordinance



“Seasonal High Groundwater”

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



Soil Evaluations

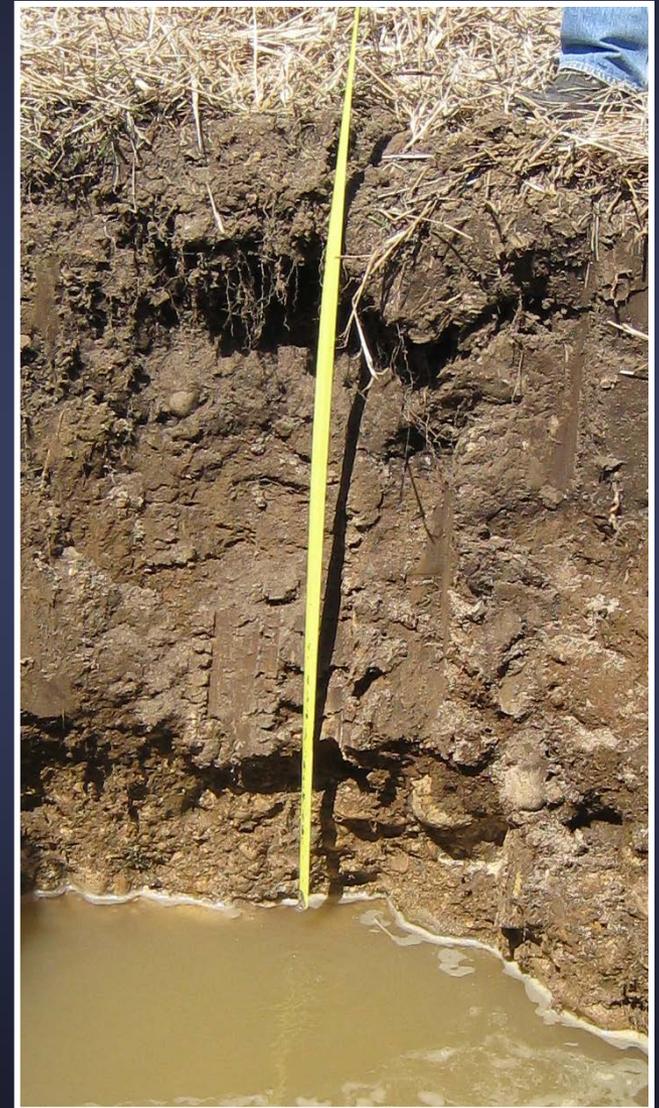
*The best available tool
for predicting water
problems*

- Soil features show long term impacts of water in the profile
- Just need to determine if it is caused by "groundwater" or not



Water Table Indicators in Soil

- Saturation/water in the hole
 - Only a snap shot in time
 - Depends on soil texture/time
 - Fluctuates by season (3-5 ft.)
 - Fluctuates by year (>10 ft.)
- Structure (massive)
- Redoximorphic features (mottling)



Soil Evaluation Standards

- SPS 385 (WI Admin. Code)
 - Procedures, forms, state certification, etc.
 - USDA classification system
- County Standards
 - Minimum 8 foot deep
 - Within 50 feet of basement
 - IF triggered by site screening criteria



Documentation

- Standardized State forms (SPS)

Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes (Privacy Law, s. 15.04 (1) (m)).

Property Owner		Property Location			
Property Owner's Mailing Address		Govt. Lot	1/4	1/4	S T N R E (or) W
City		Lot #	Block #	Subd. Name or CSM#	
State	Zip Code	Phone Number		Nearest Road	
		<input type="checkbox"/> City <input type="checkbox"/> Village <input type="checkbox"/> Town			

Drainage area _____ <input type="checkbox"/> sq. ft. <input type="checkbox"/> acres	Hydraulic Application Test Method:
Optional:	<input type="checkbox"/> Morphological Evaluation
Test Site Suitable for (check all that apply)	<input type="checkbox"/> Double-Ring Infiltrometer
<input type="checkbox"/> Irrigation <input type="checkbox"/> Bioretention trench <input type="checkbox"/> Trench(es)	<input type="checkbox"/> Other (specify) _____
<input type="checkbox"/> Rain garden <input type="checkbox"/> Grassed swale <input type="checkbox"/> Reuse	
<input type="checkbox"/> Infiltration trench <input type="checkbox"/> SDS (> 15' wide) <input type="checkbox"/> Other _____	

<input type="checkbox"/> Obs. #	<input type="checkbox"/> Boring	Ground surface elev. _____ ft.		Depth to limiting factor _____ in.		Hydraulic App. Rate			
	<input type="checkbox"/> pit								
Horizon	Depth In.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Inches/Hr

<input type="checkbox"/> Obs. #	<input type="checkbox"/> Boring	Ground surface elev. _____ ft.		Depth to limiting factor _____ in.		Hydraulic App. Rate			
	<input type="checkbox"/> pit								
Horizon	Depth In.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Inches/Hr

CST/PSS Name (Please Print)	Signature	CST/PSS Number
Address	Date Evaluation Conducted	Telephone Number

Site Screening Criteria

(When is a soil test hole required?)

- NRCS wet soil list (<3 feet to water)
- Within 8 vertical feet of a water feature or hydric soil
- Where other on-site soil evaluations show water table indicators (redox)
- Other sites that demonstrate high risk (seeps, records, sumps, drainage, topo)

Waukesha County Soil Survey (USDA – NRCS)

All data available on:
NRCS Web Soil Survey or
Waukesha County GIS



SOIL SURVEY OF DANE AND WAUKESHA COUNTIES WISCONSIN

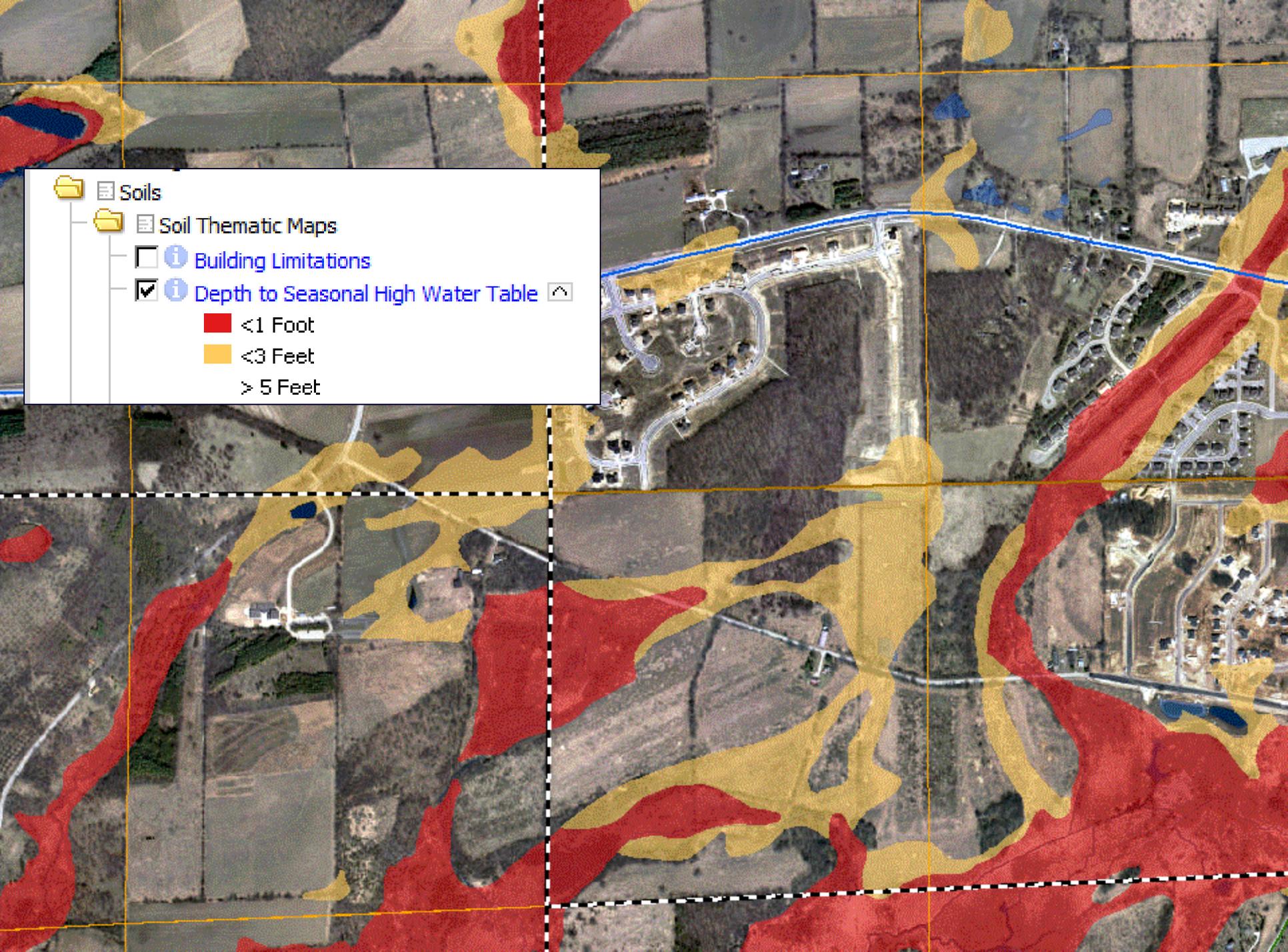


U. S. Department of Agriculture
Soil Conservation Service
In cooperation with
University of Wisconsin
Wisconsin Geological and Natural History Survey
Soils Department and
Wisconsin Agricultural Experiment Station

Issued July 1971

Exhibit X
**Waukesha County Soil Series Designated as Hydric or
 Having Seasonal High Water Table Within 3 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	
Lv	Leamy land	12-72	



Soils

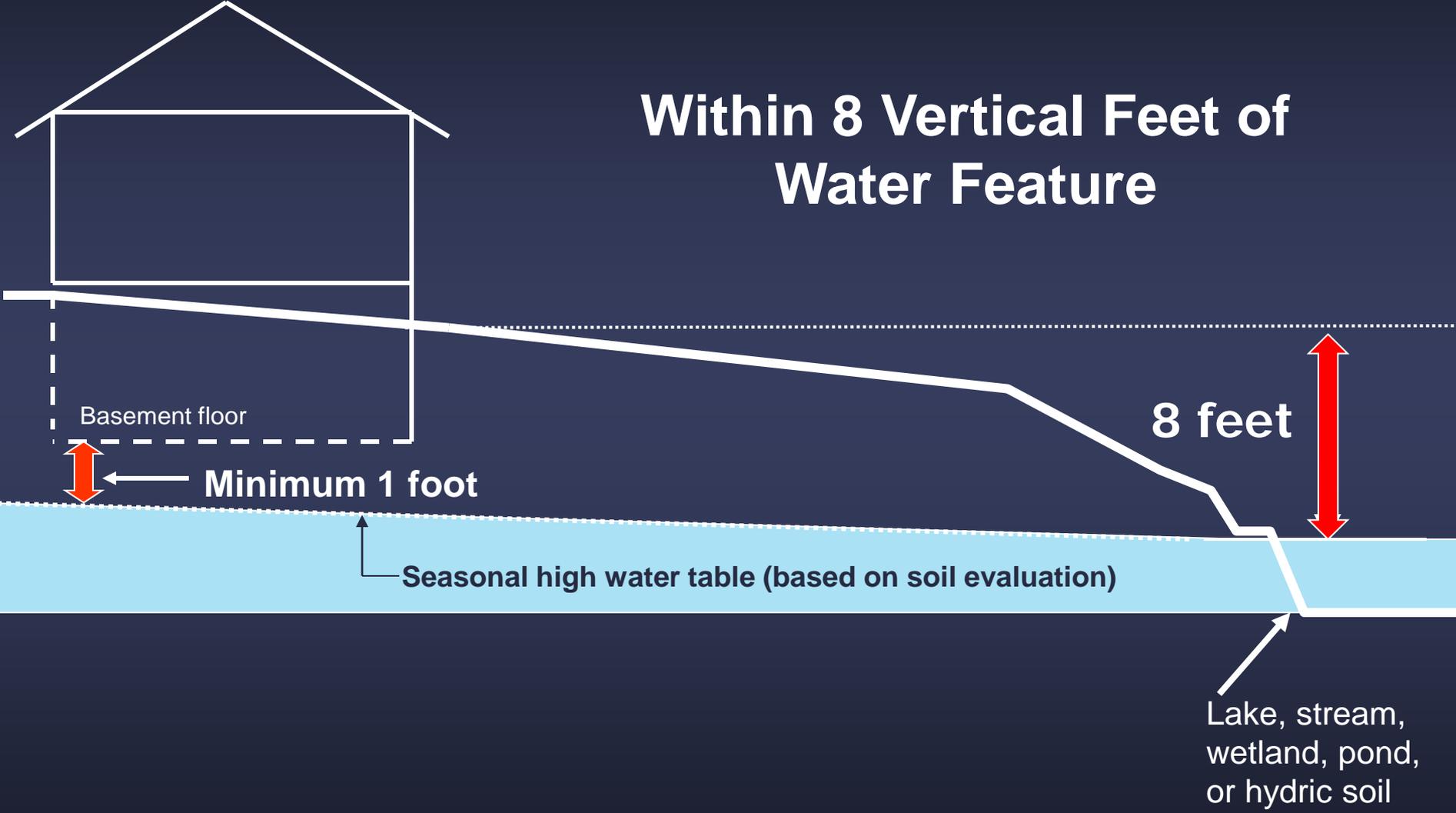
- Soil Thematic Maps
 - Building Limitations
 - Depth to Seasonal High Water Table

■ <1 Foot

■ <3 Feet

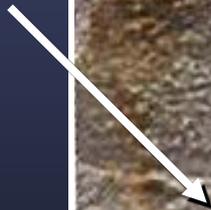
■ > 5 Feet

Within 8 Vertical Feet of Water Feature

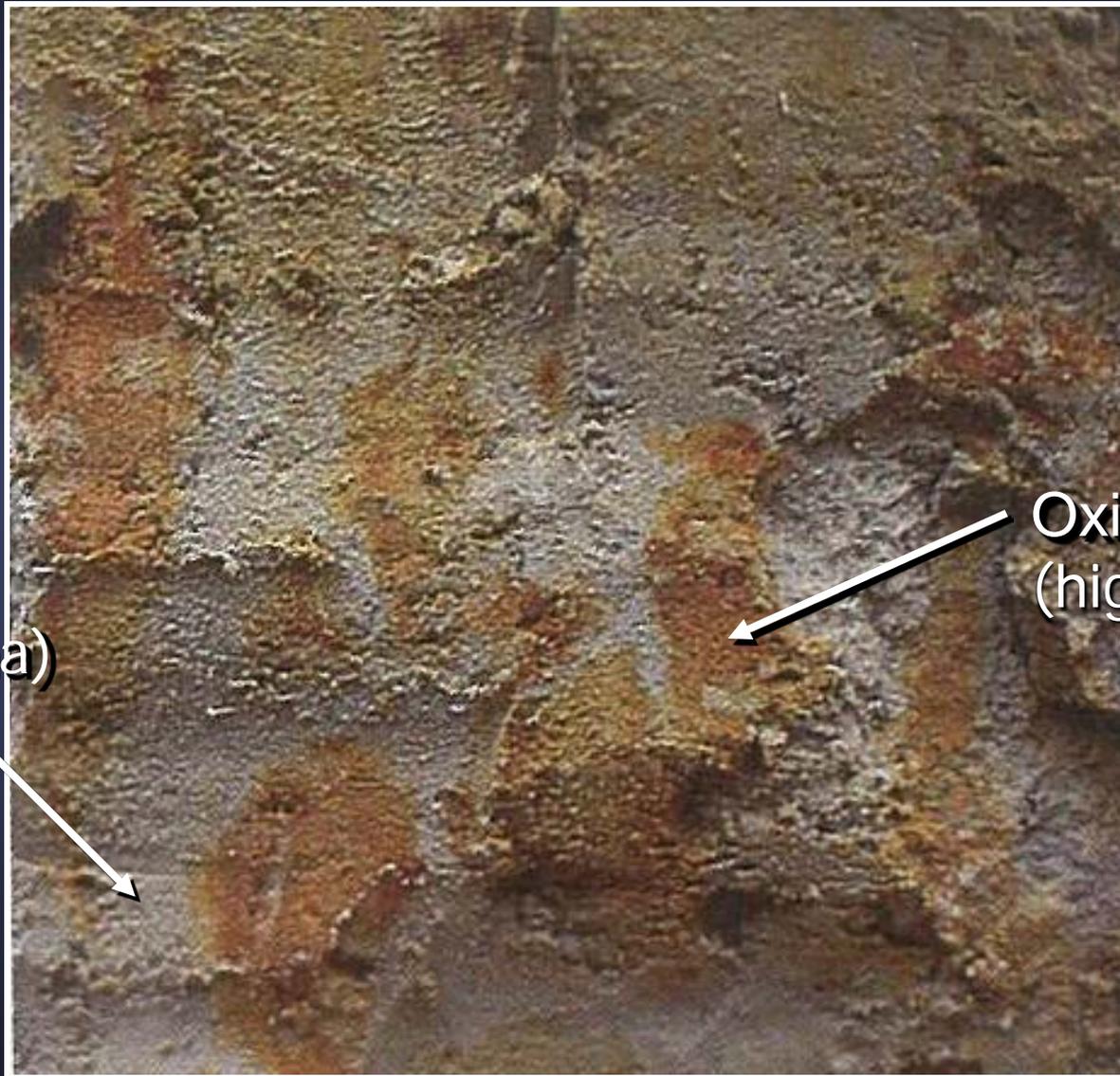


Redoximorphic Features (Soil Mottling)

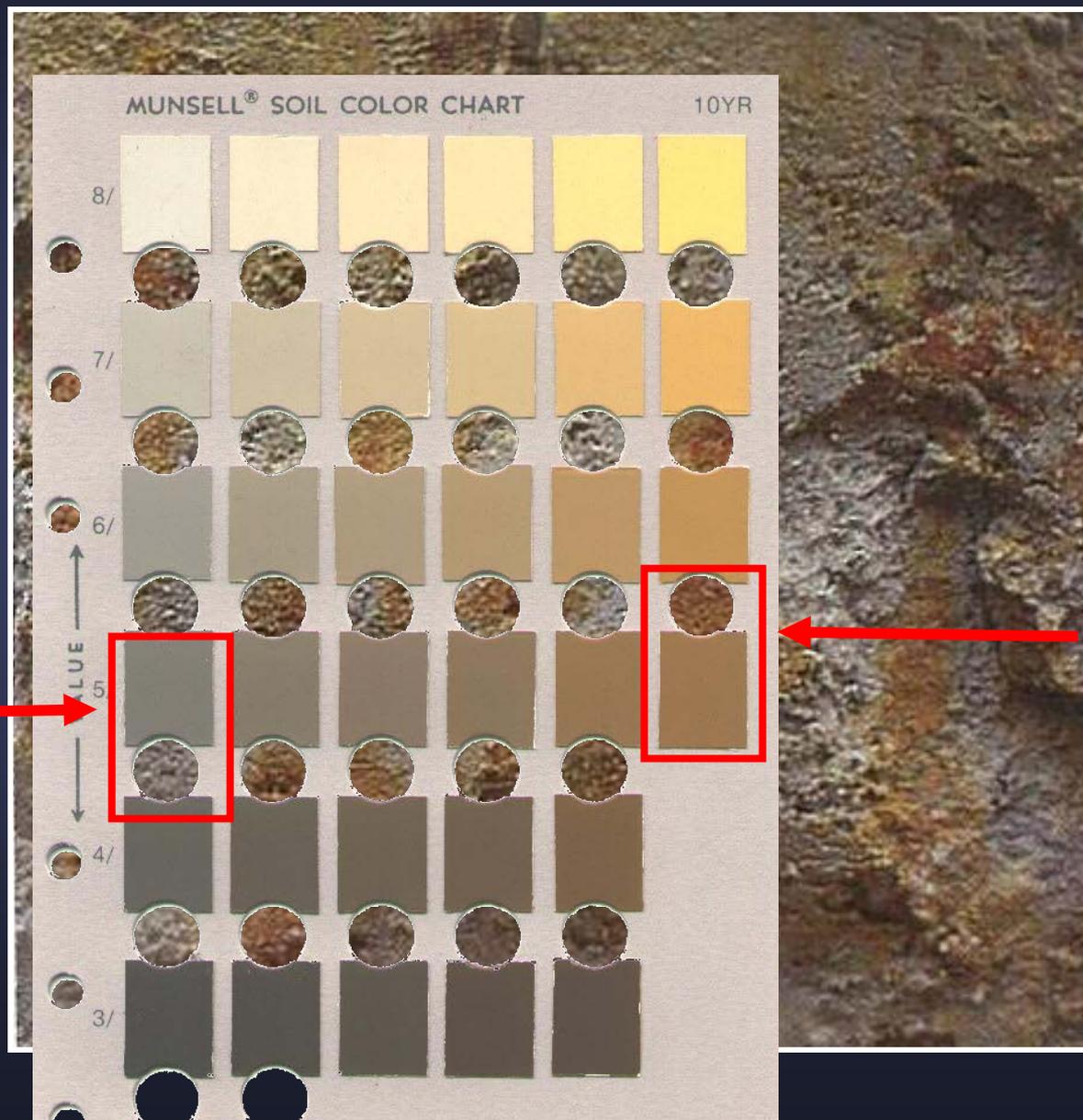
Reduced
(low chroma)



Oxidized Fe^{3+}
(high chroma)



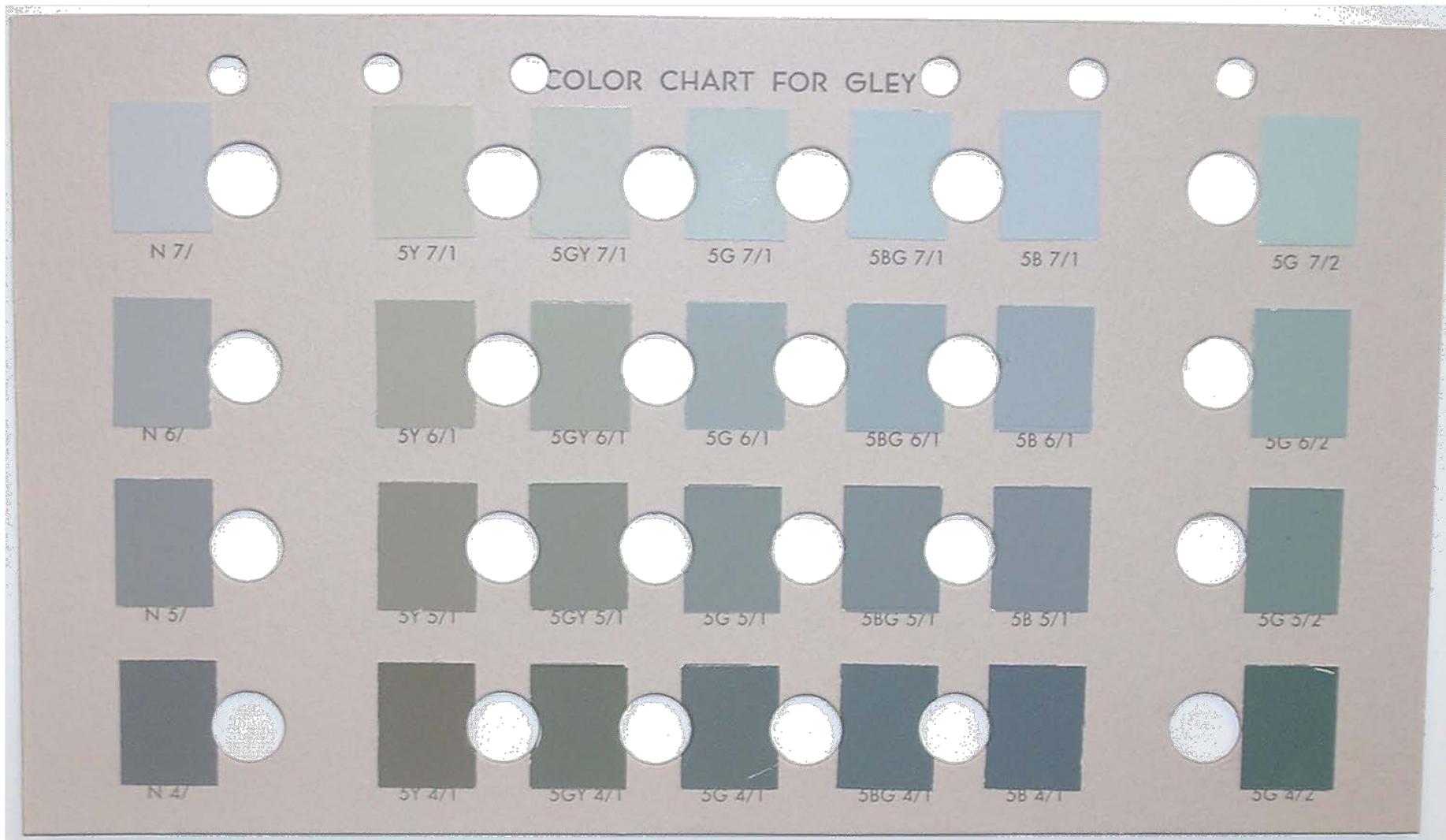
Redoximorphic Features (Soil Mottling)



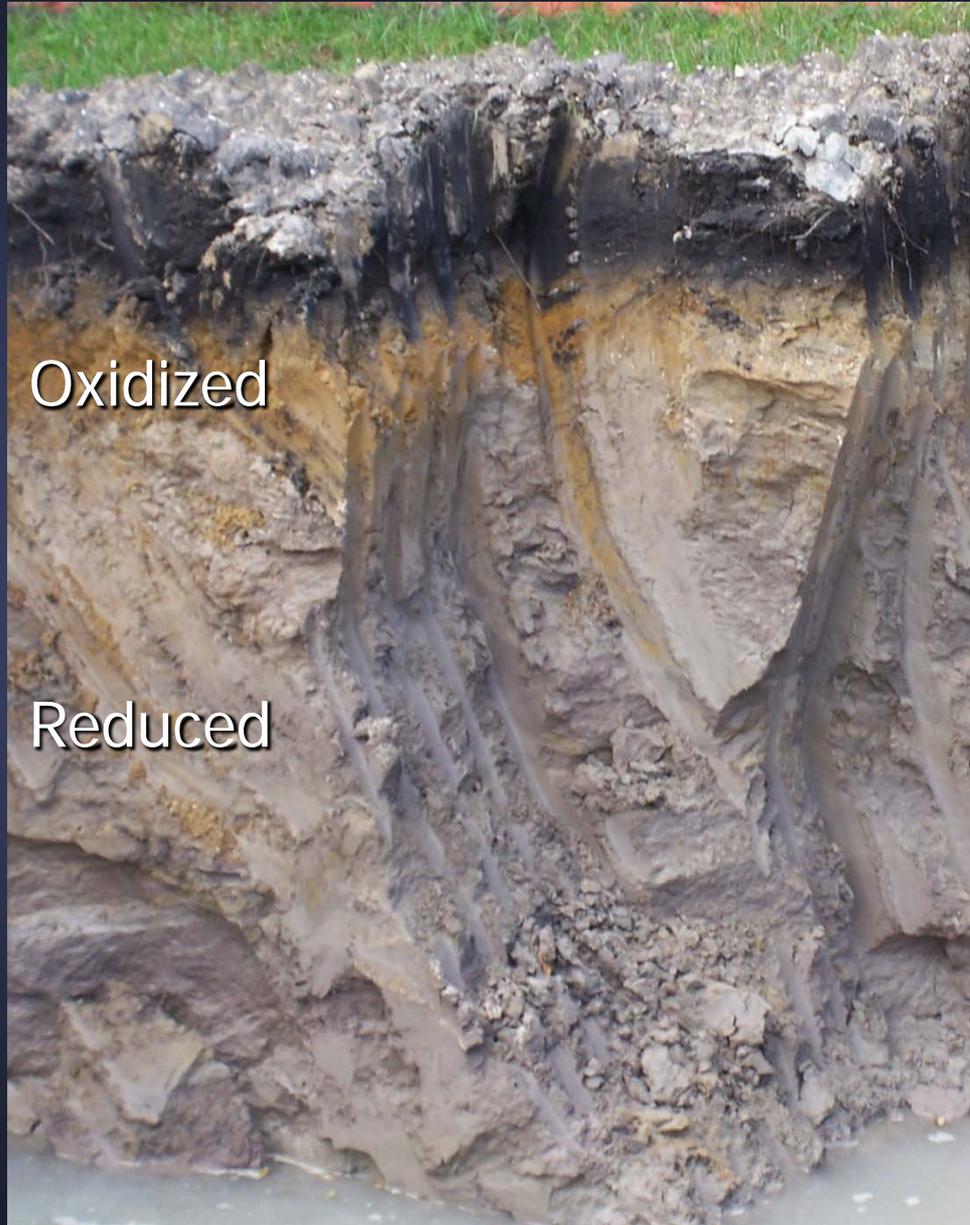
10YR 5/1
(low chroma)

10YR 5/8
(high chroma)

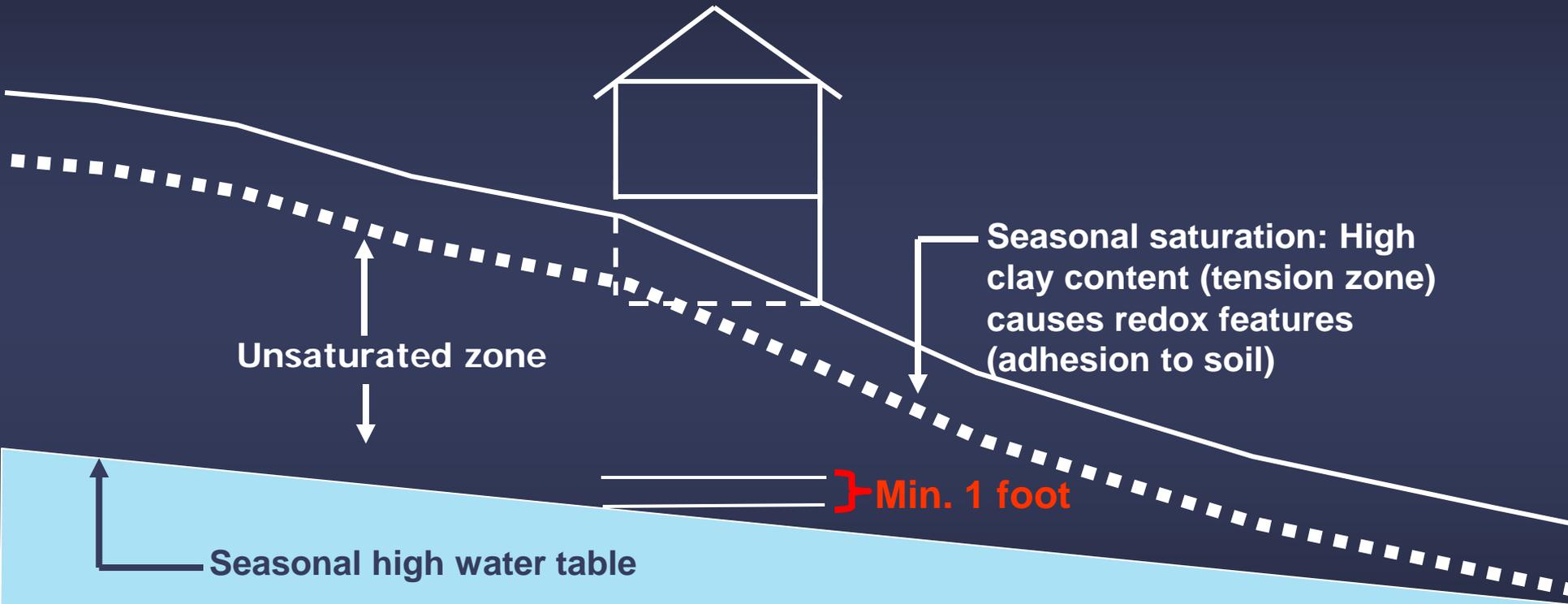
Gley Colors = Very Wet

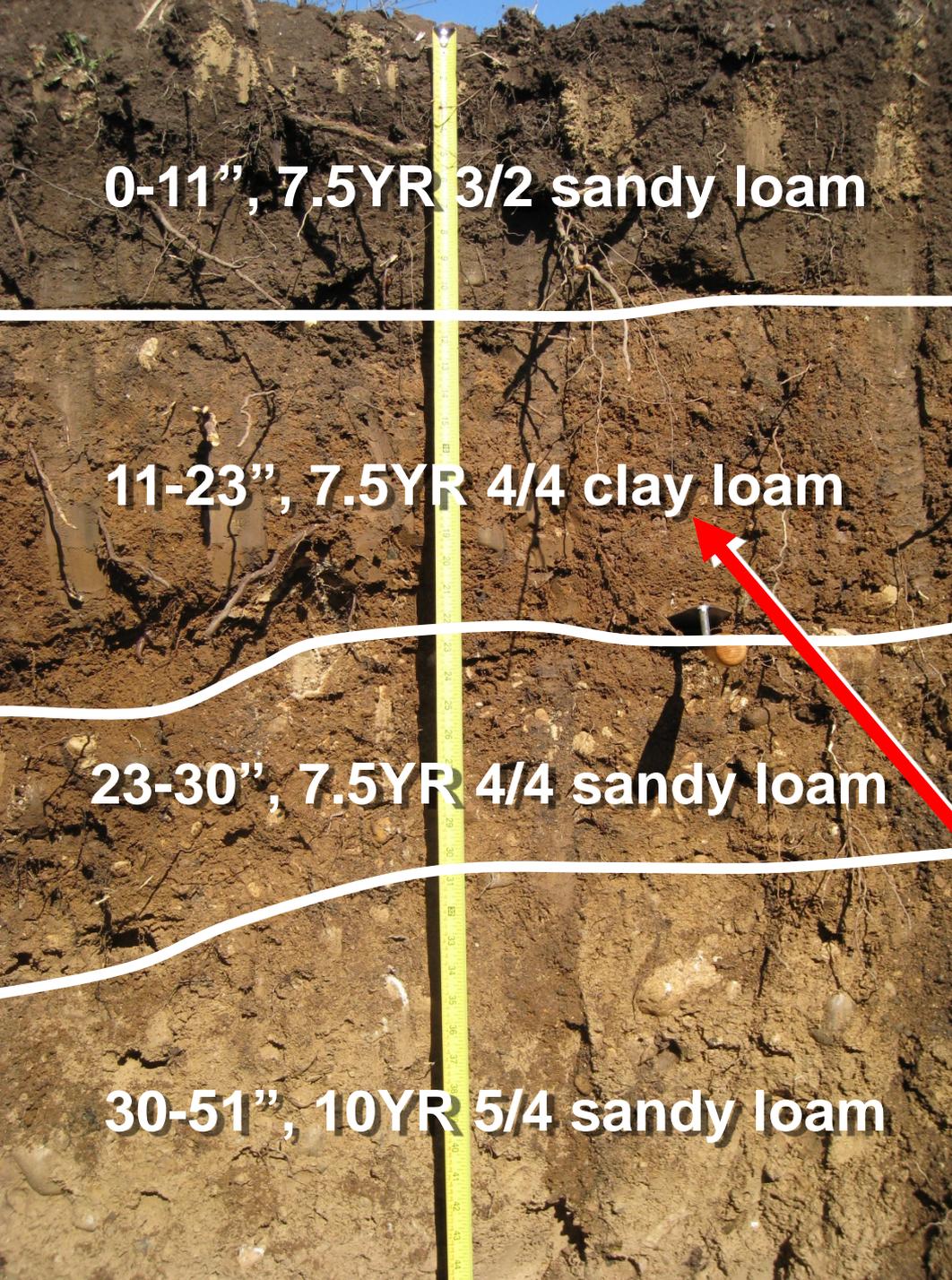


Hydric Soils (lacustrine)



Groundwater vs. Seasonal Saturation





0-11", 7.5YR 3/2 sandy loam

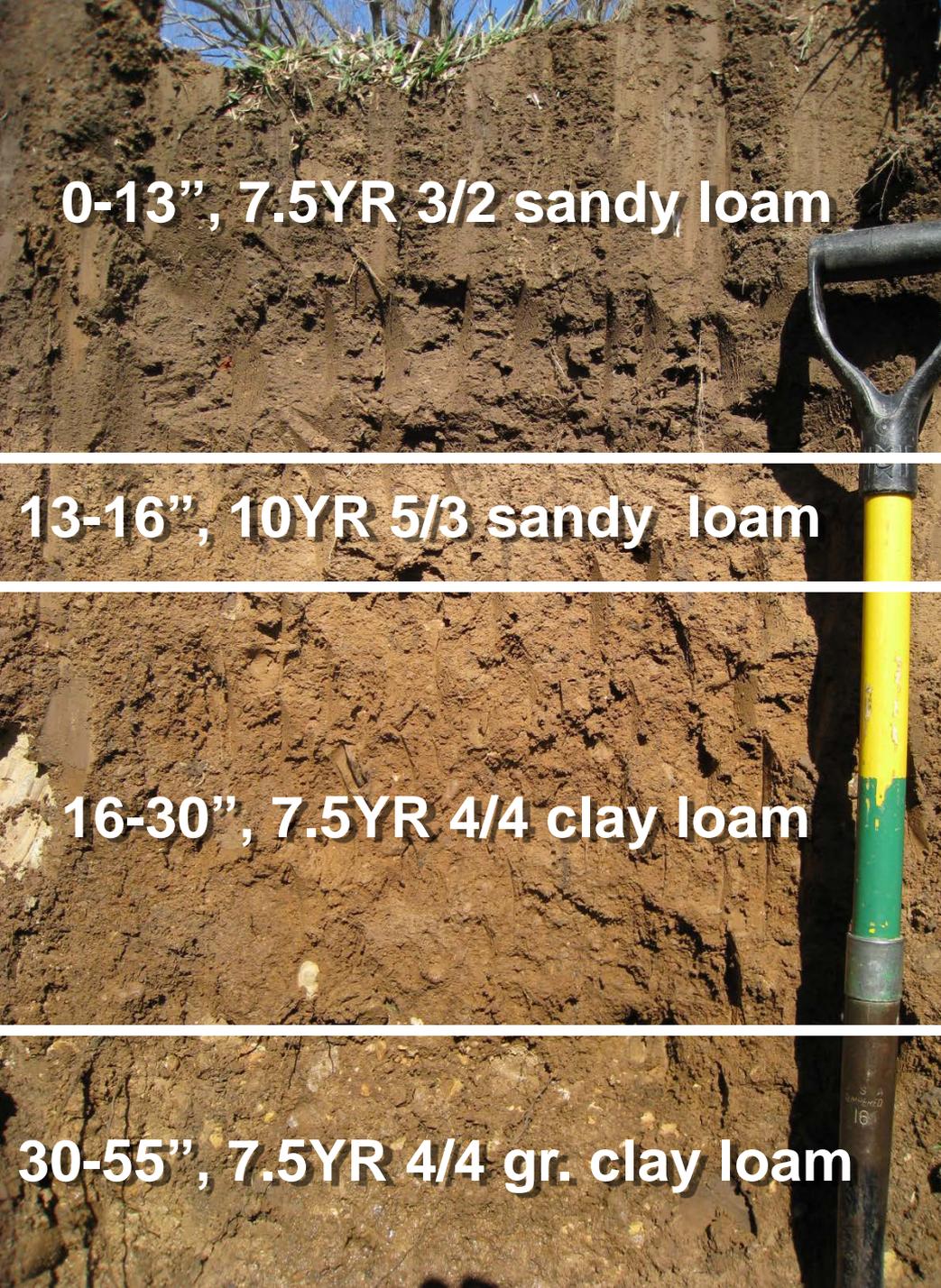
11-23", 7.5YR 4/4 clay loam

23-30", 7.5YR 4/4 sandy loam

30-51", 10YR 5/4 sandy loam

Hochheim loam

- Loamy till soil
- Clayey subsoil
- Located top of hill in Town of Genesee
- No groundwater indicators
- Tension zone may cause redox features

A vertical soil profile is shown, divided into four distinct layers. A shovel is placed vertically on the right side of the profile to provide a sense of scale. The top layer is dark brown, the second is a lighter brown, the third is a reddish-brown, and the bottom is a very dark, almost blackish-brown. The shovel has a yellow handle with a green section and a black head.

0-13", 7.5YR 3/2 sandy loam

13-16", 10YR 5/3 sandy loam

16-30", 7.5YR 4/4 clay loam

30-55", 7.5YR 4/4 gr. clay loam

Same Soil Type Down the Hill (Hochheim loam)

- Near a wetland
- Redox at 30"
- Saturation at 42"

Redox features

0-13", 7.5YR 3/2 sandy loam

13-16", 10YR 5/3 sandy loam

16-30", 7.5YR 4/4 clay loam

30-55", 7.5YR 4/4 gr. clay loam



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Example Soil Profile with Tension Zone

[SPS 385.30(3) w/o 24" limit]

Boring #	Remarks:			Redox						
	Depth	Soil Type	Redox	Soil Type						
12	0-9	10YR3/3	None	sil	1fsbk	mfr	cs	2f	0.2	0.3
	9-36	10YR4/4	None	cl	2msbk	mfr	cs	1f	0.4	0.5
	36-80	10YR5/4	m3p 10YR5/8 10YR6/1	sil	0vfsg	mfi	cs	--	N.A.	N.A.
	80-134	10YR5/4	None	ms&gr	0msg	m1	--	--	0.7	0.8

Ground elev. 81.5 ft.

Depth to limiting factor 36"

Gravitational force must exceed the strong capillary forces (adhesion/cohesion) before water is released from the finer layer

Soil Saturation Determinations

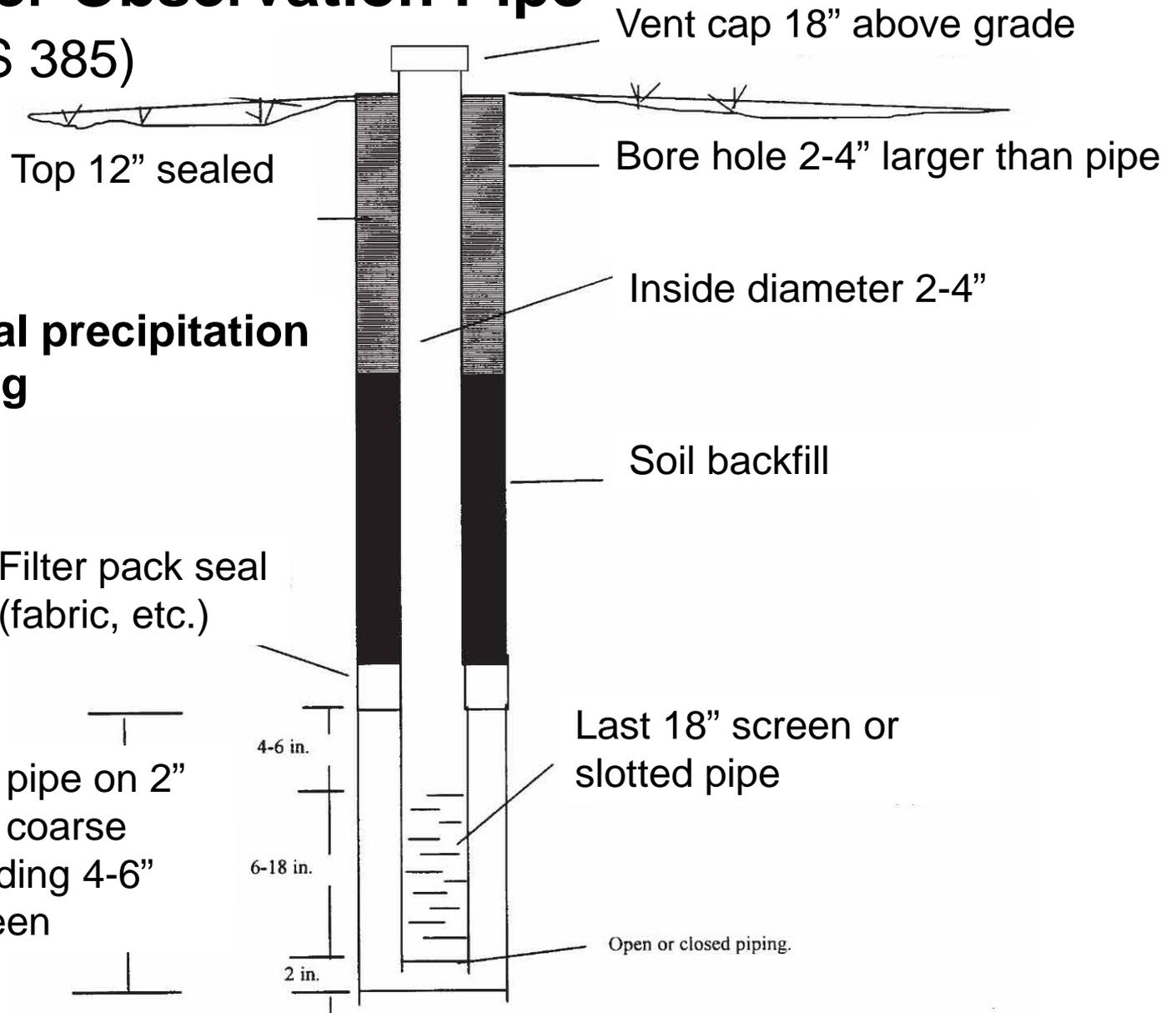
- If unsaturated zone is not found below redox features, then assume seasonal high water table, or complete additional study (SPS 385.60):
 - Interpretive Determination report
 - Groundwater observation pipe (monitoring well)



Groundwater Observation Pipe

(per SPS 385)

**Must have normal precipitation
from fall to spring**



Filter pack. Set pipe on 2" of pea gravel or coarse sand soil, extending 4-6" above slots/screen

Rain on Frozen Ground



Internally drained areas

Flooding from Surface Runoff



Internally drained areas

Internally Drained Procedures

- Runoff VOLUME for 100-year storm assuming:
 - Frozen watershed (RCN 98)
 - No infiltration at collection point
- Determine flood elevation
- Add 2 feet vertically & 50 foot setback
- Record drainage easement

Summary

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

Questions?

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