IDAHO DEPARTMENT
OF HEALTH AND WELFARE
DIVISION OF
ENVIRONMENTAL QUALITY

1410 North Hilton, Boise, ID 83706-1255, (208) 373-0502 Philip E. Batt, Governor

February 2, 1998

MEMORANDUM

To: Environmental Health Directors:
Ken W. Lustig, Panhandle District Health Department,
Paul E. Guenther, North Central District Health Department,
Tom Goss, Southwest District Health Department,
Tom N. Turco, Central District Health Department,
Dan Kriz, South Central District Health Department,
Ed Marugg, Southeastern District Health Department,
Richard Horne, District 7 Health Department

From: **Barry N. Burnell,** Acting Watershed Protection Supervisor

Re: **Individual Subsurface Sewage Disposal Site Evaluations in Wetlands**

Wetlands are protected under the Clean Water Act (33 U.S.C. 1344) Sections 404. The Corps of Engineers (FR 1982) and the EPA (FR 1980) jointly define wetlands as: 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. Wetlands generally include swamps, marshes, bogs, and similar areas.

These areas are typically not suitable for individual subsurface sewage disposal systems because of the saturated soil conditions associated with normal and seasonal high ground water. Staff that encounter wetlands on parcels during site evaluations or inspections should require ground water monitoring over the season when the highest ground water levels are typically observed. These sites may not be suitable for subsurface sewage disposal based on depth to seasonal and normal high ground water (see IDAPA 16.01.03.003.15 page 99 of the TGM).

Should ground water monitoring indicate that one of the complex alternative systems could be permitted on a parcel to address the high ground water level, the subsurface sewage disposal permit should not be issued without the prior issuance of a Corps of Engineers 404 Dredge and Fill Permit. Staff should contact the local Corps of Engineers for a determination of wetland status.

Please share this memo with your field staff.

WETLANDS RESEARCH PROGRAM

TECHNICAL REPORT Y-87-1

CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL

by

Environmental Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631, Vicksburg, Mississippi 39180-0631

January 1987
Final Report

Approved For Public Release; Distribution Unlimited

Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000

US Army Corps of Engineers

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PART II: TECHNICAL GUIDELINES

24. The interaction of hydrology, vegetation, and soil results in the development of characteristics unique to wetlands. Therefore, the following technical guideline for wetlands is based on these three parameters, and diagnostic environmental characteristics used in applying the technical guideline are represented by various indicators of these parameters.

25. Because wetlands may be bordered by both wetter areas (aquatic habitats) and by drier areas (nonwetlands), guidelines are presented for wetlands, deepwater aquatic habitats, and nonwetlands. However, procedures for applying the technical guidelines for deepwater aquatic habitats and nonwetlands are not included in the manual.

Wetlands

26. The following definition, diagnostic environmental characteristics, and technical approach comprise a guideline for the identification and delineation of wetlands:

- a. Definition. The CE (Federal Register 1982) and the EPA (Federal Register 1980) jointly define wetlands as: 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. Wetlands generally include swamps, marshes, bogs, and similar areas.
- b. Diagnostic environmental characteristics. Wetlands have the following general diagnostic environmental characteristics:
  - (1) Vegetation. The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions described in a above. Hydrophytic species, due to morphological, physiological, and/or reproductive adaptation(s), have the ability to grow, effectively compete, reproduce, and/or persist in anaerobic soil conditions.* Indicators of vegetation associated with wetlands are listed in paragraph 35.

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* Species (e.g. *Acer rubrum*) having broad ecological tolerances occur in both wetlands and nonwetlands.

(2) Soil. Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions. Indicators of soils developed under reducing conditions are listed in paragraphs 44 and 45.

(3) Hydrology. The area is inundated either permanently or periodically at mean water depths ≤6.6 ft, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation.* Indicators of hydrologic conditions that occur in wetlands are listed in paragraph 49.

c. Technical approach for the identification and delineation of wetlands. Except in certain situations defined in this manual, evidence of a minimum of one positive wetland indicator from each parameter (hydrology, soil, and vegetation) must be found in order to make a positive wetland determination.

Deepwater Aquatic Habitats

27. The following definition, diagnostic environmental characteristics, and technical approach comprise a guideline for deepwater aquatic habitats:

a. Definition. Deepwater aquatic habitats are areas that are permanently inundated at mean annual water depths >6.6 ft or permanently inundated areas ≤6.6 ft in depth that do not support rooted-emergent or woody plant species.**

b. Diagnostic environmental characteristics. Deepwater aquatic habitats have the following diagnostic environmental characteristics:

(1) Vegetation. No rooted-emergent or woody plant species are present in these permanently inundated areas.

(2) Soil. The substrate technically is not defined as a soil if the mean water depth is >6.6 ft or if it will not support rooted emergent or woody plants.

(3) Hydrology. The area is permanently inundated at mean water depths >6.6 ft.

c. Technical approach for the identification and delineation of deepwater aquatic habitats. When any one of the diagnostic characteristics identified in b above is present, the area is a deepwater aquatic habitat.

* The period of inundation or soil saturation varies according to the hydrologic/soil moisture regime and occurs in both tidal and nontidal situations.

** Areas ≤6.6 ft mean annual depth that support only submergent aquatic plants are vegetated shallows, not wetlands.

Nonwetlands

28. The following definition, diagnostic environmental characteristics, and technical approach comprise a guideline for the identification and delineation of nonwetlands:

a. Definition. Nonwetlands include uplands and lowland areas that are neither deepwater aquatic habitats, wetlands, nor other special aquatic sites. They are seldom or never inundated, or if frequently inundated, they have saturated soils for only brief periods during the growing season, and, if vegetated, they normally support a prevalence of vegetation typically adapted for life only in aerobic soil conditions.

b. Diagnostic environmental characteristics. Nonwetlands have the following general diagnostic environmental characteristics:

(1) Vegetation. The prevalent vegetation consists of plant species that are typically adapted for life only in aerobic soils. These mesophytic and/or xerophytic macrophytes cannot persist in predominantly anaerobic soil conditions.*

(2) Soil. Soils, when present, are not classified as hydric, and possess characteristics associated with aerobic conditions.

(3) Hydrology. Although the soil may be inundated or saturated by surface water or ground water periodically during the growing season of the prevalent vegetation, the average annual duration of inundation or soil saturation does not preclude the occurrence of plant species typically adapted for life in aerobic soil conditions.

c. Technical approach for the identification and delineation of nonwetlands. When any one of the diagnostic characteristics identified in b above is present, the area is a nonwetland.

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* Some species, due to their broad ecological tolerances, occur in both wetlands and nonwetlands (e.g. *Acer rubrum*).

PART III: CHARACTERISTICS AND INDICATORS OF HYDROPHYTIC VEGETATION, HYDRIC SOILS, AND WETLAND HYDROLOGY

Hydrophytic Vegetation

Definition

29. Hydrophytic vegetation. Hydrophytic vegetation is defined herein as the sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present. The vegetation occurring in a wetland may consist of more than one plant community (species association). The plant community concept is followed throughout the manual. Emphasis is placed on the assemblage of plant species that exert a controlling influence on the character of the plant community, rather than on indicator species. Thus, the presence of scattered individuals of an upland plant species in a community dominated by hydrophytic species is not a sufficient basis for concluding that the area is an upland community. Likewise, the presence of a few individuals of a hydrophytic species in a community dominated by upland species is not a sufficient basis for concluding that the area has hydrophytic vegetation. *CAUTION: In determining whether an area is "vegetated" for the purpose of Section 404 jurisdiction, users must consider the density of vegetation at the site being evaluated. While it is not possible to develop a numerical method to determine how many plants or how much biomass is needed to establish an area as being vegetated or unvegetated, it is intended that the predominant condition of the site be used to make that characterization. This concept applies to areas grading from wetland to upland, and from wetland to other waters. This limitation would not necessarily apply to areas which have been disturbed by man or recent natural events.*

30. Prevalence of vegetation. The definition of wetlands (paragraph 26a) includes the phrase "prevalence of vegetation." Prevalence, as applied to vegetation, is an imprecise, seldom-used ecological term. As used in the wetlands definition, prevalence refers to the plant community or communities that occur in an area at some point in time. Prevalent vegetation is characterized by the dominant species comprising the plant community or communities. Dominant plant species are those that contribute more to the character of a plant community than other species present, as estimated or

measured in terms of some ecological parameter or parameters. The two most commonly used estimates of dominance are basal area (trees) and percent areal cover (herbs). Hydrophytic vegetation is prevalent in an area when the dominant species comprising the plant community or communities are typically adapted for life in saturated soil conditions.

31. Typically adapted. The term "typically adapted" refers to a species being normally or commonly suited to a given set of environmental conditions, due to some morphological, physiological, or reproductive adaptation (Appendix C, Section 3). As used in the CE wetlands definition, the governing environmental conditions for hydrophytic vegetation are saturated soils resulting from periodic inundation or saturation by surface or ground water. These periodic events must occur for sufficient duration to result in anaerobic soil conditions. When the dominant species in a plant community are typically adapted for life in anaerobic soil conditions, hydrophytic vegetation is present. Species listed in Appendix C, Section 1 or 2, that have an indicator status of OBL, FACW, or FAC* (Table 1) are considered to be typically adapted for life in anaerobic soil conditions (see paragraph 35a).

Influencing factors

32. Many factors (e.g. light, temperature, soil texture and permeability, man-induced disturbance, etc.) influence the character of hydrophytic vegetation. However, hydrologic factors exert an overriding influence on species that can occur in wetlands. Plants lacking morphological, physiological, and/or reproductive adaptations cannot grow, effectively compete, reproduce, and/or persist in areas that are subject to prolonged inundation or saturated soil conditions.

Geographic diversity

33. Many hydrophytic vegetation types occur in the United States due to the diversity of interactions among various factors that influence the distribution of hydrophytic species. General climate and flora contribute greatly to regional variations in hydrophytic vegetation. Consequently, the same associations of hydrophytic species occurring in the southeastern United States are not found in the Pacific Northwest. In addition, local environmental conditions (e.g. local climate, hydrologic regimes, soil series, salinity, etc.)

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* Species having a FAC- indicator status are not considered to be typically adapted for life in anaerobic soil conditions.

Table 1

Plant Indicator Status Categories*

Indicator Category	Indicator Symbol	Definition
OBLIGATE WETLAND PLANTS	OBL	Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions, but which may also occur rarely (estimated probability <1%) in nonwetlands. Examples: *Spartina alterniflora*, *Taxodium distichum*.
FACULTATIVE WETLAND PLANTS	FACW	Plants that occur usually (estimated probability >67% to 99%) in wetlands, but also occur (estimated probability 1% to 33% in nonwetlands). Examples: *Fraxinus pennsylvanica*, *Cornus stolonifera*.
FACULTATIVE PLANTS	FAC	Plants with a similar likelihood (estimated probability 33% to 67%) of occurring in both wetlands and nonwetlands. Examples: *Gleditsia triacanthos*, *Smilax rotundifolia*.
FACULTATIVE UPLAND PLANTS	FACU	Plants that occur sometimes (estimated probability 1% to <33%) in wetlands, but occur more often (estimated probability >67% to 99%) in nonwetlands. Examples: *Quercus rubra*, *Potentilla arguta*.
OBLIGATE UPLAND PLANTS	UPL	Plants that occur rarely (estimated probability <1%) in wetlands, but occur almost always (estimated probability >99%) in nonwetlands under natural conditions. Examples: *Pinus echinata*, *Bromus mollis*.

* Categories were originally developed and defined by the USFWS National Wetlands Inventory and subsequently modified by the National Plant List Panel. The three facultative categories are subdivided by (+) and (-) modifiers (see Appendix C, Section 1).

may result in broad variations in hydrophytic associations within a given region. For example, a coastal saltwater marsh will consist of different species than an inland freshwater marsh in the same region. An overview of hydrophytic vegetation occurring in each region of the Nation has been published by the CE in a series of eight preliminary wetland guides (Table 2), and a group of wetland and estuarine ecological profiles (Table 3) has been published by FWS.

Classification

34. Numerous efforts have been made to classify hydrophytic vegetation. Most systems are based on general characteristics of the dominant species occurring in each vegetation type. These range from the use of general physiognomic categories (e.g. overstory, subcanopy, ground cover, vines) to specific vegetation types (e.g. forest type numbers as developed by the Society of American Foresters). In other cases, vegetational characteristics are combined with hydrologic features to produce more elaborate systems. The most recent example of such a system was developed for the FWS by Cowardin et al. (1979).

Indicators of hydrophytic vegetation

35. Several indicators may be used to determine whether hydrophytic vegetation is present on a site. However, the presence of a single individual of a hydrophytic species does not mean that hydrophytic vegetation is present. The strongest case for the presence of hydrophytic vegetation can be made when several indicators, such as those in the following list, are present. However, any one of the following is indicative that hydrophytic vegetation is present:*

a. More than 50 percent of the dominant species are OBL, FACW, or FAC** (Table 1) on lists of plant species that occur in wetlands. A national interagency panel has prepared a National List of Plant Species that occur in wetlands. This list categorizes species according to their affinity for occurrence in wetlands. Regional subset lists of the national list, including only species having an indicator status of OBL, FACW, or FAC, are presented in Appendix C, Section 1. The CE has also developed regional lists of plant species that commonly occur

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* Indicators are listed in order of decreasing reliability. Although all are valid indicators, some are stronger than others. When a decision is based on an indicator appearing in the lower portion of the list, re-evaluate the parameter to ensure that the proper decision was reached.

** FAC+ species are considered to be wetter (i.e., have a greater estimated probability of occurring in wetlands) than FAC species, while FAC- species are considered to be drier (i.e., have a lesser estimated probability of occurring in wetlands) than FAC species.

Table 2

List of CE Preliminary Wetland Guides

Region	Publication Date	WES Report No.
Peninsular Florida	February 1978	TR Y-78-2
Puerto Rico	April 1978	TR Y-78-3
West Coast States	April 1978	TR-Y-78-4
Gulf Coastal Plain	May 1978	TR Y-78-5
Interior	May 1982	TR Y-78-6
South Atlantic States	May 1982	TR Y-78-7
North Atlantic States	May 1982	TR Y-78-8
Alaska	February 1984	TR Y-78-9

Table 3

List of Ecological Profiles Produced by the FWS Biological Services Program

Title	Publication Date	FWS Publication No.
"The Ecology of Intertidal Flats of North Carolina"	1979	79/39
"The Ecology of New England Tidal Flats"	1982	81/01
"The Ecology of the Mangroves of South Florida"	1982	81/24
"The Ecology of Bottomland Hardwood Swamps of the Southeast"	1982	81/37
"The Ecology of Southern California Coastal Salt Marshes"	1982	81/54
"The Ecology of New England High Salt Marshes"	1982	81/55
"The Ecology of Southeastern Shrub Bogs (Pocosins) and Carolina Bays"	1982	82/04
"The Ecology of the Apalachicola Bay System"	1984	82/05
"The Ecology of the Pamlico River, North Carolina"	1984	82/06
"The Ecology of the South Florida Coral Reefs"	1984	82/08
"The Ecology of the Sea Grasses of South Florida"	1982	82/25
"The Ecology of Tidal Marshes of the Pacific Northwest Coast"	1983	82/32
"The Ecology of Tidal Freshwater Marshes of the U.S. East Coast"	1984	83/17
"The Ecology of San Francisco Bay Tidal Marshes"	1983	83/23
"The Ecology of Tundra Ponds of the Arctic Coastal Plain"	1984	83/25
"The Ecology of Eelgrass Meadows of the Atlantic Coast"	1984	84/02
"The Ecology of Delta Marshes of Louisiana"	1984	84/09

(Continued)

Table 3 (Concluded)

Title	Publication Date	FWS Publication No.
"The Ecology of Eelgrass Meadows in the Pacific Northwest"	1984	84/24
"The Ecology of Irregularly Flooded Marshes of Northeastern Gulf of Mexico"	(In press)	85(7.1)
"The Ecology of Giant Kelp Forests in California"	1985	85(7.2)

in wetlands (Appendix C, Section 2). Either list may be used. Note: A District that, on a subregional basis, questions the indicator status of FAC species may use the following option: When FAC species occur as dominants along with other dominants that are not FAC (either wetter or drier than FAC), the FAC species can be considered as neutral, and the vegetation decision can be based on the number of dominant species wetter than FAC as compared to the number of dominant species drier than FAC. When a tie occurs or all dominant species are FAC, the nondominant species must be considered. The area has hydrophytic vegetation when more than 50 percent of all considered species are wetter than FAC. When either all considered species are FAC or the number of species wetter than FAC equals the number of species drier than FAC, the wetland determination will be based on the soil and hydrology parameters. Districts adopting this option should provide documented support to the Corps representative on the regional plant list panel, so that a change in indicator status of FAC species of concern can be pursued. Corps representatives on the regional and national plant list panels will continually strive to ensure that plant species are properly designated on both a regional and subregional basis.

b. Other indicators. Although there are several other indicators of hydrophytic vegetation, it will seldom be necessary to use them. However, they may provide additional useful information to strengthen a case for the presence of hydrophytic vegetation. Additional training and/or experience may be required to employ these indicators.

(1) Visual observation of plant species growing in areas of prolonged inundation and/or soil saturation. This indicator can only be applied by experienced personnel who have accumulated information through several years of field experience and written documentation (field notes) that certain species commonly occur in areas of prolonged (>10 percent) inundation and/or soil saturation during the growing season. Species such as *Taxodium distichum*, *Typha latifolia*, and *Spartina alterniflora* normally occur in such areas. Thus, occurrence of species commonly observed in other wetland areas provides a strong indication that hydrophytic vegetation is present. *CAUTION: The presence of standing water or saturated soil on a site is insufficient evidence that the species present are able to tolerate long periods of inundation. The user must relate the observed species to other similar situations and determine whether they are normally found in wet areas, taking into consideration the season and immediately preceding weather conditions.*

(2) Morphological adaptations. Some hydrophytic species have easily recognized physical characteristics that indicate their ability to occur in wetlands. A given species may exhibit several of these characteristics, but not all hydrophytic species have evident morphological

adaptations. A list of such morphological adaptations and a partial list of plant species with known morphological adaptations for occurrence in wetlands are provided in Appendix C, Section 3.

(3) Technical literature. The technical literature may provide a strong indication that plant species comprising the prevalent vegetation are commonly found in areas where soils are periodically saturated for long periods. Sources of available literature include:

(a) Taxonomic references. Such references usually contain at least a general description of the habitat in which a species occurs. A habitat description such as, "Occurs in water of streams and lakes and in alluvial floodplains subject to periodic flooding," supports a conclusion that the species typically occurs in wetlands. Examples of some useful taxonomic references are provided in Table 4.

(b) Botanical journals. Some botanical journals contain studies that define species occurrence in various hydrologic regimes. Examples of such journals include: Ecology, Ecological Monographs, American Journal of Botany, Journal of American Forestry, and Wetlands: The Journal of the Society of Wetland Scientists.

(c) Technical reports. Governmental agencies periodically publish reports (e.g. literature reviews) that contain information on plant species occurrence in relation to hydrologic regimes. Examples of such publications include the CE preliminary regional wetland guides (Table 2) published by the US Army Engineer Waterways Experiment Station (WES) and the wetland community and estuarine profiles of various habitat types (Table 3) published by the FWS.

(d) Technical workshops, conferences, and symposia. Publications resulting from periodic scientific meetings contain valuable information that can be used to support a decision regarding the presence of hydrophytic vegetation. These usually address specific regions or wetland types. For example, distribution of bottomland hardwood forest species in relation to hydrologic regimes was examined at a workshop on bottomland hardwood forest wetlands of the Southeastern United States (Clark and Benforado 1981).

(e) Wetland plant database. The NWI is producing a Plant Database that contains habitat information on approximately 5,200 plant species that occur at some estimated probability in wetlands, as compiled from the technical literature. When completed, this computerized database will be available to all governmental agencies.

Table 4

List of Some Useful Taxonomic References

Title	Author(s)
Manual of Vascular Plants of Northeastern United States and Adjacent Canada	Gleason and Cronquist (1963)
Gray's Manual of Botany, 8th edition	Fernald (1950)
Manual of the Southeastern Flora	Small (1933)
Manual of the Vascular Flora of the Carolinas	Radford, Ahles, and Bell (1968)
A Flora of Tropical Florida	Long and Lakela (1976)
Aquatic and Wetland Plants of the Southwestern United States	Correll and Correll (1972)
Arizona Flora	Kearney and Peebles (1960)
Flora of the Pacific Northwest	Hitchcock and Cronquist (1973)
A California Flora	Munz and Keck (1959)
Flora of Missouri	Steyermark (1963)
Manual of the Plants of Colorado	Harrington (1979)
Intermountain Flora - Vascular Plants of the Intermountain West, USA - Vols I and II	Cronquist et al. (1972)
Flora of Idaho	Davis (1952)
Aquatic and Wetland Plants of the Southeastern United States - Vols I and II	Godfrey and Wooten (1979)
Manual of Grasses of the United States	Hitchcock (1950)

(4) Physiological adaptations. Physiological adaptations include any features of the metabolic processes of plants that make them particularly fitted for life in saturated soil conditions. *NOTE: It is impossible to detect the presence of physiological adaptations in plant species during onsite visits.* Physiological adaptations known for hydrophytic species and species known to exhibit these adaptations are listed and discussed in Appendix C, Section 3.

(5) Reproductive adaptations. Some plant species have reproductive features that enable them to become established and grow in saturated soil conditions. Reproductive adaptations known for hydrophytic species are presented in Appendix C, Section 3.

Hydric Soils

Definition

36. A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation (US Department of Agriculture (USDA) Soil Conservation Service (SCS) 1985, as amended by the National Technical Committee for Hydric Soils (NTCHS) in December 1986).

Criteria for hydric soils

37. Based on the above definition, the NTCHS developed the following criteria for hydric soils:

a. "All Histosols* except Folists;

b. Soils in Aquic suborders, Aquic subgroups, Albolls suborder, Salorthids great group, or Pell great groups of Vertisols that are:

(1) Somewhat poorly drained and have a water table less than 0.5 ft** from the surface for a significant period (usually a week or more) during the growing season, or

(2) Poorly drained or very poorly drained and have either:

(a) A water table at less than 1.0 ft from the surface for a significant period (usually a week or more) during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within 20 inches; or

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* Soil nomenclature follows USDA-SCS (1975).

** A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 4.

(b) A water table at less than 1.5 ft from the surface for a significant period (usually a week or more) during the growing season if permeability is less than 6.0 in/hr in any layer within 20 inches; or

c. Soils that are ponded for long or very long duration during the growing season; or

d. Soils that are frequently flooded for long duration or very long duration during the growing season."

A hydric soil may be either drained or undrained, and a drained hydric soil may not continue to support hydrophytic vegetation. Therefore, not all areas having hydric soils will qualify as wetlands. Only when a hydric soil supports hydrophytic vegetation and the area has indicators of wetland hydrology may the soil be referred to as a "wetland" soil.

38. A drained hydric soil is one in which sufficient ground or surface water has been removed by artificial means such that the area will no longer support hydrophyte vegetation. Onsite evidence of drained soils includes:

a. Presence of ditches or canals of sufficient depth to lower the water table below the major portion of the root zone of the prevalent vegetation.

b. Presence of dikes, levees, or similar structures that obstruct normal inundation of an area.

c. Presence of a tile system to promote subsurface drainage.

d. Diversion of upland surface runoff from an area.

Although it is important to record such evidence of drainage of an area, a hydric soil that has been drained or partially drained still allows the soil parameter to be met. However, the area will not qualify as a wetland if the degree of drainage has been sufficient to preclude the presence of either hydrophytic vegetation or a hydrologic regime that occurs in wetlands. *NOTE: the mere presence of drainage structures in an area is not sufficient basis for concluding that a hydric soil has been drained; such areas may continue to have wetland hydrology.*

General information

39. Soils consist of unconsolidated, natural material that supports, or is capable of supporting, plant life. The upper limit is air and the lower limit is either bedrock or the limit of biological activity. Some soils have very little organic matter (mineral soils), while others are composed primarily of organic matter (Histosols). The relative proportions of particles (sand, silt, clay, and organic matter) in a soil are influenced by many

interacting environmental factors. As normally defined, a soil must support plant life. The concept is expanded to include substrates that could support plant life. For various reasons, plants may be absent from areas that have well-defined soils.

40. A soil profile (Figure 2) consists of various soil layers described from the surface downward. Most soils have two or more identifiable horizons. A soil horizon is a layer oriented approximately parallel to the soil surface, and usually is differentiated from contiguous horizons by characteristics that can be seen or measured in the field (e.g., color, structure, texture, etc.). Most mineral soils have A-, B-, and C-horizons, and many have surficial organic layers (O-horizon). The A-horizon, the surface soil or topsoil, is a

		DESCRIPTION
ORGANIC HORIZONS	01	ORGANIC MATTER CONSISTING OF VISIBLE VEGETATIVE MATTER.
	02	ORGANIC MATTER IN A FORM WHERE INDIVIDUAL COMPONENTS ARE UNRECOGNIZABLE TO THE NAKED EYE.
MINERAL HORIZONS	A1	DECOMPOSED ORGANIC MATTER MIXED WITH MINERAL MATTER AND COATING MINERAL PARTICLES, RESULTING IN DARKER COLOR OF THE SOIL MASS. USUALLY THIN IN FOREST SOILS AND THICK IN GRASSLAND SOILS.
	A2	ZONE WHERE CLAY, IRON, OR ALUMINUM IS LOST. GENERALLY LIGHTER IN COLOR AND LOWER IN ORGANIC MATTER CONTENT THAN THE A1 HORIZON.
	A3 B1	THESE HORIZONS ARE TRANSITIONAL BETWEEN THE A AND B HORIZONS. THE A3 HORIZON HAS PROPERTIES MORE LIKE A THAN B. THE B1 HORIZON HAS PROPERTIES MORE LIKE B THAN A.
	B2	ZONE WHERE THE SOIL LACKS PROPERTIES OF THE OVERLYING A AND UNDERLYING C HORIZONS. GENERALLY THE ZONE OF MAXIMUM CLAY CONTENT AND SOIL STRUCTURE DEVELOPMENT.
	B3	ZONE OF TRANSITION BETWEEN THE B AND C OR R HORIZONS, BUT WITH PREDOMINANT CHARACTERISTICS OF THE B HORIZON.
	C	A MINERAL LAYER, EXCLUSIVE OF BEDROCK, THAT HAS BEEN RELATIVELY LITTLE AFFECTED BY SOIL-FORMING PROCESSES AND LACKS PROPERTIES OF EITHER THE A OR B HORIZONS, BUT WHICH CONSISTS OF MATERIALS WEATHERED BELOW THE ZONE OF BIOLOGICAL ACTIVITY.
	R	CONSOLIDATED BEDROCK, WHICH IS NOT NECESSARILY THE SOURCE OF MINERAL MATTER FROM WHICH THE SOIL FORMED.

Figure 2. Generalized soil profile

zone in which organic matter is usually being added to the mineral soil. It is also the zone from which both mineral and organic matter are being moved slowly downward. The next major horizon is the B-horizon, often referred to as the subsoil. The B-horizon is the zone of maximum accumulation of materials. It is usually characterized by higher clay content and/or more pronounced soil structure development and lower organic matter than the A-horizon. The next major horizon is usually the C-horizon, which consists of unconsolidated parent material that has not been sufficiently weathered to exhibit characteristics of the B-horizon. Clay content and degree of soil structure development in the C-horizon are usually less than in the B-horizon. The lowest major horizon, the R-horizon, consists of consolidated bedrock. In many situations, this horizon occurs at such depths that it has no significant influence on soil characteristics.

Influencing factors

41. Although all soil-forming factors (climate, parent material, relief, organisms, and time) affect the characteristics of a hydric soil, the overriding influence is the hydrologic regime. The unique characteristics of hydric soils result from the influence of periodic or permanent inundation or soil saturation for sufficient duration to effect anaerobic conditions. Prolonged anaerobic soil conditions lead to a reducing environment, thereby lowering the soil redox potential. This results in chemical reduction of some soil components (e.g. iron and manganese oxides), which leads to development of soil colors and other physical characteristics that usually are indicative of hydric soils.

Classification

42. Hydric soils occur in several categories of the current soil classification system, which is published in Soil Taxonomy (USDA-SCS 1975). This classification system is based on physical and chemical properties of soils that can be seen, felt, or measured. Lower taxonomic categories of the system (e.g. soil series and soil phases) remain relatively unchanged from earlier classification systems.

43. Hydric soils may be classified into two broad categories: organic and mineral. Organic soils (Histosols) develop under conditions of nearly continuous saturation and/or inundation. All organic soils are hydric soils except Folists, which are freely drained soils occurring on dry slopes where excess litter accumulates over bedrock. Organic hydric soils are commonly

known as peats and mucks. All other hydric soils are mineral soils. Mineral soils have a wide range of textures (sandy to clayey) and colors (red to gray). Mineral hydric soils are those periodically saturated for sufficient duration to produce chemical and physical soil properties associated with a reducing environment. They are usually gray and/or mottled immediately below the surface horizon (see paragraph 44d), or they have thick, dark-colored surface layers overlying gray or mottled subsurface horizons.

Wetland indicators (nonsandy soils)

44. Several indicators are available for determining whether a given soil meets the definition and criteria for hydric soils. Any one of the following indicates that hydric soils are present:*

a. Organic soils (Histosols). A soil is an organic soil when: (1) more than 50 percent (by volume) of the upper 32 inches of soil is composed of organic soil material;** or (2) organic soil material of any thickness rests on bedrock. Organic soils (Figure 3) are saturated for long periods and are commonly called peats or mucks.

b. Histic epipedons. A histic epipedon is an 8- to 16-inch layer at or near the surface of a mineral hydric soil that is saturated with water for 30 consecutive days or more in most years and contains a minimum of 20 percent organic matter when no clay is present or a minimum of 30 percent organic matter when clay content is 60 percent or greater. Soils with histic epipedons are inundated or saturated for sufficient periods to greatly retard aerobic decomposition of the organic surface, and are considered to be hydric soils.

c. Sulfidic material. When mineral soils emit an odor of rotten eggs, hydrogen sulfide is present. Such odors are only detected in waterlogged soils that are permanently saturated and have sulfidic material within a few centimetres of the soil surface. Sulfides are produced only in a reducing environment.

d. Aquic or peraquic moisture regime. An aquic moisture regime is a reducing one; i.e., it is virtually free of dissolved oxygen because the soil is saturated by ground water or by water of the capillary fringe (USDA-SCS 1975). Because dissolved oxygen is removed from ground water by respiration of microorganisms, roots, and soil fauna, it is also implicit that the soil temperature is above biologic zero (5° C) at some time while the

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* Indicators are listed in order of decreasing reliability. Although all are valid indicators, some are stronger indicators than others. When a decision is based on an indicator appearing in the lower portion of the list, re-evaluate the parameter to ensure that the proper decision was reached.

** A detailed definition of organic soil material is available in USDA-SCS (1975).

soil is saturated. Soils with peraquic moisture regimes are characterized by the presence of ground water always at or near the soil surface. Examples include soils of tidal marshes and soils of closed, landlocked depressions that are fed by permanent streams.

e. Reducing soil conditions. Soils saturated for long or very long duration will usually exhibit reducing conditions. Under such conditions, ions of iron are transformed from a ferric valence state to a ferrous valence state. This condition can often be detected in the field by a ferrous iron test. A simple colorimetric field test kit has been developed for this purpose. When a soil extract changes to a pink color upon addition of α-α-dipyridil, ferrous iron is present, which indicates a reducing soil environment. *NOTE: This test cannot be used in mineral hydric soils having low iron content, organic soils, and soils that have been desaturated for significant periods of the growing season.*

f. Soil colors. The colors of various soil components are often the most diagnostic indicator of hydric soils. Colors of these components are strongly influenced by the frequency and duration of soil saturation, which leads to reducing soil conditions. Mineral hydric soils will be either gleyed or will have bright mottles and/or low matrix chroma. These are discussed below:

(1) Gleyed soils (gray colors). Gleyed soils develop when anaerobic soil conditions result in pronounced chemical reduction of iron, manganese, and other elements, thereby producing gray soil colors. Anaerobic conditions that occur in waterlogged soils result in the predominance of reduction processes, and such soils are greatly reduced. Iron is one of the most abundant elements in soils. Under anaerobic conditions, iron in converted from the oxidized (ferric) state to the reduced (ferrous) state, which results in the bluish, greenish, or grayish colors associated with the gleying effect (Figure 4). Gleying immediately below the A-horizon or 10 inches (whichever is shallower) is an indication of a markedly reduced soil, and gleyed soils are hydric soils. Gleyed soil conditions can be determined by using the gley page of the Munsell Color Book (Munsell Color 1975).

(2) Soils with bright mottles and/or low matrix chroma. Mineral hydric soils that are saturated for substantial periods of the growing season (but not long enough to produce gleyed soils) will either have bright mottles and a low matrix chroma or will lack mottles but have a low matrix chroma (see Appendix D, Section 1, for a definition and discussion of "chroma" and other components of soil color). Mottled means "marked with spots of contrasting color." Soils that have brightly colored mottles and a low matrix chroma are indicative of a fluctuating water table. The soil matrix is the portion (usually more than 50 percent) of a given soil layer that has the predominant

color (Figure 5). Mineral hydric soils usually have one of the following color features in the horizon immediately below the A-horizon or 10 inches (whichever is shallower):

(a) Matrix chroma of 2 or less* in mottled soils.

(b) Matrix chroma of 1 or less* in unmottled soils.

NOTE: The matrix chroma of some dark (black) mineral hydric soils will not conform to the criteria described in (a) and (b) above; in such soils, gray mottles occurring at 10 inches or less are indicative of hydric conditions.

CAUTION: Soils with significant coloration due to the nature of the parent material (e.g. red soils of the Red River Valley) may not exhibit the above characteristics. In such cases, this indicator cannot be used.

g. Soil appearing on hydric soils list. Using the criteria for hydric soils (paragraph 37), the NTCHS has developed a list of hydric soils. Listed soils have reducing conditions for a significant portion of the growing season in a major portion of the root zone and are frequently saturated within 12 inches of the soil surface. The NTCHS list of hydric soils is presented in Appendix D, Section 2. *CAUTION: Be sure that the profile description of the mapping unit conforms to that of the sampled soil.*

h. Iron and manganese concretions. During the oxidation-reduction process, iron and manganese in suspension are sometimes segregated as oxides into concretions or soft masses (Figure 6). These accumulations are usually black or dark brown. Concretions >2 mm in diameter occurring within 7.5 cm of the surface are evidence that the soil is saturated for long periods near the surface.

Wetland indicators (sandy soils)

45. Not all indicators listed in paragraph 44 can be applied to sandy soils. In particular, soil color should not be used as an indicator in most sandy soils. However, three additional soil features may be used as indicators of sandy hydric soils, including:

a. High organic matter content in the surface horizon. Organic matter tends to accumulate above or in the surface horizon of sandy soils that are inundated or saturated to the surface for a significant portion of the growing season. Prolonged inundation or saturation creates anaerobic conditions that greatly reduce oxidation of organic matter.

b. Streaking of subsurface horizons by organic matter. Organic matter is moved downward through sand as the water table

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* Colors should be determined in soils that have been moistened; otherwise, state that colors are for dry soils.

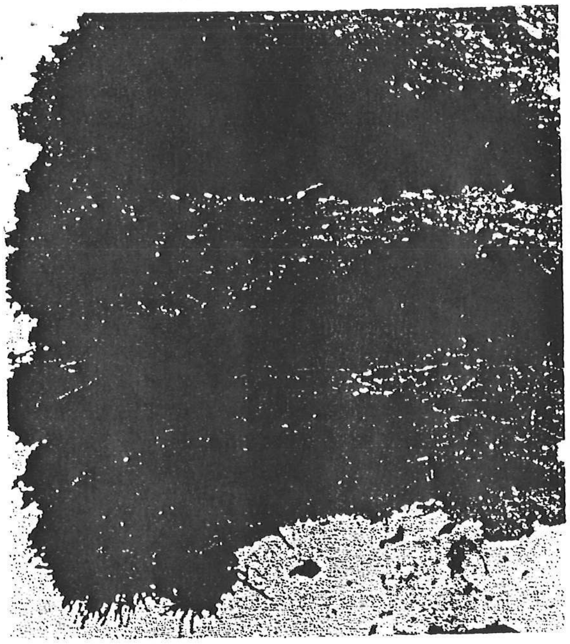

Figure 3. Organic soil

Figure 4. Gleyed soil

Figure 5. Soil showing matrix (brown) and mottles (reddish-brown)

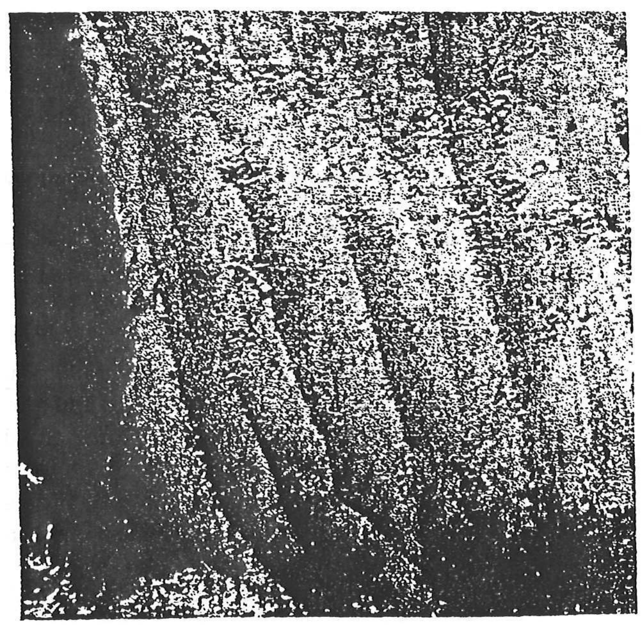

Figure 6. Iron and manganese concretions

fluctuates. This often occurs more rapidly and to a greater degree in some vertical sections of a sandy soil containing high content of organic matter than in others. Thus, the sandy soil appears vertically streaked with darker areas. When soil from a darker area is rubbed between the fingers, the organic matter stains the fingers.

c. Organic pans. As organic matter is moved downward through sandy soils, it tends to accumulate at the point representing the most commonly occurring depth to the water table. This organic matter tends to become slightly cemented with aluminum, forming a thin layer of hardened soil (spodic horizon). These horizons often occur at depths of 12 to 30 inches below the mineral surface. Wet spodic soils usually have thick dark surface horizons that are high in organic matter with dull, gray horizons above the spodic horizon.

CAUTION: In recently deposited sandy material (e.g. accreting sandbars), it may be impossible to find any of these indicators. In such cases, consider this as a natural atypical situation.

Wetland Hydrology

Definition

46. The term "wetland hydrology" encompasses all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface at some time during the growing season. Areas with evident characteristics of wetland hydrology are those where the presence of water has an overriding influence on characteristics of vegetation and soils due to anaerobic and reducing conditions, respectively. Such characteristics are usually present in areas that are inundated or have soils that are saturated to the surface for sufficient duration to develop hydric soils and support vegetation typically adapted for life in periodically anaerobic soil conditions. Hydrology is often the least exact of the parameters, and indicators of wetland hydrology are sometimes difficult to find in the field. However, it is essential to establish that a wetland area is periodically inundated or has saturated soils during the growing season.

Influencing factors

47. Numerous factors (e.g., precipitation, stratigraphy, topography, soil permeability, and plant cover) influence the wetness of an area. Regardless, the characteristic common to all wetlands is the presence of an abundant supply of water. The water source may be runoff from direct precipitation,

headwater or backwater flooding, tidal influence, ground water, or some combination of these sources. The frequency and duration of inundation or soil saturation varies from nearly permanently inundated or saturated to irregularly inundated or saturated. Topographic position, stratigraphy, and soil permeability influence both the frequency and duration of inundation and soil saturation. Areas of lower elevation in a floodplain or marsh have more frequent periods of inundation and/or greater duration than most areas at higher elevations. Floodplain configuration may significantly affect duration of inundation. When the floodplain configuration is conducive to rapid runoff, the influence of frequent periods of inundation on vegetation and soils may be reduced. Soil permeability also influences duration of inundation and soil saturation. For example, clayey soils absorb water more slowly than sandy or loamy soils, and therefore have slower permeability and remain saturated much longer. Type and amount of plant cover affect both degree of inundation and duration of saturated soil conditions. Excess water drains more slowly in areas of abundant plant cover, thereby increasing frequency and duration of inundation and/or soil saturation. On the other hand, transpiration rates are higher in areas of abundant plant cover, which may reduce the duration of soil saturation.

Classification

48. Although the interactive effects of all hydrologic factors produce a continuum of wetland hydrologic regimes, efforts have been made to classify wetland hydrologic regimes into functional categories. These efforts have focused on the use of frequency, timing, and duration of inundation or soil saturation as a basis for classification. A classification system developed for nontidal areas is presented in Table 5. This classification system was slightly modified from the system developed by the Workshop on Bottomland Hardwood Forest Wetlands of the Southeastern United States (Clark and Benforado 1981). Recent research indicates that duration of inundation and/or soil saturation during the growing season is more influential on the plant community than frequency of inundation/saturation during the growing season (Theriot, in press). Thus, frequency of inundation and soil saturation are not included in Table 5. The WES has developed a computer program that can be used to transform stream gage data to mean sea level elevations representing

Table 5

Hydrologic Zones* - Nontidal Areas

Zone	Name	Duration**	Comments
I†	Permanently inundated	100%	Inundation >6.6 ft mean water depth
II	Semipermanently to nearly permanently inundated or saturated	>75% - <100%	Inundation defined as ≤6.6 ft mean water depth
III	Regularly inundated or saturated	>25% - 75%	
IV	Seasonally inundated or saturated	>12.5% - 25%	
V	Irregularly inundated or saturated	≥5% - 12.5%	Many areas having these hydrologic characteristics are not wetlands
VI	Intermittently or never inundated or saturated	<5%	Areas with these hydrologic characteristics are not wetlands

* Zones adapted from Clark and Benforado (1981).

** Refers to duration of inundation and/or soil saturation during the growing season.

† This defines an aquatic habitat zone.

the upper limit of each hydrologic zone shown in Table 5. This program is available upon request.*

Wetland indicators

49. Indicators of wetland hydrology may include, but are not necessarily limited to: drainage patterns, drift lines, sediment deposition, watermarks, stream gage data and flood predictions, historic records, visual observation of saturated soils, and visual observation of inundation. Any of these indicators may be evidence of wetland hydrologic characteristics. Methods for determining hydrologic indicators can be categorized according to the type of indicator. Recorded data include stream gage data, lake gage data, tidal gage data, flood predictions, and historical records. Use of these data is commonly limited to areas adjacent to streams or other similar

* R. F. Theriot, Environmental Laboratory, US Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, Miss. 39180.

areas. Recorded data usually provide both short- and long-term information about frequency and duration of inundation, but contain little or no information about soil saturation, which must be gained from soil surveys or other similar sources. The remaining indicators require field observations. Field indicators are evidence of present or past hydrologic events (e.g. location and height of flooding). Indicators for recorded data and field observations include:*

a. Recorded data. Stream gage data, lake gage data, tidal gage data, flood predictions, and historical data may be available from the following sources:

(1) CE District Offices. Most CE Districts maintain stream, lake, and tidal gage records for major water bodies in their area. In addition, CE planning and design documents often contain valuable hydrologic information. For example, a General Design Memorandum (GDM) usually describes flooding frequencies and durations for a project area. Furthermore, the extent of flooding within a project area is sometimes indicated in the GDM according to elevation (height) of certain flood frequencies (1-, 2-, 5-, 10-year, etc.).

(2) US Geological Survey (USGS). Stream and tidal gage data are available from the USGS offices throughout the Nation, and the latter are also available from the National Oceanic and Atmospheric Administration. CE Districts often have such records.

(3) State, county, and local agencies. These agencies often have responsibility for flood control/relief and flood insurance.

(4) Soil Conservation Service Small Watershed Projects. Planning documents from this agency are often helpful, and can be obtained from the SCS district office in the county.

(5) Planning documents of developers.

b. Field data. The following field hydrologic indicators can be assessed quickly, and although some of them are not necessarily indicative of hydrologic events that occur only during the growing season, they do provide evidence that inundation and/or soil saturation has occurred:

(1) Visual observation of inundation. The most obvious and revealing hydrologic indicator may be simply observing the areal extent of inundation. However, because seasonal

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* Indicators are listed in order of decreasing reliability. Although all are valid indicators, some are stronger indicators than others. When a decision is based on an indicator appearing in the lower portion of the list, re-evaluate the parameter to ensure that the proper decision was reached.

conditions and recent weather conditions can contribute to surface water being present on a nonwetland site, both should be considered when applying this indicator.

(2) Visual observation of soil saturation. Examination of this indicator requires digging a soil pit (Appendix D, Section 1) to a depth of 16 inches and observing the level at which water stands in the hole after sufficient time has been allowed for water to drain into the hole. The required time will vary depending on soil texture. In some cases, the upper level at which water is flowing into the pit can be observed by examining the wall of the hole. This level represents the depth to the water table. The depth to saturated soils will always be nearer the surface due to the capillary fringe. For soil saturation to impact vegetation, it must occur within a major portion of the root zone (usually within 12 inches of the surface) of the prevalent vegetation. The major portion of the root zone is that portion of the soil profile in which more than one half of the plant roots occur. *CAUTION: In some heavy clay soils, water may not rapidly accumulate in the hole even when the soil is saturated. If water is observed at the bottom of the hole but has not filled to the 12-inch depth, examine the sides of the hole and determine the shallowest depth at which water is entering the hole. When applying this indicator, both the season of the year and preceding weather conditions must be considered.*

(3) Watermarks. Watermarks are most common on woody vegetation. They occur as stains on bark (Figure 7) or other fixed objects (e.g. bridge pillars, buildings, fences, etc.). When several watermarks are present, the highest reflects the maximum extent of recent inundation.

(4) Drift lines. This indicator is most likely to be found adjacent to streams or other sources of water flow in wetlands, but also often occurs in tidal marshes. Evidence consists of deposition of debris in a line on the surface (Figure 8) or debris entangled in aboveground vegetation or other fixed objects. Debris usually consists of remnants of vegetation (branches, stems, and leaves), sediment, litter, and other waterborne materials deposited parallel to the direction of water flow. Drift lines provide an indication of the minimum portion of the area inundated during a flooding event; the maximum level of inundation is generally at a higher elevation than that indicated by a drift line.

(5) Sediment deposits. Plants and other vertical objects often have thin layers, coatings, or depositions of mineral or organic matter on them after inundation (Figure 9). This evidence may remain for a considerable period before it is removed by precipitation or subsequent inundation. Sediment deposition on vegetation and other

Figure 7. Watermark on trees

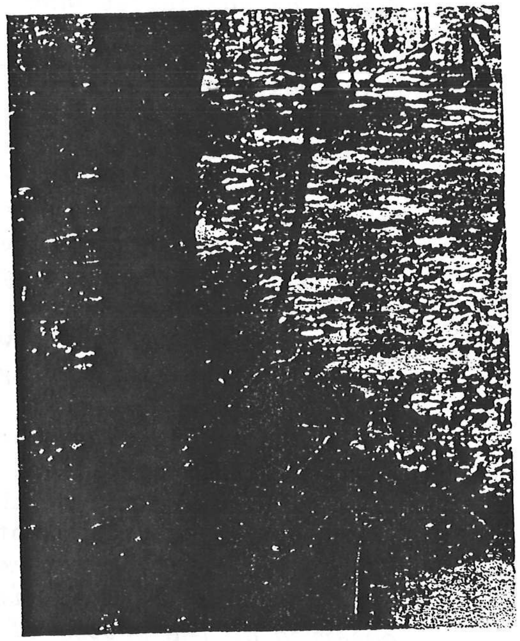

Figure 8. Absence of leaf litter and drift line (extreme left)

Figure 9. Sediment deposit on plants

Figure 10. Encrusted detritus

Figure 11. Drainage pattern

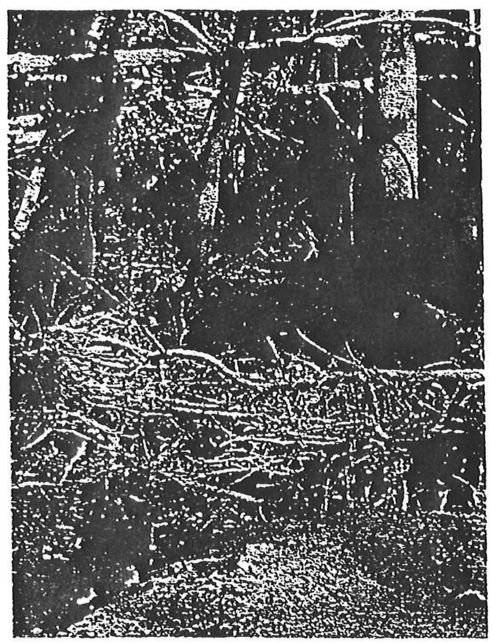

Figure 12. Debris deposited in stream channel

objects provides an indication of the minimum inundation level. When sediments are primarily organic (e.g. fine organic material, algae), the detritus may become encrusted on or slightly above the soil surface after dewatering occurs (Figure 10).

(6) Drainage patterns within wetlands. This indicator, which occurs primarily in wetlands adjacent to streams, consists of surface evidence of drainage flow into or through an area (Figure 11). In some wetlands, this evidence may exist as a drainage pattern eroded into the soil, vegetative matter (debris) piled against thick vegetation or woody stems oriented perpendicular to the direction of water flow, or the absence of leaf litter (Figure 8). Scouring is often evident around roots of persistent vegetation. Debris may be deposited in or along the drainage pattern (Figure 12). *CAUTION: Drainage patterns also occur in upland areas after periods of considerable precipitation; therefore, topographic position must also be considered when applying this indicator.*