US Army Corps
of Engineers

DRAFT TRAINING PACKAGE
WETLAND DELINEATOR CERTIFICATION PROGRAM
1993

FOR
WETLAND DELINEATOR CERTIFICATION PROGRAM
HEADQUARTERS, U.S. ARMY CORPS OF ENGINEERS
REGULATORY BRANCH, WASHINGTON, DC

PREPARED BY:
WETLAND RESEARCH AND TECHNOLOGY CENTER
ENVIRONMENTAL LABORATORY, EP-W
U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION
3909 HALLS FERRY ROAD, VICKSBURG, MS 39180-6199
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DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
3909 HALLS FERRY ROAD
VICKSBURG, MISSISSIPPI 39180-6199

April 29, 1993

REPLY TO
ATTENTION OF

Environmental Laboratory

SUBJECT: Wetland Delineator Certification Program Training Package, Public Notice, and List of Trainers

Please find enclosed the 1993 draft training package for the Wetland Delineator Certification Program (WDCP) which you requested. Also enclosed is a copy of the public notice (Federal Register Vol. 58, No. 72/ Friday, April 16, 1993) which discusses this package.

This package has been developed for those who intend to provide wetland delineator training. Additionally, the U.S. Army Corps of Engineers intends to provide a list of potential sources for this training. This list will be provided to Corps districts nationwide for dissemination to the public. If you wish to be included on this list, please write to the Wetlands Research and Technology Center at the above address.

WDCP trainers must provide students with a "Certificate of Training" signed by responsible instructors to include at a minimum, the following language:

> "This training has been based in part on the U.S. Army Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1 (1987 Manual), as provided for in the training materials developed in conjunction with Section 307(e) of the Water Resources Development Act of 1990 for the Wetland Delineator Certification Program."

Students must attach a copy of this certificate to their application to the Corps for wetlands delineator certification as of March 1994.

Sincerely,

Russell Theriot

Russell F. Theriot, PhD
Director, Wetlands Research
and Technology Center

HYDRAULICS LABORATORY   GEOTECHNICAL LABORATORY   STRUCTURES LABORATORY   ENVIRONMENTAL LABORATORY   COASTAL ENGINEERING RESEARCH CENTER   INFORMATION TECHNOLOGY LABORATORY

19806

Department of the Army

Corps of Engineers

Wetland Delineator Certification Program—Training

AGENCY: U.S. Army Corps of Engineers, DoD.

ACTION: Notice.

SUMMARY: The purpose of this notice is to announce the availability of training materials developed in conjunction with the Corps Wetland Delineator Certification Program (WDCP). The WDCP is being developed in accordance with section 307(e) of the Water Resources Development Act of 1990 (WRDA 90), as previously announced in the Federal Register December 30, 1992 (57 FR 62312). A working draft of the training materials will be available this spring. This package has been developed for those who intend to provide wetland delineation training. The Corps intends to provide a list of potential sources for this training to individuals who wish to receive wetland delineation training for the WDCP. If you want to be on this list of wetland delineation training sources, contact the Wetlands Research and Technology Center of the Corps Waterways Experiment Station (WES). This list will be provided to Corps districts nationwide for dissemination to the public.

FOR FURTHER INFORMATION CONTACT: To request a copy of the draft training materials, and/or to be included on the list of trainers of this material, contact the WES, Wetlands Research and Technology Center, 3909 Halls Ferry Road, Vicksburg, Mississippi 39180–6199, (601) 634–4217, FAX: (601) 634–3664. For information on the WDCP, contact Ms. Karen Kochenbach, Office of the Chief of Engineers, Attn: CECW–OR, 20 Massachusetts Avenue NW., Washington, DC 20314–1000, (202) 272–0199.

SUPPLEMENTARY INFORMATION: Section 307(e) of WRDA 90 authorizes the Secretary of the Army to establish a program for the training and certification of individuals as wetland delineators, and to carry out demonstration projects in districts of the Corps. The WDCP demonstration projects began March 1, 1993, in the States of Washington, Maryland, and Florida, administered by the Seattle, Baltimore, and Jacksonville Districts, respectively. For information on the demonstration project in the State of Washington, contact the U.S. Army Corps of Engineers, Seattle District, ATTN: CENPS–EN–PL–ER, P.O. Box 3755, Seattle, WA 98124–2255, or call Ms. Kathy Kunz, (206) 764–3624; in Maryland, contact the U.S. Army Corps of Engineers, Baltimore District, ATTN: CENAB–OP–RX, P.O. Box 1715, Baltimore, MD 21203–1715, or call Mrs. Deborah Nizer, (410) 962–1843; in Florida, contact the U.S. Army Corps of Engineers, Jacksonville District, ATTN: CESAJ–RD, P.O. Box 4970, Jacksonville, FL 32232–0019, or call Mr. Ron Silver, (904) 232–2502. Nationwide implementation of the final WDCP is anticipated to begin in March of 1994, at which time the demonstration projects will end. The Corps intends to issue a proposed rule on the WDCP prior to nationwide implementation.

Corps certification of wetland delineators indicates that an individual has successfully demonstrated the capability to perform satisfactory wetland delineations, consistent with the 1987 Corps of Engineers Wetland Delineation Manual (Waterways Experiment Station Technical Report Y–87–1, January, 1987) (1987 Manual) and supplemental guidance. Although certification does not guarantee that future delineations submitted to the Corps by certified delineators will be approved, delineations performed by certified delineators will take less time for the Corps to verify. The Corps districts will exercise final decision-making authority regarding acceptance of wetland delineations performed by certified delineators.

Copies of the 1987 Manual are available from the National Technical Information Service, 5285 Port Royal Road, Attn: Order Department, Springfield, Virginia 22171, Document #ADA 176 734. Copies of the supplemental guidance issued by the Corps concerning use of the 1987 Manual, which includes the October 7, 1991, Questions and Answers, and the March 6, 1992, Clarification and Interpretation memoranda, may be obtained by contacting the Regulatory Branch of your local Corps district or the Office of the Chief of Engineers, (202) 272–0199.

Training in the 1987 Manual will be a prerequisite for all WDCP applicants (i.e., individuals who apply to districts to be certified) after the demonstration projects (i.e., March 1994). The prerequisite training, as well as the requirement that all training be conducted with a certified delineator present, is waived during the demonstration phase of the WDCP. Although participation in the demonstration projects is open to all, it is unlikely that individuals lacking training and experience in the 1987 Manual will be able to demonstrate that they meet the minimum standards to be provisionally certified during the demonstration projects.

In order to meet the prerequisite for training in the future, individuals may prepare during the demonstration program by *one of the following* means:

(1) Acquisition of a provisional certification from the Baltimore, Seattle or Jacksonville Districts; or

(2) Obtaining training in Corps 1987 Wetland Delineation Manual based on the Corps training materials. A certification of successful completion of this training will be issued by the training source and required by the Corps.

If you feel you have had appropriate training, it is recommended that you take advantage of the waiver during the demonstration projects and successfully complete WDCP provisional certification. Once the WDCP is implemented nationwide, no exceptions or equivalencies to the training prerequisites, nor requests of that nature, will be accepted.

Approved:

John P. Elmore,

Chief, Operations, Construction and Readiness Division, Directorate of Civil Works.

[FR Doc. 93–8902 Filed 4–15–93; 8:45 am]

BILLING CODE 3710–92–M

~~DEPARTMENT OF ENERGY~~

~~Pittsburgh Energy Technology Center; Noncompetitive Financial Assistance Award~~

~~**AGENCY:** Bartlesville Project Office and the Pittsburgh Energy Technology Center, U.S. Department of Energy.~~

~~**ACTION:** Acceptance of a Determination of Noncompetitive Financial Assistance award with the Society of Petroleum Engineers.~~

~~**SUMMARY:** The Department of Energy (DOE), Bartlesville Project Office announces that pursuant to 10 CFR 600.07(b)(2)(i) criteria (B) and (D), it intends make a noncompetitive financial assistance (grant) award through the Pittsburgh Energy Technology Center to the Society of Petroleum Engineers for a research effort entitled "Colloquim Petroleum Engineering Education."~~

~~**ADDRESSES:** Department of Energy, Pittsburgh Energy Technology Center, Acquisition and Assistance Division, P.O. Box 10940, MS 921–118, Pittsburgh, PA 15236.~~

~~**FOR FURTHER INFORMATION CONTACT:** Cynthia Y. Mitchell, Contract Specialist, (412) 892–4862.~~

Wetland Delineator Certification Program
Authority Section 307(e) Water Resources Development Act 1990
Working Draft Training Package
1993

Summary

1. Section 307 (e) of the Water Resource Development Act of 1990 directs the Secretary of the Army to establish a training and certification program for individuals as wetland delineators. The Wetland Delineator Certification Program (WDCP) began February of 1993 with demonstration projects in three districts of the Corps of Engineers (Corps). The Corps will develop procedures for expediting the consideration and acceptance of wetland delineations performed by certified delineators, and plans to initiate a rulemaking on the WDCP in the fall of 1993. The WDCP is anticipated to be implemented nationwide in March 1994.

2. Corps certification of wetland delineators indicates that an individual has successfully demonstrated the capability to perform satisfactory wetland delineations, consistent with the methodology in use by the Corps at the time, currently the 1987 Corps of Engineers Wetland Delineation Manual (Waterways Experiment Station Technical Report Y-87-1, January, 1987) (1987 Manual) and supplemental guidance. The Corps anticipates continued use of the 1987 Manual for at least two years while the National Academy of Sciences conducts a study contracted by the Environmental Protection Agency. Modifications to the WDCP and training materials will be made consistent with any changes to the Corp's delineation procedures.

3. The enclosed training materials are based on the three-parameter approach to wetland delineation as described in the 1987 Manual. This training package represents the minimum standards provided for in the Corps Prospect training course "Regulatory IV Interagency Wetland Delineation". The training is intended to introduce an individual to the three parameters (i.e., wetland plants, hydric soils, and wetland hydrology) and the delineation of the limits of areas exhibiting these parameters (i.e., methods). Training, therefore, includes (as a minimum): (1) wetland hydrology, (2) wetland vegetation, (3) hydric soils and general soil taxonomy, and (4) wetland identification and delineation techniques which stress fields indicators and actual boundary determinations.

4. A working draft wetland delineation training package (1993) covering the required topics have been prepared at the U. S. Army Engineers Waterways Experiment Station under the auspices of the Wetland Research and Technology Center (WRTC) (Dr. Russell

Theriot is the Center Director). Copies of the draft documents may be obtained by writing the WRTC or calling (601) 634-4217 or faxing at (601) 634-3664. Review, refinement, and field verification of this package will continue throughout the demonstration period. Draft interim and final packages should be completed and available for distribution upon WDCP demonstration and nationwide implementation phases. The working draft package consists of seven sections identified as follows:

	TOPIC
Section 1.	Title, Summary, Contents
Section 2.	Schedule of Instruction (Framework)
Section 3.	Lesson Plans/Objectives
Section 4.	Lecture Outlines and Slide Reference Index
Section 5.	Word Slide Index
Section 6.	Picture Slide Index
Section 7.	Blank Routine Method Data Form with Example Provided

Contents

SCHEDULE OF INSTRUCTION

REGULATORY IV
WETLAND IDENTIFICATION AND DELINEATION ACCORDING TO THE CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL

(Course Location)
(Course Dates)

Day/Date	Hours	Subject	Instructor
Monday (Date)	0800-0845	Introductions, Orientation, Course Objectives, Safety, Registration	
	0845-0915	Pre-Test	
	0915-1000	Introduction to the Wetlands of the Local Area (Optional)	
	1000-1015	Break	
	1015-1100	The 1987 Corps of Engineers Wetlands Delineation Manual • Background • Purpose • Scope • Technical Guidelines	
	1100-1200	Hydrophytic Vegetation	
	1200-1300	Lunch	
	1300-1415	Wetland Hydrology	
	1415-1800	Field Exercise (Vegetation Sampling, Hydrology Indicators)	All
Tuesday (Date)	0800-0830	Review of Field Exercise	All
	0830-1000	Hydric Soils	
	1000-1015	Break	
	1015-1100	Soil Color	
	1100-1200	Routine Method for Small Areas	
	1200-1300	Lunch	

Day/Date	Hours	Subject	Instructor
	1300-1800	Field Exercise (Routine Method)	All
Wednesday (Date)	0800-0830	Review of Field Exercise	All
	0830-0930	Soil Taxonomy	
	0930-0945	Break	
	0945-1030	Use of Soil Surveys	
	1030-1115	Routine Method for Large Areas	
	1115-1215	Offsite Method	
	1215-1315	Lunch	
	1315-1800	Field Exercise (Routine Method)	All
Thursday (Date)	0800-0830	Review of Field Exercise	All
	0830-0930	Comprehensive Method	
	0930-0945	Break	
	0945-1045	Atypical Situations	
	1045-1145	Problem Areas	
	1145-1300	Lunch	
	1300-1800	Field Exercise (Routine or Comprehensive Method)	All
Friday (Date)	0800-0830	Review of Field Exercise	All
	0830-0930	Final Questions and Answers	All
	0930-0945	Break	
	0945-1045	Written Examination	All
	1045-1130	Review of Written Examination	All
	1130-1200	Course Evaluations and Awarding of Certificates	All
	1200	Adjourn	

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Introduction to Wetland Delineation

Approximate Lecture Time: 45 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand the purpose of the *Corps of Engineers Wetlands Delineation Manual* and reasons for its development.
- Understand the 3-parameter approach to wetland identification.
- Understand the wetland definition used by the Corps of Engineers and Environmental Protection Agency.
- Understand the concept of normal circumstances.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Cowardin, L. M., Carter, V., Golet, F. C., and LaRoe, E. T. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*, FWS/OBS-79/31, US Fish and Wildlife Service, Washington, DC.

US Army Corps of Engineers Regulatory Guidance Letter No. 90-7, Subject: Clarification of the Phrase "Normal Circumstances" as it pertains to Cropped Wetlands, 26 September 1990.

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Soil Color

Approximate Lecture Time: 45 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand the Munsell color system and Munsell notation.
- Understand how to read soil colors for hydric soil determinations.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Kollmorgen Corporation. 1975. *Munsell Soil Color Charts*, Baltimore, MD.

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Hydric Soils

Approximate Lecture Time: 90 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand relevant soil terms, concepts, and properties.
- Understand criteria and field indicators of hydric soil.
- Understand the development and use of hydric soil lists.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

USDA Soil Conservation Service. 1991. *Hydric Soils of the United States*, in cooperation with the National Technical Committee for Hydric Soils. Washington, DC. (also local lists of hydric soil map units)

Soil Survey Staff. 1975. *Soil Taxonomy*, USDA Soil Conservation Service, Agriculture Handbook No. 436, Washington, DC.

Soil Survey Staff. 1990. *Keys to Soil Taxonomy*, SMSS Technical Monograph No. 6, Virginia Tech, Blacksburg, VA. (and updates)

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Hydric Soils

Approximate Lecture Time: 90 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand relevant soil terms, concepts, and properties.
- Understand criteria and field indicators of hydric soil.
- Understand the development and use of hydric soil lists.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

USDA Soil Conservation Service. 1991. *Hydric Soils of the United States*, in cooperation with the National Technical Committee for Hydric Soils. Washington, DC. (also local lists of hydric soil map units)

Soil Survey Staff. 1975. *Soil Taxonomy*, USDA Soil Conservation Service, Agriculture Handbook No. 436, Washington, DC.

Soil Survey Staff. 1990. *Keys to Soil Taxonomy*, SMSS Technical Monograph No. 6, Virginia Tech, Blacksburg, VA. (and updates)

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Wetland Hydrology

Approximate Lecture Time: 75 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand basic factors affecting the hydrology of a site.
- Understand important hydrologic terms used in the Manual.
- Understand biochemical changes that occur in saturated soils and their significance to wetland identification.
- Understand criteria and field indicators of wetland hydrology.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Atypical Situations

Approximate Lecture Time: 60 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand the concept of an Atypical (Disturbed) Situation.
- Understand procedures for determining whether wetlands existed in an area before it was disturbed by human activities.
- Understand how to determine whether wetland hydrology still exists in a disturbed area.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Problem Area Wetlands

Approximate Lecture Time: 60 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand the concept of Problem Area Wetlands.
- Understand various problem situations, and how to deal with them.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Soil Survey Staff. 1975. *Soil Taxonomy*, USDA Soil Conservation Service, Agriculture Handbook No. 436, Washington, DC.

Soil Survey Staff. 1990. *Keys to Soil Taxonomy*, SMSS Technical Monograph No. 6, Virginia Tech, Blacksburg, VA. (and updates)

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Wetland Hydrology

Approximate Lecture Time: 75 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand basic factors affecting the hydrology of a site.
- Understand important hydrologic terms used in the Manual.
- Understand biochemical changes that occur in saturated soils and their significance to wetland identification.
- Understand criteria and field indicators of wetland hydrology.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Hydrophytic Vegetation

Approximate Lecture Time: 60 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand the concept of a hydrophyte, and the meaning of the term "dominant."
- Understand plant adaptations to wetlands.
- Understand the concept of plant indicator status.
- Understand criteria and field indicators of hydrophytic vegetation.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Reed, P. B., Jr. 1988. *National List of Plant Species that Occur in Wetlands: 1988 National Summary*, Biological Report 88(24), US Fish and Wildlife Service, Washington, DC. (and various regional versions)

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Comprehensive Method

Approximate Lecture Time: 60 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand the more quantitative procedures for sampling vegetation, soils, and hydrology for comprehensive wetland determinations in situations requiring detailed documentation.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Revised and updated Data Form for Routine Wetland Determinations (3/92).

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Routine Method for Large Areas

Approximate Lecture Time: 45 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand procedures for sampling vegetation, soils, and hydrology for wetland determinations in larger or more difficult situations.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Revised and updated Data Form for Routine Wetland Determinations (3/92).

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Offsite Method

Approximate Lecture Time: 60 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand sources of information for offsite wetland determinations.
- Understand offsite procedures used by SCS for Food Security Act wetland inventories.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Routine Method for Small Areas

Approximate Lecture Time: 60 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand how to select an onsite sampling method.
- Understand procedures for sampling vegetation, soils, and hydrology for wetland determinations in relatively simple situations.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Revised and updated Data Form for Routine Wetland Determinations (3/92).

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Soil Taxonomy

Approximate Lecture Time: 60 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand the purpose of soil classification.
- Understand the classification system used in *Soil Taxonomy*.
- Understand how to interpret soil taxonomic names.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

Soil Survey Staff. 1975. *Soil Taxonomy*, USDA Soil Conservation Service, Agriculture Handbook No. 436, Washington, DC.

Soil Survey Staff. 1990. *Keys to Soil Taxonomy*, SMSS Technical Monograph No. 6, Virginia Tech, Blacksburg, VA. (and updates)

Regulatory IV
Instructor's Lesson Plan

Subject: Wetland Identification and Delineation

Lecture Title: Use of Soil Surveys

Approximate Lecture Time: 45 minutes

Target Audience: New personnel in the Corps of Engineers Regulatory Program; regulatory personnel in other federal, state, and local agencies; environmental consultants; landscape architects, engineers, and developers; land-use planners; members of public and private conservation organizations.

Learning Objectives:

Upon completion, students will:

- Understand how to use and interpret soil maps.
- Understand kinds of soil map units.
- Understand the concept of inclusions.
- Be familiar with the contents of a typical soil survey report.

Training Aids: See Instructor's Lecture Outlines and Slide Index.

Student References: Regulatory IV Student Notebook

Instructor References:

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Various memoranda from Headquarters USACE updating and interpreting the 1987 Manual.

A modern USDA Soil Conservation Service soil survey report.

Regulatory IV

Instructor's Lecture Outlines and Slide Index

CONTENTS

Regulatory IV
US Army Corps of Engineers Training Course in Wetland Identification and Delineation
(Version 12/92)

Lecture Outline: **Introduction to Wetland Delineation**	Slides
I. Background a. People differ in their perceptions of what constitutes a wetland. b. Some wetlands are easily recognizable by most people (e.g., marshes and flooded swamps), because the presence and influence of water is obvious. c. However, many wetlands are subject only to seasonal flooding. At such times the hydrology is obvious. But for much of the year surface water is lacking; at these times, other evidence is needed to recognize them as wetlands. d. Still other wetlands develop in areas where the soil is saturated for long periods, but never floods. Wetland identification becomes more difficult and controversial. e. The diversity of wetlands across the US makes the development of consistent national standards and definitions more challenging.	1 (desert upland), 2 (cattail marsh), 3 (cypress swamp), 4 (California mountain marsh), 5 (Arkansas seasonally flooded bottomland), 6 (Arkansas bottomland during dry season), 7 (Wyoming alpine wet meadow), 8 (Utah riparian community)

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II. The *Corps of Engineers Wetlands Delineation Manual* a. Development of the Manual 1. The need for an objective, technically sound, and consistent method of wetland identification and delineation arose with the passage of the Clean Water Act amendments in 1977. a. Section 404 required a permit from the US Army Corps of Engineers for the discharge of dredged or fill material into the waters of the United States, including wetlands. b. Primary authority for implementing the Clean Water Act rests with the US Environmental Protection Agency, while responsibility for the permitting program was given to the Corps. 2. After several years of development and testing, the Corps published its *Wetlands Delineation Manual* in 1987. a. Since then, the Manual has been officially updated and refined through (1) memoranda issued by Corps Headquarters in Washington, DC, and (2) by published updates of collateral documents (e.g., *Hydric Soils of the United States* by the USDA Soil Conservation Service). b. One goal of this course is to point out where portions of the Manual have been superseded by more recent information.	9
b. Purpose -- to provide mandatory technical criteria, field indicators, and recommended methods for identifying wetlands and delineating their upper boundaries for jurisdictional purposes	10
c. While the Clean Water Act deals with all waters of the United States, the Manual only addresses wetlands. Wetlands are one of six Special Aquatic Sites designated by EPA.	11

Lecture Outline: **Introduction to Wetland Delineation**	Slides
d. The Manual is not a wetland classification system. It will not tell you what type of wetland you have. 1. For classification purposes, recommend the *Classification of Wetlands and Deepwater Habitats of the United States* developed by the Fish and Wildlife Service for the National Wetland Inventory.	12 (cover of the FWS wetland classification), 13 (example of its hierarchical structure)
e. Definitions and Concepts 1. Wetlands are transitional areas between well-drained uplands and permanently flooded aquatic habitats. a. Boundaries are sometimes distinct (e.g., abrupt topographic change). b. More often, the wetland boundary lies within a gradient of change and is not readily apparent. c. The Manual allows you to draw a consistent, technically valid, and legally defendable boundary across that gradient.	14 (diagram of upland-to-wetland gradient)
2. Joint EPA/Corps wetland definition: a. Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions	15

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b. Key features of this definition include vegetation, soils, and hydrology, which have become the basis for the 3-parameter or multiparameter approach for wetland identification. 1. *Vegetation* -- the plant community is dominated by species that are tolerant of saturated soil conditions. Hydrophytic species exhibit a variety of adaptations that allow them to grow, compete, and reproduce in standing water or in waterlogged, anaerobic soils. 2. *Soils* -- there is either direct hydrologic evidence that the soils are wet, or indirect evidence (e.g., color) that demonstrate that the soils developed under permanently or periodically saturated conditions. 3. *Hydrology* -- there is evidence of a hydrologic regime sufficient to produce anaerobic soils and exclude a strictly upland plant community.	16
c. According to the Manual, there must be evidence of all three parameters to identify an area as a wetland. 1. The diagram shows a typical determination of wetland boundaries in the field. Each parameter is evaluated separately as the investigator proceeds up or down the gradient. 2. The wetland boundary is indicated by the highest point on the gradient where evidence of all three parameters is present.	17 (diagram of wetland boundary)

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d. Additional concept of *normal circumstances*: 1. The conditions dictated by the soils and hydrology on the site, whether or not the vegetation has been altered a. Therefore, clearing of vegetation does not circumvent the wetland definition, because the normal circumstance is vegetated b. For the most part, a crop does not constitute the normal circumstance 1. Exception: Corps Headquarters has decided that areas designated as "prior converted croplands" by SCS are not subject to regulation under Section 404	18, 19
3. Wetland definitions used by other federal agencies a. The definition adopted by SCS as part of its procedures for implementing the swampbuster provisions of the 1985 Food Security Act 1. Based on the EPA/Corps wetland definition, with the addition of an exemption for certain lands in Alaska	20 (FSA Manual), 21
b. The FWS wetland definition was developed for purposes of the National Wetland Inventory. 1. The main difference is its inclusion of unvegetated wet areas (e.g., beaches, stream bottoms) as wetlands. These areas are regulated as other waters of the US under the Clean Water Act.	22
4. *Deepwater habitats* -- permanently inundated areas lying below the deepwater boundary of wetlands. Mean water depth is generally >6.6 ft, unless emergent or woody species grow beyond this depth. In marine and estuarine areas, deepwater habitats begin at the extreme low spring tide level (based on the FWS classification)	23

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Lecture Outline: **Introduction to Wetland Delineation**	Slides
f. Objectives of the Course 1. Present technical criteria and field indicators for hydrophytic vegetation, hydric soils, and wetland hydrology 2. Describe delineation methods, including those recommended for disturbed and problem wetland sites 3. Provide supporting information, including background information and additional topics too extensive for inclusion in the Manual	24
g. Flexibility 1. Existence of the Manual is not meant to substitute for experience and good judgment 2. Year-round experience with wetlands in your local area is important for accurate results 3. Use of the Manual as a "cookbook" can lead to errors	25

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Lecture Outline: **Wetland Hydrology**	Slides
I. Background a. Hydrology creates and maintains all wetlands. For the most part, vegetation composition and soil morphology reflect the long-term hydrology of the site. b. Waterlogging of the soil produces anaerobic conditions that favor wetland-adapted plants and promote distinctive soil characteristics. c. Indicators of current hydrology are needed to ensure that vegetation and soil characteristics are not relics of a previous hydrologic regime.	26
d. *Hydrology* -- the science of water, its properties, distribution and circulation, both on the surface and underground. 1. In this course, we are concerned with: a. Factors affecting the water content of the first couple of feet of the soil profile. b. The chemical and physical changes that occur in the soil as a result of prolonged saturation. c. The definition and recognition of "wetland hydrology" according to the delineation manual.	27
e. Sources of water (inputs to the water budget of a site) 1. Precipitation 2. Headwater flooding (flashy, short duration; less likely to promote wetland conditions) 3. Backwater flooding (longer duration; more likely to produce wetlands) 4. Tides (once or twice a day, depending upon location) 5. Groundwater 6. Combinations of the above	28

Lecture Outline: **Wetland Hydrology**	Slides
f. Factors that influence hydrology of a site 1. Precipitation (amount and timing) 2. Stratigraphy (shallow bedrock or slowly permeable soil horizons may perch water near the soil surface) 3. Topography or landscape position (depressions, drainages, and shorelines are generally the wettest parts of the landscape) 4. Soil texture (fine-textured soils retain water longer than coarser soils) 5. Plant cover may have opposing effects: a. Floodplain vegetation may impede flow and prolong soil saturation b. Transpiration, particularly by forest trees, can lower the water table	29
g. Combinations of different sources of water and various factors affecting hydrology produce the familiar situations where we find wetlands, such as: 1. Coastal marshes 2. Floodplains a. Cross-section of a major river floodplain reveals variations in site elevation and hydrology and, therefore, in occurrence of wetlands b. Wettest areas include abandoned river channels and backwater areas c. Current and relic natural levee deposits, comprised of the coarser sediments that drop out first when the river overtops its banks, are often the driest portions of the floodplain 3. Groundwater depressions, sometimes due to perching of water above slowly permeable soil layers a. The water table need not break the surface to produce a wetland; groundwater-dominated systems are the most difficult for delineators to deal with 4. Slope wetlands, which are particularly common in glaciated regions	30 (Connecticut coastal marsh), 31 (Missouri stream), 32 (Mississippi floodplain cross-section), 33 (seasonal groundwater depression), 34 (depression with perched water table), 35 (seep on slope)

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Lecture Outline: **Wetland Hydrology**	Slides
II. Definitions a. *Inundation* -- a condition in which water from any source temporarily or permanently covers a land surface. We recognize two forms of inundation:	36, 37 (inundated bottomland hardwoods in Arkansas)
1. *Ponding* -- a condition in which water stands in a closed depression. The water is removed only by percolation, evaporation, or transpiration	38, 39 (small pothole in agricultural field)
2. *Flooding* -- the soil surface is temporarily covered with flowing water from any source, such as overflowing streams or rivers, runoff from adjacent slopes, and inflow from high tides	40, 41 (flooding on left side and ponding on right side of levee)
b. *Saturation* -- condition in which all easily drained pores between soil particles are temporarily or permanently filled with water 1. The soil can become saturated either from above (due to inundation) or below (due to groundwater)	42, 43 (groundwater wetland in Maryland)
c. *Water table* -- the level at which water stands in an unlined borehole. At this level, water pressure is equal to atmospheric pressure	44, 45 (standing water in hole)
d. *Capillary fringe* -- a zone immediately above the water table in which water is drawn upward by capillary action (due to forces of adhesion and surface tension, which pull water upward against gravity into soil pores).	46
1. The capillary fringe is often called the "zone of tension saturation" because water molecules are being pulled in two directions (upward by capillary forces and downward by gravity) and water pressure is less than atmospheric pressure. However, all but the largest pores are filled with water, thus the soil is saturated 2. To produce wetland conditions, the capillary fringe must extend to or near the soil surface 3. Fine-textured soils have smaller pores and stronger capillary forces. Therefore, the capillary fringe is higher in fine-textured soils than in coarse-textured soils.	47 (diagram of water table and zone of tension saturation)

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Lecture Outline: **Wetland Hydrology**	Slides
III. Biochemical changes in saturated soils a. When the soil becomes saturated, air between soil particles is replaced by water. Because the rate of diffusion of oxygen through water is 1/10,000th that of the rate of diffusion through air, soil microorganisms quickly deplete the available oxygen and the soil goes anaerobic. 1. *Anaerobic* -- situation in which molecular oxygen is absent from the environment	48
b. Soil microbes metabolize (oxidize) soil organic matter as an energy source. Oxidation reactions produce extra electrons that must be accepted by other chemical elements in the organism. Under aerobic conditions, soil microbes use oxygen as the terminal electron acceptor in respiration. Thus oxygen gains an electron, declines in valence, and becomes chemically "reduced" 1. *Reduction* -- the process of giving up oxygen, gaining hydrogen, or gaining an electron	49

Lecture Outline: **Wetland Hydrology**	Slides
c. After oxygen is depleted, species adapted to anoxic conditions turn to other elements as electron acceptors. There is an ordered sequence of elements that become reduced under prolonged soil saturation 1. Redox potential is a measure of the reduction status of the soil and can be measured with special platinum electrodes and a millivolt meter 2. Certain reactions in the oxidation/reduction sequence have important consequences for wetland function and development of wetland field indicators a. Reduction of nitrate to nitrogen gas is called *denitrification*, and is one way wetlands remove nitrate from inflowing waters and reduce problems due to excessive nutrient loading of receiving streams b. Conversion of sulfate to hydrogen sulfide produces the rotten-egg odor characteristic of certain highly reduced wetland situations c. Reduction of manganic to manganous ion, and particularly ferric to ferrous ion, affect the color of wetland soils. The brownish and reddish colors of well-aerated soils are due mainly to insoluble ferric oxides that coat soil particles. During prolonged or repeated saturation, ferric ion is reduced to the grayish ferrous form. Furthermore, ferrous ion is soluble and can be leached from the soil, leaving behind the grayish colors of the uncoated mineral grains.	50 (redox sequence)
d. Under laboratory conditions (with well-mixed soil suspensions, addition of supplemental organic matter, and warm temperatures) it takes only a few days for a waterlogged sample to become significantly reduced. Actual rates in the field may vary widely in response to factors that affect microbial activity, such as temperature and food availability	51 (shows oxygen and nitrate depletion, and reduced manganese and iron accumulation in sequence through time)

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Lecture Outline: **Wetland Hydrology**	Slides
IV. Criteria for wetland hydrology a. An area has wetland hydrology if it is inundated or saturated to the surface for at least 5% of the growing season in most years 1. "In most years" means at least 51 years out of 100, or more than 50% probability in any one year	52
2. The growing season is based on the soil temperature regime, and is defined as the portion of the year when soil temperature (measured 20 inches below the surface) is above biological zero (5 C or 41 F) a. In the absence of data on soil temperature, growing season can be estimated from climatological data given in most SCS county soil surveys. Starting and ending dates generally are based on the 28 F air temperature threshold for the average year (or 5 years out of 10)	53
3. The minimum 5% duration refers to a single, continuous episode of inundation or soil saturation, and is based on the conclusions of a workshop of experts on bottomland hardwood systems in the Southeast. They studied the correlation between duration of inundation and occurrence of recognized zones of bottomland forest communities. Zones inundated more than 12.5% of the time were always wetlands. Those inundated less than 5% of the time were always nonwetlands. Zones inundated between 5 and 12.5% sometimes were wetlands and sometimes were nonwetlands	54

Lecture Outline: **Wetland Hydrology**	Slides
V. Hydrologic data and sources of information a. Hydrologic information that can be used to determine whether a site meets the wetland hydrology criteria (hydrologic data sets should encompass the entire growing season, or at least those portions of the growing season during which conditions are expected to be wettest [generally early spring and late fall, when evapotranspiration is reduced and flooding may be more common]) 1. Tide gauge data (gauge data must be related to site elevation) 2. Stream gauge data 3. Groundwater well data (in general, wells should be shallow and should be placed above any confining soil layers that may perch water) 4. Aerial imagery (requires photos taken at many different times so that one can determine whether the site is inundated long enough and frequently enough to meet the criteria)	55, 56 (staff gauge in Michigan creek), 57 (shallow groundwater well), 58 (hydrograph from gauge or well data), 59 (aerial photo of flooding)
b. Sources of hydrologic data 1. US Army Corps of Engineers District offices (for gauge data on certain navigable waters) 2. US Geological Survey (stream gauge and groundwater well data) 3. National Oceanic and Atmospheric Administration (tide gauge data) 4. USDA Soil Conservation Service (hydrologic information on individual soil series) 5. State, county, and local agencies (particularly those dealing with flood hazard) 6. Developers (groundwater monitoring at project sites)	60

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Lecture Outline: **Wetland Hydrology**	Slides
VI. Field indicators of wetland hydrology a. Primary indicators 1. Visual observation of inundation 2. Visual observation of soil saturation within 12 inches of the soil surface a. Acceptable evidence of soil saturation includes standing water in the hole, observation of glistening on broken ped faces (most mineral soils), squeezing water out of a soil sample (generally organic soils), and producing free water by gently shaking the sample (sands) 3. Water marks (e.g., silt or pollen lines) 4. Drift lines (e.g., deposits of water-borne debris) 5. Sediment deposits (e.g., sediment that settled out of standing water onto tree bases or objects on the ground) 6. Drainage patterns in wetlands (e.g., braided channels in some wetlands, scouring of debris, evidence of sheet flow)	61, 62 (inundation), 63 (glistening), 64 (squeeze test), 65 (water marks), 66 (iron stains from water), 67 (large drift line), 68 (salt marsh wrack line), 69 (debris in tree), 70 (sediment deposit), 71 (area scoured of debris by flowing water)
b. Secondary indicators (at least two secondary indicators required) (see 6 March 1992 memo from HQUSACE) 1. Oxidized root channels (rhizospheres) surrounding living roots within the upper 12 inches of the soil a. Oxidized rhizospheres result from leakage of oxygen from plant roots into the surrounding soil, causing any reduced iron that may be present to precipitate as reddish ferric oxides in an otherwise gray soil matrix b. Rhizospheres should be reasonably abundant in the sampled soil 2. Water-stained leaves a. May be present in depressional wetlands in deciduous forest. Fallen leaves turn neutral black or gray in color due to prolonged inundation under anaerobic conditions 3. Local soil survey data (e.g., typical water table depths, durations, and timing for soil series mapped in the county) 4. FAC-neutral test of the vegetation (see Hydrophytic Vegetation lecture notes)	72, 73 (oxidized rhizospheres), 74 (water-stained and normal leaf), 75 (soil survey), 76 (FAC-neutral test met in cypress swamp)

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Lecture Outline: **Hydrophytic Vegetation**	Slides
I. Background a. Along with landscape position, growth form and species composition of the vegetation is often the investigator's first clue to the presence of wetlands.	77
b. The central concept presented in the Manual is that *wetlands are dominated by hydrophytes*. To evaluate a site's vegetation, one must understand what is meant by the term *dominant*, and what constitutes a *hydrophyte*.	78
II. Hydrophytes and wetland indicator status a. *Hydrophyte* -- any macrophyte that grows in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content 1. Tolerance for occasional wetness is not sufficient; most plants can survive short periods of soil saturation, particularly during the dormant season. 2. Only specifically adapted plant species can survive prolonged soil saturation and anoxic conditions during the growing season.	79
3. Plants adapt to wetlands in various ways. Adaptations can be categorized as morphological, physiological, or reproductive	80

Lecture Outline: **Hydrophytic Vegetation**	Slides
4. In general, morphological adaptations serve to stabilize the plant in soft sediments and/or provide additional surfaces or pores for the uptake of oxygen to aerate the roots. Examples include: a. Buttressed and fluted tree trunks b. Multiple trunks (response to shallow water table; has additional causes not related to wetness) c. Pneumatophores and knees (projections of the root system that extend upward into the air or water column) d. Adventitious roots (similar function to pneumatophores) e. Shallow root systems (response to shallow water tables) f. Hypertrophied lenticels (enlarged pores on stems) g. Aerenchyma (internal air spaces that serve to transport oxygen from the aerial portions of the plant to the roots) h. Polymorphic leaves (primarily in floating and submerged plants) i. Floating leaves (serve to keep photosynthetic parts in the light and air)	81, 82, 83 (water lily), 84 (water hyacinth stem), 85 (alligator weed subject to various moisture regimes), 86 (baldcypress), 87 (slash pine), 88 (fluting), 89 (prop roots, red mangrove), 90 (pneumatophores, black mangrove), 91 (cypress knees), 92 (multiple stems and adventitious roots, black willow), 93 (shallow root system on windthrown tree)
5. Physiological adaptations include alternate metabolic pathways that adapted plants use in the absence of oxygen a. The aerobic pathway ends at CO_2 and H_2O (with 38 ATP capturing the released energy) b. The most common anaerobic pathway ends at ethanol; the energy efficiency is much lower (2 ATP per molecule of glucose) and toxic ethanol must be dealt with c. Some species accumulate malate when anaerobic, then convert to pyruvate and enter the Krebs cycle when oxygen is again available	94, 95

Lecture Outline: **Hydrophytic Vegetation**	Slides
6. Reproductive adaptations are extremely varied. They include: a. Viviparous seedlings of red mangrove, which germinate on the parent plant, giving them a head start on development before dropping into the water b. Dispersal of seeds by water (e.g., overcup oak) c. Underwater pollination (e.g., *Ceratophyllum*) d. Underwater germination (e.g., *Nuphar*) e. Flood tolerance of seedlings (e.g., overcup oak)	96, 97 (viviparous seedlings of red mangrove), 98 (flooded seedlings of overcup oak)
b. Wetland plant lists 1. For wetland investigations, it is unnecessary to identify the adaptations of plant species found on a site. Instead, lists of species adapted to wetlands have been compiled for each region of the US a. *National List of Plant Species that Occur in Wetlands* was originally developed by the Fish and Wildlife Service, and has been updated and revised by regional and national panels of experts from the concerned federal agencies and academia	99
2. Plant species are categorized by wetland indicator status, ranging from obligate wetland (OBL) to obligate upland (UPL) a. Categories are based on presumed frequency of occurrence in wetlands (i.e., percentage of random sampling plots containing the species across its entire range that would be in wetlands) b. Slides present examples of plant species by indicator status for each plant list region c. Some species are given '+' or '-' modifiers to the indicator status. A '+' indicates somewhat greater affinity for wetlands than is typical for that indicator category (e.g., FAC+); a '-' indicates lesser affinity for wetlands (e.g., FAC-)	100, select appropriate regional examples from 101-140

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Lecture Outline: **Hydrophytic Vegetation**	Slides
3. Map of plant list regions a. Indicator status is assigned at the regional level; therefore, a species may have a different indicator status in different regions b. State lists are also available; however the indicator status given on state lists is the same as that for the appropriate region	141 (map of plant list regions)
4. If a species found on a site is not listed on the regional plant list, the two most likely reasons are: a. You are not using the correct scientific name 1. The authority for plant names is the *National List of Scientific Plant Names* (2 volumes) published by the Soil Conservation Service (1982) 2. Check this reference, or the synonomy section of the regional wetland plant list for the recognized scientific name b. It is an upland (UPL) plant	142 (authority for plant names)
5. Ecological amplitude along the moisture gradient varies by species. Furthermore, some species have recognized varieties (trinomials) that are listed under a separate wetland indicator status a. If the wetland boundary were in the middle of the gradient shown in this figure, species whose distributions were entirely to the left of the midpoint would be given OBL status, those entirely to the right would be given UPL status, and those overlapping the midpoint would be FACW, FAC, or FACU depending upon how the distribution was skewed	143 (distribution of plant species along a moisture gradient)

Lecture Outline: **Hydrophytic Vegetation**	Slides
III. Plant species dominance	144
a. Dominant plant species are those which are most abundant and contribute most to the character of the community	
b. Various measures can be used to express the relative dominance of the species in the community:	
1. Percent cover (i.e., percentage of the ground surface that would be covered by the vertical projections of the aerial portions of that species; equivalent to the species' shadow if the sun were directly overhead)	
2. Stem density (i.e., count of stems or individual plants of that species per unit of area)	
3. Frequency of occurrence (i.e., percentage of sampling plots that contain the species of interest)	
4. Basal area (i.e., for trees, equal to the sum of the cross-sectional areas of all trees of that species within a prescribed area, if trees were cut off at breast height [4.5 ft above the ground surface]; expressed in units of ft^2/acre)	

Lecture Outline: **Hydrophytic Vegetation**	Slides
c. Selection of dominant plant species 1. Dominant species are selected independently from each stratum of the community. Strata (defined later under the Routine Method) consist of trees, saplings/shrubs, herbs, and woody vines 2. For routine wetland determinations, vegetation sampling is done *visually*, keeping in mind one or more of the dominance measures described previously. Different measures may be appropriate to different strata 3. The Manual suggests that the three most dominant species be selected from each stratum of the community (five from each stratum if only one or two strata are present) 4. The following is an optional but recommended alternative procedure (the "50/20 rule"): a. For each stratum in the plant community, dominant species are the most abundant plant species (when ranked in descending order of abundance and cumulatively totaled) that immediately exceed 50% of the total dominance measure for the stratum, plus any additional species comprising 20% or more of the total dominance measure for the stratum b. Review example showing selection of dominants from percent cover data. Selection can be based on raw data or on relative cover (data converted so that they sum to 100%) 5. After the dominant species are selected from each stratum, they are combined into a single list of dominants across all strata in the community. Species dominant in more than one stratum are counted more than once in the combined list	145, 146 (example showing selection of dominant species from actual or relative percent cover data)

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Lecture Outline: **Hydrophytic Vegetation**	Slides
IV. Criteria for Hydrophytic Vegetation a. The basic rule -- more than 50% of the dominant species from all strata are OBL, FACW, or FAC 1. FAC- species do not count b. A FAC-neutral option is also available, and may help to clarify the wetland determination in areas where evidence of hydric soil or wetland hydrology is weak. The FAC-neutral option can not be used to exclude areas that meet the basic rule *and* the hydrology and hydric soil requirements 1. For the FAC-neutral option, disregard all dominant species in the FAC category (including FAC+ and FAC-). The community is hydrophytic if the number of dominant species wetter than FAC is greater than the number drier than FAC	147
c. Additional hydrophytic vegetation indicators 1. Visual observation of plant species growing in areas of prolonged inundation and/or soil saturation a. Observations must be amply documented, and should be submitted to the regional plant list panel for reconsideration of the species' indicator status 2. Morphological adaptations a. Hydrophytic vegetation is present if two or more dominant species exhibit morphological adaptations for wetlands 1. Adaptations must be observed on most individuals of the two species b. Use this indicator only after applying the basic rule, and use caution with adaptations (e.g., shallow roots) that can develop for reasons other than wetness 3. Technical literature a. Includes recent literature on plant species distributions that was not available at the time the wetland plant lists were developed. Again, submit the information to the appropriate plant list panel	148

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Lecture Outline: **Hydrophytic Vegetation**	Slides
d. Examples of hydrophytic vegetation decision-making 1. Herbaceous community (single stratum) with 5 dominants; does it constitute hydrophytic vegetation? 2. Mixed herb and shrub community (two strata); is this hydrophytic vegetation? 3. To minimize confusion, stress that the vegetation decision is a 2-step process: a. Select dominant species (based on coverage or abundance, without regard to indicator status) b. Apply the basic rule after looking up the indicator status of each dominant species on the regional plant list	149, 150 (examples)

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Lecture Outline: **Hydric Soils**	Slides
I. Background a. Definition of soil -- unconsolidated natural material that supports, or is capable of supporting, plant life. Upper limit is air or shallow water, and the lower limit is either bedrock or the limit of biological activity	151, 152
1. Not all areas on the earth's surface are soil. Examples of nonsoil include: a. Badlands (highly erodible) b. Beaches (unstabilized sand) c. Rubble lands (talus and boulder fields) d. Rock outcrops e. Glaciers f. Deepwater habitats	153
b. Factors that influence soil development 1. Climate (e.g., temperature and precipitation patterns) 2. Parent material (e.g., mineralogical composition) 3. Topographical relief or landscape position (e.g., location relative to ridges, slopes, and valleys) 4. Organisms (e.g., soil microorganisms, plant roots, soil invertebrates, burrowing vertebrates) 5. Time (i.e., how long have the preceding factors been active?)	154

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Lecture Outline: **Hydric Soils**	Slides
c. Key soil properties -- the following properties may all be important in a detailed description of a soil. In this course, we will focus primarily on texture, drainage, permeability, organic matter, and color in relation to hydric soil development. 1. Texture 2. Slope 3. Drainage 4. Permeability 5. Depth 6. Structure 7. Organic matter 8. Color 9. Reaction 10. Bulk density 11. Parent material 12. Shrink-swell potential, available water capacity 13. Salinity 14. Landscape position	155, 156
d. Most routine hydric soil determinations are done by examining the top 18 to 24 inches of the soil.	157

Lecture Outline: **Hydric Soils**	Slides
e. Soils that have been in place for a sufficient period of time develop a characteristic *profile* consisting of layers or *horizons* that are the result of (1) the incorporation of materials into the surface of the soil, (2) movement of materials downward (or upward) by percolating water, and (3) chemical changes occurring within the soil. 1. A very generalized soil profile might consist of the following horizons: a. A horizon -- the surface layer in a mineral soil characterized by accumulation of organic matter and/or loss of materials (e.g., clays) to deeper layers. b. B horizon -- the subsoil, characterized by accumulation of clays or other materials and greater structural development. c. C horizon -- the underlying material, unconsolidated parent material little influenced by soil-forming processes. d. R horizon -- bedrock	158, 159 (example showing thin A horizon, thick B horizon, and underlying C horizon [Fox series, Michigan])
2. A more detailed profile description might include some of the following: a. An organic surface layer (O horizon), in various stages of decomposition (Oi, Oe, Oa) b. Recognizable subdivisions of the A, B, or C horizons (e.g., A1 and A2) c. An eluvial layer (E horizon) d. Transitional layers (e.g., AB and BA horizons) e. Zone of clay accumulation (Bt horizon)	160
f. Mineral soils are composed of various sized particles of mineral material. The smaller soil particles are classified as sand (0.05-2.00 mm), silt (0.002-0.05 mm), and clay (<0.002 mm). Larger particles are called gravel (>2.00 mm).	161
g. The *texture* of a soil refers to its proportionate content of sand, silt, and clay. Soils are categorized into various textural classes based on the textural triangle (e.g., silty clay). 1. A *loam* refers to a soil whose properties are influenced by all three particle sizes.	162

Lecture Outline: **Hydric Soils**	Slides
2. Other common terms include broader textural groups, ranging from the coarse-textured soils (sands and loamy sands) to the fine-textured soils (sandy clay, silty clay, and clay).	163
h. *Permeability* -- a measure of the ability of air or water to move through the soil profile (measured in inches/hour) 1. Permeability depends upon soil texture, with the fine-textured soils having low permeability and coarse-textured soils having high permeability. 2. A permeability of 6 inches/hour is considered rapid, and is characteristic of sandy soils.	164, 165 (permeability in relation to texture)
i. Soils are subjectively classified into seven *natural drainage classes* that reflect the frequency, duration, and depth of soil saturation, and the difficulty of growing typical agricultural crops without installation of a drainage system. 1. Drainage is affected by the permeability of the various horizons in the soil, depth to bedrock, slope, etc. 2. In general, soils classified as poorly and very poorly drained are nearly always hydric. Somewhat poorly drained soils generally are not hydric, but often contain hydric inclusions or may grade to hydric conditions at the lower end of mapping units.	166
II. Hydric Soils a. Definition -- a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part	167, 168 (diagrammatic version)

Lecture Outline: **Hydric Soils**	Slides
b. There are two main categories of soils, both of which have hydric and nonhydric members 1. Organic soils -- composed of at least 16 inches of organic material in the upper 32 inches of soil profile, or any thickness over bedrock. a. Most organic soils develop through slow accumulation of organic debris in wet areas where decomposition is slowed due to anaerobic conditions. b. Organic soils are generally called peats and mucks, depending upon degree of decomposition. 2. Mineral soils -- composed primarily of sand, silt, and/or clay with varying amounts of organic matter. a. Hydric mineral soils are saturated long enough to develop distinctive properties associated with an anaerobic, chemically reduced environment.	169, 170 (organic soil [peat] in the laboratory), 171 (mineral soil with a brownish surface layer and gray subsoil)
c. Criteria for hydric soils 1. The criteria for hydric soils were developed by the National Technical Committee for Hydric Soils, for the purpose of creating a list of hydric soils of the US by extracting appropriate soil series from a nationwide database of soil interpretation records maintained by SCS. a. The criteria are revised periodically, and are printed in the front of each updated version of the *Hydric Soils of the United States*. b. The version of the criteria printed in the 1987 *Corps of Engineers Wetlands Delineation Manual* is outdated. Refer to the latest SCS hydric soils list.	172 (cover of hydric soils list)
2. The hydric soil criteria address four kinds of wet soil situations a. Criterion (1.) -- organic soils b. Criterion (2.) -- mineral soils with high water tables (this criterion has several subsections) c. Criterion (3.) -- ponded soils d. Criterion (4.) -- flooded soils	173

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Lecture Outline: **Hydric Soils**	Slides
3. Current hydric soil criteria (as of October 1992) are: *(1.) All Histosols except Folists, or* *(2.) Soils in Aquic suborders, Aquic subgroups, Albolls suborder, Salorthids great group, Pell great groups of Vertisols, Pachic subgroups, or Cumulic subgroups that are:* *(a.) Somewhat poorly drained and have a frequently occurring water table at less than 0.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season, or* a. Folists are organic soils that develop over shallow bedrock or fragmental material in cool, humid climates; they are never wet for more than a few days following heavy rains. In the US, extensive Folists exist only in Alaska and Hawaii. In the 48 contiguous states, virtually all Histosols are hydric. b. The Soil Taxonomy lecture will help clarify other taxonomic terms	174
(b.) Poorly drained or very poorly drained and have either: *(1.) A frequently occurring water table at less than 0.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches, or for other soils*	175

Lecture Outline: **Hydric Soils**	Slides
(2.) A frequently occurring water table at less than 1.0 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is equal to or greater than 6.0 inches/hour in all layers within 20 inches, or *(3.) A frequently occurring water table at less than 1.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is less than 6.0 inches/hour in any layer within 20 inches, or* a. In general, the different water table depths are designed to bring the capillary fringe to or near the surface in soils of different texture: 1. Sands -- 0.5 ft 2. Other coarse-textured soils -- 1.0 ft 3. Moderate to fine-textured soils -- 1.5 ft	176
(3.) Soils that are frequently ponded for long duration or very long duration during the growing season, or *(4.) Soils that are frequently flooded for long duration or very long duration during the growing season.* a. Clarification of terms: 1. Frequently -- more than 50 years out of 100, or more than 50% probability in any one year 2. Long duration -- a single event lasts 7 to 30 days 3. Very long duration -- a single event lasts more than 30 days 4. Growing season -- based on the soil temperature regime (see Wetland Hydrology lecture outline)	177

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Lecture Outline: **Hydric Soils**	Slides
d. Hydric Soil Lists 1. Lists of soils meeting these criteria are compiled at various levels: a. National list -- *Hydric Soils of the United States* published by SCS b. State lists c. Local or field office lists	178
2. National hydric soils list a. A computer-generated list using information on the soil interpretations record for soil series in the US b. Limited to recognized series or special phases that are represented by a separate soil interpretations record c. The national list does not contain: 1. Wet miscellaneous areas shown on many soil survey maps (e.g., swamp, marsh) 2. Soils classified at higher levels than the series (e.g., Fluvaquents)	179
3. State hydric soils lists a. Presently state lists are subsets of the national list, showing hydric soils that exist in a state	180
4. Local, county, or field office lists of hydric soil mapping units a. These are lists of soil mapping units that are named for soil series on the national list, for wet miscellaneous areas, or for wet soils classified at levels higher than the series b. Also listed are mapping units that potentially contain hydric soil inclusions c. Local lists are available from local, county, or state offices of the SCS d. Local lists usually contain the best available information for making hydric soil determinations	181

Lecture Outline: **Hydric Soils**	Slides
5. Therefore, the first step in a hydric soil determination is to identify the soil series (by using soil maps and profile descriptions given in the county soil survey) and see whether it is listed on the local list of hydric soils. a. Always follow up and verify by checking for field indicators of hydric soil. b. The presence or absence of field indicators can supersede the listing of that soil on a hydric soil list.	182 (diagram of soils decision process)
e. Field Indicators of Hydric Soils 1. Prolonged and repeated inundation or soil saturation leads to the distinctive morphological characteristics of most hydric soils a. The most important processes involved in development of these distinctive features are (1) reduction and movement of iron or other elements and (2) accumulation of organic matter under anaerobic conditions	183
2. Hydric soil indicators for non-sandy soils a. *Organic soil* -- the soil has more than 16 inches of organic material in the upper 32 inches, or any thickness over bedrock b. *Histic epipedon* -- soil has an organic surface layer 8 to 16 inches thick c. *Sulfidic material* -- the soil smells of hydrogen sulfide, with its characteristic rotten egg odor d. *Aquic or peraquic moisture regime* -- the soil is saturated for long periods resulting in a chemically reducing environment.	184, 185 (organic soil, Houghton muck, Michigan), 186 (histic epipedon, organic over sand), 187 (area with peraquic moisture regime, tidal coastal marsh)

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Lecture Outline: **Hydric Soils**	Slides
e. *Reducing soil conditions* -- the soil contains reduced iron (Fe^{++}) according to the α,α,dipyridyl colorimetric test	188, 189 (gleyed soil), 190 (mottled soil)
f. *Soil colors* -- mineral hydric soils are either gleyed, or have a low-chroma matrix with or without bright mottles (more details follow)	
g. *Soil appears on the hydric soils list* -- verify the series by comparing the observed profile against the profile description given in the soil survey	
h. *Iron and manganese concretions* -- the soil contains nodules or soft masses of iron and/or manganese oxides that are due to movement of the soluble elements under reduced conditions and precipitation in the larger air-filled pores. Concretions should be >2 mm in diameter, located near the soil surface, and be surrounded by a low-chroma matrix.	

Lecture Outline: **Hydric Soils**	Slides
i. Use of soil color as a hydric soil indicator	191, 192
1. Terms and concepts	
a. The Delineation Manual and most soil survey reports use an old terminology that refers to the predominant color in a soil sample as the *matrix*, and spots of contrasting color as *mottles*.	
b. A new terminology (starting in 1992), refers to all wetness color patterns as *redoximorphic features*:	
1. Reddish orange blotches (called *redox concentrations*) form in soil layers that are alternately wet and dry, such as in the zone of fluctuation of the water table.	
2. Redox concentrations form when reduced Fe and Mn dissolved in the soil solution oxidize and precipitate out along ped faces or within larger pores where oxygen is more available.	
3. As Fe and Mn become concentrated, areas where Fe and Mn have moved out (called *redox depletions*) become more gray.	
4. Finally, a *reduced matrix* refers to soil matrix that changes color when exposed to air (due to rapid oxidation of reduced Fe).	
5. In most hydric soils, redox depletions comprise the matrix, and redox concentrations (if present) comprise the mottles.	

Lecture Outline: **Hydric Soils**	Slides
2. Typical colors of mineral hydric soils a. Matrix chroma of 2 or less in mottled soils b. Matrix chroma of 1 or less in unmottled soils 1. Matrix colors of hydric soils should be both *low chroma* and *high value*. Low values (2, 3, and sometimes 4) are produced by organic matter; high values (≥4) indicate reduction and movement of iron. c. The Manual says to measure colors immediately below the A horizon or at 10 inches, whichever is shallower 1. The color of the A horizon is determined mainly by organic matter that may mask any redoximorphic features in that horizon. Therefore, it is desirable to get below the A horizon to read soil colors. 2. The 10-inch limit is meant as guidance only. In soils with thick A horizons, it may be necessary to go deeper. In general, read colors in the horizon immediately below the A horizon (see the lecture outline on Problem Area Wetlands for other exceptions).	193

Lecture Outline: **Hydric Soils**	Slides
3. Hydric soil indicators for sandy soils a. The color changes described above are mainly a function of the finer particles (silt and clay) in the soil. Sands lack sufficient fine particles and, therefore, color is unreliable as a hydric soil indicator in sands. b. Indicators of hydric soil for sandy soils 1. *High organic matter content in the surface horizon* -- the organic matter accumulates due to retarded decomposition under saturated conditions 2. *Streaking of subsurface horizons by organic matter* -- streaks form as the fluctuating water table pulls organic matter downward along paths of least resistance in the subsoil 3. *Wet Spodosols* (soils with "organic pans") -- not all Spodosols are hydric. Wet Spodosols are addressed in the lecture on Problem Area Wetlands 4. *Others mentioned previously for nonsandy soils* -- other indicators that also apply to sands include histic epipedon, aquic moisture regime, and hydric soils list c. The SCS South Region has developed a list of hydric soil indicators for sandy soils in the Southeast (particularly Florida). Individuals who work in that region should consult the list to help clarify the general guidance given the the Delineation Manual.	194, 195 (high organic matter content in the surface horizon, Florida sandy soil), 196 (organic streaking in the subsoil, Florida Spodosol [spodic horizon at bottom])
f. Review and wrap-up 1. First identify the soil series and look it up on the appropriate hydric soil list 2. Then verify by checking field indicators	197 (review of soils decision process)

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Lecture Outline: **Soil Color**	Slides
I. Background a. Color is one of the most easily determined characteristics of soil, and it is an indirect indicator of other important soil properties. 1. Two properties affecting soil color are (1) organic matter content and (2) presence and chemical form of Fe and Mn 2. Both of these properties are important in identification of hydric soils	198
b. Common names for colors (e.g., light red, grayish brown) mean different things to different people. To bring consistency to color determinations, soil scientists have borrowed from industry in using the Munsell color system c. Soil colors are determined by matching a soil sample to color chips contained in the *Munsell Soil Color Charts* (Kollmorgen Corporation, Baltimore, MD)	199 (using the Munsell soil color book)
II. Aspects of soil color a. The Munsell color system describes three aspects of color -- hue, value, and chroma	200
1. *Hue* refers to the spectral color or chromatic composition of light reflected by an object	201 (diagram of visible spectrum)
a. Munsell soil color books contain only those hues that are important in describing soils. Those are red (R), yellow-red (YR), and yellow (Y). Each hue is divided into 4 equal steps (e.g., 2.5YR, 5YR, 7.5YR, and 10YR) 1. In the Munsell soil color book, each page represents a different hue, and pages range from 10R through 5Y	202
b. Example of the 10YR page (all chips on a page are of the same hue)	203 (10YR page)
c. Some additional hues are important in very wet soils, including blue-green (BG) and green-yellow (GY). These are given on the *gley page* of the Munsell book.	204 (gley page)

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Lecture Outline: **Soil Color**	Slides
2. *Value* refers to the amount of light reflected from the chip. a. On a neutral gray scale, a value of 10 indicates pure white, and value of 0 indicates pure black.	205
b. Value runs north-south on the Munsell page. All chips in a row have equal value.	206 (7.5YR page)
3. *Chroma* refers to the relative purity or strength of the spectral color. a. Chroma runs from 0 (neutral gray) to 8 (highest strength of color found in soils)	207
b. Chroma runs east-west across the Munsell page. All chips in a column have equal chroma. c. Chroma is the most important aspect of color for hydric soil determinations. Typical hydric soils have a matrix chroma of 1 or less (if unmottled), or a matrix chroma of 2 or less (if mottled), immediately below the A horizon.	208 (2.5Y page)
d. Zero-chroma chips have no color, they are neutral gray. Therefore, they are the same no matter which hue page they are found on. Often they are simply given a hue designation N (neutral).	209
4. Each color chip is designated by its Munsell notation (e.g., hue value/chroma), and each has an English name (although more than one color chip may be described by the same English name)	210
III. Reading colors a. Read soil colors in the field by placing the sample behind the Munsell page where it is visible through the holes in the page.	211 (using Munsell book)
b. When reading soil colors, you should consider: 1. Light 2. Moisture 3. Surface texture	212

Lecture Outline: **Soil Color**	Slides
c. Light should be: 1. White enough to reflect true color 2. Intense enough for you to discriminate between chips 3. Oriented at right angles to the sample and the color chips	213
d. Moisture 1. Hydric soil determinations are made on *moist* samples. a. Soils change color as they dry, and soils that are too wet may give erroneous readings due to reflection of light from water films.	214
e. Optimal conditions for reading soil colors 1. Natural light (don't wear sunglasses) 2. Clear, sunny day 3. Midday 4. Light at right angles 5. Soil moist	215
IV. Color patterns in soils a. A complete description of soil color patterns should include: 1. Matrix (predominant) color 2. Mottle colors 3. Contrast, abundance, and size of mottles	216

Lecture Outline: **Soil Color**	Slides
b. *Contrast* refers to the degree of visual distinction between the mottles and their background. Three categories: 1. *Faint* -- Mottles are evident only on close examination. Typically, faint mottles have the same hue as the matrix, and differ by no more than 1 unit of chroma or 2 units of value. 2. *Distinct* -- Mottles are readily seen but contrast only moderately with the matrix. a. If same hue, color differs by: 1. 2-4 units of chroma, or 2. 3-4 units of value. b. If hue differs by 2.5 units (one page), color differs by: 1. 1 unit of chroma, or 2. 1-2 units of value. 3. *Prominent* -- Mottles contrast strongly with the matrix. Prominent mottles typically differ from the matrix by at least two pages (5 units) of hue (if chroma and value are the same); at least 4 units of value or chroma (if the hue is the same); or at least 1 unit of chroma or 2 units of value if hue differs by 1 page. 4. For hydric soil determinations, mottles should be either distinct or prominent. Observations suggest that faint mottles can develop in a single season; soils with faint mottles should be considered unmottled.	217, 218
c. *Abundance* of mottles (three categories): 1. *Few* -- mottles occupy less than 2% of the exposed surface 2. *Common* -- mottles occupy 2 to 20% of the exposed surface 3. *Many* -- mottles occupy more than 20% of the exposed surface	219

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Lecture Outline: **Soil Color**	Slides
d. *Size* of mottles (three categories): 1. *Fine* -- Mottles less than 5mm in longest dimension 2. *Medium* -- Mottles range from 5 to 15mm in longest dimension 3. *Coarse* -- Mottles greater than 15mm in longest dimension	220

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Lecture Outline: **Use of Soil Surveys**	Slides
I. Background a. A modern soil survey report covering the site in question is the most useful single reference available to assist in making a wetland determination, if you understand how to interpret and use it.	221, 222 (cover of soil survey report)
II. Soil maps and map units a. The heart of a soil survey is a series of maps of soils within the survey area (usually a county). 1. The *General Soil Map* shows the major soil groups or associations in the county. Each association has a distinctive pattern of soils, relief, and drainage. a. The general soil map is useful for orientation and for general planning purposes, but its coarse scale limits its usefulness for wetland determinations.	223 (general soil map)
2. To locate a particular site on the detailed soil maps, consult the *Index to Map Sheets.*	224 (index to map sheets)
3. The index leads to the appropriate *Map Sheet*, which has soil delineations marked on an aerial photograph. The map sheets include major cultural features, such as towns and major roads, for orientation. Soil delineations are given numerical or alphabetical codes.	225 (soil map sheet)
4. The codes are explained in the *Soil Legend*, which gives the names of the *Map Units* delineated on the map sheets.	226 (soil legend)
5. Map units are named for the predominant soil or soils found within them. For example: a. Ac -- Alliance loam, 0 to 1 percent slopes 1. "Ac" is the map unit symbol 2. "Alliance" is the name of the predominant soil series in the map unit 3. "Loam" is the texture of the surface layer (which can vary within a series) 4. "0 to 1 percent slopes" is the soil phase, a subset of the series that affects soil management.	227

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Lecture Outline: **Use of Soil Surveys**	Slides
6. *Map Unit Descriptions* are found in the front of the soil survey. Map units are highly variable in their composition, and usually consist of more than one soil series or miscellaneous soil type.	228
7. Soil series, on the other hand, have much more narrowly defined properties. All representatives of a series have similar types and arrangement of horizons. *Soil Series Descriptions* for series that exist in the county are also given in the front of the soil survey, generally separate from the map unit descriptions. a. Series descriptions include a description of the typical pedon of that series found in the county, as well as the range of properties (textures, colors, thickness of horizons) expected in the county. b. It is important to remember that soil survey maps delineate *map units* and not series.	229 (series description)
b. Kinds of soil map units 1. *Consociations* -- soil map units dominated by and named for a single kind of soil a. For example: 1. Massie silty clay, 0 to 1 percent slopes (hydric) 2. Tama silty clay loam, 2 to 5 percent slopes (nonhydric) 3. Wet alluvial land (hydric) b. However, the map unit may consist of up to 49% other soils, if they are similar in interpretation, and up to 25% dissimilar soils.	230

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Lecture Outline: **Use of Soil Surveys**	Slides
2. *Complexes and Associations* -- soil map units that consist of two or more different soils that occur in a regular pattern on the landscape (e.g., one soil on ridges, another in swales). The terms "complex" and "association" are arbitrarily distinguished by mapping scale. a. Examples: 1. Tryon-Valentine complex, 0 to 6 percent slopes (Tryon hydric, Valentine nonhydric) 2. Canyon-Bridget-Rock Outcrop, steep (first two are series names; Rock Outcrop is a miscellaneous land type) b. Complexes and associations are identified by hyphenated names. c. In each map unit of a complex or association, each major soil component is normally present, although their proportions may vary from unit to unit. d. Again, map units may have up to 25% dissimilar inclusions.	231
3. *Undifferentiated groups* -- soil map units that consist of two or more different soils that are not consistently associated and occur irregularly on the landscape a. Examples: 1. Hord and Hall silt loams, terrace, 0 to 1 percent slopes b. Undifferentiated groups are identified by the "and" between soil names. c. A delineation of Hord and Hall silt loam may contain only Hord, only Hall, or both. d. Again, map units may have up to 25% dissimilar inclusions.	232

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4. *Inclusions within map units* -- soils contained within a map unit that are not part of the name of that unit. a. Areas of included soils may be too small to delineate separately at the mapping scale, or they may be too difficult to locate and delineate by practical field methods. 1. Up to 49% of the map unit can be included soils. b. The map unit description in the soil survey should list all known included soils.	233
c. Local lists of hydric soil map units 1. Local lists of hydric soils are generally compiled at the county level and are designed to accompany the soil survey report. a. Local hydric soil lists are available from the county or area SCS office. 2. Generally, the local list consists of: a. Map unit symbol b. Map unit name c. Hydric soil component (this may be one or more of the named soils, or specified inclusions) d. Landscape position	234
3. Examples: a. The named soil is hydric (remember that there may still be nonhydric inclusions) b. Included soils are hydric c. Example of depressional landscape position d. Example of bottomland landscape position	235, 236, 237, 238

Lecture Outline: **Use of Soil Surveys**	Slides
c. Orders of soil surveys 1. Soil surveys are done at different levels of detail or resolution depending upon the needs of anticipated users. a. *First order surveys* are made for very intensive land uses. Map units are mostly consociations and phases of soil series. Delineations have a minimum size of 2.5 acres or less depending upon scale. Base map scale is generally 1:15,840 or larger. b. *Second order surveys* are for intensive land uses requiring detailed information about land suitability for different uses and management requirements. Map units are mostly consociations and complexes, including phases. Minimum delineation size ranges from 1.5 to 10 acres depending on scale and landscape complexity. Base map scale generally ranges from 1:12,000 to 1:31,680. 1. Most county soil surveys are second order surveys. c. *Third, fourth, and fifth order surveys* are progressively less detailed. Map units are mostly associations. Minimum delineation size ranges from 4 to 10,000 acres. Map scales range from 1:20,000 to 1:1,000,000.	239

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Lecture Outline: **Use of Soil Surveys**	Slides
III. Review of soil survey information a. Modern soil surveys contain a wealth of information useful to wetland determinations. 1. Introductory section on climate, history, and physiography 2. Map unit descriptions (describing included soils) 3. Series descriptions (containing profile descriptions and ranges of characteristics) 4. Tables, including: a. Monthly precipitation records b. Growing season information c. Physical and chemical properties (including permeabilities by horizon) d. Soil and water features (flooding and water table data by series) e. Classification of the soils 5. Soil map sheets and legends	Examine copies of a soil survey

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Lecture Outline: **Soil Taxonomy**	Slides
I. Background a. A regulator can reduce the amount of time required to make a wetland determination on an unfamiliar site by first reviewing available information in the office. At a minimum, one should examine the USGS topographic map, NWI map, and the appropriate county soil survey report. b. One can gain a great deal of information about the soils on a site by examining the final table in most modern soil surveys -- "Classification of the Soils". c. It is not the purpose of this course to teach you how to classify soils; that is the job of a soil scientist. The goal is to teach you how to translate soil taxonomic names so that you can: 1. Rapidly orient yourself to the soil conditions on an unfamiliar site. 2. Quickly identify which soil units are likely to contain wetlands. 3. Identify problem soil situations in which the typical field indicators of hydric soil may not be reliable (see the Problem Area lecture outline).	240
II. Soil Taxonomy a. A basic system of soil classification for making and interpreting soil surveys 1. The complete reference on the taxonomic system is *Soil Taxonomy* (Agriculture Handbook No. 436) published by SCS in 1975. The abridged version and vehicle for updates to the system is *Keys to Soil Taxonomy*, which is revised and reprinted every couple years.	241, 242 (photo of Munsell color book, *Soil Taxonomy*, and *Keys to Soil Taxonomy*)
b. Objective of soil taxonomy -- to develop a hierarchical classification system that reflects the relationships between different soils, and between soils and the factors responsible for their distinctive characteristics	243
c. The classification is based on soil properties observed in the field, in combination with information from other disciplines (e.g., soil temperature and moisture regimes are inferred from meteorological data)	244

Lecture Outline: **Soil Taxonomy**	Slides
d. A hierarchical classification starts with a few broad classes of soils having a great deal of variability within classes, and repeatedly sorts them into smaller and smaller categories in which soil types are more and more similar 1. Soil classification has six levels -- order, suborder, great group, subgroup, family, and series (also sometimes phases) 2. Similar to animal classification (phylum, class, order, family, genus, species, and sometimes subspecies)	245
e. Broadest category is the *order*, and there are only 11 of them. 1. Distinguished by presence or absence of major diagnostic horizons, which indicate the major soil-forming processes that have occurred	246
2. The 11 orders are: Alfisols, Andisols, Aridisols, Entisols, Histosols, Inceptisols, Mollisols, Oxisols, Spodosols, Ultisols, and Vertisols (briefly describe with the help of handouts) a. Show examples of Histosol, Mollisol, Entisol, Vertisol, Ultisol, Spodosol	247, 248 (Histosol), 249 (Mollisol), 250 (Entisol), 251 (Vertisol), 252 (Ultisol), 253 (Spodosol)
3. Taxonomic names are comprised of "formative elements," which are assembled from right to left. The last element in a taxonomic name represents the soil order.	254
f. Orders are divided into *suborders* (53 of them) 1. Distinguished by wetness characteristics, parent materials, and effects of vegetation 2. This is the first point in the system where wetness may be reflected in the name 3. Refer to handouts giving the complete list of suborder formative elements (Table 9 in *Soil Taxonomy*)	255

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Lecture Outline: **Soil Taxonomy**	Slides
4. Example of four Entisol suborders (Arents not shown) a. Aquents -- indicating aquic conditions b. Fluvents -- floodplain soils c. Psamments -- sandy Entisols d. Orthents -- catch-all category for typical Entisols	256
g. Suborders are divided into *great groups* (211 of them) 1. Distinguished by kind, arrangement, and degree of expression of horizons; soil moisture and temperature regimes; and base status	257
2. Examples of great groups within the Aquents, Fluvents, and Psamments a. Refer to handout of great group formative elements (Table 10 in *Soil Taxonomy*)	258, 259, 260
h. Great groups are divided into *subgroups* (>1,000 of them) 1. Three kinds of subgroups: a. "Typic" -- the central concept or typical representative of the great group b. Intergrades -- soils that are transitional toward some other recognized soil taxon c. Extragrades -- soils that deviate from the central concept of the great group, but not in a way that is transitional to any other recognized soil classification	261
2. Examples of subgroups, showing how soil taxonomic names are assembled from right to left a. Typic Fluvaquent b. Mollic Fluvaquent (an intergrade, toward Mollisol) c. Aeric Fluvaquent (an extragrade)	262, 263, 264
i. Great groups are divided into *families* (>5,000 recognized) 1. Distinguished by physical and chemical properties that affect management (e.g., particle-size distribution, mineral [clay] content, reaction [pH], and temperature regime)	265

Lecture Outline: **Soil Taxonomy**	Slides
2. Many family-level descriptors may be added to a soil name. One item of interest to us is the soil temperature regime, which indicates average soil temperature and *approximate* growing season length a. Figure shows the broad soil temperature regime zones in the contiguous US b. In general, these zones coincide with the distribution of major agricultural crops (i.e., the wheat belt, the corn belt, the cotton belt, and the citrus belt [from north to south])	266 (map of soil temperature regime regions)
j. Families are divided into *series* (>15,000 currently recognized) 1. Series are further distinguished by kind and arrangement of horizons, color, texture, and structure 2. Generally it is series names that appear on soil survey maps, and series are listed on hydric soils lists 3. Series names themselves are uninformative; usually they are taken from the post office nearest to the place where the series was first described	267
k. Review 1. Example showing how the name Aquic Fragiochrept was assembled 2. Additional examples -- What does the name mean? What should the soil look like? Then show an example. a. Typic Medisaprist b. Aquic Quartzipsamment c. Typic Argiaquoll d. Aeric Haplaquod	268, 269, 270 (Typic Medisaprist, Torry series, FL) 271, 272 (Aquic Quartzipsamment, Corolla series, FL), 273, 274 (Typic Argiaquoll, Chobee series, FL), 275, 276 (Aeric Haplaquod, Smyrna series, FL)

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Lecture Outline: **Offsite Method**	Slides
I. Background a. With rare exceptions, wetland jurisdictional boundary determinations must be based on on-site examination of vegetation, soils, and hydrology. b. However, for some applications (e.g., resource inventories, advanced identification of wetlands, planning studies) offsite methods may be adequate.	277, 278
c. Use the offsite method when: 1. Information is available in the office concerning hydrology, soils, and vegetation on a site. 2. Field inspection is not possible due to time constraints or other reasons (e.g., National Wetland Inventory and Food Security Act inventories, which must be done rapidly over vast areas).	279
d. The accuracy of offsite wetland determinations depends on: a. Quality of the available data b. One's ability and experience to interpret these data	280
e. If a more accurate delineation is required, then onsite procedures must be employed.	281
II. Sources of information for an offsite determination a. USGS topographic maps -- give site location and landmarks, topographic information and drainage (although the contour interval is generally too large for delineation purposes)	282, 283 (USGS topo map)
b. SCS soil survey reports -- provide soil maps, map unit and series descriptions, hydrologic information, and growing season data	284 (soil surveys)
c. National Wetland Inventory maps -- wetland maps based on interpretation of aerial photography with limited ground truthing. Wetland types are based on the Cowardin et al. (1979) classification system. NWI itself is an offsite method.	285 (NWI map)

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Lecture Outline: **Offsite Method**	Slides
d. Aerial photography -- available from both local and national sources (e.g., ASCS Aerial Photo Field Office, Salt Lake City, UT; USGS Eros Data Center, Sioux Falls, SD).	286 (CIR aerial photo)
e. Environmental impact statements and other planning documents -- check Corps of Engineers planning offices and other agencies	287 (environmental impact statement)
f. Land use and land cover maps available from USGS and local sources	288 (land use map)
g. Permit applicant's engineering drawings and site maps may provide enough information for a preliminary wetland determination.	289, 290 (engineeering drawings)
III. Example of Food Security Act offsite techniques a. In implementing the Swampbuster provisions of the Food Security Act of 1985, SCS is inventorying wetlands in agricultural areas throughout the US. They have put considerable effort into development of offsite methods. Their procedures are also relevant to Clean Water Act wetland determinations. b. The procedure: 1. Step 1 -- Locate and delineate the area of interest on a USGS topographic map or other suitable base map. 2. Step 2 -- Review appropriate National Wetlands Inventory maps, or state or local wetland maps. 3. Step 3 -- Review SCS soil survey maps and county hydric soils list for the presence of hydric soil map units or map units with hydric soil inclusions.	291

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Lecture Outline: **Offsite Method**	Slides
4. Step 4a -- Review recent aerial photos of the project area. Examples include: a. ASCS yearly compliance slides 1. These generally are low-altitude photos taken during June or July when crops are identifiable. They are used to monitor acreage restrictions for farmers participating in crop subsidy programs. Recent slides are kept at ASCS local offices; older slides at SCS county offices. b. High altitude flights c. Satellite photography 5. Step 4b -- Review and evaluate climatological data to determine whether the area had high, low, or normal precipitation for at least 2-3 months prior to the date of the photography.	292
6. Step 4c -- During photo interpretation, look for one or more signs of wetlands. For example: a. Hydrophytic vegetation b. Surface water c. Saturated soils d. Flooded or drowned-out crops e. Stressed crops due to wetness f. Greener crops in dry years g. Differences in vegetation patterns due to different planting dates	293
7. Step 5 -- Review available site-specific information. 8. Step 6 -- Determine whether wetlands exist in the subject area. Wetlands can be assumed to exist if: a. Wetlands are shown on NWI or other wetland maps, and hydric soil or a soil with hydric soil inclusions is shown on the soil survey; or	294

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Lecture Outline: **Offsite Method**	Slides
b. Hydric soil or a soil with hydric soil inclusions is shown on the soil survey and: 1. Site-specific information confirms hydrophytic vegetation, hydric soils, and/or wetland hydrology, or 2. Signs of wetland are detected by reviewing aerial photos, or c. Any combination of the above or parts thereof (e.g., vegetated wetland on NWI maps and signs of wetland on aerial photos).	295
c. Analysis of remote imagery is a major part of FSA wetland inventories. To insure consistency in interpretation, each SCS region developed wetland mapping conventions. We will look at two examples: (a) for the prairie pothole region and (b) for the lower Mississippi valley bottomland hardwood region.	296 (SCS South Wetland Mapping Conventions)
d. Mapping conventions in the prairie pothole region 1. Mapping conventions are tailored for the tools and information available locally. Here an investigator examines ASCS compliance slides for all available years.	297 (examining ASCS yearly compliance slides)
2. Prairie potholes vary considerably in size, shape, and hydroperiod.	298 (prairie potholes)
3. Some potholes pond water only temporarily or seasonally. Most potholes are farmed at least during dry years.	299 (farmed pothole)
4. Some potholes are clearly wetlands, while others barely meet wetland criteria, if at all. Variability in wetness poses problems for the photo interpreter, thus the need for mapping conventions.	300 (aerial of potholes)
5. Soil surveys generally are not of much help in this region because potholes occur as inclusions within map units. None of these map units is hydric in its entirety but all have hydric inclusions.	301 (soil map)

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Lecture Outline: **Offsite Method**	Slides
6. ASCS slides are an invaluable tool in this region. Mapping conventions require that an area be called wetland if it exhibits a wetland signature more often than not (e.g., in 3 out of 5 yearly ASCS slides). a. These 5 slides are of the same area in 5 different years. As an example, select a pothole on the first slide and see how many years a wetland signature is visible by examining the same spot on subsequent slides.	ASCS slides of the same area in 5 different years: 302, 303, 304, 305, 306
7. SCS mapping conventions also require that an area be called wetland if it is delineated on NWI map and is supported by any other piece of office information (e.g., ASCS slides, soil surveys, etc.).	307 (pothole on NWI map)
8. Example of previous NWI delineation confirmed on 1:660 black-and-white photo. Notice, however, the ditch that extends to the wetland. This wetland could be partially or totally drained.	308 (1:660 photo of previous pothole)
9. The final step in offsite determinations is a map on which wetlands are delineated.	309 (map with wetlands delineated)
e. Bottomland hardwood region 1. Next we look at mapping conventions used in the bottomland hardwood region in Mississippi	310 (bottomland forest)
2. This slide demonstrates three wetland categories as they might appear on the ground: a. Areas still in woody vegetation on hydric soils are assumed to be wetlands (right side of photo) b. Farmed areas converted to agriculture before December 1985 and inundated for at least 15 consecutive days during the growing season are designated "farmed wetlands" (in distance) c. Farmed areas converted before December 1985 and inundated for less than 15 consecutive days are "prior converted croplands" (in foreground)	311 (farmed field adjacent to forest)
3. Useful office information includes the USGS topographic map (this is the Six Mile Lake area in the delta of Mississippi)	312 (USGS topo map)

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Lecture Outline: **Offsite Method**	Slides
4. Soil surveys are much more extensively used in this region, because it is more typical for whole map units to be hydric. SCS mapping conventions in this region state that any area in woody vegetation on mapped hydric soil is assumed to be wetland.	313 (soil survey map)
5. Another convention states that if NWI delineates an area as wetland and that is supported by any other piece of collateral data (e.g., ASCS slides, soil survey, aerial photos, etc.), delineate it as wetland. However, NWI generally doesn't delineate farmed wetlands for much of the US outside the pothole and playa regions.	314 (NWI map)
6. Again, if wetland signatures occur more often than not on yearly ASCS slides, delineate the area as wetland. Use these 4 slides to identify wetlands in this area.	ASCS slides of the same area in 4 different years: 315, 316, 317, 318
7. The National Aerial Photography (NAP) and National High Altitude Photography (NHAP) programs provide other useful tools. Resolution is better than ASCS slides, but timing and frequency of flights are a problem.	319 (NAP photo)
8. Some of the best information on flooding over extensive areas comes from satellite data which, through multiple passes, can provide information on frequency and duration of flooding episodes.	320 (satellite photo)
9. SCS has worked with NASA to identify and define satellite signatures that indicate seasonal flooding, and can be used to delineate wetlands. Yellow is farmed wetlands flooded 15 days or more. Green is wetlands still in woods.	321 (satellite mapping of wetlands)
10. Again, the final step is the delineation. Here is the FSA inventory base map with wetland types indicated.	322 (final FSA inventory)

The USDA Soil Conservation Service contributed many of the slides in this lecture.

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Lecture Outline: **Routine Method for Small Areas**	Slides
I. Background a. In most cases, wetland boundary determinations are made in the field using an appropriate on-site method. b. The Methods section of the Manual offers general guidance on sampling designs for identifying wetlands and determining their boundaries in the field. Investigators must use their experience and good judgment in adapting the sampling protocol to the site. Deviations from the suggested procedure should be documented.	323
c. The Manual describes three approaches for on-site wetland determinations: 1. Routine Method for small areas (≤5 acres) 2. Routine Method for large areas (>5 acres) a. The routine methods are relatively rapid procedures based on largely qualitative information. One of these methods should be sufficient in the vast majority of projects. 3. Comprehensive Method a. The comprehensive method is a much more laborious procedure based on more quantitative vegetation analysis and larger sample sizes. Intended for use only when highly detailed information is needed, such as in cases involving lawsuits.	324
II. Routine Method for Small Areas a. Use this method when: 1. Project area is small (≤5 acres) 2. Plant communities are homogeneous 3. Plant community boundaries are abrupt 4. Project is not controversial a. Although the Manual suggests the 5-acre threshold, this approach also works well in larger areas if plant communities are discrete.	325, 326, 327

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Lecture Outline: **Routine Method for Small Areas**	Slides
b. Equipment and materials needed for routine methods: 1. Base map (with project area identified) 2. Copies of data form (one for each sampling point) a. The routine data form originally published in Appendix B of the Manual has been superseded by a new form approved for use by Corps Headquarters in a 6 March 1992 memorandum. Do not use any other data forms for jurisdictional purposes without Headquarters approval. 3. Wetland plant list (for the appropriate region) 4. Hydric soils list (use the local list, if available) 5. County soil survey 6. Compass (for establishing transects in large areas) 7. Tile spade, soil auger, or probe 8. Measuring tape (short tape for soil measurements, long tape for laying out transects and sampling plots) 9. Munsell soil color book a. Additional items one may wish to consider: stakes or flagging, plant guides, water bottle to moisten soil.	328
c. Procedures: 1. Step 1 -- Locate the project area. 2. Step 2 -- Is the area (or any part of it) disturbed such that procedures for Atypical Situations must be used? a. Become familiar with the Atypical Situation section of the Manual. 3. Step 3 -- Select a sampling approach (here we choose the routine method for small areas).	329

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Lecture Outline: **Routine Method for Small Areas**	Slides
4. Step 4 -- Identify and map the plant communities (if community boundaries are not obvious, use a different method). 5. Step 5 -- Determine whether normal conditions are present (is it a potential Problem Area wetland?) a. Become familiar with the Problem Area section of the Manual. 6. Step 6 -- Select a representative observation point in each plant community. a. Again, if plant communities are so variable that it is not possible to select a representative point, use a different method.	330
b. Example: a small site is bounded by a road, a stream, and marked property lines. The investigator maps the plant communities and gives each a name (A, B, C, D).	331 (map of project site, with cover types indicated)
c. Example: at least one representative point is selected in each plant community. More points can be sampled if desired.	332 (map indicating representative sampling points)
7. Step 7 -- Visually select dominant species from each stratum in the community. Two options: a. Select the three most dominant plant species from each stratum (5 if only 1 or 2 strata). b. Use the 50/20 rule to select dominants from each stratum (see Hydrophytic Vegetation lecture notes). 8. Step 8 -- Record the wetland indicator status of each dominant species using the appropriate regional wetland plant list. 9. Step 9 -- Determine whether the vegetation is hydrophytic. a. The basic rule states that more than 50% of dominant species from all strata must be OBL, FACW, or FAC (not counting FAC-).	333

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Lecture Outline: **Routine Method for Small Areas**	Slides
b. Dominant species are selected independently from each of 4 strata: 1. Tree -- woody plants ≥3 inches DBH, regardless of height 2. Sapling/shrub -- woody plants ≥3.2 ft tall but <3 inches DBH 3. Herb -- all nonwoody plants, and woody plants <3.2 ft tall 4. Woody vine -- woody climbing plants ≥3.2 ft tall	334 (definitions of strata)
c. Examples: 1. Plant community having only one stratum (herb) 2. Plant community having two strata (herb and sapling/shrub) 3. Plant community having all 4 strata 4. Record information on approved data form.	335 (Washington tidal marsh), 336 (Alaska black spruce bog), 337 (Mississippi bottomland forest), 338, 339 (data form)
10. Step 10 -- Record indicators of wetland hydrology. a. At least one primary indicator or two secondary indicators are needed. 11. Step 11 -- Determine whether wetland hydrology is present.	340, 341 (data form)

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Lecture Outline: **Routine Method for Small Areas**	Slides
12. Step 12 -- Determine whether soil must be characterized. Soil is assumed to be hydric if: a. All dominant species are OBL, or b. All dominant species are OBL or FACW and the wetland boundary is abrupt 13. Step 13 -- If needed, dig a soil pit. a. Recommend that this always be done, even in obvious cases. b. Dig the pit at least 18 inches deep. A tile spade (sharpshooter) exposes more soil and gives more reliable results than a probe or auger in most cases. 14. Step 14 -- Record indicators of hydric soil. a. This includes describing the soil profile (in terms of depth, color, and texture of horizons), determining the soil series by comparing with the profile descriptions given in the soil survey for series contained in that map unit, and looking up that series on the hydric soils list. Also record other hydric soil indicators. 15. Step 15 -- Determine whether the soil is hydric.	342, 343 (data form)
16. Step 16 -- Make the wetland determination in each plant community. a. Note the wording in the Manual: "If the entire area presently *or normally* has wetland indicators of all three parameters, the entire area is a wetland [p. 62]." b. In other words, be aware that certain highly seasonal wetlands may lack indicators of one or more parameters at certain times of year (see the Problem Area section). Use experience and good judgment in making your decision, and thoroughly document any departures from the letter of the Manual. 17. Step 17 -- Determine the wetland/nonwetland boundary. Verify by walking the boundary and making minor adjustments based on soils and vegetation.	344, 345 (data form)

Lecture Outline: **Routine Method for Small Areas**	Slides
a. Example: On the base map, mark each sampling point as wetland (W) or nonwetland (N). Because these points were representative of the plant communities in which they were located, the entire community is assumed to be wetland or nonwetland.	346
b. Example: Combine wetland communities and nonwetland communities into separate units. The wetland boundary is assumed to coincide with the boundary between wetland and nonwetland communities. Verify by walking the boundary and adjusting as needed.	347

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Lecture Outline: **Routine Method for Large Areas**	Slides
I. Background a. This method is particularly useful, even in small areas, if plant communities are not homogeneous, or if community boundaries are indistinct (e.g., areas where plant communities change more gradually in response to environmental gradients).	348
II. Procedure: a. Steps 1 through 3 are the same as for smaller areas (locate the site, map the plant communties, select a sampling method). b. Step 18 -- Establish a baseline. 1. The baseline should be a linear feature, readily apparent on a map or aerial photograph of the site, running perpendicular to the expected moisture gradient (e.g., a road, powerline, or marked property line). c. Step 19 -- Determine the number and position of transects. 1. Divide the baseline length by the desired number of transects to determine the length of baseline segments. Establish a transect at the midpoint of each baseline segment and run them down (or up) the hydrologic gradient, perpendicular to the baseline. 2. Each plant community in the area must be traversed by at least one transect. If needed, adjust transect locations to sample all communities.	349
3. Suggested minimum number of transects. 1. Based on baseline length: a. <1.0 mile -- minimum of 3 transects b. 1.0-2.0 miles -- 3-5 transects c. 2.0-4.0 miles -- 5-8 transects d. >4.0 miles -- 8 or more transects	350 (table of suggested minimum number of transects)
4. Example: Same site used for the routine method for small areas, now demonstrating the transect approach. Four transects were selected. The position of the last transect had to be adjusted to pass through plant community A.	351 (site map, showing transects)

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Lecture Outline: **Routine Method for Large Areas**	Slides
d. Step 20 -- Sample points along the first transect. 1. Determine whether normal conditions are present (again, is this a Problem Area situation?). 2. Establish an observation point at a representative location in the first plant community. 3. Characterize the vegetation, soil, and hydrology and record information on the data form. a. For vegetation sampling, use an estimated 5-ft radius plot centered at the sampling point for herbs, and a 30-ft radius plot for all other strata (plot sizes may be adjusted as needed). 4. Make the wetland determination at that point. a. Again, are indicators of all three parameters present, or *normally present*, at that point. 5. Sample the remaining points (established at representative locations in the remaining plant communities) along that transect. 6. Determine the wetland boundary *between* sampling points. a. Sample intermediate points between adjacent wetland/nonwetland points until the wetland boundary is located. Document the highest extent of wetland with another data form.	352
7. Example: Sampling points are established at representative locations in each plant community along each transect.	353 (site map, showing sampling points)
8. Example: Intermediate points are sampled to locate the wetland boundary along each transect (X marks the boundary).	354 (site map, showing intermediate points)

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Lecture Outline: **Routine Method for Large Areas**	Slides
e. Step 21 -- Sample the remaining transects. f. Step 22 -- Synthesize data and determine the wetland boundary between transects. 1. If transects are close enough together, the wetland boundary may be approximated with a point-to-point survey. 2. More accurate results are obtained by drawing the boundary along the topographic contour, then walking the line to make minor adjustments as needed. 3. In field notes, record the distance along each transect from the baseline to the wetland boundary.	355
3. Example: The final result is a map of wetland boundaries that may or may not coincide with plant community boundaries. A point-to-point survey of the wetland boundary may be desired.	356 (site map with wetland boundary), 357 (surveyor)

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Lecture Outline: **Comprehensive Method**	Slides
I. Background a. The Comprehensive Method differs from the Routine Method mainly in the detail with which vegetation is sampled, and in the larger number of sampling points. It involves more quantitative analysis of the vegetation to justify the choice of dominant species from each stratum of the plant community. b. It is a much more laborious and time-consuming procedure that is intended for detailed documentation of controversial decisions (e.g., court challenges).	358
c. Equipment and materials 1. The list is similar to that for routine determinations, with the addition of a vegetation sampling frame, diameter tape or basal-area prism, and a calculator. 2. Additional data forms are also needed to compile and analyze the vegetation data.	359
II. Procedures: a. Step 1 -- Identify the project area. b. Step 2 -- Determine whether procedures for Atypical Situations must be used (are any areas significantly disturbed?). c. Step 3 -- Identify and map the plant communities.	360
d. Step 4 -- Determine the type and number of strata in each plant community. e. Step 5 -- Determine whether normal environmental conditions are present (again, is it a potential Problem Area?). f. Step 6 -- Establish a baseline. g. Step 7 -- Determine number and position of transects. 1. The Manual suggests that transect starting points should be located at random within each baseline segment. This is unnecessary and, in fact, can result in large unsampled gaps between transects. Start transects at midpoints of baseline segments. h. Step 8 -- Determine the number of observation points along each transect. 1. Observation points are established at fixed intervals along each transect, without regard to plant community boundaries.	361

Lecture Outline: **Comprehensive Method**	Slides
2. Suggested minimum number of transects, depends on baseline length: a. <1,000 ft -- minimum of 3 transects b. 1,000-5,000 ft -- 5 transects c. 5,000-10,000 ft -- 7 transects d. >10,000 ft -- 8 or more transects 1. Note that suggested transect spacing is much closer than that recommended for the routine method.	362 (suggested minimum number of transects)
3. Example: Four plant communities (A, B, C, D) are mapped in a small watershed where wetlands are to be delineated. Seven transects are established perpendicular to a road which serves as a baseline.	363 (site map showing transects)
4. Suggested spacing of sampling points, based on transect length: a. <1,000 ft -- 100 ft between sampling points b. 1,000-10,000 ft -- 100-1,000 ft between points c. >10,000 ft -- 1,000 ft between sampling points	364 (suggested spacing of sampling points)
5. Example: The result is a rectangular grid of sampling points. Use common sense whether all points need to be sampled; it may be unnecessary to sample long stretches of the same community.	365 (site map showing sampling points)
i. Step 9 -- Characterize vegetation at the first sampling point. j. Step 10 -- Analyze vegetation data and select dominant species from each stratum.	366
1. Characterize the tree stratum a. Identify, measure the diameter, and calculate the basal area of each tree in a 30-ft radius plot. 1. As an alternative, use a forester's 10-factor prism to estimate basal area of each tree species.	367 (measuring DBH with a diameter tape)
b. Data Form 2 provided in Appendix B of the Manual can be used to compile vegetation data. This is the section of the form for trees.	368 (data form)

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Lecture Outline: **Comprehensive Method**	Slides
1. Filled-out data form gives basal area of each individual tree, and total by species. Use these data to select the dominant species, either by choosing the top three species, or by using the 50/20 rule.	369 (data form)
2. Characterize the herb stratum a. Use the procedure described in the Manual if the herb stratum is homogeneous: 1. Place a meter-square quadrat at the sampling point. 2. Identify all species in the quadrat and estimate percent cover by species.	370 (sampling herb stratum)
3. Assign each species to a cover class, and give it a cover value equal to the midpoint for that cover class. a. This step is optional, and may help improve the reliability of visual estimates of cover.	371 (cover classes)
4. Record the results in the appropriate block of Data Form 2. Use these data to select dominant species from the herb stratum.	372 (data form)
b. Alternative procedure if the herb stratum is so patchy and heterogeneous that a centrally located plot does not give a representative sample: 1. Divide the 30-ft radius sampling plot into quarters along compass directions and randomly cast the sampling frame at least two times into each quarter. a. A smaller sampling frame can be used with this alternative procedure (e.g., half meter square). 2. Identify all species in each quadrat and estimate percent cover by species. 3. Average these values for each species across all quadrats. 4. Record the results on Data Form 2 and select the dominant species.	373 (diagram of random placement of sampling quadrats)

Lecture Outline: **Comprehensive Method**	Slides
3. Characterize the sapling/shrub and woody vine strata using similar methods. a. Sapling/shrub species can be sampled using visual estimates of percent cover within the 30-ft radius plot, or by the cumulative-height technique described in the Manual. b. Use percent cover or stem density within the 30-ft radius plot for woody vines. c. Select dominants from each stratum.	374 (measuring a sapling/shrub)
k. Step 11 -- Characterize the soil. 1. Procedures are the same as for routine methods: a. Dig a pit; describe the profile; determine the series by comparing the observed profile with profile descriptions given in the soil survey; and look up the series on the local hydric soils list. b. Record other indicators of hydric soils. l. Step 12 -- Characterize hydrology. 1. Record indicators of wetland hydrology. m. Step 13 -- Determine whether vegetation is hydrophytic. n. Step 14 -- Determine whether soil is hydric. o. Step 15 -- Determine whether wetland hydrology is present. p. Step 16 -- Make the wetland determination at that point.	375
q. Step 17 -- Sample additional points along that transect. r. Step 18 -- Determine the wetland boundary between points, by sampling intermediate points. s. Step 19 -- Sample the remaining transects. t. Step 20 -- Synthesize the data across all transects. u. Step 21 -- Determine the wetland boundary between transects. 1. Connect boundary locations (generally along the contour), and walk the line to verify and make minor adjustments.	376
2. Example: Sample intermediate points as needed to locate the wetland boundary (or boundaries) along each transect (X marks the wetland lines).	377 (site map)

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Lecture Outline: **Comprehensive Method**	Slides
3. Example: Connect the boundary locations to delineate the wetlands. Additional short transects may be needed to firm up the boundary in unsampled areas. Record the distances to wetland boundaries from the baseline.	378 (site map showing wetland boundary)

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Lecture Outline: **Atypical Situations**	Slides
I. Background a. *Atypical situations* is the Manual's term for areas where one or more field indicators of wetlands have been obscured by some recent change. *Disturbed areas* is a more descriptive term.	379
b. Examples of disturbances that can obscure wetland indicators include: 1. Human activities a. Removal of vegetation b. Removal of soil c. Placement of fill d. Construction of dams and levees e. Conversion to agriculture f. Channelization g. Drainage 2. Natural events a. Change in river course b. Beaver dams c. Avalanches and mud slides d. Fires e. Volcanic deposition c. This section of the Manual is designed primarily for enforcement situations, where the goal is to determine whether wetlands existed on the site *before* a human-induced alteration. 1. It is largely a forensic section, involving a search for missing wetland indicators. d. If the goal is to determine whether wetlands *currently* exist on a site that was disturbed in the past, standard methods for undisturbed sites may be sufficient. e. At the end of this lecture, some methods for evaluating current hydrology on disturbed areas will be discussed.	380, 381 (area cleared, leveled, and leveed [in distance]), 382 (ditch), 383 (conversion to agriculture), 384 (drained potholes), 385 (downcut stream), 386 (beaver dam), 387 (flood control channel)

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Lecture Outline: **Atypical Situations**	Slides
II. Procedures for disturbed areas a. The disturbance may affect any one or all of the three wetland parameters -- vegetation, soils, hydrology. In each case, the procedural steps are similar. 1. Perform the wetland determination using standard methods for all undisturbed parameters. Refer to the section on Atypical Situations as needed for suggestions on dealing with disturbed parameters. Then return to the Methods section to complete the wetland delineation.	388
b. Any time an enforcement action is being considered in the case of a man-induced wetland alteration, one must first determine the date of the alteration in relation to Clean Water Act implementation dates. Dates of disturbances may be determined from: 1. Direct questioning 2. Aerial photographs 3. Building permits	389
c. Disturbances to the vegetation 1. Step 1 -- Describe the alteration (e.g., timber was harvested, area was bulldozed, site was filled). a. Record observations and conclusions on Data Form 3 in Appendix B of the Manual. 2. Step 2 -- Describe the effects on the vegetation. a. Cleared or partially cleared b. Certain layers removed (as in timber harvest) c. Selected species removed d. Burned, mowed, or heavily grazed e. Covered by fill f. Mortality due to excessive water	390, 391 (site cleared), 392 (tree layer removed), 393 (mowed)

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Lecture Outline: **Atypical Situations**	Slides
3. Step 3 -- Characterize the original vegetation. a. Aerial photography pre-dating the disturbance b. Onsite inspection for any surviving vegetation c. Records of previous site inspections d. Adjacent vegetation at the same elevation and on similar soils e. SCS records during mapping or other studies f. Permit applicant (e.g., in cases involving unintentional wetland disturbance) g. Public interviews (e.g., ask the neighbors) h. National Wetland Inventory maps 4. Step 4 -- Determine whether the vegetation was hydrophytic.	394
a. Example: Data Form 3 provides spaces to record observations and conclusions. This is the vegetation section.	395 (data form)
b. Example: Filled-out data form for a hypothetical situation.	396 (data form)
d. Disturbances to the soils 1. Step 1 -- Describe the alteration. a. Dredged or fill material covers original soil. This is indicated by: 1. Color or texture differences 2. Decomposing vegetation between layers 3. Nonwoody debris at the surface (e.g., building rubble) b. Subsurface plowing c. Removal of surface layers, indicated by: 1. Exposed plant roots or scrape scars d. Presence of man-made structures	397
e. Example: Fill in a forested wetland in Oregon.	398 (fill in wetland)
2. Step 2 -- Describe the effects on the soils. a. Record depth of fill over buried soil b. Record depth of plow zone c. Describe change in soil phase d. Describe effects of soil compaction	399

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Lecture Outline: **Atypical Situations**	Slides
3. Step 3 -- Characterize original soils. a. Soil survey information pre-dating the disturbance b. Excavate and characterize buried soils c. Characterize plowed soils below the plow zone d. Examine adjacent reference areas or the B horizon if surface layer is removed 4. Step 4 -- Determine whether soils were hydric.	400
a. Example: Filled-out soil section of the data form.	401 (data form)
e. Disturbance to hydrology 1. Step 1 -- Describe the alteration. a. Dams (man-made or natural) b. Levees or dikes c. Ditches or subsurface tiles d. Filling of channels or depressions e. Water diversion f. Ground-water extraction g. Channelization 1. Examples	402, 403 (inflatable weir), 404 (machine for installing drain tile), 405 (land levelers), 406 (channelized stream), 407 (ditches and drains)
2. Step 2 -- Describe effects on hydrology, in terms of: a. Frequency of inundation b. Duration of inundation or soil saturation	408
3. Step 3 -- Characterize previous hydrology. a. Stream or tide gauge data pre-dating the disturbance b. Field indicators of wetland hydrology that have persisted c. Aerial imagery pre-dating the disturbance d. Historical records e. Floodplain management maps f. Public or local officials 4. Step 4 -- Determine whether wetland hydrology was present.	409
a. Example: Filled out hydrology section of Data Form 3.	410 (data form)

Lecture Outline: **Atypical Situations**	Slides
f. Evaluating *existing* hydrology on disturbed sites 1. Even if the hydrology of a wetland has been altered, the site may still meet wetland hydrology criteria. a. Drainage activities may not have been effective, or they may simply have made the wetland somewhat less wet. 2. If wetland hydrology obviously is still present, there is no need to treat the site as an Atypical Situation. 3. If it is not clear whether drainage was successful, the following procedures may help to determine whether wetland hydrology still is present: a. Review hydrologic information post-dating the disturbance (e.g., gauges, wells, recent observations) b. Examine recent wet-season aerial photos c. Examine field indicators of wetland hydrology 1. Caution: Plant morphological adaptations and soil characteristics (e.g., oxidized root channels) may be relics of the previous hydrology. d. Examine a nearby undisturbed reference site at the same elevation and with similar soils e. Determine the zone of influence of drainage ditches or tiles (consult an SCS drainage specialist) f. Conduct groundwater studies	411

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Lecture Outline: **Problem Area Wetlands**	Slides
I. Background a. *Problem Area Wetlands* are wetlands that are inherently difficult to identify because field indicators of one or more wetland parameters may be absent or misleading, at least at certain times of the year. 1. These uncertainties exist even in the natural, undisturbed condition. b. The Problem Area section of the Manual describes "representative examples of potential problem areas." Problem wetland situations are not limited to this list. c. In this lecture, we will also discuss several problem soil situations that are only mentioned briefly in other parts of the Manual.	412, 413
II. Problem Areas a. Those described in the Manual: 1. Wetlands on drumlins or other glacial deposits 2. Seasonal wetlands 3. Prairie potholes 4. Vegetated flats b. Wetlands on drumlins or other glacial deposits 1. *Description:* In glaciated areas, often encounter wetland communities on side slopes where subsurface groundwater flow is constrained near the surface by impermeable soil layers. These wetlands are seasonally saturated and rarely, if ever, inundated. 2. *The problem:* The unusual landscape position (slopes), potential lack of hydrology indicators during dry periods, and very stony soils. 3. *Potential solutions:* During dry periods, delineate these wetlands largely on the basis of vegetation and soils.	414, 415

Lecture Outline: **Problem Area Wetlands**	Slides
c. Seasonal wetlands 1. *Description:* Many parts of the western US are characterized by pronounced wet/dry seasons. Depressional wetlands in these areas (e.g., vernal pools) may be difficult to identify during the prolonged dry season. 2. *The problem:* (a) Potential lack of hydrology indicators during the dry season. (b) The pools may be dominated during dry periods by upland annuals (UPL and FACU) that can germinate, grow, flower, and set seed before the onset of the wet season; thus hydrophytic vegetation indicators may be lacking. (c) Some pools exist due to tight soils that perch water during rainy periods; therefore, hydric indicators may exist only near the surface. 3. *Potential solutions:* During the dry season, identify and delineate these wetlands on the basis of depressional landscape position, ordinary high water marks, soil characteristics, and/or presence of live individuals or dead remnants of plant species known to specialize on these wetlands.	416, 417 (California vernal pool in February), 418 (same vernal pool in May), 419 (same vernal pool in October)

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Lecture Outline: **Problem Area Wetlands**	Slides
d. Prairie potholes 1. *Description:* Prairie potholes are depressional wetlands abundant in the glaciated region of the northcentral US. They are critical nesting habitat for many species of waterfowl. The prairie pothole region is subject to multiyear wet and dry cycles. During dry years, potholes are often cultivated or pastured. 2. *The problem:* During dry years, potholes may not be inundated or saturated during the growing season. They may lack hydrologic indicators during dry periods, and may be invaded by upland plant species. Agricultural disturbance may make vegetation and soil decisions more difficult. Furthermore, the soils are mostly Mollisols (see later in this lecture). 3. *Potential solutions:* During dry periods, delineate these wetlands largely on the basis of soil characteristics, depressional landscape position, remnant hydrophytic vegetation, and/or persistent hydrology indicators. Consult SCS concerning Food Security Act procedures for wetland identification involving examination of annual ASCS compliance photography.	420, 421 (prairie potholes)
e. Vegetated flats 1. *Description:* Vegetated flats are wetlands that are dominated by annual or nonpersistent wetland species (e.g., wild rice, arrowhead), which disappear completely after the growing season. 2. *The problem:* Vegetated flats resemble unvegetated mudflats during the nongrowing season. Although mudflats are also regulated waters of the US, regulatory procedures may differ for vegetated wetlands. 3. *Potential solutions:* Identify these areas by interviews with local residents, aerial photography taken during the growing season, and/or presence of persistent below-ground plant parts.	422, 423 (vegetated flat during nongrowing season)

Lecture Outline: **Problem Area Wetlands**	Slides
f. Problem areas noted elsewhere in the Manual 1. Man-induced wetlands 2. Wet Entisols 3. Wet soils from red or low-chroma parent materials 4. Wet Spodosols 5. Wet Mollisols	424
g. Man-induced wetlands 1. *Description:* These are wetlands that have developed characteristics of naturally occurring wetlands due to intentional or incidental human activities. a. Examples: irrigated wetlands, impoundment wetlands, constructed wetlands, and filled deepwater habitats 2. *The problem:* Recently created wetlands may lack typical indicators of hydric soils (e.g, gray subsoil colors), although soils meet hydric criteria based on inundation or saturation. 3. *Potential solutions:* Use indicators other than color to evaluate hydric soils, particularly direct information on inundation or saturation.	425, 426, 427, 428 (mitigation wetland [center] in New Hampshire)
h. Wet Entisols 1. *Description:* Entisols are recently derived soils that show little profile development. They form in recent river deposits, sand dunes, and glacial deposits. Although many wet Entisols are easily recognized as hydric soils, some may not have had sufficient time to develop the low chromas and other characteristics seen in more typical hydric soils. 2. *The problem:* Hydric Entisols may lack certain indicators (e.g., low-chroma colors) of hydric soils. 3. *Potential solutions:* Rely on other hydric soil indicators, particularly direct evidence of inundation or saturation. Refer to *Keys to Soil Taxonomy* for key to Aquents (wet Entisols).	429, 430 (wet Entisols [formed of Mount St. Helens ash] along the Toutle River in Washington)

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Lecture Outline: **Problem Area Wetlands**	Slides
i. Wet soils from red or low-chroma parent materials 1. *Description:* Some soils retain the color of their parent materials even after a long history of saturation and reduction. Examples include red soils (rich in iron-containing minerals) derived from Triassic sandstones and shales. 2. *The problem:* Hydric components of these soils may not exhibit typical hydric soil colors. 3. *Potential solutions:* Rely on other hydric soil indicators. Consult the soil survey and local SCS office for assistance in identifying hydric series derived from red, green, or gray parent materials.	431, 432 (Triassic sandstones and shales outcrop in a Colorado stream; transported alluvial deposits form red soils downstream)
j. Wet Spodosols 1. *Description:* Spodosols generally are coarse-textured soils associated with coniferous forests in humid regions. Organic acids from the leaf litter move downward through the soil with rainfall, cleaning the sand grains in the layer below the A-horizon (forming a gray eluvial or E-horizon), and coating the sands below with organic matter, iron, and aluminum, forming a dark spodic (Bh) horizon. 2. *The problem:* Even nonhydric Spodosols have low-chroma colors in the E-horizon immediately below the A-horizon. The color is due to the inherent color of the uncoated sand grains and not necessarily due to reduction. 3. *Potential solutions:* Refer to *Keys to Soil Taxonomy* for key to identifying Aquods (wet Spodosols). Also consult SCS for local or regional guidance. The SCS South Region has developed a list of hydric soil indicators for sandy soils that is useful for identifying hydric Spodosols throughout the southeastern coastal plain. Depending on location, hydric Spodosols may have some or all of the following: a mucky surface layer; thick, organic-rich mineral surface; organic streaking through the E-horizon; mottling in the E-horizon or upper part of the spodic horizon; and/or low-chroma colors below the spodic horizon.	433, 434 (Spodosol)

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Lecture Outline: **Problem Area Wetlands**	Slides
k. Wet Mollisols 1. *Description:* Mollisols are prairie soils that develop under grass or grasslike vegetation. They are particularly common throughout the Great Basin. These soils typically have deep, dark topsoil layers (mollic epipedons) that can extend to considerable depths. The color is due to accumulation of organic matter and churning by soil organisms. 2. *The problem:* Even nonhydric Mollisols can have low-chroma matrix colors "immediately below the A-horizon or 10 inches (whichever is shallower)." Ten inches may not be sufficient to get below the A-horizon, and the color is due to organic matter rather than reduction. 3. *Potential solution:* Refer to the Aquoll key in *Keys to Soil Taxonomy* and consult the local SCS office for guidance. In many situations, hydric Mollisols can be recognized by gray colors immediately below the mollic epipedon (even if deeper than 10 inches) and/or distinct or prominent mottles in the lower part of the mollic epipedon.	435, 436 (Mollisol country in North Dakota), 437 (gray mottles in a sample of mollic epipedon from a Michigan soil)

CORPS OF ENGINEERS
WETLAND DELINEATION METHOD

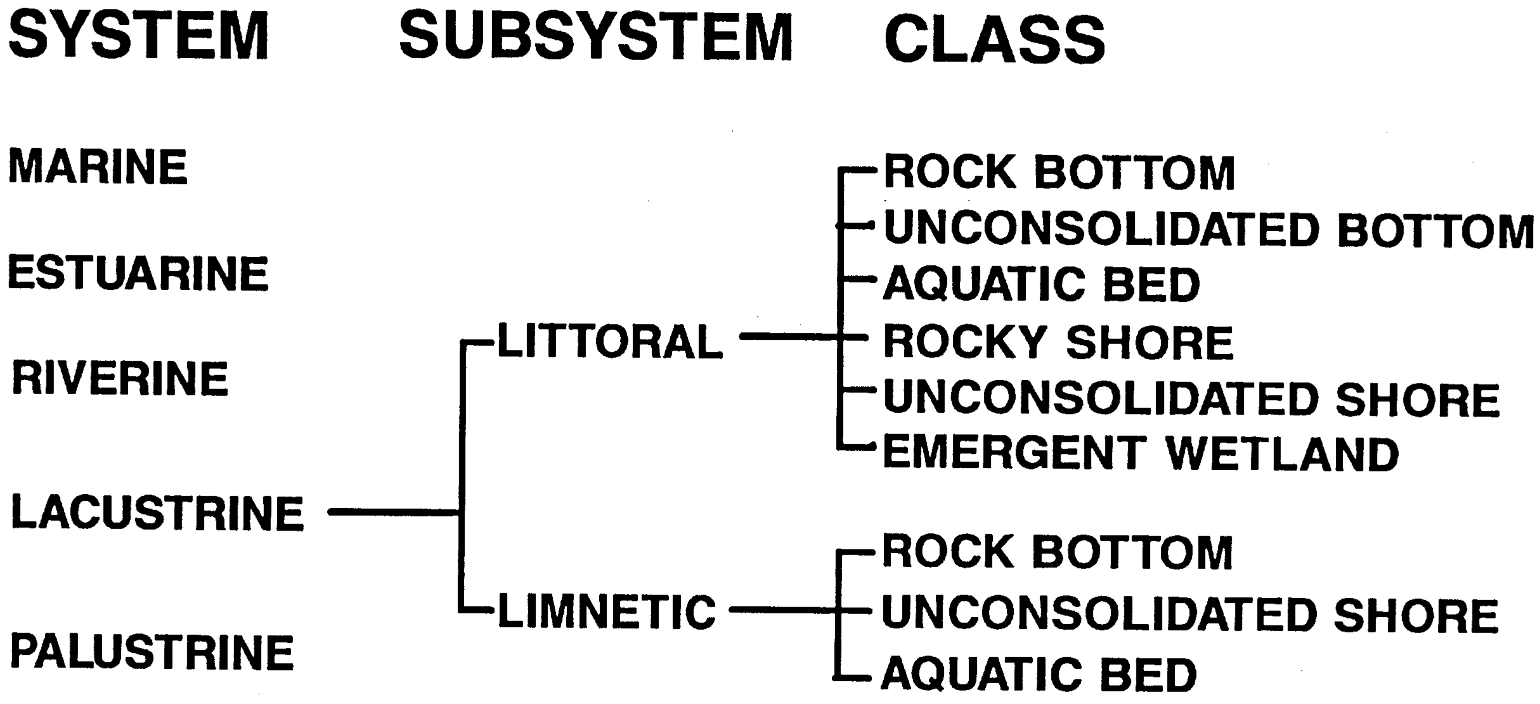
PURPOSE

PROVIDE MANDATORY TECHNICAL CRITERIA, FIELD INDICATORS, AND RECOMMENDED METHODS FOR IDENTIFYING WETLANDS AND DELINEATING THEIR UPPER BOUNDARIES FOR JURISDICTIONAL PURPOSES.

EPA SPECIAL AQUATIC SITES

○ WETLANDS
○ SANCTUARIES AND REFUGES
○ MUDFLATS
○ VEGETATED SHALLOWS
○ CORAL REEFS
○ RIFFLE AND POOL COMPLEXES

FWS WETLAND CLASSIFICATION SYSTEM



SYSTEM

- MARINE
- ESTUARINE
- RIVERINE
- LACUSTRINE
  - LITTORAL
    - ROCK BOTTOM
    - UNCONSOLIDATED BOTTOM
    - AQUATIC BED
    - ROCKY SHORE
    - UNCONSOLIDATED SHORE
    - EMERGENT WETLAND
  - LIMNETIC
    - ROCK BOTTOM
    - UNCONSOLIDATED SHORE
    - AQUATIC BED
- PALUSTRINE

SUBSYSTEM

CLASS

WETLAND DEFINITIONS

COE/EPA - SECTION 404 CWA:

AREAS THAT ARE INUNDATED OR SATURATED BY SURFACE OR GROUND WATER AT A FREQUENCY AND DURATION SUFFICIENT TO SUPPORT, AND THAT UNDER NORMAL CIRCUMSTANCES DO SUPPORT, A PREVALENCE OF VEGETATION TYPICALLY ADAPTED FOR LIFE IN SATURATED SOIL CONDITIONS.

DIAGNOSTIC CHARACTERISTICS

- ○ VEGETATION
- ○ SOILS
- ○ HYDROLOGY

WDM00002 02/25/88:ABC

NORMAL CIRCUMSTANCES

- ○ THE SOIL AND HYDROLOGICAL CONDITIONS THAT WOULD EXIST IF THE VEGETATION WERE NOT ALTERED OR REMOVED
- ○ CROPPING OR CROPPING HISTORY IS NOT THE NORMAL CIRCUMSTANCE

NORMAL CIRCUMSTANCES

AREAS DESIGNATED AS "PRIOR CONVERTED CROPLANDS" BY SCS ARE NOT SUBJECT TO REGULATION UNDER SECTION 404.

RGL 90-7

WETLAND DEFINITIONS

SCS - FSA "SWAMPBUSTER" PROVISIONS:

AREAS THAT HAVE A PREDOMINANCE OF HYDRIC SOILS AND THAT ARE INUNDATED OR SATURATED BY SURFACE OR GROUND WATER AT A FREQUENCY AND DURATION SUFFICIENT TO SUPPORT, AND UNDER NORMAL CIRCUMSTANCES DO SUPPORT, A PREVALENCE OF HYDROPHYTIC VEGETATION TYPICALLY ADAPTED FOR LIFE IN SATURATED SOIL CONDITIONS, EXCEPT LANDS IN ALASKA IDENTIFIED AS HAVING A HIGH POTENTIAL FOR AGRICULTURAL DEVELOPMENT AND A PREDOMINANCE OF PERMAFROST SOILS.

WETLAND DEFINITIONS

FWS - CLASSIFICATION OF WETLANDS AND DEEPWATER HABITATS:

LANDS TRANSITIONAL BETWEEN TERRESTRIAL AND AQUATIC SYSTEMS WHERE THE WATER TABLE IS USUALLY AT OR NEAR THE SURFACE, OR THE LAND IS COVERED BY SHALLOW WATER. FOR PURPOSES OF THIS CLASSIFICATION, WETLANDS MUST HAVE ONE OR MORE OF THE FOLLOWING THREE ATTRIBUTES: (1) AT LEAST PERIODICALLY, THE LAND SUPPORTS PREDOMINANTLY HYDROPHYTES; (2) THE SUBSTRATE IS PREDOMINANTLY UNDRAINED HYDRIC SOIL; AND (3) THE SUBSTRATE IS NONSOIL AND IS SATURATED WITH WATER OR COVERED BY SHALLOW WATER AT SOME TIME OF THE GROWING SEASON OF EACH YEAR.

DEEPWATER HABITATS

PERMANENTLY INUNDATED AREAS LYING BELOW THE DEEPWATER BOUNDARY OF WETLANDS. MEAN WATER DEPTH IS GENERALLY > 6.6 FT, UNLESS EMERGENT OR WOODY PLANT SPECIES GROW BEYOND THIS DEPTH. IN MARINE AND ESTUARINE AREAS, DEEPWATER HABITATS BEGIN AT THE EXTREME LOW SPRING TIDE LEVEL.

WDM00147 03/30/88:CDC

OBJECTIVES

○ PRESENT TECHNICAL CRITERIA

○ DESCRIBE FIELD INDICATORS

○ DESCRIBE DELINEATION METHODS

○ PROVIDE SUPPORTING INFORMATION

WDM00149 03/30/88:CDC

FLEXIBILITY

WETLAND DELINEATIONS SHOULD BE BASED ON THE BEST AVAILABLE DATA, TEMPERED WITH PROFESSIONAL JUDGMENT.

HYDROLOGY

HYDROLOGY

SCIENCE OF WATER, ITS PROPERTIES, DISTRIBUTION AND CIRCULATION, BOTH ON THE SURFACE AND UNDERGROUND.

WDM00085 02/25/88:ABC

SOURCES OF WATER

- DIRECT PRECIPITATION
- HEADWATER FLOODING
- BACKWATER FLOODING
- TIDES
- GROUND WATER
- COMBINATIONS OF ABOVE

FACTORS THAT INFLUENCE HYDROLOGY

○ PRECIPITATION

○ STRATIGRAPHY

○ TOPOGRAPHY

○ SOIL TEXTURE

○ PLANT COVER

INUNDATION

A CONDITION IN WHICH WATER FROM ANY SOURCE TEMPORARILY OR PERMANENTLY COVERS A LAND SURFACE.

PONDED

A CONDITION IN WHICH WATER STANDS IN A CLOSED DEPRESSION. THE WATER IS REMOVED ONLY BY PERCOLATION, EVAPORATION, OR TRANSPIRATION.

FLOODED

THE SOIL SURFACE IS TEMPORARILY COVERED WITH FLOWING WATER FROM ANY SOURCE, SUCH AS OVERFLOWING STREAMS OR RIVERS, RUNOFF FROM ADJACENT SLOPES, AND INFLOW FROM HIGH TIDES.

SATURATION

CONDITION IN WHICH ALL EASILY DRAINED PORES BETWEEN SOIL PARTICLES ARE TEMPORARILY OR PERMANENTLY FILLED WITH WATER.

WATER TABLE

THE LEVEL AT WHICH WATER STANDS IN AN UNLINED BOREHOLE.

ANAEROBIC

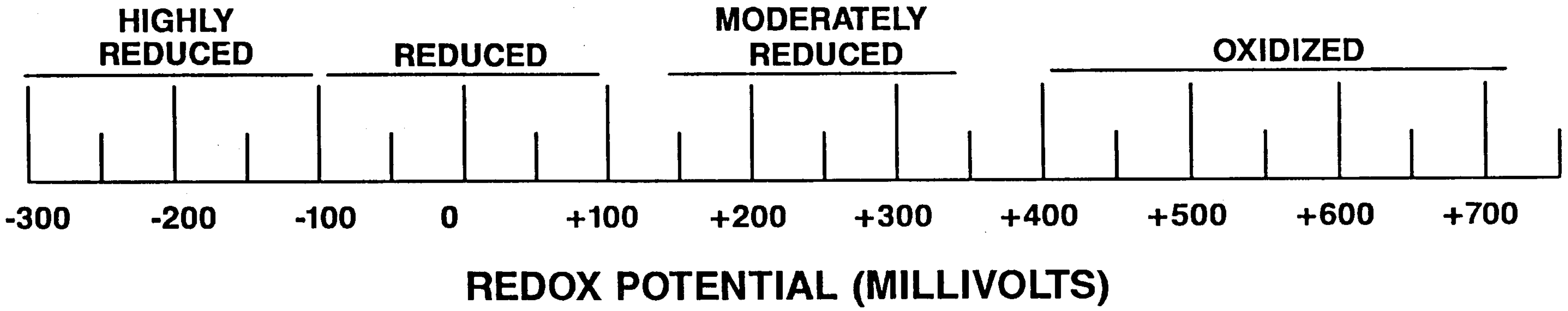
A SITUATION IN WHICH MOLECULAR OXYGEN IS ABSENT FROM THE ENVIRONMENT.

REDUCTION

THE PROCESS OF GIVING UP OXYGEN, GAINING HYDROGEN, OR GAINING AN ELECTRON.

OXIDATION/REDUCTION SEQUENCE

+350 mV	OXYGEN	O_2	→	H_2O
+220 mV	NITROGEN	NO_3^-	→	NO_2^-, N_2, NH_4^+
+200 mV	MANGANESE	Mn^{+4}	→	Mn^{+2}
+120 mV	IRON	Fe^{+3}	→	Fe^{+2}
-150 mV	SULFUR	SO_4^{-2}	→	H_2S
-250 mV	CARBON	CO_2	→	CH_4



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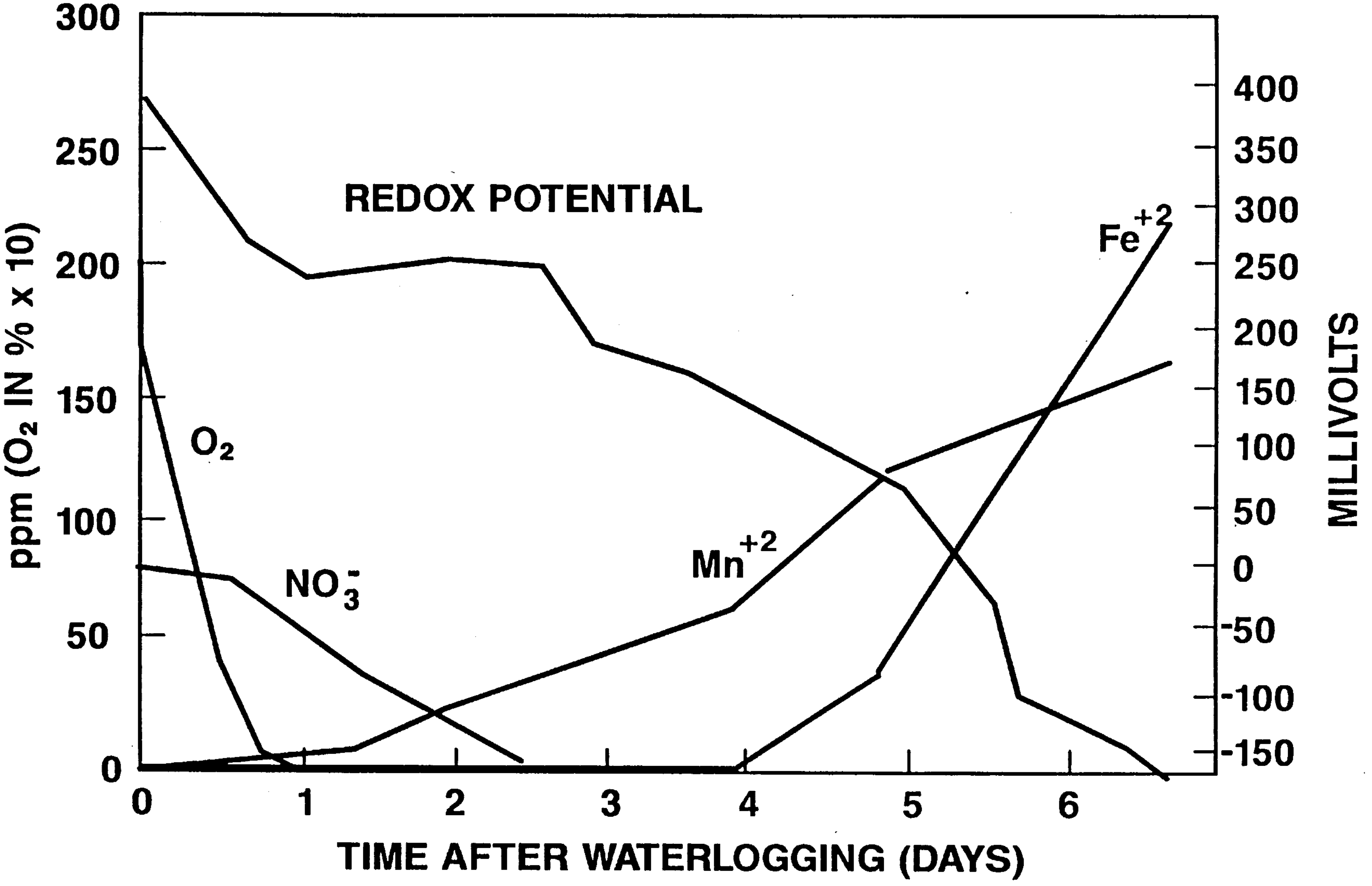


#WDM0185

CRITERIA FOR WETLAND HYDROLOGY
(1987)

AREA IS INUNDATED OR SATURATED TO THE SURFACE FOR AT LEAST 5% OF THE GROWING SEASON IN MOST YEARS

WDM00218 03/22/89:HMH

GROWING SEASON

THE PORTION OF THE YEAR WHEN SOIL TEMPERATURE (MEASURED 20 INCHES BELOW THE SURFACE) IS ABOVE BIOLOGIC ZERO (41°F).

WDM00197 03/09/89:HMH

HYDROLOGIC INFORMATION

○ TIDE GAUGE DATA

○ STREAM GAUGE DATA

○ GROUNDWATER WELL DATA

○ AERIAL IMAGERY

SOURCES OF HYDROLOGIC DATA

- ○ CORPS DISTRICT OFFICES
- ○ USGS
- ○ NOAA
- ○ SCS
- ○ STATE, COUNTY, AND LOCAL AGENCIES
- ○ DEVELOPERS

HYDROLOGY FIELD INDICATORS
(1987)

PRIMARY INDICATORS

○ OBSERVATION OF INUNDATION

○ OBSERVATION OF SOIL SATURATION

○ WATER MARKS

○ DRIFT LINES

○ SEDIMENT DEPOSITS

○ DRAINAGE PATTERNS IN WETLANDS

HYDROLOGY FIELD INDICATORS
(1987)

SECONDARY INDICATORS
(2 OR MORE REQUIRED)

- ○ OXIDIZED ROOT CHANNELS
- ○ WATER-STAINED LEAVES
- ○ LOCAL SOIL SURVEY DATA
- ○ FAC-NEUTRAL TEST

VEGETATION

WETLANDS ARE DOMINATED BY HYDROPHYTES

HYDROPHYTE

ANY MACROPHYTE THAT GROWS IN WATER OR ON A SUBSTRATE THAT IS AT LEAST PERIODICALLY DEFICIENT IN OXYGEN AS A RESULT OF EXCESSIVE WATER CONTENT.

ADAPTATIONS

- ○ MORPHOLOGICAL
- ○ PHYSIOLOGICAL
- ○ REPRODUCTIVE

ADAPTATIONS

○ MORPHOLOGICAL

○ PHYSIOLOGICAL

○ REPRODUCTIVE

WDM00213 03/22/89:RMH

MORPHOLOGICAL ADAPTATIONS OF PLANTS

○ BUTTRESSED TREE TRUNKS

○ MULTIPLE TRUNKS

○ PNEUMATOPHORES

○ ADVENTITIOUS ROOTS

○ SHALLOW ROOTS

○ HYPERTROPHIED LENTICELS

○ AERENCHYMA

○ POLYMORPHIC LEAVES

○ FLOATING LEAVES

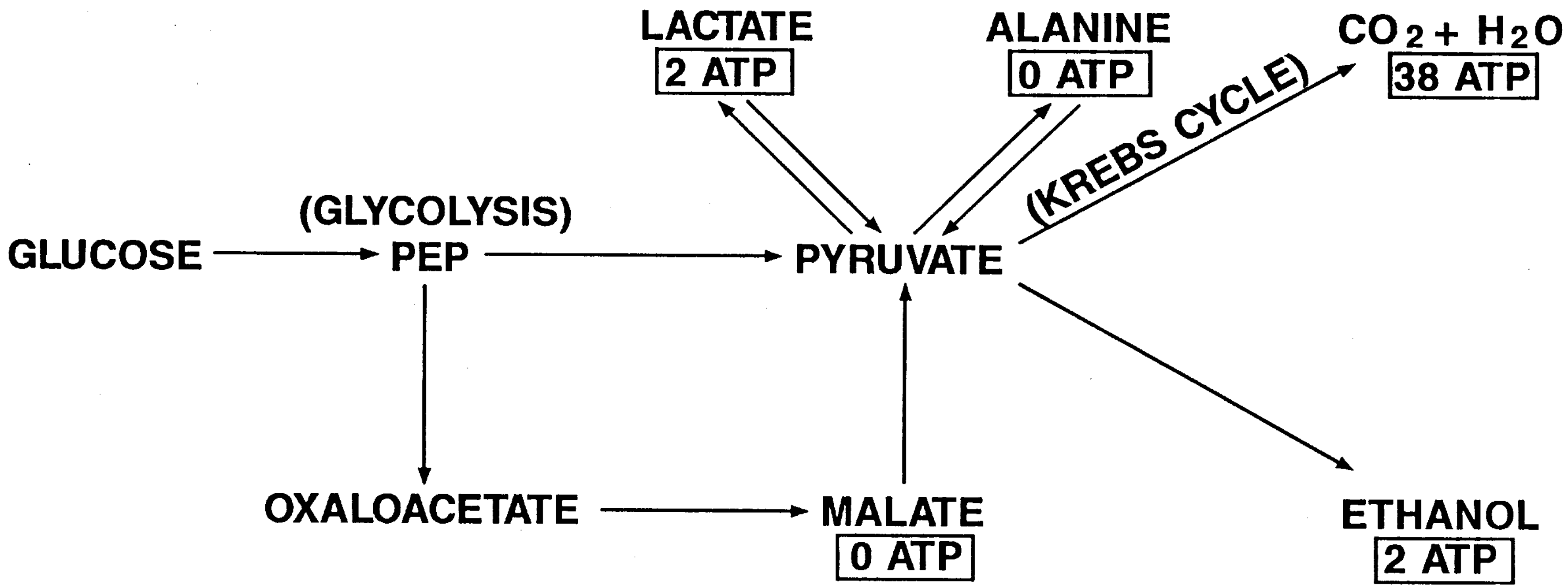
ADAPTATIONS

○ MORPHOLOGICAL

○ PHYSIOLOGICAL

○ REPRODUCTIVE

METABOLIC PATHWAYS



LACTATE
2 ATP

ALANINE
0 ATP

$CO_2 + H_2O$
38 ATP

(KREBS CYCLE)

(GLYCOLYSIS)

GLUCOSE

PEP

PYRUVATE

OXALOACETATE

MALATE
0 ATP

ETHANOL
2 ATP

ADAPTATIONS

○ MORPHOLOGICAL
○ PHYSIOLOGICAL
○ REPRODUCTIVE

PLANT INDICATOR STATUS

INDICATOR CATEGORY	SYMBOL	OCCURRENCE IN WETLANDS
OBLIGATE WETLAND PLANTS	OBL	>99%
FACULTATIVE WETLAND PLANTS	FACW	67-99%
FACULTATIVE PLANTS	FAC	34-66%
FACULTATIVE UPLAND PLANTS	FACU	1-33%
OBLIGATE UPLAND PLANTS	UPL	<1%

OBLIGATE WETLAND PLANTS (OBL)

(REGION 1 EXAMPLES)

ASTER PUNICEUS	SWAMP ASTER
OSMUNDA REGALIS	ROYAL FERN
CAREX STRICTA	TUSSOCK SEDGE
CEPHALANTHUS OCCIDENTALIS	BUTTONBUSH
CHAMAECYPARIS THYOIDES	ATLANTIC WHITE CEDAR
SPARTINA ALTERNIFLORA	SMOOTH CORDGRASS

WDM00261 10/06/89:DLS

FACULTATIVE WETLAND PLANTS (FACW)

(REGION 1 EXAMPLES)

ALNUS RUGOSA	SPECKLED ALDER
ASTER NEMORALIS	BOG ASTER
CALAMAGROSTIS CANADENSIS	BLUEJOINT GRASS
FRAXINUS PENNSYLVANICA	GREEN ASH
ONOCLEA SENSIBILIS	SENSITIVE FERN
ULMUS AMERICANA	AMERICAN ELM

FACULTATIVE PLANTS (FAC)
(REGION 1 EXAMPLES)

*ACER RUBRUM**	RED MAPLE
CLETHRA ALNIFOLIA	SWEET PEPPERBUSH
KALMIA ANGUSTIFOLIA	SHEEP LAUREL
MAIANTHEMUM CANADENSE	CANADA MAYFLOWER
TRIENTALIS BOREALIS	AMERICAN STARFLOWER
VIBURNUM DENTATUM	ARROWWOOD

* VARIETY *TRILOBUM* AND SUBSPECIES *DRUMMONDII* ARE FACW.

WDM00264 10/06/89:DLS

FACULTATIVE UPLAND PLANTS (FACU)
(REGION 1 EXAMPLES)

ARALIA NUDICAULIS	WILD SARSAPARILLA
MITCHELLA REPENS	PARTRIDGEBERRY
PHLEUM PRATENSE	TIMOTHY
PINUS STROBUS	EASTERN WHITE PINE
ROSA MULTIFLORA	MULTIFLORA ROSE
RUBUS ALLEGHENIENSIS	ALLEGHENY BLACKBERRY

WDM00257 10/06/89:DLS

OBLIGATE WETLAND PLANTS (OBL)
(REGION 2 EXAMPLES)

CAREX LUPULIFORMIS	FALSE HOP SEDGE
CEPHALANTHUS OCCIDENTALIS	BUTTONBUSH
JUNCUS ROEMERIANUS	BLACK NEEDLERUSH
QUERCUS LYRATA	OVERCUP OAK
SAGITTARIA LATIFOLIA	BROADLEAF ARROWHEAD
TAXODIUM DISTICHUM	BALD CYPRESS

WDM00258 10/06/89:DLS

FACULTATIVE WETLAND PLANTS (FACW)
(REGION 2 EXAMPLES)

ARUNDINARIA GIGANTEA	GIANT CANE
FRAXINUS PENNSYLVANICA	GREEN ASH
JUNCUS EFFUSUS	SOFT RUSH
LEUCOTHOE RACEMOSA	FETTERBUSH
PINUS ELLIOTTII	SLASH PINE
QUERCUS PHELLOS	WILLOW OAK

FACULTATIVE PLANTS (FAC)

(REGION 2 EXAMPLES)

ARISTIDA STRICTA	PINELAND THREE-AWN GRASS
LIQUIDAMBAR STYRACIFLUA	SWEET GUM
PINUS TAEDA	LOBLOLLY PINE
POLYGONUM VIRGINIANUM	VIRGINIA KNOTWEED
QUERCUS NIGRA	WATER OAK
TOXICODENDRON RADICANS	POISON IVY

FACULTATIVE UPLAND PLANTS (FACU)

(REGION 2 EXAMPLES)

CELTIS OCCIDENTALIS	COMMON HACKBERRY
JUGLANS NIGRA	BLACK WALNUT
PINUS PALUSTRIS	LONG-LEAF PINE
PTERIDIUM AQUILINUM	BRACKEN FERN
*QUERCUS FALCATA**	SOUTHERN RED OAK
SERENOA REPENS	SAW PALMETTO

* VARIETY *PAGODIFOLIA* IS FAC.

OBLIGATE WETLAND PLANTS (OBL)
(REGION 3 EXAMPLES)

BRASENIA SCHREBERI	WATERSHIELD
IRIS VERSICOLOR	BLUEFLAG IRIS
POLYGONUM PUNCTATUM	DOTTED SMARTWEED
SALIX NIGRA	BLACK WILLOW
SCIRPUS VALIDUS	SOFTSTEM BULRUSH
TYPHA LATIFOLIA	COMMON CATTAIL

FACULATIVE WETLAND PLANTS (FACW)
(REGION 3 EXAMPLES)

ACER SACCHARINUM	SILVER MAPLE
CORNUS AMOMUM	SILKY DOGWOOD
EUPATORIUM PERFOLIATUM	BONESET
LINDERA BENZOIN	SPICEBUSH
OSMUNDA CINNAMOMEA	CINNAMON FERN
PLATANUS OCCIDENTALIS	AMERICAN SYCAMORE

FACULTATIVE PLANTS (FAC)
(REGION 3 EXAMPLES)

ACER RUBRUM	RED MAPLE
EQUISETUM ARVENSE	COMMON HORSETAIL
HORDEUM JUBATUM	FOXTAIL BARLEY
POPULUS DELTOIDES	EASTERN COTTONWOOD
SMILAX ROTUNDIFOLIA	COMMON GREENBRIER
TOXICODENDRON RADICANS	POISON IVY

FACULTATIVE UPLAND PLANTS (FACU)
(REGION 3 EXAMPLES)

PINUS STROBUS	EASTERN WHITE PINE
TSUGA CANADENSIS	EASTERN HEMLOCK
FRAXINUS AMERICANA	WHITE ASH
PRUNUS SEROTINA	BLACK CHERRY
RUBUS ALLEGHENIENSIS	ALLEGHENY BLACKBERRY
RHAMNUS CATHARTICA	COMMON BUCKTHORN

OBLIGATE WETLAND PLANTS (OBL)
(REGION 4 EXAMPLES)

NUPHAR LUTEUM	YELLOW COW-LILY
TYPHA LATIFOLIA	BROAD-LEAF CATTAIL
SAGITTARIA LATIFOLIA	BROAD-LEAF ARROW-HEAD
POLYGONUM AMPHIBIUM	WATER SMARTWEED
JUNCUS BALTICUS	BALTIC RUSH
BECKMANNIA SYZIGACHNE	AMERICAN SLOUGHGRASS

FACULTATIVE WETLAND PLANTS (FACW)
(REGION 4 EXAMPLES)

APIOS AMERICANA	AMERICAN POTATO-BEAN
ANEMONE CANADENSIS	CANADA THIMBLE-WEED
BIDENS FRONDOSA	DEVIL'S BEGGAR-TICKS
LILIUM CANADENSE	CANADA LILY
MERTENSIA CILIATA	STREAMSIDE BLUEBELLS
POPULUS ANGUSTIFOLIA	NARROW-LEAF COTTON-WOOD

FACULTATIVE PLANTS (FAC)
(REGION 4 EXAMPLES)

AGRIMONIA PARVIFLORA	SMALL-FLOWER GROOVEBUR
APOCYNUM CANNABINUM	CLASPING-LEAF DOGBANE
FRAXINUS PENNSYLVANICA	GREEN ASH
PLANTAGO LANCEOLATA	ENGLISH PLANTAIN
SPIRANTHES MAGNICAMPORUM	GREAT PLAINS LADIES' TRESSES
STACHYS HISPIDA	SMOOTH HEDGENETTLE

FACULTATIVE UPLAND PLANTS (FACU)
(REGION 4 EXAMPLES)

AMELANCHIER ALNIFOLIA	SASKATOON SERVICE-BERRY
ANDROPOGON GERARDII	BIG BLUESTEM
MEDICAGO LUPULINA	BLACK MEDIC
SAMBUCUS RACEMOSA	EUROPEAN RED ELDER
TRIFOLIUM REPENS	WHITE CLOVER
VULPIA OCTOFLORA	SIX-WEEKS FESCUE

OBLIGATE WETLAND PLANTS (OBL)

(REGION 5 EXAMPLES)

BECKMANNIA SYZIGACHNE	AMERICAN SLOUGHGRASS
CAREX LACUSTRIS	LAKEBANK SEDGE
IRIS VERSICOLOR	BLUEFLAG
POLYGONUM HYDROPIPEROIDES	SWAMP SMARTWEED
SALIX NIGRA	BLACK WILLOW
SIUM SUAVE	HEMLOCK WATER-PARSNIP

WDM00247 03/15/88:CDC

FACULTATIVE WETLAND PLANTS (FACW)

(REGION 5 EXAMPLES)

ACER SACCHARINUM	SILVER MAPLE
AGROSTIS ALBA	REDTOP
RIBES AMERICANUM	WILD BLACK CURRANT
SALIX BEBBIANA	BEBB WILLOW
SOLIDAGO GIGANTEA	GIANT GOLDENROD
URTICA DIOICA	STINGING NETTLE

WDM00246 03/15/88:CDC

FACULTATIVE PLANTS (FAC)
(REGION 5 EXAMPLES)

ATHYRIUM FILIX-FEMINA	SUBARCTIC LADY FERN
CAMPANULA ROTUNDIFOLIA	SCOTCH BELLFLOWER
HYPERICUM PYRAMIDATUM	GREAT ST. JOHN'S-WORT
QUERCUS SHUMARDII	SHUMARD OAK
SANICULA GREGARIA	CLUSTERED BLACK-SNAKEROOT
VERNONIA MARGINATA	PLAINS IRONWEED

WDM00184 03/15/88:CDC

FACULATIVE UPLAND PLANTS (FACU)
(REGION 5 EXAMPLES)

ACHILLEA MILLEFOLIUM	COMMON YARROW
ASTER PILOSUS	WHITE HEATH ASTER
CERASTIUM VULGATUM	COMMON MOUSE-EAR CHICKWEED
ORNITHOGALUM UMBELLATUM	COMMON STAR-OF-BETHLEHEM
QUERCUS MACROCARPA	BUR OAK
SAPONARIA OFFICINALIS	BOUNCING-BET

OBLIGATE WETLAND PLANTS (OBL)

(REGION 6 EXAMPLES)

ASCLEPIAS LANCEOLATA	FEN-FLOWER MILKWEED
TYPHA DOMINGENSIS	SOUTHERN CATTAIL
PONTEDERIA CORDATA	PICKEREL WEED
CEPHALANTHUS OCCIDENTALIS	COMMON BUTTONBUSH
FORESTIERA ACUMINATA	SWAMP PRIVET
NYSSA AQUATICA	WATER-TUPELO

FACULTATIVE WETLAND PLANTS (FACW)
(REGION 6 EXAMPLES)

ASTER SIMPLEX	PANICLED ASTER
BRACHIARIA PURPURASCENS	PARAGRASS
ERYNGIUM YUCCIFOLIUM	RATTLESNAKE-MASTER
QUERCUS LAURIFOLIA	LAUREL OAK
VERNONIA MISSURICA	MISSOURI IRONWEED
TAMARIX CHINESIS	CHINESE TAMARISK

WDM00223 03/15/88:CDC

FACULTATIVE PLANTS (FAC)
(REGION 6 EXAMPLES)

ARALIA SPINOSA	HERCULES CLUB
ERAGROSTIS PECTINACEA	PURPLE LOVEGRASS
HALESIA CAROLINA	CAROLINA SILVER-BELL
POPULUS DELTOIDES	EASTERN COTTONWOOD
SANICULA GREGARIA	CLUSTERED BLACK-SNAKEROOT
SMILAX ROTUNDIFOLIA	COMMON GREENBRIER

WDM00224 03/15/88:CDC

FACULTATIVE UPLAND PLANTS (FACU)
(REGION 6 EXAMPLES)

AMELANCHIER ARBOREA	DOWNY SERVICE-BERRY
ANDROPOGON TERNARIUS	SILVER BLUESTEM
EUPATORIUM CAPILLIFOLIUM	SMALL DOG-FENNEL THOROUGH-WORT
OENOTHERA LACINIATA	CUT-LEAF EVENING-PRIMROSE
PHLEUM PRATENSE	TIMOTHY
RUDBECKIA HIRTA	BLACK-EYED SUSAN

OBLIGATE WETLAND PLANTS (OBL)
(REGION 7 EXAMPLES)

ALISMA PLANTAGO-AQUATICA	BROAD-LEAF WATER-PLANTAIN
BIDENS AUREA	ARIZONA BEGGAR-TICKS
CAREX NEBRASCENSIS	NEBRASKA SEDGE
LOBELIA CARDINALIS	CARDINAL FLOWER
CEPHALANTHUS OCCIDENTALIS	COMMON BUTTONBUSH
SPARGANIUM EURYCARPUM	GIANT BURREED

WDM00226 03/15/88:CDC

FACULTATIVE WETLAND PLANTS (FACW)

(REGION 7 EXAMPLES)

BIDENS FRONDOSA	DEVIL'S BEGGAR-TICKS
CAREX MICROPTERA	SMALL-WING SEDGE
EQUISETUM HYEMALE	ROUGH HORSETAIL
POPULUS FREMONTII	FREMONT'S COTTON-WOOD
SPARTINA GRACILIS	ALKALI CORDGRASS

FACULTATIVE PLANTS (FAC)
(REGION 7 EXAMPLES)

ACER GLABRUM	ROCKY MOUNTAIN MAPLE
ASTER FALCATUS	WHITE PRAIRIE ASTER
BACCHARIS SALICINA	GREAT PLAINS FALSE-WILLOW
PICEA PUNGENS	BLUE SPRUCE
SAMBUCUS MEXICANA	MEXICAN ELDER
VITIS ARIZONICA	CANYON GRAPE

WDM00228 03/15/88:CDC

FACULTATIVE UPLAND PLANTS (FACU)
(REGION 7 EXAMPLES)

ACHILLEA MILLEFOLIUM	COMMON YARROW
BROMUS JAPONICUS	JAPANESE BROME
ERAGROSTIS MEXICANA	MEXICAN LOVEGRASS
POPULUS TREMULA	QUAKING ASPEN
PTERIDIUM AQUILINUM	BRACKEN FERN
SOLIDAGO CANADENSIS	CANADA GOLDEN-ROD

OBLIGATE WETLAND PLANTS (OBL)

(REGION 8 EXAMPLES)

CAREX AQUATILIS	WATER SEDGE
ELEOCHARIS OBTUSA	BLUNT SPIKERUSH
NUPHAR LUTEUM	YELLOW COW-LILY
RANUNCULUS AQUATILIS	WHITE WATER BUTTER-CUP
SAGITTARIA LATIFOLIA	BROAD-LEAF ARROW-HEAD
SALIX EXIGUA	SANDBAR WILLOW

FACULTATIVE WETLAND PLANTS (FACW)

(REGION 8 EXAMPLES)

ASCLEPIAS SPECIOSA	SHOWY MILKWEED
BACCHARIS VIMINEA	MULEFAT
ATRIPLEX SEMIBACCATA	AUSTRALIAN SALTBUSH
CORNUS STOLONIFERA	RED-OSIER DOGWOOD
JUNCUS BALTICUS	BALTIC RUSH
SALIX GOODDINGII	GOODDING WILLOW

WDM00255 10/06/89:DLS

FACULTATIVE PLANTS (FAC)
(REGION 8 EXAMPLES)

ASTRAGALUS AGRESTIS	FIELD MILKVETCH
HERACLEUM LANATUM	COW-PARSNIP
LONICERA INVOLUCRATA	FOUR-LINE HONEYSUCKLE
RUBUS PARVIFLORUS	WESTERN THIMBLEBERRY
SMILACINA STELLATA	STARRY FALSE-SOLOMON'S-SEAL
VACCINIUM CESPITOSUM	DWARF BLUEBERRY

FACULTATIVE UPLAND PLANTS (FACU)
(REGION 8 EXAMPLES)

ACHILLEA MILLEFOLIUM	COMMON YARROW
PHLEUM PRATENSE	TIMOTHY
OENOTHERA BIENNIS	COMMON EVENING-PRIMROSE
PINUS MONTICOLA	WESTERN WHITE PINE
STELLARIA MEDIA	COMMON CHICKWEED
SALSOLA KALI	RUSSIAN THISTLE

FACULTATIVE UPLAND PLANTS (FACU)
(REGION 9 EXAMPLES)

LOLIUM PERENNE	**PERENNIAL RYEGRASS**
POLYSTICHUM LONCHITUS	**NORTHERN HOLLY FERN**
GALIUM APARINE	**CATCHWEED BEDSTRAW**
ROSA WOODSII	**WOODS ROSE**
RUBUS DISCOLOR	**HIMALAYAN BLACKBERRY**
ACER MACROPHYLLUM	**BIG-LEAF MAPLE**

OBLIGATE WETLAND PLANTS (OBL)
(REGION 0 EXAMPLES)

SCIRPUS CALIFORNICUS	CALIFORNIA BULRUSH
BATIS MARITIMA	SALTWORT
ELEOCHARIS PALUSTRIS	CREEPING SPIKERUSH
SPIRAEA DOUGLASII	DOUGLAS' SPIRAEA
POTENTILLA ANSERINA	SILVERWEED
CAREX NEBRACENSIS	NEBRASKA SEDGE

FACULTATIVE WETLAND PLANTS (FACW)
(REGION 0 EXAMPLES)

DESCHAMPSIA CESPITOSA	TUFTED HAIRGRASS
CIRCAEA ALPINA	ALPINE CIRCAEA
POLYPOGON MONSPELIENSIS	RABBIT-FOOT GRASS
FRANKENIA GRANDIFOLIA	ALKALI HEATH
POPULUS FREMONTII	FREMONT COTTONWOOD
COTULA CORONOPIFOLIA	BRASS BUTTONS

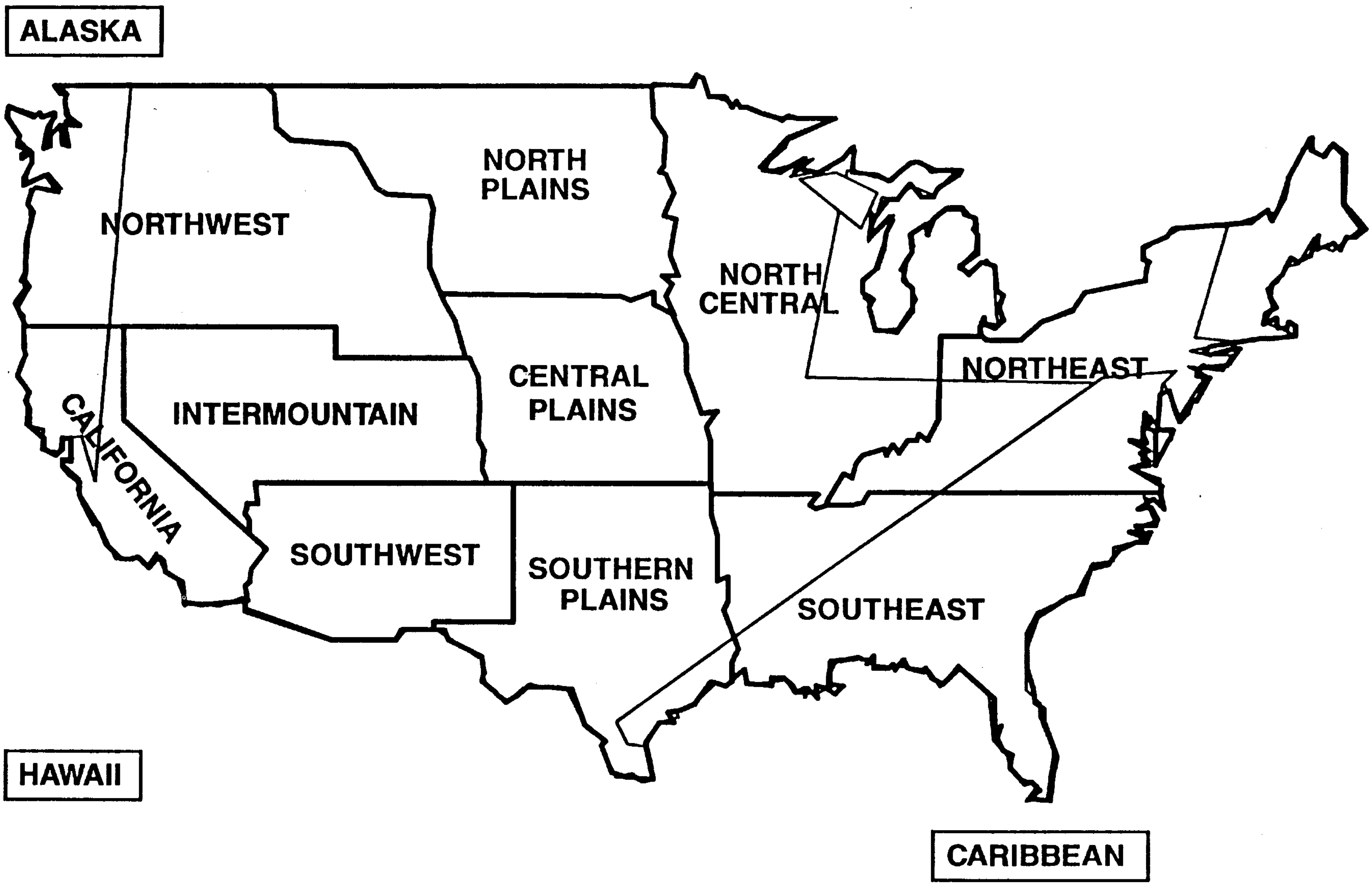
FACULTATIVE PLANTS (FAC)
(REGION 0 EXAMPLES)

ATHYRIUM FILIX-FEMINA	SOUTHERN LADY FERN
CHENOPODIUM AMBROSIOIDES	MEXICAN-TEA
ACER CIRCINATUM	VINE MAPLE
EQUISETUM ARVENSE	FIELD HORSETAIL
ERAGROSTIS MEXICANA	MEXICAN LOVEGRASS
JUGLANS CALIFORNICA	CALIFORNIA BLACK WALNUT

FACULTATIVE UPLAND PLANTS (FACU)

(REGION 0 EXAMPLES)

SAMBUCUS RACEMOSA	EUROPEAN RED ELDER
BROMUS MOLLIS	SOFT BROME
LACTUCA CANADENSIS	TALL YELLOW LETTUCE
ACHILLEA MILLEFOLIUM	COMMON YARROW
LEPIDIUM VIRGINICUM	POOR-MAN'S PEPPER-GRASS
PINUS MONTICOLA	WESTERN WHITE PINE


ALASKA
NORTHWEST
NORTH PLAINS
NORTH CENTRAL
NORTHEAST
CALIFORNIA
INTERMOUNTAIN
CENTRAL PLAINS
SOUTHWEST
SOUTHERN PLAINS
SOUTHEAST
HAWAII
CARIBBEAN

MEASURES OF PLANT SPECIES DOMINANCE

○ PERCENT COVER
○ STEM DENSITY
○ FREQUENCY OF OCCURRENCE
○ BASAL AREA

SELECTION OF DOMINANT SPECIES

FOR EACH STRATUM IN THE PLANT COMMUNITY, DOMINANT SPECIES ARE THE MOST ABUNDANT PLANT SPECIES (WHEN RANKED IN DESCENDING ORDER OF ABUNDANCE AND CUMULATIVELY TOTALED) THAT IMMEDIATELY EXCEED 50 PERCENT OF THE TOTAL DOMINANCE MEASURE FOR THE STRATUM, PLUS ANY ADDITIONAL SPECIES COMPRISING 20 PERCENT OR MORE OF THE TOTAL DOMINANCE MEASURE FOR THE STRATUM.

WDM00207 03/09/89:RMR

SELECTION OF DOMINANT PLANTS

SHRUBS	% COVER	RELATIVE % COVER	CUMULATIVE TOTAL
* CORNUS FOEMINA	25	33	33
* SPIRAEA ALBA	20	27	60
* CORNUS AMOMUM	15	20	80
RHAMNUS FRANGULA	10	13	93
TOXICODENDRON VERNIX	5	7	100
	75	100	

* DOMINANTS

CRITERIA FOR HYDROPHYTIC VEGETATION (1987)

○ **MORE THAN 50% OF THE DOMINANT SPECIES ARE OBL, FACW, OR FAC (FAC- SPECIES DO NOT COUNT)**

- A FAC-NEUTRAL OPTION IS ALSO AVAILABLE

HYDROPHYTIC VEGETATION (1987)

OTHER INDICATORS:

- ○ VISUAL OBSERVATION OF PLANT SPECIES GROWING UNDER PROLONGED INUNDATION OR SATURATION
- ○ MORPHOLOGICAL ADAPTATIONS
- ○ TECHNICAL LITERATURE

WDM00058 02/25/88:ABC

HERBACEOUS COMMUNITY

SPECIES	REGION 3 INDICATOR STATUS
JUNCUS EFFUSUS	OBL
ELEOCHARIS ENGELMANNI	FACW
POLYGONUM CAREYI	FACW+
TYPHA LATIFOLIA	OBL
EUPATORIUM PERFOLIATUM	FACW+

MIXED HERB AND SHRUB COMMUNITY

HERB SPECIES	REGION 3 INDICATOR STATUS
PANICUM VIRGATUM	FAC+
ACHILLEA BOREALIS	UPL
PTERIDIUM AQUILINUM	FACU
SHRUB SPECIES	
AMELANCHIER ARBOREA	FACU
CORNUS STOLONIFERA	FACW
COMPTONIA PEREGRINA	UPL

SOILS

SOIL

UNCONSOLIDATED, NATURAL MATERIAL THAT SUPPORTS, OR IS CAPABLE OF SUPPORTING, PLANT LIFE. UPPER LIMIT IS AIR OR SHALLOW WATER AND THE LOWER LIMIT IS EITHER BEDROCK OR THE LIMIT OF BIOLOGICAL ACTIVITY.

NONSOIL

○ BADLANDS

○ BEACHES

○ RUBBLE LANDS

○ ROCK OUTCROPS

○ GLACIERS

○ DEEPWATER HABITATS

FACTORS THAT INFLUENCE SOIL DEVELOPMENT

○ CLIMATE
○ PARENT MATERIAL
○ TOPOGRAPHICAL RELIEF
○ ORGANISMS
○ TIME

WDM00267 10/19/89:RMH

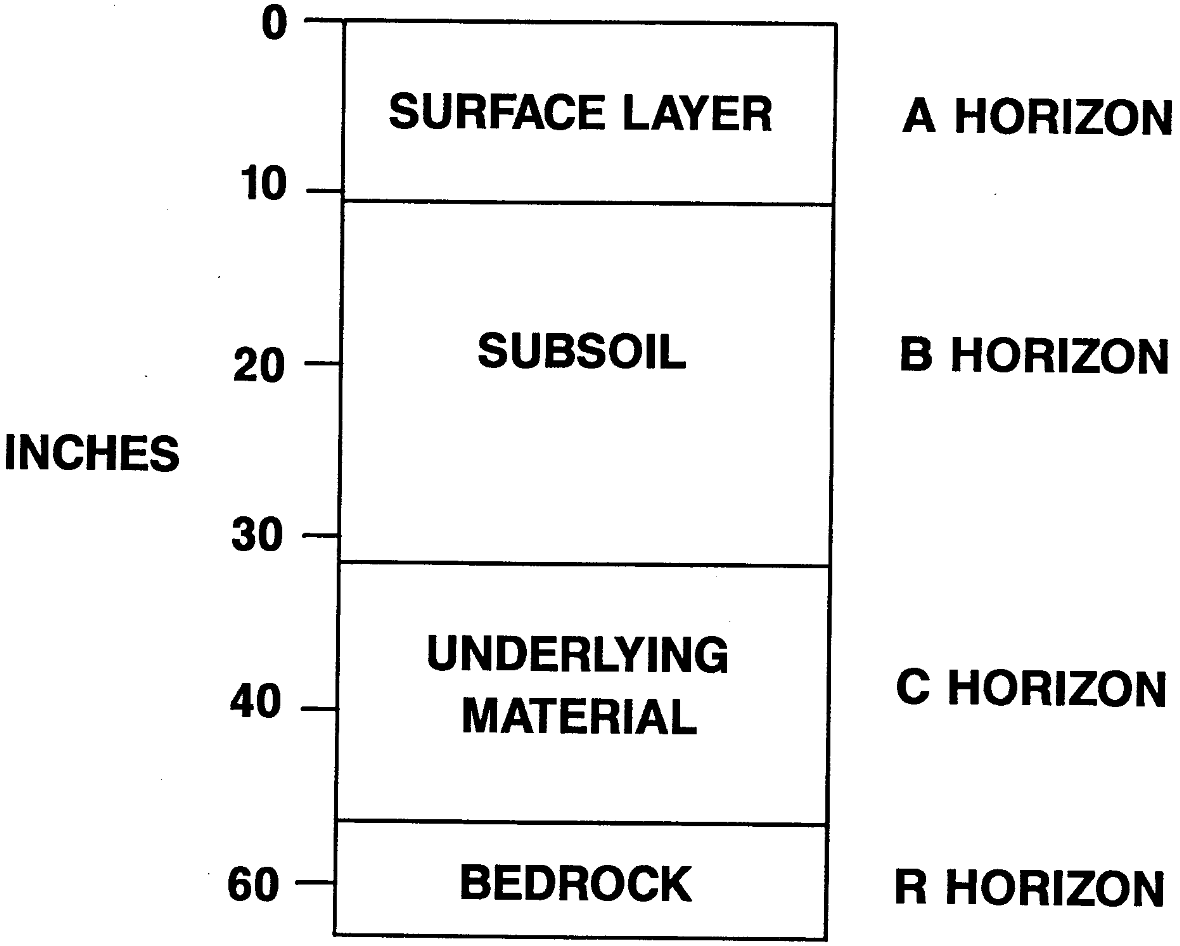
KEY SOIL PROPERTIES

1. TEXTURE
2. SLOPE
3. DRAINAGE
4. PERMEABILITY
5. DEPTH
6. STRUCTURE
7. ORGANIC MATTER
8. COLOR
9. REACTION

KEY SOIL PROPERTIES

10. BULK DENSITY
11. PARENT MATERIAL
12. SHRINK-SWELL POTENTIAL, AVAILABLE WATER CAPACITY
13. SALINITY
14. LANDSCAPE POSITION
    - ○ UPLAND
    - ○ TERRACE
    - ○ BOTTOMLAND

MAJOR SOIL HORIZONS



INCHES

0

SURFACE LAYER

A HORIZON

10

SUBSOIL

B HORIZON

20

30

UNDERLYING MATERIAL

C HORIZON

40

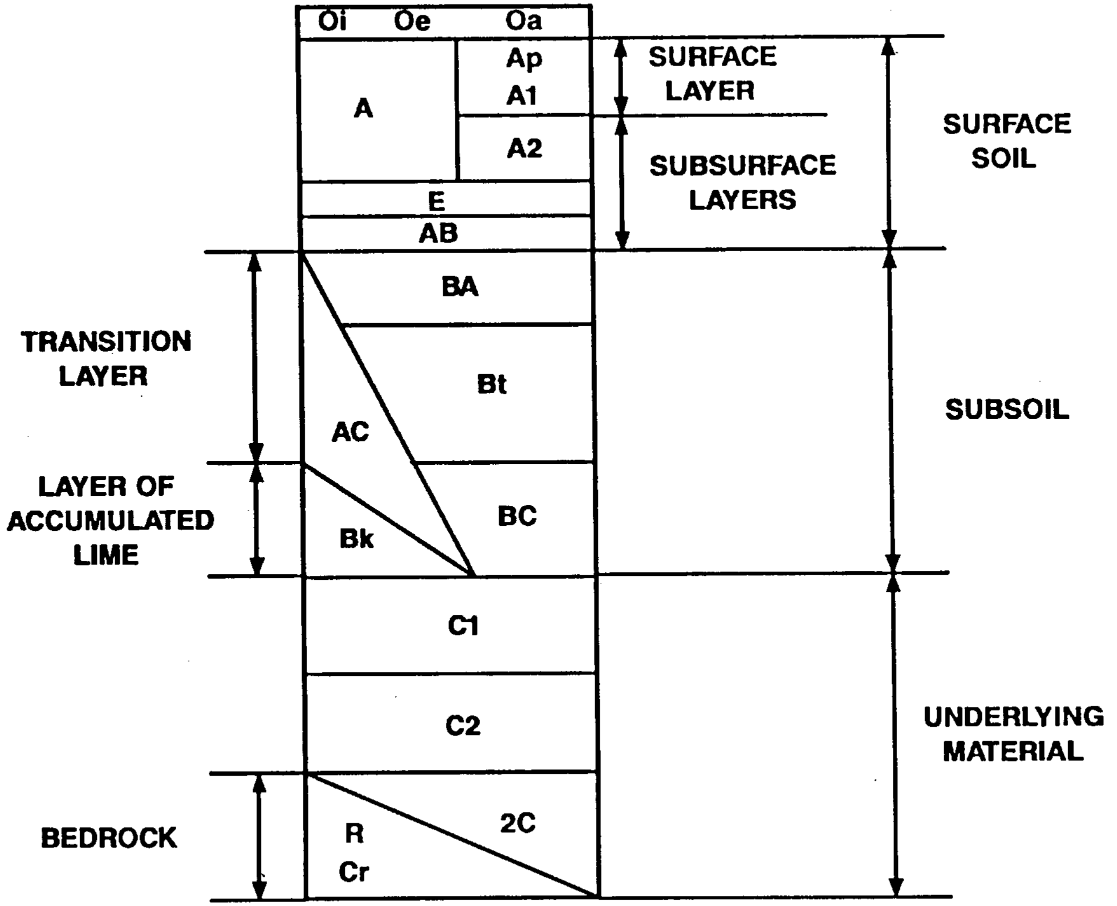
BEDROCK

R HORIZON

60

WDM00277 10/19/89:RMH

HORIZON TERMINOLOGY



WDM00182 04/21/88:CDC

PARTICLE-SIZE CLASSIFICATION

CLASS	SIZE (mm)
GRAVEL	> 2.00
SAND	0.05 - 2.00
SILT	0.002 - 0.05
CLAY	< 0.002

WDM00271 10/19/89:RMH

SOIL TEXTURE GROUPS

- SANDY SOILS
  - COARSE-TEXTURED SOILS
    - SAND
    - LOAMY SAND
- LOAMY SOILS
  - MODERATELY COARSE-TEXTURED SOILS
    - SANDY LOAM
    - FINE SANDY LOAM
  - MEDIUM-TEXTURED SOILS
    - VERY FINE SANDY LOAM
    - LOAM
    - SILT LOAM
    - SILT
  - MODERATELY FINE-TEXTURED SOILS
    - CLAY LOAM
    - SANDY CLAY LOAM
    - SILTY CLAY LOAM
- CLAYEY SOILS
  - FINE-TEXTURED SOILS
    - SANDY CLAY
    - SILTY CLAY
    - CLAY

PERMEABILITY

A MEASURE OF THE ABILITY OF WATER OR AIR TO MOVE THROUGH THE SOIL PROFILE. PERMEABILITY IS MEASURED IN INCHES PER HOUR.

DRAINAGE CLASSES

○ EXCESSIVELY DRAINED

○ SOMEWHAT EXCESSIVELY DRAINED

○ WELL DRAINED

○ MODERATELY WELL DRAINED

○ SOMEWHAT POORLY DRAINED

○ POORLY DRAINED

○ VERY POORLY DRAINED

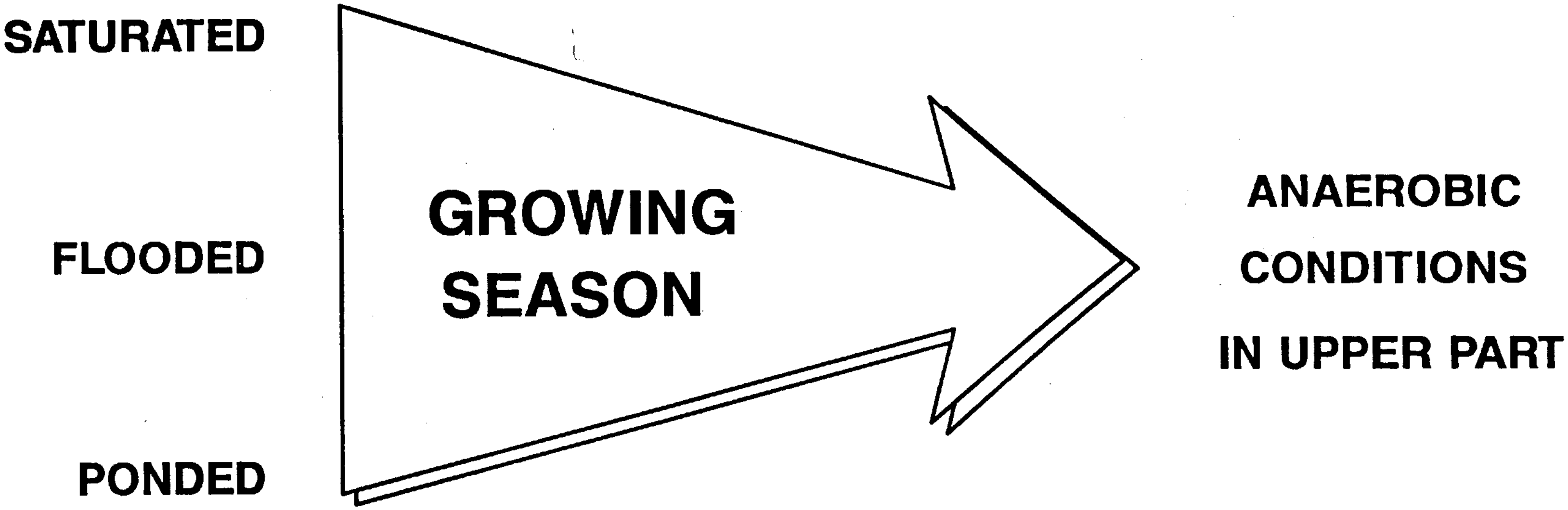
HYDRIC SOILS

A HYDRIC SOIL IS A SOIL THAT IS SATURATED, FLOODED, OR PONDED LONG ENOUGH DURING THE GROWING SEASON TO DEVELOP ANAEROBIC CONDITIONS IN THE UPPER PART.

NTCHS (12/87)

WDM00186 03/15/88 RON

HYDRIC SOIL



SATURATED

FLOODED

PONDED

GROWING SEASON

ANAEROBIC
CONDITIONS
IN UPPER PART

TWO MAIN CATEGORIES OF HYDRIC SOILS

ORGANIC SOILS - ORGANIC MATTER COMPRISES AT LEAST 16 OF THE UPPER 32 INCHES OF SOIL. THEY DEVELOP UNDER NEARLY CONTINUOUS SATURATION OR INUNDATION AND ARE COMMONLY CALLED PEATS OR MUCKS.

HYDRIC MINERAL SOILS - COMPOSED MAINLY OF CLAY, SILT, AND/OR SAND WITH VARYING AMOUNTS OF ORGANIC MATTER. THEY ARE SATURATED LONG ENOUGH TO PRODUCE SOIL PROPERTIES ASSOCIATED WITH A REDUCING ENVIRONMENT.

CRITERIA FOR HYDRIC SOILS

1. ORGANIC SOILS
2. MINERAL SOILS WITH HIGH WATER TABLES
3. PONDED SOILS
4. FLOODED SOILS

CRITERIA FOR HYDRIC SOILS

1. ALL HISTOSOLS EXCEPT FOLISTS, OR
2. SOILS IN AQUIC SUBORDERS, AQUIC SUBGROUPS, ALBOLLS SUBORDER, SALORTHIDS GREAT GROUP, PELL GREAT GROUPS OF VERTISOLS, PACHIC SUBGROUPS, OR CUMULIC SUBGROUPS THAT ARE:
   a. SOMEWHAT POORLY DRAINED AND HAVE A FREQUENTLY OCCURRING WATER TABLE LESS THAN 0.5 FT FROM THE SURFACE FOR A SIGNIFICANT PERIOD (USUALLY MORE THAN TWO WEEKS) DURING THE GROWING SEASON, OR

CRITERIA FOR HYDRIC SOILS

2.b. POORLY DRAINED OR VERY POORLY DRAINED AND HAVE EITHER:

1. A FREQUENTLY OCCURRING WATER TABLE LESS THAN 0.5 FT FROM THE SURFACE FOR A SIGNIFICANT PERIOD (USUALLY MORE THAN TWO WEEKS) DURING THE GROWING SEASON IF TEXTURES ARE COARSE SAND, SAND, OR FINE SAND IN ALL LAYERS WITHIN 20 INCHES, OR FOR OTHER SOILS

CRITERIA FOR HYDRIC SOILS

2.b.2. A FREQUENTLY OCCURRING WATER TABLE LESS THAN 1.0 FT FROM THE SURFACE FOR A SIGNIFICANT PERIOD (USUALLY MORE THAN TWO WEEKS) DURING THE GROWING SEASON IF PERMEABILITY IS EQUAL TO OR GREATER THAN 6.0 INCHES / HR IN ALL LAYERS WITHIN 20 INCHES, OR

3. A FREQUENTLY OCCURRING WATER TABLE LESS THAN 1.5 FT FROM THE SURFACE FOR A SIGNIFICANT PERIOD (USUALLY MORE THAN TWO WEEKS) DURING THE GROWING SEASON IF PERMEABILITY IS LESS THAN 6.0 INCHES / HR IN ANY LAYER WITHIN 20 INCHES, OR

CRITERIA FOR HYDRIC SOILS

3. SOILS THAT ARE FREQUENTLY PONDED FOR LONG DURATION OR VERY LONG DURATION DURING THE GROWING SEASON, OR

4. SOILS THAT ARE FREQUENTLY FLOODED FOR LONG DURATION OR VERY LONG DURATION DURING THE GROWING SEASON

HYDRIC SOIL LISTS

- ○ NATIONAL
- ○ STATE
- ○ LOCAL OR FIELD OFFICE

NATIONAL LIST OF HYDRIC SOILS

○ COMPUTER GENERATED LIST USING INFORMATION ON THE SOIL INTERPRETATIONS RECORD FOR SOIL SERIES IN THE UNITED STATES

○ LIMITED TO SOIL SERIES OR SPECIAL PHASES THAT ARE REPRESENTED BY A SEPARATE SOIL INTERPRETATIONS RECORD

○ THE LIST DOES NOT CONTAIN:
  - WET MISCELLANEOUS AREAS
  - SOILS CLASSIFIED AT LEVELS HIGHER THAN THE SERIES

STATE LISTS OF HYDRIC SOILS

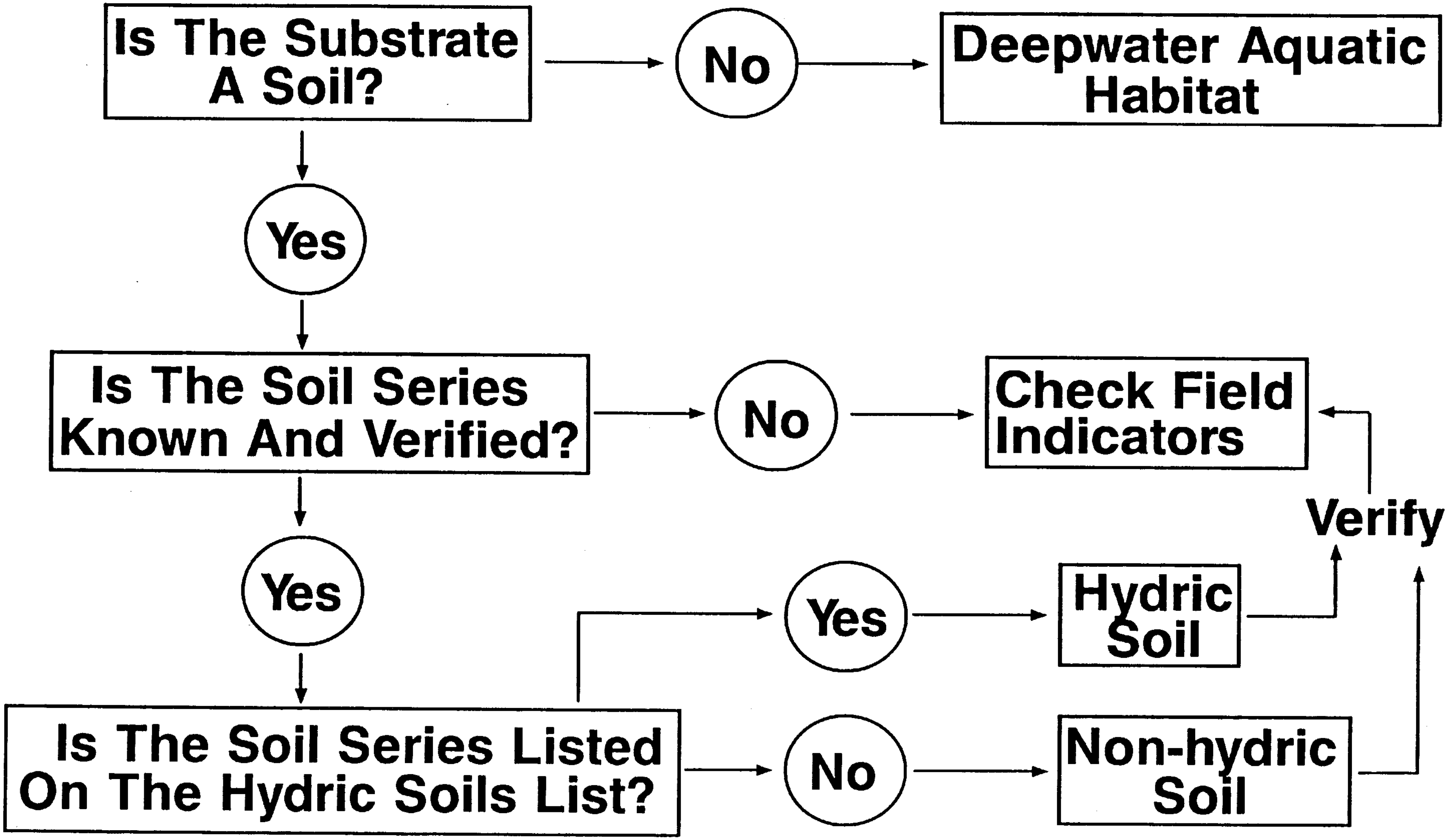
PRESENTLY STATE LISTS ARE SUBSETS OF THE NATIONAL LIST SHOWING SOILS THAT EXIST IN A STATE

LOCAL LISTS OF HYDRIC SOILS

○ THESE ARE LISTS OF MAP UNITS THAT ARE NAMED BY SOIL SERIES ON THE NATIONAL LIST, BY WET MISCELLANEOUS AREAS, OR BY WET SOILS CLASSIFIED AT LEVELS HIGHER THAN THE SERIES

○ ALSO LISTED ARE MAP UNITS THAT POTENTIALLY CONTAIN HYDRIC SOIL INCLUSIONS

HYDRIC SOILS DETERMINATION PROCEDURE



Is The Substrate A Soil?

No

Deepwater Aquatic Habitat

Yes

Is The Soil Series Known And Verified?

No

Check Field Indicators

Yes

Is The Soil Series Listed On The Hydric Soils List?

Yes

Hydric Soil

No

Non-hydric Soil

Verify

DEVELOPMENT OF HYDRIC SOILS

INUNDATION OR SATURATION

ANAEROBIC CONDITIONS

REDUCING ENVIRONMENT

LOWER REDOX POTENTIAL

CHEMICAL REDUCTION
(Fe, Mn, ETC.)

DISTINCTIVE SOIL CHARACTERISTICS

INDICATORS OF HYDRIC SOILS
(NON-SANDY)

ORGANIC SOILS - MORE THAN 50 PERCENT ORGANIC MATERIAL IN UPPER 32 IN., OR ANY THICKNESS OVER BEDROCK.

HISTIC EPIPEDON - AN 8-16 IN. ORGANIC LAYER AT OR NEAR THE SURFACE THAT IS SATURATED FOR 30 OR MORE CONSECUTIVE DAYS. REQUIRED ORGANIC MATTER CONTENT VARIES WITH CLAY CONTENT.

SULFIDIC MATERIAL - CONTAINS HYDROGEN SULFIDE WITH ITS CHARACTERISTIC ROTTEN EGG ODOR.

AQUIC OR PERAQUIC MOISTURE REGIME - SATURATED SOIL CONDITIONS CREATING A REDUCING REGIME VIRTUALLY FREE OF OXYGEN.

(CONTINUED)

INDICATORS OF HYDRIC SOILS (NON-SANDY)

REDUCING SOIL CONDITIONS - DETERMINE WITH FERROUS IRON TEST KIT.

SOIL COLORS - MINERAL HYDRIC SOILS ARE GLEYED OR HAVE A LOW-CHROMA MATRIX WITH OR WITHOUT BRIGHT MOTTLES.

SOIL APPEARS ON THE HYDRIC SOILS LIST - VERIFY SERIES BY COMPARING PROFILE AGAINST SOIL SURVEY DESCRIPTION.

IRON AND MANGANESE CONCRETIONS

WDM00075 02/25/88:ABC

SOIL COLOR

MATRIX - PREDOMINANT COLOR.

MOTTLE - SPOTS OF CONTRASTING COLOR.

REDOXIMORPHIC FEATURES

○ REDOX CONCENTRATIONS -- HIGH-CHROMA AREAS WHERE Fe AND Mn ARE CONCENTRATED

○ REDOX DEPLETIONS -- LOW-CHROMA, HIGH-VALUE AREAS WHERE Fe AND Mn HAVE MOVED OUT

○ REDUCED MATRIX -- SOIL MATRIX THAT CHANGES COLOR WHEN EXPOSED TO AIR

TYPICAL COLORS OF MINERAL HYDRIC SOILS

○ MATRIX CHROMA OF 2 OR LESS IN MOTTLED SOILS.

○ MATRIX CHROMA OF 1 OR LESS IN UNMOTTLED SOILS.

○ MEASURED IMMEDIATELY BELOW THE A-HORIZON OR AT 10 INCHES, WHICHEVER IS SHALLOWER

INDICATORS OF HYDRIC SOILS
(SANDY)

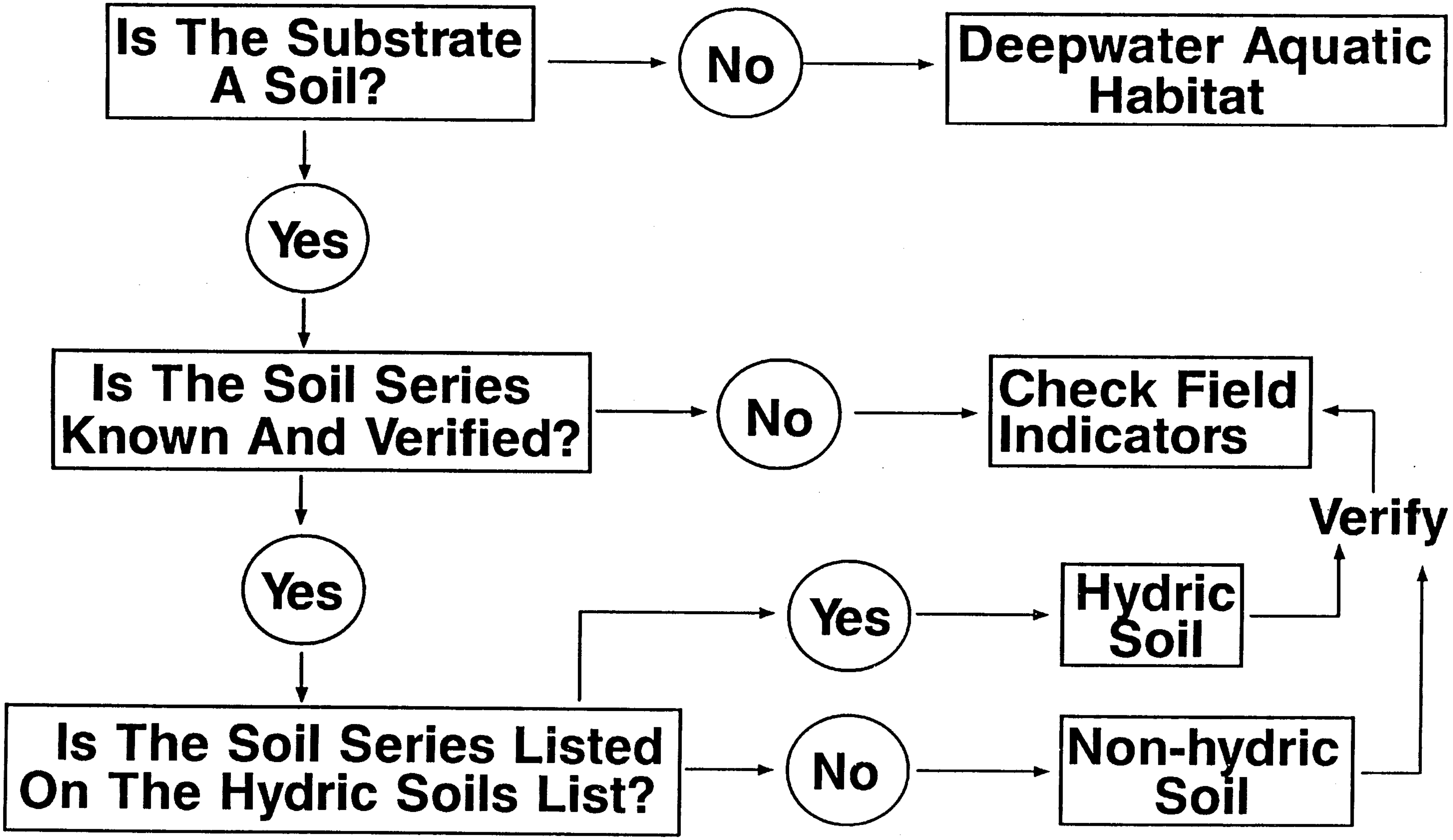
HIGH ORGANIC MATTER CONTENT IN THE SURFACE HORIZON.

STREAKING OF SUBSURFACE HORIZONS BY ORGANIC MATTER - ORGANIC MATTER STAINS FINGERS WHEN RUBBED.

WET SPODOSOLS - ORGANIC MATTER, IRON, AND ALUMINUM ACCUMULATE TO FORM A DISTINCT LAYER (SPODIC HORIZON) BENEATH A LEACHED LAYER (E-HORIZON) AT THE MOST COMMON WATER TABLE DEPTH (NOT ALL SPODOSOLS ARE HYDRIC).

OTHERS MENTIONED PREVIOUSLY FOR NON-SANDY SOILS.

HYDRIC SOILS DETERMINATION PROCEDURE



Is The Substrate A Soil?

No

Deepwater Aquatic Habitat

Yes

Is The Soil Series Known And Verified?

No

Check Field Indicators

Verify

Yes

Is The Soil Series Listed On The Hydric Soils List?

Yes

Hydric Soil

No

Non-hydric Soil

SOIL
COLORS

WDM00079 02/25/88:ABC

ASPECTS OF SOIL COLOR

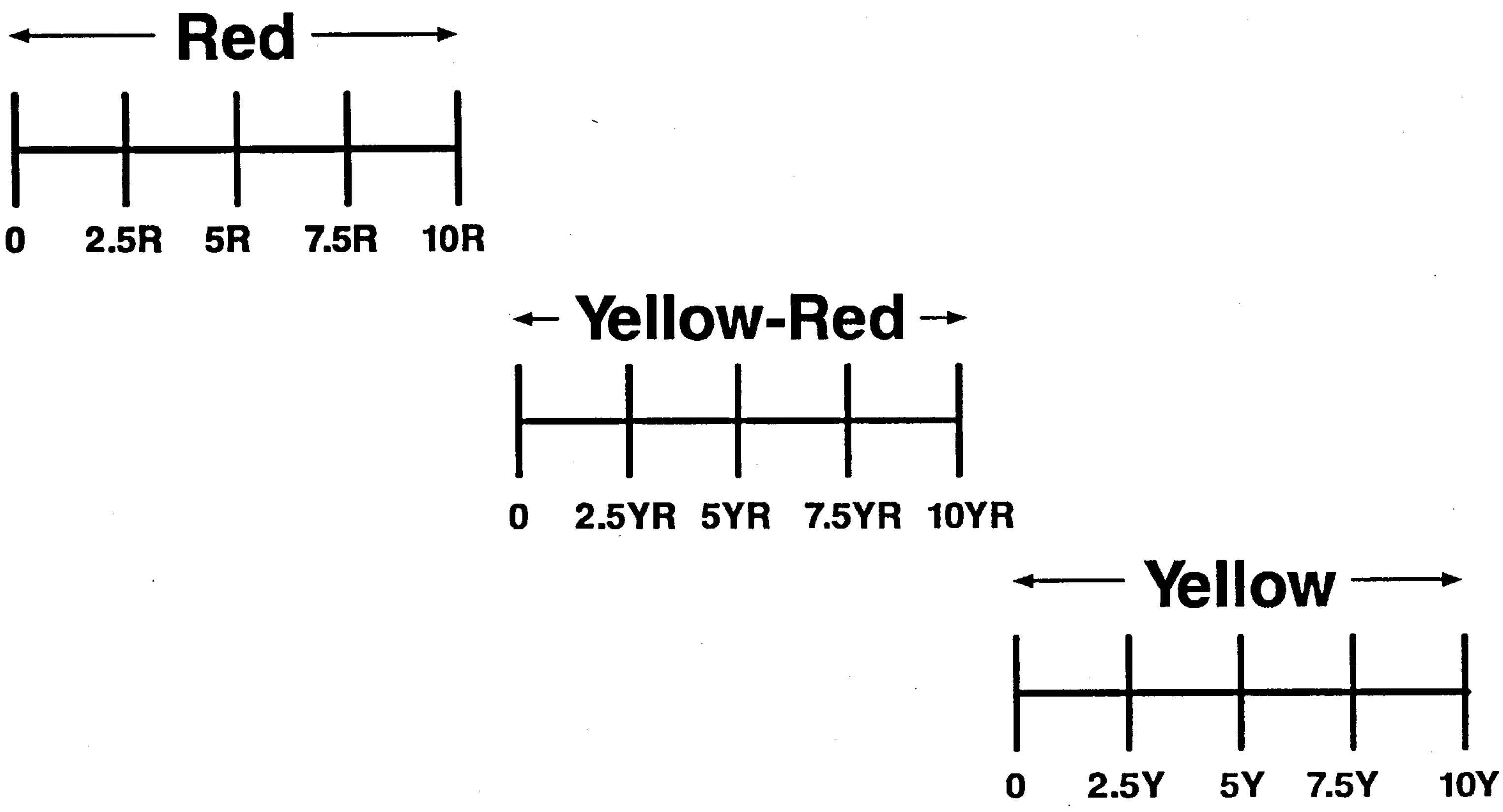
○ **HUE**

○ **VALUE**

○ **CHROMA**

WDM00169 03/15/88:CDC

HUE



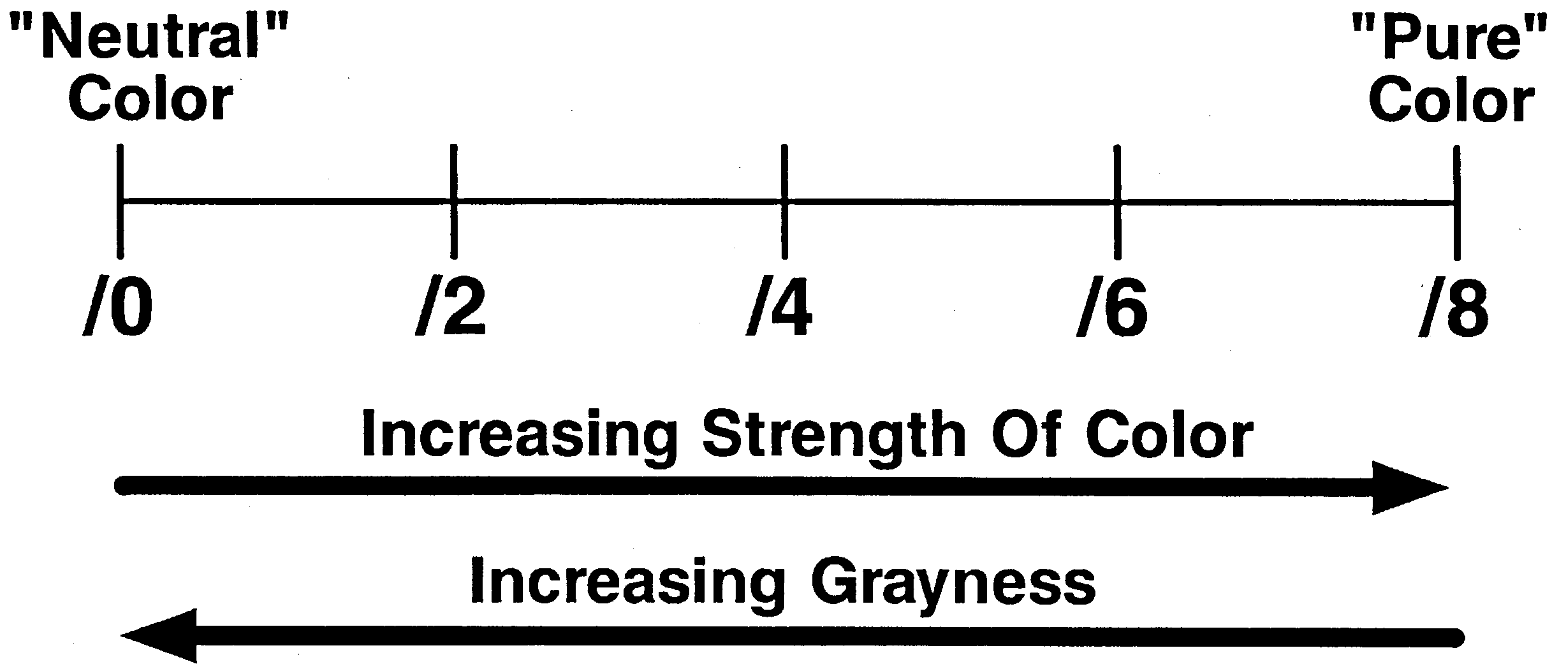
VALUE

10/0 - Pure White

5/0 - "Gray"

0/0 - Pure Black

CHROMA



"Neutral" Color

"Pure" Color

/0

/2

/4

/6

/8

Increasing Strength Of Color

Increasing Grayness

WDM00162 03/15/88:CDC

NEUTRAL COLOR/ZERO CHROMA

2.5YR 5/0 = 7.5YR 5/0 = 2.5Y 5/0 = N 5/

SOIL COLOR

MUNSELL NOTATION	ENGLISH NAME
10R 6/6	Light Red
10R 6/8	
2.5YR 6/8	
7.5YR 6/8	Reddish Yellow
10YR 6/8	Brownish Yellow
5Y 6/8	Olive Yellow
5B 6/1	Bluish Gray

WDM00163 03/15/88·CDC

READING SOIL COLORS

FACTORS TO CONSIDER

- ○ Light
- ○ Moisture
- ○ Surface Texture

READING SOIL COLORS

LIGHT

○ Quality - Must Be White Enough For Sample To Reflect True Color

○ Intensity - Amount Of Light Must Be Adequate For Visual Distinction Between Chips This Is Especially Critical When Matching Soil To Chips Of Low Value And Low Chroma

○ Direction - Light Should Be At Right Angles To Surface Of Sample And Color Chips

READING SOIL COLORS

MOISTURE

- ○ Record The Moisture State Of Sample (Dry/Moist/Wet)
  - ○ Color Value Of Most Soils Decreases As Soil Is Moistened
  - ○ Colors Read From Wet Soils May Be In Error Because Of The Effect Of Light Reflected From The Water Films
- ○ Normally Read Colors Of Moist Soil
  - ○ Moisten Sample And Read Colors As Soon As Visible Moisture Films Have Disappeared

READING SOIL COLORS

OPTIMUM CONDITIONS

○ Natural Light
○ Clear, Sunny Day
○ Midday
○ Light At Right Angles
○ Soil Moist

COLOR PATTERNS IN SOILS

- ○ MATRIX (PREDOMINANT) COLOR
- ○ MOTTLE COLORS
- ○ MOTTLE CONTRAST, ABUNDANCE, AND SIZE

CONTRAST OF MOTTLES

CONTRAST REFERS TO THE DEGREE OF VISUAL DISTINCTION BETWEEN ASSOCIATED COLORS

- ○ FAINT -- EVIDENT ONLY ON CLOSE EXAMINATION
- ○ DISTINCT -- READILY SEEN
- ○ PROMINENT -- CONTRAST STRONGLY

CONTRAST OF MOTTLES

DISTINCT

○ **SAME HUE**
  - 2-4 UNITS OF CHROMA, OR
  - 3-4 UNITS OF VALUE

○ **2.5 UNITS OF HUE (ONE PAGE)**
  - 1 UNIT OF CHROMA, OR
  - 1-2 UNITS OF VALUE

ABUNDANCE OF MOTTLES

○ FEW -- LESS THAN 2%

○ COMMON -- 2 TO 20%

○ MANY -- MORE THAN 20%

SIZE OF MOTTLES

- ○ FINE -- SMALLER THAN 5 MM
- ○ MEDIUM -- 5 TO 15 MM
- ○ COARSE -- LARGER THAN 15 MM

SOIL
SURVEYS

WDM00272 10/19/89:RMR

DEFINITION OF TERMS

Ac - ALLIANCE LOAM, 0 TO 1 PERCENT SLOPES

- ○ SOIL SERIES - ALLIANCE
- ○ TEXTURE OF SURFACE LAYER - LOAM
- ○ PHASE - 0 TO 1 PERCENT SLOPES

KINDS OF SOIL MAP UNITS

1. CONSOCIATIONS ARE SOIL MAP UNITS NAMED FOR A SINGLE KIND OF SOIL (TAXON) OR MISCELLANEOUS AREA.

e.g., MASSIE SILTY CLAY, 0 TO 1 PERCENT SLOPES (HYDRIC)

TAMA SILTY CLAY LOAM, 2 TO 5 PERCENT SLOPES (NONHYDRIC)

WET ALLUVIAL LAND (HYDRIC)

KINDS OF SOIL MAP UNITS

2. COMPLEXES AND ASSOCIATIONS ARE SOIL MAP UNITS NAMED FOR TWO OR MORE KINDS OF SOILS (TAXA) OR MISCELLANEOUS AREAS. NAMED SOILS OCCUR IN A REGULAR PATTERN ON THE LANDSCAPE.

COMPLEX - 2 OR MORE NAMED SOILS - USUALLY ORDER 2 SOIL SURVEY

ASSOCIATION - 2 OR MORE NAMED SOILS - USUALLY ORDER 3 SOIL SURVEY

e.g., TRYON - VALENTINE COMPLEX, 0 TO 6 PERCENT SLOPES (TRYON-HYDRIC; VALENTINE-NONHYDRIC)

CANYON-BRIDGET-ROCK OUTCROP, STEEP

KINDS OF SOIL MAP UNITS

3. UNDIFFERENTIATED GROUPS ARE SOIL MAP UNITS NAMED FOR TWO OR MORE KINDS OF SOILS (TAXA) OR MISCELLANEOUS AREAS. NAMED SOILS OCCUR IN AN IRREGULAR PATTERN ON THE LANDSCAPE.

e.g., HORD AND HALL SILT LOAMS, TERRACE,
0 TO 1 PERCENT SLOPES

INCLUSIONS WITHIN MAPPING UNITS

29A - Pilchuck Fine Sand. This Nearly Level Soil Is Excessively Drained. It Formed In Mixed Alluvium Under Hardwoods And Conifers In Major River Valleys.

Most Areas Are Long And Narrow. They Range From 6 Acres To More Than 400 Acres But Average About 75 Acres.

Included With This Soil In Mapping Are Areas That Are As Much As 15 Percent Aquic Xerofluvents And Other Areas That Are As Much As 8 Percent Puyallup Fine Sandy Loam.

ELEMENTS OF A HYDRIC SOIL MAP UNIT LIST

○ SOIL MAP UNIT SYMBOL . . . . GK

○ SOIL MAP UNIT NAME . . . . . GIBBON SILT LOAM, 0 TO 2 PERCENT SLOPES

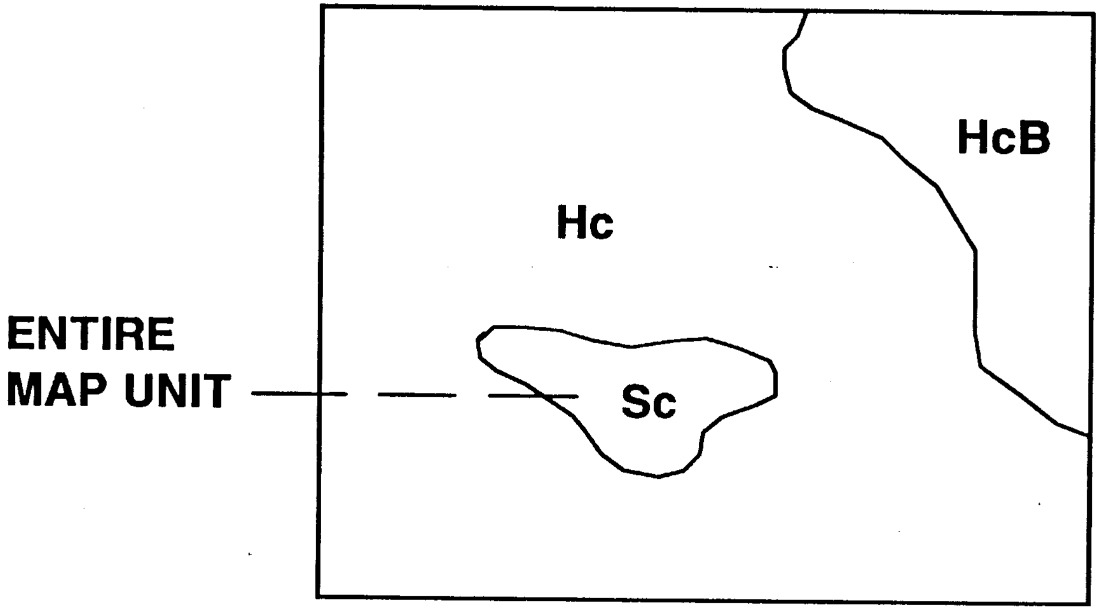
○ HYDRIC SOIL COMPONENT . . LAWET SOILS AS INCLUSIONS

○ LANDSCAPE POSITION . . . . . DEPRESSIONAL AREAS

HYDRIC SOILS

1. - ENTIRE SOIL MAP UNIT HYDRIC

MAP SYMBOL	SOIL NAME
Sc	SCOTT SILT LOAM, 0 TO 1 PERCENT SLOPES



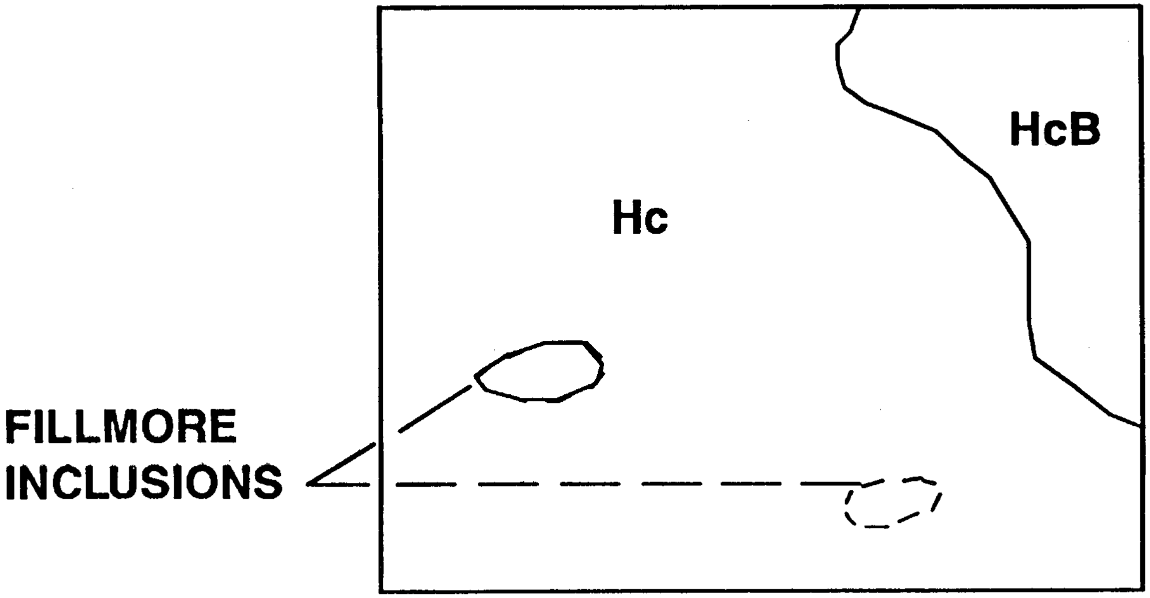
SOIL MAP

HYDRIC SOILS

2. - SOIL MAP UNITS WITH HYDRIC SOILS AS INCLUSIONS

MAP SYMBOL	SOIL NAME
Hc	HASTINGS SILT LOAM, 0 TO 1 PERCENT SLOPES

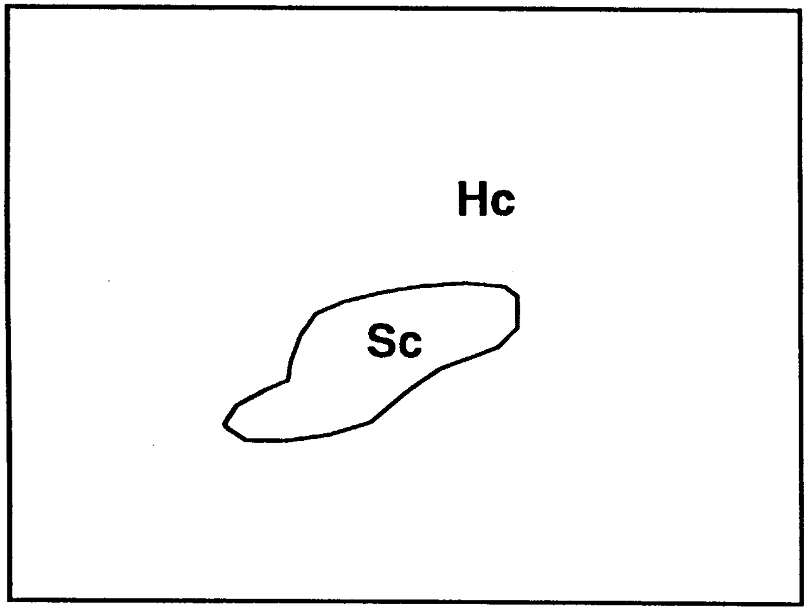
(HAS INCLUSIONS OF FILLMORE SOILS IN DEPRESSIONAL AREAS)



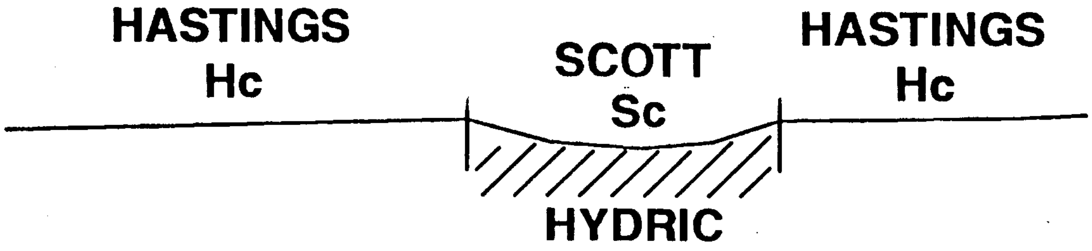
SOIL MAP

WDM00280 10/25/89:RMR

HYDRIC SOILS IN DEPRESSIONS



SOIL MAP



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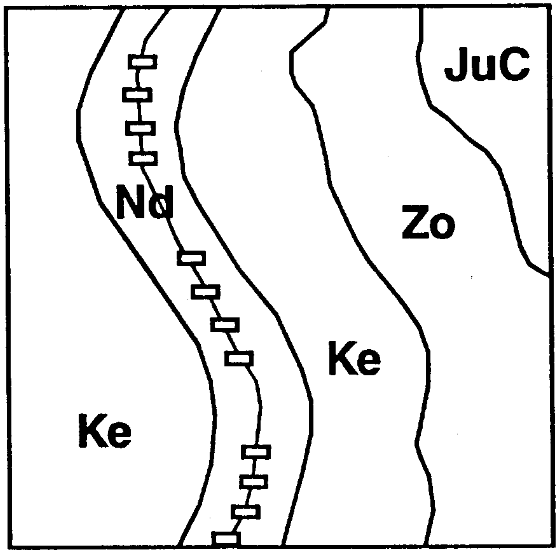
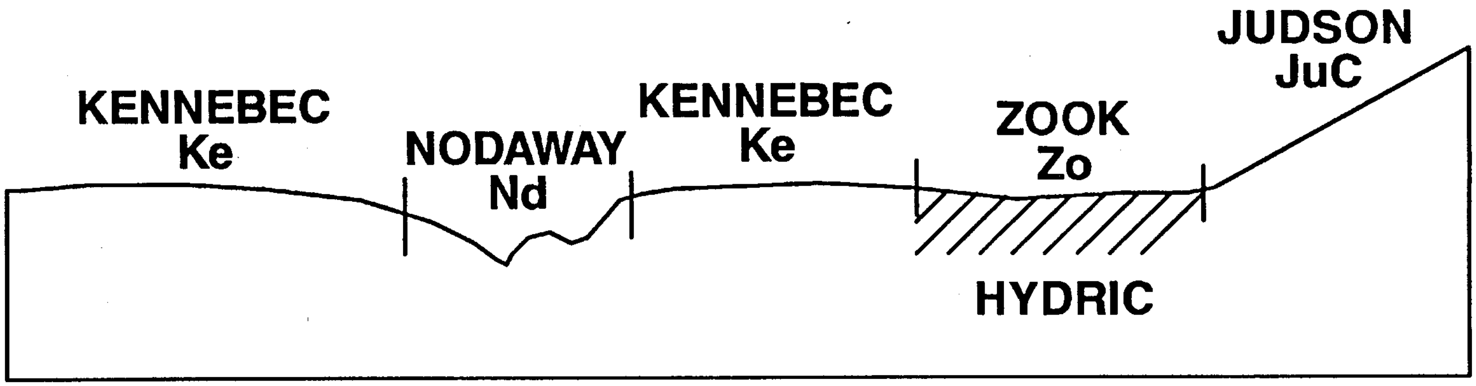
HYDRIC SOILS IN BOTTOMLANDS



SOIL MAP



ORDERS OF SOIL SURVEYS

ORDER	MINIMUM DELINEATION
FIRST	≤2.5 ACRES
SECOND	1.5 TO 10 ACRES
THIRD	4 TO 40 ACRES
FOURTH	40 TO 640 ACRES
FIFTH	640 TO 10,000 ACRES

SOIL
TAXONOMY

SOIL TAXONOMY

A BASIC SYSTEM OF SOIL
CLASSIFICATION FOR MAKING
AND INTERPRETING SOIL
SURVEYS.

SOIL TAXONOMY

OBJECTIVE:

TO DEVELOP A HIERARCHICAL CLASSIFICATION THAT REFLECTS THE RELATIONSHIPS BETWEEN DIFFERENT SOILS, AND BETWEEN SOILS AND THE FACTORS RESPONSIBLE FOR THEIR CHARACTER.

SOIL TAXONOMY

PROCEDURE:

SOILS ARE CLASSIFIED ON THE BASIS OF:

○ SOIL PROPERTIES OBSERVED IN THE FIELD (E.G., SOIL HORIZONS, TEXTURE, COLOR, pH), AND

○ SOIL PROPERTIES INFERRED FROM THE COMBINED DATA OF SOIL SCIENCE AND OTHER DISCIPLINES (E.G., SOIL TEMPERATURE AND MOISTURE REGIMES INFERRED FROM SOIL SCIENCE AND METEOROLOGY).

WDM00116 03/29/88:CDC

SOIL TAXONOMY

○ Order

○ Suborder

○ Great Group

○ Subgroup

○ Family

○ Series

SOIL TAXONOMY

CATEGORY	NUMBER OF TAXA	NATURE OF DIFFERENTIATING CHARACTERISTICS
Order	11	Soil-forming Processes As Indicated By Presence Or Absence Of Major Diagnostic Horizons.

SOIL ORDERS

ALFISOL
ANDISOL
ARIDISOL
ENTISOL
HISTOSOL
INCEPTISOL
MOLLISOL
OXISOL
SPODOSOL
ULTISOL
VERTISOL

NOMENCLATURE

ORDER	FORMATIVE ELEMENT	DERIVATION
Alfisol	ALF	Pedalfer - AL & FE Enriched
Aridisol	ID	Arid - Dry Soil
Entisol	ENT	Recent - Little Or No Profile Development
Inceptisol	EPT	Inception - Young; Horizons Beginning To Develop
Mollisol	OLL	Mollis - Soft
Oxisol	OX	Oxide - Enriched With Oxides
Spodosol	OD	Podzol - Wood Ash Horizon; Acid Leaching
Ultisol	ULT	Ultimate - Maximum Leaching
Vertisol	ERT	Invert - To Turn; Crack
Histosol	IST	Histos - Tissue; High Fiber Content

SOIL TAXONOMY

CATEGORY	NUMBER OF TAXA	NATURE OF DIFFERENTIATING CHARACTERISTICS
Suborder	53	Vary With The Order, But Include Such Things As: ○ Wetness ○ Soil Moisture Regimes ○ Major Parent Material ○ Vegetational Effects

ENTISOL SUBORDERS

Aquents
(L. *Aqua,* Water)
Wet Entisols

Fluvents
(L. *Fluvius,* River)
Floodplain Soils

Orthents
(Gr. *Orthos,* True)
The Common Ones

Psamments
(Gr. *Psammos,* Sand)
Sandy Soils

SOIL TAXONOMY

CATEGORY	NUMBER OF TAXA	NATURE OF DIFFERENTIATING CHARACTERISTICS
Great Group	211	○ Kind, Arrangement, And Degree Of Expression Of Diagnostic Horizons (Especially Upper Horizons) ○ Soil Moisture Regimes ○ Temperature Regimes ○ Base Status

WDM00132 03/29/88:CDC

ENTISOL GREAT GROUPS

SUBORDER	GREAT GROUP
Aquents	Cryaquents - Cold
	Haplaquents - Simple
(Wet Entisols)	Hydraquents - Water
	Psammaquents - Sand
	Tropaquents - Tropical (Hot And Humid)

ENTISOL GREAT GROUPS

SUBORDER	GREAT GROUP
Fluvents	Cryofluvents
	Torrifluvents - Torrid (Hot And Dry)
(Floodplain Soils)	Tropofluvents
	Udifluvents - Humid (Not Dry In Most Years)
	Ustifluvents - Dry (Between Udic-Aridic)
	Xerofluvents - Dry (Moist Cold Winter - Dry Warm Summer; Mediterranean Climate)

WDM00135 03/29/88:CDC

ENTISOL GREAT GROUPS

SUBORDER	GREAT GROUP
Psamments	Cryopsamments
	Quartzipsamments - Quartz
(Sandy Soils)	Torripsamments
	Udipsamments
	Ustipsamments
	Xeropsamments

SOIL TAXONOMY

CATEGORY	NUMBER OF TAXA	NATURE OF DIFFERENTIATING CHARACTERISTICS
Subgroup	1000+	Three Kinds Of Subgroups: ○ The Central (Typic) Concept Of The Great Group; ○ Intergrades Or Transitional Forms To Other Orders, Suborders, Or Great Groups; And, ○ Extragrades That Are Not Representative Of The Great Group, But Do Not Indicate Transitions To Any Other Known Kind Of Soil.

SUBGROUPS

4 3 2 1
Typic Fluvaquents

4 1 2
Typical Entisols With Aquic Moisture
3
Regimes That Occur On Floodplains.

1 Order
2 Suborder
3 Great Group
4 Subgroup

SUBGROUPS

4 3 2 1
Mollic Fluvaquents

1 2
Entisols With Aquic Moisture Regimes That
3
Occur On Floodplains, And That Have Thick,
4
Dark Surface Layers.

1 Order
2 Suborder
3 Great Group
4 Subgroup

SUBGROUPS

4 3 2 1
Aeric Fluvaquents

1 3
Entisols, Occurring On Floodplains,
2
With An Aquic Moisture Regime That Are Not
4
So Wet. They Are Better Aerated In The
Upper Part Of The Soil Profile.

1	Order	3	Great Group
2	Suborder	4	Subgroup

SOIL TAXONOMY

CATEGORY	NUMBER OF TAXA	NATURE OF DIFFERENTIATING CHARACTERISTICS
Family	5000+	Similar Physical And Chemical Properties That Affect Management, Including: ○ Particle-size Distribution ○ Mineral Content ○ Reaction ○ Temperature Regime

SOIL TAXONOMY

CATEGORY	NUMBER OF TAXA	NATURE OF DIFFERENTIATING CHARACTERISTICS
Series	15,000+	A Series May Have Virtually The Full Range That Is Permitted In A Family In Several Properties, But In One Or More Properties The Range Is Restricted, Such As: ○ Kind And Arrangement Of Horizons ○ Color ○ Texture ○ Structure

SOIL TAXONOMY

ORDER	INCEPTISOL
SUBORDER	OCHREPT
GREAT GROUP	FRAGIOCHREPT
SUBGROUP	AQUIC FRAGIOCHREPT

TYPIC MEDISAPRIST

AQUIC
QUARTZIPSAMMENT

TYPIC ARGIAQUOLL

AERIC HAPLAQUOD

METHODS

OFFSITE
DETERMINATIONS
OF WETLANDS

OFFSITE DETERMINATIONS

USE THE OFFSITE METHOD WHEN:

- ○ INFORMATION IS AVAILABLE ON HYDROLOGY, HYDRIC SOILS, AND HYDROPHYTIC VEGETATION
- ○ FIELD INSPECTION IS NOT POSSIBLE DUE TO TIME CONSTRAINTS OR OTHER REASONS (e.g., NWI, FSA INVENTORIES, ETC.)

OFFSITE DETERMINATIONS

ACCURACY DEPENDS ON:

○ QUALITY OF AVAILABLE DATA

○ ONE'S ABILITY AND EXPERIENCE TO INTERPRET THESE DATA

WDM00018 02/25/88:ABC

OFFSITE DETERMINATIONS

**IF A MORE ACCURATE DELINEATION
IS REQUIRED, THEN ONSITE PROCEDURES
MUST BE EMPLOYED**

SOURCES OF INFORMATION

OFFSITE DETERMINATION METHOD

STEP 1 - LOCATE AND DELINEATE THE AREA OF INTEREST ON A USGS TOPOGRAPHIC MAP OR OTHER SUITABLE BASE MAP.

STEP 2 - REVIEW APPROPRIATE NATIONAL WETLANDS INVENTORY (NWI) MAPS, OR STATE OR LOCAL WETLAND MAPS.

STEP 3 - REVIEW SCS SOIL SURVEY MAPS AND COUNTY HYDRIC SOILS LIST FOR THE PRESENCE OF HYDRIC SOIL MAP UNITS OR MAP UNITS WITH HYDRIC SOIL INCLUSIONS.

OFFSITE DETERMINATION METHOD

STEP 4(A) - REVIEW RECENT AERIAL PHOTOS OF THE PROJECT AREA. EXAMPLES INCLUDE:

- ○ ASCS YEARLY COMPLIANCE SLIDES
- ○ HIGH ALTITUDE FLIGHTS (B/W OR CIR)
- ○ SATELLITE PHOTOGRAPHY

STEP 4(B) - REVIEW AND EVALUATE CLIMATOLOGICAL DATA TO DETERMINE WHETHER THE AREA HAD HIGH, LOW, OR NORMAL PRECIPITATION FOR AT LEAST 2-3 MONTHS PRIOR TO THE DATE OF THE PHOTOGRAPHY.

OFFSITE DETERMINATION METHOD

STEP 4(C) - DURING PHOTO INTERPRETATION, LOOK FOR ONE OR MORE SIGNS OF WETLANDS. FOR EXAMPLE:

- ○ HYDROPHYTIC VEGETATION
- ○ SURFACE WATER
- ○ SATURATED SOILS
- ○ FLOODED OR DROWNED OUT CROPS
- ○ STRESSED CROPS DUE TO WETNESS
- ○ GREENER CROPS IN DRY YEARS
- ○ DIFFERENCES IN VEGETATION PATTERNS DUE TO DIFFERENT PLANTING DATES

OFFSITE DETERMINATION METHOD

STEP 5 - REVIEW AVAILABLE SITE-SPECIFIC INFORMATION.

STEP 6 - DETERMINE WHETHER WETLANDS EXIST IN THE SUBJECT AREA. WETLANDS CAN BE ASSUMED TO EXIST IF:

○ WETLANDS ARE SHOWN ON NWI OR OTHER WETLAND MAPS, AND HYDRIC SOIL OR A SOIL WITH HYDRIC SOIL INCLUSIONS IS SHOWN ON THE SOIL SURVEY; OR

OFFSITE DETERMINATION METHOD

STEP 6 (CONTINUED)

- ○ HYDRIC SOIL OR SOIL WITH HYDRIC SOIL INCLUSIONS IS SHOWN ON THE SOIL SURVEY, AND
  - ○ SITE-SPECIFIC INFORMATION CONFIRMS HYDROPHYTIC VEGETATION, HYDRIC SOILS, AND/OR WETLAND HYDROLOGY, OR
  - ○ SIGNS OF WETLAND ARE DETECTED BY REVIEWING AERIAL PHOTOS; OR
- ○ ANY COMBINATION OF THE ABOVE OR PARTS THEREOF (e.g., VEGETATED WETLAND ON NWI MAPS AND SIGNS OF WETLAND ON AERIAL PHOTOS)

ONSITE DETERMINATIONS OF WETLANDS

METHODS (1987)

○ ROUTINE
  - AREAS $\leq$ 5 ACRES
  - AREAS $>$ 5 ACRES

○ COMPREHENSIVE

ROUTINE
METHOD

ROUTINE METHOD FOR SMALL AREAS

ROUTINE DETERMINATIONS

USE THE ROUTINE METHOD FOR SMALL AREAS WHEN:

○ PROJECT AREA IS SMALL (<5 ACRES)

○ PLANT COMMUNITIES ARE HOMOGENEOUS

○ PLANT COMMUNITY BOUNDARIES ARE ABRUPT

○ PROJECT IS NOT CONTROVERSIAL

ROUTINE METHOD

EQUIPMENT AND MATERIALS

○ BASE MAP
○ COPIES OF DATA FORM
○ WETLAND PLANT LIST
○ HYDRIC SOILS LIST
○ COUNTY SOIL SURVEY
○ COMPASS
○ SPADE, SOIL AUGER OR PROBE
○ MEASURING TAPE
○ MUNSELL SOIL COLOR BOOK

ROUTINE METHOD (1987)

STEP 1. LOCATE THE PROJECT AREA

STEP 2. IS THE AREA DISTURBED SUCH THAT PROCEDURES FOR ATYPICAL SITUATIONS MUST BE USED?

STEP 3. SELECT A SAMPLING APPROACH

ROUTINE METHOD (1987)

FOR AREAS $\leq$5 ACRES IN SIZE:

STEP 4. IDENTIFY AND MAP THE PLANT COMMUNITY TYPES

STEP 5. DETERMINE WHETHER NORMAL CONDITIONS ARE PRESENT (IS IT A POTENTIAL PROBLEM AREA WETLAND?)

STEP 6. SELECT A REPRESENTATIVE OBSERVATION POINT IN EACH PLANT COMMUNITY

ROUTINE METHOD (1987)

FOR AREAS $\leq$5 ACRES IN SIZE:

STEP 7. VISUALLY SELECT DOMINANT SPECIES FROM EACH STRATUM OF THE COMMUNITY

STEP 8. RECORD INDICATOR STATUS OF DOMINANT SPECIES

STEP 9. DETERMINE WHETHER VEGETATION IS HYDROPHYTIC

DEFINITIONS OF STRATA (1987)

TREE	WOODY PLANTS $\geq$3.0 INCHES DBH, REGARDLESS OF HEIGHT
SAPLING / SHRUB	WOODY PLANTS $\geq$3.2 FT TALL BUT <3.0 INCHES DBH
HERB	ALL NONWOODY PLANTS, AND WOODY PLANTS <3.2 FT TALL
WOODY VINE	WOODY CLIMBING PLANTS $\geq$3.2 FT TALL

ROUTINE METHOD (1987)

FOR AREAS $\leq$5 ACRES IN SIZE:

STEP 10. RECORD INDICATORS OF WETLAND HYDROLOGY

STEP 11. DETERMINE WHETHER WETLAND HYDROLOGY IS PRESENT

ROUTINE METHOD (1987)

FOR AREAS $\leq$5 ACRES IN SIZE:

STEP 12. DETERMINE WHETHER SOIL MUST BE CHARACTERIZED. SOIL IS ASSUMED TO BE HYDRIC IF:

- ○ ALL DOMINANT SPECIES ARE OBL
- ○ ALL DOMINANTS ARE OBL OR FACW AND THE WETLAND BOUNDARY IS ABRUPT

STEP 13. IF NEEDED, DIG A SOIL PIT

STEP 14. RECORD INDICATORS OF HYDRIC SOIL

STEP 15. DETERMINE WHETHER SOIL IS HYDRIC

ROUTINE METHOD (1987)

FOR AREAS ≤ 5 ACRES IN SIZE:

STEP 16. MAKE THE WETLAND DETERMINATION IN EACH PLANT COMMUNITY

STEP 17. DETERMINE THE WETLAND / NONWETLAND BOUNDARY. VERIFY BY WALKING THE BOUNDARY AND MAKING MINOR ADJUSTMENTS BASED ON SOILS AND VEGETATION

ROUTINE METHOD FOR LARGE AREAS

ROUTINE METHOD (1987)

FOR AREAS >5 ACRES IN SIZE:

STEP 18. ESTABLISH A BASELINE

STEP 19. DETERMINE THE NUMBER AND
POSITION OF TRANSECTS

SUGGESTED MINIMUM NUMBER OF TRANSECTS

BASELINE LENGTH (MI)	NO. OF TRANSECTS
<1.0	3
1.0-2.0	3-5
2.0-4.0	5-8
>4.0	8 OR MORE*

* INTERVAL BETWEEN TRANSECTS SHOULD NOT EXCEED 0.5 MILE.

ROUTINE METHOD (1987)

FOR AREAS >5 ACRES IN SIZE:

STEP 20. SAMPLE POINTS ALONG THE FIRST TRANSECT

- ○ DETERMINE WHETHER NORMAL CONDITIONS ARE PRESENT
- ○ ESTABLISH AN OBSERVATION POINT IN THE FIRST PLANT COMMUNITY
- ○ CHARACTERIZE VEGETATION, SOIL, AND HYDROLOGY, AND RECORD ON DATA FORM
- ○ MAKE THE WETLAND DETERMINATION AT THAT POINT
- ○ SAMPLE REMAINING POINTS ON THAT TRANSECT
- ○ DETERMINE THE WETLAND BOUNDARY BETWEEN POINTS

ROUTINE METHOD (1987)

FOR AREAS >5 ACRES IN SIZE:

STEP 21. SAMPLE THE REMAINING TRANSECTS

STEP 22. SYNTHESIZE DATA AND DETERMINE THE WETLAND BOUNDARY BETWEEN TRANSECTS

COMPREHENSIVE
METHOD

COMPREHENSIVE METHOD

EQUIPMENT AND MATERIALS

○ BASE MAP
○ COPIES OF DATA FORMS
○ WETLAND PLANT LIST
○ HYDRIC SOILS LIST
○ COUNTY SOIL SURVEY
○ COMPASS
○ SPADE, SOIL AUGER OR PROBE
○ MEASURING TAPE
○ MUNSELL SOIL COLOR BOOK
○ VEGETATION SAMPLING FRAME
○ BASAL-AREA OR DIAMETER TAPE, OR BASAL-AREA PRISMS
○ CALCULATOR

COMPREHENSIVE METHOD (1987)

STEP 1. IDENTIFY THE PROJECT AREA

STEP 2. DETERMINE WHETHER PROCEDURES FOR ATYPICAL SITUATIONS MUST BE USED

STEP 3. IDENTIFY AND MAP THE PLANT COMMUNITIES

COMPREHENSIVE METHOD (1987)

- STEP 4. DETERMINE TYPE AND NUMBER OF STRATA IN EACH COMMUNITY
- STEP 5. DETERMINE WHETHER NORMAL ENVIRONMENTAL CONDITIONS ARE PRESENT
- STEP 6. ESTABLISH A BASELINE
- STEP 7. DETERMINE NUMBER AND POSITION OF TRANSECTS
- STEP 8. DETERMINE NUMBER OF OBSERVATION POINTS ALONG EACH TRANSECT

SUGGESTED MINIMUM NUMBER OF TRANSECTS

BASELINE LENGTH (FT)	NUMBER OF TRANSECTS	BASELINE SEGMENT (FT)
<1,000	3	18-333
1,000-5,000	5	200-1,000
5,000-10,000	7	700-1,400
>10,000	8+	2,000

NOTE: IF BASELINE LENGTH EXCEEDS 5 MILES, BASELINE SEGMENTS SHOULD BE 0.5 MILES LONG.

SUGGESTED SPACING OF SAMPLING POINTS

TRANSECT LENGTH (FT)	NUMBER OF POINTS	INTERVAL BETWEEN POINTS (FT)
<1,000	<10	100
1,000-10,000	10	100-1,000
>10,000	>10	1,000

NOTE: FIRST PLOT SHOULD BE ESTABLISHED 50 FT FROM THE BASELINE.

COMPREHENSIVE METHOD (1987)

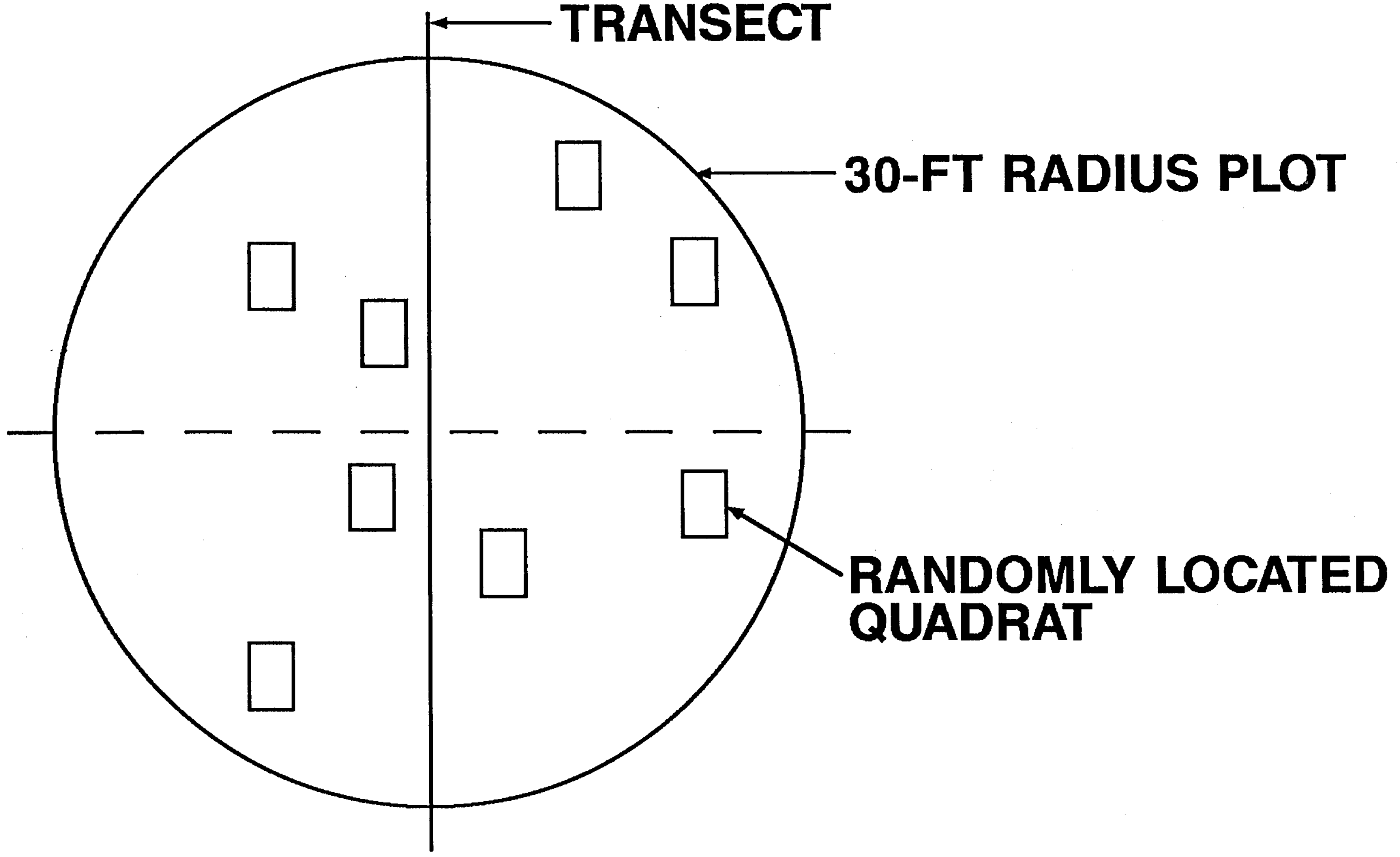
STEP 9. CHARACTERIZE VEGETATION AT THE FIRST OBSERVATION POINT

STEP 10. ANALYZE VEGETATION DATA AND SELECT DOMINANT SPECIES FROM EACH STRATUM

COVER CLASSES

COVER CLASS	CLASS RANGE (%)	MIDPOINT OF RANGE (%)
T	<1	0.0
1	1-5	3.0
2	6-15	10.5
3	16-25	20.5
4	26-50	38.0
5	51-75	63.0
6	76-95	85.5
7	96-100	98.0

#WDM0297 12/19/89:CBC



COMPREHENSIVE METHOD (1987)

STEP 11. CHARACTERIZE SOIL

STEP 12. CHARACTERIZE HYDROLOGY

STEP 13. DETERMINE WHETHER VEGETATION IS HYDROPHYTIC

STEP 14. DETERMINE WHETHER SOIL IS HYDRIC

STEP 15. DETERMINE WHETHER WETLAND HYDROLOGY IS PRESENT

STEP 16. MAKE THE WETLAND DETERMINATION AT THAT POINT

COMPREHENSIVE METHOD (1987)

STEP 17. SAMPLE ADDITIONAL POINTS ALONG THAT TRANSECT

STEP 18. DETERMINE THE WETLAND BOUNDARY BETWEEN POINTS

STEP 19. SAMPLE REMAINING TRANSECTS

STEP 20. SYNTHESIZE DATA ACROSS ALL TRANSECTS

STEP 21. DETERMINE THE WETLAND BOUNDARY BETWEEN TRANSECTS

DISTURBED AREAS

EXAMPLES OF DISTURBED AREAS

- ○ **HUMAN ACTIVITIES**
  - ○ REMOVAL OF VEGETATION
  - ○ REMOVAL OF SOIL
  - ○ PLACEMENT OF FILL
  - ○ CONSTRUCTION OF DAMS AND LEVEES
  - ○ CONVERSION TO AGRICULTURE
  - ○ CHANNELIZATION
  - ○ DRAINAGE
- ○ **NATURAL EVENTS**
  - ○ CHANGE IN RIVER COURSE
  - ○ BEAVER DAMS
  - ○ AVALANCHES AND MUDSLIDES
  - ○ FIRES
  - ○ VOLCANIC DEPOSITION

WDM00216 03/22/89:HMH

DISTURBED AREAS

PROCEDURES:

○ VEGETATION

○ SOILS

○ HYDROLOGY

WDM00027 02/25/88:ABC

DETERMINE THE DATE OF THE ALTERATION

○ DIRECT QUESTIONING

○ AERIAL PHOTOGRAPHS

○ BUILDING PERMITS

WDM00028 02/25/88:ABC

DISTURBED AREAS -- VEGETATION

STEP 1 - DESCRIBE THE ALTERATION.

STEP 2 - DESCRIBE EFFECTS ON VEGETATION.

- ○ CLEARED OR PARTIALLY CLEARED
- ○ CERTAIN LAYERS REMOVED
- ○ SELECTED SPECIES REMOVED
- ○ BURNED, MOWED, OR HEAVILY GRAZED
- ○ COVERED BY FILL
- ○ MORTALITY DUE TO WATER

DISTURBED AREAS -- VEGETATION

STEP 3 - CHARACTERIZE ORIGINAL VEGETATION.

○ AERIAL PHOTOGRAPHY
○ ONSITE INSPECTION
○ PREVIOUS SITE INSPECTION
○ ADJACENT VEGETATION
○ SCS RECORDS
○ PERMIT APPLICANT
○ PUBLIC INTERVIEWS
○ NWI MAPS

STEP 4 - DETERMINE WHETHER THE VEGETATION WAS HYDROPHYTIC.

DISTURBED AREAS -- SOILS

STEP 1 - DESCRIBE THE ALTERATION.

- ○ DREDGED OR FILL MATERIAL COVERS ORIGINAL SOIL
  - ○ COLOR OR TEXTURE DIFFERENCES
  - ○ DECOMPOSING VEGETATION BETWEEN LAYERS
  - ○ NON-WOODY DEBRIS AT SURFACE
- ○ SUBSURFACE PLOWING
- ○ REMOVAL OF SURFACE LAYERS
  - ○ EXPOSED PLANT ROOTS OR SCRAPE SCARS
- ○ PRESENCE OF MAN-MADE STRUCTURES

DISTURBED AREAS -- SOILS

STEP 2 - DESCRIBE EFFECTS ON SOILS.

○ RECORD DEPTH OF FILL OVER BURIED SOIL

○ RECORD DEPTH OF PLOW ZONE

○ DESCRIBE CHANGE IN SOIL PHASE

○ DESCRIBE EFFECTS OF SOIL COMPACTION

DISTURBED AREAS -- SOILS

STEP 3 - CHARACTERIZE ORIGINAL SOILS.

- ○ SOIL SURVEYS
- ○ EXCAVATE AND CHARACTERIZE BURIED SOILS
- ○ CHARACTERIZE PLOWED SOILS BELOW PLOW ZONE
- ○ EXAMINE ADJACENT AREAS OR B-HORIZON IF SURFACE LAYERS REMOVED

STEP 4 - DETERMINE WHETHER SOILS WERE HYDRIC.

DISTURBED AREAS -- HYDROLOGY

STEP 1 - DESCRIBE THE ALTERATION.

- ○ DAMS (MAN-MADE OR NATURAL)
- ○ LEVEES OR DIKES
- ○ DITCHES OR SUBSURFACE TILES
- ○ FILLING OF CHANNELS OR DEPRESSIONS
- ○ WATER DIVERSION
- ○ GROUND-WATER EXTRACTION
- ○ CHANNELIZATION

DISTURBED AREAS -- HYDROLOGY

STEP 2 - DESCRIBE EFFECTS ON HYDROLOGY.

- ○ FREQUENCY OF INUNDATION
- ○ DURATION OF INUNDATION AND SOIL SATURATION

DISTURBED AREAS -- HYDROLOGY

STEP 3 - CHARACTERIZE PREVIOUS HYDROLOGY.

- ○ STREAM OR TIDAL GAUGE DATA
- ○ FIELD HYDROLOGIC INDICATORS
- ○ AERIAL IMAGERY
- ○ HISTORICAL RECORDS
- ○ FLOODPLAIN MANAGEMENT MAPS
- ○ PUBLIC OR LOCAL OFFICIALS

STEP 4 - DETERMINE WHETHER WETLAND HYDROLOGY WAS PRESENT.

DISTURBED AREAS -- HYDROLOGY

STEP 5 - DETERMINE WHETHER WETLAND HYDROLOGY STILL EXISTS.

○ REVIEW EXISTING INFORMATION (GAUGES, WELLS, RECENT OBSERVATIONS)

○ EXAMINE WET-SEASON AERIAL PHOTOS

○ EXAMINE FIELD INDICATORS (EXCEPT HYDRIC SOIL MORPHOLOGICAL CHARACTERISTICS)

○ EXAMINE A NEARBY UNDISTURBED REFERENCE SITE

○ DETERMINE "ZONE OF INFLUENCE" OF DRAINAGE SYSTEM

○ CONDUCT GROUNDWATER STUDIES

PROBLEM AREAS

PROBLEM AREA WETLANDS

WETLANDS IN WHICH INDICATORS OF ONE OR MORE PARAMETERS MAY PERIODICALLY BE LACKING DUE TO NORMAL SEASONAL OR ANNUAL VARIABILITY

PROBLEM AREAS (1987)

○ WETLANDS ON DRUMLINS OR OTHER GLACIAL DEPOSITS

○ SEASONAL WETLANDS

○ PRAIRIE POTHOLES

○ VEGETATED FLATS

PROBLEM AREAS (1987)

○ WETLANDS ON DRUMLINS OR OTHER GLACIAL DEPOSITS

○ SEASONAL WETLANDS

○ PRAIRIE POTHOLES

○ VEGETATED FLATS

PROBLEM AREAS (1987)

- ○ WETLANDS ON DRUMLINS OR OTHER GLACIAL DEPOSITS
- ○ SEASONAL WETLANDS
- ○ PRAIRIE POTHOLES
- ○ VEGETATED FLATS

PROBLEM AREAS (1987)

○ WETLANDS ON DRUMLINS OR OTHER GLACIAL DEPOSITS

○ SEASONAL WETLANDS

○ PRAIRIE POTHOLES

○ VEGETATED FLATS

PROBLEM AREAS (1987)

○ WETLANDS ON DRUMLINS OR OTHER GLACIAL DEPOSITS

○ SEASONAL WETLANDS

○ PRAIRIE POTHOLES

○ VEGETATED FLATS

PROBLEM AREAS (1987)

OTHER PROBLEM AREAS NOTED ELSEWHERE IN THE 1987 MANUAL:

- ○ MAN-INDUCED WETLANDS
- ○ WET ENTISOLS
- ○ WET SOILS FROM RED OR LOW-CHROMA PARENT MATERIALS
- ○ WET SPODOSOLS
- ○ WET MOLLISOLS

PROBLEM AREAS (1987)

○ MAN-INDUCED WETLANDS

○ WET ENTISOLS

○ WET SOILS FROM RED OR LOW-CHROMA PARENT MATERIALS

○ WET SPODOSOLS

○ WET MOLLISOLS

MAN-INDUCED WETLANDS

AREAS THAT HAVE DEVELOPED CHARACTERISTICS OF NATURALLY OCCURRING WETLANDS DUE TO EITHER INTENTIONAL OR INCIDENTAL HUMAN ACTIVITIES

MAN-INDUCED WETLANDS

- ○ IRRIGATED WETLANDS
- ○ IMPOUNDMENT WETLANDS
- ○ CONSTRUCTED WETLANDS
- ○ FILLED DEEPWATER HABITATS

PROBLEM AREAS (1987)

- ○ MAN-INDUCED WETLANDS
- ○ WET ENTISOLS
- ○ WET SOILS FROM RED OR LOW-CHROMA PARENT MATERIALS
- ○ WET SPODOSOLS
- ○ WET MOLLISOLS

PROBLEM AREAS (1987)

○ MAN-INDUCED WETLANDS

○ WET ENTISOLS

○ WET SOILS FROM RED OR LOW-CHROMA PARENT MATERIALS

○ WET SPODOSOLS

○ WET MOLLISOLS

PROBLEM AREAS (1987)

- ○ MAN-INDUCED WETLANDS
- ○ WET ENTISOLS
- ○ WET SOILS FROM RED OR LOW-CHROMA PARENT MATERIALS
- ○ WET SPODOSOLS
- ○ WET MOLLISOLS

PROBLEM AREAS (1987)

- ○ MAN-INDUCED WETLANDS
- ○ WET ENTISOLS
- ○ WET SOILS FROM RED OR LOW-CHROMA PARENT MATERIALS
- ○ WET SPODOSOLS
- ○ WET MOLLISOLS

February 23, 1993

Descriptions of Picture Slides and Drawings in the Regulatory IV Slide Set

Slide No.	Description
1	Desert scene; obvious nonwetland.
2	Cattail marsh; obvious wetland.
3	Cypress swamp; obvious wetland.
4	High elevation marsh; obvious wetland.
5	Flooded bottomland hardwood swamp; apparent wetland.
6	Bottomland hardwood swamp during the dry season. Is it still a wetland?
7	Mountain meadow. Wetland?
8	Western riparian scene. Wetland?
12	Cover of the Fish and Wildlife Service wetland classification.
14	Diagram of gradient from upland to deepwater habitat.
17	Diagram of gradient showing that the wetland boundary is the highest point having evidence of all three wetland parameters.
20	Cover of the SCS National Food Security Act manual.
30	Aerial view of a tidal marsh.
31	Picture of a stream and floodplain.
32	Diagram of cross section of a river floodplain showing natural levees, backswamps, and abandoned channel.
33	Drawing of a depressional wetland with a water table that reaches the surface during wet seasons.
34	Drawing of a depressional wetland with water perched over a slowly permeable soil layer.
35	Drawing of a slope wetland.

37	Picture of inundated forested wetland.
39	Picture of ponded depression (pothole) in an agricultural field.
41	Picture of stream at flood stage.
43	Picture of a groundwater-fed wetland.
45	Picture of water standing in a shovel hole.
56	Picture of a staff gauge on a small stream.
57	Picture of a groundwater monitoring well.
58	Example of a hydrograph plotted from stream gauge data.
59	Aerial photo of a flooded forest.
62	Picture of inundated swamp.
63	Picture of water films glistening on soil sample.
64	Picture of water being squeezed out of a soil sample.
65	Picture of watermarks on tree.
66	Picture of watermarks (stains) on boulders.
67	Picture of debris line made by a flooding stream.
68	Picture of wrack line in coastal marsh.
69	Picture of debris caught in the limbs of a tree.
70	Picture of sediment deposits on fallen leaves.
71	Picture of forest floor that has been scoured of litter by flowing water.
73	Picture of oxidized root channels in a gray soil matrix.
74	Picture of water-stained leaf compared with unstained leaf.
75	Cover of a county soil survey.
76	Picture of a swamp forest that passes the FAC-neutral test.
83	Picture of floating leaves of water lily.
84	Photomicrograph of aerenchyma in water hyacinth.
85	Photomicrograph showing different amounts of aerenchyma in individual alligator weed plants grown in progressively wetter locations.

86	Picture of buttressed bases of baldcypress.
87	Picture of buttressed base of slash pine.
88	Picture of fluted roots.
89	Picture of prop roots on red mangrove.
90	Picture of pneumatophores on black mangrove.
91	Picture of baldcypress knees.
92	Picture of multiple stems and adventitious roots on black willow.
93	Picture of shallow root mass on windthrown tree.
97	Picture of viviparous seedlings on red mangrove.
98	Picture of overcup oak seedlings in standing water.
99	Covers of Fish and Wildlife Service lists of plant species that occur in wetlands.
142	Covers of the National List of Scientific Plant Names.
143	Diagram showing the distribution of several plant species as bell curves on a moisture gradient.
157	Picture of someone digging a soil pit for evaluation of hydric soils.
159	Picture of the wall of a soil pit showing soil profile.
162	Diagram of the soil texture triangle.
165	Diagram relating permeability to soil texture.
170	Picture of an organic soil.
171	Picture of a shovel slice of a mineral soil.
172	Cover of Hydric Soils of the United States.
185	Picture of an organic soil.
186	Picture of a histic epipedon.
187	Picture of a tidal salt marsh (peraquic moisture regime).
189	Picture of a gleyed soil.
190	Picture of a mottled soil.
195	Picture of a sandy soil with a dark, organic-rich surface layer.

196	Picture of a sandy soil with organic streaks in the subsoil.
199	Picture of someone using a Munsell color book.
201	Diagram of visible spectrum.
203	Picture of 10YR page.
204	Picture of gley page.
206	Picture of 7.5YR page.
208	Picture of 2.5Y page.
211	Picture of someone using a Munsell book.
222	Cover of a county soil survey.
223	Picture of the general soil map in a soil survey.
224	Picture of the map sheet index.
225	Picture of a soil map sheet.
226	Picture of the soil legend.
228	Picture of a map unit description.
229	Picture of a soil series description.
242	Covers of Soil Taxonomy, the Keys to Soil Taxonomy, and the Munsell Soil Color Book.
248	Picture of the profile of a Histosol.
249	Picture of a Mollisol.
250	Picture of an Entisol.
251	Picture of a Vertisol.
252	Picture of an Ultisol.
253	Picture of a Spodosol.
266	Picture of map showing the general soil temperature regime regions in the US.
270	Picture of the profile of a Typic Medisaprist.
272	Picture of an Aquic Quartzipsamment.
274	Picture of a Typic Argiaquoll.

276	Picture of an Aeric Haplaquod.
283	Picture of a USGS topographic map.
284	Cover of a county soil survey.
285	Picture of a National Wetlands Inventory map.
286	Color IR aerial photo.
287	Cover of an environmental impact statement.
288	Picture of a land-use, land-cover map.
289	Engineering drawing of a proposed project.
290	Detailed topographic map developed as part of project planning.
296	Cover of SCS South Wetland Mapping Conventions for Food Security Act applications.
297	Picture of investigator using multiple slide viewers to identify wetlands from ASCS annual compliance slides.
298	Aerial view of prairie pothole country.
299	Ground-level view of a small pothole.
300	Aerial view showing variability in pothole size and wetness.
301	Soil map in an area containing potholes.
302	ASCS slide of tract containing potholes (1986).
303	ASCS slide of same tract (1987).
304	ASCS slide of same tract (1988).
305	ASCS slide of same tract (1989).
306	ASCS slide of same tract (1990).
307	Pothole wetlands indicated on NWI map.
308	High-altitude aerial photo of same potholes indicated in the previous slide.
309	Completed map of pothole wetlands.
310	Picture of southeastern bottomland hardwood forest.

311	Picture illustrating three different SCS wetland designations: (1) wetland (forest at right), (2) farmed wetland (flooded field in background), and (3) prior converted cropland (dry field in foreground).
312	USGS topographic map of the Sixmile Lake area in Mississippi.
313	SCS soil survey map of the same area.
314	National Wetlands Inventory map of the same area.
315	ASCS slide of the same area (1986).
316	ASCS slide of the same area (1987).
317	ASCS slide of the same area (1988).
318	ASCS slide of the same area (1989).
319	High-altitude photo of the same area.
320	Example of satellite imagery of the Mississippi Delta region.
321	Classification of satellite imagery into wetlands (green) and farmed wetlands (yellow).
322	Completed wetland map.
331	Map of project site showing project boundaries, scale, and mapped cover types.
332	Map of project site showing locations of representative sampling points in each cover type.
335	Picture of plant community with one stratum (coastal marsh).
336	Picture of plant community with two strata (black spruce bog).
337	Picture of plant community with multiple strata (bottomland forest).
338	Picture of the first section of the data form for routine wetland determinations (form approved 2/92 by Headquarters, Army Corps of Engineers).
339	Picture of the Vegetation section of the data form.
341	Picture of the Hydrology section of the data form.
343	Picture of the Soils section of the data form.
345	Picture of the Wetland Determination section of the data form.

346	Map of project site with wetland and nonwetland sampling points indicated.
347	Final wetland map showing wetland boundary corresponding with the boundary between wetland and nonwetland cover types.
351	Map of the same project site with transect locations indicated.
353	Map of project site with representative sampling points in each plant community along each transect indicated.
354	Map of project site with intermediate sampling points and wetland boundary on each transect indicated.
356	Final wetland map produced by connecting the wetland boundary points on each transect with a line following the topographic contour.
357	Picture of surveyor; optional final step in the wetland determination.
363	Map of project site for comprehensive wetland determination, showing cover types and transect locations.
365	Map of project site with evenly spaced grid of sampling points indicated.
367	Investigator measuring diameter of tree.
368	Picture of the tree portion of the vegetation section of Data Form 2 (blank).
369	Picture of the tree portion of the vegetation section of Data Form 2 (filled out).
370	Picture of investigators using a quadrat frame to collect information about the herb stratum.
372	Picture of the herb portion of the vegetation section of Data Form 2 (filled out).
374	Investigators collecting data about the sapling/shrub stratum.
377	Map of project site indicating the wetland boundary on each transect.
378	Final wetland map developed by connecting the wetland boundary points on each transect.

381	Picture of recently disturbed area that has been cleared, leveled, and leveed off from the stream that previously flooded the site.
382	Picture of drainage ditch through an agricultural field.
383	Aerial view of area that has been converted to agriculture; wetter portions are indicated by yellow and stunted corn.
384	Aerial view of prairie potholes that have been ditched in an attempt to drain them.
385	Picture of downcut stream that no longer overflows onto its floodplain.
386	Picture of beaver dam and pond.
387	Picture of concrete-lined drainage channel.
391	Picture of totally cleared bottomland forest.
392	Picture of partially cleared spruce/hemlock forest (understory layer still present).
393	Picture of mowed wetland edge behind an apartment complex.
395	Vegetation section of Data Form 3 (blank).
396	Vegetation section of Data Form 3 (filled out).
398	Picture of new fill placed in a forested wetland.
401	Soils section of Data Form 3 (filled out).
403	Picture of water-control structure (weir) on small stream.
404	Picture of machine used to install drainage tiles.
405	Picture of earthmoving equipment in leveled area.
406	Picture of channelized stream.
407	Picture of ditch and drains helping to drain a forested wetland.
410	Hydrology section of Data Form 3 (filled out).
417	Picture of California vernal pool in February (wet season).
418	Same vernal pool in May.
419	Same vernal pool in October (dry season).
421	Aerial view of prairie potholes.

423	Picture of vegetated flat during the nongrowing season, resembling a mudflat.
428	Picture of a constructed wetland in New Hampshire.
430	Picture of new alluvial deposits (Entisols) along the Toutle River near Mount St. Helens, Washington.
432	Picture of streambank consisting of red Triassic sandstone and shale in Colorado.
434	Picture of wet Spodosol in Florida.
436	Picture of prairie pothole in North Dakota (Mollisol soils).
437	Picture of sample of mollic epipedon showing gray mottles.

[SAMPLE] [SAMPLE]

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 45th STREET
Applicant/Owner: J. JOHNSON
Investigator: WAKELEY, TEAFORD, McCALEB

Date: 5/10/92
County: KALAMAZOO
State: MICHIGAN

Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem Area? Yes [✓ No]
(If needed, explain on reverse.)

Community ID: # 2
Transect ID:
Plot ID: B

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. TILIA AMERICANA	T	FACU	9.		
2. FRAXINUS PENNSYL.	T	FACW	10.		
3. CARPINUS CAROLINIANA	S/S	FAC	11.		
4. CORNUS FOEMINA	S/S	FACW-	12.		
5. ULMUS AMERICANA	S/S	FACW-	13.		
6. SYMPLOCARPUS FOETIDUS	H	OBL	14.		
7. CAREX STRICTA	H	OBL	15.		
8. SENECIO AUREUS	H	FACW	16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 7/8 = 87.5 %

Remarks: SHALLOW ROOTS IN TILIA.
FAC-NEUTRAL TEST = 6 WET : 1 NONWET

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

✓ No Recorded Data Available

Field Observations:

Depth of Surface Water: NONE (in.)

Depth to Free Water in Pit: 16 (in.)

Depth to Saturated Soil: 4 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ✓ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ✓ Water-Stained Leaves
- ✓ Local Soil Survey Data
- ✓ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: SOIL SURVEY INDICATES HIGH WATER TABLE 0-1.0 FT, SEPT TO MAY. GROWING SEASON 20 APR – 27 OCT.

[SAMPLE]

SOILS

Map Unit Name (Series and Phase): HOUGHTON AND SEBEWA SOILS, PONDED (SAMPLE IS SEBEWA MEMBER)
Drainage Class: VPD
Taxonomy (Subgroup): TYPIC ARGIAQUOLL
Field Observations Confirm Mapped Type? [✓ Yes] No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-9	A	10YR 3/1	—	—	FSL
9-14	B	10YR 4/1	7.5YR 6/6	FEW, DISTINCT	CL
14-		10YR 5/1	7.5YR 5/6	COMMON, DIST.	CL

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ✓ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ✓ Listed on Local Hydric Soils List
- ✓ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [✓ Yes] No (Circle)
Wetland Hydrology Present? [✓ Yes] No
Hydric Soils Present? [✓ Yes] No

(Circle)
Is this Sampling Point Within a Wetland? [✓ Yes] No

Remarks:

Approved by HQUSACE 2/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: ____________________
Applicant/Owner: ____________________
Investigator: ____________________

Date: __________
County: __________
State: __________

Do Normal Circumstances exist on the site? Yes No
Is the site significantly disturbed (Atypical Situation)? Yes No
Is the area a potential Problem Area? Yes No
(If needed, explain on reverse.)

Community ID: __________
Transect ID: __________
Plot ID: __________

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1.			9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). ____________________

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
  ___ Stream, Lake, or Tide Gauge
  ___ Aerial Photographs
  ___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: __________(in.)

Depth to Free Water in Pit: __________(in.)

Depth to Saturated Soil: __________(in.)

Wetland Hydrology Indicators:
- Primary Indicators:
  - ___ Inundated
  - ___ Saturated in Upper 12 Inches
  - ___ Water Marks
  - ___ Drift Lines
  - ___ Sediment Deposits
  - ___ Drainage Patterns in Wetlands
- Secondary Indicators (2 or more required):
  - ___ Oxidized Root Channels in Upper 12 Inches
  - ___ Water-Stained Leaves
  - ___ Local Soil Survey Data
  - ___ FAC-Neutral Test
  - ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name
(Series and Phase): ______________________________ Drainage Class: __________
Field Observations
Taxonomy (Subgroup): ______________________________ Confirm Mapped Type? Yes No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes No (Circle)
Wetland Hydrology Present? Yes No
Hydric Soils Present? Yes No

(Circle)
Is this Sampling Point Within a Wetland? Yes No

Remarks:

Approved by HQUSACE 2/92