Module 3: Determining if Under Normal Circumstances the Site Supports the Prevalence of FSA Hydrophytic Vegetation, Hydric Soils, and Hydrology

In this module, the course participant will be presented with the decision-making process used to determine if, under normal circumstances AND normal environmental conditions, a site supports Hydrophytic Vegetation, Hydric Soils, and Hydrology as defined by the FSA. The NFSAM provides a definition of hydrophytic vegetation, hydric soils, and wetland hydrology that must be used for FSA purposes. This definition differs from that used for Clean Water Act purposes.

Developers:

Modified from the National Wetland Phase I Training Course

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Module 3- Determining Under Normal Circumstances if a Site Supports a Prevalence of FSA Hydrophytic Vegetation, Hydric Soils, and Wetland Hydrology.

Objectives

Upon completion of this module, the student will:

- **Understand the FSA definition of hydrophytic vegetation, hydric soils, and wetland hydrology and associated "indicators"**
- **Understand mechanisms plants use to mitigate stressful environments**
- **Understand the different Indicator categories**
- **Become familiar with the US Army Corps of Engineers Manual (COEM) and USDA NRCS websites and other reference material**
- **Become familiar with the different tools and information available to assist in wetland determination**
- **Recognize the difference between the Corps of Engineers 404 Wetland Manual (COEM) and the National Food Security Act Manual (NFSAM)**

Key Concepts

- The frequency and duration of excessive water on a given site can exert significant stress on plants. Many species that normally exist in wetlands have developed physiological and morphological adaptations that allow them to survive in excessively wet environments.
- The *National List of Plant Species That Occur in Wetlands* (Reed 1988) establishes a "wetland status indicator" for most plant species based on the estimated likelihood that species occurs in a wetland.
- Disturbance and changing climatic/hydrologic conditions can make decision making more difficult. The Corps provides recommended solutions to these problems (Problem Area) in their 1987 Manual (Part IV; Sections F and G) and Regional Supplements (Chapter 5).
- For FSA purposes, normal circumstances or NC includes the disturbance-based wetland identification challenges (typical and Atypical sections in Part IV of the COEM) and normal environmental conditions or NEC the climate-based wetland identification challenges (Problem Area section of Part IV of the COEM).
- Regardless of the methods used or the Corps indicators observed, the decision (determination) of a presence or absence of a prevalence of hydrophytic vegetation is ultimately based on the decision of the agency expert.
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This module is designed to take 3 hours and includes required exercises. Links are provided to necessary information and additional learning opportunities.

Learning Concept 3-1: What is Hydrophytic Vegetation?

This Learning Concept is designed to take 15 minutes and includes office exercises. Links are provided as optional learning opportunities.

Starting Time: _____

For purposes of the Food Security Act (FSA) the hydrophytic vegetation definition adopted by Congress (as written in the NFSAM, section 514.5) is:

"A plant growing in (1) water or (2) a substrate that is periodically deficient in oxygen during the growing season because of excessive water content."

For purposes of the Clean Water Act (CWA) the hydrophytic vegetation definition:

"**The sum total of macrophytic plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content. When hydrophytic vegetation comprises a community where indicators of hydric soils and wetland hydrology also occur, the area has wetland vegetation.**"

To view the definition of hydrophytic vegetation in the NFSAM follow this internet link:

http://directives.sc.egov.usda.gov/RollupViewer.aspx?hid=29369

Why is this important to me? The decision is based on the individual (plant) not the species when determining if a plant is a hydrophyte. The CWA definition refers to the assemblage of individual plants "as a plant community." Some plants within the same species "act" as hydrophytes while other individuals don't. Paper birch (*Betula neoalaskana)* occurs primarily on well drained loamy uplands. But, it can also grow in dissected, concave, seasonally saturated landforms (its shallow roots provide an adaptive advantage in both environments). When growing on well drained sites, it is not hydrophytic; however, when growing in water or reduced soils of a depressional site, it is hydrophytic. Few species (other than aquatics) are completely restricted to acting as either hydrophytic or not. The ultimate question is how are they "behaving" on the site in question.

If a black spruce tree is found growing on a well drained soil on a slope of 30% but is never saturated long enough to begin the reduction process (anaerobic), is the black spruce hydrophytic, per the FSA definition of hydrophytic vegetation for the location in question?

Another common misperception is the concept that a plant community can be hydrophytic or not. Only individual plants are hydrophytic - species and communities are not. The mandate in the FSA wetland definition (and in the Corps definition) is a "prevalence of hydrophytic vegetation". We make decisions at the community or sampling unit scale. Are most of the plants in the sampling unit behaving as hydrophytic vegetation (growing in water or growing in a reduced substrate) sometime during the year?

In the next Learning Concept we'll take what we have learned about the FSA hydrophytic vegetation definition and expand these ideas to ecological concepts.

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Learning Concept 3-2: Morphological and Physiological adaptations.

- **Understand mechanisms plants use to mitigate stressful environments.**

This Learning Concept is designed to take 30-45 minutes and includes office exercises. Links are provided as optional learning opportunities.

Plant Adaptation to Stress

Many plant habitats are extreme with respect to one environmental characteristic or another, at least periodically. Factors such as shade, drought, temperature, high water tables, flooding, excess salts or heavy metals, and deficiencies or excesses in nutrients can create stress on a plant's ability to become established, survive, and/or complete its life cycle. The factors listed above are commonly referred to as "stressors". Seldom are individual plants subjected to a single stressor; but rather they must deal with many stressors across various levels of intensity.

Over time the influence of stressors has resulted in some species being more competitive (adaptive) when presented with a particular stressor or suite of stressors and being less competitive in other situations. When presented with two strong stressors (i.e. shade and wetness), a plant that can tolerate **both** stressors simultaneously will have a competitive advantage over a plant that is adapted to only one of the two stressors. This can be easily viewed when visiting a wet sunny herbaceous wetland. These sites will have a completely different herbaceous plant community than what occurs at a wet, shady site.

Hydrophytic plants are considered to be those which are adapted to growing conditions that are saturated or ponded, but sometimes plants that occur in wetlands may be there because of the interaction of several stressors, not just hydrology. The experienced observer must learn to recognize these interactions in order to correctly interpret the data. Usually, it is the suite of species on a site that gives the correct interpretation, not just one or two, especially in the case of highly adaptable non-native species.

When visiting a site, the experienced observer's first observation regarding vegetation is stressors – not species. The experienced observer will ask:

- ✓ How many stressors are there?
- ✓ What are they?
- ✓ How intense are they?
- ✓ What do I know about each species "tolerance" to different stressors?
- ✓ What do I know about how stressors interact to amplify or mitigate their effect on plants?

Those with less experience need to ask the questions too. The problem is that the answers are elusive - they are site and regionally specific and have never been documented in the literature. Only through experience are these insights acquired.

Why is this important to me? Most plant species do not have a simple linear relationship to soil moisture gradient. They are responding to an array of stressors - not just water. Reed's (1988) plant list "predicts" which species commonly occur in wetlands, but agency experts must recognize that it is how individual plants are behaving on the site in question that is most important in the wetland identification process. You will find that, with experience, you will begin to recognize those species that do have a very strong relationship with saturation or ponding (this is why NRCS requires that agency experts are experienced - "demonstrates the proficiency" –in their work area). These species serve as the integral piece of the puzzle (preponderance of evidence).

A site with very few/mild stressors (loamy soils, low salts, free sun, moderate fertility and mild pH) that supports species common to wetlands should be a clue that the vegetation is "telling the hydrology story" very accurately. If the site is cold, shady, very acid or very alkaline, excessively fertile or has low fertility - you might want to ask yourself: Are the species occurring on this site here because of wetland hydrology (or the lack of wetland hydrology), or are they there due to something else? The observer should always be "reading the land" for clues of potential problematic situations (false positives and false negative with regard to Corps indicators).

An example of a **False Positive**:

- An indicator for a plant species on the Alaska Wetland Plant List is met but the agency expert determines that the preponderance of evidence (including best professional judgment or BPJ) suggests that the site would not under normal circumstances support a prevalence of FSA hydrophytic vegetation. The determination was made that the vegetation on the site would not under normal circumstances be growing in water or on a reduced substrate.
- An indicator for hydrology is met (a drift line is present) but the preponderance of evidence suggests that the drift line did not result from a normal flooding or ponding event.

An example of a **False Negative**:

- An indicator for a plant species on the Alaska Wetland Plant List is not met (i.e., vegetation is dominated by FACU indicators), but the agency expert determines that under normal circumstances the site supports indicators of hydric soils and of hydrology.
- A hydric soil indicator (NTCHS) (National Technical Committee for Hydric Soils) is not present but the preponderance of evidence suggests that under normal circumstances the definition would be met. Typical hydric soil indicators are sometimes difficult to observe in soils with high ph (greater than 7.2) which are typical of soils in the Copper Basin.
- Absence of a hydrology indicator but the site is made during a dry portion of the growing season. Other evidence and BPJ suggests that the site would meet the wetland hydrology definition under NC.

The identification of wetlands for the trainee is, by necessity, a step-by-step process. However, for the agency expert, it is a constant series of questions regarding the clues being provided by stressors and individual plant responses to those stressors. In the following discussion topic, we will delve even deeper into how plants deal with growing in water or substrates deficient in oxygen. This relates to the importance of National Policy (NFSAM) placed on the States to establish State Rosters of Agency Experts that limits the list to only experienced staffs who have demonstrated proficiency in applying the FSA Wetland ID Procedures. This is because the federal agencies have been provided great leeway by the courts in the utilization of their technical expertise (technical experts) in decision making. NRCS considers this leeway granted by the federal courts, not as a right, but rather as a responsibility that should not be abused.

Anaerobic Stress Due to the Presence of Water

Plants depend upon a supply of oxygen from their environment to support respiration and various other life-sustaining processes. A plant's access to oxygen is often inhibited by environmental conditions that restrict oxygen to a part or all of the plant (Hook and Crawford, 1978; Jackson, Davies and Lambers, 1991). Saturation and inundation can inflict significant stress on plants by limiting available atmospheric oxygen to plant roots or even the entire plant if totally submerged. Although water contains oxygen, this oxygen does not diffuse as readily into plant tissues as oxygen in the gaseous form. The result is that these excessively wet areas can experience frequent and long-term anaerobic (absence of free oxygen) conditions. Without sufficient oxygen, most plant species are unable to survive for more than a few days or weeks and cannot develop sufficiently to reproduce. At a minimum their growth and reproductive rates are reduced.

Hydrophytes have evolved physiological, reproductive, and morphological features/processes that enable them survive and reproduce in anaerobic conditions produced by periodic or long-term soil saturation and inundation. These can be described below:

Physiological adaptations in plants generally include various special biochemical processes that allow hydrophytes to process and/or store toxic metabolic by-products that accumulate in anaerobic conditions.

Reproductive adaptations include the development of prolonged seed viability, seed germination in low oxygen environments, and flood-tolerant seedlings.

Morphological adaptations are structural modifications that can be readily observed. Such modifications most often provide the plant with increased buoyancy or support and, in some cases, may facilitate the uptake of nutrients and/or gases (particularly oxygen).

Of the three, morphological adaptations can (on occasion) be helpful when identifying wetlands. Not all species occurring in areas having anaerobic soil conditions exhibit morphological adaptations for such conditions. It is helpful for the student to understand what these are. In Alaska many of the morphological adaptations are changes in growth form of certain plants, such as stunting or reduced vigor due to stress. A list of these can be found in the Alaska Supplement on the Alaska SharePoint site (refer to Job Aides):

https://nrcs.sc.egov.usda.gov/west/ak/ecological_sciences/

Below are some of the more commonly viewed morphological adaptations to anaerobic soil conditions that occur nationwide:

1. Buttressed tree trunks (Photo 1) and Multi-trunked trees. An example of species exhibiting multiple characteristics is Paper birch (*Betula neoalaskana*) in Alaska. In wet conditions it tends to be stunted, have multiple trunks, has an "apple tree"-like growth form, is reduced in size, and many times have a rotten core in the tree trunk. Tree species commonly develop enlarged trunks at or just above the ground in response to frequent inundation. In Alaska, White spruce (*Picea glauca)* and Paper birch (*Betula neoalaskana)* can form buttressed tree trunks when growing in seasonally saturated conditions.

2. Pneumatophores (Photo 2). These are modified roots and may serve as respiratory organs in species subjected to frequent inundation or soil saturation. Cypress knees are classic examples, but other species may also develop pneumatophores.

3. Adventitious roots (Photo 3). Sometimes referred to as "water roots," adventitious roots occur on plant stems in positions where roots normally are not found. These may appear as small fibrous roots protruding from the base of trees or roots on stems of herbaceous plants and tree seedlings in

positions immediately above the soil surface. Such features usually develop during periods of prolonged soil saturation sufficient to destroy most of the root system.

4. Shallow root systems. When soils are inundated or saturated for long periods during the growing season and anaerobic conditions develop, most species with deep root systems cannot survive. Consequently, most species capable of growth during periods when soils are oxygenated only near the surface have shallow root systems. In forested wetlands, wind thrown trees (Photo 4) are often indicative of shallow root systems. However, remember that shallow root systems can also be the result of shallow soils or permafrost, where the roots cannot penetrate more deeply. Black spruce (*Picea mariana*) in cold and wet environs have shallow root systems.

5. Inflated leaves, stems, or roots (Photo 5). Many hydrophytic species have or develop spongy tissues (aerenchyma) in leaves, stems, and/or roots that provide buoyancy or support and serve as a reservoir or passageway for oxygen.

6. Polymorphic leaves (Photo 6). Some herbaceous species produce different types or shapes of leaves, depending on the water level at the time of leaf formation. For example, water plantains produce broad, floating leaves when totally submerged, but produce strap-shaped leaves when plants are emergent.

7. Floating leaves (Photo 7). Some species produce leaves that are uniquely adapted for floating on a water surface. These leaves have stomata (pores) primarily on the upper surface and a thick waxy cuticle that restricts water penetration.

8. Floating stems (Photo 8). A number of species (e.g., alligator weed) produce matted stems that have large internal air spaces when occurring in inundated areas. Such species root in shallow water and grow across the water surface into deeper areas. Species with floating stems often produce adventitious roots at leaf nodes.

Photo 1. Buttressing of tree trunks and multi-trunks in Paper Birch.

Photo 2. Pneumatophores of Cypress trees (Cypress knees).

Photo 3. Adventitious roots.

Photo 4. Wind thrown tree showing shallow root system.

Photo 5. Inflated leaves.

Photo 6. Polymorphic leaves.

Photo 7. Floating leaves.

Photo 8. Floating stems.

Name a single wetland species that occurs in your area of which you are familar with and its morphological adaptation. Those less experienced may need to search the internet or obtain assistance from an individual with more experience with plants of the area.

Why is this important to me? Morphological adaptations can provide visual cues to observers on a site's normal hydro patterns. Some adaptations are common to ponded situations only, while others are more or less common in saturated situations. Observers should be aware that not all species occurring in areas subject to periodic anaerobic conditions exhibit morphological adaptations. Many plant species found in non-wetlands also exhibit some of these features. For example, many non-wetland species exhibit polymorphic leaves, lenticels on stems, or multiple stemmed trunks. In addition, not all adventitious roots develop as a result of inundation or soil saturation. Aerial roots on woody vines are very common and are not normally produced as a response to inundation or soil saturation. *NOTE: Knowledge and skills are acquired by making repeated site visits during different seasons and different conditions over many years. Training alone is not a substitute for "getting one's feet wet".*

By now you should have a sound foundation regarding what is meant by hydrophytic vegetation for Food Security Act purposes and how plants are in a constant fight for survival against other plants that may (or may not) have an adaptive advantage to the same stressors.

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Learning Concept 3-3: Wetland Plant Indicators and Categories

- **Understand the different Indicator categories**
- **Become familiar with the US Army Corps of Engineers and USDA NRCS websites and other reference material**

This Learning Concept is designed to take 30-45 minutes and includes office exercises. Links are provided as optional learning opportunities.

Hydrophytic vegetation is the community of macrophytes that occurs in areas where saturation or inundation is either permanent or of sufficient frequency and duration to exert a controlling influence on the plant species present. The examples of the morphological and physiological adaptations describe some of the ways plants have adapted to a wet environment. In order to ensure that all those working in the field of wetland identification in a region were using the same interpretations of plant adaptations, the National Wetland Plant List was developed and adopted in 1988.

The National Indicators reflect the range of estimated probabilities (expressed as a frequency of occurrence) of a species occurring in wetlands versus non-wetlands across the entire distribution of the species.

The National Wetland Plant List (NWPL) is the document that lists the official Indicator Status for species known to occur in or near wetlands. The NWPL has been a cooperative effort of the Army Corps of Engineers (Corps), the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the Natural Resources Conservation Service. The Wetland Plant Lists are available from the Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL).

To access the plant list go to: **http://wetland_plants.usace.army.mil**

1. From the NWPL home page, left frame select 2012 States/US Territories
2. Select either the XLS or the PDF for Alaska.
3. You can save to your computer and sort as needed.
4. You can also search for a species

Prior to the update, wetland plant species were rated using five categories (see table below) based on percentages representing the frequency that a species occurs in a wetland. The updated plant list uses the same five categories but they are now defined based on qualitative ecological descriptions. Quantitative frequency categories are now used only for field-based studies designed to challenge a species' wetland rating. The National Wetland Plant List Indicator Rating Definitions (ERDC/CRREL TN-12-1 July 2012) Technical Note (refer to References on the Share Point Site) presents the new definitions for the five wetland plant categories. A long version is intended to standardize the groups using wetland features to define the groups, and a short version is intended to be easy to use for everyday purposes. The following tables were used to describe indicator definitions and Region descriptions for the 1988 list.

Indicator categories

Indicator Code	Wetland Type	Description
OBL	Obligate Wetland	Occurs almost always (estimated probability 99%) under natural conditions in wetlands.
FACW	Facultative Wetland	Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
FACU	Facultative Upland	Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).
UPL	Obligate Upland	Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List.
NA	No agreement	The regional panel was not able to reach a unanimous decision on this species.
NI	No indicator	Insufficient information was available to determine an indicator status.
NO	No occurrence	The species does not occur in that region.

National Indicators reflect the range of estimated probabilities (expressed as a frequency of occurrence) of a species occurring in wetlands versus non-wetland across the entire distribution of the species. A frequency, for example, of 67%-99% (Facultative Wetland) means that 67%-99% of sample plots containing the species randomly selected across the range of the species would be wetland. When two indicators are given, they reflect the range from the lowest to the highest frequency of occurrence in wetlands across the regions in which the species is found. A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher (wetter) end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands). A question mark (?) following a National Indicator denotes a tentative assignment based on the botanical literature and not confirmed by regional review. *The definitions of these indicators have been updated with the National List of Plant Species is revised. The NA, NI and NO are no longer used in the updated lists.*

Regional Indicators express the estimated probability (likelihood) of a species occurring in wetlands versus non-wetlands in the region. Regional Indicators reflect the unanimous agreement of the Regional Interagency Review Panel. An asterisk (*) following a regional Indicator identifies tentative assignments based on limited information from which to determine the indicator status.

The wetland indicator categories should not be equated to degrees of wetness. Many obligate wetland species occur in permanently or semi-permanently flooded wetlands, but a number of obligates also occur in and some are restricted to wetlands which are only temporarily or seasonally flooded. The facultative upland species include a diverse collection of plants, which range from weedy species adapted to exist in a number of environmentally stressful or disturbed sites (including wetlands), to species in which a portion of the gene pool (an ecotype) always occurs in wetlands. Both the weedy and ecotype representatives of the facultative upland category occur in seasonally and semi-permanently flooded wetlands.

Regions

The codes, their corresponding regions, and states in each region are:

Code	Region	Geographic areas in region
1	Northeast	CT, DE, KY, MA, MD, ME, NH, NJ, NY, OH, PA, RI, VA, VT, WV
2	Southeast	AL, AR, FL, GA, LA, MS, NC, SC, TN
3	North Central	IA, IL, IN, MI, MN, MO, WI
4	North Plains	MT (Eastern), ND, SD, WY (Eastern)
5	Central Plains	CO (Eastern), NE, KS
6	South Plains	OK, TX
7	Southwest	AZ, NM
8	Intermountain	CO (Western), NV, UT
9	Northwest	ID, OR, MT (Western), WA, WY (Western)
0	California	CA
A	Alaska	AK
C	Caribbean	PR (Puerto Rico), VI (U.S. Virgin Islands)
H	Hawaii	HI (Hawaiian Islands), AS (American Samoa), FM (Federated States of Micronesia), GU (Guam), MH (Marshal Islands), MP (Northern Mariana Islands), PW (Palau), UM (U.S. Minor Outlying Islands)

Bryophytes

Although the use of bryophytes has not been recommended in federal delineation procedures, two regional supplements to the *Corps of Engineers Wetlands Delineation Manual* permit the use of some nonvascular plants in specific circumstances. In both cases, soils and hydrology must first indicate wetland conditions. The *Interim Regional Supplement for the Western Mountains, Valleys, and Coast Region* proposes the use of specific bryophyte indicator species for delineations in areas dominated by *Tsuga heterophylla* (USACE 2008a). In Alaska, certain bryophyte species may be used as vegetation indicators when vascular vegetation has been greatly disturbed or entirely removed and in landscapes dominated by *Picea mariana (USACE 2008c).* Both regional supplements require sampling the bryophyte layer using at least three 25- × 25-cm plots, placed at hummock bases. If more than 50% of the total bryophyte cover consists of bryophytes designated as "wetland specialists," the vegetative criterion has been met.

In Alaska, bryophytes are used in Chapter 5 of the Supplement "Difficult Wetland Situations" primarily in Black Spruce forests. For more information about bryophytes in wetland determinations, see *The Use of Bryophytes as Indicators of Hydric Soils and Wetland Hydrology during Wetland Delineations in the United States* USACE ERDC/CRREL TR-10-9, 2010 which is located on the Alaska Ecological Sciences SharePoint Site:

https://nrcs.sc.egov.usda.gov/west/ak/ecological_sciences/

Plant Identification

Floras (plant identification keys) are available across the U.S. Generally, they are regional, and cover an area of similar climate and topography. A good plant identification book is essential for accurate plant data collection. A list of references can be found on the Alaska Ecological Sciences SharePoint site and many identification guides are now available electronically. An excellent link listing resources by state is located at:

http://plants.usda.gov/

The USDA NRCS Plants Database provides the user to enter a specific plant species to see what the wetland indicator status is or can show all the plants within a State.

Guides are also available at almost all bookstores and many libraries. A list of guide books is located on the Alaska SharePoint Site. It is recommended that all field office planners be familiar in the common plants in their Service Areas.

From the Alaska Wetland Plant List, what indicator is Black spruce? What indicator is Green Alder?

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Learning Concept 3-4: Wetland Identification for FSA Hydric Soils

- **Understand the FSA definition of a hydric soil**
- **Become familiar with direct evidence of hydric soils**
- **Understand the use of indictors for hydric soils**
- **Become familiar with some of the tools that guide decisions**

This Learning Concept is designed to take 30-45 minutes and includes office exercises. Links are provided as optional learning opportunities.

According to the FSA the definition of hydric soil is:

"**A soil that, in its undrained condition, is saturated, flooded, or ponded long enough during a growing season to develop an anaerobic condition that supports the growth and regeneration of hydrophytic vegetation" (16 U.S.C. 3801 (a) (12).**"

It is interesting to note that the definition of hydric soil is the same for the FSA and the COEM but differs slightly from the definition in the COE Supplements and the Field Indicators of Hydric Soils in the United States. For more information about Hydric Soils go to: http://soils.usda.gov/use/hydric/

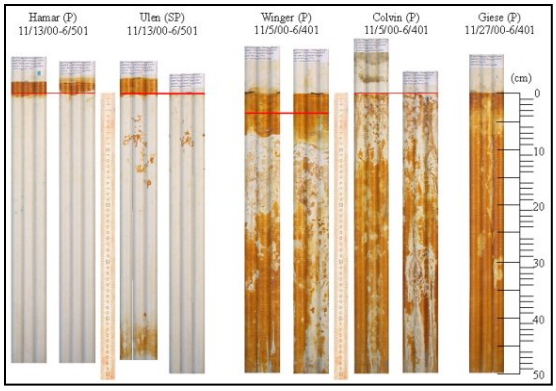
Direct Evidence vs. Indicators

Direct evidence would be eyewitness accounts, video(s) or pictures of something that once existed or some piece of evidence that irrefutably proves that something happened. For example, look at the pictures below:

Photo 1. The picture above left was taken in 1955. Photo 2. The picture on the right is the same location but taken in 2008. The picture on the right has been filled and farmed. The above pictures can be used as direct evidence.

Another example of direct evidence is the use of IRIS Tubes which can be used to monitor reduced conditions in Soils. (Photo 3). The soil microbes "eat" the iron oxide "paint" from the tubes at the level in which anaerobic

activity is present. In Alaska, the IRIS tubes do work on moderately reduced soils but it is a qualitative measurement (the estimate of the loss of iron paint from the tube is a qualitative estimate not quantitative). The MRIS tubes use manganese and respond at higher redox potentials (less reducing conditions) and therefore should be a better indicator of reduction. Unfortunately, there is not much data on these tubes in Alaska other than what the UAF Experiment Station has done in the upper Susitna Valley and Adak.



Other examples of direct evidence and observation of hydric soils:

- Alpha-alpha dipyridyl – note that some soils may be completely saturated and give a "false negative" reaction and using metal sampling tools can contaminate the soil samples and give a "false positive" reaction
- Data logging equipment piezometers and water-table wells or platinum electrodes

Indicators that are used for identifying hydric soils for both FSA and COE (Corps of Engineers) are the "Field Indicators of Hydric Soils Indicators, Version 7.0" (or any subsequent version)(NTCHS). *Note: The Field Guide is on the Ecological Sciences share point site under references.*

Just because a soil may not meet a Field Indicator of Hydric soil it does not mean that it is not a hydric soil. Chemistry of certain types of soils may inhibit the formation of redox features, organic matter may mask the expression redox features, or sandy soils may lack the organic matter or iron necessary to support the formation of redox features. If this is the case then these soils fall under Chapter 5 of the Alaska Regional Supplement as a Problem Soil (refer to the Alaska Supplement on the Alaska SharePoint Site).

Name a situation in Alaska where a hydric soil indicator(s) could be considered a Problem Soil. Where do you find this information?

Indicators are used to document evidence of a hydric soil during periods that are not normal circumstances. Agency experts utilize Chapter 3 of the COE Regional Supplements to make the determination of a predominance of hydric soils with the following FSA variances:

- If soil mapping and hydric soil lists are used, the criteria in 7 C.F.R. 12.31 (a)(2) will be followed:

- NRCS shall determine whether a sampling unit has a predominance of hydric soils that are inundated or saturated as follows:
  - If a soil map unit has hydric soil as all or part of its name, that soil map unit or portion of the map unit related to the hydric soil shall be determined to have a predominance of hydric soils; (i.e. consociations, complexes, undifferentiated groups, or associations)
  - If a soil map unit contains inclusions of hydric soils, that portion of the soil map unit identified as hydric soil shall be determined to have a predominance of hydric soils

The Official Source of the Hydric Soils List is located in the FOTG, Chapter II.

Web Soil Survey is a tool that a landowner or agency personnel can use to locate hydric soil ratings for a location of interest. Once the "Area of Interest" (AOI) is selected and located, the user can go to the Soil Data Explorer tab and select the Suitability's and Limitations for Use. Under this tab, the Hydric Rating by Map Unit can be found under Land Classification. The map can show soil ratings by: all hydric, partially hydric, not hydric, unknown, or not rated. The link for Web Soil Survey is at:

http://websoilsurvey.nrcs.usda.gov/app/

To meet the Hydric Soil Diagnostic Factor, according to FSA, under normal circumstances (NC), the site supports a predominance of "soil that, in its **undrained** condition, is saturated, flooded, or ponded long enough during a growing season to develop an anaerobic condition that supports the growth and regeneration of hydrophytic vegetation." When conducting a wetland determination, the first step is to look first at your indicators for Off-site and On-site and to remember that the soil must be in the undrained condition (the site must be saturated, flooded, or ponded long enough to develop anaerobic conditions).

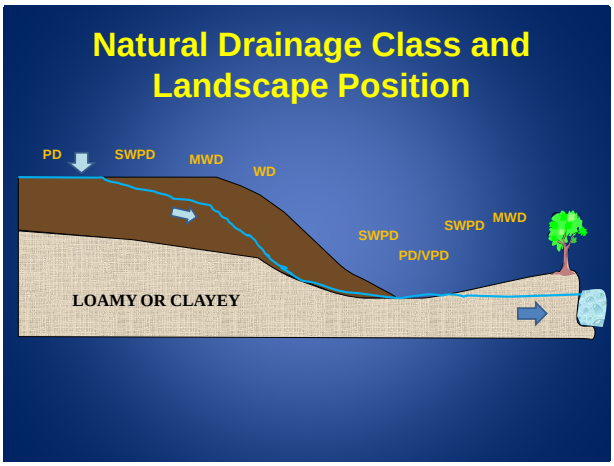
Go to the web soil survey link above. Create an AOI in your area. Then go to the Suitabilities and Limitations for Use Tab. Click on Land Classifications down arrow button (to get the choice box) and select the Hydric Rating by Map Unit. Click the View Rating button. Then Click on the Legend tab (on the upper corner of the Map) to get the Map Legend. What are the hydric soil ratings? Would this map be considered direct evidence of hydric soils present? Why not? (go to Page 23, NFSAM Appendix). Where does the field office planner get a soils map and associated hydric soil ratings? Go into toolkit and pull in the "One Big Wetland" layer into a plan.

Soil Properties

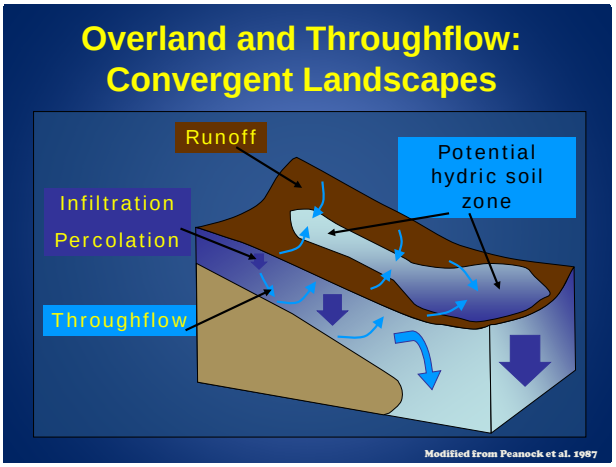
Soil and site properties such as landscape position and slope shape are important features to assist the wetland expert in understanding hydric soil indicators. Soils will form differently on Mountain Summits compared to soils formed on Floodplains. Soils on mountain summits can be well developed while soils on floodplains are weakly developed. A well developed soil profile usually consists of an A, B, C and R horizons while a weakly developed soil profile can consist of an A and C horizon. Photo 4 is a picture of a floodplain. Floodplain soils have different properties and characteristics in comparison to soils that are found on mountain tops.

Natural Drainage Class and Landscape Positions

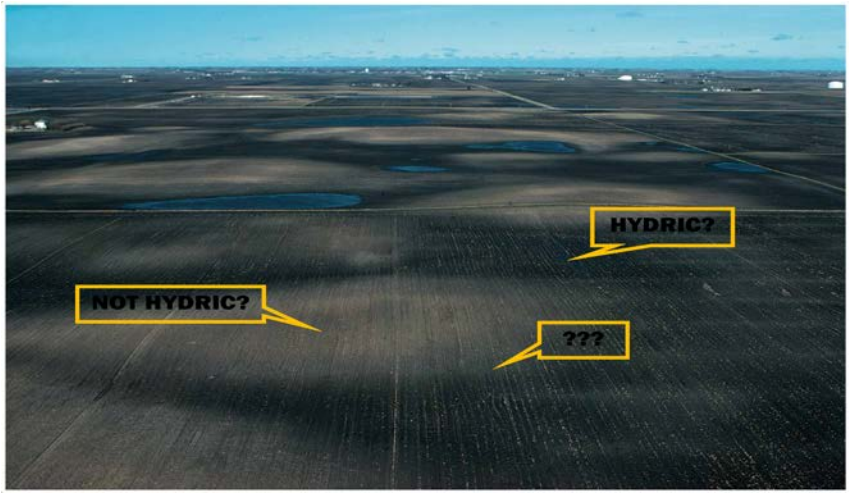
It is also important to understand some "soil lingo" in terms of drainage classes. A PD is a poorly drained soil, SWPD is a somewhat poorly drained soil, and WD is? You guessed it; well drained soil. The following diagram (Photo 5) helps display the general relationship between landscape (general, broad term compared to landform) and drainage patterns. Where are the poorly drained soils located? Why?



How water flows through a system and the type of soils (well drained gravels or poorly drained organic soils) can assist the wetland expert in understanding where hydric soils may occur in the landscape (Photo 6):



After looking at the picture below (photo 7), where do you think the hydric soils might occur? Why? What other remote resource data elements could help in this?



Hydric Soil Documentation

First, every office should have at least one little blue book called the "Munsell Soil Color Chart". It is recommended for this next section to grab this book. If you do not have one, order one! Go to the Alaska SharePoint site for a recommended equipment list for conducting wetlands.

Go to the Alaska Supplement and take a look at the data collection section for Soils. For hydric soils field documentation includes looking at:

- Depth by layer or horizon
- Colors of the Matrix
- Redoximorphic features
  - Color
  - Amount
  - Type
  - Location
- Texture

Optimum soil conditions for reading soil colors in Alaska can be challenging. Moist soil colors are critical. All hydric indictors and color guidelines refer to moist colors (this is usually not a problem). Below is a picture of a soil color chart and a soil sample being held up to a color chip (photo 8):

Color patterns in soils include the Matrix Color or Dominant color and also redoximorphic "redox" features which include splotches or mottles of color different than the matrix color. Redox concentrations refer to an increase of color (red) (Photo 9, left) and Redox depletion refers to a depletion of color (gray) (Photo 9, right):

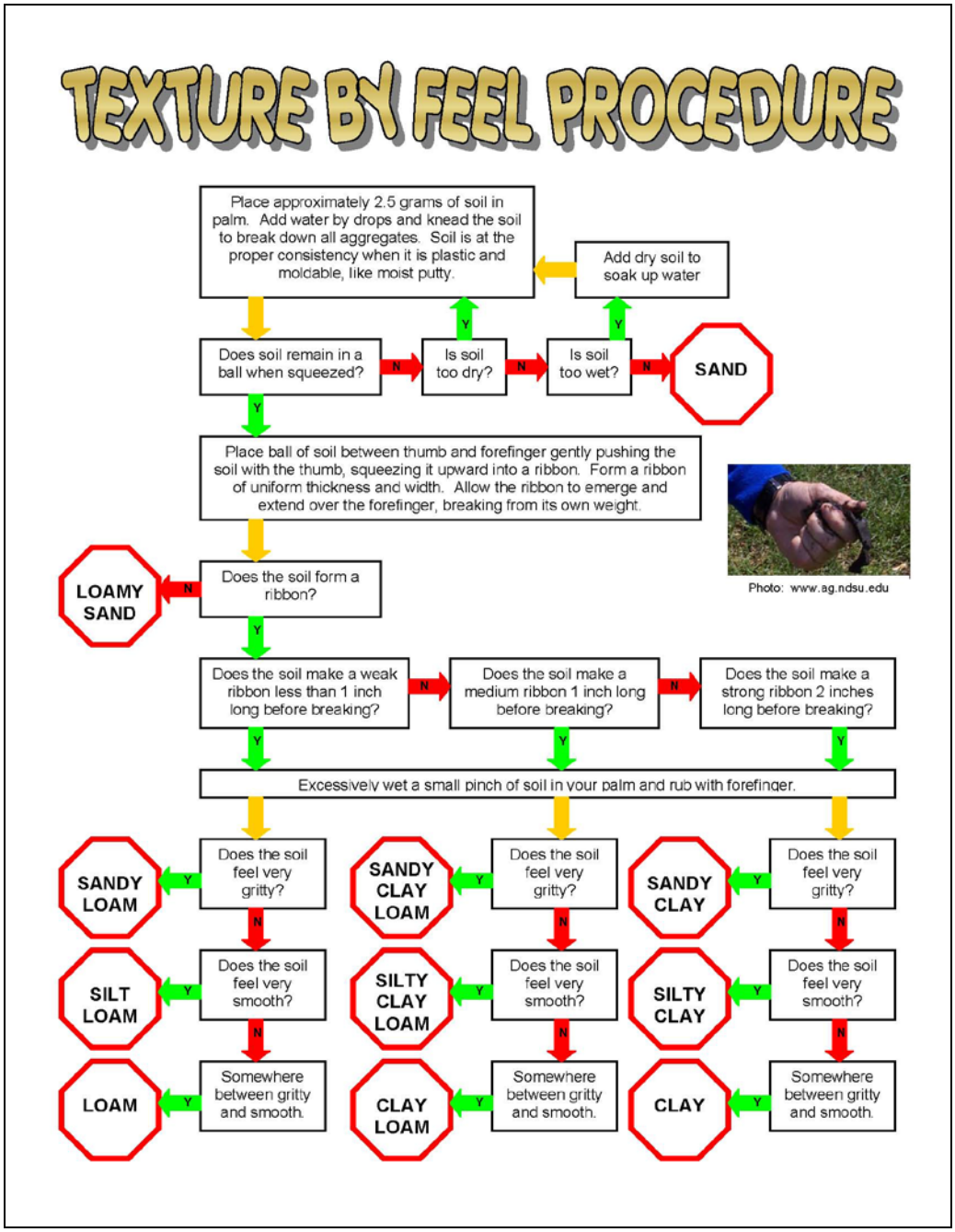
A complete description of soil color patterns should include percentages of different colors, what those colors are, and where are they located. Refer to the Alaska Supplement for more information on redox features.

The contrast of features is basically the degree of visual distinction between associated colors. For hydric soil determinations, mottles should be either distinct or prominent. Faint mottles don't really mean much:

- Faint are only evident on close examination
- Distinct are readily seen
- Prominent contrasts strongly

Charts for estimating abundance of features range from few (less than 2%), common (2-20%), and many (more than 20%) can be found in the Munsell book. Some indicators require different abundance thresholds.

How many times have you been in the field with a soil scientist and watched them pluck a soil sample and roll it between their fingers? The reason for this is to confirm the texture of a soil. Texture is important so the wetland expert can tell the difference between whether or not a soil is sandy (S) or loamy (F) for example. Determination of texture is a field determination and can vary by individual and also by mineralogy. The following diagram can be printed as a single page and may be helpful in the field. It is also located on the Alaska SharePoint Site:



Texture by Feel diagram.

The term Soil Horizon or layers are important diagnostic features in a soil profile. The following are general guidance for determining soil horizons:

- **A horizons** are the first layer of mineral soil and referred to as the top of the soil. They are typically darker in color than the soil layers below due to higher organic matter
- **E horizons** are a zone of eluviations and are much lighter in color than the horizon above due to removal of iron minerals and organic matter. They have high value/low chroma and also may have Eg (gleyed with redox features
- **B horizons** are a zone of illuviation and mineral change either by color or structure

Refer to the Alaska Supplement and review the hydric soil indicators.

Learning Concept 3-5: Wetland Identification for FSA Hydrology

- **Understand the FSA definition of hydrology**
- **Become familiar with direct evidence of hydrology**
- **Understand the use of indictors for hydrology**
- **Become familiar with some of the tools that guide decisions**

This Learning Concept is designed to take 30-45 minutes and includes office exercises. Links are provided as optional learning opportunities.

Wetland hydrology is defined as inundation or saturation by surface or groundwater at a frequency and duration sufficient to support a **prevalence of hydrophytic vegetation** typically adapted for life in saturated soil conditions (NFSAM, 514.6). However, if you try to find a "statutory" definition, the FSA basically states that "hydrology and wetland hydrology are not explicitly defined in Statute or Regulation. There is an inference in 12.6 (c) 7 that states "An On-site determination … will be made…when site conditions are favorable for the evaluation of …hydrology…"

Based on this inference of the current rule that wetland hydrology should be considered as a diagnostic factor in the 1985 FSA wetland identification process, NRCS has adopted the concepts in Chapter 4 – Wetland Hydrology Indicators of the Supplements.

It is important that the agency expert confirms that under normal circumstances and normal environmental conditions wetland hydrology is still present prior to rendering a FSA 1985 wetland identification decision. So basically we need to be looking for indicators or evidence of the "wetland hydrology" using the Hydrology Indicators in Chapter 4 of the Regional Supplement.

Direct evidence are observations of conditions under NC and NEC and indirect evidence or indicators "indicate" what the site condition would be under NC and NEC. Direct observation or evidence is not always possible so we are relying on the indicators (sometimes referred to circumstantial evidence) to demonstrate that wetland hydrology exists on the site. It might sound crazy but observation of hydrology or "wetland hydrology" is very difficult. The indicators are divided into four groups differentiated by Observation and Evidence.

The Alaska Regional Supplement (AES) can be found at the following sites:

http://www.poa.usace.army.mil/

http://www.poa.usace.army.mil/Missions/Regulatory.aspx

https://nrcs.sc.egov.usda.gov/west/ak/ecological_sciences/

In Chapter 4, find the table titled "List of Wetland Hydrology Indicators" . Look at the Groups A-D to understand that Group A indicators for hydrology would be considered direct observation under FSA (if observed during the wet portion of the growing season of a normal climatic year and without recent (post-1985) alteration to the hydrology). If observed outside of the NC and NEC, observation of water (flooding, ponding, or saturation) would be an indicator as the water observed does not directly demonstrate that the FSA wetland hydrology definition would be met during NC.

Off-site wetland hydrology indicators can include both Primary and Secondary. In the imagery below (photo 1) inundation is considered a primary (dark color) indicator but saturation may or may not be primary.

Variances or differences between the COE hydrology indicators and FSA are:

- Hydrology Tools for Wetland Determinations such as those in the NEH, Chapt. 19, part 650 can be used as primary indicators
- Wetland hydrology can be verified directly if the site is conducted under NC and NEC

The difference between CWA and FSA is in the consideration of indicators and evidence:

- For determining the CWA Hydrology Factor, the indicators are the ONLY consideration
  - If you meet the hydrology indicators then you confirm wetland hydrology
- For determining the FSA Hydrology Factor, the indicators are ONLY ONE consideration
  - If you meet the hydrology indicators then you confirm wetland hydrology AND
  - You must also consider remote data sources, professional judgment, and the FSA Concept of wetland hydrology

The presence of the COE indicators is suggestive that the diagnostic factor of wetland hydrology has been met. However, the absence of the COE indicators also suggests that the diagnostic factor of wetland hydrology has **not** been met. This can result in the possibility of "false positives" (left) (Photo 2) and "false negatives" (right) (Photo 3). The photo on the left is taken outside of the growing season. The photo on the right is taken during the growing season.

What questions should you be asking if you were evaluating the site in Photo 2 and 3?

Stop Time: _____

Notes:

_____

_____

_____

_____

Congratulations! You have finished with Module 3. Proceed to Module 4.