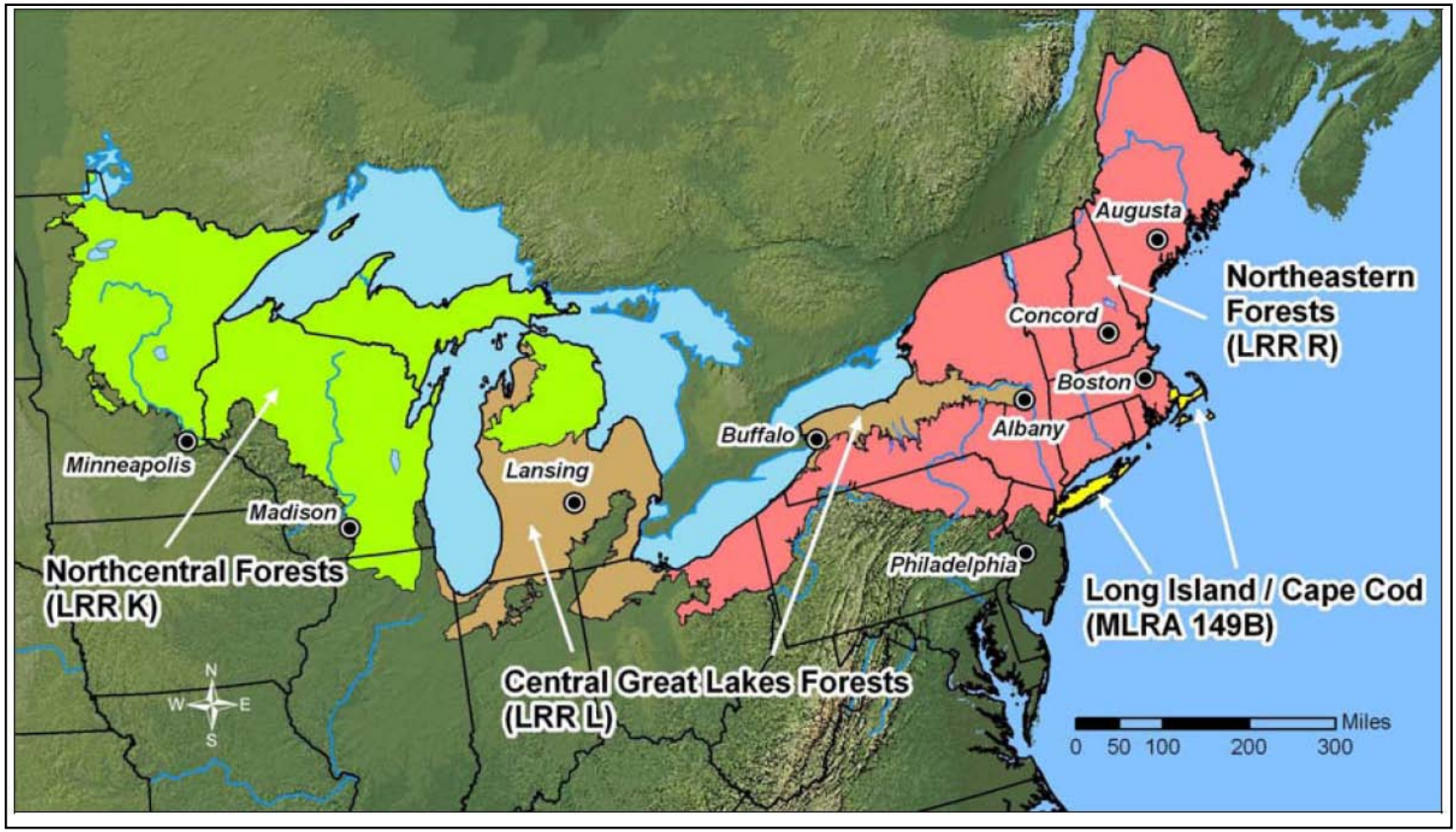
Wetland Hydrology Criteria and Field Indicators

Chapter 4: Wetland Hydrology Indicators



Hydrology Sections Replaced by All Supplements

Item	Replaced Portions of the Corps Manual (Environmental Laboratory 1987)	Replacement Guidance (this Supplement)
Wetland Hydrology Indicators	Paragraph 49(b), all subparts, and all references to specific indicators in Part IV.	Chapter 4
Growing Season Definition	Glossary	Chapter 4, Growing Season; Glossary
Hydrology Standard for Highly Disturbed or Problematic Wetland Situations	Paragraph 48, including Table 5 and the accompanying User Note in the online version of the Manual	Chapter 5, Wetlands that Periodically Lack Indicators of Wetland Hydrology, Procedure item 3(g).

Criterion for Wetland Hydrology

A site meets the wetland hydrology criterion if it is inundated or saturated for a sufficient time during the growing season in most years to result in the development of hydric soils and dominance by hydrophytic vegetation

Hydrology Criterion

- ✓ **Hydrology criterion "inundated or saturated to the surface for 5% or more of the growing season in most years"**
- ✓ **5% ranges from about 7 to 18 days around the country**
- ✓ **5% of the growing season doesn't work well in the south and coastal areas that essentially have a year-round growing season**
- ✓ **National Academy of Sciences recommended a uniform criterion for wetland hydrology – a minimum of 14 consecutive days in most years**

Growing Season

- ✓ **Growing season dates are needed to:**
  - ✓ **Evaluate and interpret some wetland hydrology indicators**
  - ✓ **Analyze recorded hydrologic data to determine if the Corps Technical Standard for wetland hydrology is met**

Growing Season

✓ Technical Definition:

The portion of the year when soil temperatures at 19.7 in. below the soil surface are higher than biologic zero (41° F.)

✓ Approximated by:

The number of frost-free days (last frost in spring and first frost in autumn of 28 degrees F., 5 years in 10, using WETS table)

Represents safe planting period for agricultural crops but natural vegetation is much more frost hardy

New indicator based on observing actual plant growth…

Indicators of Start of the Growing Season

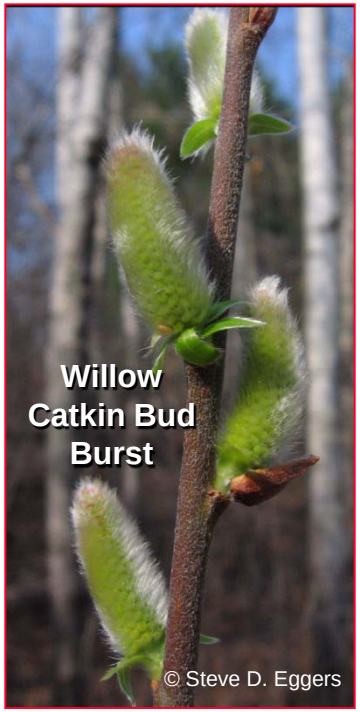
1. "Green-Up" indicator (new)

2. Soil temperature at 12 inches is 41 degrees F. or higher (modified)

3. In the absence of site-specific information (e.g., no site visit), use the 28-degree F., 5 years in 10, per WETS tables

"Green-Up" Indicator for Start of Growing Season

1. Two or more species of non-evergreen plants show active growth in a wetland or surrounding area with similar elevation and aspect



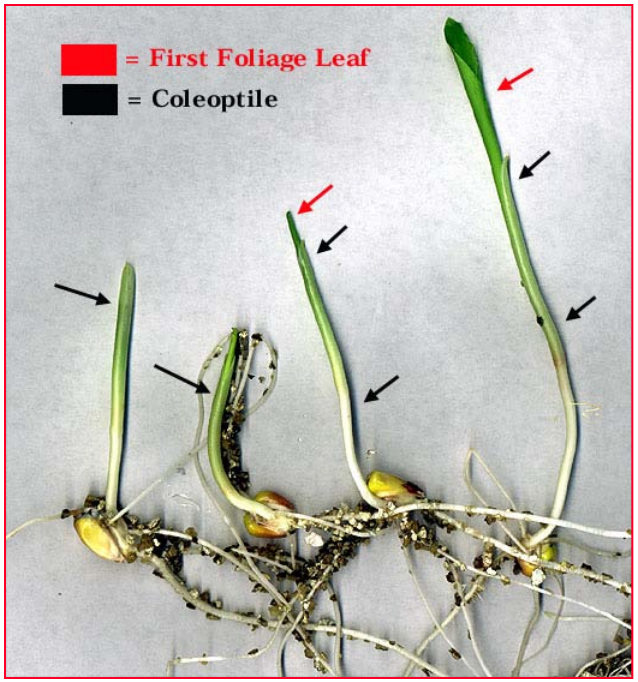
Growing Season

1. "Green-up" Indicators (cont.):

- ✓ **Record supporting data on data sheet**
- ✓ **Include the species observed, their abundance and location relative to the potential wetland, and type of biological activity observed**
- ✓ **Recommend photo documentation**

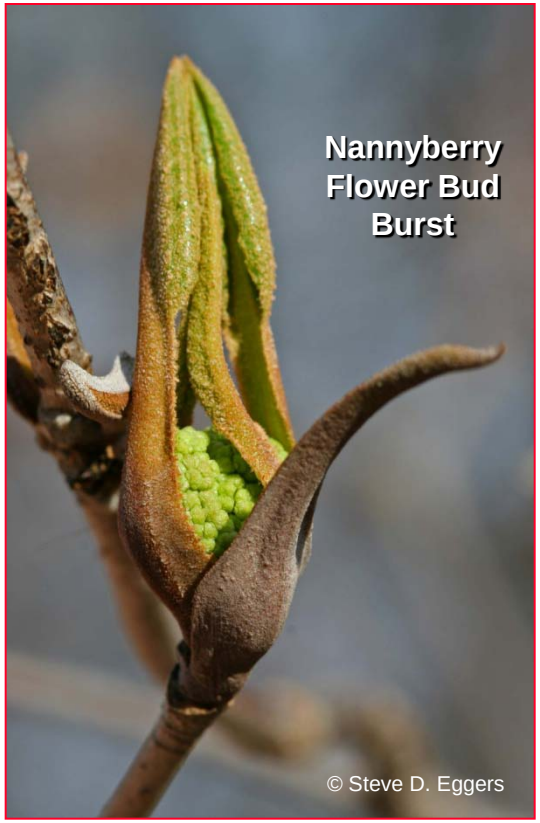
Growing Season

- ✓ **Emergence from seed**



Growing Season

- ✓ **Emergence or opening of flowers**



Growing Season

- ✓ **Appearance of new growth from vegetative crowns (e.g., grasses, bulbs, and corms)**

Growing Season

2. The growing season has begun when soil temperature measured at the 12-in. (30-cm) depth is 41 ºF (5 ºC) or higher.

- ✓ **A one-time temperature measurement is sufficient, but is not required unless growing season information is necessary to evaluate particular wetland hydrology indicators.**

End of Growing Season

The end of the growing season is indicated when woody deciduous species lose their leaves and/or the last herbaceous plants cease flowering and their leaves die back

Wetland Hydrology Indicators

- ✓ **Lack of a hydrology indicator does not confirm the lack of wetland hydrology; many Midwest wetlands lack hydrology indicators during latter half of growing season and during drier than normal years**
- ✓ **If no hydrology indicators are present in an area with wetland vegetation and hydric soil, use the procedures in Chapter 5 to determine if wetland hydrology is present**

Table 10

Hydrology Indicators: Northcentral and Northeast

Indicator	Category	
	Primary	Secondary
Group A – Observation of Surface Water or Saturated Soils		
A1 – Surface water	X	
A2 – High water table	X	
A3 – Saturation	X	
Group B – Evidence of Recent Inundation		
B1 – Water marks	X	
B2 – Sediment deposits	X	
B3 – Drift deposits	X	
B4 – Algal mat or crust	X	
B5 – Iron deposits	X	
B7 – Inundation visible of aerial imagery	X	
B8 – Sparsely vegetated concave surface	X	
B9 – Water-stained leaves	X	
B13 – Aquatic fauna	X	
B15 – Marl deposits	X	
B6 – Surface soil cracks		X
B10 – Drainage patterns		X
B16 – Moss trim lines		X
Group C – Evidence of Current or Recent Soil Saturation		
C1 – Hydrogen sulfide odor	X	
C3 – Oxidized rhizospheres along living roots	X	
C4 – Presence of reduced iron	X	
C6 – Recent iron reduction in tilled soils	X	
C7 – Thin muck surface	X	
C2 – Dry-season water table		X
C8 – Crayfish burrows		X
C9 – Saturation visible on aerial imagery		X
Group D – Evidence from Other Site Conditions or Data		
D1 – Stunted or stressed plants		X
D2 – Geomorphic position		X
D3 – Shallow aquitard		X
D4 – Microtopographic relief		X
D5 – FAC-neutral test		X

Midwest vs. Northcentral/Northeast Supplement Hydrology Indicators

- **29 Field Indicators in NC/NE Supplement of which the following are not in the Midwest Supplement:**
  - **B15 – Marl deposits**
  - **B16 – Moss trim lines**
  - **D3 – Shallow aquitard**
  - **D4 – Microtopographic relief**
- **27 Field Indicators in Midwest Supplement of which the following are not in the NC/NE Supplement:**
  - **D9 – Gauge or well data**
  - **B14 – True aquatic plants**

Hydrology Field Indicators

- ✓ **Organized into 4 categories:**

Group A: Observations of Surface Water or Saturated Soils

Group B: Evidence of Recent Inundation

Group C: Evidence of Current or Recent Soil Saturation

Group D: Evidence from Other Site Conditions or Data

29 hydrology field indicators total compared to 10 specifically listed in 1987 Manual/1992 data sheet

Wetland Hydrology Indicators

Group A: Observation of surface water or saturated soils

Indicator	Category
A1 – Surface water	Primary
A2 – High water table	Primary
A3 – Saturation	Primary

Black text = indicator specified by 87 Manual.
Blue text = new indicator in the Midwest supplement.

Wetland Hydrology Indicators

Group B: Evidence of recent inundation

Indicator	Category
B1 – Water marks	Primary
B2 – Sediment deposits	Primary
B3 – Drift deposits	Primary
B4 – Algal mat or crust	Primary
B5 – Iron deposits	Primary
B6 – Surface soil cracks	Secondary

Black text = indicator specified by 87 Manual.
Blue text = new indicator in NC/NE Supplement.

Wetland Hydrology Indicators

Group B: Evidence of recent inundation continued…

Indicator	Category
B7 – Inundation visible on aerial imagery	Primary
B8 – Sparsely vegetated concave surface	Primary
B9 – Water-stained leaves	Primary !
B10 – Drainage patterns	Secondary !
B13 – Aquatic invertebrates *(Fauna)*	Primary
B15 – Marl deposits	Primary
B16 – Moss trim lines	Secondary

Black text = indicator specified by 1987 Manual.
Blue text = new indicator in the NC/NE supplement.

Wetland Hydrology Indicators

Group C: Evidence of current or recent soil saturation.

Indicator	Category
C1 – Hydrogen sulfide odor	Primary
C2 – Dry season water table	Secondary
C6 – Presence of iron reduction in tilled soils	Primary
C3 – Oxidized rhizospheres along living roots	Primary !
C4 – Presence of reduced iron	Primary
C7 – Thin muck surface	Primary
C8 – Crayfish burrows	Secondary
C9 – Saturation visible on aerial imagery	Secondary

Wetland Hydrology Indicators

Group D: Evidence from other site conditions or data.

Indicator	Category
D1 – Stunted or stressed plants	Secondary
D2 – Geomorphic position	Secondary
D3 – Shallow aquitard	Secondary
D4 – Microtopographic relief	Secondary
D5 – FAC-neutral test	Secondary

Black text = indicator specified by 87 Manual.
Blue text = new indicator in NC/NE Supplement.

Wetland Hydrology Indicators

- ✓ **Local soil survey data deleted as an indicator in all supplements**

  1. **Misuse, misidentification of soil series;**

  2. **Soil scientist needed to verify soil series using soil pits much deeper than those used for wetland delineation; and**

  3. **Little to no hard (quantified) data on seasonal high water table and frequency/duration of flooding used in soil surveys/data mart**

Soil Saturation

Blackened Leaves

Oxidized Root Channels

Redox in Recently Tilled Soils

Wetland Hydrology Indicators

- ✓ **Format for hydrology indicators is more user friendly:**
  - ✓ **An indicator reference number;**
  - ✓ **An indicator category (Primary or Secondary);**
  - ✓ **A general description of the indicator;**
  - ✓ **Cautions and user notes to further clarify indicator use; and**
  - ✓ **A photo, when available, to visually represent the indicator.**

Indicator B1: Water marks

Category: Primary

General Description: Water marks are discolorations or stains on the bark of woody vegetation, rocks, bridge supports, buildings, fences, or other fixed objects as a result of inundation (Figure 26).

Figure 26. Water marks (dark stains) on trees in a seasonally flooded wetland.

Cautions and User Notes: When several water marks are present, the highest reflects the maximum extent of inundation. Water marks indicate a water-level elevation and can be extrapolated from nearby objects across lower elevation areas. Use caution with water marks that may have been caused by extreme, infrequent, or very brief flooding events. In regulated systems, such as reservoirs, water-level records can be used to distinguish unusually high pools from normal operating levels.

Wetland Hydrology Indicators

B4 – Algal mat or crust;

Category: Primary.

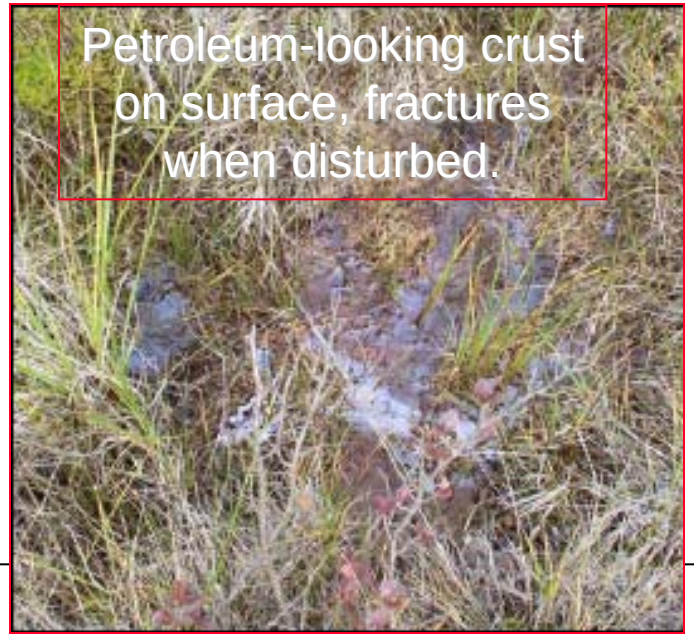
General Description: This indicator consists of a mat or dried crust of algae, perhaps mixed with other detritus, left on or near the soil surface after dewatering.

Wetland Hydrology Indicators

B5 – Iron deposits

Category: Primary.

General Description: This indicator consists of a thin orange or yellow crust or gel of oxidized iron on the soil surface or on objects near the surface.

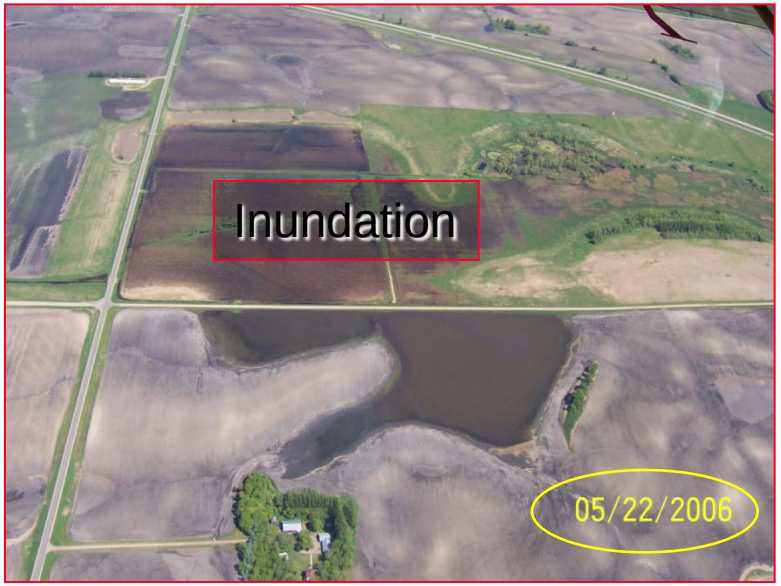


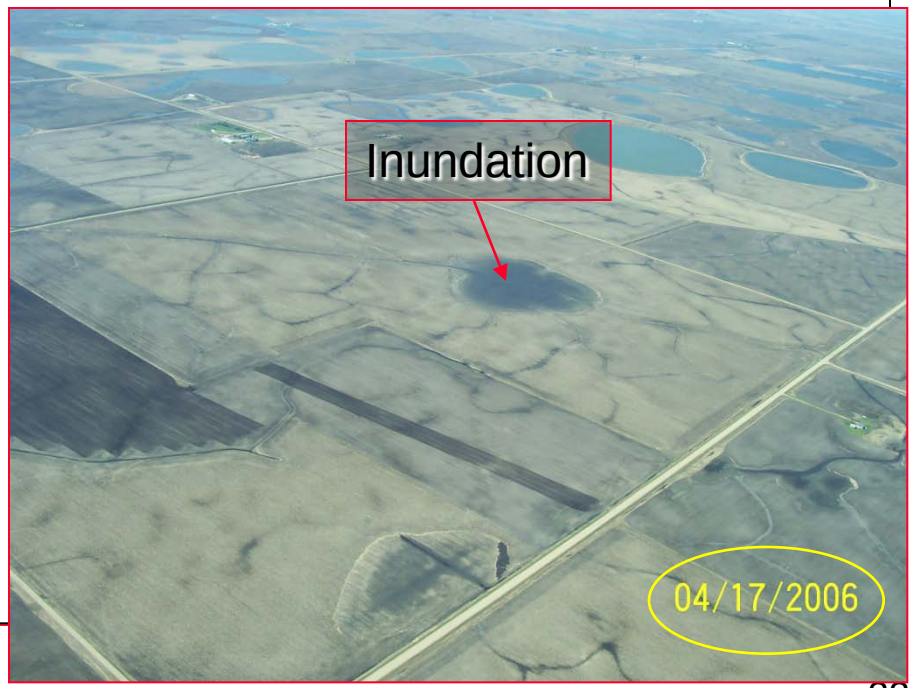
Wetland Hydrology Indicators

B7 – Inundation on aerial imagery

Category: Primary.

General Description: One or more recent aerial photographs or satellite images show the site to be inundated.





Wetland Hydrology Indicators

B7 – Inundation on aerial imagery

- ✓ **Surface water may be present on non-wetland sites immediately after a heavy rain or during periods of unusually high precipitation, runoff, or river stages.**
- ✓ **Use Chapter 5 to evaluate normality of precipitation prior to photo.**
- ✓ **Surface water observed during non-growing season may be an acceptable indicator if BPJ suggests that wet conditions normally extend into the growing season for sufficient duration in most years.**
- ✓ **Evaluate multiple years of photos whenever possible.**

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Wetland Hydrology Indicators

B8 – Sparsely vegetated concave surface

Category: Primary.

General Description: On concave land surfaces (e.g., depressions and swales), the ground surface is either unvegetated or sparsely vegetated (less than 5 percent ground cover) due to long-duration ponding during the growing season.

Wetland Hydrology Indicators

B8 – Sparsely vegetated concave surface

Cautions and User Notes::

- ✓ **Caused by ponding during the growing season that limits the establishment and growth of ground-layer vegetation.**
- ✓ **Sparsely vegetated concave surfaces should contrast with vegetated slopes and convex surfaces in the same area.**

Wetland Hydrology Indicators

B13 – Aquatic invertebrates;

Category: **Primary.**

General Description: **Presence of numerous live individuals, diapausing insect eggs or crustacean cysts, or dead remains of aquatic invertebrates, such as clams, snails, insects, ostracods, shrimp, and other crustaceans, either on the soil surface or clinging to plants or other emergent objects.**

Wetland Hydrology Indicators

B13 – Aquatic Invertebrates

- ✓ **Examples of dead remains include clam shells, chitinous exoskeletons, insect head capsules, and aquatic snail shells.**
- ✓ **Invertebrates or their remains should be reasonably abundant, one or two individuals are not sufficient.**
- ✓ **Use caution in areas where remains may have been transported by wind, water, or other animals into non-wetland areas.**
- ✓ **Shells and exoskeletons may persist in the soil for years after dewatering.**

Wetland Hydrology Indicators

C2 – Dry season water table

Category: Secondary.

General Description: Visual observation of the water table between 12 and 24 in. (30 and 60 cm) below the surface during the normal dry season or during a drier-than-normal year.

Wetland Hydrology Indicators

C2 – Dry season water table

Cautions and User Notes:

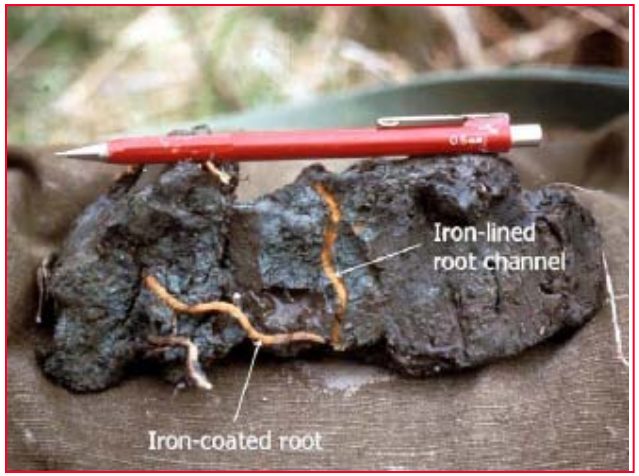
- ✓ **Allow sufficient time for water to drain into a newly dug hole and to stabilize at the water table level.**
- ✓ **For an accurate determination of the water-table level, sampling techniques must not penetrate restrictive layers that may be present.**
- ✓ **Is a test positive. Many Midwest wetlands have a water table below 24 inches during the dry season.**

Wetland Hydrology Indicators

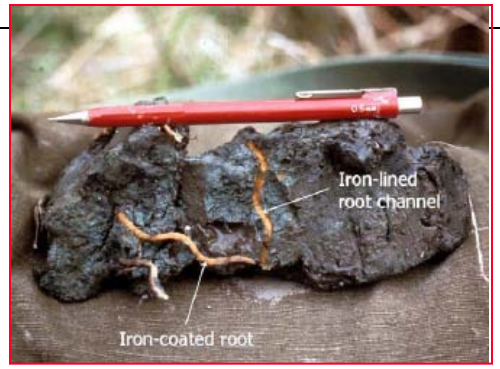
C3 – Oxidized rhizospheres along living roots

Category: Primary.

General Description: Presence of a layer containing 2 percent or more iron-oxide coatings or plaques on the surfaces of living roots and/or iron-oxide coatings or linings on soil pores immediately surrounding living roots within 12 inches of the soil surface.



Wetland Hydrology Indicators



C3 – Oxidized rhizospheres along living roots

Cautions and User Notes:

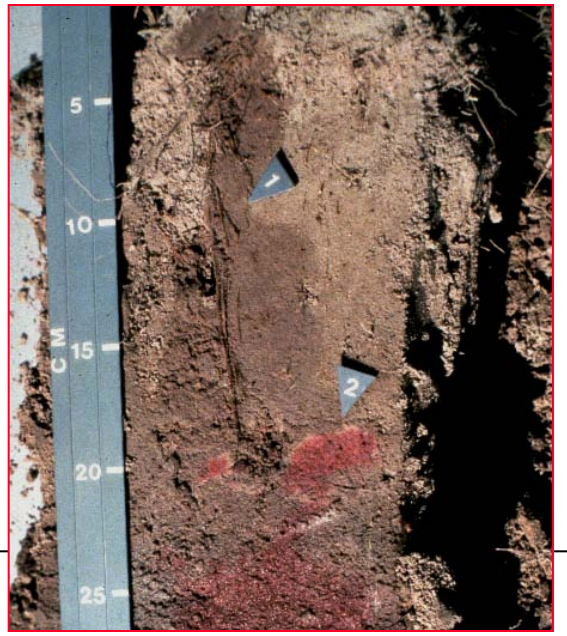
- ✓ **Oxidized iron must be associated with living roots to indicate contemporary wet conditions and distinguish these features from other pore linings.**
- ✓ **Care must be take to distinguish iron-oxide coatings from organic matter associated with plant roots, use hand lens when necessary.**

Wetland Hydrology Indicators

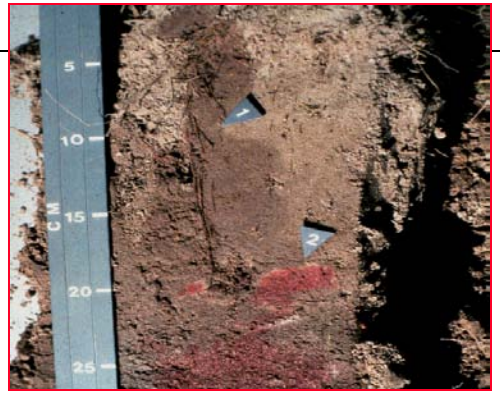
C4 – Presence of reduced iron

Category: Primary.

General Description: Presence of a layer containing reduced (ferrous) iron in the upper 12 in. (30 cm) of the soil profile, as indicated by a ferrous iron test or by the presence of a soil that changes color upon exposure to the air.



Wetland Hydrology Indicators



C4 – Presence of reduced iron

Cautions and User Notes:

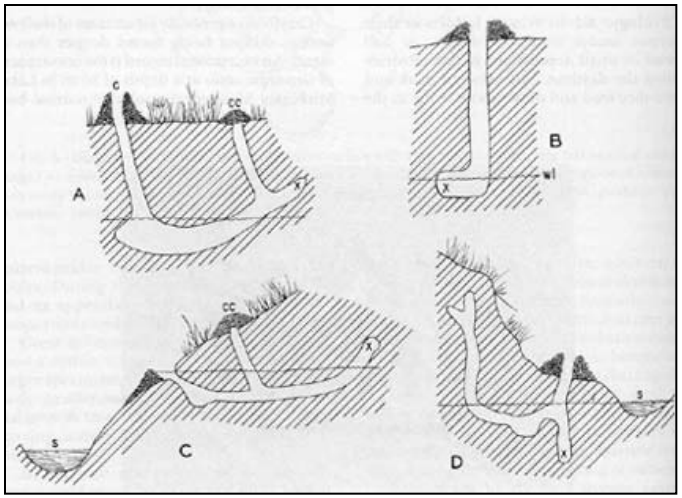
- ✓ **A positive reaction to alpha alpha-dipyridyl dye should occur over more than 50% of the soil layer in question.**
- ✓ **Soil samples should be tested or examined immediately after opening a pit.**
- ✓ **Avoid testing soil that may have come into contact with iron digging tools.**

Wetland Hydrology Indicators

C8 – Crayfish burrows

Category: Secondary.

General Description: Presence of crayfish burrows, as indicated by openings in soft ground up to 2 in. (5 cm) in diameter, often surrounded by chimney-like mounds of excavated mud.

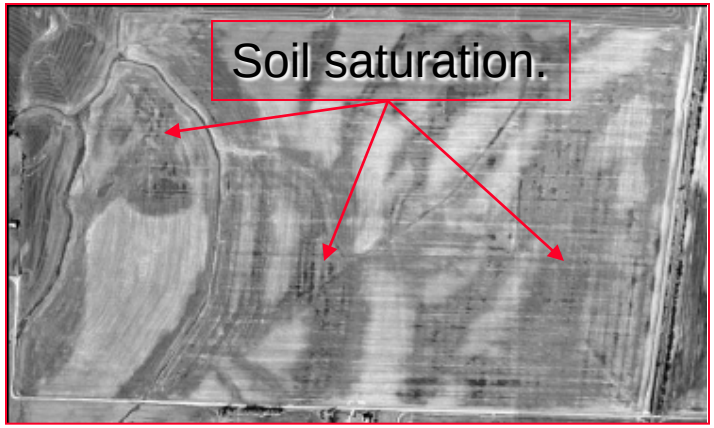


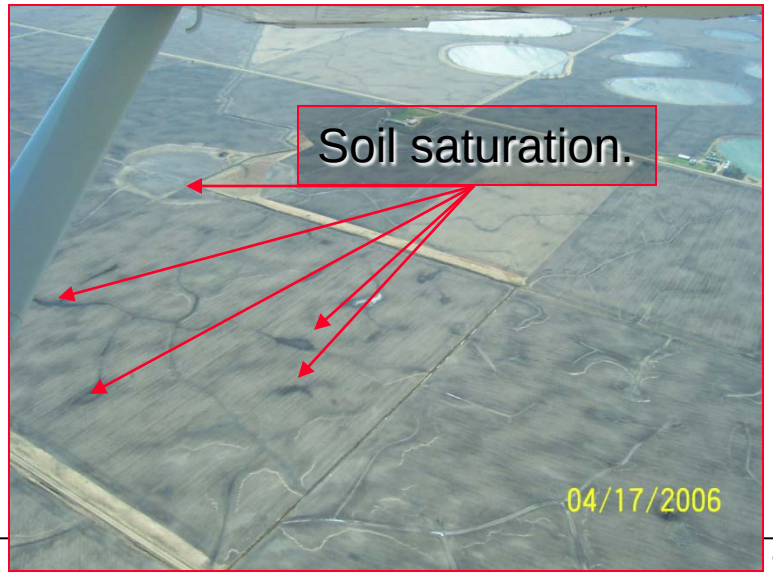
Wetland Hydrology Indicators

C9 – Saturation visible on aerial imagery

Category: Secondary.

General Description: One or more recent aerial photographs or satellite images indicate soil saturation. Saturated soil signatures must correspond to field-verified hydric soils, depressions or drainage patterns, differential crop management, or other evidence of a seasonal high water table.





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Wetland Hydrology Indicators

C9 – Saturation visible on aerial imagery

Cautions and User Notes:

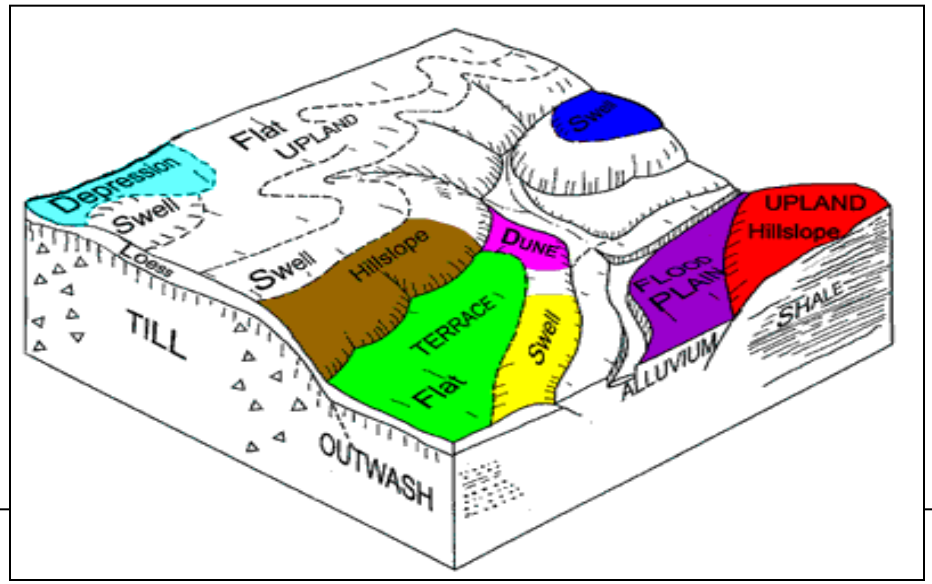
- ✓ **This indicator requires on-site verification that saturation signatures seen on photos correspond to hydric soils or other evidence of a seasonal high water table.**
- ✓ **Saturation may be present on non-wetland sites immediately after heavy rains or during periods of unusually high precipitation, runoff, or river stages.**
- ✓ **Use Chapter 5 to evaluate normality of precipitation prior to photo.**
- ✓ **Saturation observed during non-growing season may be an acceptable indicator if BPJ suggests that wet conditions normally extend into the growing season for sufficient duration in most years.**
- ✓ **Evaluate multiple years of photos whenever possible.**

Wetland Hydrology Indicators

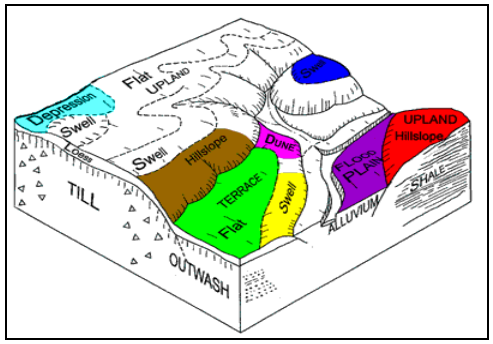
D2 – Geomorphic position

Category: Secondary.

General Description: Located in a localized depression, linear drainageway, concave position within a floodplain, at the toe of a slope, on the low-elevation fringe of a pond or other water body, or in an area where groundwater discharges.



Wetland Hydrology Indicators



D2 – Geomorphic position

Cautions and User Notes:

- ✓ **Does not include concave positions on rapidly permeable soils that lack wetland hydrology unless the water table is near the surface**

Chapter 5: Difficult Wetland Situations

Wetlands that Periodically Lack Indicators of Wetland Hydrology

Agricultural Lands

Supplements adopt state mapping conventions approach – no change to current practice

Wetlands Lacking Hydrology Indicators

- ✓ **Much of the Midwest region is characterized by long summer dry seasons; during which surface water evaporates, water tables drop, and many wetlands dry out completely.**
- ✓ **Long-term patterns or multi-year droughts often result in wetlands not becoming inundated or saturated in a given year, and some wetlands may not inundate or saturate for several years in a row.**

Wetlands Lacking Hydrology Indicators

- ✓ **Evaluation of wetland hydrology requires special care on a site where indicators of hydrophytic vegetation and hydric soils are present but hydrology indicators appear to be absent.**
- ✓ **Wetland hydrology evaluations should consider timing of the site visit in relation to normal seasonal and annual hydrologic variability, and whether the amount of rainfall prior to the site visit has been "normal".**

Wetlands Lacking Hydrology Indicators

- **Procedure**
  - **Verify that indicators of hydrophytic vegetation and hydric soil are present;**
  - **Verify that the site is in a geomorphic position where wetlands are likely to occur; then**
  - **Use one or more identified approaches to determine whether wetland hydrology is present and the site is a wetland.**

Wetlands Lacking Hydrology Indicators

- ✓ **Site visits during the dry season:**

  If a visit occurs during the dry season on a site that contains hydric soils and hydrophytic vegetation and no evidence of hydrologic manipulation (e.g., no drainage ditches, dams, levees, water diversions, etc.), then consider the hydrology criterion to be met.

Wetlands Lacking Hydrology Indicators

- ✓ **Periods with below normal rainfall:**

  Determine whether the amount of rainfall in the 2-3 months preceding the visit was normal, above normal, or below normal (use WETS tables or Wetland Delineation Precipitation Data Retrieval from a Gridded Database). If precipitation was below normal prior to the visit on a site that contains hydric soils and hydrophytic vegetation and no evidence of hydrologic manipulation, then consider the hydrology criterion to be met.

Wetlands Lacking Hydrology Indicators

- ✓ **Drought Years:**

  Determine whether the area has been subject to drought (using WETS tables or drought indices). If wetland hydrology indicators appear to be absent on a site that has hydrophytic vegetation and hydric soils, there is no evidence of hydrologic manipulation, and the region has been affected by drought, then consider the hydrology criterion to be met.

Wetlands Lacking Hydrology Indicators

- ✓ **Reference Sites:**

  If indicators of hydric soil and hydrophytic vegetation are present on a site that lacks hydrology indicators, the site may be considered wetland if the landscape setting, topography, soils, and vegetation are substantially the same as those on a nearby wetland reference area. Wetland reference areas should have documented hydrology established through long-term monitoring or by repeated direct hydrologic observations and the data kept on file in the District or field office of the Corps of Engineers.

Wetlands Lacking Hydrology Indicators

✓ Hydrology Tools:

The "Hydrology Tools" (USDA Natural Resources Conservation Service 1997) is a collection of methods that can be used to determine whether wetland hydrology is present on a potential wetland site that lacks indicators due to disturbance or other reasons, particularly on lands used for agriculture. A hydrologist may be needed to help select and carry out the proper analysis.

Wetlands Lacking Hydrology Indicators

✓ Hydrology Tools:

- ✓ Stream and lake gauge data;
- ✓ Estimates of runoff volumes;
- ✓ Frequency of wet signatures on air photos;
- ✓ Model water-table using DRAINMOD;
- ✓ Estimate scope and effect of ditches or tile;
- ✓ Use NRCS drainage guides; or
- ✓ Analyze data from groundwater monitoring wells *(replaces paragraph 48, Table 5, and user notes in 87 Manual)*.

Wetlands Lacking Hydrology Indicators

- ✓ **Evaluating multiple years of aerial photography:**

  Use NRCS mapping conventions on five or more years of growing season photos. Assess the site for wetness signatures on photos taken in normal rainfall years, or an equal number of wetter-than-normal and drier-than-normal years. If wetness signatures are observed on photos in more than half of the years included in the analysis, then wetland hydrology is present.

Wetlands Lacking Hydrology Indicators

✓ Long-term Hydrologic Monitoring:

On sites where the hydrology has been manipulated by man or natural events, direct monitoring of surface and groundwater may be needed. Refer to the Corps of Engineers "Technical Standard for Water Table Monitoring of Potential Wetland Sites" (ERDC TN-WRAP-05-2, 2005). A disturbed or problematic site that has ≥14 consecutive days of inundation or water table ≤12 inches below the soil surface, during the growing season, at a minimum frequency of 5 years in 10 has wetland hydrology.

Wetlands Lacking Hydrology Indicators

- ✓ **Long-term Hydrologic Monitoring:**

  This standard does not:

  1) **Overrule and indicator-based wetland determination on a site that is not disturbed or problematic, or**

  2) **Test or validate existing or proposed wetland indicators.**

Further Information

- **Sprecher, S. W. and Warne, A. G. (2000).** "Accessing and Using Meteorological Data to Evaluate Wetland Hydrology," **ERDC/EL TR-WRAP-00-01, U.S. Army Engineer Research and Development Center, Vicksburg, MS. Online: http://el.erdc.usace.army.mil/elpubs/pdf/wrap00-1/wrap00-1.pdf**

- **Warne, A. G., and Wakeley, J. S. (2000).** "Guidelines for conducting and reporting hydrologic assessments of potential wetland sites," **ERDC TN-WRAP-00-01, U.S. Army Research and Development Center, Vicksburg, MS. Online: http://el.erdc.usace.army.mil/elpubs/pdf/tnwrap00-1.pdf**

- **Sprecher, S. W. (2000).** "Installing Monitoring Wells/Piezometers in Wetlands," **ERDC TN-WRAP-00-02, U.S. Army Research and Development Center, Vicksburg, MS. Online: http://el.erdc.usace.army.mil/wrap/pdf/tnwrap00-2.pdf**

Data Sources on the Web

- ✓ NRCS Web Soil Survey
  - ✓ http://websoilsurvey.nrcs.usda.gov/app/
- ✓ WETS tables (NRCS Water and Climate Center)
  - ✓ http://www.wcc.nrcs.usda.gov/climate/wetlands.html
- ✓ USGS Real-Time Water Data
  - ✓ http://waterdata.usgs.gov/nwis/rt
- ✓ USGS Surface-Water Data for the Nation
  - ✓ http://nwis.waterdata.usgs.gov/nwis/sw

More Data Sources on the Web

- ✓ NOAA - National Climate Data Center
  - ✓ http://www.ncdc.noaa.gov/oa/ncdc.html
- ✓ National Weather Service Forecast Office – Milwaukee/Sullivan. Daily and Monthly Precipitation Data –Yesterday and Back to 2002
  - ✓ http://www.weather.gov/climate/index.php?wfo=mkx
- ✓ Volunteer Weather Observers – Wisconsin. Daily and Monthly Precipitation Data and Archived Data
  - ✓ http://www.soils.wisc.edu/wimnext/opu/opu.html