Concepts and Components of Performance Standards for Target Hydrology

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U.S.ARMY

US Army Corps of Engineers
BUILDING STRONG®

Performance Standards (PS)

- Observable or measurable physical, chemical and/or biological attributes used to determine if a compensatory mitigation project meets its objectives (Federal Mitigation Rule (§ 332.2))
- Must be based on "best available science" that can be measured or assessed in a practicable manner (§ 332.5)
  - Must be enforceable ⇨ **"shall"**

Why Important: Compensatory wetland mitigation involves millions of dollars and thousands of acres nationwide. This mitigation needs to be objectively evaluated in striving for the goal of replacing wetland functions and services lost due to authorized impacts.

Targets for Compensation Sites

- **Target Hydrology:** the hydrology necessary to achieve the goals/ objectives of a compensation site
- **Target Vegetation:** the specific wetland plant communities to be established at a compensation site
- **Approach:** match target hydrology with target vegetation to achieve goals/objectives set for wetland compensation sites

A compensation site that meets performance standards for both target hydrology and target vegetation is typically on the correct trajectory for meeting goals/objectives

Components of Hydrology Performance Standards

1. Frequency, duration, depth and seasonality of inundation and/or water table ≤12 inches below soil surface

2. During the growing season

3. In context of precipitation antecedent to and during monitoring period

4. Using monitoring wells/dataloggers

5. Specific to each "wetland type"

Components of Hydrology Performance Standards……

1. Frequency, duration, depth and seasonality of inundation and/or water table ≤12 inches below soil surface

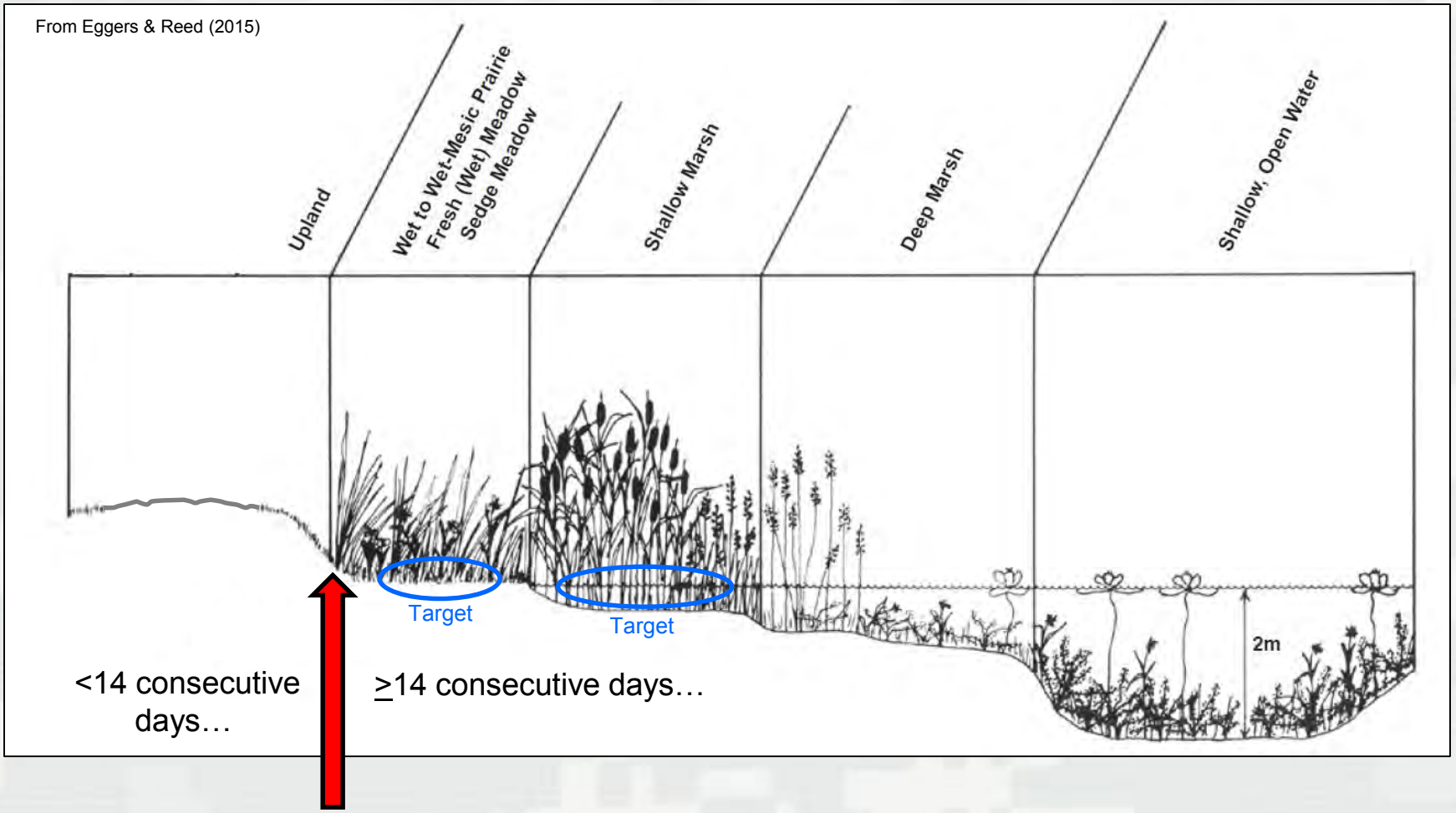
- **Starting point is the wetland hydrology technical standard for interpreting monitoring well data**

(*Technical Standard for Water-Table Monitoring of Potential Wetland Sites* [U.S. Army Corps of Engineers 2005])

https://www.nrc.gov/docs/ML1327/ML13276A040.pdf

Inundation and/or a water table ≤12 inches below the soil surface for ≥14 consecutive days during the growing season in most years (≥50 percent probability)

- The goal is not to establish the **minimum** wetland hydrology, but rather to establish the **optimum** hydrology for targeted wetland types and associated functions and services

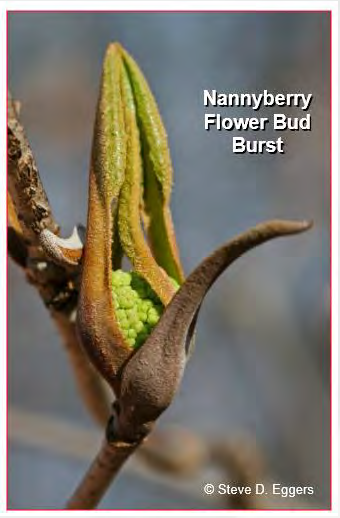


Minimum (driest) condition that meets wetland hydrology is not suitable for establishing most wetland types

Components of Hydrology Performance Standards….

2. During the growing season

- Growing season determined in accordance with the regional supplements to the 1987 *Corps of Engineers Wetlands Delineation Manual* (e.g., the “green up” indicator)



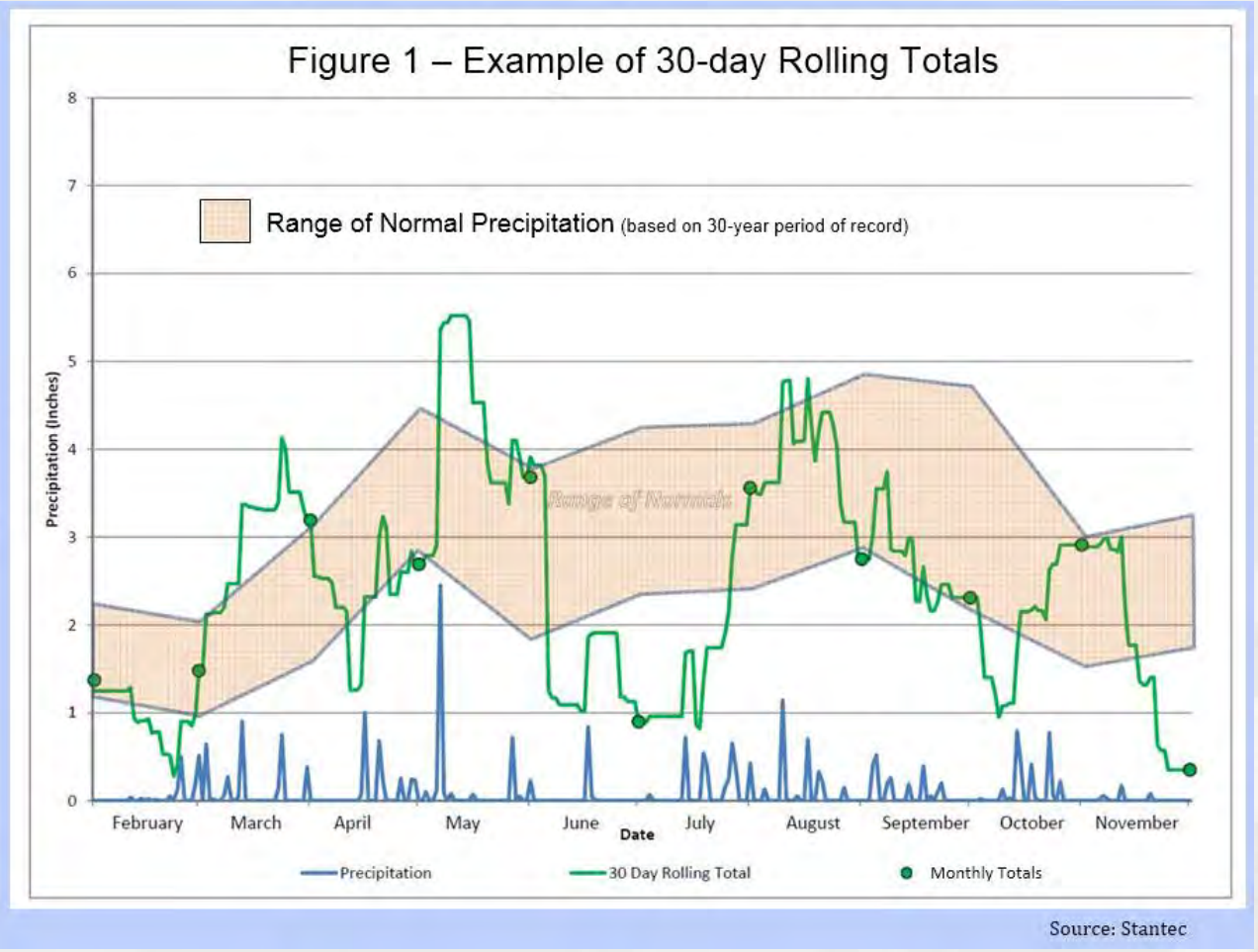
Components of Hydrology Performance Standards….

3. In context of precipitation antecedent to and during monitoring period

- References for categorizing antecedent precipitation as normal, wetter than normal, and drier than normal
  - ***Accessing and Using Meteorological Data to Evaluate Wetland Hydrology*** (Sprecher and Warne 2000)
    http://www.dtic.mil/docs/citations/ADA378910
  - ***Hydrology Tools for Wetland Determination*** (Woodward, ed. 1997)
    http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17556.wba
  - ***Hydrology Tools for Wetland Identification and Analysis*** (Weber, ed. 2015)
    http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=37808.wba

Components of Hydrology Performance Standards….

3. In context of precipitation antecedent to and during monitoring period



Recommended approach for presenting precipitation data in monitoring reports

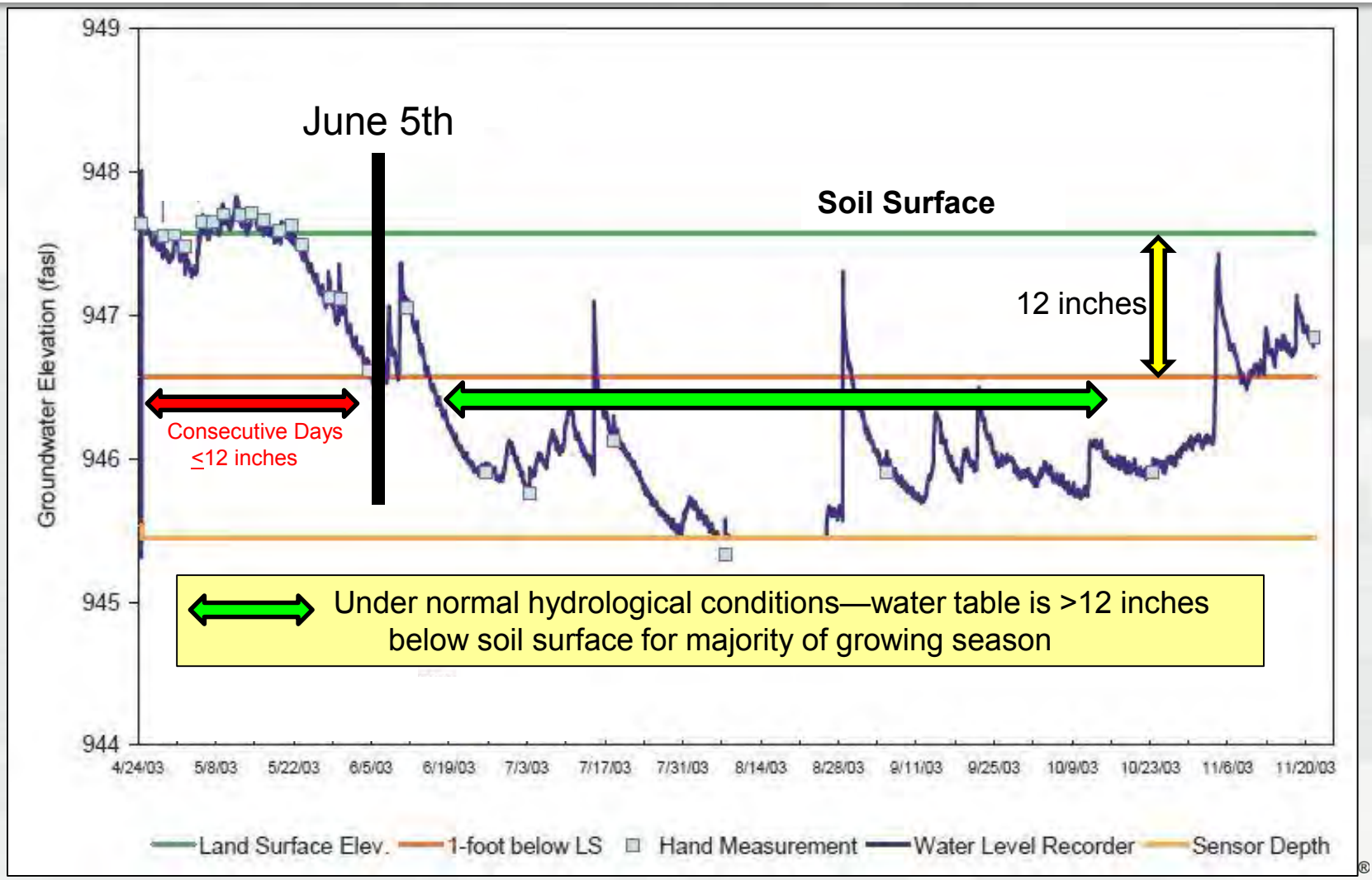
Components of Hydrology Performance Standards….

3. In context of precipitation antecedent to and during monitoring period

- Many types of wetlands are naturally dry during late summer or during periods of below normal precipitation
- Thus, performance standards do not require inundation and/or a water table ≤12 inches below the soil surface for certain wetland types during late summer—as well as monitoring periods that are "drier than normal" including **"drought conditions"**

Need to define for PS

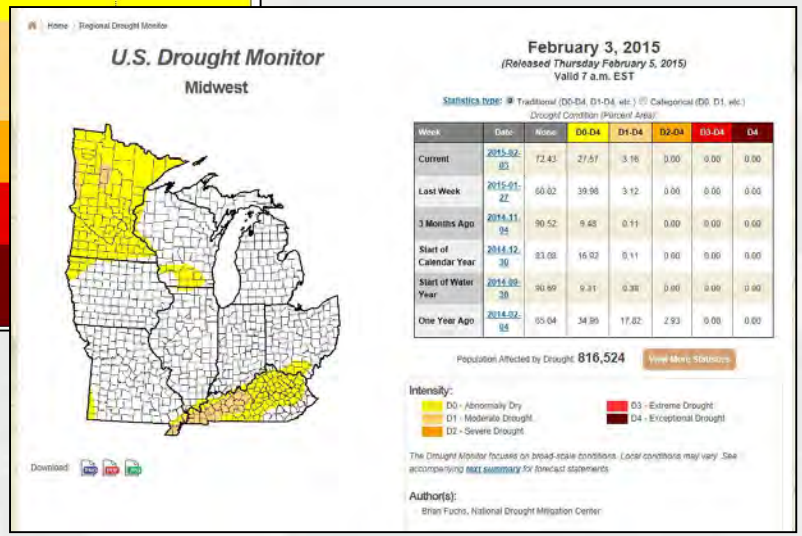
Seasonal Wetlands: "Wet" early growing season followed by summer drawdown, then recovery post growing season

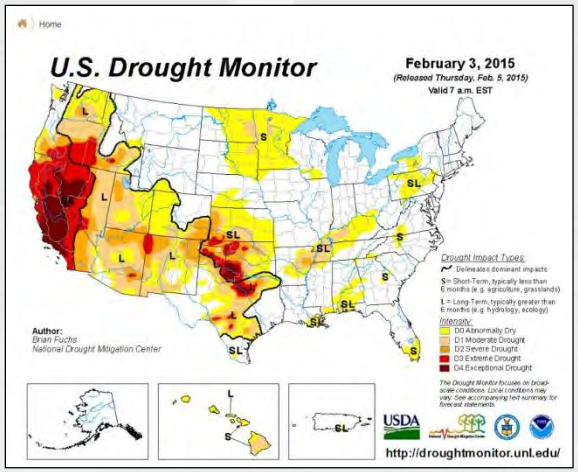


Defining "Drought Conditions"

Drought Severity Classification

Category	Description	Possible Impacts	Ranges: Palmer Drought Index	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Short and Long-term Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9	21-30	21-30	-0.5 to -0.7	21-30
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9	11-20	11-20		
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10		
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5		
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0-2	0-2		





Source: National Drought Mitigation Center
http://droughtmonitor.unl.edu/

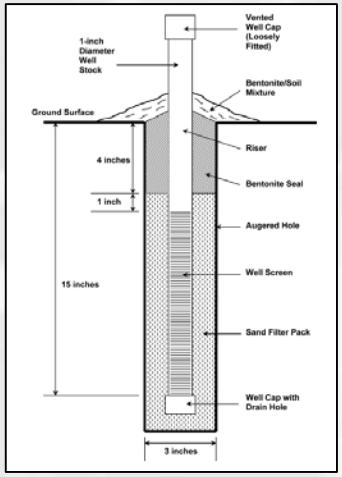
Components of Hydrology Performance Standards….

4. Using Monitoring Wells/Dataloggers

- Performance standards use consecutive days of inundation and/or water table ≤12 inches; therefore, daily readings are necessary (recommend 4x-6x daily, averaged)

- Monitoring wells measure depth to **water table**, not saturated soils—therefore, performance standards use depth to the **water table** (as does the wetland hydrology technical standard)

Monitoring Well and Dataloggers



Monitoring Well Design for Wetland Hydrology Determinations

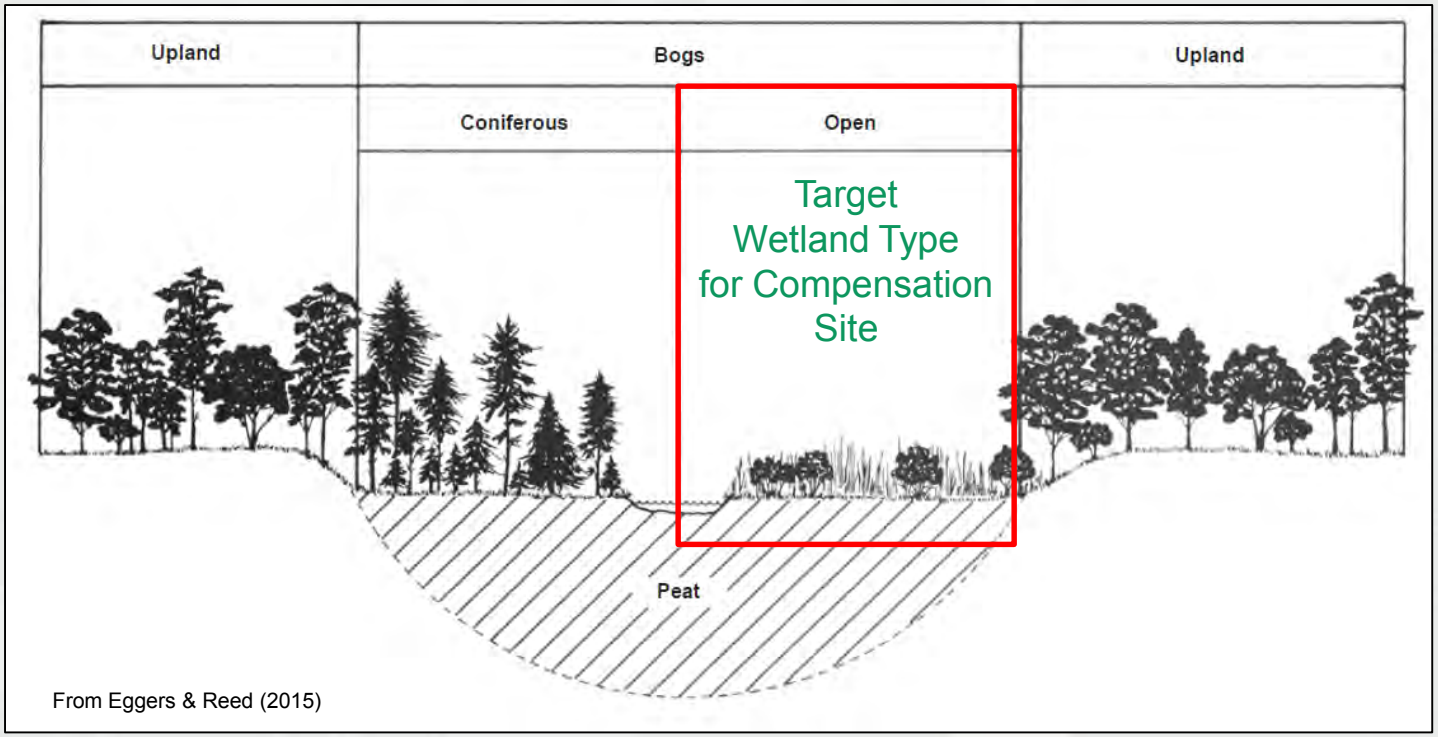
Include soil profile description of bore hole

Components of Hydrology Performance Standards…..

5. Specific to a "Wetland Type"– Numerous ways to define, one is:

Plant Community + HGM Class[1] + Soil Type

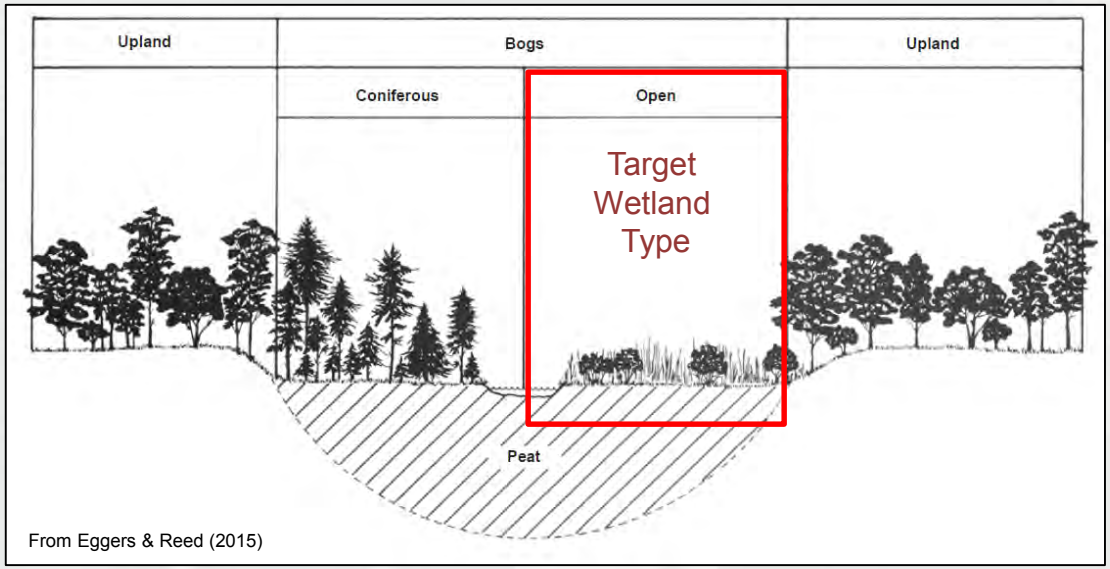
Example:



[1] Brinson, M.1993. *A Hydrogeomorphic Classification for Wetlands*. ERDC Tech Report WRP-DE-4.

Components of Hydrology Performance Standards: Wetland Type

Plant Community[1]	+	HGM Class	+	Soil Type
Shallow, Open Water		Depressional		Mineral-Sandy
Deep Marsh		Slope		Mineral-Clayey/Loamy
Shallow Marsh		Riverine		Deep Peat
Sedge Meadow		Lacustrine Fringe		Shallow Peat over Mineral
Fresh (Wet) Meadow		Organic Soil Flat		Etc.
Wet Prairie		Mineral Soil Flat		
Calcareous Fen				
Open Bog				
Coniferous Bog				
Shrub-Carr				
Alder Thicket				
Hardwood Swamp				
Coniferous Swamp				
Floodplain Forest				
Seasonally Flooded Basin				



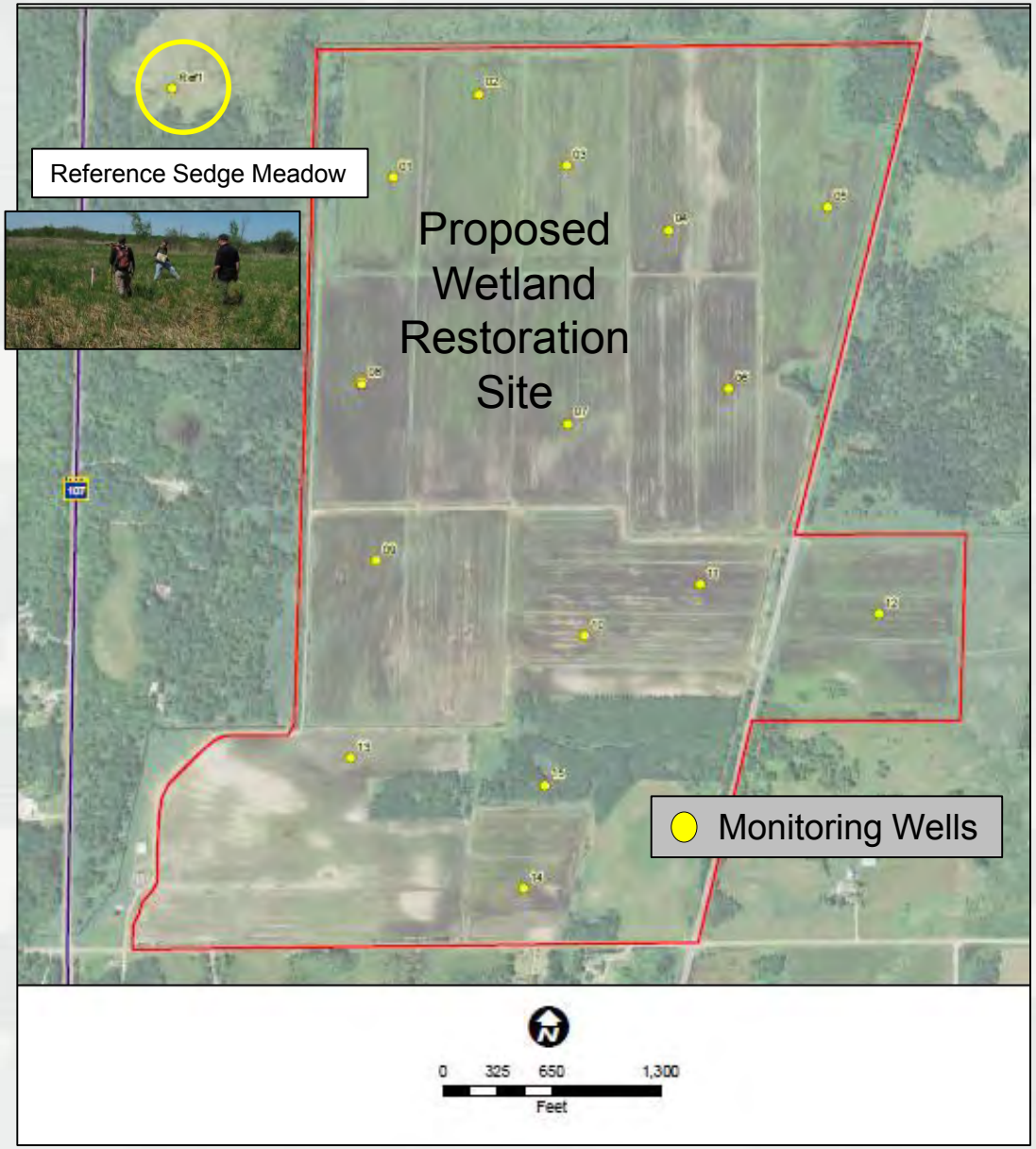
From Eggers & Reed (2015)

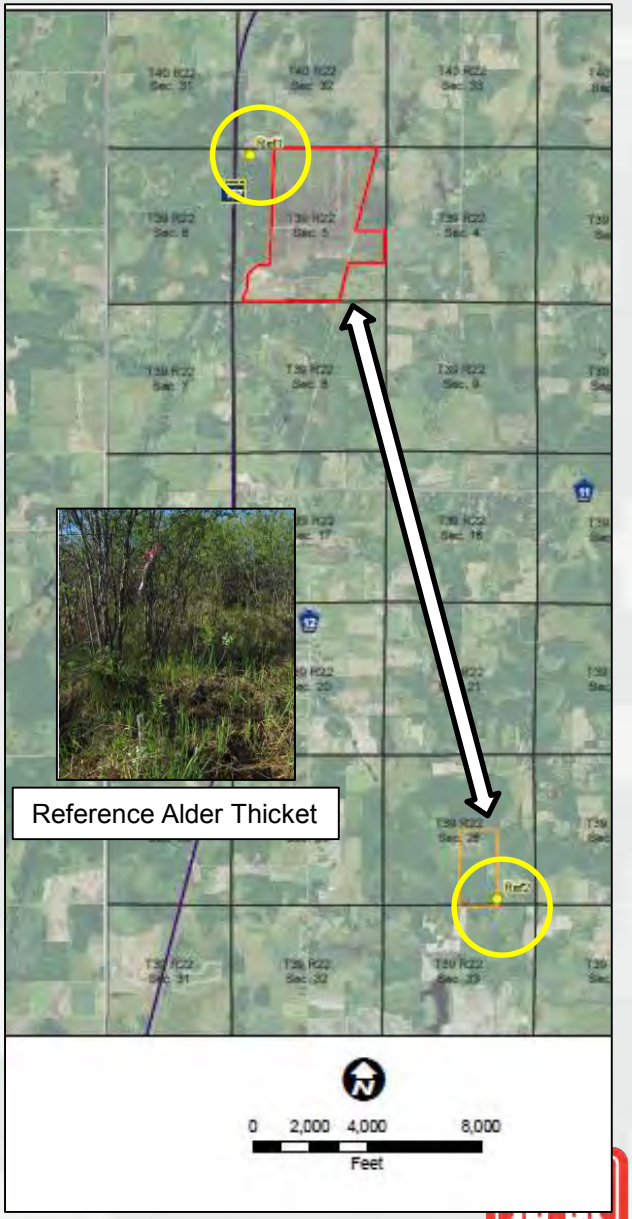
[1] Eggers, S and D. Reed. 2015. *Wetland Plants and Plant Communities of Minnesota and Wisconsin—Version 3.2.* http://cdm16021.contentdm.oclc.org/cdm/compoundobject/collection/p266001coll1/id/2801/rec/1

Monitoring to Determine if Hydrology PS are met: Preferential Sequence

- **First Priority:** Use on-site, or in proximity, reference wetland(s) instrumented with monitoring wells/dataloggers for contemporaneous comparison to water levels within the compensation site
  - Set criteria for an acceptable range of variability between reference and compensation site wetlands, e.g., water levels in restored wetland shall be plus or minus 20% of those in the reference wetland

    Reference Site: Water table ≤12 inches below soil surface for 50 consecutive days during a particular growing season—thus, 40 to 60 consecutive days would be +/- 20% for that monitoring period
  - Advantage of minimizing analysis and interpretation of precipitation prior to and concurrent with the monitoring period


Reference Sedge Meadow
Proposed Wetland Restoration Site
Monitoring Wells
0 325 650 1,300
Feet


Reference Alder Thicket
0 2,000 4,000 8,000
Feet

First Priority: On-Site or in Proximity Reference Wetlands

- Recognize that this approach may not be practicable in some or many cases given degree of disturbances typical of many compensation sites and difficulties in obtaining access to nearby properties not owned by the party proposing the wetland compensation

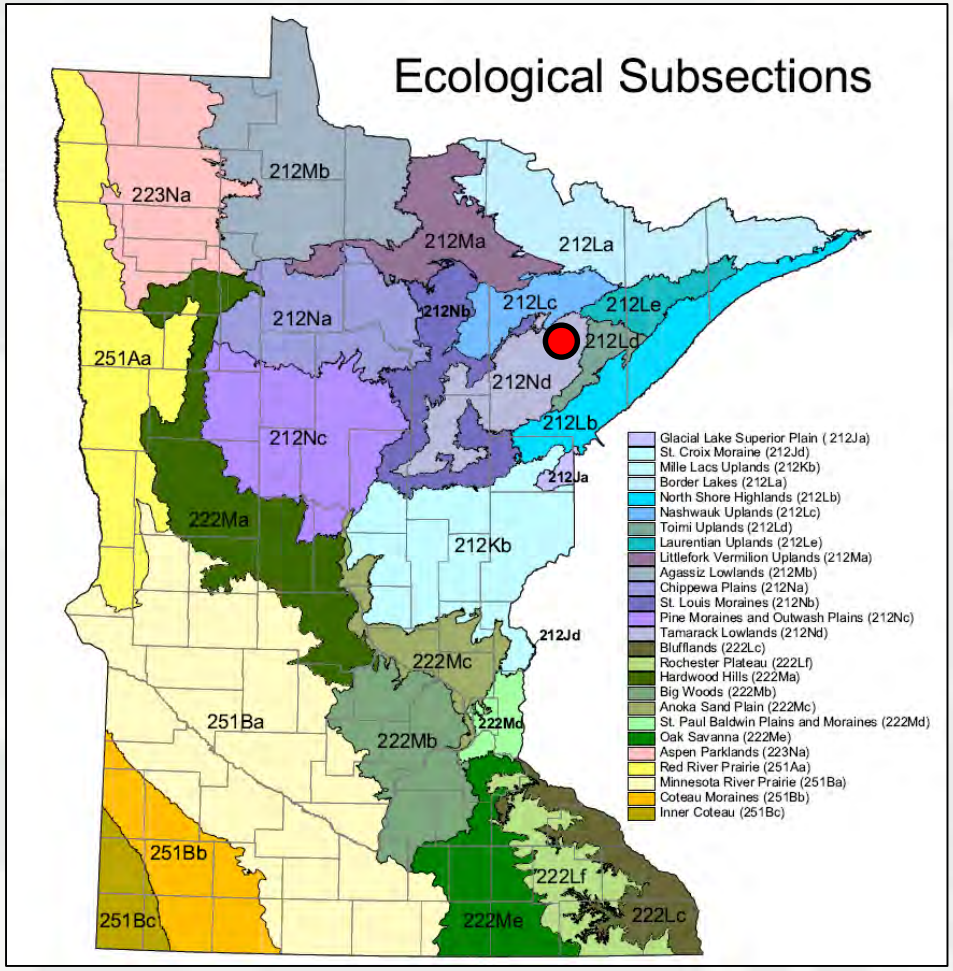
Preferential Sequence

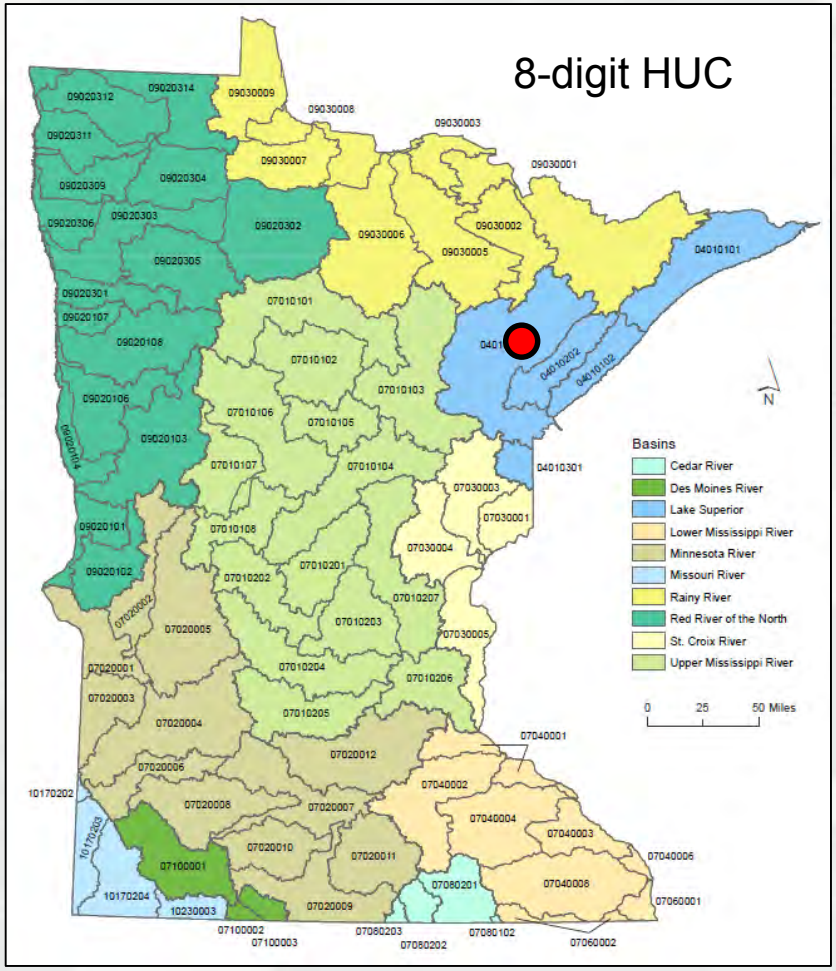
- **Second Priority:**
  - When collecting monitoring well data from on-site, or in proximity, reference wetland(s) is not practicable
  - Obtain monitoring well data from reference wetlands of the same "wetland type"—and located within the same reference domain—as the compensation site. Most pertinent are data from the same 8-digit HUC and/or ecoregion, if available. Progressively broaden the search area within the reference domain, as necessary.
  - Definitions (modified from HGM guidebooks for wetland functional assessments)

Reference Wetlands: wetlands whose hydrographs are used for developing performance standards; sites with disturbed vegetation—but intact, unaltered hydrology—may still have potential as reference sites for hydrology performance standards

Reference Standard Wetlands: subset of reference wetlands representing the least altered examples of a particular wetland type in the least altered landscapes within a reference domain

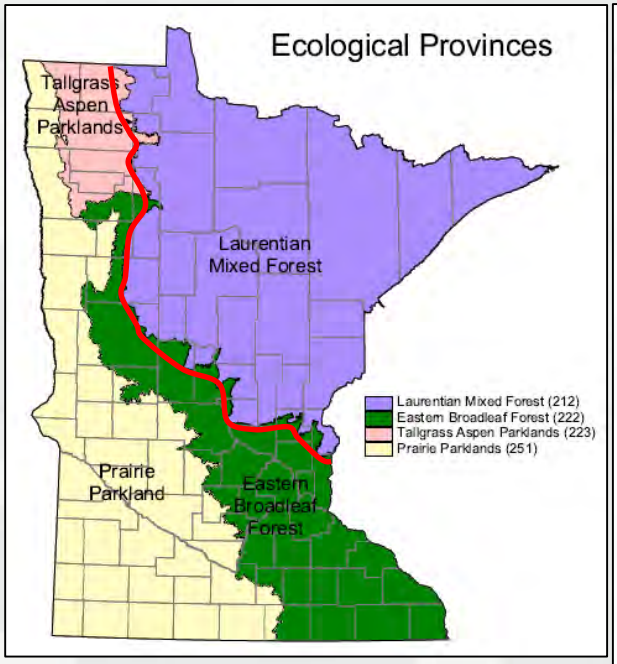
Reference Domain: the geographic area (e.g., watershed, ecoregion) occupied by the reference wetlands of a particular wetland type

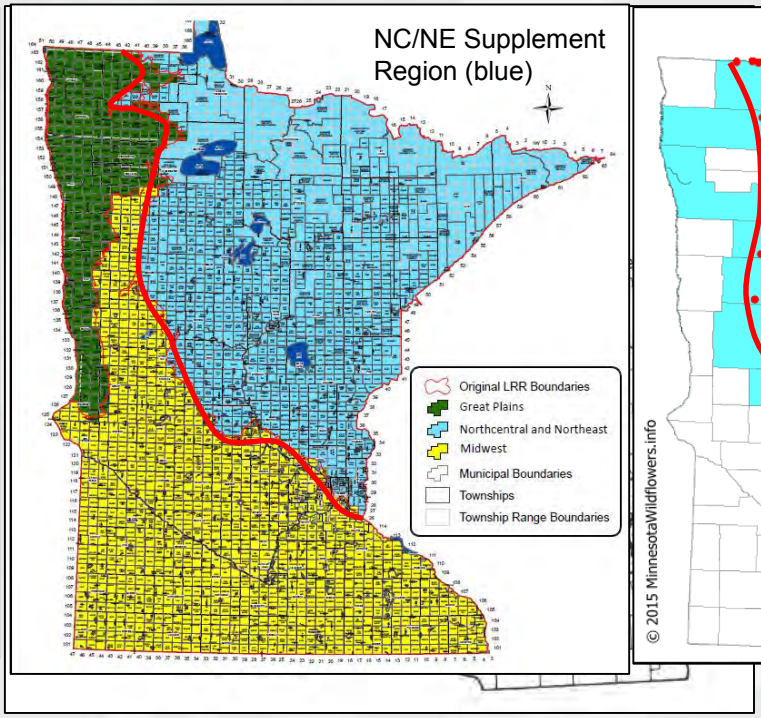


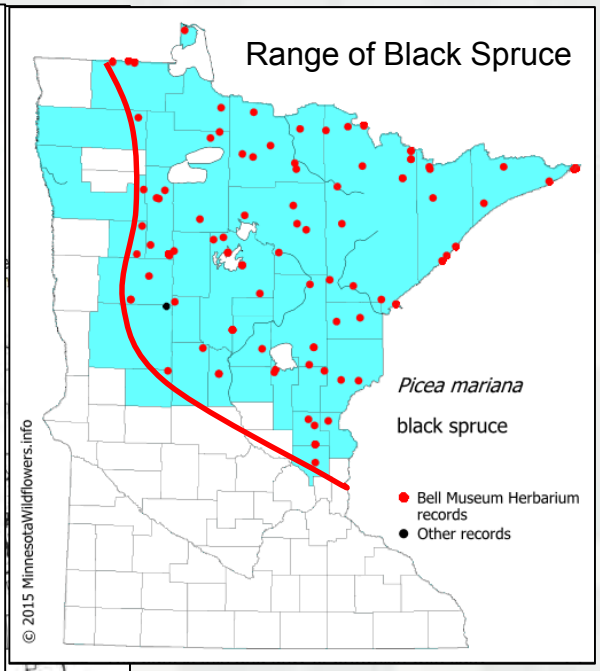


Is monitoring well data available from reference wetlands of the same wetland type and within the same reference domain as the compensation site? First search within the same 8-digit HUC and ecoregion as the compensation site, then progressively broaden search area within the reference domain, as necessary.

Example Reference Domain for Coniferous Bog Hydrographs in Minnesota







Preferential Sequence

- **Third Priority:**
  - Monitoring well data from reference wetlands is unavailable or insufficient in detail
  - Consult scientific literature
  - Consult regional wetland experts
  - Incorporate site-specific data, analysis
  - **Build PS based on best available science**
  - Recognize that hydrology performance standards are *targets*, not absolutes

Example 1

- Wetland compensation site in northeastern MN
- Target “wetland type” is:

Coniferous Bog + Organic Soil Flat + Deep Peat, Acidic

- No practicable on–site or in proximity reference wetland(s)

- Monitoring well data for this “wetland type” are available from reference sites within same 8-digit HUC and ecoregion as compensation site—thus, apply Second Priority approach

Proposed compensation site: ditched, cropped peatland

Coniferous Bog + Organic Soil Flat + Deep Peat, Acidic

- Three reference sites with nine growing seasons of data
- Review data to develop a characteristic hydrograph for this wetland type

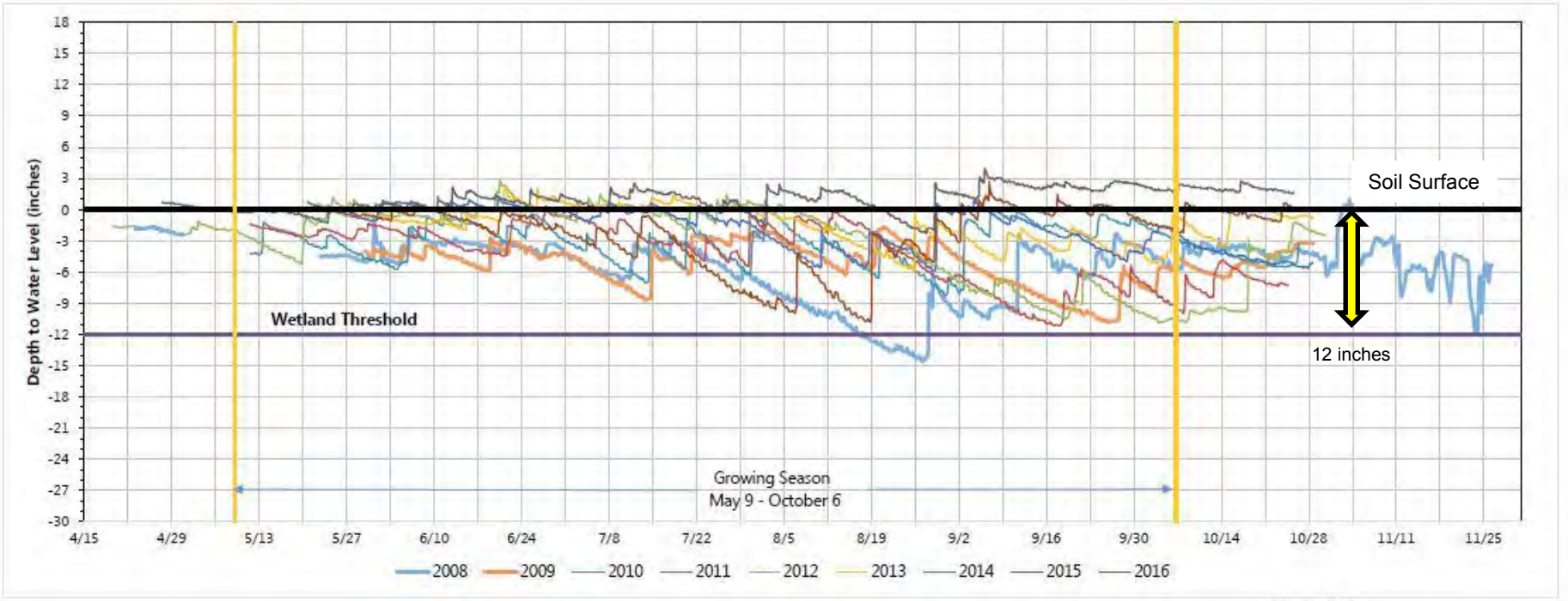
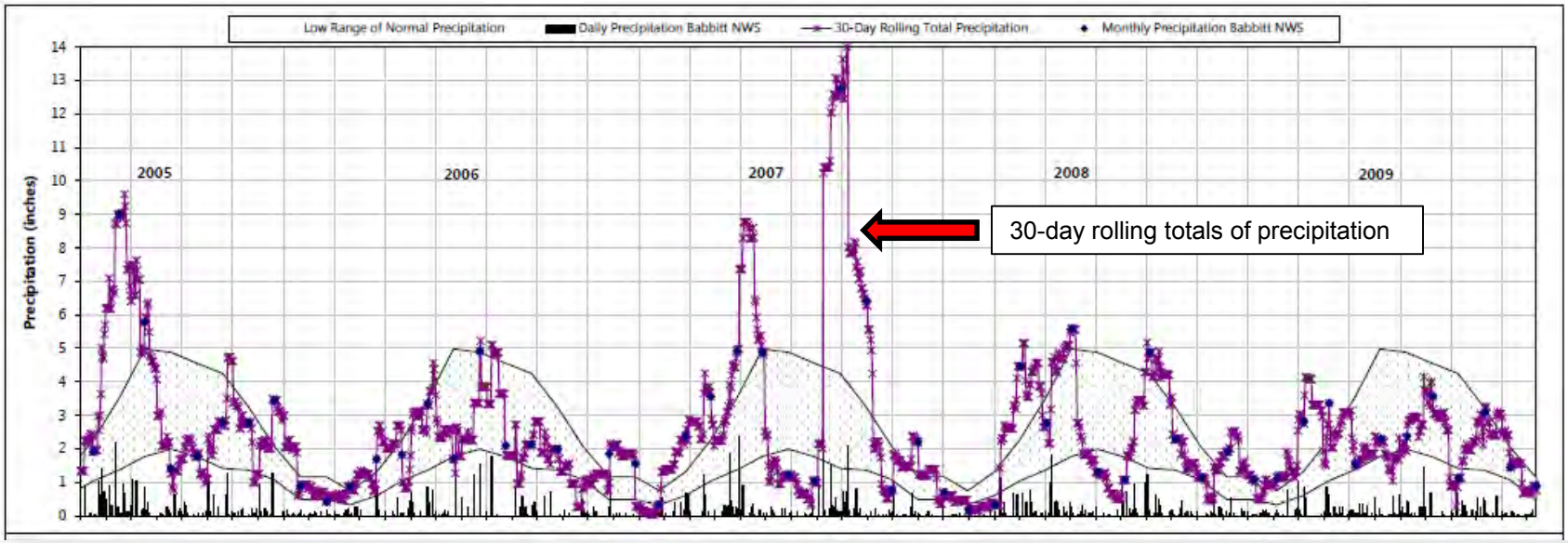


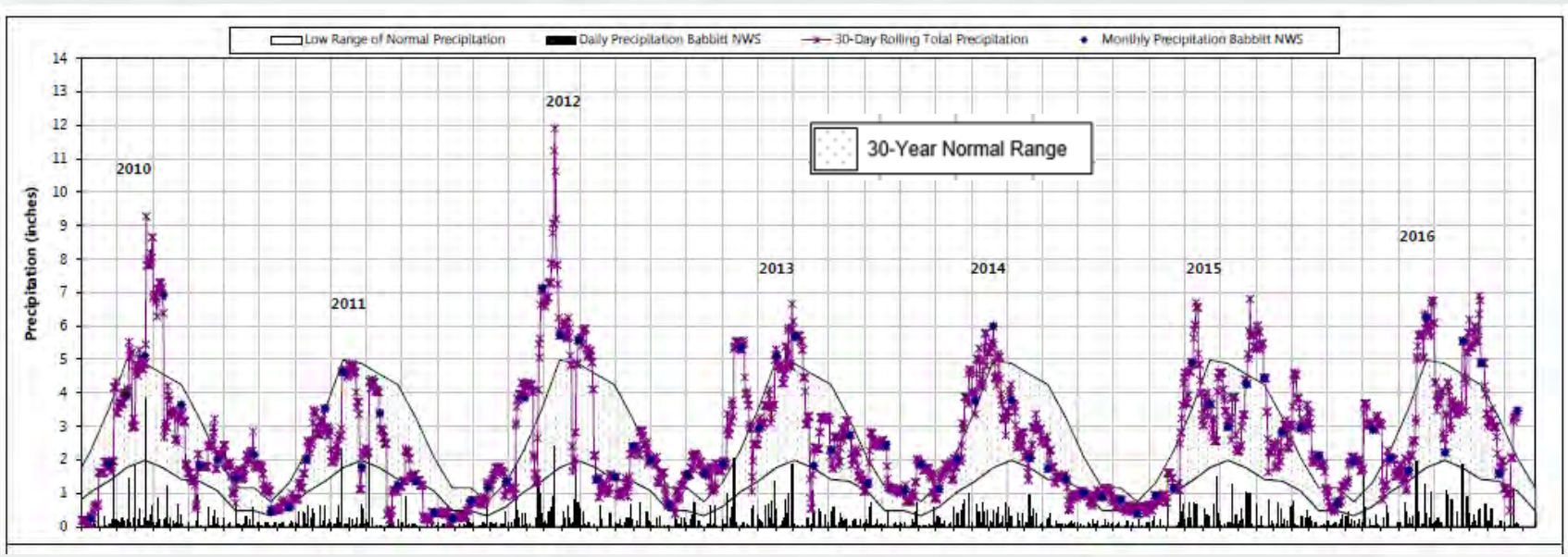
Figure 21-1
WETLAND MONITORING WELL 21

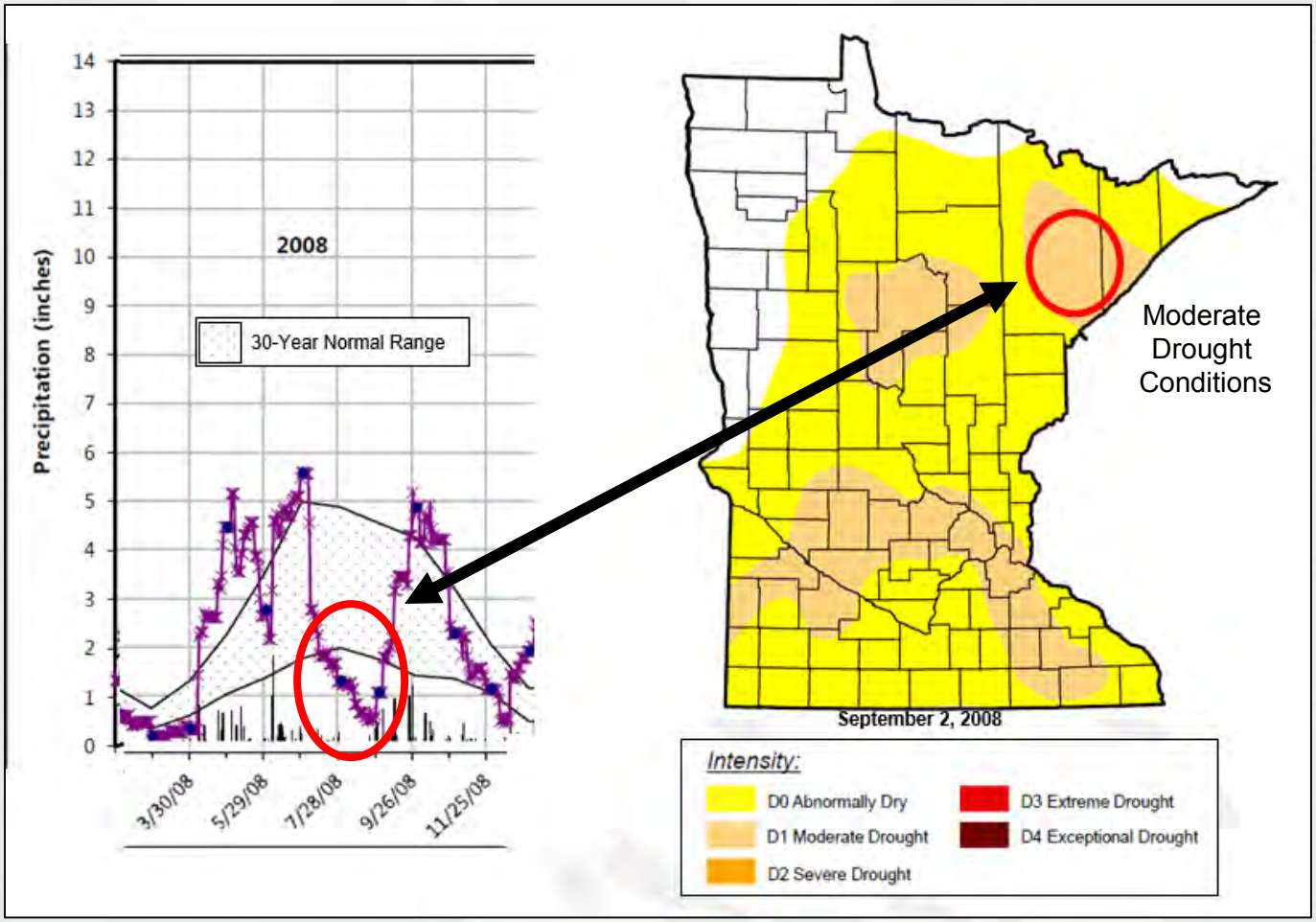
Reference Site 1

Soil Profile: >40 inches of peat

In context of precipitation antecedent to and during monitoring period….







U.S. Drought Monitor http://droughtmonitor.unl.edu

Coniferous Bog + Organic Soil Flat + Deep Peat, Acidic

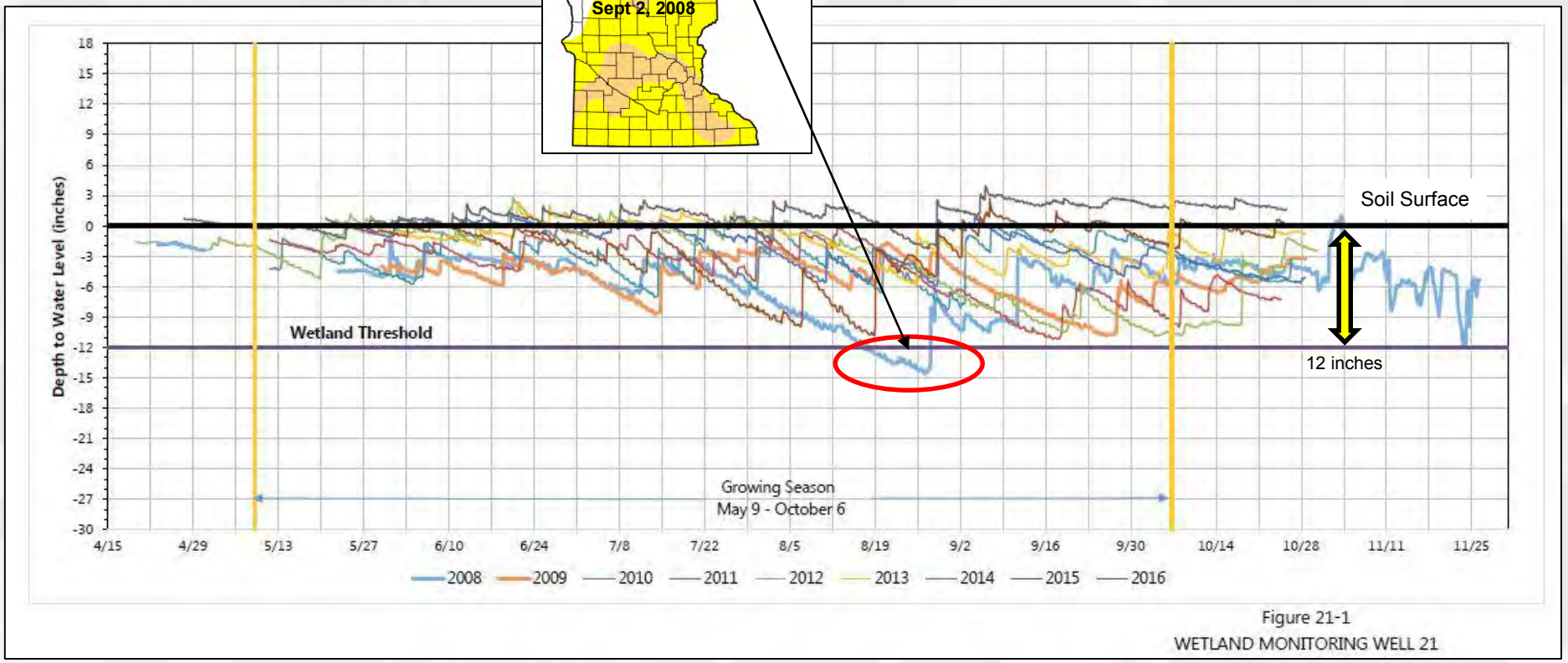
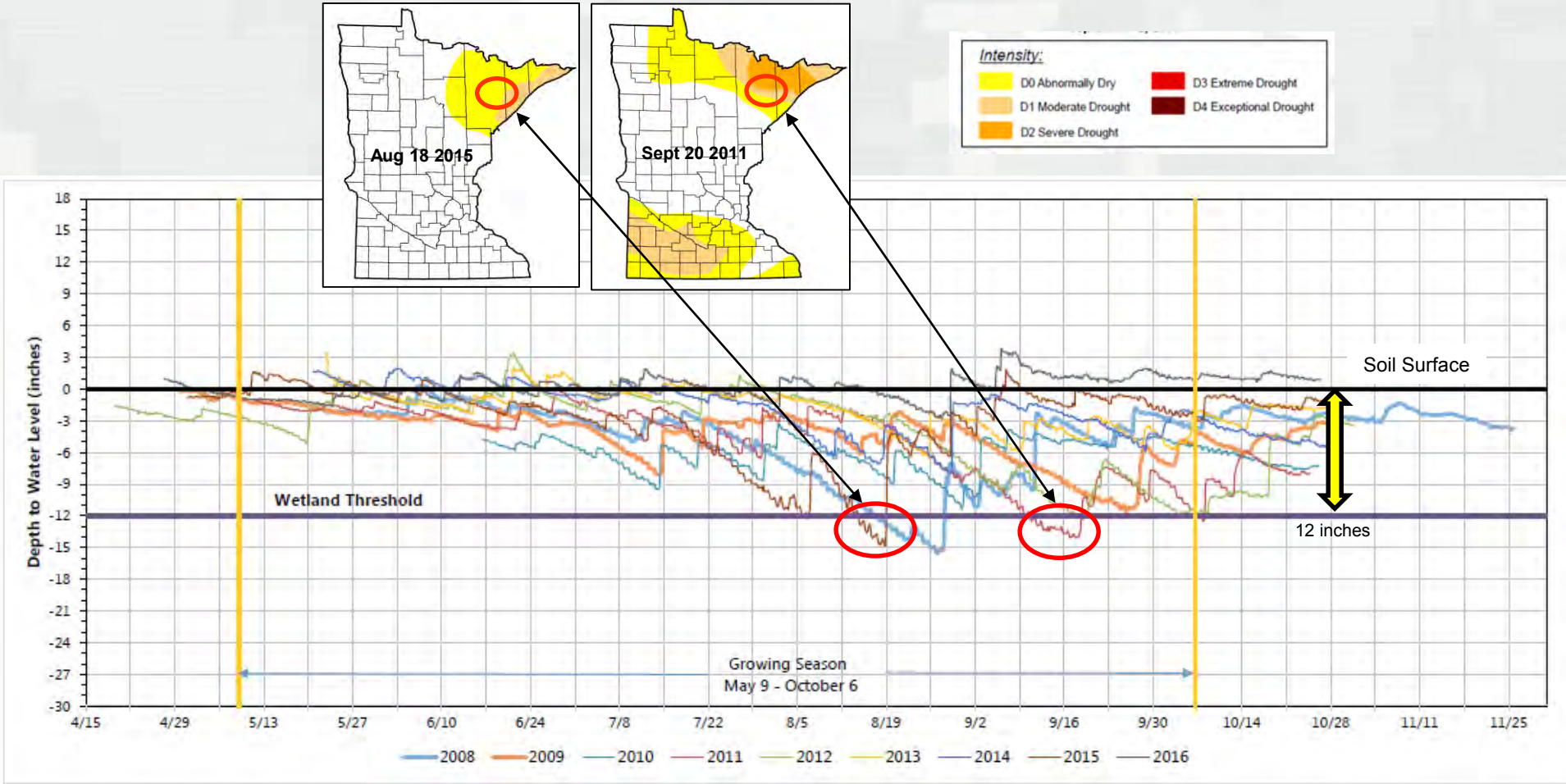


Figure 21-1
WETLAND MONITORING WELL 21

Reference Site 1

Soil Profile: >40 inches of peat

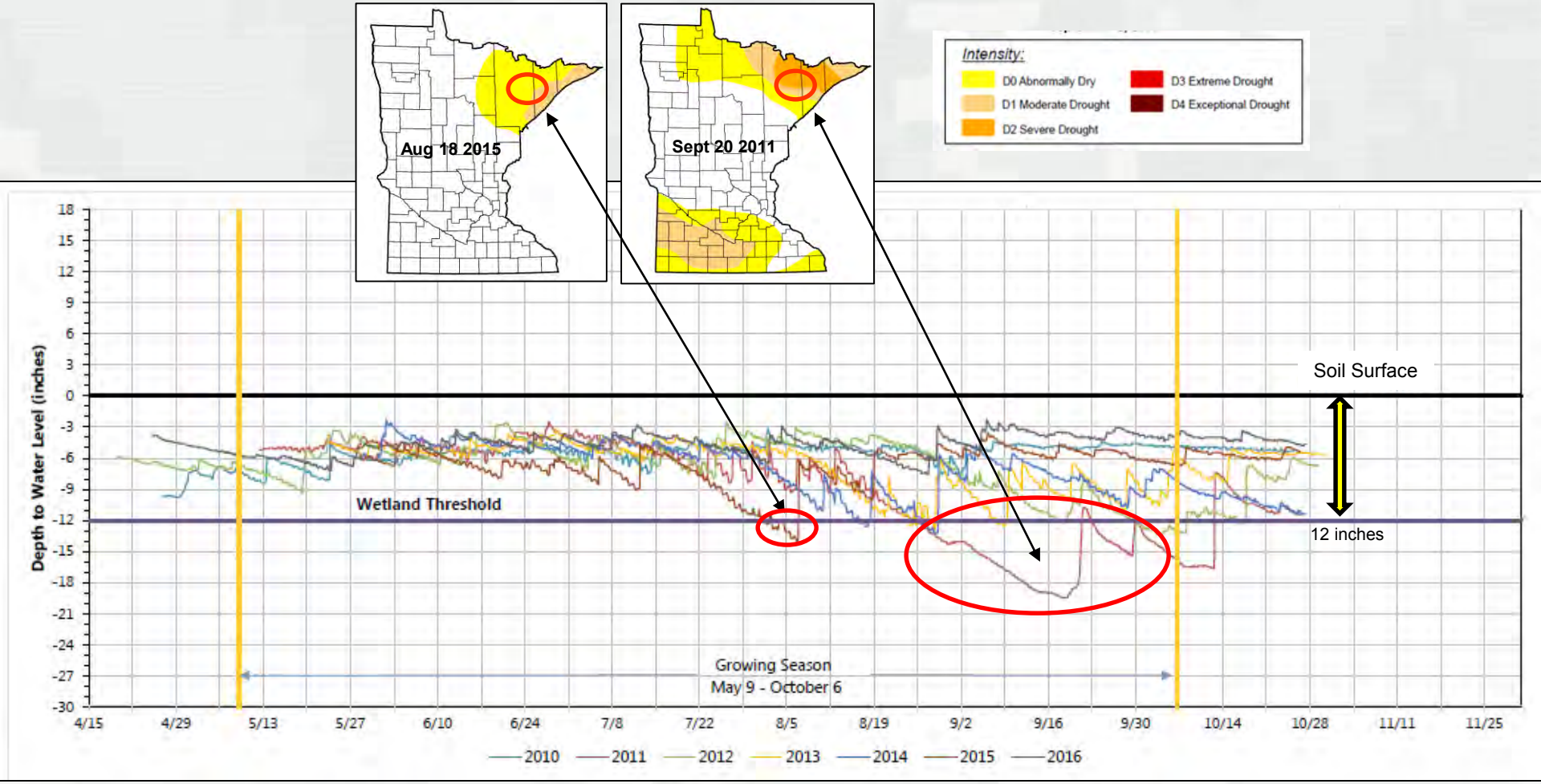
Coniferous Bog + Organic Soil Flat + Deep Peat, Acidic



Reference Site 2

Soil Profile: >42 inches peat

Coniferous Bog + Organic Soil Flat + Deep Peat, Acidic

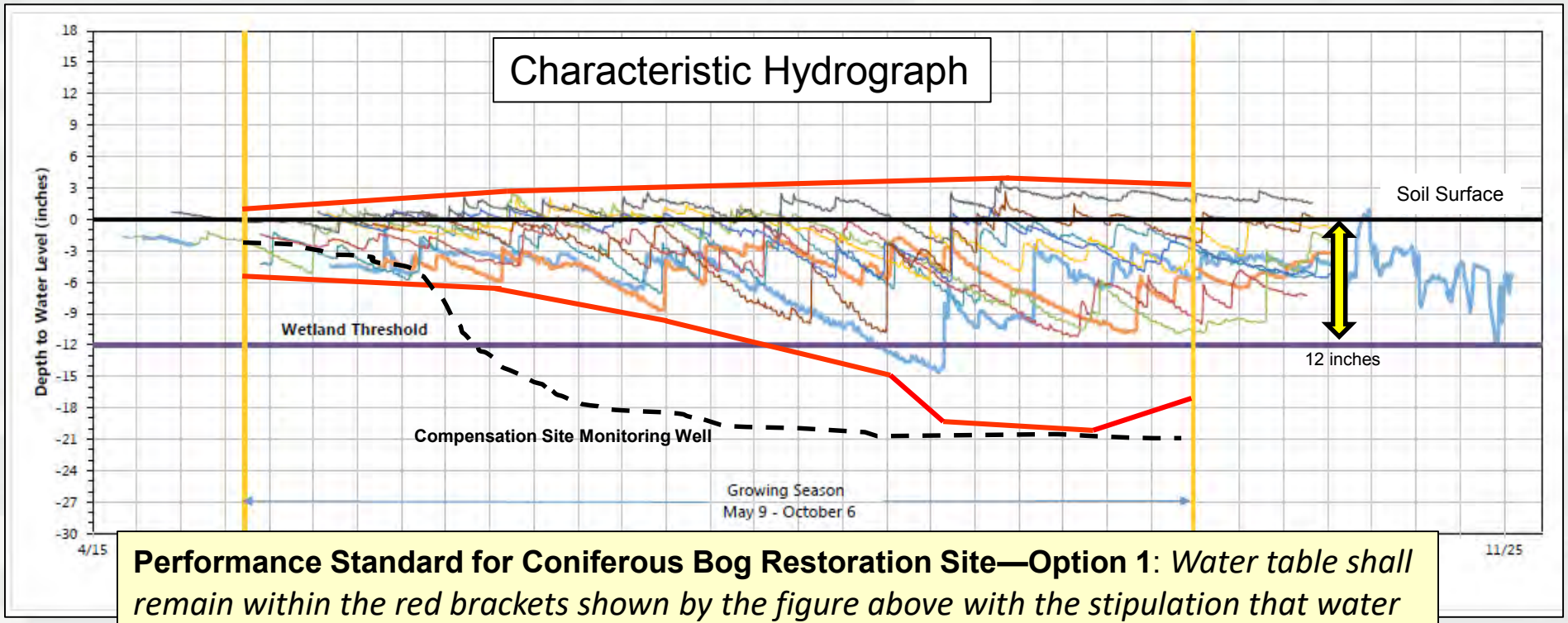


Reference Site 3

Soil Profile: >38 inches peat

Coniferous Bog + Organic Soil Flat + Deep Peat, Acidic

Composite for three reference coniferous bogs: red brackets set upper and lower limits for variability in water table depths over nine growing seasons



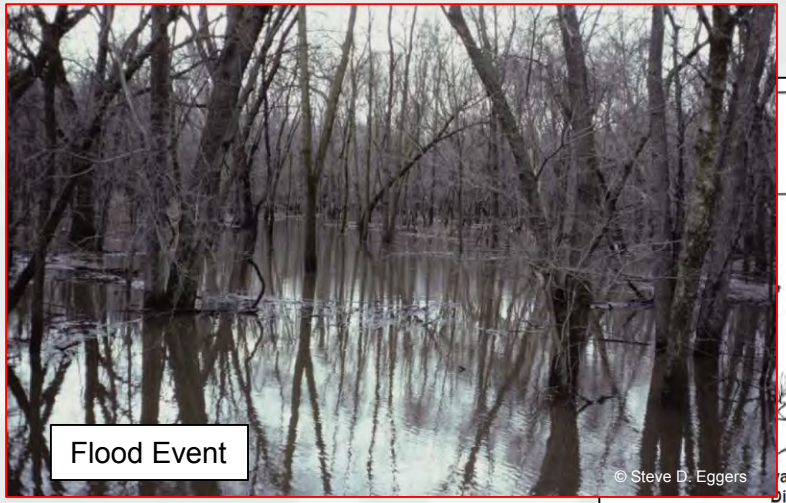
Performance Standard for Coniferous Bog Restoration Site—Option 1: *Water table shall remain within the red brackets shown by the figure above with the stipulation that water levels more than 12 inches below the soil surface be correlated with drought conditions (per U.S. Drought Monitor).*

Performance Standard for Coniferous Bog Restoration Site—Option 2: *Water table shall be +4 inches to -12 inches of the soil surface throughout the growing season with the exception of drought conditions (per U.S. Drought Monitor).*

Example 2

Floodplain Forest + Riverine + Mineral, Alluvial

- General Description: Forested communities dominated by hydrophytic, deciduous hardwoods growing on alluvial soils associated with riverine systems. Temporarily inundated during flood events but relatively well-drained for much of the growing season.*



Need to assign metrics

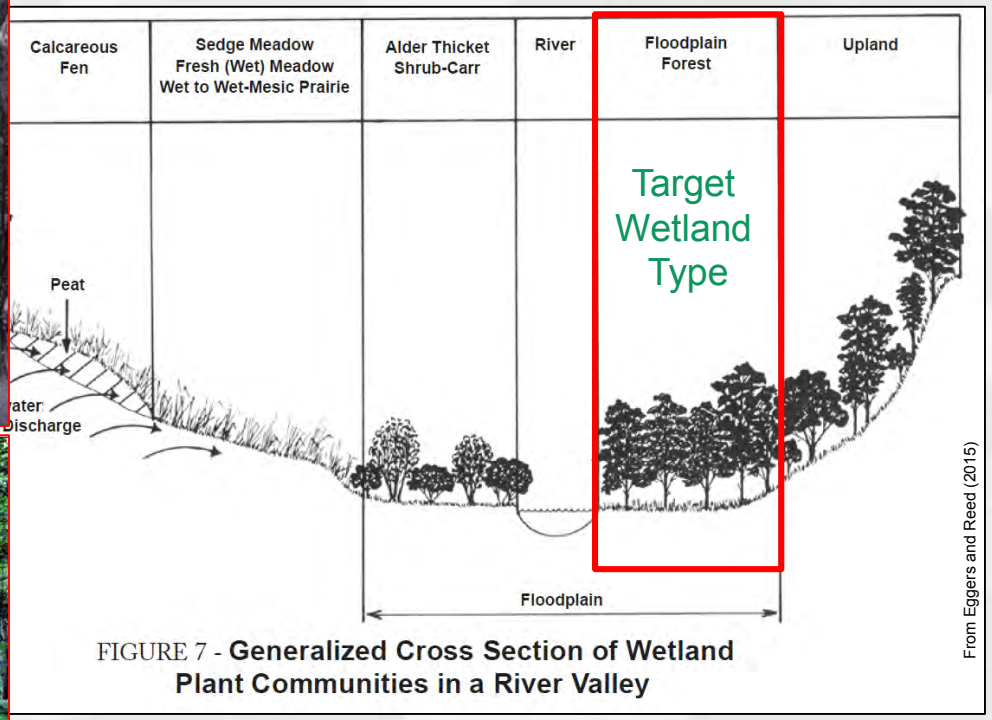


FIGURE 7 - **Generalized Cross Section of Wetland Plant Communities in a River Valley**

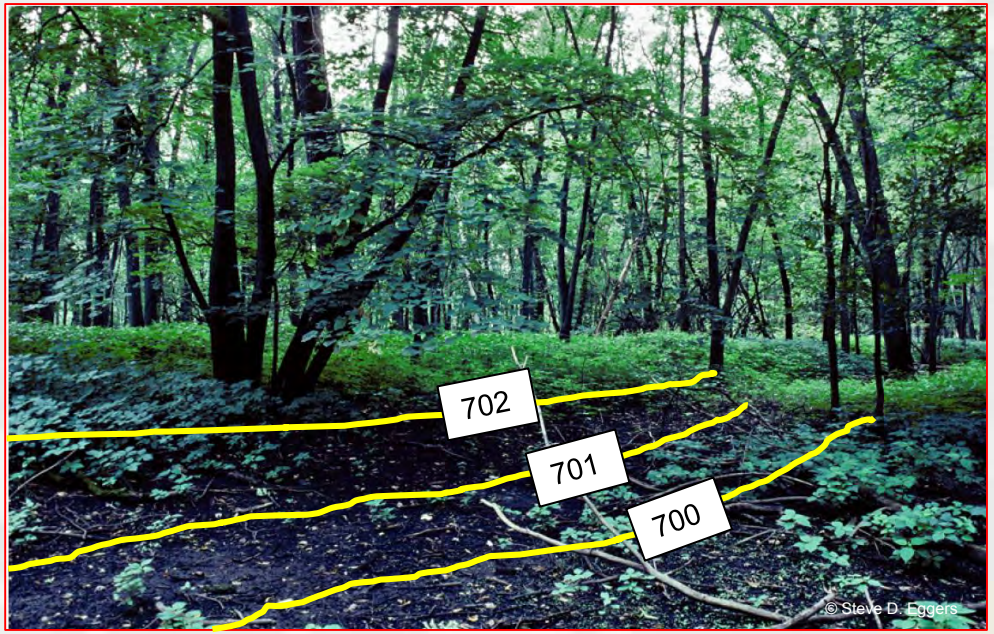
*Cowardin et al. (1979) hydrologic regime "temporarily flooded"

Floodplain Forest + Riverine + Mineral, Alluvial*

- **Performance Standard:** *Hydrology shall consist of inundation for a minimum of 14 consecutive days during the growing season at the following annual frequencies:*
  - *Elevations below 700: ≥90%*
  - *Elevations 700-701: ≥70%*
  - *Elevations 701-702: ≥50%*

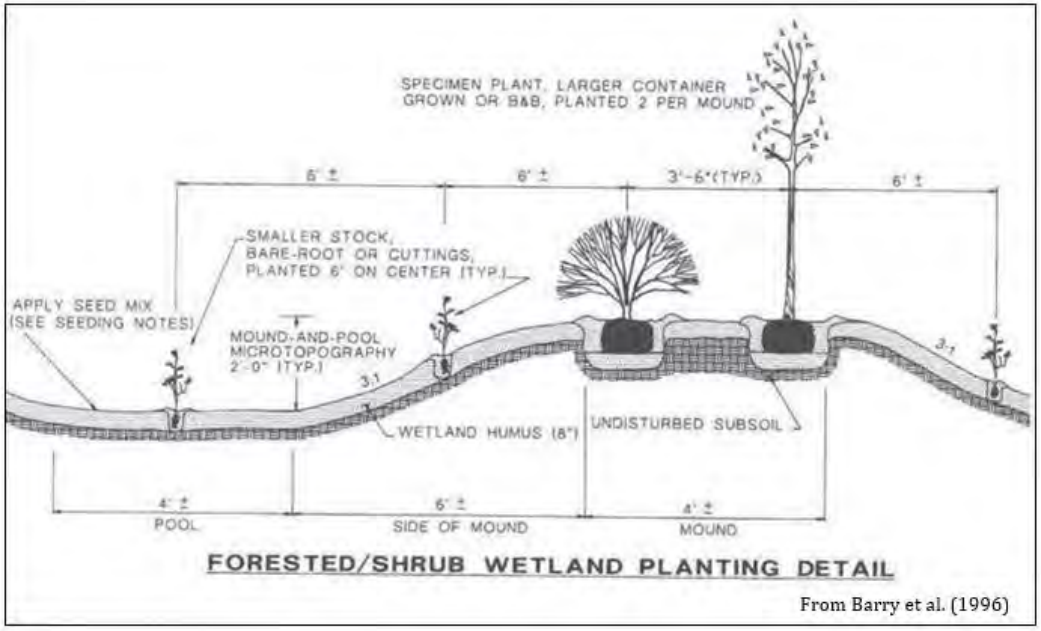
- **Performance Standard:** *Duration of inundation during the growing season shall not exceed _____ consecutive days.*

Base duration on flood tolerances of the target vegetation and site-specific characteristics



*Requires 1-foot contour interval mapping of the compensation site. Use gauging data from reference floodplain forests to determine frequencies/durations of inundation.

ISSUE: Forested Wetland Reference Sites vs. Restoration Sites



Initially, restoration site needs to be “wetter” than reference site

Barry, W., A. Garlo and C. Wood. 1996. Duplicating the mound-and-pool microtopography of forested wetlands. Ecological Restoration 14:15-21.

Summary for Hydrology PS

Should a compensation site develop a different hydrologic regime than specified by the PS:

- Not necessarily a failure
- Corps evaluates overall site
- Were other PS satisfactorily met
- Does the compensation site support diverse, native, hydrophytic plant communities
- Determine extent of overall functions and services established
- Apply flexibility with regard to hydrology PS if site is meeting other PS and goals/objectives

Summary for Hydrology PS

- Develop target hydrology PS based on reference sites and best available science
- Use site-specific data to tailor PS to achieve goals/objectives
- Confirm whether hydrology PS are met via monitoring wells/dataloggers
- Use 30-day rolling totals to characterize precipitation during each monitoring year
- Use best professional judgment and, when warranted, flexibility in applying hydrology PS

Contact: Steve Eggers, Senior Ecologist, Regulatory Branch, St. Paul District Corps of Engineers
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